U.S. Integrated Ocean Observing System (IOOS®)

NATIONAL ANIMAL TELEMETRY NETWORK
Data Assembly Center

Hassan Moustahfid
U.S. IOOS

IOOS DAMC RAs Workshop, Sep.10-12 2013

Outline

- ATN Vision
- Existing ATN Data Networks
- Tagging/Telemetry Technology
- ATN Proposed DAC Why DAC?
- IOOS/ONR/TOPP Project
- IOOS/NANOOS/POST/OTN Project
- ATN DAC Prototype Development
- Fwd Looking

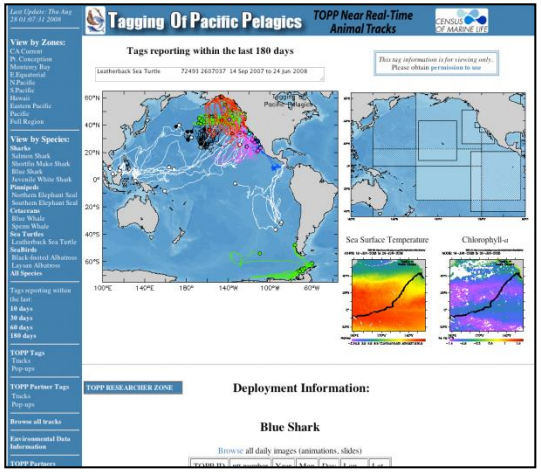
ATN Vision

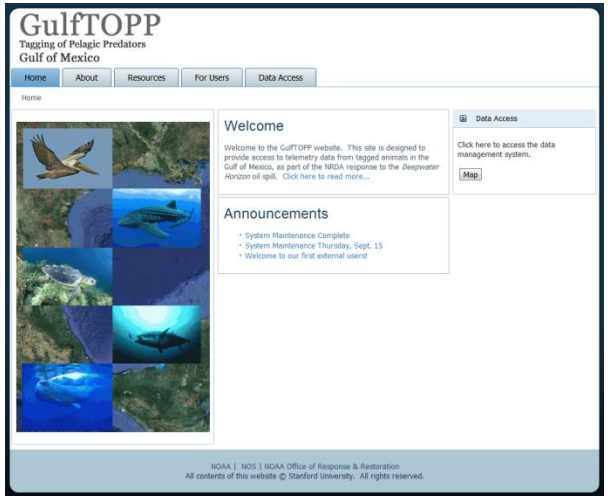
"Establish a National Animal Telemetry Observing Network (ATN) under the US IOOS capable of providing observations for ocean modeling and forecasting and a science-based source of information crucial for effective Ecosystem Based Management (EBM)."

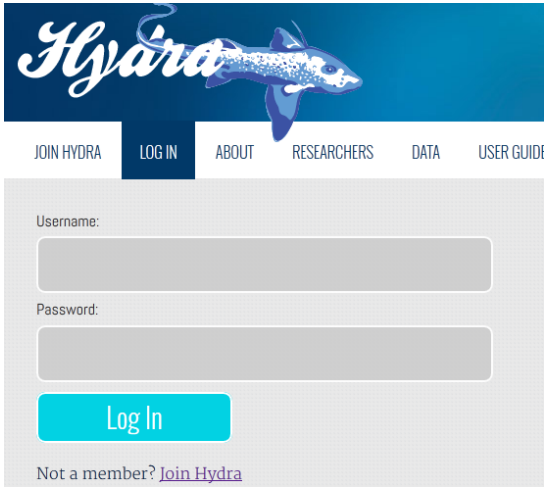
The ATN will:

- Facilitate integration of animal telemetry instrument with existing observing systems
- **Improve data standards, management, sharing capability and establish a cyber- infrastructure for archiving and displaying telemetry data**
- Serve as a focal point for the development of new sensors technology
- Bring permanence and sustainability to a national telemetry network
- Expand animal telemetry outreach and education programs.

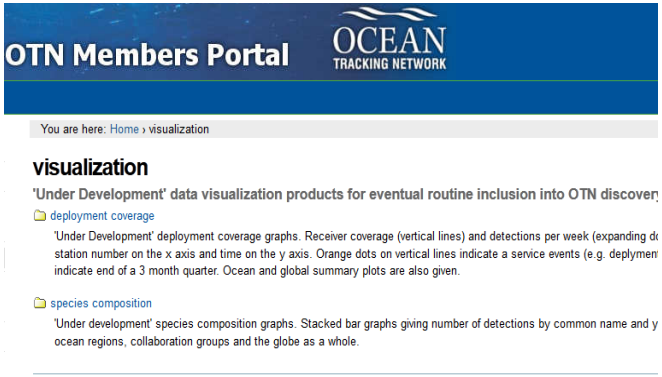
Current ATN Data Management
Scattered and Less interoperable







MATOS



THE USE OF AN INSTRUMENTED MARINE MAMMAL AS AN OCEANOGRAPHIC SURVEY PLATFORM

by
W. E. Evans
J. S. Leatherwood
Undersea Surveillance and Ocean Sciences Department
December 1972

NAVAL UNDERSEA CENTER
NUC
SAN DIEGO, CALIFORNIA

Approved for public release, distribution unlimited.

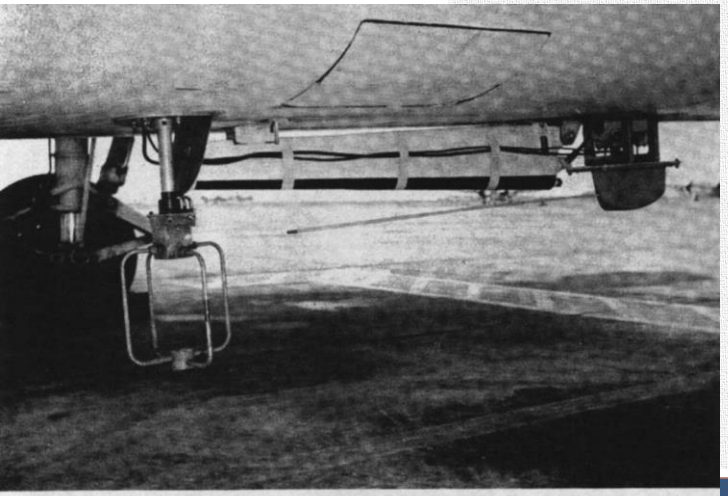


Figure 1. The tracking antennae installed on an S-2 aircraft. The antenna to the right is a motor-controlled sense antenna which can be lowered to the vertical position during flight. The directional loops are to the left.

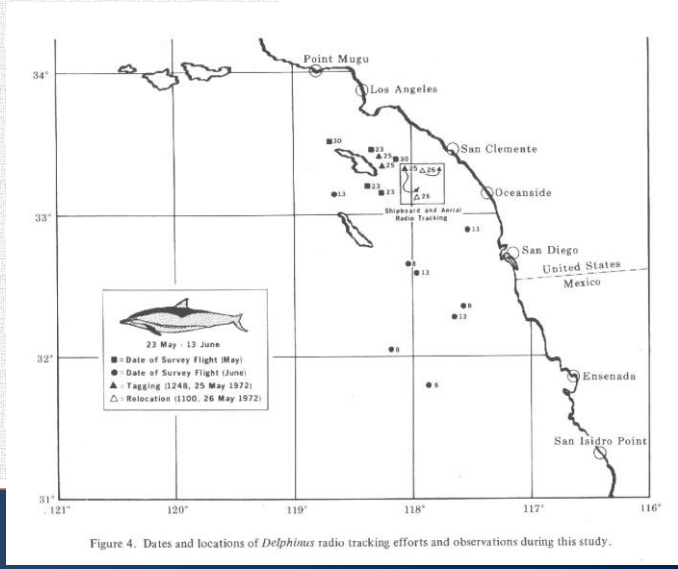
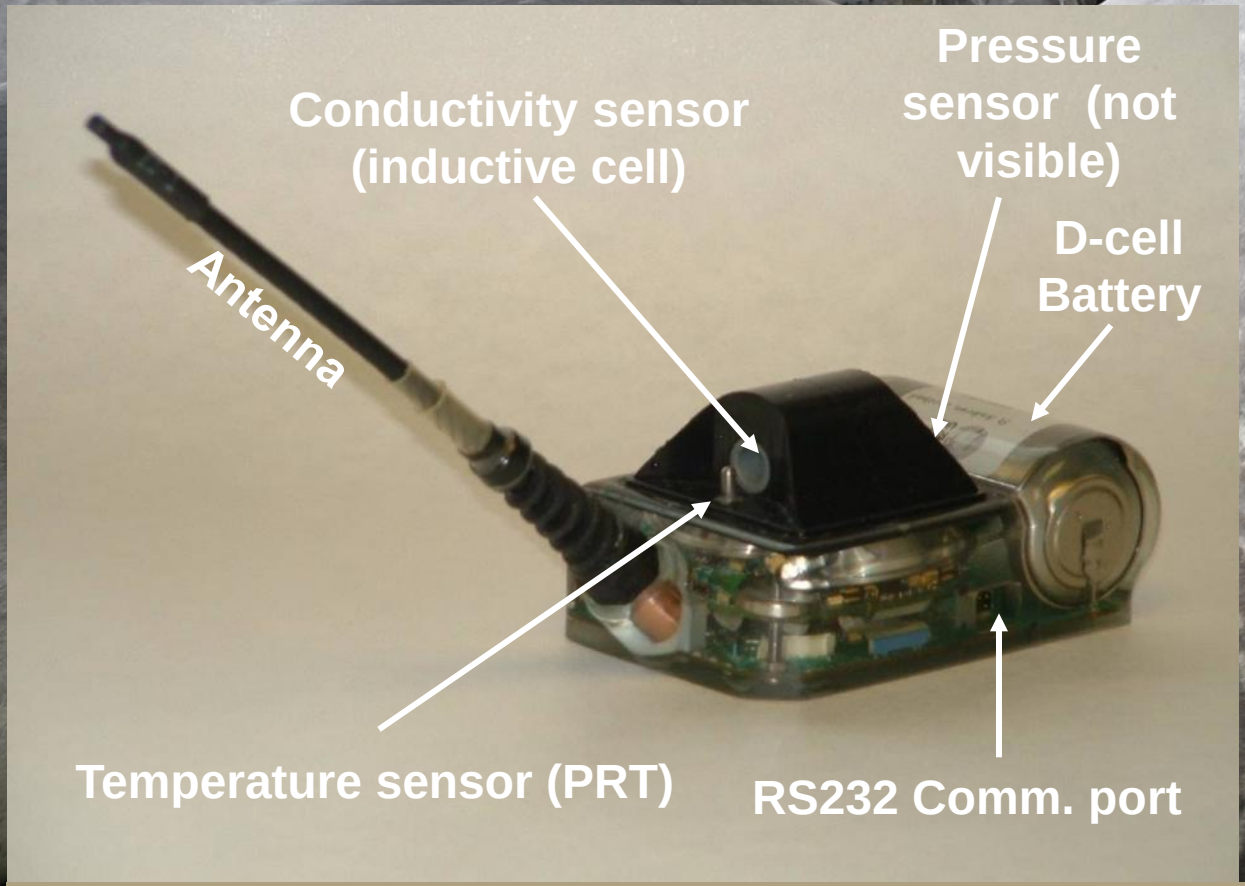


Figure 4. Dates and locations of *Delphinus* radio tracking efforts and observations during this study.

Current version of CTD tag:



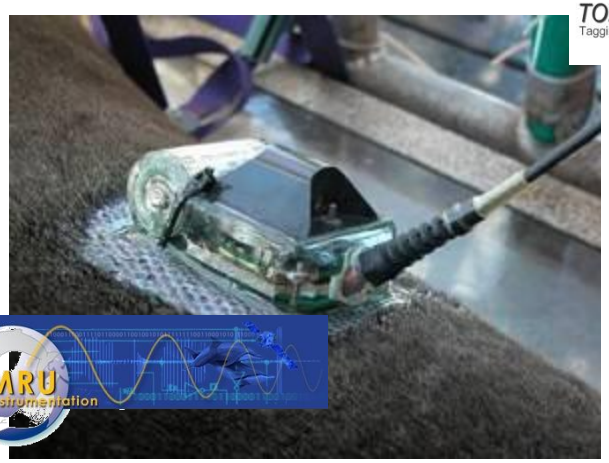
Office of Naval Research

NOPP funding

Sensor performance: Temperature: ± 0.01° C
Salinity: ± 0.01
Pressure: 1% of full scale (~2000 dBar)

A Decade of Building Next Generation Technology, Data Storage & Display

CTD Tag



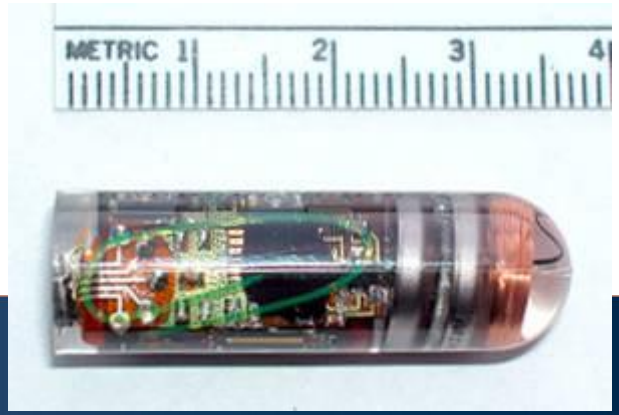
Pop-Up Satellite Tags

Rapid Temperature TDR

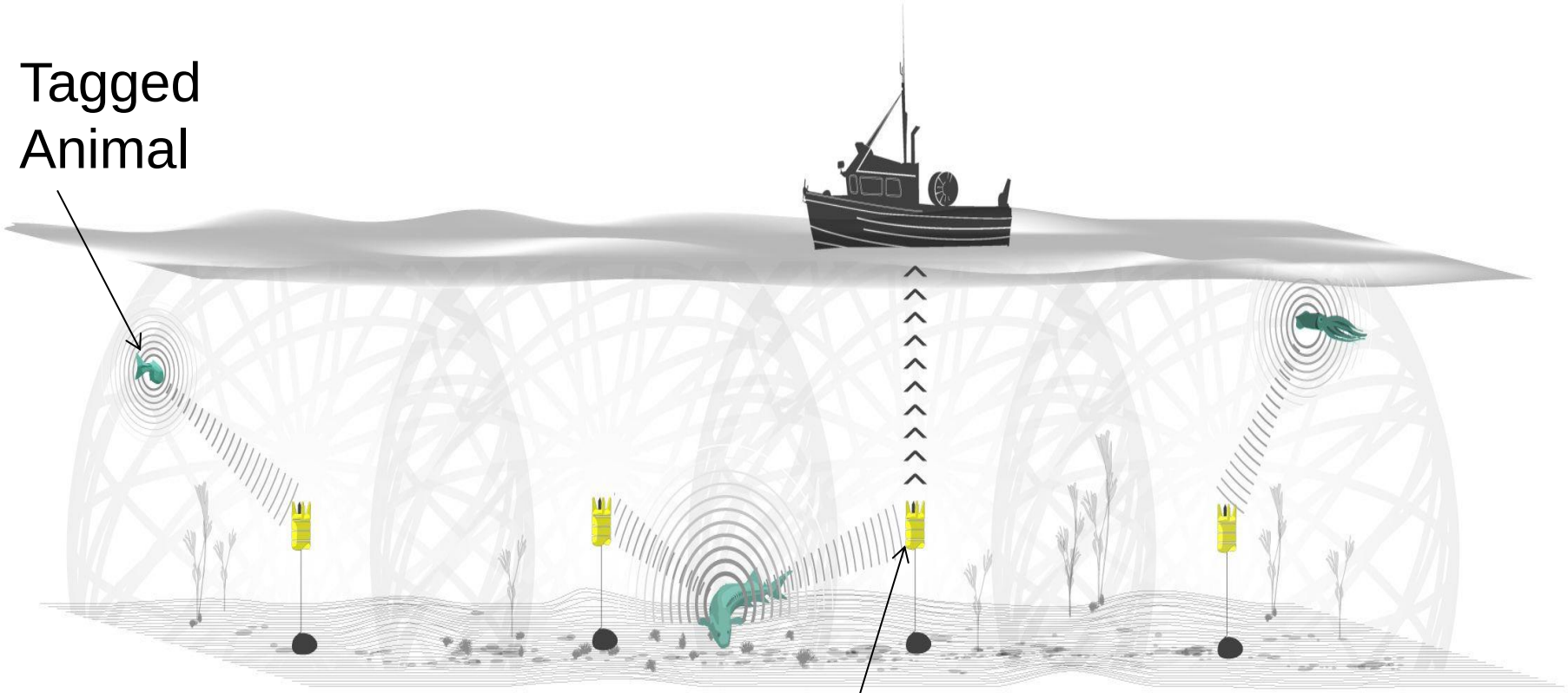
Prototype GPS Tag

Small Acoustic Tags

Geolocation Tags (6 g)



Tagged Animal

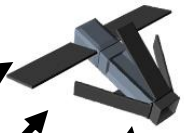


Acoustic Receiver

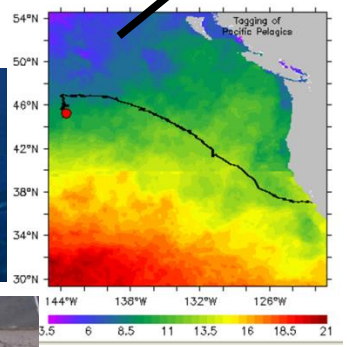
Image Credit: POST

Challenge: An IOOS ATN Data Management System: Must Ingest the Diverse Animal Tag Platforms





Tracking Data

ATN

PSQL

Webservice

Client-side scripts

Websites

Lab

IOOS
NOAA
NOS, NASA

Public

DATA FLOW FOR ATN.
Must Ingest the Diverse Animal Tag Platforms

Archival tags

Satellite tags

Acoustic Receivers Data

Tracking data

ATN DAC

ATN data & Products

WMO

Global Telecommunication System

National Oceanic and Atmospheric Administration's National Data Buoy Center
Center of Excellence in Marine Technology

Operational Forecasting Systems

Research Modeling Systems e.g. IEA, EBM, MPA etc.

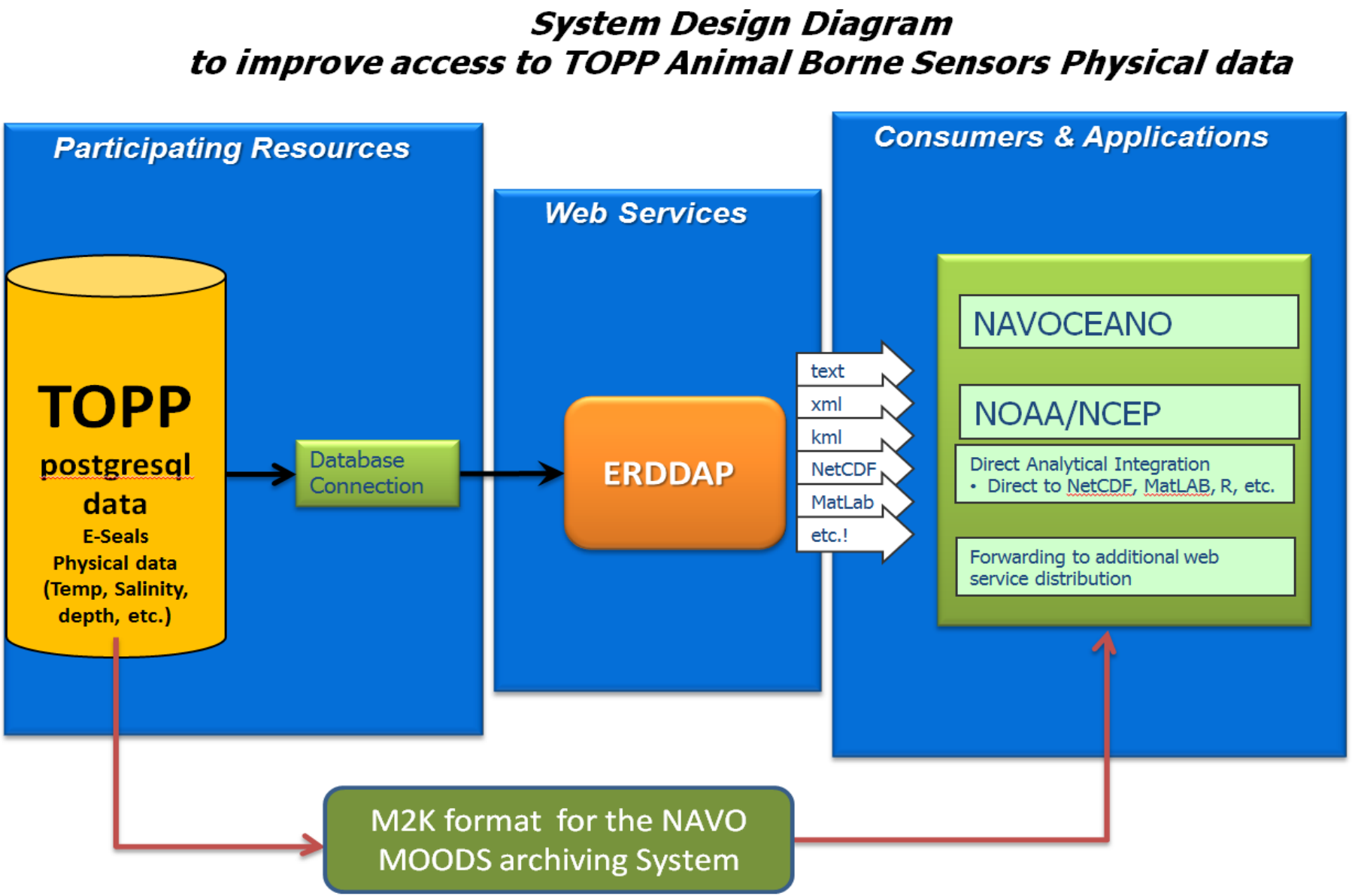
Research education& training

Other Users

NOAA NATIONAL OCEANOGRAPHIC DATA CENTER (NODC)
UNITED STATES DEPARTMENT OF COMMERCE

ATN Data to HYCOM models US NAVY NAVOCEANO

http://dataxfer.stanford.edu:8080/erddap/index.html



Real-time data flow

Met Office

Coriolis
OPERATIONAL OCEANOGRAPHY

user

Global
Telecommunication
System

British Oceanographic
Data Centre

Challenges of Acoustic Telemetry Data

- Three interlocking parts (Receiver Metadata, Tag Metadata, and Detections) must be assembled to recreate an animal track
- Must keep track of Receiver Histories

- Metadata may be fairly complex:

  - Instrument attributes (e.g. tag and receiver programming)
  - Positions and position errors
  - Time (tracks)
  - Quality control
  - Attribution for objects served

Reconciled AAT Data Content Convention

A metadata convention for animal acoustic telemetry data

Version 1.1

May 29. 2013

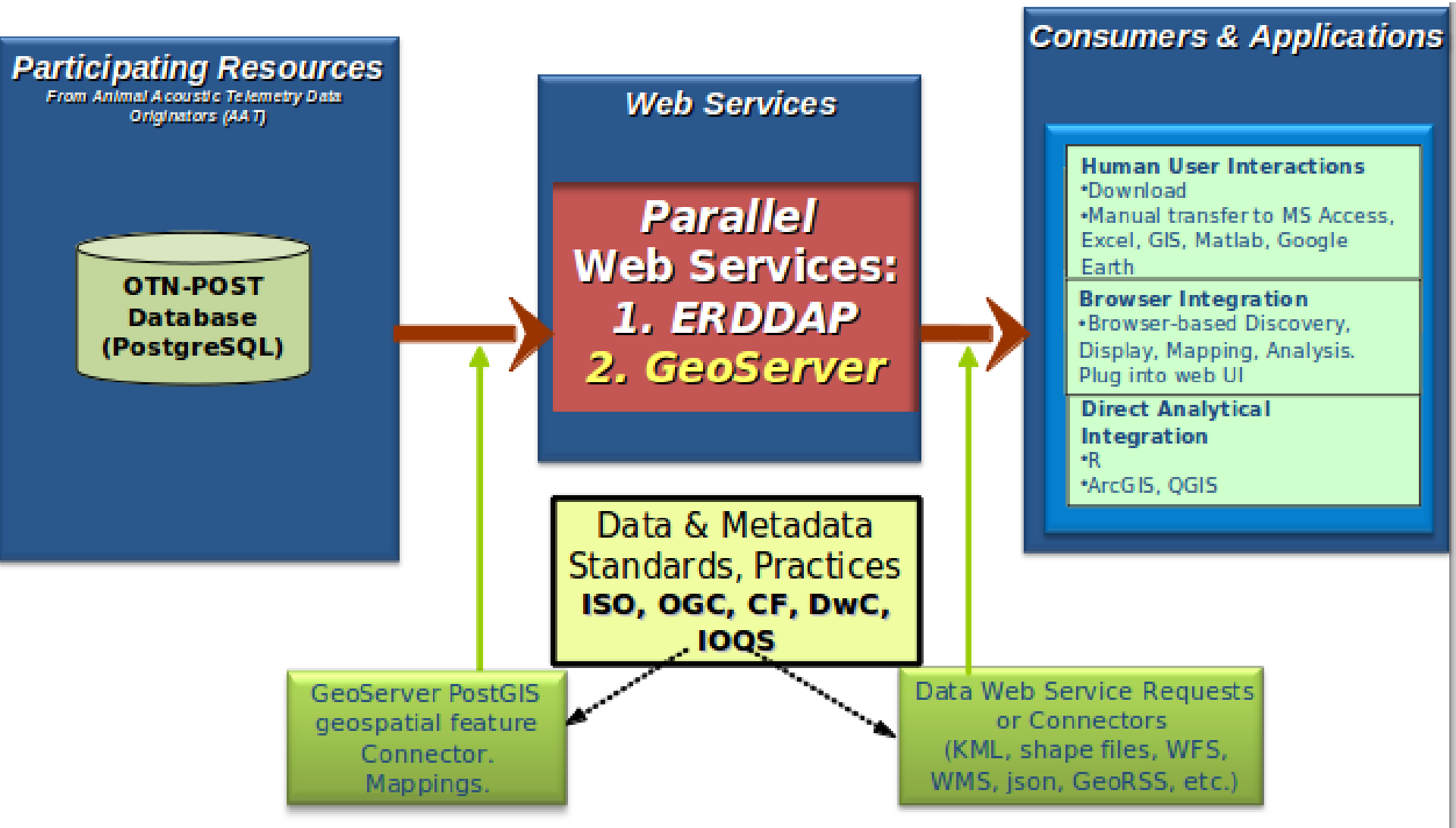
John Payne, Hassan Moustahfid, Emilio Mayorga

Robert Branton, Marta Mihoff, Lenore Bajona

[More details AAT WIKI in IOOSTech https://code.google.com/p/ioostech/wiki/AnimalAcousticTelData]

Table of Contents

AAT Observations System Design – Service Connections. Geospatial access to data via GeoServer: RDBMS > GeoServer.



NANOOS Pilot Implementation with OTN data

ERDDAP
Easier access to scientific data

NOAA NMFS

ERDDAP > List of All Datasets

http://nile.apl.washington.edu/erddap/index.html

Or, Do a Full Text Search for Datasets:

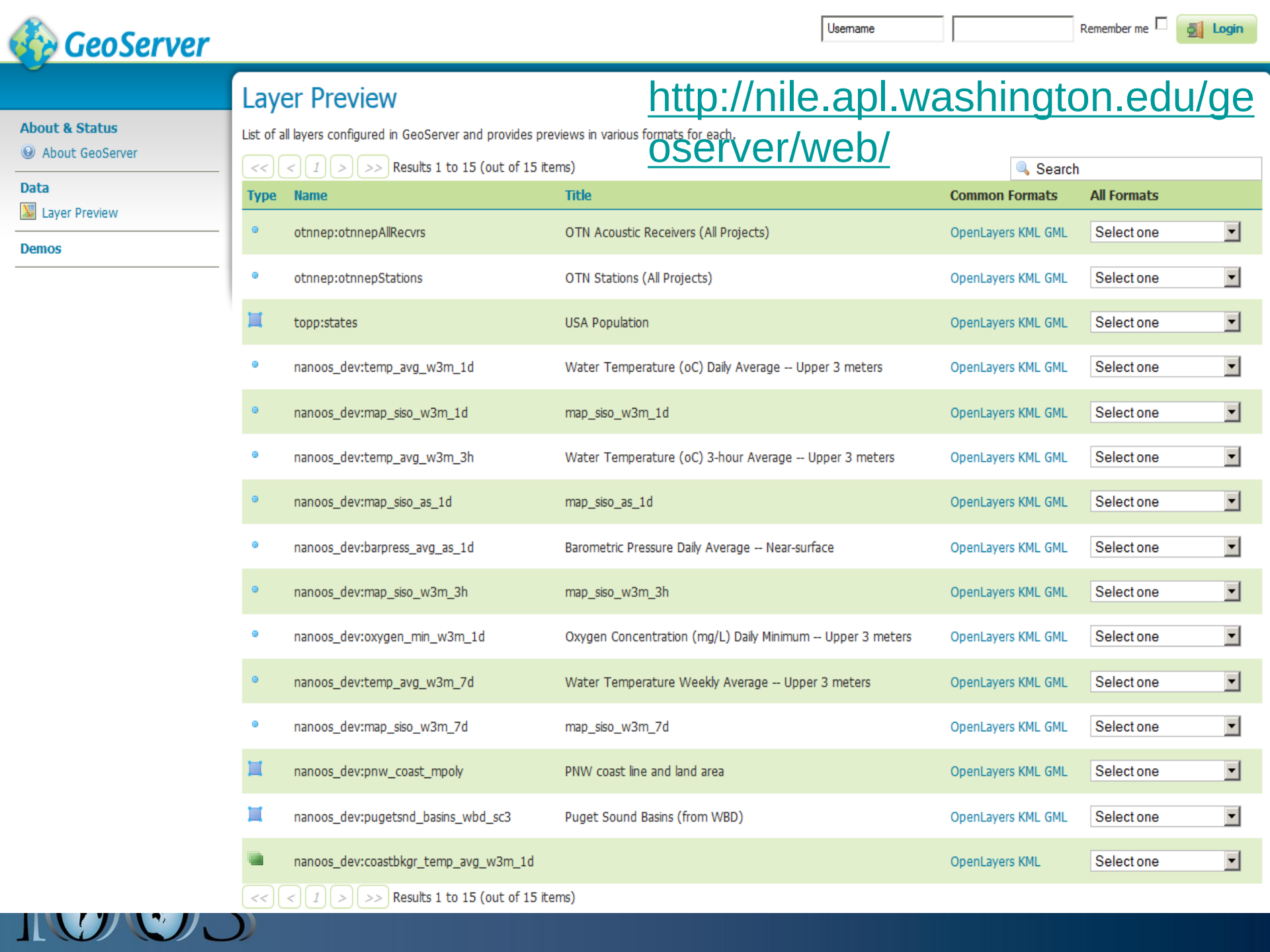
Or, Search for Datasets by Category:
cdm_data_type, institution, ioos_categ
long_name, standard_name, variableN

Or, Search for Datasets with Advanced

Pick a Dataset

14 matching datasets, listed in alphabetical order.

Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	WMS	Title	Sum-mary	FGDC, ISO, Metadata	Back-ground Info	RSS	E mail	Institution	Dataset ID
	set	data	graph		OTN NEP - Acoustic Receivers and Stations		F I M	background	RSS		OTN	otnnepRecvrs
	set	data	graph		OTN NEP - Acoustic Tags and Animal Information		F I M	background	RSS		OTN	otnnepAnTags
	set	data	graph		OTN NEP - Detections		F I M	background	RSS		OTN	otnnepDetects
	set	data	graph		OTN NEP - Stations		F I M	background	RSS		OTN	otnnepStations
	set	data	graph		OTN NEP JDF - OTN Strait of Juan de Fuca Line Acoustic Receivers and Stations		F I M	background	RSS		OTN	otnnepJDFRecvrs
	set	data	graph		OTN NEP JDF - OTN Strait of Juan de Fuca Line Detections		F I M	background	RSS		OTN	otnnepJDFDetects
	set	data	graph		OTN NEP LIND - Lindley Tags Acoustic Tags and Animal Information		F I M	background	RSS		NOAA-SWFSC	otnnepLINDAnTags
	set	data	graph		OTN NEP MOSER - Moser Tags Acoustic Tags and Animal Information		F I M	background	RSS		NOAA-NWFSC	otnnepMOSERAnTags
	set	data	graph		OTN NEP PSS2 - OTN Canada Pacific Sockeye Sal ... roject 2 Acoustic Tags and Animal Information		F I M	background	RSS		UBC	otnnepPSS2AnTags
	set	data	graph		OTN NEP QCS - OTN Queen Charlotte Strait Line Acoustic Receivers and Stations		F I M	background	RSS		OTN	otnnepQCSRecvrs
	set	data	graph		OTN NEP QCS - OTN Queen Charlotte Strait Line Detections		F I M	background	RSS		OTN	otnnepQCSDetects
	set	data	graph		OTN NEP VOGL - Vogel Tags Acoustic Tags and Animal Information		F I M	background	RSS		NRS	otnnepVOGLAnTags
	set	data	graph		OTN NEP WILL - Willapa Bay, OR Acoustic Receivers and Stations		F I M	background	RSS		KRS	otnnepWILLRecvrs
	set	data	graph		OTN NEP WILL - Willapa Bay, OR Detections		F I M	background	RSS		KRS	otnnepWILLDetects


GeoServer
Username
Remember me
Login
About & Status
About GeoServer
Data
Layer Preview
Demos
Layer Preview
http://nile.apl.washington.edu/geoserver/web/
List of all layers configured in GeoServer and provides previews in various formats for each.
<< < 1 > >> Results 1 to 15 (out of 15 items)
Search
Type Name Title Common Formats All Formats
otnnep:otnnepAllRecvrs OTN Acoustic Receivers (All Projects) OpenLayers KML GML Select one
otnnep:otnnepStations OTN Stations (All Projects) OpenLayers KML GML Select one
topp:states USA Population OpenLayers KML GML Select one
nanoos_dev:temp_avg_w3m_1d Water Temperature (oC) Daily Average -- Upper 3 meters OpenLayers KML GML Select one
nanoos_dev:map_siso_w3m_1d map_siso_w3m_1d OpenLayers KML GML Select one
nanoos_dev:temp_avg_w3m_3h Water Temperature (oC) 3-hour Average -- Upper 3 meters OpenLayers KML GML Select one
nanoos_dev:map_siso_as_1d map_siso_as_1d OpenLayers KML GML Select one
nanoos_dev:barpress_avg_as_1d Barometric Pressure Daily Average -- Near-surface OpenLayers KML GML Select one
nanoos_dev:map_siso_w3m_3h map_siso_w3m_3h OpenLayers KML GML Select one
nanoos_dev:oxygen_min_w3m_1d Oxygen Concentration (mg/L) Daily Minimum -- Upper 3 meters OpenLayers KML GML Select one
nanoos_dev:temp_avg_w3m_7d Water Temperature Weekly Average -- Upper 3 meters OpenLayers KML GML Select one
nanoos_dev:map_siso_w3m_7d map_siso_w3m_7d OpenLayers KML GML Select one
nanoos_dev:pnw_coast_mpoly PNW coast line and land area OpenLayers KML GML Select one
nanoos_dev:pugetsnd_basins_wbd_sc3 Puget Sound Basins (from WBD) OpenLayers KML GML Select one
nanoos_dev:coastbkgr_temp_avg_w3m_1d OpenLayers KML Select one
<< < 1 > >> Results 1 to 15 (out of 15 items)

REAL-TIME DETECTIONS FROM CBIBS BUOY IN CHESAPEAKE

NOAA Chesapeake Bay Office (NCBO) Fish Tag Notification

Requested Fish Tag Data Found

You are receiving this email as part of the NCBO Telemetry program. To change or unsubscribe email ncbo.it

Tag Data Counts

Event Date UTC	Tag Owner	Tag VUE Id	Data Count
04/29/2013	unknown	A69-1601-9341	**5**
04/30/2013	unknown	A69-1601-9341	**14**
05/01/2013	unknown	A69-1601-9341	**1**
05/02/2013	unknown	A69-1601-9341	**5**
05/03/2013	unknown	A69-1601-9341	**3**
05/04/2013	unknown	A69-1601-9341	**4**

ATN DAC Prototype Development at NOAA/Stanford US IOOS/US NAVY

- 12 months project with NOAA and Stanford CoML Tagging of Pacific Predators Program TOPP
- Archival, Satellite and Acoustic Telemetry
- Leverage existing capabilities

GTOPP and Gulf TOPP

IMOS AATAMS and OTN

GulfTOPP

Tagging of Pelagic Predators
Gulf of Mexico

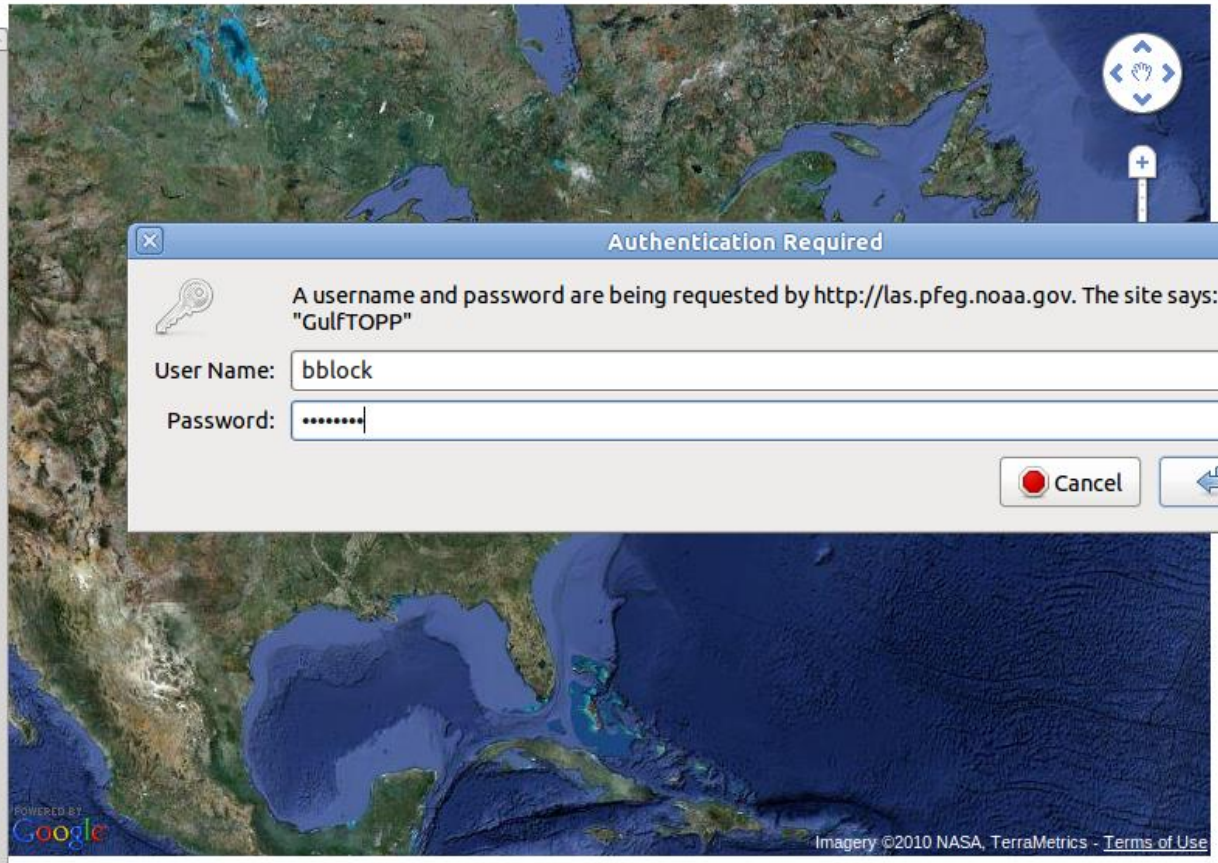
You are not logged in

Log In

Log Out

Home

Please log in to view GulfTOPP data



Show Latest Satellite Data: SST | Chlorophyll | Remove overlay

Choose a time range then click 'Replot', use: ○ deployment time ◉ last heard from

Time: [ ] to [ ] days: [ ]

Replot

GulfTOPP

Tagging of Pelagic Predators
Gulf of Mexico

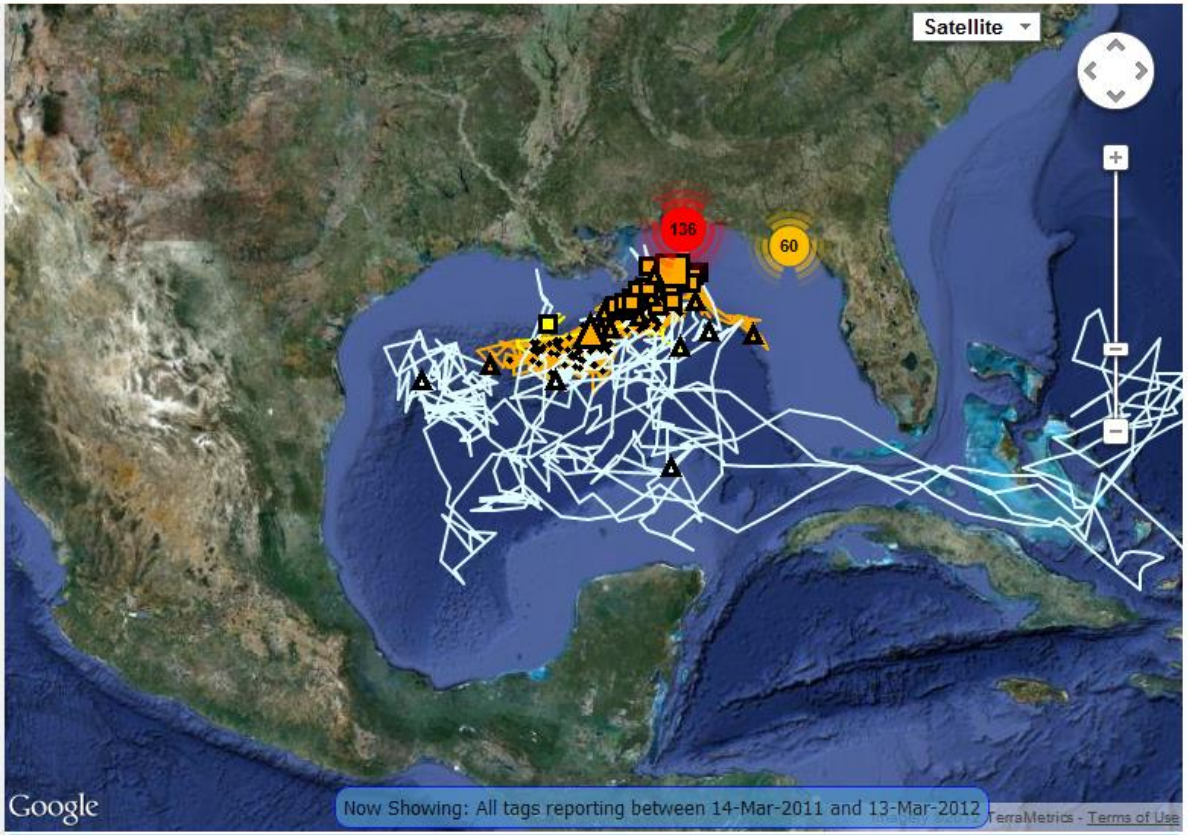
Logged in as Barbara Block (The Chief Scientist)
Log In
Log Out

Home

Browse GulfTOPP tags with the tree OR **extract tags in a region** by species and time range with the menu below the map.

Help

- Cetaceans
  - Sperm Whale
    - 2011
- Fish
  - Atlantic Bluefin Tuna
    - 2007
    - 2008
    - 2009
    - 2010
  - Gulf Sturgeon
    - 2010
    - 2011
- Sharks
  - Whale Shark
    - 2010
    - 2011
      - 3811001--SSM



Extract tags in selected region *by species and time range.*

Choose species | Time: Sep 25, 2010 to Oct 14, 2011 days: 384

2007 2008 2009 2010 2011 2012 2013

Show tracks in region

30 tags crossed selected region in chosen 365 days

Remove region

SW: 19.99,-98.514
NE: 30.77,-81.486

Remove satellite overlay

GulfTOPP

Tagging of Pelagic Predators
Gulf of Mexico

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Home

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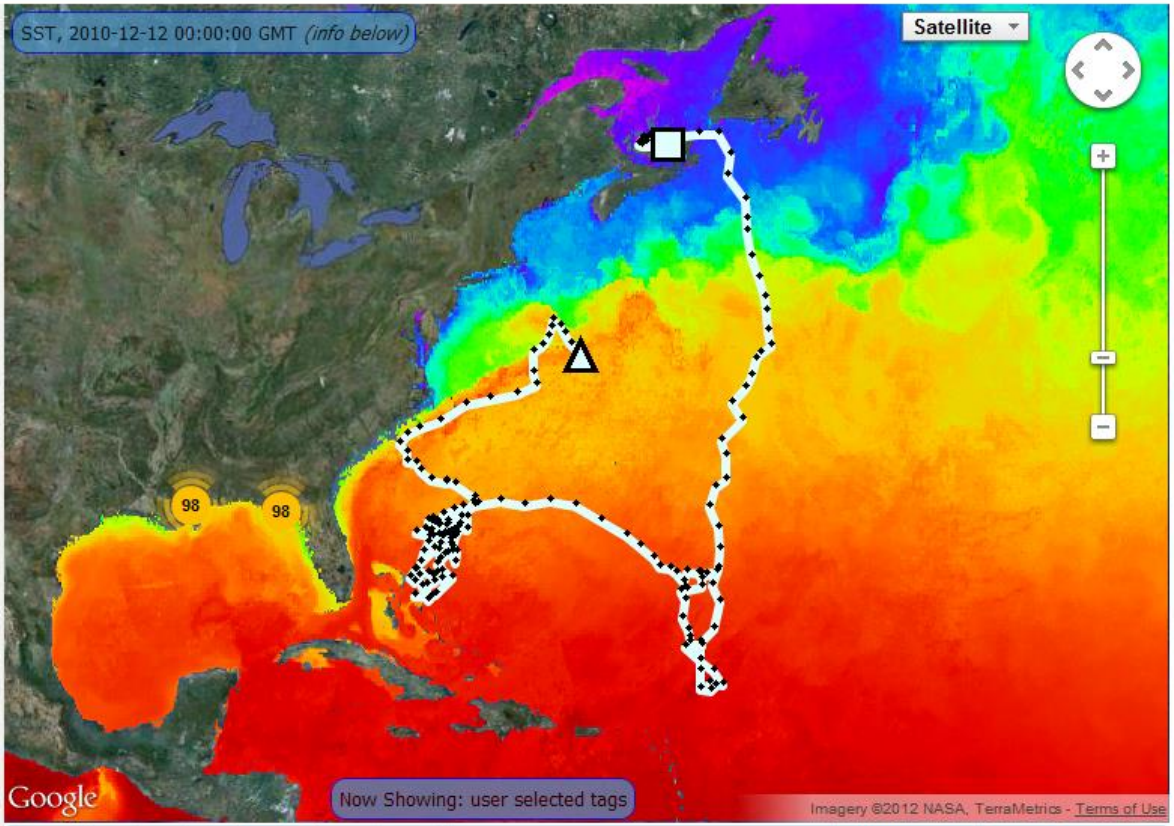
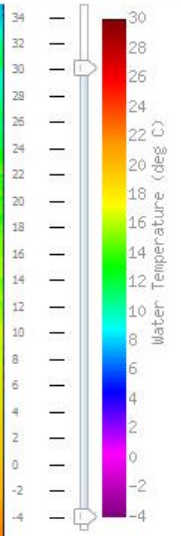
Help

- Cetaceans
  - Sperm Whale
- Fish
  - Atlantic Bluefin Tuna
    - 2007
    - 2008
    - 2009
    - 2010
      - 5110056-MA0110A0662-SS
      - 5110058-MA0110A0674-SS
      - 5110059-MA0110A0675-SS
      - 5110060-MA0110A0677-SS
      - 5110061-MA0110A0678-SS
      - 5110062-MA0110A0679-SS
      - 5110063-MA0110A0680-SS
      - 5110064-MA0110A0681-SS
      - 5110067-MA0110A0726-SS
      - 5110068-MA0110A0727-SS
      - 5110070-MA0110A0729-SS
      - 5110072-MA0110A0732-SS
      - 5110073-MA0110A0733-SS
      - 5110074-MA0110A0734-SS
      - 5110075-MA0110A0685-SS
      - 5110076-MA0110A0687-SS
      - 5110077-MA0110A0690-SS
      - 5110078-MA0108A0623-SS
      - 5110080-MA0110A0731-SS
      - 5110083-MA0110A0632-SS
      - 5110085-MA0110A0802-SS
      - 5110087-PAM110P0237-SSI
      - 5110088-MA0110A0763-SS
      - 5110089-MA0110A0801-SS
  - Gulf Sturgeon





new range:
-4.0 to 30.0 deg C

re-scale

Extract tags in selected region *by species and time range.*

Choose species | Time: Sep 20, 2010 to Mar 26, 2011 days: 187

2007 2008 2009 2010 2011 2012 2013

Show tracks in region

1 user selected tags on the map

Remove region

SW: 19.99,-98.514
NE: 30.77,-81.486

Environmental Data Information:
SST, Blended, Global, EXPERIMENTAL (8 Day Composite)
Provided by: CoastWatch West Coast Regional Node
Data information
Download this data

Remove satellite overlay

GulfTOPP

Tagging of Pelagic Predators
Gulf of Mexico

Logged in as Barbara Block (The Chief Scientist)
Log In
Log Out

Home

Browse GulfTOPP tags with the tree OR **extract tags in a region** by species and time range with the menu below the map.

Help

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  - Sperm Whale
- Fish
  - Atlantic Bluefin Tuna
    - 2007
    - 2008
    - 2009
    - 2010
      - 5110056-MA0110A0662-SS
      - 5110058-MA0110A0674-SS
      - 5110059-MA0110A0675-SS
      - 5110060-MA0110A0677-SS
      - 5110061-MA0110A0678-SS
      - 5110062-MA0110A0679-SS
      - 5110063-MA0110A0680-SS
      - 5110064-MA0110A0681-SS
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      - 5110080-MA0110A0731-SS
      - 5110083-MA0110A0632-SS
      - 5110085-MA0110A0802-SS
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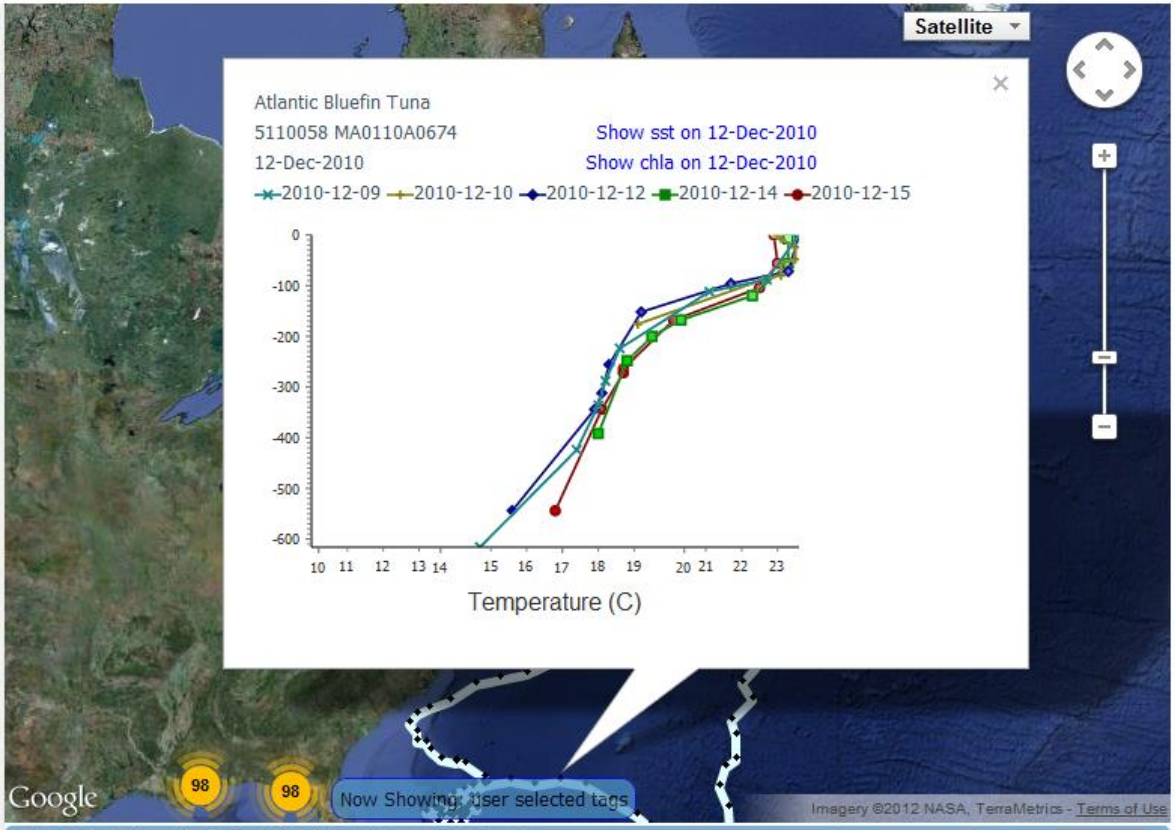
      - 5110089-MA0110A0801-SS



Extract tags in selected region *by species and time range.*

Choose species | Time: Sep 20, 2010 to Mar 26, 2011 days: 187

2007 2008 2009 2010 2011 2012 2013

Show tracks in region

1 user selected tags on the map

Remove region

SW: 19.99,-98.514
NE: 30.77,-81.486

Remove satellite overlay

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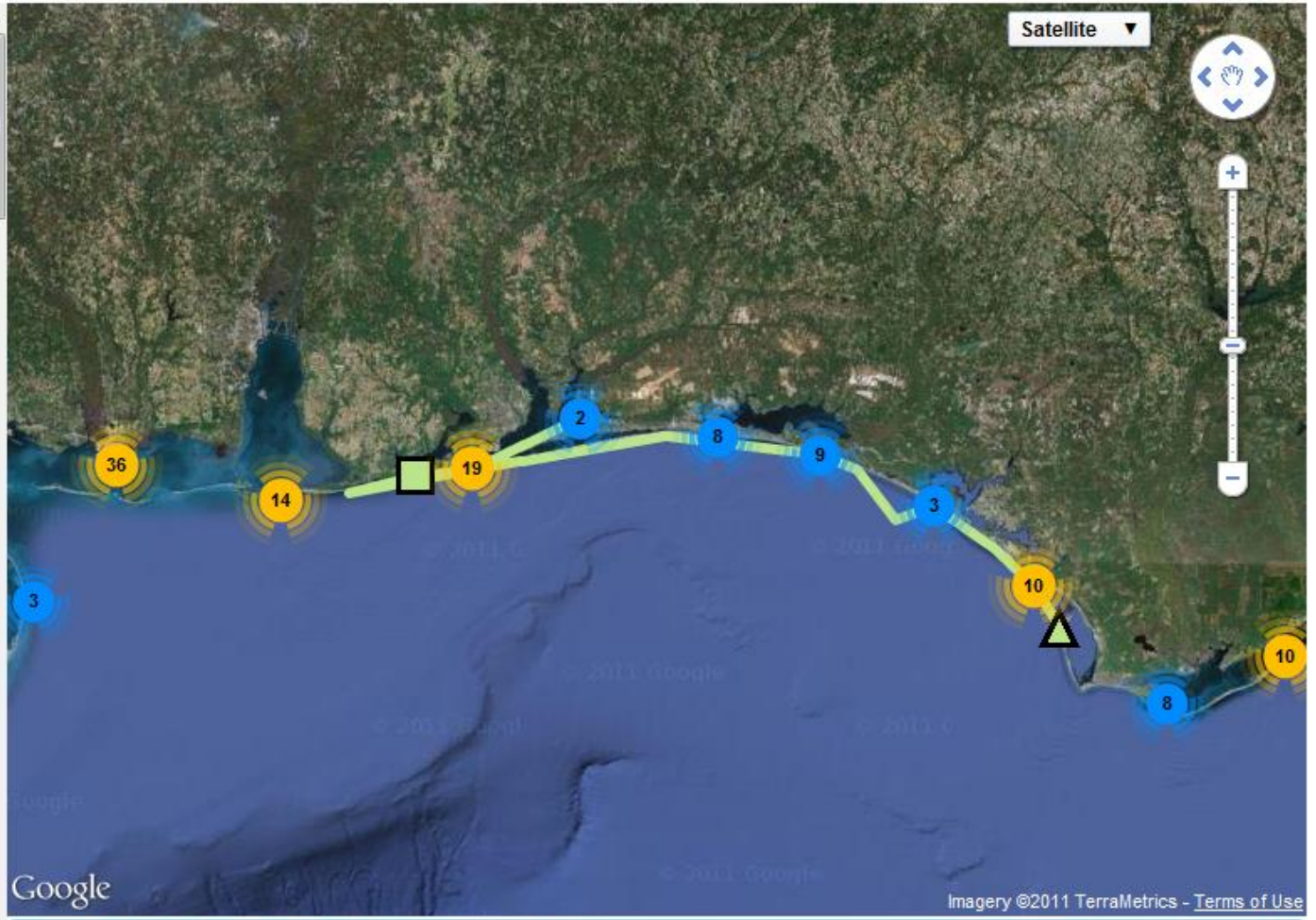
Help

- Fish
  - Atlantic Bluefin Tuna
    - 2007
    - 2008
    - 2009
    - 2010
  - Gulf Sturgeon
    - 2010
      - GS10000-46789-ACOU
      - GS10001-10270-ACOU
      - GS10002-10143-ACOU
      - GS10003-10160-ACOU
      - GS10004-10175-ACOU
      - GS10005-10140-ACOU
      - GS10006-10271-ACOU
      - GS10007-10150-ACOU
      - GS10008-46573-ACOU
      - GS10009-10152-ACOU
      - GS10010-10277-ACOU
      - GS10011-10263-ACOU
      - GS10012-10166-ACOU
      - GS10013-10141-ACOU
      - GS10014-45719-ACOU
      - GS10015-46161-ACOU
      - GS10016-46147-ACOU
      - GS10017-45717-ACOU
      - GS10018-61029-ACOU
      - GS10019-46151-ACOU
      - GS10020-46150-ACOU
      - GS10021-46160-ACOU
      - GS10022-46154-ACOU



Extract tags in selected region *by species and time range.*

Choose species | Time: Oct 15, 2010 to Nov 10, 2010 | days: 26

2007 2008 2009 2010 2011 2012

Show tracks in region

1 user selected tags on the map

Remove region

SW: 19.99,-98.514
NE: 30.77,-81.486

Remove satellite overlay

GulfTOPP

Tagging of Pelagic Predators
Gulf of Mexico

Logged in as Barbara Block (The Chief Scientist)
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      - GS10002-10143-ACOU
      - GS10003-10160-ACOU
      - GS10004-10175-ACOU
      - GS10005-10140-ACOU
      - GS10006-10271-ACOU
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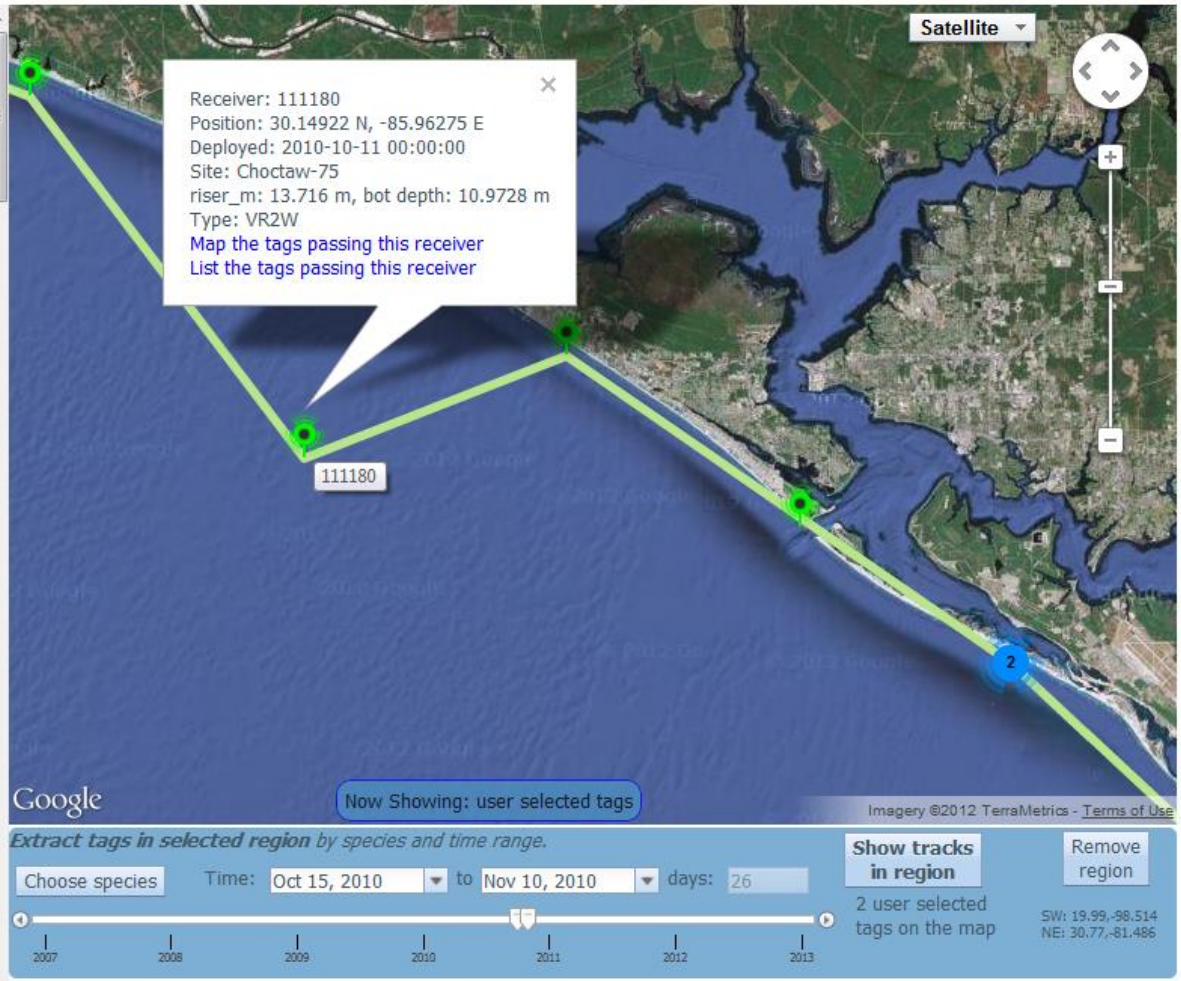
      - GS10013-10141-ACOU
      - GS10014-45719-ACOU
      - GS10015-46161-ACOU
      - GS10016-46147-ACOU
      - GS10017-45717-ACOU
      - GS10018-61029-ACOU
      - GS10019-46151-ACOU
      - GS10020-46150-ACOU
      - GS10021-46160-ACOU
      - GS10022-46154-ACOU
      - GS10023-46156-ACOU
      - GS10024-46144-ACOU
      - GS10025-46148-ACOU



Extract tags in selected region by species and time range.

Choose species | Time: Oct 15, 2010 to Nov 10, 2010 days: 26

2007 2008 2009 2010 2011 2012 2013

Show tracks in region

2 user selected tags on the map

Remove region

SW: 19.99,-98.514
NE: 30.77,-81.486

Remove satellite overlay

Animal Satellite Telemetry

ATN DAC
NOAA/Stanford

USERS

Global
Telecommunication
System

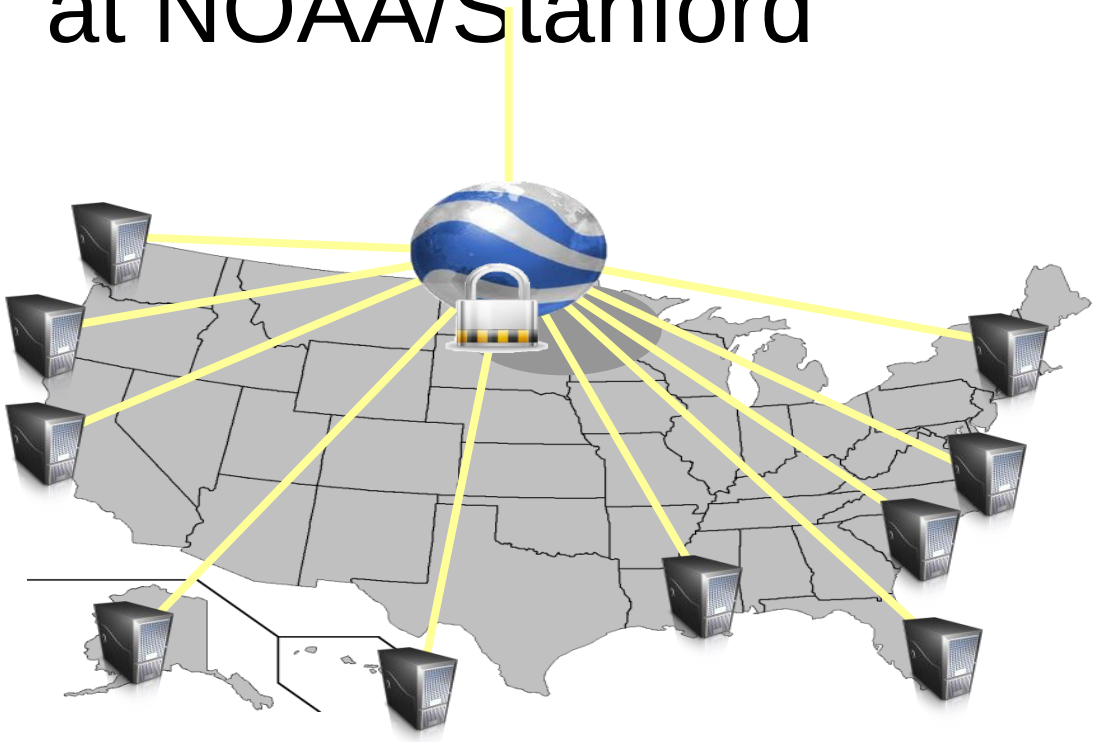
NDBC

National Oceanic and Atmospheric Administration's
National Data Buoy Center
Center of Excellence in Marine Technology

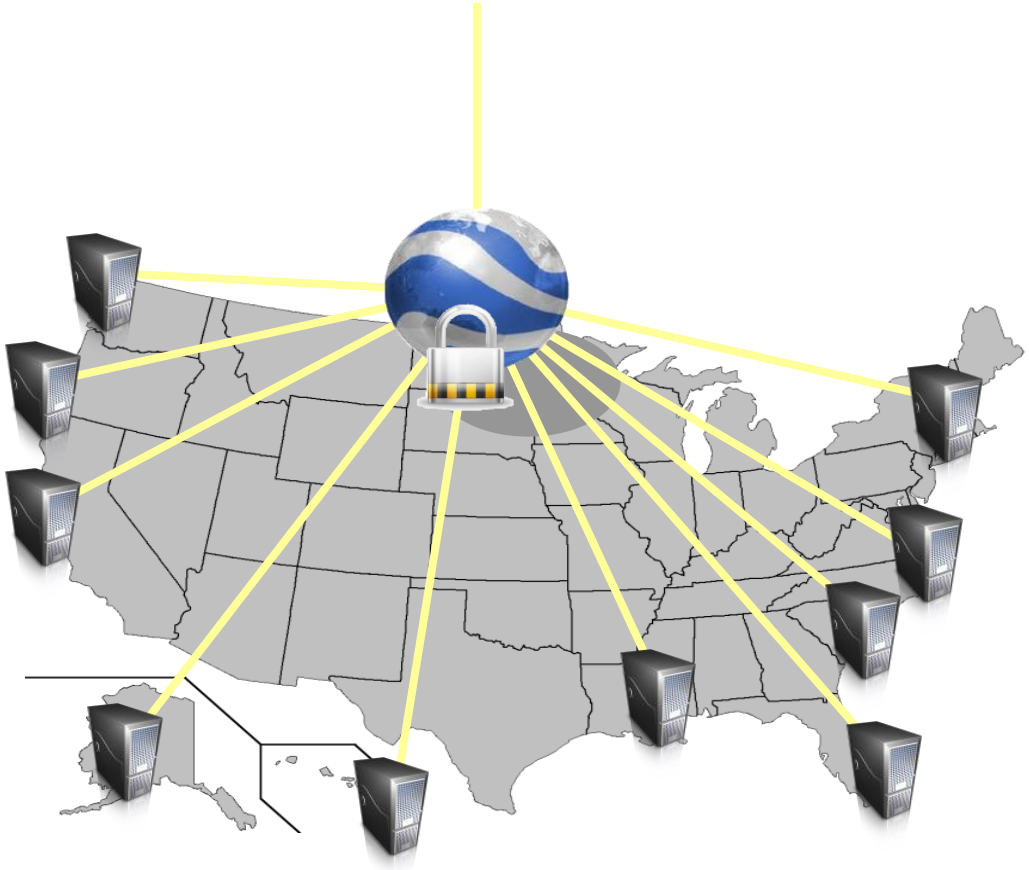
Options for AAT Data

1. Aggregate AAT Data at RAs

Duplicate NANOOS AAT capability in all RAs and Link to IOOS RCV or ATN DAC at NOAA/Stanford



2. Aggregate AAT Data directly at the ATN DAC




Questions &
Comments?
Likes & Dislikes?

Economics of Tagging – an Example

- 15-20 tags per year will provide a comprehensive spatial and temporal coverage of most of the target region (N Atl/Arctic; Anderson et al. 2009)
- Battery life – 10-12 months (molt)
- 12,000 profiles (CTD)
- Near-real time data
- Tags are ~$5K; <$10/profile