Increasing global accessibility and understanding of water column sonar data

Carrie C. Wall

Charles Anderson, Sharon Mesick, Rost Parsons, Tim Boyer, and Susan J. McLean

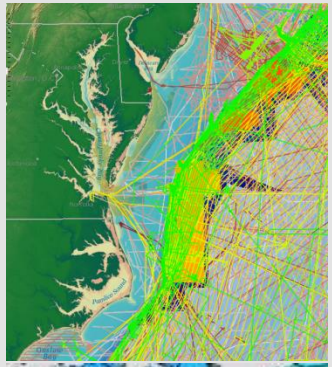
www.ngdc.noaa.gov/mgg/wcd

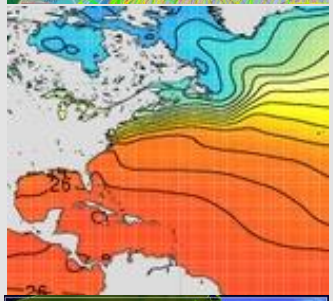
NOAA Satellite and Information Service | National Centers for Environmental Information (NCEI) | Center for Coasts, Oceans, and Geophysics (CCOG)

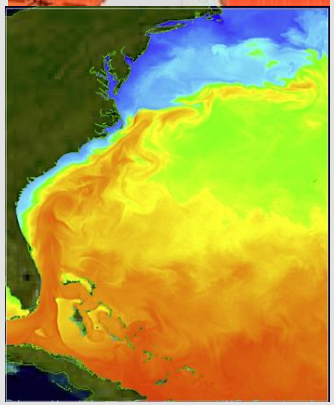
NCEI...never heard of it!

- **National Centers for Environmental Information** (NCEI) formed from the merging of NOAA's Data Centers:
  - National Geophysical Data Center (NGDC), Boulder, CO
  - National Oceanographic Data Center (NODC), Silver Spring, MD
  - National Climatic Data Center (NCDC), Asheville, NC

- Integrated ocean data stewardship
  - ***Easier*** to contribute data
  - Integrated discovery of and access to ***all*** data from a survey
  - Covering the gaps: assuring a proper home for all ocean data

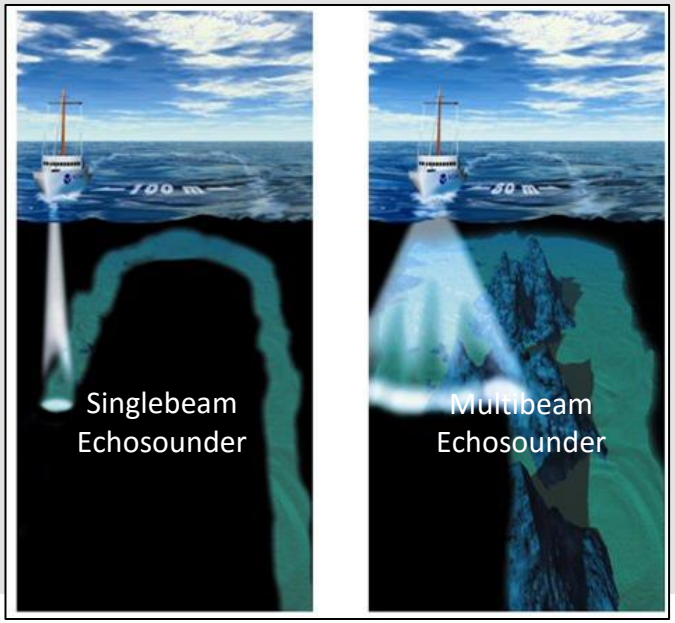


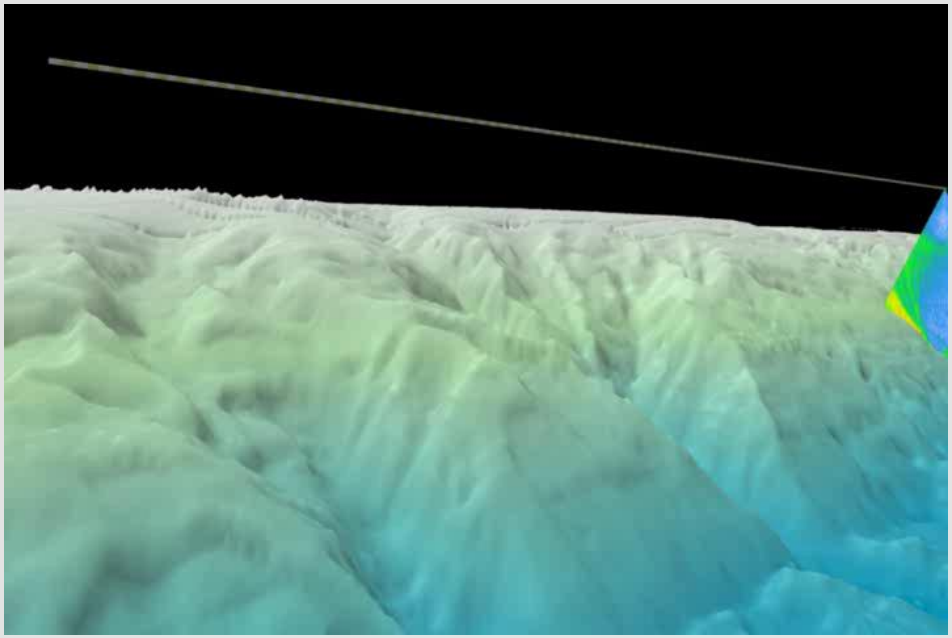


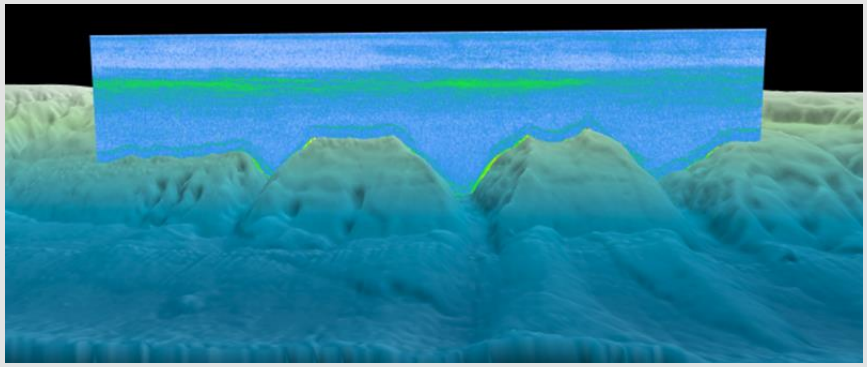


Water Column Sonar Data

- Acoustic backscatter from the ocean surface to the seafloor
- Sonar Technology
  - Singlebeam echosounder
    - Single and multiple frequency
  - Multibeam echosounder
    - Single and multiple frequency



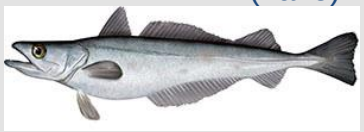




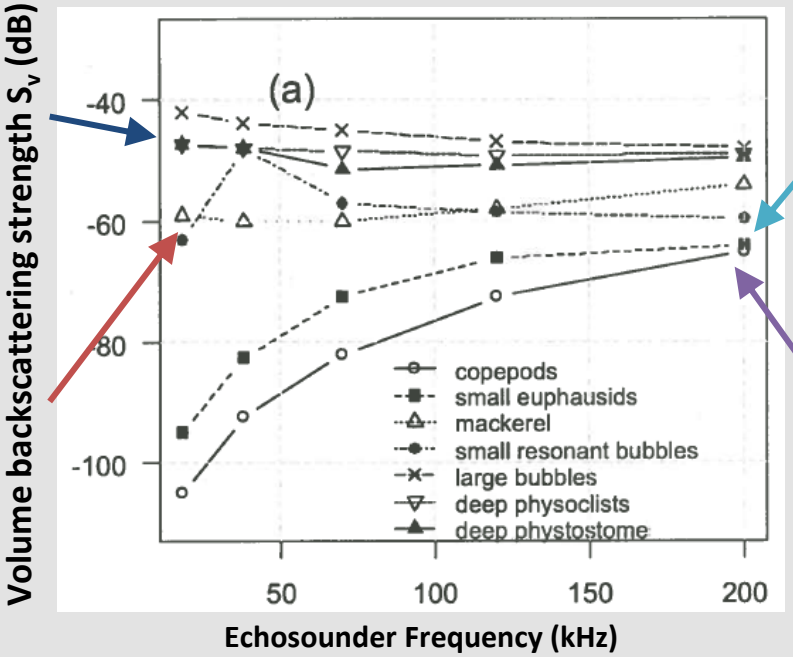
Fisheries Acoustics

- Why use multiple frequencies?
  - Depth range varies
  - **Signal size varies**
    - Large, swimbladder organisms reflect strongest at low frequencies (18 kHz)
    - Small organisms reflect strongest at high frequencies (200 kHz)

Fish **with** a swimbladder (hake)



Fish **without** a swimbladder (mackerel)



Small euphausiids (krill)

Photo: Stephen Brookes

Copepod (small crustaceans)

© Micropolitan.org

Trenkel & Berger (2013)

Applications of Fisheries Acoustic Data

- Uses
  - Identify fish school morphology and behavior, estimate biomass, determine species and tropic level
    - Primary means to non-invasively monitor fish and their environment
    - **Valuable for fisheries management**
  - Characterize habitat
    - Typically for commercially important species
    - Valuable for understanding and delineating essential fish habitat
  - Map methane seeps and undersea plumes (bubbles)
    - Valuable for environmental monitoring and oil and gas exploration

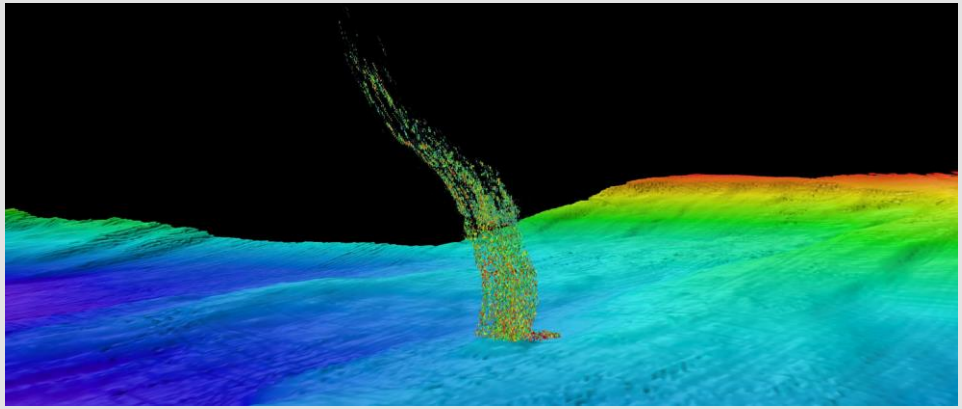
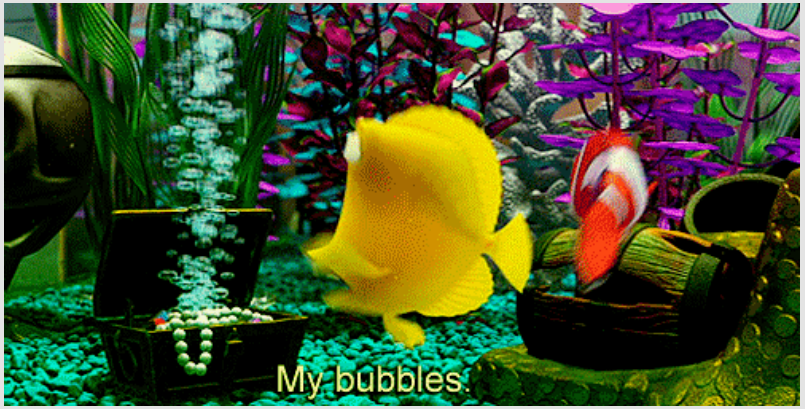
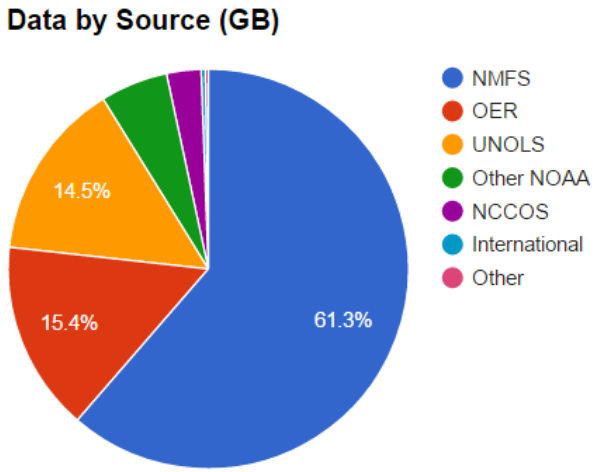


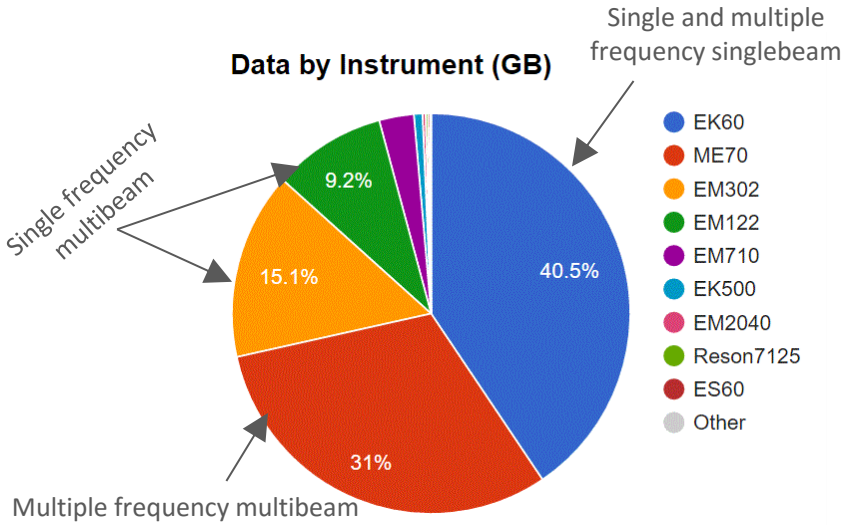
Photo: Brendan Philip/UW



Water Column Sonar Data Archive

- National Marine Fisheries Service (NMFS) collects a lot of data
  - 78+ TB backlogged data, 12+ TB annually
  - **Increasingly large volume not stored sustainably, publicly funded data now need to be accessible**
- Partnership between NMFS and NCEI initiated in 2011
  - 2013: Water column sonar data project fully staffed and operational
  - **Goal: Stewardship, discovery, delivery and development of products related to NOAA's water column sonar data at NCEI**
- 21.45 TB of data archived to date
  - Data received from NOAA, international and academic institutions
  - **12.74 TB of data requested and delivered**

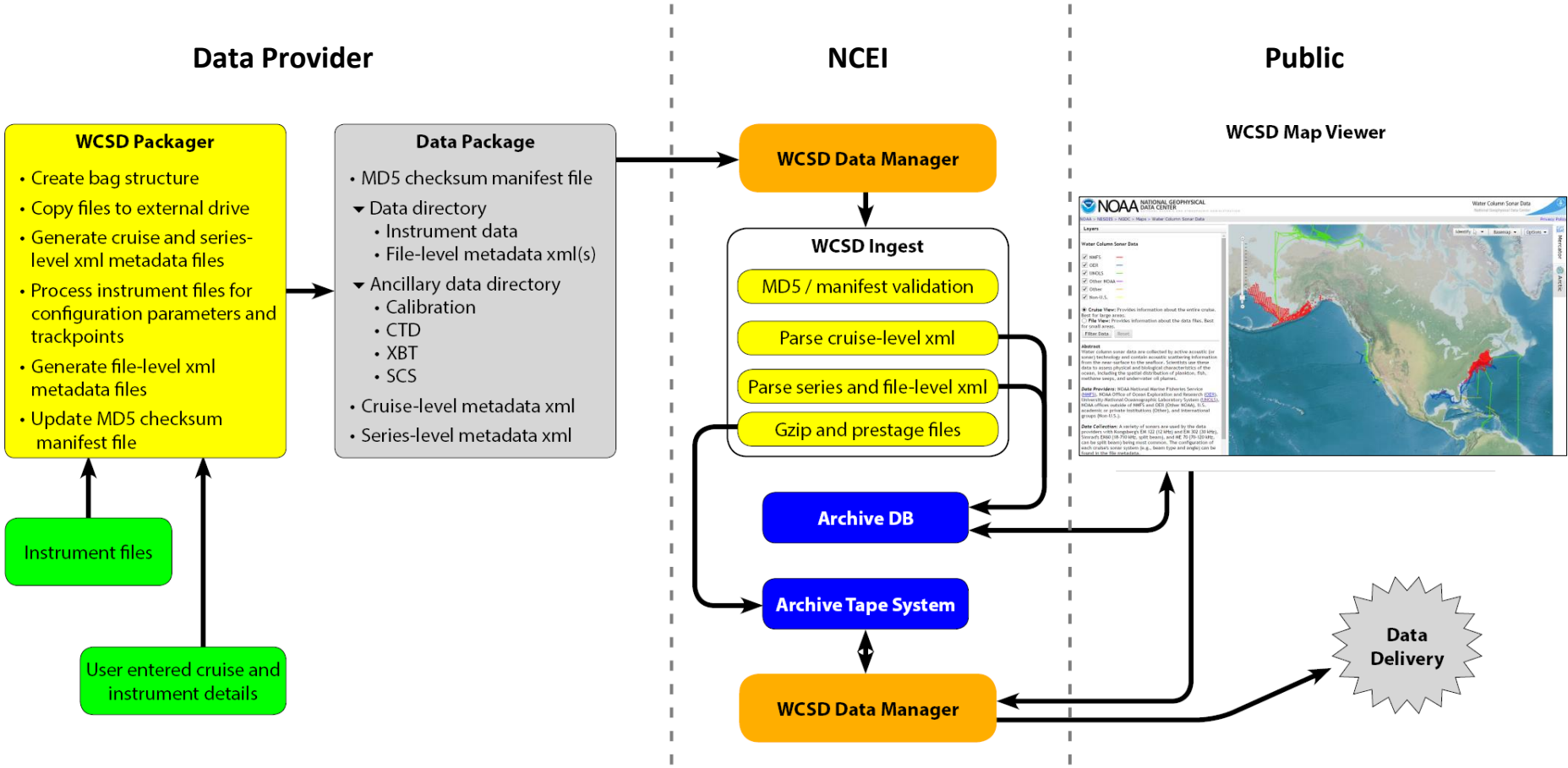




Water Column Sonar Data Archive

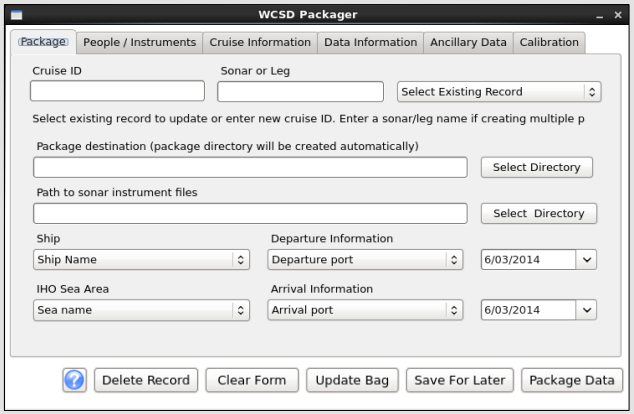
From the vessel to the web

Water Column Sonar Data Pipeline



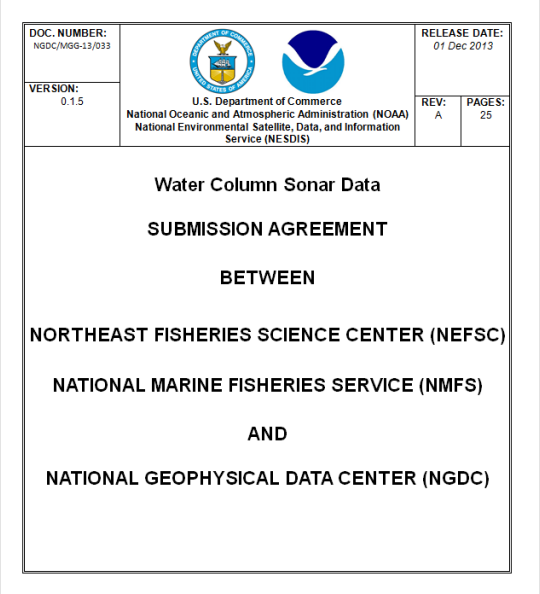
From the vessel to NCEI

- Easy data packaging interface
  - Standalone executable
  - Creates ISO compliant metadata
  - Hands-free once initiated



- Service Level Agreement with NMFS

- Submission Agreements
  - *Completed*:
    - AFSC, NEFSC, NWFSC, SEFSC & PIFSC
    - NCCOS, several academic institutions
  - *To come:*
    - SWFSC



DOC. NUMBER: NGDC/MGG-13/033	U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS)	RELEASE DATE: 01 Dec 2013	
VERSION: 0.1.5		REV: A	PAGES: 25

Water Column Sonar Data

SUBMISSION AGREEMENT

BETWEEN

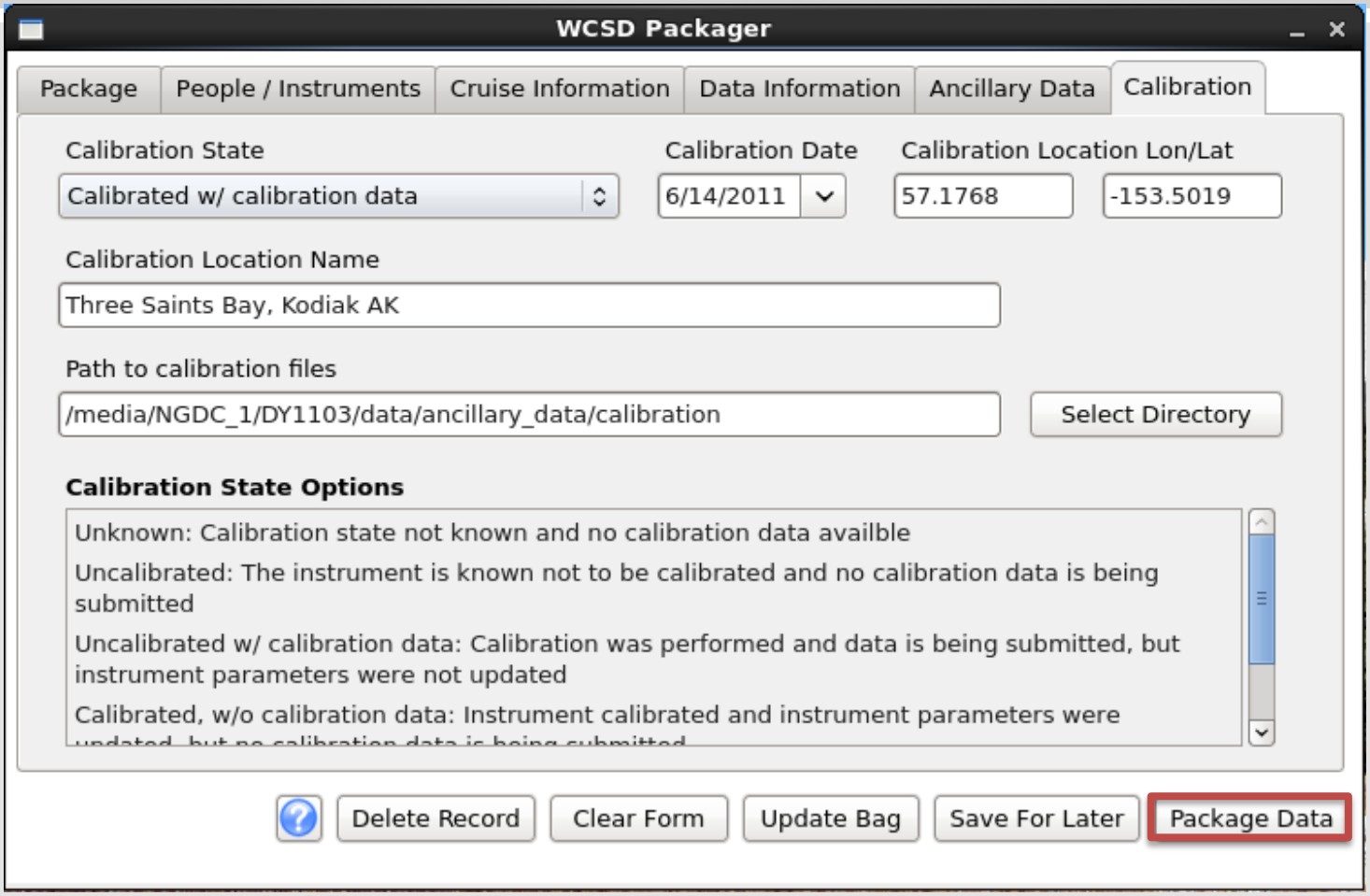
NORTHEAST FISHERIES SCIENCE CENTER (NEFSC)

NATIONAL MARINE FISHERIES SERVICE (NMFS)

AND

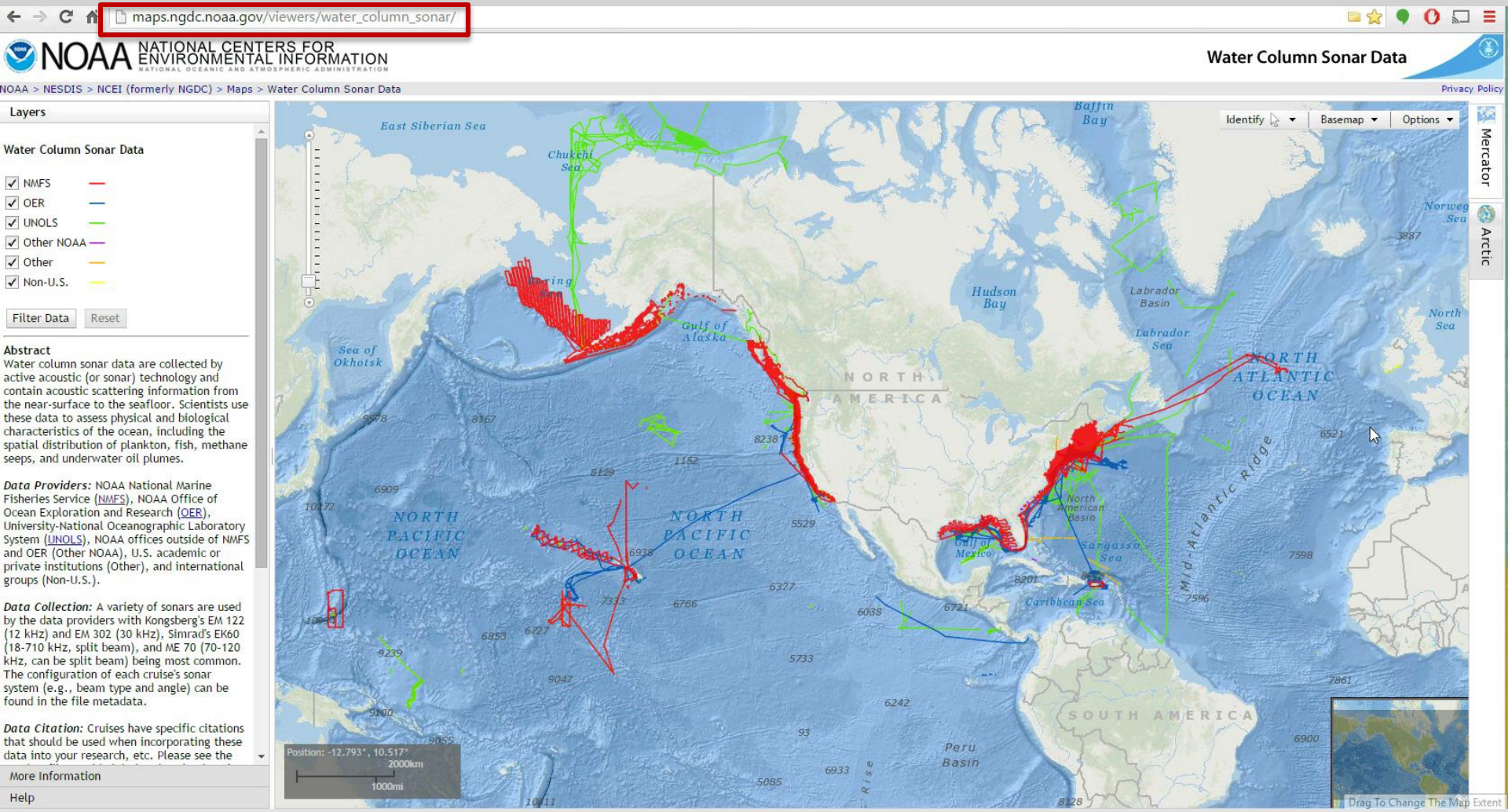
NATIONAL GEOPHYSICAL DATA CENTER (NGDC)

From the vessel to NCEI



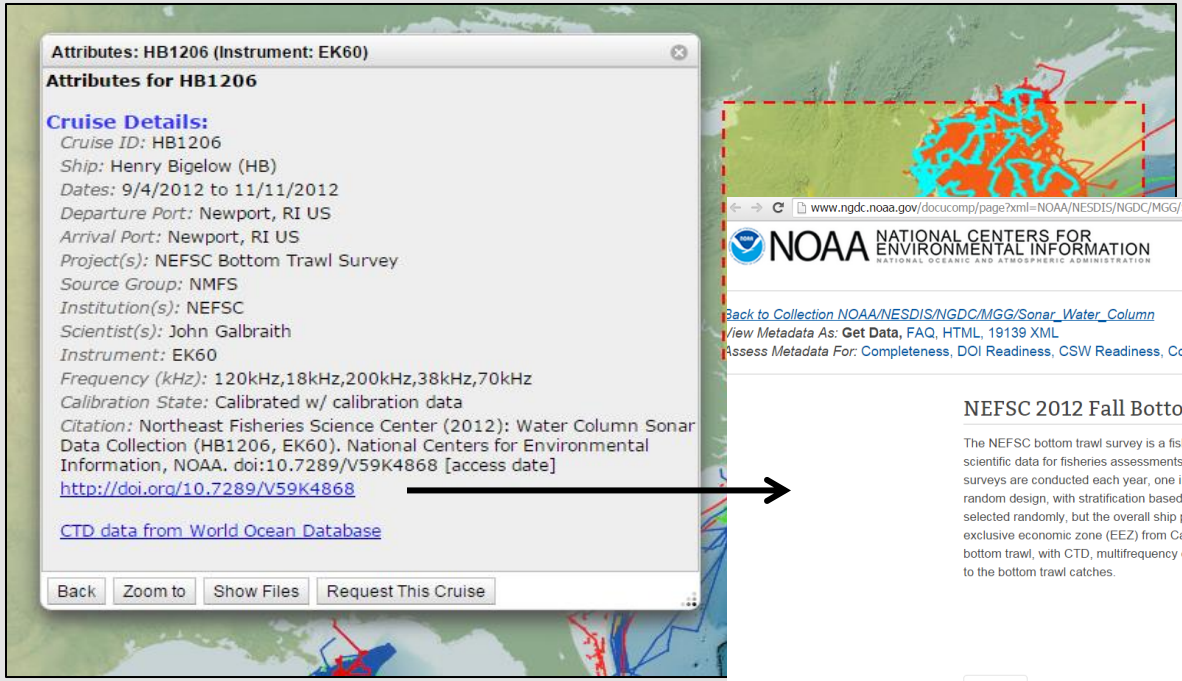
Chuck Anderson, CIRES/NCEI
Rick Towler, NMFS AFSC

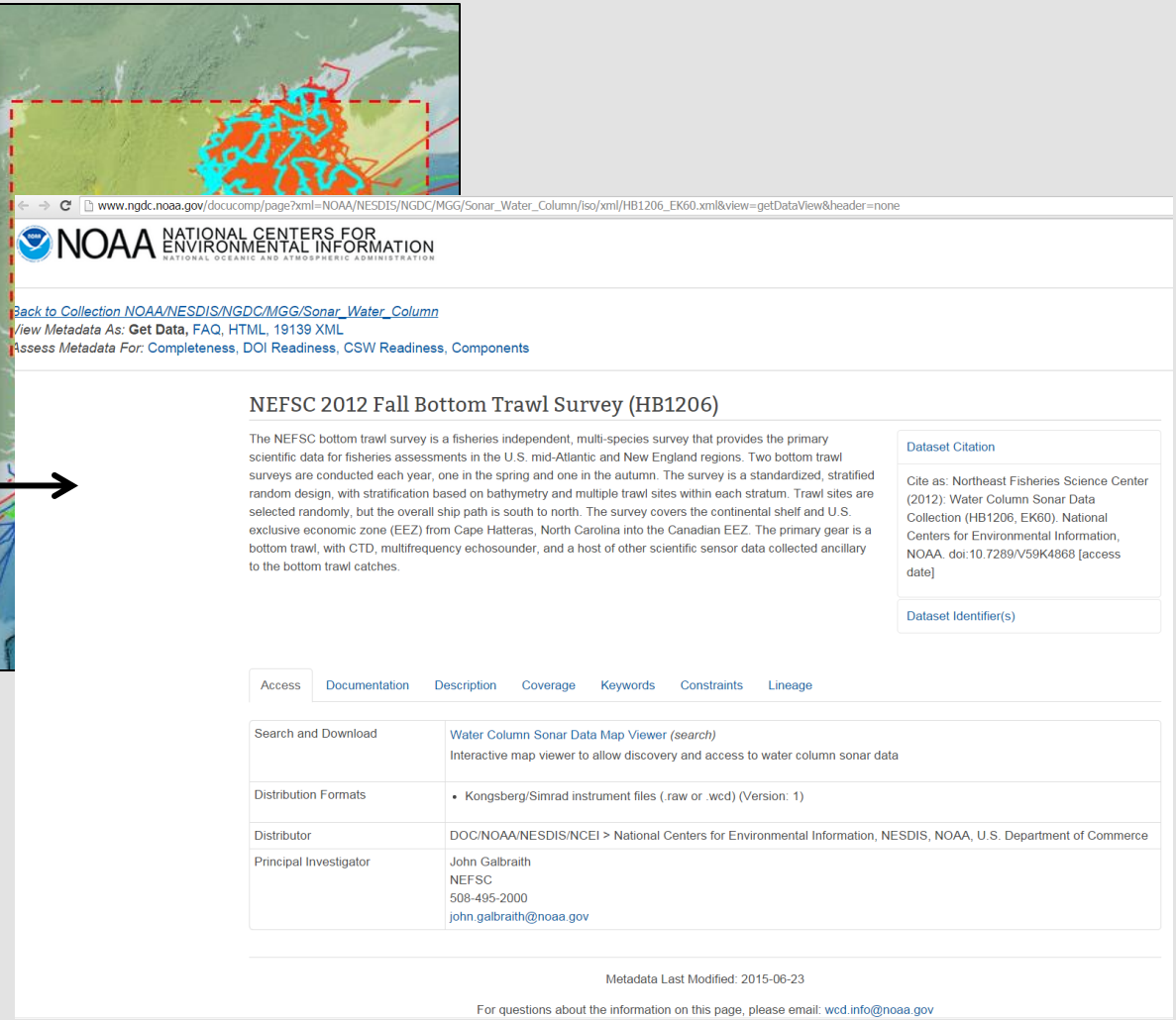
From the archive to the web



John Cartwright, NCEI
Jesse Varner, CIRES/NCEI

From the archive to the web

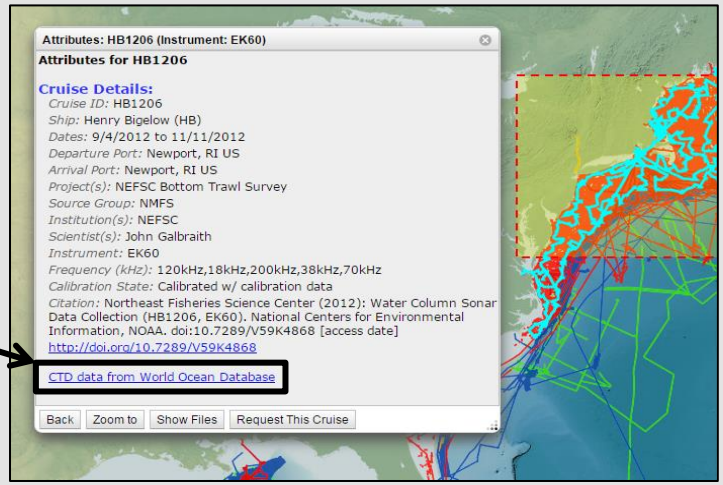


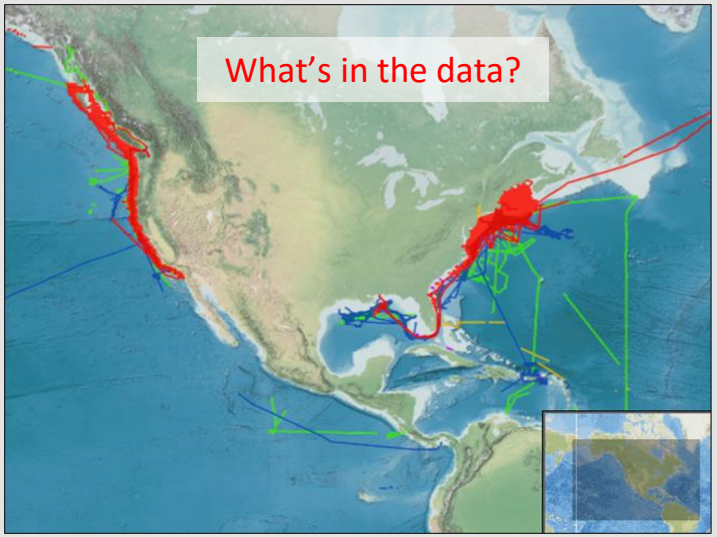


Current and Future Initiatives

Increasing the Impact of the Archive

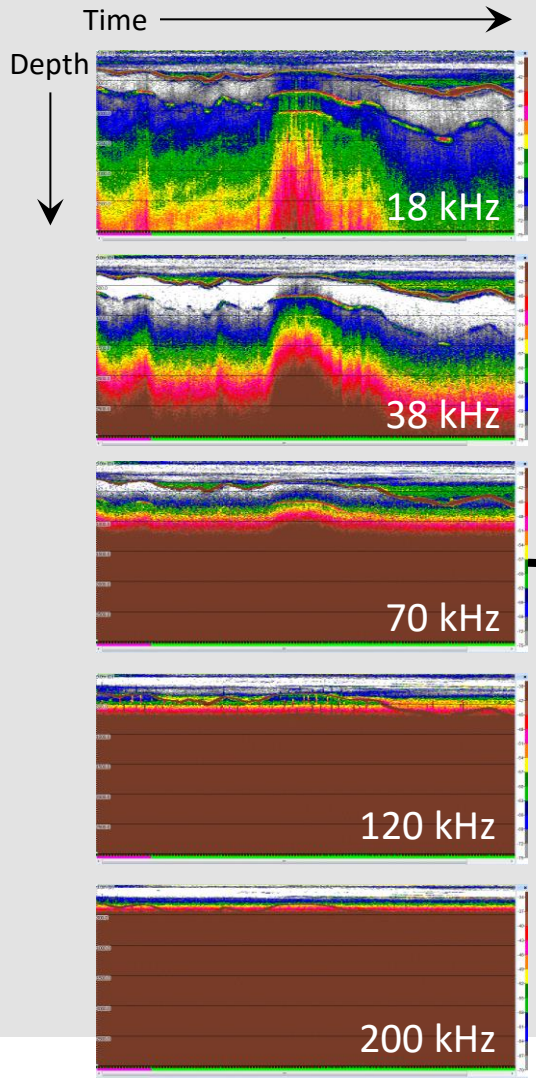
- Provide direct link to NCEI CTD, bathymetric, biological and other oceanographic data
- Archive all NMFS backlogged and current data from all sonar systems
  - Completed for 3 of 6 NMFS FSC
- Incorporate data products to help users understand what's in the data
  - Current efforts are focused on singlebeam data
  - Future work will expand to multibeam data



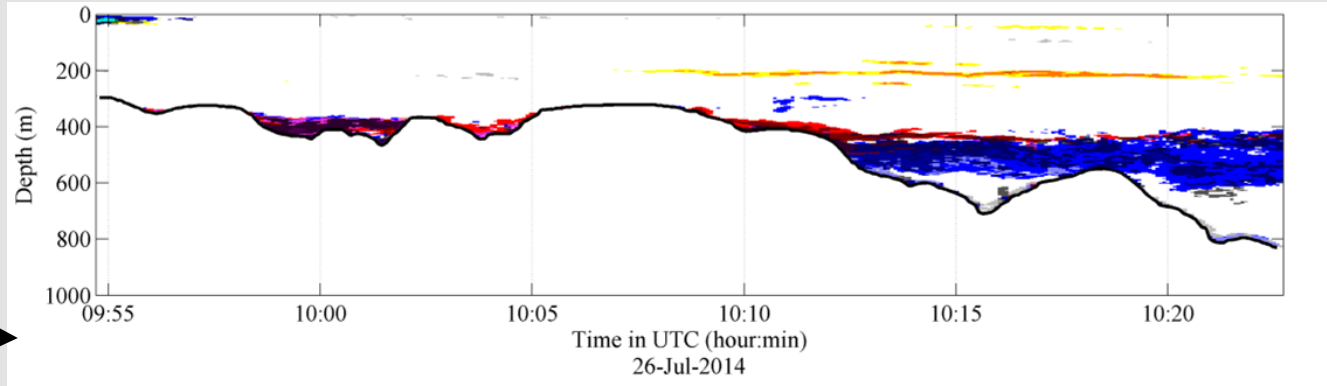


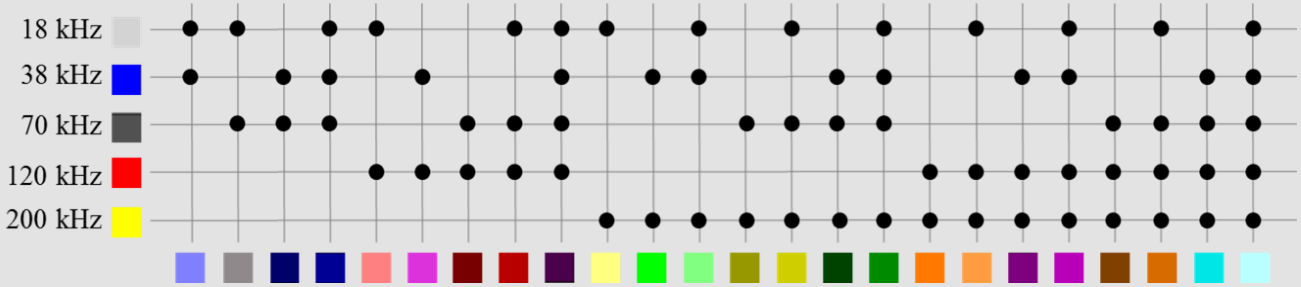
Visualizing the Archived Data

Multiple Frequency Singlebeam Data



Processing algorithms transform these complex data into a single image that illustrates the quality and content of the acoustic data

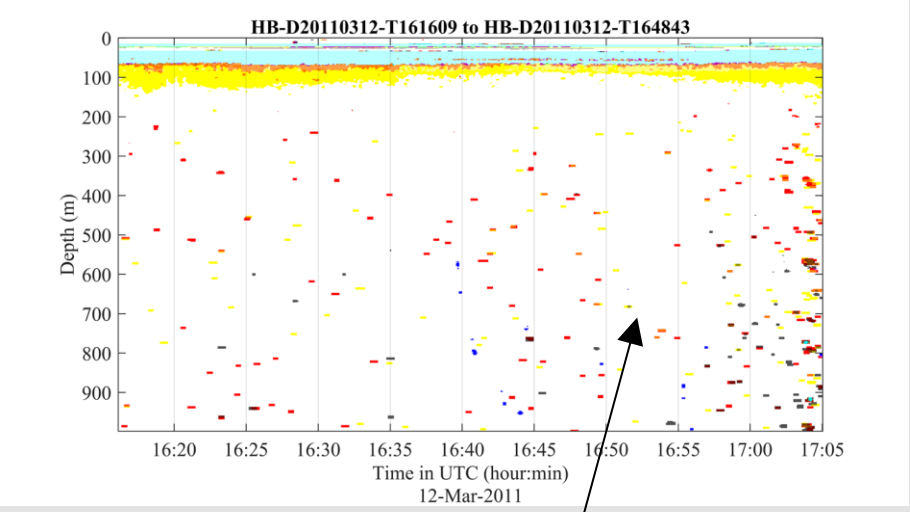




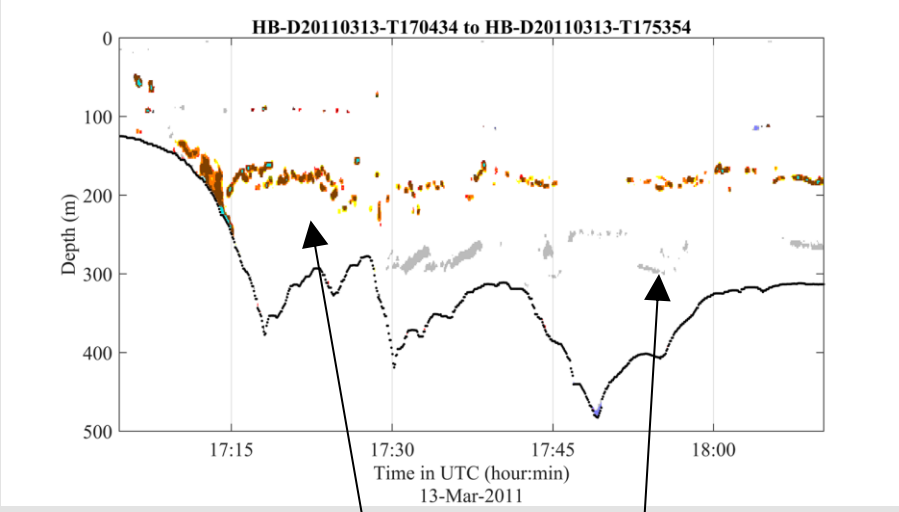
Wall et al (*in press*)

Visualizing the Archived Data

- Users will be able to understand the quality and content of the raw data files prior to submitting data requests
  - More informed on whether the data/area of interest is in fact relevant to their research question
  - Creates a more efficient process for both the user and the archive staff
  - Users of various backgrounds can easily understand these complex data



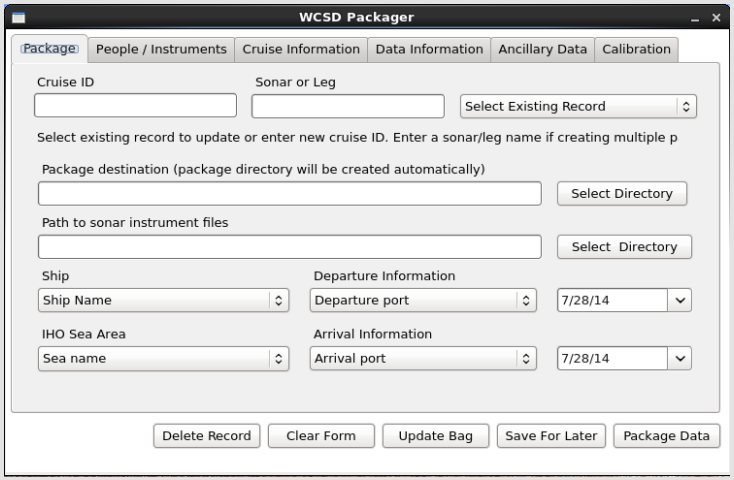
Noise in high frequency tranducers

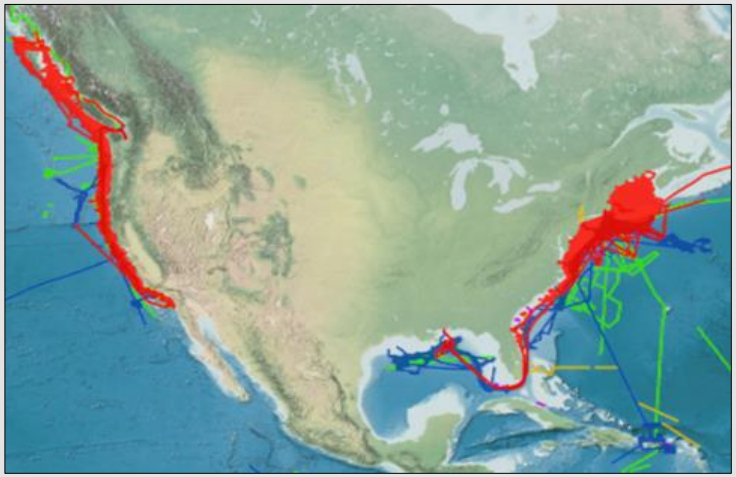


Patches of zooplankton and fish

Benefits of the Archive

- Easy to use packaging interface to assist in submitting data to the archive
  - Help data providers meet their data management directives
  - Create ISO compliant metadata, mint digital object identifiers
- Easy access to the archived data through online web map
  - Central repository for global access to an unprecedented dataset
- Increase the potential for these data to be used beyond their original collection purpose
  - Identify areas data gaps or repeated surveys
  - Aim to promote collaboration and research that advances the field of marine ecosystem acoustics





Acknowledgements

- Special thanks to
  - *Data Providers & Partners*: Michael Jech, Rick Towler, Scott Furnish, Warren Mitchell, Dezhang Chu, Réka Domokos, Joe Warren, OER (Sharon Mesick and Susan Gottfried), and UNOLS
  - *Support*: Dan Kowal, John Cartwright, Jesse Varner, Dani Austin, Anna Milan, John LaRocque, Michael Gallagher, David Detlor

- Funding provided by NOAA FISHERIES