Field Installation Guide

For Iridium ATON Current Measurement System
Version 1.0

Winston Hensley
Bob Heitsenrether
Christopher Haith

May 2017

noaa **National Oceanic and Atmospheric Administration**

U S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services

NOTICE

Mention of a commercial company or product does not constitute an endorsement by NOAA. Use of information from this publication for publicity or advertising purposes concerning proprietary products or the tests of such products is not authorized.

Table of Contents

Table of Contents **3**

List of Figures **4**

1.0 Introduction **6**

2.0 High-Level Process Overview **7**

3.0 Site Reconnaissance **9**

3.1 Notify Local Contact 9

3.2 Bouy 9

3.2 Siting 11

4.0 Laboratory Pre-Deployment Procedures **12**

4.1 Prepare Acoustic Current Profiler Sensor 12

4.1.1 Internal Acoustic Current Profiler Battery Check and Desiccant Replacement 12

4.1.2 Seal Profiler 12

4.1.3 Verify Profiler Operation 13

4.2 Install Current Meter on Clamparatus 14

4.2.1 Prepare Profiler in Fiberglass Clamparatus Tube 14

4.2.2 Remove Power Connector from Battery Enclosure 18

4.3 Verify Data Throughput 19

5.0 Field Installation Procedures **22**

5.1 Safety Precautions 22

5.2 Field Procedures 22

5.2.1 Installation 23

5.2.2 Current Profiler Compass Calibration 23

5.2.3 DCP Procedures 28

6.0 Removal and Recovery **32**

6.1 Notify CORMS of Removal 32

6.2 Turn Off Recording on DCP 32

6.3 Remove Clamparatus 32

4.0 References **33**

Appendix A: Reconnaissance Checklist **34**

Appendix B: iATON Deployment Packing List **35**

Appendix C: Nortek Aquadopp Deployment Procedures **36**

Appendix D: Compass Calibration – Nortek Service Manual **37**

Appendix E: Compass Calibration Checklist **39**

List of Figures

Figure 1: High Level Process Overview 7
Figure 2: iATON Enclosures 8
Figure 3: Check top buoy surface during recon to ensure it’s flat. 10
Figure 4: Example installation photo 10
Figure 5: Buoy lifting eye 11
Figure 6: Replace Aquadopp Battery 12
Figure 7: Tighten Aquadopp Bolts 13
Figure 8: Collar Bolts 14
Figure 9: Connect Aquadopp Cable 15
Figure 10: Axis Orientation 16
Figure 11: Secure Aquadopp in Tube 16
Figure 12: Paint Sensor Tube 17
Figure 13: Tighten Top Cap Set Screws 18
Figure 14: System power and ON/OFF cable 19
Figure 15: Tidepool FTP Server Directory Structure 20
Figure 16: Tidepool - Short Burst Data Files 21
Figure 17: Aquapro Baud Rates 24
Figure 18: Aquapro Compass Calibration Screen 25
Figure 19: Save Aquapro Calibration Data 26
Figure 20: Save Aquapro Calibration Data Subsets 26
Figure 21: PC - DCP Interface Cable Connector 28
Figure 22: Keyed, 2-pin Power Cable 28
Figure 23: Iridium Signal Strength 29
Figure 24: Start Recording on DCP 29
Figure 25: Verify Recent.dat/Output.dat Updated pt.1 30
Figure 26:Verify Recent.dat/Output.dat Updated pt.2 30
Figure 27: Iridium Formatter Verification pt.1 31
Figure 28: Iridium Formatter Verification pt.2 31
Figure 29: Successful Compass Calibration 38

Acknowledgements

Thanks go out to the many contributors on this project and the original ATON ADCP integrators, which made the ATON ADCP system a success from the beginning.

Kathryn Bosley, Ph.D
Jennifer Dussault
Chris McGrath
Mark Erickson
Tammy Graff
Mark Bushnell
Warren Krug
Eddie Roggenstein
Kevin Harrison
Helen Worthington

1.0 Introduction

The National Oceanic and Atmospheric Administration (NOAA) National Ocean Services' Center for Operational Oceanographic Products and Services (NOS/CO-OPS) developed a real-time, ocean current measurement system, affixed to U.S. Coast Guard (USCG) aids-to-navigation (ATON) buoys. The system employs an acoustic Doppler current profiler (ADCP) sensor, referred to as the "ATON ADCP" system, to measure ocean currents. Motivation for the ATON ADCP design and development came from the need to fulfill Physical Oceanographic Real-Time Systems (PORTS®) users' requests for real-time vertical current profile information in or near shipping channels. The first PORTS ATON ADCP systems were transitioned into operational use in 2005 [1, 2]. Throughout 2015-16, CO-OPS Engineering Division's (ED) Ocean Systems Test and Evaluation Program (OSTEP) pursued an effort to design, develop and test enhancements to the ATON ADCP system, which simplify the installation and increases data throughput. The improved system design consists of a single, buoy mounted, component (eliminating the need for a shore station) and utilizes Iridium Short Burst Data (SBD) as a primary means of real-time data telemetry.

Details on OSTEP's related FY15-16 project plans, system requirements, and the latest system design details can be found in references 3-7. Following OSTEP's recent completion of several successful laboratory and field tests with the improved ATON ADCP system (hereinafter referred to as the iATON system), ED developed a Transition-to-Operations Plan (TOP) for the iATON to support wider use across CO-OPS PORTS.

In accordance with the iATON TOP, OSTEP was tasked to complete two supporting documents, a system design document that provides details and guidance on how to assemble and integrate the iATON system's components [8] and this field installation guide.

The purpose of this field installation guide is to outline the procedure for laboratory preparation and throughput testing, field installation, and then verifying proper field operation of an iATON ADCP system. This document will be updated periodically, as experience is refined and to better address the range of specific issues that each different installation may present. This document should serve as a base set of guidelines and not a rigid operating procedure, because technology is rapidly advancing and the design must be agile to adapt when necessary.

2.0 High-Level Process Overview

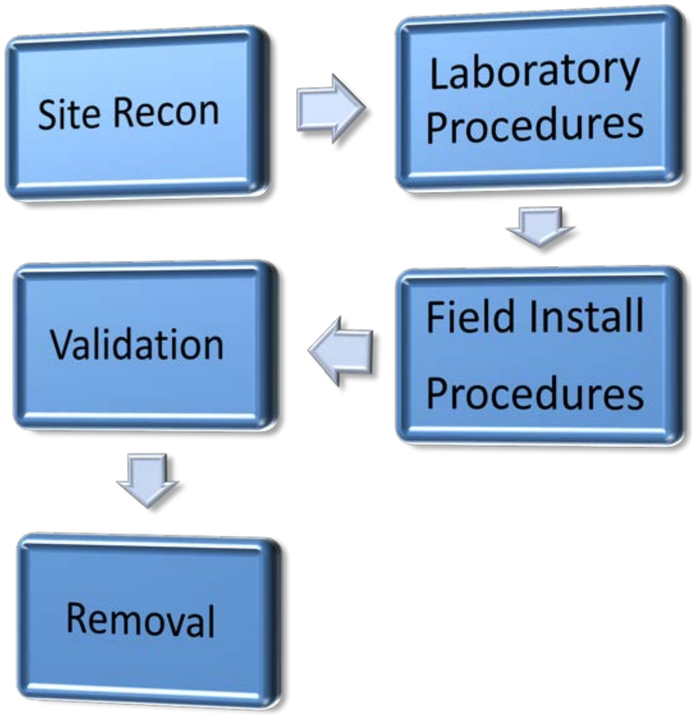

Figure 1: High Level Process Overview

The process outline above (Figure 1) shows how this document is organized based on the major efforts of the deployment process. Prior to proceeding, it is assumed that the all components have been procured and the electronics enclosure has been assembled and/or checked out by a qualified technician in the Chesapeake Instrument Lab (CIL).

A separate, detailed system design document with guidance on how to assemble and integrate the iATON system's payload is maintained by CIL [8]. Instructions in this design document should followed during the buildout of any new iATON system.

The final, CIL integrated system has two different enclosure boxes that are referred to throughout this document: the electronics enclosure, which houses the system's data collection and telemetry system and 2) the battery enclosure. Figure 2 shows two pictures of these enclosures mounted to an integrated iATON system's mount assembly, which is referred to as a 'Clamparatus' (in the lab and post field installation).

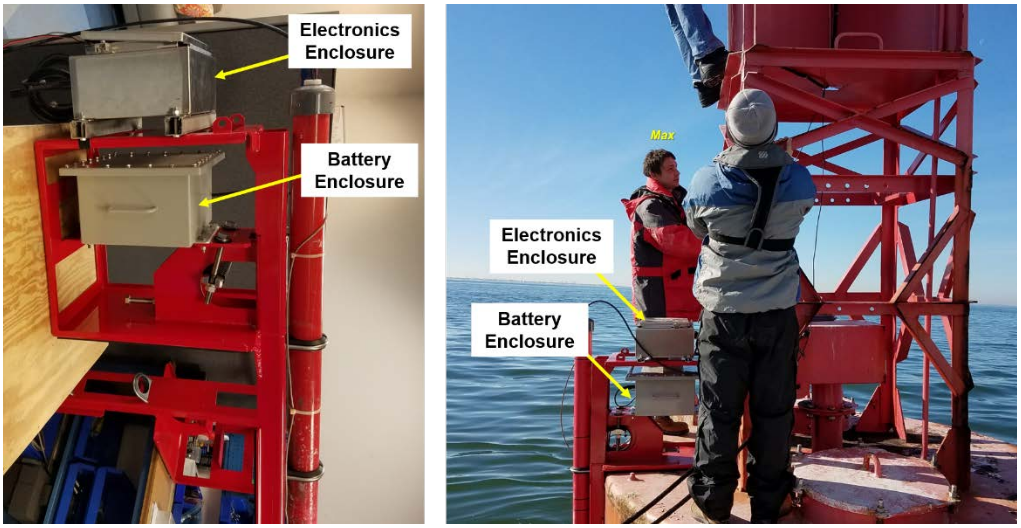

Figure 2: iATON Enclosures

3.0 Site Reconnaissance

Prior to beginning the system procurement process, it is necessary to reach out to the local point of contact (POC) which will be provided by the CO-OPS PORTS® site representative or a specific PORTS® project manager. It will be the responsibility of the field team lead to notify the POCs in advance of the reconnaissance and installation and if the iATON ADCP system will be near a heavily trafficked area, a local pilot dispatcher must be notified.

A checklist is found in Appendix A.

3.1 Notify Local Contact

As previously noted in the Reconnaissance instructions, the PORTS® representative shall reach out to the local POC and the USCG several days in advance of the installation, maintenance or removal of the iATON ADCP system.

3.2 Bouy

In most cases, buoy sizes for USCG ATONs are standardized but in practice, there have been variations, which make affixing an iATON ADCP system more difficult or even non-feasible. This makes a buoy reconnaissance trip a critical prior to procurement of all system components and installation.

The first buoy feature to confirm on site is color. The Clamparatus must be ordered in a matching color (red or green) in accordance with USCG policy.

Measurements must be taken to verify that the buoy diameter. Some buoys are marked as 8ft but are actually 6ft in diameter. For the smaller 6ft diameter buoys, different hardware is required to mount the battery and electronics in the center of the buoy.

The top surface of the buoy where the iATON system's Clamparatus will sit atop must be flat and not rounded. Also, take note of the location of drainage bungs or repairs that would interfere with the Clamparatus' flat pad. Figure 3 shows examples of both compatible (flat) and non-compatible rounded (sloped) ATON buoy surfaces.

Another important factor to take into account is the location of the ATON lifting eyes. If the lifting eye extends beyond the outside of the buoy hull greater than 3 inches, it will prevent a flush installation of the Clamparatus. In this case, a new buoy should be chosen for the installation. Figure 5 shows a lifting eye which only extends the nominal 3 inches from the buoy hull, which is acceptable for an iATON installation.

Figure 3: Check top buoy surface during recon to ensure it's flat.

Figure 4: Example installation photo

Figure 5: Buoy lifting eye

3.2 Siting

The iATON ADCP system provides current speed and direction information in discreet bins, throughout the water column. It is important to recognize the advantages and disadvantages of this system and choose a buoy location with sufficient depth to provide the most useful data for users. CO-OPS standard current meter bin size is 1m. The maximum number of bins that can be transmitted via Iridium SBD at this time is 16 m. The total number of bins transmitted by the iATON system can be adjusted based on the water depth at the field site.

Close coordination between the PORTS® users and CO-OPS' Oceanography Division is necessary to select the optimal available site and to ensure the most useful data is being measured and disseminated from the resulting system installation.

4.0 Laboratory Pre-Deployment Procedures

4.1 Prepare Acoustic Current Profiler Sensor

The following procedure for preparing the acoustic current profiler is identical to the procedure used with legacy ATON ADCP system [1]. The profiler that is used in the ATON ADCP systems is a Nortek Aquadopp Profiler. The steps in this procedure involve plugging in the battery, replacing desiccant and applying anti-fouling paint prior to deployment.

Plugging in the profiler should be performed the day of deployment to limit drain on the internal battery.

4.1.1 Internal Acoustic Current Profiler Battery Check and Desiccant Replacement

Battery voltage for the acoustic sensor's internal battery should read approximately +14 Volts prior to installation. If deployment is delayed, battery should be disconnected to limit discharging. Access to the battery is available by loosening the profiler's Allen key machine screws using the driver provided in the blue Nortek Maintenance Kit.

Figure 6: Replace Aquadopp Battery

If the battery voltage is lower than 14V, it is necessary to replace the battery prior to sealing the profiler.

4.1.2 Seal Profiler

A new, unused bag of desiccant must also be inserted inside the instrument at this time, prior to sealing the profiler.

Verify that all O-Rings are lubricated and free of dust or defect. Replace the O-Ring if necessary and tighten the profiler's Allen key machine screws using the driver located in the blue Nortek Maintenance Kit.

O-Rings are to be lubricated with Molycote 111® or equivalent. All Impulse plugs should be lubricated with a thin coat of 3M Silicone Spray.

Caution! Be sure to use silicone spray and not silicone greast on the dummy plugs and cables. The use of silicone grease on these may cause permanent damage to the system! Silicone grease should be applied to the O-rings only![

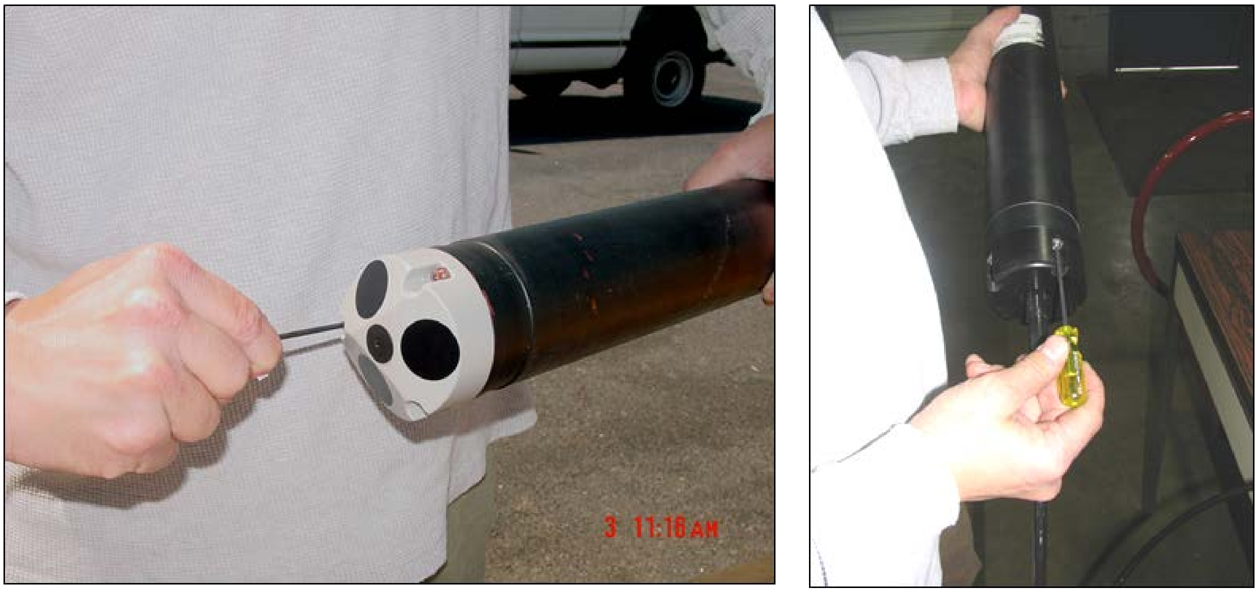

Figure 7: Tighten Aquadopp Bolts

4.1.3 Verify Profiler Operation

Prior to installing the Nortek Profiler into the fiberglass tube, connect to the instrument using the latest version of AquaPro and the cable that will be used in the deployment. It is important here to avoid using the external power cable, to verify that the profiler's internal battery is connected.

1. Verify Continuity of Pins on Sensor Cable
2. Lubricate Profiler Cable Pins w/ Silicone Spray
3. Connect PC to Profiler Using NortekUSA "AquaPro" software tool
    a. Use the Check Connection Button
4. Disconnect from Recorder with Disconnect Button

4.2 Install Current Meter on Clamparatus

4.2.1 Prepare Profiler in Fiberglass Clamparatus Tube

1. Detach Delrin® Collar from Clamparatus Tube – 4 Bolts

Figure 8: Collar Bolts

2. Inspect Safety Cable for Damage and Insert in Collar

3. Loosen All Bolts and Seat Sensor Head in Collar

Figure 9: Connect Aquadopp Cable

4. Connect Aquadopp Communication Cable to Profiler
5. Attach Profiler and Collar to Clamparatus Tube
6. Align Profiler in Tube
    a. 'X' on Sensor Head Faces Directly Away from Clamparatus
    b. Tighten Securing Bolt to Secure Sensor Head

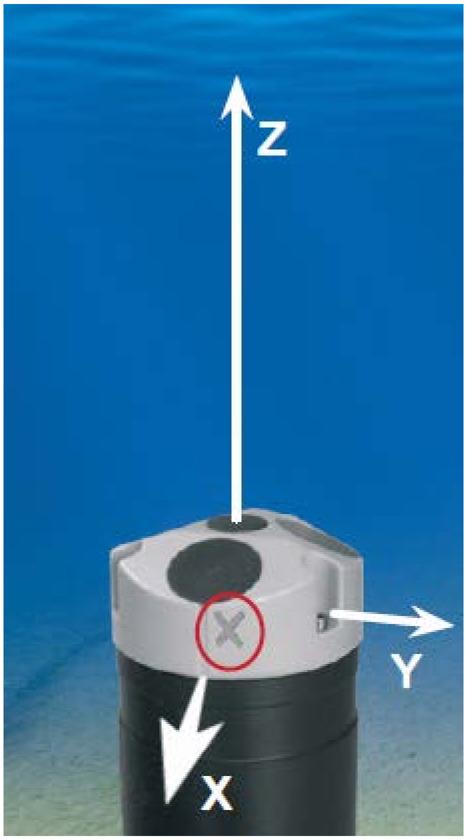

Figure 10: Axis Orientation

7. Secure Collar with 4 Bolts from Step 1

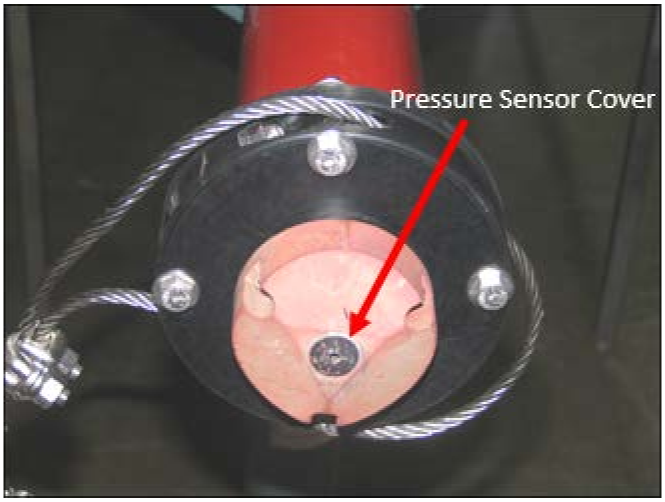

Figure 11: Secure Aquadopp in Tube

8. Paint Tube and Sensor Head w/ Anti-Fouling Within 2 Weeks of Deployment
   a. Do Not Paint Over Pressure Sensor Cover (Figure 11)

b. Paint Pipe From Bottom to First Clamp (at least)

c. Apply Thin Layer of Anti-Fouling Paint to Transducer Faces

Figure 12: Paint Sensor Tube

9. Remove Grey PVC Top Cap

10. Feed Cable Through Cable Clamp's Rubber Gasket

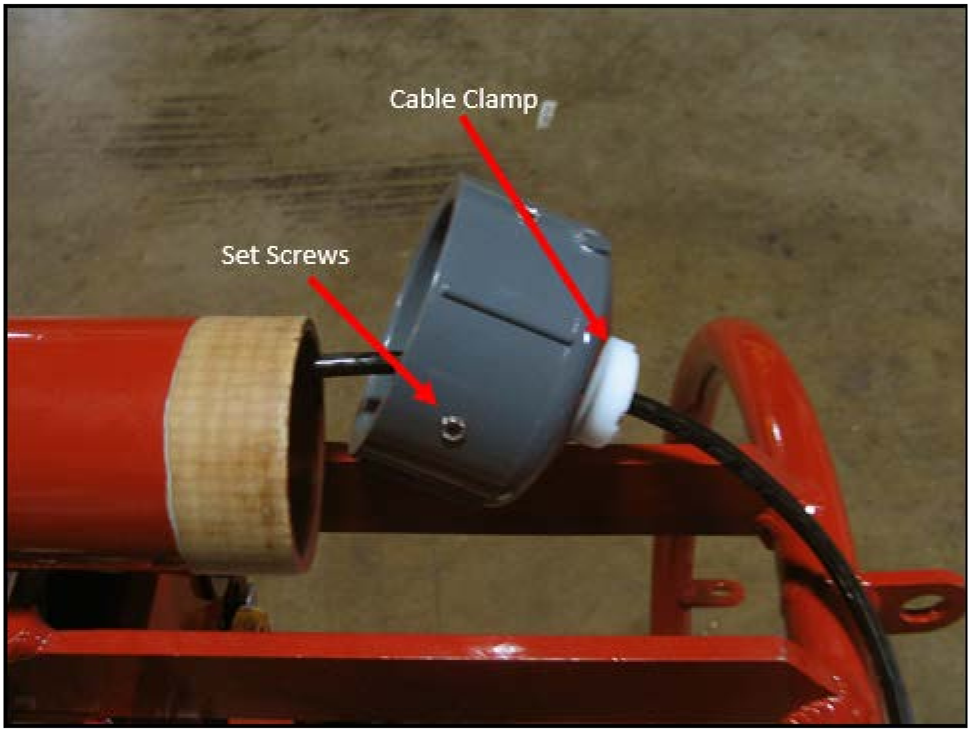

Figure 13: Tighten Top Cap Set Screws

11. Secure Set Screws and Cable Clamp Screws
12. Attach Safety Cable to Fiberglass/Polycarbonate Tube with UV Resistant Zip Ties
13. Secure All Cables with UV Resistant Zip Ties
14. Connect Sensor Cable to Electronics Enclosure

4.2.2 Remove Power Connector from Battery Enclosure

The iATON system can be turned ON/OFF by connecting/disconnecting the two-pin power cable that runs from the battery enclosure to the electronics enclosure (Figure 14). After removing the power connector, the system should be OFF and drawing no current from the main battery bank. The system is now ready to perform the final data throughput test. This test was performed prior to shipment and verified by CIL.

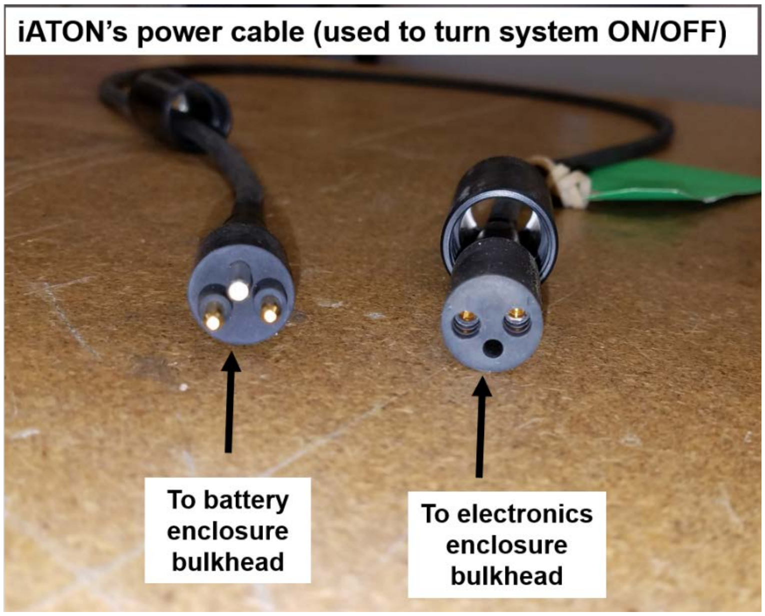

Figure 14: System power and ON/OFF cable

4.3 Verify Data Throughput

After performing the laboratory preparation, it is critical that data throughput be verified once again. This is accomplished by taking the system outside where the Iridium antenna has clear view of the sky and applying power to the system by plugging in the power cable.

When the system has been powered on and transmitting for an hour, verify that data is being populated in the Tidepool FTP server:

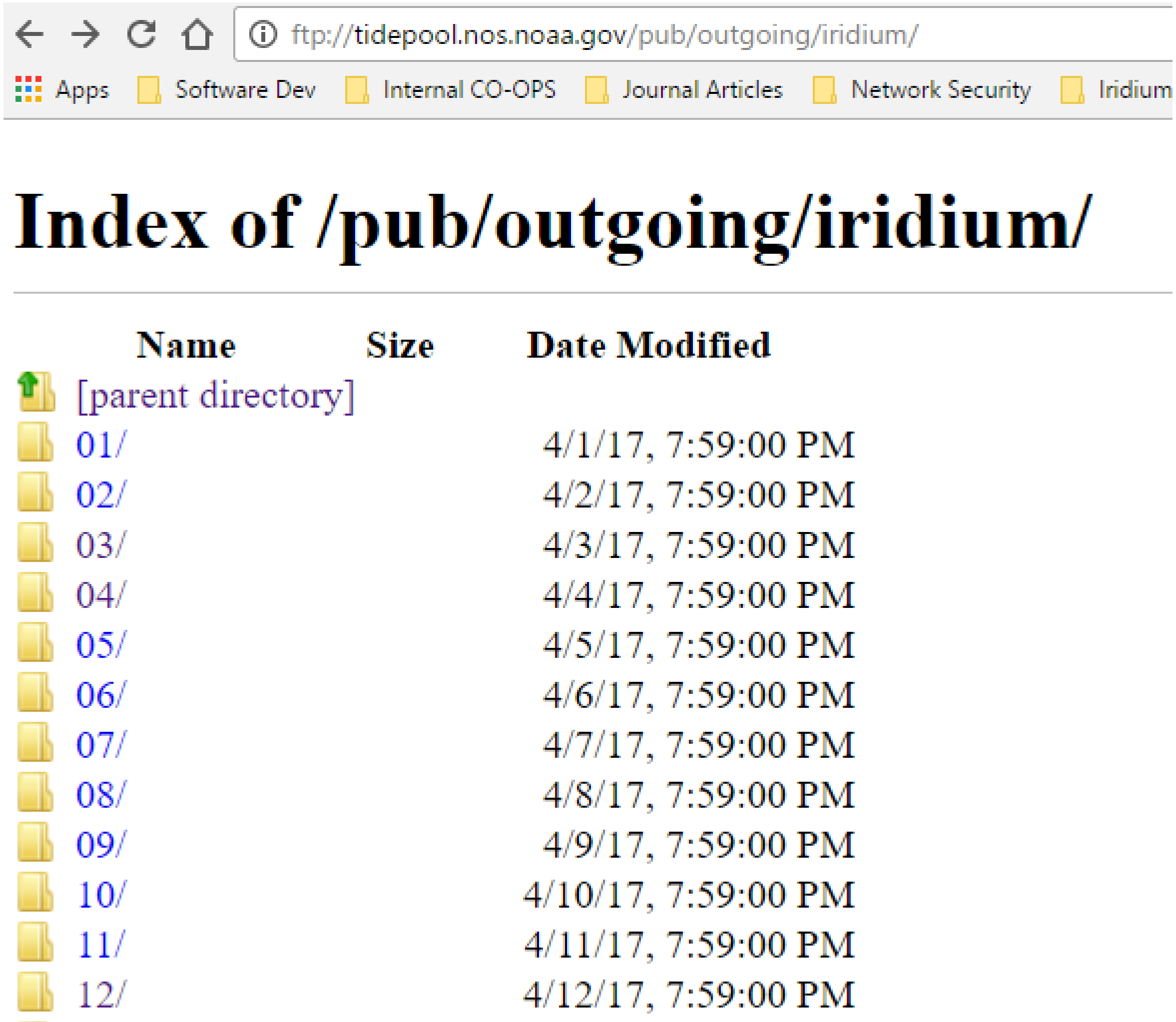

Figure 15: Tidepool FTP Server Directory Structure

Iridium Short Burst Data files are organized in Daily (UTC) folders.

1. Power Up Station
2. Wait 1 Hour
3. Visit ftp://tidepool.nos.noaa.gov/pub/outgoing/iridium/
4. Click on folder with a number corresponding to the current day in UTC

5. *Ctrl-F* to Search for SBD Messages, Corresponding to Station's International Mobile Equipment Identity (IMEI) Number (Figure 16)

6. Ensure messages arriving on the TidePool server are the expected size (343 bytes for maximum 16 bin option)

7. Verify ingestion by contacting POC in CO-OPS Oceanography Division's Data Monitoring and Analysis Team (they will check for data in CMIST)

8. Power Down Station (disconnect two-pin power cable from electronics enclosure to the battery enclosure.

If the station is transmitting as expected, there should be SBD messages arriving in the FTP Server every 6 minutes with a data payload differs with every transmission.

A message that contains data for a full 16 bins is expected to b 343 bytes in size. Occasionally, shorter messages are seen containing approximately 34 Bytes, which is the size of an Iridium SBD header without a payload. This is normal if seen periodically but if messages sizes are consistently small there may be a larger, underlying issue that needs investigated by CIL.

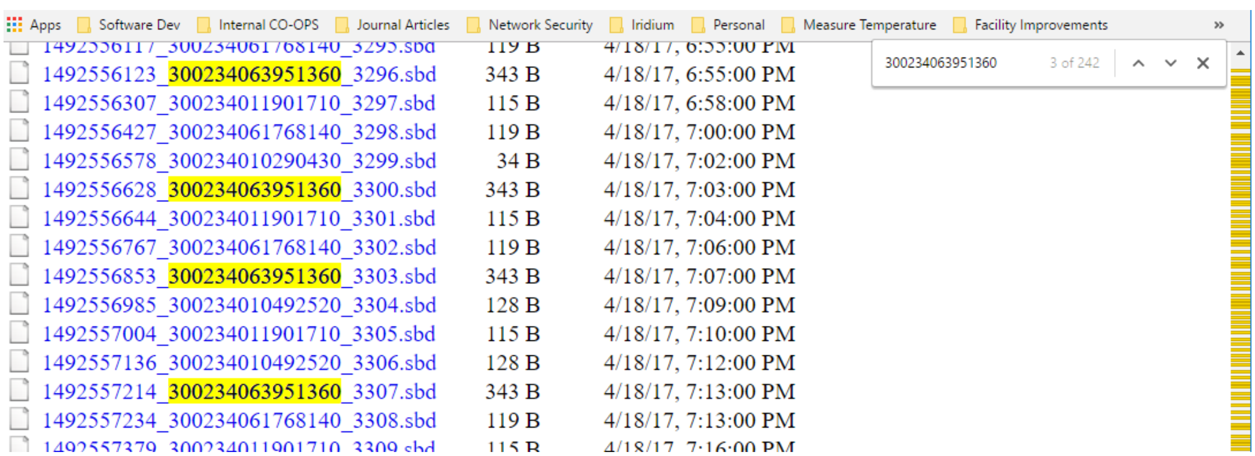

Figure 16: Tidepool - Short Burst Data Files

If corresponding data is not arriving or is not updating and transmitting the same payload at each transmission then something is not operating properly, contact COOPS' CIL for more information. A total of 4 hours of 6-minute transmissions will be sufficient for the final throughput test.

5.0 Field Installation Procedures

5.1 Safety Precautions

Besides using situational awareness and precautions, it is required that all NOAA safety procedures be followed during the staging and installation process, outlined in NAO 209-1: NOAA Safety Policy and in NAO 209-125: Small Boat Safety Program. If supplemental safety requirements are identified by the Project Lead or by stakeholders, those safety requirements are also in effect although they do not supersede judgement of captain while underway. A packing list for the deployment is located in Appendix B. Prior to installation, removal or maintenance of an iATON system; ensure that all items are located in the deployment bag(s). Deployment personnel shall bring a laminated copy of the list in their gear.

Issued 04/30/09; Effective 04/30/09; Reviewed Last: 08/2016 Pending Revisions

http://www.corporateservices.noaa.gov/ames/administrative_orders/chapter_209/209-1.pdf

Issued 04/30/09; Effective 04/30/09; Reviewed Last: 08/2016 Pending Revisions

http://www.corporateservices.noaa.gov/ames/administrative_orders/chapter_209/209-125.pdf

The list below is not meant to be exhaustive and all it is the responsibility of all crewmembers read safety policy documentation above and apply safe working practices at all times.

- Before leaving the dock, the lead individual will talk through the install or maintenance procedure and outline everyone's roles and responsibilities (as mentioned in 5.3).
- Personnel must not risk injury or loss of life for data or equipment.
- Every individual has the right and responsibility to stop work at any time if they feel that conditions are unsafe, or if they identify a potential hazard.
- PFDs shall be worn at all times when on NOAA or chartered vessels.
- Steel-toe boots shall be worn during installation, maintenance and removal.
- Hearing protection is highly recommended as some ATONs have loud fog horns or bells.
- Installation and Recovery require a minimum crew of four people, not including the vessel Captain.

5.2 Field Procedures

The packing list in Appendix B identifies the equipment needed to deploy or recover a Clamparatus and associated hardware. On the day of the deployment, prior to leaving the dock, a walkthrough must be performed where all roles and responsibilities are for the deployment, maintenance or recovery are made clear. Transfer of the Clamparatus from the boat to the buoy is identical to the procedure currently in place [1]. The original "Hoistaratus," which is a system of rope, pulleys and clips originally designed by CO-OPS for this project, is used for transfer of the iATON ADCP system and should be inspected for frays and excessive wear prior to deployment.

Note: Some ATON buoys are equipped with horns or bells, which are quite loud. Bring hearing protection.

5.2.1 Installation

1. 2 Crew Members Aboard the Buoy / 2 Crew Members on Vessel (This does not include the Captain, who will be standing watch and monitoring radio traffic during buoy operations).

   The Crew Members on the vessel are responsible for handling the Clamparatus until it is clear of vessel, while Crew Members on the buoy are responsible for receiving the Clamparatus, positioning it and securing to the ATON buoy.

2. Secure Clamparatus to USCG Buoy with Tag Line
3. Affix Hoistaratus to USCG Buoy's Tower
4. Attach Hoistaratus Quick Release Hooks at 3 Lifting Eyes on Clamparatus
5. Transfer Clamparatus to USCG Buoy
6. Secure Clamparatus to USCG Buoy Lifting Eye w/ Clamping Block
7. Release Hooks and Tag Line

Caution: CO-OPS cables and lines must not be attached to any USCG cables that may be on the buoy.

5.2.2 Current Profiler Compass Calibration

Because the sensor uses the Doppler Shift to measure speed and direction of the water, calibration of the transducers is unnecessary by the end user. However, due to magnetic field variation in field mounting configurations, it is necessary to calibrate the internal compass. The process for calibrating the sensor in-situ is documented in the Nortek Service Manual in Section 1.2.1 Compass Calibration, which is attached in Appendix D. This procedure requires a single, slow rotation around the instrument's tilt axis. The CO-OPS practice for calibration of the compass uses this process with slight variation, as shown below and follows the checklist in Appendix E.

Refer to Nortek Aquadopp Profiler Manual and Nortek Service Manual to supplement the instructions in this section.

1. Wrap Line Completely Around Buoy 4 Times
2. Connect Directly to Profiler w/ AquaPro Software
3. Click *Communications* > *Serial Port*
    a. Increase Baud Rate to 115,200
    b. Baud Rate & Recorder/Configuration Baud Rate
    c. Do Not Select Hard Break

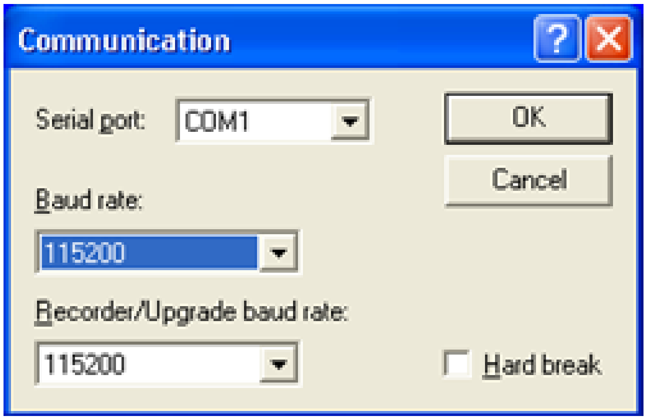

Figure 17: Aquapro Baud Rates

4. Click *Online* > *Compass Calibration*
5. Crew on Buoy Hand Line to Boat Crew
6. Boat Slowly Pulls Line to Rotate Buoy
7. Click *Start* (Figure 18) After Rotation Commences
8. Click *Stop* After 3 Full Rotations, Before Buoy Stops Rotating
9. *Update the instrument?* Will appear. If calibration error < 5º then select *Yes*.
    a. Select No if Error > 5º
    b. Sources of Error
        i. Rotation too fast > 3 rev/min

ii. Less than one rotation

iii. Stop in rotation

iv. Trace not consistent over 3 rotations

10. If Calibration Outside of Spec, Repeat Steps 4 Through 9.

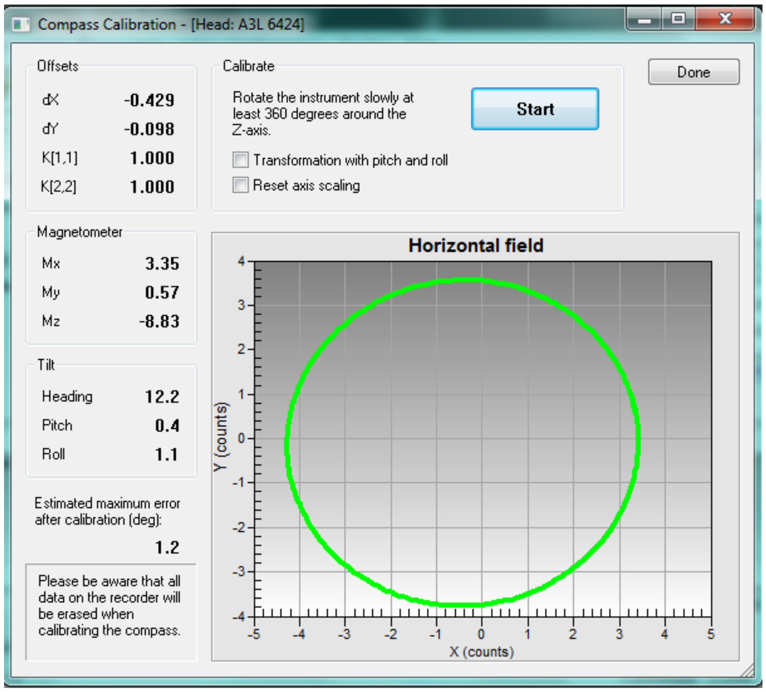

Figure 18: Aquapro Compass Calibration Screen

11. Save Calibration Data

   1. Right-click on *Data plot* > *Export*
   2. Select *Text/Data Only*, *File*
   3. Browse and select the folder and filename
   4. Click *Export* (Figure 19)

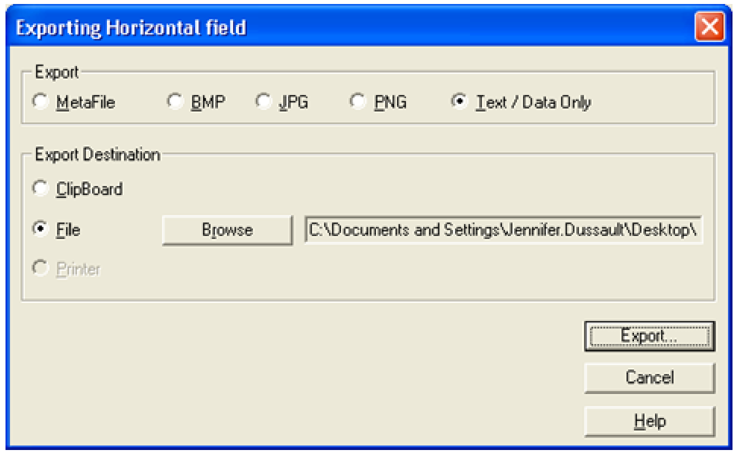

Figure 19: Save Aquapro Calibration Data

5. Select *Data*, *Table*, *Subsets/Points*

6. Export

UPDATE Figure 19 ABOVE and 20 BELOW After Next Deployment

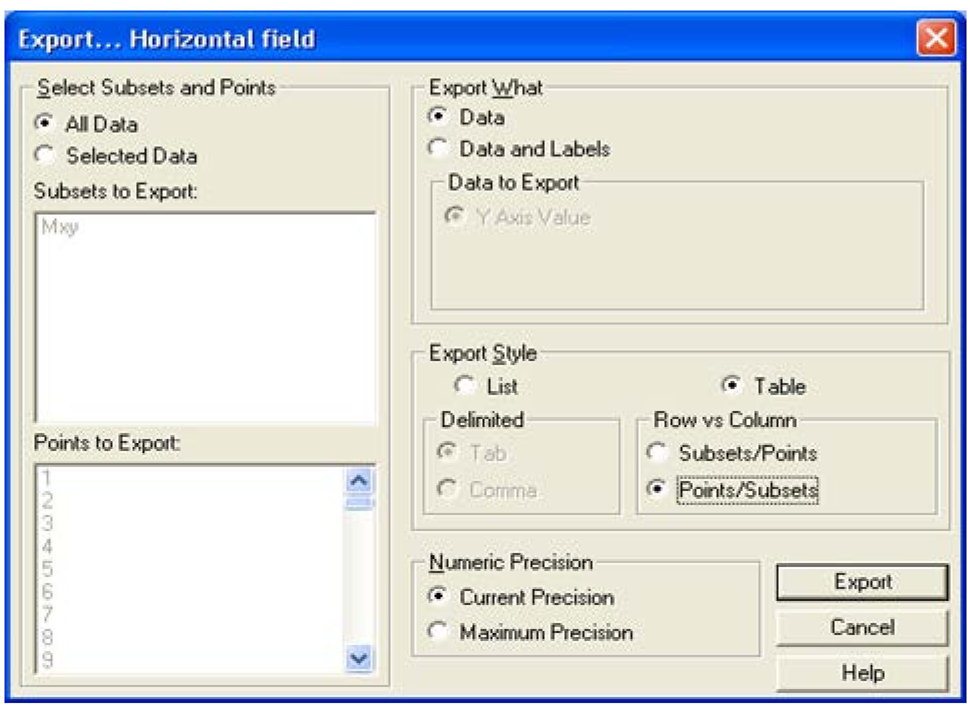

Figure 20: Save Aquapro Calibration Data Subsets

7. Save Screenshots of Export Configurations to PC

8. Reset Baud Rates for Sutron DCP Recording
    - Click *Communications* > *Serial Port*
        - Both “Baud Rate” and “Recorder/Configuration Baud Rate” should be set to 9600

5.2.3 DCP Procedures

1. Turn on the DCP using the 2-pin, keyed cable from the electronics enclosure to the other battery box (Figure 21).

Figure 21: PC - DCP Interface Cable Connector

2. Using custom cable (9-pin RS232 from PC to 8-pin Impulse bulkhead) on iATON electronics box. Connect to DCP in electronics enclosure

Figure 22: Keyed, 2-pin Power Cable

3. Verify Iridium Signal Quality > 0

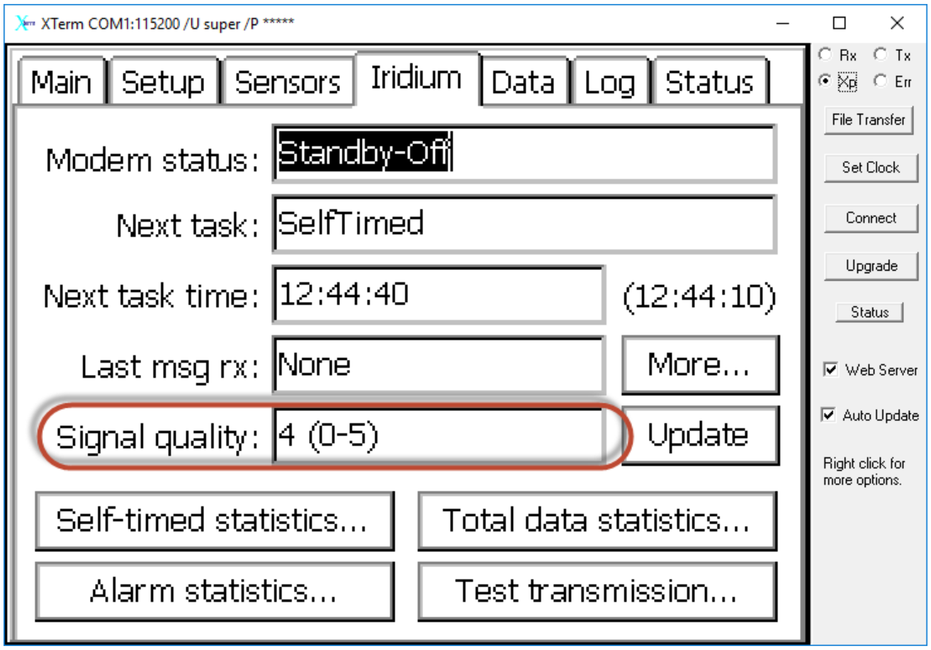

Figure 23: Iridium Signal Strength

4. Start Recording

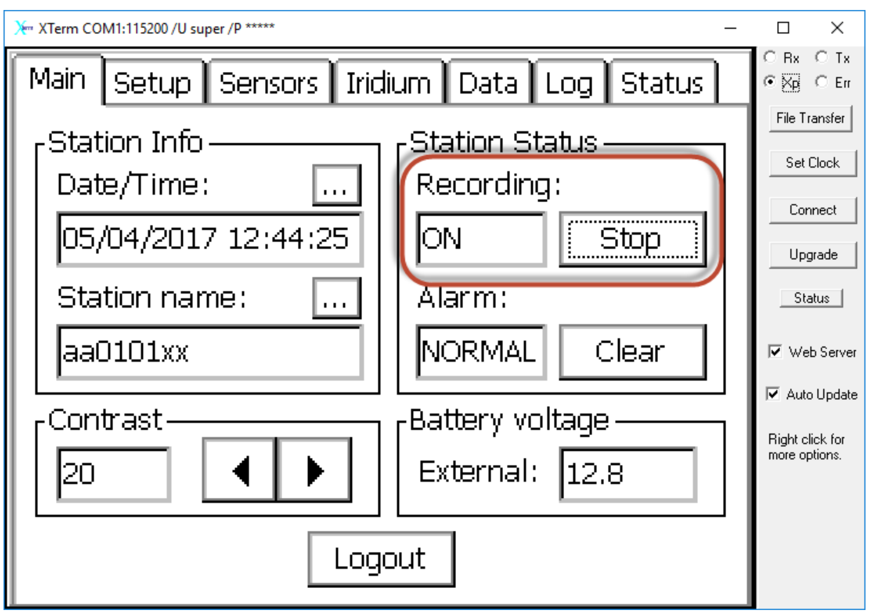

Figure 24: Start Recording on DCP

5. Wait For Two 6-Minute Samples

6. Verify Sensor Data

    - Confirm Files are Being Recorded

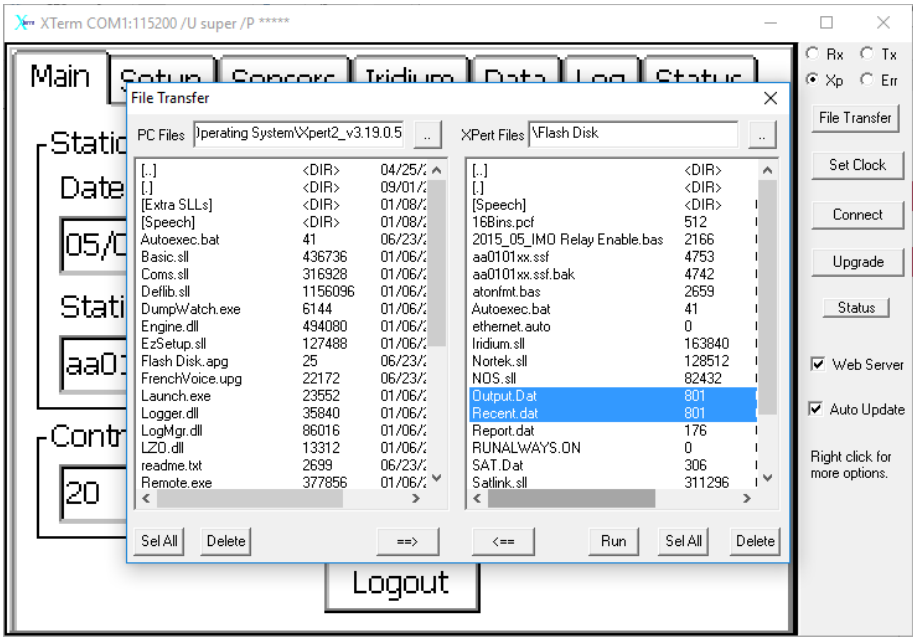

Figure 25: Verify Recent.dat/Output.dat Updated pt.1

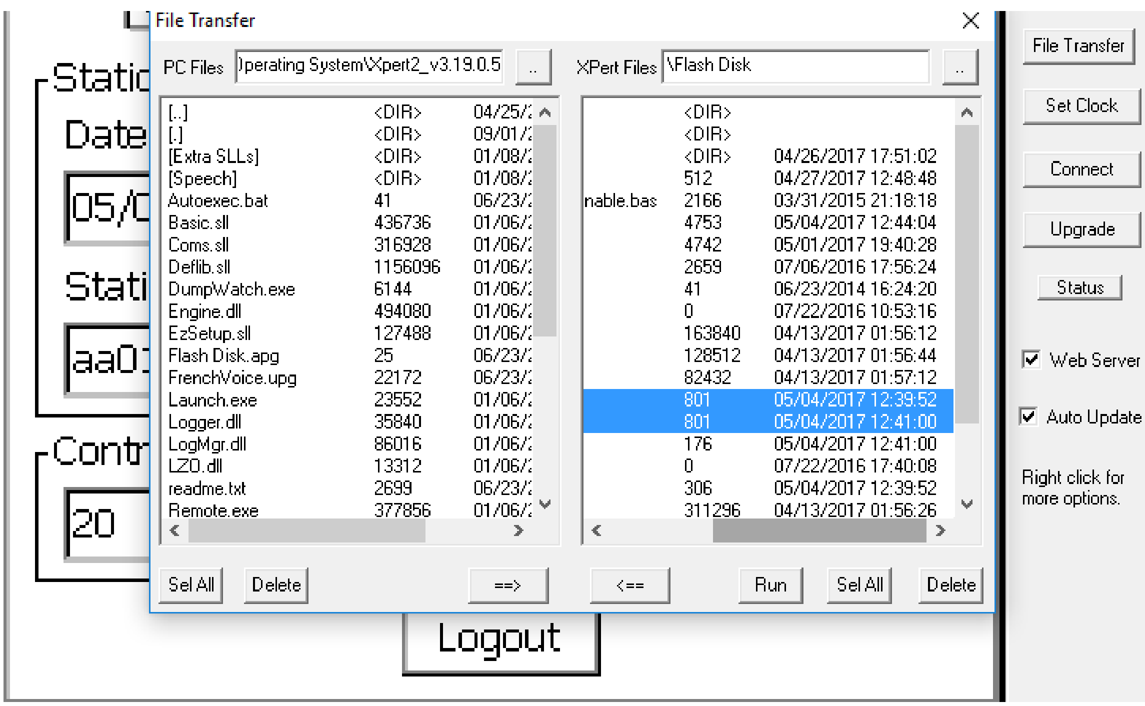

Figure 26:Verify Recent.dat/Output.dat Updated pt.2

- Confirm Satellite Transmission Formatting (Figure 28)

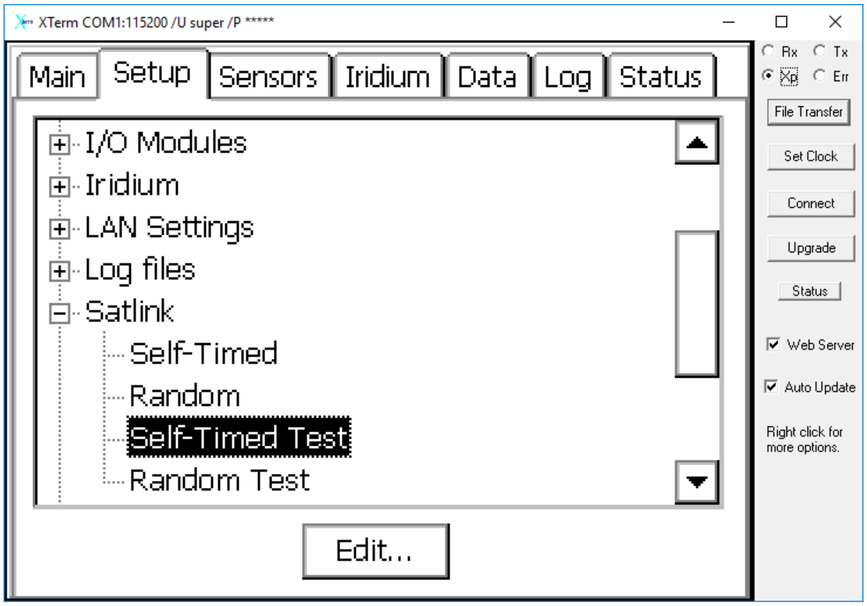

Figure 27: Iridium Formatter Verification pt.1

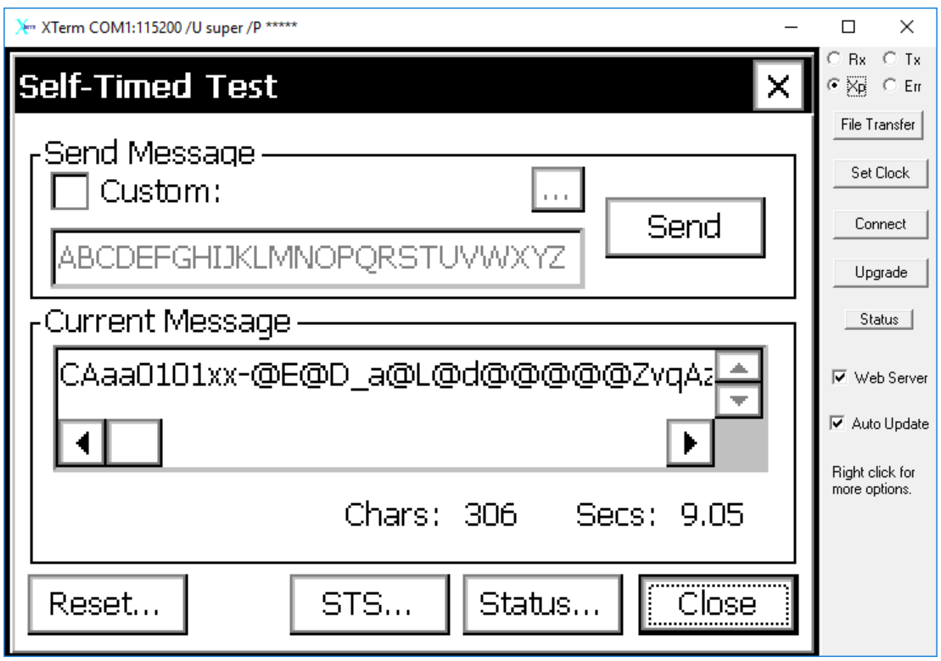

Figure 28: Iridium Formatter Verification pt.2

7. Contact CORMS and Verify Full Data Throughput

6.0 Removal and Recovery

6.1 Notify CORMS of Removal

It is necessary to notify the CORMS office prior to work anytime a site visit is required or scheduled. Notification is also required after the maintenance or removal has been completed.

CORMS Phone Number: (301) 713-2540

6.2 Turn Off Recording on DCP

1. Connect to the DCP
2. Log-in
3. *Stop* Recording

6.3 Remove Clamparatus

1. 2 Crew Members Aboard the Buoy / 2 Crew Members on Vessel

The Crew Members on the buoy are responsible for securing iATON antennas, Hoistaratus and Clamparatus until it has been transferred to the vessel.

2. Affix Hoistaratus to USCG Buoy Tower’s Top Rung
3. Secure Clamparatus to Vessel with Tag Line
4. Attach Quick Release Hooks at 3 Lifting Eyes on Clamparatus
5. Secure Clamparatus to USCG Buoy Lifting Eye w/ Clamping Block
6. Transfer Clamparatus to Vessel
7. Release Hooks and Tag Line

4.0 References

1. Bosley, K.T.; J. Dussault, C. McGrath, M. Bushnell; M. Evans; G. French; K. Earwaker. 2005. Oceans System Test and Evaluation Program Test, Evaluation, and Implementation of Current Measurement Systems on Aids-To-Navigation. NOAA Technical Report NOS CO-OPS 043, http://www.tidesandcurrents.noaa.gov/publications/technical_report_43.pdf

2. Bosley, K.T.; C. McGrath, T. Graff, J. Stepnowski. 2006. Enhancements to the NOAA current measurement system on US Coast Guard navigation buoys. OCEANS 2006, DOI: 10.1109/OCEANS.2006.306996, pp. 1-3. Boston, MA: MTS/IEEE.

3. Krug, W., Heitsenrether, R., Hensley, Project Plan for Development and Test of Enhanced PORTS® ATON ADCP Real-Time Current Measurement System, November 2014 – September 2015, OSTEP Project Plan, November 2014, http://intranet.nos-tcn.noaa.gov/media/wikidocs/OSTEP/New_ATON_ADCP/ATONADCP_ProjectPlan_v6.pdf

4. Heitsenrether, R., W. Krug, W. Hensley, M. Bushnell, System Requirements for the Enhanced PORTS® ATON ADCP Real-Time Current Measurement System, December 2014. http://intranet.nos-tcn.noaa.gov/media/wikidocs/OSTEP/New_ATON_ADCP/ATON_ADCP_Requirements_v3.pdf

5. OSTEP Preliminary Design Review Presentation (April 2015): http://intranet.nos-tcn.noaa.gov/media/wikidocs/OSTEP/New_ATON_ADCP/PrelimDesignSummary_v4.pdf

6. OSTEP Critical Design Review Presentation (July 2015): http://intranet.nos-tcn.noaa.gov/media/wikidocs/OSTEP/New_ATON_ADCP/DetailedDesignSummary_v2

7. Nortek System Integrator Manual. Last Accessed September 20, 2016. http://www.nortek-as.com/lib/manuals/system-integrator-manual.

8. Nortek Aquadopp Profiler Manual. Last Accessed Septembber 20, 2016. http://www.nortek-as.com/lib/manuals/aquadopp-profiler/view

9. System Design for Iridium ATON ADCP Real-Time Current Measurement System. Hensley, Haith and Heitsenrether. September 2016.

Appendix A: Reconnaissance Checklist

iATON Recon Packing List and Checklist

Responsible Party:

Date:

Item	**Notes**	
100m Measuring Tape		
25’ Measuring Tape		
Rags and Baby Wipes (for Bird Goo)		
Safety Gear		
Camera		
Notebook		
1. Notify Local POCs		
2. Buoy Diameter Measurements		
3. Buoy Color (R/G)		
4. Water Depth Measurement	**Date/Time:**	
5. Cellular Coverage at Site?		
6. Top surface of buoy (where clamparatus to be mounted) flat and not curved (y/n)?		
7. Ensure no obstructions atop buoy surface where clamparatus will sit when mounted.		

Appendix B: iATON Deployment Packing List

iATON Current Profiler Deployment Packing List	
Responsible Party: Date:	
Assembled Clamparatus, Mounting Hardware and Spares	
Line for Profiler Calibration Spin	
Safety Gear	
“Hoistaratus”	
Camera	
Rags and Baby Wipes (for Bird Goo)	
Work Gloves & Nitrile Gloves	
Never Seize	
Deployment or Recover Logs	
Aquadopp Profiler Manual	
Nortek Service Manual	
Spare Hardware (Zippered Bag)	
Diagonal Wire Cutter (x2)	
Cable Ties	
Ratchets and Open Wrenches (x2)	
Delrin® Antenna Mounts and Hardware (x3)	
Marine Grade Iridium Antennas (x2)	
Digital Antenna for IP Modem (x2)	
Large Crescent Wrench (x2)	
Laptop w/ Aquapro Software, XTerm Software & RS232 Port	
Extra Laptop Battery	
iATON DCP to PC Interface Cable (x2)	
2-Pin Impulse Battery Cable	
RS-232 Cable	
Nortek Interface Cable w/ All Necessary Power Attachments	
12V Battery Backup for Profiler Compass Calibration	
Alligator Clips for Inverter	
Vulcanizing Tape	
Electrical Tape	
Power Inverter	
Knife. Nothing Beats a Good Knife.	
8 Pin & 2 Pin Dummy Plugs (x2 each)	

Appendix C: Nortek Aquadopp Deployment Procedures

Current Profiler Deployment Check List	
Responsible Party: Date:	
Change Baud Rate to 115200 in AquaPro	
Calibrate Compass With <= 5º error	
Save Calibration Data	
Reset Baud Rates to 9600, Do Not Check ‘Hard Breaks’	
Re-Attach Sensor and Start Recording on DCP	
Verify Sensor Data Recorded on DCP	
Verify Iridium Signal Strength Greater than 0 (Preferable: 5)	

Appendix D: Compass Calibration – Nortek Service Manual

Compass Calibration

Each compass system has been calibrated at the factory to quantify the characteristic response of the individual components and of the system as a whole. When it leaves the factory, each system can measure its tilt and the direction of its magnetic field vector accurately, anywhere in the world. However, users disturb the magnetic field near the instrument when they deploy. Adding a battery pack and mounting the instrument with deployment hardware adds magnetic materials that change the earth's field at the instrument. The compass calibration procedure quantifies this magnetic disturbance, and the instrument's compass algorithm then corrects for it to obtain accurate heading. As a side note, the compass is not used when measuring velocity in XYZ or beam coordinates, but if you plan on using the compass heading at a later point (for instance to orient the XYZ velocities relative to the lake axes, it is probably worth calibrating the compass in advance.

You should perform the compass calibration just prior to deployment to correct for the introduction of new magnetic materials, as you can correct for magnetic sources that rotate in the same coordinate system as the compass itself. The compass calibration procedure requires a single, slow rotation around the instrument's tilt axis. A rotation taking at least 60 seconds is sufficient. For the calibration procedure to work, the compass and all magnetic materials must remain fixed relative to each other. As long as this is the case, the calibration procedure can correct for magnetic field disturbances that are greater than the earth's magnetic field. You should conduct this procedure outdoors, away from other possible magnetic elements.

1) Assemble the frame (or similar) with the instrument, battery canister, and extra ballast, etc. and connect the system to the computer.

2) Make sure the frame is level when calibrating the compass, and that it is possible to rotate the entire system 360° horizontally.

3) Click On-line > Compass Calibration.

4) Click Start and rotate the entire system slowly around the Z-axis of the instrument. An example of a successful rotation is shown below. Note that when doing this in the field, you cannot expect to end up with a circle as perfect as this one. **However, we recommend you to do this slowly in an attempt to come as close to the ideal circle as possible**.

5) To utilize the obtained values, click Done. You will be prompted to confirm that the new values shall be transferred to the instrument to serve as the new compass setting.

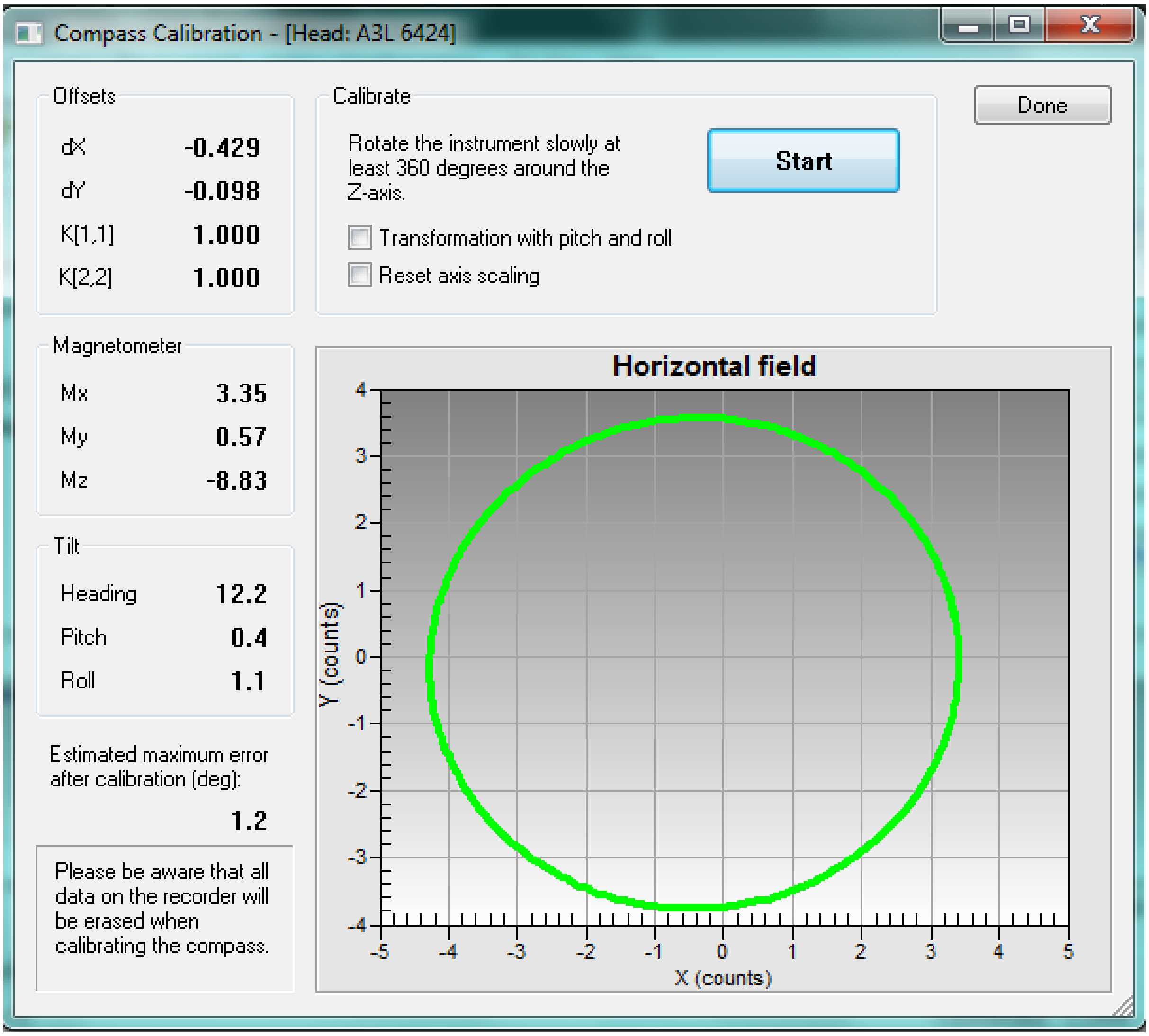

Figure 29: Successful Compass Calibration

Appendix E: Compass Calibration Checklist

iATON Current Profiler Compass Calibration Checklist	
Responsible Party: Date:	
Wrap Line Completely Around Buoy 4 Times	
Connect Directly to Profiler w/ AquaPro	
Increase Baud Rate to 115,200	
Do Not Select Hard Break	
Click Online > Compass Calibration	
Boat Slowly Pulls Line to Rotate Buoy	
Click **Start** After Rotation Commences	
Click **Stop** Before Buoy Stops Rotating	
Calibration Error < 5º ? **(Y/N)**	
Repeat if Calibration Error > 5º	
Save Calibration Data	
Test/Data File	
Data, Table, Subsets/Points	
Screenshots of Export Configurations	
Reset Baud Rate to 9600	