

Arctic - COLORS

Coastal Land Ocean Interactions in the Arctic

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Arctic-COLORS (Arctic-Coastal Land Ocean Interactions) is a Field Campaign Scoping Study funded by NASA's Ocean Biology and Biogeochemistry Program

→ **Overarching objective:** to improve understanding and prediction of land-ocean interactions in a rapidly changing Arctic coastal zone, and assess vulnerability, response, feedbacks and resilience of coastal ecosystems, communities and natural resources to current and future pressures.

→ Focus on coastal ocean processes amenable to study by airborne or space-based assets

→ A needed linkage between field campaigns focusing on the Arctic open ocean environment (e.g. ICESCAPE, ArcticNET), and field activities focusing on Arctic river processes, chemistry and fluxes, including NASA's Arctic Boreal Vulnerability Experiment (ABOVE).

→ **Deliverable:** a comprehensive report to NASA outlining the major scientific questions, and developing the initial study design and implementation concept for this new campaign

Approach

During the preparation of the field campaign scoping study, we are consulting with the community to refine the research questions and objectives, and develop a robust field campaign composed of multiple research cruises, deployment of long-term platforms, and more frequent sampling with local support.

Addressing the Campaign's objectives will require multidisciplinary expertise, and a combination of field studies, remote sensing observations from various platforms (shipboard, ground-based, airborne, satellite), process studies, coupled physical and biogeochemical models, and data assimilation.

Science Team

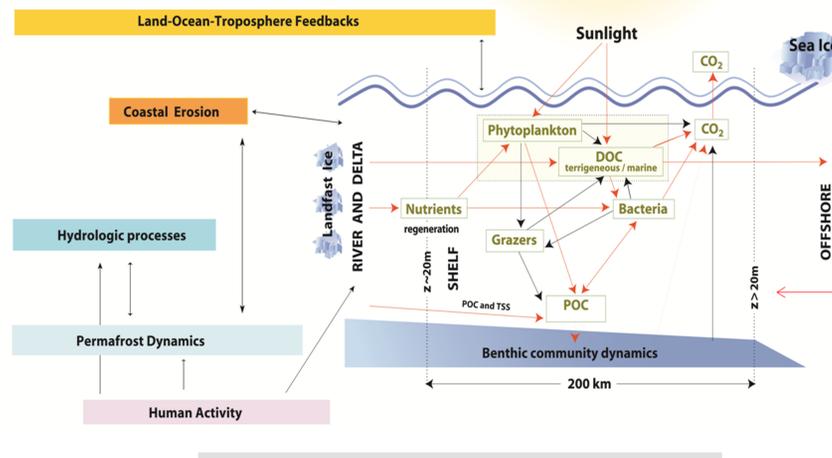
A large group of collaborators, experts in a wide range of disciplines

Name	Institution	Expertise
Carlos Del Castillo, PI	NASA GSFC	Ocean optics; CDOM & DOC river fluxes; DOM biogeochemistry
Marjorie Friedrichs, PI	VIMS	Coupled physical-biochemical modeling; data assimilation; remote sensing of primary productivity
Peter Hernes, PI	UC-Davis	River and coastal biogeochemistry; organic biomarkers; land-water interactions; CDOM photochemistry
Antonio Mannino, lead PI	NASA GSFC	Coastal C cycling; CDOM and DOM biogeochemistry; ocean color remote sensing; estuarine processes
Patricia Matrai, PI	Bigelow	Arctic air-sea ice exchange of gases and biogenic aerosols; Arctic primary production
Joseph Salisbury, PI	UNH	Coastal DIC processes; land-ocean interactions; remote sensing
Maria Tzortziou, PI	UMD/GSFC	Estuarine and coastal biogeochemistry; land/ocean/atmosphere interactions; remote sensing; optics
Matthew Allaire	U. Washington	Arctic coastal and riverine biogeochemistry
Marcel Rabin	U. Laval	Ocean optics; CDOM and DOM dynamics; remote sensing of ocean color; MALINA expedition in Beaufort Sea
Simon Bélanger	UQAR Canada	Ocean optics; Arctic biomass production; remote sensing of ocean color; MALINA expedition
Emmanuel Boss	U. Maine	Ocean optics; ongoing field activities in the Arctic
Eddy Carmack	Fisheries & Oceans Canada	Climate; coastal runoff influences regional ocean circulation and climate
Lee Cooper	UMCES/CBL	Arctic Ocean OM biogeochemistry; stable & radiotopes; SBI PI
Susanne Craig	Dalhousie University	Biological Oceanography; satellite remote sensing
Jerome Flechter	UC Santa Cruz	Coupled physical-biochemical modeling; Gulf of Alaska
Joaquim Goes	Lamont-Doherty	Phytoplankton physiology & productivity; Bering Sea; climate change
Peter Griffiths	Sigma Space/GSFC	Carbon cycle; Ocean microbiology; ABOVE Program Chief Support Scientist
David Kirchner	U. Delaware	Microbial Ecology including Arctic Ocean
Diane Lavoie	Fisheries & Oceans Canada	Model climate change impacts on PP & C fluxes in Canadian Arctic
Bonnie Light	U. Washington	Radiative transfer in ice & snow, optical & structural properties of Arctic sea ice
James McClelland	U. Texas / MSI	Arctic land-sea coupling; coastal ecosystem dynamics
Donald McEwen	CHRS	Arctic land-sea coupling coastal ecosystem dynamics
Trina Overeem	U. Colorado	Arctic rivers and sea ice
Chris Polashenski	U.S. Army Corps of Engineers	Coastal and pack ice physical properties
Michael Rawlins	U. Massachusetts	Arctic meteorology; climate models; ABOVE SDT member
Rick Reynolds	Scrapps/UCSD	Ocean particle optics including Arctic; ICESCAPE
Michael Steele	U. Washington	Arctic freshwater export; physical oceanography
Dariusz Stramski	Scrapps/UCSD	Ocean optics; ICESCAPE
Robert Strick	USGS	River carbon chemistry - Yukon; ABOVE SDT member
James Svytcki	U. Colorado	Rivers, deltas, estuaries, particle dynamics, sediment transport & stratigraphy
Suzanne Tank	U. Alberta	Ecology & Biogeochemistry at land-river-ocean interface in Canadian Arctic
Muyin Wang	U. Washington	Climate and climate change in the Arctic; sea ice projections
Tom Weingartner	U. Washington	Coastal Arctic Ocean physical oceanography
Paula Bontempi	NASA HQ	Biological oceanography; ocean color remote sensing

Overarching 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 coastal dynamics



Engaging the Broader Community

A series of activities to engage the broader community and involve interagency and international partnerships in Arctic-COLORS.

	2014												2015											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Town Halls & Presentations																								
Scoping Study Workshops																								
Refining of Science Questions																								
Develop Field Campaign Study																								
Engage User Communities																								
Engage Others on Programmatics																								
Drafting of Scoping Study Report																								
Posting of Draft Report - 30 days																								
Submission of Final Report to NASA																								
NASA Posting of Report - 45 days																								
NASA Review Panel																								

Where? When? What?

WHERE?

The geographical extent of this Arctic land-ocean exchange study is envisioned to extend in a core area from the Yukon Delta to the Mackenzie Delta, from the head of tidal influence on to the coastal shelf (pink-shaded region on map)

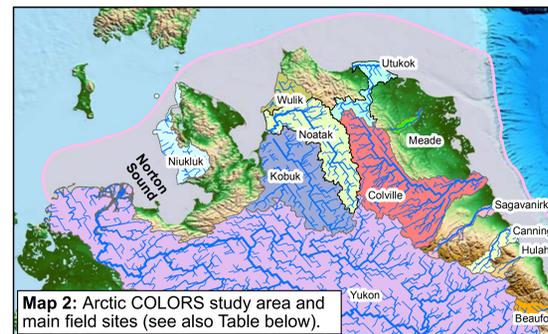
WHEN?

The proposed timeline for Arctic-COLORS is 2018-2026, (i) to overlap with the first three years of NASA's new ocean color mission PACE, and (ii) to coincide with NASA's ABOVE field program, thus linking processes in the Arctic coastal oceans and terrestrial ecosystems.

WHAT?

Intensive sampling and process experiments will be conducted from river mouths to outer shelf of large and small rivers from the Beaufort Sea, Chukchi Sea and Norton Sound regions and 3 coastal erosion sites. Key measurements will include primary productivity, air-sea fluxes, photooxidation, optics, biogeochemistry, physics, grazing, phytoplankton taxonomy, land-sea fluxes of carbon, sediments, and nutrients. To resolve the seasonal cycle associated with biogeochemical processes in this region, five cruises/deployments will be conducted each year throughout each of four years.

Timing of Intensive Field Work: March (end of winter), May/early June (peak discharge, under ice blooms), July (increasing biological & photochemical activity), Sept (max open water, low discharge, pre-conditioning for winter), October (freeze-up period).



Site Contrasts: Loadings of particles, DOC, DIC, CDOM and nutrients, temporal discharge dynamics, residence time, sea ice change at coast, watershed vegetation, soil type and terrain, soils, coastal ice coverage vs open water duration.

Coastal erosion sites: in July and Sept/Oct.; contrast exposed bluffs and lagoon sites.

Survey studies will also be conducted to determine: (1) the interaction between the coastal ocean and the shallower shelf regions occupied during the process studies; (2) scaling for remote sensing monitoring; (3) distinguish point sources versus distributed inputs.

Timing of Survey Studies: late July (high biological & photochemical activity) and September (min. sea ice, low discharge)

Notional Observational Program: Timeline and Field Sites

	Timeline
Pre-Arctic-COLORS (Phase I)	6 mo to 1 Year; 2018-2019
Field Campaigns (Phase II)	4 years; 2019-2023
Synthesis (Phase III)	2 years; 2022-2026
Phase IIa and IIb Field Work and Modeling projects	4 years each; 2019-2025 and 2021-2024
Duration of Phase II & III	8 years; 2019-2026
Intensive river outflow sites	
Beaufort coastal region	Mackenzie, Hulahlula, Canning, Sagavanirktok, Kuparuk, Colville, Meade
Chukchi coastal region	Utukok, Wulik, Noatak, and Kobuk
Norton Sound coastal region	Yukon and Niukluk
Seasonality of intensive studies	1 full season per site plus a 2 nd full season at select sites
Coastal erosion sites	1. Drew Point coast (exposed bluffs; east of Ikpukpuk R. outflow) 2. Jago Lagoon (near Kaktovik) 3. Beaufort Lagoon
Survey Studies: late July and September	Norton Sound to Mackenzie River outflow

Get Involved

- 2015 IOCS Mtg, San Francisco, CA, 15-18 June 2015
- CERF 2015 23rd Biennial Conference, Portland, OR, 8-12 Nov 2015
- 2015 AGU Fall Meeting, San Francisco, CA, 14-18 Dec 2015
- 2016 Ocean Sciences Meeting, New Orleans, LA, 21-26 Febr 2016

Programmatic Information

Programmatic questions & feedback are referred to Dr. Paula Bontempi; NASA HQ;
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Tel: 202.358.1508