Synthesis of Modes of Ocean-Ice-Atmosphere Covariability in the Arctic System from Multivariate Century-Scale Observations

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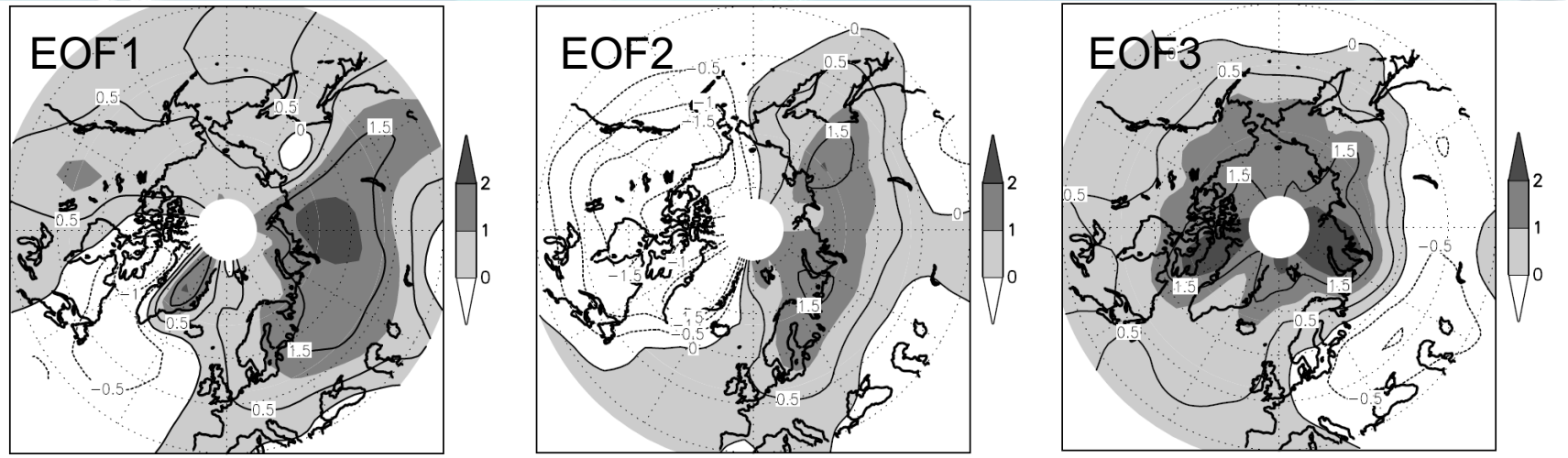
1. Objective

Quantitatively synthesize modes of (co)variability – and changes in these modes – in the Arctic and subarctic North Atlantic ocean–ice–atmosphere system in the past 1–2 centuries

‘Modes of variability’ concept

- Organized (spatial and temporal) patterns of (co)variability
- ‘Statistical’ modes vs. ‘physical’, dynamical modes



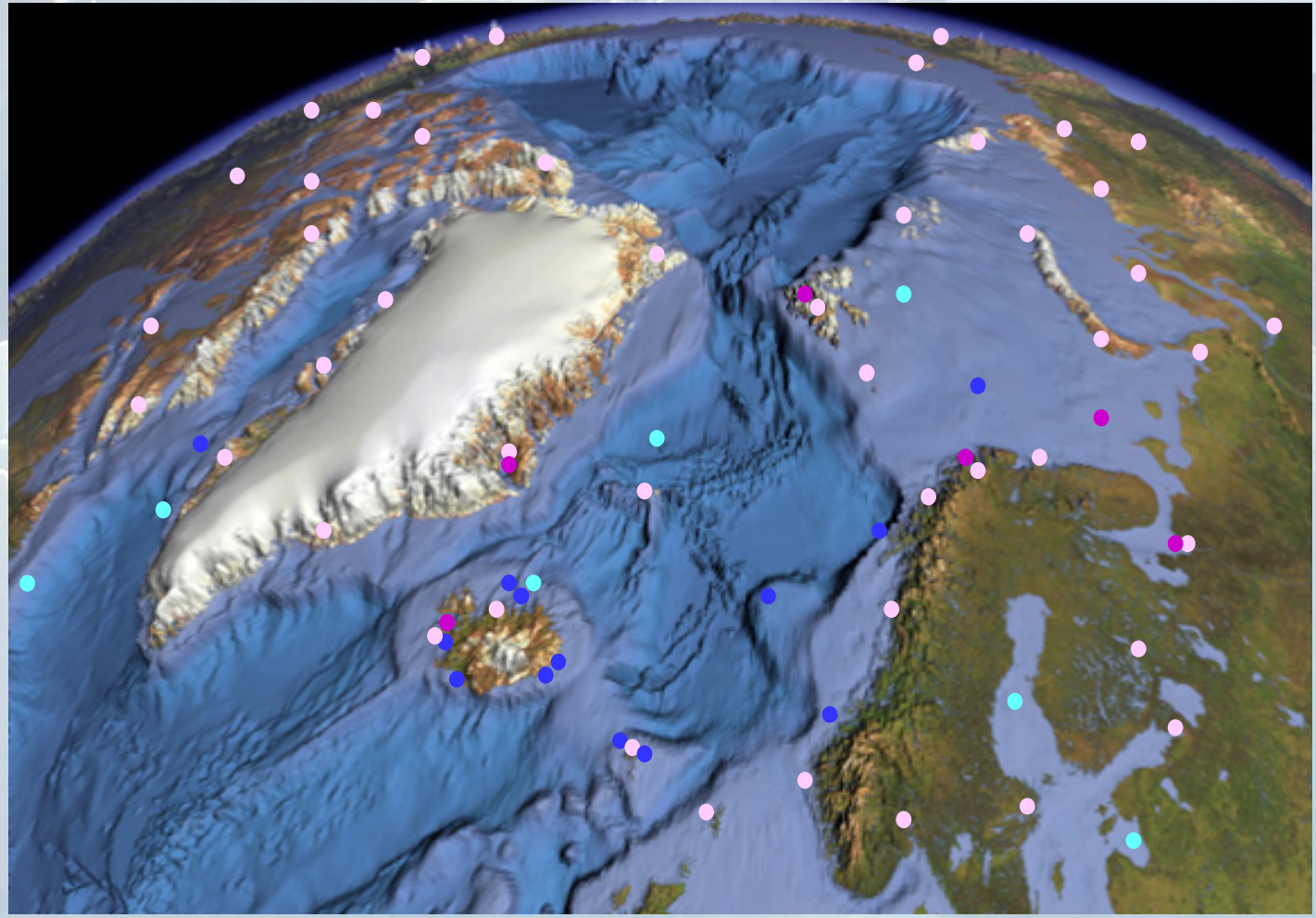
NAO-related PNA-related no atmos. pattern

Modes of winter SAT variability

Specific objectives

1. *Dataset development*: Assemble, systematize and update long, continuous, under-utilized time series of oceanographic and meteorological measurements, sea ice observations and climate indices

SASS I: Modes of Ocean-Ice-Atmosphere Covariability



Locations of century-scale time series of climate (●) atmosphere (●), ocean (●) and sea ice (●) variables from the Arctic and subarctic Atlantic.

Specific objectives

2. *Quantitatively characterize* the ocean–ice–atmosphere system, through documenting modes of (co)variability, distinguishing modes *other than* the *AO/NAO*

3. *Document changes* in modes of (co)variability – e.g., re-organization of the signals and linkages that may represent 'regime shifts' in the system

4. *Synthesize* the project results together with other observational and modelling analyses

Science questions

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Atlantic Multidecadal Oscillation (AMO): manifestation in sea ice and other arctic records; mechanisms, interactions, role in recent sea ice decrease and arctic warming?

2. Approach

Data synthesis: Integrated, consistent multi-method, multi-variate statistical analysis.

'Set the record(s) straight' and apply multiple techniques, simple and advanced:

- time-series analysis: time and frequency domain
- spatial analysis: e.g., composites, correlations, EOFs

3. Deliverables or output

- Data: *Long-term baseline time series* from multivariate observations, bridging a gap between contemporary measurements and paleo-environmental data

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- Data: *Long-term baseline time series* from multivariate observations, bridging a gap between contemporary measurements and paleo-environmental data
- Results: 1) Synthesis of modes of covariability
  2) Focused synthesis papers
     - Early 20th-century warming onset (Overland)
     - Summertime atmospheric circulation (Serreze)
     - Recent arctic warming (Serreze)
     - Wintertime warming patterns (Miles)
     - Sea ice and Atlantic Multidecadal Oscillation (Miles)

J. Climate, Geophys. Res. Lett., Nature, Science

4. Linkages to other efforts

- Data: *Long-term baseline time series* from multivariate observations, bridging a gap between contemporary measurements and paleo-environmental data
- Documentation and understanding: *Modes-of - variability as overarching driver* of other aspects of arctic system: temporal and spatial patterns, linkages and mechanisms of change in the arctic system