NOAA Technical Memorandum NOS CS 24

SKILL ASSESSMENT OF THE DELAWARE RIVER AND BAY OPERATIONAL FORECAST SYSTEM (DBOFS)

Silver Spring, Maryland
January 2011

noaa National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Coast Survey Development Laboratory

Office of Coast Survey
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

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Silver Spring, MD

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EXECUTIVE SUMMARY

An experimental numerical oceanographic nowcast/forecast system for the Delaware River and Bay has been developed by NOAA/National Ocean Service's Coast Survey Development Laboratory (CSDL) Marine Modeling and Analysis Programs. This hydrodynamic forecast modeling system called the Delaware River and Bay Operational Forecast System (DBOFS) uses the Regional Ocean Modeling System (ROMS) as its core ocean circulation model to provide six-hourly nowcasts and forecast guidance out to 48 hour forecasts four times a day of water levels, currents, salinity, and water temperatures. The nowcast/forecast system is run under the NOS High Performance Computing Coastal Ocean Modeling Framework (HPC-COMF) implemented for operational oceanographic forecast systems on the NOAA Central Computer System (CCS) operated by the National Weather Service's National Centers for Environmental Prediction (NCEP). Output from DBOFS was implemented operationally at NOS' Center for Operational Oceanographic Products and Services in September 2010.

A standard suite of NOS skill assessment (SA) statistics which includes Central Frequency (CF), Negative and Positive Outlier Frequency (NOF and POF), Maximum Duration of Negative and Positive Outlier (MDNO and MDPO), and the Worst Outlier Frequency (WOF) were computed for four DBOFS scenarios: 1) astronomical tidal simulation, 2) hindcast simulation, 3) semi-operational nowcast simulation, and 4) semi-operational forecast simulation. A forecast method comparison is presented between the model forecast and persistence forecast which is based upon the observed persisted residual value and astronomical tidal prediction. For the astronomical tide and hindcast scenarios, the modeled and observed time series of water levels and currents were compared at nine water level stations and nineteen current meter stations, respectively. For the hindcast scenario modeled and observed salinities and temperatures were compared at twenty and twenty one stations, respectively. For the semi-operational nowcast and forecast scenarios, water levels, currents, salinities, and water temperatures were compared at twelve, two, three, and eight stations, respectively. Time series of astronomical tide and hindcast simulations were created for the thirteen month period March 1984-March 1985, and the time series of semi-operational nowcast and forecast simulations were created for the three month period 15 April - 15 July of 2010.

The skill assessment statistics for water levels pass the majority of the criteria in the lower Delaware Bay and lower Delaware River with results in the upper River above Philadelphia, PA slightly degraded for each of the four scenarios. Therefore, the model's water level nowcasts and forecasts were of sufficient accuracy to recommend that the DBOFS be made operational.

Most of CF, NOF, POF, MDNO, and MDPO for water currents either pass or are close to the criteria for the astronomical tidal and hindcast simulations. However, model nowcasts and forecasts of water currents are improved from the hindcast simulation, and meet the majority of the criteria for the test periods.

Salt front location and transition cannot be confirmed in either the hindcast or during the nowcast/forecast period due to lack of station coverage. There is some evidence during the nowcast that the model predictions are too fresh in the transition region from Reedy Point, DE to Ship John Shoal, DE by 2 – 3 PSU.

Seasonal heating and cooling are confirmed during the hindcast, with some evidence of over-heating in the lower Bay and near Shelf. During the nowcast/forecast test period, CFs at all stations throughout the Bay and River are near 75%.

The skill assessment results for each scenario are summarized as follows:

Astronomical Tidal Simulation:

1) Water Level

The modeled tidal constituents are in very close agreement with the observed values. At the Bay entrance the M_2 dominant constituent errors were at Cape May, NJ -3.1 cm RMSE in amplitude and -1.3^o in phase and at Lewes, DE 0.7 cm RMSE in amplitude and -1.8^o in phase error. At Chesapeake City, MD errors in M_2 were -4.1 cm RMSE in amplitude and 4.9^o in phase. At Reedy Point, DE errors in M_2 were -8.4 cm RMSE in amplitude and -1.2^o in phase. As one proceeds upriver M_2 errors at Philadelphia, PA are -4.3 cm RMSE in amplitude and -4.2^o in phase and at Trenton, NJ are -2.5 cm RMSE in amplitude and -10.9^o in phase. CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria for the entire time series, as do the amplitudes of high and low water for most stations in the Delaware Bay. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts except at Burlington, NJ and Trenton, NJ near the head of tide.

2) Currents

The principal current directions of the modeled and observed currents are very close, with differences between the modeled and observed values of 6, 1, 2, 5, and 1 degrees at Station 5 at the Bay entrance , Station 23 in the lower mid-Bay channel , Station 33 in the upper Bay channel, Station 154 at the Chesapeake and Delaware (C&D) canal, and Station 52 in the mid-River near Philadelphia, PA, respectively. For the dominant M_2 constituent, the modeled amplitude is nearly identical to the observed value at the Bay entrance Station 5, while at Stations 23, 33, 154, and 52 the model amplitudes are smaller than the observed values with differences of -1.6, -22.9, -16.6, and -44.2 cm/s, respectively. The phase differences between the modeled and observed M_2 currents are 3.0, -4.2, -7.1, -10.7, and -18.9 degrees at Stations 5, 23, 33, 154, and 52, respectively. CF, NOF, POF, MDNO, and MDPO all nearly pass the criteria for current speed time series, amplitudes of maximum flood and ebb currents at Bay stations, but fail to pass the criteria at the upper-River stations. CF, NOF, POF, MDNO, and MDPO passed the criteria for current direction at the majority of the stations.

Hindcast

1) Water Level

At Lewes, DE, Cape May, NJ, and Chesapeake City, MD, the RMSEs and CFs were 12 cm, 12 cm, 11 cm and 83, 85, and 84, respectively. At Philadelphia, PA and Trenton, NJ the RMSEs and CFs were 13 cm, 21 cm, 87, and 79, respectively. CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria for the entire time series, as do the amplitudes of high and low water for most stations in the Delaware Bay. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts except at Burlington, NJ and Trenton, NJ near the head of tide.

2) Currents

At Station 5 (Bay entrance), the modeled and observed mean velocity values are 53.2 cm/s and 52.4 cm/s, and the RMSE between the simulated and observed current speeds is 33.2 cm/s. At Station 23 (lower mid-Bay channel), the modeled and observed mean current speeds are 44.8 cm/s and 37.9 cm/s, respectively. The RMSE of the current speeds is 27.7 cm/s. At Station 33 (upper mid-Bay channel), the modeled and observed mean current speeds are 50.8 cm/s and 62.6 cm/s, respectively. The RMSE of the current speeds is 39.9 cm/s. At Station 154 (at C&D canal entrance), the modeled and observed mean current speeds are 39.8 cm/s and 45.1 cm/s, respectively. The RMSE of the current speeds is 39.3 cm/s. At Station 52 (in the mid-River near Philadelphia), the modeled and observed mean current speeds are 18.9 cm/s and 45.9 cm/s, respectively. The RMSE of the current speeds is 32.4 cm/s.

The CF, NOF, POF, MDNO, and MDPO statistics at most stations fail the criteria for the entire 6-minute current speed time series, and the amplitudes of maximum flood and ebb currents and times of maximum flood and ebb and start and end times of the slack before flood and slack before ebb. Current direction comparisons were made, but were totally inconsistent with those of the astronomical tide simulation and are not reported.

Semi-Operational Nowcast

1) Water Level

CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria for the entire time series, as do the amplitudes of high and low water for most stations in the Delaware Bay. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts accept at Burlington, NJ and Newbold, PA. At Lewes, DE, Cape May, NJ, Chesapeake City, MD, the RMSEs and CFs were 9 cm, 9 cm, 6 cm and 93, 94, and 98, respectively. At Philadelphia, PA and Newbold, PA the RMSEs and CFs were 14 cm, 21 cm, 83, and 59, respectively.

2) Currents

For Philadelphia, PA, the mean velocity of 56.8 cm/s for the model nowcast is less than the observed value of 66.08 cm/s. The RMSE for the entire 6-minute time series of current speed is 21.7 cm/s. CF, NOF, and POF fail to pass the skill assessment criteria, but MDNO and MDPO pass the criteria for all tests. The maximum ebb current speeds of the nowcast are less than the observed values with the RMSE being 17.6 cm/s. The time of the maximum ebb currents and slack currents in the nowcast falls about 30 to 40 minutes behind those of the observations (the RMSE is 0.5 to 0.6 hours). For the directions of the currents, the mean directions of the nowcast and observed currents are 116 and 127 degrees, respectively (the RMSE is 25 degrees). CF, NOF, POF, MDPO, and MDPO pass the criteria for the entire 6-minutes time series of the current directions. CF, NOF, POF, MDPO, and MDPO pass the criteria for the directions of the maximum ebb and flood currents.

At Brown Shoal Light, DB, the mean velocity of 49.3 cm/s for the model nowcast is less than the observed value of 50.4 cm/s. The RMSE for the entire 6-minute time series of current speed is 14.3 cm/s. CF, NOF, and POF criteria, and the MDNO and MDPO pass the criteria for the amplitude of the ebb and flood. The maximum ebb and flow current speeds of the nowcast are larger than the observed values with the RMSE being around 10 cm/s. The time of the maximum ebb currents and slack currents in the nowcasts falls about 25 to 40 minutes behind those of the observations (the RMSE is 0.4 to 0.6 hours). For the directions of the currents, the mean directions of the nowcast and observed currents are 234 and 227 degrees, respectively (the RMSE is 19 degrees). CF, NOF, POF, MDPO, and MDPO pass the criteria for the entire 6-minutes time series of the current directions. CF, NOF, POF, MDPO, and MDPO pass the criteria for the directions of the maximum ebb and flood currents.

Semi-Operational Forecast

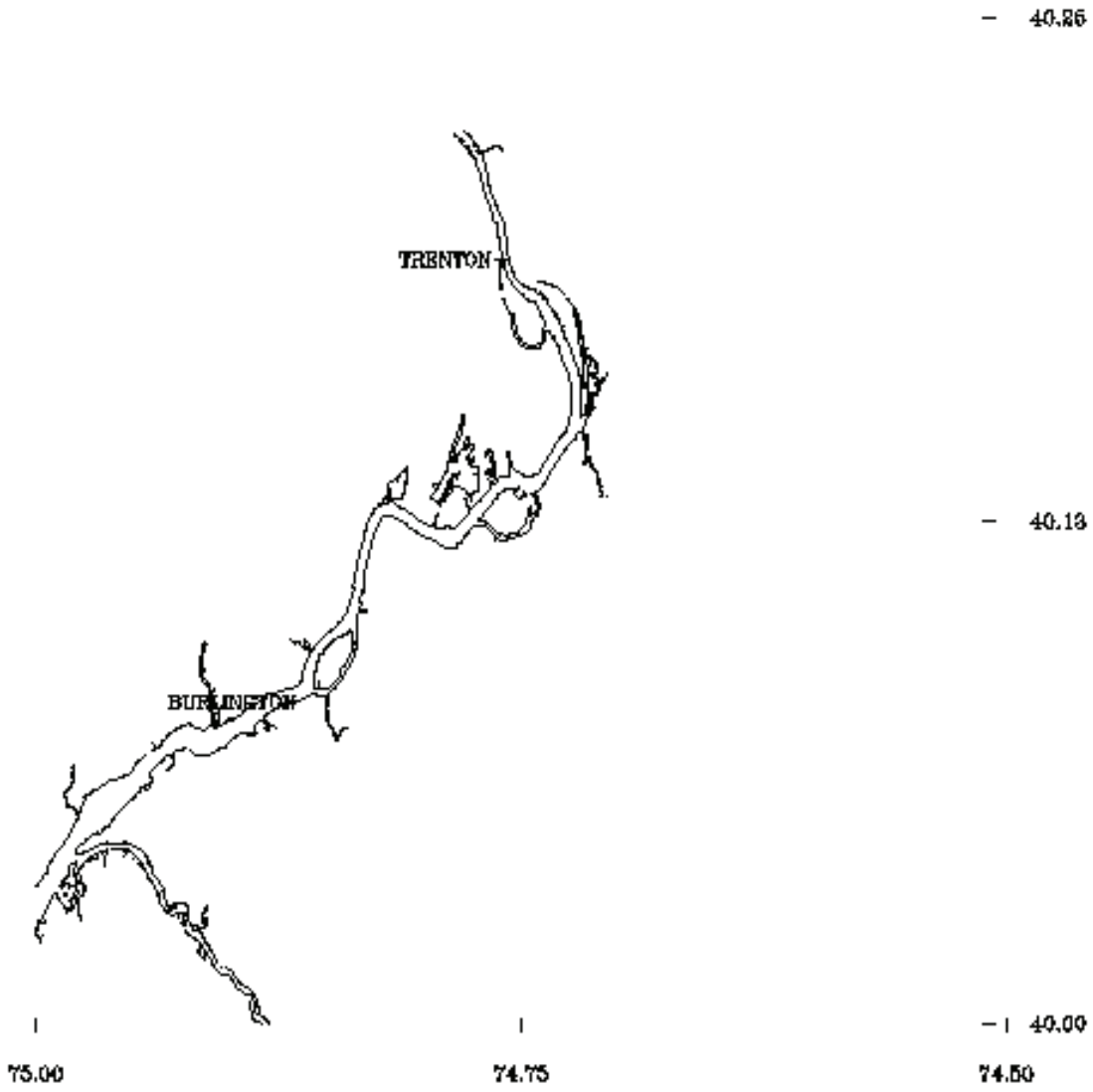
1) Water Level

For the semi-operational forecasts, the RMSEs out to 24 hours are less than 17 cm at all stations. CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria throughout the 24 forecasts hours for the stations below Philadelphia, PA. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts accept at Burlington, NJ and Newbold, PA. At Lewes, DE, Cape May, NJ, and Chesapeake City, MD, the RMSEs and CFs were 9 cm, 9 cm, 13 cm and 91, 90, and 85, respectively. At Philadelphia, PA and Newbold, PA the RMSEs and CFs were 12 cm, 16 cm, 83, and 66, respectively. At the Bay entrance stations of Cape May, NJ and Lewes, DE the RMSE increases from forecast hour 0 to forecast hour 24 by order 2 cm, while at Chesapeake City, MD the RMSE increases over the same forecast horizon by order 11 cm.

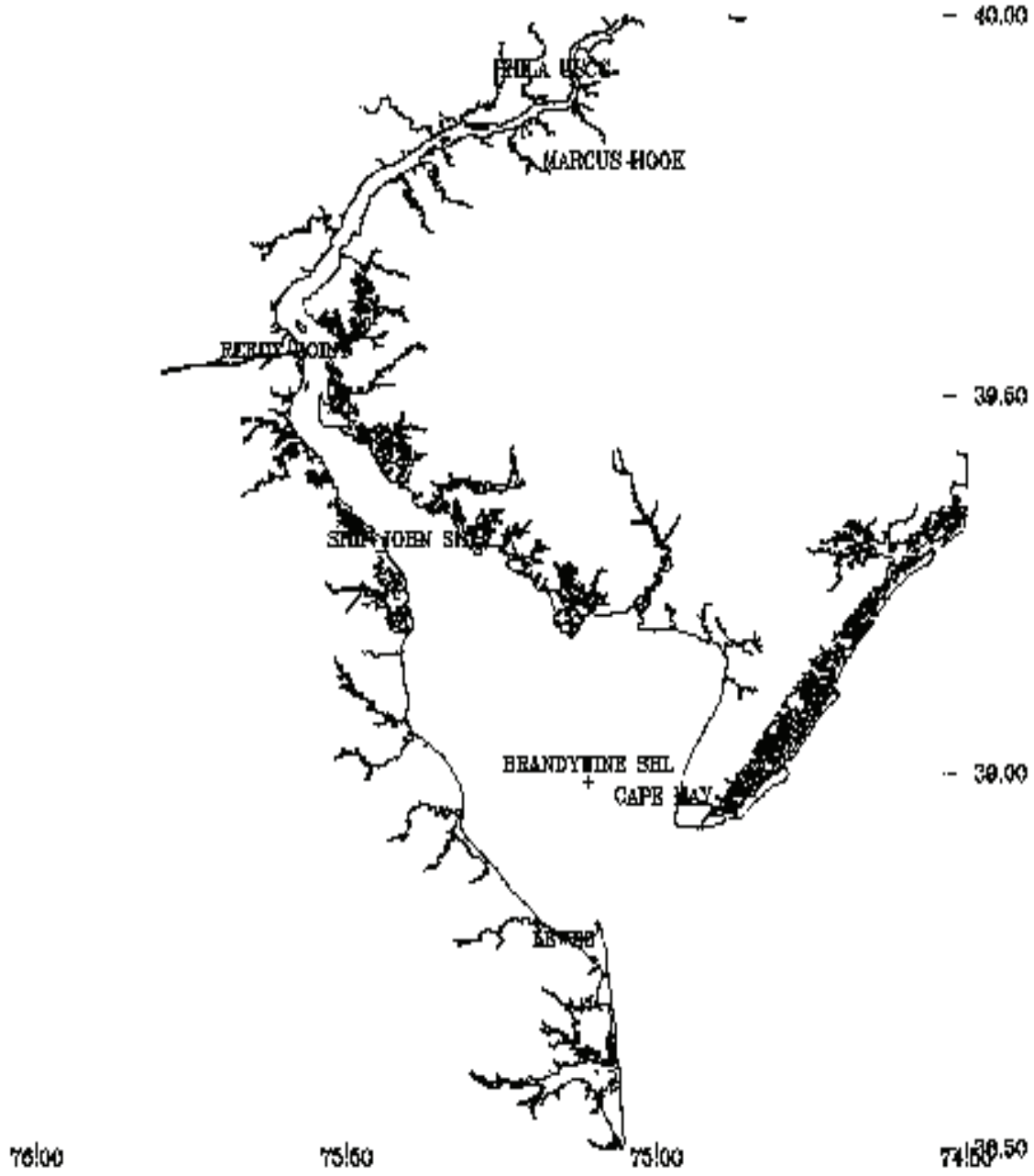
2) Currents

For Philadelphia, PA, the RMSEs of the current speed range remain between 19 and 20 cm/s from forecast hour 0 to forecast hour 24. CF remains between 84% and 85% throughout the 24 forecast hours, and thus it does not degrade with time. POF, NOF, MDNO, and MNPO pass the criteria for all forecast hours. The maximum flood and ebb current speeds of the model forecasts are less than the observations with an RMSE of 18 cm/s. The time of the modeled maximum flood and ebb currents occur about 24 ad 42 minutes before the observations, respectively. CF and NOF fail to pass the criteria for all forecast hours. For current direction, RMSEs range from 21 to 15 degrees and improve with forecast age. NOF, CF, and POF all pass the criteria for all forecast hours.

At Brown Shoal Light, DB, RMSEs of current speed range from 13 cm/s at forecast hour 0 to 15 cm/s at forecast hour 24, and CF is above 95% (forecast hour 0) throughout the 24 forecast hours. NOF, MDNO, and MDPO pass the criteria for the current speed forecasts throughout the 24 forecast hours. The RMSE of the maximum flood current speed is 9 cm/s and the RMSE of the maximum ebb current speeds is 11 cm/s. CF, NOF, POF, MDNO, and MDPO pass the criteria for both the maximum flood and ebb current speeds. The RMSEs of the time of the maximum flood and ebb current speeds are 48 minutes and 36 minutes, respectively, and the CF of them fails to pass the criteria (37% and 61%). Most of CF, NOF, POF, MDNO, and MDPO fail to pass the criteria for the start and end time of slack currents before flood and ebb. For current direction, the RMSEs range from 14 degrees (forecast hour 0) to 21 degrees (forecast hour 24). CF, NOF, POF, MDNO, and MDPO pass the criteria for the directions of the maximum flood and ebb currents.



Base Map 1. Upper Delaware River Principal Measurement Locations.



Base Map 2. Lower Delaware River and Bay Principal Measurement Locations.

1. INTRODUCTION

Over half of the U.S. population lives within 50 miles of the coast, and coastal areas serve as centers of commerce for tourism, transportation, recreation, fishing and other activities. Maritime accidents and groundings can cause substantial costs to this infrastructure, which is inextricably linked to the U.S. economy. The Physical Oceanographic Real Time Systems (PORTS) Program is a nationwide effort led by NOAA to improve maritime safety and efficiency and environmental quality. The Delaware River and Bay PORTS was installed during 2003 to provide water surface elevation, currents at prediction depth (4.7m below MLLW) as well as near-surface and near-bottom temperature and salinity, and meteorological information at the locations shown in Figure 1 and the PORTS screen capture in Figure 2. To complement the PORTS, a nowcast/forecast system is being developed within the High Performance Coastal Ocean Modeling Framework (Zhang et al., 2010a; Gross et al., 2006) as discussed by Aikman et al. (2008) and Zhang et al. (2010b).

In conjunction with this effort, a National Ocean Service (NOS) Model Evaluation Environment (MEE) as described by Patchen (2008) was constructed for the Delaware River and Bay based on the NOS 1984-1985 Circulation Data Survey (Klavans et al., 1986). To use these data it was necessary to perform considerable restoration efforts for the CTD data as described by Loeper (2006) and for the current and CT data as described by Richardson and Schmalz (2006). The purpose of the MEE is to provide for a consistent comparison of hydrodynamic models using the same geometrical, forcing, and validation data. In the context of the Delaware River and Bay Operational Nowcast/Forecast System (DBOFS), the MEE provides additional validation data particularly for currents and density that is not available within the PORTS. Therefore as a first step, the MEE results were used to further guide the development of DBOFS, which can provide forecasts of water levels, currents, salinity and temperature throughout the Delaware River, lower Bay and adjacent continental shelf. The Coast Survey Development Laboratory (CSDL) of the NOS is leading the development of this forecast system for operational implementation at NCEP under HPC-COMF with web outputs available from the NOS Center for Operational Oceanographic Products and Services (CO-OPS).

The operational framework for implementation of coastal ocean modeling systems in NOS is referred to as the Coastal Ocean Modeling Framework (COMF). The first component of HPC-COMF is a standard file format for output of the model results. The DBOFS model application used ROMS (Haidvogel et al., 2008), and therefore the initial step in porting this model into COMF was to adjust the output into the COARDS-compliant netCDF format that NOS supports. Another component of HPC-COMF is the use of standard scripts to access real-time data and forecasts used as input to the nowcast/forecast model simulations. The ROMS simulations were set up to perform four nowcasts (a simulation over the previous six hours up until the present time) and four forecasts (extending 48 hours into the future) per day using these standard HPC-COMF scripts.

With these components of HPC-COMF in place for DBOFS, the final step in the transition to operational implementation is to quality assess the performance of a model application against standard NOS skill assessment criteria (NOS 1999, Hess et al., 2003, Zhang et al., 2010b). A software tool (Zhang et al., 2009) was developed to perform this skill assessment with models in the COMF environment, and the Delaware River and Bay model results were subsequently analyzed using this tool for different simulation scenarios (tides only, hindcasts, operational nowcasts and forecasts). Skill assessment score tables were compiled for each location where observations were available using the software package.

Section 2 of this report focuses on an overview of the DBOFS with a brief description of Regional Ocean Modeling System (ROMS), the model grid for this application, the input files, and installation of DBOFS using the Subversion Versioning System (SVN). Section 3 describes the model run scenarios for the astronomical tide simulation, a model hindcast simulation, and semi-operational nowcast/forecast simulations. A summary of the NOS skill assessment criteria and available observations in the Delaware River and Bay are summarized in Section 4. Next, the performance of DBOFS is reviewed based upon skill assessment criteria relating to water levels and currents in Sections 5 and 6, respectively. Lastly, the performance of DBOFS is reviewed based upon skill assessment criteria for salinity and temperature in Sections 7 and 8, respectively. Section 9 presents a summary of the DBOFS skill assessment.

Figure 1. The NOAA/NOS/CO-OPS Delaware River and Bay PORTS. Note cu=current meter, wl=water level, wind=wind, at=air temperature, wt=water temperature, baro=barometric pressure, and ag=air gap. (From http://tidesandcurrents.noaa.gov/ports/index.shtm?port=db)

Delaware River and Bay PORTS, NOAA/NOS 2010-03-03 09:34 EST

Water Levels (above MLLW)

Newbold	3.1 ft, Falling	Burlington	2.5 ft, Falling
Tacony-Palmyra Brdg	1.9 ft, Falling	Philadelphia	1.5 ft, Falling
Marcus Hook	0.7 ft, Falling	Delaware City	2.7 ft, Rising
Reedy Point	*** ft,	Ship John Shoal	5.3 ft, Rising
Brandywine Shoal Lt	6.6 ft, Rising	Cape May	6.8 ft, Rising
Lewes	6.1 ft, Rising		

Winds

	Spd	Dir	Gusts		Spd	Dir	Gusts
Newbold	9 kn	ENE	18	Burlington	*** kn	***	***
Delaware City	19 kn	NNE	24	Ship John Shoal	20 kn	NNE	23
Brandywine Shoal Lt	24 kn	NNE	27	Cape May	*** kn	***	***
Lewes	20 kn	NNE	25				

Air and Water Temperature

	Air	Water		Air	Water
Newbold	36 °F	40 °F	Burlington	37 °F	39 °F
Tacony-Palmyra Brdg	37 °F	38 °F	Philadelphia	37 °F	39 °F
Marcus Hook	37 °F	40 °F	Delaware City	37 °F	37 °F
Reedy Point	*** °F	*** °F	Ship John Shoal	37 °F	37 °F
Brandywine Shoal Lt	37 °F	37 °F	Cape May	37 °F	40 °F
Lewes	37 °F	38 °F			

Barometric Pressure

Newbold	1001 mb	Falling	Burlington	1001 mb	Falling
Tacony-Palmyra Brdg	1001 mb	Falling	Philadelphia	1001 mb	Falling
Marcus Hook	1001 mb	Steady	Delaware City	1001 mb	Rising
Reedy Point	*** mb		Ship John Shoal	1000 mb	Rising
Brandywine Shoal Lt	999 mb	Rising	Cape May	999 mb	Rising
Lewes	999 mb	Rising			

Salinity/Specific Gravity

Station	Salin.	S.G.	Station	Salin.	S.G.
Burlington	0.0 psu	1.0	Ship John Shoal	13.5 psu	1.01
Brandywine Shoal Lt	14.1 psu	1.01			

Air Gap/Bridge Clearance (above water surface)

Reedy Point Bridge	*** ft,

Currents (F)lood, (S)lack, (E)bb, towards °T

	Spd	Dir		Spd	Dir
Philadelphia	1.6 kn	(E), 201.0°T	Reedy Point	*** kn	( ), ***°T
Brown Shoal	1.7 kn	(F), 346.0°T			

*** Data not displayed as a result of missing data or quality control monitoring. For more information, go to https://corms.nos.noaa.gov/instrument_status.html, or call CORMS at 301-713-2540.

Figure 2. Screen capture of the NOS/CO-OPS Text-based Delaware River and Bay PORTS Screen for March 3, 2010 9:34 EST. (Available at http://tidesandcurrents.noaa.gov/ports/textscreen.shtml?port=db)

2. MODEL SYSTEM OVERVIEW

2.1 ROMS Hydrodynamic Model

The physics of the ROMS model and many aspects of the computational scheme are equivalent to the widely used Princeton Ocean Model (Blumberg and Mellor, 1987; Blumberg and Herring, 1987). The ROMS model solves the three-dimensional, vertically hydrostatic, free surface, turbulent averaged equations of motions for a variable density fluid. The model uses a stretched or sigma vertical coordinate and Cartesian or curvilinear, orthogonal horizontal coordinates. Dynamically coupled transport equations for turbulent kinetic energy, turbulent length scale, salinity and temperature are also solved. The two turbulence parameter transport equations implement the Mellor-Yamada level 2.5 turbulence closure scheme (Mellor and Yamada, 1982) as modified by Galperin et al. (1988). The numerical scheme employed in ROMS to solve the equations of motion is summarized in Shchepetkin and McWilliams (2005).

The ROMS model application to the lower Delaware River and Bay uses external forcing by water level, ocean density, wind, seal level atmospheric pressure, air temperature, relative humidity, downward long wave radiation, short wave radiation, and fresh water discharges entering the model domain. The model calculates water levels, velocity in three components, salinity, and temperature. The ROMS had been well calibrated for a simulation of the lower Delaware River and Bay for the 13-month period March 1984 – March 1985 (Schmalz, 2010), which extends the seven month MEE period (Patchen, 2008; Lanerolle, 2008) using the NOS Delaware River and Bay Circulation Survey data for model-data intercomparison.

2.2 ROMS Grid

A 120 x 733 horizontal high resolution grid (HRG) was developed using the DELFT3D RGFGRID software package (Delft Hydraulics, 2004) with resolution order 3 km at the shelf break and order 100 m at the head of tide at Trenton, NJ. Resolution in the C&D Canal is 200 m with grid cell length ranges of [49 m, 6092 m] in the x-direction and [51 m, 3053 m] in the y-direction. At head of tide at Trenton, NJ the Delaware River is represented by 3 grid cells across. In the grid construction process, three separate splines and grid segments were developed for the upper River, the C&D canal, and for the lower Bay-Shelf region, respectively. To generate the final grid, the grid segments were combined using the active-passive option and then the grid was orthogonalized. Grid point locations were reviewed and edited as necessary to improve orthogonality. The SMS software package (Brigham Young University Environmental Modeling Research Laboratory, 2006) was used to place and edit the bathymetry on the grid. Bathymetric information was obtained from the NOAA's National Geophysical Data Center. In Figure 3, the new HRG in the C&D canal region is shown. Note the ability of the grid to exactly follow the canal and to represent the main navigation channel bathymetric features as shown in Figure 4.

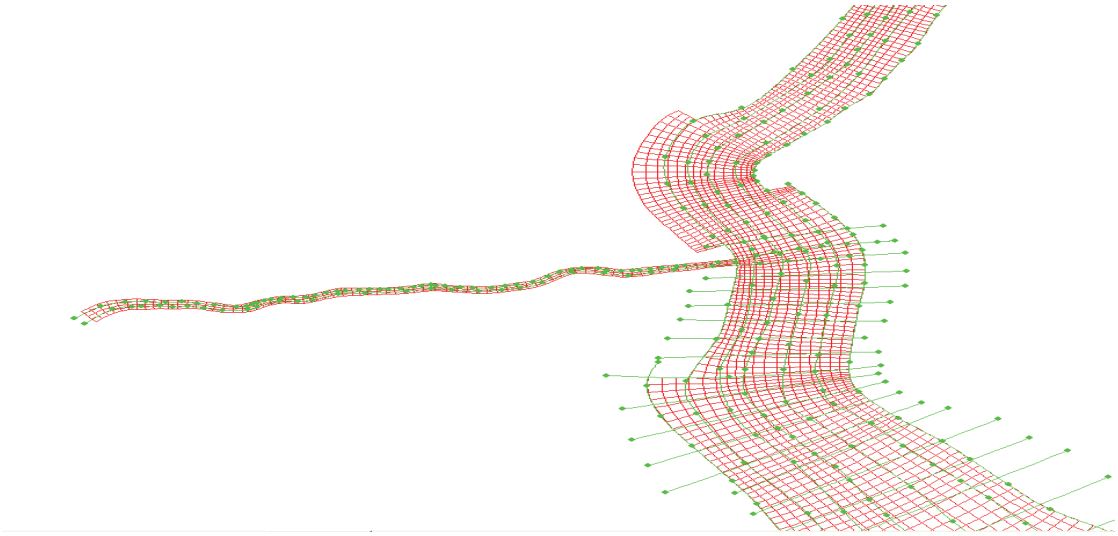


Figure 3. Map depicting Delaware River and Bay DELFT-3D High Resolution Grid in the C&D Canal Region. Splines are constructed through the appropriate points along each coordinate direction. Within each rectangle formed by the intersection of the splines, the number of grid cells in each coordinate direction is specified.

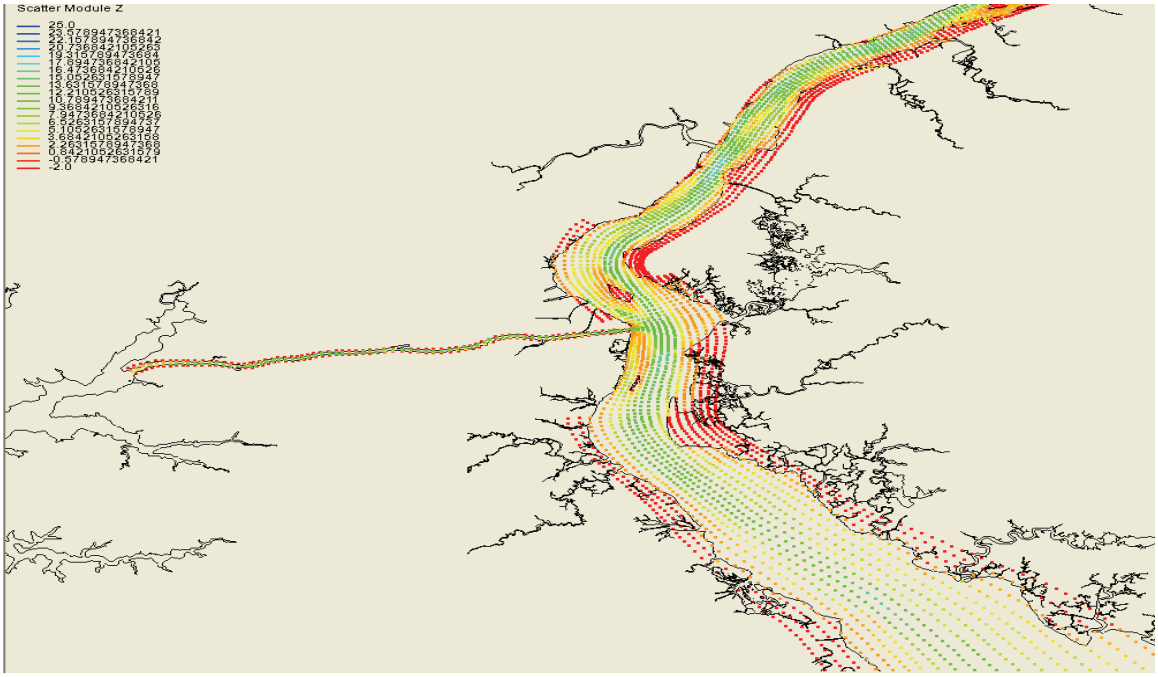


Figure 4. Map depicting bathymetry with respect to Model Datum in the C&D Canal Region. Each dot corresponds to a grid cell center with the darker shadings indicating the navigation channel.

2.3. ROMS Input and Output Files

The master input file, nos.DBOFS.ROMS.in, is required for all model runs. The information in DBOFS.ROMS.in provides model runtime control parameters, output control, and physical information describing the model domain and external forcing functions. Many options in the code are activated through the C precompiler using CPPDEF options. ROMS as such represents a family of three-dimensional finite difference approaches. Further details on the CPPDEF options and a more detailed explanation about the master input file can be found in Urizar and Lanerolle (2005) and on the ROMS website (http://myroms.org).

Additional input netCDF files required in order to run the ROMS model are listed below, where r* and t* correspond to the run type (nowcast,forecast) and time stamp yyyymdd.t{hr}z, respectively.

File Name	Comments
nos.DBOFS.ROMS.nc	Grid information
nos.DBOFS.init.nowcast.t*.nc	Initial conditions
nos.DBOFS.obc.t*.nc	Boundary Conditions
nos.DBOFS.met.t*.nc	Wind and atmospheric pressure
nos.DBOFS.river.r*.t*.nc	River inputs
nos.DBOFS.hflux.r*.t*.nc	Heat Fluxes
nos.DBOFS.ROMS.tides.nc	Tidal Forcings

The three major netCDF files generated by the ROMS model are as follows:

File Name	Comments
nos.DBOFS.rst.r*.t*.nc	Restart information
nos.DBOFS.fields.r*.t*.nc	Hydrodynamic fields
nos.DBOFS.stations.r*.t*.nc	Station time series

2.4. Installation Using SVN System

SVN is a software package which coordinates the separate version of the code for each model developer. ROMS is distributed by the ROMS Group at Rutgers University using the SVN system. This software package keeps all the programs in a directory structure, which allows control over updated versions, so users/developers can install the most updated version of ROMS for use on the user's local computer. The preferred approach is

to run ROMS on NOAA's CCS operated by the NWS's National Centers for Environmental Prediction (NCEP), where all HPC-COMF related directories and programs are stored.

3. MODEL RUN SCENARIO DEFINITION

To evaluate the performance of the DBOFS under a range of conditions, the NOS skill assessment criteria are applied to four model simulation scenarios. These include a simulation of just the tides, a hindcast simulation, the nowcast simulations and the forecast simulations. Each is discussed in more detail below. Tide and hindcast simulation water level stations are shown in the upper River in Figure 5 and in the lower River and Bay in Figure 6. The majority of the current stations are in the river from Philadelphia, PA down through the Bay entrance and near shelf as shown in Figure 7 for the tidal and hindcast simulations. Observed salinity and temperature are derived from the CT sensors located at the current meter locations during the hindcast simulation. For the nowcast/forecast simulations all measurement locations are shown at the NOS PORTS stations in Figure 1.

3.1. Astronomical Tides Only Simulation

For the astronomical tides only simulation, water levels along the open ocean boundary are forced using the harmonic constants as derived from the ADCIRC model for the Western North Atlantic Ocean on the East Coast 1995 grid as developed by Myers (2007, personal communication) following Mukai et al. (2001). River discharge inflows were specified as average daily climatological values. The salinity and temperature at the open boundaries were determined from NOAA's World Ocean Atlas 2001 (Conkright et al., 2002). The initial salinity and temperature fields were determined using historical circulation survey CT and CTD data (Klavans et al., 1986). Heat flux forcing data were determined from the NCEP North American Regional Reanalysis (NARR), while winds were set to zero, and sea level atmospheric pressure was set to 1013 mb.

3.2. Model Hindcast Simulation

For the hindcast simulation, the ocean boundary of the grid is forced with a superposition of the subtidal water levels at Cape May, NJ (shown in Figure 1) and predicted tides. The subtidal water level signal at Cape May, NJ is empirically reduced by 30% to prescribe the subtidal water level along the outer boundary. The predicted tides are based on the same techniques used for the tide only simulation. At the Chesapeake Bay end of the C&D canal the subtidal water level was based on Chesapeake City, MD as determined via a linear regression (bias=0.003, gain=0.784) from the Baltimore, MD water level observations. The NOS accepted harmonic constants at Chesapeake City, MD were slightly adjusted to provide the corresponding tidal forcing.

The initial and boundary conditions for salinity and temperature were the same as those used in the hindcast.

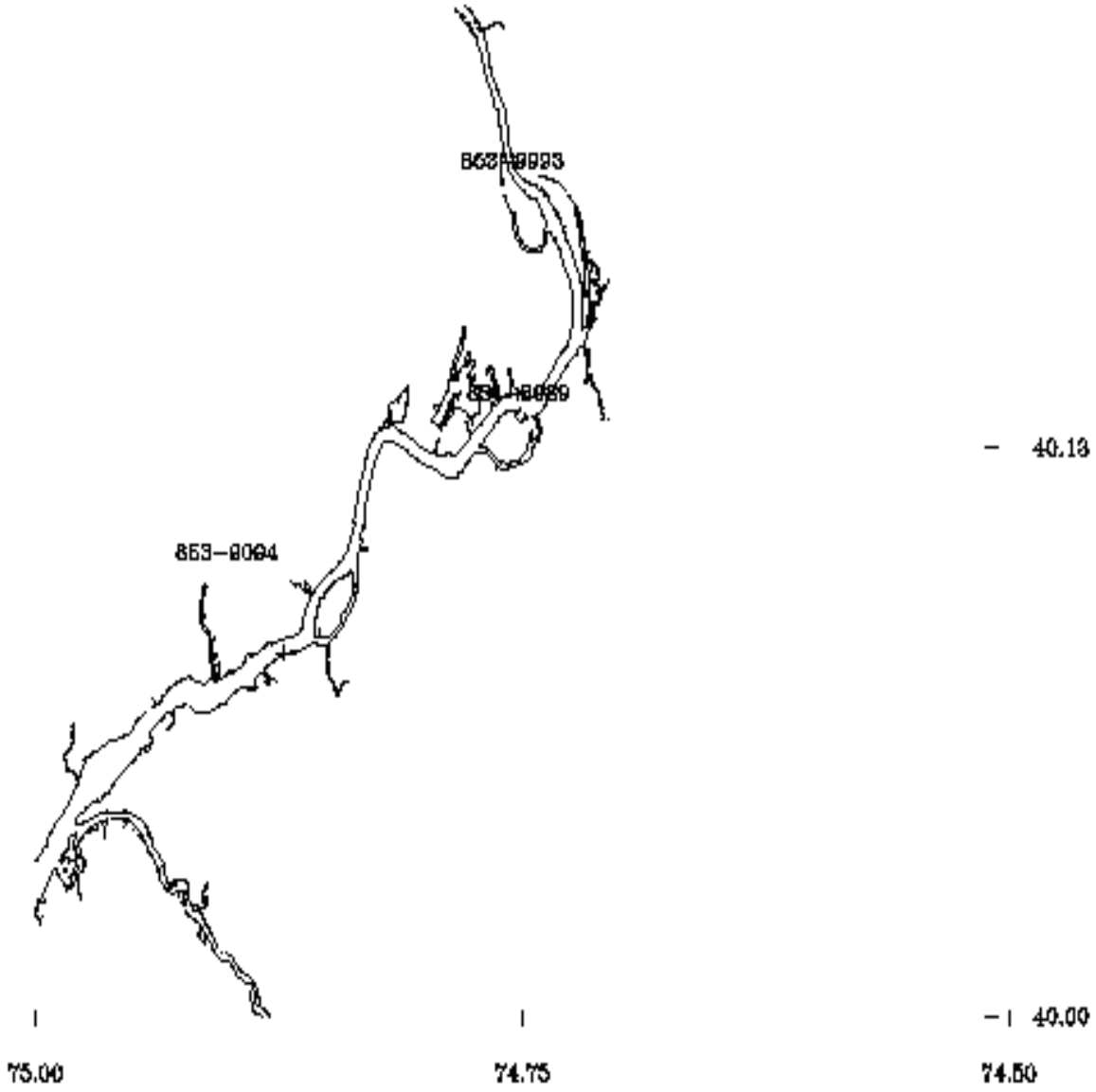


Figure 5. Upper Delaware River NOS Water Level Locations: Tidal and Hindcast Simulations.

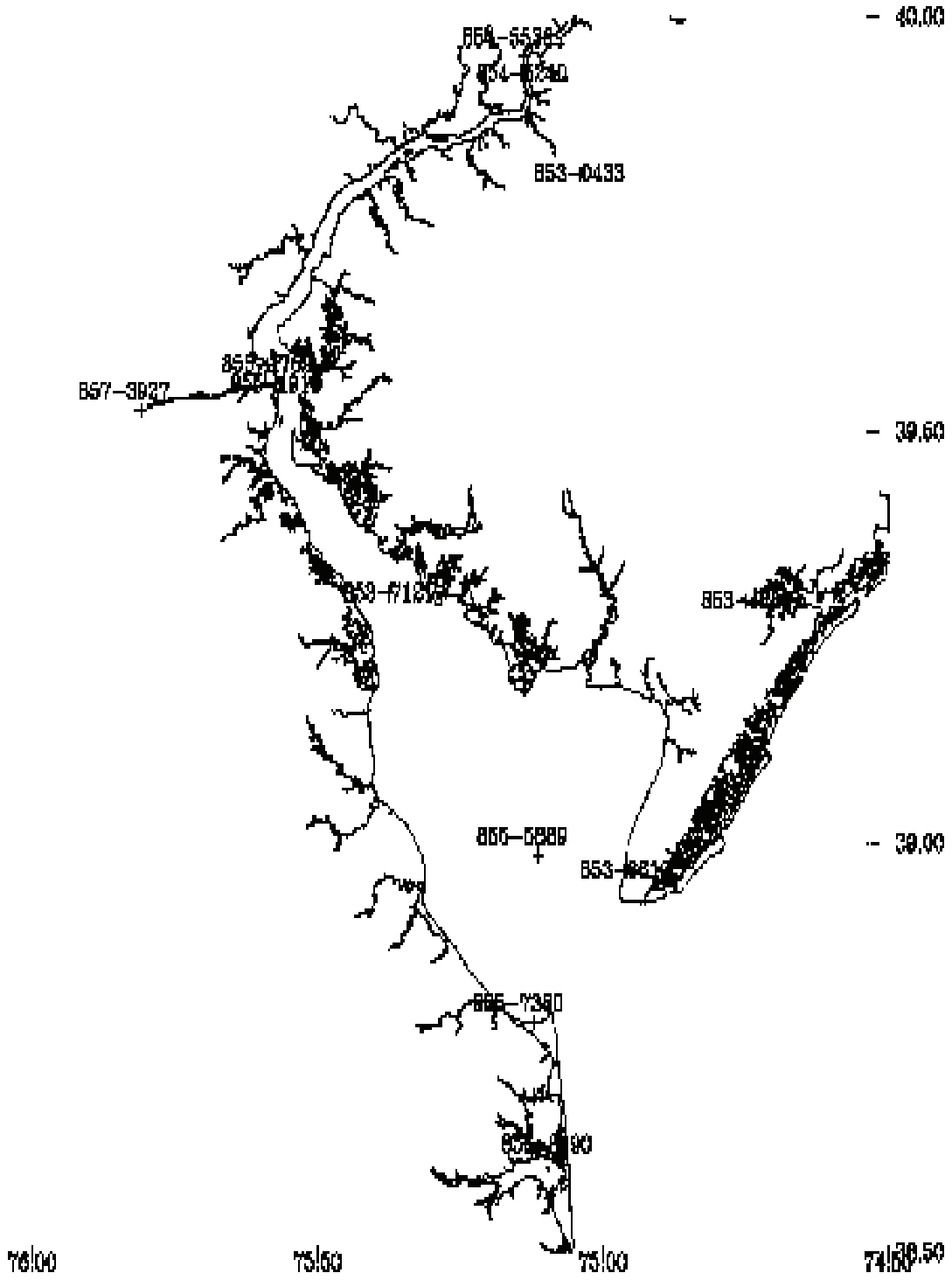


Figure 6. Lower Delaware River and Bay NOS Water Level Locations: Tidal and Hindcast Simulations.

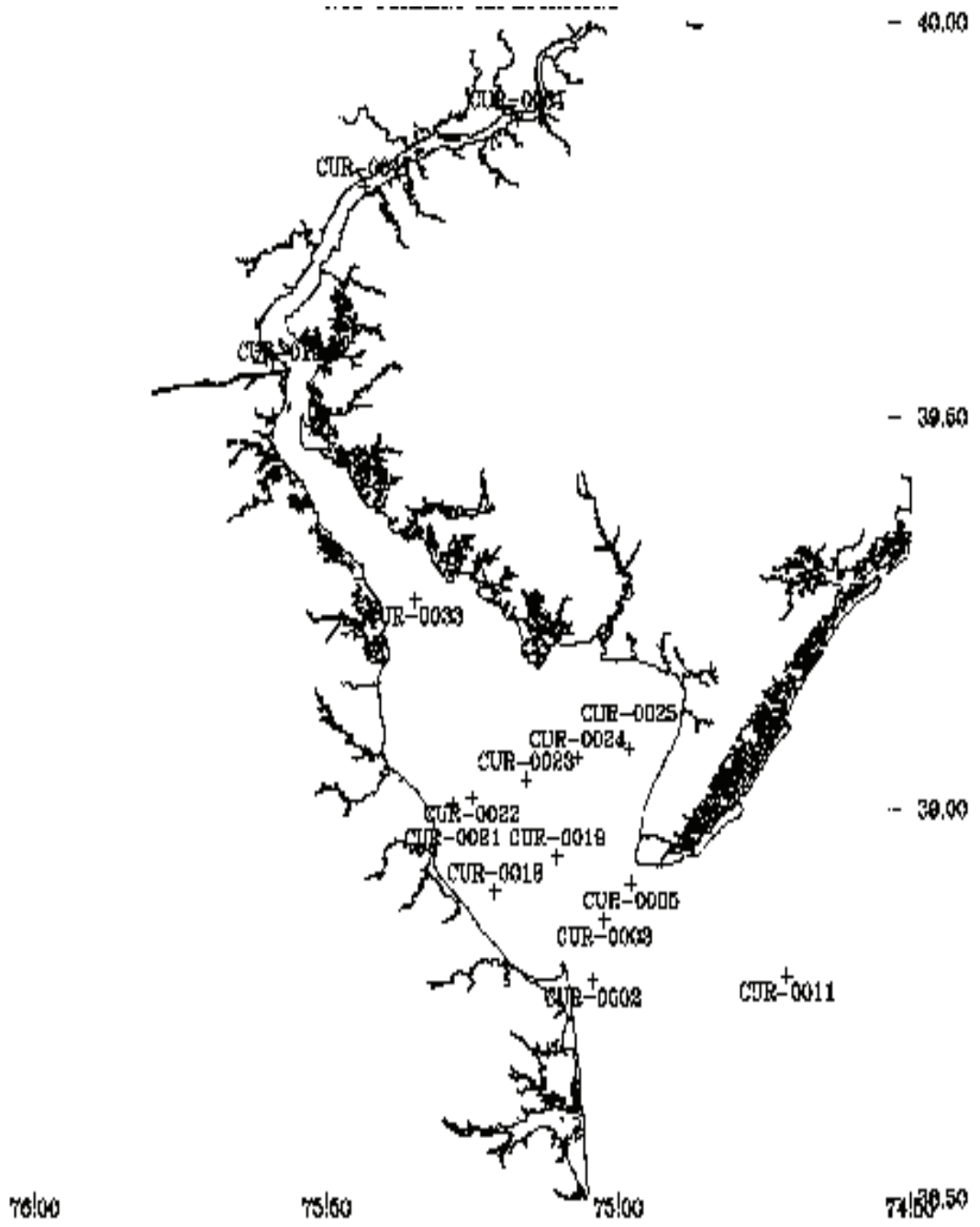


Figure 7. Lower Delaware River and Bay NOS Current Locations: Tidal and Hindcast Simulations.

At the upstream boundary, DBOFS specifies the Delaware River inflow over three grid cells (0.3, 0.4, 0.3) of the USGS measured inflows at Trenton, NJ. Freshwater discharge from the following 11 additional tributaries was specified in the model: Schuylkill River, Maurice River, Salem River, Cohansey River, Neshaminy Creek, Frankford Creek, Raccoon Creek, Brandywine Creek, Chester Creek, Millsboro Pond Outlet, and Roach Marsh. Discharge values were determined from USGS streamflow gage readings. Salinity is assumed zero. Water temperatures were specified from nearby CT stations.

Wind and sea level atmospheric pressure forcing fields were provided from a Barnes (1973) interpolation of surface marine weather observations at 10 meteorological stations. Radiation fluxes were derived from a Barnes (1973) interpolation of the NARR product at these same 10 meteorological stations.

3.3. Semi-Operational Nowcast/Forecast Simulation

For the nowcasts, the subtidal water levels along the open ocean boundary are determined using adjustment of the NOAA Extratropical Storm Surge Model (ETSS) latest hourly subtidal forecast guidance. The adjustment is determined by averaging the hourly subtidal anomalies at Ocean City, MD and Cape May, NJ over the previous six-hour nowcast period and ramping the latest subtidal values to the adjusted level and subsequent forecast values. The astronomical tide is determined from the tidal constituent netCDF file and the application of the latest node factor and equilibrium argument values at six-minute intervals. The total open ocean boundary six-minute values are the sum of the six-minute interpolated hourly subtidal and six-minute tidal values. A similar process is used at the C&D canal boundary with the subtidal and tidal values based on the Chesapeake City, MD observations and tidal constituents. Salinity and temperature along the open ocean boundary is obtained from adjusted Navy Coastal Ocean Model (NCOM) forecast guidances. The adjustment is determined by averaging the salinity and temperature hourly anomalies at Ocean City, MD and Cape May, NJ over the previous six-hour nowcast period and ramping the latest values to the adjustment and subsequent forecast values. If the anomalies are not available, they are determined from NOAA's World Ocean Atlas 2005 climatology (Locarnini et al., 2006). Wind at 10m above ground level (AGL), sea level atmospheric pressure, air temperature at 2m (AGL), and relative humidity at 2m (AGL) from the NCEP Real-Time Mesoscale Analysis (RTMA) and short wave radiation at 2m (AGL) and downward long wave radiation at 2m (AGL) fields from the NCEP North American Mesoscale (NAM) numerical weather prediction model are interpolated at each hour to the DBOFS grid to provide the nowcast meteorological forcings. Finally, real-time river discharges and water temperatures are downloaded from the USGS with salinity assumed zero to specify inflow conditions. The nowcasts are run every six hours.

Forecasts out to forty-eight hours are made with DBOFS four times a day. Along the open ocean boundary, water levels are specified as a superposition of the tide predictions and the subtidal water level forecasts using the same procedures used during the nowcast. Note the nowcast adjustments are persisted for the forecast period. A similar approach is used for the salinity and temperature open boundary conditions. Wind at 10m (AGL), sea

level atmospheric pressure, air temperature at 2m (AGL), relative humidity at 2m (AGL), short wave radiation at 2m (AGL), and, downward long wave radiation at 2m (AGL) fields at three-hour intervals from the NCEP NAM numerical weather prediction model are interpolated to the DBOFS grid to provide the forecast meteorological forcings. River discharges are persisted from the latest observations from the same USGS river gauges used in the nowcasts. Salinity is assumed zero. Water temperatures were specified from USGS streamflow stations.

4. SKILL ASSESSMENT STATISTICS AND DATA

4.1. Skill Assessment Statistics

Skill assessment is an objective measurement of the performance of a model when systematically compared with observations. NOS skill assessment criteria were created for evaluating the performance of circulation models (NOS, 1999; Hess et al., 2003), and a software package was subsequently developed to compute these criteria using standard file formats output from the models (Zhang et al., 2009). The software can compute the skill assessment scores automatically using files containing observations, predictions, and nowcast/forecast model results. A standard suite of skill assessment statistics is defined in Table 1 (Hess et al., 2003). The target frequencies of the associated statistics are,

$CF(X) \geq 90\%$, $POF(2X) \leq 1\%$, $NOF(2X) \leq 1\%$, $WOF(2X) \leq 0.5\%$
$MDPO(2X) \leq L$, $MDNO(2X) \leq L$

Table 1. Skill Assessment Statistics (from Hess et al., 2003)

Variable	Explanation
Error	The error is defined as the predicted value, p, minus the reference (observed or astronomical tide value, r : $e_i = p_i - r_i$.
SM	Series Mean. The mean value of a series y. Calculated as $\bar{y} = \frac{1}{N}\sum_{i=1}^{N} y_i$.
RMSE	Root Mean Square Error. Calculated as $RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N} e_i^2}$.
SD	Standard Deviation. Calculated as $SD = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N} (e_i - \bar{e})^2}$
CF(X)	Central Frequency. Fraction (percentage) of errors that lie within the limits $\pm$X.
POF(X)	Positive Outlier Frequency. Fraction (percentage) of errors that are greater than X.
NOF(X)	Negative Outlier Frequency. Fraction (percentage) of errors that are less than -X.
MDPO(X)	Maximum Duration of Positive Outliers. A positive outlier event is two or more consecutive occurrences of an error greater than X. MDPO is the length of time (based on the number of consecutive occurrences) of the longest event.
MDNO(X)	Maximum Duration of Negative Outliers. A negative outlier event is two or more consecutive occurrences of an error less than -X. MDNO is the length of time (based on the number of consecutive occurrences) of the longest event.
WOF(X)	Worst Case Outlier Frequency. Fraction (percentage) of errors that, given an error of magnitude exceeding X, either (1) the simulated value of water level is greater than the astronomical tide and the observed value is less than the astronomical tide, or (2) the simulated value of water level is less than the astronomical tide and the observed value is greater than the astronomical tide.

There are three types of data sets (Table 2): Group 1, a time series of values at uniform time intervals; Group 2, a set of values representing the consecutive occurrences of an event (such as high water or slack water); and Group 3, a set of values representing a forecast valid at a given projection time. The acceptable error limits (X) and maximum duration limits (L) for the associated variable are presented in Table 3.

Table 2. Data series groups and the variables in each. Note that upper case letters indicate a prediction series (e.g., H), and lower case letters (e.g., h) indicate a reference series (observation or astronomical prediction). Slack water is defined as a current speed less than ½ knot. The direction is computed only for current speeds greater than ½ knot (from Hess et al., 2003).

Group	Variable	Symbol
Group 1	Water level	H, h
(Time Series)	Current speed	U, u
	Current direction	D,d
	Salinity	S, s
	Water temperature	T,t
Group 2	Amplitude of high water	AHW,ahw
(Values at a Tidal Stage)	Amplitude of low water	ALW,ahw
	Time of high water	THW,thw
	Time of low water	TLW,tlw
	Amplitude of maximum flood current	AFC,afc
	Amplitude of maximum ebb current	AEC,aec
	Time of maximum flood current	TFC,tfc
	Time of maximum ebb current	TEC,tec
	Direction of current at maximum flood	DFC,dfc
	Direction of current at maximum ebb	DEC,dec
	Time of start of current slack before flood	TSF,tsf
	Time of end of current slack before flood	TEF, tef
	Time of start of current slack before ebb	TSE, tse
	Time of end of current slack before ebb	TEE, tee
Group 3	Water level at forecast projection time of nn hrs	Hnn, hnn
(Values from a Forecast)	Current speed at forecast projection time of nn hrs	Unn, unn
	Current direction at forecast projection time of nn hrs	Dnn, dnn
	Salinity at forecast projection time of nn hrs	Snn, snn
	Water temperature at forecast projection time of nn hrs	Tnn, tnn

Table 3. Acceptance error limits (X) and the maximum duration limits (L)

variables	X	L (hours)
H, Hnn, AHW,ALW	15 cm	24
THW, TLW	0.5 hours	25
U, Unn, AFC, AEC	0.26 m/s	24
TFC, TEC	0.5 hours	25
TSF, TEF, TSE, TEE	0.25 hours	25
D, Dnn,	22.5 degrees	24
DFC, DEC	22.5 degrees	25

4.2. Data

For the thirteen-month (1 March 1984 through 31 March 1985) DBOFS astronomical tide and hindcast simulations, skill assessment scores were computed at 9 locations for water levels (Table 4) and at 19 locations for currents (Table 5) where the observations are available in both 1984 and 1985 from the NOS historical circulation survey as reported by Klavans et al. (1986). Refer to Figures 5 and 6 for water level and Figure 7 for current station locations. The accepted harmonic constants for tidal water levels at the thirteen water level stations derived by CO-OPS were used to make water level tidal predictions and were also used in comparisons with the modeled harmonic constants obtained through harmonic analysis of water level time series from the astronomical tide simulation. Harmonic constants of the water currents were obtained by harmonically-analyzing the NOS historical circulation data time series and were used to make tidal current predictions via the methods described by Shureman (1958). For salinity and temperature, hindcast skill assessment scores were computed at the 20 stations in Table 6 and at the 21 stations in Table 7, respectively.

For the skill assessment of the nowcast and forecast simulations, the verified water level observations at the twelve stations (Table 8) and PORTS current meter observations (Table 9) over the three month period 15 April, through 15 July, 2010 were obtained from CO-OPS. Salinity skill scores were computed at the three stations given in Table 10, while temperature skill scores were computed at the nine stations given in Table 11. Refer to Figure 1 for PORTS station locations.

Table 4. NOS water level stations used in the astronomical tide and hindcast skill assessment periods: 1 March 1984 – 31 March 1985

Station ID	Name	Latitude	Longitude	Data Period (Gap in (days)
857-0280	Ocean City, MD	38.327	-75.083	4/8-1/2/1985 (4.42)
857-3927	Chesapeake City, MD	39.525	-75.810	6/7-11/6/1984 (0.)
853-6110	Cape May, NJ	38.968	-74.960	4/1-4/2/1984 (0.)
855-7380	Lewes, DE	38.782	-75.120	3/1-4/2/1984 (0.)
855-5889	Brandywine Shoal, DE	38.983	-75.113	3/18-4/2/1984 (0.)
855-1910	Reedy Point, DE	39.558	-75.573	3/1-1/2/1985 (0.)
854-5530	Philadelphia Pier 11, PA	39.953	-75.138	3/1-1/2/1985 (14.17)
853-9094	Burlington, NJ	40.080	-74.873	3/1-4/6/1984 (14.17)
853-9993	Trenton, NJ	40.188	-74.755	3/1-1/2/1985 (14.17)

Table 5. NOS current stations used in the astronomical tide and hindcast skill assessment periods: 1 March 1984 – 31 March 1985

Station ID	Latitude	Longitude	PCD (deg T)	Depth (m)	Data Period
002	38.781	-75.043	327.	3.96	4/2-12/2/1984
003	38.859	-75.024	325.	5.49	4/3-11/21/1984
005	38.906	-74.978	313.	4.57	4/3-11/21/1984
012	38.785	-74.368	239.	7.92	10/20-11/19/1984
016	39.201	-74.413	233.	7.32	3/8-11/27/1984
017	39.051	-74.072	257.	7.62	4/17-10/9/1984
018	38.896	-75.211	314.	4.27	9/18-10/18/1984
019	38.941	-75.105	339.	5.18	9/18-10/18/1984
020	38.985	-74.988	340.	4.57	9/18-10/10/1984
021	39.008	-74.284	316.	4.57	9/19-10/18/1984
022	39.016	-75.251	332.	4.27	5/9-10/18/1984
023	39.039	-75.158	346.	3.66	3/8-11/28/1984
024	39.067	-75.070	345.	3.96	5/9-10/18/1984
025	39.078	-74.981	1.	3.96	9/18-10/18/1984
033	39.269	-75.348	323.	3.66	3/8-9/11/1984
047	39.795	-75.435	63.	4.57	6/14-4/3/1985
051	39.880	-75.173	92.	5.18	3/6/-4/3/1985
052	39.986	-75.063	36.	6.10	3/6-4/6/1984
154	39.561	-75.570	264.	4.57	6/20-4/3/1985

Table 6. NOS salinity stations used in the hindcast skill assessment period:
1 March 1984 – 31 March 1985

Station ID	Latitude	Longitude	Depth (m)	Data Period
002	38.781	-75.043	3.96	4/2-12/2/1984
003	38.859	-75.024	5.49	4/3-11/21/1984
005	38.906	-74.978	4.57	4/3-11/21/1984
011	38.788	-74.711	7.62	11/4-11/19/1984
012	38.785	-74.368	7.92	10/20-11/19/1984
016	39.201	-74.413	7.32	3/8-11/27/1984
018	38.896	-75.211	4.27	9/18-10/18/1984
020	38.985	-74.988	4.57	9/18-10/18/1984
021	39.008	-74.284	4.57	9/18-10/10/1984
022	39.016	-75.251	4.27	5/9-10/18/1984
023	39.039	-75.158	3.66	3/8-11/28/1984
024	39.067	-75.070	3.96	5/9-10/18/1984
033	39.269	-75.348	3.66	3/8-9/11/1984
047	39.795	-75.435	4.57	6/14-4/3/1985
050	39.967	-75.119	7.32	3/22-4/6/1984
051	39.880	-75.173	5.18	3/6/-4/2/1985
052	39.986	-75.063	6.10	3/6-4/6/1984
053	40.076	-74.887	6.40	3/6-3/22/1984
054	40.134	-74.756	4.57	3/6-3/26/1984
154	39.561	-75.570	4.57	6/20-4/2/1985

Table 7. NOS temperature stations used in the hindcast skill assessment period:
1 March 1984 – 31 March 1985

Station ID	Latitude	Longitude	Depth (m)	Data Period
002	38.781	-75.043	3.96	4/24-12/2/1984
003	38.859	-75.024	5.49	4/3-11/21/1984
005	38.906	-74.978	4.57	4/3-11/21/1984
011	38.788	-74.711	7.62	11/4-11/19/1984
012	38.785	-74.368	7.92	10/20-11/19/1984
016	39.201	-74.413	7.32	3/8-11/27/1984
017	39.051	-74.072	7.62	4/17-10/9/1984
018	38.896	-75.211	4.27	9/18-10/18/1984
019	38.941	-75.105	5.18	9/18-10/18/1984
020	38.985	-74.988	4.57	9/18-10/10/1984
021	39.008	-74.284	4.57	9/18-10/10/1984
022	39.016	-75.251	4.27	5/9-10/18/1984
023	39.039	-75.158	3.66	3/8-11/28/1984
024	39.067	-75.070	3.96	5/9-10/18/1984
033	39.269	-75.348	3.66	3/8-9/11/1984
047	39.795	-75.435	4.57	6/14-4/2/1985
050	39.967	-75.119	7.32	3/22-4/6/1984
051	39.880	-75.173	5.18	3/6/-4/2/1985
052	39.986	-75.063	6.10	3/6-4/6/1984
054	40.134	-74.756	4.57	3/6-3/26/1984
154	39.561	-75.570	4.57	9/27-4/2/1985

Table 8. NOS water level stations used in the nowcast/forecast skill assessment period: 15 April – 15 July 2010

Station ID	Name	Latitude	Longitude	MD -MSL (m)	Data Gap (days)
857-3927	Chesapeake City, MD	39.525	-75.810	0.	0.
853-6110	Cape May, NJ	38.968	-74.960	0.	0.
855-7380	Lewes, DE	38.782	-75.120	0.	0.
855-5889	Brandywine Shoal, DE	38.983	-75.113	0.	0.
853-7121	Ship John Shoal, NJ	39.305	-75.375	0.	0.
855-1910	Reedy Point, DE	39.558	-75.573	0.	0.
855-1762	Delaware City, DE	39.582	-75.588	0.	0.
854-0433	Marcus Hook, PA	39.812	-75.410	-0.04	0.
854-5240	Philadelphia USCG, PA	39.933	-75.142	-0.11	0.
853-8886	Tacony Bridge, NJ	40.012	--75.043	-0.14	0.
853-9094	Burlington, NJ	40.080	-74.873	-0.17	0.
854-8989	Newbold, PA	40.136	-74.753	-0.18	0.

Table 9. NOS current stations used in nowcast/forecast skill assessment period: 15 April – 15 July 2010

Station ID	Name	Latitude	Longitude	PCD (deg T)	Data Gap (days)
db0301	Philadelphia SL	39.946	-75.140	19.	0.
db0501	Brown Shoal	38.922	-75.100	336.	2.18

Table 10. NOS salinity stations used in nowcast/forecast skill assessment period: 15 April – 15 July 2010

Station ID	Name	Latitude	Longitude	Data gap (days)
853-9094	Burlington, NJ	40.080	-74.873	0.
855-5889	Brandywine Shoal, DE	38.983	-75.113	0.
853-7121	Ship John Shoal, NJ	39.305	-75.375	0.

Table 11. NOS temperature stations used in nowcast/forecast skill assessment period: 15 April – 15 July 2010

Station ID	Name	Latitude	Longitude	Data Gap (days)
854-8989	Newbold	40.136	-74.753	0.
855-5889	Brandywine Shoal, DE	38.983	-75.113	0.
855-7380	Lewes, DE	38.782	-75.120	0.
853-9094	Burlington, NJ	40.080	-74.873	0.
854-5240	Philadelphia USCG, PA	39.933	-75.142	0.
855-1762	Delaware City, DE	39.582	-75.588	0.
853-7121	Ship John Shoal, NJ	39.305	-75.375	0.
853-6110	Cape May, NJ	38.968	-74.960	0.
857-3927	Chesapeake City, MD	39.525	-75.810	0.58

5. RESULTS FOR WATER LEVEL SKILL ASSESSMENT

Skill assessment statistics were calculated for each DBOFS model scenario (astronomical tides only, hindcast, nowcast and forecast). The NOS skill assessment software was used to automatically generate skill assessment tables for each of the stations mentioned in Section 4.2. Tables of observed and modeled tidal harmonic constants were also generated using a least squares harmonic analysis algorithm in the skill assessment software. The results of the skill assessment for each scenario are presented below.

5.1. Astronomical Tide Only Simulation

The astronomical tidal simulation was made for the thirteen month period March 1984 through March 1985, and water level time series were saved in six minute intervals at locations where observations were available. DBOFS was forced with water level ocean boundary conditions derived from the tidal predictions at each ocean open boundary cell based on adjusted ADCIRC Western North Atlantic tidal inversion harmonic constants from Myers (2007, personal communication). For the Sa and Ssa long period constituents the values at Cape May, NJ were used. For the C&D Canal open boundary, the harmonic constants at Chesapeake City, MD including the Sa and Ssa long period constituents were used. Refer to Schmalz (2010) for details in the adjustments of the tidal inversion harmonic constants and for the development of the spatially varying bottom roughness coefficient zone values. At the Bay entrance the M_2 dominant constituent errors were at Cape May, NJ -3.1 cm RMSE in amplitude and -1.3^o in phase and at Lewes, DE 0.7 cm RMSE in amplitude and -1.8^o in phase error. At Chesapeake City, MD errors in M_2 were -4.1 cm RMSE in amplitude and 4.9^o in phase. At Reedy Point, DE errors in M_2 were -8.4 cm RMSE in amplitude and -1.2^o in phase. As one proceeds upriver, M_2 errors at Philadelphia, PA are -4.3 cm RMSE in amplitude and -4.2^o in phase and at Trenton, NJ are -2.5 cm RMSE in amplitude and -10.9^o in phase. The harmonic constants derived from the simulated water level time series are compared with the CO-OPS accepted harmonic constants in Appendix A.

The standard suite of statistics was computed for comparing the simulated and predicted tidal water level time series and is presented in Appendix B (Scenario: Tidal Simulation Only). CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria for the entire time series, as do the amplitudes of high and low water for most stations in the Delaware Bay. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts except at Burlington, NJ and Trenton, NJ near the head of tide. At Lewes, DE, Cape May, NJ, and Chesapeake City, MD, the RMSEs and CFs were 8 cm, 8 cm, 10 cm and 96, 93, and 88, respectively. At Philadelphia, PA and Trenton, NJ the RMSEs and CFs were 13 cm, 24 cm, 77, and 50, respectively.

5.2. Hindcast Simulation

The DBOFS simulated water level time series were compared with the NOS historical observations from the Delaware River and Bay Circulation Survey (Klavans et al., 1985) at the nine water level stations over the thirteen month period March 1984 through March 1985. The standard suite of statistics for this simulation is presented in Appendix B (Scenario: Hindcast). The vertical reference datum is a common issue for total water level comparisons of model simulations and observations. The model simulation has a single well defined mean sea level datum that is equal to zero (the sea surface with no slope). The mean sea level reported with the observations is a local value calculated from data which is generally not the same as the value of model mean sea level because of fresh water effects, meteorological forcing, and baroclinic effects. Results are shown for two vertical datums. In the first case, the vertical datum is considered to be equal to the MSL of the astronomical tide at each station over the thirteen month period. In the second case, the vertical datum is considered to equal to tidal epoch MSL for stations below Marcus Hook, PA, while for the river stations above Marcus Hook, PA the vertical datum is considered the North American Vertical Datum of 1988 (NAVD88). For the stations in the Bay below Marcus Hook, PA the results are comparable for both cases, while above Marcus Hook, PA the results for the second case are improved over those of case one and are considered to more accurately include the baroclinic effects and are discussed here. CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria for the entire time series, as do the amplitudes of high and low water for most stations in the Delaware Bay. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts accept at Burlington, NJ and Trenton, NJ near the head of tide. At Lewes, DE, Cape May, NJ, and Chesapeake City, MD, the RMSEs and CFs were 12 cm, 12 cm, 11 cm and 83, 85, and 84, respectively. At Philadelphia, PA and Trenton, NJ the RMSEs and CFs were 13 cm, 21 cm, 87, and 79, respectively.

5.3. Semi-Operational Nowcast/Forecast Simulation

DBOFS semi-operational nowcasts and forecasts were made during the three-month period 15 April through 15 July 2010, and the results from these simulations were concatenated into continuous time series for analysis using the skill assessment software. Tables in Appendix B (SCENARIO: Semi-Operational Nowcast) show the skill assessment statistics for the semi-operational nowcast for both vertical datums. Here we discuss the results for the second case. CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria for the entire time series, as do the amplitudes of high and low water for most stations in the Delaware Bay. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts except at Burlington, NJ and Newbold, PA. At Lewes, DE, Cape May, NJ, and Chesapeake City, MD, the RMSEs and CFs were 9 cm, 9 cm, 6 cm and 93, 94, and 98, respectively. At Philadelphia, PA and Newbold, PA the RMSEs and CFs were 14 cm, 21 cm, 83, and 59, respectively.

For the semi-operational forecasts, the RMSEs out to 24 hours are less than 17 cm at all stations. CF, NOF, POF, MDNO, MDPO, and WOF all pass the criteria throughout the 24 forecasts hours for the stations below Philadelphia, PA. CF fails at some stations for the times of high and low water. At stations in the river sections at and above Philadelphia, PA, the SA targets are not met, but in general are not missed by large amounts accept at Burlington, NJ and Newbold, PA. At Lewes, DE, Cape May, NJ, and Chesapeake City, MD, the RMSEs and CFs were 9 cm, 9 cm, 13 cm and 91, 90, and 85, respectively. At Philadelphia, PA and Newbold, PA the RMSEs and CFs were 12 cm, 16 cm, 83, and 66, respectively. At the Bay entrance stations of Cape May, NJ and Lewes, DE the RMSE increases from forecast hour 0 to forecast hour 24 by order 2 cm, while at Chesapeake City, MD the RMSE increases over the same forecast horizon by order 11 cm. Time series plots of representative water level stations are shown against observations in Figure 8, for the tidal prediction, nowcast, and forecast.

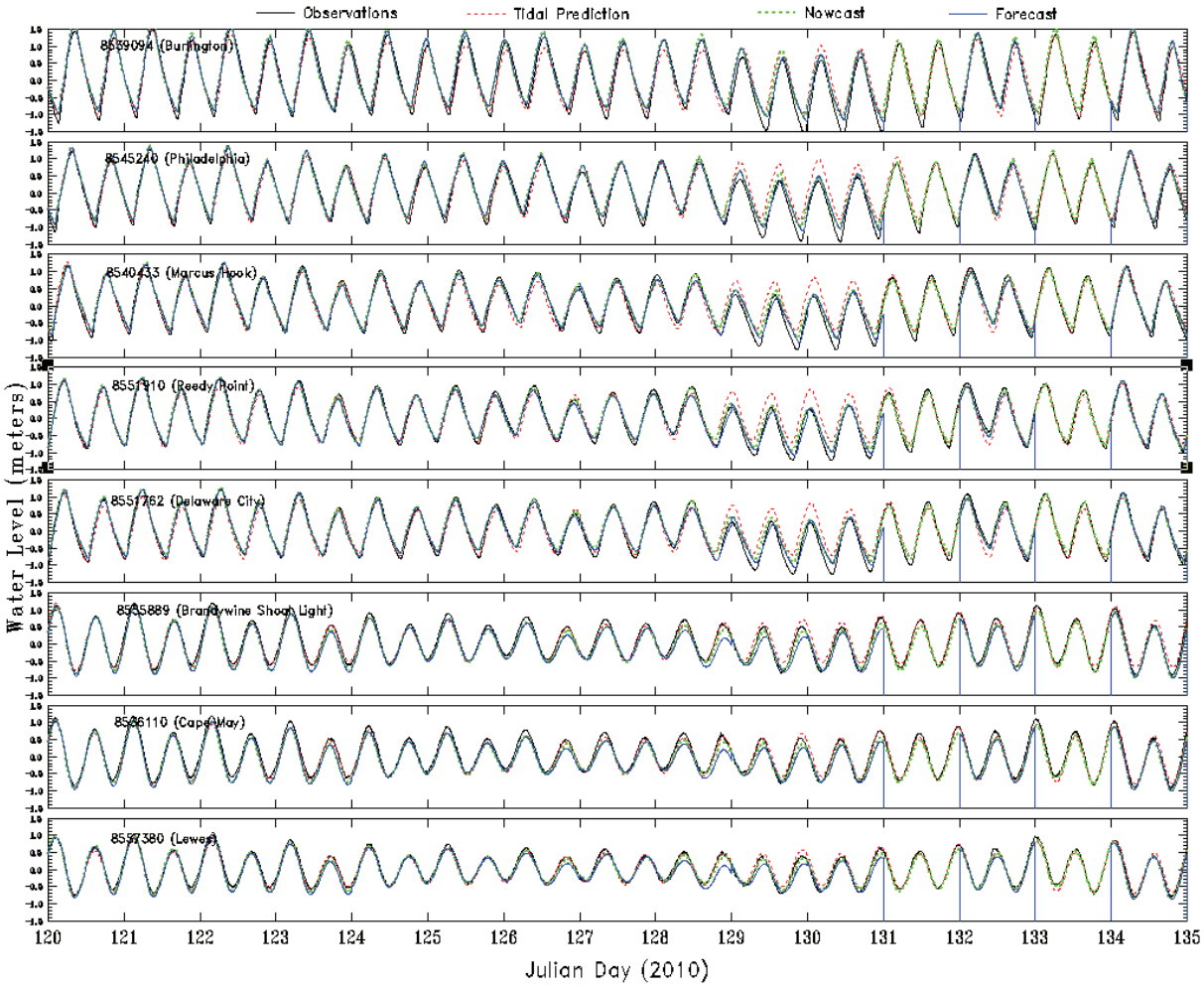


Figure 8. Water level time series comparison for DBOFS' semi-operational nowcasts during JD 120-135, 2010 at eight NOS stations.

6. SKILL ASSESSMENT OF WATER CURRENTS

Skill assessment for DBOFS currents was made at nineteen locations from the NOS Delaware River and Bay circulation survey in 1984 and 1985 (Klavans et al., 1986). The observations of water currents at the depth shown in Table 5 below the Mean Lower Low Water (MLLW) were compared with the model results at the corresponding depth. The current observations were not filtered.

6.1. Tidal Simulation Only Simulation

The observed harmonic constants of the currents derived from the historical current meter time series are compared with the modeled harmonic constants derived from the 13-month, March 1984 through March 1985, tide-only simulations in Appendix D. The results for five representative stations, throughout the estuary are next considered.

The principal current directions of the modeled and observed currents are very close, with differences between the modeled and observed values of 6, 1, 2, 5, and 1 degrees at Station 5 at the Bay entrance , Station 23 in the lower mid-Bay channel , Station 33 in the upper Bay channel, Station 154 at C&D canal, and Station 52 in the mid-River near Philadelphia, PA, respectively. For the dominant M_2 constituent, the modeled amplitude is nearly identical to the observed value at the Bay entrance Station 5, while at Stations 23, 33, 154, and 52 the model amplitudes are smaller than the observed values with differences of -1.6, -22.9, -16.6, and -44.2 cm/s, respectively. The phase differences between the modeled and observed M_2 currents are 3.0, -4.2, -7.1, -10.7, and -18.9 degrees at Stations 5, 23, 33, 154, and 52, respectively. For the second largest constituent, N_2, amplitude differences are 3.5, 0.3, -4.0, -2.6, and -9.1 cm/s at Stations 5, 23, 33, 154, and 52, respectively, and phase differences between the model and observed values are 6.4 (Station 5), -2.2 (Station 23), -39.4 (Station 33), -37.6 (Station 154), and -24.1 degrees (Station 52).

The tide-only model simulation was compared with the tidal current prediction using the observed harmonic constants. The skill assessment score tables listed in Appendix E show the results from these comparisons. The results for five representative stations, throughout the estuary are next considered.

At Station 5 (Bay entrance), the modeled and observed mean velocity values are 51.9 cm/s and 50.9 cm/s, respectively and the RMSE between the simulated and observed current speeds is 9.3 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 6-minute current speed time series, and the amplitudes of maximum flood and ebb currents. CF, NOF, POF, MDNO, MDPO all pass the criteria, but CF fails for the start time of slack currents before ebb, TSE=86.5.

At Station 23 (lower mid-Bay channel), the modeled and observed mean current speeds are 42.9 cm/s and 43.1 cm/s, respectively. The RMSE of the current speeds is 6.6 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 6-minute current speed time series, and the amplitudes of maximum flood and ebb currents.

CF, NOF, POF, MDNO, MDPO all pass the criteria, but CF fails for the end times of slack currents before ebb and flood, TEE =88.1 and TEF=89.3.

At Station 33 (upper mid-Bay channel), the modeled and observed mean current speeds are 48.0 cm/s and 61.3 cm/s, respectively. The RMSE of the current speeds is 22.9 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 6-minute current speed time series, and the amplitudes of maximum flood and ebb currents and times of maximum flood and ebb and start and end times of the slack before flood and slack before ebb.

At Station 154 (at the C&D canal entrance), the modeled and observed mean current speeds are 37.5 cm/s and 49.2 cm/s, respectively. The RMSE of the current speeds is 24.9 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 6-minute current speed time series, and the amplitudes of maximum flood and ebb currents and times of maximum flood and ebb and start and end times of the slack before flood and slack before ebb.

At Station 52 (in the mid-River near Philadelphia), the modeled and observed mean current speeds are 18.8 cm/s and 46.7 cm/s, respectively. The RMSE of the current speeds is 34.1 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 6-minute current speed time series, and the amplitudes of maximum flood and ebb currents and times of maximum flood and ebb and start and end times of the slack before flood and slack before ebb.

In Appendix F, the tidal simulation current directions are compared to the predicted tidal current directions over the same thirteen-month period. At Stations 5, 23, 33, 154, and 52, the RMSEs in direction are 6.5^{o}, 4.1^{o}, 5.5^{o}, 6.1^{o}, and 1.8^{o}, respectively. The CF, NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 6-minute current direction time series at most stations.

6.2. Hindcast Simulation

The observed NOS historical current meter time series were compared with the 13-month DBOFS hindcast simulation from March 1984 through 1985 at nineteen locations. The skill assessment score tables listed in Appendix G show the results from these comparisons. The results for five representative stations, throughout the estuary are next considered.

At Station 5 (Bay entrance), the modeled and observed mean velocity values are 53.2 cm/s and 52.4 cm/s, and the RMSE between the simulated and observed current speeds is 33.2 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 10-minute current speed time series, and the times of maximum flood and ebb currents. No comparisons for the amplitudes for flood and ebb currents are reported by the skill assessment procedure.

At Station 23 (lower mid-Bay channel), the modeled and observed mean current speeds are 44.8 cm/s and 37.9 cm/s, respectively. The RMSE of the current speeds is 27.7 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 10-minute current speed time series, and the times of maximum flood and ebb currents. No comparison for the amplitude of flood currents is reported by the skill assessment procedure. For the amplitude of ebb currents all statistics meet the criteria, however, there are only 4 values used in the comparisons.

At Station 33 (upper mid-Bay channel), the modeled and observed mean current speeds are 50.8 cm/s and 62.6 cm/s, respectively. The RMSE of the current speeds is 39.9 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 10-minute current speed time series, and the times of maximum flood and ebb and start and end times of the slack before flood and slack before ebb. No comparisons for the amplitudes for flood and ebb currents are reported by the skill assessment procedure.

At Station 154 (at the C&D canal entrance), the modeled and observed mean current speeds are 39.8 cm/s and 45.1 cm/s, respectively. The RMSE of the current speeds is 39.3 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 10-minute current speed time series, and the amplitudes of maximum flood and ebb currents and times of maximum flood and ebb and start and end times of the slack before flood and slack before ebb.

At Station 52 (in the mid-River near Philadelphia), the modeled and observed mean current speeds are 18.9 cm/s and 45.9 cm/s, respectively. The RMSE of the current speeds is 32.4 cm/s. The CF, NOF, POF, MDNO, and MDPO statistics all fail the criteria for the entire 10-minute current speed time series, and the amplitudes of maximum flood and ebb currents and times of maximum flood and ebb and start and end times of the slack before flood and slack before ebb.

6.3. Semi-Operational Nowcast/Forecast Simulation

The simulated speeds and directions of the currents from the semi-operational nowcasts were compared with the measurements taken by CO-OPS over the period 15 April through 15 July 2010 at two PORTS locations, Philadelphia, PA and Brown Shoal Light, DB. Skill assessment results for this scenario are listed in Appendix G for current speeds and in Appendix H for current directions (Scenario: Semi-Operational Nowcast).

For Philadelphia, PA, the mean velocity of 56.8 cm/s for the model nowcast is less than the observed value of 66.08 cm/s. The RMSE for the entire 6-minute time series of current speed is 21.7 cm/s. CF, NOF, and POF fail to pass the skill assessment criteria, but MDNO and MDPO pass the criteria for all tests. The maximum ebb current speeds of the nowcast are less than the observed values with the RMSE being 17.6 cm/s. The time of the maximum ebb currents and slack currents in the nowcasts falls about 30 to 40 minutes behind those of the observations (the RMSE is 0.5 to 0.6 hours). For the directions of the currents, the mean directions of the nowcast and observed currents are 116 and 127 degrees, respectively (the RMSE is 25 degrees). CF, NOF, POF, MDPO,

and MDPO pass the criteria for the entire 6-minutes time series of the current directions. CF, NOF, POF, MDPO, and MDPO pass the criteria for the directions of the maximum ebb and flood currents.

At Brown Shoal Light, DB, the mean velocity of 49.3 cm/s for the model nowcast is less than the observed value of 50.4 cm/s. The RMSE for the entire 6-minute time series of current speed is 14.3 cm/s. CF, NOF, and POF criteria, and the MDNO and MDPO pass the criteria for the amplitude of the ebb and flood. The maximum ebb and flood current speeds of the nowcast are larger than the observed values with the RMSE around 10 cm/s. The time of the maximum ebb currents and slack currents in the nowcasts falls about 25 to 40 minutes behind those of the observations (the RMSE is 0.4 to 0.6 hours). For the directions of the currents, the mean directions of the nowcast and observed currents are 234 and 227 degrees, respectively (the RMSE is 19 degrees). CF, NOF, POF, MDPO, and MDPO pass the criteria for the entire 6-minutes time series of the current directions. CF, NOF, POF, MDPO, and MDPO pass the criteria for the directions of the maximum ebb and flood currents.

Time series of nowcast are compared with observations at Philadelphia, PA and Brown Shoal Light, DB in Figure 9 over the period JD 120-135, 2010. The major velocity components are well replicated at both stations.

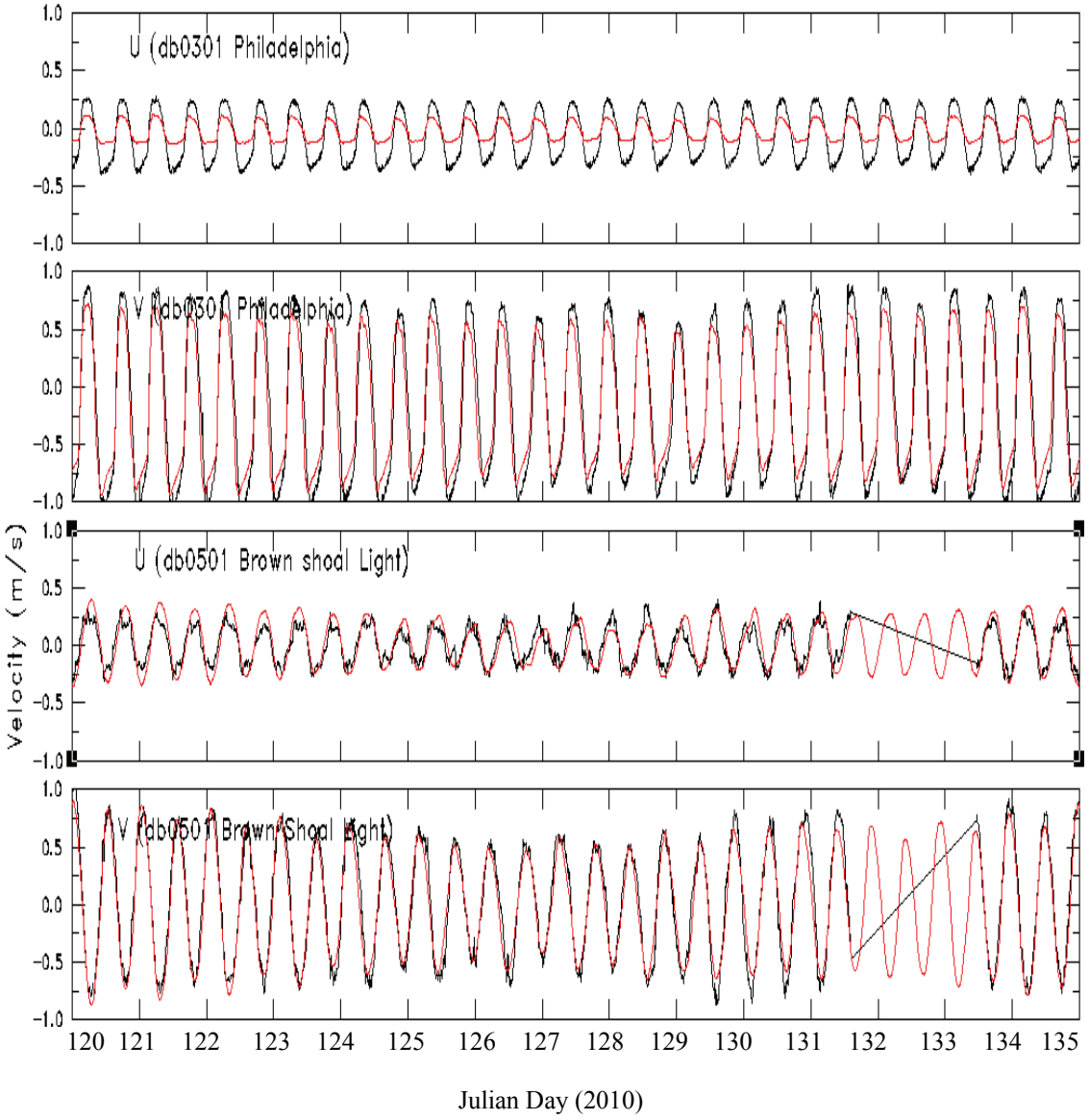


Figure 9. Velocity time series comparison for DBOFS' semi-operational nowcasts at four NOS ADCPs . Note u is the true eastward velocity component, and v is the true northward velocity component.

The semi-operational forecasts of current speed are similar to those of the model nowcasts at both Philadelphia, PA and Brown Shoal Light, DB. Skill assessment results are listed in Appendix G for current speeds and in Appendix H for current directions (Scenario: Semi-Operational Forecast).

For Philadelphia, PA, the RMSEs of the current speed range remain between 19 and 20 cm/s from forecast hour 0 to forecast hour 24. CF remains between 84% and 85% throughout the 24 hour forecast period, and thus it does not degrade with time. POF, NOF, MDNO, and MNPO pass the criteria for all forecast hours. The maximum flood and ebb current speeds of the model forecasts are less than the observations with an RMSE of 18 cm/s. The time of the modeled maximum flood and ebb currents occur about 24 and 42 minutes before the observations, respectively. CF and NOF fail to pass the criteria for all the tests. For current direction, RMSEs range from 21 to 15 degrees and improve with forecast age. NOF, CF, and POF all pass the criteria for all forecast hours.

At Brown Shoal Light, DB, RMSEs of current speed range from 13 cm/s at forecast hour 0 to 15 cm/s at forecast hour 24, and CF is above 95% (forecast hour 0) for all forecast hours. NOF, MDNO, and MDPO pass the criteria for the current speed forecasts throughout the 24 forecast hours. The RMSE of the maximum flood current speed is 9 cm/s and the RMSE of the maximum ebb current speeds is 11 cm/s. CF, NOF, POF, MDNO, and MDPO pass the criteria for both the maximum flood and ebb current speeds. The RMSEs of the time of the maximum flood and ebb current speeds are 48 minutes and 36 minutes, respectively, and the CF of them fails to pass the criteria (37% and 61%). Most of CF, NOF, POF, MDNO, and MDPO fail to pass the criteria for the start and end time of slack currents before flood and ebb. For current direction, the RMSEs range from 14 degrees (forecast hour 0) to 21 degrees (forecast hour 24). CF, NOF, POF, MDNO, and MDPO pass the criteria for the directions of the maximum flood and ebb currents.

7. SKILL ASSESSMENT OF SALINITY

7.1. Hindcast Simulation

The observed NOS Delaware River and Bay circulation survey time series (Klavans et al., 1986) were compared with DBOFS' hindcast simulations over the thirteen month period March 1984 through March 1985 at the twenty locations in Appendix I. The results for five representative stations, throughout the estuary are next considered.

At Station 5 (Bay entrance), the modeled and observed mean salinity values are 30.1 PSU and 30.0 PSU, and the RMSE between the simulated and observed salinity is 2.9 PSU. The CF is 77%, while the NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 10-minute time series.

At Station 23 (lower mid-Bay channel), the modeled and observed salinity values are 27.2 PSU and 25.8 PSU, respectively. The RMSE of the salinity is 2.8 PSU. The CF is 82% and the NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 10-minute speed time series.

At Station 33 (upper mid-Bay channel), the modeled and observed salinity values are 11.6 PSU and 13.7 PSU, respectively. The RMSE of the salinity is 5.0 PSU. The CF is 46% and the NOF and POF fail the criteria, while the MDNO and MDPO statistics pass the criteria for the entire 10-minute time series.

At Station 154 (at C&D canal entrance), the modeled and observed salinity values are 3.6 PSU and 6.4 PSU, respectively. The RMSE of the salinity is 9.0 PSU. The CF is 72% and the NOF, MDNO, and MDPO statistics all fail the criteria for the entire 10-minute time series.

At Station 52 (in the mid-River near Philadelphia), the modeled and observed salinity values are 0.0 PSU and 0.0 PSU, respectively. The RMSE of the salinity is 0.0 PSU. The CF, NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 10-minute time series.

7.2. Semi-Operational Nowcast/Forecast Simulation

The simulated salinities from the semi-operational nowcasts were compared with the NOS PORTS measurements taken by CO-OPS over the three-month period 15 April through 15 July, 2010 at Ship John Shoal, DB and Burlington, NJ in Appendix J.

At Ship John Shoal, DB, the modeled and observed mean salinity values are 10.5 PSU and 14.5 PSU, and the RMSE between the simulated and observed salinity is 4.8 PSU. The CF is 52%, while only the MDNO statistic passes the criteria for the entire 6-minute time series.

At Burlington, NJ, the modeled and observed salinity values are 0.0 PSU and 0.0 PSU, respectively. The RMSE of the salinity is 0.0 PSU. The CF, NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 6-minute time series.

Nowcast salinities are compared with observations over the period JD 105 – 180, 2010 proceeding down estuary at Burlington, NJ, Ship John Shoal, DB, and Brandywine Shoal, DB in Figure 10. Note at Brandywine Shoal, DB, there is evidence of bio-fouling over the entire measurement period, which accounts for the MDPO being greater than 1000 hours noted in the skill table by *****. Note the freshwater event in the period JD 150-158 evidenced at both Ship John Shoal, DB and Brandywine Shoal, DB.

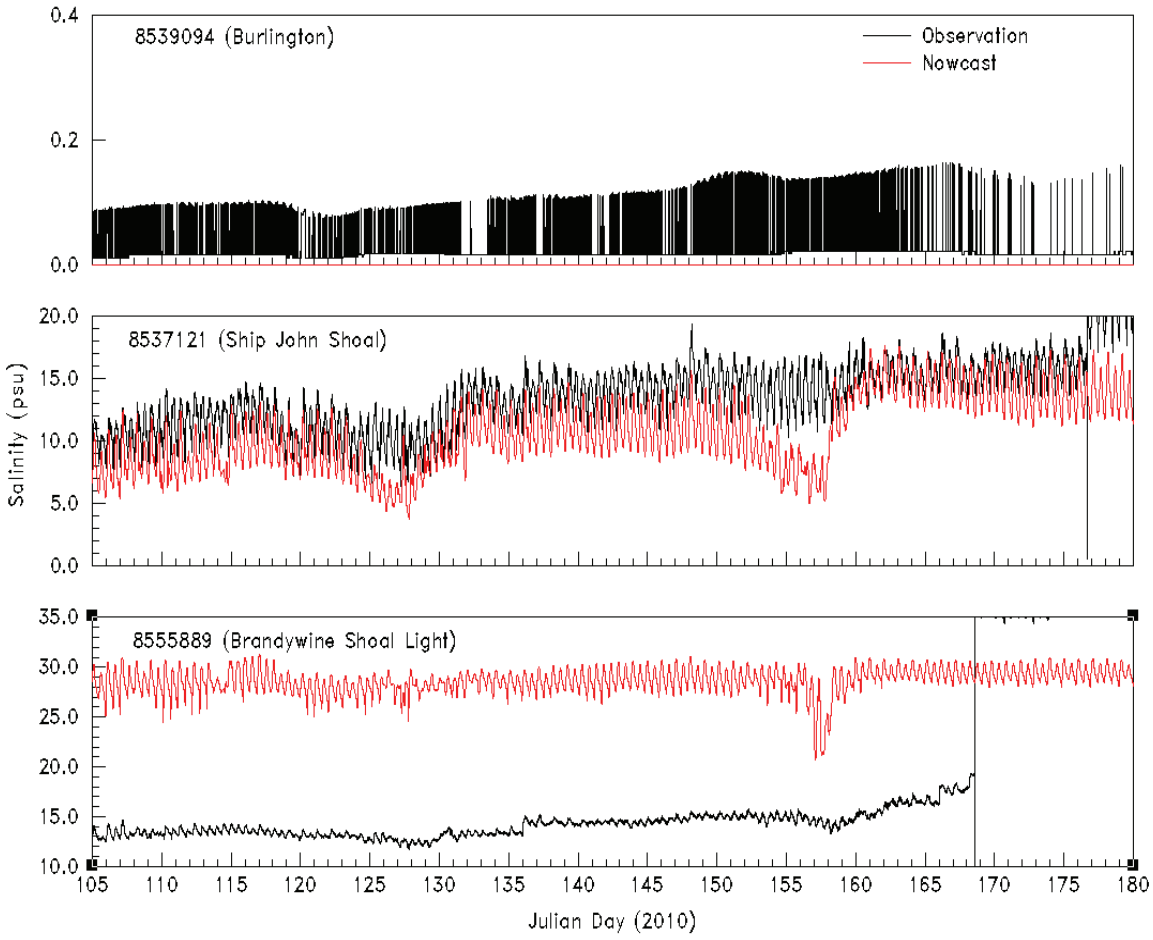


Figure 10. Surface salinity time series comparison for DBOFS' semi-operational nowcasts at three NOS stations.

The simulated salinities from the semi-operational forecasts were compared with the PORTS measurements taken by CO-OPS over the three-month period 15 April through 15 July, 2010 at Ship John Shoal, DB and Burlington, NJ in Appendix J.

At Ship John Shoal, DB, the RMSEs of the salinity range remain near 5.0 PSU from forecast hour 0 to forecast hour 24. CF remains 48% throughout the first 24 hours of the

forecast, and thus it does not degrade with time. Only POF and MDPO pass the criteria for all forecast hours.

At Burlington, NJ, the modeled and observed salinity values are 0.0 PSU and 0.0 PSU, respectively. The RMSE of the salinity is 0.0 PSU. The CF, NOF, POF, MDNO, and MDPO statistics all pass the criteria for all forecast hours.

8. SKILL ASSESSMENT OF WATER TEMPERATURE

8.1. Hindcast Simulation

The observed historical NOS Delaware River and Bay circulation survey time series (Klavans et al., 1986) were compared with the DBOFS hindcast simulations over the thirteen month period March 1984 through March 1985 at the twenty two locations in Appendix K. The results for five representative stations, throughout the estuary are next considered.

At Station 5 (Bay entrance), the modeled and observed mean temperature values are 17.3 ^{o}C and 14.3 ^{o}C, and the RMSE between the simulated and observed temperature is 3.8 ^{o}C. The CF is 58% and only the NOF and MDNO statistics pass the criteria for the entire 10-minute time series.

At Station 23 (lower mid-Bay channel), the modeled and observed temperature values are 17.2 ^{o}C and 14.7 ^{o}C, respectively. The RMSE of the temperature is 3.1 ^{o}C. The CF is 70% and only the NOF and MDNO statistics pass the criteria for the entire 10-minute time series.

At Station 33 (upper mid-Bay channel), the modeled and observed temperature values are 19.3 ^{o}C and 17.3 ^{o}C, respectively. The RMSE of the temperature is 2.3 ^{o}C. The CF is 81% and the NOF, POF, MDNO, and MDPO statistics pass the criteria for the entire 10-minute time series.

At Station 154 (at C&D canal entrance), the modeled and observed temperature values are 15.8 ^{o}C and 13.3 ^{o}C, respectively. The RMSE of the temperature is 4.0 ^{o}C. The CF is 71% and only the NOF and MDNO statistics pass the criteria for the entire 10-minute time series

At Station 52 (in the mid-River near Philadelphia), the modeled and observed temperature values are 5.9 ^{o}C and 5.1 ^{o}C, respectively. The RMSE of the temperature is 1.1 ^{o}C. The CF, NOF, POF, MDNO, and MDPO statistics all pass the criteria for the entire 10-minute time series.

8.2. Semi-Operational Nowcast/Forecast Simulation

The simulated temperatures from DBOFS' semi-operational nowcasts were compared with the NOS PORTS measurements over the three-month period 15 April through 15 July, 2010 in Appendix L at the following nine stations: Cape May, NJ, Ship John Shoal, DB, Burlington, NJ, Philadelphia, PA, Newbold, PA, Delaware City, DE, Brandywine Shoal, DB, Lewes, DE, and Chesapeake City, MD. The results for four representative stations, throughout the estuary are next considered.

At Cape May, NJ, (at the Bay entrance) the modeled and observed mean temperature values are 19.5 ^{o}C and 18.2 ^{o}C, and the RMSE between the simulated and observed

temperature is 3.0 ^{o}C. The CF is 76%, while the NOF, MDNO, and MDPO statistics all pass the criteria for the entire 6-minute time series. The POF is 3%.

At Delaware City, DE, (in the upper-Bay) the modeled and observed mean temperature values are 18.6 ^{o}C and 20.5 ^{o}C, and the RMSE between the simulated and observed temperature is 4.4 ^{o}C. The CF is 75%, and the NOF and MDNO statistics also fail the criteria for the entire 6-minute time series. The POF and MDPO statistics pass the criteria for the entire 6-minute time series.

At Philadelphia, PA, (in the mid-River) the modeled and observed mean temperature values are 19.7 ^{o}C and 20.4 ^{o}C, and the RMSE between the simulated and observed temperature is 3.7 ^{o}C. The CF is 90%, while only the NOF and MDNO statistics fail the criteria for the entire 6-minute time series. The POF and MDPO statistics pass the criteria for the entire 6-minute time series.

At Newbold, PA, (in the upper-River) the modeled and observed mean temperature values are 20.6 ^{o}C and 20.6 ^{o}C, and the RMSE between the simulated and observed temperature is 1.9 ^{o}C. The CF is 95%, while only the NOF and MDNO statistics fail the criteria for the entire 6-minute time series. The POF and MDPO statistics pass the criteria for the entire 6-minute time series.

Nowcast surface temperatures proceeding down estuary from Burlington, NJ, Philadelphia, PA, Delaware City, DE, Brandywine Shoal, DB to Cape May, NJ and Lewes, DE at the Bay entrance are compared with PORTS observations over the period JD 105-180, 2010 in Figure 11. While no PORTS observations were available at Marcus Hook, PA and Reedy Point, DE, at the other stations the temperature rise from early to late Spring and the daily heating/cooling cycles are well replicated in DBOFS.

The simulated temperatures from the semi-operational forecasts were compared with the PORTS measurements taken by CO-OPS over the three-month period 15 April through 15 July, 2010 in Appendix L at the following nine stations: Cape May, NJ, Ship John Shoal, DB, Burlington, NJ, Philadelphia, PA, Newbold, PA, Delaware City, DE, Brandywine Shoal, DB, Lewes, DE, and Chesapeake City, MD. The results for four representative stations, throughout the estuary are next considered.

At Cape May, NJ, (at the Bay entrance), the RMSEs of the temperature range remain near 2.5 ^{o}C from forecast hour 0 to forecast hour 24. CF remains between 77% (hours 0 and 6) and 79% (hour 24), and thus it does not degrade with time. Only POF and MDPO pass the criteria for all forecast hours.

At Delaware City, DE, (in the upper-Bay), the RMSEs of the temperature range remain near 4.0 ^{o}C from forecast hour 0 to forecast hour 24. CF remains between 78% (hours 0 and 6) and 80% (hours 18 and 24), and thus it does not degrade with time. Only POF and MDPO pass the criteria for all forecast hours.

At Philadelphia, PA, (in the mid-River), the RMSEs of the temperature range remain near 3.0 ^{o}C from forecast hour 0 to forecast hour 24. CF remains above 92% and thus it does not degrade with time. Only POF and MDPO pass the criteria for all forecast hours.

At Newbold, PA, (in the upper-River), the RMSEs of the temperature range remain near 1.0 ^{o}C from forecast hour 0 to forecast hour 24. CF remains above 96% and thus it does not degrade with time. NOF, POF, MDNO, and MDPO all pass the criteria for all forecast hours.

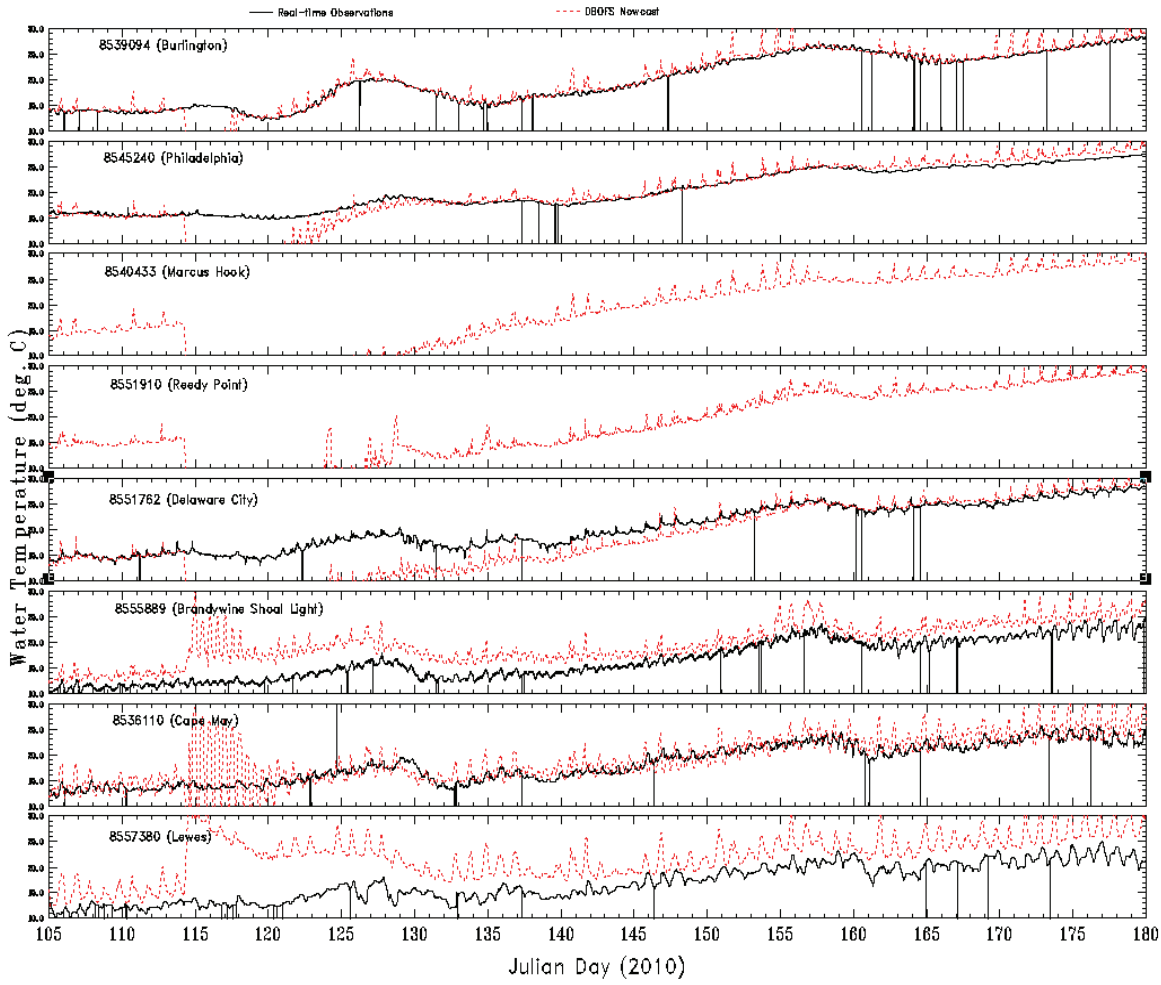


Figure 11. Surface water temperature time series comparison for DBOFS'semi-operational nowcasts at eight NOS stations.

9. CONCLUSIONS

NOS/CSDL developed and tested the Delaware River and Bay Operational Nowcast/Forecast System (DBOFS) using ROMS to perform operational six-hourly nowcasts and 48-hour forecasts. The application was integrated into the High Performance Computing Coastal Ocean Modeling Framework (HPC-COMF) that NOS has implemented for operational coastal and estuarine systems running on the NOAA Central Computer System operated by NWS/NCEP. The DBOFS results were compared with the observations at nine water level, nineteen current meter, twenty salinity stations, and twenty-one temperature stations for the tidal and hindcast simulation thirteen month period 1 March 1984 through 31 March 1985 using the NOS standard skill assessment software. Model response during the three month 15 April through 15 July, 2010, semi-operational nowcast/forecast period was compared to NOS/CO-OPS PORTS observations at twelve water level, two current, three salinity, and eight water temperature stations. The skill assessment for this application focused on the performance of the model in simulating water levels and currents in the four model run scenarios, although salinity and temperature comparisons were also performed.

The skill assessment results indicate that most statistical parameters of water levels pass the NOS skill assessment criteria for the four model run scenarios, and amplitudes and epochs of the dominant M_2 constituent from the model tide-only simulation are very close to the observed values at all stations.

Most of CF, NOF, POF, MDNO, and MDPO either pass or are close to the criteria at the Bay current stations for both tide-only simulation and model hindcast simulations, since tidal current dominate the signal in lower Delaware Bay. The CF, NOF, POF, MDNO, and MDPO pass the criteria for the semi-operational nowcast and forecast simulations at the two PORTS current stations. The semi-operational current nowcast results are improved over those from the hindcast simulation.

Based on the skill assessment results for the model hindcast and the semi-operational nowcast/forecast described above, the following issues should be addressed to further evaluate DBOFS: (1) comparisons over a longer twelve to eighteen month period for the nowcast/forecast temperature response to test Winter cooling and Spring warming cycles and (2) real time salinity data are needed determine the salinity front location and evaluate the ability of DBOFS to forecast the salinity distribution within the transition zone (approximately from Reedy Point, DE to Ship John Shoal, DB).

It is recommended that a plot capability be added to the skill assessment software. This capability would allow the verification of the model to data comparison techniques. The maintenance of the PORTS conductivity sensors and current meters is essential to enable further evaluation of the DBOFS in an operational setting. With respect to the conductivity sensor maintenance requirements, additional cooperation and coordination with the USGS and the City of Philadelphia would be useful.

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This work has been carried out in the Marine Modeling and Analysis Programs branch of the Coast Survey Development Laboratory (CSDL) in NOS's Office of Coast Survey (OCS) under the direction of Dr. Frank Aikman. Dr. Aijun Zhang, NOS/CO-OPS, assisted greatly in the skill assessment and provided guidance on the transition of DBOFS to NOAA's CCS. Dr. Lyon Lanerolle in CSDL provided the initial bathymetry and as well as many useful discussions on ROMS numerics throughout the project. Mr. Philip H. Richardson, CSDL, and Mr. Thomas Loeper, OCS, assisted in the CTD and CT/Current data recovery and analysis efforts.

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APPENDICES:

In the Appendices tables, water level units are in meters, water current units are in meters/second, phase (epoch) units are in degrees referenced to UTC (GMT), time is in hours. Salinity is expressed in practical salinity units (PSU) and temperature in degrees Celsius (^{o}C).

APPENDIX A. Comparison of Water Level Harmonic Constants

Station: "CAPE MAY CANAL,DELAWARE BAY"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.734	29.4	0.703	28.1	-0.031	-1.3
2	S(2)	0.121	57.5	0.153	55.2	0.032	-2.3
3	N(2)	0.158	11.5	0.173	358.4	0.015	13.1
4	K(1)	0.112	198.2	0.081	184.2	-0.031	-14.0
5	M(4)	0.014	91.7	0.014	122.9	0.000	31.2
6	O(1)	0.085	183.6	0.077	186.7	-0.008	3.1
7	M(6)	0.009	28.1	0.008	18.5	-0.001	-9.6
8	MK(3)	0.005	187.2	0.002	221.8	-0.003	34.6
9	S(4)	0.001	322.3	0.001	224.4	0.000	-97.9
10	MN(4)	0.003	88.6	0.006	107.5	0.003	18.9
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.000	0.0	0.000	0.0	0.000	0.0
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.018	7.5	0.003	72.7	-0.015	65.2
15	OO(1)	0.005	199.0	0.000	0.0	-0.005	161.0
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.005	202.3	0.000	274.4	-0.005	72.1
19	J(1)	0.004	146.0	0.002	323.3	-0.002	177.3
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.002	194.4	0.000	0.0	-0.002	165.6
26	Q(1)	0.012	206.3	0.011	189.7	-0.001	-16.6
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.002	78.7	0.000	0.0	-0.002	-78.7
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.001	12.5	0.002	239.3	0.001	133.2
32	M(3)	0.008	97.5	0.001	96.1	-0.007	-1.4
33	L(2)	0.045	50.3	0.026	63.0	-0.019	12.7
34	2MK(3)	0.005	130.2	0.003	197.1	-0.002	66.9
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.004	179.0	0.003	215.3	-0.001	36.3
37	MS(4)	0.007	131.1	0.006	159.3	-0.001	28.2

Station: "BURLINGTON, DELAWARE RIVER"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	1.042	217.0	1.009	203.5	-0.033	-13.5
2	S(2)	0.130	244.3	0.161	251.9	0.031	7.6
3	N(2)	0.202	202.3	0.183	182.9	-0.019	-19.4
4	K(1)	0.129	305.7	0.080	278.1	-0.049	-27.6
5	M(4)	0.127	347.9	0.136	350.3	0.009	2.4
6	O(1)	0.091	259.0	0.079	274.0	-0.012	15.0
7	M(6)	0.023	13.4	0.035	294.9	0.012	78.5
8	MK(3)	0.000	0.0	0.020	19.7	0.000	0.0
9	S(4)	0.036	32.5	0.003	129.2	-0.033	96.7
10	MN(4)	0.000	0.0	0.053	330.5	0.000	0.0
11	NU(2)	0.039	204.3	0.000	0.0	-0.039	155.7
12	S(6)	0.009	96.3	0.000	0.0	-0.009	-96.3
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.027	187.7	0.014	223.4	-0.013	35.7
15	OO(1)	0.004	352.4	0.001	243.6	-0.003	-108.8
16	LAMBDA(2)	0.007	229.7	0.000	0.0	-0.007	130.3
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.006	282.4	0.003	324.5	-0.003	42.1
19	J(1)	0.007	329.1	0.007	81.3	0.000	112.2
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.003	238.9	0.000	0.0	-0.003	121.1
26	Q(1)	0.018	235.6	0.011	300.8	-0.007	65.2
27	T(2)	0.008	244.3	0.000	0.0	-0.008	115.7
28	R(2)	0.001	244.3	0.000	0.0	-0.001	115.7
29	2Q(1)	0.002	212.3	0.000	0.0	-0.002	147.7
30	P(1)	0.043	305.7	0.000	0.0	-0.043	54.3
31	2SM(2)	0.000	0.0	0.010	69.5	0.000	0.0
32	M(3)	0.000	0.0	0.011	271.7	0.000	0.0
33	L(2)	0.029	231.6	0.157	228.3	0.128	-3.3
34	2MK(3)	0.000	0.0	0.022	9.4	0.000	0.0
35	K(2)	0.035	244.3	0.000	0.0	-0.035	115.7
36	M(8)	0.016	82.2	0.016	47.9	0.000	-34.3
37	MS(4)	0.000	0.0	0.049	38.5	0.000	0.0

Station: "TRENTON MARINE TERMINAL"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	1.121	221.4	1.096	210.5	-0.025	-10.9
2	S(2)	0.112	258.6	0.178	259.9	0.066	1.3
3	N(2)	0.162	197.6	0.200	190.1	0.038	-7.5
4	K(1)	0.121	298.3	0.081	281.5	-0.040	-16.8
5	M(4)	0.200	356.8	0.206	1.2	0.006	4.4
6	O(1)	0.089	283.2	0.081	277.0	-0.008	-6.2
7	M(6)	0.088	50.3	0.056	2.2	-0.032	-48.1
8	MK(3)	0.044	40.1	0.027	30.9	-0.017	-9.2
9	S(4)	0.003	203.1	0.005	143.6	0.002	-59.5
10	MN(4)	0.067	337.4	0.081	342.4	0.014	5.0
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.003	218.6	0.000	0.0	-0.003	141.4
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.043	180.1	0.015	230.9	-0.028	50.8
15	OO(1)	0.000	0.0	0.001	246.2	0.000	0.0
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.005	303.6	0.003	325.4	-0.002	21.8
19	J(1)	0.004	188.1	0.008	84.7	0.004	-103.4
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.007	263.5	0.000	0.0	-0.007	96.5
26	Q(1)	0.010	335.2	0.012	303.6	0.002	-31.6
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.011	185.6	0.000	0.0	-0.011	174.4
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.009	85.7	0.011	76.2	0.002	-9.5
32	M(3)	0.012	303.0	0.014	283.5	0.002	-19.5
33	L(2)	0.147	228.2	0.169	234.1	0.022	5.9
34	2MK(3)	0.044	357.5	0.029	20.9	-0.015	23.4
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.051	179.1	0.047	142.8	-0.004	-36.3
37	MS(4)	0.043	48.8	0.077	51.5	0.034	2.7

Station: "PHILADELPHIA, PA"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.867	185.8	0.824	181.6	-0.043	-4.2
2	S(2)	0.098	225.5	0.130	225.8	0.032	0.3
3	N(2)	0.143	168.7	0.149	159.2	0.006	-9.5
4	K(1)	0.112	278.6	0.076	268.7	-0.036	-9.9
5	M(4)	0.095	264.7	0.060	275.4	-0.035	10.7
6	O(1)	0.085	264.8	0.076	265.2	-0.009	0.4
7	M(6)	0.058	250.2	0.050	211.9	-0.008	-38.3
8	MK(3)	0.027	340.9	0.012	334.5	-0.015	-6.4
9	S(4)	0.002	357.8	0.002	16.5	0.000	18.7
10	MN(4)	0.034	252.7	0.026	252.5	-0.008	-0.2
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.003	47.9	0.000	0.0	-0.003	-47.9
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.027	178.5	0.012	204.0	-0.015	25.5
15	OO(1)	0.000	0.0	0.001	236.5	0.000	0.0
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.005	298.0	0.003	317.1	-0.002	19.1
19	J(1)	0.005	157.0	0.006	69.6	0.001	-87.4
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.004	194.1	0.000	0.0	-0.004	165.9
26	Q(1)	0.011	303.3	0.011	290.3	0.000	-13.0
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.010	154.1	0.000	0.0	-0.010	-154.1
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.002	179.1	0.008	44.2	0.006	-134.9
32	M(3)	0.009	259.3	0.006	225.3	-0.003	-34.0
33	L(2)	0.114	203.1	0.122	209.1	0.008	6.0
34	2MK(3)	0.026	300.9	0.013	325.5	-0.013	24.6
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.024	342.8	0.022	312.4	-0.002	-30.4
37	MS(4)	0.025	311.1	0.025	315.0	0.000	3.9

Station: "Delaware City, DE"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.744	114.1	0.730	110.8	-0.014	-3.3
2	S(2)	0.100	148.0	0.130	148.4	0.030	0.4
3	N(2)	0.144	99.2	0.145	86.8	0.001	-12.4
4	K(1)	0.095	247.4	0.073	235.6	-0.022	-11.8
5	M(4)	0.060	147.4	0.070	150.2	0.010	2.8
6	O(1)	0.068	226.2	0.072	234.3	0.004	8.1
7	M(6)	0.033	60.0	0.039	29.0	0.006	-31.0
8	MK(3)	0.016	237.8	0.010	231.2	-0.006	-6.6
9	S(4)	0.002	133.1	0.002	251.0	0.000	117.9
10	MN(4)	0.027	127.1	0.031	130.7	0.004	3.6
11	NU(2)	0.037	91.2	0.000	0.0	-0.037	-91.2
12	S(6)	0.001	132.0	0.000	0.0	-0.001	-132.0
13	MU(2)	0.031	228.3	0.000	0.0	-0.031	131.7
14	2N(2)	0.014	122.4	0.009	129.7	-0.005	7.3
15	OO(1)	0.004	215.5	0.000	0.0	-0.004	144.5
16	LAMBDA(2)	0.019	118.9	0.000	0.0	-0.019	-118.9
17	S(1)	0.026	191.4	0.000	0.0	-0.026	168.6
18	M(1)	0.005	282.3	0.002	289.3	-0.003	7.0
19	J(1)	0.007	332.0	0.005	27.9	-0.002	55.9
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.041	31.3	0.000	0.0	-0.041	-31.3
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.006	239.7	0.000	0.0	-0.006	120.3
26	Q(1)	0.009	236.5	0.010	254.5	0.001	18.0
27	T(2)	0.010	155.1	0.000	0.0	-0.010	-155.1
28	R(2)	0.002	258.3	0.000	0.0	-0.002	101.7
29	2Q(1)	0.005	199.2	0.000	0.0	-0.005	160.8
30	P(1)	0.034	246.1	0.000	0.0	-0.034	113.9
31	2SM(2)	0.002	322.8	0.006	317.5	0.004	-5.3
32	M(3)	0.007	174.2	0.006	116.1	-0.001	-58.1
33	L(2)	0.104	127.7	0.085	134.6	-0.019	6.9
34	2MK(3)	0.019	197.5	0.012	220.9	-0.007	23.4
35	K(2)	0.029	149.0	0.000	0.0	-0.029	-149.0
36	M(8)	0.006	68.6	0.013	57.8	0.007	-10.8
37	MS(4)	0.018	189.7	0.029	193.1	0.011	3.4

Station: "Reedy Point,DE"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.827	105.8	0.743	104.6	-0.084	-1.2
2	S(2)	0.109	143.0	0.133	142.1	0.024	-0.9
3	N(2)	0.150	88.8	0.147	80.6	-0.003	-8.2
4	K(1)	0.103	237.1	0.066	231.6	-0.037	-5.5
5	M(4)	0.067	123.6	0.061	133.6	-0.006	10.0
6	O(1)	0.070	225.2	0.065	229.2	-0.005	4.0
7	M(6)	0.036	44.9	0.036	22.7	0.000	-22.2
8	MK(3)	0.020	216.6	0.011	207.7	-0.009	-8.9
9	S(4)	0.004	121.1	0.002	232.0	-0.002	110.9
10	MN(4)	0.025	106.5	0.027	113.7	0.002	7.2
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.001	171.1	0.000	0.0	-0.001	-171.1
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.020	81.1	0.008	113.3	-0.012	32.2
15	OO(1)	0.004	255.1	0.000	0.0	-0.004	104.9
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.005	214.1	0.002	291.0	-0.003	76.9
19	J(1)	0.003	82.1	0.005	20.6	0.002	-61.5
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.004	311.9	0.000	0.0	-0.004	48.1
26	Q(1)	0.015	261.7	0.010	253.8	-0.005	-7.9
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.011	131.2	0.000	0.0	-0.011	-131.2
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.002	264.1	0.006	311.2	0.004	47.1
32	M(3)	0.007	160.8	0.006	98.1	-0.001	-62.7
33	L(2)	0.087	126.0	0.086	127.5	-0.001	1.5
34	2MK(3)	0.023	181.8	0.014	201.8	-0.009	20.0
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.010	32.2	0.011	31.3	0.001	-0.9
37	MS(4)	0.015	161.4	0.026	175.6	0.011	14.2

Station: "BRANDYWINE SHOAL LIGHT, DELAWARE BAY"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.754	36.3	0.720	38.0	-0.034	1.7
2	S(2)	0.119	61.6	0.153	65.6	0.034	4.0
3	N(2)	0.154	17.2	0.174	8.0	0.020	-9.2
4	K(1)	0.115	198.5	0.083	189.2	-0.032	-9.3
5	M(4)	0.011	120.6	0.010	235.7	-0.001	115.1
6	O(1)	0.086	186.4	0.079	191.3	-0.007	4.9
7	M(6)	0.004	55.3	0.003	50.4	-0.001	-4.9
8	MK(3)	0.005	174.5	0.001	154.8	-0.004	-19.7
9	S(4)	0.000	0.0	0.000	0.0	0.000	0.0
10	MN(4)	0.003	133.8	0.005	197.1	0.002	63.3
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.000	0.0	0.000	0.0	0.000	0.0
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.014	359.7	0.004	86.2	-0.010	86.5
15	OO(1)	0.005	205.8	0.000	0.0	-0.005	154.2
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.006	193.9	0.001	265.9	-0.005	72.0
19	J(1)	0.004	136.5	0.002	330.9	-0.002	165.6
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.002	242.1	0.000	0.0	-0.002	117.9
26	Q(1)	0.012	213.9	0.011	195.0	-0.001	-18.9
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.004	79.0	0.000	0.0	-0.004	-79.0
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.001	173.7	0.003	252.5	0.002	78.8
32	M(3)	0.007	106.0	0.001	65.8	-0.006	-40.2
33	L(2)	0.044	66.2	0.032	75.7	-0.012	9.5
34	2MK(3)	0.005	123.7	0.003	158.4	-0.002	34.7
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.002	221.9	0.001	260.7	-0.001	38.8
37	MS(4)	0.006	143.2	0.004	253.0	-0.002	109.8

Station: "LEWES,FT MILES DE"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.610	31.7	0.617	29.9	0.007	-1.8
2	S(2)	0.103	58.3	0.137	54.4	0.034	-3.9
3	N(2)	0.134	9.3	0.157	357.9	0.023	11.4
4	K(1)	0.107	200.4	0.080	185.5	-0.027	-14.9
5	M(4)	0.012	168.4	0.020	199.1	0.008	30.7
6	O(1)	0.083	186.1	0.076	187.9	-0.007	1.8
7	M(6)	0.004	355.3	0.009	335.7	0.005	-19.6
8	MK(3)	0.002	206.0	0.001	234.5	-0.001	28.5
9	S(4)	0.001	288.2	0.001	245.6	0.000	-42.6
10	MN(4)	0.006	173.4	0.010	165.0	0.004	-8.4
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.000	0.0	0.000	0.0	0.000	0.0
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.013	14.4	0.002	102.6	-0.011	88.2
15	OO(1)	0.004	204.7	0.000	0.0	-0.004	155.3
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.005	199.5	0.000	276.9	-0.005	77.4
19	J(1)	0.005	157.8	0.001	323.5	-0.004	165.7
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.003	217.5	0.000	0.0	-0.003	142.5
26	Q(1)	0.013	199.0	0.011	187.4	-0.002	-11.6
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.002	79.9	0.000	0.0	-0.002	-79.9
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.002	151.1	0.001	267.1	-0.001	116.0
32	M(3)	0.005	93.5	0.001	106.2	-0.004	12.7
33	L(2)	0.027	72.6	0.017	89.5	-0.010	16.9
34	2MK(3)	0.002	121.8	0.002	201.4	0.000	79.6
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.002	238.1	0.002	246.6	0.000	8.5
37	MS(4)	0.004	191.0	0.009	225.1	0.005	34.1

Station: "OCEAN CITY, FISHING PIER"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.489	0.3	0.478	2.7	-0.011	2.4
2	S(2)	0.074	27.4	0.111	26.2	0.037	-1.2
3	N(2)	0.115	346.9	0.130	325.6	0.015	-21.3
4	K(1)	0.097	196.2	0.072	175.6	-0.025	-20.6
5	M(4)	0.008	222.3	0.019	215.4	0.011	-6.9
6	O(1)	0.085	180.6	0.071	184.1	-0.014	3.5
7	M(6)	0.015	299.7	0.013	347.8	-0.002	48.1
8	MK(3)	0.001	130.3	0.001	282.6	0.000	152.3
9	S(4)	0.001	264.4	0.000	0.0	-0.001	95.6
10	MN(4)	0.006	166.7	0.009	180.9	0.003	14.2
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.000	0.0	0.000	0.0	0.000	0.0
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.015	6.9	0.000	0.0	-0.015	-6.9
15	OO(1)	0.004	178.0	0.000	0.0	-0.004	-178.0
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.004	217.7	0.000	0.0	-0.004	142.3
19	J(1)	0.007	175.4	0.000	0.0	-0.007	-175.4
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.003	185.7	0.000	0.0	-0.003	174.3
26	Q(1)	0.013	187.0	0.010	175.3	-0.003	-11.7
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.002	171.4	0.000	0.0	-0.002	-171.4
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.003	89.5	0.000	0.0	-0.003	-89.5
32	M(3)	0.005	45.6	0.000	0.0	-0.005	-45.6
33	L(2)	0.020	4.4	0.002	179.9	-0.018	175.5
34	2MK(3)	0.001	71.8	0.001	229.8	0.000	158.0
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.001	18.9	0.002	347.3	0.001	31.6
37	MS(4)	0.001	273.8	0.008	247.2	0.007	-26.6

Station: "CHESAPEAKE CITY"
Observation:CO-OPS Accepted Harmonic Constants
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in meters, and Phase is in degrees (GMT)

		Observed		Modeled		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
1	M(2)	0.471	93.9	0.430	98.8	-0.041	4.9
2	S(2)	0.048	142.2	0.070	138.3	0.022	-3.9
3	N(2)	0.081	84.6	0.077	77.0	-0.004	-7.6
4	K(1)	0.037	338.6	0.025	301.5	-0.012	-37.1
5	M(4)	0.030	144.9	0.038	144.4	0.008	-0.5
6	O(1)	0.014	13.4	0.014	270.0	0.000	103.4
7	M(6)	0.012	100.7	0.018	88.6	0.006	-12.1
8	MK(3)	0.010	291.3	0.009	260.6	-0.001	-30.7
9	S(4)	0.001	318.2	0.002	213.3	0.001	-104.9
10	MN(4)	0.011	141.9	0.017	126.6	0.006	-15.3
11	NU(2)	0.000	0.0	0.000	0.0	0.000	0.0
12	S(6)	0.001	331.4	0.001	211.6	0.000	-119.8
13	MU(2)	0.000	0.0	0.000	0.0	0.000	0.0
14	2N(2)	0.008	28.5	0.011	24.5	0.003	-4.0
15	OO(1)	0.004	345.7	0.002	56.2	-0.002	70.5
16	LAMBDA(2)	0.000	0.0	0.000	0.0	0.000	0.0
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.004	117.6	0.002	309.8	-0.002	167.8
19	J(1)	0.006	97.4	0.005	342.0	-0.001	115.4
20	MM	0.000	0.0	0.000	0.0	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.000	0.0	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.004	299.1	0.000	0.0	-0.004	60.9
26	Q(1)	0.007	322.9	0.007	315.8	0.000	-7.1
27	T(2)	0.000	0.0	0.000	0.0	0.000	0.0
28	R(2)	0.000	0.0	0.000	0.0	0.000	0.0
29	2Q(1)	0.002	325.1	0.002	343.1	0.000	18.0
30	P(1)	0.000	0.0	0.000	0.0	0.000	0.0
31	2SM(2)	0.004	12.0	0.002	342.4	-0.002	29.6
32	M(3)	0.004	216.8	0.002	133.5	-0.002	-83.3
33	L(2)	0.060	102.0	0.043	111.6	-0.017	9.6
34	2MK(3)	0.008	255.5	0.009	235.3	0.001	-20.2
35	K(2)	0.000	0.0	0.000	0.0	0.000	0.0
36	M(8)	0.006	105.1	0.007	95.9	0.001	-9.2
37	MS(4)	0.005	200.3	0.014	185.0	0.009	-15.3

APPENDIX B. Skill Assessment Scores of Water Levels: Astronomical Tide and Hindcast Simulations

Station: CAPE MAY CANAL,DELAWARE BAY
Observed data time period from: / 3/ 1/1984 to / 4/ 2/1984 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	-0.011									
h			87600	-0.011									
H-h	15	cm 24h	87600	0.001	0.083	0.083	0.0	92.8	0.0	1.2	2.0	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.025	0.081	0.077	0.0	92.1	0.0	0.0	0.0		
ALW-alw	15	cm 24h	706	0.008	0.080	0.080	0.1	95.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.009	0.218	0.218	0.0	97.9	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	706	-0.095	0.244	0.224	0.0	97.2	0.1	0.0	0.0		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			7861	-0.039									
h			7861	-0.011									
H-h	15	cm 24h	7861	-0.027	0.118	0.115	1.0	86.4	0.6	1.3	2.3	0.75	0.99
AHW-ahw	15	cm 24h	62	-0.030	0.105	0.102	0.0	85.5	0.0	0.0	0.0		
ALW-alw	15	cm 24h	63	-0.055	0.134	0.123	1.6	88.9	0.0	0.0	0.0		
THW-thw	0.50	h 25h	62	0.047	0.519	0.522	1.6	66.1	4.8	0.0	0.0		
TLW-tlw	0.50	h 25h	63	-0.006	0.631	0.636	4.8	58.7	7.9	0.0	0.0		
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to DBOFS model datum													
H			87600	-0.021									
h			87600	-0.011									
H-h	15	cm 24h	87600	-0.009	0.084	0.083	0.0	92.7	0.0	1.2	2.0	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.035	0.084	0.077	0.0	91.9	0.0	0.0	0.0		
ALW-alw	15	cm 24h	706	-0.002	0.080	0.080	0.1	94.8	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.009	0.218	0.218	0.0	97.9	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	706	-0.095	0.244	0.224	0.0	97.2	0.1	0.0	0.0		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			7861	-0.049									
h			7861	-0.011									
H-h	15	cm 24h	7861	-0.037	0.121	0.115	1.1	85.2	0.6	1.4	2.3	0.81	0.99
AHW-ahw	15	cm 24h	62	-0.040	0.109	0.102	1.6	88.7	0.0	0.0	0.0		
ALW-alw	15	cm 24h	63	-0.065	0.139	0.123	1.6	87.3	0.0	0.0	0.0		
THW-thw	0.50	h 25h	62	0.047	0.519	0.522	1.6	66.1	4.8	0.0	0.0		
TLW-tlw	0.50	h 25h	63	-0.006	0.631	0.636	4.8	58.7	7.9	0.0	0.0		

Station: BURLINGTON, DELAWARE RIVER
Observed data time period from: / 3/ 1/1984 to / 4/ 6/1984 with gaps of 14.17 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	0.110									
h			87600	0.110									
H-h	15	cm 24h	87600	0.000	0.239	0.239	10.9	44.5	11.7	5.7	4.8	0.00	0.97
AHW-ahw	15	cm 24h	705	0.112	0.175	0.134	0.0	57.3	8.5	0.0	75.1		
ALW-alw	15	cm 24h	705	-0.027	0.145	0.142	1.0	68.7	2.6	0.0	62.0		
THW-thw	0.50	h 25h	705	-0.259	0.420	0.331	0.7	74.5	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.074	0.454	0.449	1.4	66.8	0.1	0.0	0.0		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			8701	0.120									
h			8701	-0.009									
H-h	15	cm 24h	8701	0.130	0.231	0.192	0.5	47.2	15.4	1.7	11.6	4.10	0.98
AHW-ahw	15	cm 24h	71	0.231	0.273	0.147	0.0	19.7	25.4	0.0	24.0		
ALW-alw	15	cm 24h	70	0.139	0.194	0.137	0.0	61.4	10.0	0.0	12.0		
THW-thw	0.50	h 25h	71	-0.049	0.436	0.437	0.0	74.6	1.4	0.0	0.0		
TLW-tlw	0.50	h 25h	70	0.016	0.459	0.462	1.4	77.1	2.9	0.0	0.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	-0.001									
h			87600	0.110									
H-h	15	cm 24h	87600	-0.111	0.264	0.239	23.3	39.2	4.5	6.8	3.7	0.00	0.97
AHW-ahw	15	cm 24h	705	0.001	0.134	0.134	1.4	73.3	0.9	0.0	0.0		
ALW-alw	15	cm 24h	705	-0.138	0.198	0.142	12.5	46.4	0.0	99.8	0.0		
THW-thw	0.50	h 25h	705	-0.259	0.420	0.331	0.7	74.5	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.074	0.454	0.449	1.4	66.8	0.1	0.0	0.0		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			8701	0.009									
h			8701	-0.009									
H-h	15	cm 24h	8701	0.019	0.193	0.192	4.1	59.8	5.9	3.8	9.4	2.57	0.98
AHW-ahw	15	cm 24h	71	0.120	0.189	0.147	1.4	63.4	9.9	0.0	0.0		
ALW-alw	15	cm 24h	70	0.028	0.139	0.137	0.0	80.0	2.9	0.0	0.0		
THW-thw	0.50	h 25h	71	-0.049	0.436	0.437	0.0	74.6	1.4	0.0	0.0		
TLW-tlw	0.50	h 25h	70	0.016	0.459	0.462	1.4	77.1	2.9	0.0	0.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum 10% tidal range													
H			87600	-0.001									
h			87600	0.110									
H-h	21	cm 24h	87600	-0.111	0.264	0.239	8.9	55.8	1.2	5.0	2.8	0.00	0.97
AHW-ahw	21	cm 24h	705	0.001	0.134	0.134	0.0	87.7	0.0	0.0	0.0		
ALW-alw	21	cm 24h	705	-0.138	0.198	0.142	0.4	70.6	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.259	0.420	0.331	0.7	74.5	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.074	0.454	0.449	1.4	66.8	0.1	0.0	0.0		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum 10% tidal range													
H			8701	0.009									
h			8701	-0.009									
H-h	21	cm 24h	8701	0.019	0.193	0.192	0.2	76.3	2.1	1.2	4.7	0.92	0.98
AHW-ahw	21	cm 24h	71	0.120	0.189	0.147	0.0	78.9	2.8	0.0	0.0		
ALW-alw	21	cm 24h	70	0.028	0.139	0.137	0.0	87.1	1.4	0.0	0.0		
THW-thw	0.50	h 25h	71	-0.049	0.436	0.437	0.0	74.6	1.4	0.0	0.0		
TLW-tlw	0.50	h 25h	70	0.016	0.459	0.462	1.4	77.1	2.9	0.0	0.0		

Station: TRENTON MARINE TERMINAL
Observed data time period from: / 3/ 1/1984 to / 1/ 2/1985 with gaps of 14.17 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	0.199									
h			87600	0.199									
H-h	15	cm 24h	87600	-0.001	0.239	0.239	9.2	49.7	9.1	6.3	4.3	0.00	0.98
AHW-ahw	15	cm 24h	706	0.141	0.174	0.102	0.1	50.7	3.3	0.0	87.7		
ALW-alw	15	cm 24h	705	0.017	0.143	0.142	0.0	72.1	3.7	0.0	111.9		
THW-thw	0.50	h 25h	706	-0.159	0.405	0.372	3.3	81.7	0.0	74.4	0.0		
TLW-tlw	0.50	h 25h	705	0.394	0.588	0.437	0.0	52.2	5.5	0.0	74.2		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			73861	0.228									
h			73861	0.078									
H-h	15	cm 24h	73861	0.150	0.260	0.212	1.6	44.3	19.5	3.7	29.0	9.99	0.98
AHW-ahw	15	cm 24h	595	0.268	0.302	0.138	0.2	18.3	38.5	0.0	212.0		
ALW-alw	15	cm 24h	594	0.235	0.268	0.128	0.0	19.4	24.1	0.0	86.0		
THW-thw	0.50	h 25h	595	-0.084	0.450	0.443	1.5	72.4	1.3	0.0	0.0		
TLW-tlw	0.50	h 25h	594	0.214	0.517	0.471	0.5	63.6	5.2	0.0	37.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	0.037									
h			87600	0.199									
H-h	15	cm 24h	87600	-0.163	0.289	0.239	28.6	37.3	4.1	7.9	3.6	0.00	0.97
AHW-ahw	15	cm 24h	706	-0.021	0.104	0.102	0.3	89.7	0.0	12.2	0.0		
ALW-alw	15	cm 24h	705	-0.145	0.202	0.142	13.2	41.7	0.3	99.4	12.6		
THW-thw	0.50	h 25h	706	-0.159	0.405	0.372	3.3	81.7	0.0	74.4	0.0		
TLW-tlw	0.50	h 25h	705	0.394	0.588	0.437	0.0	52.2	5.5	0.0	74.2		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			73861	0.066									
h			73861	0.078									
H-h	15	cm 24h	73861	-0.012	0.213	0.212	7.3	58.8	5.9	5.3	25.0	5.17	0.98
AHW-ahw	15	cm 24h	595	0.106	0.174	0.138	0.2	62.4	6.4	0.0	25.0		
ALW-alw	15	cm 24h	594	0.073	0.147	0.128	0.3	77.6	2.2	0.0	49.0		
THW-thw	0.50	h 25h	595	-0.084	0.450	0.443	1.5	72.4	1.3	0.0	0.0		
TLW-tlw	0.50	h 25h	594	0.214	0.517	0.471	0.5	63.6	5.2	0.0	37.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum 10% tidal range													
H			87600	0.037									
h			87600	0.199									
H-h	24	cm 24h	87600	-0.163	0.289	0.239	7.9	56.2	1.5	6.0	3.0	0.00	0.97
AHW-ahw	24	cm 24h	706	-0.021	0.104	0.102	0.1	98.3	0.0	0.0	0.0		
ALW-alw	24	cm 24h	705	-0.145	0.202	0.142	0.0	71.3	0.0	0.0	0.0		
THW-thw	0.50	h 25h	706	-0.159	0.405	0.372	3.3	81.7	0.0	74.4	0.0		
TLW-tlw	0.50	h 25h	705	0.394	0.588	0.437	0.0	52.2	5.5	0.0	74.2		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum 10% tidal range													
H			73861	0.066									
h			73861	0.078									
H-h	24	cm 24h	73861	-0.012	0.213	0.212	1.4	78.7	2.1	3.6	20.4	1.68	0.98
AHW-ahw	24	cm 24h	595	0.106	0.174	0.138	0.2	84.0	1.3	0.0	12.0		
ALW-alw	24	cm 24h	594	0.073	0.147	0.128	0.0	94.4	1.0	0.0	12.0		
THW-thw	0.50	h 25h	595	-0.084	0.450	0.443	1.5	72.4	1.3	0.0	0.0		
TLW-tlw	0.50	h 25h	594	0.214	0.517	0.471	0.5	63.6	5.2	0.0	37.0		

Station: PHILADELPHIA, PA
Observed data time period from: / 3/ 1/1984 to / 1/ 2/1985 with gaps of 14.17 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	0.095									
h			87600	0.095									
H-h	15	cm 24h	87600	0.000	0.130	0.130	0.4	77.4	2.3	3.1	3.4	0.00	0.99
AHW-ahw	15	cm 24h	705	0.054	0.088	0.069	0.0	93.9	0.0	0.0	0.0		
ALW-alw	15	cm 24h	705	-0.006	0.073	0.073	0.0	96.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.073	0.359	0.351	0.3	82.7	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.117	0.397	0.380	0.0	74.2	0.3	0.0	12.7		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			70463	0.095									
h			70463	0.043									
H-h	15	cm 24h	70463	0.053	0.142	0.132	0.6	75.3	3.6	7.3	8.4	2.11	0.99
AHW-ahw	15	cm 24h	566	0.117	0.162	0.112	0.0	63.1	4.8	0.0	63.0		
ALW-alw	15	cm 24h	568	0.071	0.112	0.088	0.2	83.1	0.9	0.0	0.0		
THW-thw	0.50	h 25h	566	-0.009	0.442	0.442	1.1	69.1	0.5	0.0	0.0		
TLW-tlw	0.50	h 25h	568	0.076	0.453	0.447	1.2	70.2	1.4	0.0	0.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	0.055									
h			87600	0.095									
H-h	15	cm 24h	87600	-0.040	0.136	0.130	1.3	73.1	1.4	5.0	3.1	0.00	0.99
AHW-ahw	15	cm 24h	705	0.014	0.071	0.069	0.0	97.6	0.0	0.0	0.0		
ALW-alw	15	cm 24h	705	-0.046	0.087	0.073	0.0	93.5	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.073	0.359	0.351	0.3	82.7	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.117	0.397	0.380	0.0	74.2	0.3	0.0	12.7		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			70463	0.055									
h			70463	0.043									
H-h	15	cm 24h	70463	0.013	0.132	0.132	0.9	78.0	2.2	7.5	6.1	1.64	0.99
AHW-ahw	15	cm 24h	566	0.077	0.136	0.112	0.0	74.7	2.8	0.0	13.0		
ALW-alw	15	cm 24h	568	0.031	0.093	0.088	0.4	92.1	0.5	0.0	0.0		
THW-thw	0.50	h 25h	566	-0.009	0.442	0.442	1.1	69.1	0.5	0.0	0.0		
TLW-tlw	0.50	h 25h	568	0.076	0.453	0.447	1.2	70.2	1.4	0.0	0.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum 10% tidal range													
H			87600	0.055									
h			87600	0.095									
H-h	18	cm 24h	87600	-0.040	0.136	0.130	0.2	83.1	0.5	2.6	2.8	0.00	0.99
AHW-ahw	18	cm 24h	705	0.014	0.071	0.069	0.0	99.9	0.0	0.0	0.0		
ALW-alw	18	cm 24h	705	-0.046	0.087	0.073	0.0	98.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.073	0.359	0.351	0.3	82.7	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.117	0.397	0.380	0.0	74.2	0.3	0.0	12.7		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum 10% tidal range													
H			70463	0.055									
h			70463	0.043									
H-h	18	cm 24h	70463	0.013	0.132	0.132	0.4	86.5	1.1	5.7	5.5	0.89	0.99
AHW-ahw	18	cm 24h	566	0.077	0.136	0.112	0.0	83.9	1.2	0.0	13.0		
ALW-alw	18	cm 24h	568	0.031	0.093	0.088	0.2	96.0	0.2	0.0	0.0		
THW-thw	0.50	h 25h	566	-0.009	0.442	0.442	1.1	69.1	0.5	0.0	0.0		
TLW-tlw	0.50	h 25h	568	0.076	0.453	0.447	1.2	70.2	1.4	0.0	0.0		

Station: Reedy Point,DE
Observed data time period from: / 3/ 1/1984 to / 1/ 2/1985 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	0.067									
h			87600	0.067									
H-h	15	cm 24h	87600	0.000	0.113	0.113	0.3	81.6	0.6	1.6	3.4	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.043	0.086	0.075	0.0	90.4	0.0	0.0	0.0		
ALW-alw	15	cm 24h	705	0.046	0.083	0.069	0.0	93.0	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	0.089	0.289	0.275	0.0	91.2	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.312	0.453	0.329	0.0	63.5	0.3	0.0	12.7		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			73861	0.057									
h			73861	0.029									
H-h	15	cm 24h	73861	0.028	0.118	0.115	0.7	84.1	1.1	9.4	5.5	0.93	0.99
AHW-ahw	15	cm 24h	594	0.030	0.105	0.101	0.5	87.9	0.7	0.0	0.0		
ALW-alw	15	cm 24h	595	0.051	0.091	0.075	0.0	90.9	0.5	0.0	0.0		
THW-thw	0.50	h 25h	594	0.135	0.499	0.481	1.2	67.7	2.9	0.0	13.0		
TLW-tlw	0.50	h 25h	595	0.256	0.518	0.451	0.2	63.9	4.7	0.0	13.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	0.061									
h			87600	0.067									
H-h	15	cm 24h	87600	-0.006	0.114	0.113	0.3	81.4	0.5	1.7	3.3	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.049	0.090	0.075	0.0	88.5	0.0	0.0	0.0		
ALW-alw	15	cm 24h	705	0.040	0.080	0.069	0.0	93.8	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	0.089	0.289	0.275	0.0	91.2	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.312	0.453	0.329	0.0	63.5	0.3	0.0	12.7		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			73861	0.051									
h			73861	0.029									
H-h	15	cm 24h	73861	0.022	0.117	0.115	0.7	84.5	1.0	9.4	5.5	0.92	0.99
AHW-ahw	15	cm 24h	594	0.024	0.103	0.101	0.5	88.4	0.7	0.0	0.0		
ALW-alw	15	cm 24h	595	0.045	0.088	0.075	0.0	91.8	0.3	0.0	0.0		
THW-thw	0.50	h 25h	594	0.135	0.499	0.481	1.2	67.7	2.9	0.0	13.0		
TLW-tlw	0.50	h 25h	595	0.256	0.518	0.451	0.2	63.9	4.7	0.0	13.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum 10% tidal range													
H			87600	0.061									
h			87600	0.067									
H-h	17	cm 24h	87600	-0.006	0.114	0.113	0.1	86.9	0.2	1.0	3.1	0.00	0.99
AHW-ahw	17	cm 24h	705	-0.049	0.090	0.075	0.0	92.3	0.0	0.0	0.0		
ALW-alw	17	cm 24h	705	0.040	0.080	0.069	0.0	97.0	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	0.089	0.289	0.275	0.0	91.2	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.312	0.453	0.329	0.0	63.5	0.3	0.0	12.7		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum 10% tidal range													
H			73861	0.051									
h			73861	0.029									
H-h	17	cm 24h	73861	0.022	0.117	0.115	0.5	88.9	0.6	9.2	5.3	0.69	0.99
AHW-ahw	17	cm 24h	594	0.024	0.103	0.101	0.3	91.9	0.5	0.0	0.0		
ALW-alw	17	cm 24h	595	0.045	0.088	0.075	0.0	95.3	0.2	0.0	0.0		
THW-thw	0.50	h 25h	594	0.135	0.499	0.481	1.2	67.7	2.9	0.0	13.0		
TLW-tlw	0.50	h 25h	595	0.256	0.518	0.451	0.2	63.9	4.7	0.0	13.0		

Station: BRANDYWINE SHOAL LIGHT, DELAWARE BAY
Observed data time period from: / 3/18/1984 to / 4/ 2/1984 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	-0.006									
h			87600	-0.006									
H-h	15	cm 24h	87600	0.001	0.083	0.083	0.0	92.5	0.0	1.1	2.3	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.038	0.086	0.077	0.0	90.8	0.0	0.0	0.0		
ALW-alw	15	cm 24h	705	0.005	0.067	0.067	0.0	98.7	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	0.025	0.207	0.205	0.0	97.4	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.060	0.221	0.213	0.0	96.0	0.1	0.0	0.0		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			3621	0.083									
h			3621	0.100									
H-h	15	cm 24h	3621	-0.018	0.089	0.087	0.6	91.5	0.1	1.9	0.3	0.41	0.99
AHW-ahw	15	cm 24h	29	-0.018	0.098	0.097	3.4	93.1	0.0	0.0	0.0		
ALW-alw	15	cm 24h	29	-0.055	0.090	0.072	0.0	89.7	0.0	0.0	0.0		
THW-thw	0.50	h 25h	29	0.210	0.492	0.453	0.0	69.0	3.4	0.0	0.0		
TLW-tlw	0.50	h 25h	29	0.055	0.525	0.532	0.0	69.0	6.9	0.0	0.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	0.007									
h			87600	-0.006									
H-h	15	cm 24h	87600	0.014	0.084	0.083	0.0	91.9	0.0	0.9	2.3	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.025	0.081	0.077	0.0	92.9	0.0	0.0	0.0		
ALW-alw	15	cm 24h	705	0.018	0.070	0.067	0.0	96.7	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	0.025	0.207	0.205	0.0	97.4	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.060	0.221	0.213	0.0	96.0	0.1	0.0	0.0		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			3621	0.096									
h			3621	0.100									
H-h	15	cm 24h	3621	-0.005	0.088	0.087	0.2	91.8	0.2	0.6	0.5	0.19	0.99
AHW-ahw	15	cm 24h	29	-0.005	0.096	0.097	0.0	93.1	0.0	0.0	0.0		
ALW-alw	15	cm 24h	29	-0.042	0.083	0.072	0.0	93.1	0.0	0.0	0.0		
THW-thw	0.50	h 25h	29	0.210	0.492	0.453	0.0	69.0	3.4	0.0	0.0		
TLW-tlw	0.50	h 25h	29	0.055	0.525	0.532	0.0	69.0	6.9	0.0	0.0		

Station: LEWES,FT MILES DE
Observed data time period from: / 3/ 1/1984 to / 4/ 2/1984 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	0.023									
h			87600	0.023									
H-h	15	cm 24h	87600	0.000	0.077	0.077	0.0	95.7	0.0	1.0	1.9	0.00	0.99
AHW-ahw	15	cm 24h	705	0.002	0.074	0.074	0.0	96.3	0.0	0.0	0.0		
ALW-alw	15	cm 24h	706	-0.030	0.084	0.079	0.1	94.9	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.097	0.217	0.194	0.0	98.6	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	706	-0.131	0.247	0.210	0.0	96.6	0.3	0.0	12.7		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			7861	0.005									
h			7861	0.023									
H-h	15	cm 24h	7861	-0.018	0.120	0.119	1.2	84.0	0.6	1.5	2.1	0.65	0.99
AHW-ahw	15	cm 24h	61	0.030	0.100	0.097	0.0	86.9	0.0	0.0	0.0		
ALW-alw	15	cm 24h	62	-0.088	0.161	0.136	1.6	75.8	0.0	0.0	0.0		
THW-thw	0.50	h 25h	61	-0.038	0.575	0.579	3.3	55.7	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	62	0.105	0.727	0.726	1.6	46.8	12.9	0.0	12.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	0.012									
h			87600	0.023									
H-h	15	cm 24h	87600	-0.011	0.078	0.077	0.0	95.4	0.0	1.0	1.9	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.009	0.074	0.074	0.0	95.9	0.0	0.0	0.0		
ALW-alw	15	cm 24h	706	-0.041	0.089	0.079	0.1	92.4	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	-0.097	0.217	0.194	0.0	98.6	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	706	-0.131	0.247	0.210	0.0	96.6	0.3	0.0	12.7		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			7861	-0.006									
h			7861	0.023									
H-h	15	cm 24h	7861	-0.029	0.123	0.119	1.3	83.1	0.6	1.6	2.1	0.66	0.99
AHW-ahw	15	cm 24h	61	0.019	0.098	0.097	0.0	86.9	0.0	0.0	0.0		
ALW-alw	15	cm 24h	62	-0.099	0.167	0.136	1.6	74.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	61	-0.038	0.575	0.579	3.3	55.7	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	62	0.105	0.727	0.726	1.6	46.8	12.9	0.0	12.0		

Station: OCEAN CITY, FISHING PIER
Observed data time period from: / 4/ 8/1984 to / 1/ 2/1985 with gaps of 4.42 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	0.027									
h			87600	0.027									
H-h	15	cm 24h	87600	0.000	0.083	0.083	0.0	93.3	0.0	0.8	1.1	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.008	0.086	0.086	0.0	91.1	0.1	0.0	0.0		
ALW-alw	15	cm 24h	705	-0.009	0.084	0.084	0.0	92.8	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	0.140	0.292	0.256	0.1	88.4	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.174	0.304	0.249	0.0	86.8	0.0	0.0	0.0		
SCENARIO: HINDCAST--- vertical datum set to MSL of observation period													
H			63642	0.022									
h			63642	0.063									
H-h	15	cm 24h	63642	-0.041	0.107	0.099	0.6	84.3	0.1	3.1	2.3	0.58	0.98
AHW-ahw	15	cm 24h	508	-0.037	0.099	0.092	0.4	89.4	0.4	0.0	0.0		
ALW-alw	15	cm 24h	509	-0.066	0.114	0.093	0.4	80.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	508	0.346	0.815	0.738	2.8	44.7	14.8	13.0	50.0		
TLW-tlw	0.50	h 25h	509	0.313	0.740	0.672	2.0	49.1	13.6	0.0	62.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	0.027									
h			87600	0.027									
H-h	15	cm 24h	87600	0.000	0.083	0.083	0.0	93.3	0.0	0.8	1.1	0.00	0.99
AHW-ahw	15	cm 24h	705	-0.008	0.086	0.086	0.0	91.1	0.1	0.0	0.0		
ALW-alw	15	cm 24h	705	-0.009	0.084	0.084	0.0	92.8	0.0	0.0	0.0		
THW-thw	0.50	h 25h	705	0.140	0.292	0.256	0.1	88.4	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	705	0.174	0.304	0.249	0.0	86.8	0.0	0.0	0.0		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			63642	0.022									
h			63642	0.063									
H-h	15	cm 24h	63642	-0.041	0.107	0.099	0.6	84.3	0.1	3.1	2.3	0.58	0.98
AHW-ahw	15	cm 24h	508	-0.037	0.099	0.092	0.4	89.4	0.4	0.0	0.0		
ALW-alw	15	cm 24h	509	-0.066	0.114	0.093	0.4	80.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	508	0.346	0.815	0.738	2.8	44.7	14.8	13.0	50.0		
TLW-tlw	0.50	h 25h	509	0.313	0.740	0.672	2.0	49.1	13.6	0.0	62.0		

Station: CHESAPEAKE CITY
Observed data time period from: / 6/ 7/1984 to /11/ 6/1984 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY --- vertical datum set to MSL of observation period													
H			87600	0.000									
h			87600	0.000									
H-h	15	cm 24h	87600	0.000	0.097	0.097	0.1	88.2	0.0	0.9	0.0	0.00	0.98
AHW-ahw	15	cm 24h	704	-0.039	0.094	0.085	0.0	85.4	0.0	0.0	0.0		
ALW-alw	15	cm 24h	704	0.041	0.088	0.077	0.0	98.4	0.0	0.0	0.0		
THW-thw	0.50	h 25h	704	0.213	0.356	0.285	0.0	79.8	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	704	0.572	0.737	0.465	0.0	41.9	16.2	0.0	136.2		
SCENARIO: HINDCAST --- vertical datum set to MSL of observation period													
H			36421	0.052									
h			36421	0.000									
H-h	15	cm 24h	36421	0.052	0.090	0.074	0.0	91.4	0.2	0.0	2.5	0.10	0.98
AHW-ahw	15	cm 24h	293	0.034	0.082	0.074	0.0	92.5	0.7	0.0	0.0		
ALW-alw	15	cm 24h	293	0.086	0.099	0.048	0.0	93.9	0.0	0.0	0.0		
THW-thw	0.50	h 25h	293	0.282	0.586	0.515	0.7	61.1	10.6	0.0	13.0		
TLW-tlw	0.50	h 25h	293	0.637	0.898	0.634	0.7	37.5	28.3	0.0	75.0		
SCENARIO: TIDAL SIMULATION ONLY ---- vertical datum set to DBOFS model datum													
H			87600	0.027									
h			87600	0.000									
H-h	15	cm 24h	87600	0.027	0.101	0.097	0.0	86.3	0.0	0.4	0.0	0.00	0.98
AHW-ahw	15	cm 24h	704	-0.012	0.086	0.085	0.0	93.0	0.0	0.0	0.0		
ALW-alw	15	cm 24h	704	0.068	0.103	0.077	0.0	86.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	704	0.213	0.356	0.285	0.0	79.8	0.1	0.0	0.0		
TLW-tlw	0.50	h 25h	704	0.572	0.737	0.465	0.0	41.9	16.2	0.0	136.2		
SCENARIO: HINDCAST ---- vertical datum set to DBOFS model datum													
H			36421	0.079									
h			36421	0.000									
H-h	15	cm 24h	36421	0.079	0.108	0.074	0.0	83.5	0.3	0.0	2.8	0.13	0.97
AHW-ahw	15	cm 24h	293	0.061	0.096	0.074	0.0	89.4	1.0	0.0	0.0		
ALW-alw	15	cm 24h	293	0.113	0.123	0.048	0.0	76.8	0.0	0.0	0.0		
THW-thw	0.50	h 25h	293	0.282	0.586	0.515	0.7	61.1	10.6	0.0	13.0		
TLW-tlw	0.50	h 25h	293	0.637	0.898	0.634	0.7	37.5	28.3	0.0	75.0		

APPENDIX C. Skill Assessment Scores of Water Levels: Nowcast/Forecast DBOFS Version 1.1

Station: CAPE MAY CANAL,DELAWARE BAY
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.130									
h			21841	0.125									
H-h	15	cm 24h	21841	0.004	0.094	0.093	0.3	92.6	0.5	5.4	4.1	0.28	0.99
AHW-ahw	15	cm 24h	176	-0.021	0.116	0.115	0.6	92.6	0.6	0.0	0.0		
ALW-alw	15	cm 24h	176	0.029	0.098	0.093	0.0	89.8	0.6	0.0	0.0		
THW-thw	0.50	h 25h	176	0.096	0.329	0.316	0.0	86.9	0.6	0.0	0.0		
TLW-tlw	0.50	h 25h	176	0.041	0.357	0.355	0.0	84.7	1.7	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.002	0.084	0.084	0.0	93.2	0.0	0.0	0.0	0.00	
H06-h06	15	cm 24h	296	0.007	0.087	0.087	0.0	91.9	0.0	0.0	0.0	0.00	
H12-h12	15	cm 24h	296	0.004	0.089	0.089	0.0	91.6	0.0	0.0	0.0	0.00	
H18-h18	15	cm 24h	296	-0.008	0.092	0.092	0.0	90.9	0.0	0.0	0.0	0.00	
H24-h24	15	cm 24h	296	-0.011	0.098	0.098	0.0	87.2	0.0	0.0	0.0	0.00	
AHW-ahw	15	cm 24h	129	-0.031	0.096	0.091	0.8	90.7	0.0				
ALW-alw	15	cm 24h	131	0.032	0.096	0.091	0.0	87.0	0.0				
THW-thw	0.50	h 25h	129	0.091	0.304	0.291	0.0	91.5	0.8				
TLW-tlw	0.50	h 25h	131	0.059	0.366	0.363	0.0	84.0	0.0				

Station: Ship John Shoal
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.119									
h			21841	0.114									
H-h	15	cm 24h	21841	0.004	0.149	0.149	0.7	89.0	0.6	8.0	4.3	0.88	0.99
AHW-ahw	15	cm 24h	175	0.046	0.117	0.108	0.0	86.9	1.1	0.0	0.0		
ALW-alw	15	cm 24h	174	0.012	0.085	0.084	0.0	92.5	0.0	0.0	0.0		
THW-thw	0.50	h 25h	175	0.070	0.284	0.276	0.0	93.1	0.6	0.0	0.0		
TLW-tlw	0.50	h 25h	174	0.130	0.299	0.270	0.0	86.2	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.005	0.080	0.080	0.0	93.6	0.0	0.0	0.0	0.00	
H06-h06	15	cm 24h	296	-0.003	0.079	0.079	0.0	92.6	0.0	0.0	0.0	0.00	
H12-h12	15	cm 24h	296	-0.004	0.086	0.086	0.0	92.2	0.3	0.0	0.0	0.00	
H18-h18	15	cm 24h	296	-0.015	0.088	0.087	0.0	91.2	0.0	0.0	0.0	0.00	
H24-h24	15	cm 24h	296	-0.015	0.133	0.132	0.0	89.5	0.3	0.0	0.0	0.00	
AHW-ahw	15	cm 24h	132	0.023	0.096	0.093	0.0	87.9	0.0				
ALW-alw	15	cm 24h	131	0.011	0.088	0.088	0.0	91.6	0.0				
THW-thw	0.50	h 25h	132	0.065	0.284	0.278	0.0	96.2	0.8				
TLW-tlw	0.50	h 25h	131	0.126	0.311	0.286	0.0	93.1	0.0				

Station: Tacony-Palmyra Bridge
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.101									
h			21841	0.094									
H-h	15	cm 24h	21841	0.007	0.157	0.156	0.7	75.0	2.6	5.6	3.9	2.09	0.99
AHW-ahw	15	cm 24h	175	0.061	0.115	0.097	0.6	92.0	1.1	0.0	0.0		
ALW-alw	15	cm 24h	176	0.085	0.124	0.091	0.0	80.7	2.8	0.0	24.4		
THW-thw	0.50	h 25h	175	-0.188	0.332	0.274	0.0	89.1	0.6	0.0	0.0		
TLW-tlw	0.50	h 25h	176	-0.116	0.278	0.253	0.0	90.3	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.010	0.132	0.132	0.0	76.4	2.4	0.0	0.0	2.03	
H06-h06	15	cm 24h	296	-0.002	0.131	0.131	0.0	78.4	2.0	0.0	0.0	1.35	
H12-h12	15	cm 24h	296	-0.009	0.129	0.129	0.3	78.0	2.0	0.0	0.0	1.69	
H18-h18	15	cm 24h	296	-0.011	0.132	0.132	0.0	75.3	2.7	0.0	0.0	2.03	
H24-h24	15	cm 24h	296	-0.024	0.130	0.128	0.3	77.7	1.4	0.0	0.0	1.69	
AHW-ahw	15	cm 24h	131	0.044	0.082	0.069	0.0	96.2	0.0				
ALW-alw	15	cm 24h	130	0.069	0.106	0.080	0.0	84.6	0.8				
THW-thw	0.50	h 25h	131	-0.208	0.300	0.217	0.0	90.8	0.0				
TLW-tlw	0.50	h 25h	130	-0.118	0.283	0.258	0.0	89.2	0.0				

Station: BURLINGTON, DELAWARE RIVER
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.094									
h			21841	0.088									
H-h	15	cm 24h	21841	0.007	0.196	0.196	3.4	62.3	4.6	5.9	4.2	5.04	0.98
AHW-ahw	15	cm 24h	175	0.096	0.143	0.106	0.6	73.1	1.7	0.0	0.0		
ALW-alw	15	cm 24h	176	0.116	0.152	0.099	0.0	69.3	2.8	0.0	36.6		
THW-thw	0.50	h 25h	175	-0.209	0.329	0.254	0.0	87.4	0.6	0.0	0.0		
TLW-tlw	0.50	h 25h	176	-0.126	0.286	0.257	0.6	90.9	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.007	0.162	0.162	2.4	66.2	4.7	0.0	0.0	4.39	
H06-h06	15	cm 24h	296	-0.003	0.159	0.159	1.7	66.6	3.7	0.0	0.0	3.04	
H12-h12	15	cm 24h	296	-0.011	0.158	0.158	1.0	64.5	3.0	0.0	0.0	2.36	
H18-h18	15	cm 24h	296	-0.011	0.161	0.161	2.4	64.9	2.7	0.0	0.0	3.72	
H24-h24	15	cm 24h	296	-0.028	0.153	0.151	3.7	65.2	1.4	0.0	0.0	3.72	
AHW-ahw	15	cm 24h	131	0.076	0.110	0.079	0.0	84.0	0.0				
ALW-alw	15	cm 24h	130	0.101	0.131	0.084	0.0	69.2	2.3				
THW-thw	0.50	h 25h	131	-0.228	0.305	0.202	0.0	90.8	0.0				
TLW-tlw	0.50	h 25h	130	-0.118	0.289	0.265	0.0	91.5	0.0				

Station: Marcus Hook
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.137									
h			21841	0.133									
H-h	15	cm 24h	21841	0.004	0.134	0.134	0.6	82.3	1.2	7.5	2.9	0.89	0.99
AHW-ahw	15	cm 24h	176	-0.024	0.118	0.116	0.6	93.8	0.6	0.0	0.0		
ALW-alw	15	cm 24h	175	0.081	0.112	0.078	0.0	84.0	1.1	0.0	0.0		
THW-thw	0.50	h 25h	176	0.076	0.258	0.247	0.6	92.6	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	175	0.070	0.306	0.298	0.0	93.1	0.6	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.010	0.116	0.116	0.0	82.4	1.4	0.0	0.0	0.34	
H06-h06	15	cm 24h	296	-0.007	0.118	0.118	0.3	80.1	0.7	0.0	0.0	0.68	
H12-h12	15	cm 24h	296	-0.009	0.122	0.122	0.7	79.4	0.7	0.0	0.0	0.68	
H18-h18	15	cm 24h	296	-0.012	0.125	0.124	0.7	77.7	1.0	0.0	0.0	0.68	
H24-h24	15	cm 24h	296	-0.022	0.130	0.129	0.3	75.0	1.0	0.0	0.0	0.68	
AHW-ahw	15	cm 24h	131	-0.044	0.086	0.073	0.0	92.4	0.0				
ALW-alw	15	cm 24h	131	0.062	0.094	0.071	0.0	87.8	0.0				
THW-thw	0.50	h 25h	131	0.082	0.250	0.237	0.0	97.7	0.0				
TLW-tlw	0.50	h 25h	131	0.065	0.280	0.273	0.0	90.8	0.0				

Station: PHILADELPHIA, PA
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.107									
h			21841	0.100									
H-h	15	cm 24h	21841	0.007	0.135	0.135	0.6	83.1	2.1	5.6	2.3	1.65	0.99
AHW-ahw	15	cm 24h	176	0.039	0.118	0.112	1.1	93.8	1.1	0.0	0.0		
ALW-alw	15	cm 24h	176	0.094	0.127	0.086	0.0	79.0	2.3	0.0	12.4		
THW-thw	0.50	h 25h	176	-0.143	0.324	0.292	0.6	92.0	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	176	-0.119	0.278	0.252	0.0	89.8	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.014	0.120	0.119	0.0	83.1	2.7	0.0	0.0	2.36	
H06-h06	15	cm 24h	296	0.011	0.119	0.118	0.0	83.1	2.7	0.0	0.0	2.36	
H12-h12	15	cm 24h	296	0.006	0.118	0.118	0.0	84.1	3.0	0.0	0.0	2.70	
H18-h18	15	cm 24h	296	0.004	0.122	0.122	0.0	81.8	3.0	0.0	0.0	3.04	
H24-h24	15	cm 24h	296	-0.008	0.120	0.120	0.0	83.1	2.4	0.0	0.0	2.03	
AHW-ahw	15	cm 24h	131	0.037	0.079	0.070	0.0	93.9	0.0				
ALW-alw	15	cm 24h	131	0.091	0.121	0.081	0.0	77.1	1.5				
THW-thw	0.50	h 25h	131	-0.127	0.266	0.234	0.0	93.1	0.0				
TLW-tlw	0.50	h 25h	131	-0.120	0.285	0.260	0.0	90.8	0.0				

Station: Newbold, PA
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.047									
h			21841	0.042									
H-h	15	cm 24h	21841	0.006	0.214	0.214	5.1	59.2	4.7	6.0	5.5	5.52	0.98
AHW-ahw	15	cm 24h	175	0.129	0.176	0.121	0.6	54.9	1.7	0.0	0.0		
ALW-alw	15	cm 24h	176	0.147	0.181	0.106	0.0	59.7	4.5	0.0	36.8		
THW-thw	0.50	h 25h	175	-0.255	0.360	0.254	0.0	83.4	0.6	0.0	0.0		
TLW-tlw	0.50	h 25h	176	-0.056	0.292	0.287	0.6	92.6	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.002	0.164	0.164	4.1	66.6	2.7	0.0	0.0	3.72	
H06-h06	15	cm 24h	296	-0.010	0.164	0.164	4.7	65.9	3.4	0.0	0.0	4.39	
H12-h12	15	cm 24h	296	-0.021	0.162	0.161	5.1	65.5	1.7	0.0	0.0	3.72	
H18-h18	15	cm 24h	296	-0.019	0.163	0.162	5.7	68.9	1.7	0.0	0.0	4.05	
H24-h24	15	cm 24h	296	-0.032	0.165	0.163	5.7	65.5	1.4	0.0	0.0	4.05	
AHW-ahw	15	cm 24h	131	0.103	0.139	0.094	0.0	66.4	1.5				
ALW-alw	15	cm 24h	131	0.129	0.156	0.088	0.0	62.6	3.8				
THW-thw	0.50	h 25h	131	-0.272	0.354	0.228	0.0	82.4	0.0				
TLW-tlw	0.50	h 25h	131	-0.047	0.271	0.268	0.0	95.4	0.0				

Station: Delaware City, DE
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.111									
h			21841	0.107									
H-h	15	cm 24h	21841	0.004	0.136	0.136	0.6	87.0	1.0	7.8	3.5	0.92	0.99
AHW-ahw	15	cm 24h	175	0.003	0.089	0.090	0.0	94.9	1.1	0.0	0.0		
ALW-alw	15	cm 24h	174	0.068	0.098	0.070	0.0	88.5	0.6	0.0	0.0		
THW-thw	0.50	h 25h	175	-0.027	0.250	0.250	0.0	94.9	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	174	0.090	0.267	0.252	0.0	90.2	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.009	0.101	0.101	0.0	85.8	0.7	0.0	0.0	0.00	
H06-h06	15	cm 24h	296	-0.012	0.102	0.101	0.3	85.8	0.0	0.0	0.0	0.34	
H12-h12	15	cm 24h	296	-0.013	0.111	0.110	0.0	84.8	0.3	0.0	0.0	0.00	
H18-h18	15	cm 24h	296	-0.018	0.105	0.104	0.7	83.8	0.0	0.0	0.0	0.34	
H24-h24	15	cm 24h	296	-0.020	0.148	0.147	1.7	82.1	0.3	0.0	0.0	0.68	
AHW-ahw	15	cm 24h	131	-0.028	0.086	0.081	0.0	92.4	0.0				
ALW-alw	15	cm 24h	130	0.053	0.090	0.073	0.0	90.0	0.0				
THW-thw	0.50	h 25h	131	-0.044	0.234	0.231	0.0	95.4	0.0				
TLW-tlw	0.50	h 25h	130	0.096	0.279	0.263	0.0	93.8	0.0				

Station: Reedy Point,DE
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.117									
h			21841	0.113									
H-h	15	cm 24h	21841	0.004	0.134	0.133	0.6	89.3	0.8	7.9	3.6	1.02	0.99
AHW-ahw	15	cm 24h	175	0.022	0.086	0.083	0.0	96.6	0.6	0.0	0.0		
ALW-alw	15	cm 24h	174	0.055	0.089	0.070	0.0	90.2	0.0	0.0	0.0		
THW-thw	0.50	h 25h	175	-0.101	0.282	0.264	0.0	91.4	0.0	0.0	0.0		
TLW-tlw	0.50	h 25h	174	0.034	0.277	0.275	0.0	90.2	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.010	0.092	0.092	0.0	88.9	0.0	0.0	0.0	0.00	
H06-h06	15	cm 24h	296	-0.004	0.093	0.093	0.0	87.2	0.0	0.0	0.0	0.00	
H12-h12	15	cm 24h	296	-0.007	0.101	0.101	0.0	88.2	0.3	0.0	0.0	0.00	
H18-h18	15	cm 24h	296	-0.013	0.096	0.095	0.0	86.5	0.0	0.0	0.0	0.00	
H24-h24	15	cm 24h	296	-0.016	0.134	0.134	0.7	84.8	0.3	0.0	0.0	0.00	
AHW-ahw	15	cm 24h	131	-0.003	0.082	0.082	0.0	94.7	0.0				
ALW-alw	15	cm 24h	130	0.045	0.085	0.073	0.0	90.0	0.0				
THW-thw	0.50	h 25h	131	-0.106	0.261	0.239	0.0	95.4	0.0				
TLW-tlw	0.50	h 25h	130	0.037	0.287	0.286	0.0	93.1	0.0				

Station: BRANDYWINE SHOAL LIGHT, DELAWARE BAY
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.135									
h			21841	0.128									
H-h	15	cm 24h	21841	0.006	0.104	0.104	0.4	91.7	0.5	6.8	4.4	0.37	0.99
AHW-ahw	15	cm 24h	175	-0.011	0.103	0.103	0.6	93.7	0.6	0.0	0.0		
ALW-alw	15	cm 24h	176	0.008	0.085	0.085	0.0	92.0	0.6	0.0	0.0		
THW-thw	0.50	h 25h	175	0.107	0.287	0.267	0.0	89.7	0.6	0.0	0.0		
TLW-tlw	0.50	h 25h	176	0.169	0.367	0.326	0.0	86.4	1.1	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.006	0.082	0.081	0.0	93.6	0.0	0.0	0.0	0.00	
H06-h06	15	cm 24h	296	0.007	0.083	0.083	0.0	93.6	0.0	0.0	0.0	0.00	
H12-h12	15	cm 24h	296	0.004	0.086	0.086	0.0	91.2	0.0	0.0	0.0	0.00	
H18-h18	15	cm 24h	296	-0.008	0.090	0.090	0.0	90.9	0.0	0.0	0.0	0.00	
H24-h24	15	cm 24h	296	-0.010	0.099	0.099	0.0	88.2	0.3	0.0	0.0	0.00	
AHW-ahw	15	cm 24h	129	-0.026	0.096	0.093	0.8	87.6	0.0				
ALW-alw	15	cm 24h	131	0.009	0.090	0.089	0.0	91.6	0.0				
THW-thw	0.50	h 25h	129	0.107	0.314	0.297	0.0	94.6	1.6				
TLW-tlw	0.50	h 25h	131	0.184	0.369	0.321	0.0	82.4	1.5				

Station: LEWES,FT MILES DE
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.114									
h			21841	0.110									
H-h	15	cm 24h	21841	0.004	0.087	0.087	0.3	93.5	0.3	5.6	3.6	0.26	0.99
AHW-ahw	15	cm 24h	176	0.005	0.114	0.114	0.6	93.8	0.6	0.0	0.0		
ALW-alw	15	cm 24h	176	-0.011	0.089	0.088	0.0	92.6	0.6	0.0	0.0		
THW-thw	0.50	h 25h	176	-0.006	0.351	0.352	0.6	84.7	0.6	0.0	0.0		
TLW-tlw	0.50	h 25h	176	-0.052	0.396	0.394	0.6	82.4	1.1	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.003	0.081	0.081	0.0	92.9	0.0	0.0	0.0	0.00	
H06-h06	15	cm 24h	296	-0.004	0.086	0.086	0.0	92.6	0.0	0.0	0.0	0.00	
H12-h12	15	cm 24h	296	-0.009	0.086	0.086	0.0	89.9	0.0	0.0	0.0	0.00	
H18-h18	15	cm 24h	296	-0.020	0.092	0.089	0.0	88.2	0.0	0.0	0.0	0.00	
H24-h24	15	cm 24h	296	-0.024	0.097	0.094	0.0	86.8	0.0	0.0	0.0	0.00	
AHW-ahw	15	cm 24h	129	-0.016	0.091	0.089	0.8	92.2	0.0				
ALW-alw	15	cm 24h	131	-0.017	0.093	0.092	0.0	90.1	0.0				
THW-thw	0.50	h 25h	129	0.003	0.360	0.361	0.0	86.0	0.8				
TLW-tlw	0.50	h 25h	131	-0.043	0.384	0.383	0.8	84.7	2.3				

Station: CHESAPEAKE CITY
Observed data time period from: / 4/15/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST ---- vertical datum set to DBOFS model datum													
H			21841	0.130									
h			21841	0.129									
H-h	15	cm 24h	21841	0.001	0.061	0.061	0.3	98.4	0.2	4.1	2.4	0.38	0.99
AHW-ahw	15	cm 24h	176	0.002	0.052	0.052	0.0	98.9	0.0	0.0	0.0		
ALW-alw	15	cm 24h	175	0.028	0.043	0.032	0.0	99.4	0.0	0.0	0.0		
THW-thw	0.50	h 25h	176	0.105	0.398	0.385	0.6	79.5	1.7	0.0	0.0		
TLW-tlw	0.50	h 25h	175	0.293	0.611	0.538	0.0	69.1	7.4	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST ---- vertical datum set to DBOFS model datum													
H00-h00	15	cm 24h	296	0.001	0.050	0.050	0.0	99.3	0.0	0.0	0.0	0.00	
H06-h06	15	cm 24h	296	-0.005	0.100	0.100	0.0	87.8	0.3	0.0	0.0	0.34	
H12-h12	15	cm 24h	296	-0.004	0.131	0.131	1.4	78.0	1.7	6.0	12.0	1.69	
H18-h18	15	cm 24h	296	0.000	0.154	0.154	2.7	72.0	2.7	6.0	12.0	3.72	
H24-h24	15	cm 24h	296	0.001	0.163	0.164	3.4	72.6	2.4	12.0	18.0	4.05	
AHW-ahw	15	cm 24h	131	-0.006	0.119	0.119	0.8	86.3	1.5				
ALW-alw	15	cm 24h	129	0.022	0.111	0.110	0.8	87.6	2.3				
THW-thw	0.50	h 25h	131	0.322	0.498	0.382	0.0	68.7	3.1				
TLW-tlw	0.50	h 25h	129	0.758	1.119	0.826	1.6	38.0	39.5				

APPENDIX D. Comparison of Current Harmonic Constants

Station: VEL_002
Observation: Least Squares H.A. Beginning 4-24-1984 at Hour 20.70
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

		Observed(R= 0.024)		Modeled(R= 0.017)		Difference	
N	Constituent	Amplitude	Epoch	Amplitude	Epoch	Amplitude	Epoch
CURRENT ALONG PCD		DIR= 147		DIR= 144			
1	M(2)	0.977	170.8	0.807	164.4	-0.170	-6.4
2	S(2)	0.143	190.1	0.166	187.0	0.023	-3.1
3	N(2)	0.183	146.6	0.186	130.2	0.003	-16.4
4	K(1)	0.096	312.1	0.063	301.1	-0.033	-11.0
5	M(4)	0.084	76.9	0.001	17.1	-0.083	-59.8
6	O(1)	0.084	298.0	0.053	298.8	-0.031	0.8
7	M(6)	0.063	125.3	0.022	89.1	-0.041	-36.2
8	MK(3)	0.031	245.5	0.009	277.1	-0.022	31.6
9	S(4)	0.003	135.8	0.002	0.6	-0.001	-135.2
10	MN(4)	0.030	59.8	0.007	274.7	-0.023	145.1
11	NU(2)	0.000	0.0	0.011	180.0	0.000	0.0
12	S(6)	0.005	335.2	0.000	0.0	-0.005	24.8
13	MU(2)	0.000	0.0	0.028	318.5	0.000	0.0
14	2N(2)	0.023	112.8	0.004	240.9	-0.019	128.1
15	OO(1)	0.006	177.9	0.001	82.4	-0.005	-95.5
16	LAMBDA(2)	0.000	0.0	0.007	154.1	0.000	0.0
17	S(1)	0.000	0.0	0.003	284.0	0.000	0.0
18	M(1)	0.004	314.4	0.002	31.6	-0.002	77.2
19	J(1)	0.003	200.1	0.007	159.7	0.004	-40.4
20	MM	0.000	0.0	0.005	334.2	0.000	0.0
21	SSA	0.000	0.0	0.001	176.8	0.000	0.0
22	SA	0.000	0.0	0.071	76.6	0.000	0.0
23	MSF	0.000	0.0	0.009	5.7	0.000	0.0
24	MF	0.000	0.0	0.001	29.6	0.000	0.0
25	RHO(1)	0.021	240.5	0.002	355.9	-0.019	115.4
26	Q(1)	0.023	300.9	0.005	351.0	-0.018	50.1
27	T(2)	0.000	0.0	0.007	90.5	0.000	0.0
28	R(2)	0.000	0.0	0.004	160.6	0.000	0.0
29	2Q(1)	0.003	6.5	0.000	0.0	-0.003	-6.5
30	P(1)	0.000	0.0	0.004	151.7	0.000	0.0
31	2SM(2)	0.014	53.7	0.006	49.5	-0.008	-4.2
32	M(3)	0.012	178.8	0.004	189.9	-0.008	11.1
33	L(2)	0.041	228.0	0.055	229.4	0.014	1.4
34	2MK(3)	0.019	260.6	0.012	280.9	-0.007	20.3
35	K(2)	0.000	0.0	0.006	240.2	0.000	0.0
36	M(8)	0.027	230.3	0.002	271.6	-0.025	41.3
37	MS(4)	0.014	98.4	0.006	346.0	-0.008	112.4

Station: VEL_003
Observation: 29-Day H.A. Beginning 4- 3-1984 at Hour 22.00
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.014) Amplitude	Epoch	Modeled(R= 0.002) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 145		DIR= 134			
1	M(2)	0.704	141.2	0.797	143.7	0.093	2.5
2	S(2)	0.134	164.6	0.160	172.5	0.026	7.9
3	N(2)	0.146	116.0	0.175	114.1	0.029	-1.9
4	K(1)	0.052	295.6	0.042	280.8	-0.010	-14.8
5	M(4)	0.033	4.9	0.028	22.7	-0.005	17.8
6	O(1)	0.032	286.3	0.037	282.8	0.005	-3.5
7	M(6)	0.015	328.1	0.021	317.3	0.006	-10.8
8	MK(3)	0.000	0.0	0.006	196.0	0.000	0.0
9	S(4)	0.007	1.2	0.001	10.5	-0.006	9.3
10	MN(4)	0.000	0.0	0.013	342.6	0.000	0.0
11	NU(2)	0.028	119.4	0.010	136.1	-0.018	16.7
12	S(6)	0.005	164.3	0.001	2.6	-0.004	-161.7
13	MU(2)	0.000	0.0	0.034	282.1	0.000	0.0
14	2N(2)	0.019	90.8	0.005	231.9	-0.014	141.1
15	OO(1)	0.001	304.9	0.000	0.0	-0.001	55.1
16	LAMBDA(2)	0.005	152.1	0.008	111.7	0.003	-40.4
17	S(1)	0.000	0.0	0.002	59.1	0.000	0.0
18	M(1)	0.002	291.0	0.000	324.8	-0.002	33.8
19	J(1)	0.002	300.2	0.003	58.2	0.001	118.0
20	MM	0.000	0.0	0.003	328.2	0.000	0.0
21	SSA	0.000	0.0	0.003	165.1	0.000	0.0
22	SA	0.000	0.0	0.006	133.5	0.000	0.0
23	MSF	0.000	0.0	0.008	356.9	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.001	282.4	0.001	209.1	0.000	-73.3
26	Q(1)	0.006	281.7	0.006	293.4	0.000	11.7
27	T(2)	0.008	163.7	0.000	0.0	-0.008	-163.7
28	R(2)	0.001	165.6	0.003	352.9	0.002	172.7
29	2Q(1)	0.001	277.2	0.000	0.0	-0.001	82.8
30	P(1)	0.017	294.9	0.004	63.4	-0.013	128.5
31	2SM(2)	0.000	0.0	0.005	354.3	0.000	0.0
32	M(3)	0.000	0.0	0.003	128.2	0.000	0.0
33	L(2)	0.021	116.0	0.059	179.2	0.038	63.2
34	2MK(3)	0.000	0.0	0.007	211.3	0.000	0.0
35	K(2)	0.036	166.5	0.006	187.9	-0.030	21.4
36	M(8)	0.003	222.9	0.003	240.2	0.000	17.3
37	MS(4)	0.000	0.0	0.008	33.6	0.000	0.0

Station: VEL_005
Observation: Least Squares H.A. Beginning 4- 3-1984 at Hour 20.00
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.010) Amplitude	Epoch	Modeled(R= 0.002) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 132		DIR= 126			
1	M(2)	0.781	127.5	0.782	130.5	0.001	3.0
2	S(2)	0.121	150.5	0.153	160.8	0.032	10.3
3	N(2)	0.127	95.8	0.162	102.2	0.035	6.4
4	K(1)	0.043	272.0	0.034	274.6	-0.009	2.6
5	M(4)	0.021	341.9	0.011	353.9	-0.010	12.0
6	O(1)	0.030	278.8	0.031	278.8	0.001	0.0
7	M(6)	0.031	252.5	0.031	260.7	0.000	8.2
8	MK(3)	0.005	217.5	0.005	190.5	0.000	-27.0
9	S(4)	0.006	142.7	0.000	0.0	-0.006	-142.7
10	MN(4)	0.003	321.1	0.005	301.2	0.002	-19.9
11	NU(2)	0.000	0.0	0.014	121.3	0.000	0.0
12	S(6)	0.004	246.6	0.001	350.3	-0.003	103.7
13	MU(2)	0.000	0.0	0.043	269.1	0.000	0.0
14	2N(2)	0.062	170.4	0.005	221.1	-0.057	50.7
15	OO(1)	0.007	292.2	0.000	0.0	-0.007	67.8
16	LAMBDA(2)	0.000	0.0	0.010	100.9	0.000	0.0
17	S(1)	0.000	0.0	0.001	50.8	0.000	0.0
18	M(1)	0.003	248.6	0.000	344.9	-0.003	96.3
19	J(1)	0.005	185.6	0.003	37.1	-0.002	-148.5
20	MM	0.000	0.0	0.008	214.1	0.000	0.0
21	SSA	0.000	0.0	0.000	0.0	0.000	0.0
22	SA	0.000	0.0	0.003	192.5	0.000	0.0
23	MSF	0.000	0.0	0.004	238.1	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.014	344.7	0.000	0.0	-0.014	15.3
26	Q(1)	0.010	98.1	0.005	288.0	-0.005	170.1
27	T(2)	0.000	0.0	0.001	250.7	0.000	0.0
28	R(2)	0.000	0.0	0.003	316.8	0.000	0.0
29	2Q(1)	0.004	142.6	0.000	0.0	-0.004	-142.6
30	P(1)	0.000	0.0	0.004	55.7	0.000	0.0
31	2SM(2)	0.033	326.9	0.005	341.4	-0.028	14.5
32	M(3)	0.012	172.1	0.004	110.5	-0.008	-61.6
33	L(2)	0.117	183.3	0.068	164.1	-0.049	-19.2
34	2MK(3)	0.022	176.6	0.007	201.3	-0.015	24.7
35	K(2)	0.000	0.0	0.007	168.0	0.000	0.0
36	M(8)	0.009	113.2	0.003	80.0	-0.006	-33.2
37	MS(4)	0.005	254.7	0.003	336.4	-0.002	81.7

Station: VEL_012
Observation: 29-Day H.A. Beginning 10-20-1984 at Hour 13.40
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.702) Amplitude	Epoch	Modeled(R= 0.315) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 59		DIR= 118			
1	M(2)	0.074	82.0	0.136	110.3	0.062	28.3
2	S(2)	0.014	110.8	0.030	134.7	0.016	23.9
3	N(2)	0.016	58.8	0.041	82.0	0.025	23.2
4	K(1)	0.014	33.8	0.011	239.1	-0.003	154.7
5	M(4)	0.002	155.1	0.006	284.7	0.004	129.6
6	O(1)	0.017	278.4	0.006	279.5	-0.011	1.1
7	M(6)	0.004	18.3	0.002	55.0	-0.002	36.7
8	MK(3)	0.000	0.0	0.000	327.8	0.000	0.0
9	S(4)	0.003	294.2	0.000	294.2	-0.003	0.0
10	MN(4)	0.000	0.0	0.003	249.8	0.000	0.0
11	NU(2)	0.003	61.9	0.001	184.1	-0.002	122.2
12	S(6)	0.001	141.5	0.000	0.0	-0.001	-141.5
13	MU(2)	0.000	0.0	0.001	285.2	0.000	0.0
14	2N(2)	0.002	35.7	0.001	128.0	-0.001	92.3
15	OO(1)	0.001	149.3	0.000	318.1	-0.001	168.8
16	LAMBDA(2)	0.001	95.3	0.000	168.9	-0.001	73.6
17	S(1)	0.000	0.0	0.001	249.5	0.000	0.0
18	M(1)	0.001	336.1	0.000	223.2	-0.001	-112.9
19	J(1)	0.001	91.1	0.000	288.0	-0.001	163.1
20	MM	0.000	0.0	0.008	179.5	0.000	0.0
21	SSA	0.000	0.0	0.011	268.6	0.000	0.0
22	SA	0.000	0.0	0.013	123.9	0.000	0.0
23	MSF	0.000	0.0	0.003	275.7	0.000	0.0
24	MF	0.000	0.0	0.006	147.8	0.000	0.0
25	RHO(1)	0.001	228.8	0.000	259.7	-0.001	30.9
26	Q(1)	0.003	221.1	0.002	247.8	-0.001	26.7
27	T(2)	0.001	109.6	0.001	206.0	0.000	96.4
28	R(2)	0.000	111.9	0.001	45.4	0.000	0.0
29	2Q(1)	0.000	163.9	0.000	0.0	0.000	0.0
30	P(1)	0.005	25.2	0.001	183.5	-0.004	158.3
31	2SM(2)	0.000	0.0	0.000	147.8	0.000	0.0
32	M(3)	0.000	0.0	0.000	0.0	0.000	0.0
33	L(2)	0.002	58.8	0.003	159.4	0.001	100.6
34	2MK(3)	0.000	0.0	0.000	267.1	0.000	0.0
35	K(2)	0.004	113.1	0.001	168.0	-0.003	54.9
36	M(8)	0.001	191.4	0.000	277.9	-0.001	86.5
37	MS(4)	0.000	0.0	0.002	314.6	0.000	0.0

Station: VEL_016
Observation: Least Squares H.A. Beginning 3-22-1984 at Hour 0.10
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.420) Amplitude	Epoch	Modeled(R= 0.357) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 55		DIR= 88			
1	M(2)	0.058	72.9	0.104	84.5	0.046	11.6
2	S(2)	0.010	104.2	0.025	111.8	0.015	7.6
3	N(2)	0.014	40.7	0.032	24.0	0.018	-16.7
4	K(1)	0.027	350.9	0.007	219.0	-0.020	-131.9
5	M(4)	0.002	217.4	0.007	294.0	0.005	76.6
6	O(1)	0.028	278.6	0.010	292.9	-0.018	14.3
7	M(6)	0.003	343.7	0.000	325.9	-0.003	-17.8
8	MK(3)	0.001	255.4	0.000	159.3	-0.001	-96.1
9	S(4)	0.001	329.1	0.000	313.6	-0.001	-15.5
10	MN(4)	0.002	232.1	0.003	260.2	0.001	28.1
11	NU(2)	0.000	0.0	0.003	76.3	0.000	0.0
12	S(6)	0.000	326.9	0.000	206.7	0.000	0.0
13	MU(2)	0.000	0.0	0.001	225.3	0.000	0.0
14	2N(2)	0.003	46.7	0.001	71.0	-0.002	24.3
15	OO(1)	0.002	359.1	0.000	86.3	-0.002	87.2
16	LAMBDA(2)	0.000	0.0	0.001	73.5	0.000	0.0
17	S(1)	0.000	0.0	0.001	227.7	0.000	0.0
18	M(1)	0.002	255.8	0.001	181.0	-0.001	-74.8
19	J(1)	0.006	185.1	0.001	188.1	-0.005	3.0
20	MM	0.000	0.0	0.004	38.0	0.000	0.0
21	SSA	0.000	0.0	0.024	334.5	0.000	0.0
22	SA	0.000	0.0	0.058	252.5	0.000	0.0
23	MSF	0.000	0.0	0.003	240.7	0.000	0.0
24	MF	0.000	0.0	0.004	324.1	0.000	0.0
25	RHO(1)	0.001	157.7	0.001	127.8	0.000	-29.9
26	Q(1)	0.005	161.4	0.001	245.1	-0.004	83.7
27	T(2)	0.000	0.0	0.001	29.3	0.000	0.0
28	R(2)	0.000	0.0	0.001	187.9	0.000	0.0
29	2Q(1)	0.005	203.7	0.000	277.7	-0.005	74.0
30	P(1)	0.000	0.0	0.003	211.2	0.000	0.0
31	2SM(2)	0.001	206.6	0.000	51.2	-0.001	-155.4
32	M(3)	0.001	115.7	0.000	0.0	-0.001	-115.7
33	L(2)	0.003	49.5	0.004	112.0	0.001	62.5
34	2MK(3)	0.001	340.5	0.000	203.5	-0.001	-137.0
35	K(2)	0.000	0.0	0.001	91.7	0.000	0.0
36	M(8)	0.000	211.1	0.001	242.0	0.000	0.0
37	MS(4)	0.001	83.5	0.003	316.7	0.002	126.8

Station: VEL_017
Observation: Least Squares H.A. Beginning 4-17-1984 at Hour 23.00
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.638) Amplitude	Epoch	Modeled(R= 0.230) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 77		DIR= 127			
1	M(2)	0.077	75.4	0.140	107.1	0.063	31.7
2	S(2)	0.015	93.3	0.029	137.2	0.014	43.9
3	N(2)	0.016	57.3	0.057	77.5	0.041	20.2
4	K(1)	0.014	1.5	0.008	251.9	-0.006	109.6
5	M(4)	0.004	276.7	0.007	286.6	0.003	9.9
6	O(1)	0.025	266.1	0.012	13.5	-0.013	107.4
7	M(6)	0.003	10.4	0.001	76.6	-0.002	66.2
8	MK(3)	0.002	294.6	0.001	143.4	-0.001	-151.2
9	S(4)	0.001	87.3	0.000	34.8	-0.001	-52.5
10	MN(4)	0.003	191.3	0.004	249.2	0.001	57.9
11	NU(2)	0.000	0.0	0.004	175.7	0.000	0.0
12	S(6)	0.001	334.6	0.000	0.0	-0.001	25.4
13	MU(2)	0.000	0.0	0.002	269.9	0.000	0.0
14	2N(2)	0.007	22.0	0.001	188.1	-0.006	166.1
15	OO(1)	0.002	335.9	0.000	241.2	-0.002	-94.7
16	LAMBDA(2)	0.000	0.0	0.002	116.0	0.000	0.0
17	S(1)	0.000	0.0	0.011	97.6	0.000	0.0
18	M(1)	0.006	334.2	0.002	274.8	-0.004	-59.4
19	J(1)	0.007	234.0	0.001	71.6	-0.006	-162.4
20	MM	0.000	0.0	0.018	269.7	0.000	0.0
21	SSA	0.000	0.0	0.026	24.6	0.000	0.0
22	SA	0.000	0.0	0.245	248.5	0.000	0.0
23	MSF	0.000	0.0	0.003	190.9	0.000	0.0
24	MF	0.000	0.0	0.004	154.4	0.000	0.0
25	RHO(1)	0.008	198.3	0.003	26.4	-0.005	-171.9
26	Q(1)	0.003	305.7	0.006	163.7	0.003	-142.0
27	T(2)	0.000	0.0	0.003	153.2	0.000	0.0
28	R(2)	0.000	0.0	0.003	319.6	0.000	0.0
29	2Q(1)	0.005	21.7	0.001	315.3	-0.004	66.4
30	P(1)	0.000	0.0	0.008	110.6	0.000	0.0
31	2SM(2)	0.002	107.0	0.001	176.8	-0.001	69.8
32	M(3)	0.001	286.3	0.001	334.7	0.000	48.4
33	L(2)	0.003	252.5	0.001	299.7	-0.002	47.2
34	2MK(3)	0.004	338.6	0.001	297.9	-0.003	-40.7
35	K(2)	0.000	0.0	0.001	190.4	0.000	0.0
36	M(8)	0.002	123.4	0.000	0.0	-0.002	-123.4
37	MS(4)	0.002	57.4	0.002	329.6	0.000	87.8

Station: VEL_018
Observation: 29-Day H.A. Beginning 9-18-1984 at Hour 13.20
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.031) Amplitude	Epoch	Modeled(R= 0.002) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 134		DIR= 134			
1	M(2)	0.352	152.4	0.472	148.2	0.120	-4.2
2	S(2)	0.052	170.5	0.098	178.4	0.046	7.9
3	N(2)	0.081	126.9	0.106	119.8	0.025	-7.1
4	K(1)	0.029	319.1	0.027	289.5	-0.002	-29.6
5	M(4)	0.017	209.6	0.015	34.5	-0.002	-175.1
6	O(1)	0.012	280.2	0.023	288.4	0.011	8.2
7	M(6)	0.003	336.1	0.014	290.7	0.011	-45.4
8	MK(3)	0.000	0.0	0.005	211.0	0.000	0.0
9	S(4)	0.004	168.0	0.000	0.0	-0.004	-168.0
10	MN(4)	0.000	0.0	0.006	13.6	0.000	0.0
11	NU(2)	0.016	130.3	0.006	132.0	-0.010	1.7
12	S(6)	0.001	31.5	0.001	27.2	0.000	-4.3
13	MU(2)	0.000	0.0	0.021	281.7	0.000	0.0
14	2N(2)	0.011	101.5	0.003	229.1	-0.008	127.6
15	OO(1)	0.000	358.0	0.000	0.0	0.000	0.0
16	LAMBDA(2)	0.002	160.8	0.006	122.3	0.004	-38.5
17	S(1)	0.000	0.0	0.001	316.2	0.000	0.0
18	M(1)	0.001	299.6	0.000	0.0	-0.001	60.4
19	J(1)	0.001	338.4	0.001	73.8	0.000	95.4
20	MM	0.000	0.0	0.001	179.0	0.000	0.0
21	SSA	0.000	0.0	0.001	160.3	0.000	0.0
22	SA	0.000	0.0	0.001	47.0	0.000	0.0
23	MSF	0.000	0.0	0.001	287.1	0.000	0.0
24	MF	0.000	0.0	0.001	5.1	0.000	0.0
25	RHO(1)	0.000	263.5	0.000	0.0	0.000	0.0
26	Q(1)	0.002	260.9	0.003	294.6	0.001	33.7
27	T(2)	0.003	169.8	0.001	314.0	-0.002	144.2
28	R(2)	0.000	171.3	0.000	0.0	0.000	0.0
29	2Q(1)	0.000	241.6	0.000	0.0	0.000	0.0
30	P(1)	0.010	316.2	0.001	56.1	-0.009	99.9
31	2SM(2)	0.000	0.0	0.004	0.4	0.000	0.0
32	M(3)	0.000	0.0	0.002	115.5	0.000	0.0
33	L(2)	0.012	126.9	0.034	178.7	0.022	51.8
34	2MK(3)	0.000	0.0	0.006	215.7	0.000	0.0
35	K(2)	0.014	172.0	0.003	184.8	-0.011	12.8
36	M(8)	0.004	348.0	0.002	168.4	-0.002	-179.6
37	MS(4)	0.000	0.0	0.004	77.5	0.000	0.0

Station: VEL_019
Observation: 29-Day H.A. Beginning 9-18-1984 at Hour 14.40
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.007) Amplitude	Epoch	Modeled(R= 0.002) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 159		DIR= 157			
1	M(2)	0.642	156.1	0.736	155.5	0.094	-0.6
2	S(2)	0.103	174.6	0.155	184.1	0.052	9.5
3	N(2)	0.139	135.2	0.168	124.1	0.029	-11.1
4	K(1)	0.074	310.7	0.044	292.2	-0.030	-18.5
5	M(4)	0.027	73.2	0.038	69.4	0.011	-3.8
6	O(1)	0.039	286.3	0.039	293.4	0.000	7.1
7	M(6)	0.015	183.9	0.017	339.4	0.002	155.5
8	MK(3)	0.000	0.0	0.008	222.5	0.000	0.0
9	S(4)	0.002	53.6	0.001	156.6	-0.001	103.0
10	MN(4)	0.000	0.0	0.016	35.9	0.000	0.0
11	NU(2)	0.027	138.0	0.010	163.1	-0.017	25.1
12	S(6)	0.006	343.0	0.000	0.0	-0.006	17.0
13	MU(2)	0.000	0.0	0.029	296.8	0.000	0.0
14	2N(2)	0.018	114.4	0.004	219.2	-0.014	104.8
15	OO(1)	0.002	335.0	0.000	0.0	-0.002	25.0
16	LAMBDA(2)	0.004	164.7	0.009	119.1	0.005	-45.6
17	S(1)	0.000	0.0	0.000	0.0	0.000	0.0
18	M(1)	0.003	298.5	0.001	28.7	-0.002	90.2
19	J(1)	0.003	322.8	0.002	92.8	-0.001	130.0
20	MM	0.000	0.0	0.010	41.4	0.000	0.0
21	SSA	0.000	0.0	0.001	7.8	0.000	0.0
22	SA	0.000	0.0	0.004	267.8	0.000	0.0
23	MSF	0.000	0.0	0.008	44.1	0.000	0.0
24	MF	0.000	0.0	0.001	262.3	0.000	0.0
25	RHO(1)	0.001	275.8	0.000	0.0	-0.001	84.2
26	Q(1)	0.008	274.2	0.005	302.0	-0.003	27.8
27	T(2)	0.006	173.9	0.002	273.2	-0.004	99.3
28	R(2)	0.001	175.4	0.002	93.7	0.001	-81.7
29	2Q(1)	0.001	262.1	0.000	0.0	-0.001	97.9
30	P(1)	0.024	308.8	0.002	79.0	-0.022	130.2
31	2SM(2)	0.000	0.0	0.004	4.7	0.000	0.0
32	M(3)	0.000	0.0	0.003	141.7	0.000	0.0
33	L(2)	0.020	135.2	0.047	193.1	0.027	57.9
34	2MK(3)	0.000	0.0	0.009	230.9	0.000	0.0
35	K(2)	0.028	176.1	0.005	204.4	-0.023	28.3
36	M(8)	0.017	226.4	0.004	287.5	-0.013	61.1
37	MS(4)	0.000	0.0	0.012	104.4	0.000	0.0

Station: VEL_020
Observation: 15-Day H.A. Beginning 9-18-1984 at Hour 21.50
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed( ) Amplitude	Epoch	Modeled(R= 0.002) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 6		DIR= 12			
1	M(2)	0.504	319.7	0.572	312.7	0.068	-7.0
2	S(2)	0.079	339.5	0.117	346.2	0.038	6.7
3	N(2)	0.098	309.1	0.125	288.0	0.027	-21.1
4	K(1)	0.040	131.3	0.029	98.6	-0.011	-32.7
5	M(4)	0.055	215.2	0.039	195.1	-0.016	-20.1
6	O(1)	0.027	72.1	0.026	97.1	-0.001	25.0
7	M(6)	0.030	53.5	0.035	52.8	0.005	-0.7
8	MK(3)	0.000	0.0	0.008	349.8	0.000	0.0
9	S(4)	0.005	191.4	0.001	276.5	-0.004	85.1
10	MN(4)	0.000	0.0	0.017	167.1	0.000	0.0
11	NU(2)	0.019	310.5	0.011	281.4	-0.008	-29.1
12	S(6)	0.004	347.7	0.001	181.5	-0.003	-166.2
13	MU(2)	0.000	0.0	0.032	77.4	0.000	0.0
14	2N(2)	0.013	298.5	0.003	40.2	-0.010	101.7
15	OO(1)	0.001	190.5	0.000	0.0	-0.001	169.5
16	LAMBDA(2)	0.004	328.9	0.007	288.6	0.003	-40.3
17	S(1)	0.000	0.0	0.001	144.4	0.000	0.0
18	M(1)	0.002	101.7	0.000	0.0	-0.002	-101.7
19	J(1)	0.002	160.9	0.001	236.7	-0.001	75.8
20	MM	0.000	0.0	0.010	216.2	0.000	0.0
21	SSA	0.000	0.0	0.001	118.8	0.000	0.0
22	SA	0.000	0.0	0.001	49.2	0.000	0.0
23	MSF	0.000	0.0	0.010	206.9	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.001	46.6	0.000	0.0	-0.001	-46.6
26	Q(1)	0.005	42.5	0.004	107.1	-0.001	64.6
27	T(2)	0.005	339.5	0.000	0.0	-0.005	20.5
28	R(2)	0.001	339.5	0.002	77.2	0.001	97.7
29	2Q(1)	0.001	12.8	0.000	0.0	-0.001	-12.8
30	P(1)	0.013	131.3	0.001	218.6	-0.012	87.3
31	2SM(2)	0.000	0.0	0.004	162.4	0.000	0.0
32	M(3)	0.000	0.0	0.004	257.8	0.000	0.0
33	L(2)	0.014	330.3	0.049	334.0	0.035	3.7
34	2MK(3)	0.000	0.0	0.008	350.2	0.000	0.0
35	K(2)	0.021	339.5	0.005	330.6	-0.016	-8.9
36	M(8)	0.004	60.6	0.008	321.5	0.004	99.1
37	MS(4)	0.000	0.0	0.015	229.0	0.000	0.0

Station: VEL_021
Observation: 29-Day H.A. Beginning 9-18-1984 at Hour 16.90
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.023) Amplitude	Epoch	Modeled(R= 0.008) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 136		DIR= 142			
1	M(2)	0.353	171.4	0.360	156.6	0.007	-14.8
2	S(2)	0.046	177.6	0.078	190.5	0.032	12.9
3	N(2)	0.096	146.6	0.086	129.9	-0.010	-16.7
4	K(1)	0.032	339.1	0.021	294.4	-0.011	-44.7
5	M(4)	0.026	71.3	0.031	58.6	0.005	-12.7
6	O(1)	0.011	280.4	0.018	293.0	0.007	12.6
7	M(6)	0.002	336.6	0.016	282.6	0.014	-54.0
8	MK(3)	0.000	0.0	0.006	196.8	0.000	0.0
9	S(4)	0.008	84.3	0.001	153.7	-0.007	69.4
10	MN(4)	0.000	0.0	0.012	33.3	0.000	0.0
11	NU(2)	0.019	149.9	0.003	76.8	-0.016	-73.1
12	S(6)	0.002	285.9	0.001	45.5	-0.001	119.6
13	MU(2)	0.000	0.0	0.014	274.2	0.000	0.0
14	2N(2)	0.013	121.7	0.004	253.6	-0.009	131.9
15	OO(1)	0.000	37.8	0.000	0.0	0.000	0.0
16	LAMBDA(2)	0.002	174.3	0.007	150.9	0.005	-23.4
17	S(1)	0.000	0.0	0.001	338.4	0.000	0.0
18	M(1)	0.001	309.7	0.000	0.0	-0.001	50.3
19	J(1)	0.001	8.2	0.001	74.1	0.000	65.9
20	MM	0.000	0.0	0.009	35.9	0.000	0.0
21	SSA	0.000	0.0	0.001	315.8	0.000	0.0
22	SA	0.000	0.0	0.005	244.8	0.000	0.0
23	MSF	0.000	0.0	0.008	31.9	0.000	0.0
24	MF	0.000	0.0	0.001	240.1	0.000	0.0
25	RHO(1)	0.000	255.2	0.000	0.0	0.000	0.0
26	Q(1)	0.002	251.3	0.002	304.3	0.000	53.0
27	T(2)	0.003	177.4	0.001	108.0	-0.002	-69.4
28	R(2)	0.000	177.8	0.003	213.8	0.000	0.0
29	2Q(1)	0.000	222.2	0.000	0.0	0.000	0.0
30	P(1)	0.011	334.7	0.001	72.8	-0.010	98.1
31	2SM(2)	0.000	0.0	0.002	23.0	0.000	0.0
32	M(3)	0.000	0.0	0.003	102.9	0.000	0.0
33	L(2)	0.014	146.6	0.024	168.8	0.010	22.2
34	2MK(3)	0.000	0.0	0.006	197.0	0.000	0.0
35	K(2)	0.013	178.1	0.002	129.9	-0.011	-48.2
36	M(8)	0.002	356.2	0.003	221.4	0.001	-134.8
37	MS(4)	0.000	0.0	0.011	95.4	0.000	0.0

Station: VEL_022
Observation: 29-Day H.A. Beginning 5- 9-1984 at Hour 17.70
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.015) Amplitude	Epoch	Modeled(R= 0.005) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 152		DIR= 140			
1	M(2)	0.655	174.3	0.491	160.8	-0.164	-13.5
2	S(2)	0.124	217.2	0.102	189.0	-0.022	-28.2
3	N(2)	0.136	162.6	0.109	129.5	-0.027	-33.1
4	K(1)	0.044	324.5	0.026	301.5	-0.018	-23.0
5	M(4)	0.090	66.6	0.024	48.9	-0.066	-17.7
6	O(1)	0.043	318.0	0.022	301.0	-0.021	-17.0
7	M(6)	0.012	180.9	0.021	315.9	0.009	135.0
8	MK(3)	0.000	0.0	0.004	223.8	0.000	0.0
9	S(4)	0.010	124.0	0.001	188.1	-0.009	64.1
10	MN(4)	0.000	0.0	0.005	29.9	0.000	0.0
11	NU(2)	0.026	164.1	0.010	166.5	-0.016	2.4
12	S(6)	0.001	126.4	0.000	0.0	-0.001	-126.4
13	MU(2)	0.000	0.0	0.024	300.4	0.000	0.0
14	2N(2)	0.018	150.8	0.004	196.8	-0.014	46.0
15	OO(1)	0.002	331.0	0.000	0.0	-0.002	29.0
16	LAMBDA(2)	0.005	194.2	0.008	101.9	0.003	-92.3
17	S(1)	0.000	0.0	0.001	249.9	0.000	0.0
18	M(1)	0.003	321.2	0.000	162.2	-0.003	-159.0
19	J(1)	0.003	327.7	0.001	38.8	-0.002	71.1
20	MM	0.000	0.0	0.007	208.6	0.000	0.0
21	SSA	0.000	0.0	0.002	190.2	0.000	0.0
22	SA	0.000	0.0	0.000	0.0	0.000	0.0
23	MSF	0.000	0.0	0.006	224.3	0.000	0.0
24	MF	0.000	0.0	0.001	41.9	0.000	0.0
25	RHO(1)	0.002	315.2	0.001	130.7	-0.001	175.5
26	Q(1)	0.008	314.7	0.004	299.2	-0.004	-15.5
27	T(2)	0.007	215.5	0.003	284.9	-0.004	69.4
28	R(2)	0.001	218.9	0.004	61.8	0.003	-157.1
29	2Q(1)	0.001	311.5	0.000	0.0	-0.001	48.5
30	P(1)	0.014	324.0	0.001	24.4	-0.013	60.4
31	2SM(2)	0.000	0.0	0.004	344.3	0.000	0.0
32	M(3)	0.000	0.0	0.003	120.0	0.000	0.0
33	L(2)	0.019	162.6	0.036	196.0	0.017	33.4
34	2MK(3)	0.000	0.0	0.005	231.1	0.000	0.0
35	K(2)	0.034	220.7	0.005	204.4	-0.029	-16.3
36	M(8)	0.011	30.9	0.006	216.3	-0.005	174.6
37	MS(4)	0.000	0.0	0.004	91.4	0.000	0.0

Station: VEL_023
Observation: Least Squares H.A. Beginning 3-22-1984 at Hour 0.10
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.011) Amplitude	Epoch	Modeled(R= 0.003) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 166		DIR= 167			
1	M(2)	0.665	168.8	0.649	164.6	-0.016	-4.2
2	S(2)	0.140	184.4	0.133	194.1	-0.007	9.7
3	N(2)	0.142	137.4	0.145	135.2	0.003	-2.2
4	K(1)	0.047	296.4	0.039	299.8	-0.008	3.4
5	M(4)	0.052	95.1	0.058	89.7	0.006	-5.4
6	O(1)	0.038	295.0	0.037	300.9	-0.001	5.9
7	M(6)	0.008	41.8	0.019	351.0	0.011	50.8
8	MK(3)	0.015	221.1	0.011	227.9	-0.004	6.8
9	S(4)	0.006	115.7	0.001	165.3	-0.005	49.6
10	MN(4)	0.025	63.1	0.022	56.4	-0.003	-6.7
11	NU(2)	0.000	0.0	0.010	159.4	0.000	0.0
12	S(6)	0.005	305.4	0.000	0.0	-0.005	54.6
13	MU(2)	0.000	0.0	0.028	300.4	0.000	0.0
14	2N(2)	0.006	66.9	0.003	233.0	-0.003	166.1
15	OO(1)	0.005	22.8	0.000	0.0	-0.005	-22.8
16	LAMBDA(2)	0.000	0.0	0.007	121.1	0.000	0.0
17	S(1)	0.000	0.0	0.002	92.7	0.000	0.0
18	M(1)	0.008	279.1	0.001	326.6	-0.007	47.5
19	J(1)	0.010	138.2	0.002	106.4	-0.008	-31.8
20	MM	0.000	0.0	0.012	21.3	0.000	0.0
21	SSA	0.000	0.0	0.002	59.8	0.000	0.0
22	SA	0.000	0.0	0.004	28.3	0.000	0.0
23	MSF	0.000	0.0	0.011	17.0	0.000	0.0
24	MF	0.000	0.0	0.002	170.6	0.000	0.0
25	RHO(1)	0.006	193.5	0.001	256.8	-0.005	63.3
26	Q(1)	0.011	258.8	0.005	321.6	-0.006	62.8
27	T(2)	0.000	0.0	0.002	245.0	0.000	0.0
28	R(2)	0.000	0.0	0.001	27.8	0.000	0.0
29	2Q(1)	0.006	165.0	0.000	0.0	-0.006	-165.0
30	P(1)	0.000	0.0	0.003	102.3	0.000	0.0
31	2SM(2)	0.013	217.5	0.005	5.1	-0.008	147.6
32	M(3)	0.005	204.4	0.004	153.2	-0.001	-51.2
33	L(2)	0.049	251.0	0.045	195.1	-0.004	-55.9
34	2MK(3)	0.013	258.8	0.013	232.9	0.000	-25.9
35	K(2)	0.000	0.0	0.005	205.2	0.000	0.0
36	M(8)	0.009	296.7	0.003	319.5	-0.006	22.8
37	MS(4)	0.018	109.2	0.019	121.1	0.001	11.9

Station: VEL_024
Observation: 29-Day H.A. Beginning 5- 9-1984 at Hour 15.70
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.056) Amplitude	Epoch	Modeled(R= 0.003) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 165		DIR= 178			
1	M(2)	0.341	155.9	0.479	150.2	0.138	-5.7
2	S(2)	0.050	208.7	0.098	182.0	0.048	-26.7
3	N(2)	0.090	164.8	0.106	123.1	0.016	-41.7
4	K(1)	0.019	306.5	0.026	291.0	0.007	-15.5
5	M(4)	0.040	123.6	0.039	54.8	-0.001	-68.8
6	O(1)	0.012	289.2	0.023	290.4	0.011	1.2
7	M(6)	0.028	77.6	0.023	278.3	-0.005	159.3
8	MK(3)	0.000	0.0	0.008	196.9	0.000	0.0
9	S(4)	0.012	62.1	0.001	113.7	-0.011	51.6
10	MN(4)	0.000	0.0	0.018	23.3	0.000	0.0
11	NU(2)	0.018	163.6	0.008	130.5	-0.010	-33.1
12	S(6)	0.003	124.3	0.001	26.4	-0.002	-97.9
13	MU(2)	0.000	0.0	0.024	278.2	0.000	0.0
14	2N(2)	0.012	173.7	0.003	227.9	-0.009	54.2
15	OO(1)	0.001	323.8	0.000	0.0	-0.001	36.2
16	LAMBDA(2)	0.002	180.4	0.006	112.4	0.004	-68.0
17	S(1)	0.000	0.0	0.001	0.3	0.000	0.0
18	M(1)	0.001	297.8	0.000	341.7	-0.001	43.9
19	J(1)	0.001	315.1	0.002	66.8	0.001	111.7
20	MM	0.000	0.0	0.006	35.7	0.000	0.0
21	SSA	0.000	0.0	0.001	300.7	0.000	0.0
22	SA	0.000	0.0	0.003	238.5	0.000	0.0
23	MSF	0.000	0.0	0.006	20.7	0.000	0.0
24	MF	0.000	0.0	0.001	252.3	0.000	0.0
25	RHO(1)	0.000	281.7	0.000	0.0	0.000	0.0
26	Q(1)	0.002	280.6	0.003	304.0	0.001	23.4
27	T(2)	0.003	206.6	0.001	221.9	-0.002	15.3
28	R(2)	0.000	210.8	0.001	323.9	0.000	0.0
29	2Q(1)	0.000	272.0	0.000	0.0	0.000	0.0
30	P(1)	0.006	305.2	0.001	61.1	-0.005	115.9
31	2SM(2)	0.000	0.0	0.003	347.5	0.000	0.0
32	M(3)	0.000	0.0	0.003	110.0	0.000	0.0
33	L(2)	0.013	164.8	0.038	174.6	0.025	9.8
34	2MK(3)	0.000	0.0	0.008	202.4	0.000	0.0
35	K(2)	0.013	212.9	0.004	172.9	-0.009	-40.0
36	M(8)	0.019	325.5	0.005	165.6	-0.014	-159.9
37	MS(4)	0.000	0.0	0.015	85.3	0.000	0.0

Station: VEL_025
Observation: 29-Day H.A. Beginning 9-18-1984 at Hour 20.40
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.060) Amplitude	Epoch	Modeled(R= 0.003) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 1		DIR= 16			
1	M(2)	0.040	105.1	0.394	325.3	0.354	139.8
2	S(2)	0.009	154.9	0.082	358.0	0.073	156.9
3	N(2)	0.014	83.2	0.088	299.0	0.074	144.2
4	K(1)	0.016	47.1	0.021	110.0	0.005	62.9
5	M(4)	0.109	137.0	0.039	218.4	-0.070	81.4
6	O(1)	0.010	33.8	0.018	106.5	0.008	72.7
7	M(6)	0.010	300.9	0.025	73.2	0.015	132.3
8	MK(3)	0.000	0.0	0.007	3.6	0.000	0.0
9	S(4)	0.012	165.6	0.001	287.1	-0.011	121.5
10	MN(4)	0.000	0.0	0.018	190.6	0.000	0.0
11	NU(2)	0.003	86.1	0.007	298.5	0.004	147.6
12	S(6)	0.004	90.8	0.001	198.2	-0.003	107.4
13	MU(2)	0.000	0.0	0.020	89.7	0.000	0.0
14	2N(2)	0.002	61.2	0.002	46.8	0.000	-14.4
15	OO(1)	0.000	60.4	0.000	0.0	0.000	0.0
16	LAMBDA(2)	0.000	128.2	0.005	292.4	0.000	0.0
17	S(1)	0.000	0.0	0.002	171.0	0.000	0.0
18	M(1)	0.001	40.4	0.000	0.0	-0.001	-40.4
19	J(1)	0.001	53.7	0.001	247.1	0.000	166.6
20	MM	0.000	0.0	0.006	222.3	0.000	0.0
21	SSA	0.000	0.0	0.001	165.4	0.000	0.0
22	SA	0.000	0.0	0.001	135.5	0.000	0.0
23	MSF	0.000	0.0	0.005	202.9	0.000	0.0
24	MF	0.000	0.0	0.001	79.7	0.000	0.0
25	RHO(1)	0.000	28.1	0.000	0.0	0.000	0.0
26	Q(1)	0.002	27.2	0.003	117.5	0.001	90.3
27	T(2)	0.001	152.9	0.001	345.1	0.000	167.8
28	R(2)	0.000	156.9	0.001	102.7	0.000	0.0
29	2Q(1)	0.000	20.6	0.000	0.0	0.000	0.0
30	P(1)	0.005	46.1	0.001	211.9	-0.004	165.8
31	2SM(2)	0.000	0.0	0.002	169.8	0.000	0.0
32	M(3)	0.000	0.0	0.003	270.0	0.000	0.0
33	L(2)	0.002	83.2	0.030	345.3	0.028	97.9
34	2MK(3)	0.000	0.0	0.007	5.0	0.000	0.0
35	K(2)	0.002	158.9	0.003	340.3	0.001	178.6
36	M(8)	0.013	252.0	0.007	332.5	-0.006	80.5
37	MS(4)	0.000	0.0	0.016	250.0	0.000	0.0

Station: VEL_033
Observation: Least Squares H.A. Beginning 6-15-1984 at Hour 19.00
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.012) Amplitude	Epoch	Modeled(R= 0.003) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 144		DIR= 142			
1	M(2)	0.949	218.3	0.720	211.2	-0.229	-7.1
2	S(2)	0.122	261.6	0.131	236.4	0.009	-25.2
3	N(2)	0.191	213.5	0.151	174.1	-0.040	-39.4
4	K(1)	0.100	1.1	0.050	323.9	-0.050	37.2
5	M(4)	0.092	178.8	0.091	149.9	-0.001	-28.9
6	O(1)	0.079	332.9	0.044	320.1	-0.035	-12.8
7	M(6)	0.040	274.9	0.017	79.7	-0.023	164.8
8	MK(3)	0.026	317.3	0.010	276.9	-0.016	-40.4
9	S(4)	0.005	53.3	0.002	270.2	-0.003	143.1
10	MN(4)	0.039	174.3	0.033	105.5	-0.006	-68.8
11	NU(2)	0.000	0.0	0.016	236.4	0.000	0.0
12	S(6)	0.003	122.5	0.001	128.1	-0.002	5.6
13	MU(2)	0.000	0.0	0.047	15.6	0.000	0.0
14	2N(2)	0.027	135.5	0.007	322.3	-0.020	173.2
15	OO(1)	0.003	335.0	0.001	345.8	-0.002	10.8
16	LAMBDA(2)	0.000	0.0	0.011	211.5	0.000	0.0
17	S(1)	0.000	0.0	0.003	179.0	0.000	0.0
18	M(1)	0.003	339.0	0.001	177.5	-0.002	-161.5
19	J(1)	0.006	197.6	0.006	185.5	0.000	-12.1
20	MM	0.000	0.0	0.012	40.3	0.000	0.0
21	SSA	0.000	0.0	0.011	61.7	0.000	0.0
22	SA	0.000	0.0	0.007	41.4	0.000	0.0
23	MSF	0.000	0.0	0.009	70.8	0.000	0.0
24	MF	0.000	0.0	0.005	223.3	0.000	0.0
25	RHO(1)	0.009	244.9	0.002	326.0	-0.007	81.1
26	Q(1)	0.009	17.4	0.002	332.8	-0.007	44.6
27	T(2)	0.000	0.0	0.003	112.6	0.000	0.0
28	R(2)	0.000	0.0	0.001	118.4	0.000	0.0
29	2Q(1)	0.005	137.3	0.003	303.7	-0.002	166.4
30	P(1)	0.000	0.0	0.005	179.3	0.000	0.0
31	2SM(2)	0.006	146.0	0.009	86.8	0.003	-59.2
32	M(3)	0.006	305.6	0.004	216.0	-0.002	-89.6
33	L(2)	0.104	239.6	0.072	262.9	-0.032	23.3
34	2MK(3)	0.023	300.0	0.011	280.1	-0.012	-19.9
35	K(2)	0.000	0.0	0.007	270.0	0.000	0.0
36	M(8)	0.013	226.8	0.012	74.9	-0.001	-151.9
37	MS(4)	0.013	270.3	0.029	184.5	0.016	-85.8

Station: VEL_047
Observation: 29-Day H.A. Beginning 6-14-1984 at Hour 16.70
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.001) Amplitude	Epoch	Modeled(R= 0.000) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 63		DIR= 59			
1	M(2)	1.039	103.8	0.699	92.3	-0.340	-11.5
2	S(2)	0.112	136.6	0.112	135.6	0.000	-1.0
3	N(2)	0.176	90.6	0.124	69.3	-0.052	-21.3
4	K(1)	0.065	191.8	0.034	174.1	-0.031	-17.7
5	M(4)	0.143	184.8	0.068	166.0	-0.075	-18.8
6	O(1)	0.045	188.6	0.032	170.1	-0.013	-18.5
7	M(6)	0.078	152.6	0.059	108.0	-0.019	-44.6
8	MK(3)	0.000	0.0	0.016	229.5	0.000	0.0
9	S(4)	0.003	46.1	0.002	270.1	-0.001	136.0
10	MN(4)	0.000	0.0	0.029	144.4	0.000	0.0
11	NU(2)	0.034	92.4	0.027	68.2	-0.007	-24.2
12	S(6)	0.001	236.7	0.000	0.0	-0.001	123.3
13	MU(2)	0.000	0.0	0.069	219.3	0.000	0.0
14	2N(2)	0.023	77.4	0.005	173.0	-0.018	95.6
15	OO(1)	0.002	195.1	0.000	0.0	-0.002	164.9
16	LAMBDA(2)	0.007	119.0	0.013	71.5	0.006	-47.5
17	S(1)	0.000	0.0	0.002	333.0	0.000	0.0
18	M(1)	0.003	190.2	0.001	219.6	-0.002	29.4
19	J(1)	0.004	193.4	0.003	338.9	-0.001	145.5
20	MM	0.000	0.0	0.005	205.6	0.000	0.0
21	SSA	0.000	0.0	0.006	243.3	0.000	0.0
22	SA	0.000	0.0	0.012	174.4	0.000	0.0
23	MSF	0.000	0.0	0.004	224.7	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.002	187.1	0.001	117.5	-0.001	-69.6
26	Q(1)	0.009	186.9	0.004	202.3	-0.005	15.4
27	T(2)	0.007	135.3	0.001	219.0	-0.006	83.7
28	R(2)	0.001	137.9	0.003	206.5	0.002	68.6
29	2Q(1)	0.001	185.3	0.001	115.4	0.000	-69.9
30	P(1)	0.022	191.6	0.004	323.7	-0.018	132.1
31	2SM(2)	0.000	0.0	0.007	316.0	0.000	0.0
32	M(3)	0.000	0.0	0.008	127.4	0.000	0.0
33	L(2)	0.025	90.6	0.106	120.5	0.081	29.9
34	2MK(3)	0.000	0.0	0.018	224.4	0.000	0.0
35	K(2)	0.031	139.3	0.012	122.8	-0.019	-16.5
36	M(8)	0.015	197.8	0.019	159.5	0.004	-38.3
37	MS(4)	0.000	0.0	0.028	208.8	0.000	0.0

Station: VEL_051
Observation: Least Squares H.A. Beginning 5- 8-1984 at Hour 20.60
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.005) Amplitude	Epoch	Modeled(R= 0.000) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 92		DIR= 91			
1	M(2)	0.935	120.1	0.744	106.3	-0.191	-13.8
2	S(2)	0.074	160.0	0.120	153.3	0.046	-6.7
3	N(2)	0.108	98.9	0.131	84.8	0.023	-14.1
4	K(1)	0.073	198.8	0.033	178.6	-0.040	-20.2
5	M(4)	0.150	238.0	0.093	217.2	-0.057	-20.8
6	O(1)	0.045	193.2	0.030	174.6	-0.015	-18.6
7	M(6)	0.095	218.8	0.078	178.8	-0.017	-40.0
8	MK(3)	0.050	277.2	0.019	254.1	-0.031	-23.1
9	S(4)	0.007	11.2	0.003	340.6	-0.004	30.6
10	MN(4)	0.050	237.3	0.037	200.1	-0.013	-37.2
11	NU(2)	0.000	0.0	0.031	79.4	0.000	0.0
12	S(6)	0.005	82.7	0.000	0.0	-0.005	-82.7
13	MU(2)	0.000	0.0	0.076	230.6	0.000	0.0
14	2N(2)	0.053	80.1	0.006	191.4	-0.047	111.3
15	OO(1)	0.003	13.8	0.000	0.0	-0.003	-13.8
16	LAMBDA(2)	0.000	0.0	0.014	86.4	0.000	0.0
17	S(1)	0.000	0.0	0.001	120.3	0.000	0.0
18	M(1)	0.002	256.0	0.001	209.2	-0.001	-46.8
19	J(1)	0.004	122.2	0.004	344.2	0.000	138.0
20	MM	0.000	0.0	0.008	205.0	0.000	0.0
21	SSA	0.000	0.0	0.010	241.9	0.000	0.0
22	SA	0.000	0.0	0.018	169.0	0.000	0.0
23	MSF	0.000	0.0	0.008	220.2	0.000	0.0
24	MF	0.000	0.0	0.001	355.6	0.000	0.0
25	RHO(1)	0.014	319.3	0.000	0.0	-0.014	40.7
26	Q(1)	0.019	296.2	0.004	214.0	-0.015	-82.2
27	T(2)	0.000	0.0	0.002	273.3	0.000	0.0
28	R(2)	0.000	0.0	0.003	232.5	0.000	0.0
29	2Q(1)	0.004	43.1	0.000	0.0	-0.004	-43.1
30	P(1)	0.000	0.0	0.003	326.7	0.000	0.0
31	2SM(2)	0.010	328.1	0.007	334.4	-0.003	6.3
32	M(3)	0.005	200.4	0.011	152.2	0.006	-48.2
33	L(2)	0.097	136.6	0.119	132.6	0.022	-4.0
34	2MK(3)	0.044	246.5	0.021	245.4	-0.023	-1.1
35	K(2)	0.000	0.0	0.014	134.8	0.000	0.0
36	M(8)	0.057	314.9	0.035	257.7	-0.022	-57.2
37	MS(4)	0.027	288.0	0.035	265.5	0.008	-22.5

Station: VEL_052
Observation: 15-Day H.A. Beginning 3-22-1984 at Hour 0.10
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed( ) Amplitude	Epoch	Modeled(R= 0.001) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 36		DIR= 35			
1	M(2)	0.699	128.3	0.257	109.4	-0.442	-18.9
2	S(2)	0.092	156.4	0.042	157.5	-0.050	1.1
3	N(2)	0.136	113.3	0.045	89.2	-0.091	-24.1
4	K(1)	0.056	232.7	0.010	186.9	-0.046	-45.8
5	M(4)	0.140	269.2	0.060	249.9	-0.080	-19.3
6	O(1)	0.024	179.1	0.009	181.1	-0.015	2.0
7	M(6)	0.051	272.3	0.027	191.8	-0.024	-80.5
8	MK(3)	0.000	0.0	0.008	274.2	0.000	0.0
9	S(4)	0.038	305.4	0.001	22.2	-0.037	76.8
10	MN(4)	0.000	0.0	0.023	228.7	0.000	0.0
11	NU(2)	0.026	115.3	0.011	78.7	-0.015	-36.6
12	S(6)	0.018	6.4	0.000	0.0	-0.018	-6.4
13	MU(2)	0.000	0.0	0.027	231.5	0.000	0.0
14	2N(2)	0.018	98.3	0.002	192.9	-0.016	94.6
15	OO(1)	0.001	286.3	0.000	0.0	-0.001	73.7
16	LAMBDA(2)	0.005	141.3	0.005	88.9	0.000	-52.4
17	S(1)	0.000	0.0	0.001	305.5	0.000	0.0
18	M(1)	0.002	205.9	0.000	252.0	-0.002	46.1
19	J(1)	0.002	259.5	0.001	345.3	-0.001	85.8
20	MM	0.000	0.0	0.001	169.1	0.000	0.0
21	SSA	0.000	0.0	0.005	236.7	0.000	0.0
22	SA	0.000	0.0	0.012	169.6	0.000	0.0
23	MSF	0.000	0.0	0.001	228.4	0.000	0.0
24	MF	0.000	0.0	0.000	0.0	0.000	0.0
25	RHO(1)	0.001	156.1	0.000	0.0	-0.001	-156.1
26	Q(1)	0.005	152.3	0.001	216.4	-0.004	64.1
27	T(2)	0.005	156.4	0.001	244.4	-0.004	88.0
28	R(2)	0.001	156.4	0.002	217.1	0.001	60.7
29	2Q(1)	0.001	125.5	0.000	0.0	-0.001	-125.5
30	P(1)	0.019	232.7	0.001	322.3	-0.018	89.6
31	2SM(2)	0.000	0.0	0.003	337.3	0.000	0.0
32	M(3)	0.000	0.0	0.004	166.3	0.000	0.0
33	L(2)	0.020	143.4	0.042	133.2	0.022	-10.2
34	2MK(3)	0.000	0.0	0.008	261.8	0.000	0.0
35	K(2)	0.025	156.4	0.005	136.7	-0.020	-19.7
36	M(8)	0.023	17.5	0.011	307.4	-0.012	70.1
37	MS(4)	0.000	0.0	0.022	297.1	0.000	0.0

Station: VEL_154
Observation: Least Squares H.A. Beginning 6-20-1984 at Hour 21.70
Model: Least Squares H.A. Beginning 3- 1-1984 at Hour 5.00
amplitudes are in m/s, and Phase is in degrees (GMT)

N	Constituent	Observed(R= 0.003) Amplitude	Epoch	Modeled(R= 0.001) Amplitude	Epoch	Difference Amplitude	Epoch
CURRENT ALONG PCD		DIR= 84		DIR= 79			
1	M(2)	0.707	332.5	0.541	321.8	-0.166	-10.7
2	S(2)	0.066	32.2	0.096	353.3	0.030	38.9
3	N(2)	0.134	326.5	0.108	288.9	-0.026	-37.6
4	K(1)	0.263	70.9	0.118	40.9	-0.145	-30.0
5	M(4)	0.065	303.7	0.063	346.0	-0.002	42.3
6	O(1)	0.196	60.2	0.106	51.0	-0.090	-9.2
7	M(6)	0.072	200.9	0.051	188.3	-0.021	-12.6
8	MK(3)	0.035	99.1	0.035	67.3	0.000	-31.8
9	S(4)	0.006	358.3	0.001	84.4	-0.005	86.1
10	MN(4)	0.043	301.8	0.030	311.3	-0.013	9.5
11	NU(2)	0.000	0.0	0.009	356.7	0.000	0.0
12	S(6)	0.003	97.4	0.001	281.2	-0.002	176.2
13	MU(2)	0.000	0.0	0.064	103.7	0.000	0.0
14	2N(2)	0.001	303.5	0.025	28.0	0.024	84.5
15	OO(1)	0.015	49.5	0.006	63.2	-0.009	13.7
16	LAMBDA(2)	0.000	0.0	0.012	191.8	0.000	0.0
17	S(1)	0.000	0.0	0.015	246.2	0.000	0.0
18	M(1)	0.010	115.7	0.000	265.9	-0.010	150.2
19	J(1)	0.010	287.5	0.010	285.5	0.000	-2.0
20	MM	0.000	0.0	0.008	218.9	0.000	0.0
21	SSA	0.000	0.0	0.009	125.4	0.000	0.0
22	SA	0.000	0.0	0.067	104.2	0.000	0.0
23	MSF	0.000	0.0	0.010	195.6	0.000	0.0
24	MF	0.000	0.0	0.005	191.9	0.000	0.0
25	RHO(1)	0.029	64.2	0.012	1.9	-0.017	-62.3
26	Q(1)	0.036	15.7	0.015	47.2	-0.021	31.5
27	T(2)	0.000	0.0	0.018	136.3	0.000	0.0
28	R(2)	0.000	0.0	0.005	122.6	0.000	0.0
29	2Q(1)	0.015	261.5	0.007	344.8	-0.008	83.3
30	P(1)	0.000	0.0	0.009	287.0	0.000	0.0
31	2SM(2)	0.007	164.5	0.007	158.8	0.000	-5.7
32	M(3)	0.031	2.5	0.016	345.3	-0.015	17.2
33	L(2)	0.099	346.2	0.092	8.6	-0.007	22.4
34	2MK(3)	0.049	70.4	0.033	76.6	-0.016	6.2
35	K(2)	0.000	0.0	0.009	138.6	0.000	0.0
36	M(8)	0.013	188.3	0.016	184.7	0.003	-3.6
37	MS(4)	0.027	330.0	0.027	28.9	0.000	58.9

APPENDIX E . Skill Assessment Scores of Current Speed: Astronomical Tide and Hindcast Simulations

Station: VEL_002
Observed data time period from: / 4/24/1984 to /12/ 2/1984 with gaps of 68.69 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.545									
u			87600	0.667									
U-u	26 cm/s	24h	87600	-0.122	0.231	0.197	3.9	75.3	0.0	3.1	0.0		0.89
AFC-afc	26 cm/s	24h	577	-0.070	0.088	0.054	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	705	-0.315	0.331	0.102	1.7	37.3	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	577	-0.184	0.307	0.246	0.0	88.6	0.0	0.0	0.0		
TEC-tec	0.50h	25h	705	-0.343	0.558	0.440	0.7	48.8	1.0	12.6	37.2		
TSF-tsf	0.25h	25h	573	-0.608	0.735	0.413	18.0	37.0	0.3	160.2	0.0		
TEF-tef	0.25h	25h	575	-0.261	0.347	0.228	0.0	83.8	0.0	0.0	0.0		
TSE-tse	0.25h	25h	680	0.287	0.405	0.286	0.0	81.2	1.8	0.0	25.0		
TEE-tee	0.25h	25h	680	0.159	0.289	0.241	0.0	92.5	0.0	0.0	0.0		
SCENARIO: HINDCAST													
U			36732	0.575									
u			36732	0.601									
U-u	26 cm/s	24h	36732	-0.026	0.478	0.477	16.4	41.0	15.7	5.4	3.6		0.41
TSF-tsf	0.25h	25h	2	1.707	1.754	0.572	0.0	0.0	100.0	0.0	0.0		
TEF-tef	0.25h	25h	2	-0.249	0.817	1.101	50.0	0.0	0.0	0.0	0.0		
TSE-tse	0.25h	25h	50	0.123	0.864	0.864	2.0	54.0	10.0	0.0	0.0		
TEE-tee	0.25h	25h	51	0.224	0.886	0.866	2.0	60.8	13.7	0.0	0.0		

Station: VEL_003
Observed data time period from: / 4/ 3/1984 to /11/21/1984 with gaps of 137.96 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.525									
u			87600	0.471									
U-u	26 cm/s	24h	87600	0.054	0.094	0.077	0.0	99.9	0.0	0.7	0.8		0.96
AFC-afc	26 cm/s	24h	704	0.124	0.137	0.058	0.0	99.7	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	704	0.035	0.067	0.057	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	704	-0.043	0.227	0.223	0.0	96.2	0.0	0.0	0.0		
TEC-tec	0.50h	25h	704	0.036	0.158	0.154	0.0	99.9	0.0	0.0	0.0		
TSF-tsf	0.25h	25h	703	0.108	0.229	0.203	0.0	98.2	0.6	0.0	0.0		
TEF-tef	0.25h	25h	704	-0.101	0.219	0.195	0.0	98.3	0.0	0.0	0.0		
TSE-tse	0.25h	25h	704	0.316	0.365	0.184	0.0	86.8	0.4	0.0	0.0		
TEE-tee	0.25h	25h	704	0.107	0.213	0.184	0.0	98.0	0.0	0.0	0.0		
SCENARIO: HINDCAST													
U			22513	0.536									
u			22513	0.481									
U-u	26 cm/s	24h	22513	0.056	0.320	0.315	4.2	50.9	4.9	1.3	2.0		0.54
TSF-tsf	0.25h	25h	2	0.649	0.790	0.637	0.0	50.0	50.0	0.0	0.0		
TEF-tef	0.25h	25h	2	1.187	1.189	0.110	0.0	0.0	100.0	0.0	0.0		
TSE-tse	0.25h	25h	22	1.315	1.367	0.384	0.0	0.0	77.3	0.0	74.1		
TEE-tee	0.25h	25h	22	1.310	1.337	0.273	0.0	0.0	90.9	0.0	85.7		

Station: VEL_005
Observed data time period from: / 4/ 3/1984 to /11/21/1984 with gaps of 97.10 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.519									
u			87600	0.509									
U-u	26 cm/s	24h	87600	0.010	0.093	0.092	0.0	99.8	0.0	0.7	0.8		0.96
AFC-afc	26 cm/s	24h	704	0.033	0.090	0.083	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	704	-0.048	0.088	0.074	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	704	0.004	0.214	0.214	0.0	97.0	0.0	0.0	0.0		
TEC-tec	0.50h	25h	704	-0.112	0.235	0.207	0.0	96.3	0.0	0.0	0.0		
TSF-tsf	0.25h	25h	702	0.074	0.310	0.301	0.1	91.9	0.4	0.0	0.0		
TEF-tef	0.25h	25h	703	-0.023	0.241	0.240	0.0	96.2	0.0	0.0	0.0		
TSE-tse	0.25h	25h	704	0.261	0.358	0.245	0.0	86.5	0.0	0.0	0.0		
TEE-tee	0.25h	25h	704	0.124	0.265	0.235	0.0	95.5	0.0	0.0	0.0		
SCENARIO: HINDCAST													
U			32330	0.532									
u			32330	0.524									
U-u	26 cm/s	24h	32330	0.008	0.332	0.332	7.5	50.0	3.1	1.5	3.6		0.52
TSF-tsf	0.25h	25h	12	1.179	1.670	1.236	8.3	0.0	83.3	0.0	0.0		
TEF-tef	0.25h	25h	11	1.210	1.276	0.425	0.0	9.1	72.7	0.0	0.0		
TSE-tse	0.25h	25h	28	1.333	1.452	0.585	0.0	10.7	71.4	0.0	0.0		
TEE-tee	0.25h	25h	28	1.145	1.328	0.685	3.6	7.1	64.3	0.0	0.0		

Station: VEL_012
Observed data time period from: /10/20/1984 to /11/19/1984 with gaps of 97.10 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.115									
u			87600	0.116									
U-u	26 cm/s	24h	87600	-0.001	0.052	0.052	0.0	100.0	0.0	0.0	0.0		0.63
AFC-afc	26 cm/s	24h	557	0.008	0.049	0.048	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	338	-0.008	0.040	0.039	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	557	-0.008	0.370	0.370	0.7	81.1	0.9	0.0	0.0		
TEC-tec	0.50h	25h	338	-0.195	0.358	0.301	0.0	80.5	0.0	0.0	0.0		
SCENARIO: HINDCAST													
U			7261	0.122									
u			7261	0.167									
U-u	26 cm/s	24h	7261	-0.046	0.098	0.087	0.0	99.5	0.0	0.0	0.0		0.40
AFC-afc	26 cm/s	24h	9	-0.109	0.126	0.067	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	7	-0.084	0.104	0.065	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	9	-1.267	1.621	1.073	44.4	22.2	0.0	0.0	0.0		
TEC-tec	0.50h	25h	7	0.871	1.273	1.003	0.0	14.3	42.9	0.0	0.0		

Station: VEL_016
Observed data time period from: / 3/ 8/1984 to /11/27/1984 with gaps of 97.10 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.100									
u			87600	0.077									
U-u	26 cm/s	24h	87600	0.023	0.061	0.057	0.0	100.0	0.0	0.0	0.0		0.52
AFC-afc	26 cm/s	24h	551	0.008	0.067	0.067	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	233	0.059	0.064	0.024	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	551	-0.328	0.552	0.445	5.3	62.8	0.4	12.8	0.0		
TEC-tec	0.50h	25h	233	-0.622	0.736	0.394	14.6	36.9	0.0	74.5	0.0		
SCENARIO: HINDCAST													
U			63528	0.117									
u			63528	0.131									
U-u	26 cm/s	24h	63528	-0.014	0.098	0.097	0.0	98.0	0.0	0.0	1.2		0.44
AFC-afc	26 cm/s	24h	22	-0.058	0.108	0.093	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	31	-0.028	0.088	0.084	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	22	0.082	1.802	1.842	27.3	22.7	40.9	0.0	0.0		
TEC-tec	0.50h	25h	31	-0.323	1.728	1.725	41.9	16.1	29.0	0.0	0.0		
TEF-tef	0.25h	25h	6	-0.321	1.259	1.334	16.7	16.7	16.7	0.0	0.0		
TEE-tee	0.25h	25h	2	1.109	1.209	0.680	0.0	0.0	50.0	0.0	0.0		

Station: VEL_017
Observed data time period from: / 4/17/1984 to /10/ 9/1984 with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.223									
u			87600	0.082									
U-u	26 cm/s	24h	87600	0.141	0.191	0.129	0.0	80.3	0.3	0.0	5.4		0.19
AFC-afc	26 cm/s	24h	377	0.197	0.250	0.153	0.0	64.2	1.3	0.0	0.0		
AEC-aec	26 cm/s	24h	321	0.189	0.224	0.121	0.0	66.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	377	0.137	0.902	0.893	9.0	46.7	14.6	13.0	37.8		
TEC-tec	0.50h	25h	321	0.120	0.702	0.693	6.5	58.3	6.5	49.9	36.6		
SCENARIO: HINDCAST													
U			28673	0.288									
u			28673	0.157									
U-u	26 cm/s	24h	28673	0.131	0.242	0.204	0.0	71.8	3.6	0.0	8.0		0.24
AFC-afc	26 cm/s	24h	23	0.228	0.298	0.196	0.0	52.2	4.3	0.0	0.0		
AEC-aec	26 cm/s	24h	11	-0.092	0.160	0.137	0.0	90.9	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	23	-0.835	1.830	1.665	56.5	17.4	21.7	0.0	0.0		
TEC-tec	0.50h	25h	11	-0.482	1.286	1.251	27.3	27.3	18.2	0.0	0.0		
TSF-tsf	0.25h	25h	7	0.563	2.075	2.158	28.6	14.3	42.9	0.0	0.0		
TEF-tef	0.25h	25h	11	0.159	1.495	1.559	27.3	0.0	18.2	0.0	0.0		
TSE-tse	0.25h	25h	2	2.766	2.766	0.021	0.0	0.0	100.0	0.0	0.0		
TEE-tee	0.25h	25h	7	-0.039	1.419	1.532	42.9	28.6	28.6	0.0	0.0		

Station: VEL_018
Observed data time period from: / 9/18/1984 to /10/18/1984 with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.313									
u			87600	0.229									
U-u	26 cm/s	24h	87600	0.084	0.104	0.061	0.0	100.0	0.0	0.0	0.6		0.86
AFC-afc	26 cm/s	24h	704	0.095	0.101	0.035	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	704	0.127	0.131	0.032	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	704	-0.432	0.490	0.231	0.1	57.7	0.0	0.0	0.0		
TEC-tec	0.50h	25h	704	0.029	0.192	0.189	0.0	98.4	0.0	0.0	0.0		
TSF-tsf	0.25h	25h	585	0.889	0.964	0.371	0.0	12.5	37.1	0.0	258.4		
TEF-tef	0.25h	25h	703	-0.821	0.883	0.327	27.0	17.5	0.0	149.2	0.0		
TSE-tse	0.25h	25h	702	0.131	0.299	0.269	0.0	91.9	0.3	0.0	0.0		
TEE-tee	0.25h	25h	588	-0.755	0.820	0.321	21.6	21.4	0.0	124.3	0.0		
SCENARIO: HINDCAST													
U			7231	0.307									
u			7231	0.239									
U-u	26 cm/s	24h	7231	0.069	0.169	0.154	0.0	88.3	0.0	0.0	0.0		0.59
TSF-tsf	0.25h	25h	6	0.738	1.921	1.943	16.7	16.7	33.3	0.0	0.0		
TEF-tef	0.25h	25h	3	0.319	0.693	0.754	0.0	0.0	0.0	0.0	0.0		
TSE-tse	0.25h	25h	4	0.562	2.231	2.493	25.0	0.0	50.0	0.0	0.0		
TEE-tee	0.25h	25h	3	0.896	0.980	0.488	0.0	0.0	33.3	0.0	0.0		

Station: VEL_019
Observed data time period from: / 9/18/1984 to /10/18/1984 with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.483									
u			87600	0.416									
U-u	26 cm/s	24h	87600	0.067	0.103	0.079	0.0	99.4	0.0	0.4	0.9		0.95
AFC-afc	26 cm/s	24h	704	0.115	0.128	0.055	0.0	99.9	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	704	0.056	0.085	0.065	0.0	100.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	704	-0.351	0.427	0.243	0.3	68.3	0.0	0.0	0.0		
TEC-tec	0.50h	25h	704	0.006	0.224	0.224	0.0	96.7	0.0	0.0	0.0		
TSF-tsf	0.25h	25h	703	0.121	0.308	0.284	0.3	93.3	0.4	0.0	12.8		
TEF-tef	0.25h	25h	704	-0.168	0.284	0.229	0.0	91.3	0.0	0.0	0.0		
TSE-tse	0.25h	25h	704	0.228	0.349	0.265	0.0	83.5	0.7	0.0	0.0		
TEE-tee	0.25h	25h	704	-0.097	0.277	0.260	0.0	89.5	0.0	0.0	0.0		
SCENARIO: HINDCAST													
U			7206	0.469									
u			7206	0.430									
U-u	26 cm/s	24h	7206	0.039	0.254	0.251	1.5	65.8	1.2	0.8	0.9		0.64
TSE-tse	0.25h	25h	10	1.333	1.428	0.540	0.0	10.0	80.0	0.0	0.0		
TEE-tee	0.25h	25h	10	1.128	1.190	0.400	0.0	0.0	60.0	0.0	0.0		

Station: VEL_020
Observed data time period from: / 9/18/1984 to /10/10/1984 with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.387									
u			87600	0.330									
U-u	26 cm/s	24h	87600	0.057	0.096	0.077	0.0	99.4	0.0	0.0	0.6		0.92
AFC-afc	26 cm/s	24h	545	0.023	0.051	0.046	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	705	0.072	0.086	0.048	0.0	99.9	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	545	-0.474	0.629	0.414	8.3	45.5	0.0	62.0	0.0		
TEC-tec	0.50h	25h	705	-0.583	0.690	0.369	9.5	28.7	0.0	99.6	0.0		
TSF-tsf	0.25h	25h	543	-0.060	0.346	0.341	0.0	88.2	0.7	0.0	0.0		
TEF-tef	0.25h	25h	545	-0.529	0.603	0.291	5.7	47.9	0.0	49.9	0.0		
TSE-tse	0.25h	25h	653	0.013	0.231	0.231	0.0	97.1	0.0	0.0	0.0		
TEE-tee	0.25h	25h	653	-0.613	0.697	0.331	11.6	40.9	0.0	75.6	0.0		
SCENARIO: HINDCAST													
U			5187	0.389									
u			5187	0.356									
U-u	26 cm/s	24h	5187	0.033	0.195	0.192	0.1	81.4	0.5	0.1	0.6		0.66
TSF-tsf	0.25h	25h	2	1.195	1.295	0.706	0.0	0.0	50.0	0.0	0.0		
TEF-tef	0.25h	25h	2	0.302	0.373	0.310	0.0	50.0	0.0	0.0	0.0		
TSE-tse	0.25h	25h	6	0.871	1.653	1.539	16.7	0.0	66.7	0.0	0.0		
TEE-tee	0.25h	25h	6	1.065	1.145	0.460	0.0	0.0	66.7	0.0	0.0		

Station: VEL_021
Observed data time period from: / 9/18/1984 to /10/18/1984 with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.245									
u			87600	0.230									
U-u	26 cm/s	24h	87600	0.016	0.073	0.071	0.0	100.0	0.0	0.0	0.3		0.89
AFC-afc	26 cm/s	24h	701	0.004	0.040	0.040	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	685	-0.005	0.050	0.050	0.0	99.9	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	701	-0.705	0.771	0.314	15.1	22.4	0.0	162.9	0.0		
TEC-tec	0.50h	25h	685	-0.384	0.471	0.274	0.3	66.7	0.1	0.0	0.0		
TSF-tsf	0.25h	25h	608	-0.119	0.424	0.407	2.1	77.5	0.7	0.0	0.0		
TEF-tef	0.25h	25h	629	-0.739	0.816	0.346	23.7	27.3	0.0	124.2	0.0		
TSE-tse	0.25h	25h	624	-0.318	0.519	0.410	3.8	61.4	0.0	24.7	0.0		
TEE-tee	0.25h	25h	604	-0.564	0.691	0.400	11.8	38.6	0.0	123.5	0.0		
SCENARIO: HINDCAST													
U			7211	0.238									
u			7211	0.239									
U-u	26 cm/s	24h	7211	-0.001	0.116	0.116	0.0	98.2	0.0	0.0	0.0		0.71
TSF-tsf	0.25h	25h	2	0.813	1.536	1.844	0.0	50.0	50.0	0.0	0.0		
TEF-tef	0.25h	25h	2	1.002	1.024	0.296	0.0	0.0	50.0	0.0	0.0		
TSE-tse	0.25h	25h	7	0.381	1.277	1.316	28.6	14.3	42.9	0.0	0.0		
TEE-tee	0.25h	25h	6	0.764	1.059	0.804	0.0	33.3	50.0	0.0	0.0		

Station: VEL_022
Observed data time period from: / 5/ 9/1984 to /10/18/1984 with gaps of 67.41 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.330									
u			87600	0.426									
U-u	26 cm/s	24h	87600	-0.096	0.178	0.150	0.1	84.7	0.0	1.4	0.5		0.78
AFC-afc	26 cm/s	24h	695	-0.159	0.181	0.087	0.0	88.9	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	705	-0.275	0.288	0.087	0.3	45.1	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	695	-0.198	0.355	0.294	0.6	83.0	0.0	0.0	0.0		
TEC-tec	0.50h	25h	705	-0.804	0.872	0.339	25.4	10.4	0.1	198.7	0.0		
TSF-tsf	0.25h	25h	690	-0.787	0.855	0.336	24.6	16.4	0.3	161.0	0.0		
TEF-tef	0.25h	25h	694	-0.456	0.537	0.283	0.0	48.4	0.1	0.0	0.0		
TSE-tse	0.25h	25h	694	-0.362	0.463	0.290	0.4	66.9	0.1	0.0	0.0		
TEE-tee	0.25h	25h	695	-0.307	0.408	0.269	0.0	77.1	0.4	0.0	0.0		
SCENARIO: HINDCAST													
U			22720	0.346									
u			22720	0.431									
U-u	26 cm/s	24h	22720	-0.085	0.206	0.187	1.3	80.9	0.0	1.7	0.0		0.70
TSF-tsf	0.25h	25h	9	0.408	1.606	1.647	22.2	11.1	22.2	0.0	0.0		
TEF-tef	0.25h	25h	8	0.154	0.822	0.863	12.5	62.5	25.0	0.0	0.0		
TSE-tse	0.25h	25h	37	1.072	1.210	0.569	0.0	10.8	51.4	0.0	0.0		
TEE-tee	0.25h	25h	37	0.735	0.900	0.527	0.0	40.5	27.0	0.0	0.0		

Station: VEL_023
Observed data time period from: / 3/ 8/1984 to /11/28/1984 with gaps of 55.17 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.429									
u			87600	0.431									
U-u	26 cm/s	24h	87600	-0.003	0.066	0.066	0.0	99.9	0.0	1.5	0.8		0.98
AFC-afc	26 cm/s	24h	704	-0.029	0.074	0.068	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	705	-0.027	0.056	0.049	0.0	99.9	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	704	-0.344	0.404	0.212	0.1	75.9	0.0	0.0	0.0		
TEC-tec	0.50h	25h	705	-0.030	0.228	0.226	0.0	96.0	0.1	0.0	0.0		
TSF-tsf	0.25h	25h	703	-0.069	0.287	0.279	0.4	94.6	0.3	0.0	0.0		
TEF-tef	0.25h	25h	704	-0.165	0.280	0.226	0.0	89.3	0.0	0.0	0.0		
TSE-tse	0.25h	25h	704	-0.170	0.254	0.189	0.0	93.0	0.0	0.0	0.0		
TEE-tee	0.25h	25h	704	-0.258	0.325	0.197	0.0	88.1	0.0	0.0	0.0		
SCENARIO: HINDCAST													
U			50364	0.448									
u			50364	0.379									
U-u	26 cm/s	24h	50364	0.069	0.277	0.269	1.6	62.4	3.8	1.4	2.3		0.55
AEC-aec	26 cm/s	24h	4	0.096	0.144	0.124	0.0	100.0	0.0	0.0	0.0		
TEC-tec	0.50h	25h	4	-2.025	2.284	1.220	75.0	25.0	0.0	0.0	0.0		
TSF-tsf	0.25h	25h	34	0.859	1.704	1.493	11.8	11.8	52.9	0.0	0.0		
TEF-tef	0.25h	25h	29	0.973	1.394	1.016	3.4	31.0	48.3	0.0	0.0		
TSE-tse	0.25h	25h	61	1.385	1.790	1.142	3.3	14.8	68.9	0.0	0.0		
TEE-tee	0.25h	25h	59	0.937	1.208	0.770	1.7	16.9	59.3	0.0	0.0		

Station: VEL_024
Observed data time period from: / 5/ 9/1984 to /10/18/1984 with gaps of 68.07 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.321									
u			87600	0.231									
U-u	26 cm/s	24h	87600	0.090	0.125	0.087	0.0	97.3	0.0	0.0	0.7		0.79
AFC-afc	26 cm/s	24h	647	0.079	0.097	0.056	0.0	100.0	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	701	0.107	0.119	0.052	0.0	99.9	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	647	-0.162	0.419	0.386	0.8	72.6	0.3	0.0	0.0		
TEC-tec	0.50h	25h	701	0.111	0.312	0.291	0.0	86.9	0.1	0.0	0.0		
TSF-tsf	0.25h	25h	598	0.720	0.882	0.509	0.2	40.8	26.3	0.0	123.8		
TEF-tef	0.25h	25h	647	-1.100	1.135	0.277	63.5	2.2	0.0	324.2	0.0		
TSE-tse	0.25h	25h	656	0.432	0.725	0.583	0.0	61.3	16.5	0.0	149.3		
TEE-tee	0.25h	25h	611	-0.765	0.917	0.506	31.9	27.8	0.5	249.0	0.0		
SCENARIO: HINDCAST													
U			22599	0.332									
u			22599	0.261									
U-u	26 cm/s	24h	22599	0.071	0.187	0.173	0.0	84.0	0.0	0.0	0.1		0.53
AEC-aec	26 cm/s	24h	2	0.016	0.064	0.088	0.0	100.0	0.0	0.0	0.0		
TEC-tec	0.50h	25h	2	-2.350	2.351	0.070	100.0	0.0	0.0	0.0	0.0		
TSF-tsf	0.25h	25h	21	1.816	1.924	0.653	0.0	0.0	85.7	0.0	0.0		
TEF-tef	0.25h	25h	18	1.073	1.291	0.740	0.0	22.2	55.6	0.0	0.0		
TSE-tse	0.25h	25h	26	1.486	1.987	1.345	7.7	0.0	88.5	0.0	0.0		
TEE-tee	0.25h	25h	26	0.646	0.870	0.595	0.0	38.5	34.6	0.0	0.0		

Station: VEL_025
Observed data time period from: / 9/18/1984 to /10/18/1984 with gaps of 68.07 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.267									
u			87600	0.242									
U-u	26 cm/s	24h	87600	0.024	0.095	0.092	0.0	99.9	0.0	0.0	0.4		0.75
AEC-aec	26 cm/s	24h	705	0.054	0.087	0.069	0.0	100.0	0.0	0.0	0.0		
TEC-tec	0.50h	25h	705	-0.257	0.646	0.593	11.2	54.5	0.0	99.3	0.0		
TSE-tse	0.25h	25h	701	-0.521	0.788	0.591	18.5	51.4	0.1	136.7	0.0		
TEE-tee	0.25h	25h	700	-1.001	1.252	0.753	53.3	18.4	1.0	236.2	49.6		
SCENARIO: HINDCAST													
U			7219	0.257									
u			7219	0.240									
U-u	26 cm/s	24h	7219	0.017	0.144	0.143	0.0	93.3	0.0	0.0	0.0		0.64
AEC-aec	26 cm/s	24h	32	-0.061	0.111	0.094	0.0	100.0	0.0	0.0	0.0		
TEC-tec	0.50h	25h	32	1.419	1.540	0.609	0.0	0.0	68.8	0.0	87.0		
TSE-tse	0.25h	25h	28	0.748	1.022	0.709	0.0	50.0	35.7	0.0	0.0		
TEE-tee	0.25h	25h	32	1.094	1.345	0.795	0.0	18.8	59.4	0.0	88.7		

Station: VEL_033
Observed data time period from: / 3/ 8/1984 to / 9/11/1984 with gaps of 17.26 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.480									
u			87600	0.613									
U-u	26 cm/s	24h	87600	-0.134	0.229	0.187	1.9	72.9	0.0	3.0	0.6		0.85
AFC-afc	26 cm/s	24h	531	-0.367	0.389	0.128	11.5	20.7	0.0	24.9	0.0		
AEC-aec	26 cm/s	24h	705	-0.177	0.199	0.091	0.0	80.1	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	531	-0.322	0.524	0.413	4.9	60.6	0.0	74.5	0.0		
TEC-tec	0.50h	25h	705	-0.151	0.599	0.580	2.7	52.9	4.1	0.0	86.9		
TSF-tsf	0.25h	25h	528	-0.257	0.476	0.401	0.4	65.0	0.6	0.0	0.0		
TEF-tef	0.25h	25h	531	-0.136	0.365	0.339	0.0	81.2	0.0	0.0	0.0		
TSE-tse	0.25h	25h	570	-0.604	0.697	0.348	7.9	27.4	0.0	74.4	0.0		
TEE-tee	0.25h	25h	570	-0.245	0.467	0.398	0.0	65.6	0.9	0.0	0.0		
SCENARIO: HINDCAST													
U			40786	0.508									
u			40786	0.626									
U-u	26 cm/s	24h	40786	-0.117	0.399	0.381	13.9	39.2	7.7	4.5	2.7		0.52
TSF-tsf	0.25h	25h	8	-0.044	1.245	1.330	25.0	12.5	12.5	0.0	0.0		
TEF-tef	0.25h	25h	7	0.815	1.265	1.044	14.3	14.3	57.1	0.0	0.0		
TSE-tse	0.25h	25h	96	1.453	1.586	0.639	0.0	10.4	82.3	0.0	61.6		
TEE-tee	0.25h	25h	96	1.159	1.245	0.458	0.0	6.3	70.8	0.0	49.0		

Station: VEL_047
Observed data time period from: / 6/14/1984 to / 4/ 3/1985 with gaps of 256.05 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.484									
u			87600	0.684									
U-u	26 cm/s	24h	87600	-0.199	0.283	0.201	3.4	56.0	0.0	3.9	0.0		0.73
AFC-afc	26 cm/s	24h	703	-0.384	0.399	0.111	12.9	14.4	0.0	111.8	0.0		
AEC-aec	26 cm/s	24h	704	-0.310	0.329	0.110	4.7	36.2	0.0	49.7	0.0		
TFC-tfc	0.50h	25h	703	-0.274	0.359	0.232	0.0	79.7	0.0	0.0	0.0		
TEC-tec	0.50h	25h	704	-0.796	1.060	0.700	39.3	34.7	0.0	236.3	0.0		
TSF-tsf	0.25h	25h	701	-0.460	0.605	0.394	9.3	54.2	0.0	99.6	0.0		
TEF-tef	0.25h	25h	702	-0.420	0.554	0.362	7.1	60.0	0.0	74.6	0.0		
TSE-tse	0.25h	25h	703	-0.472	0.575	0.328	4.1	52.3	0.0	37.4	0.0		
TEE-tee	0.25h	25h	703	-0.286	0.404	0.286	0.0	76.0	0.0	0.0	0.0		
SCENARIO: HINDCAST													
U			7220	0.487									
u			7220	0.701									
U-u	26 cm/s	24h	7220	-0.215	0.378	0.311	14.4	39.1	1.8	2.3	0.4		0.48
TSF-tsf	0.25h	25h	4	1.601	1.615	0.246	0.0	0.0	100.0	0.0	0.0		
TEF-tef	0.25h	25h	4	1.287	1.297	0.181	0.0	0.0	100.0	0.0	0.0		

Station: VEL_051
Observed data time period from: / 3/ 6/1984 to / 4/ 3/1985 with gaps of 147.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.536									
u			87600	0.650									
U-u	26 cm/s	24h	87600	-0.114	0.221	0.189	0.5	75.6	0.4	4.7	0.3		0.78
AEC-aec	26 cm/s	24h	665	-0.182	0.189	0.049	0.0	94.0	0.0	0.0	0.0		
TEC-tec	0.50h	25h	665	-0.767	1.007	0.653	24.5	36.2	0.0	136.8	0.0		
TSE-tse	0.25h	25h	594	-0.458	0.555	0.313	5.4	56.6	0.0	74.3	0.0		
TEE-tee	0.25h	25h	594	-0.347	0.485	0.339	5.1	68.9	0.0	74.4	0.0		
SCENARIO: HINDCAST													
U			50897	0.540									
u			50897	0.637									
U-u	26 cm/s	24h	50897	-0.097	0.304	0.288	6.2	61.8	2.4	5.1	4.5		0.50
TSE-tse	0.25h	25h	85	0.059	0.971	0.975	5.9	52.9	17.6	0.0	0.0		
TEE-tee	0.25h	25h	85	0.374	0.914	0.839	2.4	60.0	17.6	0.0	0.0		

Station: VEL_052
Observed data time period from: / 3/ 6/1984 to / 4/ 6/1984 with gaps of 147.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.188									
u			87600	0.467									
U-u	26 cm/s	24h	87600	-0.279	0.341	0.197	9.5	41.1	0.0	3.6	0.0		0.50
AFC-afc	26 cm/s	24h	647	-0.491	0.503	0.111	38.9	0.5	0.0	186.4	0.0		
AEC-aec	26 cm/s	24h	51	-0.326	0.335	0.076	0.0	15.7	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	647	-0.235	0.506	0.449	5.3	69.2	0.0	24.9	0.0		
TEC-tec	0.50h	25h	51	-1.255	1.321	0.417	66.7	0.0	0.0	0.0	0.0		
TSF-tsf	0.25h	25h	75	2.213	2.592	1.359	6.7	0.0	92.0	0.0	49.9		
TEF-tef	0.25h	25h	19	0.610	0.774	0.489	0.0	36.8	21.1	0.0	0.0		
TSE-tse	0.25h	25h	28	1.637	2.055	1.266	7.1	3.6	85.7	0.0	49.5		
TEE-tee	0.25h	25h	26	0.344	0.773	0.706	0.0	61.5	11.5	0.0	0.0		
SCENARIO: HINDCAST													
U			7397	0.189									
u			7397	0.459									
U-u	26 cm/s	24h	7397	-0.269	0.324	0.179	6.3	46.8	0.0	5.0	0.0		0.48
TSF-tsf	0.25h	25h	10	-2.069	2.163	0.666	90.0	10.0	0.0	0.0	0.0		
TEF-tef	0.25h	25h	4	2.088	2.201	0.804	0.0	0.0	75.0	0.0	0.0		
TSE-tse	0.25h	25h	2	-1.696	1.800	0.854	100.0	0.0	0.0	0.0	0.0		

Station: VEL_154
Observed data time period from: / 6/20/1984 to / 4/ 3/1985 with gaps of 115.87 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
U			87600	0.375									
u			87600	0.492									
U-u	26 cm/s	24h	87600	-0.117	0.249	0.219	2.0	67.2	0.2	2.6	0.8		0.76
AFC-afc	26 cm/s	24h	488	-0.059	0.170	0.160	0.0	89.5	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	419	-0.229	0.252	0.104	0.0	57.8	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	488	-0.605	0.771	0.479	22.5	38.1	0.2	123.4	0.0		
TEC-tec	0.50h	25h	419	-0.421	0.654	0.502	8.1	54.4	0.0	49.7	0.0		
TSF-tsf	0.25h	25h	359	-0.615	0.890	0.644	29.5	38.2	0.3	98.9	0.0		
TEF-tef	0.25h	25h	361	-0.290	0.601	0.527	10.2	64.8	0.3	49.5	0.0		
TSE-tse	0.25h	25h	346	-0.691	1.098	0.854	44.2	21.4	3.8	161.8	0.0		
TEE-tee	0.25h	25h	409	0.225	0.554	0.507	0.0	65.3	9.0	0.0	12.6		
SCENARIO: HINDCAST													
U			32939	0.398									
u			32939	0.451									
U-u	26 cm/s	24h	32939	-0.053	0.393	0.389	12.5	52.2	5.7	6.3	4.2		0.43
AFC-afc	26 cm/s	24h	2	0.648	0.648	0.002	0.0	0.0	100.0	0.0	0.0		
AEC-aec	26 cm/s	24h	3	0.257	0.343	0.277	0.0	33.3	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	2	2.450	2.455	0.212	0.0	0.0	100.0	0.0	0.0		
TEC-tec	0.50h	25h	3	-0.433	1.913	2.282	33.3	33.3	33.3	0.0	0.0		
TSF-tsf	0.25h	25h	27	0.358	1.350	1.326	11.1	40.7	29.6	0.0	0.0		
TEF-tef	0.25h	25h	30	0.818	2.183	2.059	20.0	20.0	50.0	0.0	0.0		
TSE-tse	0.25h	25h	42	-0.380	1.648	1.623	45.2	19.0	19.0	0.0	0.0		
TEE-tee	0.25h	25h	33	0.266	1.668	1.672	27.3	9.1	33.3	0.0	0.0		

APPENDIX F . Skill Assessment Scores of Current Direction: Astronomical Tide Simulation

Station: VEL_002
Observed data time period from: / 4/24/1984 to /12/ 2/1984with gaps of 68.69 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	212.599									
d			87600	207.471									
D-d	22.5 dg	24h	87600	-1.774	5.996	5.728	0.0	98.9	0.0	0.2	0.0		0.92
DFC-dfc	22.5 dg	24h	577	-1.111	5.419	5.309	0.0	99.7	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	705	-3.953	4.326	1.759	0.0	100.0	0.0	0.0	0.0		

Station: VEL_003
Observed data time period from: / 4/ 3/1984 to /11/21/1984with gaps of 137.96 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	222.674									
d			87600	229.648									
D-d	22.5 dg	24h	87600	-7.341	11.548	8.914	0.0	96.5	0.0	0.4	0.0		0.98
DFC-dfc	22.5 dg	24h	704	-4.139	5.168	3.096	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	704	-16.888	17.170	3.100	0.0	92.8	0.0	0.0	0.0		

Station: VEL_005
Observed data time period from: / 4/ 3/1984 to /11/21/1984with gaps of 97.10 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	217.282									
d			87600	218.910									
D-d	22.5 dg	24h	87600	-4.026	6.489	5.090	0.0	99.9	0.0	0.3	0.2		0.96
DFC-dfc	22.5 dg	24h	704	-8.726	8.847	1.459	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	704	-5.907	6.151	1.717	0.0	100.0	0.0	0.0	0.0		

Station: VEL_012
Observed data time period from: /10/20/1984 to /11/19/1984with gaps of 97.10 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	192.004									
d			87600	205.595									
D-d	22.5 dg	24h	87600	0.000	0.000	0.000	0.0	100.0	0.0	0.0	0.0		0.76
DFC-dfc	22.5 dg	24h	557	26.635	31.443	16.725	0.0	39.3	11.0	0.0	86.8		
DEC-dec	22.5 dg	24h	338	-27.088	31.476	16.053	15.1	42.3	0.0	111.6	0.0		

Station: VEL_016
Observed data time period from: / 3/ 8/1984 to /11/27/1984with gaps of 97.10 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	188.031									
d			87600	217.336									
D-d	22.5 dg	24h	87600	0.000	0.000	0.000	0.0	100.0	0.0	0.0	0.0		0.71
DFC-dfc	22.5 dg	24h	551	-5.618	24.510	23.879	8.3	68.6	0.9	11.9	0.0		
DEC-dec	22.5 dg	24h	233	-25.295	32.207	19.979	19.3	49.8	0.0	123.1	0.0		

Station: VEL_017
Observed data time period from: / 4/17/1984 to /10/ 9/1984with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	198.694									
d			87600	197.867									
D-d	22.5 dg	24h	87600	0.000	0.000	0.000	0.0	100.0	0.0	0.0	0.0		0.62
DFC-dfc	22.5 dg	24h	377	-3.348	27.710	27.543	7.7	61.5	3.2	0.0	0.0		
DEC-dec	22.5 dg	24h	321	2.557	20.013	19.880	1.6	75.4	0.6	0.0	0.0		

Station: VEL_018
Observed data time period from: / 9/18/1984 to /10/18/1984with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	225.419									
d			87600	226.758									
D-d	22.5 dg	24h	87600	-0.449	2.169	2.122	0.0	100.0	0.0	0.0	0.0		0.97
DFC-dfc	22.5 dg	24h	704	-2.316	2.816	1.603	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	704	2.313	2.995	1.903	0.0	100.0	0.0	0.0	0.0		

Station: VEL_019
Observed data time period from: / 9/18/1984 to /10/18/1984with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	235.805									
d			87600	228.916									
D-d	22.5 dg	24h	87600	-1.338	3.269	2.983	0.0	100.0	0.0	0.2	0.0		0.90
DFC-dfc	22.5 dg	24h	704	-4.191	4.299	0.959	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	704	0.224	2.365	2.356	0.0	100.0	0.0	0.0	0.0		

Station: VEL_020
Observed data time period from: / 9/18/1984 to /10/10/1984with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	106.213									
d			87600	108.905									
D-d	22.5 dg	24h	87600	3.524	6.366	5.302	0.0	100.0	0.0	0.7	0.0		0.92
DFC-dfc	22.5 dg	24h	545	7.662	7.926	2.029	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	705	4.441	5.334	2.955	0.0	100.0	0.0	0.0	0.0		

Station: VEL_021
Observed data time period from: / 9/18/1984 to /10/18/1984with gaps of 55.38 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	230.388									
d			87600	223.314									
D-d	22.5 dg	24h	87600	1.793	3.274	2.739	0.0	100.0	0.0	0.0	0.0		0.92
DFC-dfc	22.5 dg	24h	701	5.153	6.072	3.215	0.0	98.7	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	685	6.276	6.647	2.193	0.0	100.0	0.0	0.0	0.0		

Station: VEL_022
Observed data time period from: / 5/ 9/1984 to /10/18/1984with gaps of 67.41 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	232.161									
d			87600	239.157									
D-d	22.5 dg	24h	87600	-6.630	9.212	6.395	0.0	100.0	0.0	0.0	0.0		0.95
DFC-dfc	22.5 dg	24h	695	-7.883	8.211	2.302	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	705	-15.069	15.181	1.841	0.0	100.0	0.0	0.0	0.0		

Station: VEL_023
Observed data time period from: / 3/ 8/1984 to /11/28/1984with gaps of 55.17 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	244.341									
d			87600	244.113									
D-d	22.5 dg	24h	87600	0.608	4.109	4.064	0.0	99.9	0.0	0.1	0.0		0.85
DFC-dfc	22.5 dg	24h	704	-0.117	1.608	1.605	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	705	2.995	3.400	1.611	0.0	100.0	0.0	0.0	0.0		

Station: VEL_024
Observed data time period from: / 5/ 9/1984 to /10/18/1984with gaps of 68.07 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	206.933									
d			87600	226.494									
D-d	22.5 dg	24h	87600	4.401	9.344	8.243	0.0	98.2	0.0	0.0	0.0		0.76
DFC-dfc	22.5 dg	24h	647	14.912	15.018	1.785	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	701	11.561	12.478	4.699	0.0	100.0	0.0	0.0	0.0		

Station: VEL_025
Observed data time period from: / 9/18/1984 to /10/18/1984with gaps of 68.07 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	108.299									
d			87600	185.704									
D-d	22.5 dg	24h	87600	-34.679	77.508	69.318	22.3	77.7	0.0	3.8	0.0		0.09
DEC-dec	22.5 dg	24h	705	11.344	11.532	2.073	0.0	100.0	0.0	0.0	0.0		

Station: VEL_033
Observed data time period from: / 3/ 8/1984 to / 9/11/1984with gaps of 17.26 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	222.524									
d			87600	223.468									
D-d	22.5 dg	24h	87600	-1.277	5.485	5.334	0.0	99.6	0.0	0.0	0.1		0.89
DFC-dfc	22.5 dg	24h	531	-3.463	5.106	3.756	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	705	2.190	4.406	3.826	0.0	100.0	0.0	0.0	0.0		

Station: VEL_047
Observed data time period from: / 6/14/1984 to / 4/ 3/1985with gaps of 256.05 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	156.282									
d			87600	163.335									
D-d	22.5 dg	24h	87600	-3.154	9.637	9.107	0.0	99.7	0.2	0.2	0.4		0.91
DFC-dfc	22.5 dg	24h	703	-1.375	1.457	0.482	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	704	-6.665	6.683	0.495	0.0	100.0	0.0	0.0	0.0		

Station: VEL_051
Observed data time period from: / 3/ 6/1984 to / 4/ 3/1985with gaps of 147.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	195.019									
d			87600	199.623									
D-d	22.5 dg	24h	87600	-0.011	15.370	15.370	0.2	99.3	0.5	0.4	0.6		0.92
DEC-dec	22.5 dg	24h	665	0.077	0.461	0.455	0.0	100.0	0.0	0.0	0.0		

Station: VEL_052
Observed data time period from: / 3/ 6/1984 to / 4/ 6/1984with gaps of 147.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	142.529									
d			87600	139.500									
D-d	22.5 dg	24h	87600	0.065	1.814	1.813	0.0	100.0	0.0	0.0	0.0		0.90
DFC-dfc	22.5 dg	24h	647	-5.432	5.483	0.750	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	51	4.597	4.674	0.853	0.0	100.0	0.0	0.0	0.0		

Station: VEL_154
Observed data time period from: / 6/20/1984 to / 4/ 3/1985with gaps of 115.87 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: TIDAL SIMULATION ONLY													
D			87600	183.673									
d			87600	174.262									
D-d	22.5 dg	24h	87600	-2.787	6.136	5.466	0.0	99.9	0.1	0.0	2.2		0.89
DFC-dfc	22.5 dg	24h	488	-3.669	3.793	0.961	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5 dg	24h	419	-5.311	5.394	0.948	0.0	100.0	0.0	0.0	0.0		

APPENDIX G . Skill Assessment Scores of Current Speed: Nowcast/Forecast

Station: Philadelphia
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
U			25200	0.568									
u			25200	0.660									
U-u	26 cm/s	24h	25200	-0.092	0.217	0.197	0.8	80.3	0.5	2.5	3.5		0.81
AFC-afc	26 cm/s	24h	41	-0.177	0.180	0.035	0.0	97.6	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	192	-0.176	0.185	0.057	0.0	93.8	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	41	-0.512	0.725	0.520	12.2	34.1	0.0	24.7	0.0		
TEC-tec	0.50h	25h	192	-0.681	0.822	0.461	21.4	30.7	0.0	36.4	0.0		
TSF-tsf	0.25h	25h	40	-0.170	0.320	0.274	0.0	85.0	0.0	0.0	0.0		
TEF-tef	0.25h	25h	40	-0.292	0.374	0.237	0.0	77.5	0.0	0.0	0.0		
TSE-tse	0.25h	25h	186	-0.452	0.503	0.221	0.5	62.4	0.0	0.0	0.0		
TEE-tee	0.25h	25h	186	-0.571	0.619	0.240	1.1	30.6	0.5	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST													
U00-u00	26 cm/s	24h	279	-0.133	0.192	0.139	0.0	85.3	0.0	0.0	0.0		
U06-u06	26 cm/s	24h	281	-0.136	0.193	0.137	0.0	85.8	0.0	0.0	0.0		
U12-u12	26 cm/s	24h	284	-0.139	0.195	0.137	0.4	84.2	0.0	0.0	0.0		
U18-u18	26 cm/s	24h	279	-0.140	0.193	0.134	0.0	83.9	0.0	0.0	0.0		
U24-u24	26 cm/s	24h	277	-0.141	0.192	0.130	0.0	83.8	0.0	0.0	0.0		
AFC-afc	26 cm/s	24h	36	-0.181	0.184	0.035	0.0	94.4	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	152	-0.183	0.194	0.062	0.0	89.5	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	36	-0.422	0.591	0.419	5.6	52.8	0.0	0.0	0.0		
TEC-tec	0.50h	25h	152	-0.672	0.820	0.473	24.3	38.8	0.0	48.7	0.0		
TSF-tsf	0.25h	25h	33	-0.202	0.319	0.250	0.0	87.9	0.0	0.0	0.0		
TEF-tef	0.25h	25h	33	-0.293	0.415	0.298	0.0	72.7	0.0	0.0	0.0		
TSE-tse	0.25h	25h	146	-0.463	0.521	0.240	1.4	56.2	0.0	0.0	0.0		
TEE-tee	0.25h	25h	146	-0.581	0.636	0.260	0.7	28.1	0.7	0.0	0.0		

Station: Brown Shoal Light
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 2.18 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
U			24680	0.493									
u			24680	0.504									
U-u	26 cm/s	24h	24680	-0.011	0.143	0.143	0.7	95.4	0.5	1.7	3.1		0.90
AFC-afc	26 cm/s	24h	169	-0.047	0.089	0.076	0.0	98.2	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	149	-0.013	0.110	0.110	0.0	98.0	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	169	-0.589	0.861	0.630	21.9	40.2	1.2	49.4	0.0		
TEC-tec	0.50h	25h	149	-0.115	0.623	0.615	8.1	52.3	2.7	11.9	0.0		
TSF-tsf	0.25h	25h	146	-0.025	0.336	0.336	0.0	85.6	0.0	0.0	0.0		
TEF-tef	0.25h	25h	148	-0.008	0.427	0.428	0.7	90.5	0.7	0.0	0.0		
TSE-tse	0.25h	25h	137	-0.396	0.622	0.481	5.8	56.9	0.7	0.0	0.0		
TEE-tee	0.25h	25h	138	-0.225	0.547	0.500	1.4	77.5	0.7	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST													
U00-u00	26 cm/s	24h	251	-0.007	0.126	0.126	0.0	96.4	0.0	0.0	0.0		
U06-u06	26 cm/s	24h	254	0.002	0.124	0.124	0.0	96.9	0.4	0.0	0.0		
U12-u12	26 cm/s	24h	251	0.001	0.127	0.127	0.0	96.8	0.4	0.0	0.0		
U18-u18	26 cm/s	24h	250	0.000	0.123	0.123	0.0	97.2	0.0	0.0	0.0		
U24-u24	26 cm/s	24h	247	0.009	0.146	0.146	0.0	96.0	0.4	0.0	0.0		
AFC-afc	26 cm/s	24h	132	-0.050	0.089	0.073	0.0	98.5	0.0	0.0	0.0		
AEC-aec	26 cm/s	24h	120	0.000	0.107	0.107	0.0	98.3	0.0	0.0	0.0		
TFC-tfc	0.50h	25h	132	-0.589	0.843	0.606	22.0	37.1	0.8	25.1	0.0		
TEC-tec	0.50h	25h	120	-0.129	0.634	0.624	10.0	60.8	1.7	12.1	0.0		
TSF-tsf	0.25h	25h	117	-0.035	0.389	0.389	0.9	85.5	0.0	0.0	0.0		
TEF-tef	0.25h	25h	120	0.016	0.454	0.456	0.8	88.3	2.5	0.0	0.0		
TSE-tse	0.25h	25h	107	-0.360	0.648	0.542	6.5	61.7	1.9	0.0	0.0		
TEE-tee	0.25h	25h	109	-0.171	0.577	0.554	1.8	78.9	0.9	0.0	0.0		

APPENDIX H . Skill Assessment Scores of Current Direction: Nowcast/Forecast

Station: Philadelphia
Observed data time period from: / 4/ 1/2010 to / 7/15/2010with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
D			25200	116.125									
d			25200	126.914									
D-d	22.5	dg 24h	25200	-5.299	24.505	23.926	0.0	98.3	1.7	0.1	4.6		0.90
DFC-dfc	22.5	dg 24h	41	-8.321	8.345	0.648	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5	dg 24h	192	-11.644	11.665	0.711	0.0	100.0	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST													
D00-d00	22.5	dg 24h	279	-8.508	20.729	18.936	0.0	98.9	1.1	0.0	0.0		
D06-d06	22.5	dg 24h	281	-8.578	20.614	18.778	0.0	98.9	1.1	0.0	0.0		
D12-d12	22.5	dg 24h	284	-9.237	17.841	15.291	0.0	99.3	0.7	0.0	0.0		
D18-d18	22.5	dg 24h	279	-9.819	14.848	11.157	0.0	99.6	0.4	0.0	0.0		
D24-d24	22.5	dg 24h	277	-9.876	14.724	10.941	0.0	99.6	0.4	0.0	0.0		
DFC-dfc	22.5	dg 24h	36	-8.549	8.582	0.764	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5	dg 24h	152	-11.579	11.603	0.737	0.0	100.0	0.0	0.0	0.0		

Station: Brown Shoal Light
Observed data time period from: / 4/ 1/2010 to / 7/15/2010with gaps of 2.18 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
D			24680	233.956									
d			24680	227.245									
D-d	22.5	dg 24h	24680	-3.238	19.049	18.772	0.4	97.1	0.8	1.7	2.1		0.87
DFC-dfc	22.5	dg 24h	169	-6.427	7.482	3.843	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5	dg 24h	149	-6.455	8.725	5.890	0.0	100.0	0.0	0.0	0.0		
SCENARIO: SEMI-OPERATIONAL FORECAST													
D00-d00	22.5	dg 24h	251	-4.437	14.304	13.625	0.0	98.4	0.8	0.0	0.0		
D06-d06	22.5	dg 24h	254	-4.508	15.294	14.643	0.0	97.2	0.8	0.0	12.0		
D12-d12	22.5	dg 24h	251	-4.576	15.225	14.550	0.0	98.4	0.8	0.0	12.0		
D18-d18	22.5	dg 24h	250	-4.071	18.788	18.378	0.0	98.8	1.2	0.0	24.0		
D24-d24	22.5	dg 24h	247	-3.316	21.683	21.471	0.0	97.6	1.6	0.0	30.0		
DFC-dfc	22.5	dg 24h	132	-6.669	7.563	3.582	0.0	100.0	0.0	0.0	0.0		
DEC-dec	22.5	dg 24h	120	-6.809	8.982	5.883	0.0	100.0	0.0	0.0	0.0		

APPENDIX I . Skill Assessment Scores of Salinity Hindcast

```
Station:                                SALT_002
Observed data time period from: / 4/24/1984  to /12/ 2/1984 with gaps of   68.69 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    36732  30.174
s                    36732  29.646
S-s          3.5 24h 36732   0.528  1.418  1.316   0.0  96.0   0.0    0.0  0.0         0.47

Station:                                SALT_003
Observed data time period from: / 4/ 3/1984  to /11/21/1984 with gaps of  137.96 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    22513  30.657
s                    22513  29.832
S-s          3.5 24h 22513   0.825  1.741  1.533   0.0  94.8   0.0    0.0  0.0         0.37

Station:                                SALT_005
Observed data time period from: / 4/ 3/1984  to /11/21/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    32330  30.080
s                    32330  28.964
S-s          3.5 24h 32330   1.116  2.923  2.702   0.0  77.0   1.0    0.0  3.1         0.31

Station:                                SALT_011
Observed data time period from: /11/ 4/1984  to /11/19/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                     3592  32.642
s                     3592  31.724
S-s          3.5 24h  3592   0.918  0.971  0.316   0.0 100.0   0.0    0.0  0.0         0.26

Station:                                SALT_012
Observed data time period from: /10/20/1984  to /11/19/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                     7261  32.846
s                     7261  32.836
S-s          3.5 24h  7261   0.011  0.361  0.361   0.0 100.0   0.0    0.0  0.0         0.34
```

```
Station:                                SALT_016
Observed data time period from: / 3/ 8/1984  to /11/27/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    63528  31.937
s                    63528  31.328
S-s          3.5 24h 63528   0.609  0.911  0.677   0.0 100.0   0.0    0.0  0.0         0.52

Station:                                SALT_018
Observed data time period from: / 9/18/1984  to /10/18/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                     7231  27.139
s                     7231  26.877
S-s          3.5 24h  7231   0.262  2.426  2.412   0.0  87.9   0.0    0.0  0.0         0.33

Station:                                SALT_020
Observed data time period from: / 9/18/1984  to /10/10/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                     5187  25.691
s                     5187  27.736
S-s          3.5 24h  5187  -2.045  4.650  4.176  12.7  48.8   0.0    4.5  0.0         0.16

Station:                                SALT_021
Observed data time period from: / 9/18/1984  to /10/18/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                     7211  24.852
s                     7211  26.274
S-s          3.5 24h  7211  -1.422  5.014  4.808   2.8  70.6   2.9    1.4  0.4         0.18

Station:                                SALT_022
Observed data time period from: / 5/ 9/1984  to /10/18/1984 with gaps of   67.41 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    22720  25.757
s                    22720  26.139
S-s          3.5 24h 22720  -0.382  3.541  3.520   2.0  63.7   0.5    3.6  1.6         0.32
```

```
Station:                                SALT_023
Observed data time period from: / 3/ 8/1984  to /11/28/1984 with gaps of   55.17 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                   50364  27.201
s                   50364  25.751
S-s          3.5 24h 50364   1.450  2.795  2.389   0.0  82.3   3.8    0.0 10.1        0.63

Station:                                SALT_024
Observed data time period from: / 5/ 9/1984  to /10/18/1984 with gaps of   68.08 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                   22599  21.704
s                   22599  19.607
S-s          3.5 24h 22599   2.097  8.865  8.614   1.5  58.4  21.5    2.1484.7        0.43

Station:                                SALT_033
Observed data time period from: / 3/ 8/1984  to / 9/11/1984 with gaps of   17.26 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                   40786  11.590
s                   40786  13.717
S-s          3.5 24h 40786  -2.127  4.957  4.477  13.3  46.3   3.0   21.3  4.3        0.51

Station:                                SALT_047
Observed data time period from: / 6/14/1984  to / 4/ 2/1985 with gaps of  256.05 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    7220   0.000
s                    7220   0.004
S-s          3.5 24h  7220  -0.004  0.012  0.011   0.0 100.0   0.0    0.0  0.0        0.29

Station:                                SALT_050
Observed data time period from: / 3/22/1984  to / 4/ 6/1984 with gaps of  256.05 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    3453   0.000
s                    3453   0.000
S-s          3.5 24h  3453   0.000  0.000  0.000   0.0 100.0   0.0    0.0  0.0        0.00
```

```
Station:                                SALT_051
Observed data time period from: / 3/ 6/1984  to / 4/ 2/1985 with gaps of  147.00 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                   50897   0.072
s                   50897  -0.016
S-s          3.5 24h 50897   0.088  0.173  0.148   0.0 100.0   0.0    0.0  0.0         0.10

Station:                                SALT_052
Observed data time period from: / 3/ 6/1984  to / 4/ 6/1984 with gaps of  147.00 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    7397   0.000
s                    7397  -0.015
S-s          3.5 24h  7397   0.015  0.021  0.015   0.0 100.0   0.0    0.0  0.0         0.51

Station:                                SALT_053
Observed data time period from: / 3/ 6/1984  to / 3/22/1984 with gaps of  147.00 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    3822   0.000
s                    3822   0.000
S-s          3.5 24h  3822   0.000  0.000  0.000   0.0 100.0   0.0    0.0  0.0         0.00

Station:                                SALT_054
Observed data time period from: / 3/ 6/1984  to / 3/26/1984 with gaps of  147.00 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                    4789   0.000
s                    4789  -0.076
S-s          3.5 24h  4789   0.076  0.081  0.027   0.0 100.0   0.0    0.0  0.0         0.32

Station:                                SALT_154
Observed data time period from: / 6/20/1984  to / 4/ 2/1985 with gaps of  115.87 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
S                   32939   3.646
s                   32939   6.388
S-s          3.5 24h 32939  -2.742  9.033  8.607  13.4  71.9   5.7  438.0188.1         0.53
```

APPENDIX J . Skill Assessment Scores of Salinity Nowcast/Forecast

```
Station:                          Ship John Shoal
Observed data time period from: / 4/ 1/2010  to / 7/15/2010 with gaps of    0.00 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: SEMI-OPERATIONAL NOWCAST
S                    25201  10.468
s                    25201  14.520
S-s          3.5 24h 25201  -4.053  4.808  2.587  15.7  52.4   0.0   61.4  0.0         0.76

     SCENARIO: SEMI-OPERATIONAL FORECAST
S00-s00      3.5 24h   353  -4.327  5.067  2.641  18.1  48.4   0.0  156.0  0.0
S06-s06      3.5 24h   352  -4.311  5.035  2.604  16.5  49.1   0.0  120.0  0.0
S12-s12      3.5 24h   351  -4.337  5.063  2.616  17.4  47.6   0.0  120.0  0.0
S18-s18      3.5 24h   350  -4.346  5.069  2.614  17.4  47.7   0.0  132.0  0.0
S24-s24      3.5 24h   349  -4.366  5.090  2.621  18.3  47.6   0.0  156.0  0.0

Station:               BURLINGTON, DELAWARE RIVER
Observed data time period from: / 4/ 1/2010  to / 7/15/2010 with gaps of    0.00 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: SEMI-OPERATIONAL NOWCAST
S                    25201   0.000
s                    25201   0.030
S-s          3.5 24h 25201  -0.030  0.047  0.036   0.0 100.0   0.0    0.0  0.0         0.39

     SCENARIO: SEMI-OPERATIONAL FORECAST
S00-s00      3.5 24h   353  -0.032  0.051  0.040   0.0 100.0   0.0    0.0  0.0
S06-s06      3.5 24h   352  -0.028  0.044  0.035   0.0 100.0   0.0    0.0  0.0
S12-s12      3.5 24h   351  -0.028  0.044  0.034   0.0 100.0   0.0    0.0  0.0
S18-s18      3.5 24h   350  -0.028  0.044  0.034   0.0 100.0   0.0    0.0  0.0
S24-s24      3.5 24h   349  -0.027  0.043  0.034   0.0 100.0   0.0    0.0  0.0

Station:     BRANDYWINE SHOAL LIGHT, DELAWARE BAY
Observed data time period from: / 4/ 1/2010  to / 7/15/2010 with gaps of    0.00 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: SEMI-OPERATIONAL NOWCAST
S                    25201  28.553
s                    25201  19.687
S-s          3.5 24h 25201   8.867 12.461  8.756   4.2   3.7  73.2   41.9*****         0.51

     SCENARIO: SEMI-OPERATIONAL FORECAST
S00-s00      3.5 24h   353   8.282 12.214  8.990   4.8   5.9  70.5   36.0480.0
S06-s06      3.5 24h   352   8.359 12.250  8.968   5.1   5.4  70.7   42.0474.0
S12-s12      3.5 24h   351   8.310 12.229  8.985   5.1   5.4  70.7   42.0468.0
S18-s18      3.5 24h   350   8.283 12.210  8.984   5.1   5.7  70.3   42.0462.0
S24-s24      3.5 24h   349   8.271 12.203  8.985   5.2   5.7  70.5   42.0456.0

Note the MDPO is greater than 1000 hours due to the biological fouling of the CT sensor at
this location.
```

APPENDIX K . Skill Assessment Scores of Temperature Hindcast

```
Station:                                TEMP_002
Observed data time period from: / 4/24/1984  to /12/ 2/1984 with gaps of   68.69 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    36732  18.560
t                    36732  14.634
T-t        3.0 c 24h 36732   3.926  4.411  2.011   0.0  35.0  13.0    0.0 73.5        0.74

Station:                                TEMP_003
Observed data time period from: / 4/ 3/1984  to /11/21/1984 with gaps of  137.96 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    22513  17.577
t                    22513  14.275
T-t        3.0 c 24h 22513   3.302  4.081  2.398   0.0  56.6  15.0    0.0 72.6        0.88

Station:                                TEMP_005
Observed data time period from: / 4/ 3/1984  to /11/21/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    32330  17.311
t                    32330  14.293
T-t        3.0 c 24h 32330   3.017  3.760  2.244   0.0  58.3   9.9    0.0 23.7        0.87

Station:                                TEMP_011
Observed data time period from: /11/ 4/1984  to /11/19/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                     3592  18.768
t                     3592  14.745
T-t        3.0 c 24h  3592   4.023  4.058  0.536   0.0   0.0   0.0    0.0  0.0        0.40

Station:                                TEMP_012
Observed data time period from: /10/20/1984  to /11/19/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                     7261  19.406
t                     7261  15.981
T-t        3.0 c 24h  7261   3.424  3.446  0.390   0.0  15.9   0.0    0.0  0.0        0.46
```

```
Station:                                TEMP_016
Observed data time period from: / 3/ 8/1984  to /11/27/1984 with gaps of   97.10 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                   63528  17.813
t                   63528  13.850
T-t        3.0 c 24h 63528   3.963  5.270  3.474   0.0  45.2  15.3    0.0582.3        0.83

Station:                                TEMP_017
Observed data time period from: / 4/17/1984  to /10/ 9/1984 with gaps of   55.38 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                   28673  18.324
t                   28673  15.342
T-t        3.0 c 24h 28673   2.982  3.501  1.834   0.0  45.0   4.3    0.0 36.8        0.85

Station:                                TEMP_018
Observed data time period from: / 9/18/1984  to /10/18/1984 with gaps of   55.38 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    7231  21.319
t                    7231  18.194
T-t        3.0 c 24h  7231   3.126  3.205  0.708   0.0  51.2   0.0    0.0  0.0        0.62

Station:                                TEMP_019
Observed data time period from: / 9/18/1984  to /10/18/1984 with gaps of   55.38 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    7206  21.911
t                    7206  18.459
T-t        3.0 c 24h  7206   3.452  3.482  0.454   0.0  16.7   0.0    0.0  0.0        0.58

Station:                                TEMP_020
Observed data time period from: / 9/18/1984  to /10/10/1984 with gaps of   55.38 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    5187  21.699
t                    5187  18.291
T-t        3.0 c 24h  5187   3.409  3.508  0.831   0.0  32.9   0.0    0.0  0.0        0.62
```

```
Station:                                TEMP_021
Observed data time period from: / 9/18/1984  to /10/18/1984 with gaps of   55.38 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    7211  20.811
t                    7211  18.136
T-t        3.0 c 24h  7211   2.675  2.915  1.159   0.0  73.3   0.6    0.0  0.5        0.68

Station:                                TEMP_022
Observed data time period from: / 5/ 9/1984  to /10/18/1984 with gaps of   67.41 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                   22720  21.395
t                   22720  17.222
T-t        3.0 c 24h 22720   4.174  4.757  2.284   0.0  34.2  20.6    0.0  9.0        0.70

Station:                                TEMP_023
Observed data time period from: / 3/ 8/1984  to /11/28/1984 with gaps of   55.17 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                   50364  17.246
t                   50364  14.691
T-t        3.0 c 24h 50364   2.554  3.096  1.750   0.0  70.3   6.7    0.0 36.4        0.95

Station:                                TEMP_024
Observed data time period from: / 5/ 9/1984  to /10/18/1984 with gaps of   68.08 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                   22599  21.751
t                   22599  18.692
T-t        3.0 c 24h 22599   3.058  3.326  1.306   0.0  58.4   3.3    0.0  8.1        0.82

Station:                                TEMP_033
Observed data time period from: / 3/ 8/1984  to / 9/11/1984 with gaps of   17.26 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                   40786  19.279
t                   40786  17.317
T-t        3.0 c 24h 40786   1.962  2.279  1.159   0.0  81.3   0.0    0.0  0.0        0.98
```

```
Station:                                TEMP_047
Observed data time period from: / 6/14/1984  to / 4/ 2/1985 with gaps of  256.05 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    7220  25.471
t                    7220  24.034
T-t        3.0 c 24h 7220   1.438  1.587  0.673   0.0  99.3   0.0    0.0  0.0         0.42

Station:                                TEMP_050
Observed data time period from: / 3/22/1984  to / 4/ 6/1984 with gaps of  256.05 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    3453   7.715
t                    3453   6.605
T-t        3.0 c 24h 3453   1.110  1.349  0.767   0.0 100.0   0.0    0.0  0.0         0.49

Station:                                TEMP_051
Observed data time period from: / 3/ 6/1984  to / 4/ 2/1985 with gaps of  279.55 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                   19085  18.805
t                   19085  16.724
T-t        3.0 c 24h 19085  2.081  3.223  2.462   0.0  67.1  11.2    0.0 92.5         0.96

Station:                                TEMP_052
Observed data time period from: / 3/ 6/1984  to / 4/ 6/1984 with gaps of  279.55 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    7397   5.884
t                    7397   5.128
T-t        3.0 c 24h 7397   0.756  1.134  0.846   0.0 100.0   0.0    0.0  0.0         0.93

Station:                                TEMP_054
Observed data time period from: / 3/ 6/1984  to / 3/26/1984 with gaps of  279.55 days
Data gap is filled using SVD method
Data are not filtered
-------------------------------------------------------------------------------------------
VARIABLE    X     N   IMAX    SM    RMSE    SD     NOF   CF    POF   MDNO  MDPO  WOF  SKILL
CRITERION   -     -     -     -      -      -     <1%  >90%   <1%    <N    <N  <.5%
-------------------------------------------------------------------------------------------

     SCENARIO: HINDCAST
T                    4789   6.181
t                    4789   4.581
T-t        3.0 c 24h 4789   1.600  1.925  1.071   0.0  88.1   0.0    0.0  0.0         0.73
```

Station: TEMP_154
Observed data time period from: / 9/27/1984 to / 4/ 2/1985 with gaps of 93.87 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: HINDCAST													
T			14552	15.776									
t			14552	13.309									
T-t	3.0 c 24h		14552	2.466	3.953	3.090	0.0	71.2	20.3	0.0274.0			0.77

APPENDIX L . Skill Assessment Scores of Temperature Nowcast/Forecast

Station: CAPE MAY CANAL,DELAWARE BAY
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	19.455									
t			25201	18.239									
T-t	3.0	c 24h	25201	1.216	2.958	2.697	0.7	76.0	3.0	7.0	7.2		0.91
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	1.188	2.645	2.367	0.0	77.1	2.8	0.0	6.0		
T06-t06	3.0	c 24h	352	1.140	2.559	2.295	0.0	77.0	2.6	0.0	6.0		
T12-t12	3.0	c 24h	351	1.108	2.516	2.262	0.0	77.2	2.3	0.0	0.0		
T18-t18	3.0	c 24h	350	1.058	2.445	2.207	0.0	76.6	1.4	0.0	0.0		
T24-t24	3.0	c 24h	349	0.997	2.398	2.183	0.0	79.1	1.7	0.0	0.0		

Station: Ship John Shoal
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	19.088									
t			25201	19.313									
T-t	3.0	c 24h	25201	-0.225	3.125	3.117	9.0	81.8	0.2	115.6	3.4		0.94
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	-0.064	2.805	2.808	7.4	80.7	0.0	66.0	0.0		
T06-t06	3.0	c 24h	352	-0.082	2.765	2.768	7.4	81.8	0.0	60.0	0.0		
T12-t12	3.0	c 24h	351	-0.084	2.721	2.724	8.3	82.3	0.0	66.0	0.0		
T18-t18	3.0	c 24h	350	-0.051	2.696	2.699	7.4	82.9	0.0	60.0	0.0		
T24-t24	3.0	c 24h	349	-0.071	2.689	2.692	7.4	82.2	0.0	54.0	0.0		

Station: BURLINGTON, DELAWARE RIVER
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	20.184									
t			25201	20.223									
T-t	3.0	c 24h	25201	-0.039	2.459	2.459	2.9	94.0	0.0	64.9	0.0		0.96
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	0.352	1.311	1.264	0.6	94.9	0.0	0.0	0.0		
T06-t06	3.0	c 24h	352	0.229	1.119	1.097	0.6	96.9	0.0	0.0	0.0		
T12-t12	3.0	c 24h	351	0.244	0.854	0.820	0.0	97.2	0.0	0.0	0.0		
T18-t18	3.0	c 24h	350	0.225	0.872	0.844	0.0	97.4	0.0	0.0	0.0		
T24-t24	3.0	c 24h	349	0.186	0.765	0.743	0.0	98.3	0.0	0.0	0.0		

Station: PHILADELPHIA, PA
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	19.721									
t			25201	20.377									
T-t	3.0	c 24h	25201	-0.656	3.683	3.624	7.2	90.3	0.0	152.0	0.0		0.92
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	-0.386	3.103	3.083	5.9	92.1	0.0	102.0	0.0		
T06-t06	3.0	c 24h	352	-0.412	3.001	2.977	5.7	92.3	0.0	96.0	0.0		
T12-t12	3.0	c 24h	351	-0.389	2.894	2.872	5.4	92.9	0.0	90.0	0.0		
T18-t18	3.0	c 24h	350	-0.358	2.790	2.771	4.9	93.4	0.0	84.0	0.0		
T24-t24	3.0	c 24h	349	-0.345	2.670	2.651	4.9	93.7	0.0	78.0	0.0		

Station: Newbold, PA
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	20.586									
t			25201	20.618									
T-t	3.0	c 24h	25201	-0.032	1.869	1.869	1.2	94.7	0.0	26.7	0.0		0.98
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	0.146	1.113	1.105	0.0	96.0	0.0	0.0	0.0		
T06-t06	3.0	c 24h	352	-0.061	0.992	0.992	0.0	98.0	0.0	0.0	0.0		
T12-t12	3.0	c 24h	351	-0.089	1.006	1.004	0.0	98.3	0.0	0.0	0.0		
T18-t18	3.0	c 24h	350	-0.154	1.009	0.998	0.0	98.0	0.0	0.0	0.0		
T24-t24	3.0	c 24h	349	-0.206	1.041	1.022	0.0	98.3	0.0	0.0	0.0		

Station: Delaware City, DE
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	18.578									
t			25201	20.493									
T-t	3.0	c 24h	25201	-1.915	4.439	4.005	15.0	75.4	0.0	238.6	0.0		0.89
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	-1.668	4.109	3.761	14.2	77.9	0.0	162.0	0.0		
T06-t06	3.0	c 24h	352	-1.663	4.073	3.723	13.9	78.4	0.0	156.0	0.0		
T12-t12	3.0	c 24h	351	-1.656	4.017	3.664	14.2	78.6	0.0	288.0	0.0		
T18-t18	3.0	c 24h	350	-1.597	3.935	3.602	13.7	79.7	0.0	222.0	0.0		
T24-t24	3.0	c 24h	349	-1.615	3.920	3.578	14.0	79.9	0.0	216.0	0.0		

Station: BRANDYWINE SHOAL LIGHT, DELAWARE BAY
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	19.694									
t			25201	16.602									
T-t	3.0	c 24h	25201	3.092	3.576	1.797	0.0	52.5	4.5	0.0	8.3		0.88
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	3.028	3.443	1.641	0.0	52.4	4.5	0.0	0.0		
T06-t06	3.0	c 24h	352	2.878	3.255	1.523	0.0	55.7	3.1	0.0	6.0		
T12-t12	3.0	c 24h	351	2.852	3.227	1.512	0.0	57.0	2.6	0.0	0.0		
T18-t18	3.0	c 24h	350	2.840	3.213	1.505	0.0	57.4	2.9	0.0	0.0		
T24-t24	3.0	c 24h	349	2.802	3.172	1.488	0.0	58.5	2.6	0.0	0.0		

Station: LEWES,FT MILES DE
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.00 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25201	21.877									
t			25201	16.851									
T-t	3.0	c 24h	25201	5.026	5.914	3.117	0.0	26.3	26.9	0.0260.1			0.72
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	353	4.945	5.636	2.708	0.0	21.5	26.9	0.0234.0			
T06-t06	3.0	c 24h	352	4.426	5.100	2.536	0.0	30.4	21.9	0.0180.0			
T12-t12	3.0	c 24h	351	4.302	4.972	2.498	0.0	33.0	21.1	0.0174.0			
T18-t18	3.0	c 24h	350	4.252	4.920	2.479	0.0	33.7	20.9	0.0168.0			
T24-t24	3.0	c 24h	349	4.117	4.762	2.398	0.0	38.1	19.8	0.0156.0			

Station: CHESAPEAKE CITY
Observed data time period from: / 4/ 1/2010 to / 7/15/2010 with gaps of 0.58 days
Data gap is filled using SVD method
Data are not filtered

VARIABLE	X	N	IMAX	SM	RMSE	SD	NOF	CF	POF	MDNO	MDPO	WOF	SKILL
CRITERION	-	-	-	-	-	-	<1%	>90%	<1%	<N	<N	<.5%	
SCENARIO: SEMI-OPERATIONAL NOWCAST													
T			25064	20.524									
t			25064	21.460									
T-t	3.0	c 24h	25064	-0.936	2.889	2.733	5.2	90.4	0.1	14.0	3.0		0.94
SCENARIO: SEMI-OPERATIONAL FORECAST													
T00-t00	3.0	c 24h	351	-0.828	2.415	2.272	4.6	92.0	0.3	24.0	0.0		
T06-t06	3.0	c 24h	350	-0.918	2.403	2.224	4.6	91.7	0.3	18.0	0.0		
T12-t12	3.0	c 24h	349	-0.864	2.337	2.175	4.0	92.8	0.3	24.0	0.0		
T18-t18	3.0	c 24h	348	-0.822	2.220	2.065	3.4	92.2	0.3	24.0	0.0		
T24-t24	3.0	c 24h	347	-0.937	2.331	2.137	3.7	91.9	0.3	12.0	0.0		