



# An Ocean Briefing

**Dr. John T. Everett**  
*President*

**Ocean Associates, Inc.**  
<http://www.OceanAssoc.com>

# Purpose of Discussion

**To complement the study of geophysical properties of the oceans with considerations of the importance of information about the properties to society, the tools used to gather that information and how decisions are made using that information.**

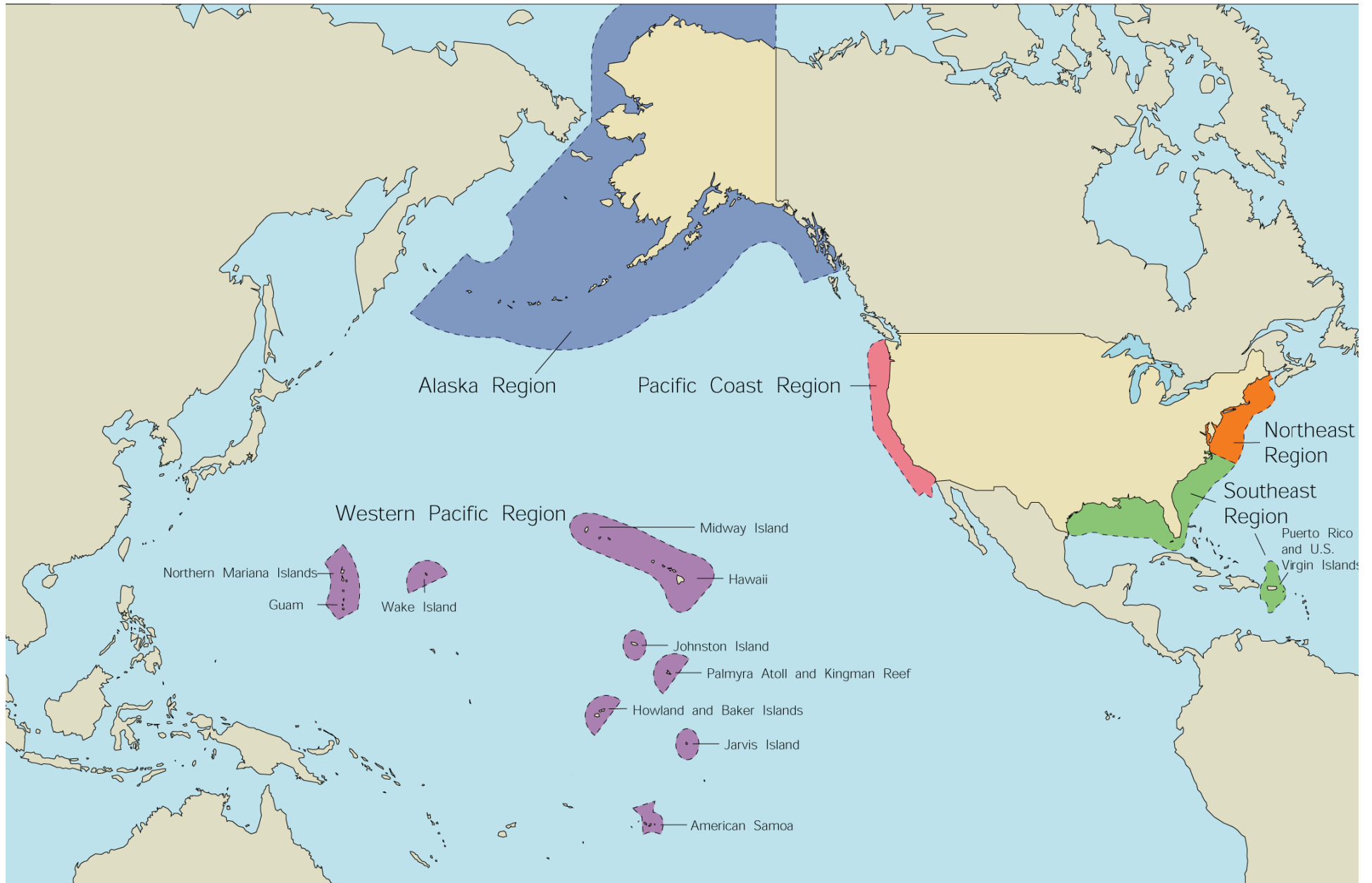
# About the Ocean

- **Half of Americans live and work within 50 miles of the coast**
- **Coastal areas are only 11 percent of our land**
- **An acre of coastal waters or wetlands can produce more food than the best farm land**
- **Commercial and recreational fisheries support more than 1.3 million jobs, and add more than \$20 billion to the economy**
- **80 % of ocean pollution comes from the land**
- **Coastal tourism provides 28 million jobs**

# Functions of Oceans

- **Climate Regulator**
- **Resources and Products**
  - fish and shellfish, marine mammals, and seaweeds
  - petroleum, sand and gravel, sulfur, hot brines, manganese nodules, and polymetallic sulfides
  - include water and unconventional energy resources
- **Waste Reception and Recycling**
- **Recreation and Tourism**
- **Transportation**

# The United States EEZ



# Study Topics

- **Currents & Upwelling**
- **Winds**
- **Waves**
- **Stratification**
- **Sea Level Rise**
- **Ice Cover**
- **Ocean Climate Oscillations**
- **Sea Floor**
- **Climate Change**

# Research Tools

- **Research Vessels**
- **Laboratories and Equipment**
- **Satellite Remote Sensing**
- **Computers**
- **People**
- **Partners**
- **Money**



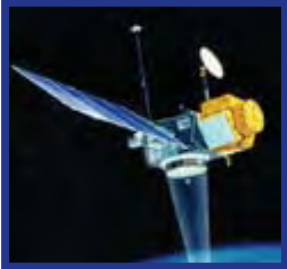
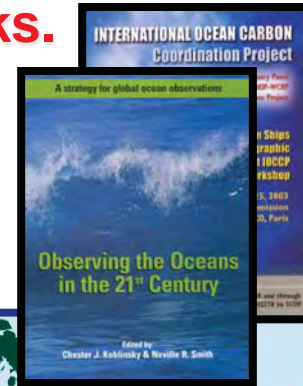
# Getting the Information



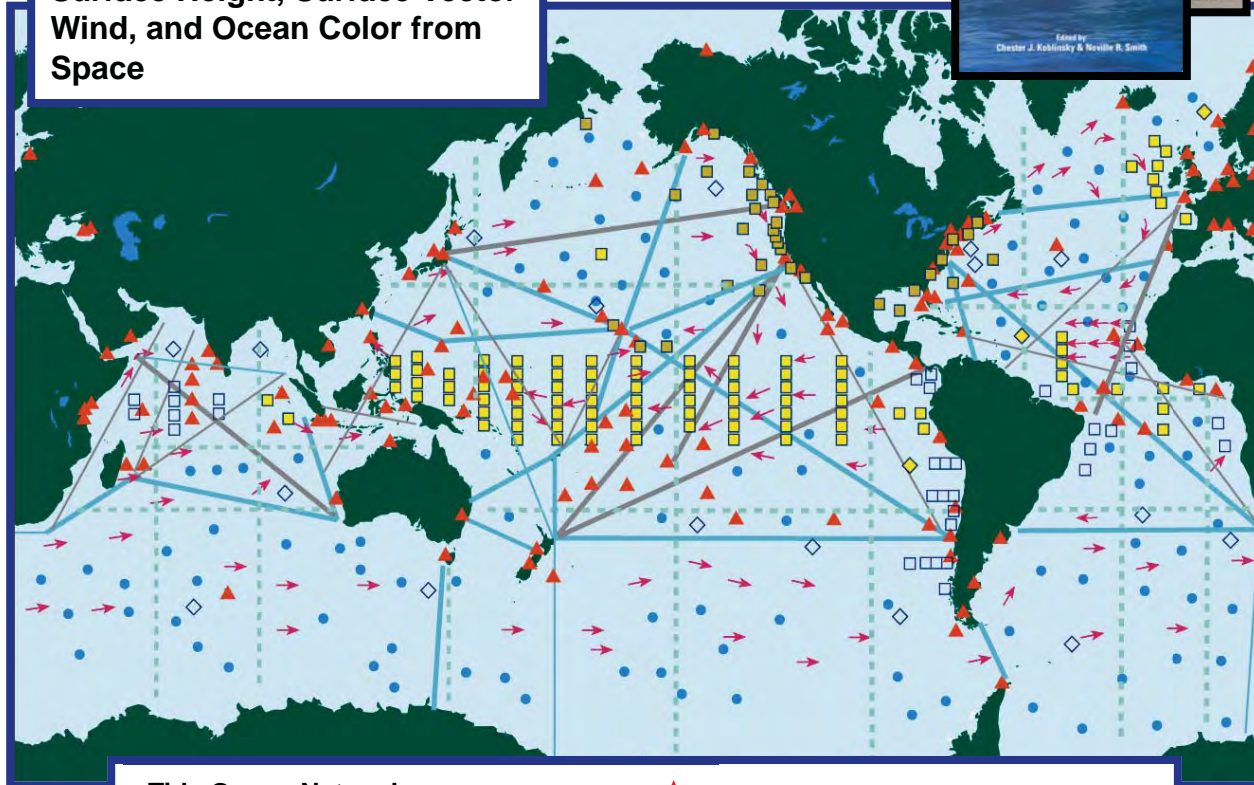
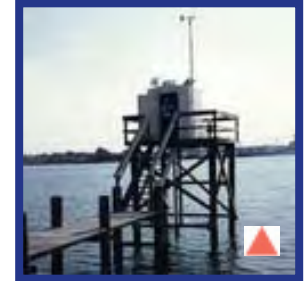
- **Surveys with research vessels**
  - Trawls, long lines, pots, gill nets, sonar
  - STDs, XBTs, bongo nets, met sensors
  - RPVs, UORs, subs, magnetometers
- **Surveys with aircraft**
  - LIDAR, observation, photo
- **Catch statistics, creel census**
- **Ships and Aircraft of Opportunity**
  - Temp, met. obs, UOR
- **Satellites**
  - radar, visual, IR, gravity, data relay, SAR, tracking
- **Fixed sites, Buoys, Drifters**
  - radar, temp, chemistry, height, current speed



# A System of Complementary Networks. Initial Design. It will Evolve. Now ~50% complete.



Sea Surface Temperature, Sea Surface Height, Surface Vector Wind, and Ocean Color from Space



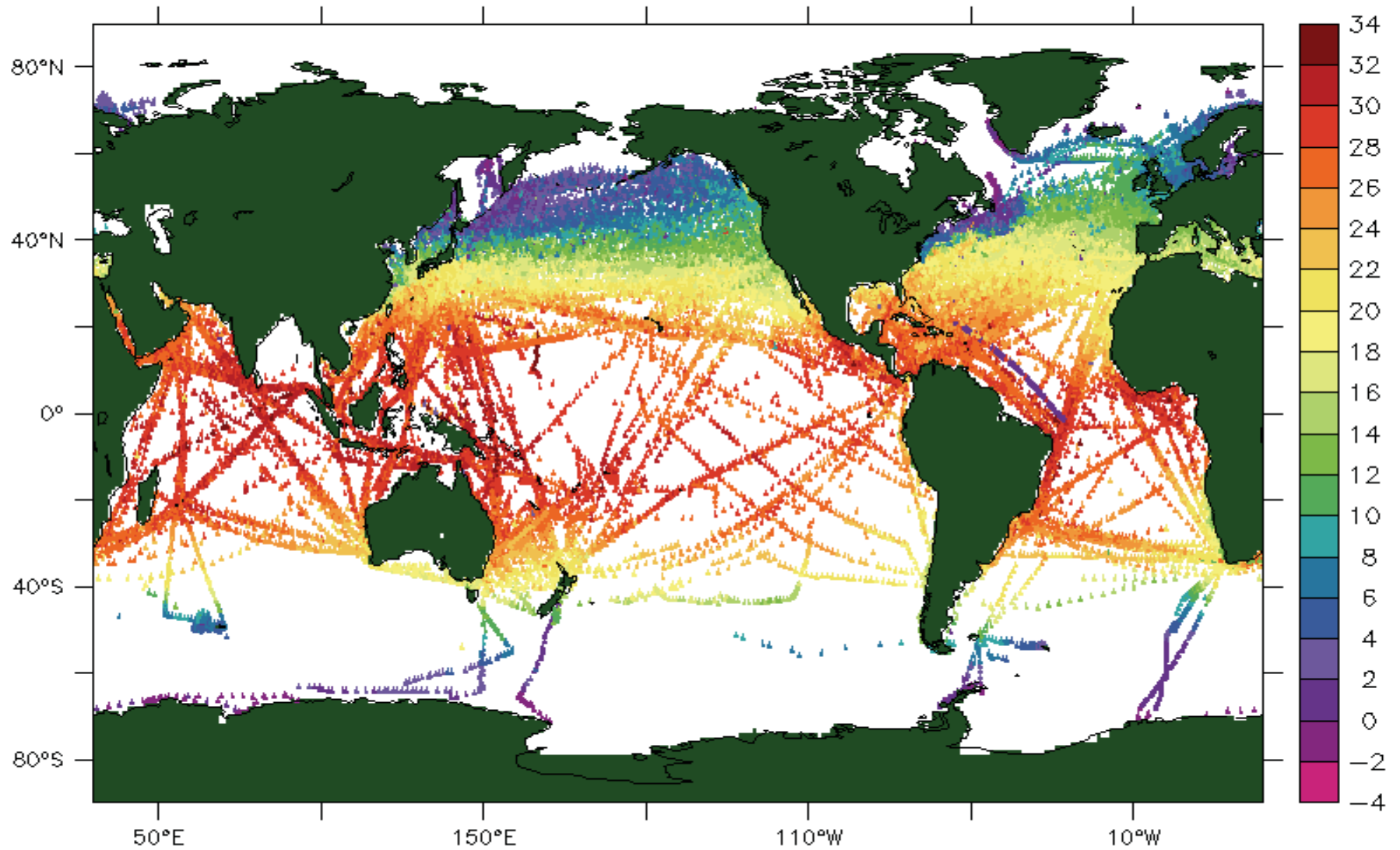
Tide Gauge Network  
 3°x3° Argo Profiling Float Array  
 5°x5° Surface Drifting Buoy Array  
 Moored Buoy  
 Ocean Reference Station  
 High Resolution XBT and Flux Line  
 Frequently Repeated XBT Line  
 Carbon Inventory & Deep Ocean Line

▲	Existing	□	Planned
●	Existing	◇	Planned
←	Existing	—	Planned
■	Existing	—	Planned
■	Existing	—	Planned
■	Existing	—	Planned
■	Existing	—	Planned

Legend for the map:

- ▲ Existing Tide Gauge Network
- Existing 3°x3° Argo Profiling Float Array
- ← Existing 5°x5° Surface Drifting Buoy Array
- Existing Moored Buoy
- Existing Ocean Reference Station
- Existing High Resolution XBT and Flux Line
- Existing Frequently Repeated XBT Line
- Existing Carbon Inventory & Deep Ocean Line
- Planned Tide Gauge Network
- ◇ Planned 3°x3° Argo Profiling Float Array
- Planned 5°x5° Surface Drifting Buoy Array
- Planned Moored Buoy
- Planned Ocean Reference Station
- Planned High Resolution XBT and Flux Line
- Planned Frequently Repeated XBT Line
- Planned Carbon Inventory & Deep Ocean Line
- Planned Global Survey @ 10 years

# Volunteer Observing Ship SST March 2004



Ship SST Observations mar 2004

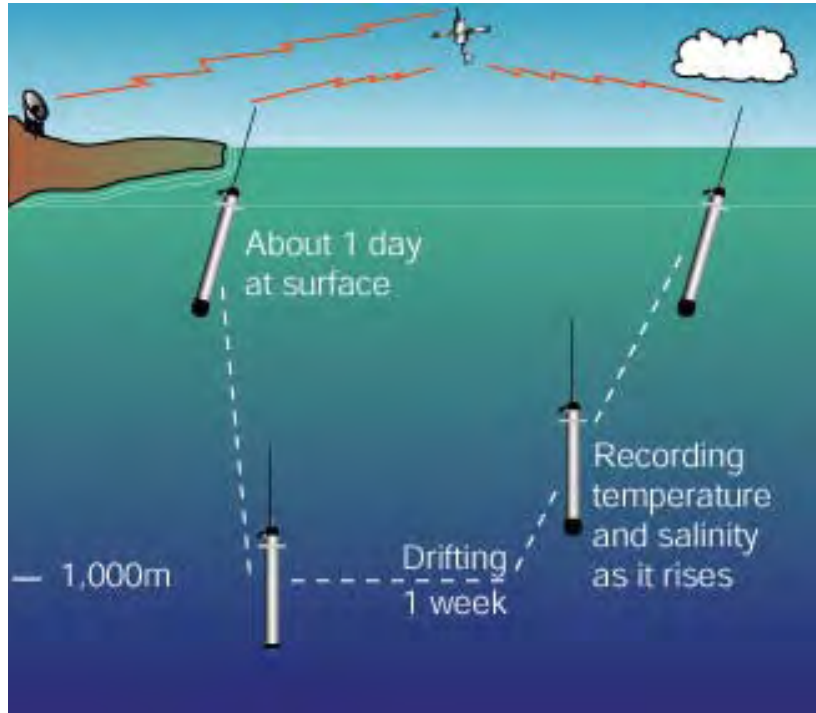


# Research at Sea



# Profiling Autonomous Floats

These are  
oceanic analogs  
to radiosondes  
used in operational  
meteorology





# Argo Status - November 2004



● AUSTRALIA  
● CANADA  
● CHINA  
● DENMARK  
● EUROPEAN UNION  
● FRANCE

● GERMANY  
● INDIA  
● IRELAND  
● JAPAN  
● KOREA (Rep. of)  
● MAURITIUS

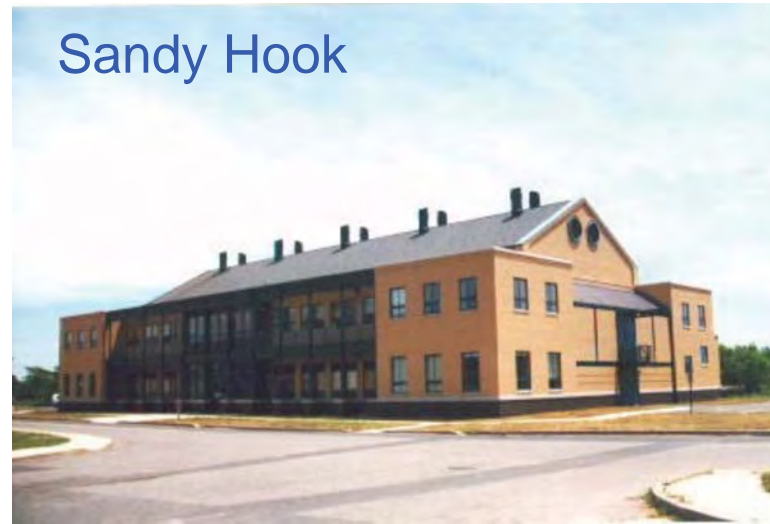
● NEW ZEALAND  
● NORWAY  
● RUSSIAN FEDERATION  
● SPAIN  
● UNITED KINGDOM  
● UNITED STATES

# Infrastructure - Labs

Auke Bay



Sandy Hook



Montlake



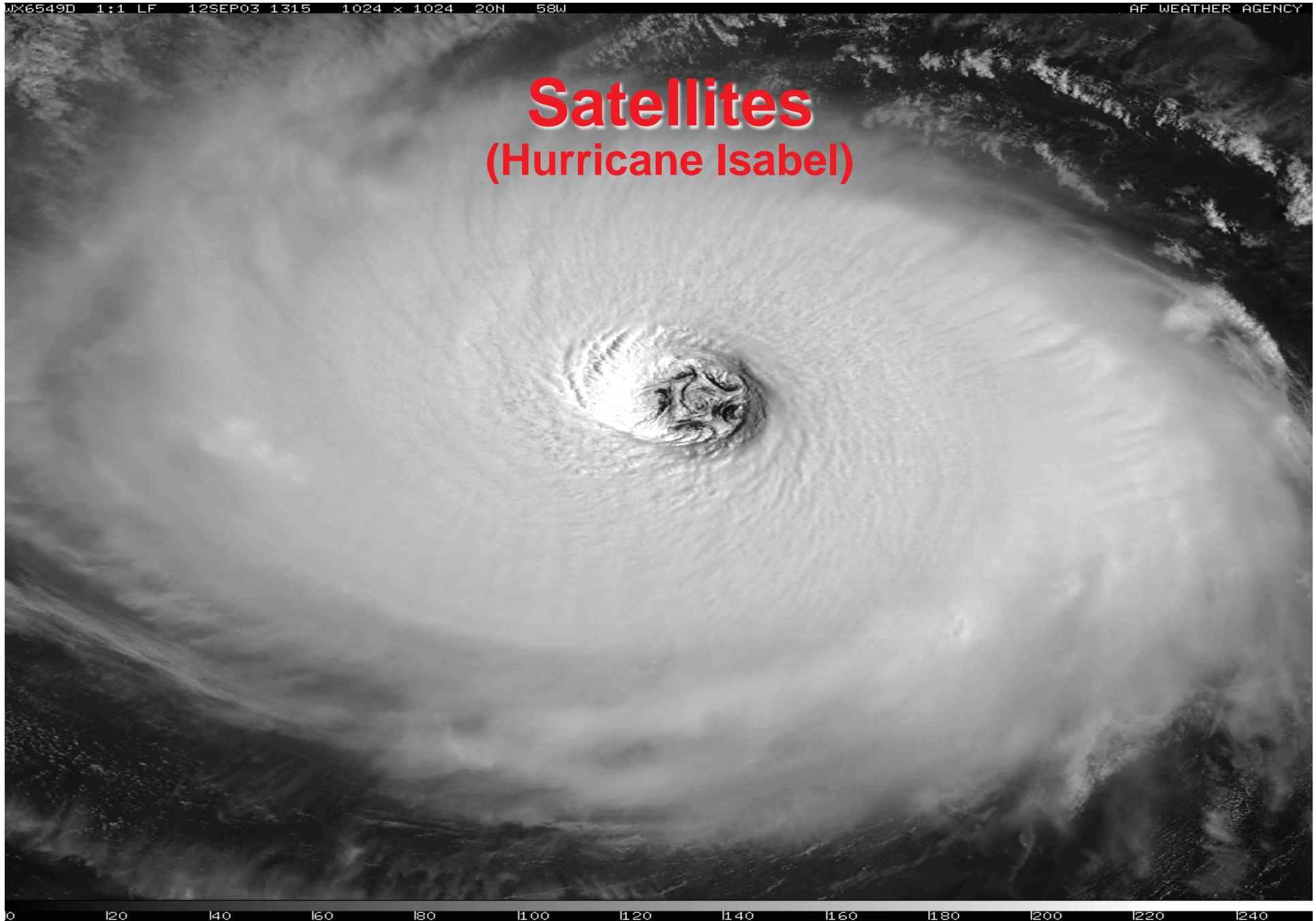
Miami





# Satellites

(Hurricane Isabel)



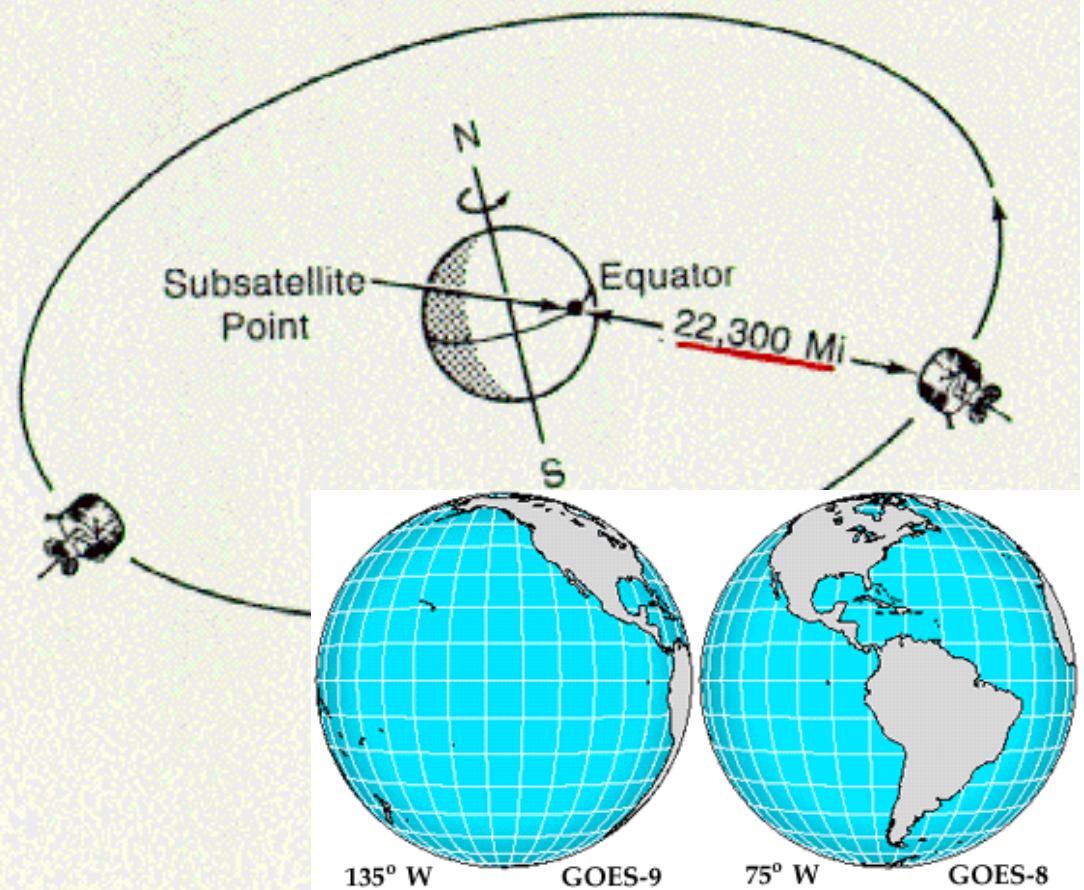
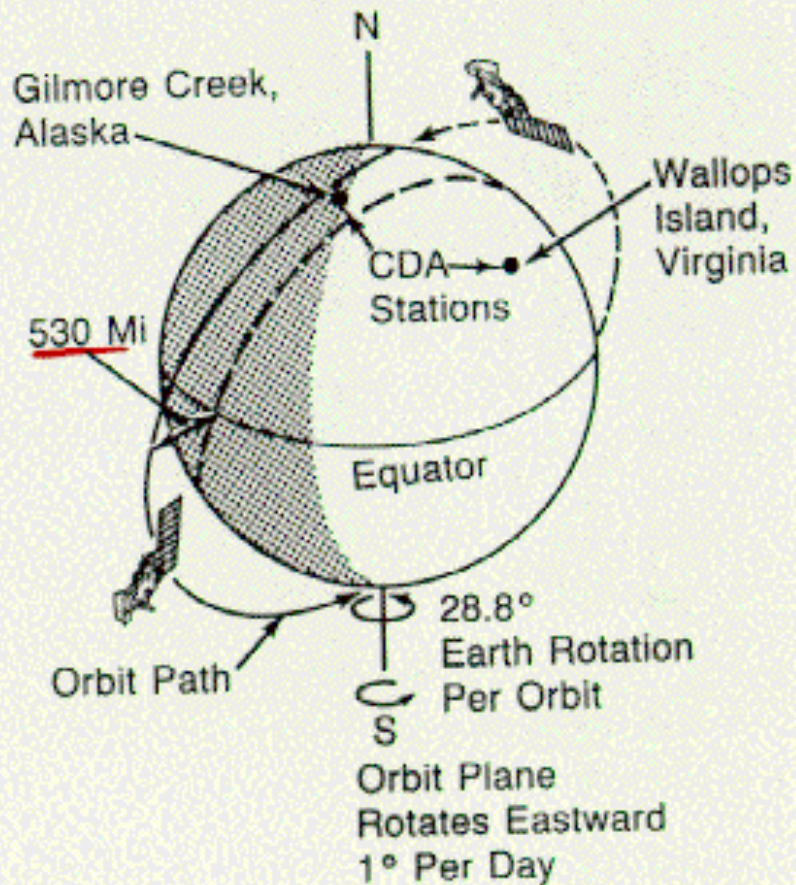


# NOAA

# GOES

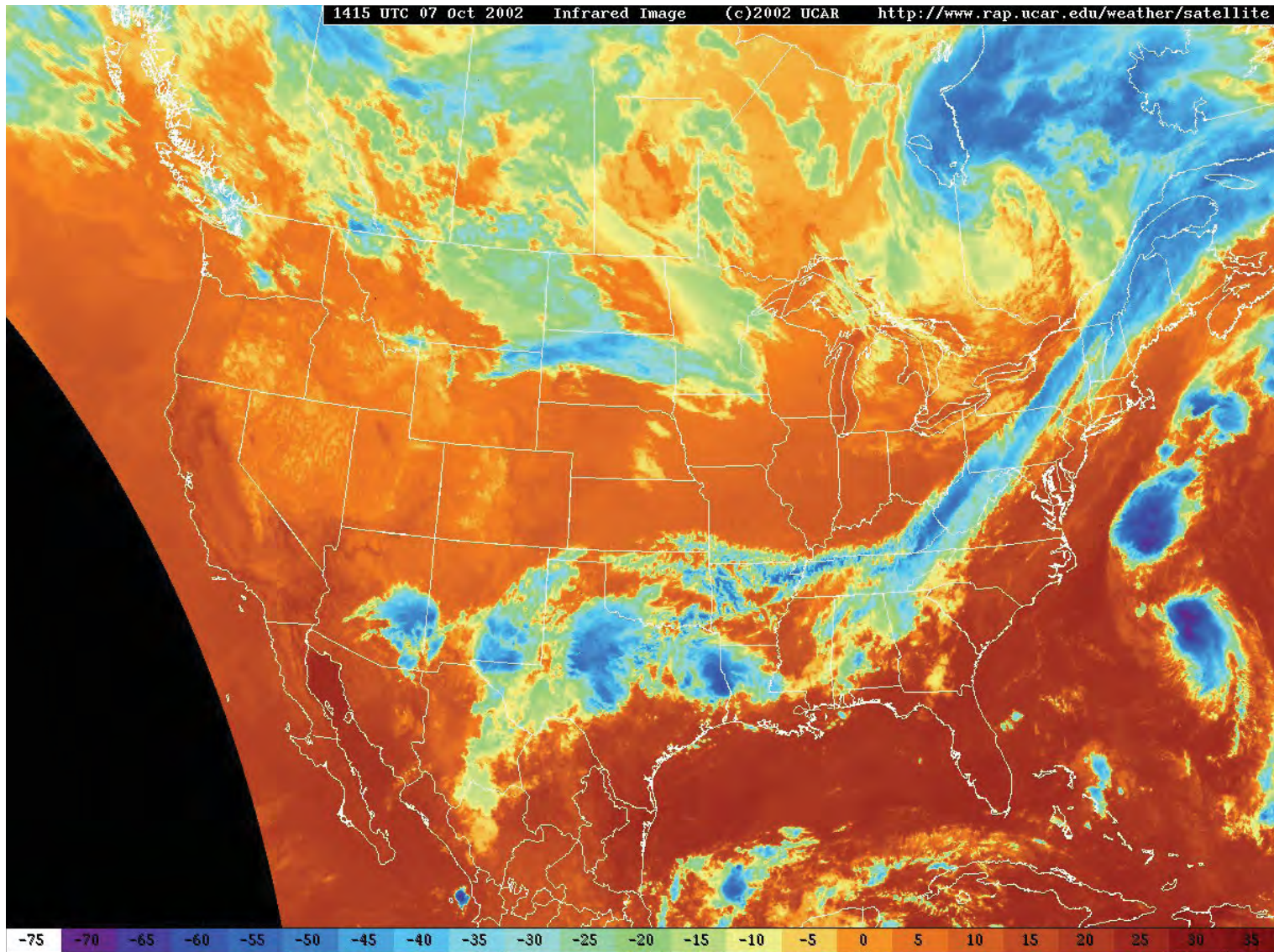
## Polar Orbiting Satellites

## Geostationary Satellites



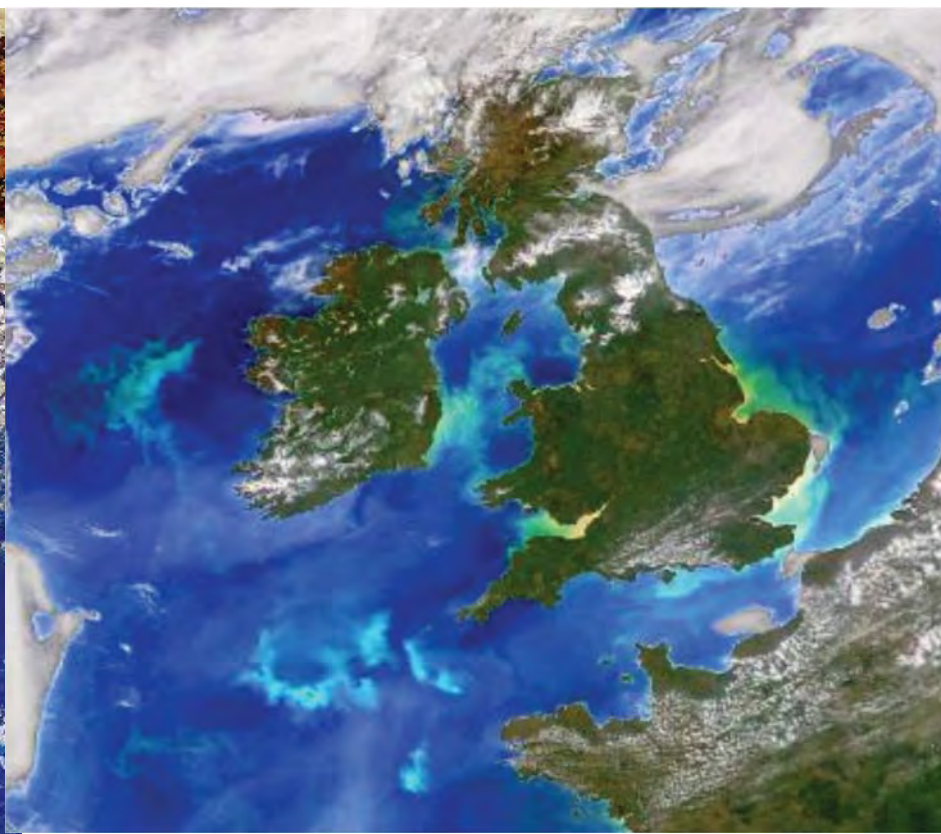
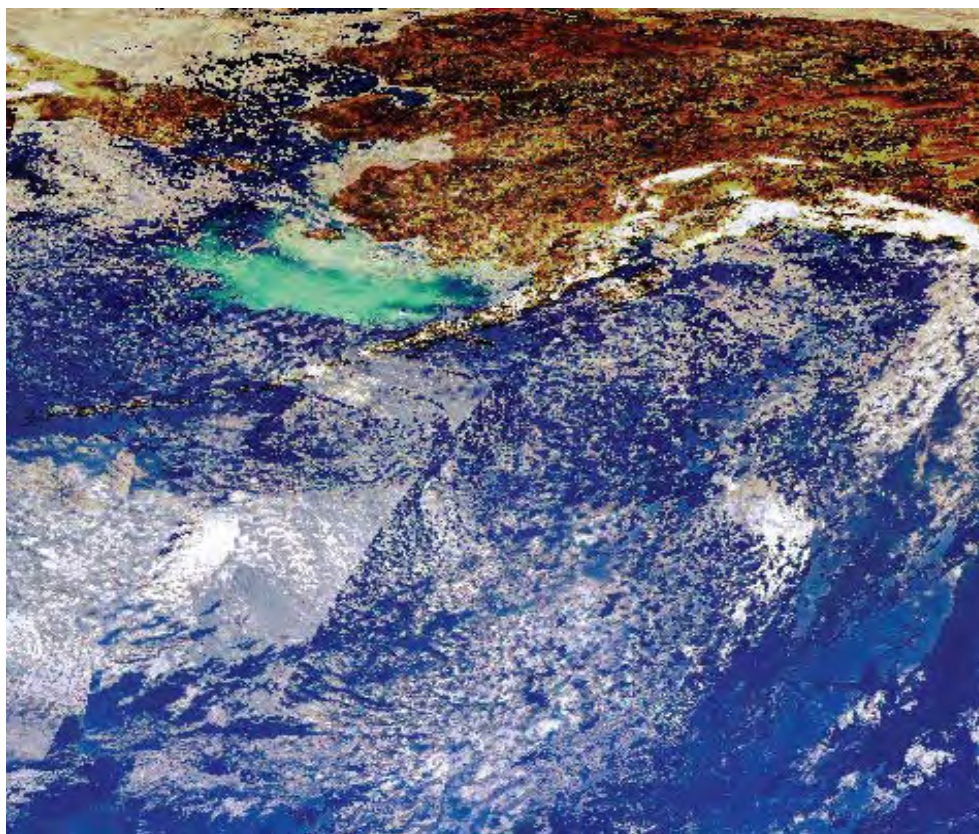


# IR Color Scale



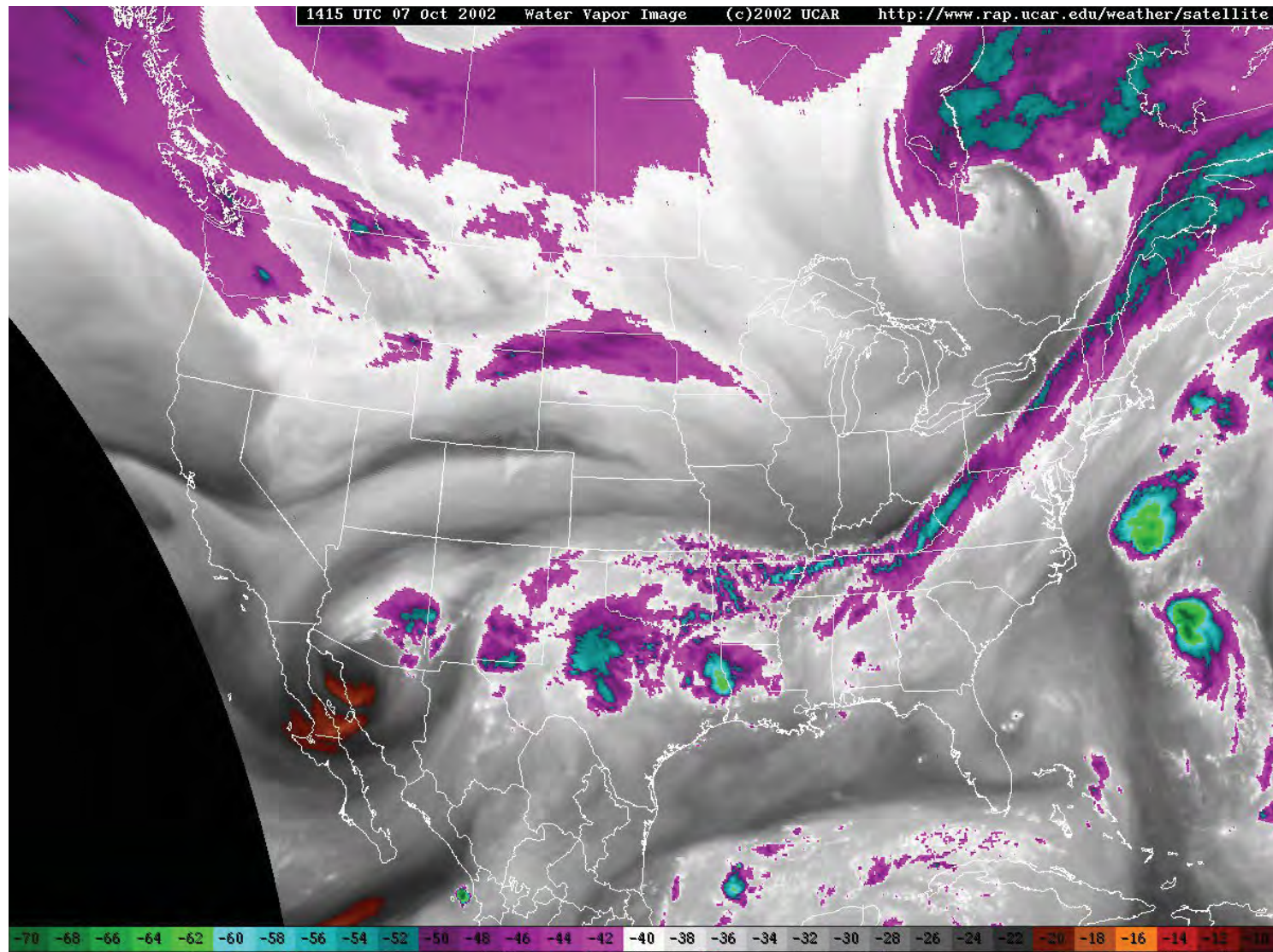


# Coccolithophore Blooms -- Bering Sea & Celtic Sea (SeaWiFS True Color)





# Enhanced Grey Scale



# Aircraft

- **Airborne remote sensing**
  - Lidar
  - Radar
  - Photo
  - Obs.
- **Platforms of Opportunity**



# NOAA, Experimental Ocean Fish Lidar (FLOE)

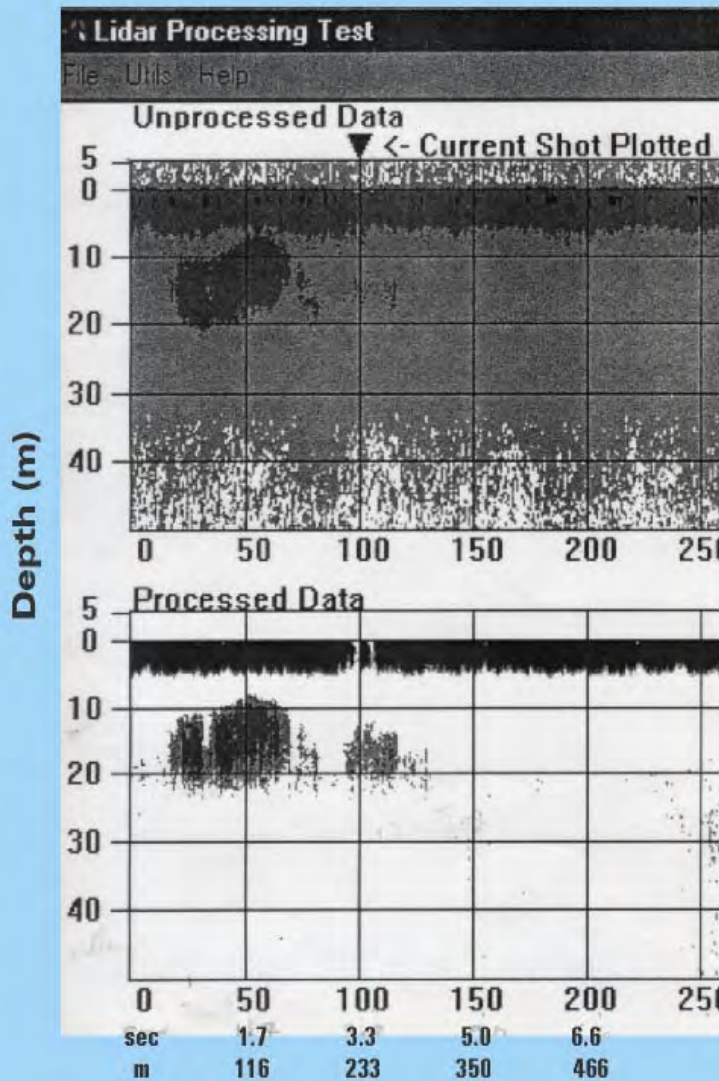
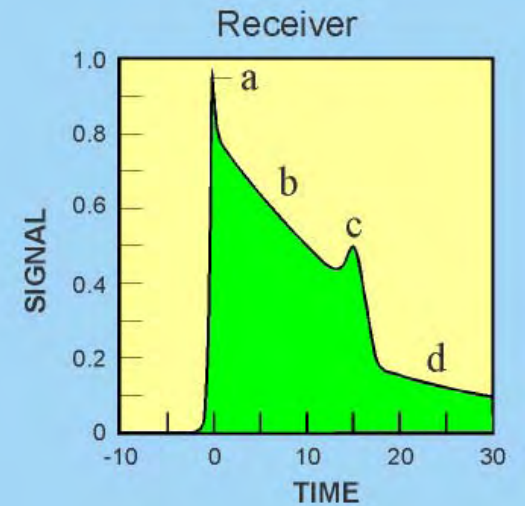
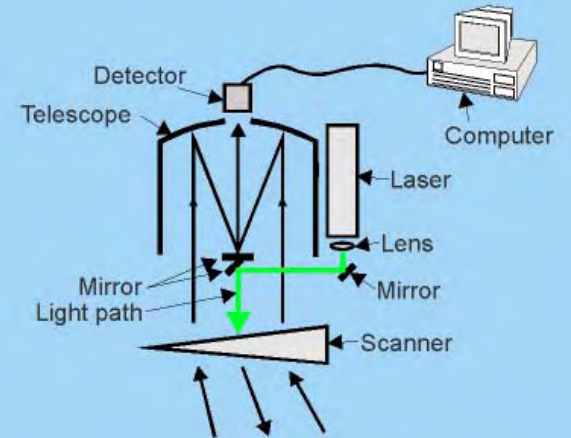
March-April 1997

### Instrument:

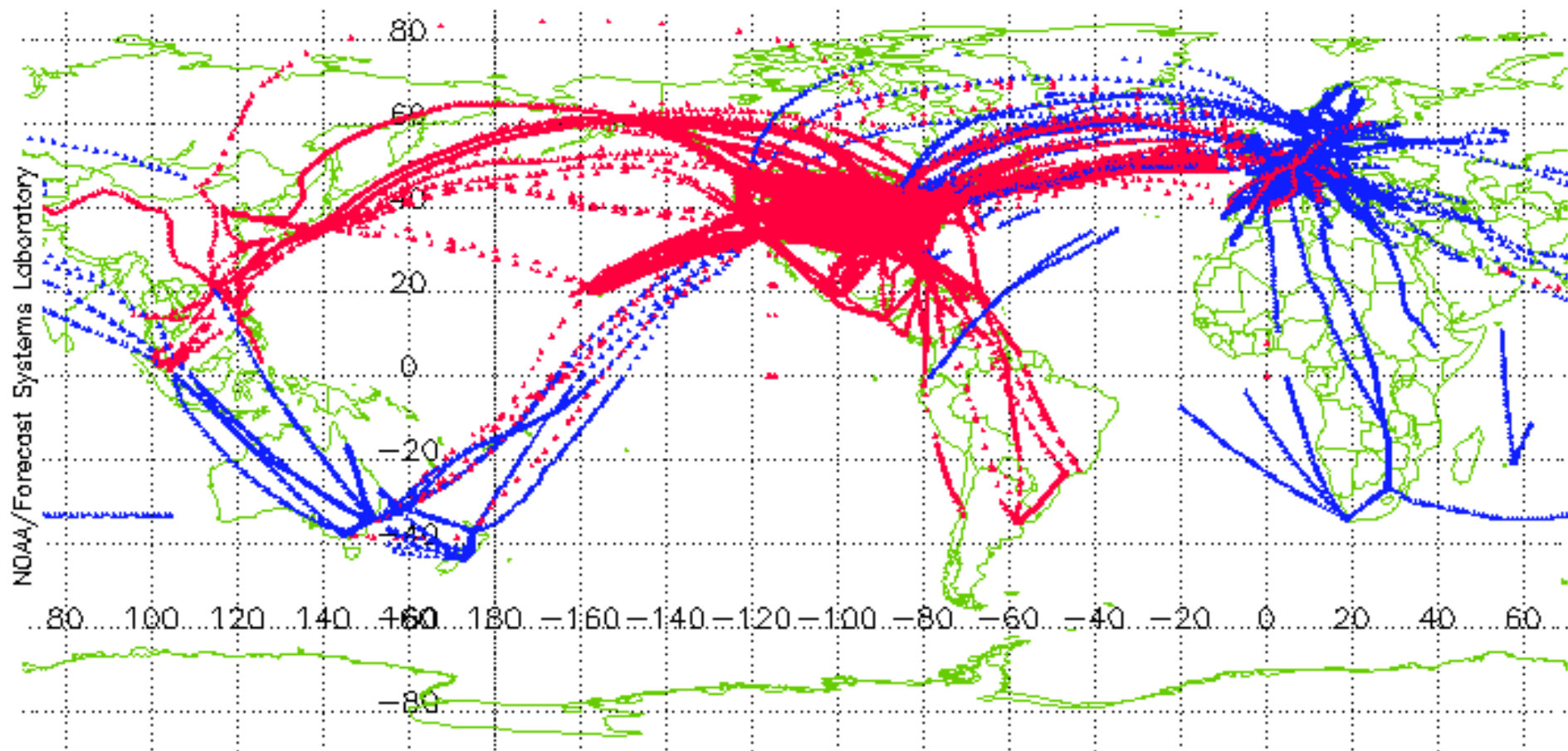
Wave Length: 532nm  
 Pulse Rate: 30Hz  
 Pulse Length: 15nsec

### Airborne Application:

Altitude: 1000ft  
 Air Speed: 140 Knots (70m/s)  
 Swath Width:  
     (day) 7m  
     (night) 20m

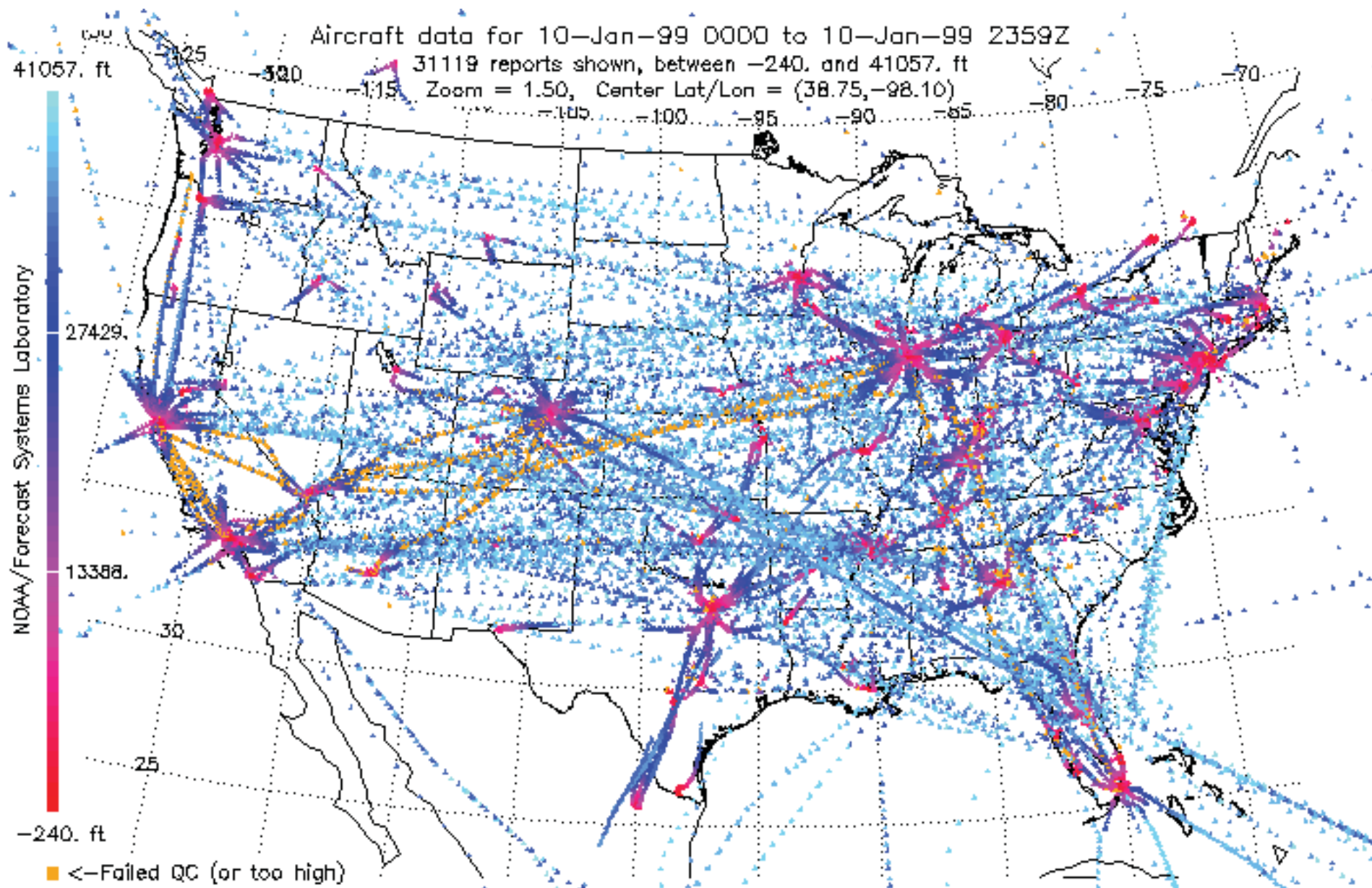


All data for 27-Mar-02 0000 to 27-Mar-02 2359 UTC  
130870 reports shown, between -500. and 43013. ft





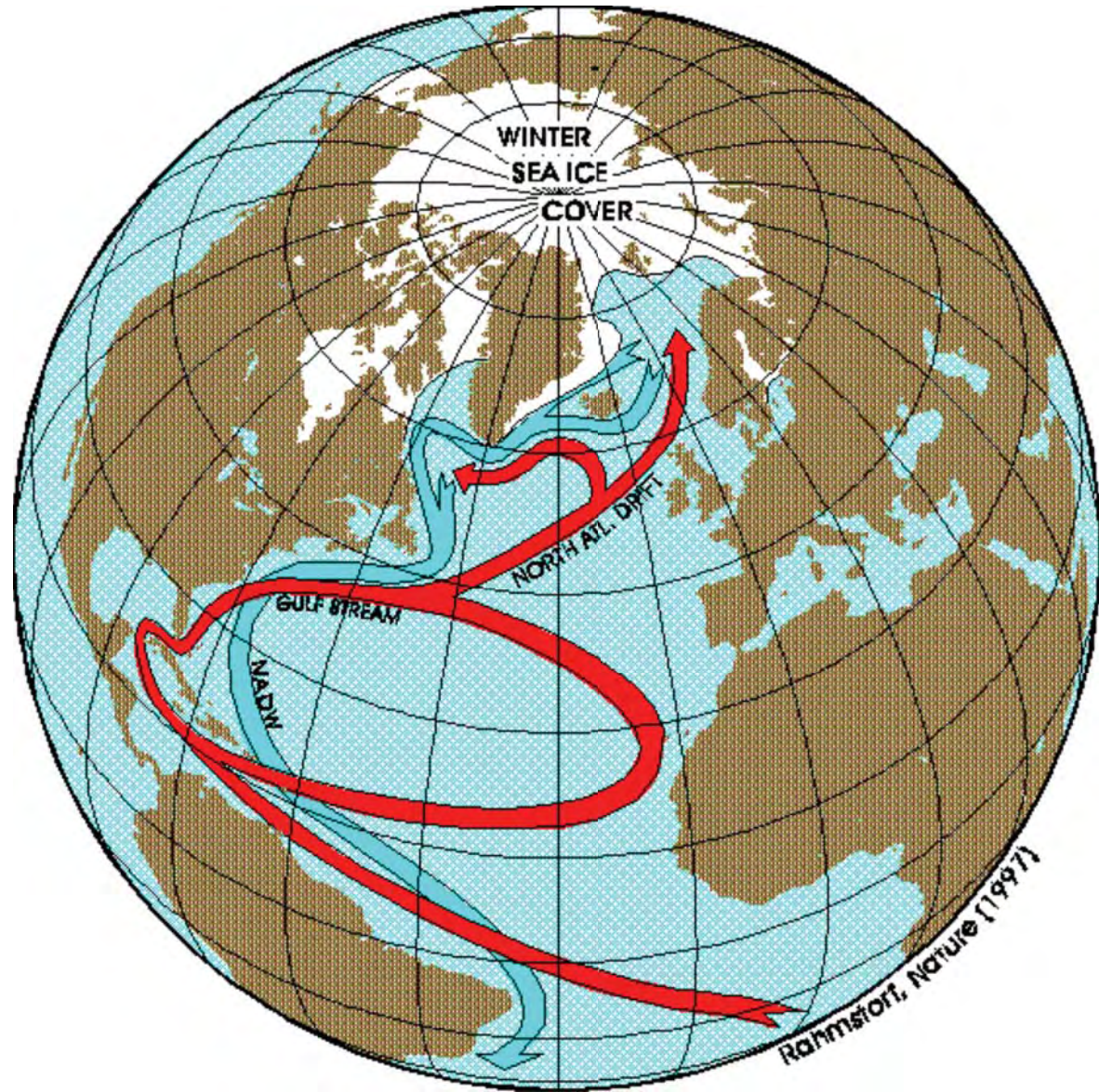
## Distribution of ACARS Data





# Ocean Currents

Will ocean currents change?



# Surface Currents

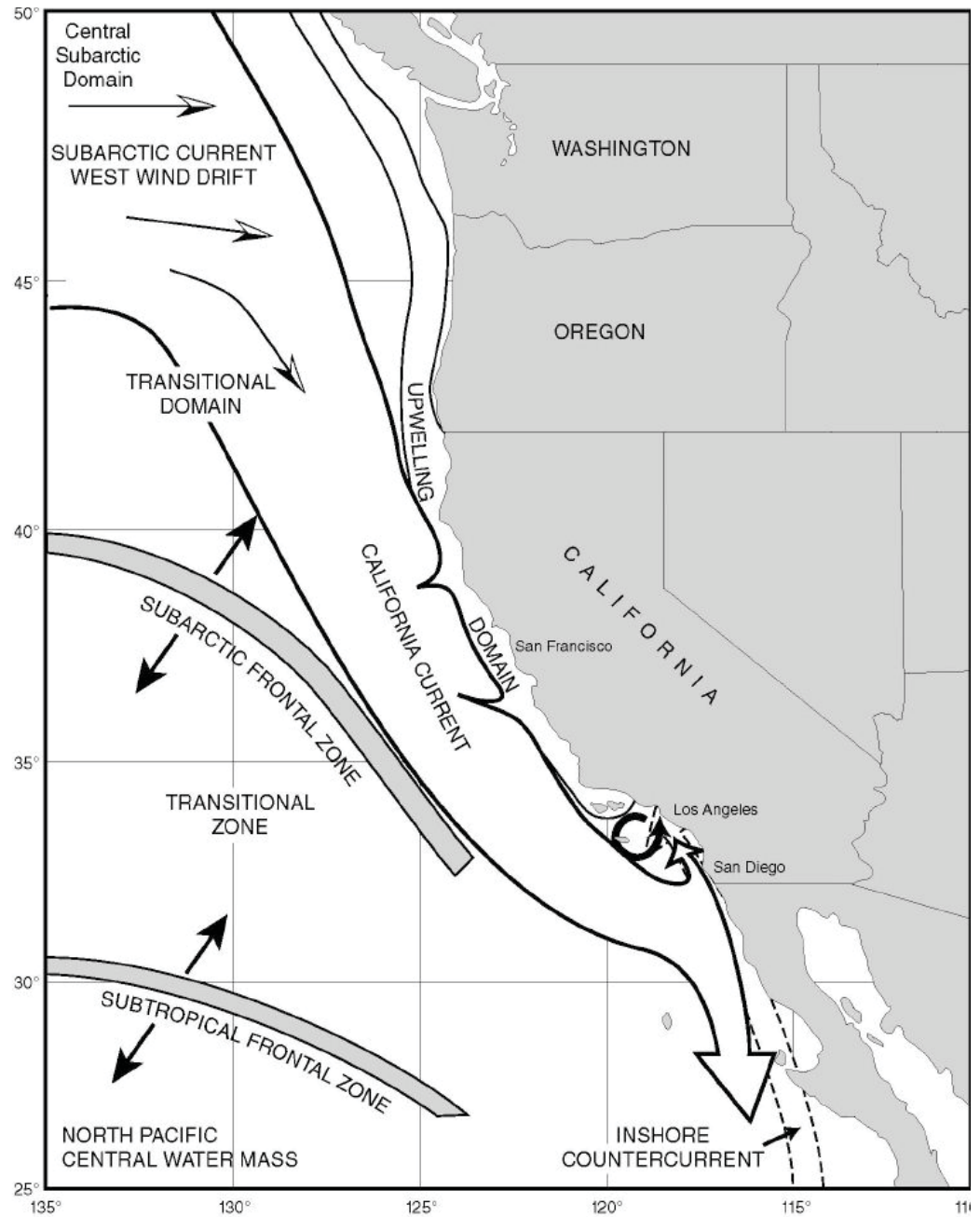
## *Use of Information*

- Fate of eggs and larvae
- Shipping routes, power needed, timing
- Heat transport for meteorology
- Disaster analysis - to find time and place
- Siting of energy generators

## *Tools*

Buoys, ships, satellite vis & IR imagery

# Primary Ocean Currents off the Pacific Coast





# Circulation of the Deep Ocean

## *Use of Information*

- Heat transport and storage for climatology
- Pollution turn over
- Indicator/mechanism for glaciation

## *Tools*

Current meters, buoys

# Winds

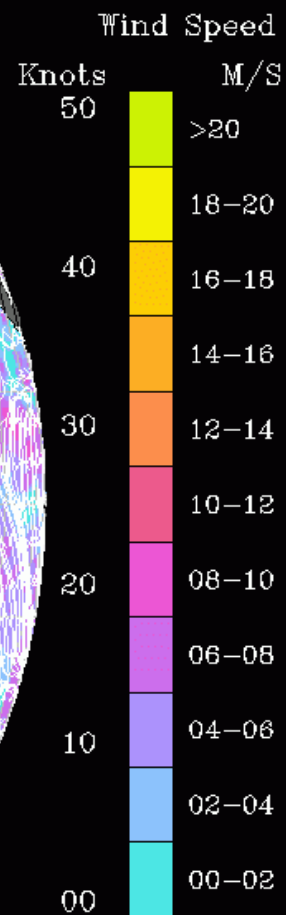
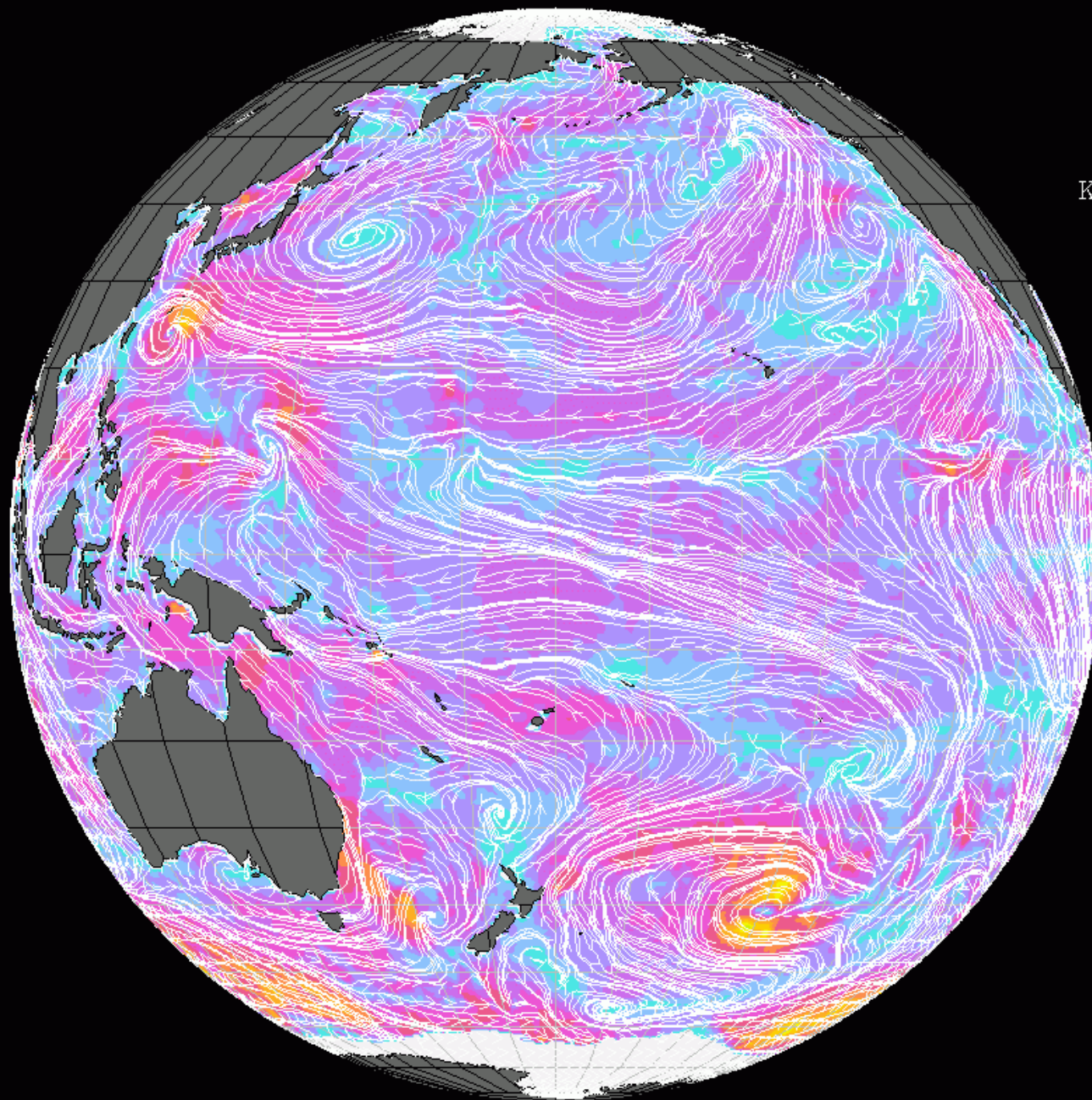
## *Use of Information*

- **Siting of offshore windmills**
- **Where and when to dig for clams**
- **Routes for shipping**
- **Iron fertilization of ocean regions**
- **Sailing and other boating**

## *Tools*

**Buoys, ships, platforms, obs., doppler radar,  
satellites, airsondes**

# Ocean Surface Wind by QuikSCAT



00Z 08/01/1999



# Waves



## *Use of Information*

- Interaction of wind and currents
- Strength of ships
- Strength of structures: e.g., oil rigs, piers
- Routing of ships
- Coastal erosion
- Rogue waves (up to 35m)

## *Tools*

# Stratification

## *Use of Information*

- **Predator/prey models**
- **Tuna fishing with purse seines**
- **Reduced primary production**
- **Energy generation**
- **Thermohaline forcing**

## *Tools*

**XBTs, STDs, sonar, satellite chlorophyll, UORs**



# Sea Level



## *Use of Information*

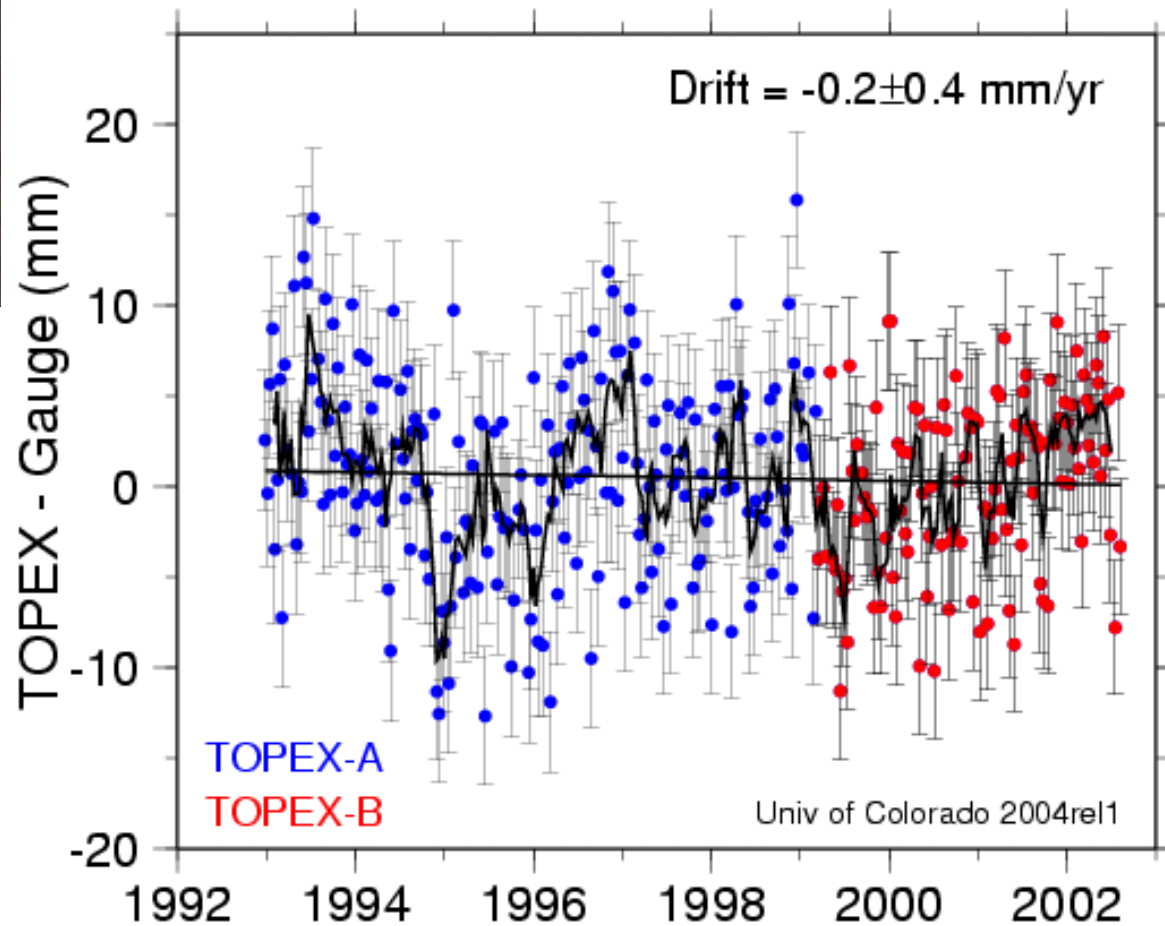
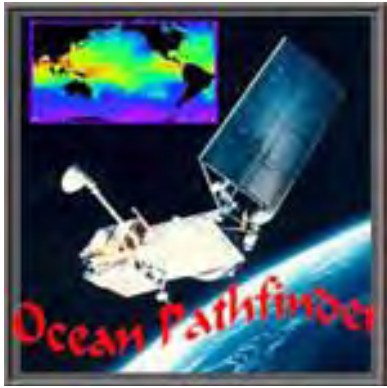
- Land moves up or down
- Sea moves up 1-2 mm/year
- Some cities are far below sea level. Protect Venice? New Orleans?
- Bridges, roads, infrastructure at risk
- Buy coastal property?

## *Tools*

Satellite altimetry, tide gages

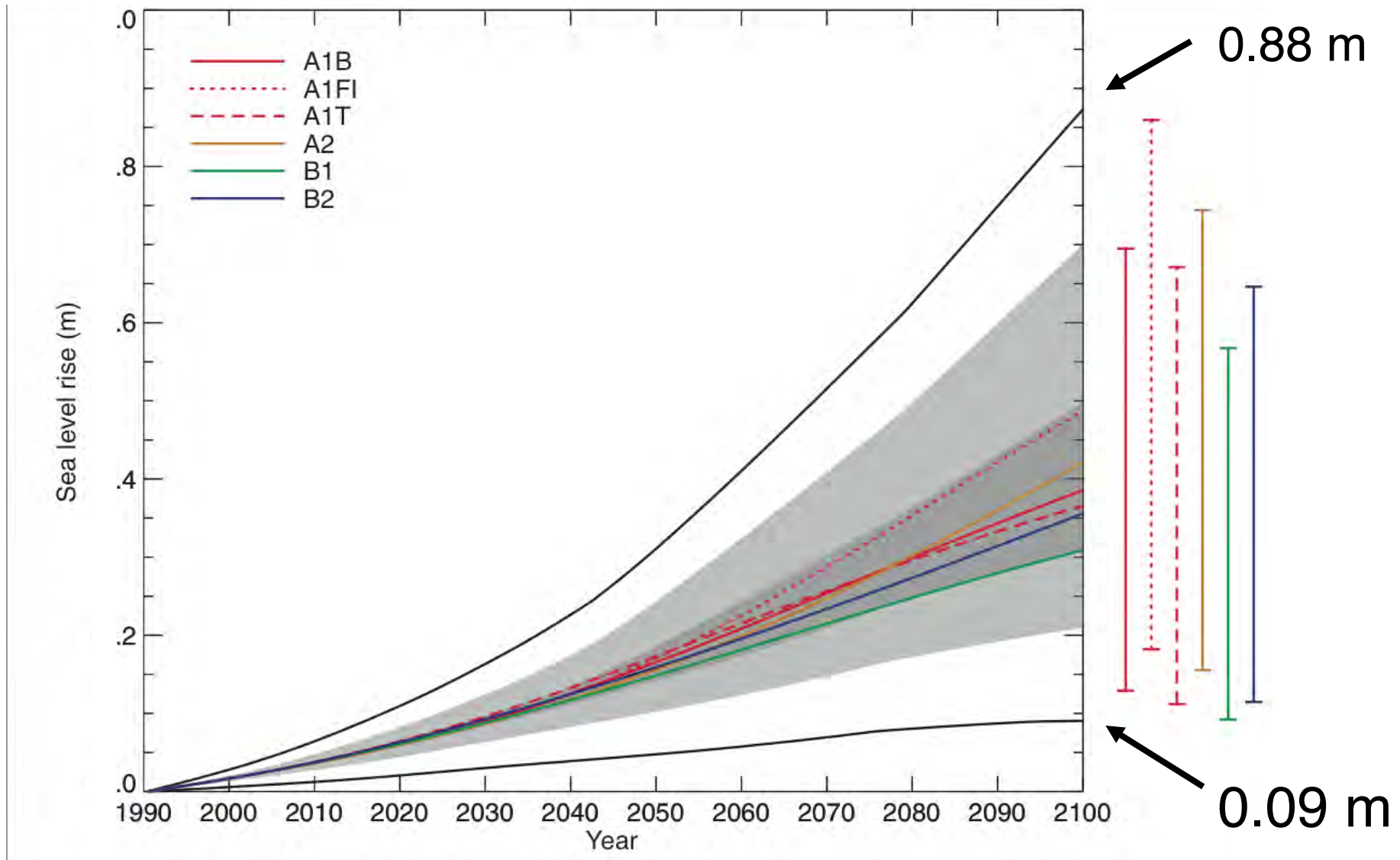


# TOPEX Altimeter - Tide Gauge Calibration

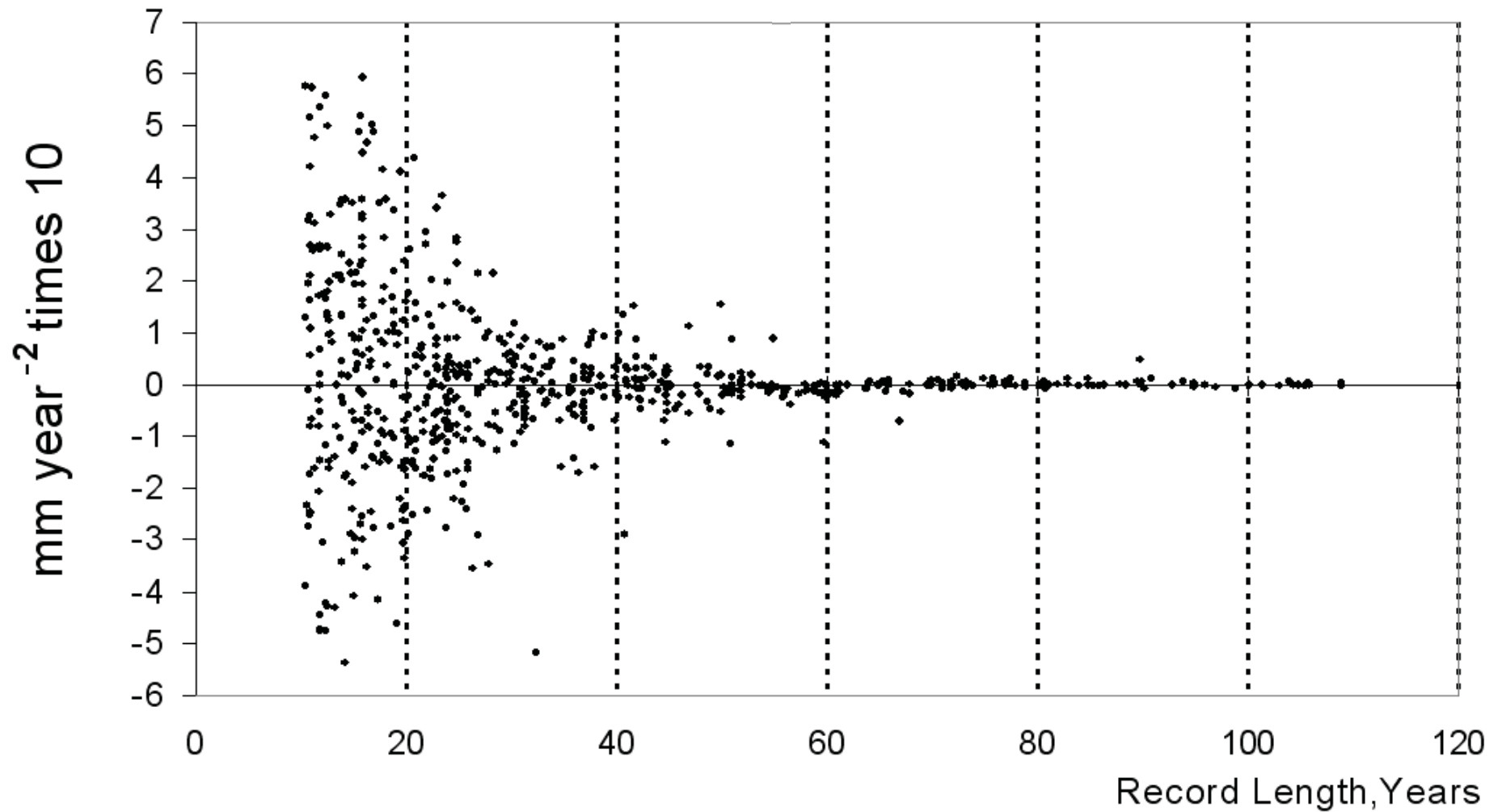


Each point is the average ALT-TG for 108 gauge sites

# Predicted Global Sea Level Rise: 1990 to 2100 for SRES Scenarios (IPCC 2001)



# Sea Level Acceleration as Function of Tide Gauge Record Length







# Ice

## *Use of Information*

Quantity & location of ice edge - very productive

Some species require ice - P.bears, walrus

Major impediment to shipping

Major climate feedback mechanism

Icebergs are potential source of freshwater

Melting or sliding into sea >>SLR

## *Tools*

Satellite altimetry, imagery, radar, obs., sonar

# Climate Cycles

## *Use of Information*

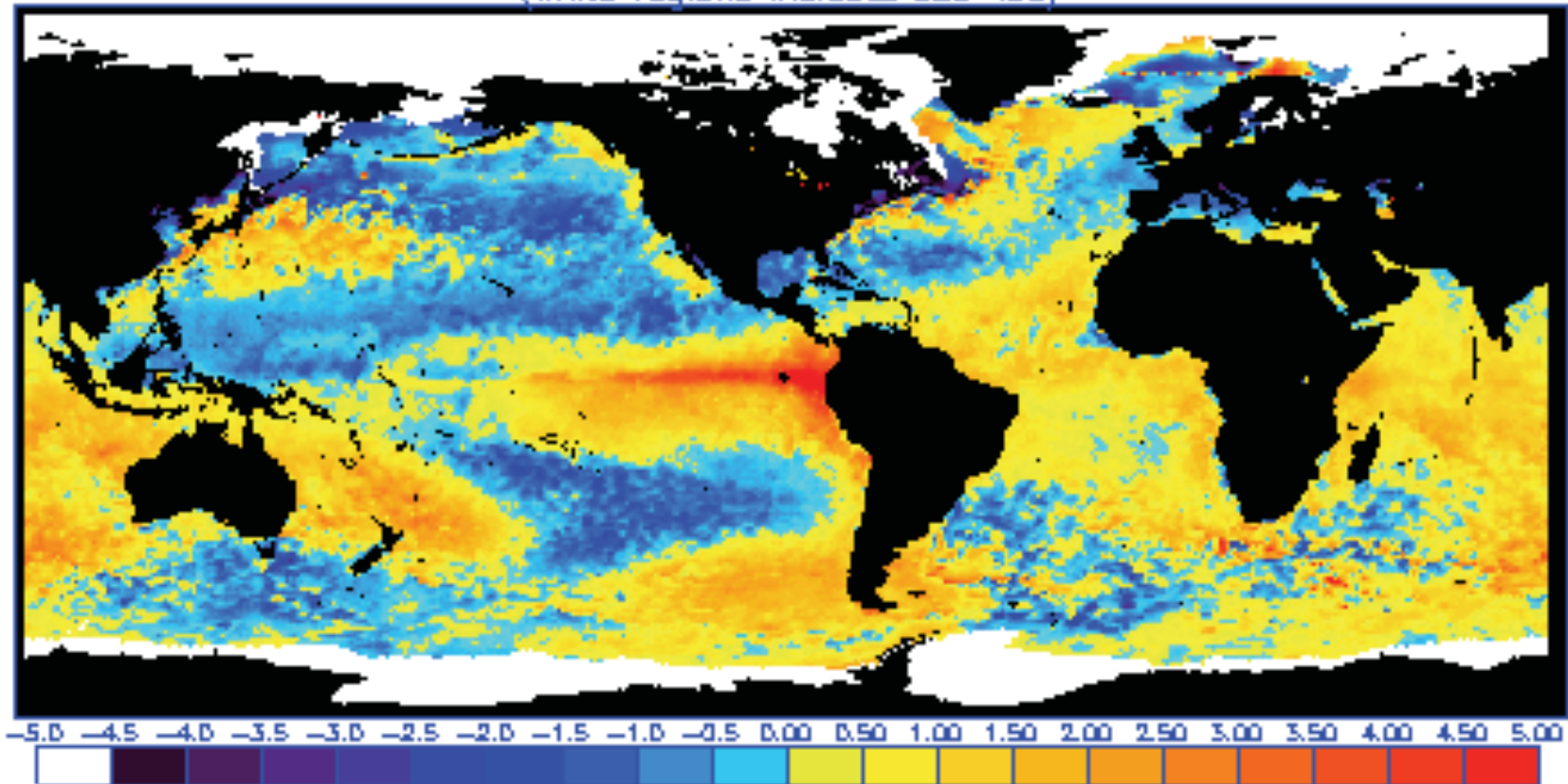
- Inter glacial: repopulation varies, perspective
- Decadal: NPO NAO; ecosystem & climate switchovers
- ENSO; ecosystem & climate switchovers, SL heights. Species flourish, or get scarce.

## *Tools*

Atmos. pressure indices, ecosystem changes

# El Niño

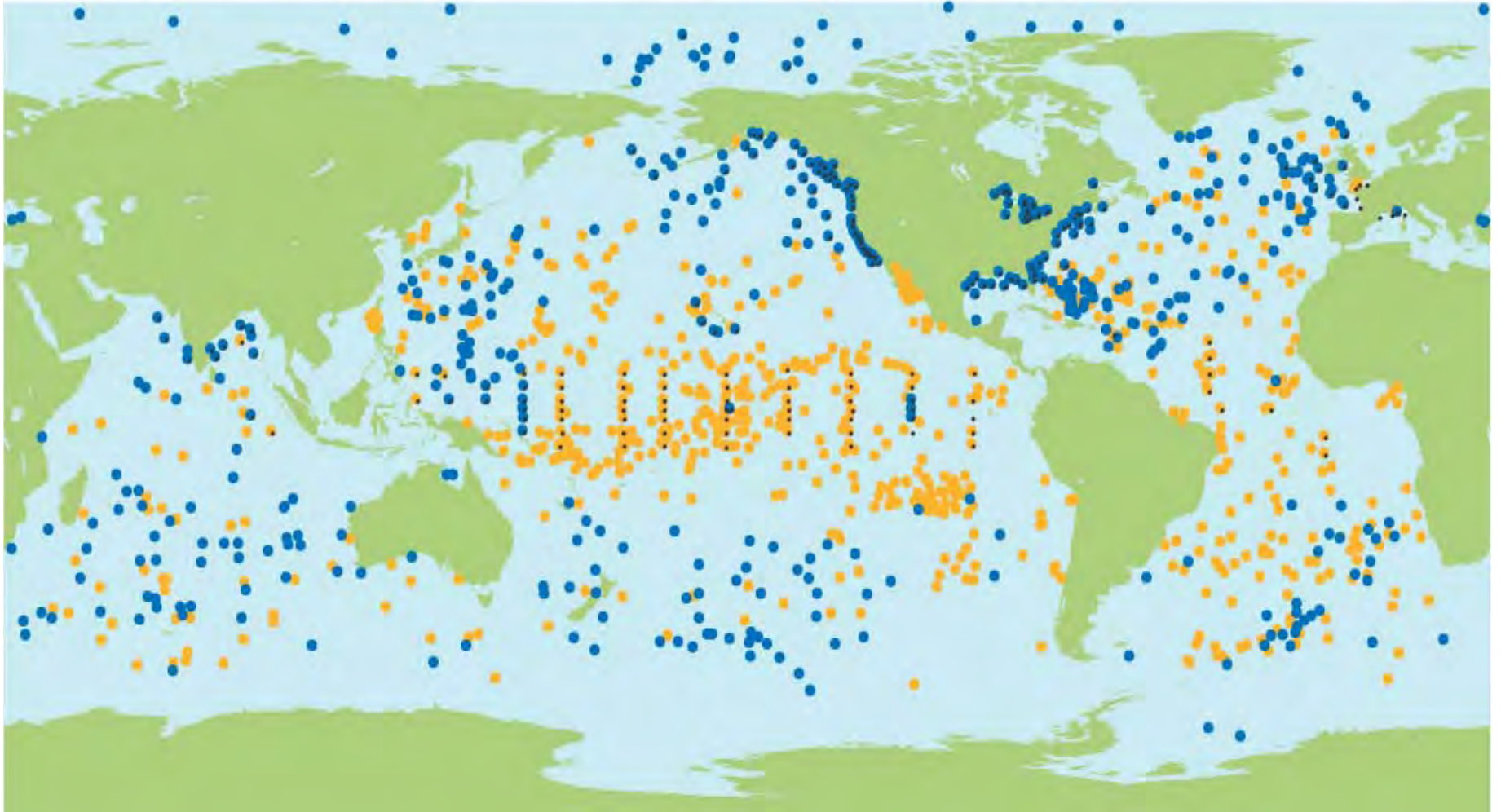
NOAA Current SST Anomalies (C), 5/5/1998  
(white regions indicate sea-ice)



- ENSO makes weather vary in much of the world
- Every 3 to 10 years; in recent years more frequently
- Will ENSO change with global warming?



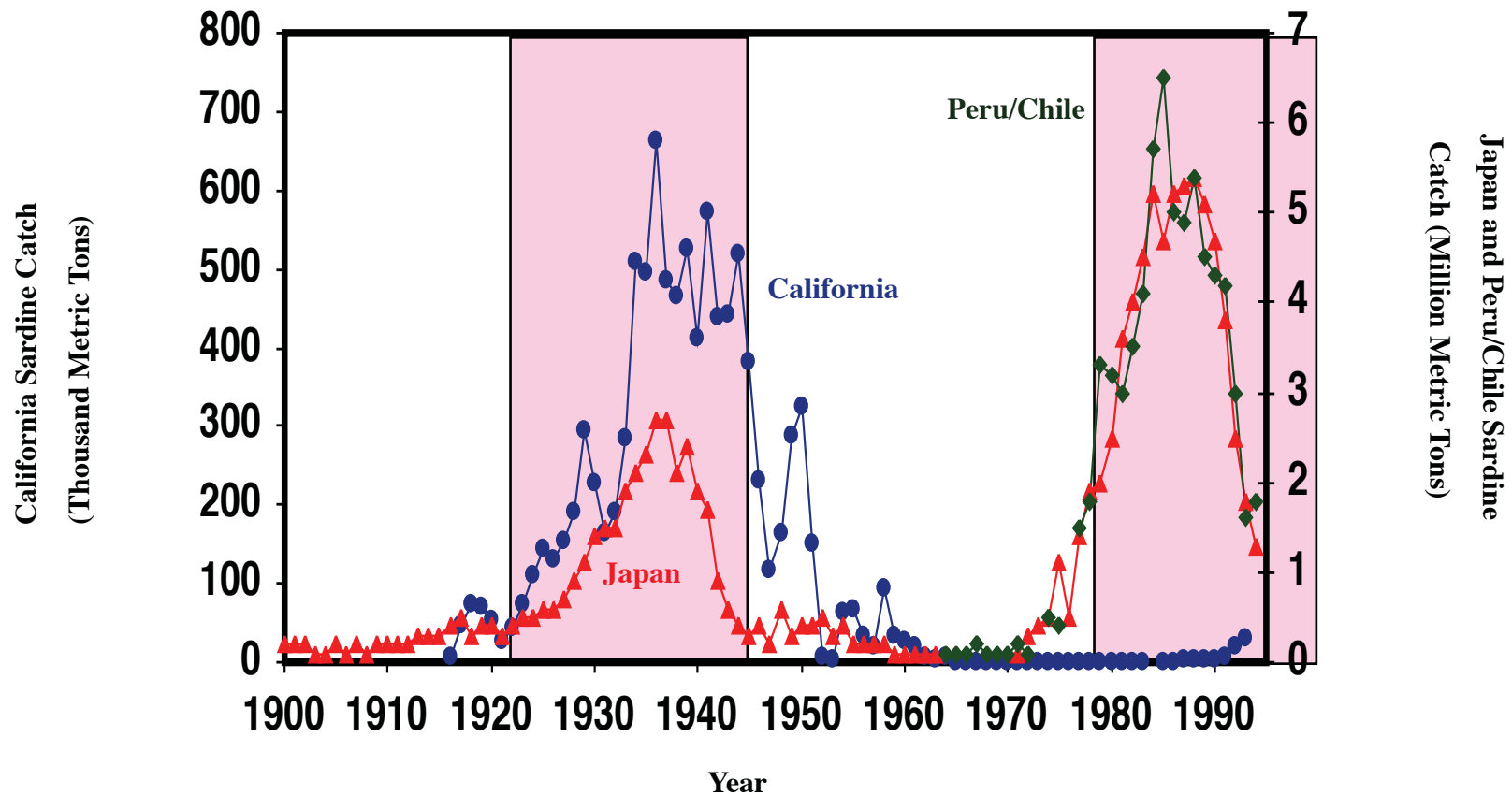
# GTS DBCP Surface Reports Sept 04



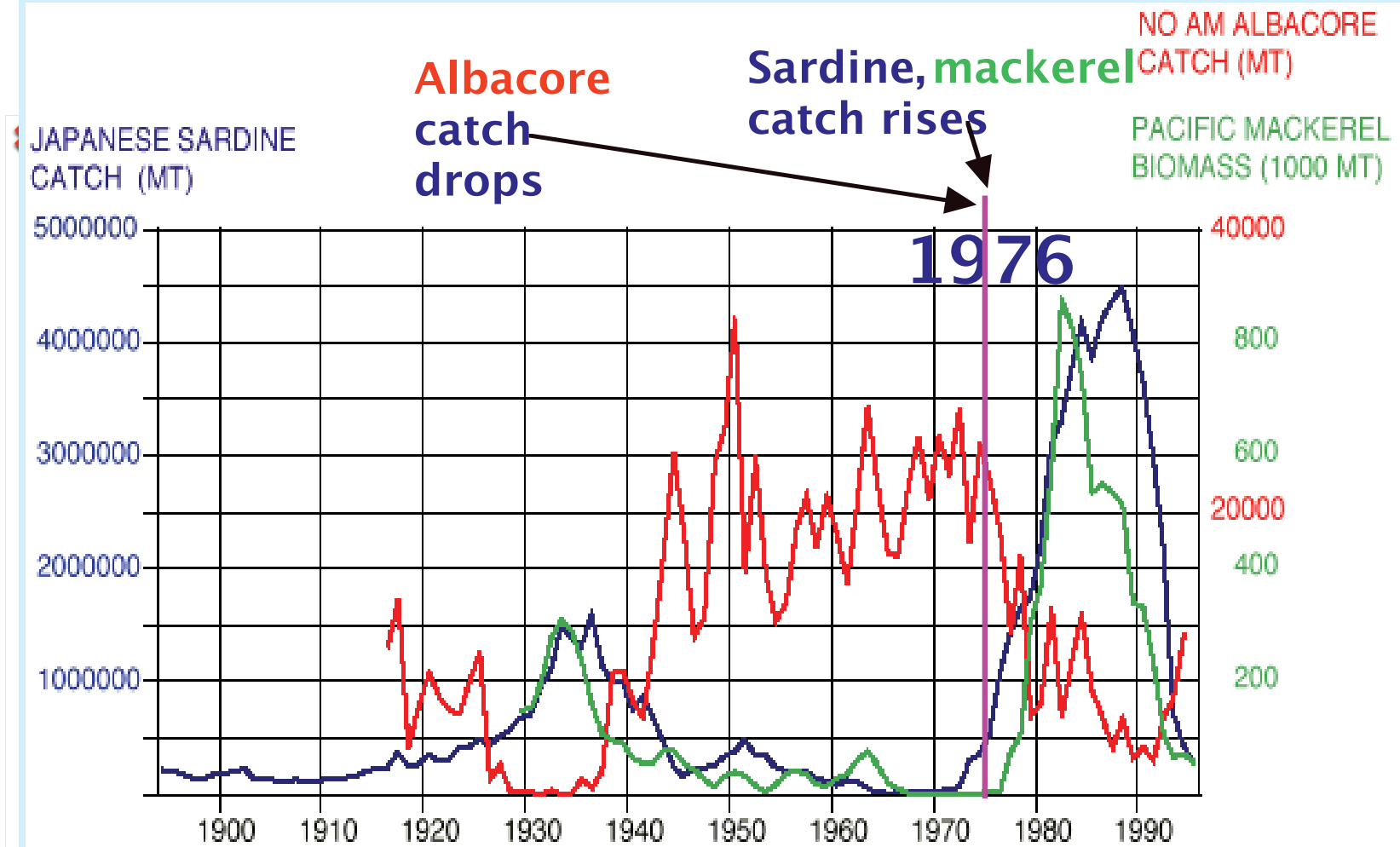
**Gold – SST; Blue – SST & SLP; black center - mooring**

# Apparent Oceanwide Synchrony in Pacific Basin Sardines

Historical catches in the sardine fisheries of Japan, California and Peru-Chile have exhibited parallel patterns, possibly in response to global-scale changes in climate (modified from Kawasaki, 1992).

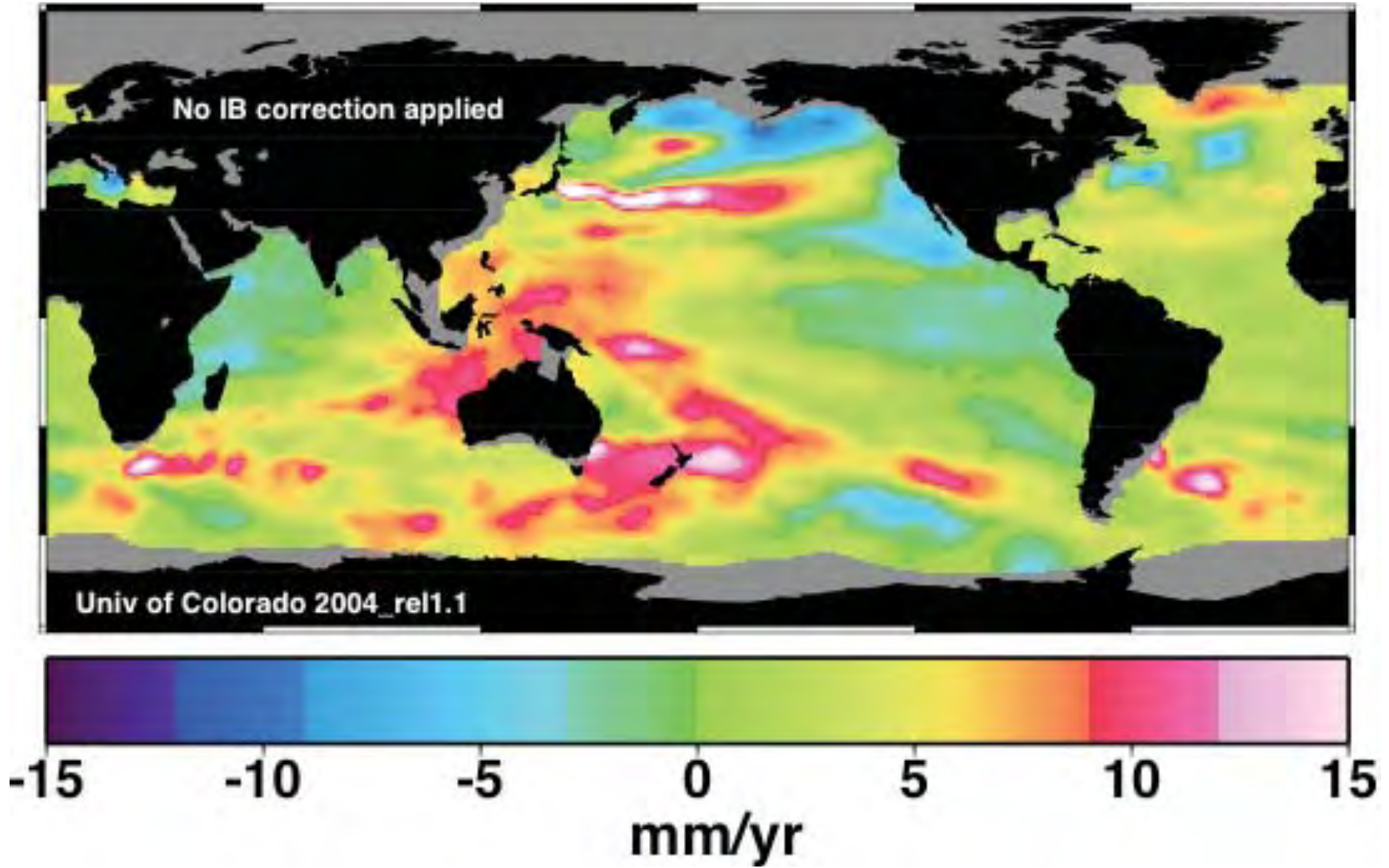


# Decadal Scale Thermal Changes affect Marine Resources





# Satellite Altimeter Sea Level Trends 1993-2004



# The Ocean Floor

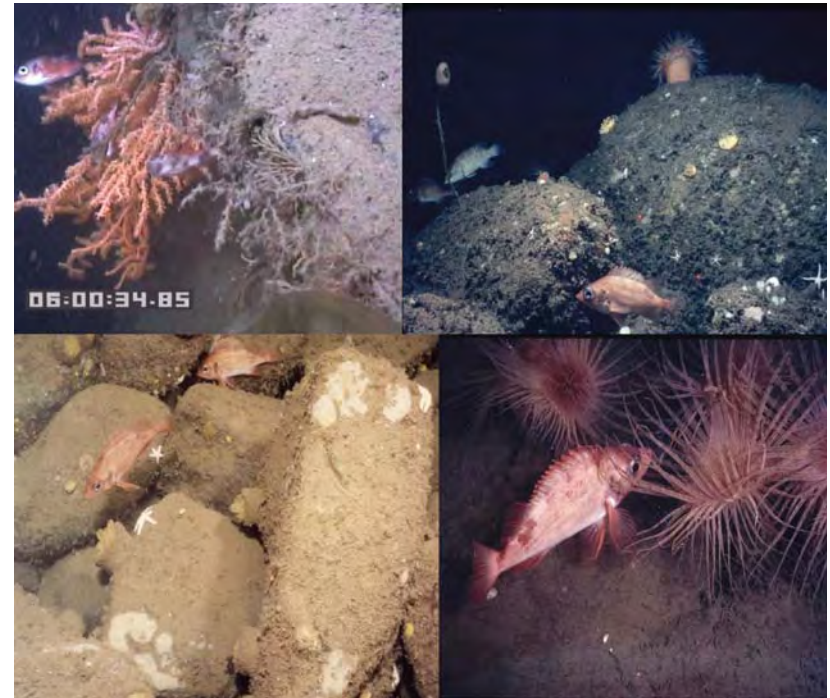
## *Use of Information*

- Mapping and charting
- Wrecks
- Habitats
- Cables
- Oil, Gas, Minerals

## *Tools*

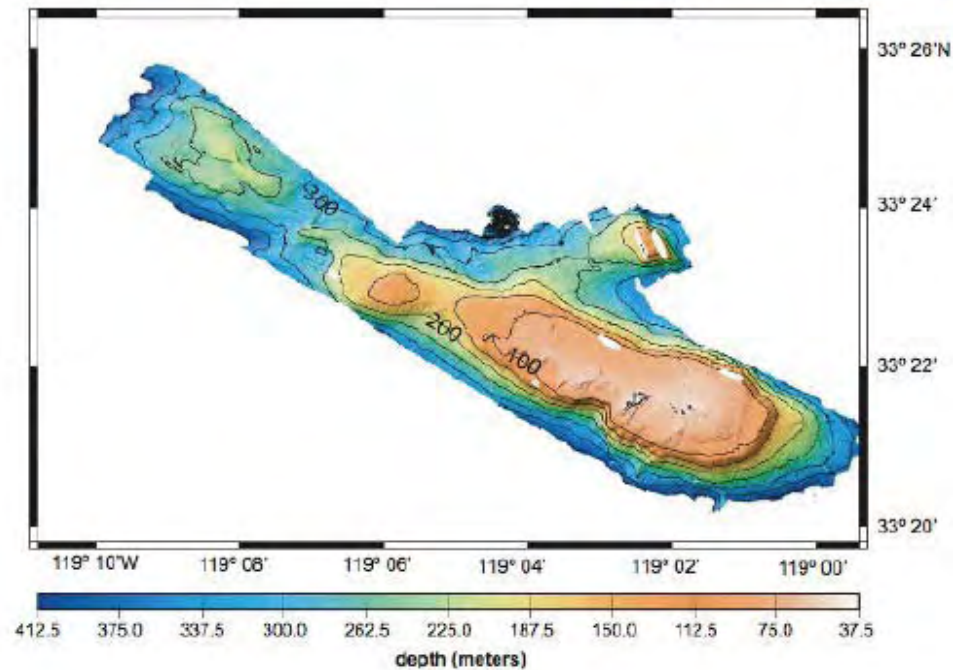
Sonars: vertical; sidescan; multibeam

Lidar, grabs, cores, video, RPVs, subs



# Multibeam Sonar

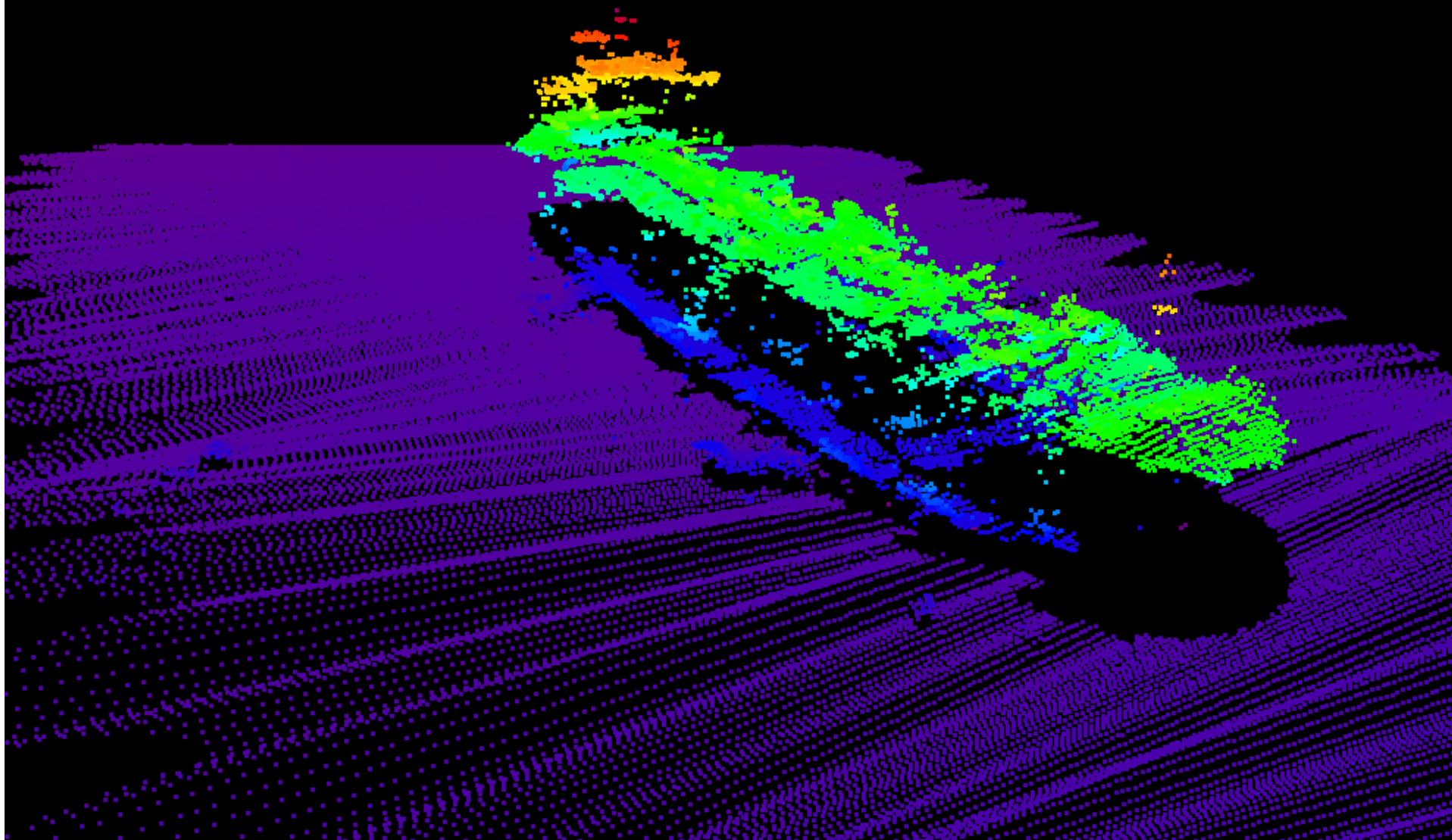
Used to map deep-water fishing banks in the Southern California Bight from the support vessel *Velero IV*. A high-resolution multibeam map of Osborn Bank, with fifty-meter contour intervals is an example of a product.







# ***Rude Side Scan Sonar of Bow Mariner***



# Global Warming



- Natural vs anthropogenic?
- 10,000 years at present Temp is rare.
- Could more warming stop thermohaline circ?
- UK conference on dangerous level of warming - but suppose in the absence of human caused CO<sub>2</sub>, we were at -2 deg. C instead of +.5 deg.C
- As President, would you sign Kyoto protocol?
- Would you sign a petition to ask the President to sign?
- Do we know enough of the answers?

# Global Warming

## *Use of Information*

- **Sea Level Rise - up to a meter over a century**
- **Temp rise of a few deg. C/Nights/winter by 2200**
- **Problems for ice & shore-dependent species**
- **Benefits for shipping and heating**
- **For ecosystems, species mixes and locations should change. Productivity depends on stratification.**
- **Effects should be greater where migration is less easy.**

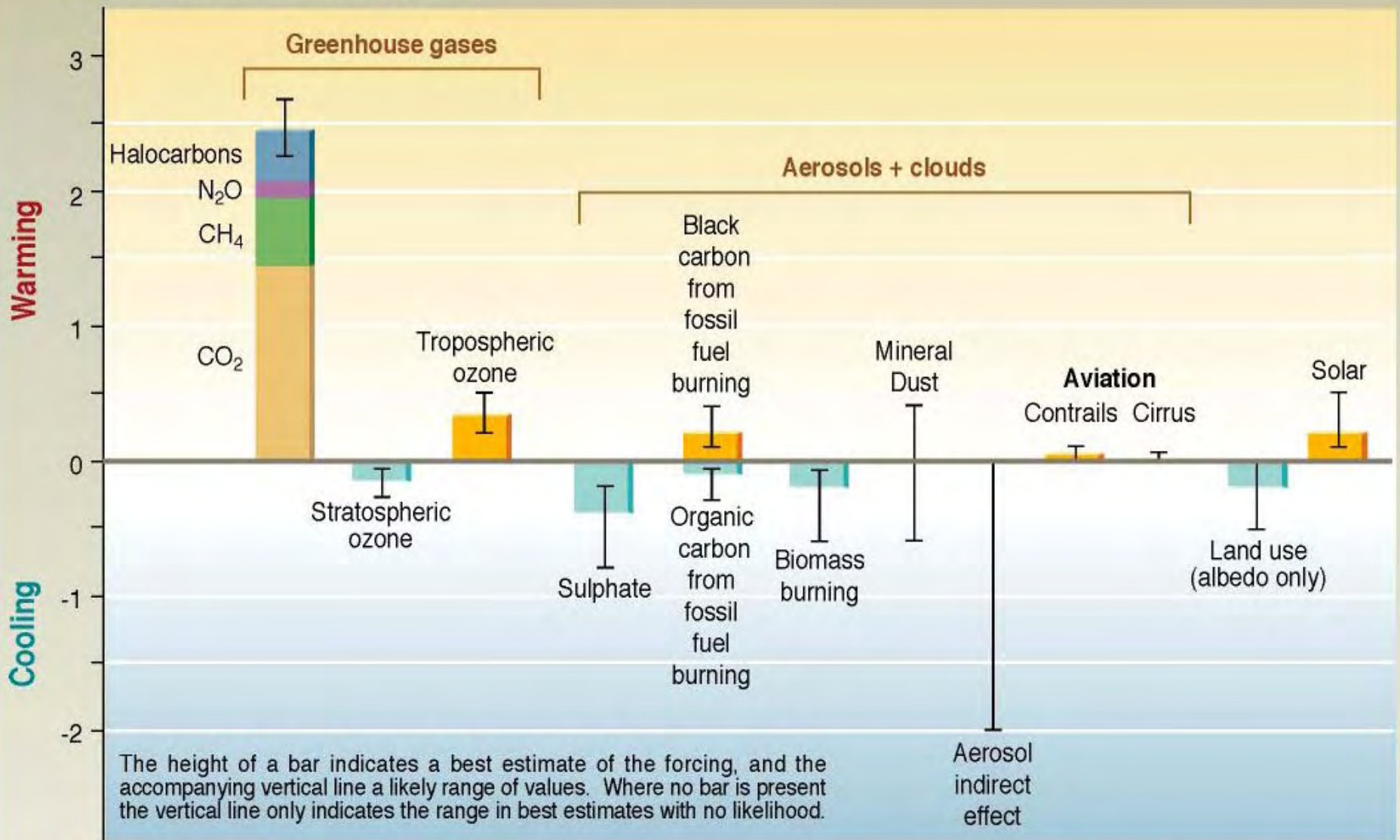
## *Tools*

- **Satellite Temp., obs., ice & snow cover, timings**



# Anthropogenic and natural forcing of the climate for the year 2000, relative to 1750

Global mean radiative forcing ( $Wm^{-2}$ )



LEVEL OF SCIENTIFIC UNDERSTANDING

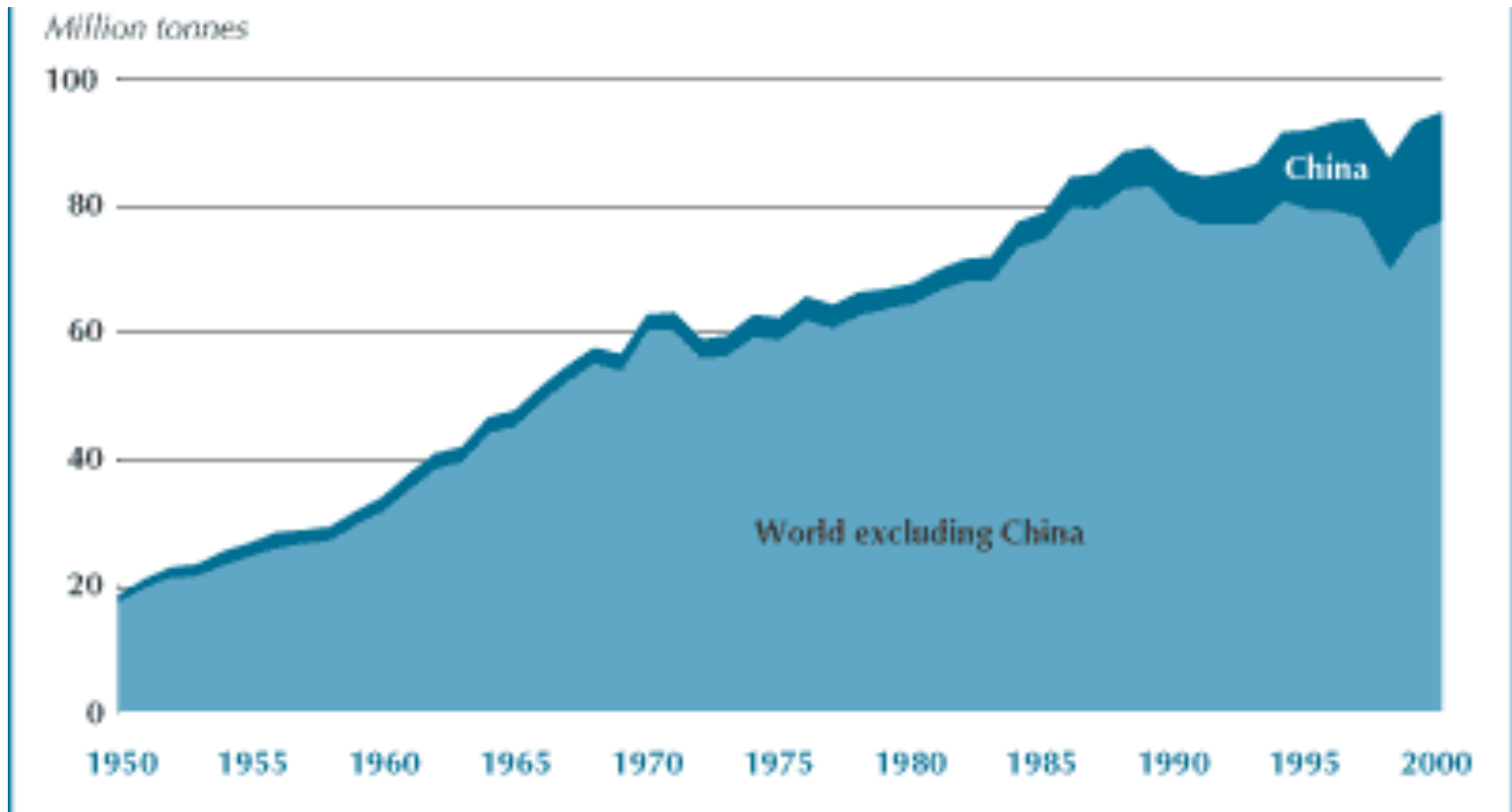
High Medium Medium Low Very low Very low Very low Very low Very low Very low Very low

# Sustainable Fisheries

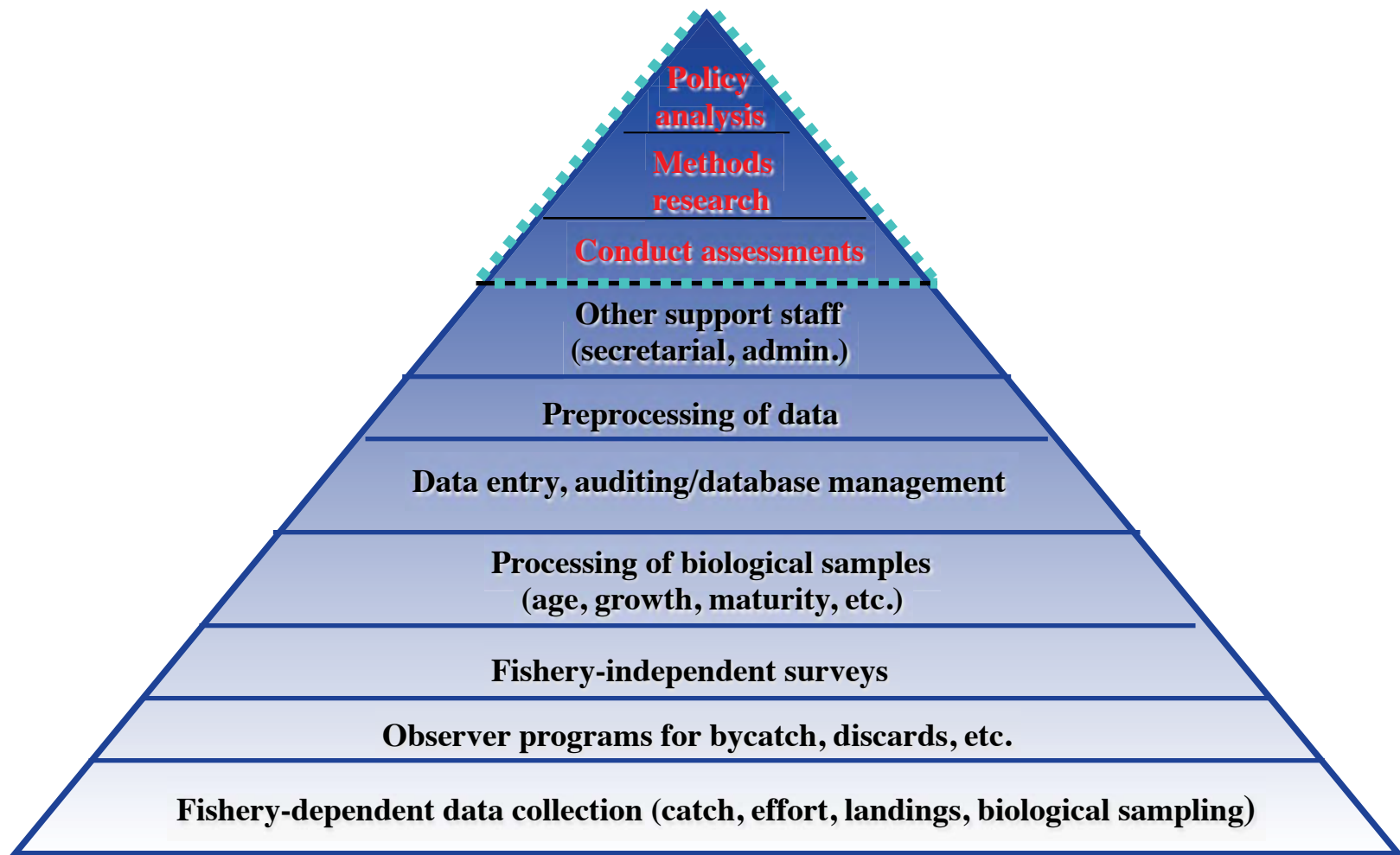
- Some fisheries have lasted for 100s of years
- Many have disappeared quickly
- How do we bring them all back to full production?



# Fisheries Production (capture)



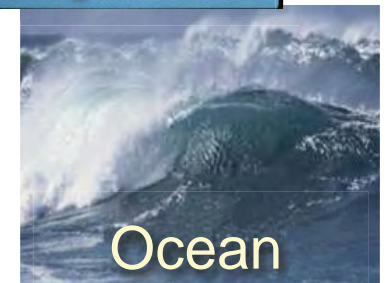
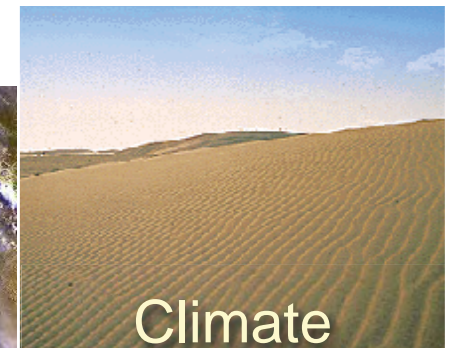
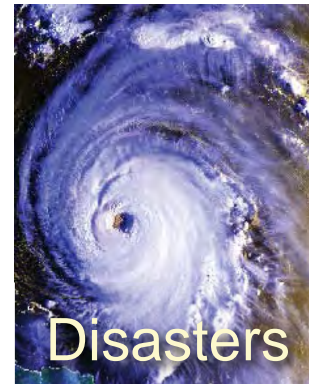




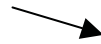
Schematic showing relative staffing requirements in support of providing scientific advice for fisheries management. Staff requirements for stock assessment modeling represent just the tip of the iceberg.

# Observational Needs

- Improved temporal, spatial, and spectral resolution at all scales
- Obtaining observations of new environmental elements
- Sustained data quality and timeliness



# How Much is Enough?



Initial levels of investment in information establish a baseline; intermediate levels of information produce substantial gains, final levels of investment may have diminishing returns on short-term recommendations, but can substantially affect long-term recommendations.





## Navigate the Atlas:

USES ISSUES ABOUT GEOGRAPHY

### Tsunami News:

- Animation of Indian Ocean tsunami
- Height of Tsunami Measured from Space
- Animation of Indian Ocean Tsunami - Global
- Fishers suffered huge material toll from tsunami, UN figures show
- UNESCO To Announce Global Strategy for Establishment of Tsunami Early Warning System

### Other News:

- Governments support new international commitments to reduce overfishing and over
- Scientists Able to Predict Coral Bleaching
- Good Science and Coral Reefs
- Underwater Robot Crosses Gulf Stream
- Sustainable fishing in the Arafura & Timor Seas

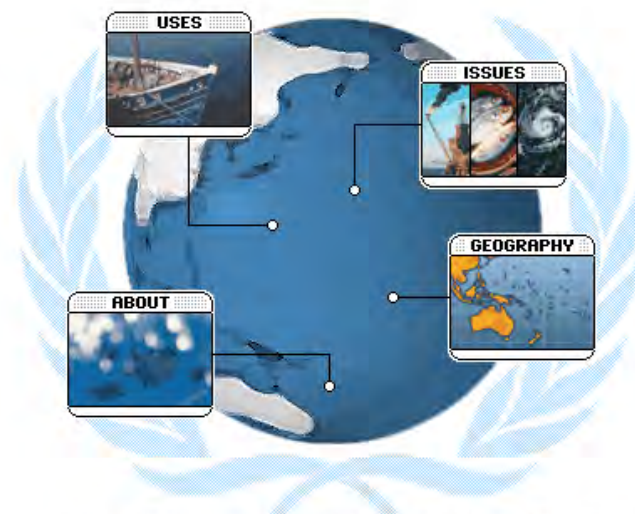
### Recently added/updated Topics:

- Sustainable Development
- Somalia
- International Oceanographic Data and Information Exchange (IODE)
- Science for the Management of Living Marine Resources
- Impact of Tsunamis on Ecosystems
- Thailand
- Sri Lanka
- Maldives

## Welcome to the United Nations Atlas of the Oceans

The Atlas is an information system designed for use by policy makers who need to become familiar with ocean issues and by scientists, students and resource managers who need access to underlying data bases and approaches to sustainability. Information about the Atlas...

**Indian Ocean Tsunami 26 December 2004** To contribute to the tsunami information exchange, become a Member of the UN Atlas community - [Join Now](#)



Comments? Please write to [UN-Atlas-Oceans-Project@fao.org](mailto:UN-Atlas-Oceans-Project@fao.org)

Members: [forgotten your password?](#)

## Partners



# UN Atlas of the Oceans

A photograph of a sunset over the ocean. The sky is filled with vibrant orange and yellow clouds, transitioning to a darker blue at the top. The water in the foreground is dark, reflecting the colors of the sunset. A silhouette of a boat is visible on the left side of the water.

**Photo Credits**

**NOAA**

**NASA**

**UNESCO/IOC**

**<http://www.OceansArt.US>**

**Dr. John T. Everett**

**JohnEverett@OceanAssoc.com**