McFLURRIE

Mackenzie Freshwater Layers Uncover River Runoff Ice Evolution

How does increased freshwater runoff influence sea ice and salinity at the mouth of the Mackenzie River?

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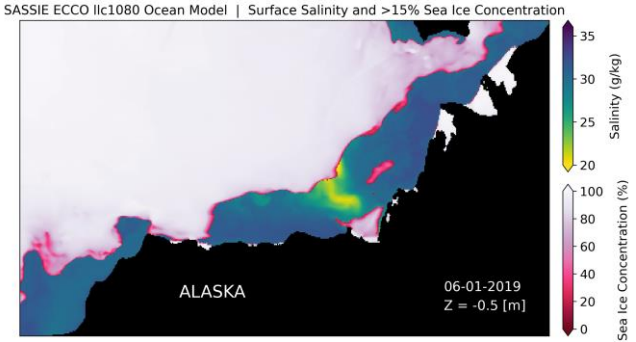
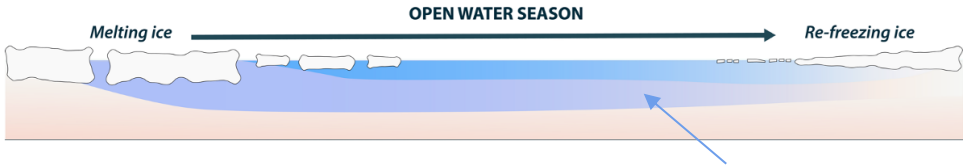
Project Motivations

Salinity controls upper ocean stratification in the Arctic

- **SASSIE mission hypothesis:** *Sea surface salinity anomalies generated by summer sea ice melt are an important predictor for autumn ice advance*

- Exploration of high resolution SASSIE ECCO LLC1080 model revealed earlier sea ice formation over Mackenzie River plume



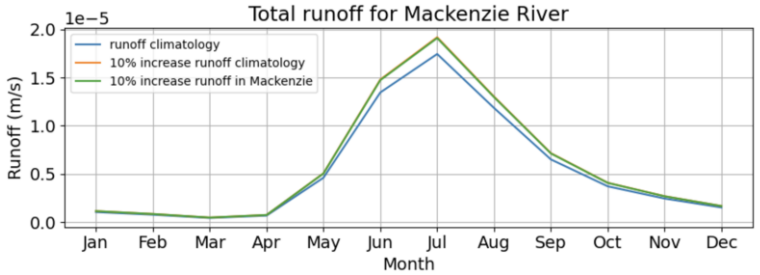


Freshwater layer traps subsurface heat

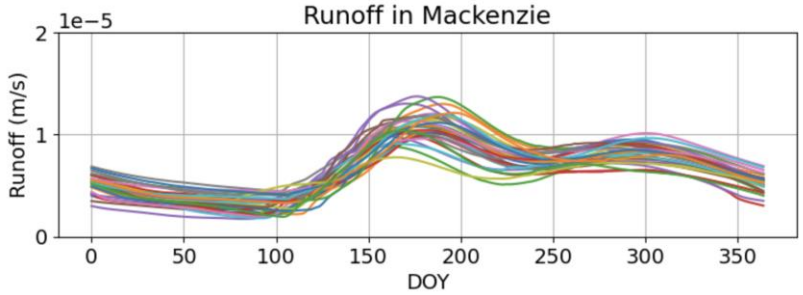
Approach

- Run ECCOv4r5 in 3 configurations from 2014-2019:
  (1) control run
  (2) increased runoff globally by 10%
  (3) increase the runoff only by the Mackenzie river by 10%
  (4) time - varying runoff (from ECCO Darwin)
- Investigate adjoint sensitivities to salinity at the mouth of the Mackenzie River
- Use EMU convolution tool to understand controls on salinity near Mackenzie

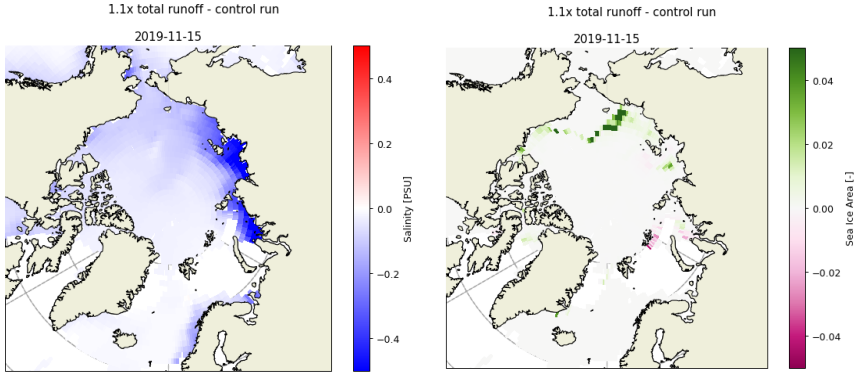
Monthly climatology



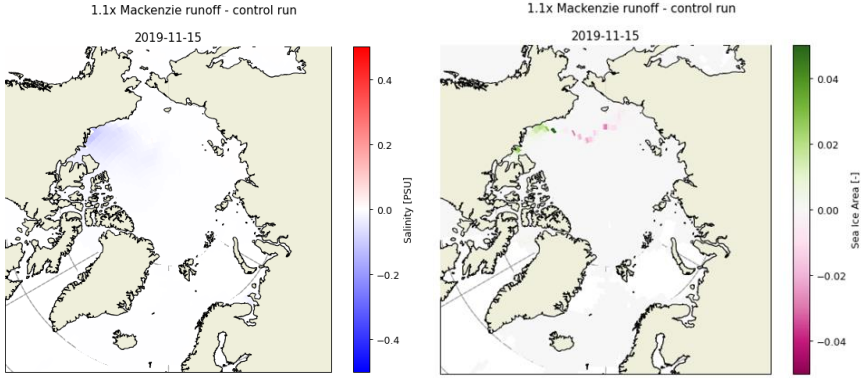
Time-varying (daily)



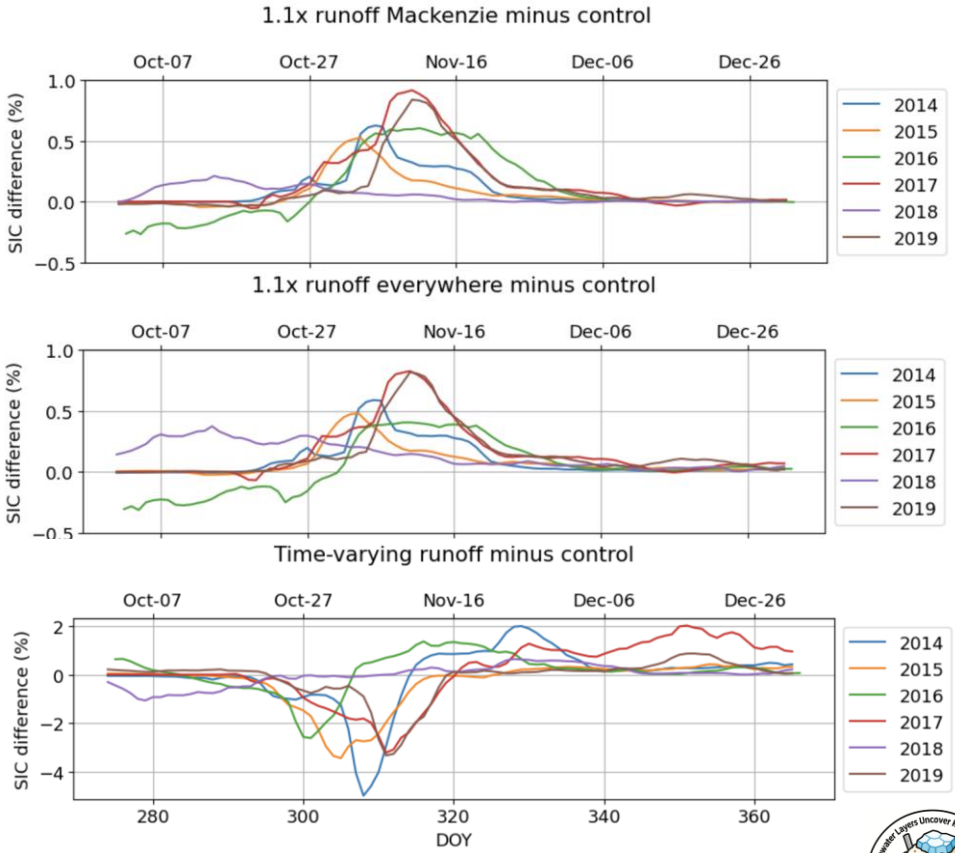
10% increase globally - control



10% increase Mackenzie - control

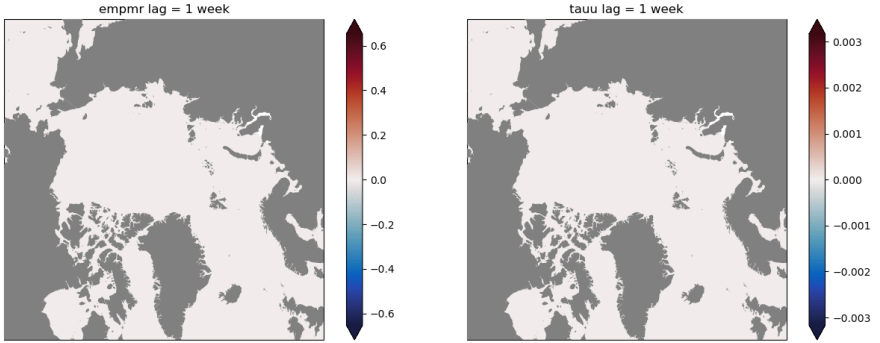


Sea ice area time series

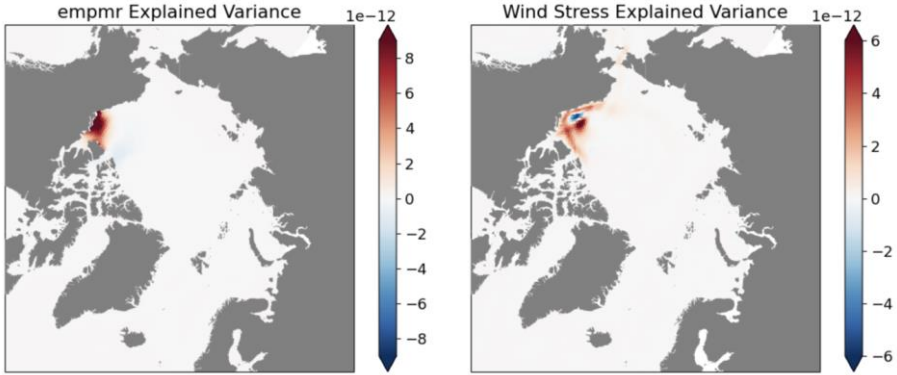


A 10% increase in runoff leads to a slightly earlier onset of sea ice formation

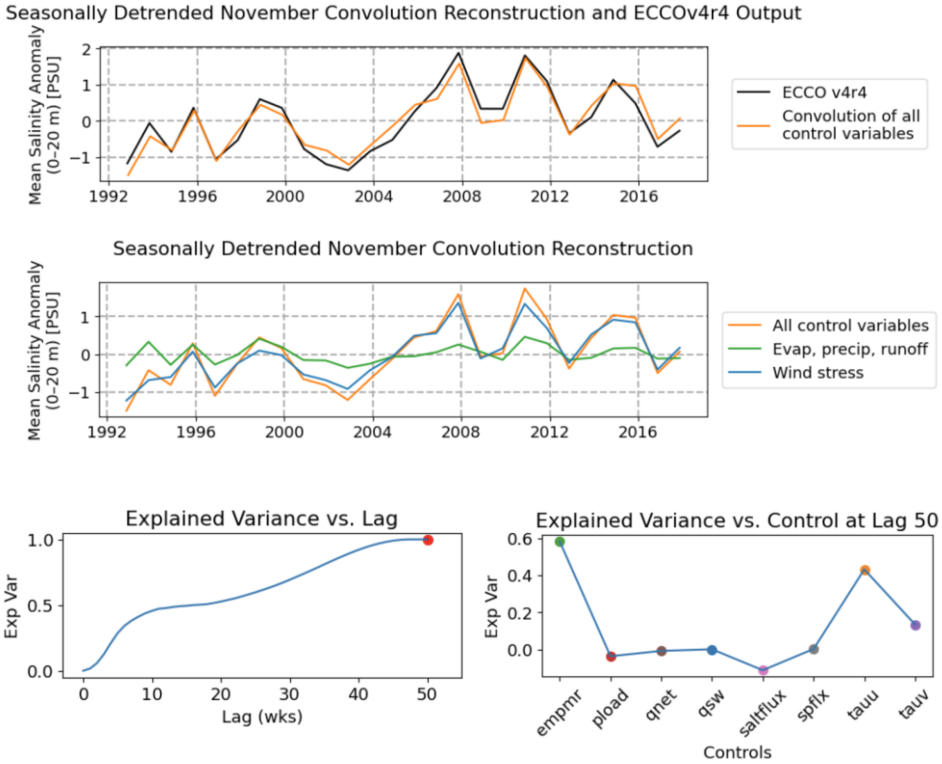
2014 adjoint sensitivities



2014 explained variance



Convolution results



Mackenzie runoff modulates seasonal variability in salinity anomalies and wind stress controls interannual variability

Reflections

- Much more analysis could be done!
  - Compare to LLC1080 output
  - Recompute the convolution with LLC1080 wind forcing
- Should repeat adjoint and convolution with a sea-ice area cost function
- A larger perturbation in runoff may yield more significant changes