Arctic - COLORS

Arctic-Coastal Land Ocean Interactions

Project PIs:

Antonio Mannino (NASA/GSFC)

Carlos Del Castillo (NASA/GSFC)

Peter Hernes (UC Davis)

Marjorie Friedrichs (VIMS)

Patricia Matrai (Bigelow)

Joseph Salisbury (Univ. of NH)

Maria Tzortziou (CCNY / CUNY)

Arctic-COLORS: a **collective effort** by members of the broader science community

Name	Institution	Expertise
Carlos Del Castillo, PI	NASA GSFC	Ocean optics; CDOM & DOC river fluxes; DOM biogeochemistry
Marjorie Friedrichs, PI	VIMS	Coupled physical-biogeochemical modeling; data assimiliation; remote sensing of primary productivity
Peter Hernes, PI	UC-Davis	[illegible]
Antonio Mannino, lead PI	NASA GSFC	[illegible]
Patricia Matrai, PI	Bigelow	[illegible]
Joseph Salisbury, PI	UNH	[illegible]
Maria Tzorziou, PI	UMD/ GSFC	[illegible]
Matthew Alkire	U. Washington	[illegible]
Marcel Babin	U. Laval	[illegible]
Simon Bélanger	UQAR Canada	[illegible]
Emmanuel Boss	U. Maine	[illegible]
Eddy Carmack	Fisheries & Oceans Canada	[illegible]
Lee Cooper	UMCES/ CBL	[illegible]
Susanne Craig	Dalhousie University	[illegible]
Jerome Fiechter	UC Santa Cruz	[illegible]
Joaquim Goes	Lamont-Doherty	[illegible]
Peter Griffith	Sigma Space/ GSFC	[illegible]
David Kirchman	U. Delaware	[illegible]
Diane Lavoie	Fisheries & Oceans Canada	[illegible]
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 McLennan	CHARS	Arctic land-sea coupling coastal ecosystem dynamics
Irina 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. Massachussets	Arctic meteorology; climate models; ABoVE SDT member
Rick Reynolds	Scripps/ UCSD	Ocean particle optics including Arctic; ICESCAPE
Michael Steele	U. Washington	Arctic freshwater export; physical oceanography
Dariusz Stramski	Scripps/ UCSD	Ocean optics; ICESCAPE
Robert Striegl	USGS	River carbon chemistry – Yukon; ABoVE SDT member
James Syvitski	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

International team of Collaborators

Broader community involved in:
- identifying the high priority science questions
- determining the study domain and research phases for the field campaign
- exploring opportunities for linking to/leveraging other field activities in the Arctic region

11 meetings so far (townhalls, special sessions) and two dedicated 2-day workshops where community & collbarators provided input

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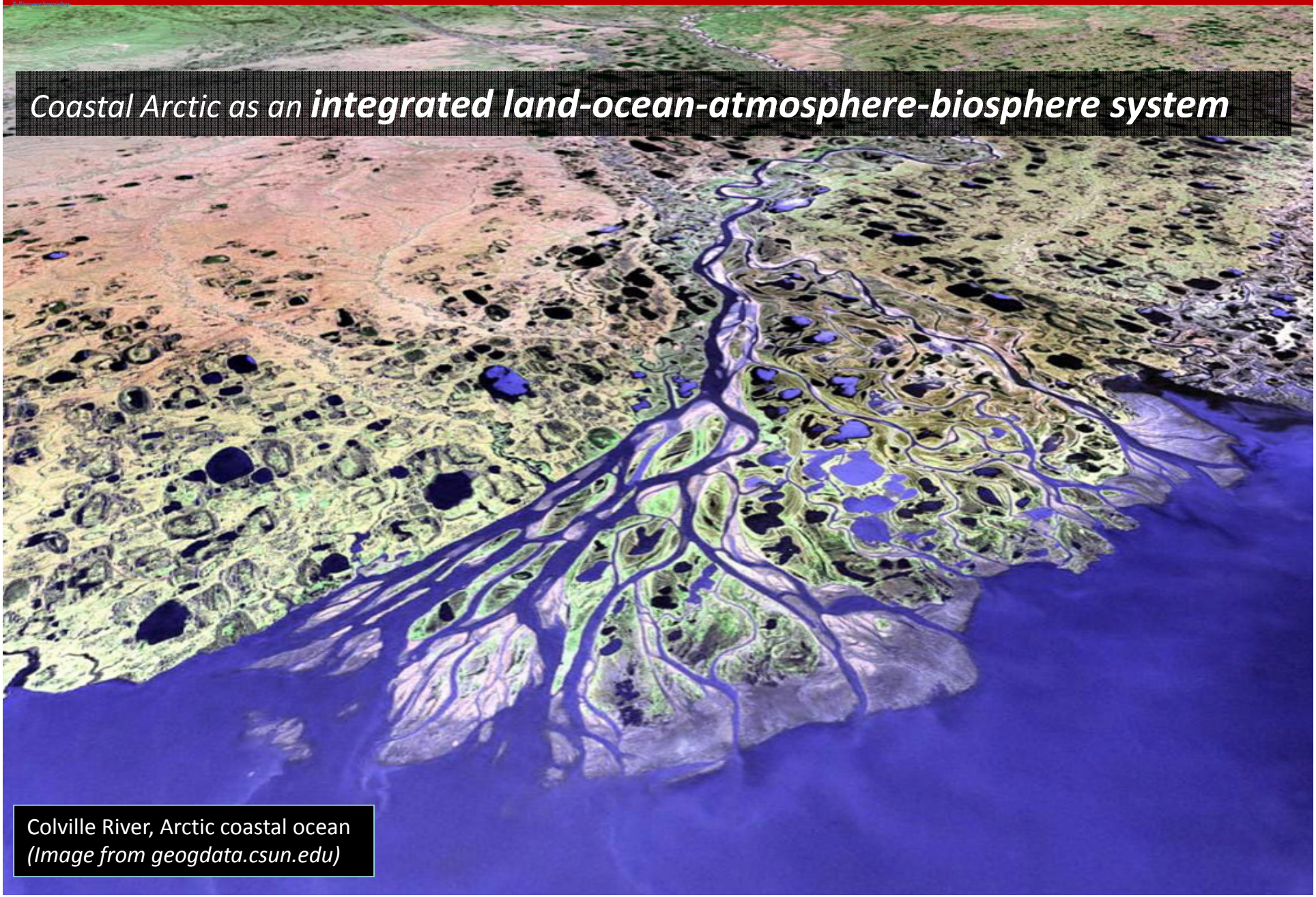
Coastal Land Ocean Interactions

*Coastal Arctic as an **integrated land-ocean-atmosphere-biosphere system***



Colville River, Arctic coastal ocean
(Image from geogdata.csun.edu)

Why Coastal Arctic?

BUT…

→ Very few interdisciplinary studies of processes at the land-ocean-atmosphere interface

→ Very few studies at larger scales, or across spatial and temporal scales (or seasonality?)

→ Inconsistent sampling and analytical methods across sites

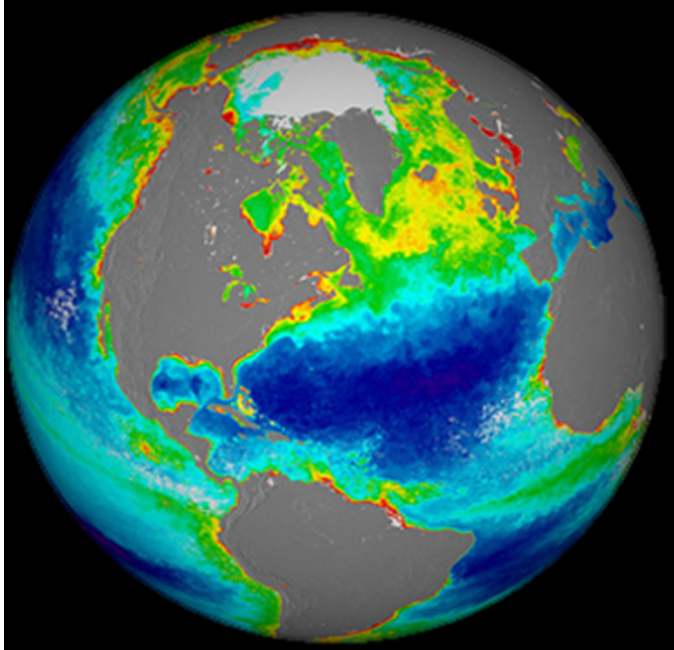
→ Poor coverage at low salinities, and *hot-spot* areas of biogeochemical exchanges

NASA's ABoVE Field Campaign: above.nasa.gov

NASA's Terrestrial Ecology Program is conducting a major field campaign:

the Arctic-Boreal Vulnerability Experiment (ABoVE)

A unique opportunity to link processes in Arctic coastal ocean and terrestrial ecosystems, leverage on-going field activities and ***get maximum return on investments in the Arctic region.***



Why Now?

PACE
Pre-Aerosol, Clouds, and ocean Ecosystem Mission

Arctic-COLORS is timely

- Further delays in establishing a comprehensive baseline will **hamper future assessments** of Arctic climate change impacts as well as any pro-active strategies.

→ in May 2013 the White House released the **National Strategy for the Arctic Region** :

a strategic priority to *"employ scientific research and traditional knowledge to increase understanding of the Arctic"*

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**?*

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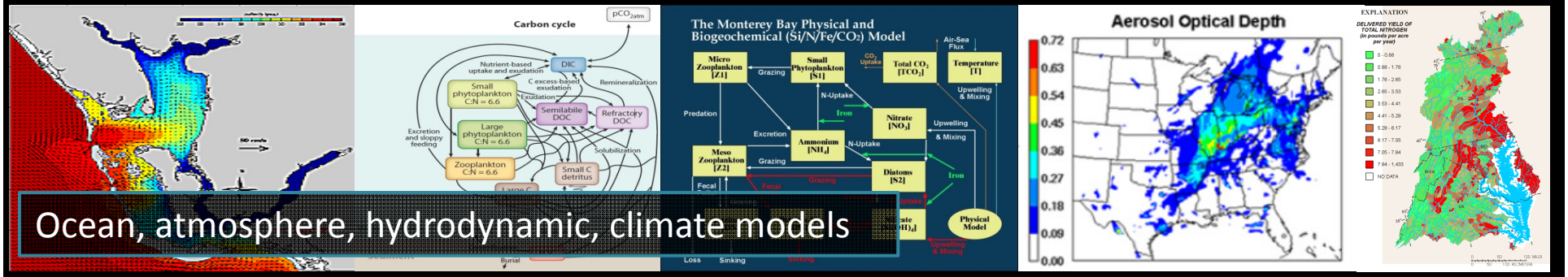
Coastal Land Ocean Interactions

Arctic-COLORS will require an integrative measuremets & modeling approach



Ocean, atmosphere, hydrodynamic, climate models

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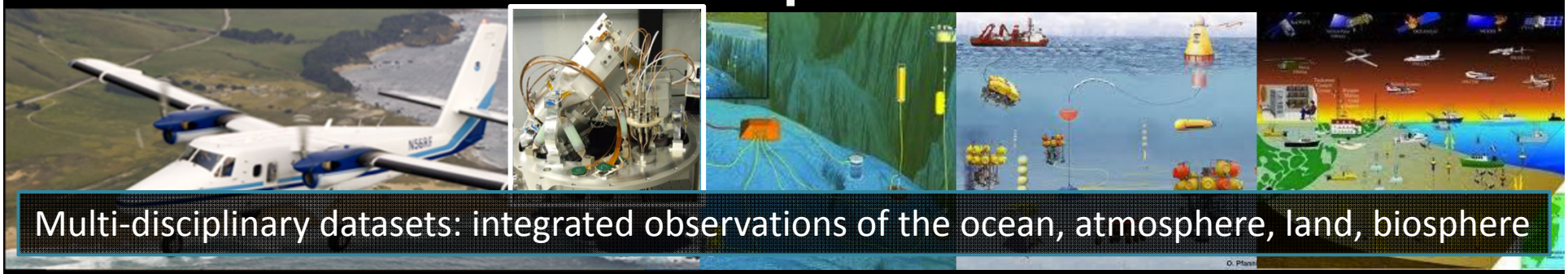

Multi-disciplinary datasets: integrated observations of the ocean, atmosphere, land, biosphere

+

Remote sensing observations from a range of platforms (airborne, space-based)

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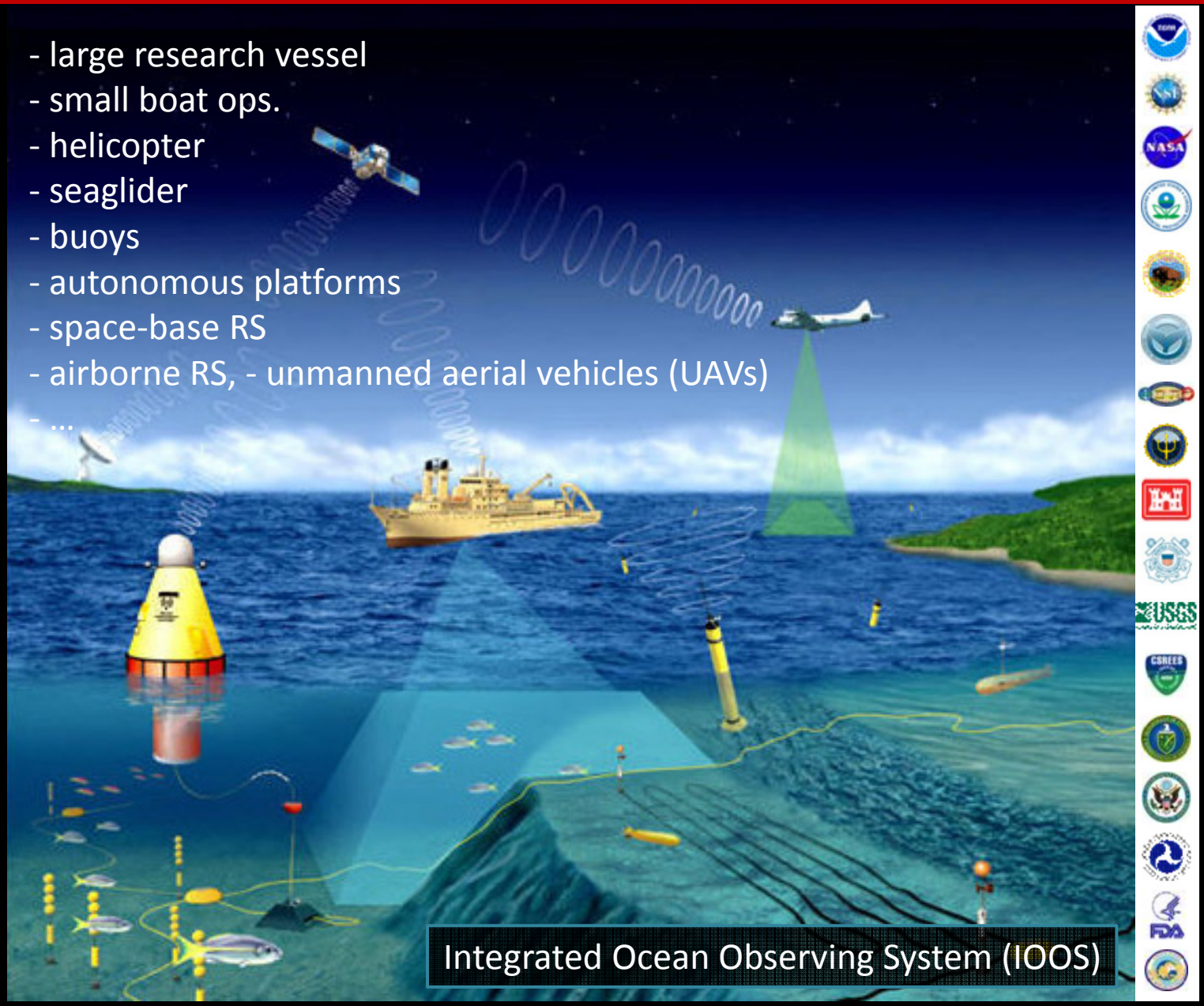
Coastal Land Ocean Interactions

- large research vessel
- small boat ops.
- helicopter
- seaglider
- buoys
- autonomous platforms
- space-base RS
- airborne RS, - unmanned aerial vehicles (UAVs)
- …



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Coastal Land Ocean Interactions

Arctic-COLORS Core Study Domain

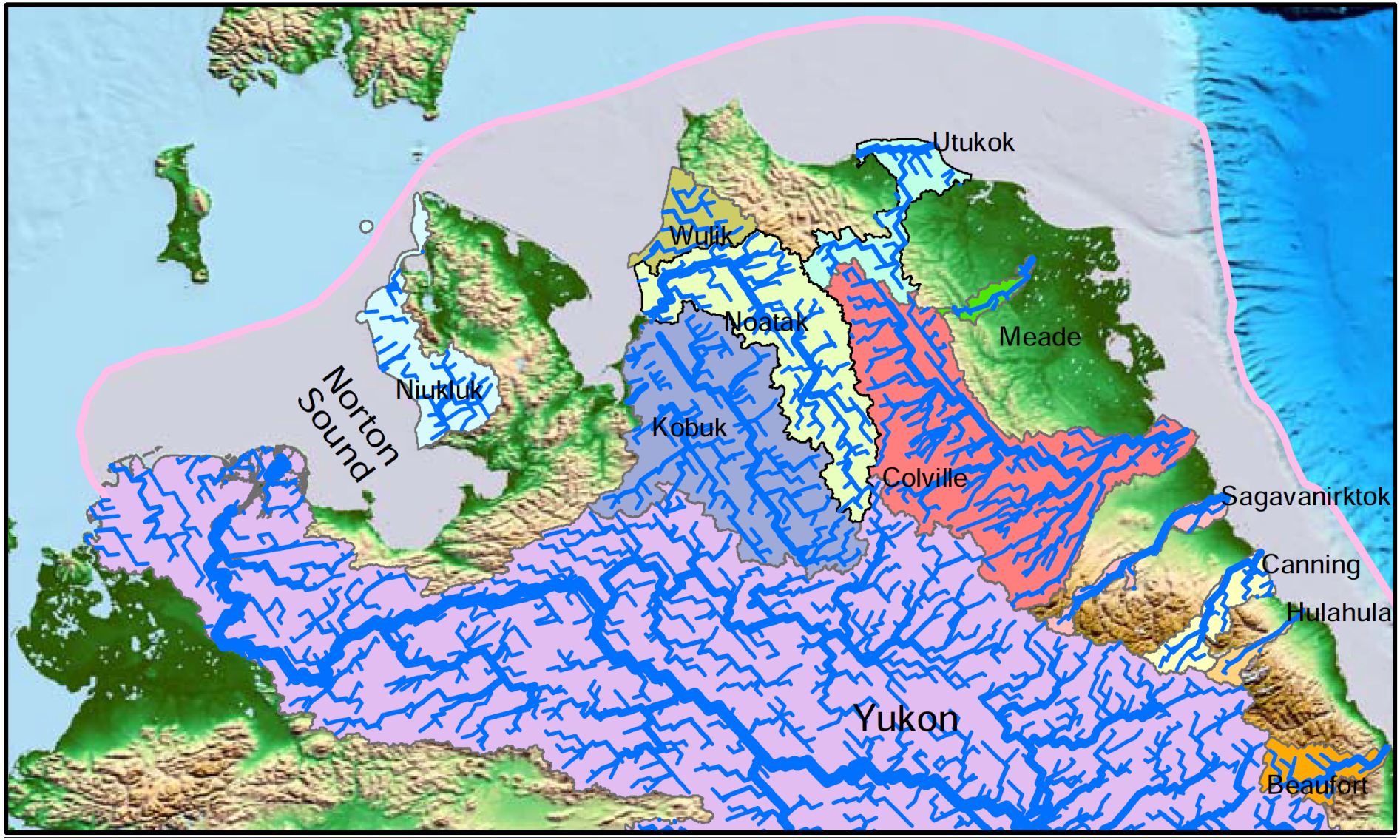
Victoria and Banks Islands in the Canadian Archipelago - CHARS
(CHARS: Canadian High Arctic Research Station)

Arctic-COLORS Study Domain

Large globally important rivers, regionally important watersheds, smaller tundra rivers, coastal lagoons, erosional bluffs

Arctic-COLORS Study Domain

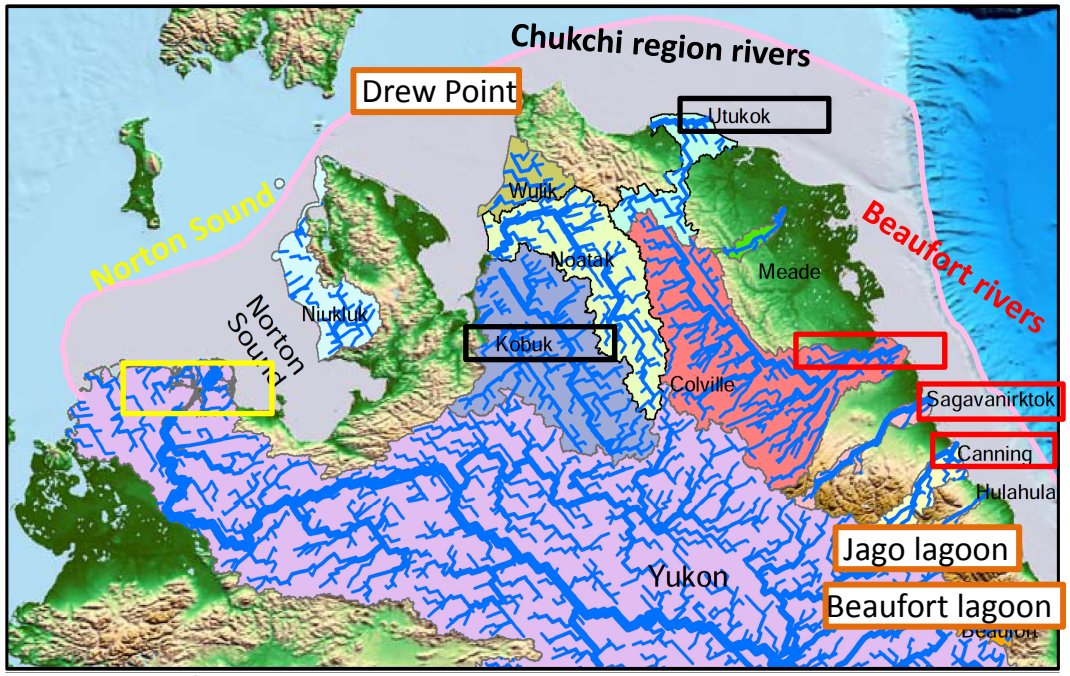
From the head of tidal influence to the coastal shelf



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**



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

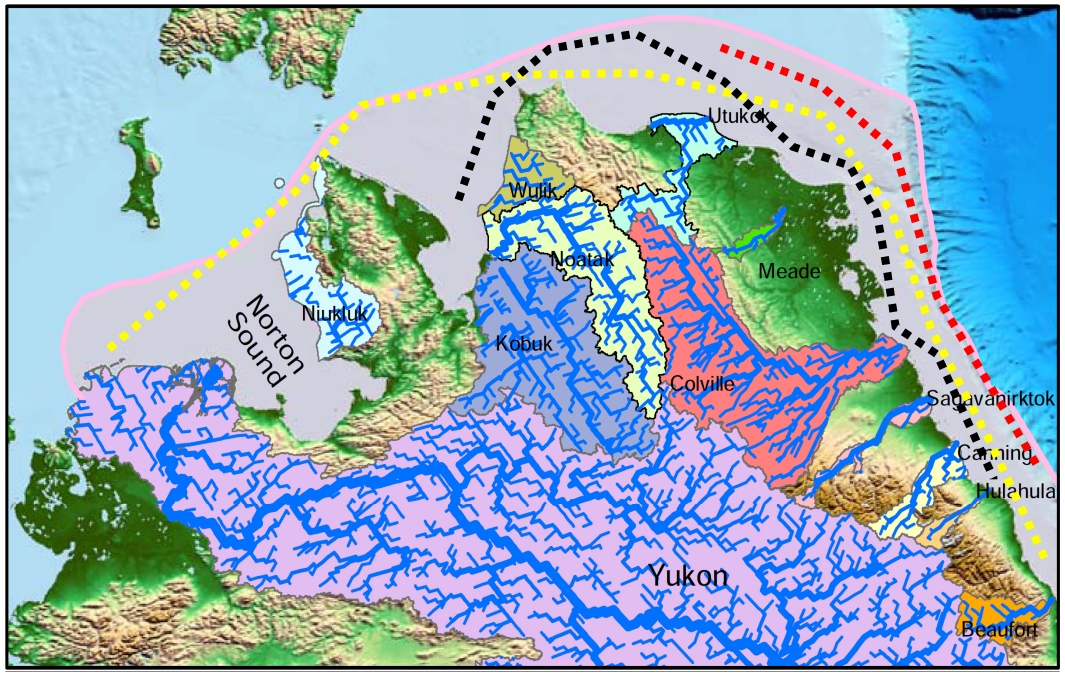
Process Studies

March	May/early June	July	Sept	October
• End of winter condition	• Peak river discharge • Under ice blooms	• Increasing biological & photochemical activity	• Max open water/min sea ice • Low river discharge • Pre-conditioning of systems prior to winter	Freeze-up period

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 | **Survey Studies**

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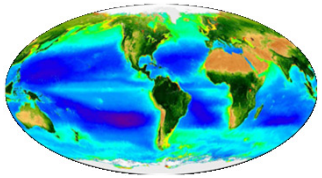
Notional Timeline for Arctic COLORS



PACE
Launch in 2022-2023

ABoVE-Arctic Boreal Vulnerability Experiment
2016-2024

Arctic-COLORS ABoVE 1st solicitation

Peer Review NASA Panel (Dec 2015)

Arctic-COLORS Report submitted (Aug 2015)

Development of repositories of field & RS datasets and modeling products

Solicitation Phase IIa 2018

Solicitation Phase IIb 2020

Solicitation Phase III 2023

NASA SDT
Apr-Dec

Phase I
Pre-work
1-year

Phase IIa:
Field Work, RS, models
Yr1 Yr2 Yr3 Yr4

Phase IIb:
Field Work, RS, models
4-yr projects
Yr3 Yr4 Yr5 Yr6

Phase III: Synthesis activities
Yr7 Yr8

2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026

Arctic-COLORS Information