The Development of an Ocean Atlas for Fisheries: Progress and Plans for Completion

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PFRP PI Meeting December 4, 2002
Overview

- Progress to date
- Hiring of Mr. Lucas Moxey, new Atlas Coordinator
- Changes in data availability
- Product development
- Partnerships with other data providers
- Data management
Overall Goal

- Deliver environmental information in a manner both useful and usable for application to fisheries management and research in the Pacific basin.
Deliver Useful and Useable Products

- Easily accessed (flexible, consistent systems)
  - Acquisition
  - Transportable formats
- Value-added products
  - Relevant
  - Simple (indices, thresholds, anomalies)
- Sample applications
Contributing Projects

- HL Ecology & Environment Investigation (including Hawaii CoastWatch, funded by NESDIS)
  - J. J. Polovina, Chief

- HL Scientific Information Technology Services
  - D. Tieman, Chief

- HL Coral Reef Ecosystem Investigation
  - R.E. Brainard, Chief

- HL Fish Biology & Ecology Investigation
  - C. Boggs, Chief

- Numerous PFRP projects
  - J. Sibert, Program Manager
The Sibert/Adam
Greater Pacific Basin
Phenomena Important to Pelagic Ecosystems

- Waves
- Tides
- Ocean eddies
- Convergence zones
- ENSO
- PDO
- Atmospheric Storms
- Monsoon
- Climate Changes
Spatial and Temporal Scales of Various Oceanic Phenomena

Foley and Sibert

Directed Development

- Understand Regional Characteristics
  - Climatic conditions
  - Physical dynamics
  - Ecological interest
- Focus on application
  - Choose appropriate platform
  - Work through example
  - Deliver product (and technology)
The Learning Curve

- Various PFRP projects
  - Adam (neural net) – success
  - Lagorn (various) – failed
  - Brainard Bigeye - marginal
  - Pooley and Walsh (and Bigelow) – promising
  - Bigelow PSAT – acceptable
  - Klieber longline – success
Address needs identified at 3 workshops (SCTB 13, 14, and 15)

- Thermocline depth
- Horizontal currents and vertical shear
- “Deep Scattering layer”
- Convergence
Proposed Tools

- Why satellites?
  - Cover all remote areas
  - Viable for long-term continuity
  - Platforms available to handle most basic ocean parameters
  - Can sample at frequencies appropriate to relevant oceanic and atmospheric phenomena.
Basic In Situ Data

- **World Ocean Database, NODC, NOAA** (Temperature, Salinity, Oxygen)

- **NODC/UH SAC Shipboard ADCP Global Database** (Ocean Currents)

- **COADS** (SST, Wind, SLP, Wave Height)

- **NMFS HL Cruise Data** (Temperature, Salinity, Oxygen, Ocean Currents)

- **Drifter Data** (Temperature, Transport)
# Basic Satellite Data

<table>
<thead>
<tr>
<th>Platform/Sensor</th>
<th>Footprint</th>
<th>Frequency</th>
<th>Source</th>
<th>Distribution</th>
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<tr>
<td>POES AVHRR HRPT SST+</td>
<td>1.1 km</td>
<td>2-4 per day</td>
<td>NCAAS</td>
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<td>POES Pathfinder SST</td>
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<td>NASAIJPL</td>
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<td><strong>Derived Products:</strong></td>
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<td>SST, Brightness Temps</td>
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<td>for channels 1-5,</td>
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<td>Aerosol optical Depth</td>
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<td>Stress Curl, Ekman</td>
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<td>Currents, Ekman</td>
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<td>Upwelling</td>
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<td>TOPEX SSH</td>
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<td>NASAIJPL</td>
<td>By Request</td>
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<tr>
<td>TOPEX SWH</td>
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<td>By Request</td>
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<td><strong>Derived Products:</strong></td>
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<tr>
<td>SSH, Geostrophic</td>
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<td>currents, SWH</td>
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<td>By Request</td>
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<td>Rates, Ocean Optical</td>
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<tr>
<td>Depth</td>
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</table>
Basic Model Output

SODA Data Re-analysis Product
OGCM with Data Assimilation
January Climatology

Zonal Current, 7m Depth

Meridional Current, 7m Depth

Currents, Temperature and Salinity
Approximately 14 levels in upper 200 metres
Monthly Data from 1950 to 1997

Data Courtesy of UH/SOEST/IPRC
Produced by Carton et al., JPO, in press
Adapting to Changes in Data Availability

- GODAE (Global Data Assimilation)
  - Data “re-analysis” products
    - Near real time
    - Historical
  - Sample data sets available now
  - Fully on-line by 2006
Products for Atlas

- Convergence time series
  - Marine debris
  - Interaction of LL fishery and turtles
- Underwater light fields
  - Modeled using satellite chlorophyll, insolation, wind speed
  - Deep scattering layer
  - Visibility
Products for Atlas

- Surface ocean currents
  - Larval transport
  - Longline effectiveness
- Extracted time series and climatologies
  - Ground truth / sky truth
  - Provide regional context for analysis
Comparing Different Spatial Scales

Sea Surface Temperature Comparison
Koko Head in situ and Satellite 1° x 1° box around Oahu

SST (°C)

Year (C.E.)

1° longitude

1° latitude

O`ahu

Koko Head

Bucket sample

AVHRR MCSST
The Importance of Time Series

Oahu Temperatures 1945 - 2000 (ongoing)
Tide Gauge, Koko Head, and Satellite

SST (degrees C)

Tabata Tide Gauge
(- 0.92 degrees C)
(1945 - 1978)

NMFS Koko Head Bucket
(1955 - 1992)

AVHRR Satellite
(1984 - ongoing)

Year (A.D.)
SST at Maro Reef

- Define minimum acceptable performance
- Know when it works
- Know when it fails
- Devise regional calibrations

Sea Surface Temperature at Maro Reef
*In situ* and Satellite-based measurements

Mooring deployed at 25° 26.791' N latitude, 170° 38.029' W longitude

Works

Fails

**Day of Year, 2001**

In Situ data from NOAA Fisheries Honolulu Laboratory
Coral Reef Ecosystem Investigation (R. Brainard)
AVHRR/GAC SST data from NOAA/NESDIS/OSD/PD (J. Sapper)
GOES-10 SST data from NOAA/NESDIS/ORAD (E. Maturi)
Additional processing and assembly by Hawaii and Northeast Coastwatches
Regional Subsets

Regional Coverage

- Western Pacific
- North Pacific Transition Zone
- Hawaiian Archipelago
- North Equatorial Current
- North Equatorial Counter Current
- American Samoa
- Pacific Basin
Timeseries and Climatologies
Data Compilation
Windows

In-Situ Window

Remote Sensing Window
SST near Laysan
Temperature near Laysan
New Product
Underwater light

- **Normalized Solar irradiance**
  - Solar emission and orbital parameters
  - Atmospheric radiative transfer
  - Satellite based estimates of clouds

- **Propagation through air/sea interface**
  - Surface wave spectrum
    - Satellite wind measurements
  - Monte Carlo “ray-tracing”
New product
Underwater Light

- Underwater radiative transfer
  - Attenuation by seawater
  - Attenuation by phytoplankton
    - Derived chlorophyll profiles
      - Satellite chlorophyll
      - Mixed layer depth
  - Monte Carlo method
- Bottom reflectance for insular work
Data Management

- All processing and storage on-site
  - CoastWatch
    - Near real time products
  - Atlas
    - Science quality images
    - Extracted time series
    - Climatologies
    - Complementary in situ data
Production of metadata for every product

- Compliance with FGDC
- Compliance with NASA-EOS
- Compliance with NOAA-NODC
- Compliance with all other data providers
Database Management

- Coordinate with HL Data Registry
  - Hierarchical scheme defined
  - Infrastructure being developed
  - Coastwatch and Atlas “trial patients”
- Distribute through the Atlas web server
  - Large storage capacity
  - Regular backups
  - Decent user interface
Insuring Continuity

- Infrastructure at HL designed to last 4-6 years
- Partner with IPRC or similar to adopt products that prove useful
  - They have the infrastructure and expertise to distill all new data streams
  - Their managers want “fisheries applications
- CoastWatch may become “OceanWatch”
Immediate Plans

- Develop and test web interface
- Develop, test, and run light model
- Acquire output from latest NRL model
- Establish link to SOPAC in Fiji
  - Cover the non-US islands
- Establish study areas for in-depth characterization.
# Targets Dates for Project Completion

<table>
<thead>
<tr>
<th>Atlas Task</th>
<th>FY03 1st quarter</th>
<th>FY03 2nd quarter</th>
<th>FY03 3rd quarter</th>
<th>FY03 4th quarter</th>
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<tbody>
<tr>
<td>Get web site on-line</td>
<td></td>
<td></td>
<td></td>
<td>Continues through end of project</td>
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<tr>
<td></td>
<td></td>
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<td>Jan 15, 2003</td>
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<tr>
<td>Let there be light</td>
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<td>Continues indefinitely</td>
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<tr>
<td>Data from GODAE/NRL</td>
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<td></td>
<td>Jan 15, 2003</td>
<td>Continues indefinitely via CoastWatch</td>
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<tr>
<td>Acquire satellite data</td>
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<td>Continued on ad hoc basis by CoastWatch</td>
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<tr>
<td>Reprocess satellite data</td>
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<td>Jan 15, 2003</td>
<td>Continues through end of project</td>
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<tr>
<td>Produce Atlases</td>
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<td>Continues through end of project</td>
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<td>Distribute Atlases</td>
<td>Feb 15, 2003</td>
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