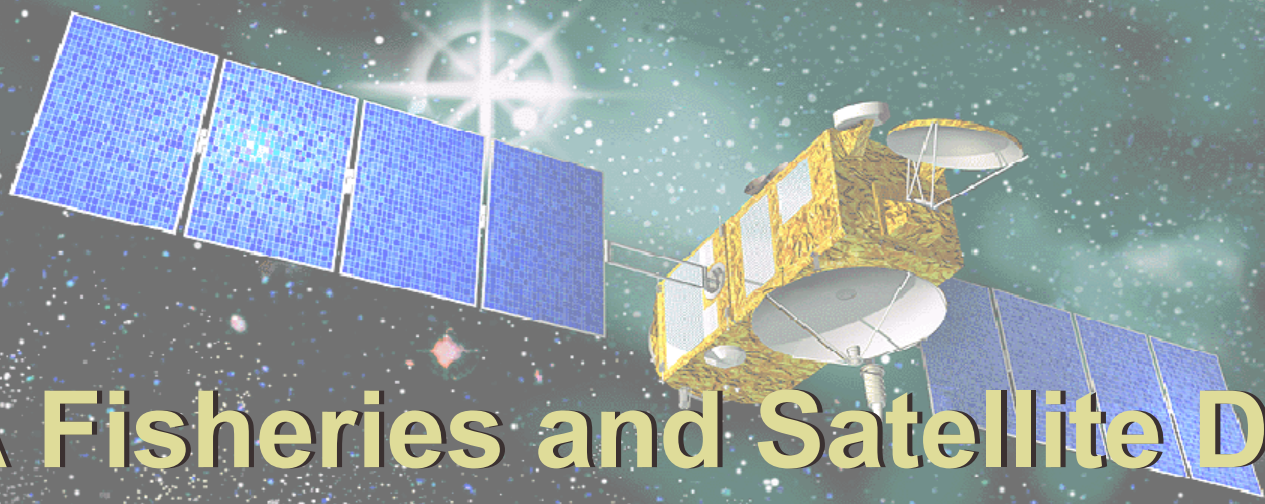

NOAA Fisheries and Satellite Data – Where are we and where are we going?

Cara Wilson

NOAA/NMFS/SWFSC

Environmental Research Division (ERD)

(formerly PFEL)

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GOES-R COAST Team	and many more…

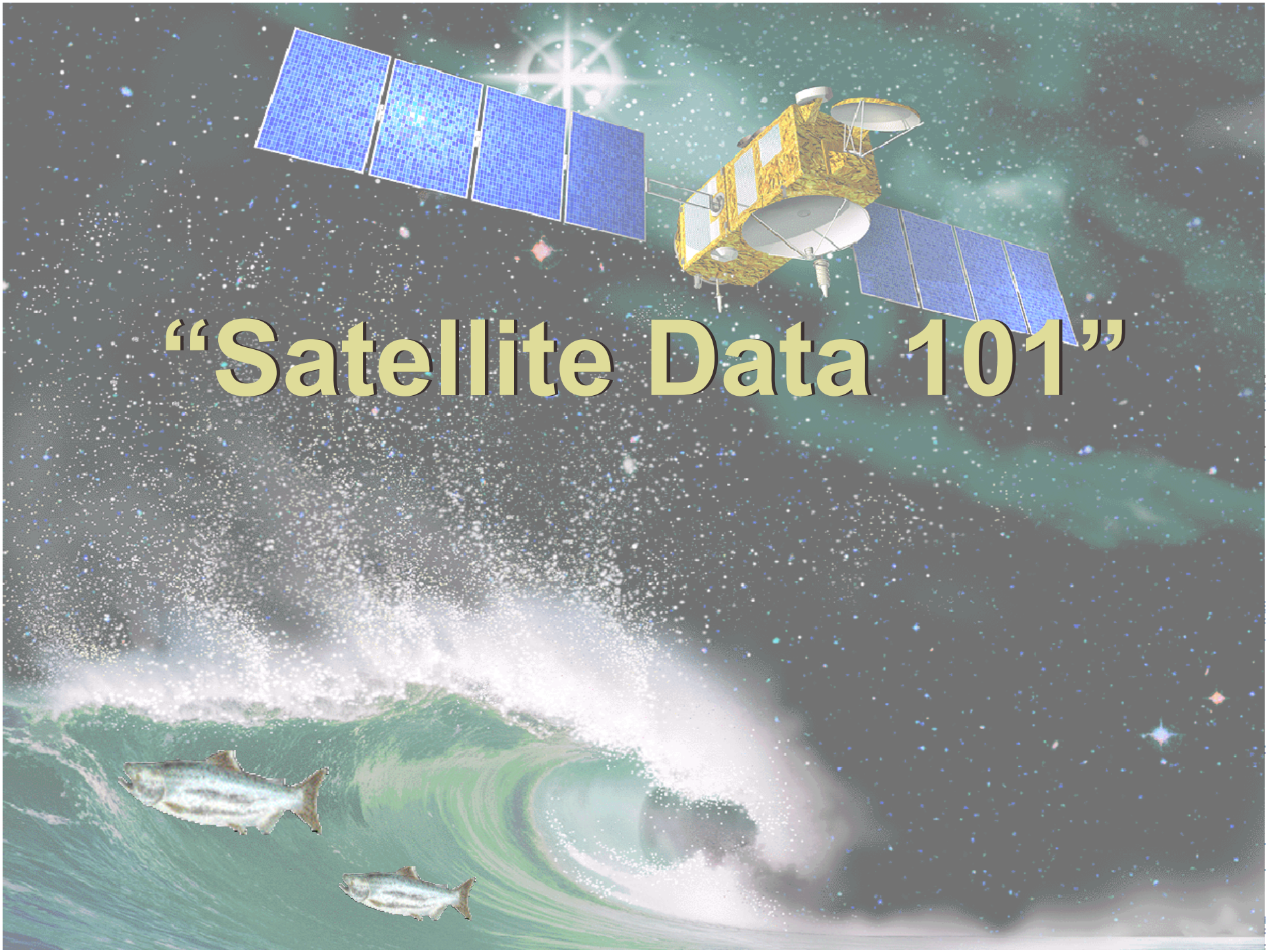
Acknowledgements

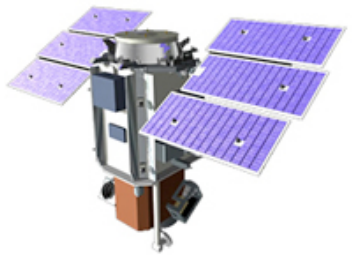
The R&O (Research & Operations) satellite transition project, Stan Wilson (NESDIS) for funding travel to NMFS labs in summer ‘05

NOAA CoastWatch, Kent Hughes (NESDIS) for funding this trip

Outline

- Brief overview of satellite data
  - "Satellite Data 101"
- Where are we?
  - Satellite usages and applications within NMFS
- Where are we going?
  - NOAA's satellite R&O (Research & Operations) transition project, and Fisheries
- What do we need/want?
  - Feedback from the summer 2005 NMFS "road tour"
- What's next?


"Satellite Data 101"

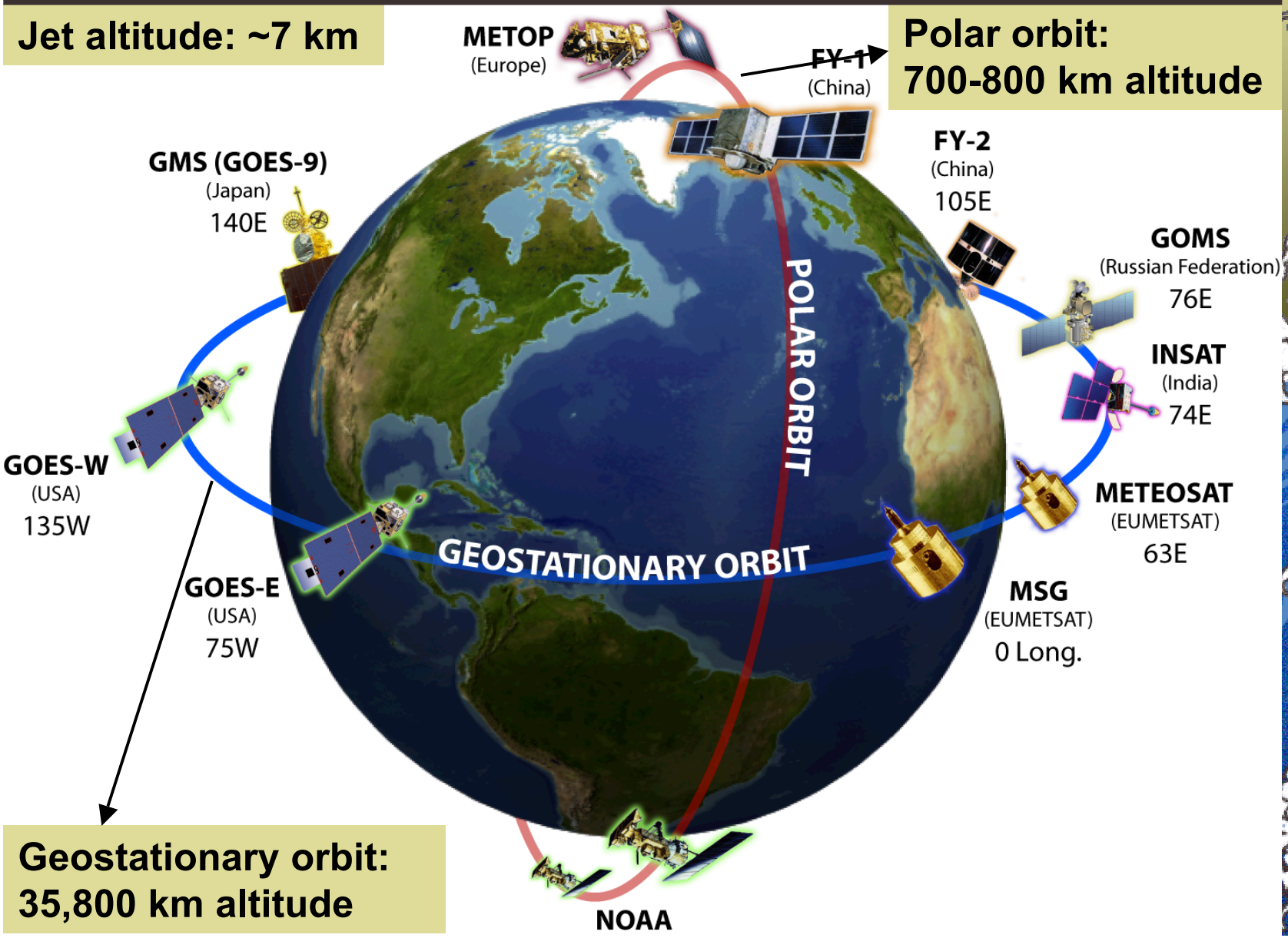


Different Types of Satellite Data

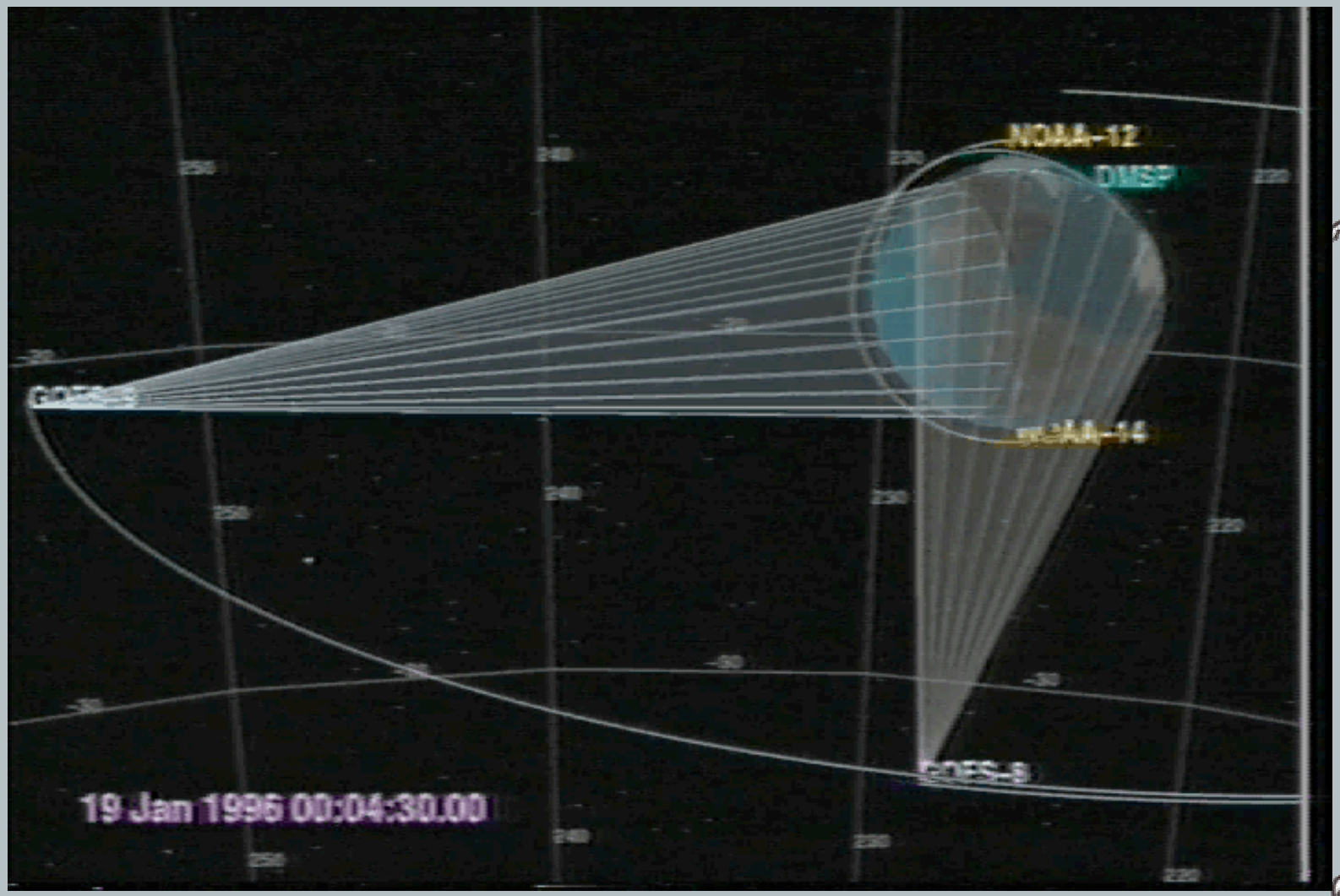
- **Environmental satellite measurements**
  - SST, SSH, ocean color, wind, sea ice
- **Satellite telemetry information (location)**
  - tracking of fish, animals, fishing ships
- ~~**High resolution mapping, aerial surveys**~~
  ~~*- IKONOS, Landsat, SPOT, QuickBird etc.*~~

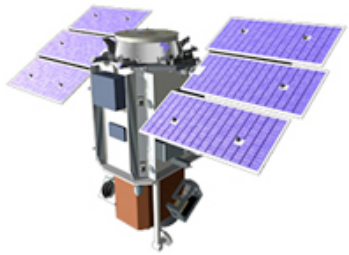
Global Earth Observing System

Operational Satellite Component



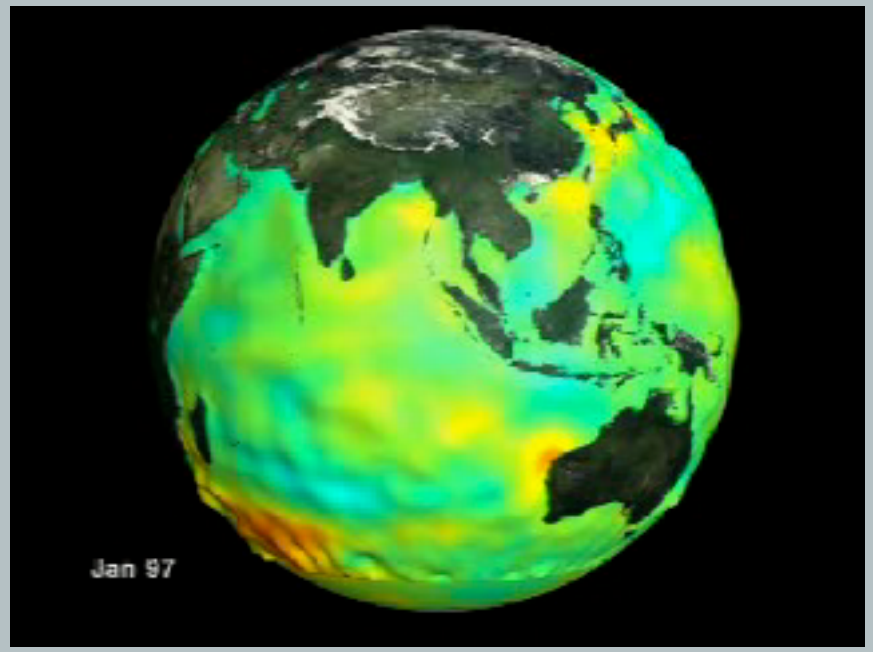
Polar versus Geostationary



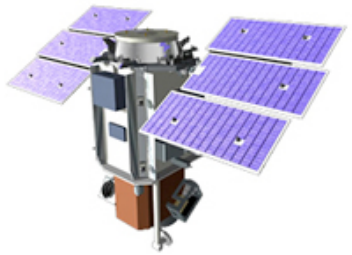


SSH and SST

Animation of SST anomalies superimposed on SSH anomalies from Jan 1997 through Feb 1998 showing the impact of the 97/98 El Niño



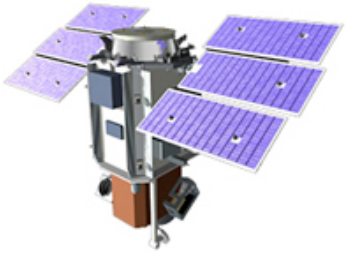
Animation by NASA Goddard's Scientific Visualization Studio
http://svs.gsfc.nasa.gov



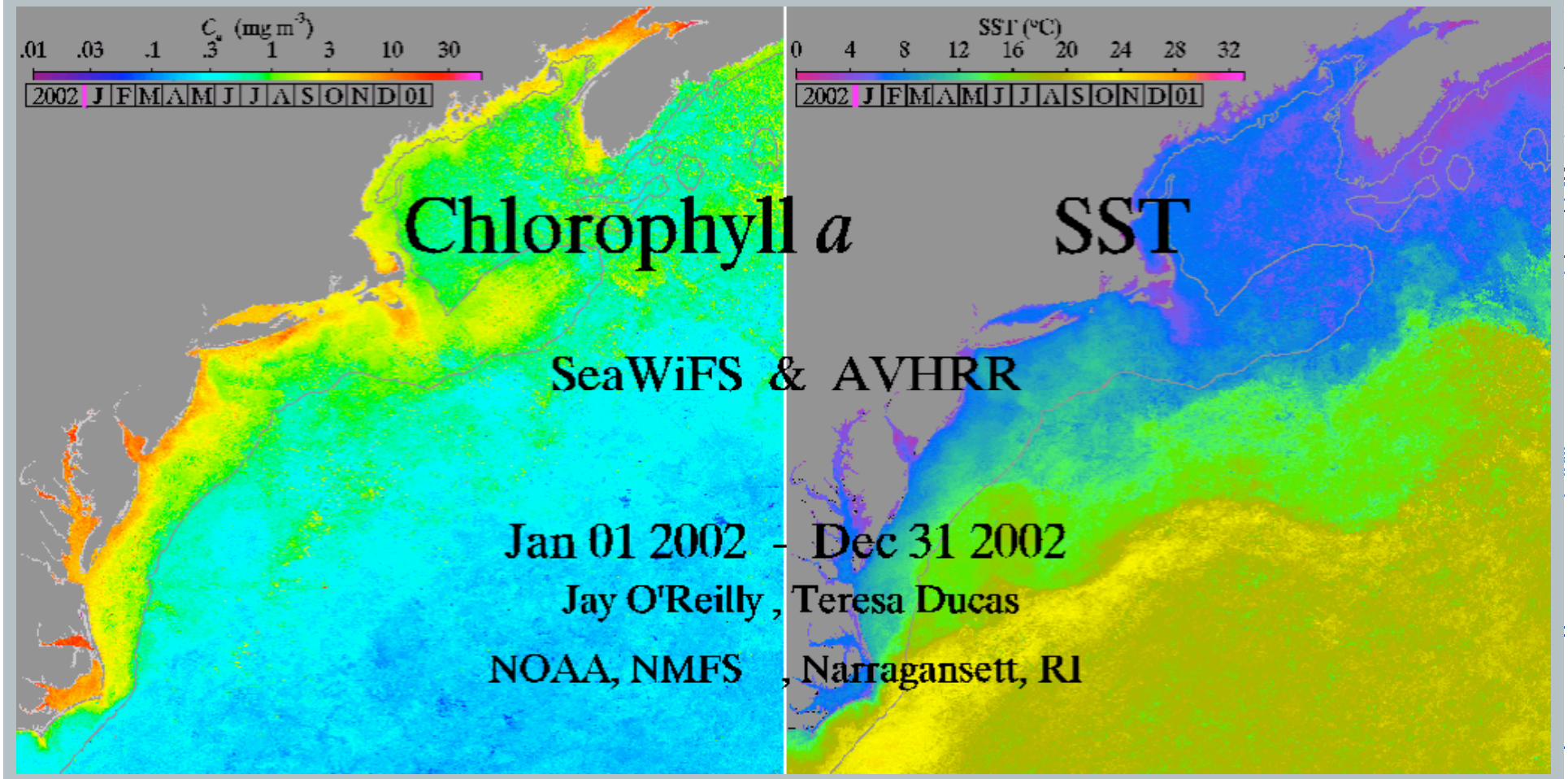
Sea Ice

Animation of daily AMSR-E sea ice concentrations from the Aqua satellite for the northern hemisphere during late 2002 and early 2003.

Animation by NASA Goddard's Scientific Visualization Studio
http://svs.gsfc.nasa.gov



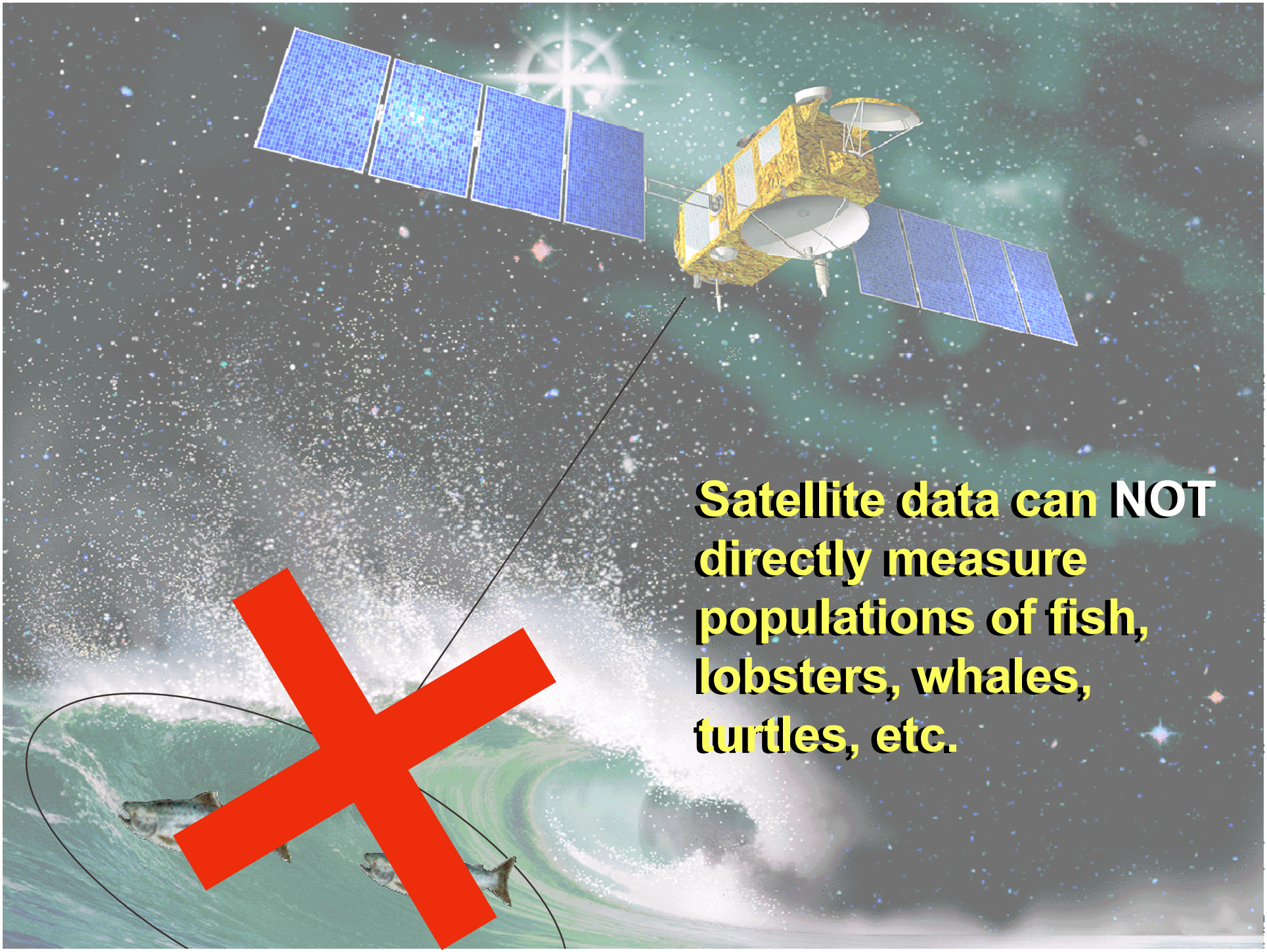
Chlorophyll and SST

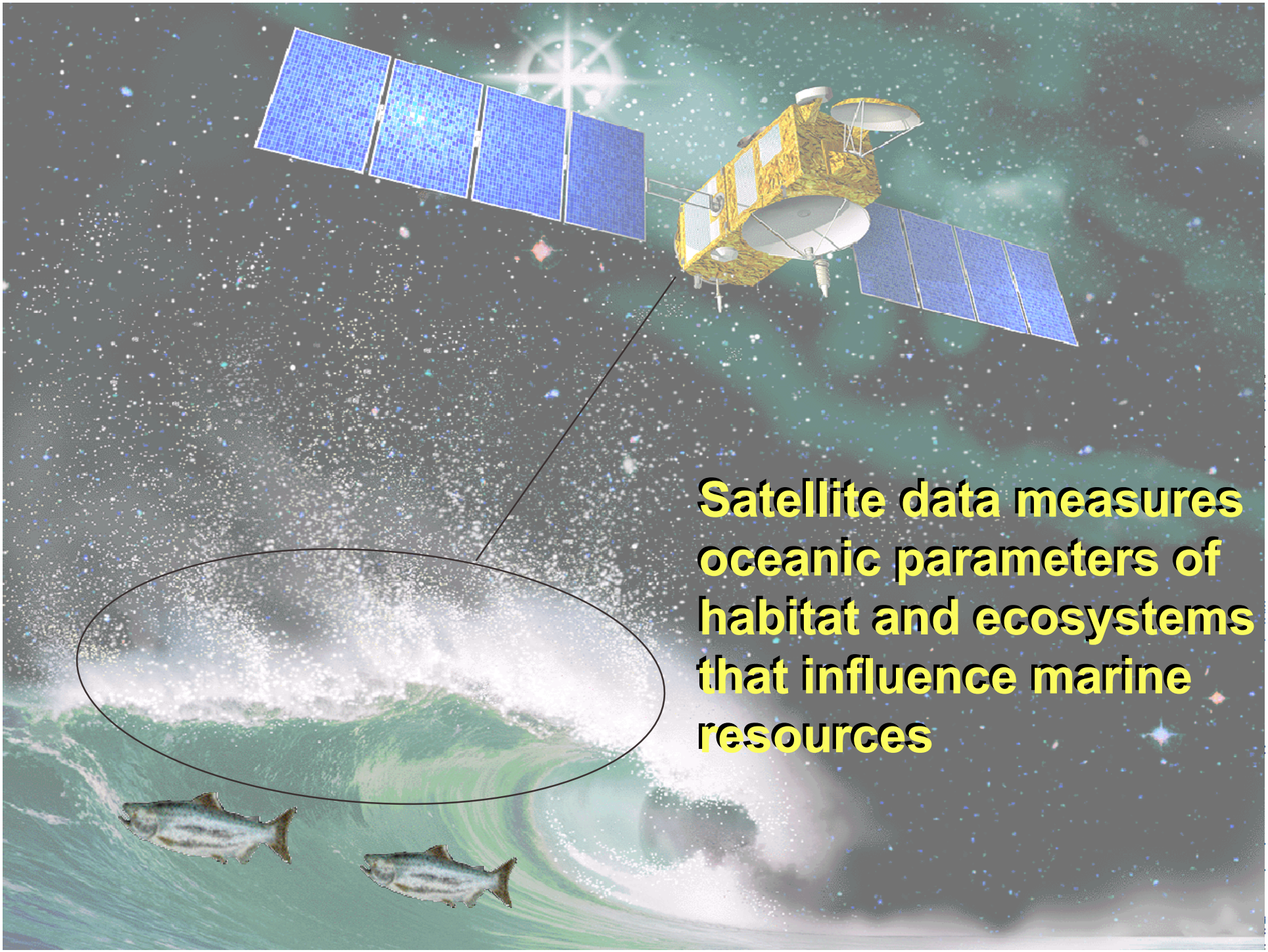


Animation by Jay O'Reilly and Teresa Ducas, NOAA/NMFS/NEFSC

Where are we?

Satellite usages and applications within NMFS

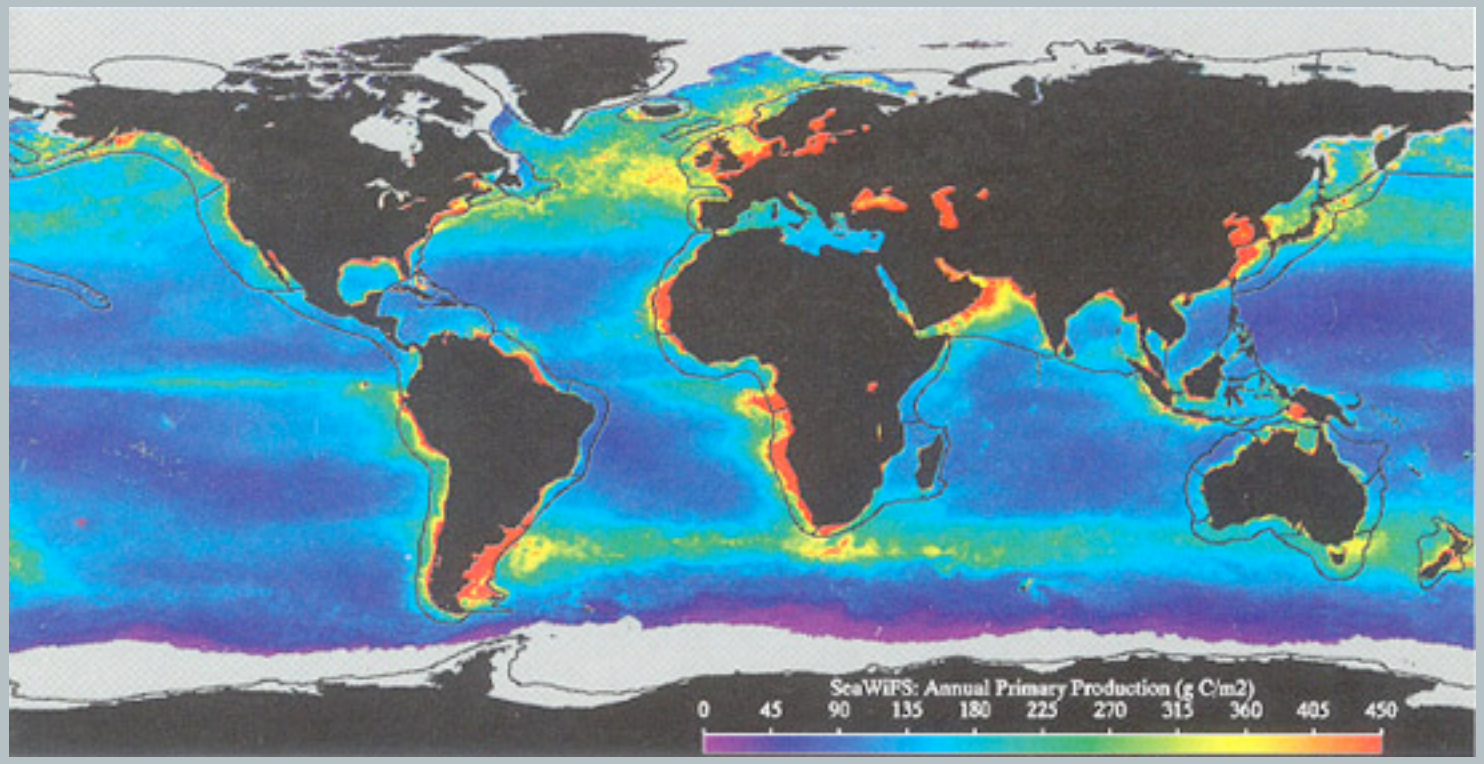

Satellite data can NOT directly measure populations of fish, lobsters, whales, turtles, etc.


Satellite data measures oceanic parameters of habitat and ecosystems that influence marine resources

Ultimate Ecosystem

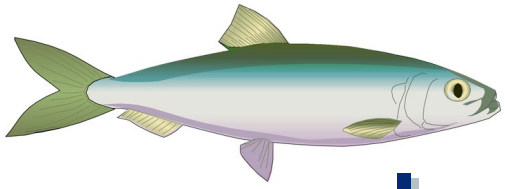
from presentation by Jack Dunnigan, former Ecosystem Goal Team Lead

Large Marine Ecosystems



Annual satellite-derived Primary Productivity and the outlines of the 64 defined LMEs

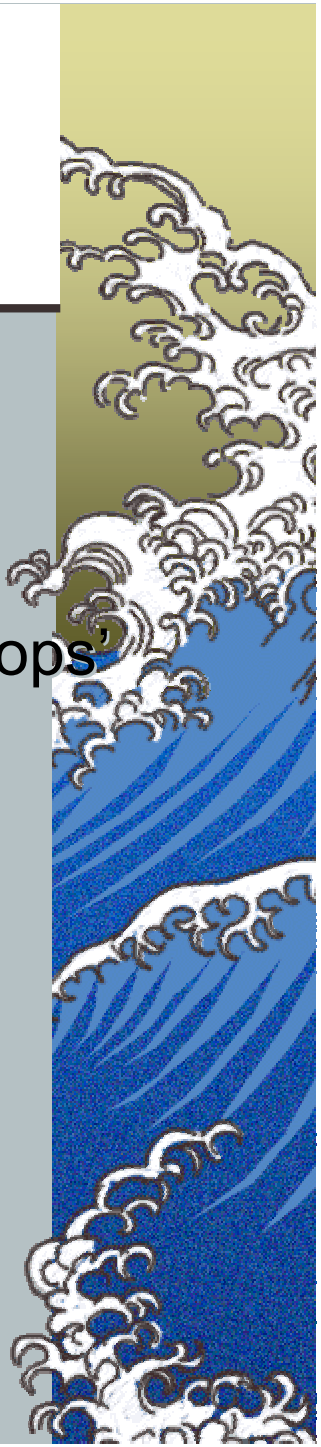
Sherman et al., MEPS, 2005 *NOAA/NMFS/NEFSC*

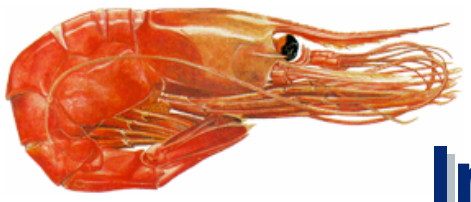


Ocean Features Important to Ecosystems

- Ocean ‘fronts’, boundaries, ‘edges’
- River plumes
- Coastal regions
- Mesoscale circulation patterns: eddies, meanders, ‘loops’
- Convergence zones
- Subsurface thermal structure: MLD, thermocline
- Ocean surface winds
- Ocean currents
- Wave heights

All of these ocean features can be measured, detected, or inferred by satellite data



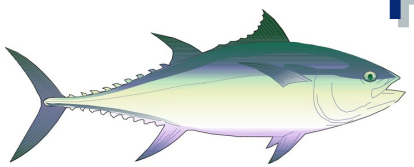


Temporal Events Important to Ecosystems

- Upwelling
- Harmful Algae Blooms (HABs)
- Oil Spills
- Seasonal Transitions
- El Niño events
- Regime Shifts (i.e. PDO)
- Global Climate Change

Climate change can affect the timing and/or intensity of many of these processes

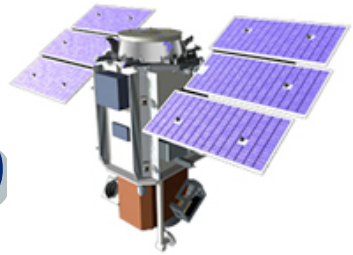
Climate Data Records (CDRs) of satellite measurements need to be maintained!

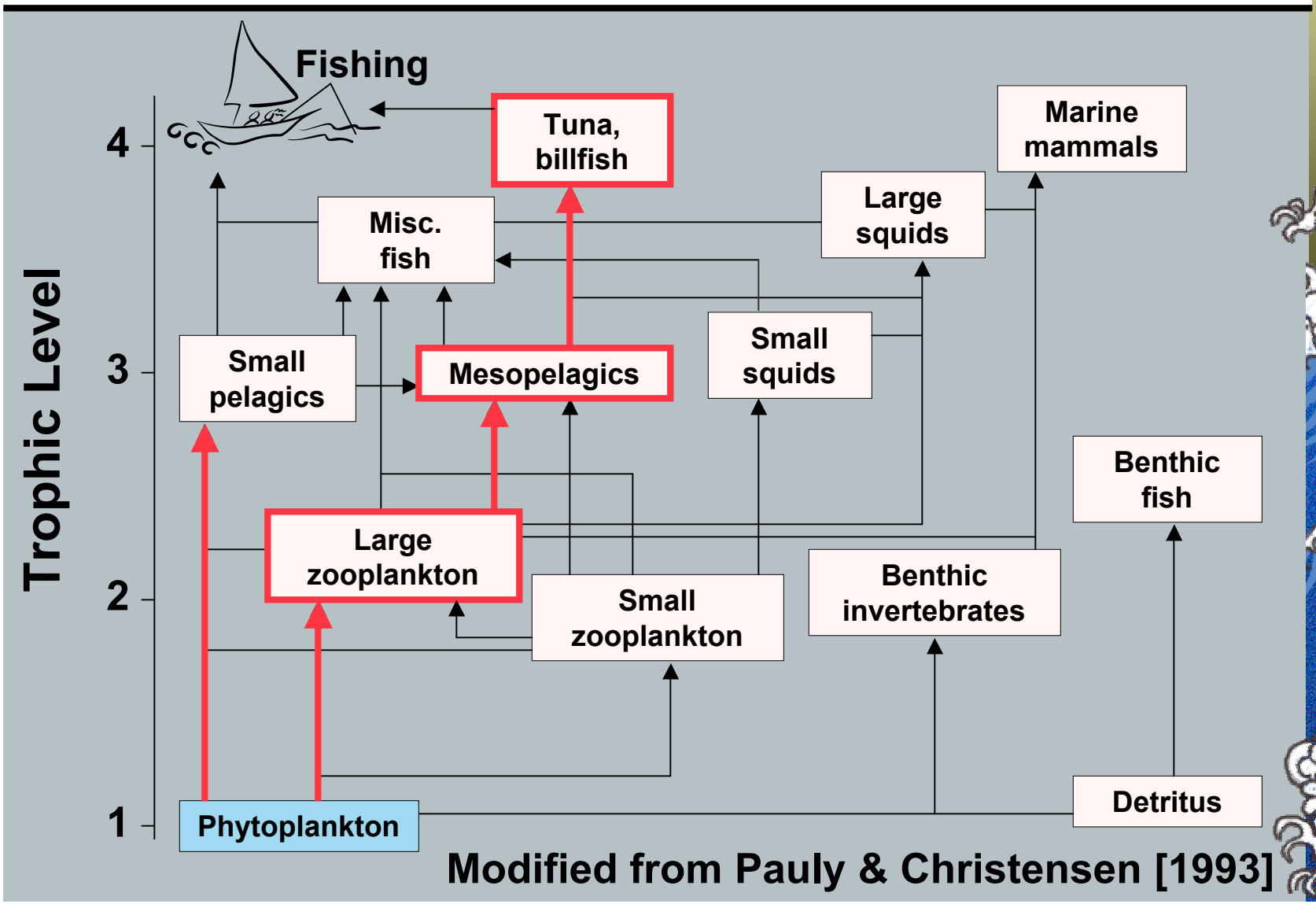


Fisheries Relevant Applications of Satellite Data

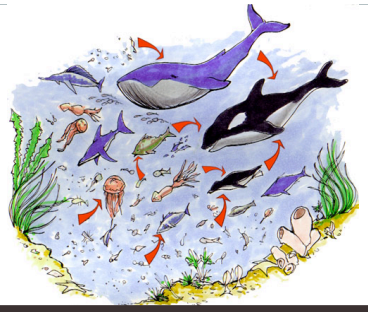
- Ecosystem Dynamics
- Pelagic Habitat Assessment
- Population Analysis
- Harmful Algal Bloom (HAB) detection
- Hazards affecting Protected Resources
- Coral Bleaching
- Optimize planning of fisheries research cruises
- Policy & Regulation

Oceanic Food Web

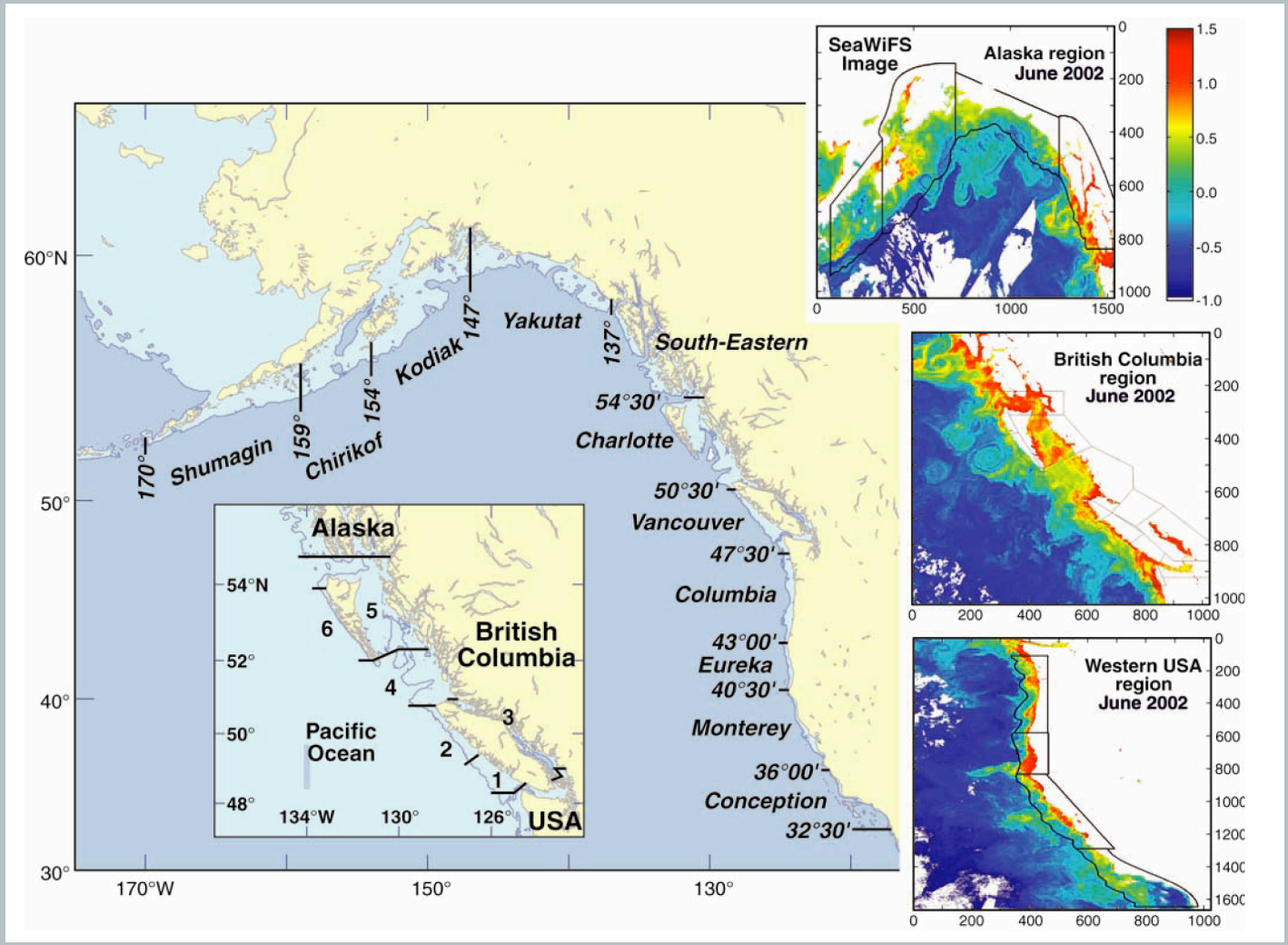




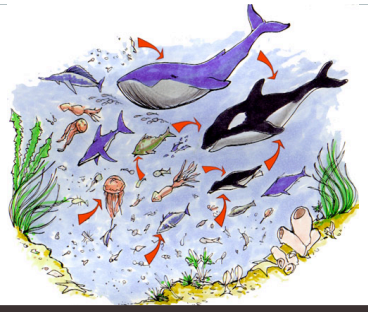
Modified from Pauly & Christensen [1993]



Linkages



Ware & Thomson [Science, 2003]



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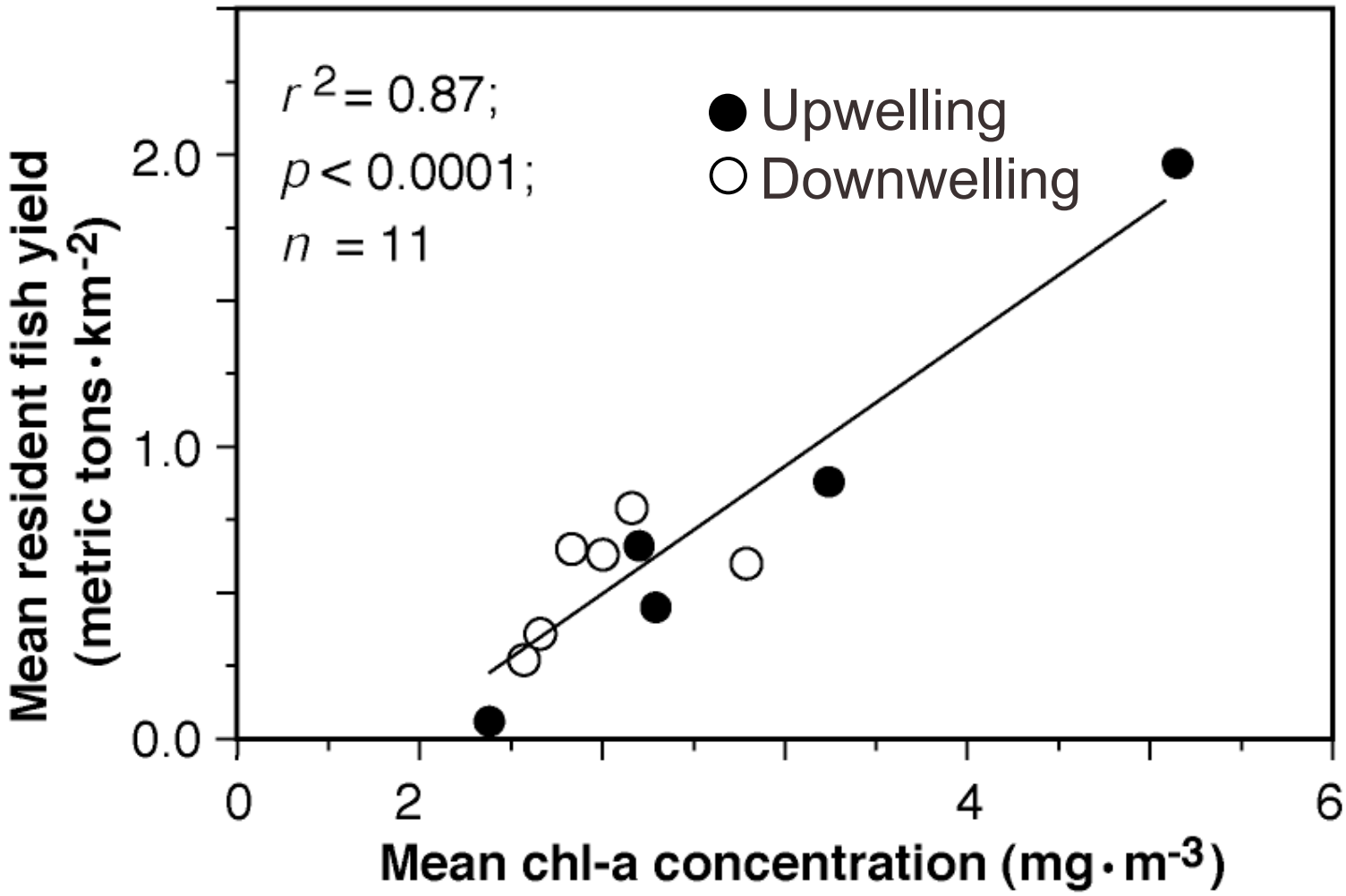
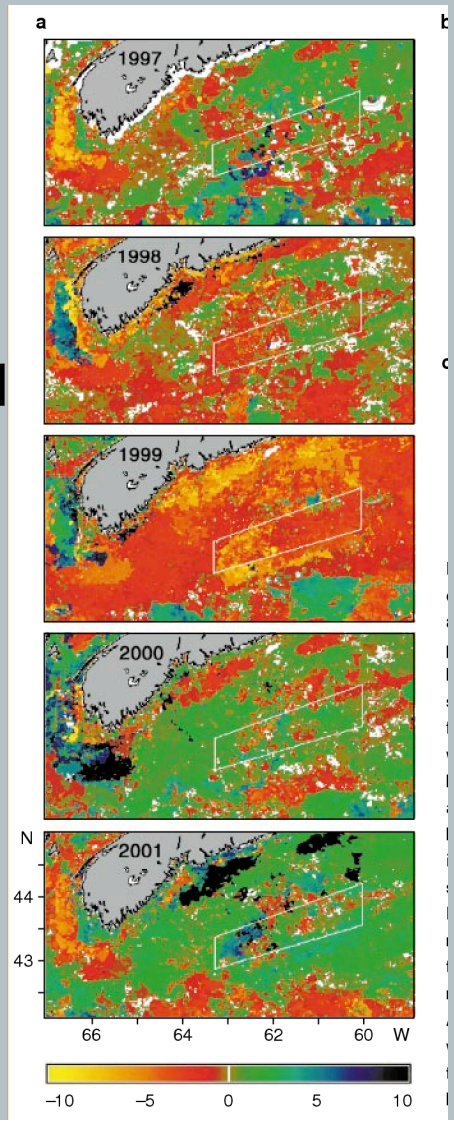
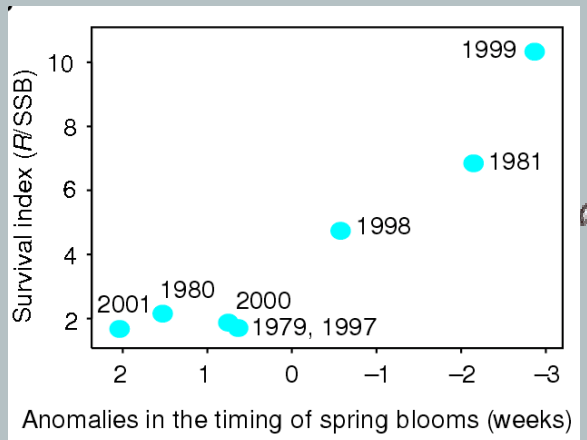


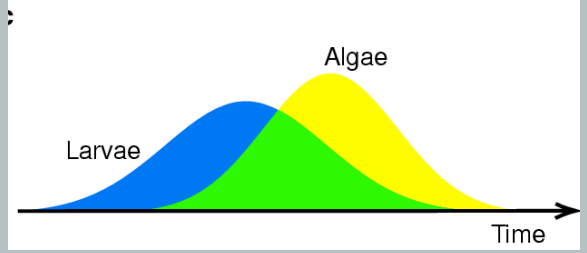
Ware & Thomson [Science, 2003]

Timing of the Spring bloom and Haddock Survival

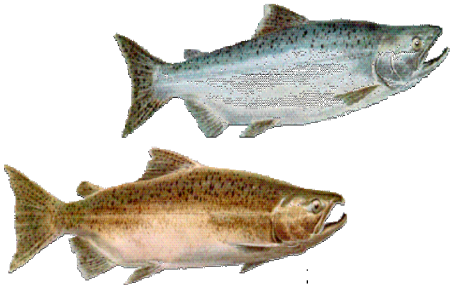
Contours of the annual anomaly in the timing of the spring bloom based on SeaWiFS chlorophyll data



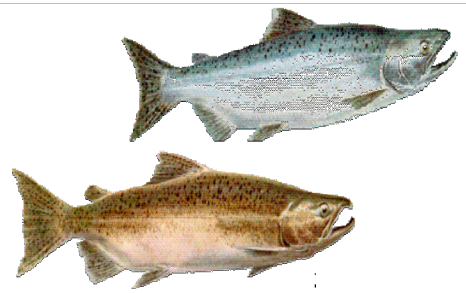




From Platt et al., Nature, 2003

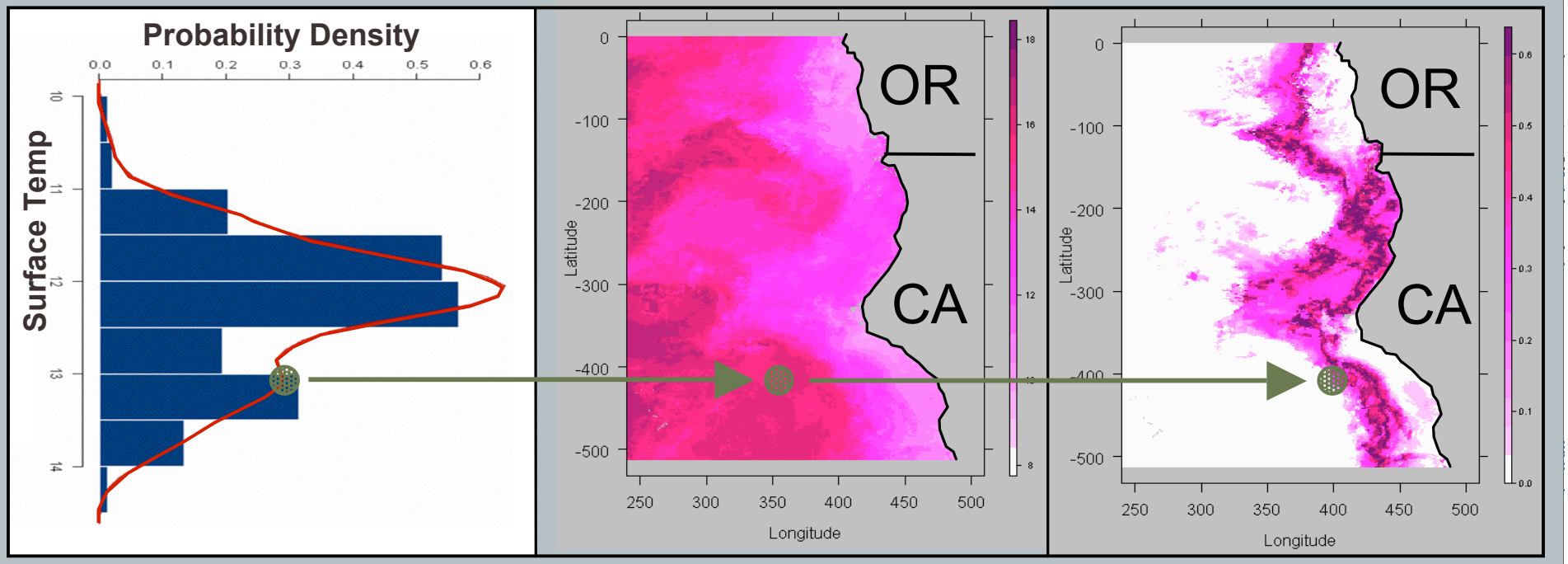


Defining Salmon Ocean Habitat



Chinook Potential Habitat

(Oncorhynchus tshawytscha)

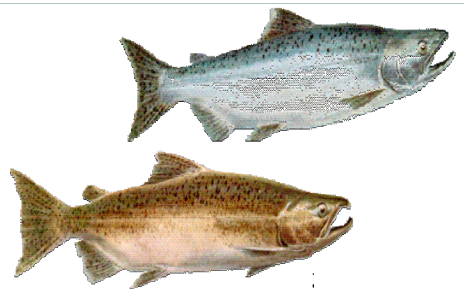


Density of fish's temperature experience at the surface from tag data

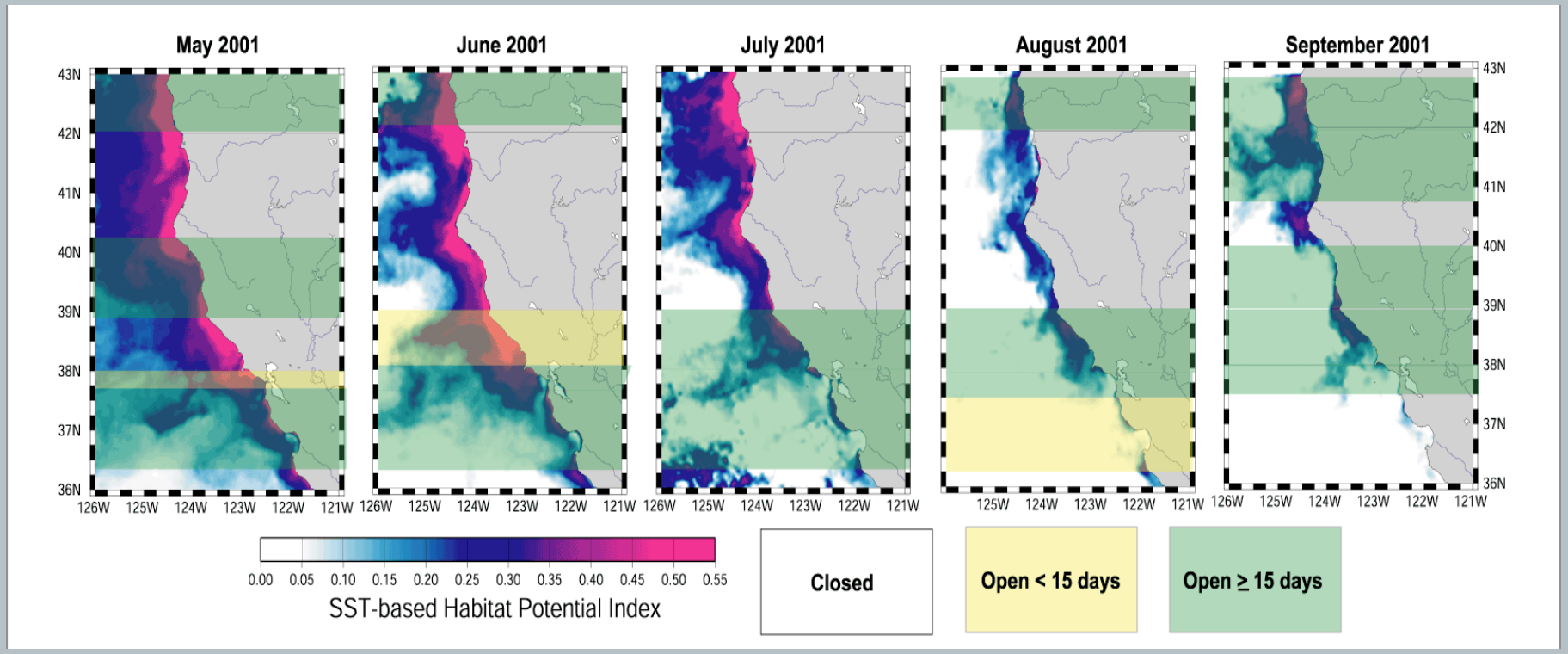
Satellite SST

"Contours of utilization" – likely fish location

Hinke et al., MEPS, 2005 *NOAA/NMFS/SWFSC*



Modeling Habitat in Chinook fishery



- Allows temporal resolution similar to closures
- Allows spatial and temporal resolution of upwelling and relaxation events which shape habitat

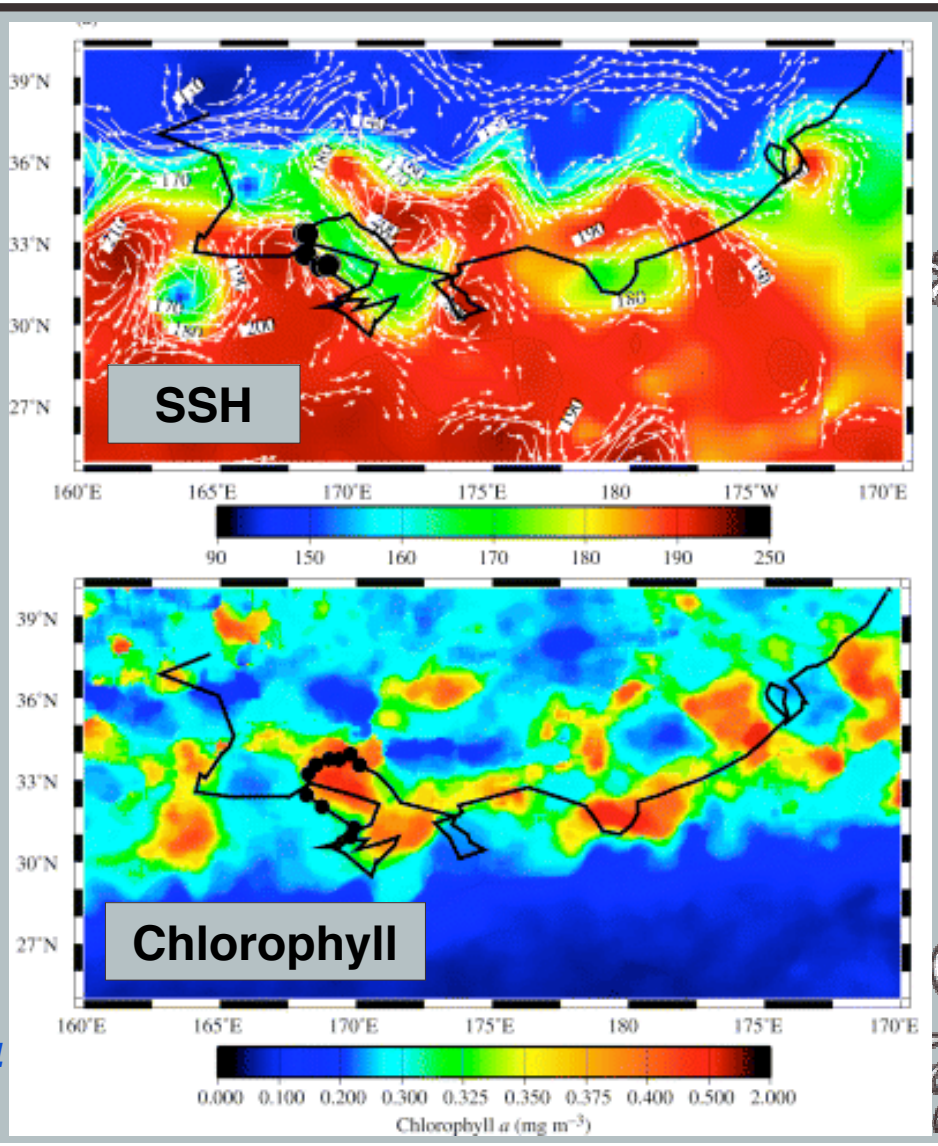
J.T. Hinke, G. Watters, C. Bessey, M. Snover, NOAA/NMFS/SWFSC ERD

Characterizing Habitat

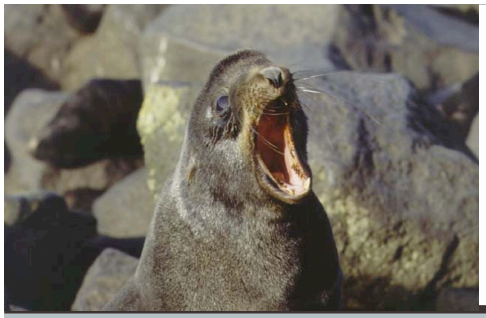
Loggerhead turtle tracks along the Transitional Zone Chlorophyll Front (TZCF) in the N. Pacific during Feb. 01

The TZCF is an important foraging ground for a number of commercial and protected species.

Interannual variability in its location has been tied to the reproductive success of endangered monk seal pups.



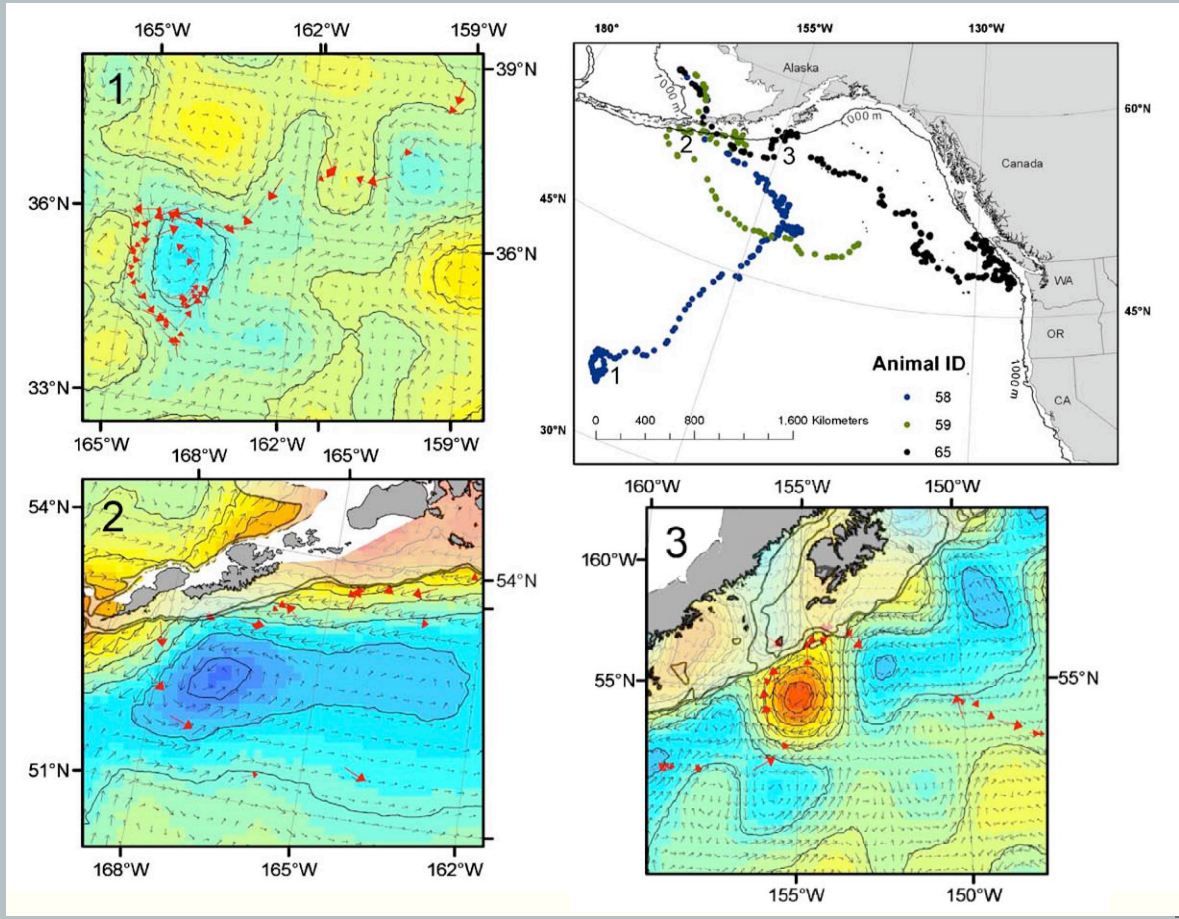
Polovina et al., Fish. Ocean., 2004
NOAA/NMFS/PIFSC



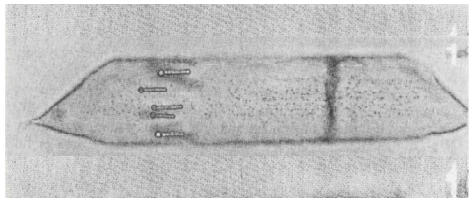
Characterizing Habitat

Northern Fur Seals

Analysis of SSH and geostrophic velocity data with telemetry from tagged animals demonstrates the interaction between northern fur seals and oceanographic eddies.



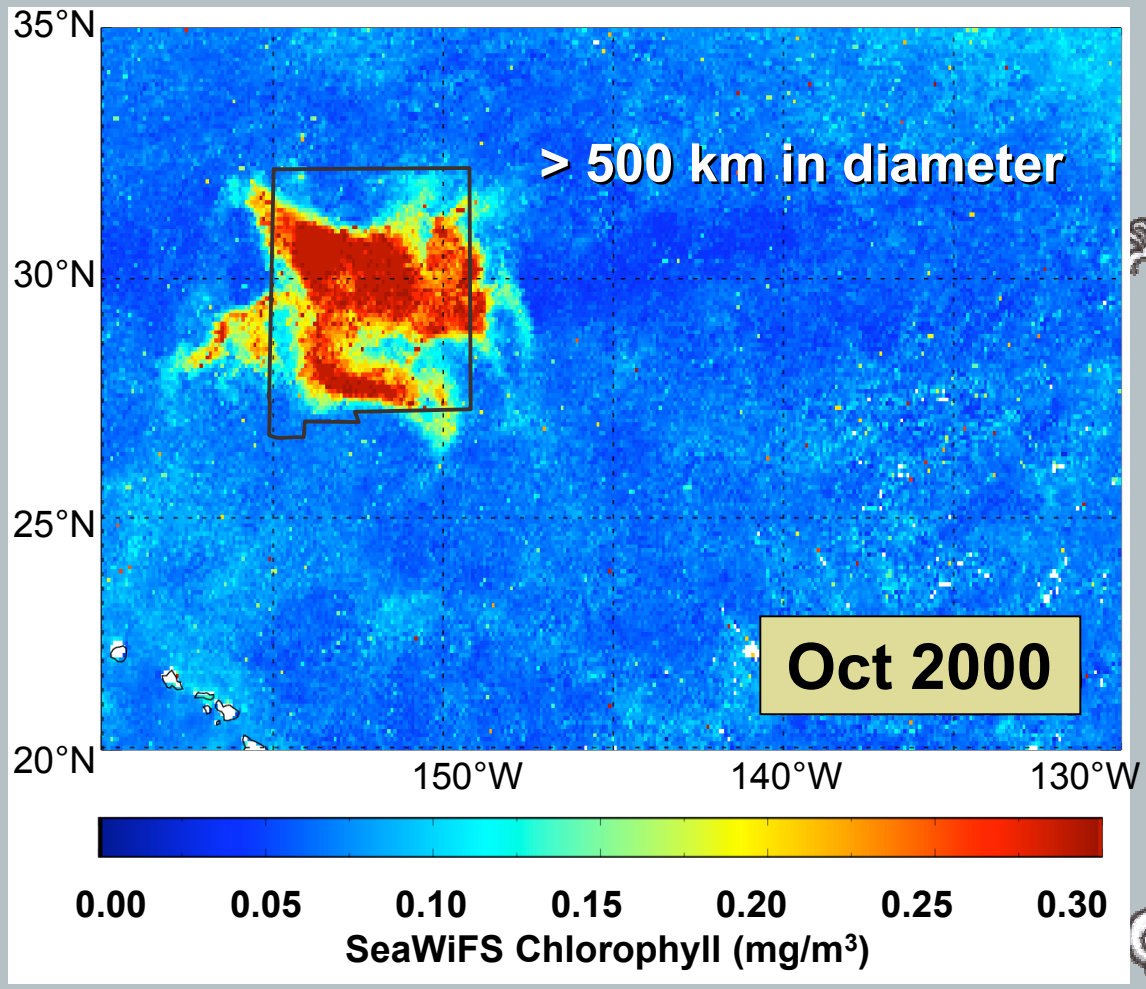
Ream et al., DSR-II, 2005 **NOAA/NMFS/AFSC**



Discovering Habitat?

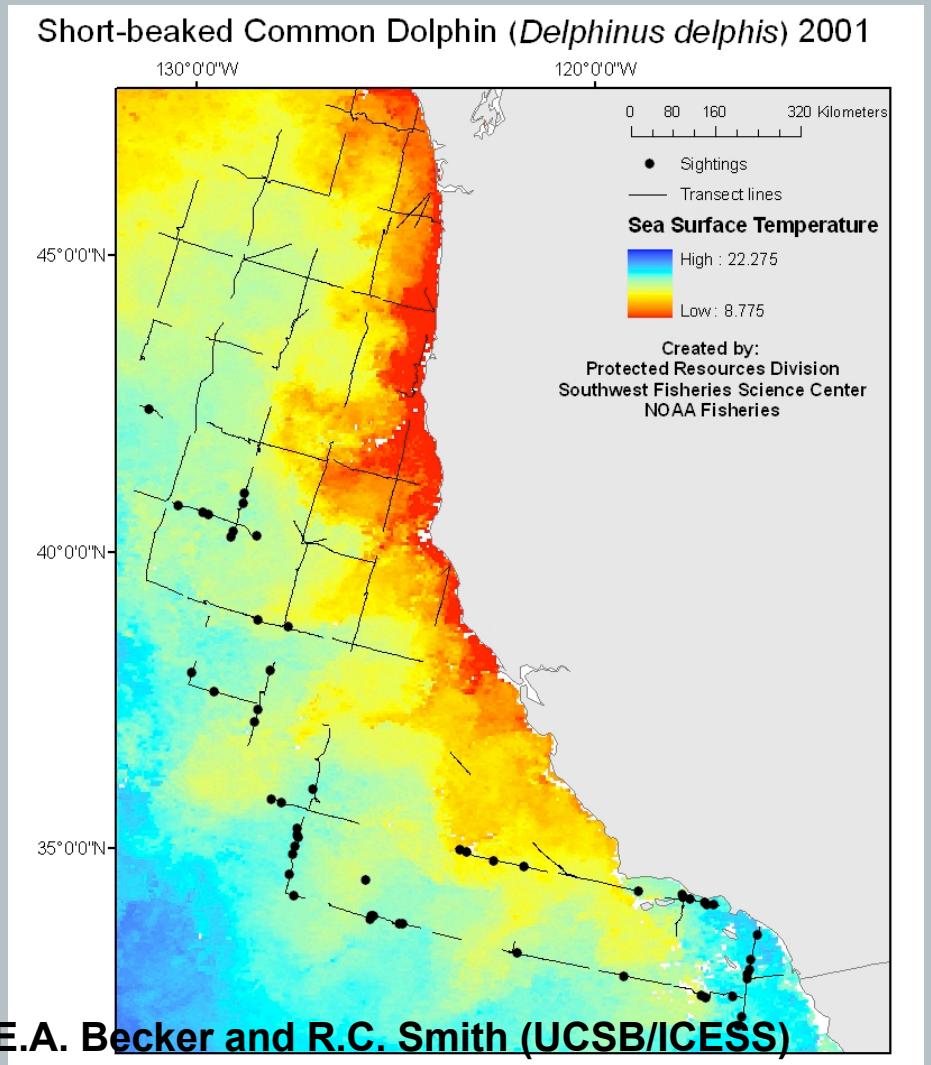
Large recurrent chlorophyll blooms discovered with satellite data in the middle of the oligotrophic Pacific gyre.

The blooms occur within the target area of several fisheries, including albacore and swordfish, but their impact on higher trophic levels is not known.



Wilson, GRL, 2003 NOAA/NMFS/SWFSC

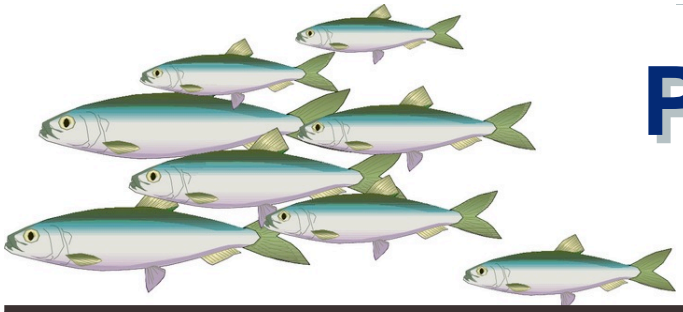
Modeling Cetacean Distribution



Pathfinder SST data

- Easily acquired in GIS-ready format
- Adequately resolves key features of CCS

E.A. Becker and R.C. Smith (UCSB/ICESS)
K.A. Forney, J.V. Redfern, M.C. Ferguson, J. Barlow, R. Cosgrove (NOAA/NMFS/SWFSC)



Population Analysis of Minke Whales

- **Abundance estimate for Antarctic Minke whales decreased from 730,000 in CPII to 360,000 in CPIII - *Why??***
- **Changes in sea-ice distribution has been put forth as a potentially important factor.**
- **Satellite sea-ice data is being examined to test this hypothesis.**

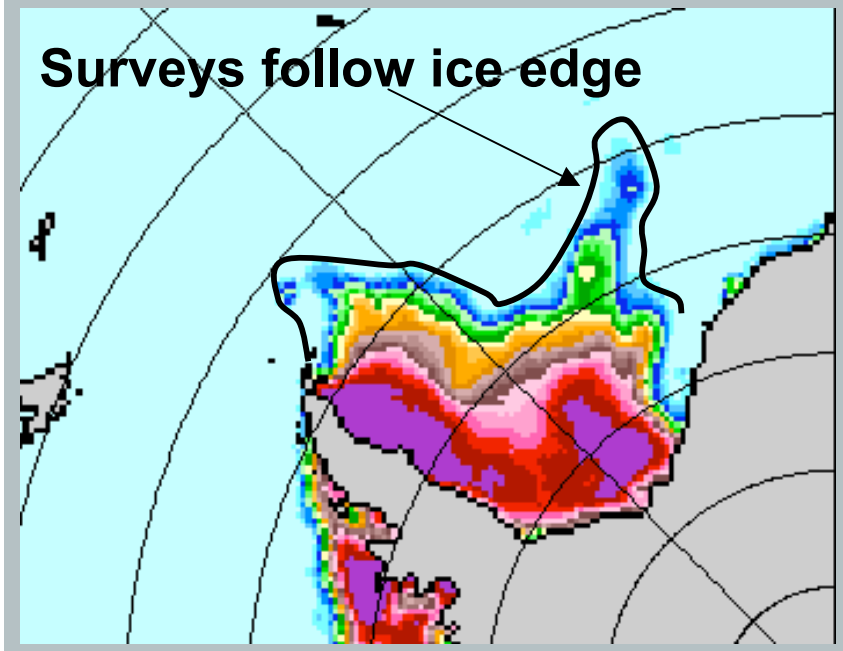
Work in progress by Brownell & Wilson, NOAA/NMFS/SWFSC

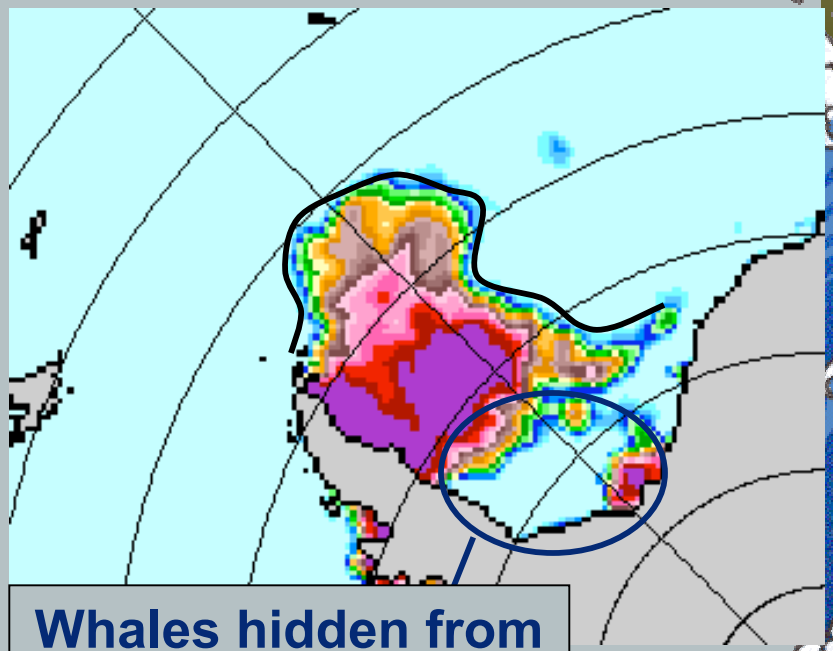
Population Analysis

(Balaenoptera bonaerensis)

Jan 1987, CP-II
141,000 Minke whales

Jan 1998, CP-III
35,000 Minke whales





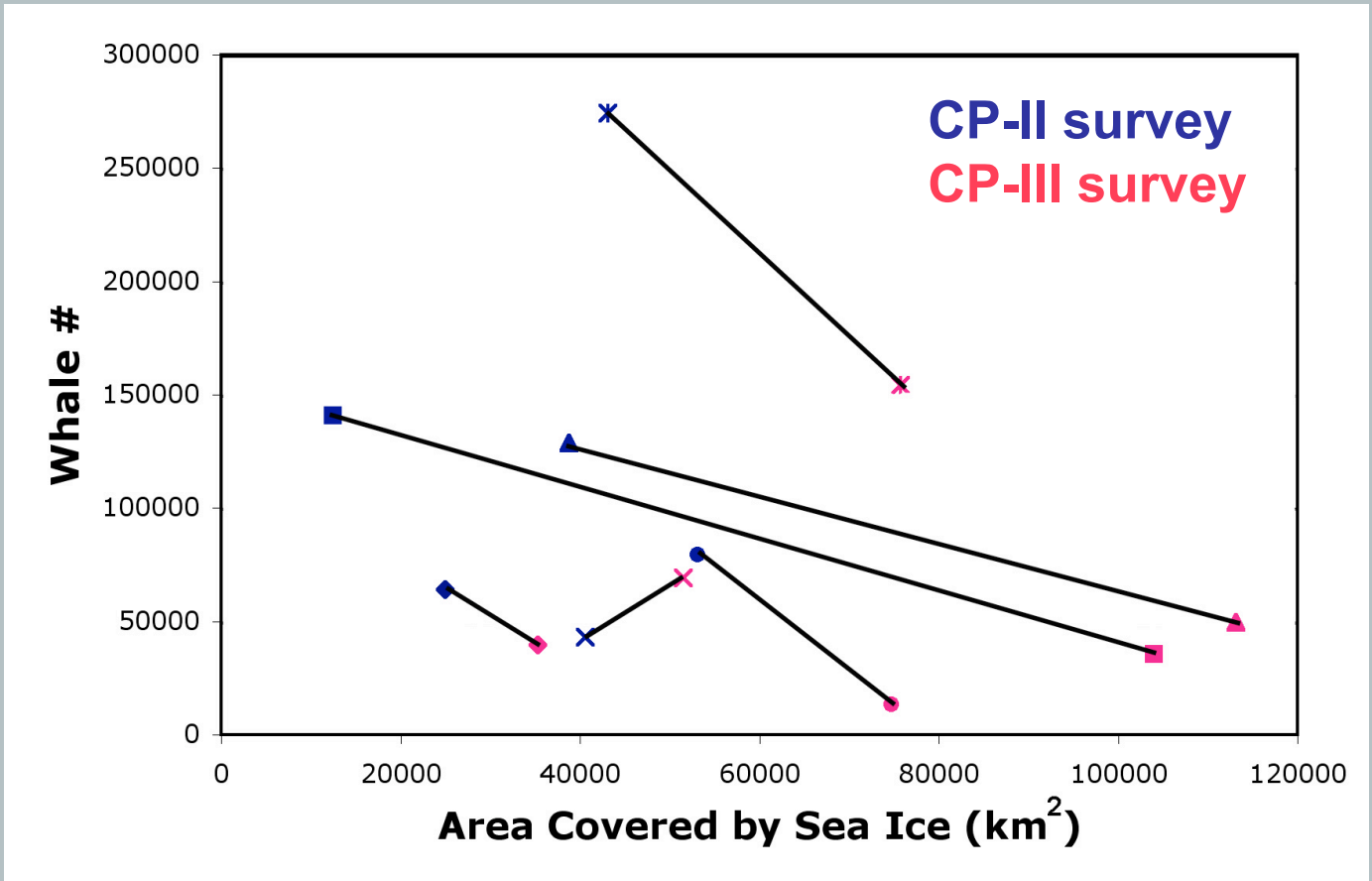
Whales hidden from survey in polynya?

Work in progress by Brownell & Wilson, NOAA/NMFS/SWFSC

Population Analysis

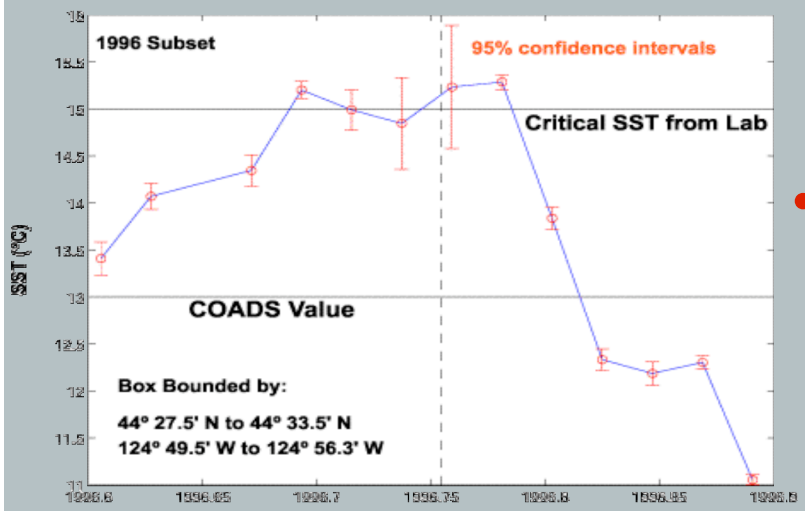
(Balaenoptera bonaerensis)

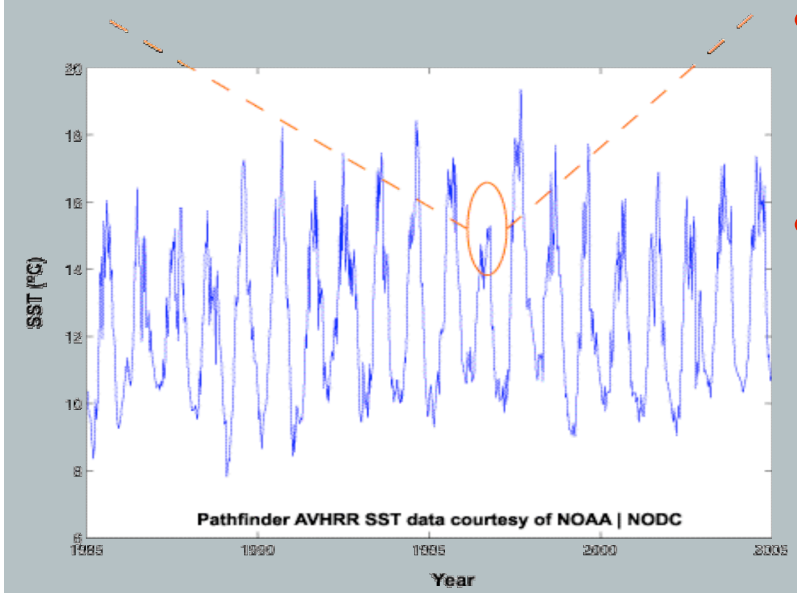
More Ice = Less whales counted
(more ice habitat for whales to hide in)



Work in progress by Brownell & Wilson, NOAA/NMFS/SWFSC

Ground Truth for Stock Assessments





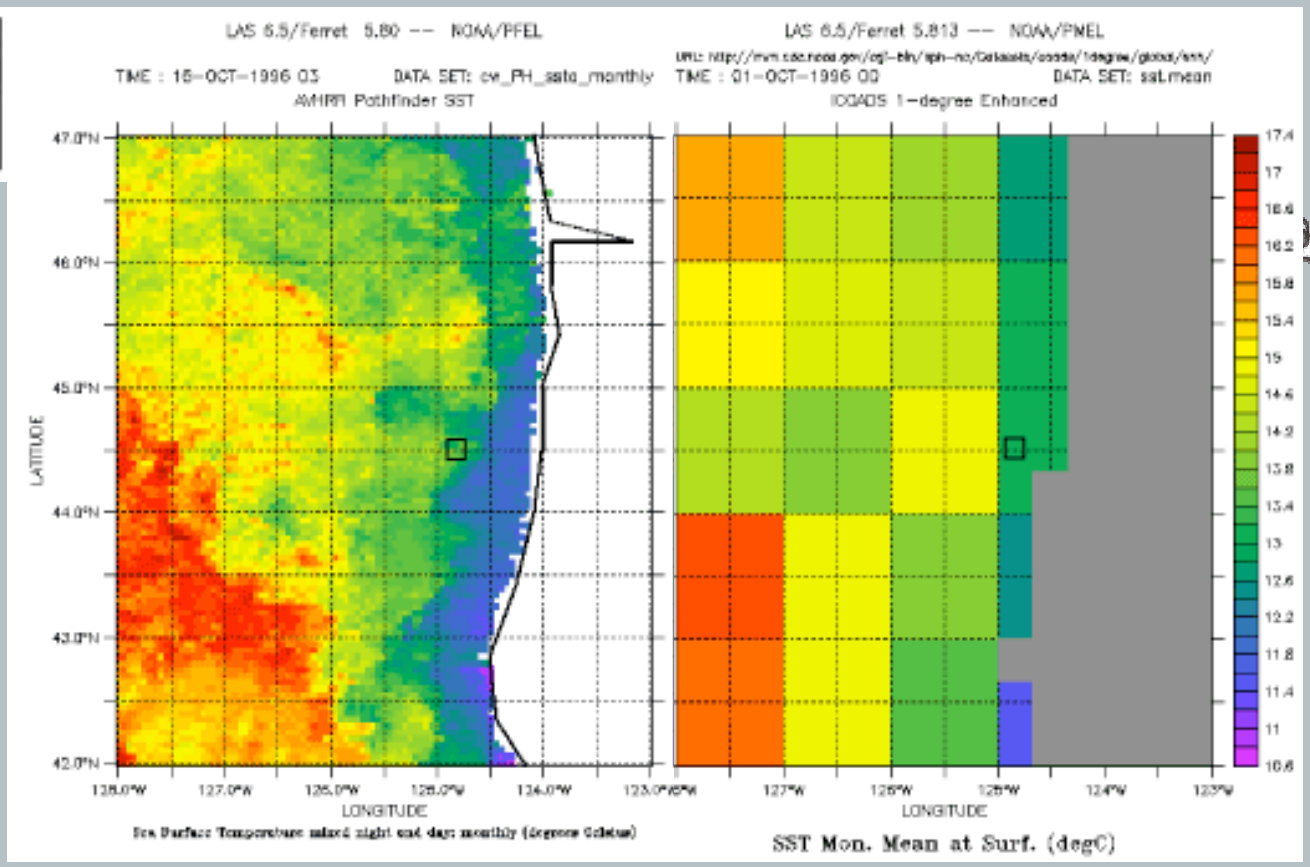
Sablefish

(*Anopoploma fimbria*)

- **Pathfinder's long time series allowed us to show that the SST > 15°C for a period when tagged sablefish were known to survive.**
- **This contradicted laboratory studies of tag-related mortality used in stock assessments.**
- **The end result will be an increase in the catch quota reflecting a more realistic stock assessment.**

S. Berkeley, UC – Santa Cruz

Ground Truth for Stock Assessments



- Version 5 Pathfinder resolves off-shore water from coastal upwelling
- 1° COADS data cannot do this.

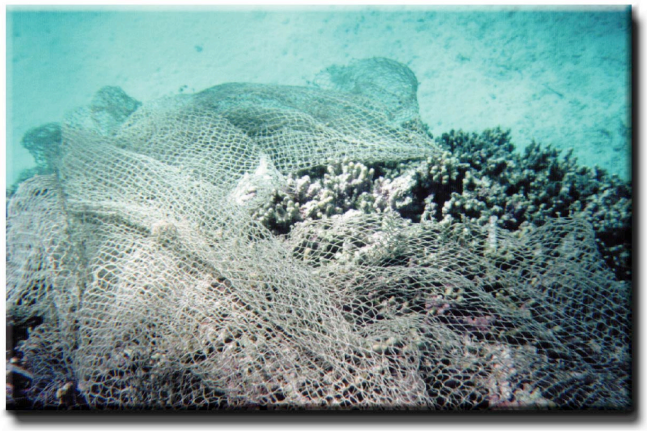
Ghostnet Program - Rationale

Minimize navigation hazards

Reduce wasteful “Ghost fishing”

Endangered Hawaiian Monk seal trapped in marine debris

Protect endangered species



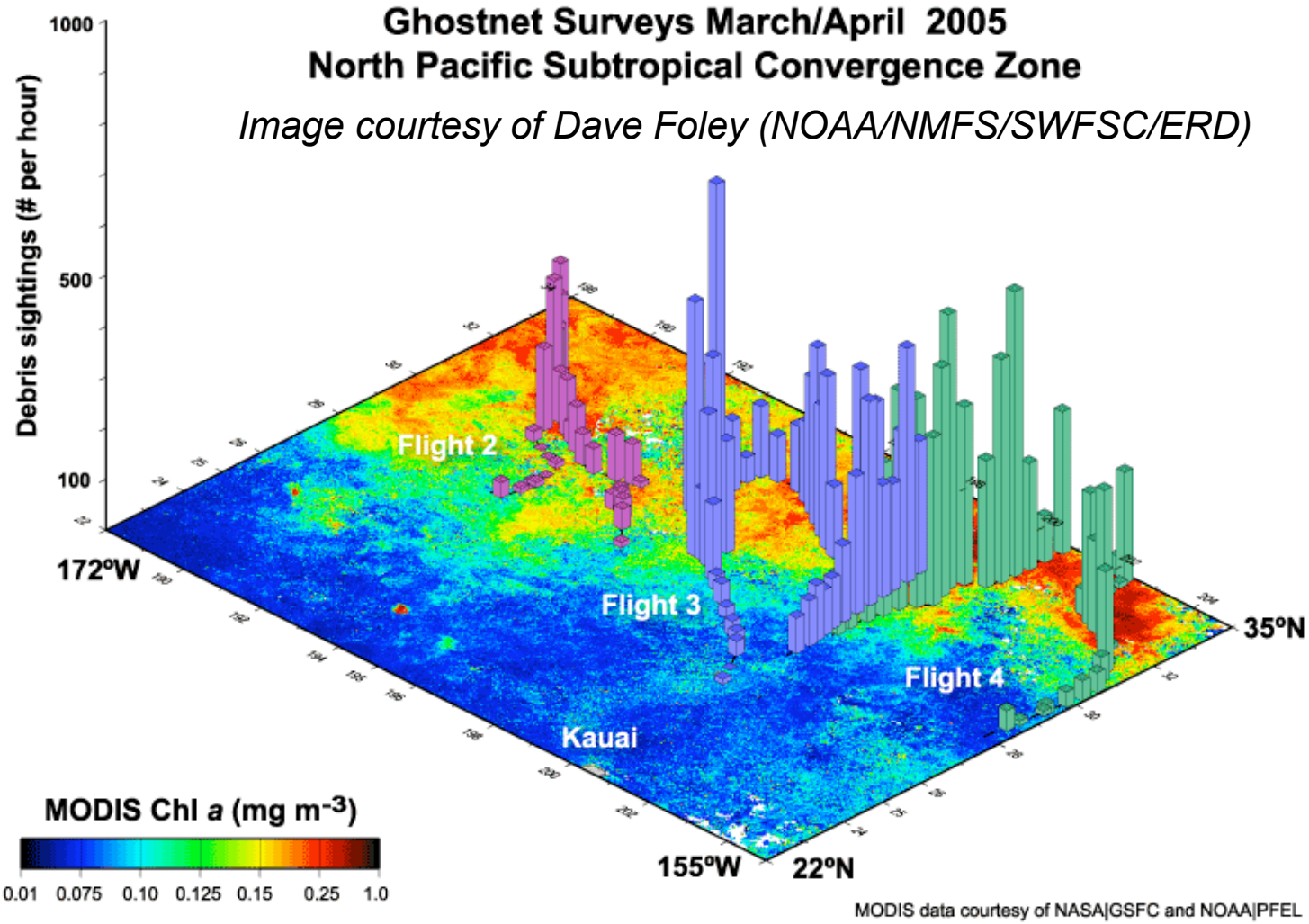
Derelict fishing net anchored on coral

Maintain healthy coral reef ecosystems

Collaboration between:

Airborne Technologies Inc.
NOAA Research/ETL
NOAA Satellites and Information/ORA
NOAA Fisheries/SWFSC/ERD

Ghostnet Preliminary Results



Ghostnet Preliminary Results

Debris Density based on Observer Sightings per unit effort, and satellite-derived meaures of SST, Chl a, and Chl a Gradient

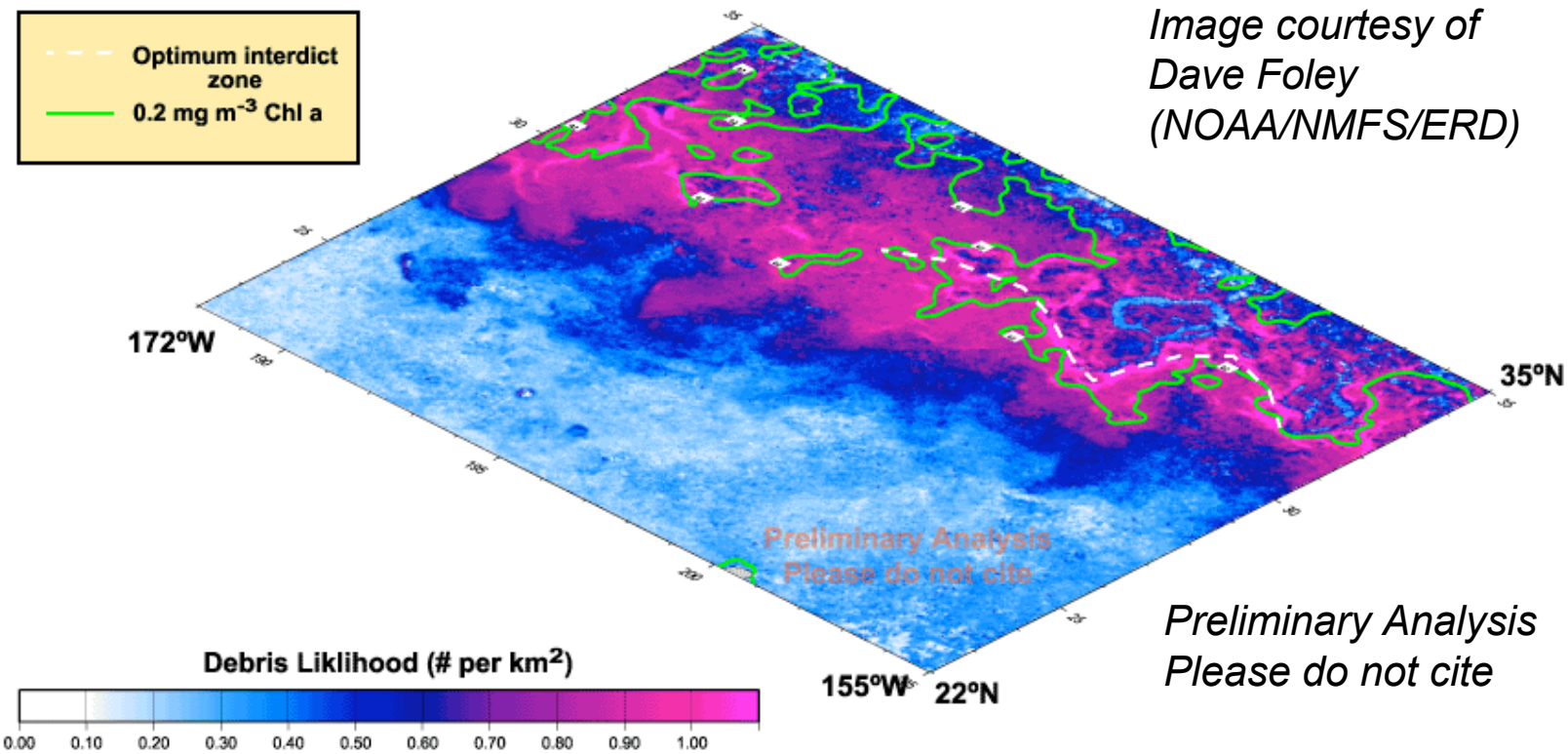
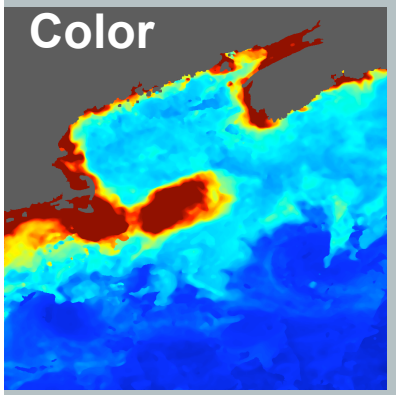


Image courtesy of Dave Foley (NOAA/NMFS/ERD)

Preliminary Analysis
Please do not cite

NOAA/SWFSC/ERD

Right Whale Forecast



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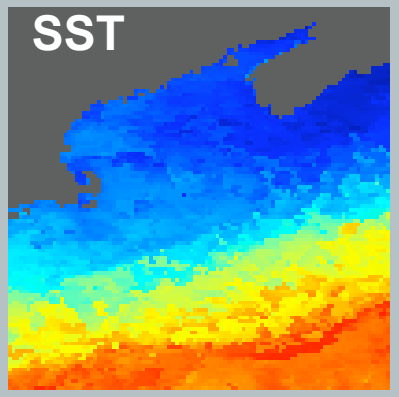

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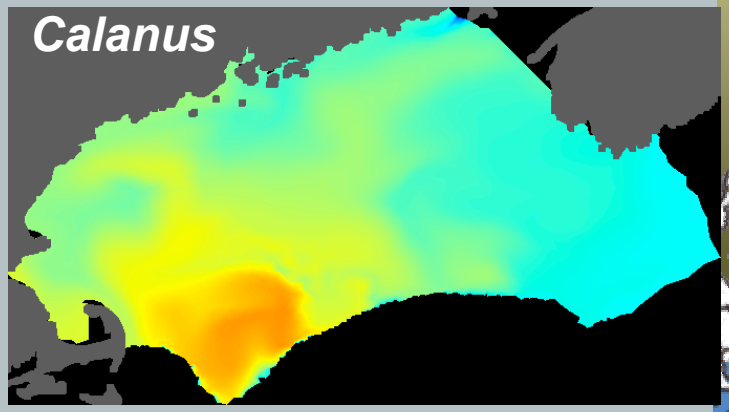

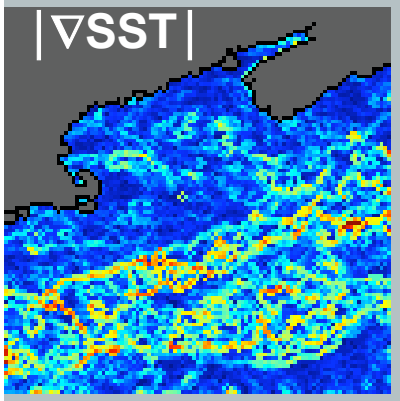

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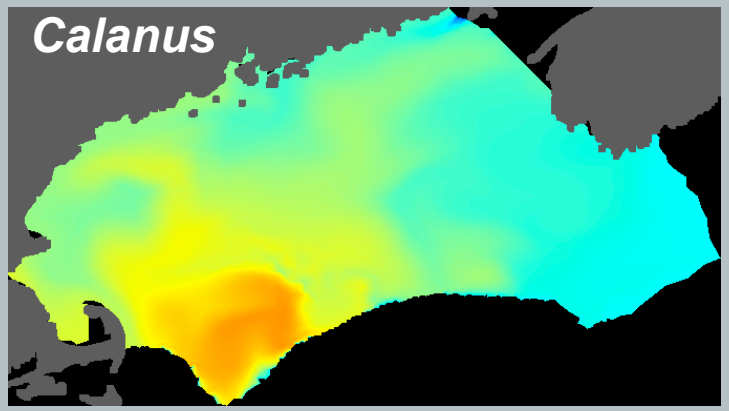

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Whale feeding areas

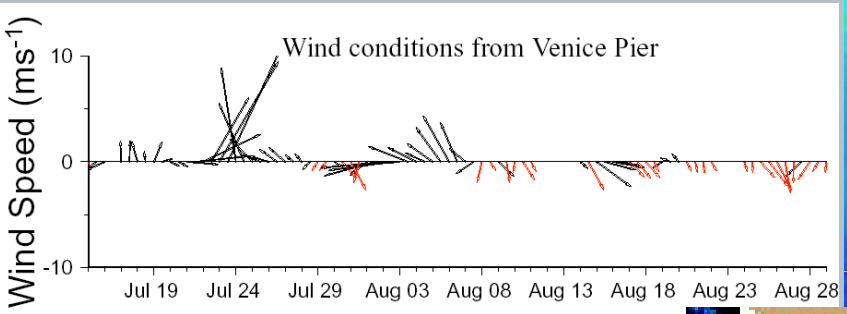
Biggest source of mortality to highly endangered (<400 left) Right Whales is ship strikes. Ability to predict their location will help NOAA minimize ship traffic in those regions.

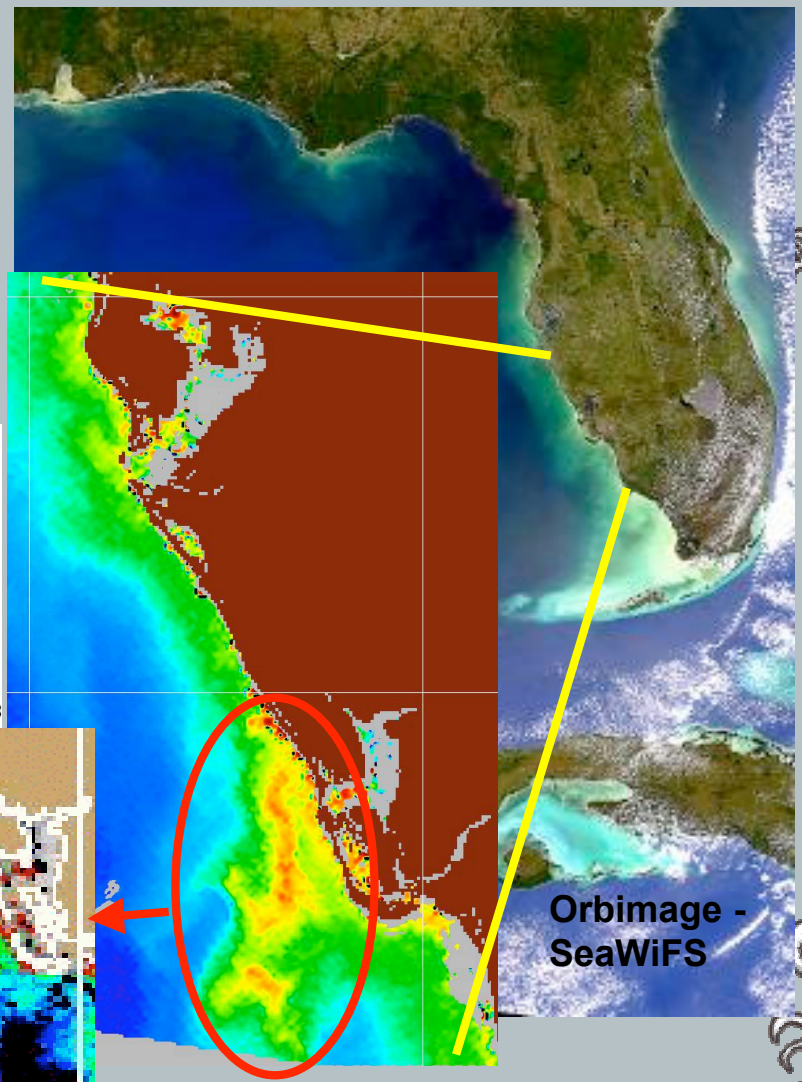
Pershing and Monger, Cornell University, funded by NOAA's Right Whale Grants Program
www.geo.cornell.edu/whales

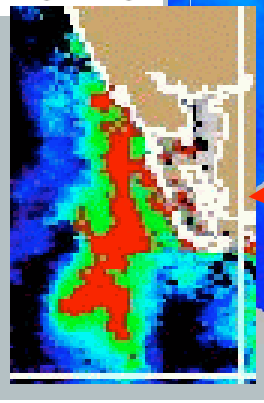
Harmful Algal Bloom (HAB) detection

NOAA National Ocean Service

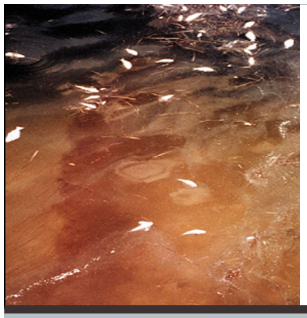
Operational Monitoring and Forecasting of HABs in the Gulf of Mexico







Courtesy of Rick Stumpf, NOS



Harmful Algal Bloom (HAB) detection

Distributed to Local/State/Federal Government

Page 1

Gulf of Mexico Harmful Algal Bloom Bulletin
21 September 2004
National Ocean Service/NCCOS and CSC
NESDIS/CoastWatch and NDBC
Last bulletin: September 17, 2004

Analysis

HAB Forecast:

No harmful algal blooms have been found along Florida's coast. Recent tropical storms have caused sediment resuspension and non-harmful blooms, which may cause discolored water.

Analysis:

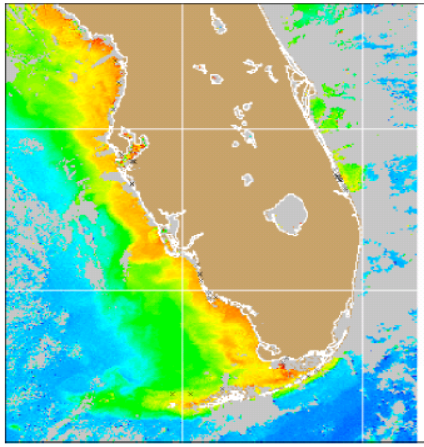
Samples taken last week from southwest Florida near Sarasota, Fort Meyers, and Naples showed no Karenia brevis. Imagery shows elevated chlorophyll along much of Florida's west coast: concentrations over 4 micrograms per liter off Cape San Blas and Cedar Key; over 5 micrograms per liter near Clearwater, Sarasota, Naples; and over 7 micrograms per liter Everglades City.

Winds have favored upwelling in southwest Florida for several days and are forecasted to continue for the rest of the week and through the weekend. These conditions are conducive to HAB formation, so this area should be monitored. Sampling here is recommended. Conditions in the panhandle don't favor HAB formation.

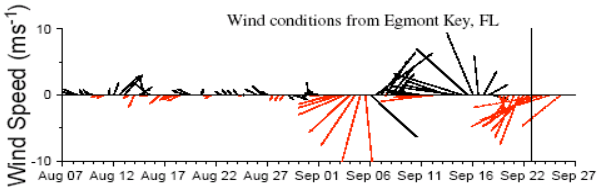
Bronder, Stolz

Please note the following restrictions on all SeaWiFS imagery derived from CoastWatch.

1. These data are restricted to civil marine applications only; i.e. federal, state, and local government use/distribution is permitted.
2. Distribution for military, or commercial purposes is NOT permitted.
3. There are restrictions on Internet/Web/public posting of these data.
4. Image products may be published in newspapers. Any other publishing arrangements must receive OrbImage approval via the CoastWatch Program.



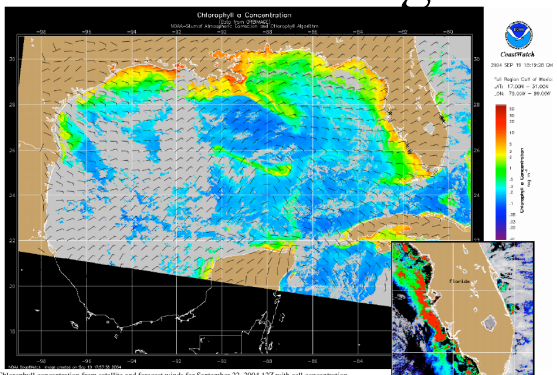
Chlorophyll concentration from satellite with possible HAB areas shown by red polygon(s). Cell concentration sampling data from September 12, 2004 shown as red squares (high), red triangles (medium), red diamonds (low b), red circles (low a), orange circles (very low b), yellow circles (very low a), green circles (present), and black "X" (not present).



Wind speed and direction are averaged over 12 hours from measurements made on buoys. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts.

Southwest Florida: Winds have been northeasterly for the past few days, and are forecasted to shift to easterly then northeasterly over the next couple of days. The NWS Marine Forecast calls for easterly winds until Thursday, then northeasterly winds over the weekend. Florida Panhandle: Winds have been northeasterly for the past few days and are forecasted to become easterly for the next couple of days.

Page 2



Chlorophyll concentration from satellite and forecast winds for September 22, 2004 12Z with cell concentration sampling data from September 12, 2004 shown as red squares (high), red triangles (medium), red diamonds (low b), red circles (low a), orange circles (very low b), yellow circles (very low a), green circles (present), and black "X" (not present).

Blooms shown in red (see p. 1 analysis and image for interpretation)

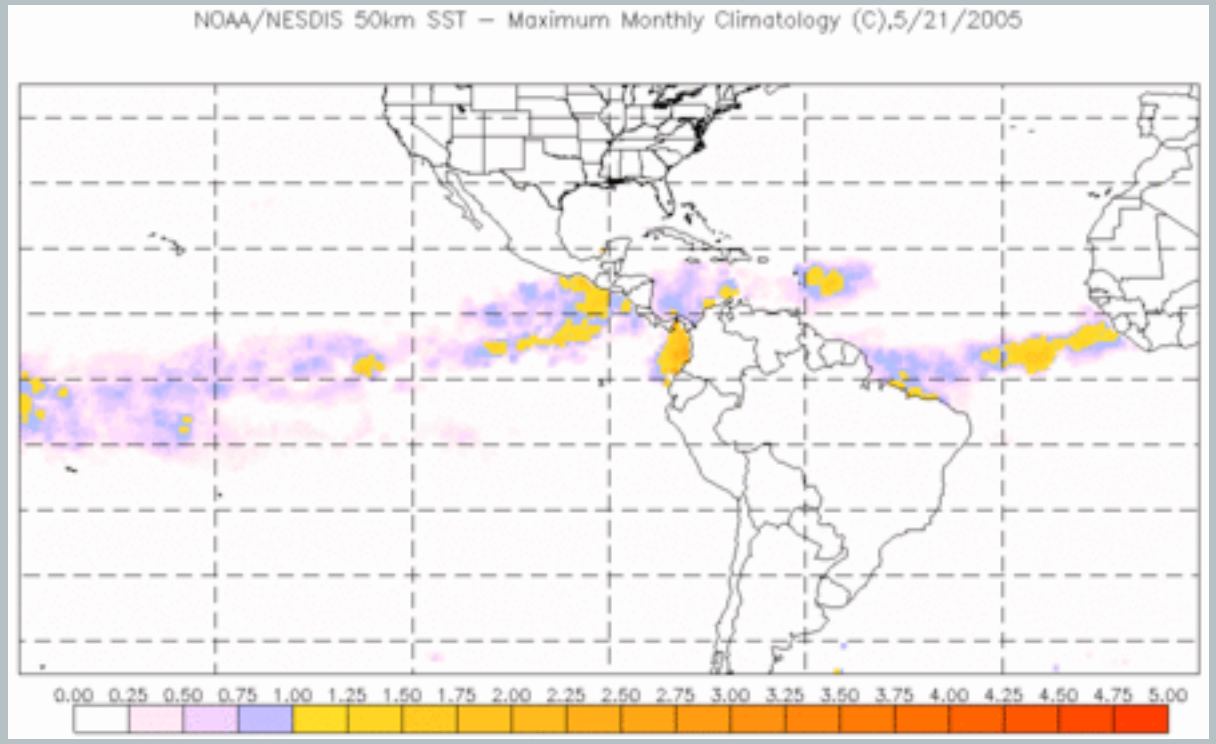
Courtesy of Rick Stumpf, NOS

Coral Bleaching

NOAA's Coral Reef Watch Satellite Bleaching Alert became operational July 2005

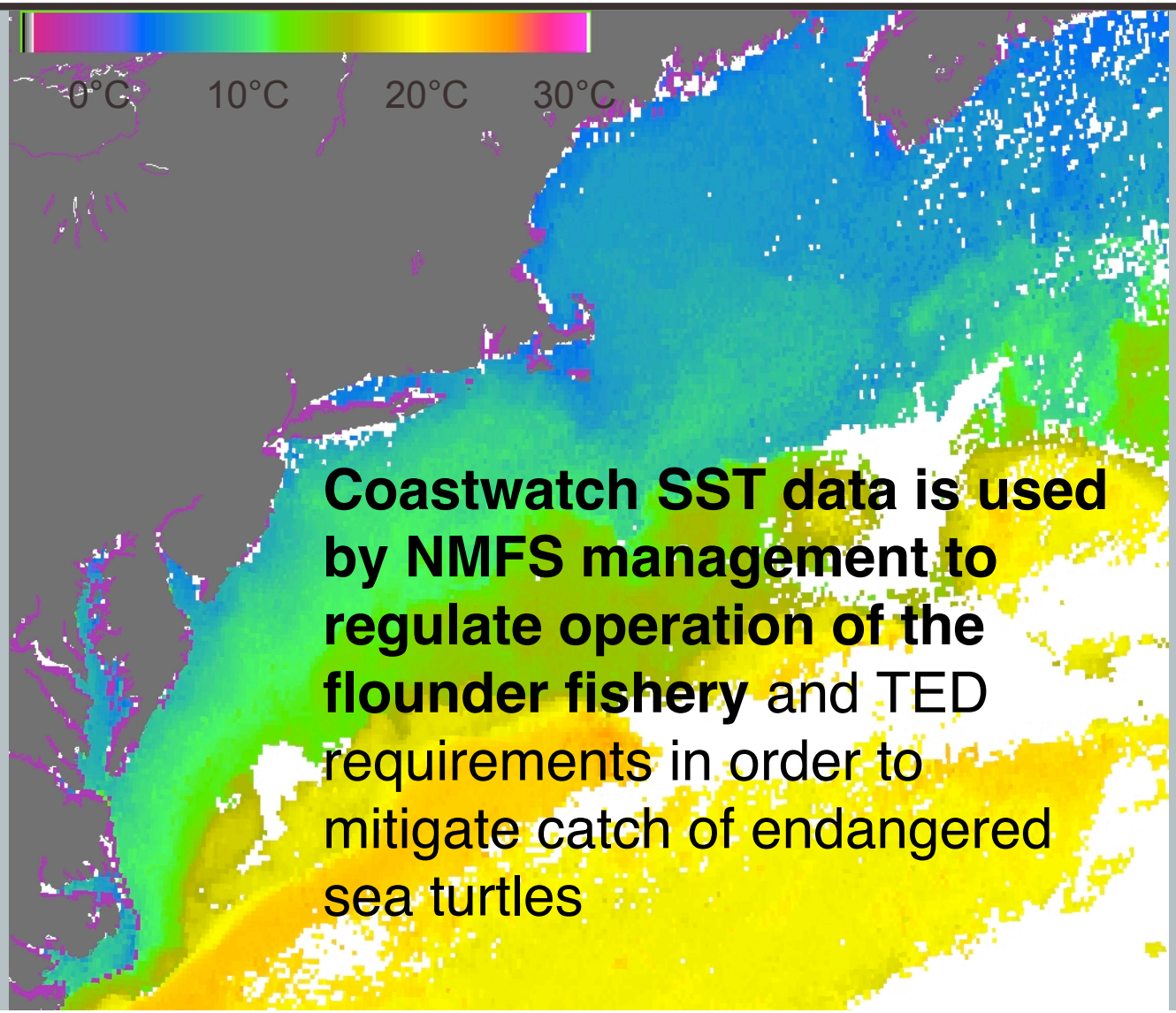
Hot Spots

5/21-7/19 2005



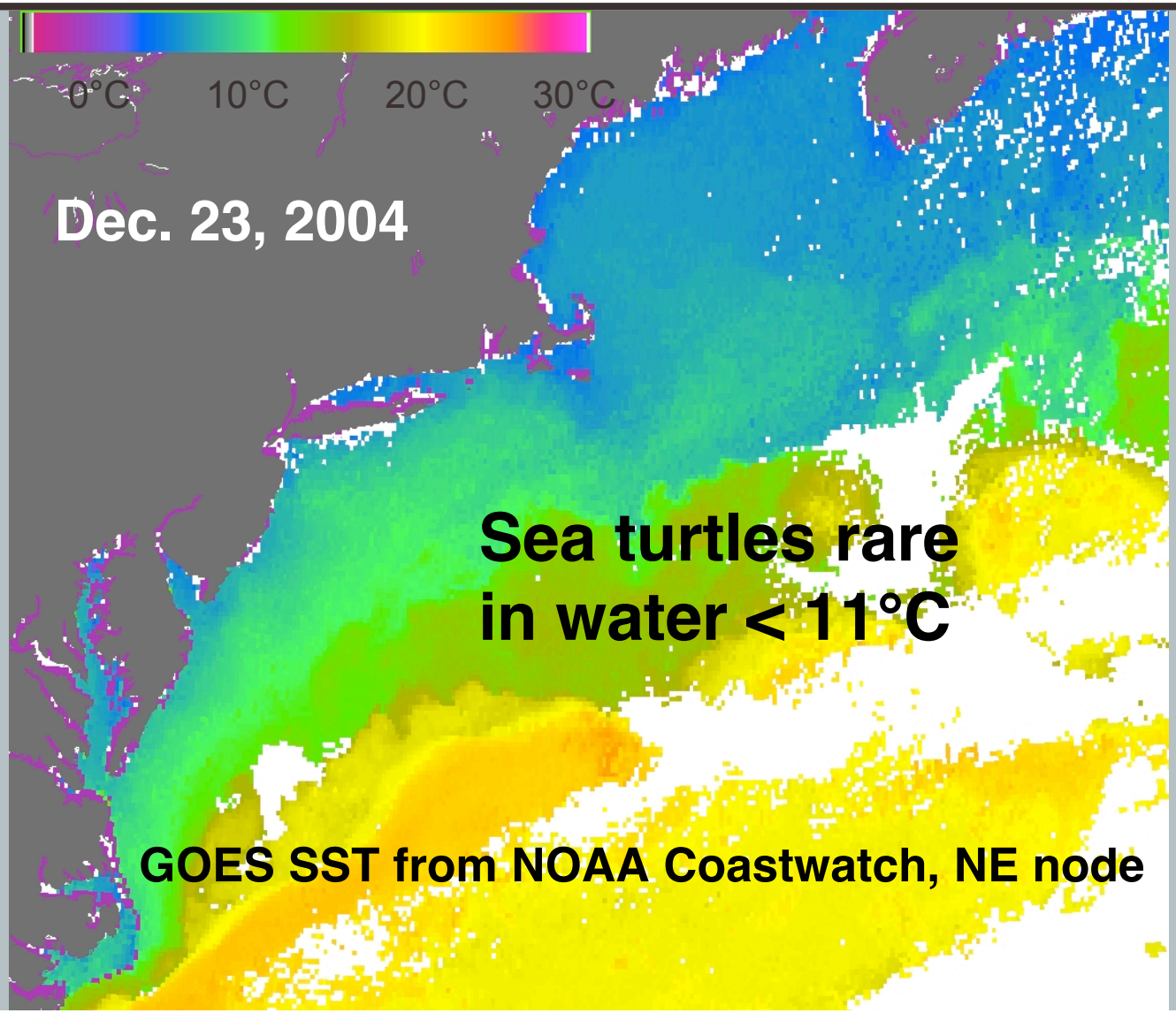
http://coralreefwatch.noaa.gov

Policy & Regulation

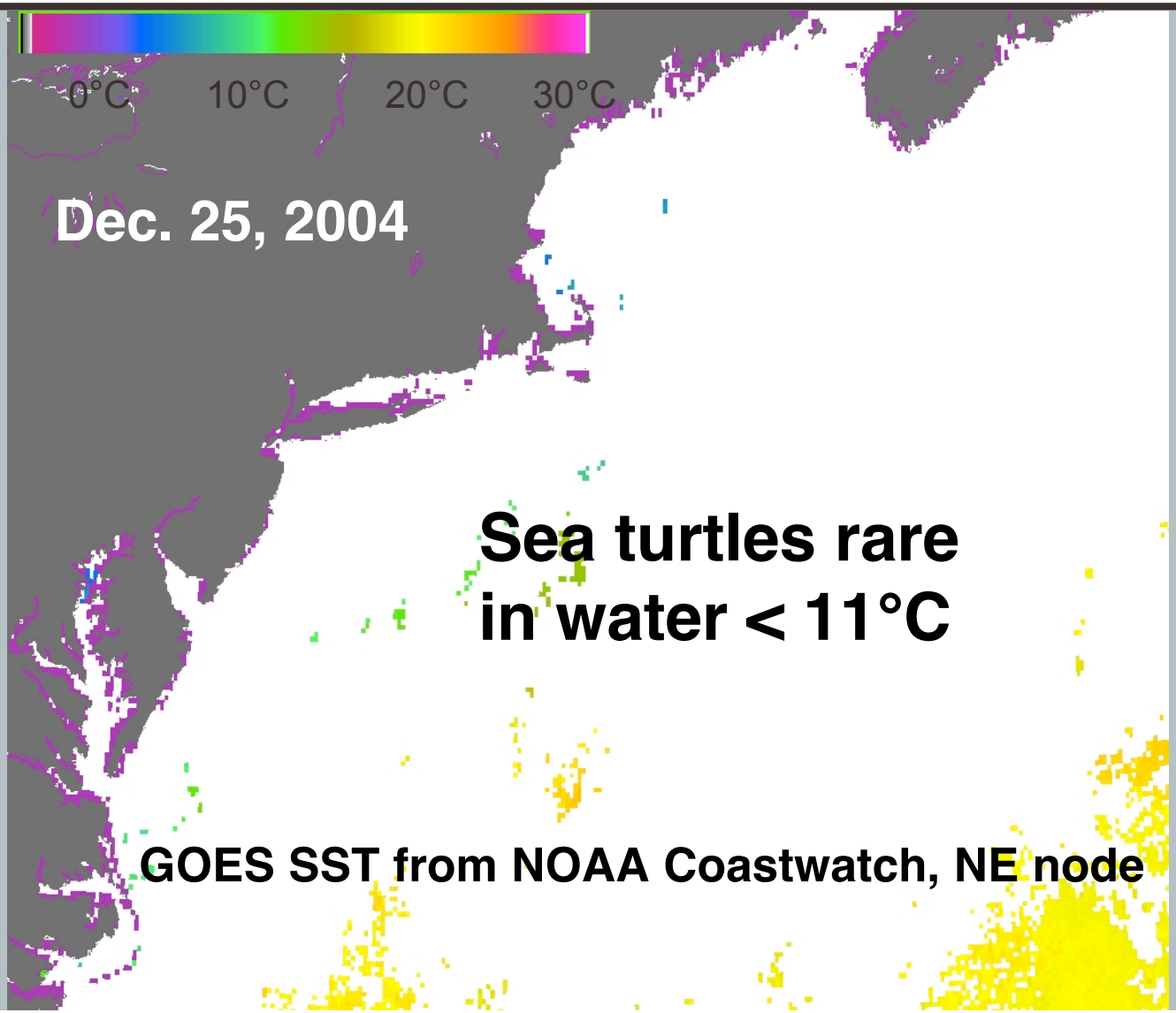


Coastwatch SST data is used by NMFS management to regulate operation of the flounder fishery and TED requirements in order to mitigate catch of endangered sea turtles

Policy & Regulation

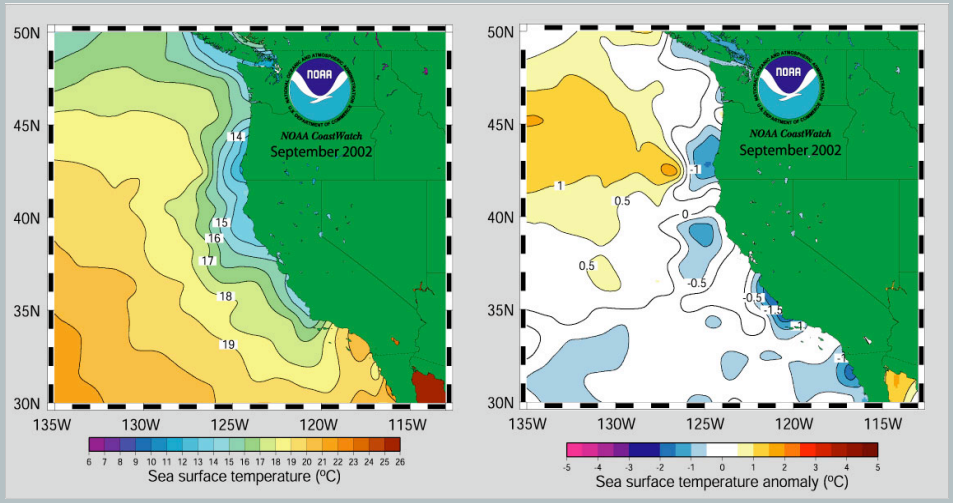


Policy & Regulation

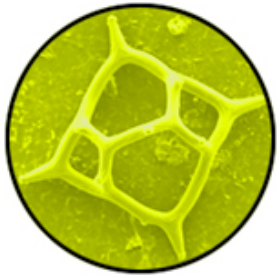


El Niño Watch

- Maintained by NOAA's West Coast CoastWatch node (SWFSC/ERD)
- Special SST data product prepared for NMFS SWR fishery managers, mandated for use in managing California fishery to mitigate turtle by-catch
- First use of satellite data in management of fisheries on the west coast

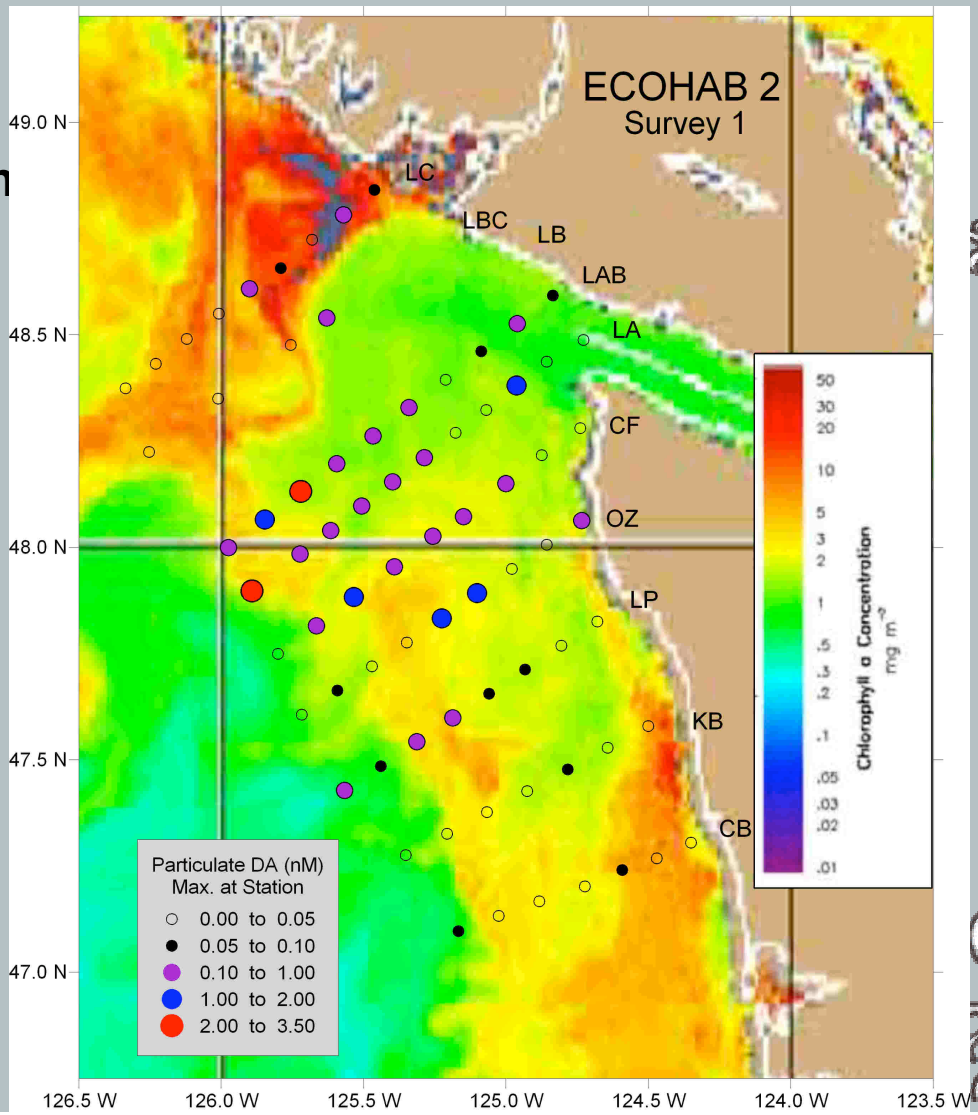


Cruise Support

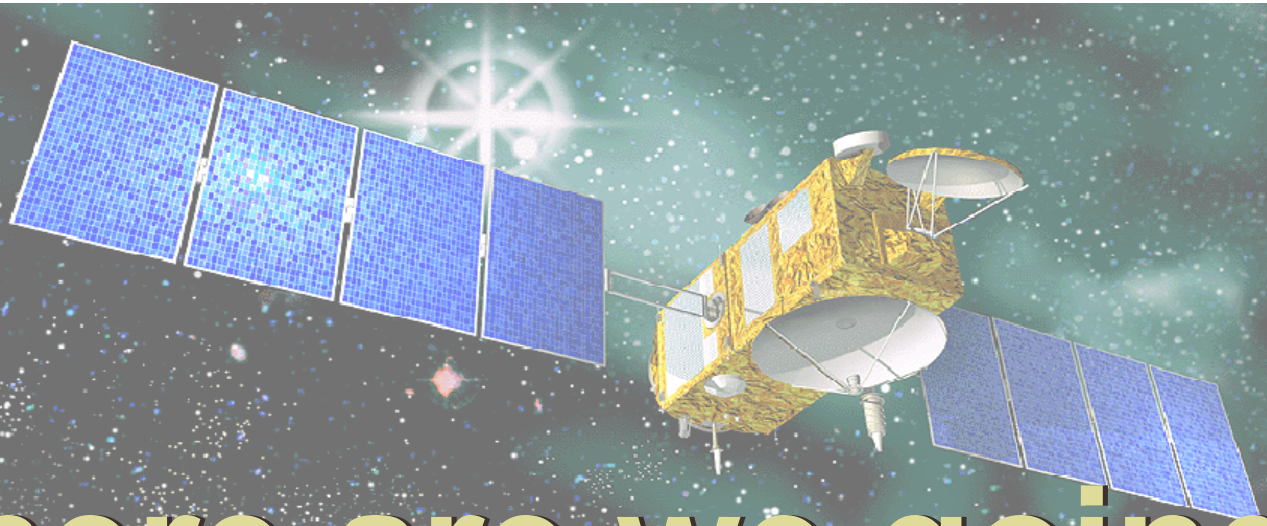


Domoic Acid levels (circles) measured during an ECOHAB survey, overlaid on top of satellite chlorophyll.

Satellite chlorophyll data is also crucial for monitoring development of harmful algal blooms (HABs).



From Vera Trainer
NOAA/NMFS/NWFSC



Where are we going?

NOAA's satellite R&O (Research & Operations) transition project and NOAA Fisheries

Where are we going?

- Over the next few years the capabilities provided by NASA ocean research satellites are to be transitioned into NOAA's operations:
  - Ocean Color
  - SSH
  - Sea Surface Winds
- Future ocean color satellites:
  - VIIRS on the NPP satellite in 2009
  - HES-CW on NOAA's GOES-R satellite in ~2012
- NMFS requirements for satellite data need to be articulated in these processes!

Senate language for NOAA in the FY05 Budget

- NOAA's mission is to fly operational satellites, but little of the sensor technology developed by NASA has been picked up by NOAA
- *"Provide NOAA the capability to transition NASA remote sensed ocean measurements into operational products for the user community"*
- Observations explicitly mentioned: *"ocean winds from* ***scatterometers****…sea level…from* ***altimeters****, and…****ocean color****"*
- Initially a one-year $4M level of effort in FY05, with no assurance for continuation, it was continued in FY06 at $4M

Research & Operations (R&O) Tiger Team

Membership:
Stan Wilson and John Pereira, leads, NESDIS
Cara Wilson and Kenric Osgood, NMFS
Rick Stumpf, NOS
Marie Colton and Eric Bayler, NESDIS/ORA
Dave Behringer, Fred Toepfer, Kevin Schrab and David Green, NWS
Mike Johnson, Tony Rosati and Ants Leetmaa, OAR

FY05 Objective:
Prepare an implementation plan that will utilize NASA research data to improve NOAA operational products and services, with clear deliverables in FY05

FY05 Accomplishment:
Identified 18 specific tasks to be accomplished, and established a timeline for their completion

FY06:
Tasks currently being developed

R&O FY05 Ocean Color Tasks

1. **Continue SeaWiFS for MODIS evaluation and VIIRS overlap**
   NOAA contributed funds for the renewed contract with OrbImage to continue free research access to SeaWiFS data
2. **Fix MODIS deficiencies in coastal waters**
   MODIS data could be crucial for providing a continuous ocean color timeseries between SeaWiFS and VIIRS
3. **Develop a more robust in-situ oceanic calibration capability**
   The MOBY calibration platform needs to be established as an operational component for satellite ocean color
4. **Make a more effective case for climate-quality ocean color**
   Workshop sponsored by CIOSS (OSU) Aug 11-12, 2005
5. **Facilitate access to multiple satellite data sets to meet fisheries & IOOS needs**
   Expand SWFSC's OceanWatch LAS to provide timeseries of satellite-derived primary productivity and to improve access to other satellite datasets

NMFS R&O FY05 Funded Project

Facilitate access to multiple satellite data sets to meet fisheries & IOOS needs

Three primary results:

- **Establishment of internal NMFS-satellite working group**
- **A series of informational seminars given at all 6 Fisheries Science Centers during the summer of 2005 (continued into 2006…)**
- **Provided access to global, satellite-derived primary productivity and geostrophic velocities via the live access server (LAS) and OPeNDAP technologies at SWFSC/ERD**

NMFS-Satellite group

- Satellite POCs for each science center (appointed by lab director)

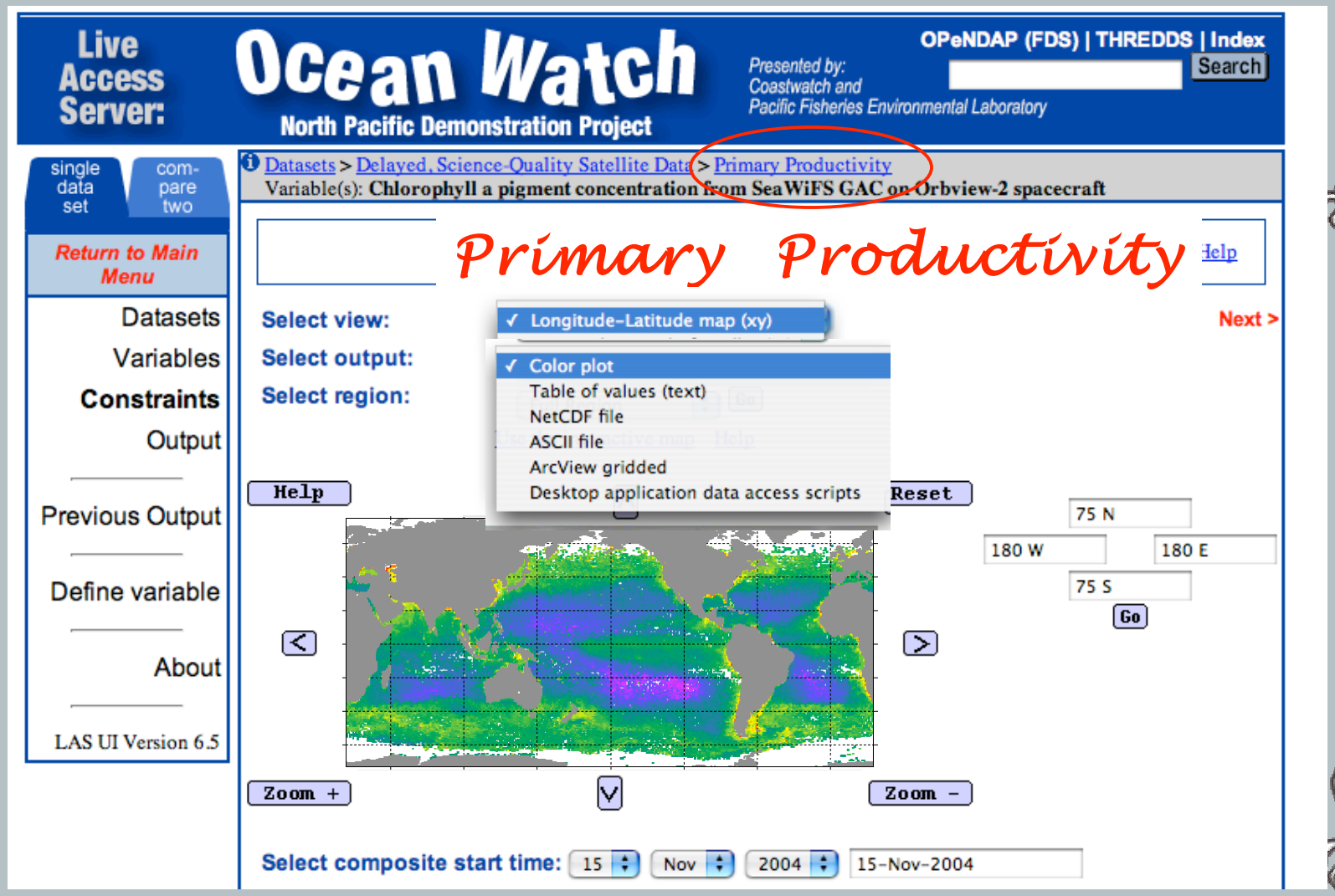
AFSC	Jeff Napp (Seattle)
NEFSC	Jay O'Reilly (Narragansett)
NWFSC	Bill Peterson (Newport)
PIFSC	Jeff Polovina (Honolulu)
SEFSC	Tom Leming (Mississippi)
SWFSC	Cara Wilson (Pacific Grove)
ST	Kenric Osgood (Silver Spring)

POC also a CoastWatch PI

Labs outside of the regional HQ laboratory

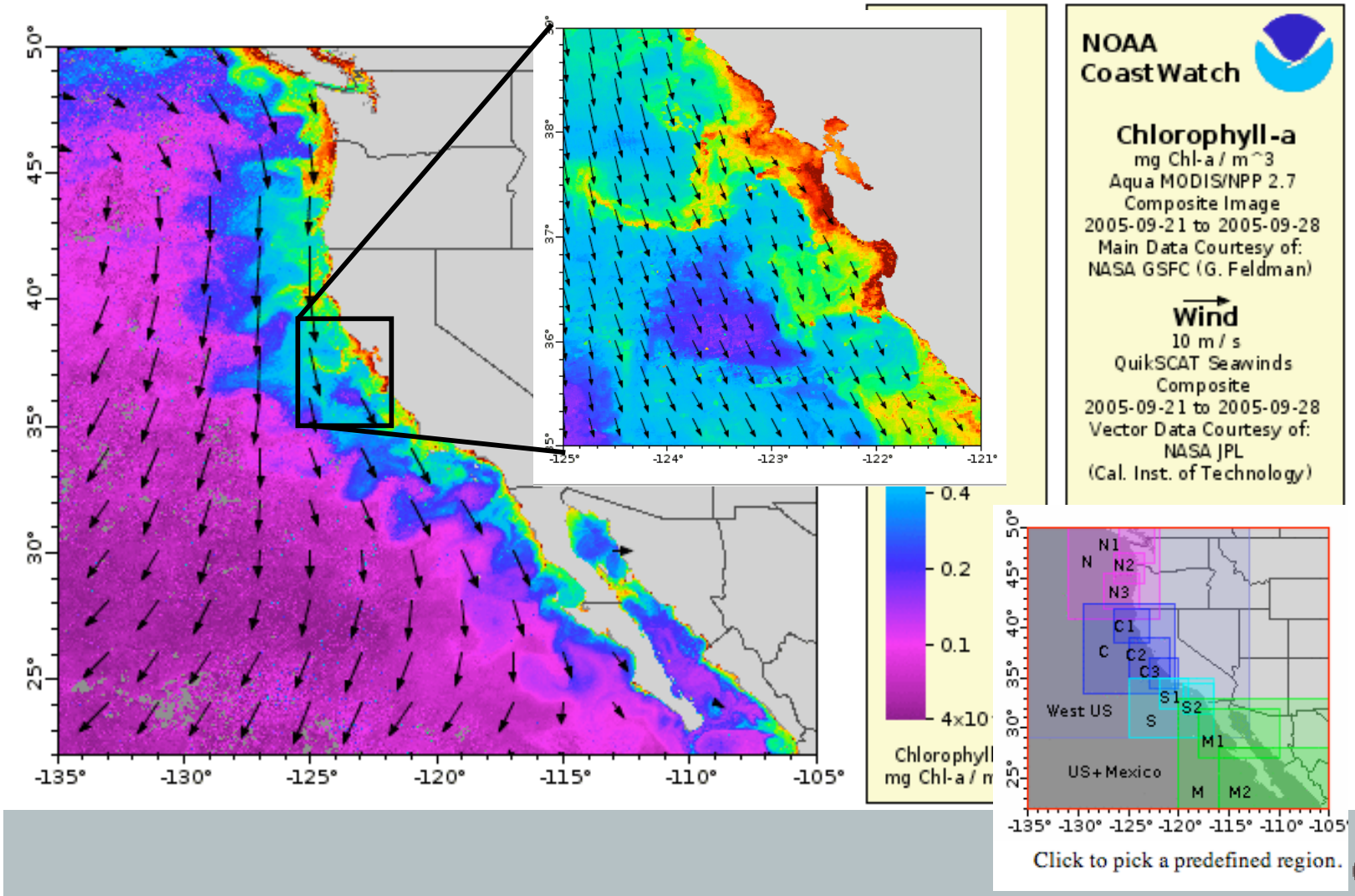
SWFSC OceanWatch LAS at ERD

http://oceanwatch.pfeg.noaa.gov



New CoastWatch Browser

http://coastwatch.pfel.noaa.gov/coastwatch/CWBrowser.jsp



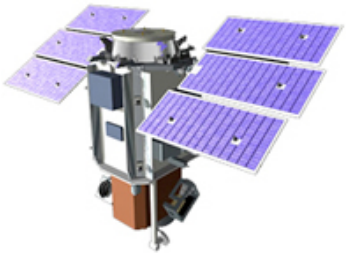
New Browser - Datasets

1. SST, 1 km
2. **SST, 11 km**
3. **ΔSST**
4. Pathfinder SST
5. GOES SST
6. NASA Aqua Chl-*a*
7. OSU Aqua Chl-*a*
8. SeaWiFS Chl-*a*
9. **Zonal Wind**
10. **Merid Wind**
11. **Div Wind**
12. **Mod Wind**
13. **Zonal Wind Stress**
14. **Merid Wind Stress**
15. **Mod Wind Stress**
16. **Stress Curl**
17. **Ekman Upwelling**
18. **Zonal Ekman**
19. **Merid Ekman**
20. **Mod Ekman**
21. Front Probability
22. Primary Productivity

Bolded datasets are all available by OPeNDAP

New Browser - File Formats

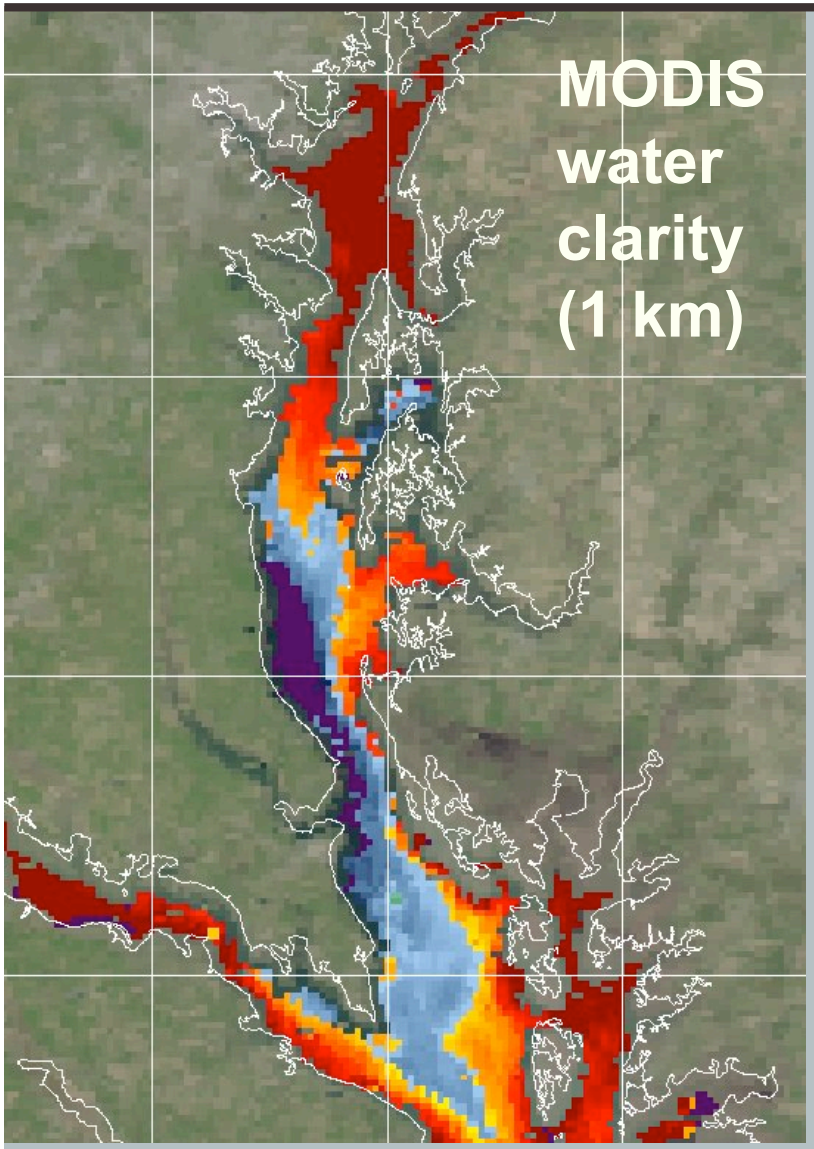
1. •**.asc** - ESRI ASCII grid file (portable into GIS)
2. •**.grd** - GMT .grd file, also a valid NetCDF file
3. •**.hdf** - Hierarchical Data Format file, works with the CoastWatch Data Analysis Tool (CDAT)
4. •**.mat** - Matlab binary file
5. •**.nc** - NetCDF binary file, compliant with COARDS, CF-1.0, THREDDS ACDD and CWHDF metadata specifications
6. •**.xyz** - tab-separated ASCII file
7. **OPeNDAP** access for most datasets
8. **FGDC** - .xml file with FGDC metadata

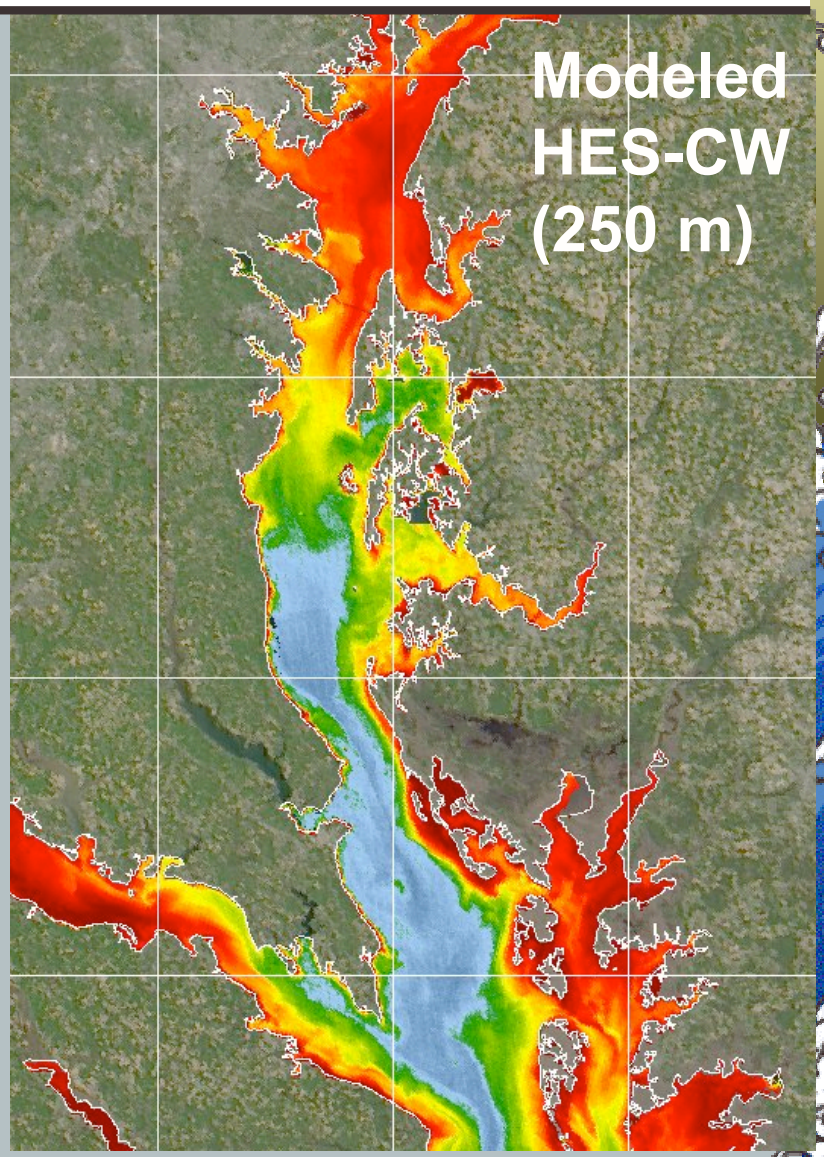


HES-CW on GOES-R

- Hyperspectral Environmental Suite with Coastal Water Imaging capability (HES-CW)
- Will be first ocean color sensor from geostationary orbit
- Sample all U.S. coastal waters (except Alaska) once every three hours (goal is hourly)
- 300 m spatial resolution at nadir; ~400-450 m in U.S. coastal waters
- 14 channels (visible & near IR), it could be hyperspectral
- Advanced Baseline Imager (ABI) could be used to selectively sample during cloud free periods
- A contractor will be selected to build HES in 2006
- GOES-R launch is planned for 2012

Spatial Resolution Comparison

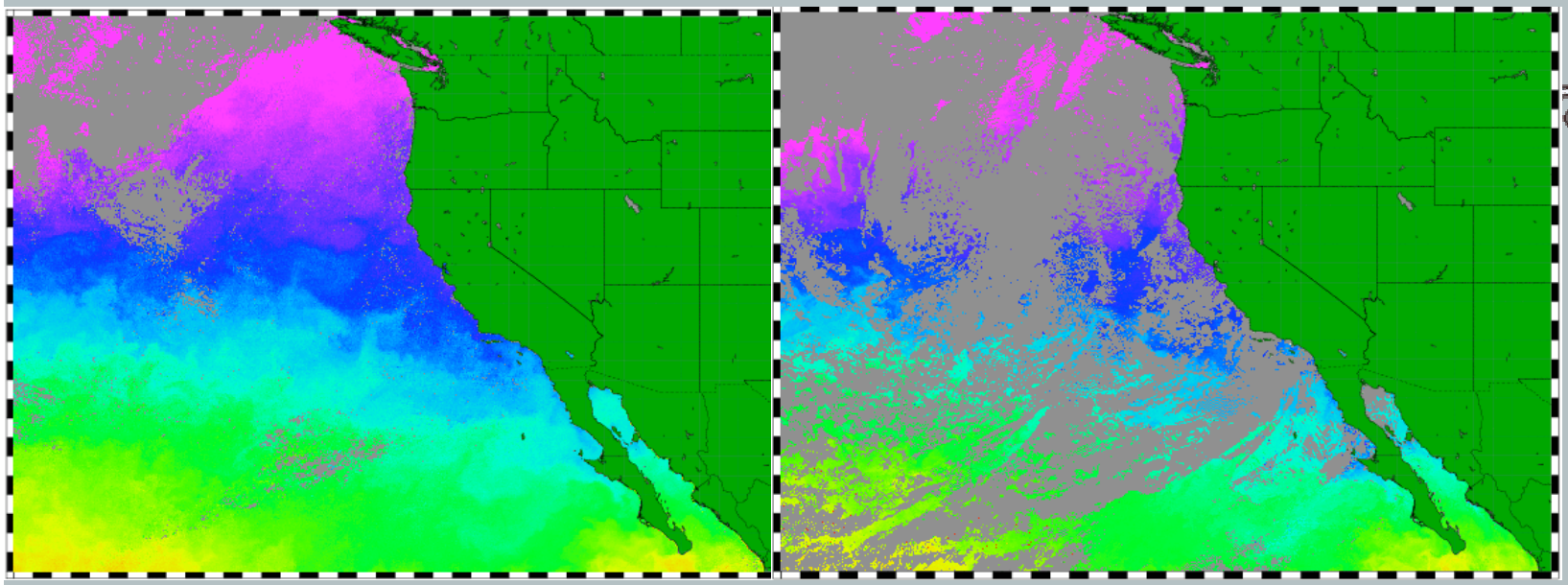




Courtesy of the GOES-R COAST team

Temporal Resolution Comparison

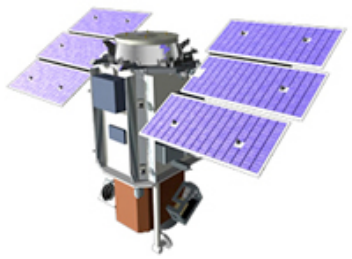
Increased temporal resolution will greatly increase data coverage in persistently cloudy areas



3 day composite of GOES SST

3 day composite of AVHRR SST

Image courtesy of NOAA CoastWatch, West Coast node at ERD



HES-CW on GOES-R

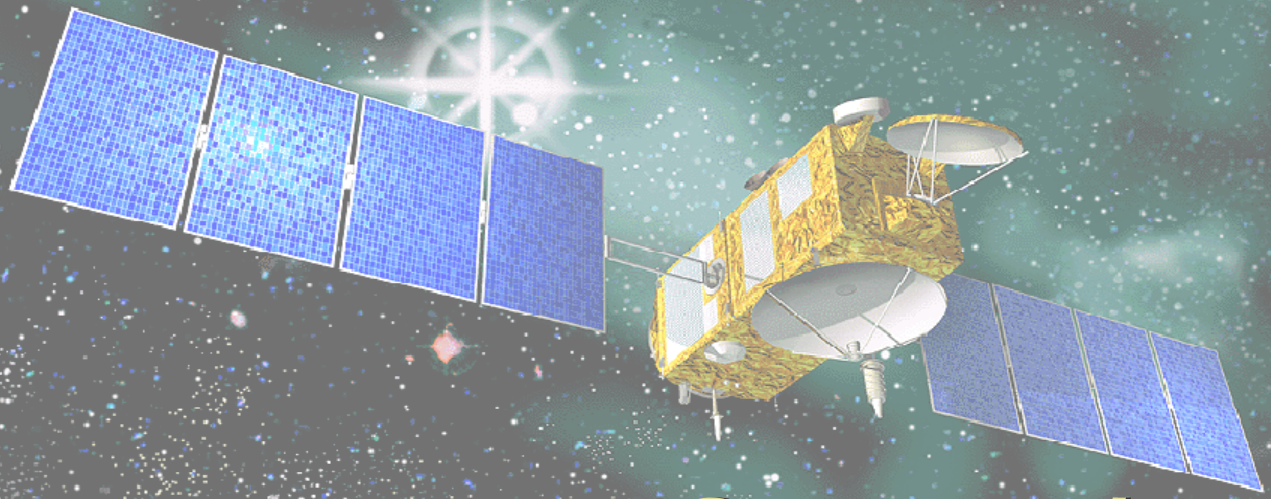
- The increased spatial and temporal resolution of the ocean color data from this sensor will greatly improve our ability to characterize and monitor coastal regions for better management of ecosystems and fisheries
- Strong support from the ocean community and from NMFS is needed to ensure that this sensor is included on the GOES-R satellite

The Bottom Line…

- NOAA will be taking over the operational acquisition of major satellite measurements such as SSH, ocean color and surface winds.
- In support of this, NOAA needs to demonstrate the ***operational use of these data*** within the agency.
- NMFS and NOS are the two NOAA LOs involved with the operational use of oceanic satellite data (ie non weather). **For the open ocean, NMFS is the only LO.**

Operational?…

- "Operational" in the context of fisheries has a different temporal scale than for other uses such as the weather service, HAB monitoring etc.
- Linkages between satellite data and ecosystems are complex, involving subsurface ocean dynamics and long-term climate variability. Understanding and monitoring these interactions requires continuous timeseries of high quality data.
- Near real time (NRT) satellite data is crucial for optimizing sampling on fisheries research cruises

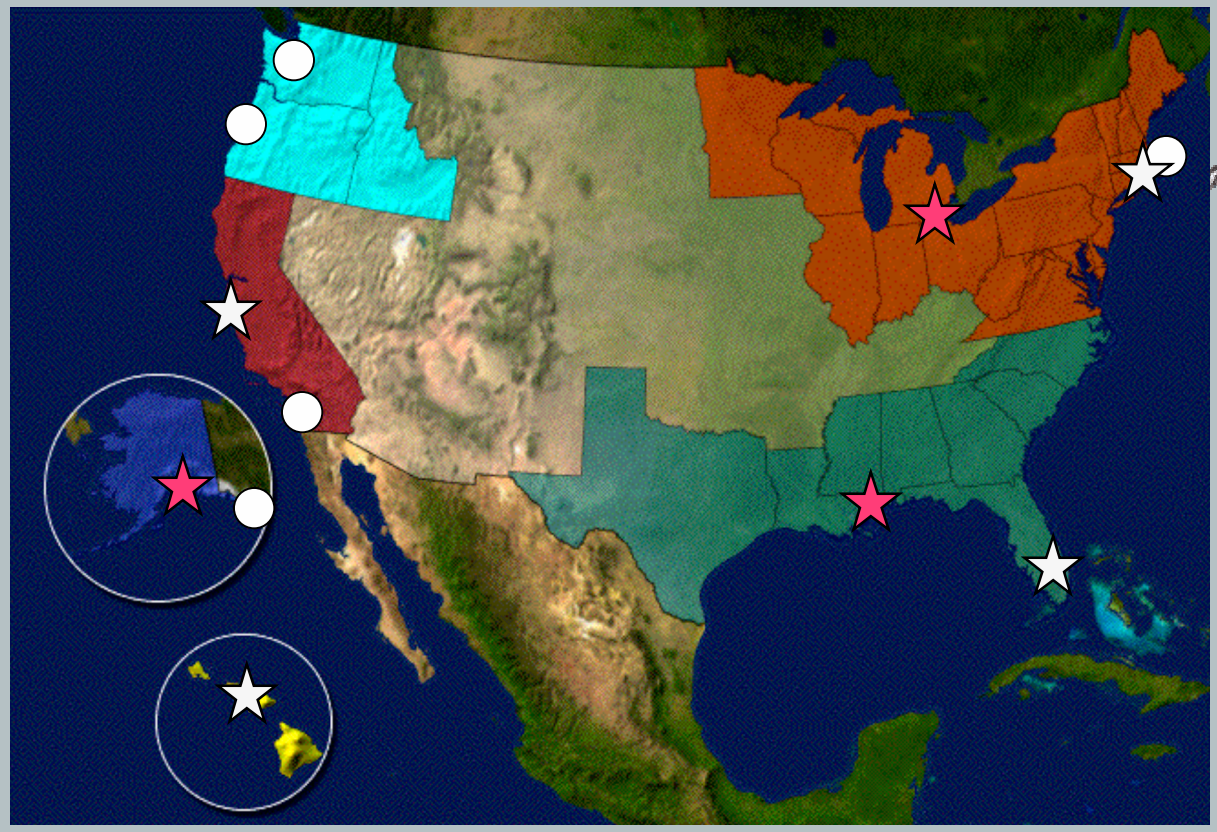


What does NMFS need/want?

Based largely on feedback from the summer 2005 NMFS "road tour", made possible by the R&O Project

NMFS Regions & CW nodes

- Northwest
- Southwest
- Alaska
- Northeast
- Southeast
- Pacific



- ☆ CoastWatch node (visited)
- ★ CoastWatch node (not visited)
- ○ NMFS lab visited (without a local CoastWatch node)

The NMFS 'Road Tour' Schedule

NOAA Fisheries and Satellite Data –
Where are we and where are we going?

Informational Seminar and visit at 8 NMFS labs:

AFSC	Seattle, WA	Jun 7, 2005
SWFSC	* La Jolla, CA	Jun 15, 2005
PIFSC	Honolulu, HI	July 18, 2005
SEFSC	* Miami, FL	July 26, 2005
NEFSC	Narragansett, RI	Aug 2, 2005
NWFSC	Newport, OR	Aug 16, 2005
AFSC	* Juneau, AK	Jan 31, 2006
NEFSC	* Woods Hole, MA	Mar 10, 2006

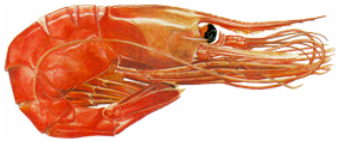
* NMFS Satellite POC not at this lab

Participation

	Total	SDU*	SA*
AFSC, Seattle	~20	?	?
AFSC, Juneau	~25	3	1
SWFSC, La Jolla	~30	6	~2
PIFSC, Honolulu	~25	4	3
SEFSC, Miami	~15	5	0
NEFSC, Narragansett	~12	6	1
NEFSC, Woods Hole	~20	5	6
NWFSC, Newport	~35	5	1

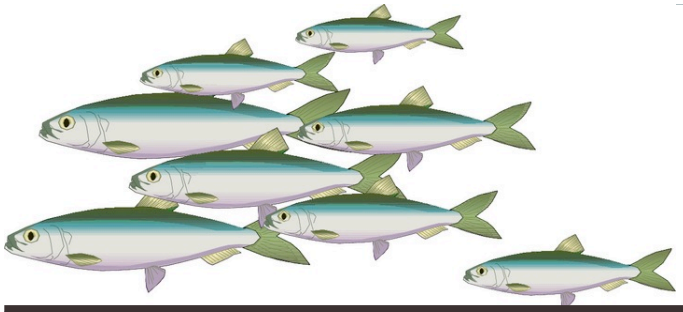
*SDU - Satellite Data Users
*SA - Involved with Stock Assessment

Interest



	Total	one-on-one talks*
AFSC, Seattle	~20	2 (both non-NMFS: PMEL)
AFSC, Juneau	~25	2
SWFSC, La Jolla	~30	2
PIFSC, Honolulu	~25	0
SEFSC, Miami	~15	5 (2 non-NMFS: AOML)
NEFSC, Narragansett	~12	11
NEFSC, Woods Hole	~20	3
NWFSC, Newport	~30	3

* Aside from discussions with local host

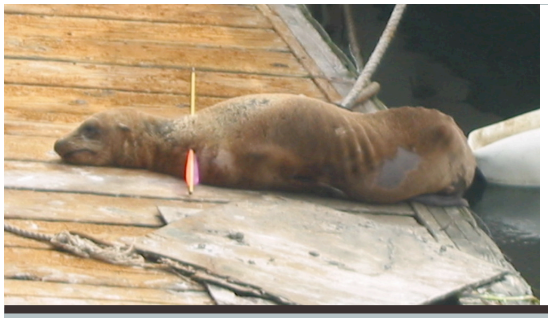


Gap Analysis

- NMFS's primary responsibility, stock assessment, has remained largely outside of these discussions.
- I will be attending the National Stock Assessment Workshop in April 2006 and giving a presentation on satellite data

Sea Ice

- Where does Sea Ice data fit in?
- Is its continuity assured?
- Of critical use at AFSC and SWFSC/Antarctic Research Division.

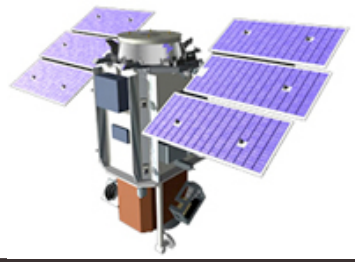


NOAA/OLE Enforcement

Satellite-based Vessel Monitoring System (VMS)

There is definite interest within NMFS in utilizing VMS data from OLE (Office of Law Enforcement) to track movements of stock populations, but this data can be difficult, if not impossible, to access.

So much for “one NOAA”….

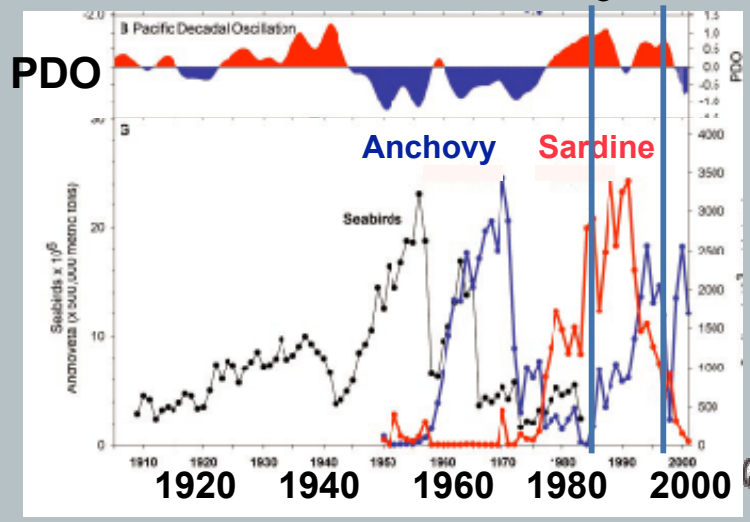


Satellite Telemetry

- Is it possible to have a dedicated channel of NOAA's polar orbiting satellites that could transmit environmental data from pop-up satellite archival tags (pSAT)?
- ARGOS system is not designed to transmit the amount of data recorded on pSATs. Currently only about 5% of the data recorded is actually transmitted, meaning 95% of the environmental data recorded is lost.
- This data is vital to understanding stocks as it is:
  - fishery independent data
  - provides information about subsurface habitat

Time Series

- Many scientists within NMFS have datasets spanning many decades, and there is significant decadal variability affecting different fish populations.
- Subsequently it can be difficult to impress fisheries scientists of the benefits of using satellite data when their time spans are relatively short.
- It's essential that climate quality records of satellite data be maintained!



Chavez et al. [Science, 2003]

Better Resolution with GOES-R…

A direct quote responding to the question of what benefits might be expected from the resolution of data from the GOES-R HES-CW:

"Better resolution increases storage constraints, so while better resolution would be useful for select areas where intensive high research is underway, *a global high res dataset would require a great deal more resources to manage… and I am not sure how useful this would be to marine researchers.*"

Meaning ?!?!…..

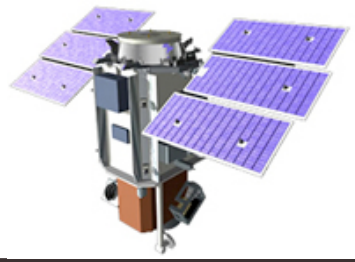
Better Resolution with GOES-R…

Meaning –

We are currently doing an inadequate job of supplying user-friendly means of:

- **ACCESS,**
- **MANIPULATION, and**
- **DELIVERY of satellite data**

To maximize the utility (and use in an 'operational' sense) of satellite data in cross-cutting applications we need to have an efficient system for users to access, manipulate and obtain satellite data, both real-time and science-quality climate data records.



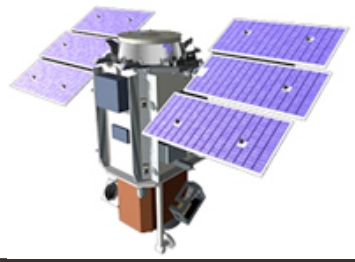
Resources

- A lot of potential applications of satellite data to fisheries requires directed work. Not enough to just point fisheries scientists to the data. The most fruitful developments come out of collaborations between satellite-oriented scientists and fisheries-oriented scientists.
- Many fisheries scientists do not have the computational power to hold and process large volumes of satellite data. Data delivery systems need to take this into account, and allow for flexible subsetting, both spatiallally and temporally.
- Bandwidth power is a serious issue at some labs. There are scientists who *download satellite data at home using a personal DSL line because their NOAA network at work is insufficient.*

What Resource Managers want

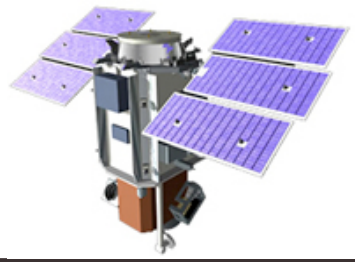
- High Quality datasets
- Temporal and spatial resolution commensurate with management activities and ecosystem dynamics
- Long, consistent, time series
- Flexible, easy access to data (OPenDAP, LAS, CWBrowser etc...)
- Multiple file formats
- “One-stop shopping” for multiple datasets

Why the Pathfinder SST product is so valuable!



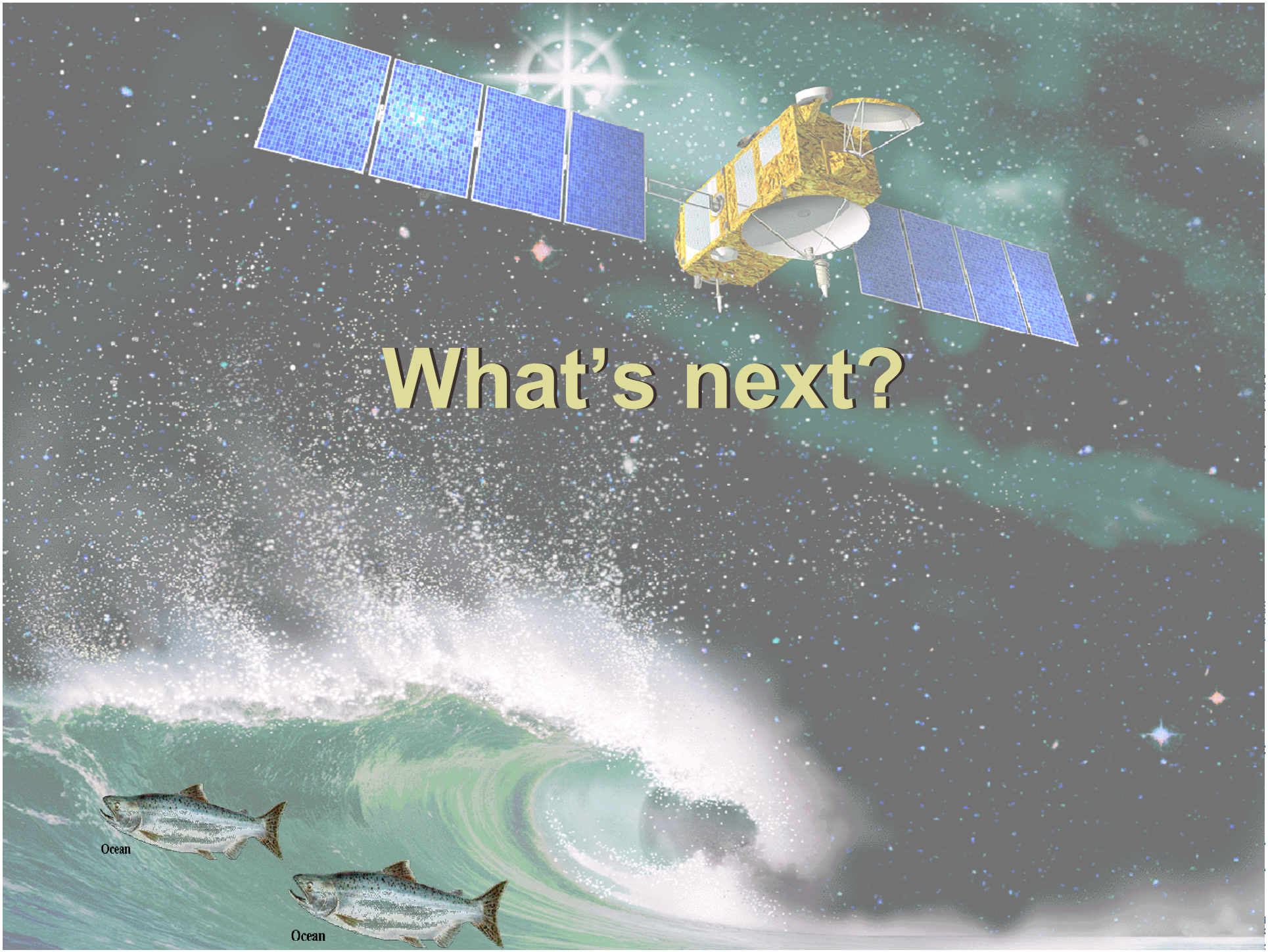
Specific Products/Requests

- Sea Ice
- Primary Productivity
- Frontal products
- Subsurface parameters
- VMS (Vessel Monitoring System) OLE data
- Better transmission for satellite archival tags



Summary

- The high spatial and temporal resolution of satellite data makes it an important tool to characterize and monitor marine ecosystems as part of an ecosystem based approach to fisheries management.
- Maintaining high quality climate data records (CDRs) of satellite data is crucial to understand interannual variability in fish stocks and living marine resources
- While satellite data is used in a wide variety of applications with NMFS, satellite data is underutilized and underappreciated within NMFS. Better systems to access and utilize satellite data, and resources to help scientists take advantage of the available data, are needed to see the full potential of satellite data.

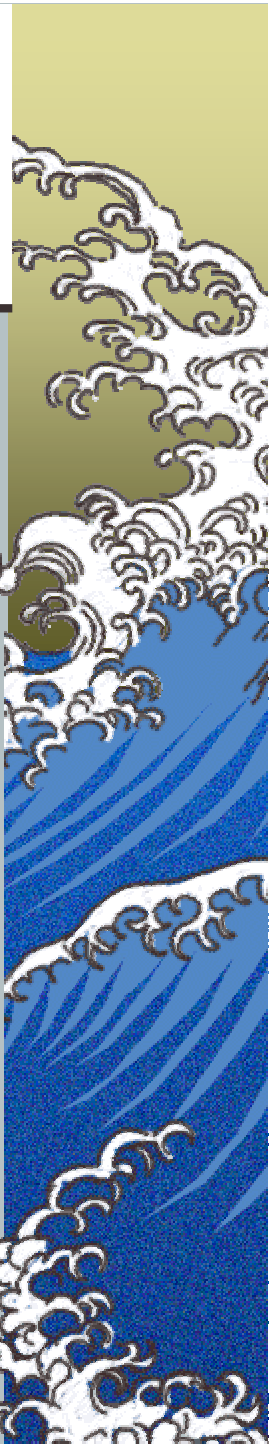

What's next?
Ocean
Ocean

R&O FY06 Projects

The R&O tiger team is currently discussing projects for FY06. Important objectives are:

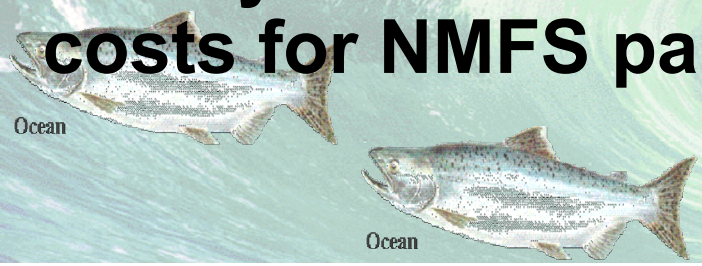
- Strengthen the usage and visibility of satellite data within NMFS, specifically **SSH, vector winds** and **ocean color**.
- Develop better **advocacy**, both inside and outside of NOAA for satellite data

The NMFS project will continue along the lines of the FY05 project, working towards improving easy access to satellite data.



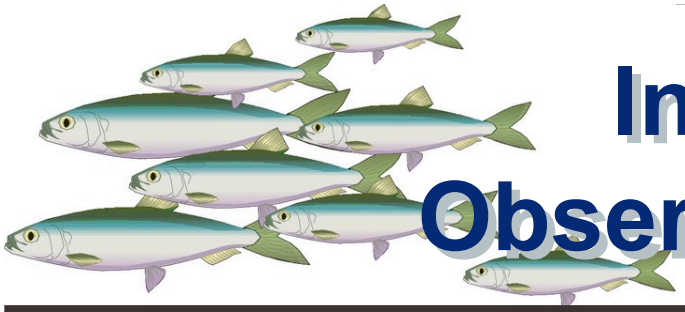
Upcoming Workshop

- NASA/NOAA invitational workshop on applications of satellite data in ecosystem management and modeling, as used by NOAA Fisheries
- 40-50 participants, including NASA, NMFS, NESDIS, NOS
- May 3-5 2006 at MBARI
- Money from NOAA's R&O project to cover travel costs for NMFS participants



Summer Class in Satellite Data

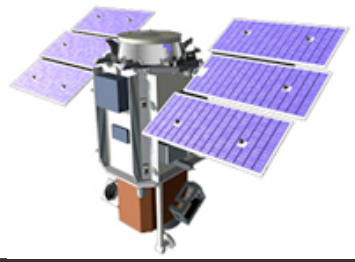
- 2-week course aimed at giving biological oceanographers and marine biologists the skills needed to effectively work with satellite data.
- At Cornell University June 2-16, taught by Bruce Monger
- R&O funds will sponsor 4 scholarships for NMFS participants to attend this training
- So far 12 people within NMFS have expressed interest (PIFSC: 5, SEFSC:4, SWFSC:1, NEFSC:2)
- More information on the class can be found on the website: www.geo.cornell.edu/ocean/RS_course



Integrated Ocean Observing System (IOOS)

- The IOOS development plan identifies a number of core ocean variables, many of which are directly derivable from current remote sensing missions:
  - Temperature
  - Ocean color
  - Sea level
  - Surface waves
  - Surface currents
  - Ice distribution

- NOAA's CoastWatch has been identified in the IOOS development plan as an operational part of the national backbone



Feedback….

- Are their applications that I missed, or that I should know more about?
- What future satellite data or products would you like to see developed?
- What could be done to make satellite data more accessible and/or useful?
- What benefits do you anticipate from the increased spatial and temporal resolution of future satellite sensors?

Please feel free to contact me at cara.wilson@noaa.gov

Thank you…