

INTERDISCIPLINARY RESEARCH FOR ARCTIC COASTAL ENVIRONMENTS (INTERFACE)



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Stephanie Waldhoff (PNNL)



Leadership Team

Joel Rowland – *Los Alamos*: Lead PI, RGMA lead, Integrated Tasks, Institutional lead

Stephanie Waldhoff – *Pacific Northwest*: MSD lead, Institutional lead

Andrew Roberts – *Los Alamos*: ESMD lead

Ethan Coon – *Oak Ridge*: Institutional lead

Diana Bull – *Sandia*: Institutional lead

Scott Rupp – *U. Alaska Fairbanks*: DM lead

Hajo Eicken (absent) - *U. Alaska Fairbanks*: Institutional lead

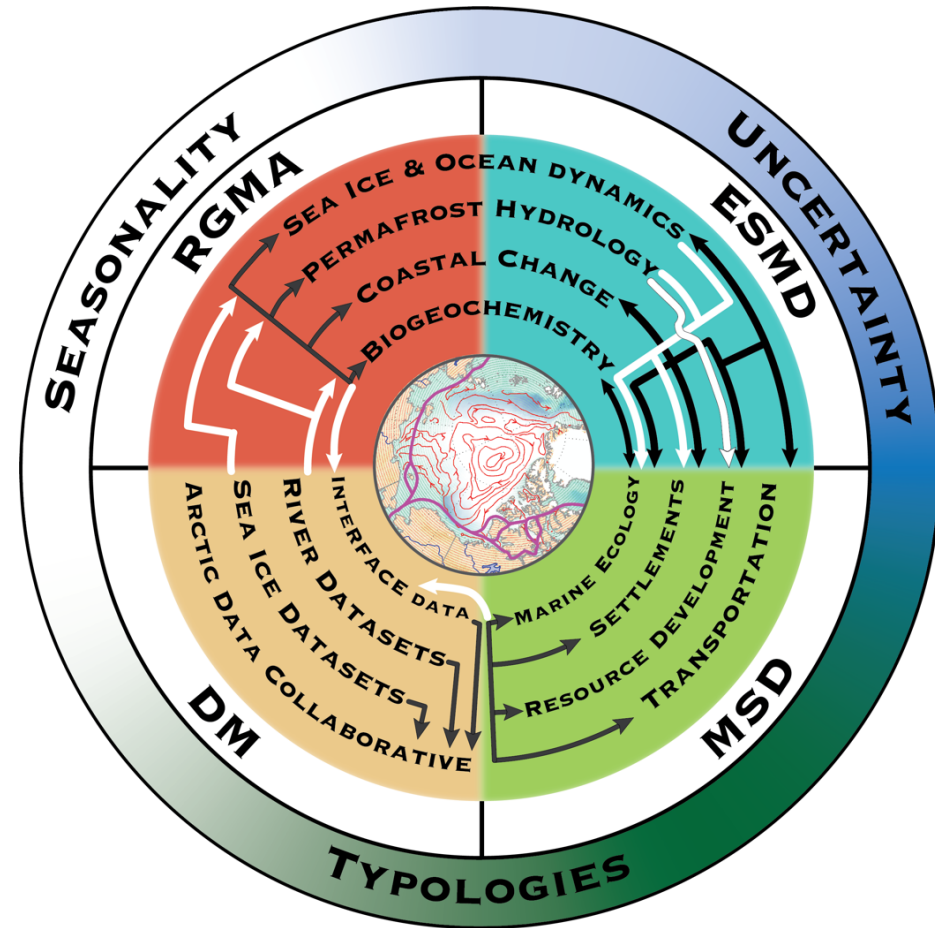
InteRFACE at a glance

Supported by 4 EESSD Programs:

Regional and Global Model Analysis
Earth System Model Development
Multisector Dynamics
Data Management

Five Institutions

Los Alamos National Laboratory
Oak Ridge National Laboratory
Pacific Northwest National Laboratory
Sandia National Laboratories
University of Alaska, Fairbanks



Integrated science focused on feedbacks

Earth System focus on:

- Sea ice and ocean dynamics
- Coastal Change
- Permafrost Hydrology
- Marine Biogeochemistry

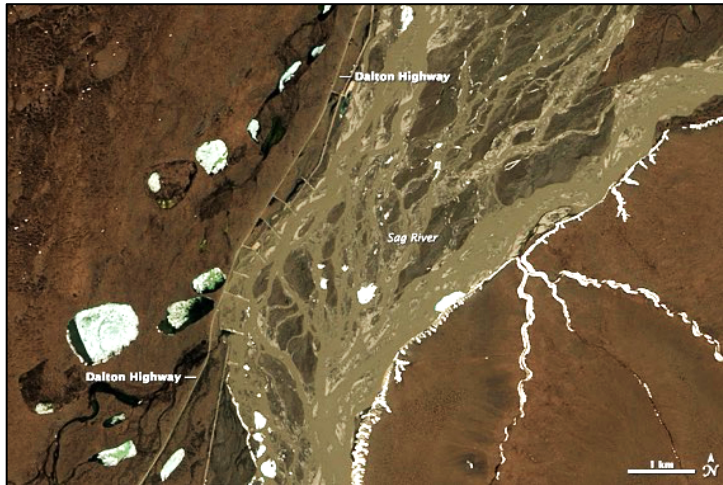
Multi-sector dynamics focus on:

- Shipping
- Settlements
- Resource development

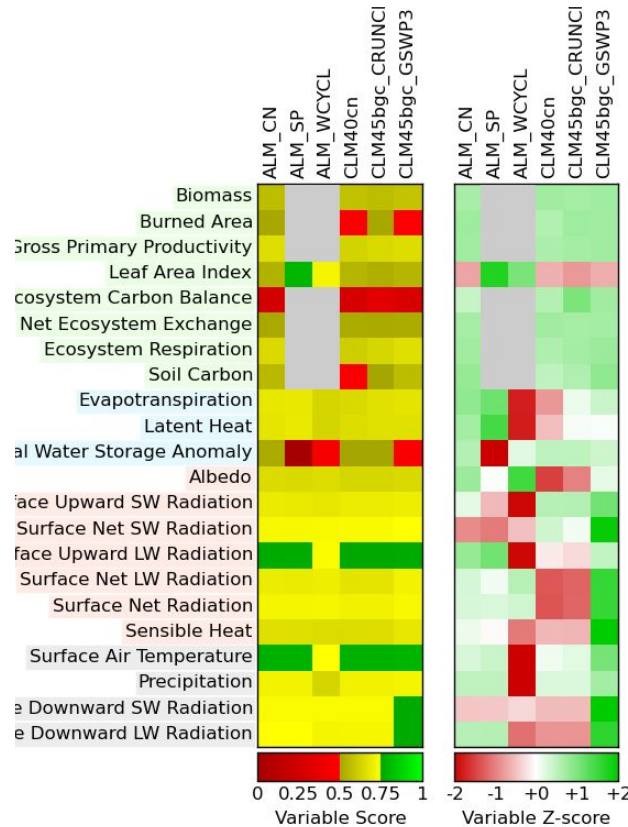


RGMA Research in InteRFACE

Permafrost Hydrology



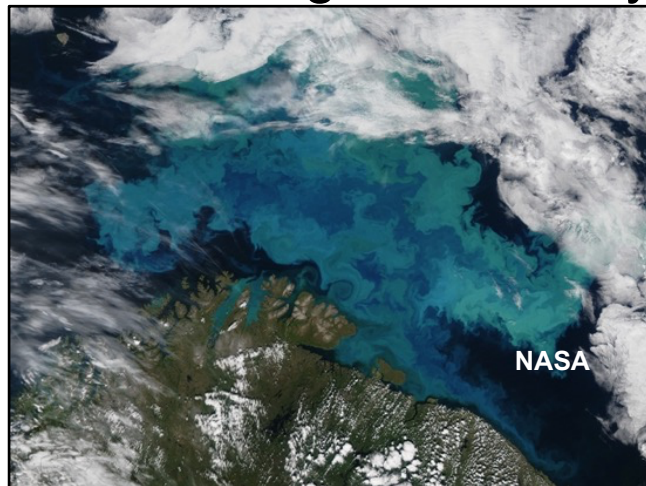
Model Benchmarking and Evaluation



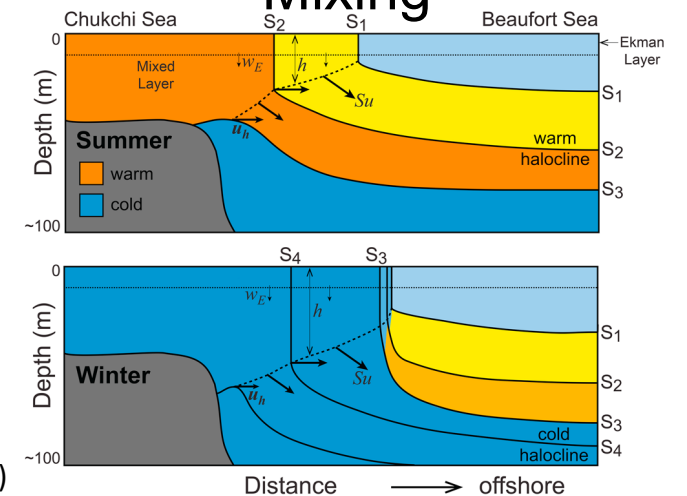
Coastal Change



Marine Biogeochemistry



Ocean Stratification and Mixing

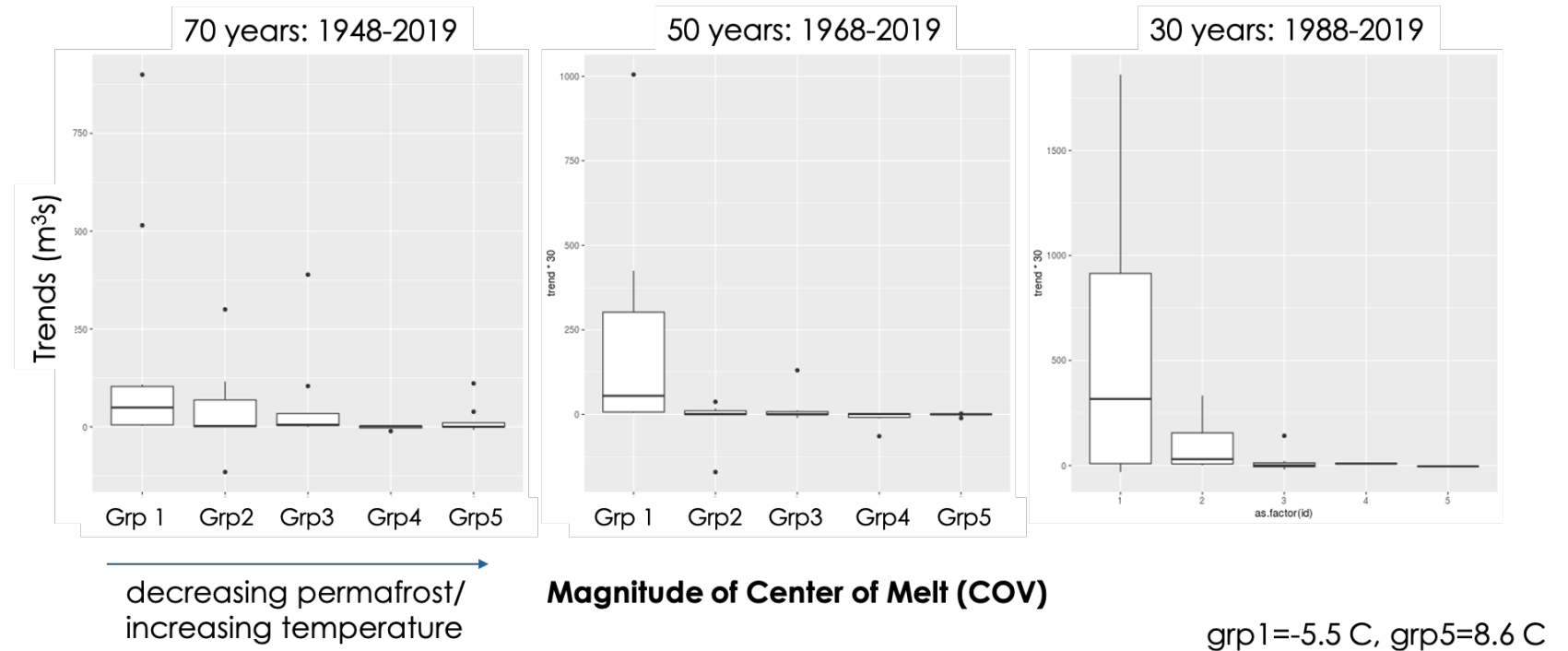


Timmermans et al. (2017)

Permafrost Hydrology – *Analysis of historical data in support of model validation and benchmarking*

- Begun historical trend analysis for North American Rivers
- Analyzed for extremes, means, timing, and magnitudes
- Trend analysis from 1970s to present day
- Start Russian rivers within this FY

Permafrost systems have a larger range/stronger in COV magnitudes versus non-permafrost systems



Team members: Katrina Bennett, Jon Schwenk, Kurt Solander, Feng Yu, Bob Bolton, Anastasia Piliouras, Nibedita Sinha

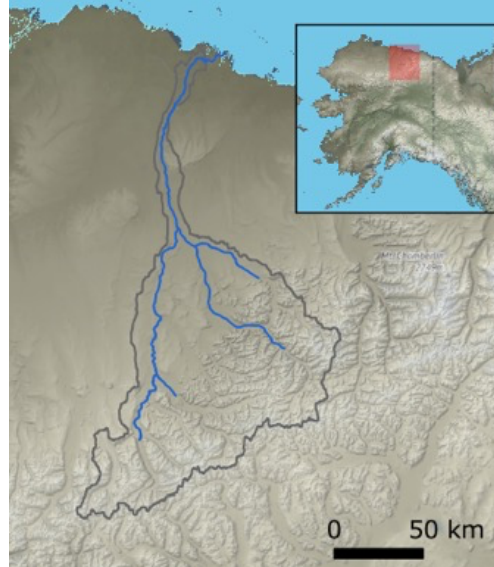
Point of collaboration with HiLAT

Permafrost Hydrology - Develop tools for analysis and ILAMB

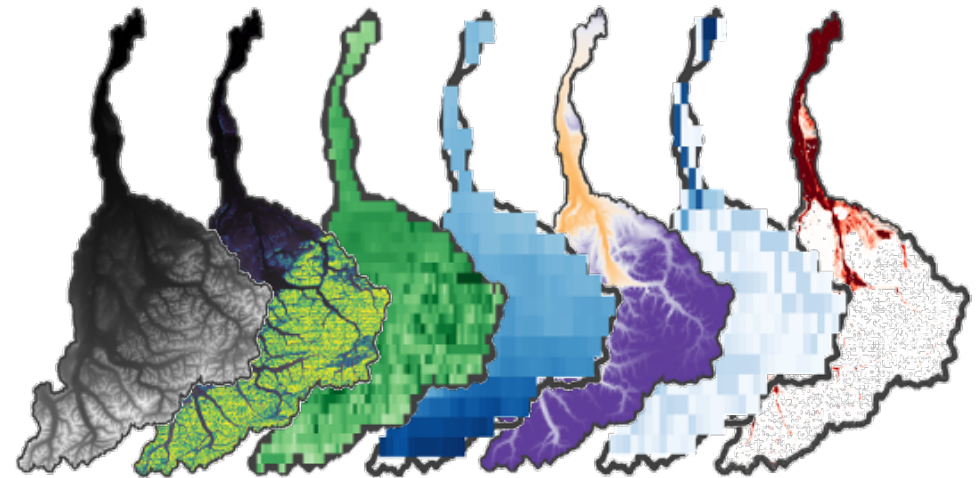
- Read watershed polygons as shapefiles into ILAMB
- Mapping river gages to ESM grid cells – starting with MOSART
- Refined tools for extraction of watershed characteristics
- Use of point-based data to benchmark results
- Developed and leading a working group across EESSD projects to identify community standards and metrics for river benchmarking – offshoot of ESS Cyberinfrastructure working groups

Team members: Jon Schwenk, Kurt Solander, Feng Yu, Jitu Kumar, Ethan Coon, Tian Zhou, Joel Rowland

Point of collaboration with RUBISCO

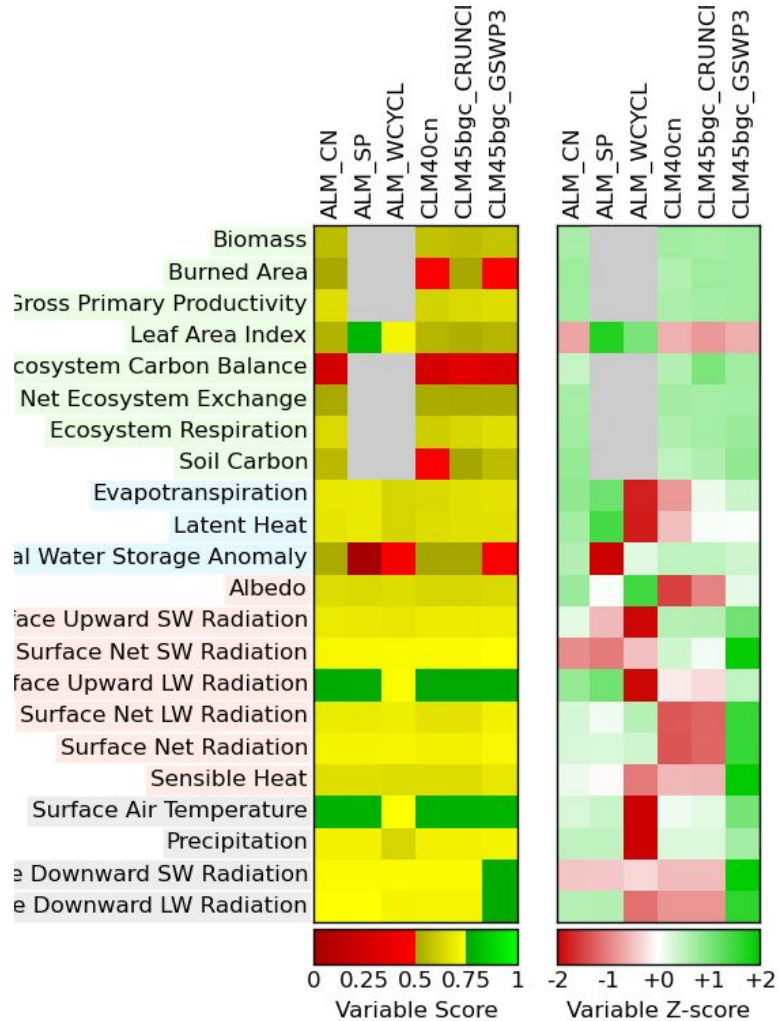


Basin statistics and parameters

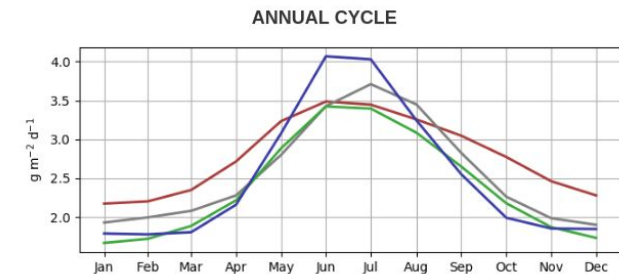
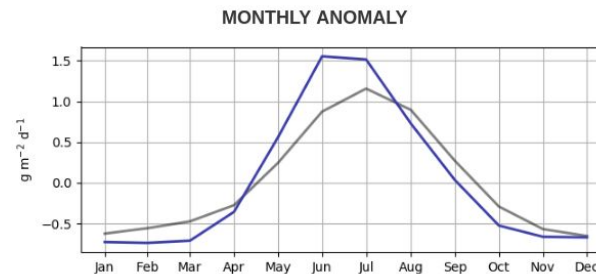


from left: elevation, slope, vegetation, precipitation, permafrost, discharge, soil thickness

Model Evaluation – Metrics and tools for rivers



- MOSART projects discharge at each observation location along the Sagavanirktok River...
- Synthesize and, as needed, digitize known Alaska river datasets
- Discharge model-data comparison in ILAMB
 - ✓ Design data standards for discharge
 - Include measurements in ILAMB
 - Include MOSART output in ILAMB
- Define metrics for river discharge in ILAMB

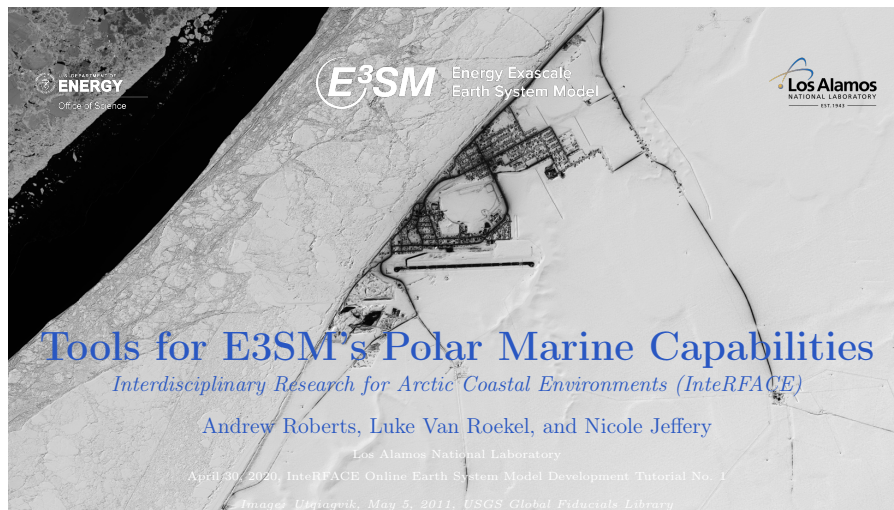


Model Evaluation - POLeSTAr



Andrew Roberts

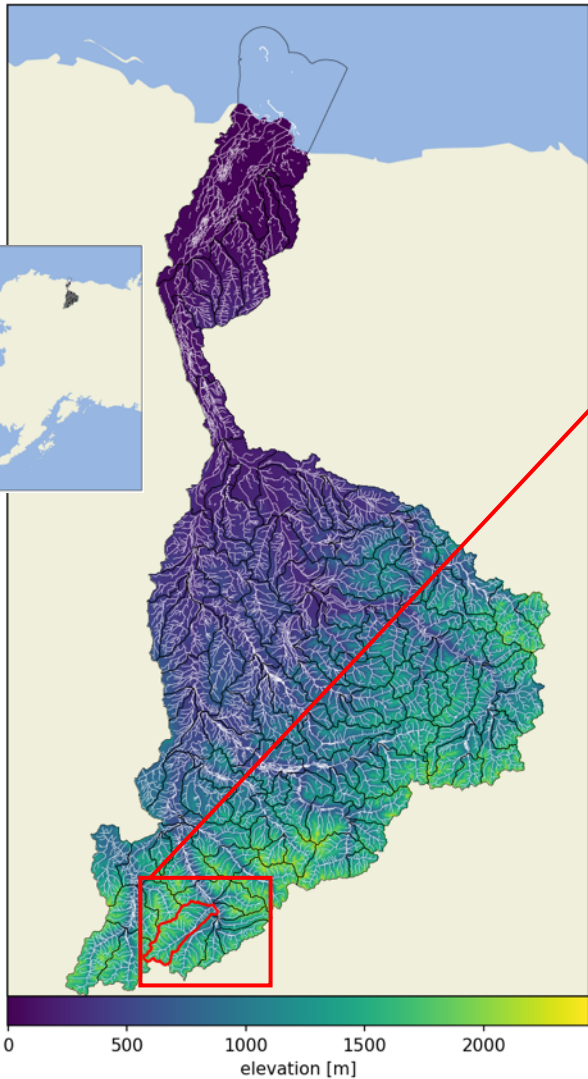
- Satellite emulator for evaluation of sea ice in ESMs
- Conversion of Ridgepack Routines to MATLAB library-independent code
- **Algorithm Development for E3SM visualization E3SM Tools tutorial attended by InteRFACE, ICoM, HiLAT-RASM, and E3SM personnel**
- Commencement of code conversion to Python.



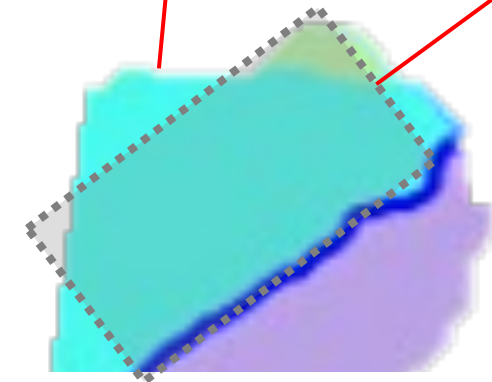
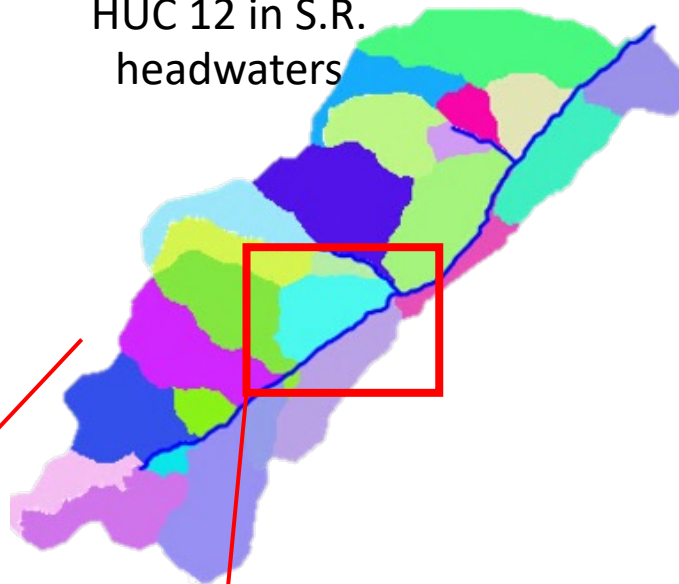
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Integrating RGMA and ESMD for Multi-scale watershed modeling

Sagavanirktok River Basin



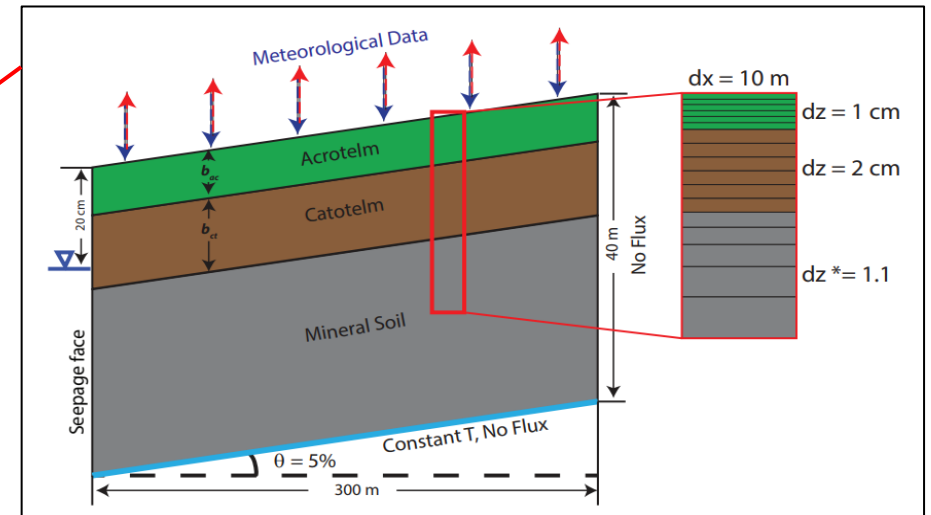
HUC 12 in S.R. headwaters



delineated subcatchment

- ✓ Subcatchments delineated via elevation, drainage algorithms
- Parameterize each subcatchment as a hillslope:
 - ✓ slope, aspect, geometry
 - vegetation type
 - soil structure
- ATS simulates discharge from each hillslope...

representative hillslope



Team Members: Ethan Coon, Tian Zhou, David Moulton, Jon Schwenk, Elchin Jafarov.

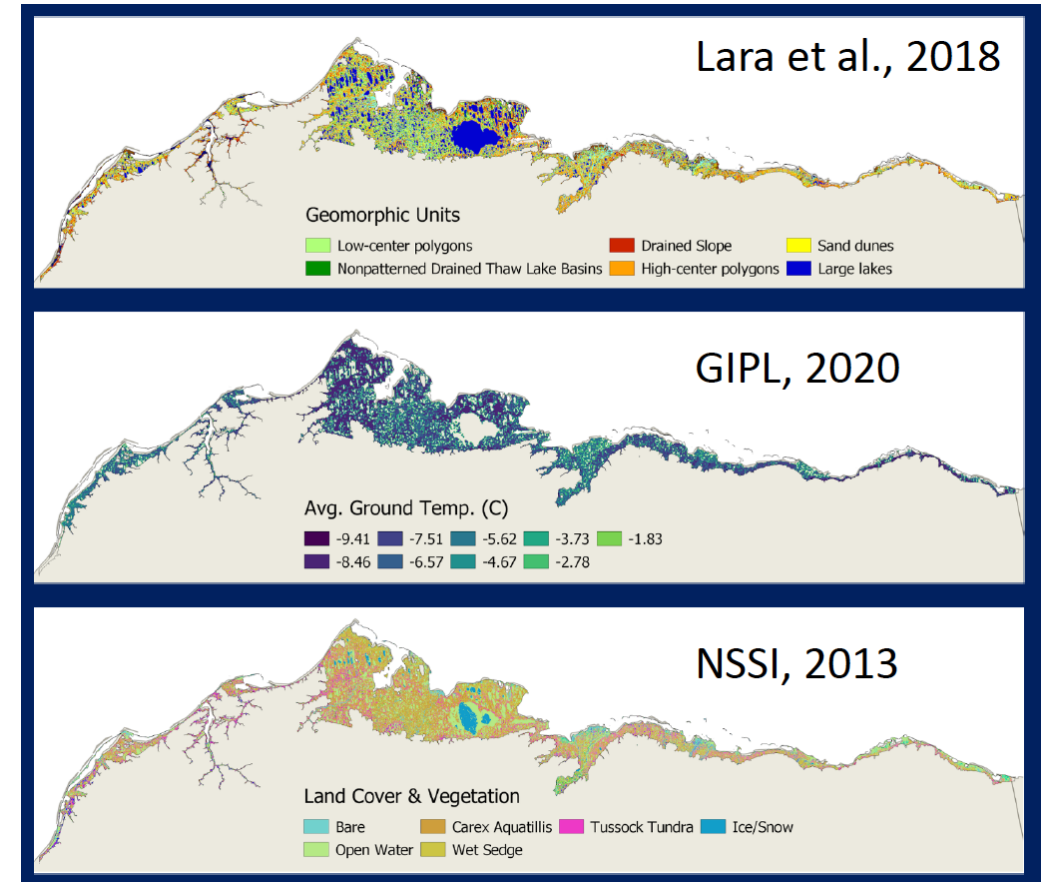
Points of Collaboration: Cardenas Lab, UT Austin, Exasheds, IDEAS, ICoM, NGEE-Arctic

Coastal Change – Develop coastal typologies

- Identified and focused on integrating land, nearshore, ocean, and atmosphere conditions
- Land datasets have focused on topography, vegetation/land cover, permafrost, soils, erosion.
- Ocean datasets on wave climates, sea ice, and wind conditions
- Exploring machine learning for classification
- Typologies will guide set up for coastal erosion modeling
- Tightly coupled with Local Human-Natural System Dynamics under Integrated Tasks

Team Members: Anastasia Piliouras, Diana Bull, Ben Jones, Alec Bennett, William Eymold, Vladimir, Aleexev, Tabitha Clevenger, Joel Rowland

Points of Collaboration: USGS, PerCS-Net, Beaufort Lagoon-LTER



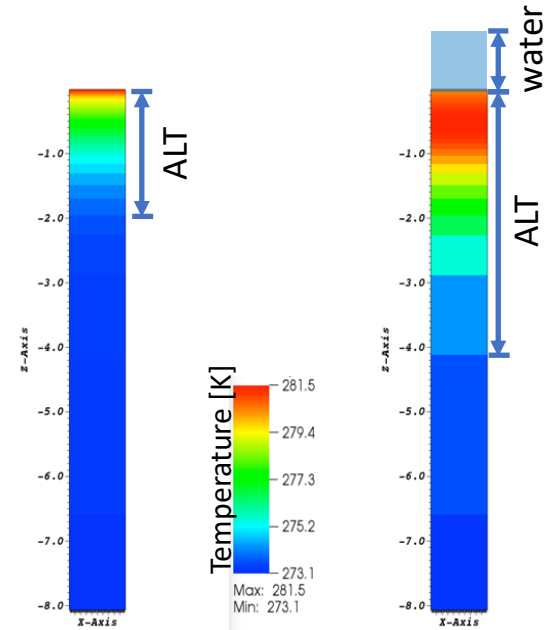
Coastal Change -Simulation of permafrost thaw due to inundation by SLR and storm surge

- Running test simulations of flooding on permafrost thaw in ATS
- Developed simulation plan for scenarios of flooding
- Working closely with ATS development team (ESMD) to develop a new process kernel for thermal conditions in standing water due to advective, conductive, and radiative heat exchange



Active layer thickness without standing water

Active layer thickness with standing water



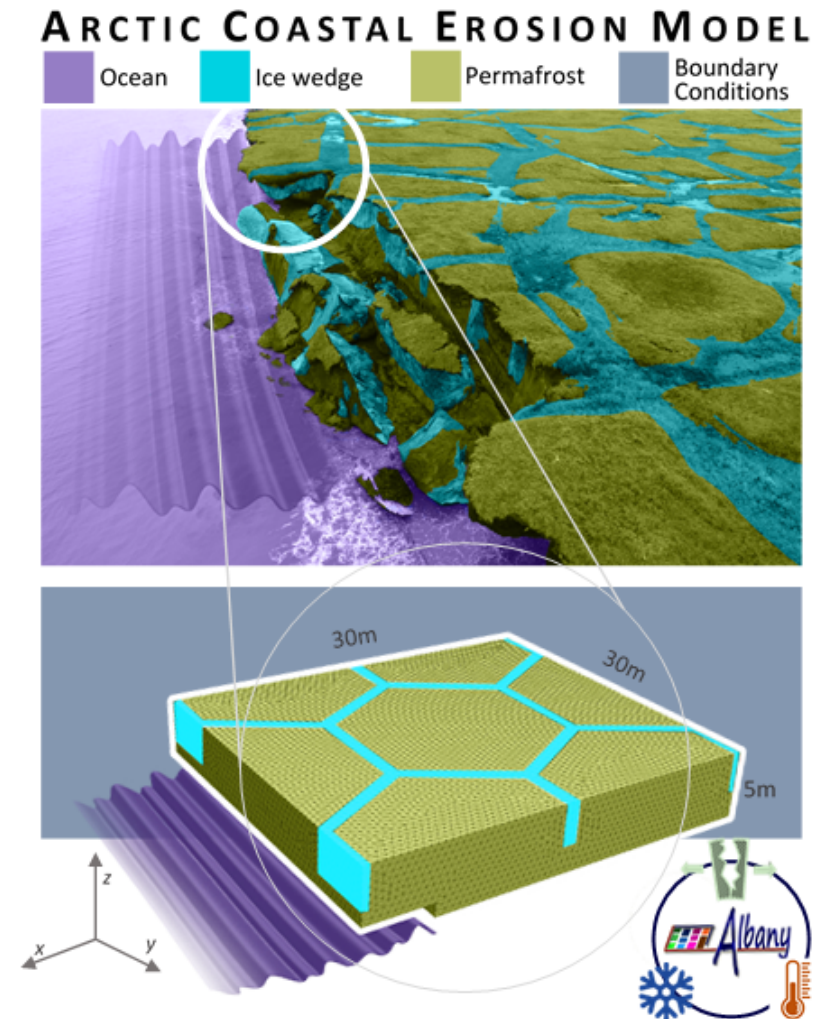
Team Members: Anastasia Piliouras, Elchin Jafarov, David Moulton, Svetlana Tokareva, Joel Rowland

Coastal Change - Simulation of coastal erosion

- Delft3D simulations of nearshore hydrodynamics and sensitivity to bathymetry
- Sandia Arctic Coastal Erosion (ACE) model resolving coupling approaches toward full simulations (SNL LDRD)
- Development of terrestrial model for different typologies

Team Members: Diana Bull, Jennifer Frederick, Ben Jones, Alec Bennett, William Eymold, Vladimir, Aleexev

Points of Collaboration: USGS, PerCS-Net, Beaufort Lagoon-LTER



Marine Biogeochemistry

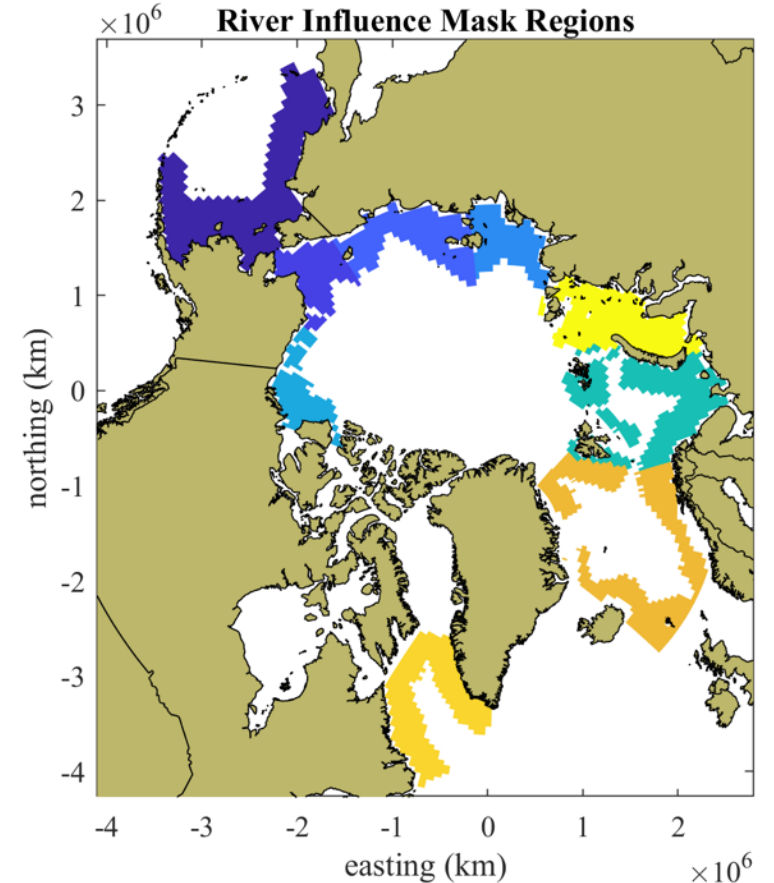
Compile marine BGC datasets

- Compiled coastal observations
- Developed collaborations with IARPC and Arctic Overserving Summit with a focus on Food Security working group
- Begun work on paper for food security and modeling for ARCTIC

Evaluate E3SM BGC

- Scripts and framework for E3SM analysis
- Mask for analysis of river impacted coastal areas for analysis

Team Members: Clara Deal, Nicole Jeffery, Georgina Gibson, Meibing Jin, Katherine Smith, Mat Maltrud



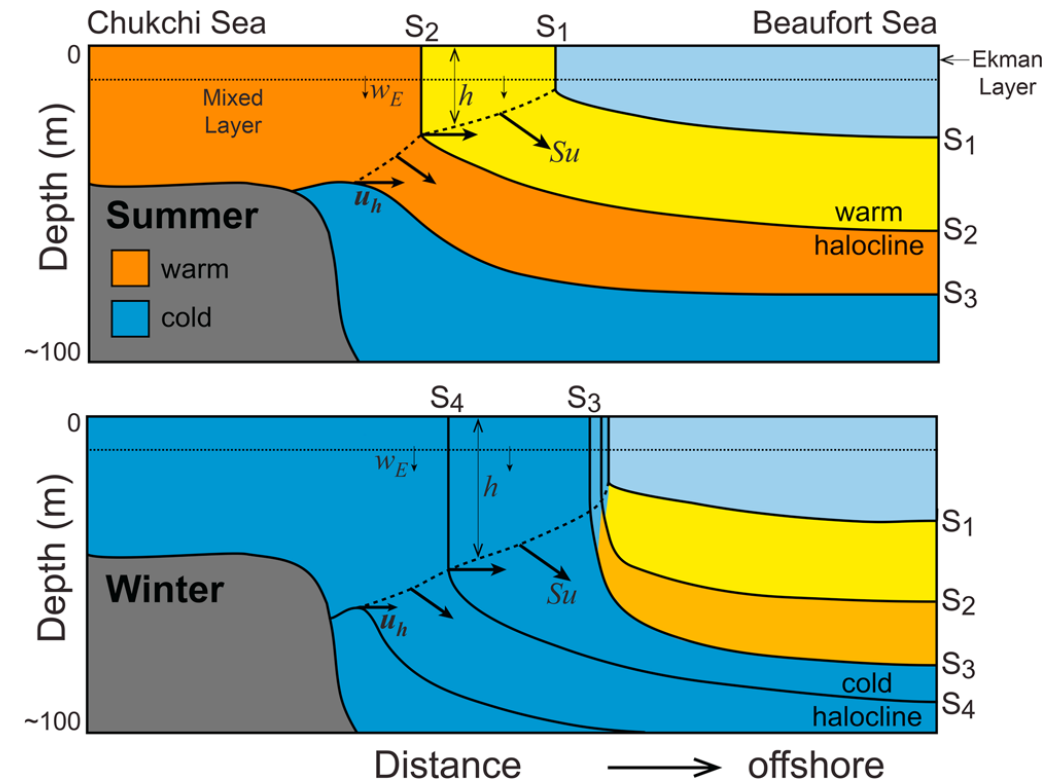
Point of collaboration with HiLAT

Sea Ice & Ocean Dynamics – Large Eddy Simulation

- Scoped Arctic LES configurations
- Developed scenarios and downloaded forcing and initial condition data
- Configured Parallel Large Eddy simulation model (PALM)

Team Members: Luke Van Roekel, Katherine Smith

Point of collaboration with E3SM, HiLAT, and ICoM



Timmermans et al. (2017)

Expanding scientific opportunities through a network of collaborations

