

Arctic - COLORS

Arctic-Coastal Land Ocean Interactions

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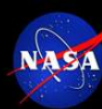
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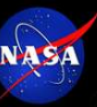
Arctic COLORS is A NASA-funded Field Campaign Scoping Study that aims to improve understanding and prediction of land-ocean interactions in the rapidly changing Arctic coastal zone, and assess vulnerability, responses, and feedbacks of coastal ecosystems, communities, and natural resources to current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

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

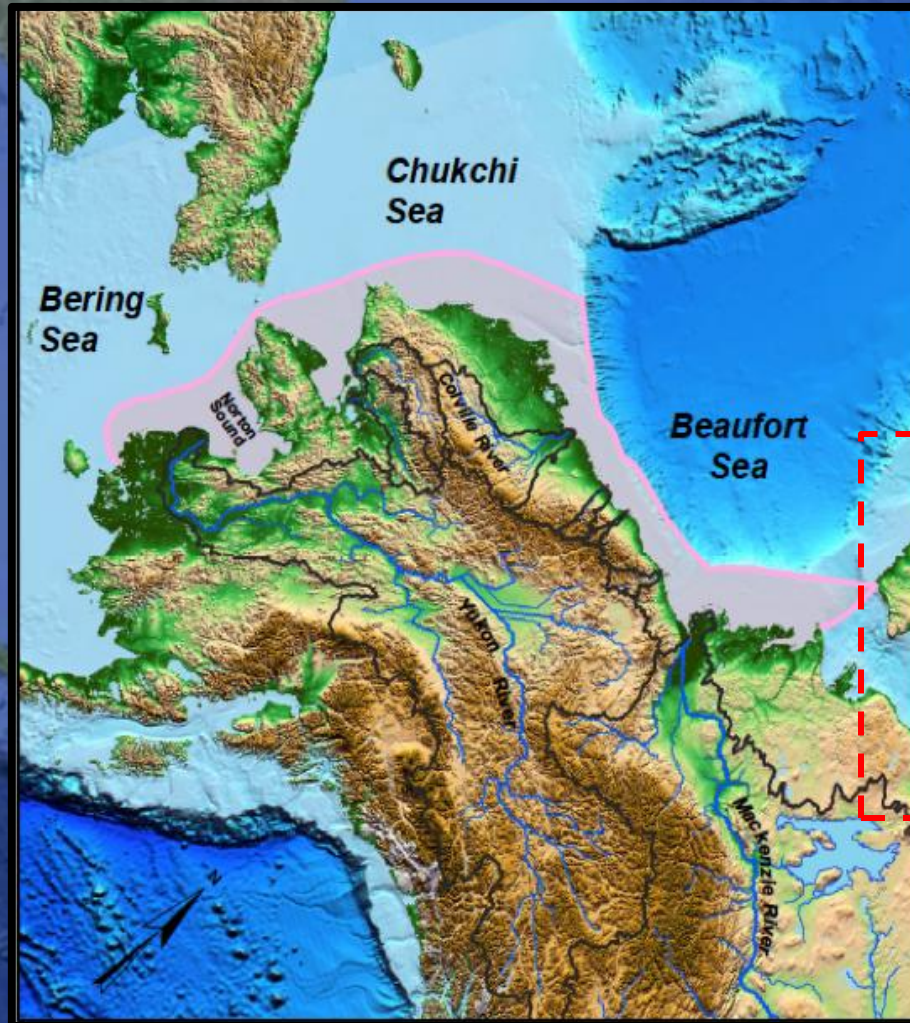


Arctic-COLORS Science Questions

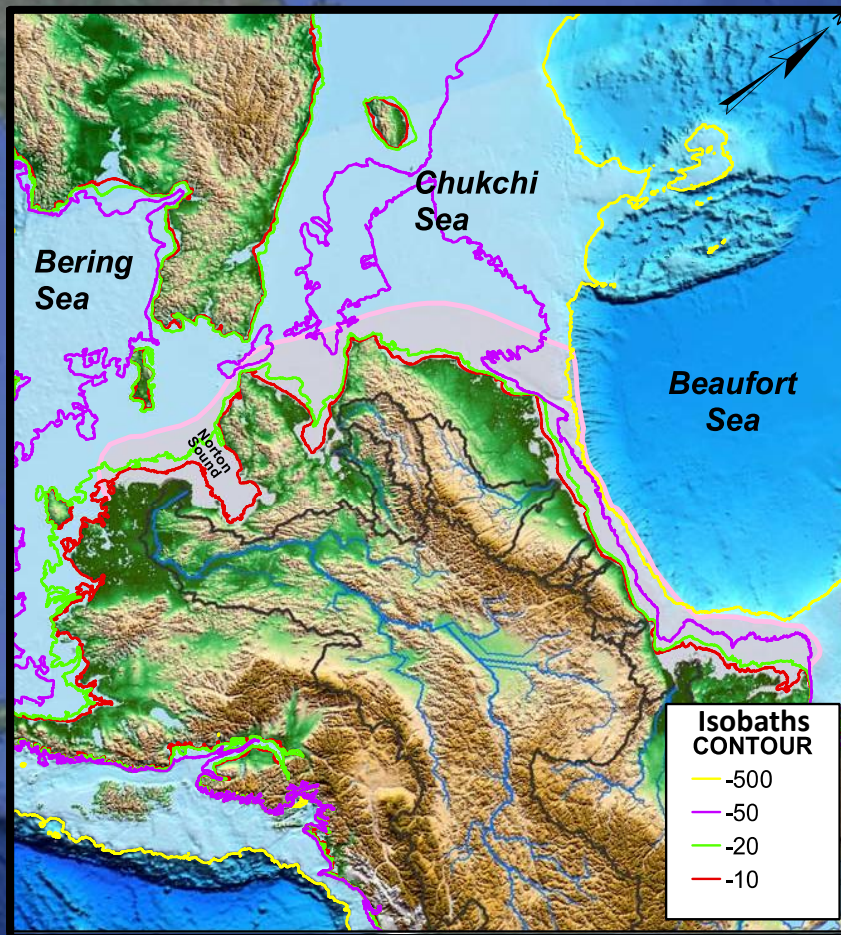
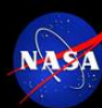
1. How do **coastal Arctic biogeochemical transformation zones** impact terrestrial, riverine, atmospheric, and coastal materials **across the continuum of Arctic rivers, estuaries and the continental shelf**?
2. How do **Arctic riverine, atmospheric, and other fluxes of constituents** effect changes 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



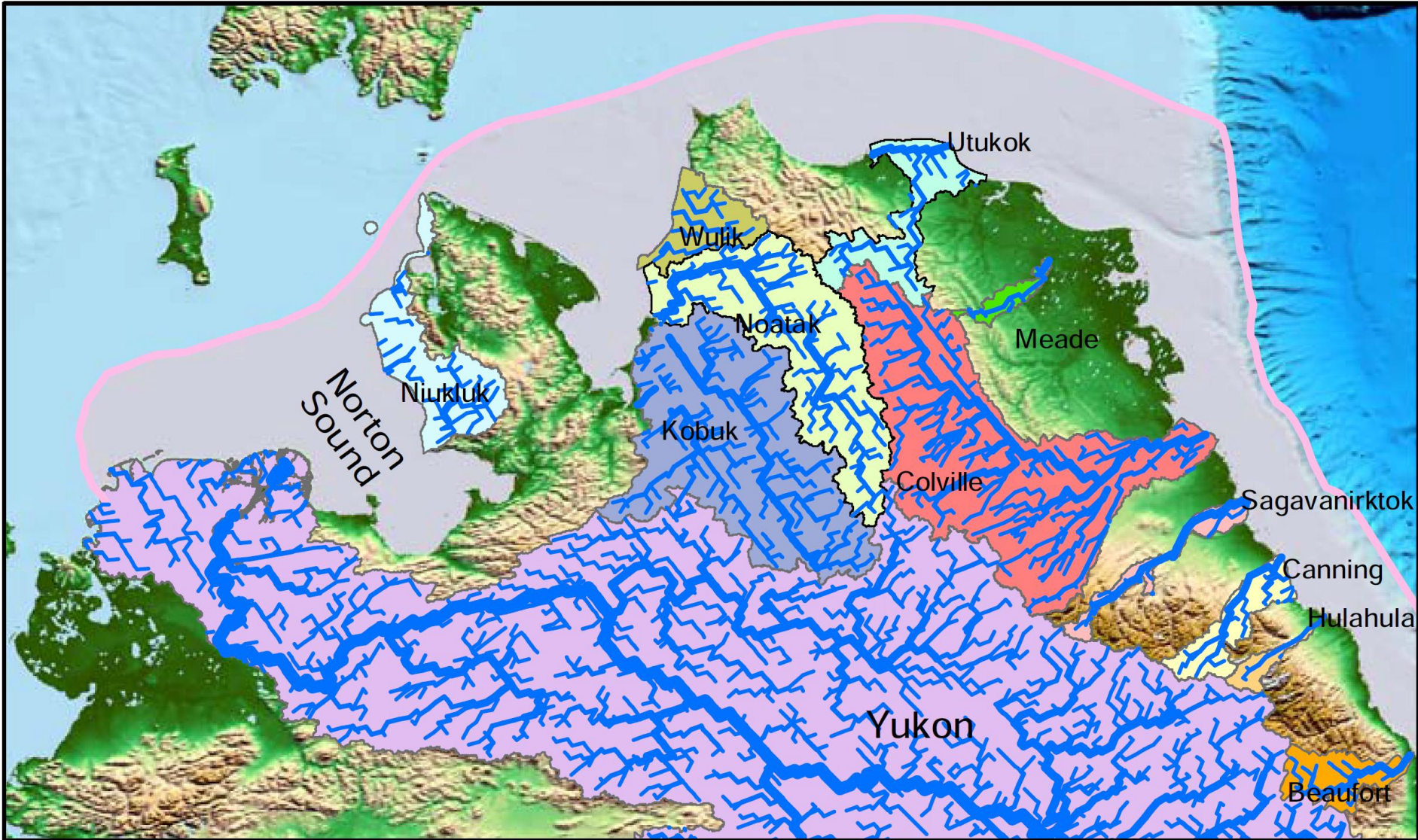
*Victoria and Banks
Islands in the Canadian
Archipelago - CHARS
(CHARS: Canadian High
Arctic Research Station)*



Arctic-COLORS Focus
from River Mouths to mid-Shelf Waters
(shallow waters to 500 m deep)

Arctic-COLORS Study Domain

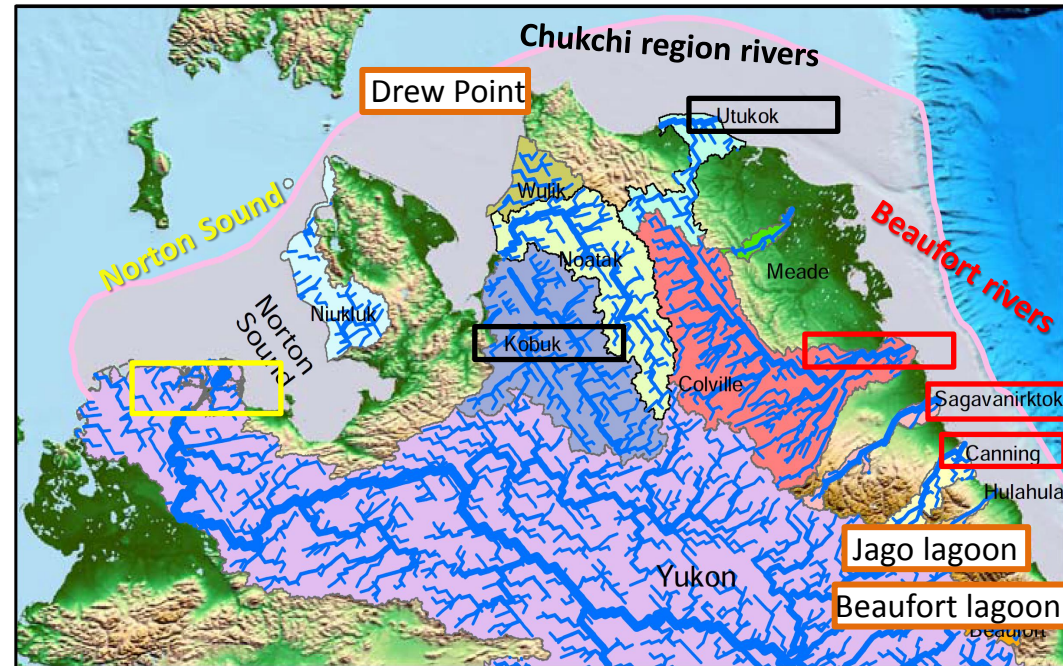
Arctic-COLORS Focus from River Mouths to mid-Shelf Waters



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**



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

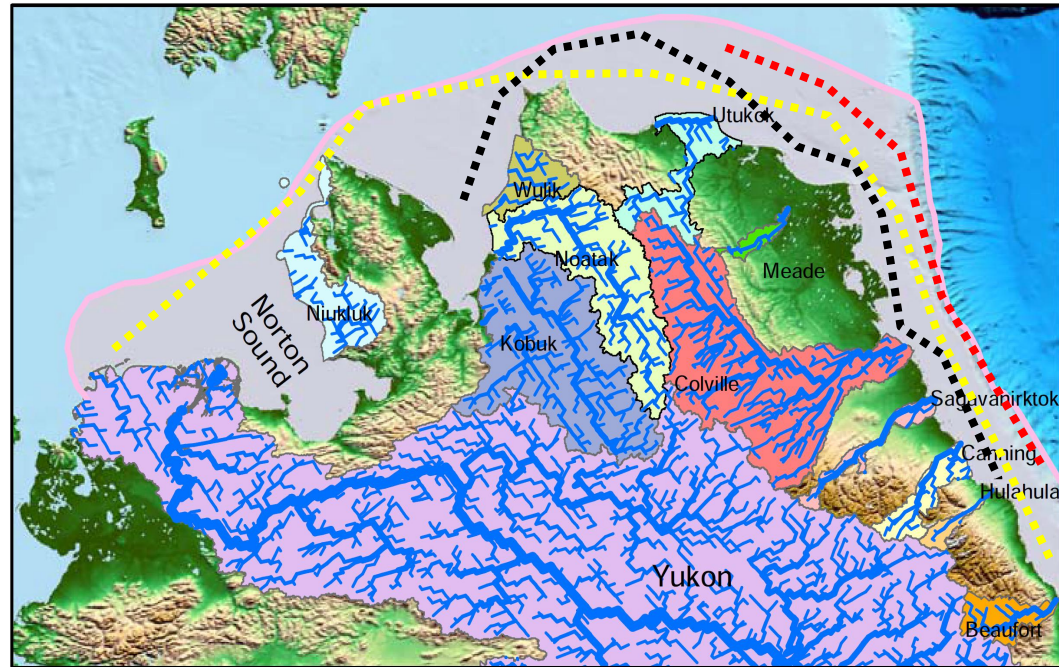
Process Studies

March	May/early June	July	Sept	October
<ul style="list-style-type: none"> • End of winter condition 	<ul style="list-style-type: none"> • Peak river discharge • Under ice blooms 	<ul style="list-style-type: none"> • Increasing biological & photochemical activity 	<ul style="list-style-type: none"> • Max open water/min sea ice • Low river discharge • Pre-conditioning of systems prior to winter 	<ul style="list-style-type: none"> • 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

March

- End of winter condition

May/early June

- Peak river discharge
- Under ice blooms

Survey Studies

July

- Increasing biological & photochemical activity

Sept

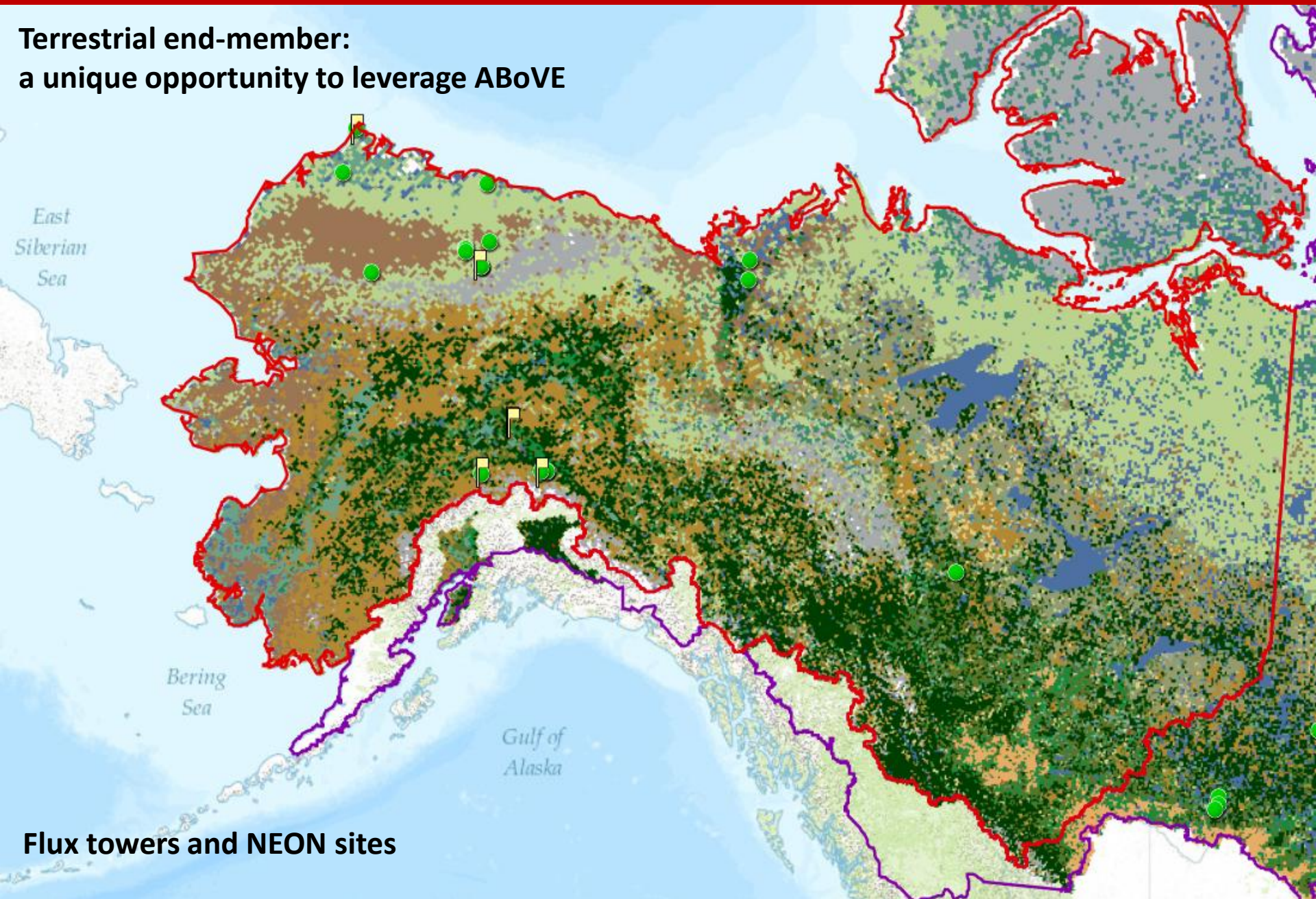
- Max open water/min sea ice
- Low river discharge
- Pre-conditioning of systems prior to winter

October

- Freeze-up period



**Terrestrial end-member:
a unique opportunity to leverage ABoVE**



Flux towers and NEON sites



NASA's ABoVE Field Campaign

National Aeronautics and Space Administration



<http://above.nasa.gov>

ABoVE Concise Experiment Plan

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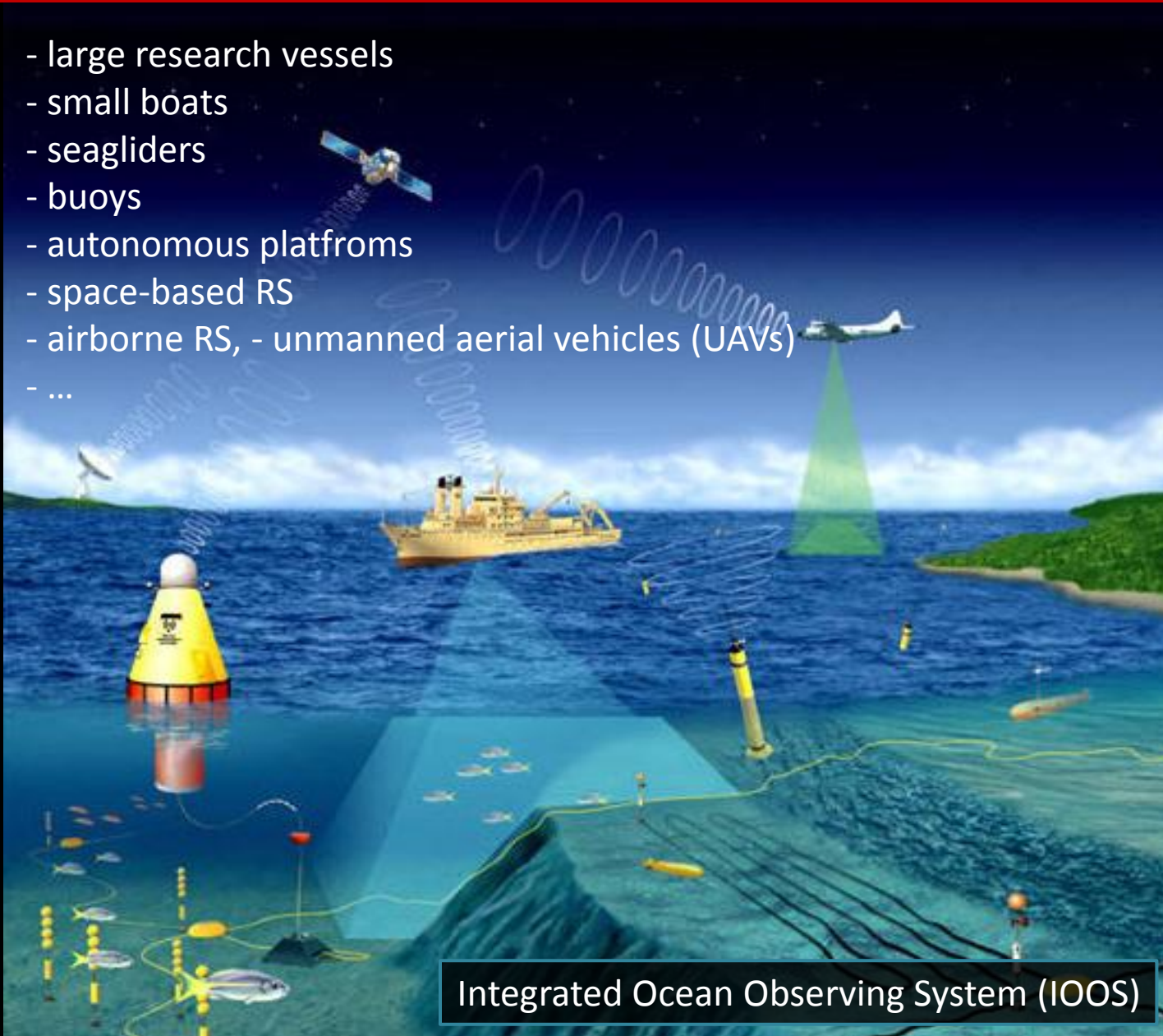
NASA's Terrestrial Ecology Program is conducting a major field campaign:

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.



- large research vessels
- small boats
- seaglidors
- buoys
- autonomous platforms
- space-based RS
- airborne RS, - unmanned aerial vehicles (UAVs)
- ...



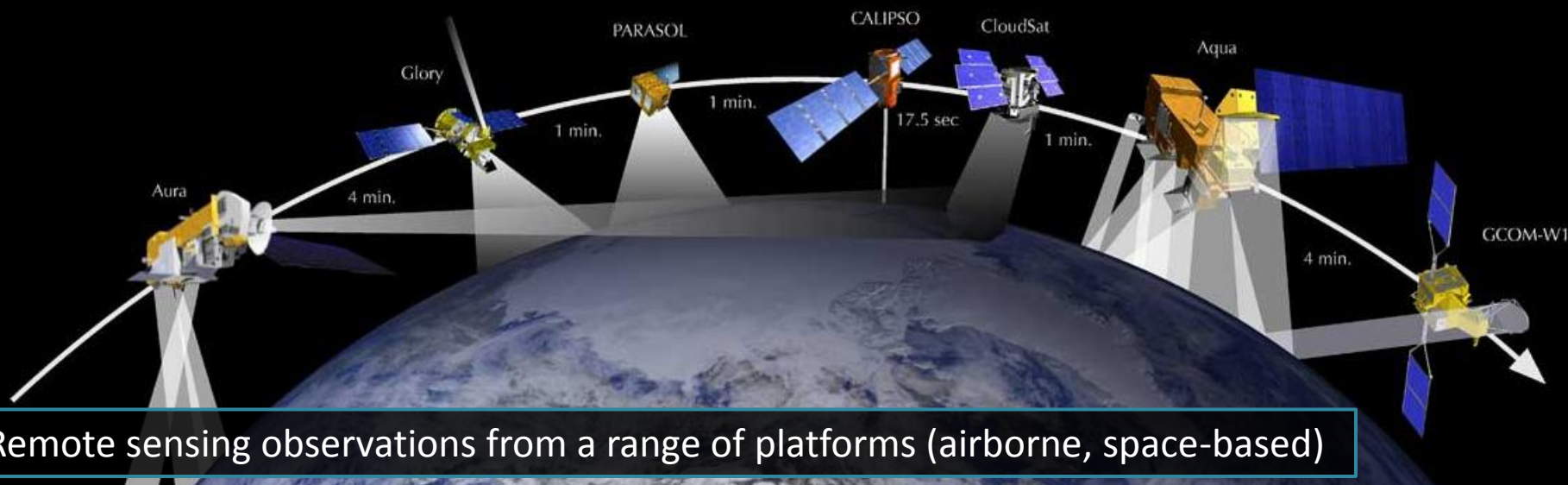
Integrated Ocean Observing System (IOOS)





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



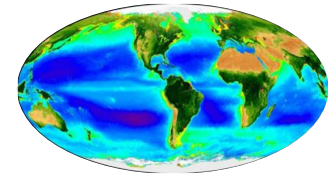


Arctic COLORS - Remote Sensing

- **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 NO₂, CO₂ and CH₄)
- **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).

VIIRS	~2/2012 to present	750 x 750 m full swath	410, 443, 486, 551, 671	Twice/day	NOAA/NASA
OLI	3/2013 to present	30 x 30 m	443, 482, 561, 655	~8 days	NASA/USGS
OLCI	Launch 2015	300 x 300 m	400, 412.5, 442.5, 490, 510, 560, 620, 665, 681, 709, 754	2-3 days	ESA
S-GLI	Launch Dec. 2016	250 x 250 m	380, 412, 443, 490, 530, 565, 670, 763	2-day	JAXA
PACE OCI	Launch ~2022/2023	~1 x 1 km or better	Hyperspectral 350-800	2-day	NASA

<http://arctic-colors.gsfc.nasa.gov>



PACE
Launch in 2022-2023



ABOVE-Arctic Boreal Vulnerability Experiment
2015-2024

