



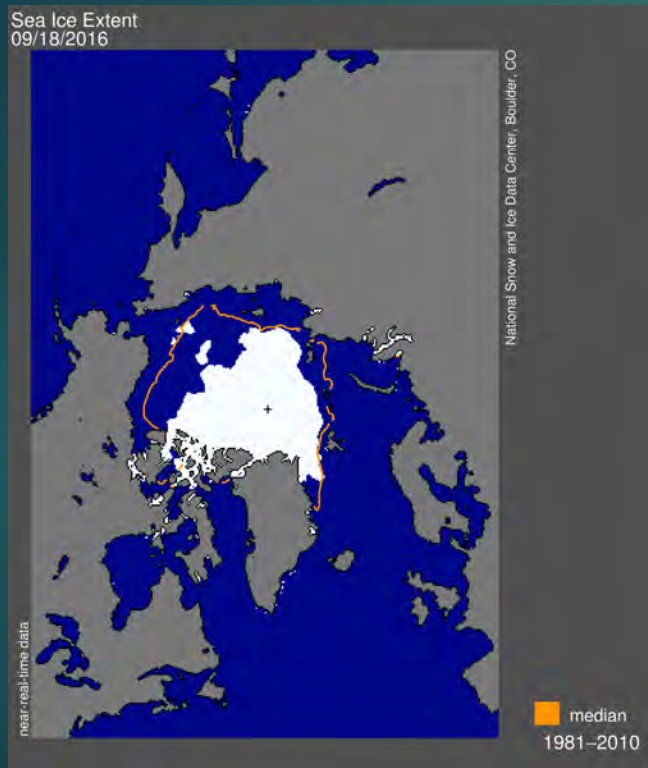
Update on The WCRP CLIVAR/CLiC Northern Oceans Region Panel (plus upcoming MOSAiC Campaign)

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IN COLLABORATION WITH NORP MEMBERS

WCRP CLIVAR/CliC Northern Oceans Region Panel



An international forum for coordination and strategy development for activities regarding the role of the Arctic Ocean in the context of the global climate system.

The panel will work to facilitate progress in developing new tools and methods to observe the Arctic Ocean and neighboring seas and their climate impacts, and to standardize and archive observations of the Arctic Ocean and the coupling with other components of the climate system.

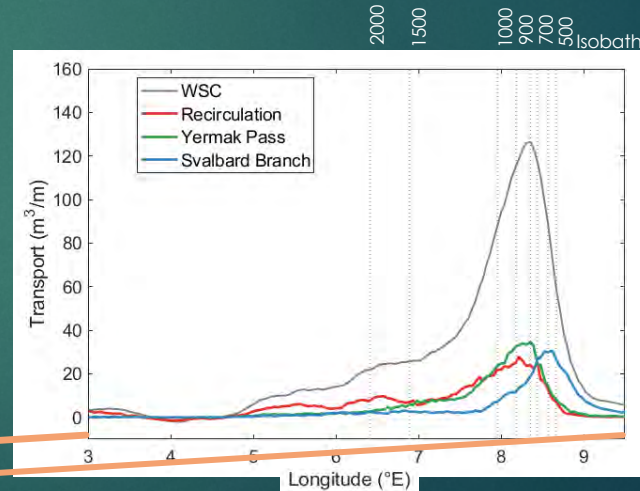
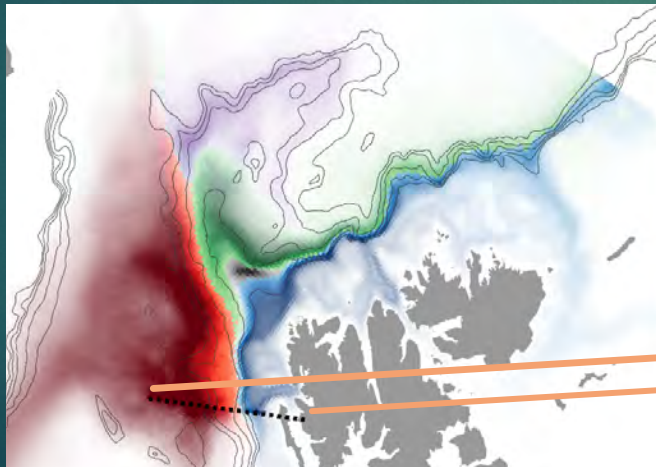
NORP Task Teams

1. The Changing Arctic Ocean
2. Development of a State-of-the-art Arctic Ocean Reanalysis
3. The Role of the Arctic Ocean in Arctic Amplification
4. Advance the understanding of climate variability due to Arctic-midlatitude linkages
5. Quantifying the response to natural external forcing and internal variability in the Arctic Ocean
6. Promoting studies to assess model errors in Arctic projections through initialized forecasts
7. Greenland Ice Sheet – ocean interactions

Task Team #1

The changing Arctic Ocean (including sea ice) – an overarching topic

- (Gaps in) present-day knowledge and understanding of Arctic Ocean
- Changing processes and impacts, including ocean turbulent mixing; impacts on SST, sea ice; dense water formation
- Changing exchanges between Arctic Ocean and (1) adjacent seas, (2) land (river runoff, ice sheet), (3) atmosphere (energy & moisture transport)



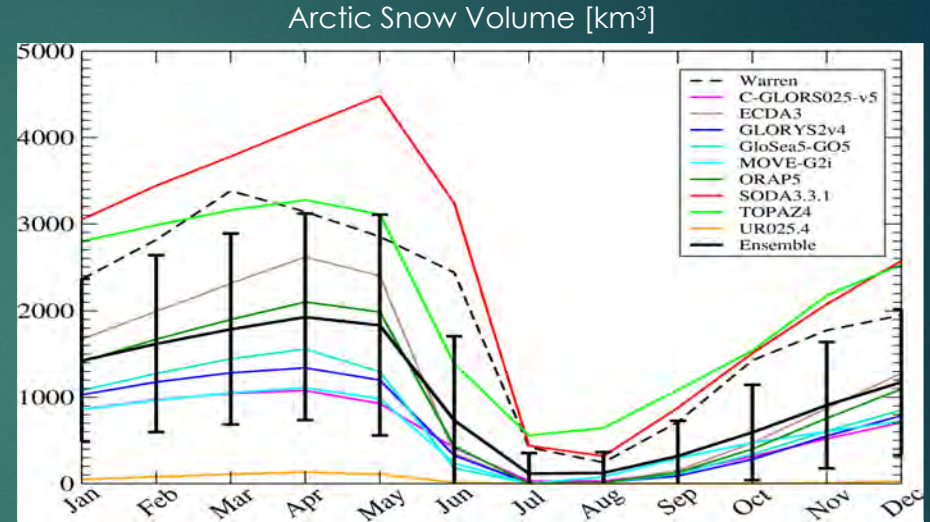
Task Team #2:

Arctic ocean-sea ice state estimates

5

Arctic Ocean Reanalysis Intercomparison

(Uotila et al. 2017)



Monthly climatology of the Arctic snow volume (km³) of the ORA-IP models for the period from 1993 to 2010, its ensemble mean (black solid line - errors bars designate one standard deviation uncertainty) and the snow volume of the Warren climatology (black dashed line).

Task Team #3

The Role of the Arctic Ocean in Arctic Amplification

This task team will address the questions:

- 1) Do we have adequate measurements to evaluate the role of the Arctic/subarctic Ocean in Arctic Amplification?
- 2) What measurements are needed to evaluate this variability in climate models?
- 3) What metrics are needed to assess these mechanisms in climate models (not included in PA-MIP)?
- 4) How to quantify internal variability in Arctic Amplification?

Opportunity to facilitate how best to use remote sensing and in situ measurements to evaluate climate models

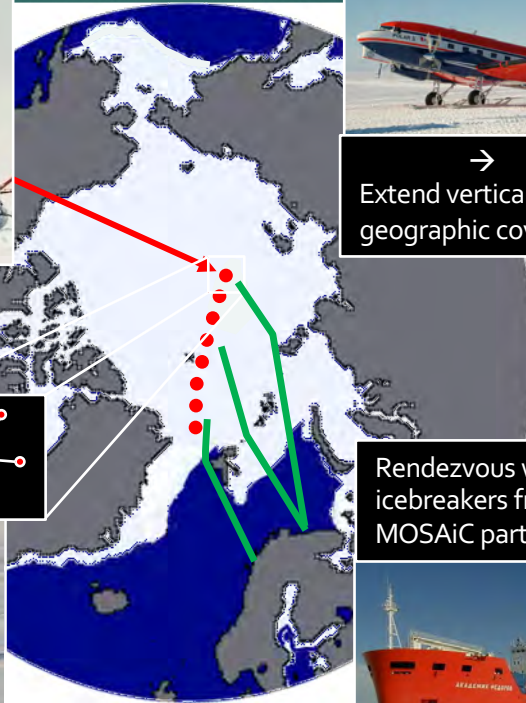
Year round observations in the Central Arctic



Intensive coupled
Atmos-Ice-Ocean-Eco-BGC
Fall 2019 > Fall 2020



Autonomous systems,
UAS, AUV, camps



Science Focus Areas

Central Arctic Coupled System



- Cloud aerosol radiative

Consistent Measurements of the Coupled Ocean-Ice-Atmosphere System

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- Thermal structure
- Small scale processes



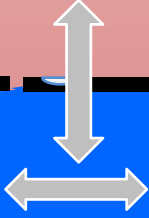
Energy & momentum fluxes

Boundary layer



Ocean

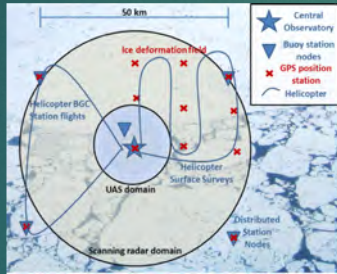
Sea ice



- Ocean variability
- Interactions with sea ice

- Formation
- Drift
- Deformation
- Melting

Multiscale Design



Central Observatory

- Ship/ice based
- Attended observations
- Stable platform
- Process scale observations

< 5 km

Distributed Network

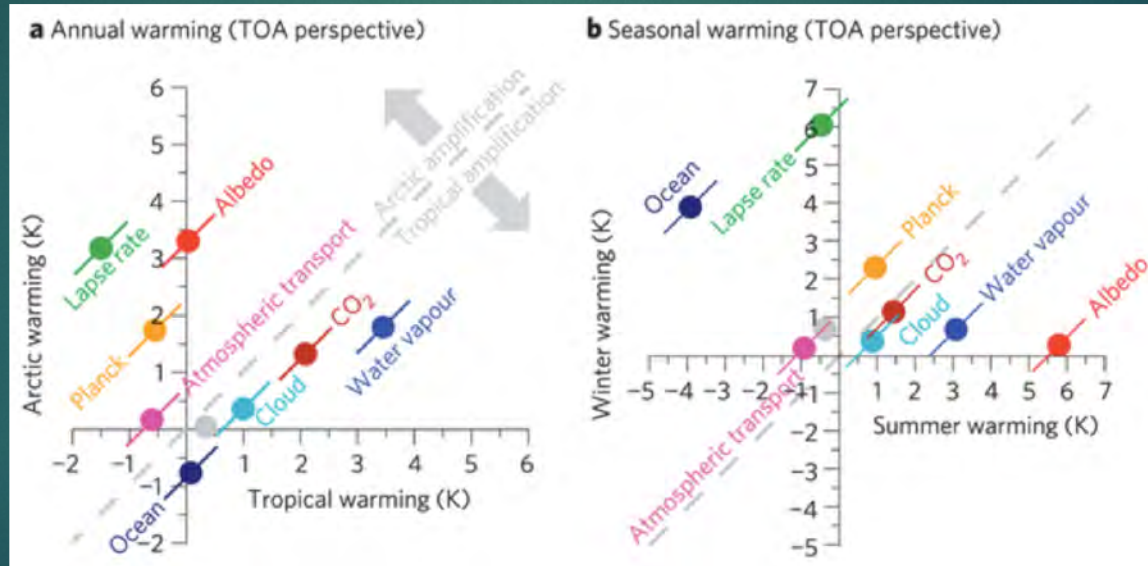
- Autonomous stations
- UAS, ocean gliders
- Heterogeneity
- Process & regional model
- Model grid cell

< 50 km

A “Drifting Climate Model Grid Box”

Unique Aspects Relevant to Arctic Amplification

Measurements over the Full Annual Cycle



NORP Co-Sponsored Workshop on Greenland Freshwater Fluxes

2018 Pre-AGU Workshop



Workshop on Greenland Freshwater Fluxes

A 1-day Pre-AGU workshop on December 9, 2018

(co-hosted by [CLIVAR OMDP](#), [CLIVAR/CLIC NORP](#), & [ISMIP6](#))



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Plans for coming year

- ❖ Organize workshop with SORP on “Role of Freshwater in Polar Ocean Climate Change and Global Linkages” (venue pending)
- ❖ Lead assessment study of CMIP6 freshwater and heat fluxes in the Arctic Ocean
- ❖ Work with national representatives to secure support for Arctic ocean-sea ice state estimates
- ❖ Advance studies on Greenland ice sheet – ocean interactions: Advocate for inclusion in CMIP7 and Sea level call in Horizon2020
- ❖ Coordinate archiving/mirroring of past/future campaign/in-situ data for assimilation and analysis with CLIVAR Global Synthesis and Observations Panel
- ❖ Organize an Arctic “Boot Camp” summer school (2020/2021)

Thank you!
Questions?



1) What are the major knowledge gaps in Arctic Ocean science?

To advance understanding of the Arctic system we need:

- Measurements over an annual cycle
- Consistent measurements of the ocean-ice-atmosphere system (need to constrain compensating errors in models)
- Measurements of "gridbox" variability

2) What are the capability gaps in observing and modeling the Arctic Ocean?

- Measurements of cloud-aerosol interactions (ice formation mechanisms, limited aerosol regimes, sources of aerosols)
- Sustained measurements of exchanges of heat, freshwater, and nutrients (primarily a funding/commitment issues, i.e., The Greenland Ice Sheet-Ocean Observing system that would measure glaciological, oceanic, and atmospheric parameters at a number of sites along the ice sheet/ocean margins for at least two decades.

3) How can US CLIVAR help fill or reduce these gaps by working closely with the domestic and international communities and funding agencies?

- The international community has organized to make progress on observations (i.e., MOSAiC) and modeling (i.e., YOPP, SIDFEx, YOPPsiteMIP) (also CMIP6; ISMIP, SIMIP, PAMIP, etc).
- The challenge will be to build on these activities (for example, the first synthesis paper from SHEBA came out 20 years later).