# Training and Outreach to NMFS and NOS end-users

PIs: Cara Wilson[1], Roy Mendelssohn[2], Dale Robinson[2] & Elliot Hazen[1]

NMFS/SWFSC

Environmental Research Division

Monterey[1] & Santa Cruz[2], CA

*JPSS Science Seminar, February 18, 2016*

# Training and Outreach to NMFS and NOS end-users

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& Elliot Hazen, NMFS/SWFSC/ERD

- Targets two broad *groups* of users:
  NMFS and NOS scientists and resource managers

- Primary objective is to increase the utilization of VIIRS ocean color and SST data within NOAA by:
  1) getting VIIRS data onto the ERD ERDDAP server
  2) distributing tools to improve data import, discovery and extraction
  3) conduct training sessions that demonstrate the easy accessibility of these datasets with these tools

# Training and Outreach to NMFS and NOS end-users

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**This projects leverages off of the work of the:**

**1. Data Team at SWFSC/Environmental Research Division:**

Roy Mendelssohn (team leader)
Lynn deWitt (genius at all things IT)
Bob Simons (creator of ERDDAP and browsers)
Ryan Belcher (NOAA corps officer)

**2. WestCoast Regional Node (WCRN) of CoastWatch**

Cara Wilson (node PI)
Dale Robinson (node manager)

WCRN 2015 Holiday Party

# Training and Outreach to NMFS and NOS end-users

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# Part I:

# ERDDAP

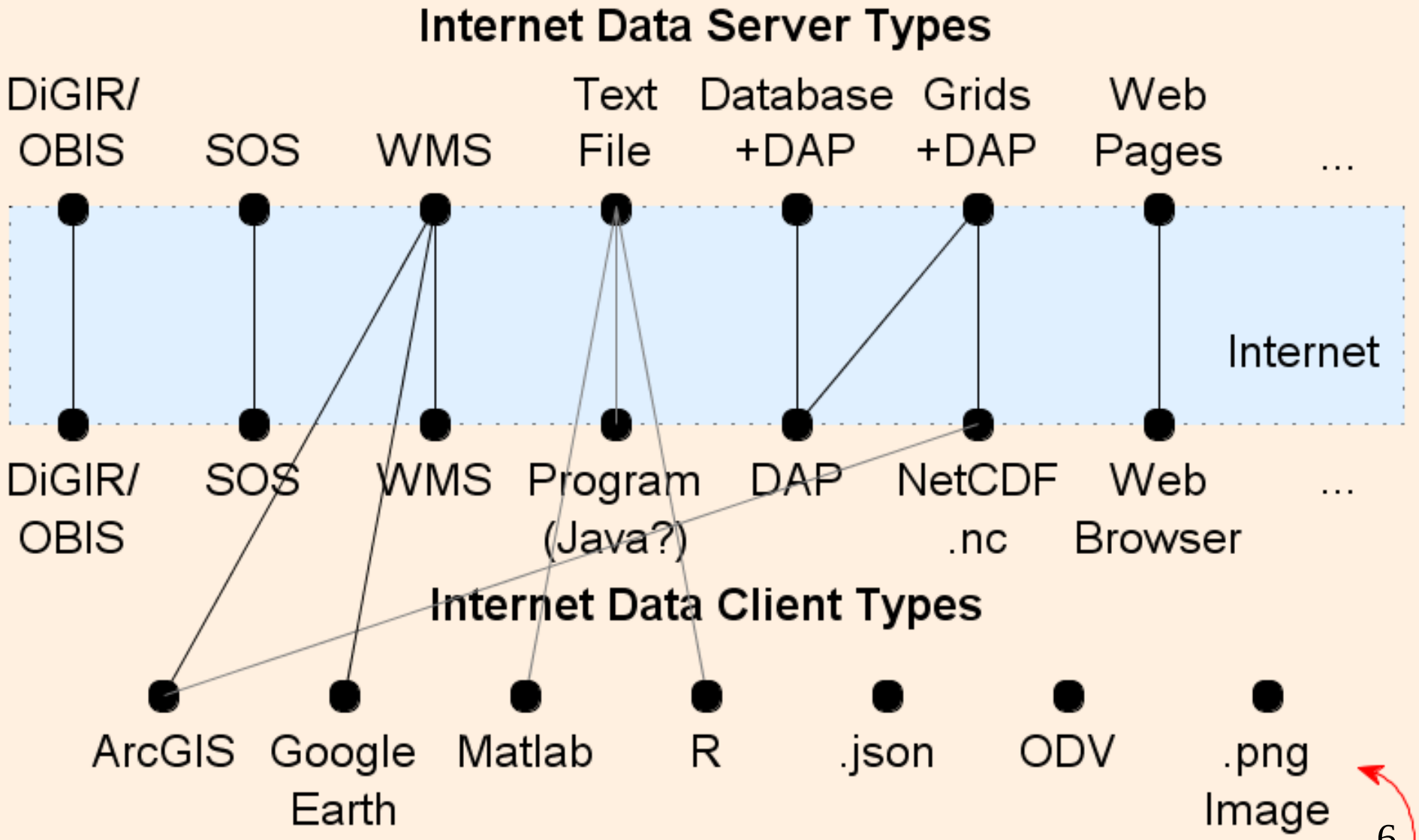
(Environmental Research Division's Data Access Program)

# What is ERDDAP?

- Developed at SWFSC/ERD by Bob Simons.
- ERDDAP is a web application (for humans with browsers) and a web service (with services for computer programs) designed to provide easier access to datasets for both people and machines.
- Multiple data formats are available
  (ncdf, grib, csv, ESRicsv, JSON, ODVtext, mat, text and more)
- Multiple image files formats are available (png, transparent png, pdf, kml)
- All different data response formats are created “on-the-fly”
- Allows temporal and spatial subsetting
- ERDDAP is “RESTful”, meaning the URL completely defines the data you want, in the format you want.
- Its better demonstrated than described

# Getting Data without ERDDAP

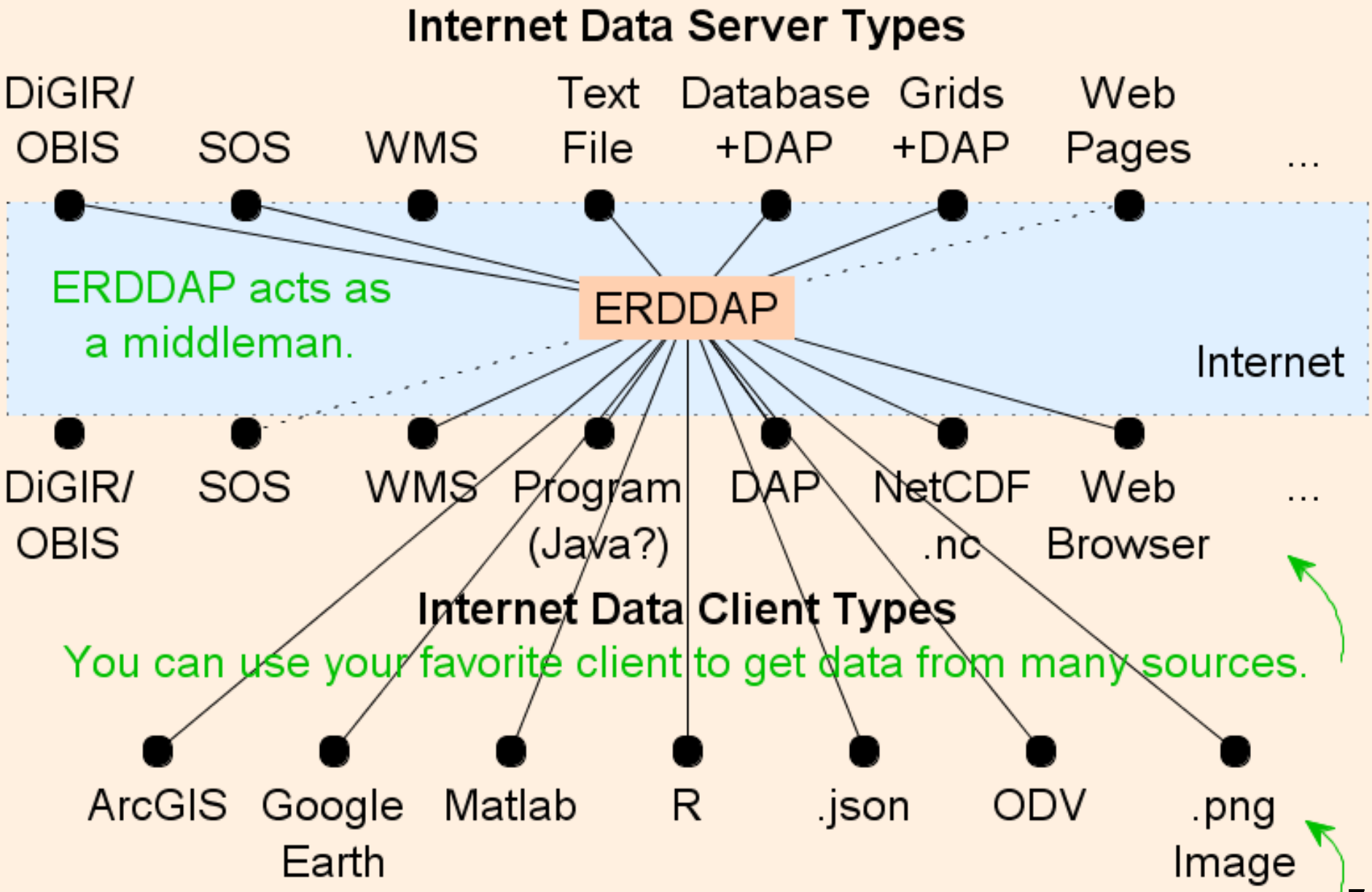
Each type of data server is great with its own client(s).






But there's no easy way to get data into other programs or file types.

# Getting Data with ERDDAP



http://coastwatch.pfeg.noaa.gov/erddap

# ERDDAP

ERDDAP is a data server that gives you a simple, consistent way to download subsets of gridded and tabular scientific datasets in common file formats and make graphs and maps. This particular ERDDAP installation has oceanographic data (for example, data from satellites and buoys).

## *Easier Access to Scientific Data*

Our focus is on making it easier for you to get scientific data.

**Different scientific communities have developed different types of data servers,** for example, OPeNDAP, WCS, SOS, OBIS, and countless custom web pages with forms. Each is great on its own. Without ERDDAP, it is difficult to get data from different types of servers:

- Different data servers make you format your data request in different ways.
- Different data servers return data in different formats, usually not the common file format that you want.
- Different datasets use different formats for time data, so the results are hard to compare.

**ERDDAP unifies the different types of data servers so you have a consistent way to get the data you want, in the format you want.**

- **ERDDAP acts as a middleman between you and various remote data servers.**
  When you request data from ERDDAP, ERDDAP reformats the request into the format required by the remote server, sends the request to the remote server, gets the data, reformats the data into the format that you requested, and sends the data to you. You no longer have to go to different data servers to get data from different datasets.

- **ERDDAP offers an easy-to-use, consistent way to request data: via the OPeNDAP standard.**
  Many datasets can also be accessed via the Web Map Service (WMS).

- **ERDDAP returns data in the common file format of your choice.**
  ERDDAP offers all data as .html table, ESRI .asc and .csv, Google Earth .kml, OPeNDAP binary, .mat, .nc, ODV .txt, .csv, .tsv, .json, and .xhtml. So you no longer have to waste time and effort reformatting data.

- **ERDDAP can also return a .png or .pdf image with a customized graph or map.**

## Start Using ERDDAP:
## Search for Interesting Datasets

- View a List of All 1,330 Datasets

- **Do a Full Text Search for Datasets**

  Search

- **Search for Datasets by Category**

  Datasets can be categorized in different ways by the values of various metadata attributes. Click on an attribute (cdm_data_type, institution, ioos_category, keywords, long_name, standard_name, variableName) to see a list of categories (values) for that attribute. Then, you can click on a category to see a list of relevant datasets.

- **Search for Datasets with Advanced Search**

- **Search for Datasets by Protocol**

  Protocols are the standards which specify how to request data.
  Different protocols are appropriate for different types of data and for different client applications.

| Protocol | Description |
|---|---|
| griddap datasets | Griddap lets you use the OPeNDAP hyperslab protocol to request data subsets, graphs, and maps from gridded datasets (for example, satellite data and climate model data). griddap documentation |
| tabledap datasets | Tabledap lets you use the OPeNDAP constraint/selection protocol to request data subsets, graphs, and maps from tabular datasets (for example, buoy data) |

**ERDDAP**
Easier access to scientific data

Brought to you by NOAA NMFS SWF

# ERDDAP > List of All Datasets

Or, Do a Full Text Search for Datasets:

Or, Search for Datasets by Category:
cdm_data_type, institution, ioos_category, ke
long_name, standard_name, variableName

Or, Search for Datasets with Advanced Searc

## Pick a Dataset

http://coastwatch.pfeg.noaa.gov/erddap

977 matching datasets, listed in alphabetical order.

| Grid DAP Data | Sub-set | Table DAP Data | Make A Graph | WMS | Source Data Files | Title | Sum-mary | FGDC, ISO, Metadata | Back-ground Info | RSS | E mail | Institution | Datas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | set | data | | | | * The List of All Active Datasets in this ERDDAP * | | M | background | | | NOAA NMFS SWFSC ... | allDatasets |
| data | | | graph | M | | AMSRE Model Output, obs4MIPs NASA-JPL, Global, 1 Degree, Monthly | | F I M | background | RSS | | Remote Sensing ... | jplAmsreSstMon |
| | | data | graph | | files | AN EXPERIMENTAL DATASET: Underway Sea Surface Temperature and Salinity Aboard the Oleander | | F I M | background | RSS | | NOAA OAR AOML | nodcPJJU |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 2, DEPRECATED, Global, 2011-2014, 3-Month | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSS3M |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 2, DEPRECATED, Global, 2011-2014, 7-Day | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSS7D |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 2, DEPRECATED, Global, 2011-2014, Daily | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSSDa |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 2, DEPRECATED, Global, 2011-2014, Monthly | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSSM |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 4, Global, 2011-2015, 3-Month | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSS3M |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 4, Global, 2011-2015, 7-Day | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSS7D |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 4, Global, 2011-2015, Daily | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSSDa |
| data | | | graph | M | | Aquarius Sea Surface Salinity, Version 4, Global, 2011-2015, Monthly | | F I M | background | RSS | | NASA/GSFC OBPG | jplAquariusSSSM |
| | | data | graph | | | Argo Float Data from the APDRC DAPPER Server | | F I M | background | RSS | | NOAA PMEL | apdrcArgoAll |
| data | | | graph | M | | AVISO Model Output, obs4MIPs NASA-JPL, Global, 1 Degree, Monthly | | F I M | background | RSS | | Centre National ... | jplAvisoSshMon |
| | set | data | graph | | | CalCOFI Continuous Underway Fish-Egg Sampler | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIcufes |
| | set | data | graph | | | CalCOFI Cruises | | M | background | RSS | | NOAA SWFSC | erdCalCOFIcruise |
| | set | data | graph | | | CalCOFI Egg Counts | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIeggcr |
| | set | data | graph | | | CalCOFI Egg Counts Positive Tows | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIeggcr |
| | set | data | graph | | | CalCOFI Egg Stages | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIeggst |
| | set | data | graph | | | CalCOFI Fish Counts | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIfshcnt |
| | set | data | graph | | | CalCOFI Fish Counts Positive Tows | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIfshcnt |
| | set | data | graph | | | CalCOFI Fish Sizes | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIfshsiz |
| | set | data | graph | | | CalCOFI Larvae Counts Positive Tows | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names A to AM | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names AN to AR | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names AS to BA | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names BCE to BZ | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names C to CE | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names CD to CH | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names CI to CO | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names CP to DE | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names DH to EC | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names ED to EU | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names EV to GN | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names GO to HA | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names HB to HI | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names HJ to ID | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | set | data | graph | | | CalCOFI Larvae Counts, Scientific Names IE to LA | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |
| | | | | | | | | F I M | background | RSS | | NOAA SWFSC | erdCalCOFIlrvcnt |

# ERDDAP > search

## Do a Full Text Search for Datasets

VIIRS Search

## The results of the search for VIIRS

44 matching datasets, with the most relevant ones listed first.

| Grid DAP Data | Sub-set | Table DAP Data | Make A Graph | WMS | Source Data Files | Title | Institution | Dataset ID |
|---|---|---|---|---|---|---|---|---|
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, Chlorophyll a, OCI Algorithm, Daily | NASA/GSFC OBPG | erdVH2chla1day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, Chlorophyll a, OCI Algorithm, 8-Day | NASA/GSFC OBPG | erdVH2chla8day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, Chlorophyll a, OCI Algorithm, Monthly | NASA/GSFC OBPG | erdVH2chlamday |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, K490, Daily | NASA/GSFC OBPG | erdVH2k4901day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, K490, 8-Day | NASA/GSFC OBPG | erdVH2k4908day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, K490, Monthly | NASA/GSFC OBPG | erdVH2k490mday |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, PAR, Daily | NASA/GSFC OBPG | erdVH2par1day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, PAR, 8-Day | NASA/GSFC OBPG | erdVH2par8day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, PAR, Monthly | NASA/GSFC OBPG | erdVH2parmday |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, PIC, Daily | NASA/GSFC OBPG | erdVH2pic1day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, PIC, 8-Day | NASA/GSFC OBPG | erdVH2pic8day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, PIC, Monthly | NASA/GSFC OBPG | erdVH2picmday |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, POC, Daily | NASA/GSFC OBPG | erdVH2poc1day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, POC, 8-Day | NASA/GSFC OBPG | erdVH2poc8day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, POC, Monthly | NASA/GSFC OBPG | erdVH2pocmday |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, Reflectance at 671 nm, Daily | NASA/GSFC OBPG | erdVH2r6711day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, Reflectance at 671 nm, 8-Day | NASA/GSFC OBPG | erdVH2r6718day |
| data | | | graph | M | | VIIRSN, Suomi-NPP, Level-3 SMI, Global, 4km, Reflectance at 671 nm, Monthly | NASA/GSFC OBPG | erdVH2r671mday |
| data | | | graph | M | | SST, VIIRS, Suomi-NPP, Day and Night, WN/Northwest US, Evaluation Data, 3-Day | NOAA/NESDIS | erdVHsstaWN3day |
| data | | | graph | M | | SST, VIIRS, Suomi-NPP, Day and Night, WS/California, Evaluation Data, 3-Day | NOAA/NESDIS | erdVHsstaWS3day |
| data | | | graph | M | | OSU Chlorophyll Bloom Product, VIIRS Suomi-NPP, Northwest US, 2012-present | Oregon State Un ... | osuBloomsViirsChla |
| data | | | graph | M | files | Chlorophyll a, North Pacific, NOAA VIIRS, 750m resolution (1 Day Composite) | NOAA NMFS SWFSC ERD | erdVHNchla1day |
| data | | | graph | M | files | Chlorophyll a, North Pacific, NOAA VIIRS, 750m resolution (3 Day Composite) | NOAA NMFS SWFSC ERD | erdVHNchla3day |
| data | | | graph | M | files | Chlorophyll a, North Pacific, NOAA VIIRS, 750m resolution (8 Day Composite) | NOAA NMFS SWFSC ERD | erdVHNchla8day |
| data | | | graph | M | files | Chlorophyll a, North Pacific, NOAA VIIRS, 750m resolution (Monthly Composite) | NOAA NMFS SWFSC ERD | erdVHNchlamday |

# ERDDAP

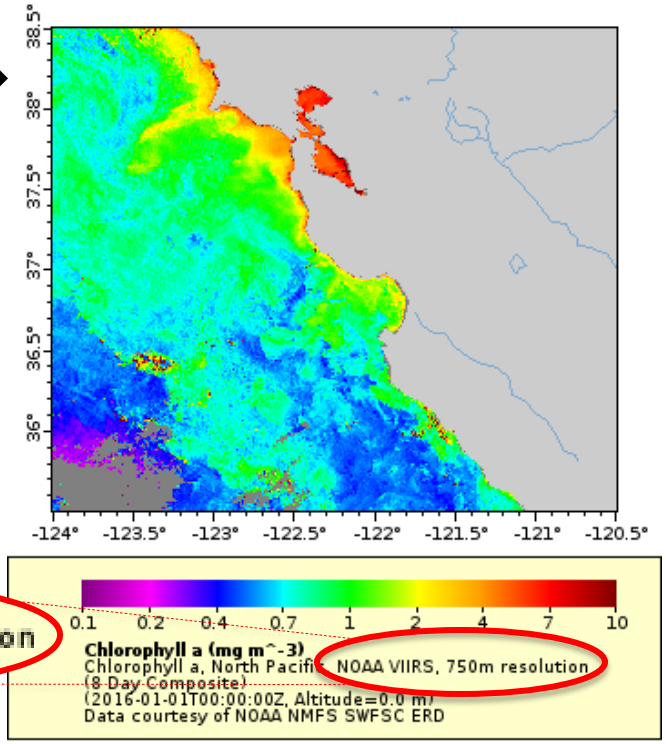
## Easier access to scientific data

http://coastwatch.pfeg.noaa.gov/erddap

# An example

http://coastwatch.pfeg.noaa.gov/erddap/griddap/**erdVHNchla8day**.**png**?chla[(**2016-01-01T00:00:00Z**)][(0.0)][**(38.5):(35.5)**][**(-124):(-120.5)**]&.draw=surface&.vars=longitude|latitude|chla&.colorBar=|||.1|10|&.bgColor=0xffcccff

Produces this image ➔




The URL can be modified to change the output:

Dataset name **erdVHNchla8day**

Filetype: **png** (can be .mat, .csv, .nc, .kml, et al.)

- **graph** extension will modify the image
- **html** extension will access the data

Date: **2016-01-01T00:00:00Z** (can also use last)

Latitude range: **(38.5):(35.5)**

Longitude range: **(-124):(-120.5)**

# ERDDAP

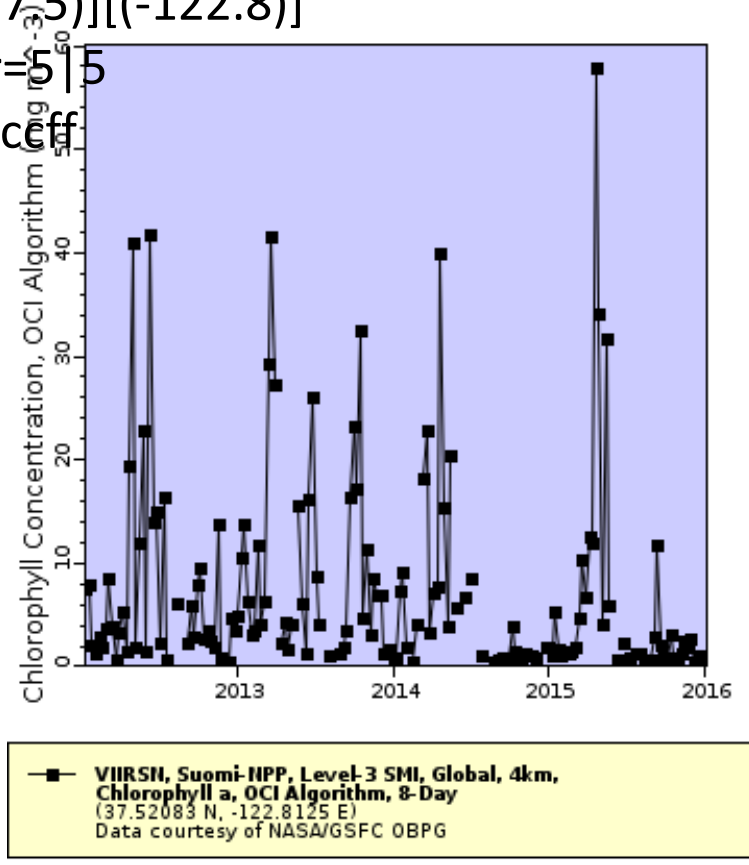
Easier access to scientific data

http://coastwatch.pfeg.noaa.gov/erddap

# Another example

http://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVH2chla8day.png?chla[(2012-01-05T00:00:00Z):(2016-01-05T00:00:00Z)][(37.5)][(-122.8)]&.draw=linesAndMarkers&.vars=time|chla|&.marker=5|5&.color=0x000000&.colorBar=||||&.bgColor=0xffccccff

Produces this image ➔



# ERDDAP

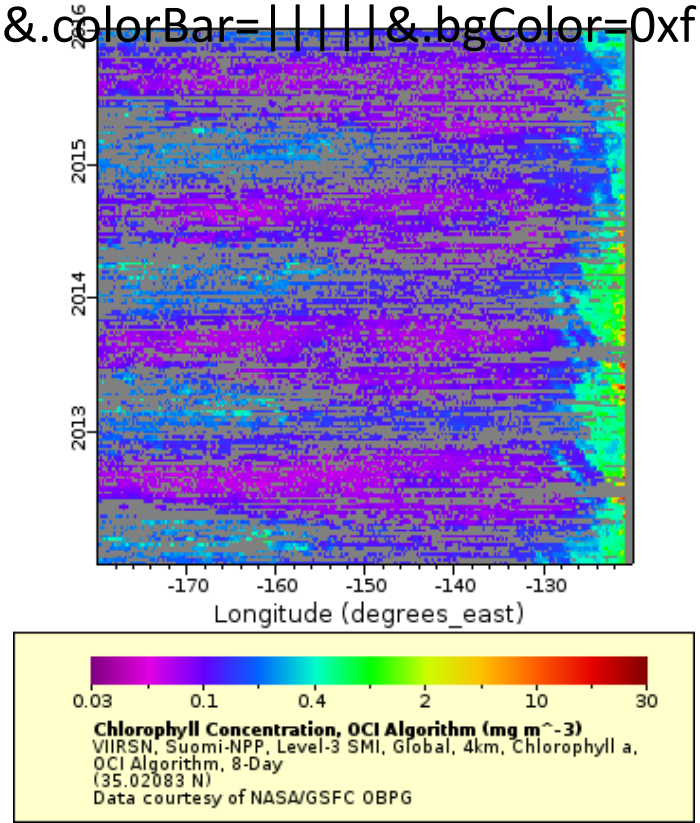
Easier access to scientific data

http://coastwatch.pfeg.noaa.gov/erddap

# Another example

http://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVH2chla8day.png?chla[(2012-01-05T00:00:00Z):(2016-01-05T00:00:00Z)][(35.02083)][(-179.9375):(-120.0208)]&.draw=surface&.vars=longitude|time|chla&.colorBar=|||||&.bgColor=0xffccccff

Produces this image ➔



# ERDDAP

Easier access to scientific data

http://coastwatch.pfeg.noaa.gov/erddap

# More than just satellite data

- All ARGO float data
- Underway data from NOAA ships and NSF RVs
- CalCOFI data
- CA Fish catch landing data
- HF radar data
- 4D model data - GFDL, NRL & SODA
- Buoy data – NDBC, TAO/TRITON, RAMA & PIRATA
- World Ocean Atlas

# ERDDAP
## Easier access to scientific data

**ERDDAP has been installed by over 50 organizations worldwide,** including:

CSIRO and IMOS, Australia
IPSC JRC, European Commission
IRD (Institut de Recherche pour le Développement), France
CNRS (Centre National de la Recherche Scientifique), France
UPMC (Université Pierre et Marie CURIE), Paris, France
IPSL (Institut Pierre Simon Laplace des sciences de l'environnement), Paris, France
UCAD (Université Cheikh Anta Diop de Dakar), Sénégal
UGB (Université Gaston Berger - Saint-Louis), Sénégal
UFHB (Université Félix HOUPHOUËT-BOIGNY), Abidjan, Côte d'Ivoire
The Marine Institute, Ireland
Marine Instruments S.A., Spain
Ocean Networks Canada
Stanford University, Hopkins Marine Station
University of California at Davis, Bodega Marine Laboratory
USGS Coastal and Marine Geology Program
UW APL

# ERDDAP

## Easier access to scientific data

**Within NOAA ERDDAP has been installed by**:

NOAA CoastWatch West Coast Node
NOAA CoastWatch Caribbean/Gulf of Mexico Node
NOAA Environmental Research Division of SWFSC
NOAA IOOS Central and Northern California Ocean Observing System
NOAA IOOS Northeastern Regional Association of Coastal and Ocean Observing Systems
NOAA IOOS National Glider Data Assembly Center
NOAA IOOS Pacific Islands Ocean Observing System
NOAA IOOS Southeast Coastal Ocean Observing Regional Association
NOAA National Centers for Environmental Information
NOAA National Geophysical Data Center, Solar - Terrestrial Physics
NOAA Observing System Monitoring Center
NOAA Unified Access Framework

**ERDDAP is recommended within NOAA:** NOAA's Data Access Procedural Directive includes ERDDAP in its list of recommended data servers for use by groups within NOAA. Installation instructions are available at:
http://coastwatch.pfeg.noaa.gov/erddap/download/setup.html

# What do users think of ERDDAP?

A quote from a user who was introduced to ERDDAP in mid Jan 2016:

"all I can say is I don't know whether this is a late Christmas or an early birthday for me! This coastwatch.pfeg.noaa.gov/erddap system seems to be *fantastic*!"

-Dan E. Kelley
Professor and Graduate Coordinator
Oceanography Department, Dalhousie University
PO BOX 15000
Halifax, NS B3H 4R2

# Training and Outreach to NMFS and NOS end-users

PIs: Cara Wilson, Roy Mendelssohn, Dale Robinson & Elliot Hazen, NMFS/SWFSC/ERD

# Part II:

# ERD Data Tools

# ERD's Data Tools & Services

- **Satellite Browsers**
  - good tool for visualizing satellite datasets
  - Not recommended for downloading data
  - Not all satellite datasets are on it, its not being maintained so datasets acquired in the last few years are not on it
- **ERDDAP**
  - the data server that is the backbone of all the tools and services
  - Extensive data holdings, not just satellite data
  - Data can be visualized and downloaded in a variety of data formats
- **EDC**
  - plug-in module for ArcGIS, Matlab or R that provides a GUI interface to ERDDAP servers (not just the one at ERD)
- **Xtracto scripts**
  - written for Matlab and R and will extract satellite data along a user-supplied x-y-t track (or a box or a polygon)
  - only works for a subset of the datasets on ERDDAP

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  - only works for a subset of the datasets on ERDDAP

# The Motivation behind the EDC

Satellite data have been largely inaccessible for those working with GIS tools, such as fisheries scientists and marine resource managers.

Without going through the painful experience of bringing satellite data into ArcGIS using only the native tools, it is hard to comprehend how truly onerous this task can be.

# EDC™ Environmental Data Connector

an extension for connecting ArcGIS to Thredds/OPeNDAP

- Allows easy selection, and importation, of both gridded and non-gridded datasets served by THREDDS, OPeNDAP, SOS, or ERDDAP
- Works with ArcGIS 9.2, 9.3 or 10, Matlab, R and Excel (Windows only for Excel)
- Data can be subset temporally and spatially
- Developed by RPS/ASA in cooperation with SWFSC/ERD
- Funded by the NOAA R&O Tiger team, IOOS, the NOAA IEA Program and the JPSS RRPG program
- Free distribution, available since May 2008

**www.pfeg.noaa.gov/products/EDC**

EDC™ Environmental Data Connector

an extension for connecting ArcGIS to Thredds/OPeNDAP

A new version (1.3.1) of the Environmental Data Connector (EDC) was released Feb 2016. The new version is a maintenance release, with the following updates to:

- Use Java 1.8
- Use the latest version of NASA's World Wind in the GUI
- Correct a problem with the latest release of Matlab
- Include a note in the installer about how to obtain a component that was missing in some releases of ArcGIS 10.3

**www.pfeg.noaa.gov/products/EDC**

# Is it really necessary?

EDC™ Environmental Data Connector
an extension for connecting ArcGIS to Thredds/OPeNDAP

"I had been struggling with satellite data in ArcGIS for three or four years. I found several workarounds. But they all tended to be very laborious, and they worked only marginally. On any given satellite data project, I was spending 90% of my time just getting the data into a usable format for ArcGIS. It was painful. So I was more than a little skeptical about the EDC product. I thought if it saves a little time, it might be worth it. Then in the first 10 minutes of using it I was amazed. Not only did it work, but it seamlessly pulled the data into ArcGIS directly from the OpenDap servers. The EDC turned all-day data import, cleanup, and temporal animation exercises into a 10-minute operation. That is not an exaggeration.

Not only does it pull the data in cleanly, but it is already structured to temporally animate, which is a huge step forward. I think that everybody who uses it will be thrilled with the way it handles temporal data. It is a must-have for anybody working with satellite data. Thanks NOAA."

Jonathan Kamler*
17th US Coast Guard District
*graduate of the 2008 NOAA Satellite Course

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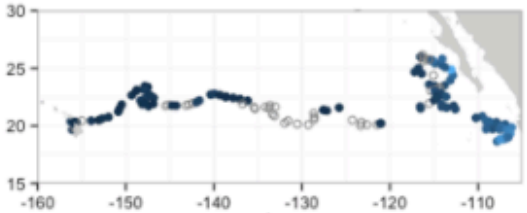
NOAA COASTWATCH WEST COAST REGIONAL NODE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

# Xtractomatic Tools

## Overview

Xtractomatic is a set of free tools, written in Matlab or in R, that allows client-side access of environmental data served on the ERD/CoastWatch ERDDAP Server.

**Chlorophyll-a at marlin track locations.**




Chlorophyll-a concentrations for a marlin track that were extracted from the MODIS satellite dataset served by ERDDAP.

The xtractomatic tools were originally developed for the marine biology tagging community to extract satellite data coincident to the tracks from tagged animals. The packages have been extended to extract a 3D cube of data and time series from the region defined by the polygon.

## Features

Xtractomatic scripts work within R and Matlab to subset and extract satellite and other oceanographic-related data from a remote server.

Data can be extracted

- for a moving point in time along a user-supplied set of longitude, latitude and time points,
- within a 3D bounding box, and
- within a polygon through time.

Xtractomatic accesses data that are served through the ERDDAP server at the NOAA/SWFSC Environmental Research Division in Santa Cruz, California.

Xtractomatic also includes two helper functions to search for and obtain information about available datasets.

## Resources

### Documentation and Examples

Using Xtractrometic with R (.pdf 1.1MB)

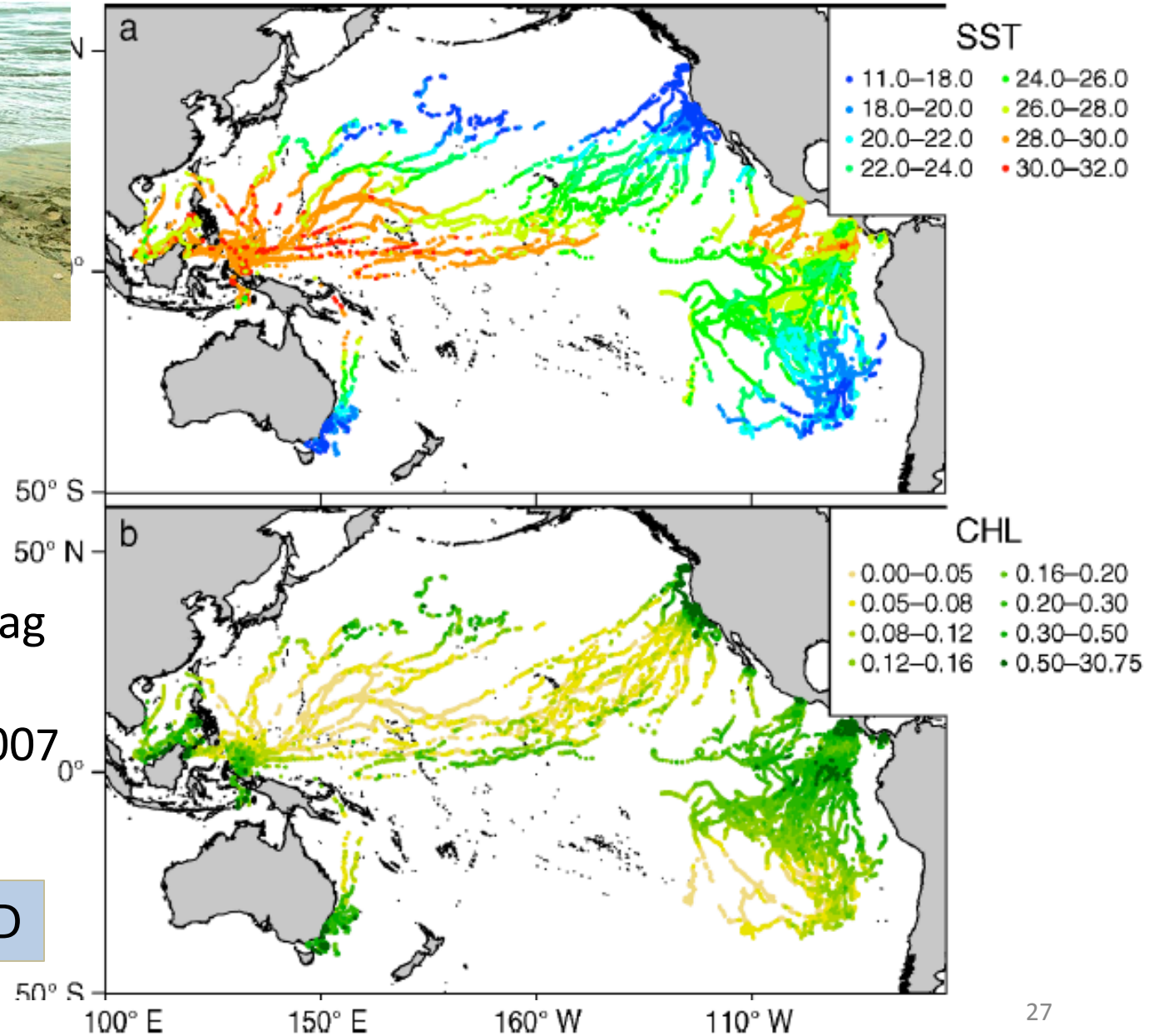
### Downloads

Xtracto for Matlab

Xtracto for R

http://coastwatch.pfeg.noaa.gov/xtracto

Bailey et al. [2012] Identification of distinct movement patterns in Pacific leatherback turtle populations influenced by ocean conditions. *Ecological Applications*, 22(3), pp. 735–747




- 135 tags
- Average 234 days/tag
- Max of 948 days
- Data spans 1992-2007

NMFS/SWFSC/ERD

# Training and Outreach to NMFS and NOS end-users

PIs: Cara Wilson, Roy Mendelssohn, Dale Robinson & Elliot Hazen, NMFS/SWFSC/ERD

# Part III:

## The 2014 & 2015 NOAA Satellite Courses

Not a complete photo – 9 people missing

# NOAA Satellite Data Training Course

- Conducted almost every year since 2006:

| DATE | LOCATION | # |
|---|---|---|
| Aug 20-22, 2015 | UW, Seattle, WA | 10* |
| Aug 20-22, 2014 | UW, Seattle, WA | 22* |
| Aug 20-22, 2013 | CIOSS/OSU, Corvallis, OR | 34* |
| Mar 13-15, 2012 | NOS/CSC, Charleston, SC | 7 |
| Mar 23-25, 2011 | CIOSS/OSU, Corvallis, OR | 26 |
| Aug 9-11, 2010 | MATE/MPC, Monterey, CA | 19 |
| Aug 2-4, 2010 | MATE/MPC, Monterey, CA | 22 |
| Mar 24-26, 2008 | CIOSS/OSU, Corvallis, OR | 19 |
| Mar 26-28, 2007 | CIOSS/OSU, Corvallis, OR | 28 |
| Aug 22-24, 2006 | CIOSS/OSU, Corvallis, OR | 31 |

*Travel funding from JPSS PGRR Initiative or JPSS VSP

# NOAA Satellite Data Training Course

- 3-day (free!) course aimed at NMFS or NOS participants who want to learn how to access & use satellite data
- Objective is to help people access and use satellite data ***in the environment they are used to working in*** – a challenging task! Focus has been on GIS, Matlab and R applications.
- Participants bring projects to work on.
- Course initiated by funding from NOAA's R&O project in 2006. The course was conducted with no funding support 2007-2012. JPSS provided full or partial funding for the 2013-2015 courses.
- The learning experience goes two ways. From conducting these courses we get a better idea of users' needs and wants, and are better able to address those needs.
- Since 2013 have requested powerpoints from participants

# How does the “wet” side of NOAA plan to use VIIRS data?

Feedback from the 2014 & 2015 NOAA Ocean Satellite Data Courses

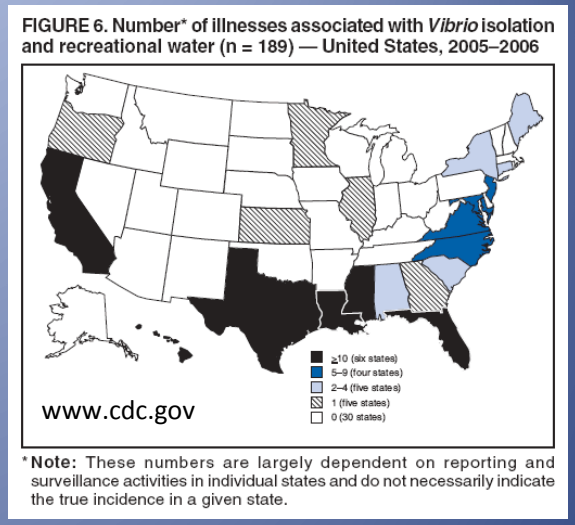
# Some statistics

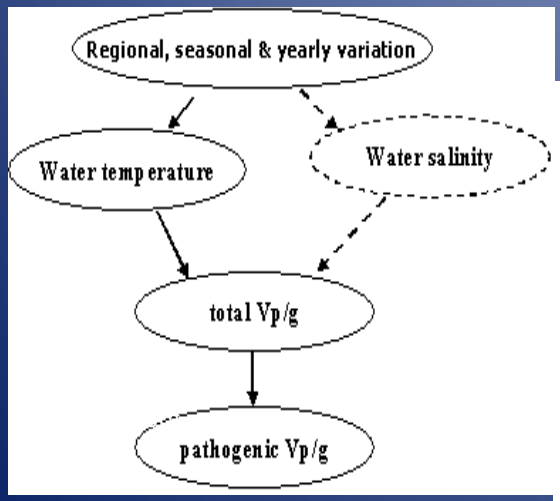
- 34 participants in the 2013 NOAA Satellite Data Course
  22 participants in the 2014 NOAA Satellite Data Course
  10 participants in the 2015 NOAA Satellite Data Course
- NMFS participants: 42 (66%)
  NOS participants: 9 (14%)
  NESDIS participants: 1 (1%)
  University participants: 13 (20%)
- 45 returned an evaluation form (70%)
  Of those 45:
  - 40 had not heard of VIIRS data before the course (89%)
  - 38 plan on using VIIRS data (84%)

# SST Anomaly may indicate risk of Vibrio in coastal waters

Gretchen Messick NOS, NCCOS, Cooperative Oxford Laboratory

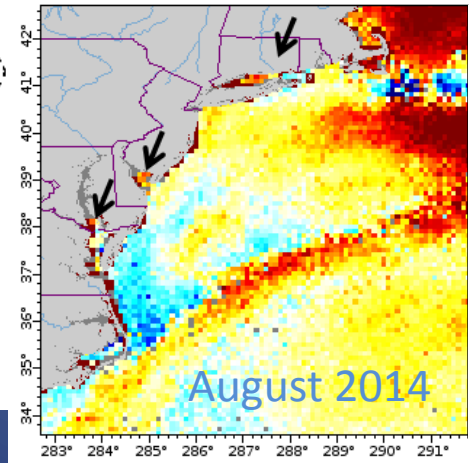
Vibrio are bacteria that thrive in warm (> 15° C or 59° F) estuarine (~10-15ppt) or inland waters that may cause disease when ingested in raw seafood or exposure to open wounds. While models are being developed, satellite data may provide managers images of where the vibrio may occur in coastal areas since higher than normal water temperatures may be where vibrio are more likely to occur.

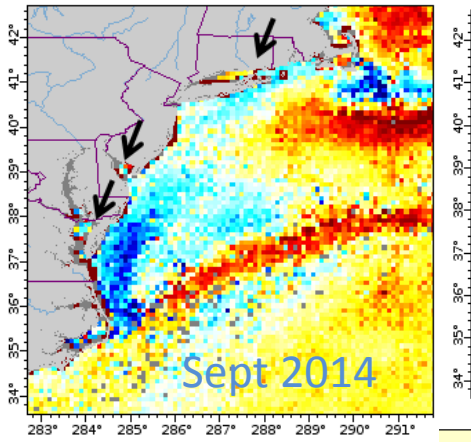


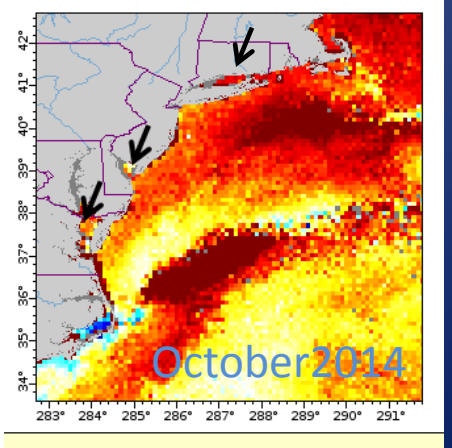



Vibrio Model

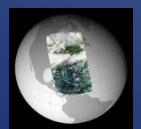
Arrows indicate coastal areas that higher than normal temperatures may have a higher risk of Vibrio infections




We ❤ VIIRS!!!



SST Anomaly, POES AVHRR, Casey and Cornillion

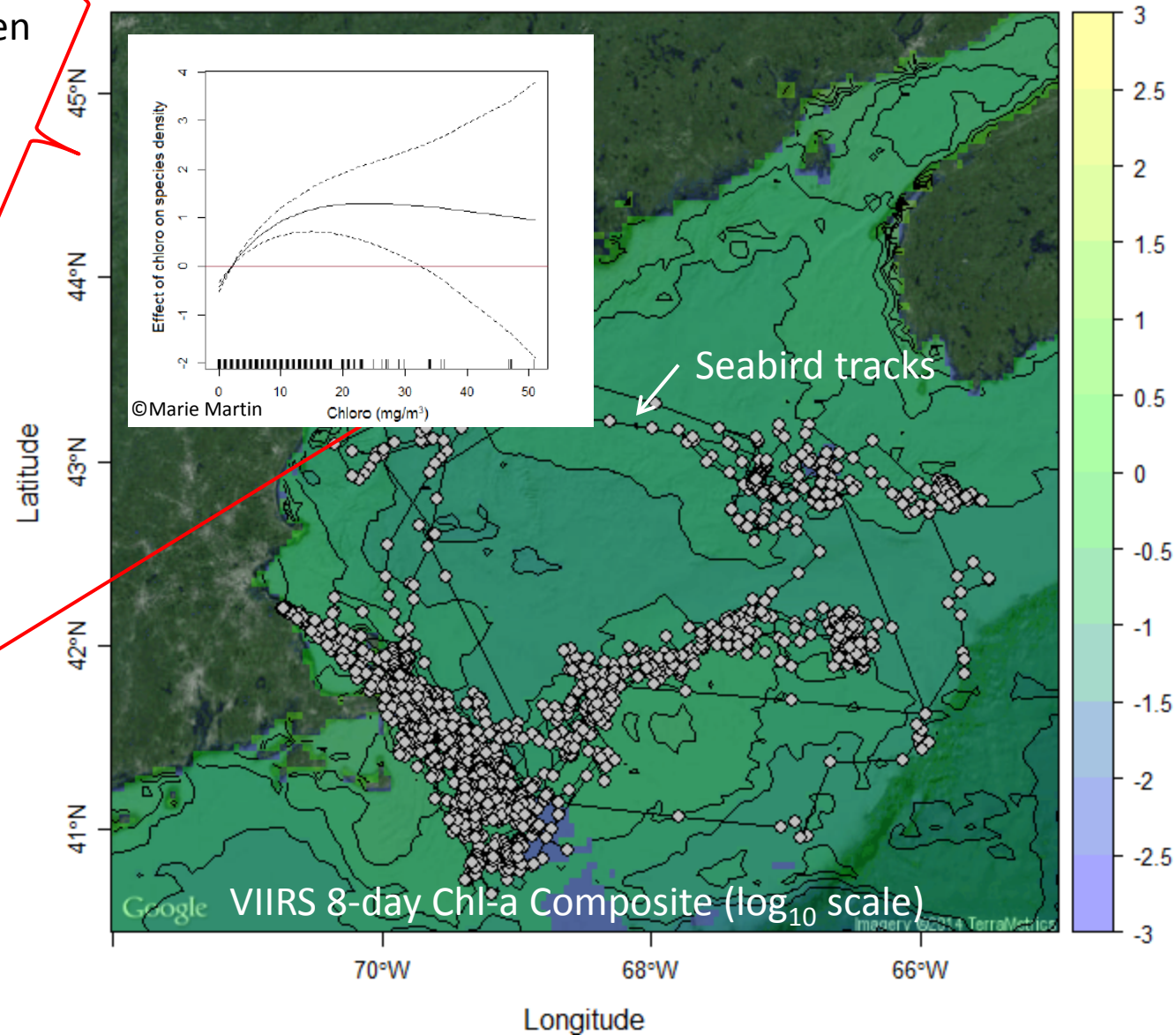
# Joshua Hatch

## NOAA/NEFSC, Resource Evaluation and Assessment Division

Chlorophyll-a has been shown to influence seabird densities (Martin 2013)

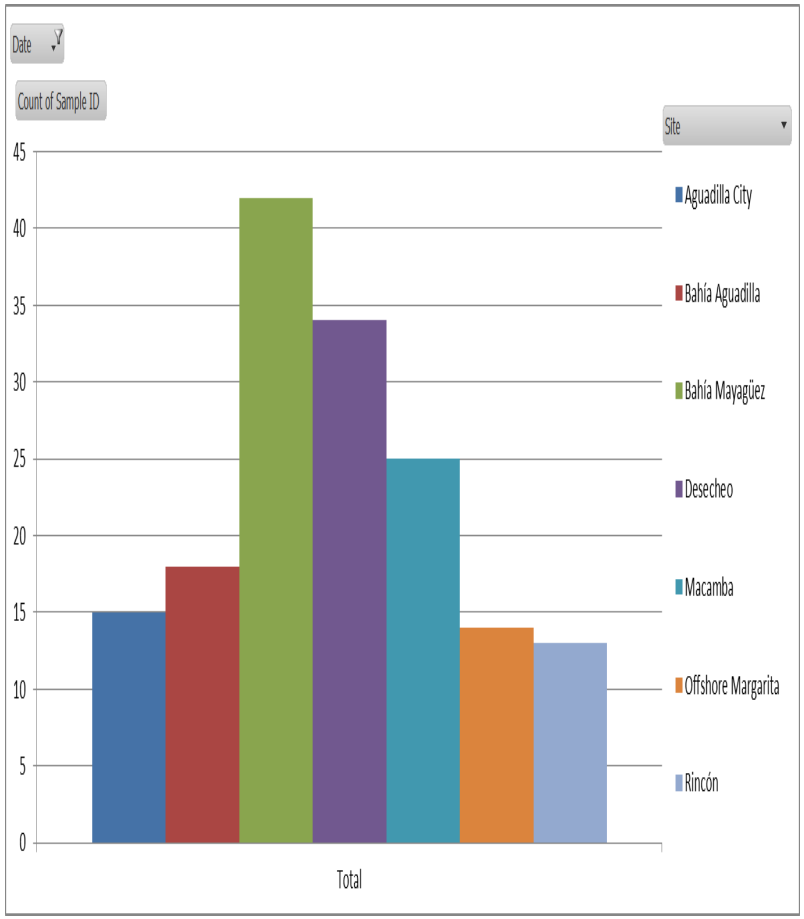
Several species of seabirds can smell dimethyl sulfide (DMS), a compound released by phytoplankton during zooplankton grazing, which may correlate with Chl-a

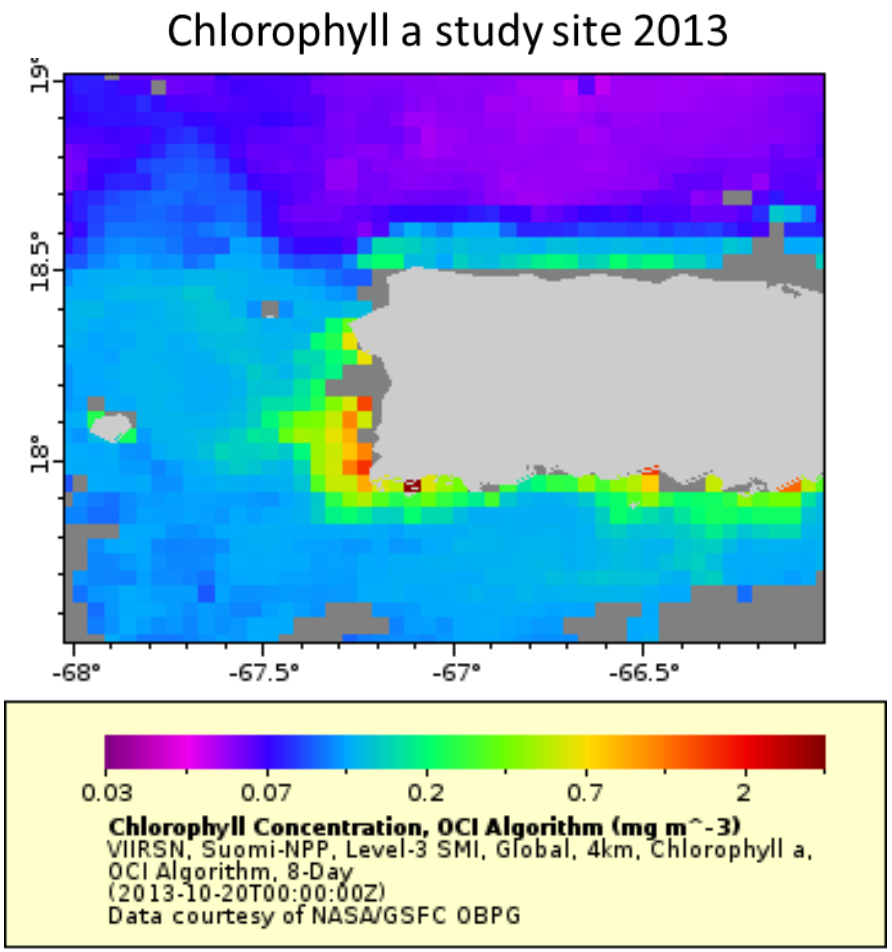
Chl-a may then be a useful metric to assess seabird presence, as they seek out productive areas to forage



# Environmental and Oceanographic Conditions off western Puerto Rico 2012-2014 and Abundance of Juvenile deep-water snapper resources

**Nancie Cummings, NMFS/SEFSC**




initial exploration for October 2013. Nominal abundance for silk snapper in study area and 8 day composite ocean color for study site, from ERDDAP.

# Salmon survival in 2011 – what happened?

Brian Burke
Fish Ecology Division
NWFSC, NOAA Fisheries

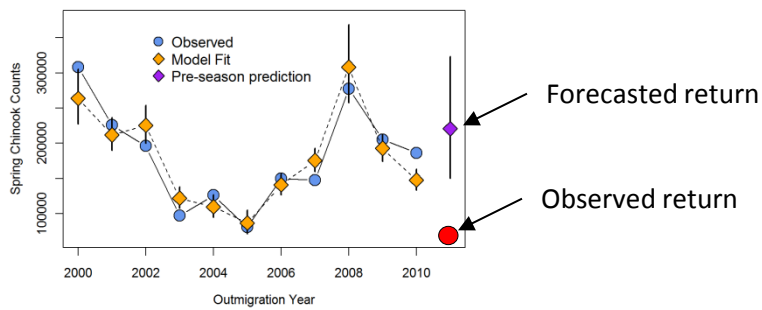



Figure 1. Observed and fitted adult spring Chinook salmon returns, with the forecasted and observed returns for fish entering the ocean in 2011.

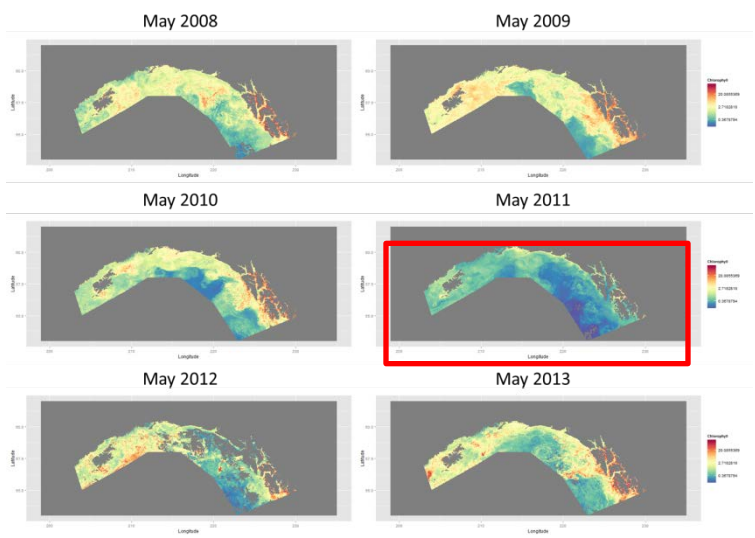



Figure 2. Chlorophyll concentration in May (2008-2013) in coastal Gulf of Alaska.

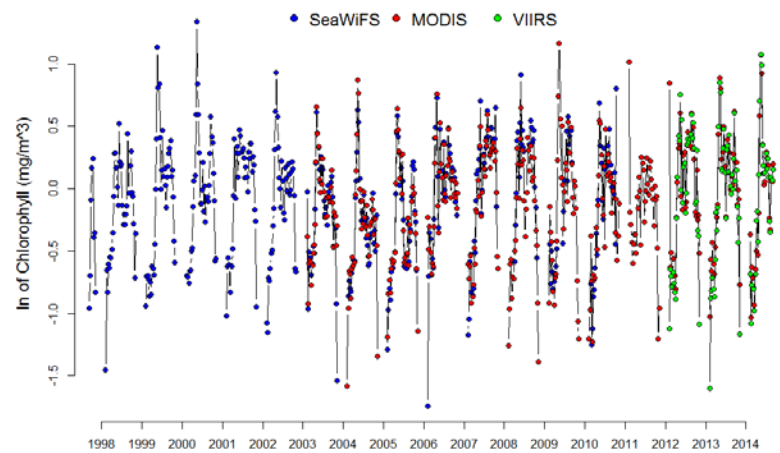



Figure 3. Time series of 8-day composite chlorophyll concentrations.

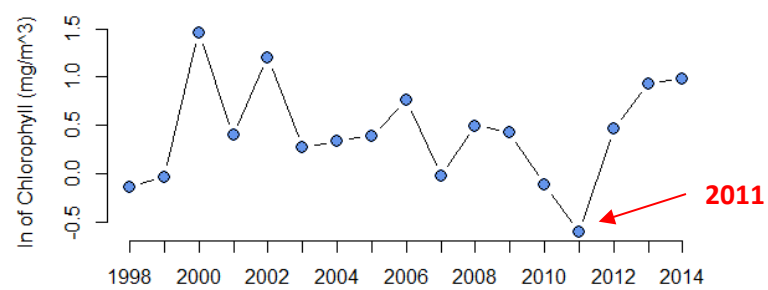
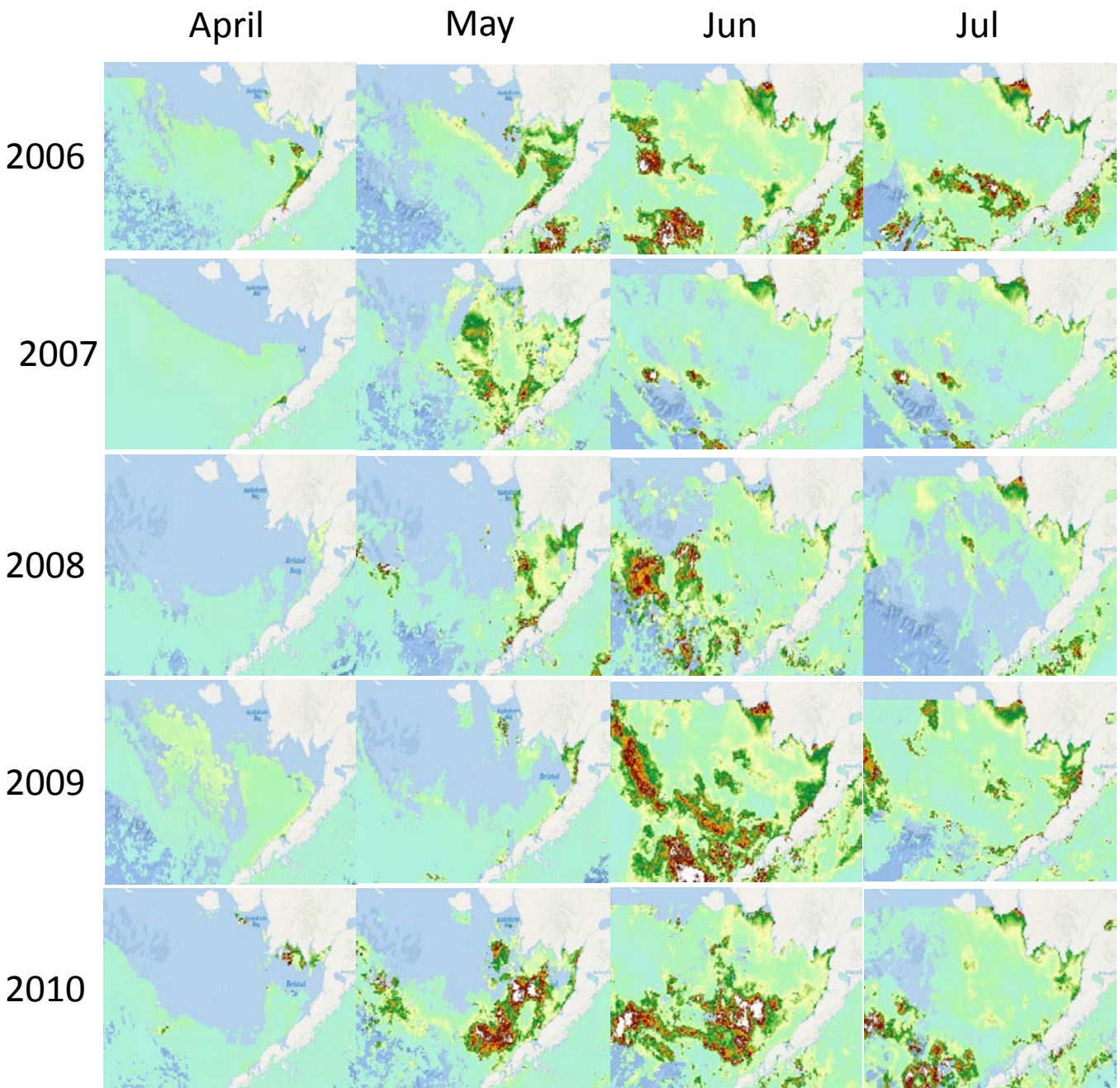



Figure 4. Time series of average April-May chlorophyll concentrations in coastal Gulf of Alaska. The lowest value (2011) suggests that low productivity could have negatively influenced salmon survival that year.

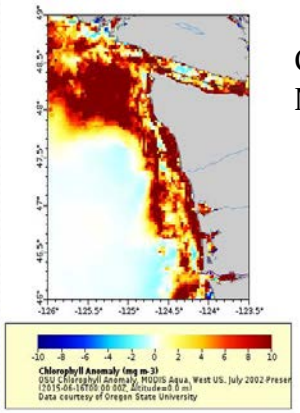
# Jeanette Gann, NMFS/AFSC



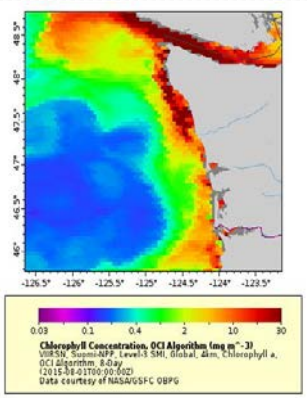

2007 was an anomalous year for primary production, low nutrients, and low recruitment for pollock. Satellite data is crucial to fill in data gaps as our datasets and surveys are restricted to primarily late summer/early fall.

Nancy Wright 2015
Olympic Coast National Marine Sanctuary

# Oceanographic Characterization of Washington State Outer Coast

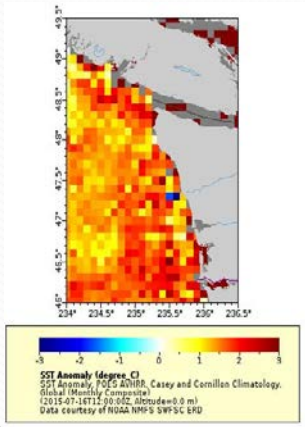


**HABs**
OSU **Chl** Anomaly
MODIS Aqua West, Daily



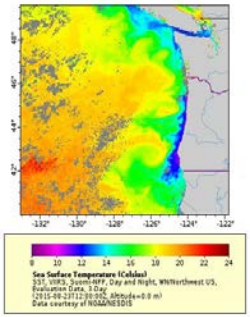
VIIRSN, Suomi-NPP,
Global, 4km,
**Chlorophyll**, OCI
Algorithm, 8-Day

## Ocean Color



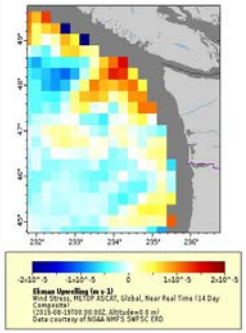
**SST** Anomaly, POES AVHRR,
Casey and Cornillon
Climatology,
Global (Monthly Composite)

**BLOB**



Non-Anomaly, **SST**,
VIIRS, Suomi-NPP,
Northwest US, 3-Day

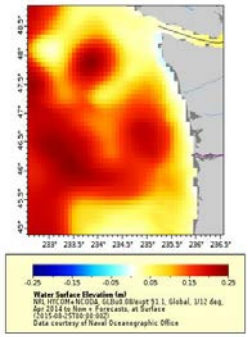
## SST



**Upwelling**

**Wind Stress**, METOP ASCAT, Global,
Near Real Time (14 Day Composite)

## Scatterometry



**Currents, Gyres**

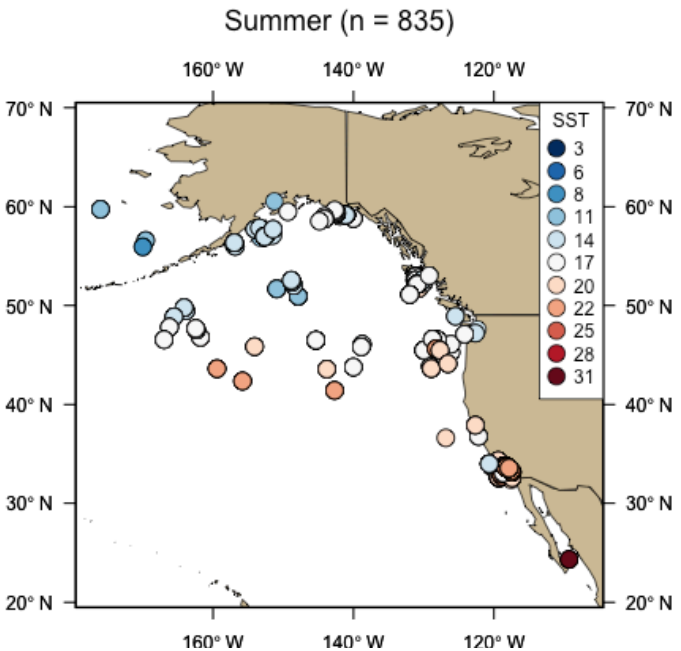
NRL HYCOM+NCODA,
Apr 2014 to Now,
Forecasts, at Surface

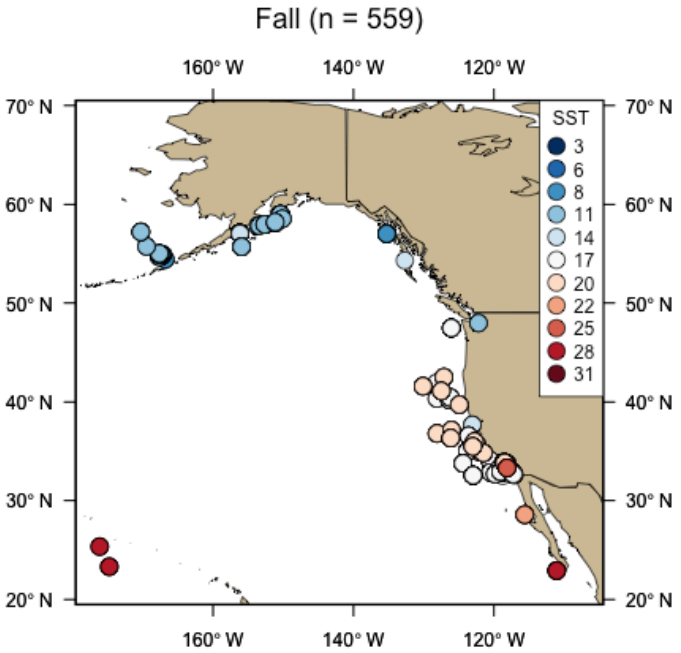
## Modeled SSHA

# Using remotely sensed data to model population structure of north Pacific fin whales (*Balaenoptera physalus*)

Eric Archer
Southwest Fisheries Science Center
8901 La Jolla Shores Drive, La Jolla, CA 92037

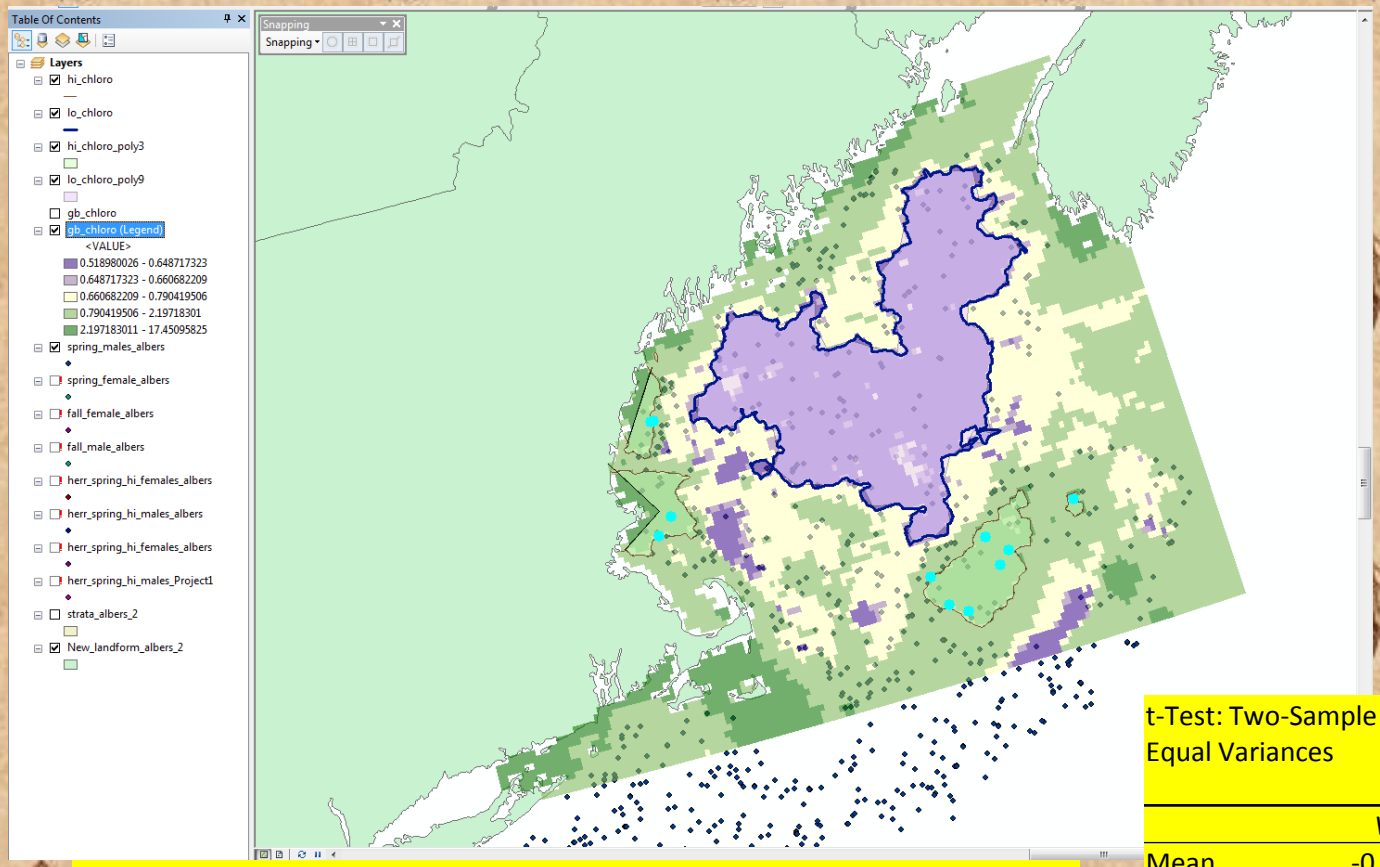
- 1,616 north Pacific fin whale samples
- 1993 – 2015
- Weighted average of SST from MUR, Pathfinder, and GHRSST where sources overlap
- Select samples to sequence/genotype that represent range of SST
- Use SST, chlorophyll-a (SeaWifs, MODIS/Aqua, VIIRS), season, location, and SERDP habitat model outputs to model distribution of haplotypes and genotypes



# Comparing Condition Indices of Atlantic Herring in High and Low Chlorophyll Areas

J.J. Pereira, NOAA Fisheries, NEFSC, Milford Laboratory




Herring data from 2003 and 2004

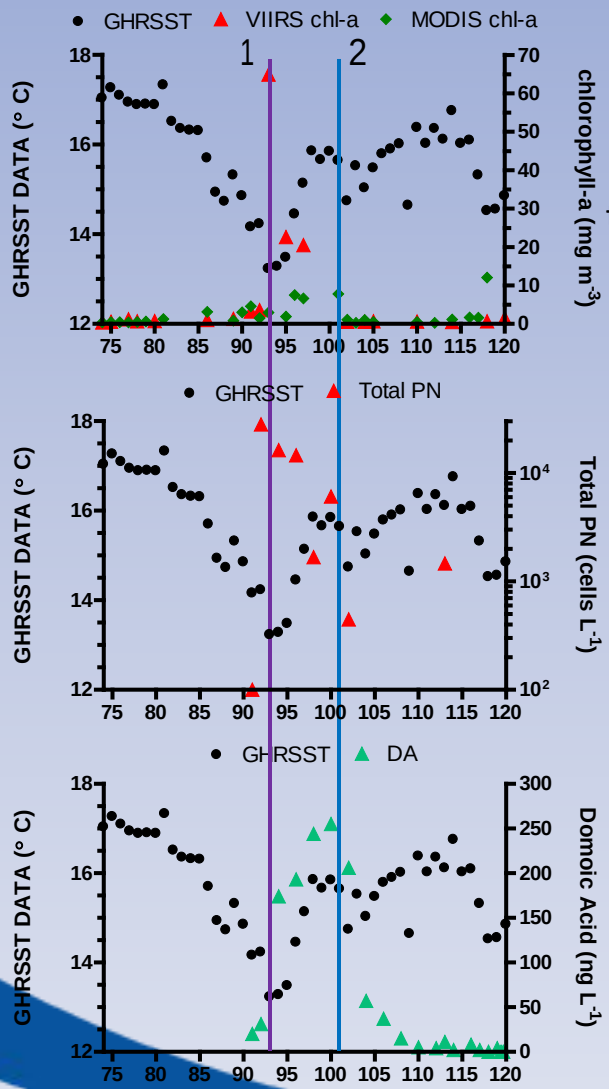
- Download MODIS chlorophyll coverage
- Use spatial analyst contour tool to contour highest and lowest chlorophyll areas
- Convert contours to features (polylines) then to polygons
- Use polygons to select herring data
- T-test to compare mean condition indices

t-Test: Two-Sample Assuming Equal Variances

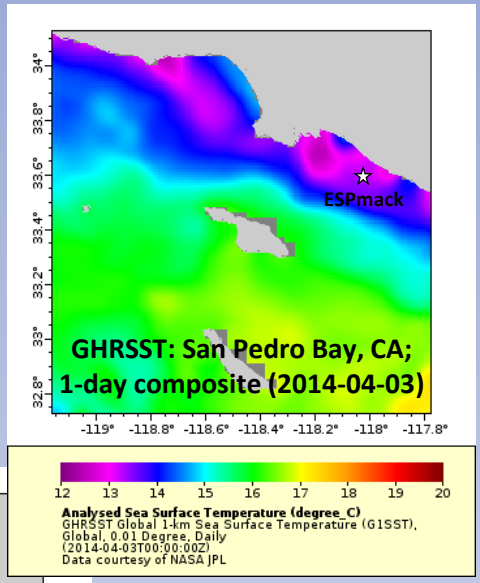
| | *Variable 1* | *Variable 2* |
|---|---|---|
| Mean | -0.031679407 | -0.0486446 |
| Variance | 0.002866206 | 0.00372122 |
| Observations | 27 | 25 |
| Pooled Variance | 0.003276613 | |
| Hypothesized Mean Difference | 0 | |
| df | 50 | |
| t Stat | 1.067816054 | |
| P(T<=t) one-tail | 0.145366051 | |
| t Critical one-tail | 1.675905025 | |
| P(T<=t) two-tail | 0.290732102 | |
| t Critical two-tail | 2.008559112 | |

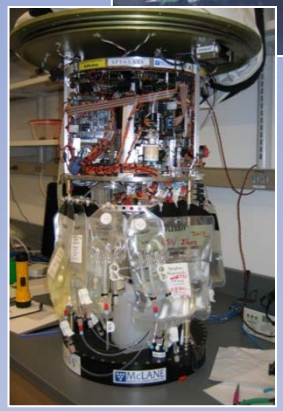
# Satellite & Subsurface Remote Sensing: potential influence of an upwelling event on HAB dynamics in San Pedro Bay, CA

Gregory J. Doucette, National Ocean Service

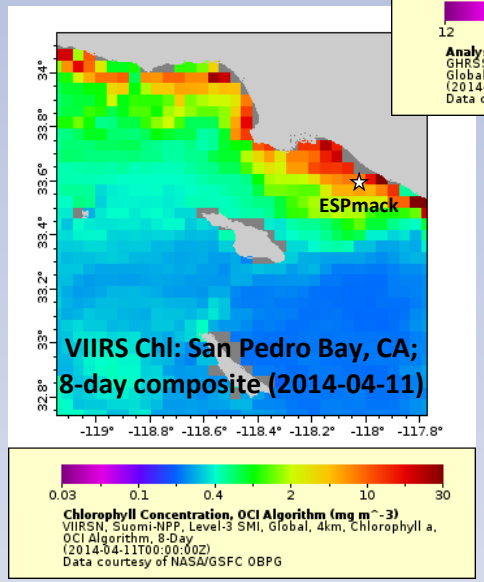



Purple line (1): peak of upwelling event revealed by GHRSST data, corresponding to the appearance of cells in HAB genus, *Pseudo-nitzschia* (PN), at ESPmack mooring



Environmental Sample Processor (ESPmack): subsurface HAB & toxin detection at mooring (☆)




Blue line (2): peak of domoic acid (DA) concentration following upwelling relaxation & corresponding to high VIIRS chl signature & continued presence of *Pseudo-nitzschia* cells at ESPmack mooring

## *Observations*

- GHRSST data revealed strong upwelling event at ESP mooring preceding toxic HAB
- VIIRS chlorophyll data consistent with PN HAB associated with upwelling event
- HAB DA toxicity peaked during upwelling relaxation period

NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE
coastalscience.noaa.gov

# Quantifying seabird use of the Columbia River plume

Elizabeth M. Phillips, University of Washington

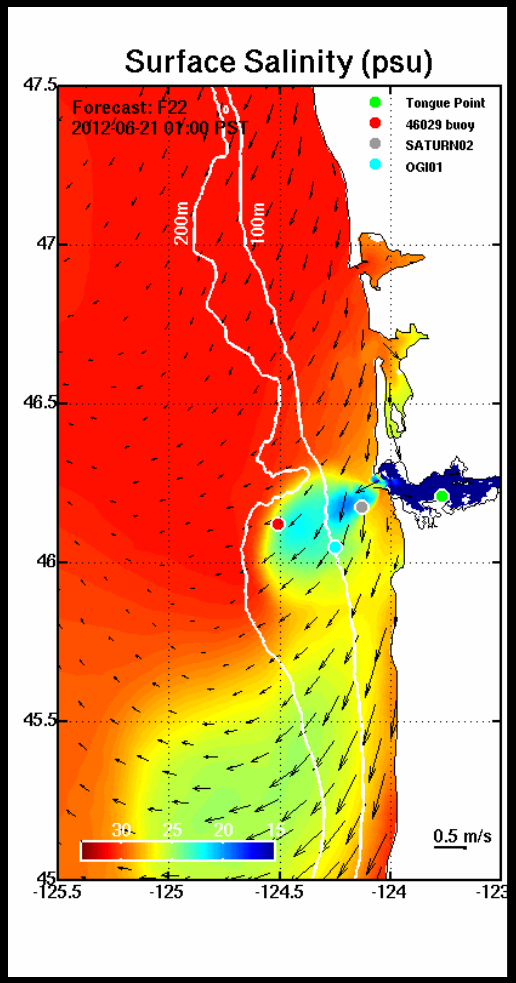
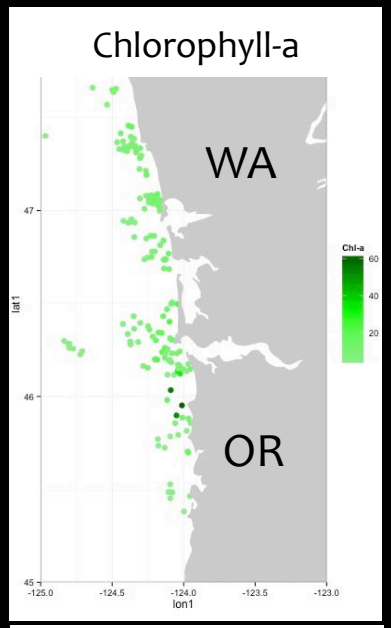
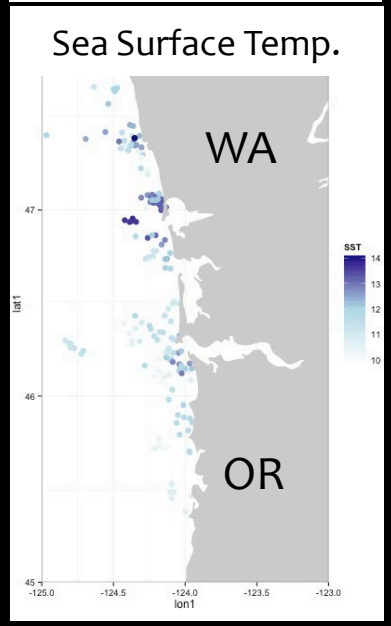



Image courtesy The Center for Coastal Margin Observation and Prediction (www.stccmop.org)

- Dynamic feature in N. California Current that influences multiple trophic levels
- Do seabirds use the plume to locate prey?
- Can predation risk to endangered salmon be predicted under varying plume conditions?

- Tagged and tracked 23 birds in 2012-13 (Josh Adams et al., USGS)
- Extracted chl-a and SST at each bird location
- Extracting salinity from SELFE hindcast model (Baptista et al., CMOP)
- Will quantify habitat use based on environmental parameters measured at each bird location

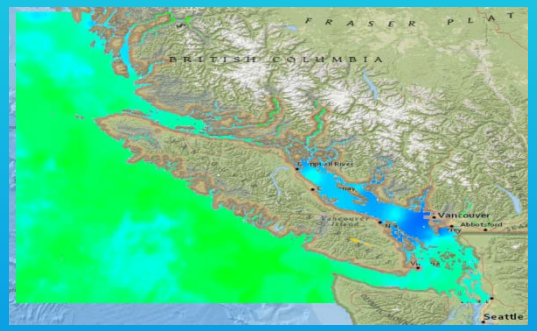


BC Centre for Aquatic Health Sciences
Campbell River, BC  Canada
www.cahs-bc.ca
Tina Podlasly

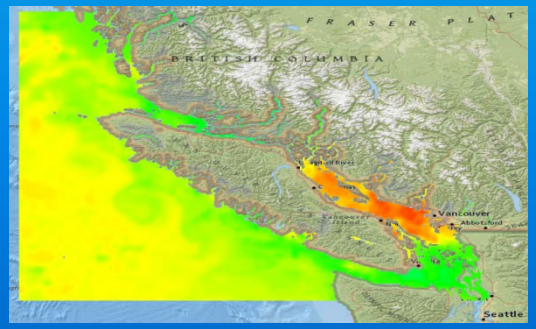
# SST Time Lapse of the West Coast of British Columbia (Vancouver Island)

*Winter Snapshot*

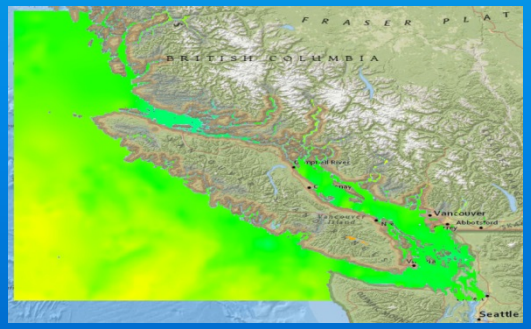



*Spring Snapshot*

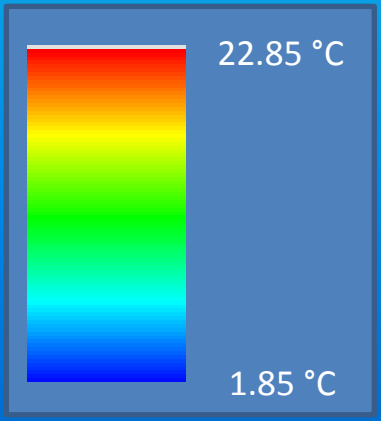
*Summer Snapshot*




*Fall Snapshot*




*Time lapse data for use in a developmental tool for ocean environmental monitoring around Vancouver Island. Applications for these data include aquaculture sea site location selection, plankton monitoring & sea lice abundance on wild & farmed fish.*




*Aquarius Sea Surface SST, Aqua MODIS, NPP, Daytime (11 microns) (8 Day Composite) (Oct 2014 – Sept 2015)*

# Deepwater Horizon: Satellite Data Use

Students: Graettinger, Hanisko, Quinlan (2013) , NOS/ORR and NMFS/SEFSC

- Response: Track oil and forecast trajectories, etc.
- Damage Assessment:
  - Ocean Circulation Modeling (Sea Surface Height)
  - Extent of Oil (Variety of sensors and neural nets)
  - Support adaptive field sampling (Ocean color and temperature)
  - Sargassum location (MERIS and others)
  - Characterize 'Cold Snap' (SST)
  - Interpret field sampling by characterizing habitats such as plumes and eddies (Variety of sensors)
  - Organism distribution and abundance (Variety of Sensors and Generalized Additive Models)

# Conclusions

- **Most NMFS and NOS end-users are unaware of VIIRS data, but are eager to use it when shown easy ways to access it.**
- **The major reason people aren't interested in using VIIRS data is that its timeseries is too short- most fisheries and ecosystem work requires long timeseries. So its critical that we produce science-quality VIIRS ocean color data that are consistent with previous sensors.**

# Training and Outreach to NMFS and NOS end-users

PIs: Cara Wilson, Roy Mendelssohn, Dale Robinson
& Elliot Hazen, NMFS/SWFSC/ERD

# Current/Future Plans

- When the VIIRS MSL12 reprocessed global Ocean Color data are available from CoastWatch we make them available on our ERDDAP server.
- Contract work for developing basic plotting capabilities in R for ERDDAP data (building off of the existing rerddap package).
- Start planning the 2016 NOAA satellite course.
- Planning a 5 day satellite training session before the 2016 PORSEC (Pan Ocean Remote Sensing Conference) meeting in Brazil.
- Establishing PolarWatch, a new CoastWatch Initiative, which could be a good vehicle to get VIIRS ice products out to users.

# Questions?