Arctic ocean observing and the Unified Forecast System

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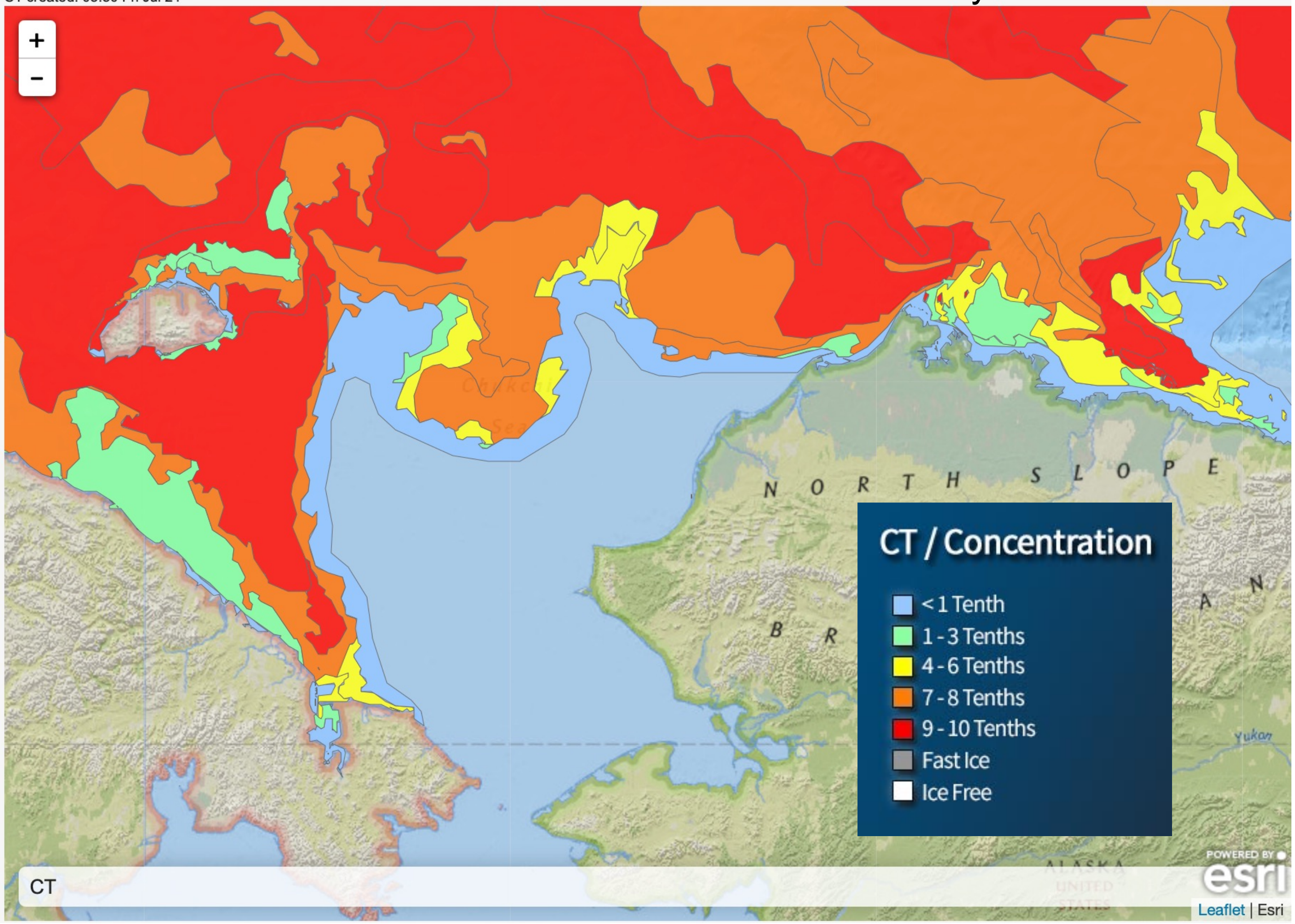
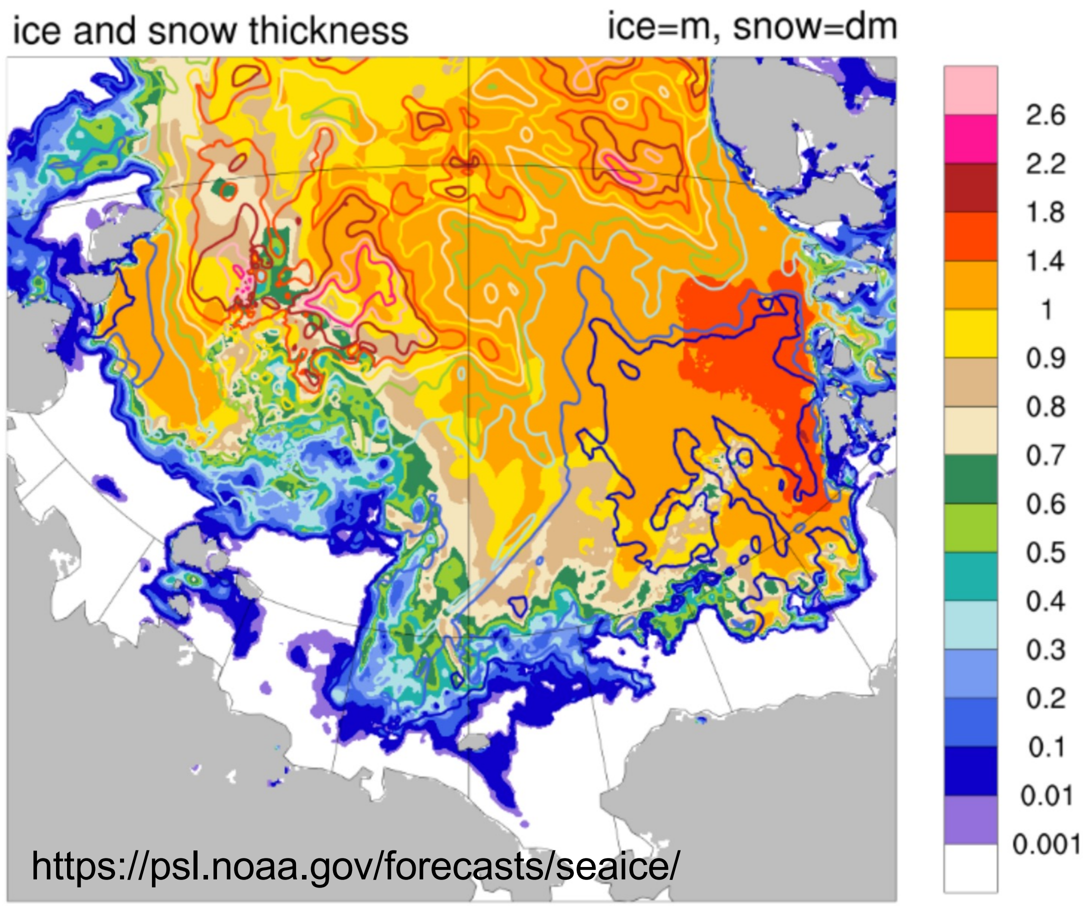
Ice Analysis Layer: Concentration Stage Forecast Legend

CT created: 03:50 Fri Jul 21

21 July 2023



Coupled Arctic Forecast System (CAFS)



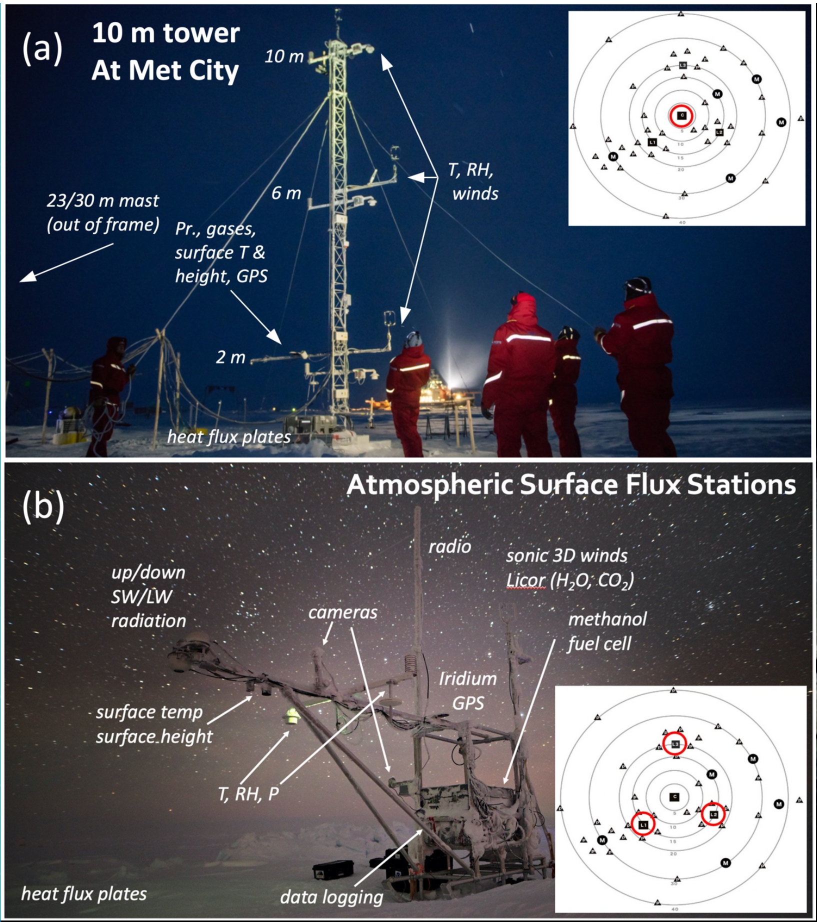
Sea ice forecasting:

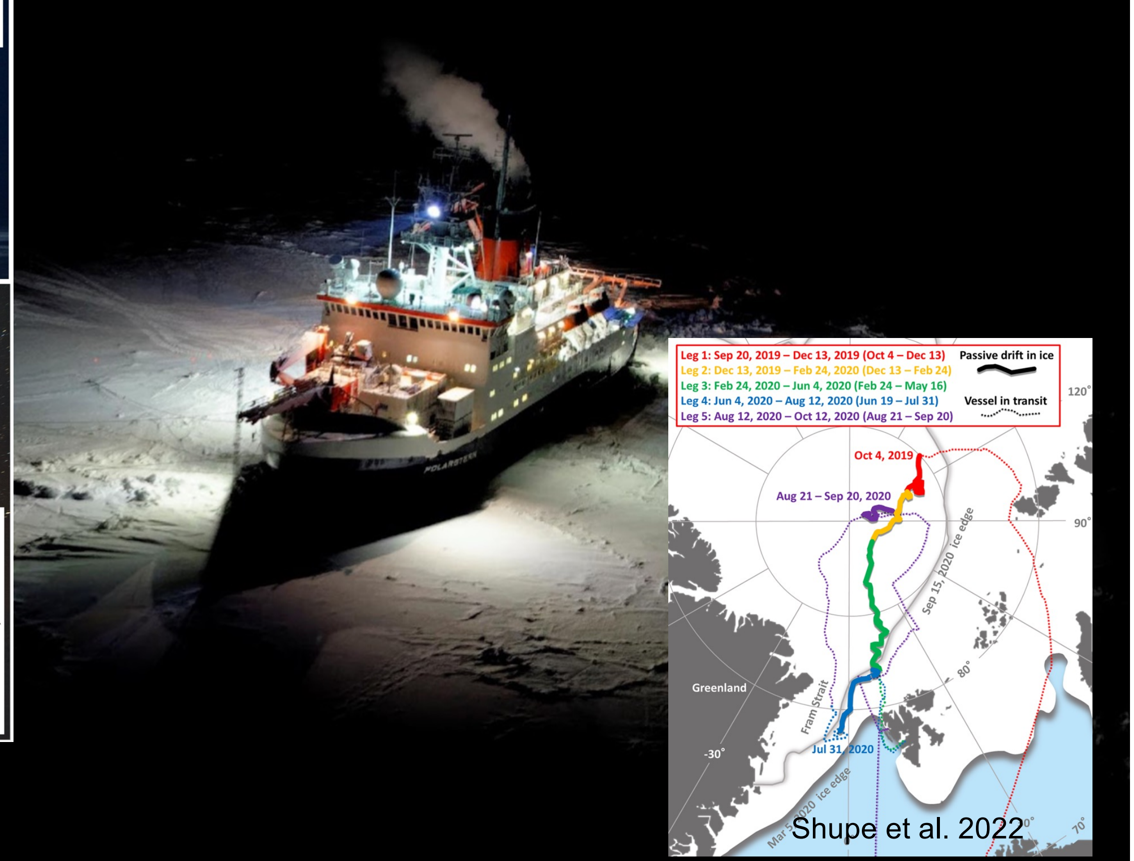
Two types of networks for two types of of errors

- Forecast initialization errors
  - State variable data suitable for assimilation: SST, SSS, SIC

- Forecast drift errors (bias)
  - Physical process data suitable for model development and evaluation.

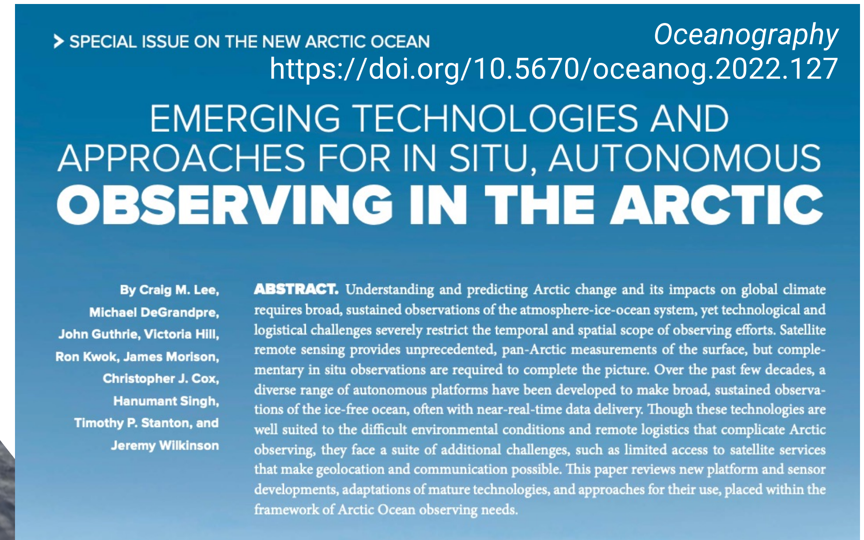
MOSAiC





Data availability in Arctic Data Center, ARM Archive, PANGAEA

Prioritizing measurements



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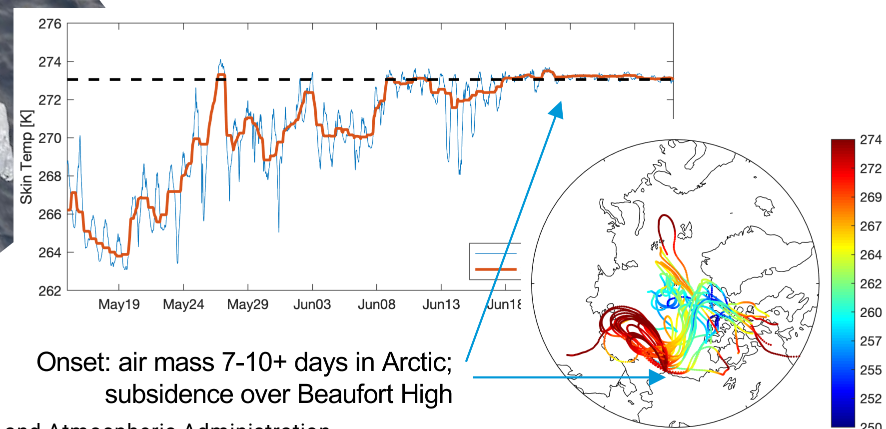
EMERGING TECHNOLOGIES AND APPROACHES FOR IN SITU, AUTONOMOUS **OBSERVING IN THE ARCTIC**

By Craig M. Lee, Michael DeGrandpre, John Guthrie, Victoria Hill, Ron Kwok, James Morison, Christopher J. Cox, Hanumant Singh, Timothy P. Stanton, and Jeremy Wilkinson

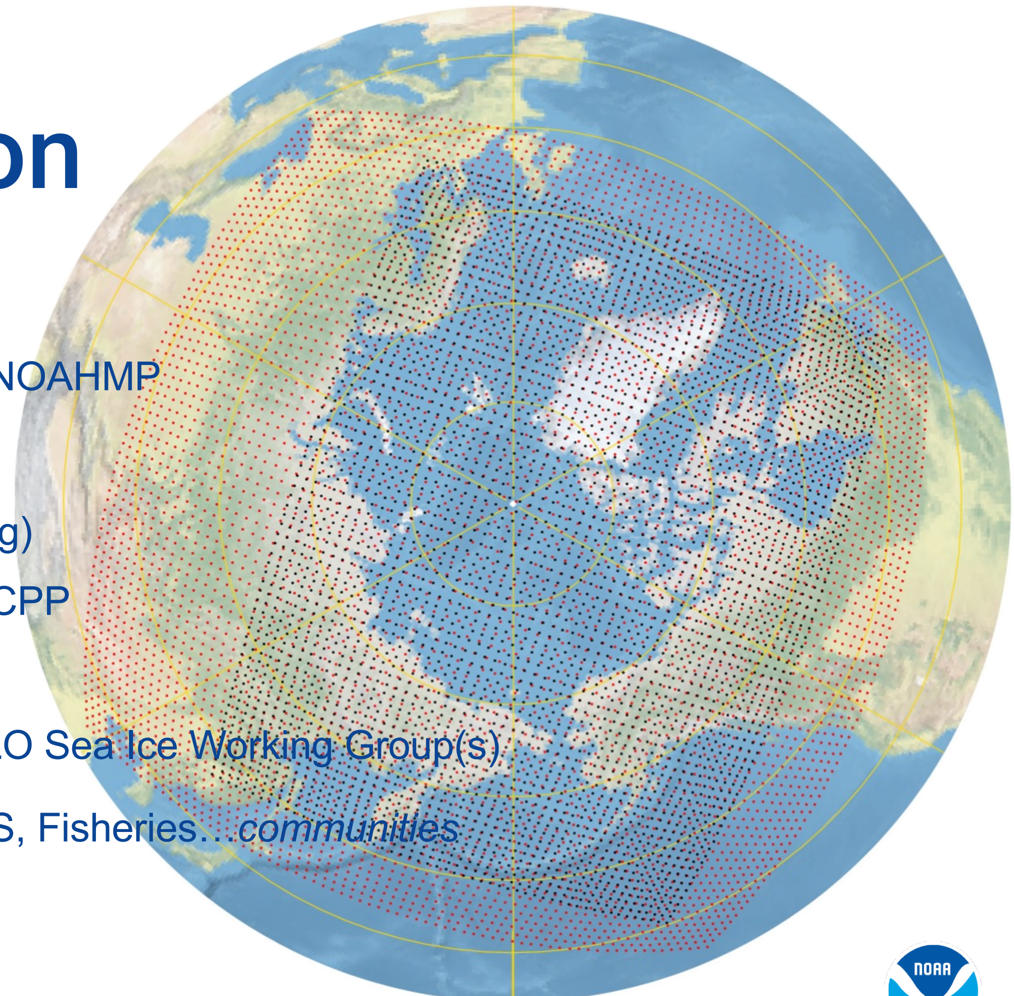
ABSTRACT. Understanding and predicting Arctic change and its impacts on global climate requires broad, sustained observations of the atmosphere-ice-ocean system, yet technological and logistical challenges severely restrict the temporal and spatial scope of observing efforts. Satellite remote sensing provides unprecedented, pan-Arctic measurements of the surface, but complementary in situ observations are required to complete the picture. Over the past few decades, a diverse range of autonomous platforms have been developed to make broad, sustained observations of the ice-free ocean, often with near-real-time data delivery. Though these technologies are well suited to the difficult environmental conditions and remote logistics that complicate Arctic observing, they face a suite of additional challenges, such as limited access to satellite services that make geolocation and communication possible. This paper reviews new platform and sensor developments, adaptations of mature technologies, and approaches for their use, placed within the framework of Arctic Ocean observing needs.



Onset: air mass 7-10+ days in Arctic;
subsidence over Beaufort High

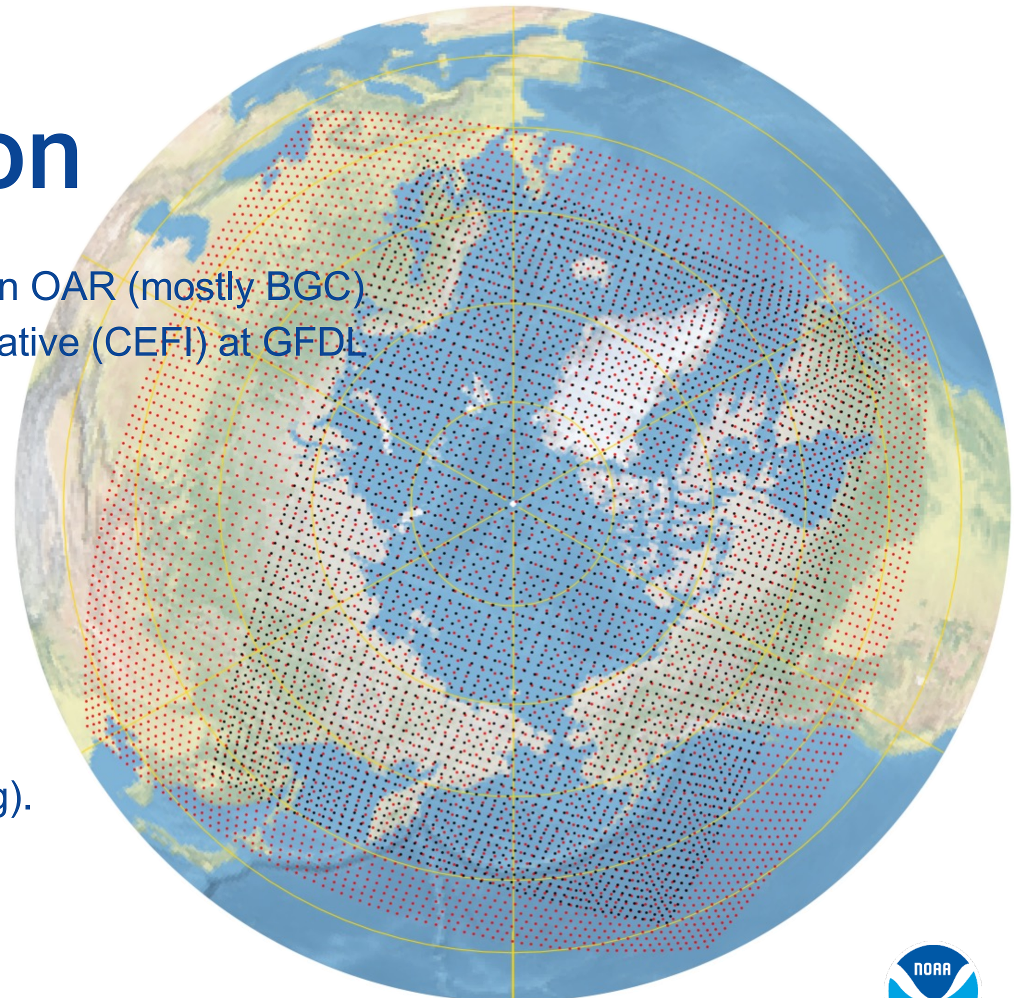
UFS-Arctic
Regional Application

- Transition Plan for CAFS -> UFS
    - FV3GFS/MOM6/CICE6/WaveWatchIII/NOAHMP
- UFS Regional Application capacity building
    - Adapt HAFS (e.g., CICE6 coupling)
    - CAFS physics packages in the CCPP
    - Roving telescopic nesting
    - Coordinating partners include EMC, x-LO Sea Ice Working Group(s)
- Target end-users: OAR labs, NWS/ASIP, NOS, Fisheries…*communities*



UFS-Arctic
Regional Application

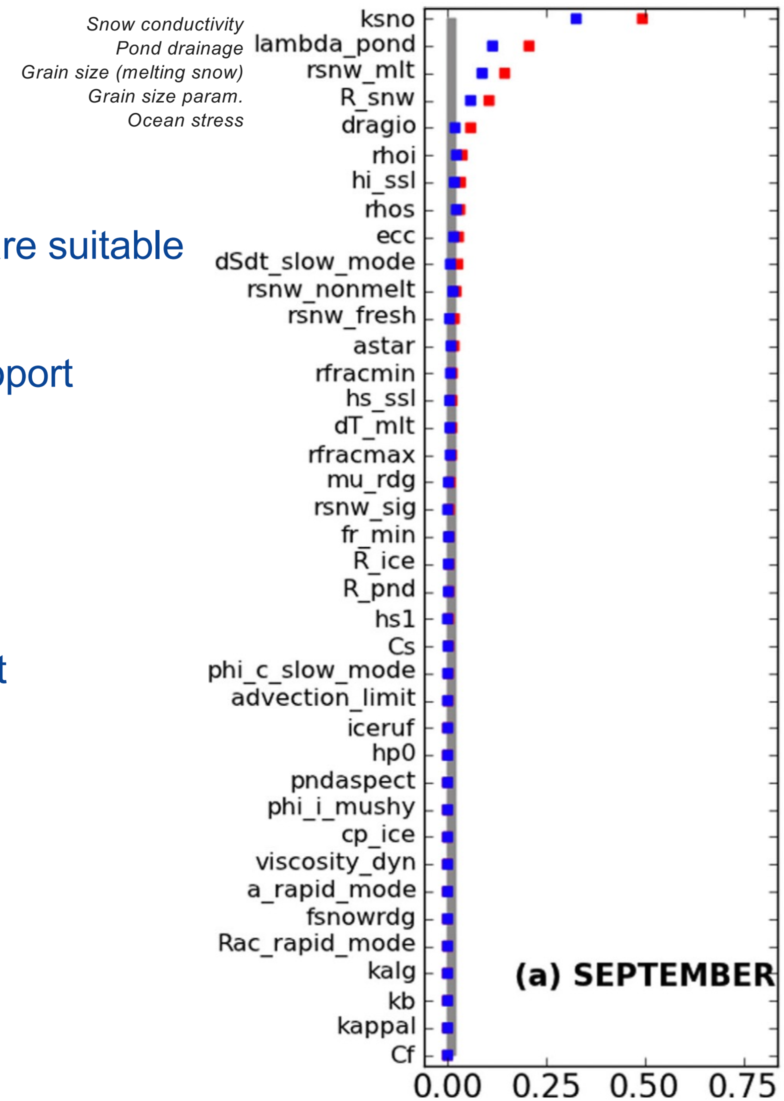
- Shared by non-UFS regional modeling within OAR (mostly BGC)
  - Climate Ecosystem and Fisheries Initiative (CEFI) at GFDL
  - Bering Sea modeling at PMEL
- Coverage
  - southern tip of Greenland
  - Alaska Fisheries regulatory areas.
- No ice at lateral boundaries.
- ~5 km resolution (w/ high res. atmos nesting).



Prioritizing measurements

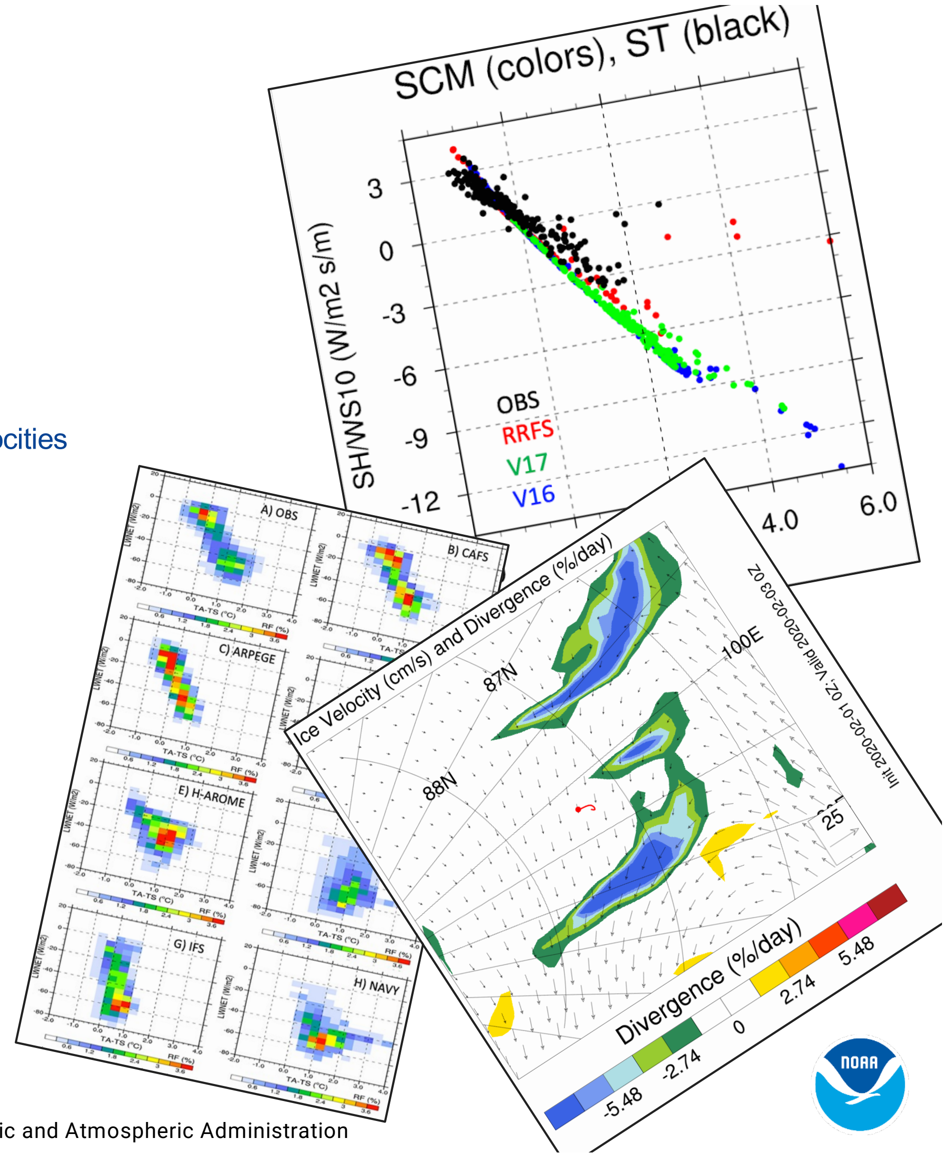
- Model sensitivity studies (e.g., Urrego-Blanco et al 2016) are suitable for prioritizing vulnerabilities in models.
  - Arctic ocean observations should be designed to support targeted areas for improvement.

- Targets for improvement differ amongst
  - Coastal areas (landfast ice parameterizations are not operations)
  - MIZ (FSD ITD; ocean-dominant drift forcing)
  - Open water (SSS, SST, initialization)
  - Central pack (thermodynamic fx drift SEB biases)



Applications…

- Parameterization development:
    - Upscale Single Column Model UFS studies
    - Subgrid heterogenetiy of cloud microphysics and vertical velocities
    - “COARE-ice”
- Develop evaluation tools for export to community:
    - Process-Oriented Diagnostics (PODs)
- New forecast product development:
    - e.g., internal ice stress/divergence (for navigation)
    - e.g., landfast ice (nested?) (travel, subsistence hunting)



Summary

- Filling observing gaps in the Arctic requires consideration of observations that address errors from initialization and model bias.
- The UFS will greatly expand tools available for forecasting sea ice, Alaska region
  - Coupled sea ice modelling for operational purposes in NOAA is in its infancy.
  - Need to meet needs to support UFS development
    - Scalable tools shared between UFS developers and OAR (UFS-Arctic, UFS-SCM, PODs)
    - Develop new types of forecast products. Should be co-productive.

Thanks!

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