(I) Models reveal a wide range of CRF responses to the same external forcing. Why?

(II) How sensitive are CRFs to the mean state of the model, model resolution and the representation of eddies and mixing?

(III) How crucial is the sea-ice state in mediating air-sea interaction and air-sea fluxes?

Explore some of these issues by focusing on:

Freshwater response of the Beaufort Gyre to a step change in the Beaufort High: model inter-comparisons

Jeffery Scott, John Marshall, Gianluca Meneghello, Laurel Regibeau-Rockett and the FAMOS CRF group

FAMOS Meeting, Woods Hole
October 26, 2017
Models reveal a wide range of CRF responses to the same external forcing. Why?

\[ FWC = \int_{D}^{\eta} \frac{S_{ref} - S}{S_{ref}} \, dz \]

\[ S_{ref} = 34.8 \]
MITgcm Model Climatology:

\[ \nabla \times \tau = \nabla \times [\alpha \tau_{ice} + (1-\alpha)\tau_{air}] \\
= \alpha \nabla \times \tau_{ice} + (1-\alpha)\nabla \times \tau_{air} + \nabla \alpha \n\]

See also Meneghello et al. poster (comparable analysis using observations)

How crucial is the sea-ice state in mediating air-sea interaction and air-sea fluxes?
Observations of seasonal upwelling and downwelling the Beaufort Sea mediated by sea ice


- Ten years mean Ekman downwelling is only 2.5 m/year.
- Regions of upwelling during winter...
  - ...driven by the geostrophic current below fast ice.
- Analysis of regional patterns
MITgcm pumping anomalies, year 0-2:

\[ \nabla \times \tau = \nabla \times [\alpha \tau_{ice} + (1-\alpha)\tau_{air}] \\
= \alpha \nabla \times \tau_{ice} + (1-\alpha)\nabla \times \tau_{air} + \nabla \alpha 
\]
Does Ekman pumping anomaly decrease over time?

Work in progress: spin-up of geostrophic currents (under ice) important?

How sensitive are CRFs to the representation of eddies and mixing processes, the mean state of the model, and model resolution?

Similar rise first 2 years
(I) Models reveal a wide range of CRF responses to the same external forcing. Why?

(II) How sensitive are CRFs to the mean state of the model, model resolution and the representation of eddies and mixing?

(III) How crucial is the sea-ice state in mediating air-sea interaction and air-sea fluxes?
Using CRFs to study Arctic Climate Change

Renske Gelderloos and FAMOS CRF group
CRF response to 1°C step warming in surface air temperature:

Observed changes:

Sea ice volume decline to a 1°C step warming: ~2000 km³

1. Identify the key atmospheric drivers to oceanic and sea ice changes (current and possible future)
CRF response to BG wind anomaly:

Spatial patterns:

2. Study the impact of changing climate patterns on matters of economic, societal, and/or environmental importance (current and future)
2. Study the impact of changing climate patterns on matters of economic, societal, and/or environmental importance (current and future).
3. Assist in attributing observed changes to different mechanisms
Discussion questions:

• How can we best explore climate change in the CRF framework?
• How can we employ CRFs to explore Arctic sea-ice change and decline?
• What are the key atmospheric drivers? Do we need to explore more than the ones we have already identified?
• How can one employ CRFs to explore how ecosystems respond to climate change?