Arctic - COLORS

Arctic-Coastal Land Ocean Interactions

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Arctic COLORS is a NASA-funded Field Campaign Scoping Study that aims to improve understanding and prediction of land-ocean interactions in the rapidly changing Arctic coastal zone, and assess vulnerability, responses, and feedbacks of coastal ecosystems, communities, and natural resources to current and future pressures.
Arctic-COLORS Science Questions

1. How do coastal Arctic biogeochemical transformation zones impact terrestrial, riverine, atmospheric, and coastal materials across the continuum of Arctic rivers, estuaries and the continental shelf?

2. How do Arctic riverine, atmospheric, and other fluxes of constituents effect changes in coastal ecology?

3. How does thawing of Arctic permafrost—either directly through coastal erosion or indirectly through changing freshwater loads—translate to quantitative changes in coastal ecology and biogeochemistry?

4. How do changing snow and ice conditions and coastal circulation effect changes in estuarine and coastal ecology and biogeochemistry?

5. How do changing environmental (short-term) and climate (long-term) conditions alter the region’s availability and use of ecosystem services?
Arctic-COLORS Core Study Domain

Victoria and Banks Islands in the Canadian Archipelago - CHARS
(CHARS: Canadian High Arctic Research Station)
Arctic-COLORS Focus
from River Mouths to mid-Shelf Waters (shallow waters to 500 m deep)
Arctic-COLORS Study Domain
Arctic-COLORS Focus from River Mouths to mid-Shelf Waters
Arctic-COLORS Field Activities

**Process Studies / Survey Studies**

- **Intensive sampling & experiments** from river mouths to outer shelf of large & small rivers.

- **Processes, Fluxes, Seasonality:**
  Productivity, photo-oxidation, air-sea fluxes, optics, biogeochemistry, physics, grazing, phytoplankton taxonomy, etc.

- **Contrast points:** Particle dynamics, carbon, CDOM and nutrient loads, temporal discharge dynamics, residence time, sea ice change at coast, terrain (boreal/tundra/mountainous), soils, coastal ice coverage vs open water duration

- **Coastal erosion sites**

**Process Studies**

<table>
<thead>
<tr>
<th>March</th>
<th>May/early June</th>
<th>July</th>
<th>Sept</th>
<th>October</th>
</tr>
</thead>
<tbody>
<tr>
<td>• End of winter</td>
<td>• Peak river discharge</td>
<td>• Increasing biological &amp; photochemical</td>
<td>• Max open water/min sea ice</td>
<td>Freeze-up period</td>
</tr>
<tr>
<td>condition</td>
<td>• Under ice blooms</td>
<td>activity</td>
<td>• Low river discharge</td>
<td></td>
</tr>
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<td></td>
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<td></td>
<td>• Pre-conditioning of systems</td>
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<td></td>
<td></td>
<td>prior to winter</td>
<td></td>
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</table>

**Prioritization of rivers:**

- **Tier 1:** Yukon, Mackenzie, Colville, Canning, Sagavanirktok, Utukok, Kobuk
- **Tier 2:** Noatak, Hulahula, Meade, Wulik, Niukluk
- **Tier 3:** Canadian Copper, Arctic National Wildlife Refuge: Canning & Hula

**NO compromise in seasonality**
Arctic-COLORS Field Activities

Survey Studies

- Assess spatial variability in physical, biological, and biogeochemical state of different shelf regions
- Determine interactions between the coastal ocean and the shallower shelf regions occupied during the process studies.
- Evaluate model simulations across temporal and spatial scales
- Scale up using remote sensing (design, evaluate RS algorithms across a range of environments)
- **Point sources versus distributed inputs**

Process Studies

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**Arctic - COLORS**

Coastal Land Ocean Interactions

NASA OCRT 2015
International Ocean Colour Science Meeting 2015
Terrestrial end-member: a unique opportunity to leverage ABoVE
NASA's Terrestrial Ecology Program is conducting a major field campaign:

**the Arctic-Boreal Vulnerability Experiment (ABoVE)**

- **improved remote-sensing of terrestrial/atmospheric processes:** LU/LC, watershed properties, vegetation characteristics, disturbances, coastal erosion.
- **improved models:** hydrological, vegetation dynamics, soil thermal, and river biogeochemistry
- **resources:** airborne sensors, new networks of field stations, new collaborations/partnerships.

[http://above.nasa.gov](http://above.nasa.gov)
- large research vessels
- small boats
- seagliders
- buoys
- autonomous platforms
- space-based RS
- airborne RS, unmanned aerial vehicles (UAVs)
- ...
Arctic COLORS - Remote Sensing

- Field measurements will capture the spatial and temporal variability in bio-optical regimes along the study sites (comprehensive data of IOPs, radiometry, biogeochemical/physicochemical variables, concentrations, fluxes, rates).

- Multiple regional algorithms may be necessary to account for the variability in bio-optical conditions found in the Arctic.

- Develop regional algorithms specific to OLCI and PACE spectral capabilities

Remote sensing observations from a range of platforms (airborne, space-based)
**Arctic COLORS - Remote Sensing**

- **Ocean biogeochemical and bio-optical properties**

- **Ocean physicochemical** properties and physical processes (e.g., sea surface temperature, sea surface height, salinity, ocean currents, sea ice extent)

- **Atmospheric** processes and composition (e.g., aerosols, traces gases including ozone and NO$_2$, CO$_2$ and CH$_4$)

- **Meteorological** measurements (e.g., wind speed and direction)

- **Hydrological** observations (e.g., precipitation)

- **Terrestrial** observations (e.g., wetland area extent, NDVI, soil moisture, snow cover and land ice).

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Launch Date</th>
<th>Swath Width</th>
<th>Channels</th>
<th>Frequency</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIIRS</td>
<td>~2/2012 to present</td>
<td>750 x 750 m full swath</td>
<td>410, 443, 486, 551, 671</td>
<td>Twice/day</td>
<td>NOAA/NASA</td>
</tr>
<tr>
<td>OLI</td>
<td>3/2013 to present</td>
<td>30 x 30 m</td>
<td>443, 482, 561, 655</td>
<td>~8 days</td>
<td>NASA/USGS</td>
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<tr>
<td>OLCI</td>
<td>Launch 2015</td>
<td>300 x 300 m</td>
<td>400, 412.5, 442.5, 490, 510, 560, 620, 665, 681, 709, 754</td>
<td>2-3 days</td>
<td>ESA</td>
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<tr>
<td>S-GLI</td>
<td>Launch Dec. 2016</td>
<td>250 x 250 m</td>
<td>380, 412, 443, 490, 530, 565, 670, 763</td>
<td>2-day</td>
<td>JAXA</td>
</tr>
<tr>
<td>PACE OCI</td>
<td>Launch ~2022/2023</td>
<td>~1 x 1 km or better</td>
<td>Hyperspectral 350-800</td>
<td>2-day</td>
<td>NASA</td>
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Notional Timeline for Arctic COLORS

**Phase I**
- Pre-work (2015)
- Solicitation Phase Ia 2017
- Development of repositories of field & RS datasets and modeling products

**Phase IIla**
- Field Work, RS, models
- Yr1, Yr2, Yr3, Yr4

**Phase IIb**
- Field Work, RS, models
- 4-yr projects
- Yr3, Yr4

**Phase III**
- Synthesis activities
- Yr5, Yr6
- Yr7, Yr8

**ABoVE-Arctic Boreal Vulnerability Experiment**
- 2015-2024

**PACE**
- Launch in 2022-2023

**NASA SDT**
- Peer Review NASA Panel (Dec 15)
- 1st solicitation

**NASA OCRT 2015**
- International Ocean Colour Science Meeting 2015

**http://arctic-colors.gsfc.nasa.gov**