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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

Global Survey @ 10 years
Research at Sea

OREGON II

ALBATROSS IV

R/V Seward Johnson and JSL sub

NURP-1 ROV
Profiling Autonomous Floats

These are oceanic analogs to radiosondes used in operational meteorology.
Infrastructure - Labs

- Auke Bay
- Sandy Hook
- Montlake
- Miami
Satellites
(Hurricane Isabel)
IR Color Scale
Coccolithophore Blooms -- Bering Sea & Celtic Sea (SeaWiFS True Color)
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

Aircraft data for 10-Jan-99 0000 to 10-Jan-99 2359Z
31119 reports shown, between -240. and 41057. ft
Zoom = 1.50, Center Lat/Lon = (38.75, -98.10)

NOAA/Forecast Systems Laboratory

-240. ft

Failed QC (or too high)
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
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
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
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

Albacore catch drops

Sardine, mackerel catch rises

1976
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 CO2, 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)

- Greenhouse gases
  - Halocarbons
  - N₂O
  - CH₄
  - CO₂
  - Tropospheric ozone
  - Sulphate
  - Stratospheric ozone

- Aerosols + clouds
  - Black carbon from fossil fuel burning
  - Mineral Dust
  - Organic carbon from fossil fuel burning
  - Biomass burning

- Aviation
  - Contrails
  - Cirrus
  - Land use (albedo only)

The height of a bar indicates a best estimate of the forcing, and the accompanying vertical line a likely range of values. Where no bar is present the vertical line only indicates the range in best estimates with no likelihood.
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
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.
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

Members: forgotten your password?

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