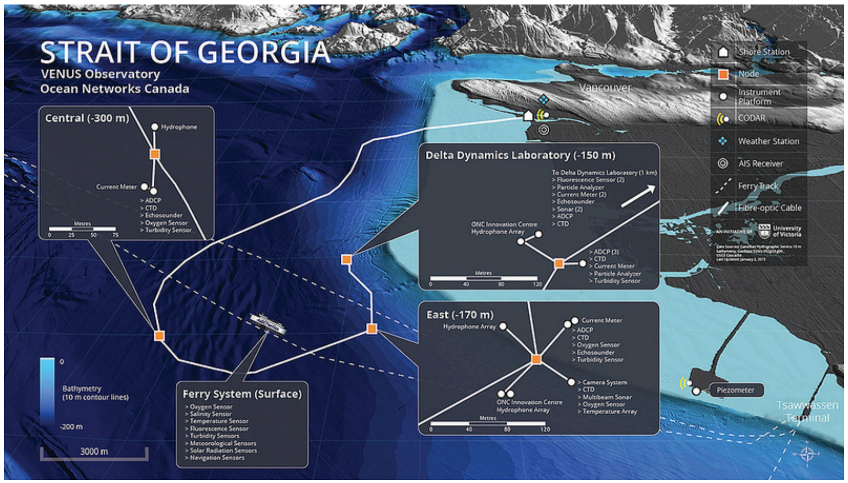
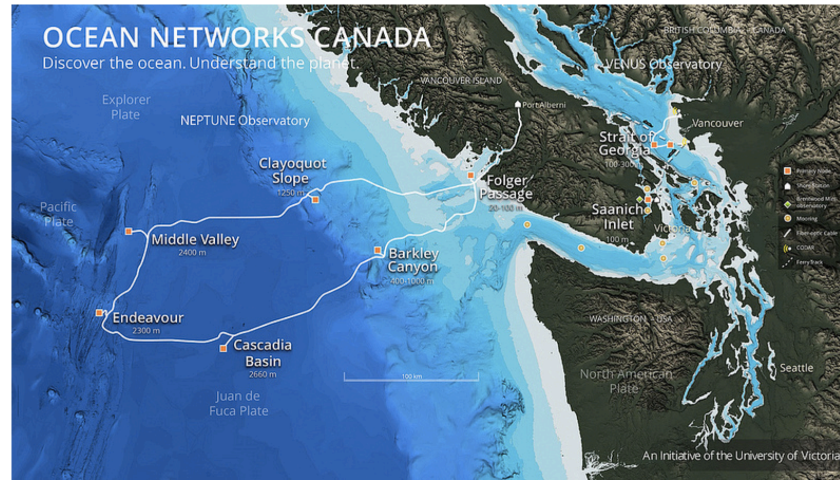
# Development and implementation of best practices for the Ocean Networks Canada ocean observatories



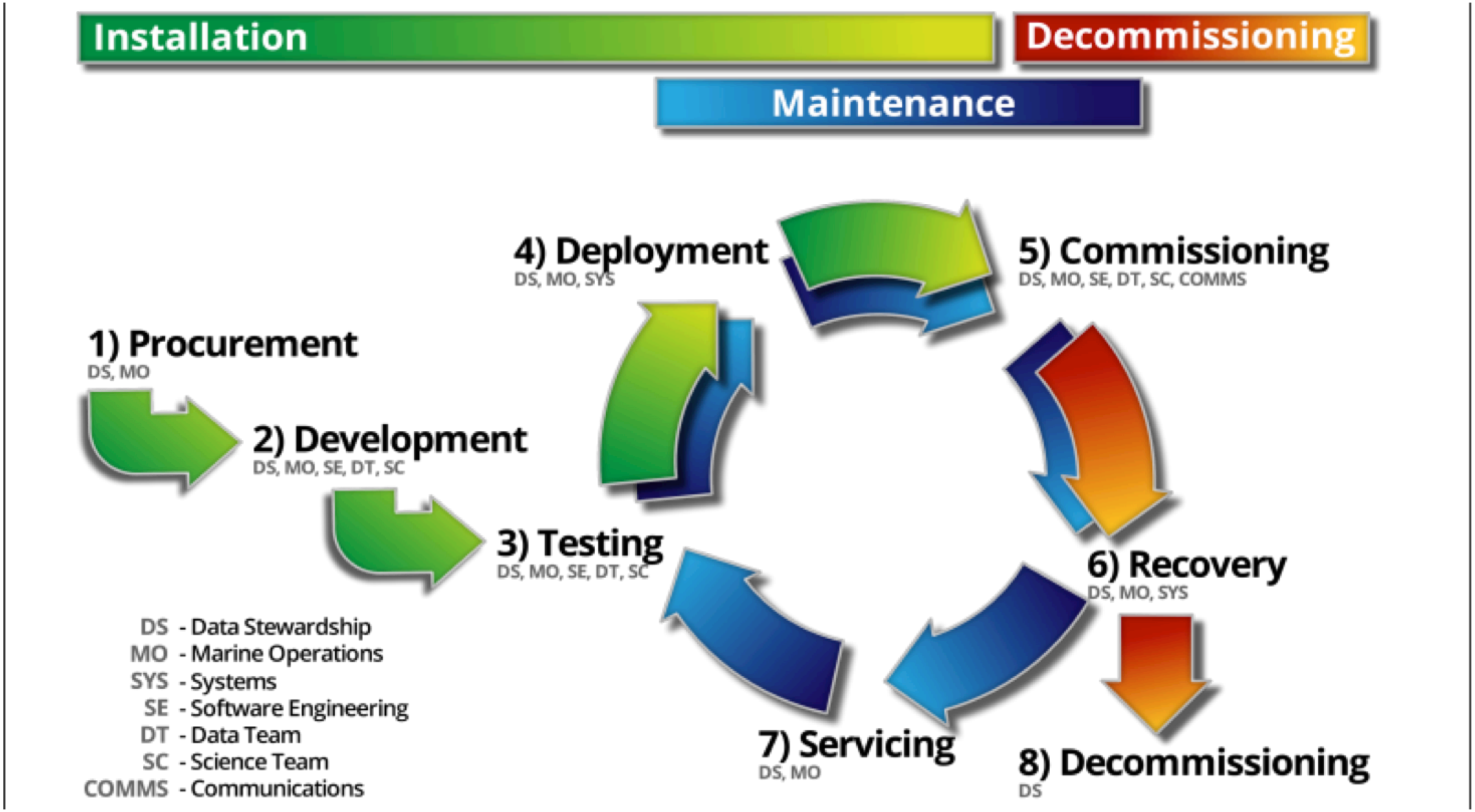





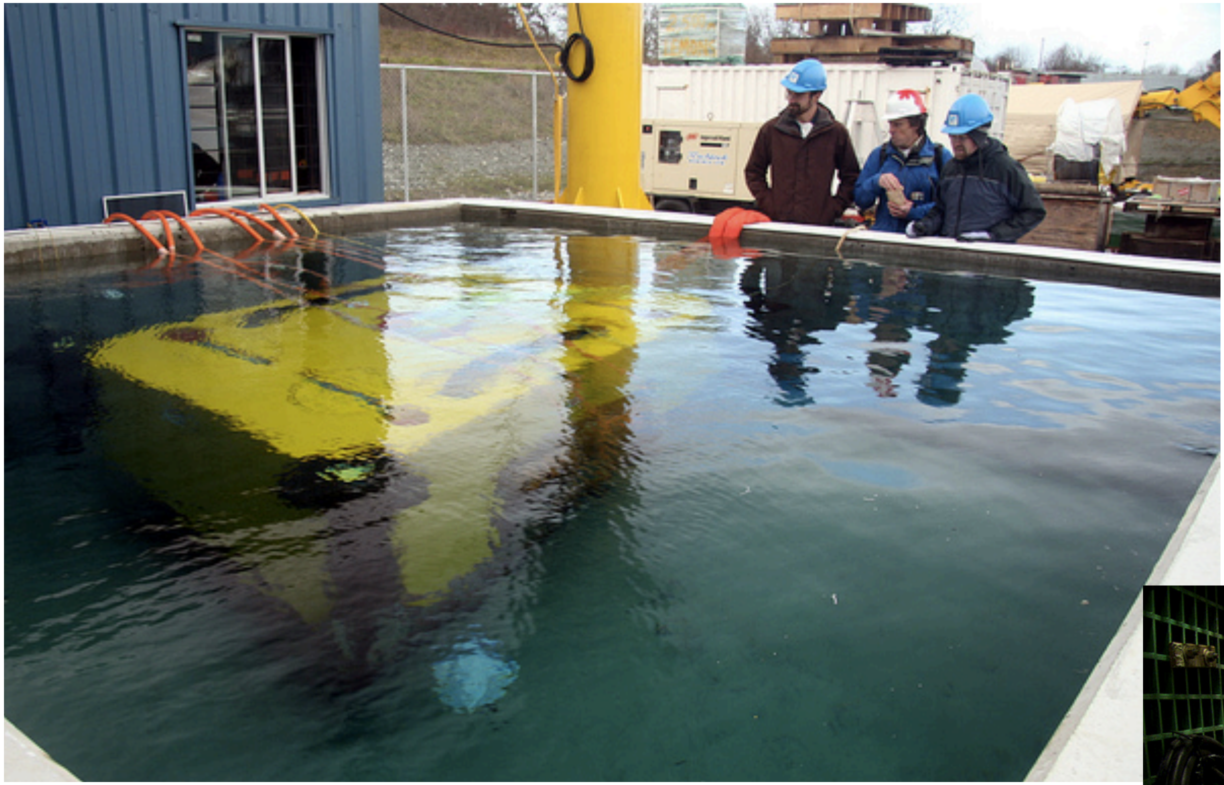
*S. Kim Juniper, Akash Sastri, Reyna Jenkins and Marlene Jeffries*

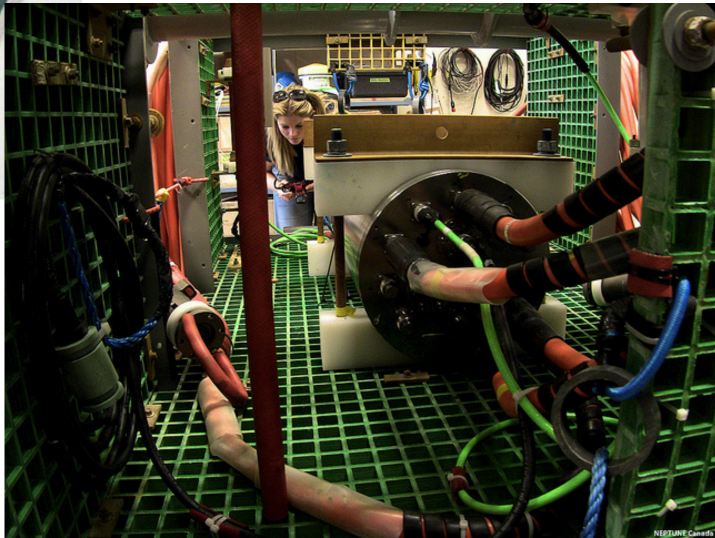
*Ocean Networks Canada*

# Quality Assurance Process - Instruments

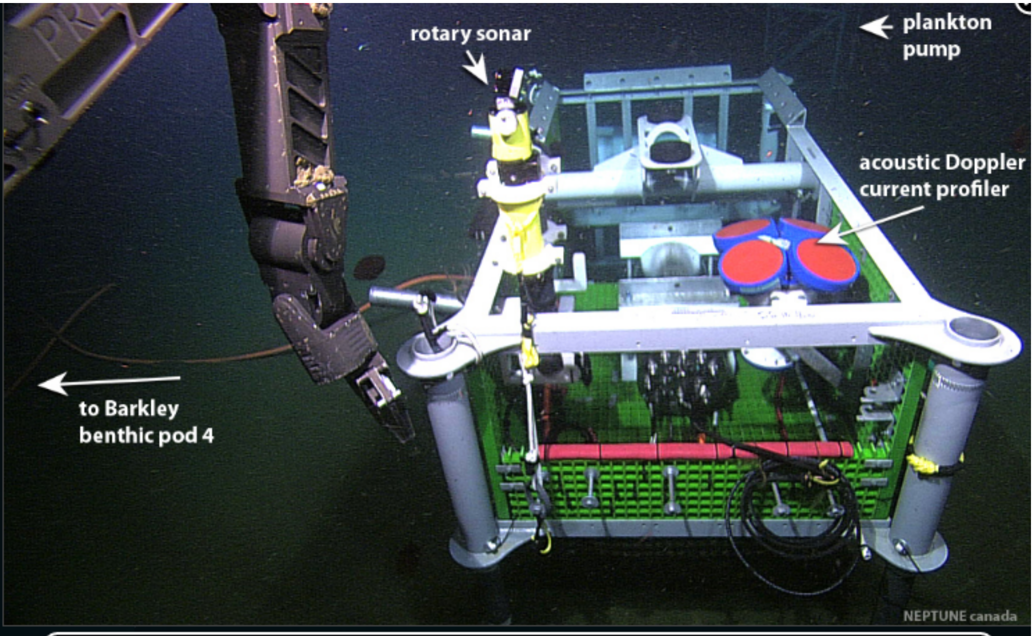


# Pre-Deployment Testing - Instruments





# Instrument deployments



Barkley benthic pod 3 in position on the seafloor, with rotary sonar lifted into deployment position, 11 September 2009.


# Instrument Deployment and Maintenance Expeditions – Workflows

**Ocean Networks Canada** Device Details
Oceans 2.0

Logged in as **Reyna Jenkyns** | Profile | Help | Logout

Data Search | Code Runner | Plotting Utility | SeaTube | Digital Fishers | Cameras | Projects | More | Tools

Device Id: **10610** Device Name: **Sea-Bird SeaCAT SBE19plus V2 6316**

General | Sensor | Ip | Electrical Rating | Data Rating | Nameplate | Port | Physical Characteristics | Device Action | Event | Site | Procurement | Additional Attributes | Workflow | SeaScript

**ONC 2013-09 Falkor Leg 2: Autonomous Cruise Device** (Process Group)

**Autonomous Cruise Device On-Shore Development** — Complete: 7/7

| Task | Area of Responsibility | Status | Comment | JIRA | Last Modified (UTC) | Modified By |
|---|---|---|---|---|---|---|
| Device - create | Data Stewardship | Complete | | | 16-Oct-2013 00:08:32 | Reyna Jenkyns |
| Sensors - create | Data Stewardship | Complete | | | 23-Apr-2014 21:36:07 | Reyna Jenkyns |
| Ports - create | Data Stewardship | Complete | | | 23-Apr-2014 21:36:07 | Reyna Jenkyns |
| Calibrations - update | Data Stewardship | Complete | calibration sheets received | NEPDATA-1878 | 20-Jun-2014 15:06:10 | Reyna Jenkyns |
| Conversion routine - prepare | Data Stewardship | Complete | | | 20-Jun-2014 01:48:50 | Reyna Jenkyns |
| Parser - develop | Software Development/Testing | Complete | | | 20-Jun-2014 01:41:40 | Reyna Jenkyns |
| Data Products - develop | Data Team | Complete | log files are sufficient for now | | 20-Jun-2014 01:42:18 | Reyna Jenkyns |

Edit

**Autonomous Cruise Device Field Procedure** — Complete: 8/9

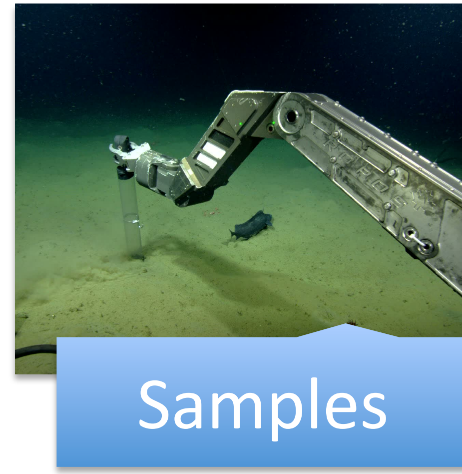
| Task | Area of Responsibility | Status | Comment | JIRA | Last Modified (UTC) | Modified By |
|---|---|---|---|---|---|---|
| Instrument Documentation - collect | Data Stewardship | Complete | scanned calibration sheets obtained by Karen | | 16-Oct-2013 00:09:37 | Reyna Jenkyns |
| Power supply - verify | Engineering | Complete | | | 16-Oct-2013 00:09:37 | Reyna Jenkyns |
| Autonomous Data Storage - verify | Data Stewardship | Complete | | | 16-Oct-2013 00:09:37 | Reyna Jenkyns |
| Instrument - prepare | Engineering | Complete | | | 16-Oct-2013 00:09:37 | Reyna Jenkyns |
| Instrument Clock - synchronize | Engineering | Incomplete | | | 18-Sep-2013 23:07:15 | Reyna Jenkyns |
| Autonomous data - download | Engineering | Complete | | | 16-Oct-2013 00:09:37 | Reyna Jenkyns |
| Data Stream - verify | Systems | Complete | | | 16-Oct-2013 00:09:37 | Reyna Jenkyns |
| Instrument - configure | Engineering | Complete | | | 16-Oct-2013 00:09:37 | Reyna Jenkyns |
| Deployments - document | Data Stewardship | Complete | via ROV dive logs, topology, sitedevices and device actions | | 21-Jul-2014 22:52:45 | Meghan Tomlin |

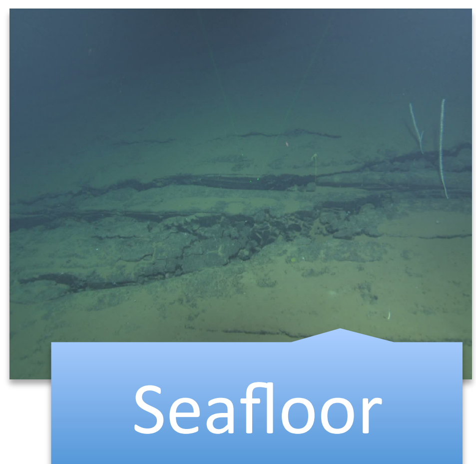
Edit

# Logging during ROV maintenance operations

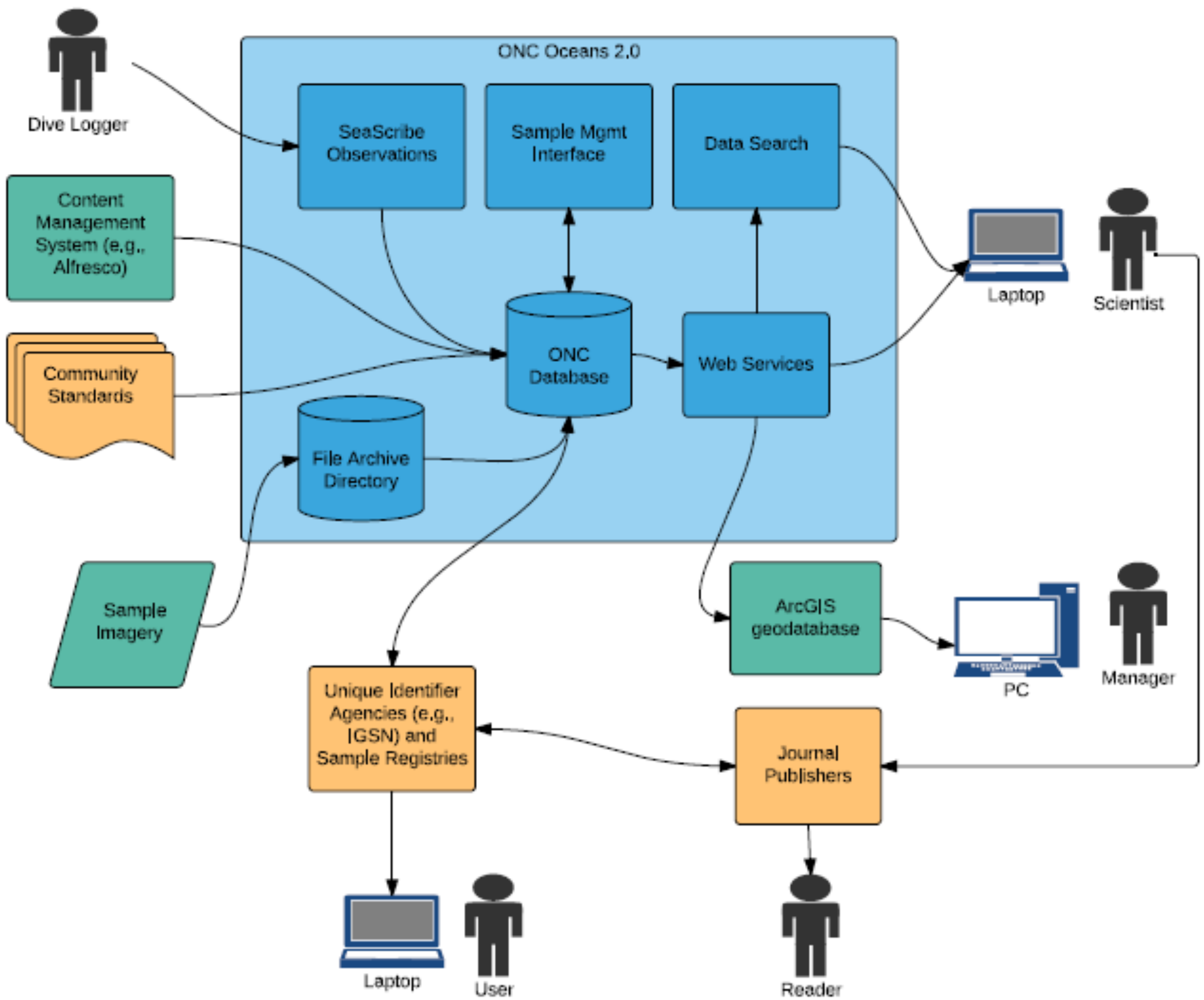
# Logging during ROV maintenance operations

- SeaScribe logging system annotates maintenance, survey, and sampling activities on ROV video
- Annotations also record scientific observations of seafloor substratum and biology
- Increases searchability and usability of dive video
- Supports derivative applications, such as automated classifiers and generation of geodatabase layers


# Integrating Physical Sample Info and Video Annotations into Digital Infrastructure



# ONC Quality Assurance and Quality Control (QA/QC) Best Practices

## Quality Assurance

- Entire organization follows process to ensure best possible data quality
- Instruments collecting data must be tested, validated and commissioned to ensure data quality throughout deployments

## Quality Control

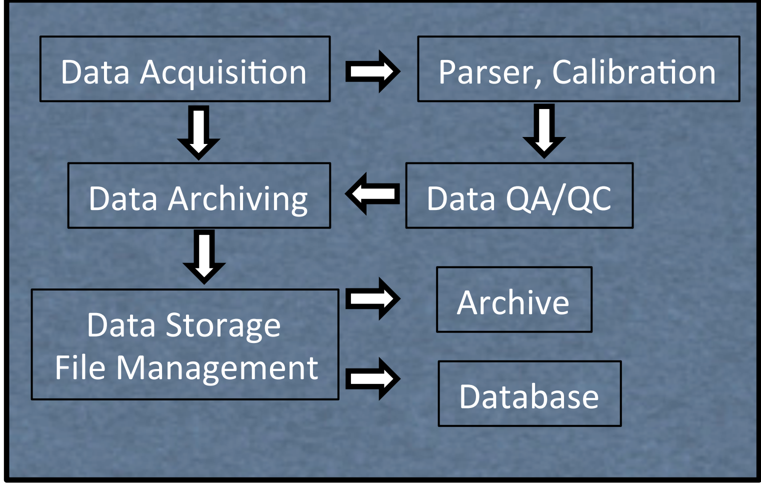
- Maximizing scientific value of data received from instruments by
  - Identifying and flagging outliers in the data
  - Returning information about the quality to the user
  - Adhering to international standards for quality control

# ONC Quality Control

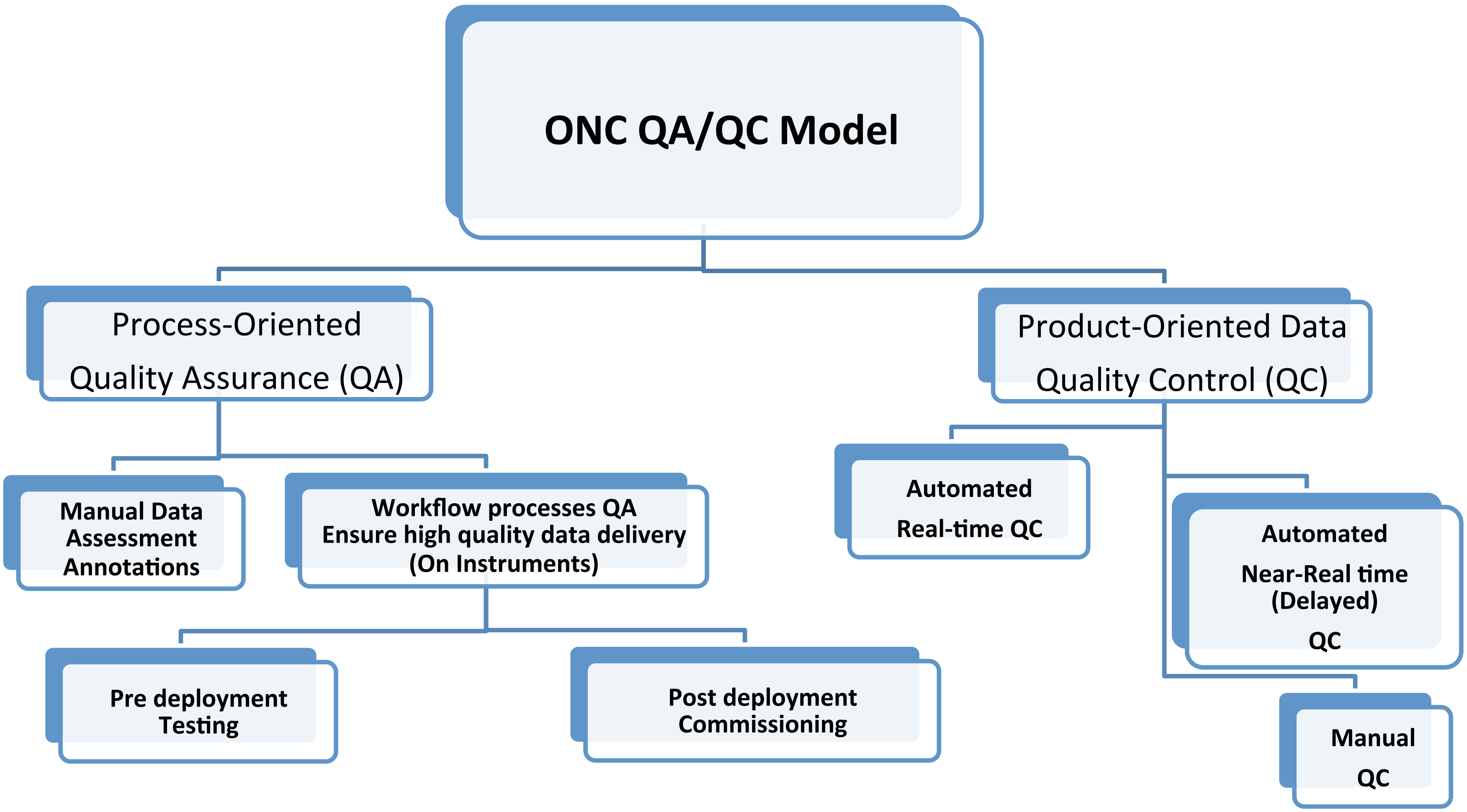
## Automated tests and Manual review

- Automated QC tests:
  - Provide QC flags in real-time
  - Gross range values tests to ensure instruments are working within specifications
  - Other range values tests to ensure data are similar to other data from the site
- Manual QA/QC
  - All data are reviewed by a Data Specialist
  - QC flags are adjusted as needed

# Automated QC



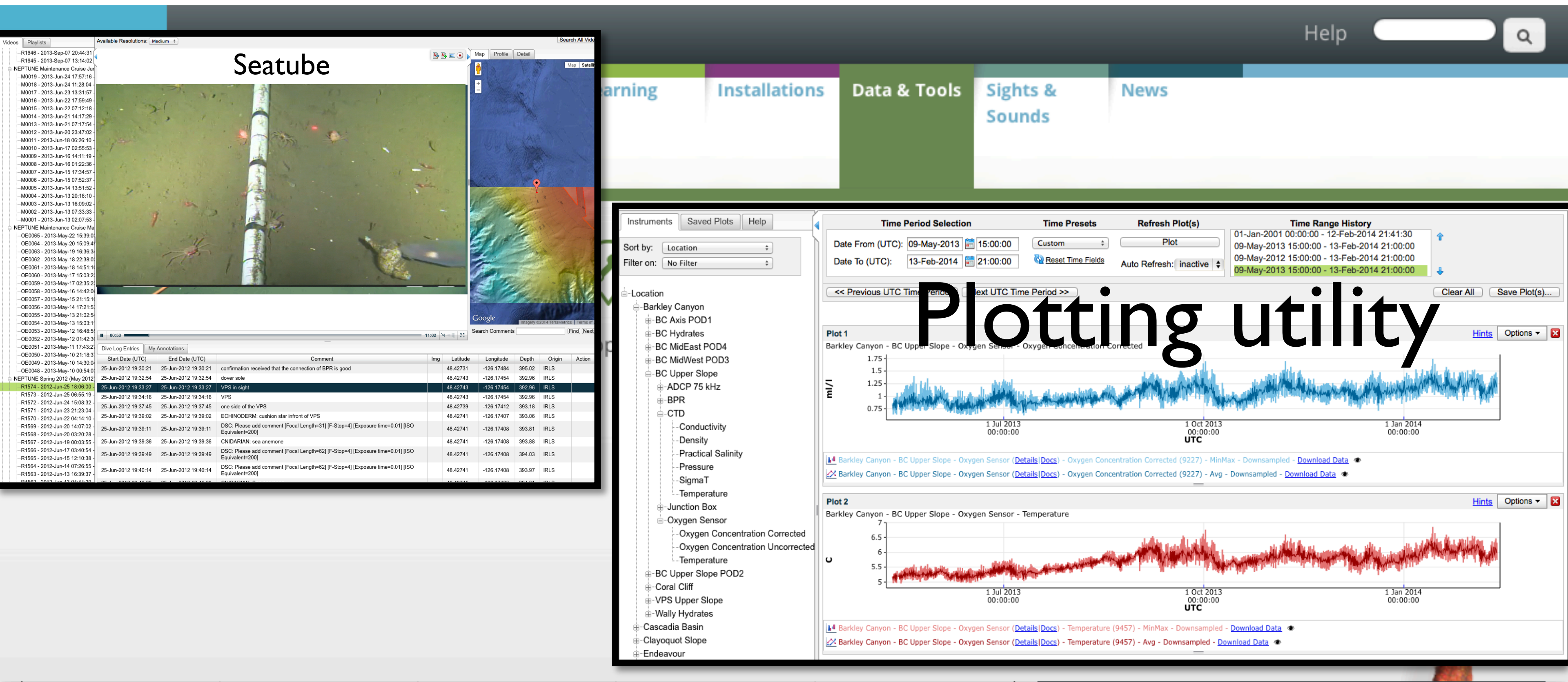

- Tests applied to most scalar data as they are parsed from received data string
- Flagged data available in real-time
- Two types of Automated tests: Real-time and Delayed mode QA/QC
  - Real-time tests
    - Single sensor tests – range value test
      - Instrument manufacturer levels for sensors
      - Regionally applicable levels (climatological)
      - Site specific levels – 3-$\sigma$ values based on statistics of previously recorded data
    - Dual Sensor tests – use of 2 sensors to qualify data
      - Temperature/Conductivity tests to validate conductivity data based on previous site data
  - Delayed mode tests are not 'real-time'
    - Spike and gradient tests - both need data surrounding in time to validate the data being tested
    - Delayed by sample time but can also be batch processed on a schedule




***Note :*** The tasks listed under workflow processes are limited to those actions that has a direct impact on data quality.

# Data Curation and Access

- all sensor data and imagery archived
- records of data processing and derivations
- free and open access to all data and imagery
- online graphical previews of scalar data
- online viewing of annotated, archived video
- web services delivery of data & downloads of all data



# Data Stewardship Best Practices & Standards

ICSU
WORLD DATA SYSTEM

- Member of the World Data System since July 2014
  - Committed to high quality data, data stewardship and participation in interoperability efforts.
- Data acquisition and hosting services for third party organizations
  - Partners include Pacific Salmon Foundation, FORCE, DFO's Arctic drifter program, and more.
- Actively participation in relevant working group activities
  - CODATA, RDA, ESIP, WDS, Earth Cube and others.

# Data Stewardship Best Practices & Standards

## Future Plans

- ISO 19115 metadata records
- IGSN registration of geological samples,
- OBIS support for biological samples,
- Glider data contributions to the IOOS Glider Data Assembly Center,
- Citations and unique identifiers for datasets
- OPeNDAP dataset expansion

# Interoperability Protocols, Formats & Conventions

## Data Access Protocol

- OPeNDAP (Open source Project for a Network Data Access Protocol)
- Initially designed by oceanographers and computer scientists
- Existing web services for metadata and data delivery

## Data Format

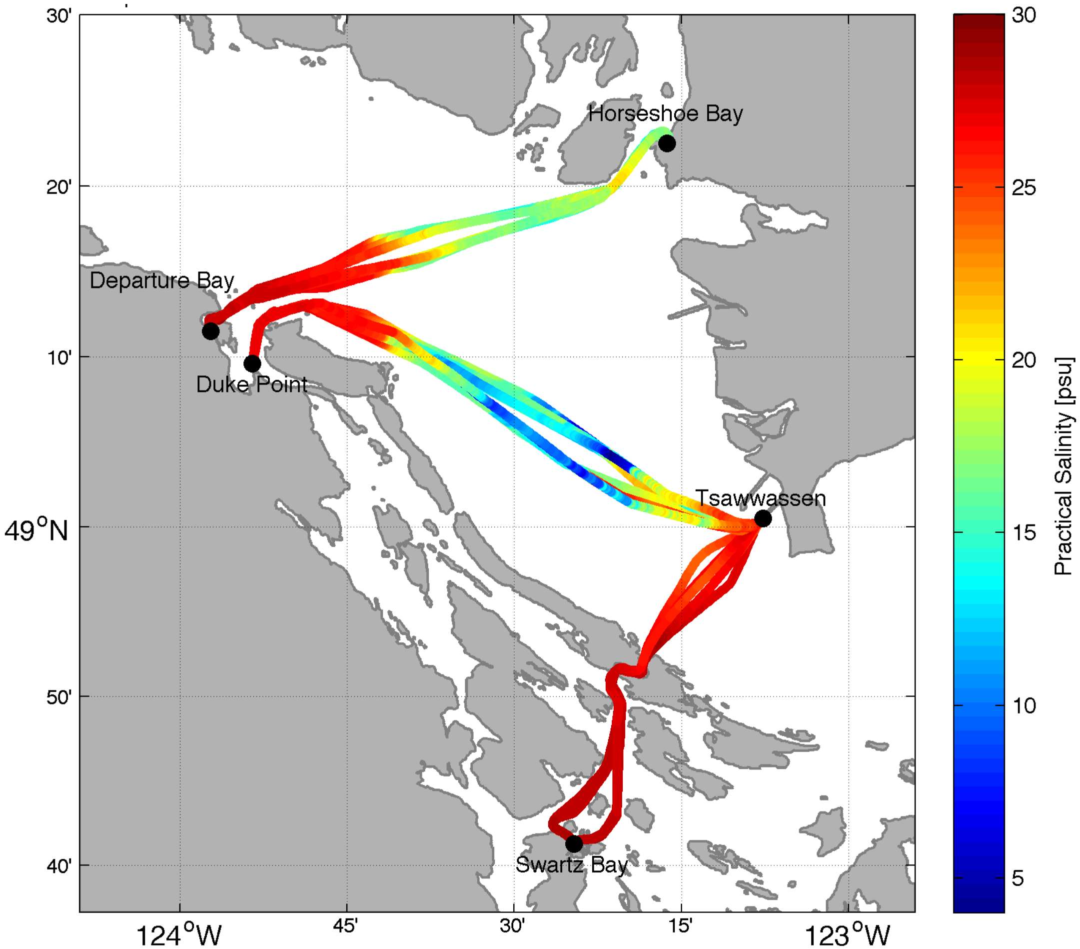
- NetCDF (Network Common Data Form)
- Multi-dimensional data and embedded metadata
- Widely adopted by oceanographic and climate communities

## Metadata Convention

- CF (Climate & Forecast)
- Specifically designed for use with NetCDF
- Defines metadata field-value options, and standard variable names

# Case Study - BC Ferries sea-surface monitoring program

# Daily patterns: Salinity



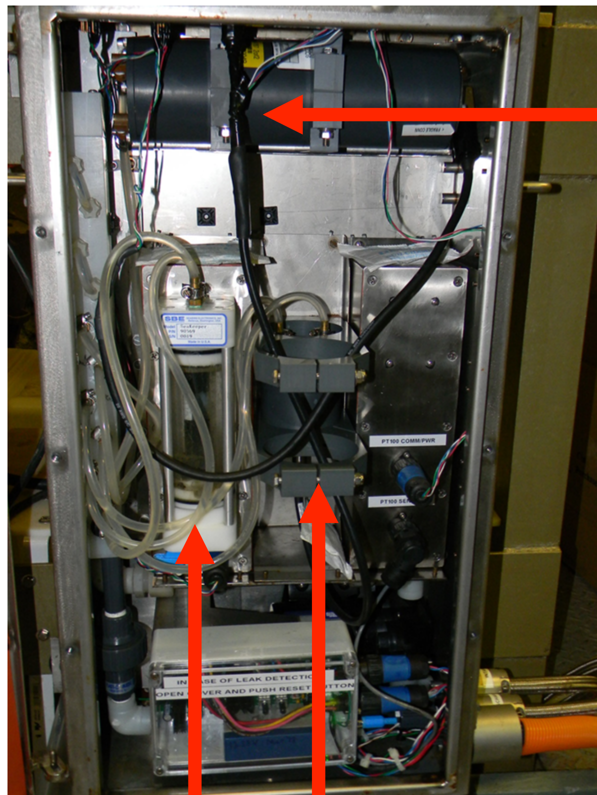

- Central route typically transits through the Fraser River plume
- Northern and Southern ferries often transit through the plume
- Strong cross-strait salinity gradient

- Measurements every 10 seconds; Trip duration = ~1.5 - 2.5 hours
- 4 - 8 cross-Strait trips / day

# Instrumentation

Meteorological

Oceanographic

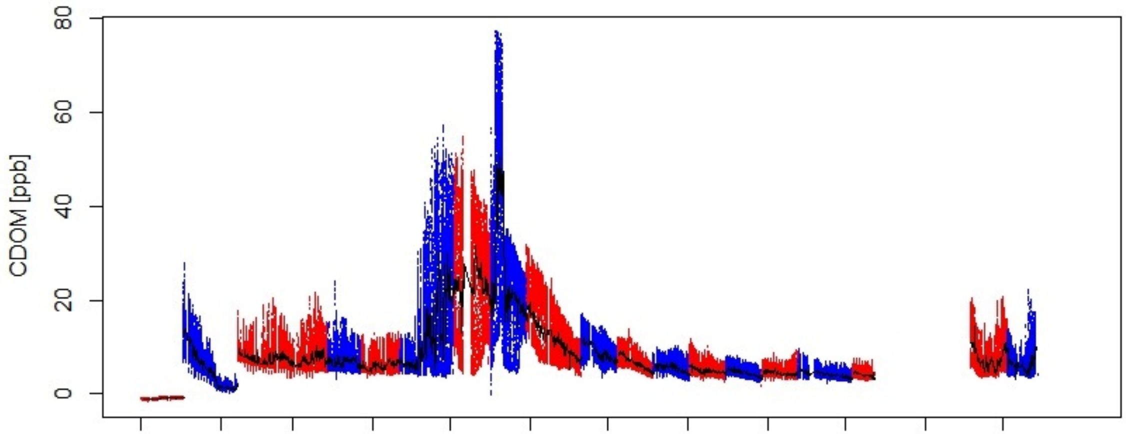


**Chl. / CDOM**
**Turbidity**

**Oxygen Optode**

**Thermosalinograph**

# Impact of fouling and cleaning on CDOM fluorescence

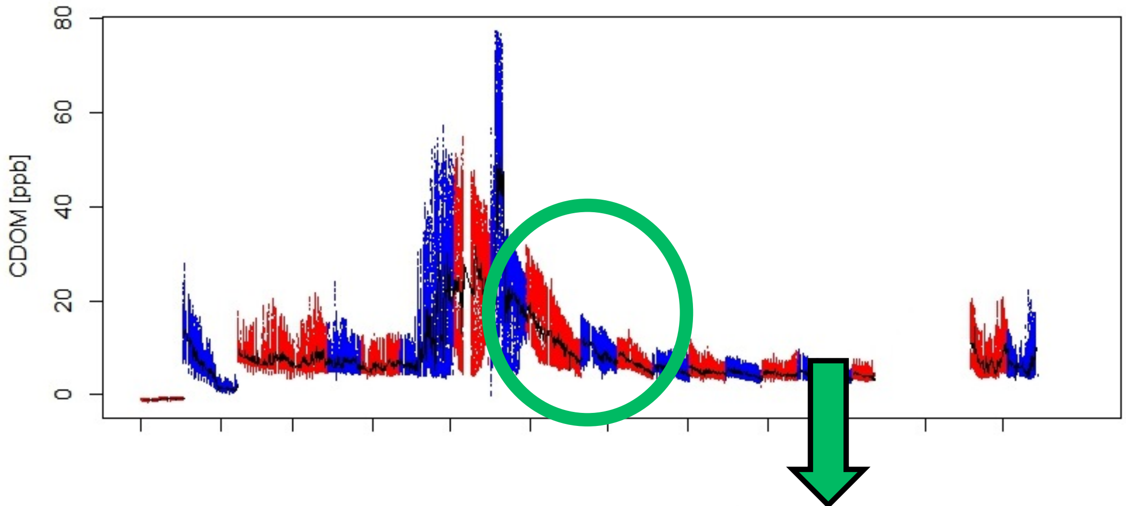



1. Significant bio-fouling of optical instruments

2. Fouling:
   a) Elevated baseline
   b) Diminished signal range

- Instruments cleaned every 2-3 weeks

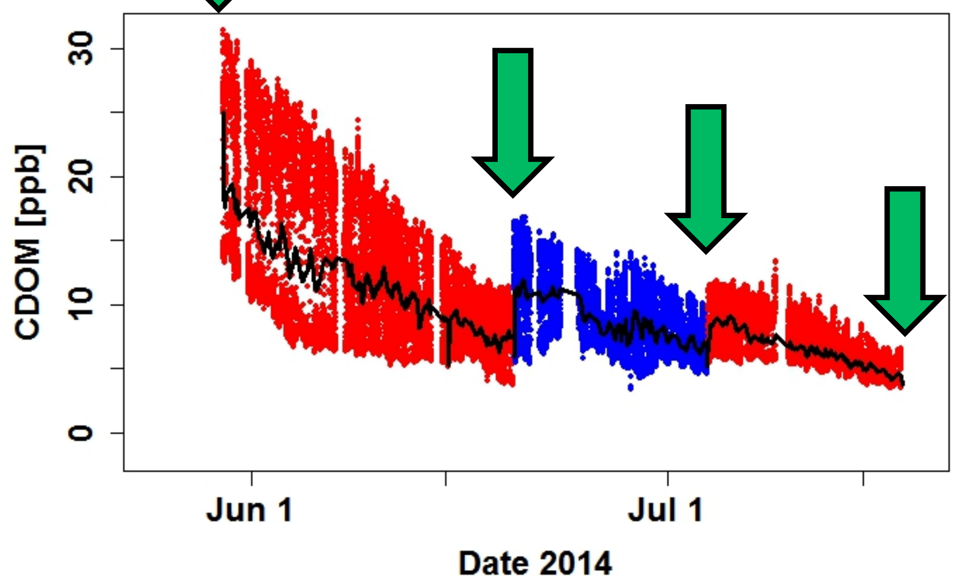
# Impact of fouling and cleaning on CDOM fluorescence



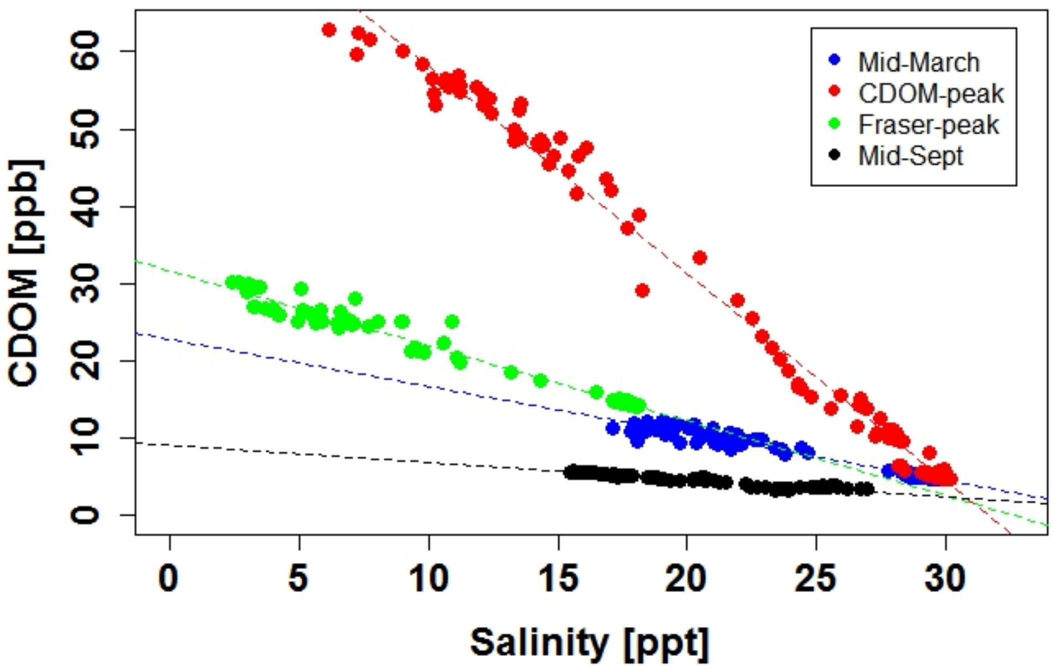

1. Significant bio-fouling of optical instruments

2. Fouling:
   a) Elevated baseline
   b) Diminished signal range

- Instruments cleaned every 2-3 weeks
- Cleaning yields significant improvement of signal quality



# Inter-variable comparisons: Salinity and CDOM




1. Fraser River = major source of freshwater and CDOM in the Strait of Georgia

2. Salinity-CDOM relationship is strong

3. Thermosalinograph not as susceptible to fouling

4. Salinity-CDOM = potential index of fouling

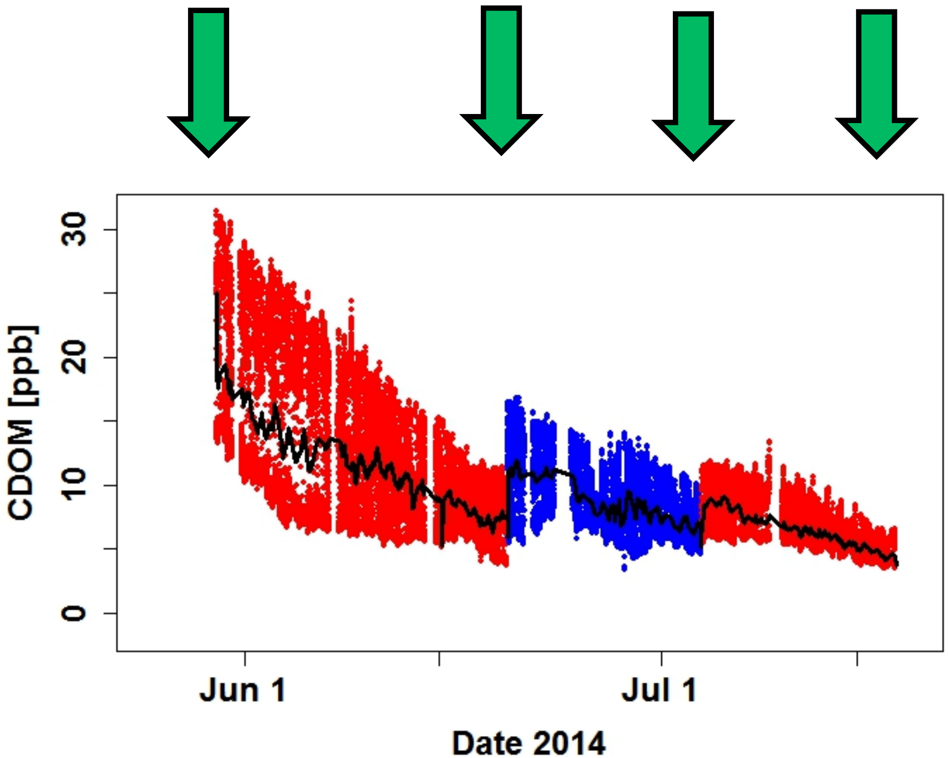
# Salinity vs. CDOM (pre/post cleaning)

Slope (pre) = - 0.78
Slope(post) = -1.02

Pre = - 0.27
Post = -0.39

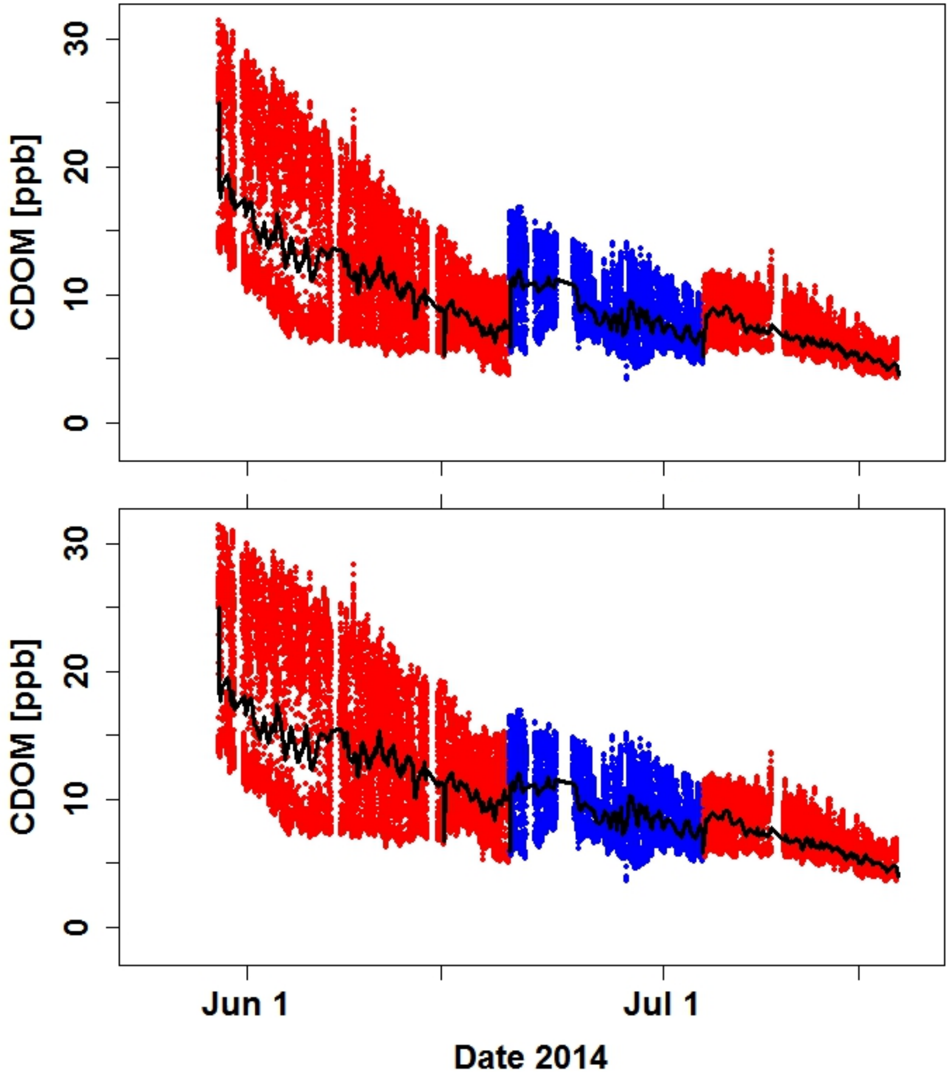
Pre = - 0.22
Post = -0.26

Pre = - 0.13
Post = -0.15



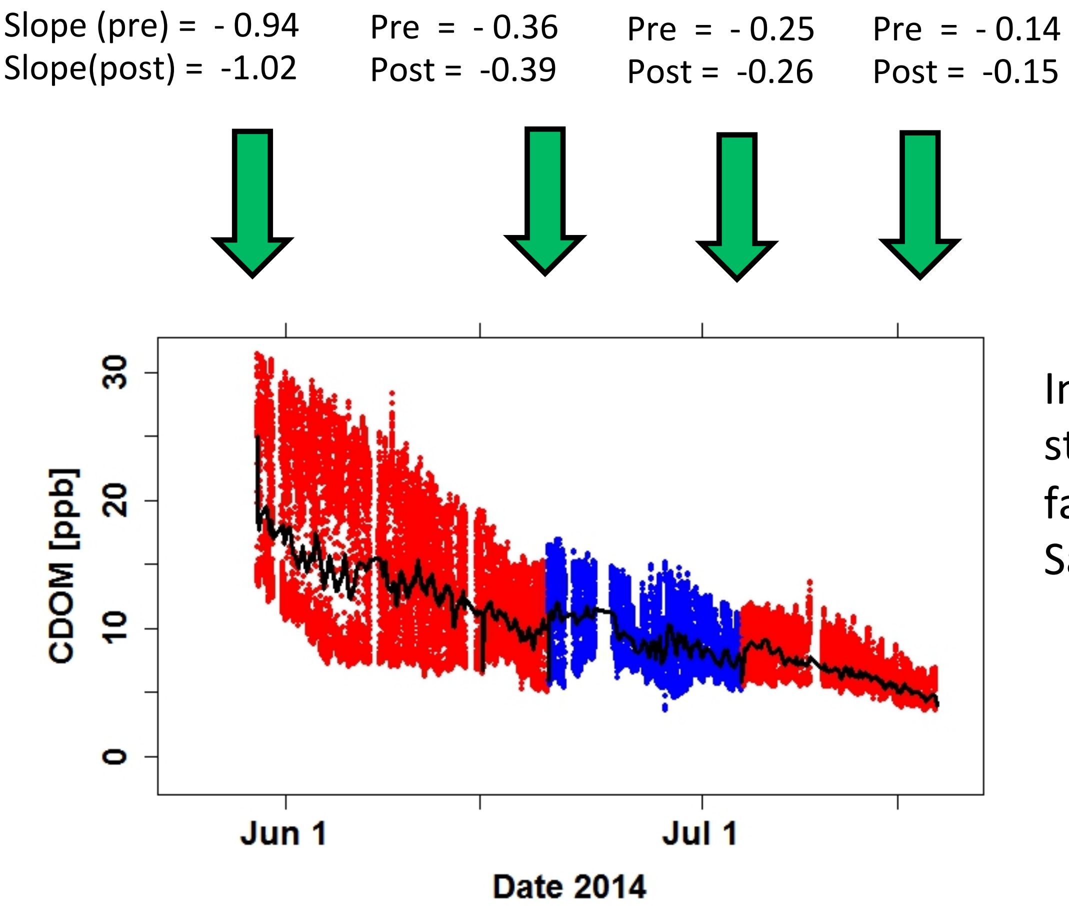

1. R2adj > 0.93 : Spatio-temporal pattern of CDOM/Salinity relatively immune to fouling
2. Compared slope of Salinity-CDOM relationships on the trip before and after cleaning
3. Slope of the relationship significantly reduced due to fouling
4. Good index of fouling *specific to this environment*

# Methods: Routine Maintenance Program




1. CDOM fluorescence measurements are very sensitive to bio-fouling
2. Fluorescence is clearly improved with cleaning every 2-3 weeks
3. Pre/Post cleaning fluorescent measurements using a CDOM "standard" = Tonic Water
4. Applied a linear retrospective correction based on % change in fluorescence Pre/Post cleaning

# Salinity vs. CDOM: Calibration corrections




In all cases, application of standards-based correction factors improved pre/post Salinity-CDOM slopes

# Summary

1. Optical sensors are susceptible to fouling
2. Especially problematic in surface waters (shallow coastal, gliders, ferries)
3. Regular cleaning routines are necessary
4. Inter-variable relationships are negatively impacted by fouling in short time-scales
5. "Correction-factors" can be derived using pre/post cleaning approaches
6. Useful approach to improve data quality
7. Applicable at a variety of time-scales?