An Overview of the IGOS Coastal Theme

Coastal Theme Co-Chairs:

Dr. Paul M. DiGiacomo
Jet Propulsion Laboratory

Prof. Liana Talaue-McManus
University of Miami
Goal of IGOS Coastal Theme:

Develop a strategy for integrated global observations that will provide improved understanding of earth system variability and change in the coastal zone, with a particular emphasis on the land-sea-air interface.

Objectives:

- **Specify** coastal user information needs and observation requirements
- **Evaluate** existing/planned capabilities and identify gaps & continuity needs
- **Establish** a framework to integrate observations across the land-sea-air interface in support of coastal research and improved coastal management
- **Stimulate & facilitate** coordination & collaboration among diverse groups/organizations
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<thead>
<tr>
<th>Chairs:</th>
<th>AFFILIATION</th>
<th>COUNTRY</th>
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<tbody>
<tr>
<td>Paul DiGiacomo</td>
<td>NASA-JPL/ CEOS</td>
<td>USA</td>
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<td>Liana Talaue McManus</td>
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<td>USA</td>
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<td>CEOS representatives:</td>
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<tr>
<td>Daniel DeLisle</td>
<td>CSA/ CEOS</td>
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<td>Hiroshi Kawamura</td>
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<td>JAPAN</td>
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<td>Shailesh Nayak</td>
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<td>INDIA</td>
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<td>Andreas Nuemann</td>
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<td>NOAA/ CEOS</td>
<td>USA</td>
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<td>Michael Hales</td>
<td>NOAA/ CEOS</td>
<td>USA</td>
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<td>“User” representatives:</td>
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<tr>
<td>Robert Christian</td>
<td>E. CAROLINA UNIV/ C-GTOS (Chair)</td>
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<td>Tom Malone</td>
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<td>USA</td>
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<td>Thorkild Aarup</td>
<td>IOC/ GOOS-COOP</td>
<td>FRANCE</td>
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<tr>
<td>Julie Hall</td>
<td>NIWA/ GOOS-COOP/ IGBP-IMBER (Chair)</td>
<td>NEW ZEALAND</td>
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<td>Arthur Dahl</td>
<td>UNEP/ IGOS CORAL REEF SUBTHEME (Chair)</td>
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<td>MEXICO</td>
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<td>Sin-Iti Iwasaki</td>
<td>NRI FOR EARTH SCIENCE &amp; PREVENTION</td>
<td>JAPAN</td>
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<tr>
<td>Nicole Lenôtre</td>
<td>BRGM</td>
<td>FRANCE</td>
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Expected Benefits of IGOS Coastal Theme

• **Identify** gaps in observations and reduce unnecessary duplication

• **Strengthen** the linkage between *in situ* and space-based observations, integrated with watershed-ocean models, for coastal research and management applications

• **Stimulate** building of long-term coastal data sets

• **Assist** in the design and implementation of the coastal components of GOOS and GTOS

• **Establish** priorities for research & development projects to improve the operational elements of observing systems and other programmes

• **Support** user needs through improved products and services

• **Cross-cutting** links w/IGOS Water Cycle, Ocean, Geohazards, Carbon Themes
Key Milestones to date

- Jan. 2003: Coastal Theme Workshop #1 in Washington, D.C.
- June 2003: Approval of Coastal Theme proposal at IGOS-P-10 meeting
- Nov. 2003: Coastal Theme Workshop #2 in Hamilton, New Zealand
- Feb. 2004: Presentation at CEOS-SIT-13 and IGOS International Workshop
- Feb. 2004: Coastal Theme Workshop #3 in Paris, France
- May 2004: Presentation on Coastal Theme at CEOS-SIT-14 and IGOS-P-11
- July 2004: Presentation on Coastal Theme at COSPAR meeting in Paris, France
- Nov. 2004: Tentative Approval of Coastal Theme Report by IGOS-P/CEOS-SIT
IGOS COASTAL THEME: PRIORITY ISSUES

Coastal Human Populations
- Coastal Hazards
- Coastal Development & Urbanization

Coastal Ecosystems
- Hydrological & Biogeochemical Cycles
- Ecosystem Health & Productivity
  - Coral Reef Subtheme
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<tr>
<th>IGOS COASTAL THEME</th>
<th>GEOSS THRUSTS</th>
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<tr>
<td><strong>USER ISSUES</strong></td>
<td><strong>CLIMATE VARIABILITY &amp; CHANGE</strong></td>
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<td>Coastal hazards</td>
<td>Disasters</td>
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<tr>
<td>Coastal development &amp; urbanization</td>
<td>Human Health &amp; Agriculture; energy management</td>
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<td>Ecosystem health &amp; productivity</td>
<td>Ecosystem &amp; biodiversity</td>
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<tr>
<td>Hydrological &amp; biogeochemical cycles</td>
<td>Water cycle &amp; weather thrusts</td>
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Targeted User Groups

- Regional & global environmental assessments, agencies, accords & conventions
- Advisory & regulatory agencies
- National governments
- Research communities
- Commercial organizations
Coastal Observing Requirements

**Geophysical:**
- ocean winds, waves, sea surface height, currents, salinity, temperature, discharge, precipitation, ice cover;

**Biological and Biogeochemical:**
- pigments, nutrients, particulate and dissolved matter, aerosol properties, slicks and spills, fluorescence, optical properties, O\textsubscript{2} and pCO\textsubscript{2};

**Mapping (Physical, Ecological, and Socio-Economic):**
- topography, bathymetry, shoreline position & use, high/low tide lines, habitat types and condition, land cover/use, reef maps, coastal population assessments/demographics.
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$=>$ Existing space observations provide inadequate spatial, temporal and/or spectral resolution and coverage of coastal regions!
<table>
<thead>
<tr>
<th>Observation</th>
<th>Knowledge Challenges</th>
<th>Resolution Challenges</th>
<th>Continuity Challenges</th>
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</table>
| Geophysical | • Blending SST data streams  
• Measuring salinity remotely  
• Improve SSH measurements  
• measure currents from space  
• Assimilate HF radar data and derive user products  
• Develop SAR algorithms & assess other measurements | • Extracting higher resolution info from satellite wind sensors  
• Add additional Doppler weather radar & HF radar sites | • Maintain and expand stream & tide gauge networks  
• Maintain microwave RS capabilities for ice  
• facilitate HF radar transition: research to operational mode |
| Bio-optical & Biochemical | • Hyperspectral ocean color  
• Improve bio-optical algorithms  
• Merged chlorophyll products  
• Ocean color/ SAR data relationships with ecology  
• Taxonomic discrimination  
• Improve aerosol characterization | • Need ocean color observations from geostationary orbit  
• more nutrient measurements  
• Rapid & accurate pollutant/pathogen assays | • Maintain global multi-spectral ocean color observations for context and climate data records |
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<th>Resolution Challenges</th>
<th>Community Challenges</th>
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<tr>
<td>Mapping</td>
<td>• Need a common habitat classification system</td>
<td>• Require high spatial res. hyperspectral imagery for corals and vegetation</td>
<td>• Maintain DMSP-OLS for human population assessments</td>
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<td>• Spatially explicit socio-economic variables</td>
<td>• Improve availability and use of high-res. color and lidar data for physical mapping</td>
<td>• Maintain high-res. multispectral optical imagers for habitat maps</td>
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<td>• Access to highest res.</td>
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<td>CROSS CUTTING</td>
<td>• Satellite CAL/VAL &amp; Standardize &amp; QA/QC in situ obs</td>
<td>• require improved temporal &amp; spatial resolution from satellite sensors</td>
<td>• Need to facilitate transition from research to operational satellites</td>
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<td>• Adaptive sampling</td>
<td>• Expand coverage of in situ measurements</td>
<td>• Need to maintain and replace in situ assets</td>
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<td>• Power/telemetry/biofouling issues</td>
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Recommended Space Agency Observing Priorities for Coastal Areas

- **Provide**
  - geostationary, hyperspectral sea spectral reflectance observations of coastal areas
  - synoptic observations of coastal currents and salinity
  - higher resolution/improved coverage for ocean vector winds & SSH
  - high spatial and spectral resolution capacity to assess coral reef community changes & vegetation assessments

- **Improve**
  - calibration/validation of measurements in coastal regions
  - data management infrastructure (near-real time delivery; climate data records)

- **Support** development of a Coastal Data Assimilation Experiment (CODAE)

- **Facilitate** international efforts to blend high-resolution multi-sensor data products

- **Ensure** access to highest resolution DEM as soon as possible
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<th>Integration Challenges</th>
<th>Integration Strategies</th>
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</table>
| **Communication:** Biases in disciplines & applications | *Interdisciplinary training programs/workshops*  
> Prioritizing interdisciplinary observation products |
| **Data Access & Management**  
• What data is available?  
• Data sharing across national boundaries  
• Fully “dry” land & Fully “wet” ocean data/models; separation of remote and *in situ* data | *Coordinated* cataloguing, archiving & distribution of current and historical coastal datasets & metadata; potentially leveraging the **GTOS-TEMS** database  
*Improve Data Management Infrastructure* to store, (re)process and disseminate expanding data streams, incl. (near) real-time & climate data records  
*Modeling & data assimilation* => **CODAE** |
| **Unique Challenges**  
• Mapping the coast  
• Scale dependent attributes  
• People at coastal interface | *Tidal monitoring, hydrodynamic models + Vertical datum transformation tool*  
*Long term time series and data continuity*  
*Data integration*  
> Land & sea; humans & ecosystem => **Coastal GIS** |
Institutional Arrangements

CEOS Providers
CSA, DLR, ESA, ISRO, JAXA, NASA, NOAA et al.

Other Providers

Coastal issues
- Coastal hazards
- Coastal development & Urbanization
- Hydrological & Biogeochemical cycles
- Ecosystem health & Productivity

Regional/National Alliances

Products
Feedback
Stakeholders
## Implementation Schedule: Key Elements

<table>
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<tr>
<th>Year Range</th>
<th>Key Elements</th>
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| 2005       | • Finalization and printing of Coastal Theme Report.  
|            | • Establishment of Coastal Theme Implementation team  
|            | • Workshops: CODAE; Integration of Socio-Economic data |
| 2005-2007  | • Joint oversight mechanism between Coastal modules of GOOS and GTOS  
|            | • Design CODAE Pilot Project  
|            | • Support development of platforms/sensors with CEOS |
| 2007-2010  | • Implement CODAE  
|            | • Strengthen socioeconomic component  
|            | • Revision of the Coastal Theme Report after 5 years |
| 2010-2014  | • Analysis of CODAE results  
|            | • Increasing implementation of coastal observing programmes on a regional basis  
|            | • Second revision of the Coastal Theme Report after 10 years |
Acknowledgements:

We thank NASA, NOAA, IGBP, IOC/GOOS, FAO/GTOS and UNEP for their ongoing support and contributions.