NOAA CoastWatch/OceanWatch/PolarWatch: Aiding Value-Chain Transitions from Data to Applications

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And the
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NOAA/NESDIS/STAR Seminar Series
20 November 2019
Questions

• Where are the gaps in operational satellite ocean/coast/water data or data products?
• What barriers to access and use are perceived by stakeholders?
• How do we fill these gaps and bridge these barriers?
• Where are the opportunities for expanding the number and types of applications that could benefit from satellite data?
Outine

• What is the “value chain”?
• What is “moderate assurance” operational satellite oceanography?
• What ocean/coastal/inland water observations can we get from satellites?
• What is NOAA CoastWatch/OceanWatch/PolarWatch
• What are our future directions, challenges, and opportunities?
• How are we aiding in the use of satellite data for applications, decisions and social benefit?

STAR scientists have roles as both “users” and “providers”
Value Chain of Data, Products, Information, Knowledge

- **Data**: (~from bytes to geophysical parameters)
- **Data Products**: (~from swath/granule to merged, mapped, anomalies, etc.)
- **Information**: (such as combine data types, outside information, get the full picture)
- **Knowledge**: *to inform actions*

*There are gaps*
Expanding the “operational” paradigm

• Routine and sustained provision of accurate, consistent, mature and fit for purpose, well-described, discoverable and accessible oceanographic satellite observations spanning different time-scales (i.e., NRT to climate) for multiple uses (e.g., research, applications and services) that lead to decisions and actions.

• Can be high assurance/high-service, or moderate assurance/moderate-service
Expanding the “operational” paradigm

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Ocean (Water) Parameters from SPACE

- Temperature (SST)
- Sea Level Anomaly
- Ocean Surface Vector Winds
- Ocean Color
- Sea Ice
- Imagery
- Surface Salinity
- SAR

("roughness" e.g., ice, winds, oil spills, etc.)
Satellite input - Model output: e.g., Seascapes Product

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US and global Marine Biodiversity Observation Network (MBON) scientists (Kananaugh, Muller-Karger and others) partnered with US Integrated Ocean Observation System (IOOS), NOAA/OAR/AOML and NOAA/NESDIS/STAR (NOAA CoastWatch/OceanWatch)

1987, Unprecedented HAB in NC. Satellite SST points to likely source.

An expatriate red tide bloom: Transport, distribution, and persistence

Abstract—In November 1987, the toxic dinoflagellate Gymnodinium breve bloomed in North Carolina nearshore waters. This occurrence was the first record of *G. breve* north of Florida, a range extension of >800 km. We propose the (Gulf of Mexico) Loop Current-Florida Current-Gulf Stream system as the transport mechanism for *G. breve* cells from a late summer bloom off the southwest coast of Florida (Charlotte Harbor–Sarasota). The estimated transit time for cells around the peninsula and northward to the continental shelf off North Carolina is 22–54 d.

About 30 d after the Charlotte Harbor–Sarasota bloom, satellite images of sea-surface temperature substantiated the shoreward movement of a filament of Gulf Stream water onto the nearshore continental shelf between Cape Hatteras and Cape Lookout. The filament, likely a proxy source of *G. breve* cells, remained in nearshore waters and was identifiable in satellite images for >19 d. Once the bloom was inshore, both windspeed and direction were important in determining its distribution.

The toxic dinoflagellate *Gymnodinium breve* (Davis 1948) (formerly *Psychodiscus*...
CoastWatch/OceanWatch Data

- Timeline of Satellite Oceanographic Data Products

1 Petabyte
Aid in the use of ocean /aquatic satellite data along the value chain from observations to decision-making

- Data Search and Access
- Product Descriptions
- Value added product development and distribution
- Data monitoring (quality/quantity)
- Transition new products
- Outreach, training, education
- User engagement
- Feedback to satellite science

CoastWatch.NOAA.gov
CoastWatch mission is to help users access and use satellite data

- Provide access to datasets with data servers
- Develop tools and tutorials to help users access and use data
- Provide training and hands-on assistance
- Find or create products in response to users needs
- Work directly with users on projects

*The CoastWatch Nodes are Value Added Providers*
NOAA CoastWatch/OceanWatch/PolarWatch Program

**NOAA Data Providers**
- SOCD
- STAR
- OSPO
- NCEI
- OAR
- NWS

**External Data Providers**
- USGS
- NASA
- Copernicus; EUMETSAT; ESA (Sentinels)
- JAXA

**External Users**
- Federal Agencies
- State Agencies
- Commercial
- Academia
- International
- General Public

**“HUB and SPOKES”**
## Contact information for the nodes, central office and program

<table>
<thead>
<tr>
<th>Region</th>
<th>Ops Manager</th>
<th>Node Manager</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central Pacific OceanWatch</strong></td>
<td>Melanie Abecassis</td>
<td>Evan Howell</td>
<td>oceanwatch.pifsc.noaa.gov</td>
</tr>
<tr>
<td><strong>Caribbean/Gulf of Mexico, Atlantic OceanWatch</strong></td>
<td>Joaquin A. Trinanes</td>
<td>Gustavo Goni</td>
<td>cwcaribbean.aoml.noaa.gov</td>
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<td><strong>Great Lakes</strong></td>
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<td>Philip Chu</td>
<td>coastwatch.glerl.noaa.gov</td>
</tr>
<tr>
<td><strong>West Coast</strong></td>
<td>Dale Robinson</td>
<td>Cara Wilson</td>
<td>coastwatch.pfeg.noaa.gov</td>
</tr>
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<td>Jennifer Sevadjian</td>
<td>Cara Wilson</td>
<td>polarwatch.noaa.gov</td>
</tr>
</tbody>
</table>

**CoastWatch Central**
- Contact email and helpdesk: coastwatch.info@noaa.gov
- Website: coastwatch.noaa.gov

**CoastWatch/OceanWatch/PolarWatch Program**
- Program Manager: Veronica Lance, veronica.lance@noaa.gov

**STAR Seminar, 20 November 2019, NCWCP, College Park, MD**
Typical Product Lifecycle

Experimental  Pre-operational/Developmental  Operational

Reanalysis/Reprocessing

Data Access by USERS

Archive & Science Worthy
Collections

OceanData “Collection”

Data Collection

Quality Data replaces 15-day old NRT data

Near Real-time
Science Quality / Delayed / Reanalysis

Launch
Post-Commissioning
Reprocessing
Reprocessed V2
Forward Stream V2
2 Weeks Ago
Today

Time

*Early mission data are not routinely distributed due to quality issues. They can be specially requested but will come with a quality warning.
## Consistent NRT & Science Quality Datasets
### Example from NOAA MSL12 VIIRS Ocean Color

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Near-Real Time</th>
<th>Delayed-Mode/Science-Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency:</td>
<td>Best effort, as soon as possible (~12-24h)</td>
<td>Best effort, on a 2-week delay</td>
</tr>
<tr>
<td>Processing System:</td>
<td><strong>MSL12</strong> (v1.01; will transition to v1.2x)</td>
<td><strong>MSL12</strong> (v1.2x)</td>
</tr>
<tr>
<td>SDR:</td>
<td><strong>IDPS Operational SDR</strong></td>
<td><strong>OC-improved SDR</strong></td>
</tr>
<tr>
<td>Ancillary Data:</td>
<td>Global Forecast System (GFS) Model</td>
<td>Science quality (assimilated; GDAS) from NCEP</td>
</tr>
<tr>
<td>Spatial Coverage:</td>
<td>May be gaps due to various issues</td>
<td>Complete global coverage</td>
</tr>
<tr>
<td>Processed by:</td>
<td>OSPO (operational)</td>
<td>NOAA/STAR</td>
</tr>
<tr>
<td>Distributed by:</td>
<td>CoastWatch, OSPO</td>
<td>CoastWatch, NCEI</td>
</tr>
<tr>
<td>Archive Plans:</td>
<td>Yes, from OSPO to NCEI</td>
<td>Yes, from CoastWatch to NCEI</td>
</tr>
<tr>
<td>Full Mission Reprocessing:</td>
<td>No</td>
<td>Yes, every ~2-3 years or as needed</td>
</tr>
</tbody>
</table>
CoastWatch “Value Added” Products
Example: VIIRS Hi-Res Sectors Co-Located for Ocean Color and SST
CoastWatch “Value Added” Products
Example: Hi-Res Sectors for OLCI S3 (=VIIRS x9)
Satellite Data Products Pages

- Data Access
  - ERDDAP
  - THREDS
  - FTP
  - NRT
- Science Quality, RAN or Delayed Mode
- Description text
- Standardized tabular product information
- Documentation
Data Portal

- Visualize
- Layer
- Probe
- Subset
  - Time
  - Space
- Download

https://coastwatch.noaa.gov/cw_html/cwViewer.html
Data Portal Tutorial Animation

Downloading and subsetting data  
https://coastwatch.noaa.gov/cw_html/cwViewer.html
Ocean Monitor

- Maps
- Timeseries
- Hovmöller Diagrams
- Reference Data Sets

https://www.star.nesdis.noaa.gov/socd/om/
Data Performance Tracking

- Monitors data
  - availability
  - stability
- Quantitative, statistics

https://www.star.nesdis.noaa.gov/sod/mecb/coastwatch/NRT-QA/QM_Reports.html
CoastWatch Utilities and CDAT Software

CoastWatch Utilities 3.5.0

Table of Contents

- Software Features
- New in Version 3.5.0 (build 924)
- Screenshots
- Downloads
- Documentation
- Presentations

https://coastwatch.noaa.gov/cw/user-resources/coastwatch-utilities.html
NOAA CoastWatch Satellite Training

Coastwatch.info@noaa.gov

https://coastwatch.noaa.gov/cw/user-resources/satellite-data-training-courses.html

Upcoming full 3-day courses Spring 2020

• **San Juan PR** - 5 to 7 February at the University of Puerto Rico

• **Anchorage, AK** - Tentative dates 7 to 9 April, Alaska Fisheries Science Center

• **Charleston, SC.** – Dates TBD - in association with Hollings Marine Laboratory
NOAA CoastWatch Future Directions

**Challenges & Opportunities:**

- Knowing our users (and what they use, how they access, etc.)
- Fully mine and exploit data access logs (no required “registration” process)
- Data product database development including key users
- Proactively and systematically asking permission for users to be identified for specific purposes
- Establish an online user forum
- Overcoming language barriers to make satellite data products more understandable
  - Increasing the number of in-person, hands-on training classes
  - Improve online self-learning materials (“Learning Portal”)
  - Develop university (at UMD?) course and/or curriculum
- Improve user experience on website
  - Data visualization
  - Data searches and access
  - Quality tracking
  - Themed portals
  - Event tracker
- Develop or identify new value added products, derived products, L4 analysis products, etc.
  - that serve specific or multiple applications
  - transition them to operations
  - In situ databases and satellite matchups
- Grow the definition and implementation of “moderate assurance”
  - Quantification
  - Infrastructure IT requirements
  - Conveying benefits/limitations of datasets (both content and technical) to users
- Document history of CoastWatch (pre-proposal submitted to 2019 NOAA Heritage Program)
Upcoming CW/STAR presentations:

- Data Portal – Michael Soracco
- OceanWatch Monitor – Prasanjit Dash
- Data Access and Stability Monitor – Sathya Ramachandran
- Training and Tutorials – Melanie Abecassis

Recent CW/STAR presentations:

- PolarWatch – Jenn Sevadjian 8/29/2019 [NOAA Polar Watch](NOAA Polar Watch)
- ERDDAP – Cara Wilson 8/22/2019 [ERDDAP](ERDDAP)
Applications and Research Examples
Observation inputs:
• NRT Geo-Polar Blended Day-Night SST
• AMSR-2 sea ice concentration

Application:
initialize the Coupled Arctic Forecast Systems (CAFS) model. CAFS will be used during the upcoming Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) field campaign.

Distributed through: CW Central

*Courtesy: Janet Intrieri and Amy Solomon at NOAA/ESRL Physical Sciences Division, Boulder, CO from their Web site https://www.esrl.noaa.gov/psd/*
EcoCast

Observations: SST, chl, EKE, SSH, winds

Application: Bycatch avoidance
Distributed through: CW West Coast Node

This project is funded in part through JPSS/PGRR

Courtesy: Elliot Hazen, Heather Welch, NMFS SWFSC developers and Dale Robinson, operations production West Coast Node

https://coastwatch.pfeg.noaa.gov/ecocast/map_product.html
C-HARM 3-Day Advanced Forecast:

*Pseudo-nitzschia*, cellular domoic acid, and particulate domoic acid probability, California and Southern Oregon coast

Observations: SST and Chlorophyll

Application: Human health, wildlife health, shellfish aquaculture, etc.

Courtesy: Dale Robinson, West Coast Node; Developed by Kudela et al.. UC Santa Cruz, etc.
Local validation of global satellite product for further use.
Example Slide from Recent 3-Day CoastWatch Satellite Training Course

**Observation:** SST

**Application:** Management of Flower Garden Banks National Marine Sanctuary

_Courtesy: Michelle A. Johnston, NOAA_
Seward Peninsula is host to natural and cultural resources significant enough for the majority of the northeast coast to be designated a Natural Preserve.

Storm activity in ice-free conditions is accelerating erosion.

Erosion threatens coastal villages, important archeological artifacts and migratory bird habitat.
Sediment Plume 2018 Unprecedented Rainfall, Chesapeake Bay

Sediment plumes per peak discharge event – as seen by satellite
USGS Susquehanna River discharge at Conowingo, MD / NOAA Total Suspended Matter

Note: satellite view only available in cloud-free conditions
First International Operational Satellite Oceanography Symposium

18 to 20 June 2019
National Climate and Weather Prediction Center
College Park, MD USA

2nd In’tl OSO Symposium
Spring 2021
Germany
9-13 December 2019, San Francisco

E-Lightning and Poster Sessions:
Oceanography from Space: Applications for Satellite-based Ocean Observations
https://agu.confex.com/agu/fm19/gateway.cgi

Town Hall:
NOAA Ocean Satellite Data Products for Science and Applications
https://agu.confex.com/agu/fm19/gateway.cgi

And Ocean Sciences
February 2020, San Diego
Questions?

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