IRA Topic 2: Water Levels

IOOS Annual DMAC Meeting

Silver Spring, MD

29 April – 1 May 2025

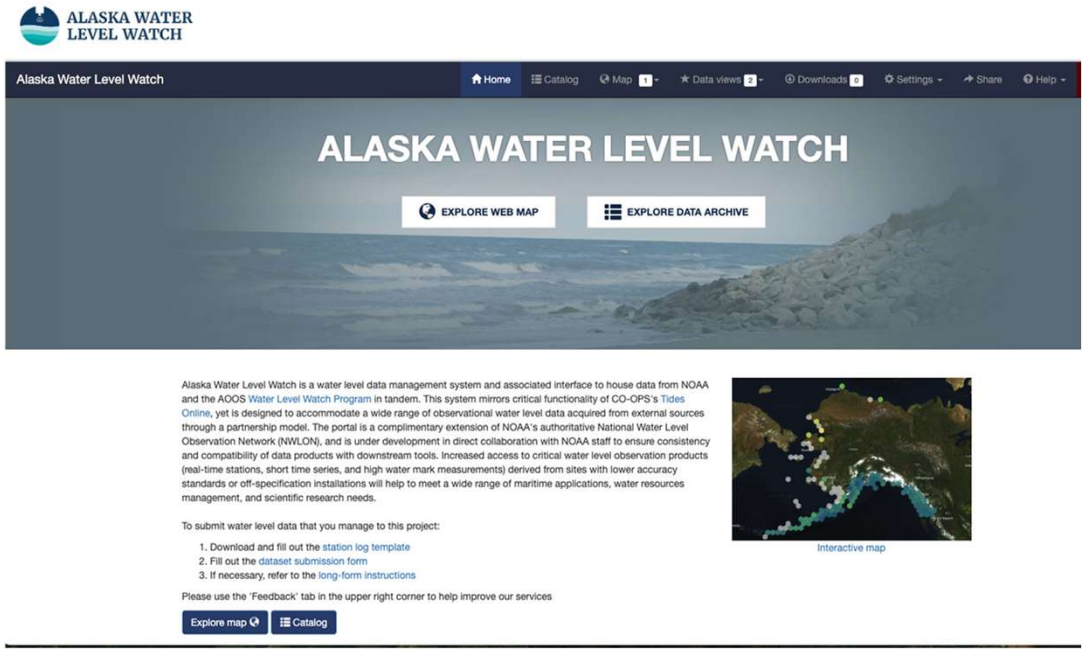
Introduction: Water Levels

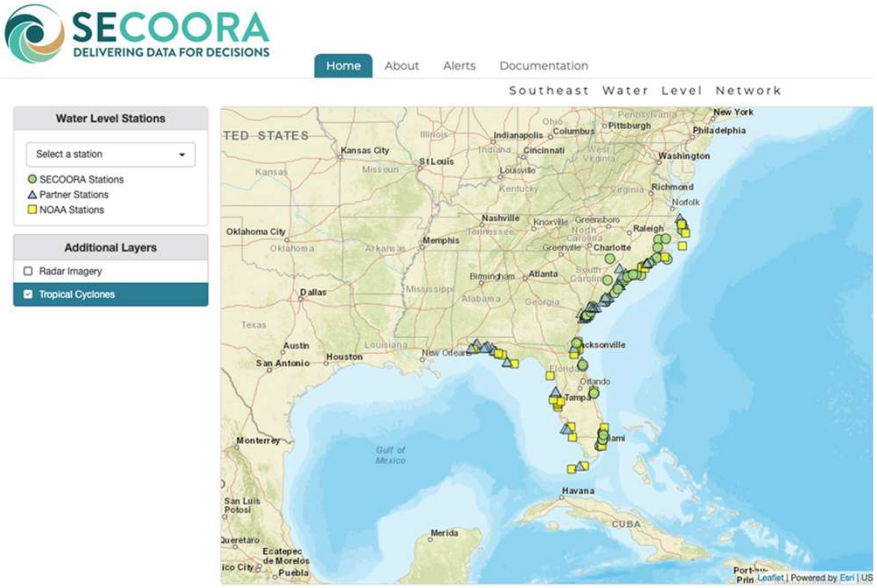
- Collection of water level data has typically been lead by NOAA CO-OPS through their NWLON network.
- New, lower cost water level sensors are being used to fill gaps in water level data
- Example Uses: Local community flood alerts, highway/transportation planning, high resolution data for flood model development

Overarching DM Goals for Water Level

- Establish and develop data management pathways, protocols, and tools
- Standardize metadata so we know what decisions the water level data can support
- Data Sharing: Determine data pipelines to share data with NOAA and other users
  - Leading to the ability to compare similar data across RAs

Community Water Levels (before IRA)





Data Management: Challenges

- 11 RAs with 7 different Data Management structures
- Different readiness levels for water level installations
- Various water level installers (e.g. PIs, contractors, community partners) with differing data provider requirements and abilities

Path Forward

RAs coordinate across four areas:

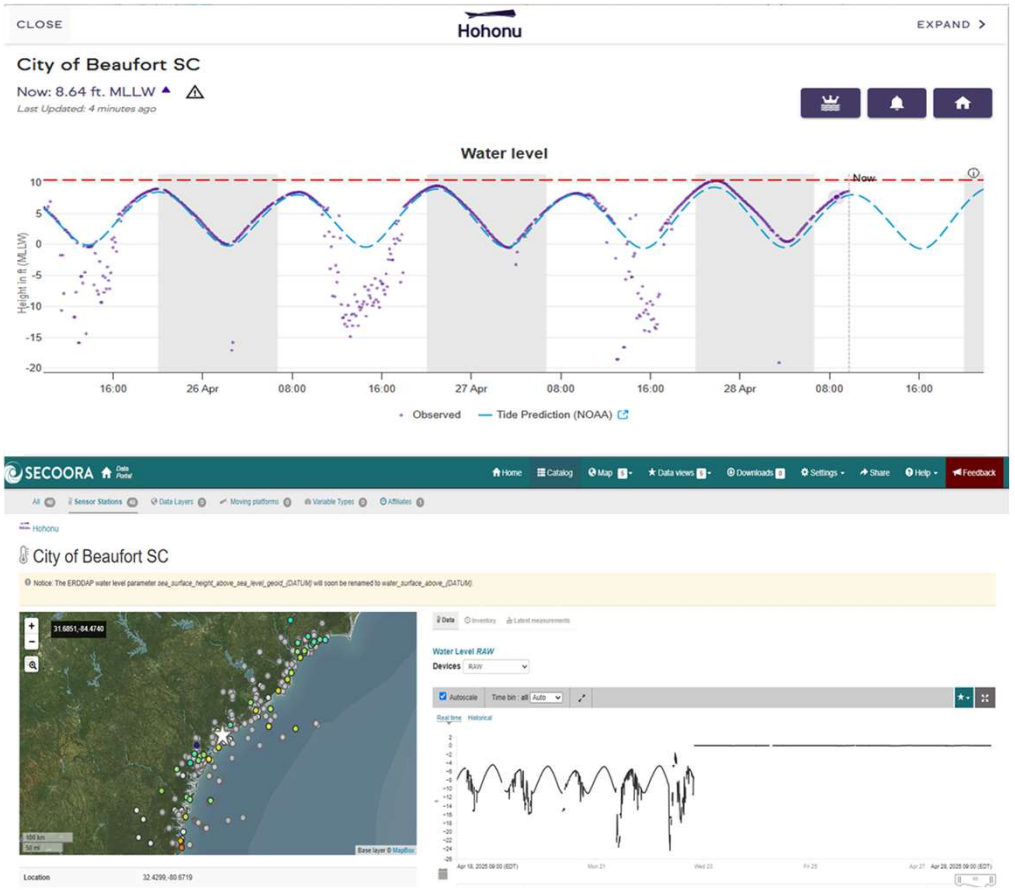
- ERDDAP
- Metadata
- QARTOD implementation
- Data sharing

Data Management: ERDDAP

- Can ERDDAP handle high volume and high frequency data?
  - 6 minute data for potentially 1,000’s of data points
- Technology on all sides could be strained by large data volumes (e.g. provider API)
  - Alerts management to identify source problem
- Should we have a consistent naming structure?
  - sea_surface_height_above_sea_level_{datum} -> water_surface_above_{datum}
  - Local Station Datum -> STND

Metadata: ERDDAP solutions

- ERDDAP is adopted across the community and standardized
- When establishing water level networks, potentially have a federated ERDDAP server solely for water level
- Set up alerts to monitor data streams and identify points of failure
- DMAC community works together to adopt consistent naming structures for water level data



Data Management: Metadata

- ERDDAP metadata needs water level specific attributes
  - sensor height (ellipsoid/station datum)
  - reference datum (datum sensor is referenced to - e.g. NGS datum)
  - surveyed NGS benchmarks (do not exist everywhere, number of benchmarks required for station tiering)
  - datum conversion offsets (making data available in consistent reported datum, making it possible for end-user to convert to their desired datum)
  - sensor sampling schema
  - QC flags
  - others?

```
      Water Level Station Information Form v.1.1
      Alaska Water Level Watch (AWLW)

0.    Form

      Prepared by                          : (Your Name)
      Date Prepared              : (CCYY-MM-DD)
      Report Type                : (UPDATE/NEW)
      If Update:
       Previous Site Log         :
       Modified/Added Sections   :


1.    Site Identification of the Water Level Station

      Site Name                  :
          State                      :
          Identifiers
            CO-OPS ID                :
            Other ID                 :
          Water Body Setting         : (e.g., INLET)
          Approximate Position
        Latitude (N is +)        :
        Longitude (E is +)       :
        Projection               : (e.g., NAD83)
      Date Established           :
      Additional Information     : (multiple lines)


2.    Water Level Sensor Information

2.1   Sensor Category             : (e.g., RADAR)
          Manufacturer and Model     :
          Serial Number              :
      Sample Interval (min)      :
          Sample Avg. Window (sec) :
          Mounting Structure         :
          Date Installed             : (CCYY-MM-DDThh:mmZ)
      Date Removed               : (CCYY-MM-DDThh:mmZ)
      Additional Information     :

2.x   Sensor Category             : (Vented or Non-Vented Pressure/Radar/Acoustic/GNSS-R/GNSS Buoy/etc.)
          Manufacturer and Model     :
          Serial Number              :
          Sample Interval (min)      : (1/6/15/60/etc.)
          Sample Avg. Window (sec)   : (0/60/181/etc.)
          Mounting Structure         : (Bridge/Seawall/Dock/Bedrock/Anchor/etc.)
      Date Installed             : (CCYY-MM-DDThh:mmZ)
      Date Removed               : (CCYY-MM-DDThh:mmZ)
      Additional Information     : (multiple lines)
```

1. AOOS Data Submission Form
2. AOOS WL Station Information Form:
   - Text file for data providers to complete for each station
   - Captures everything required for metadata creation

HOWEVER -

- Other RA water level operators found the forms too cumbersome

*https://drive.google.com/file/d/198tNKrJ_b69E211zKYnTAJsn3tnOE2qE/view

Data Management: CO-OPS Metadata


```
<PartnerStations>
  <count>9</count>
  <PartnerStationList>
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      <lon>-80.67189</lon>
      <affiliation>Hohonu</affiliation>
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      <sensortype>Hohonu</sensortype>
      <sensormodel>Hohonu</sensormodel>
      <dataSource>SECOORA</dataSource>
      <sourceURL>https://erddap.secoora.org/erddap/tabledap/hohonu_10047_city_of_beaufort_sc.csv?
      time%2Csea_surface_height_above_sea_level_geoid_navd88_surveyed_navd88%2Csea_surface_height_above_sea_level_geoid_navd88_surveyed_navd88_qc_agg&time%3E%3D</sourceURL>
      <refDatum>NAVD88</refDatum>
      <disclaimer>These data have previously undergone quality control by the partner but have not been subjected to the National Ocean Service's quality control or quality assurance procedures. They are
      released for limited public use as preliminary data to be used only with appropriate caution for coastal hazards applications. Data should not be used for navigation. Tidal datum offsets compiled using
      VDatum. Station data has an accuracy standard of 11 to 30 cm and does not fully meet all of CO-OPS defined standards.</disclaimer>
      <datumsoffsets xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:type="datumsOffsets">
        <mhhw_offset>3.57</mhhw_offset>
        <mhw_offset>3.18</mhw_offset>
        <mtl_offset>-0.51</mtl_offset>
        <msl_offset>-0.1</msl_offset>
        <mlw_offset>-4.2</mlw_offset>
        <mllw_offset>-4.41</mllw_offset>
        <navd_offset>0.0</navd_offset>
      </datumsoffsets>
      <floodlevels xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:type="floodLevel" self="https://api.tidesandcurrents.noaa.gov/mdapi/prod/webapi/stations/PR86601/floodlevels.xml">
        <nos_minor xsi:nil="true"/>
        <nos_moderate xsi:nil="true"/>
        <nos_major xsi:nil="true"/>
        <nws_minor xsi:nil="true"/>
        <nws_moderate xsi:nil="true"/>
        <nws_major xsi:nil="true"/>
        <action xsi:nil="true"/>
      </floodlevels>
```


https://api.tidesandcurrents.noaa.gov/mdapi/prod/webapi/stations.xml?type=partnerstations&expand=details&units=english

Metadata solutions

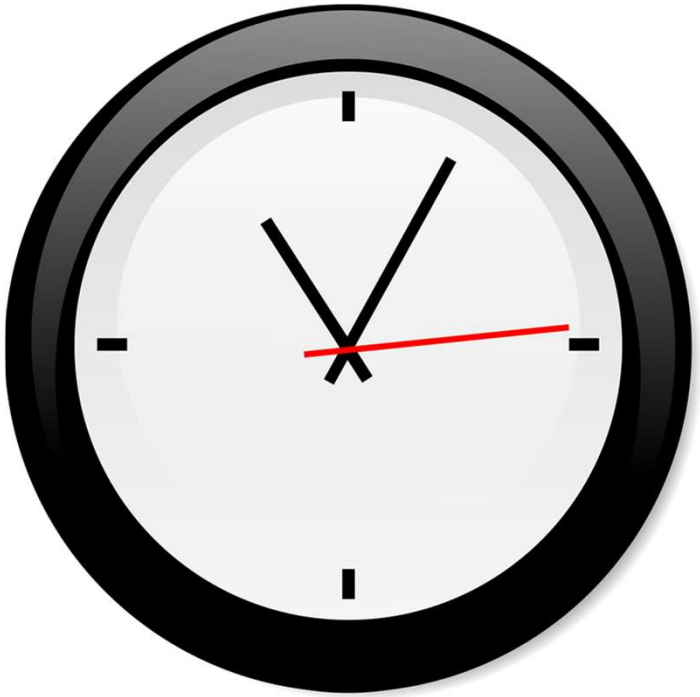
1. Can a water level contractor include all of the metadata in an API that updates the ERDDAP station page?
2. Spreadsheet that RA Water Level Manager updates for stations
3. Develop a metadata form using AOOS Station Information Form (text file) that is machine readable and easy to use by RA staff and water level contractors.
4. CO-OPS solution: Online portal to update metadata record for each station that is updated when stations are deployed and serviced. The metadata record then interfaces with ERDDAP station page to updated the metadata record. **This will require development effort within IOOS and RAs*.

Data Management: QARTOD

- Who's on first?
  - Some RAs have data provider implement QARTOD and ingest the flags
  - Others have the data management team implement QARTOD
- Do we want to require minimum standards related to QC, no matter who implements? For example, at minimum, should everyone implement tests:
  - Timing
  - Syntax
  - Spike
  - Gross Range
  - Rate of Change
  - Flat Line
  - Climatology (season max/mins; use this one or not at all?)

Data Management: QARTOD

- When is QARTOD testing run:
  - On the fly
  - Batch run (approximately once every 24 hours)



Data Management: Data sharing

- Reporting datums should be consistent
  - Standardized datum (e.g. MLLW)
  - Datum converter tool (e.g. convert from MLLW -> MHHW)
- NCEI says archived data requires an open data service license
  - Private sector partners need to understand that the data is not proprietary
  - Data must be given an attribute in metadata to denote origin

Data Management: Data sharing

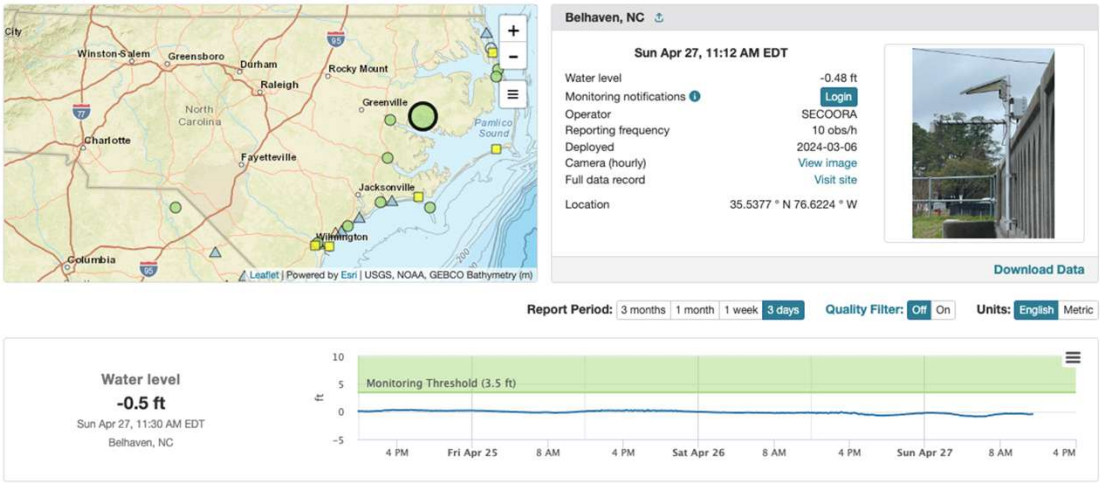
How are we getting data to NOAA/other federal programs (or other places)?

- NOAA CO-OPS Inundation Dashboard - for a subset of stations*
- NOAA, National Weather Service, AWIPS
- Used for validating operational regional models/forecasts: NOAA modelers, RA modelers, others
- USGS Flood Event Viewer?

INTEROPERABILITY is key

Data Management: Data sharing in the future

- Do we need to develop a centralized water level app that looks the same across regions?
- Or do RAs do their own thing?
  - Smartphone App (released in Apple and Google Play)
  - Text-a-station
  - Email Notifications
  - RA Data Portals or websites



Summary for DMAC Teams

Recommendation: Establish working groups to address:

- ERDDAP
- Metadata
- QARTOD implementation
- Data sharing

Other recommendations?

Session planning notes

- https://docs.google.com/document/d/1ACDaPIhN7-KgVFjSSvjFDmrAR4iU9JzdLgoO1Kn6ZLA/edit?tab=t.0

Data Management: Metadata

Example 1

- 1 hz sampling
- 30 second sample period, send avg of 30 samples
- Reports every 6 minutes/10 water level readings per hour

Example 2

- 6 hz sampling
- Sensor turns on every 5 minutes, samples for 5 seconds
- 30 observations, throw out the first 5
- Average the remaining 25 samples
- Reports every 5 minutes/12 readings per hour

Example 3

- 6 hz sampling
- Sensor turns on every 5 minutes, samples for 11 seconds
- Keep 80% of the data - remove highest and lowest 10% of the data
- Average of 80% sent as water level
- Reports every 5 minutes/12 readings per hour