NOAA Fisheries mandate is to act as a steward of living marine resources, which involves ecosystem and habitat characterization and stock assessment (i.e. NMFS does not help fishers find fish).

Better characterization of the coastal zone is of interest to NMFS since many commercial and recreational fisheries are focused in the coastal zone.

Altimetry data is commonly used in the open ocean to provide an environmental context to tracked animals, in particular how animals interact with mesoscale features.

Coastal measurements of velocity and transport would be useful to NMFS. The west coast node of CoastWatch is planning to implement a near shore transport product to better engage coastal resource managers.
NOAA Fisheries (NMFS) is responsible for managing over 900 fish stocks (stock assessment).

In addition, NMFS manages ~260 protected or endangered species.

NMFS is transitioning to ecosystem approaches to management.
  - Ecosystem characterization of tagged species
  - Improving stock assessments

NMFS does **not** help fishermen find fish
Fisheries focused in Coastal Zone

CA 2006 Landings

Coastal (0-3 miles)
EEZ (3-200 miles)
High Seas (>200 miles)

Dollars
- $101M (78%)
- $27M

Weight
- 278M lbs (82%)
- 62M lbs

Source:
NOAA Fisheries Office of Science & Technology
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!
Some Example Applications

Coastal Altimetry Workshop, Silver Spring, MD  Feb 5-7 2008
Electronic tagging is a key methodology used by NOAA Fisheries to gather information on stock productivity and recruitment, fish behavior, feeding ecology and habitat selection—the information needed for accurate and responsible fisheries management.¹

Satellite data, such as ocean color, SST, SSH and SVW, are necessary to place the telemetric data from tags in an environmental context as part of the transition to an ecosystem approach to management.


http://spo.nmfs.noaa.gov/tm
Characterizing Turtle Habitat

Loggerhead turtle tracks (black line and blue arrows)

Polovina et al., DSR-II, 2006  NOAA/NMFS/PIFSC
Loggerhead turtle tracks (black line and blue arrows) overlaid over geostrophic currents (white arrows) and SSH.

*Polovina et al., DSR-II, 2006*  
NOAA/NMFS/PIFSC
Understanding Turtle Migration Patterns

Winter

Turtles prefer the Kuroshio Extension Current (KEC) in winter when chlorophyll is high. In summer, when chlorophyll decreases, they migrate north into the TZCF (transitional zone chlorophyll front).

Summer

Polovina et al., DSR-II, 2006
NOAA/NMFS/PIFSC
Simulating Larval Dispersion

Satellite altimetry data used to simulate the transport dynamics of the spiny lobster, *Panulirus marginatus*, around the Hawaiian Islands.

*Polovina et al., Fish. Bull., 1999*  NOAA/NMFS/PIFSC
Hawaiian Bottomfish (snappers, groupers, jacks)

- Pilot project to assess if inclusion of satellite data can improve the stock assessment of Hawaiian Bottomfish. Led by Jon Brodziak at NMFS/PIFSC.
- There is a consistent pattern of negative association between SSH anomalies and CPUE (catch per unit effort) residuals for Hawaiian Bottomfish, suggesting that the inclusion of satellite-derived SSH could improve the stock assessment of Hawaiian Bottomfish.
- Funded in part by NASA and by NOAA’s R&O project

Objective
Explore integrating satellite derived environmental time series (SST, chl, SSH) into the sablefish stock assessment to reduce recruitment uncertainty

Sablefish (*Anoplopoma fimbria*)
- Fast growing, wide distribution, highly valuable ($100M) commercial species
- Adults generally at 200+ meters in continental slope, gullies, fjords

Early life history largely unknown
- Spawning at depth, larvae swim to surface, collect at shelf break
- Juveniles move nearshore to overwinter, then offshore in summer
- Reach adult habitat and recruit to fishery or survey in 4 to 5 years

Recruitment calculated in age-structure model
- Recruitments are estimated as two year-olds
- Estimates for most recent years are highly variable with large uncertainty and excluded from model projections
The high temporal and spatial resolution of satellite data, and its continuity, make satellite data an important tool for monitoring and characterizing marine ecosystems.

Satellite data will become increasingly more important as NOAA implements ecosystem approaches to management.

Currently, however, the full potential of satellite data has not been realized within NMFS, or within fisheries science more generally.

Why is satellite data underutilized within NMFS?

What can be done to take advantage of the wealth of information this data can provide?
Why is satellite data underutilized within NMFS?

1) Satellite data can be difficult to access, manipulate and process, particularly for people who have never used it before.

2) Work required to get relevant parameters can be cumbersome, ie:
   - current/transport information from SSH
   - front locations from SST fields
   - climatologies required to generate anomalies
   - rigorous ‘data mining’ needed to match up satellite data with telemetry records.

3) Timeseries of satellite data are relatively short compared to many fisheries datasets.

4) Higher resolution (spatial and temporal) datasets needed for coastal areas.
• Compared to many fisheries datasets, the time series of satellite data are relatively short:
  - Sea Ice: 1979 →
  - SST: 1985 →
  - SSH: 1993 →
  - Chlorophyll: 1997 →
  - Wind: 1999 →

• Subsequently it can be difficult to impress fisheries scientists of the benefits of using satellite data.

• It’s essential that climate quality records of satellite data be maintained!

From Chavez et al. [Science, 2003]
The Issues

1) Satellite data can be difficult to access, manipulate and process, particularly for people who have never used it before.

2) Work required to get relevant parameters can be cumbersome, ie:
   • current/transport information from SSH
   • front locations from SST fields
   • climatologies required to generate anomalies
   • rigorous ‘data mining’ needed to match up satellite data with telemetry records.

What can be done to address these issues?
NOAA Satellite Data Training Course

- 3-day (free!) course for 30 NMFS or NOS participants wanting to learn how to access & use satellite data

- Held at OSU/CIOSS in Corvallis, OR:
  Aug 22-24, 2006
  Mar 26-28, 2007
  Mar 24-26, 2008

- 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 and Matlab applications.

- Participants expected to bring projects to work on.

- Course initiated by funding from NOAA’s R&O project.

- The learning experience goes two ways. From conducting these courses we get a better idea of users’ needs and wants, and are subsequentially better able to address those needs.
Viewing Anomalies

BloomWatch 360
Create custom maps and download near-real-time oceanographic data. [Help]

Edit:
- The Map
- Grid Data
- Contour Data
- Vector Data
- Station Vector Data
- Station Data 1
- Station Data 2

1) Select a data set: Chlorophyll-a, Aqua MODIS, NPP, 0.05 degrees, Global, Science Quality
2) Select a time period: 5 day, 8 day, 1 month
3) Select a centered time (GMT): 2006-06-16 00:00:00
4) View: Data, Anomalies (Data - Climatologies)
5) Select the units: mg m^3
6) Select a palette: BlueWhiteRed
7) Download the anomaly data: asc, ESRI_asc, Google Earth, grd, hof, mat, nc, nclheader, tif, xyz, FGDC
8) Optional: Enter a longitude 240.144 and latitude 46.927 or click on the map to see a time series of 'Time Period' averages.
9) Select a begin time (GMT): 2005-12-16 12:00:00
10) Download time series: (No data is available for the current lat/lon range, Time Period and End Date) Data Set Info

Providing climatologies & anomalies made possible by NOAA’s R&O program.
Viewing Timeseries

Simply clicking on any point on the map will generate a timeseries at that location.

Science quality satellite timeseries are crucial to NMFS.
Comparing Datasets

AVHRR SST from 4/27-5/04 2007
Overlay of in-situ SST data from NDBC buoys from the same time period
Ability created in response to needs of IOOS RAs
• Timescales relevant to understanding population variability are interannual and decadal.

• NMFS is transitioning to ecosystem approaches to management.
  - Ecosystem characterization of tagged species
  - Improving stock assessments

• Many fisheries scientists are not familiar with satellite data.