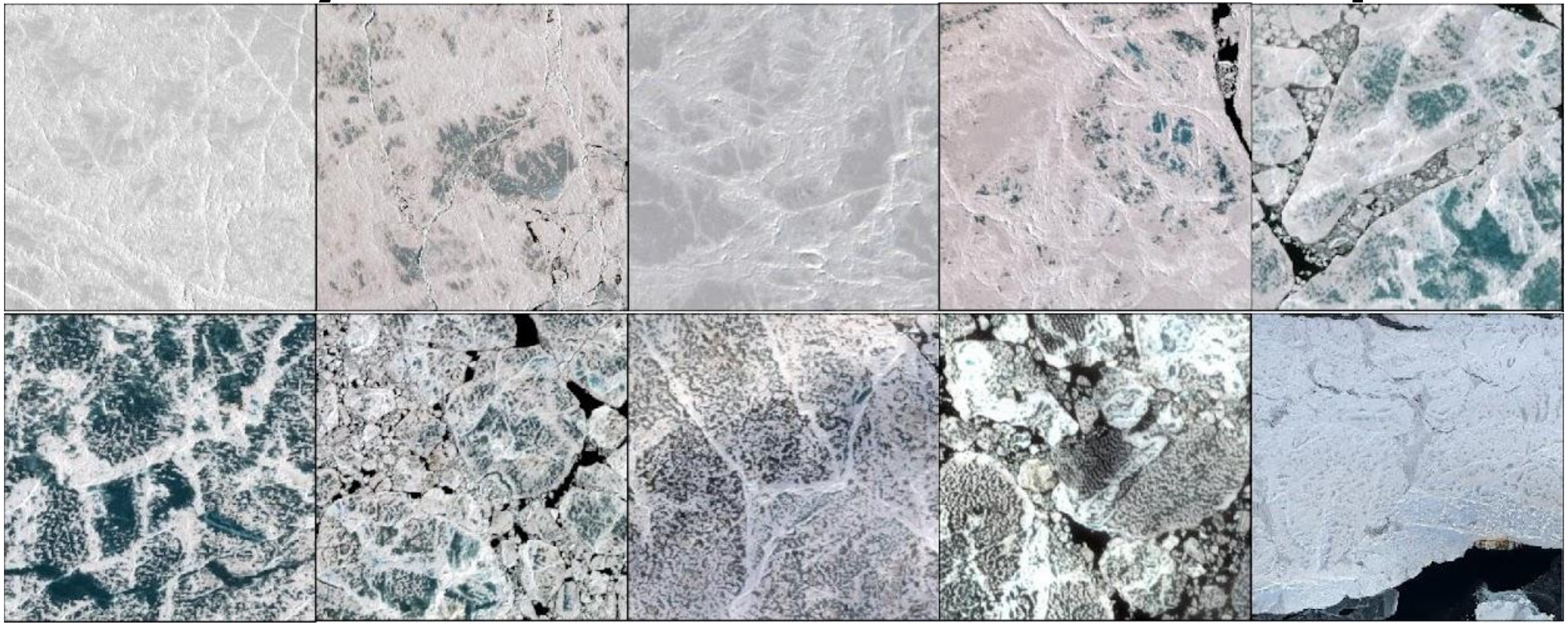
Progress Towards an Icepack Model Case Study for the MOSAiC Expedition



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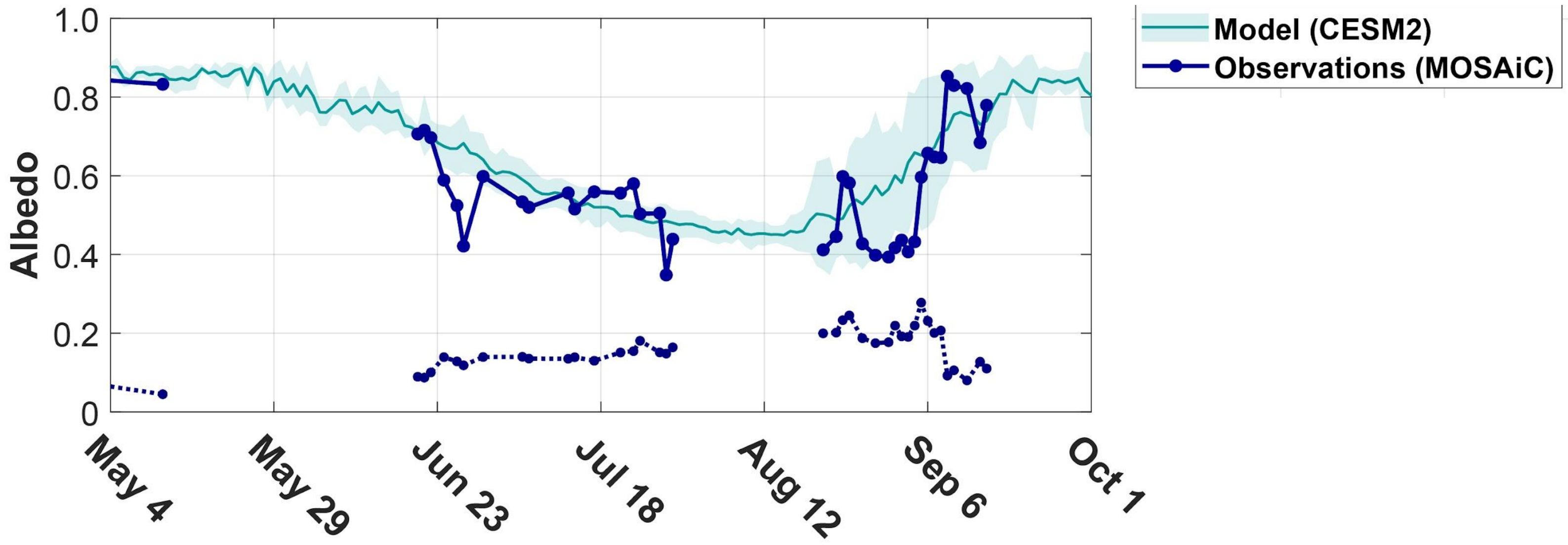
[1]NCAR, [2]NASA, [3]NOAA, [4]OSU, [5]UW, [6]Dartmouth, [7]CRREL, [8]UT, [9]WHOI

Outline

- Motivation
- Background
- Results
- Sensitivity to initial conditions, snow thermal conductivity, oceanic forcing, and thermodynamic parameterization
- Offsetting errors
- Conclusions and next steps

Motivation

Direct comparison between coupled-climate model output and observations is challenging because of internal variability and the potential for offsetting errors.



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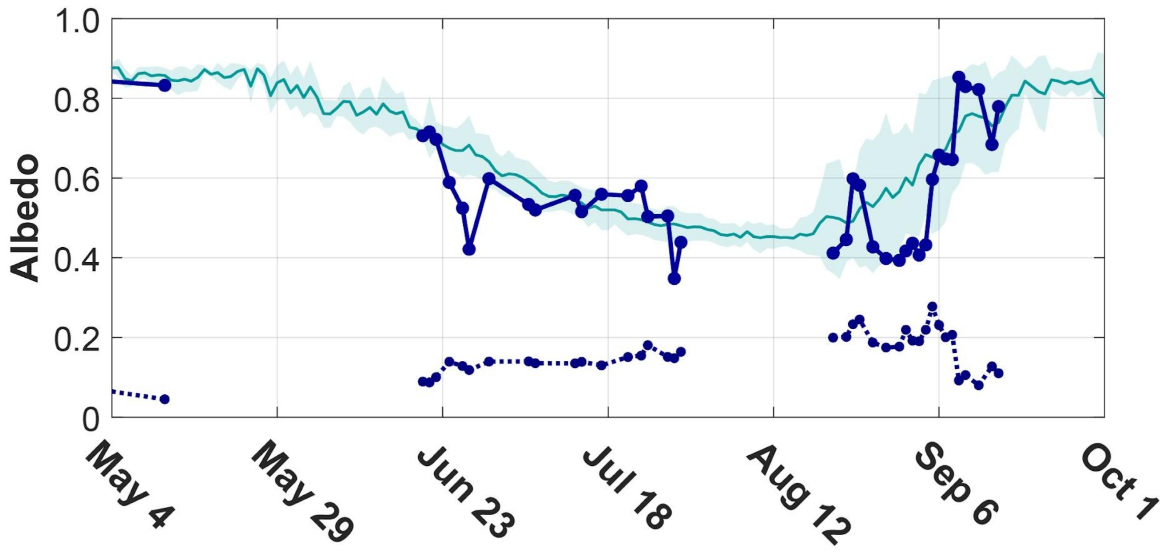
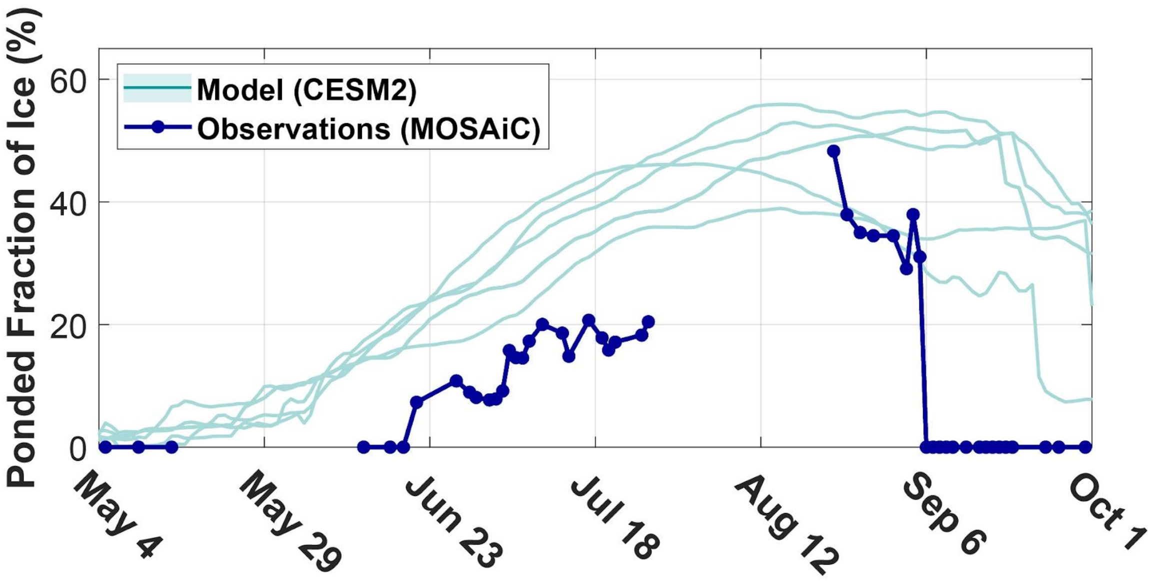




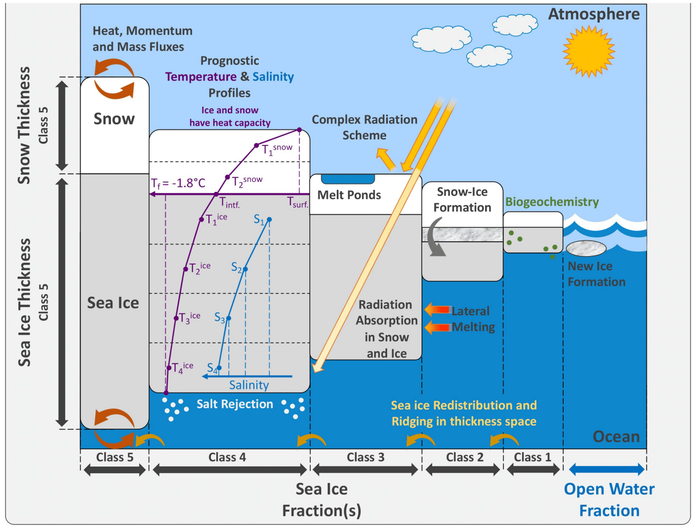
Background – Single Column Modeling

Atmosphere Measurements

Ocean Measurements

Photo: J. Schaffer

Icepack SCM

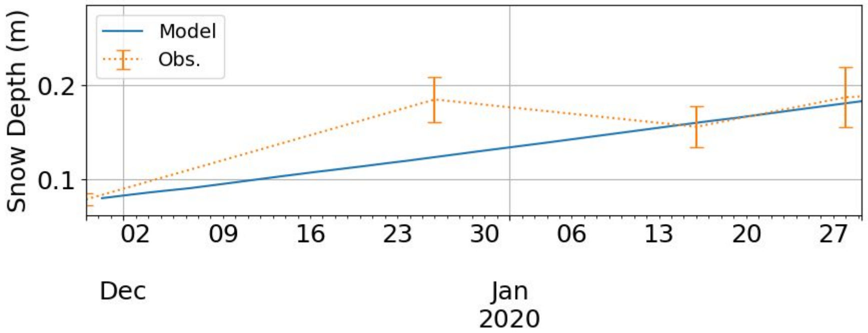


Zampieri (2021)

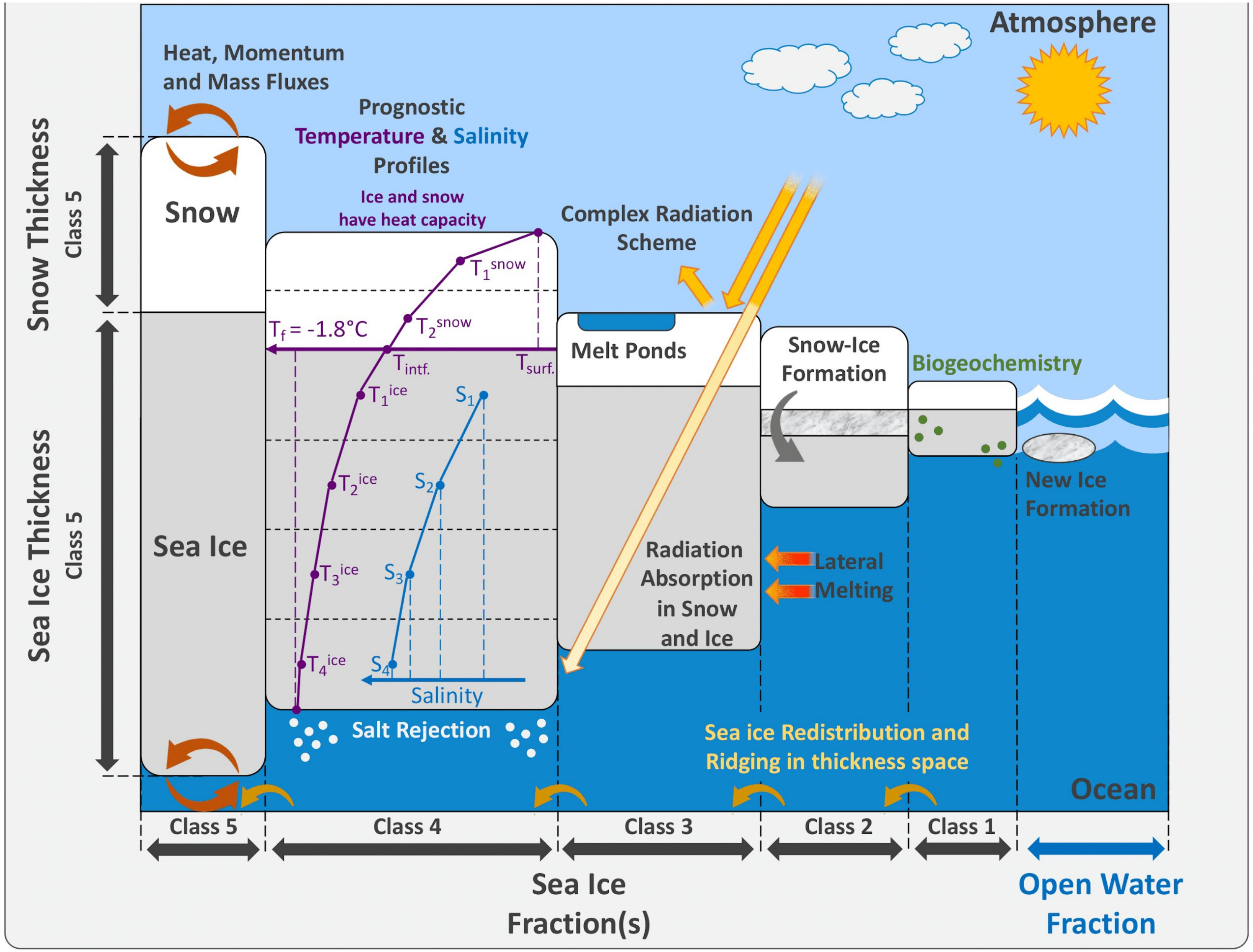
Snow and Ice Measurements

Photo: D. Clemens-Sewall

Model Validation



Background – Icepack sea ice model



Zampieri (2021)

Background – MOSAiC Expedition

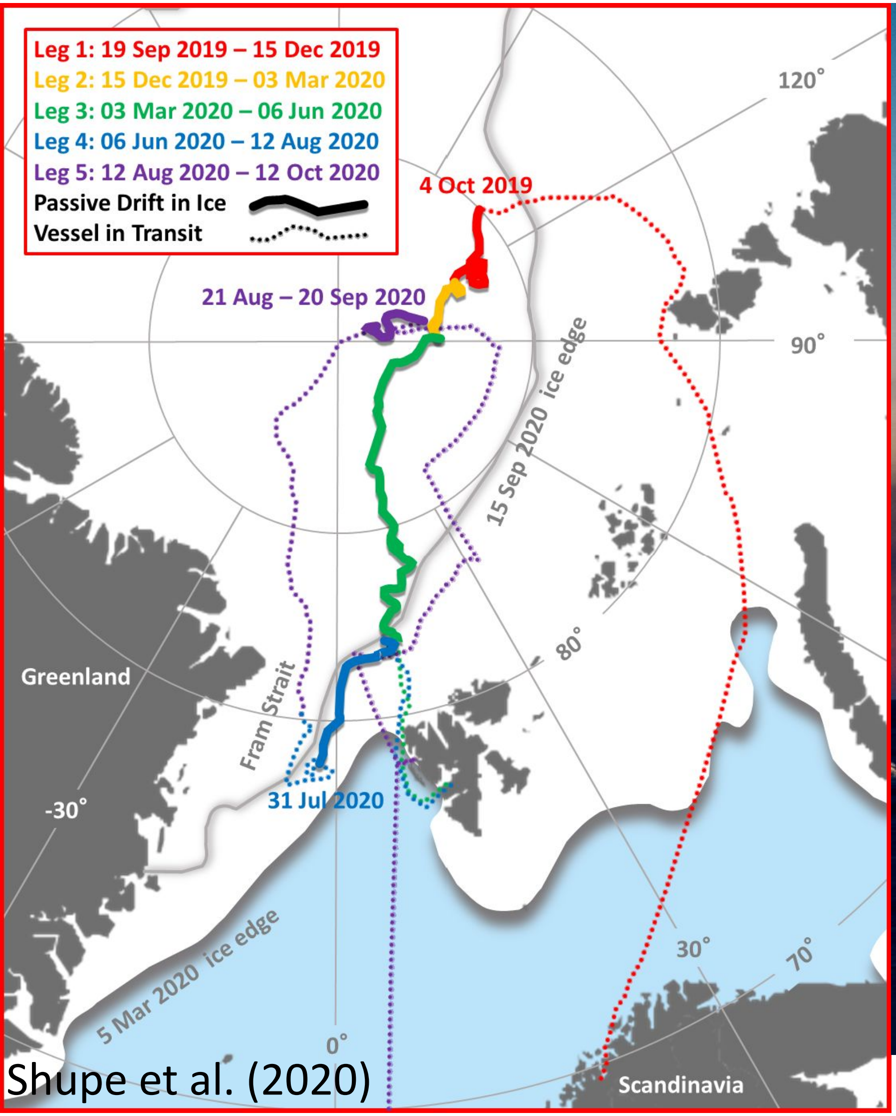
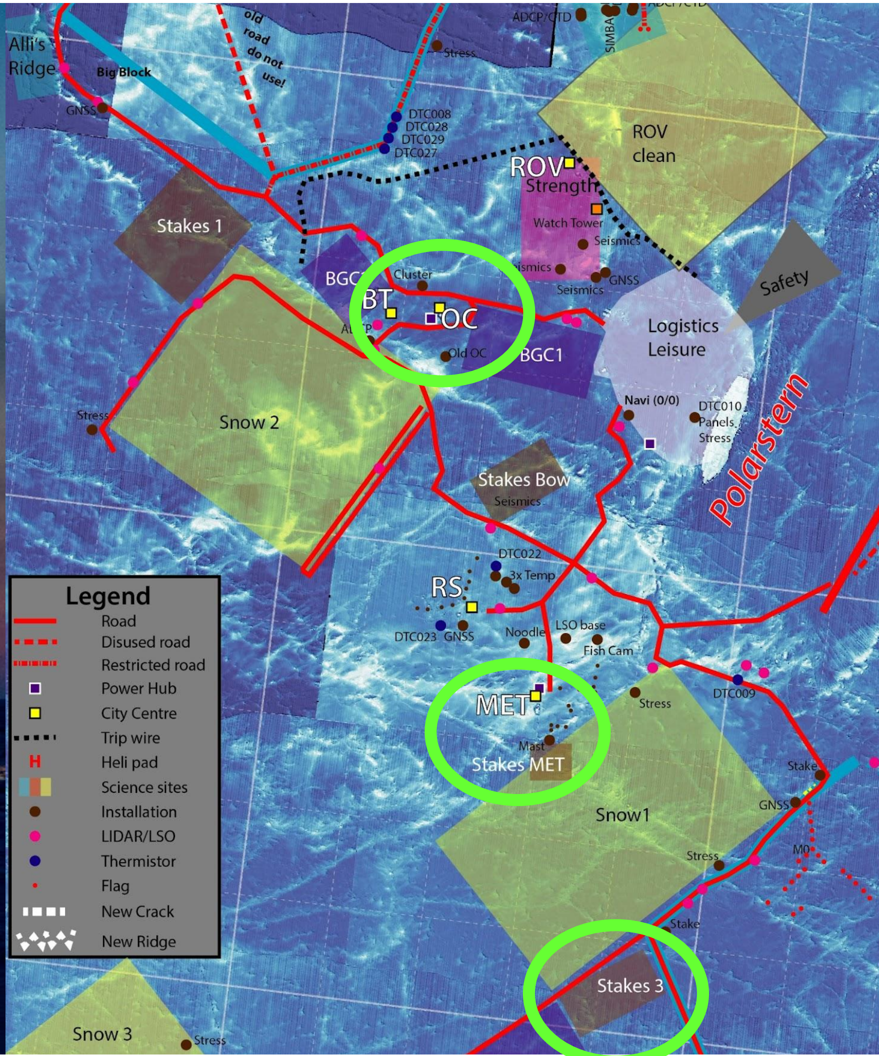
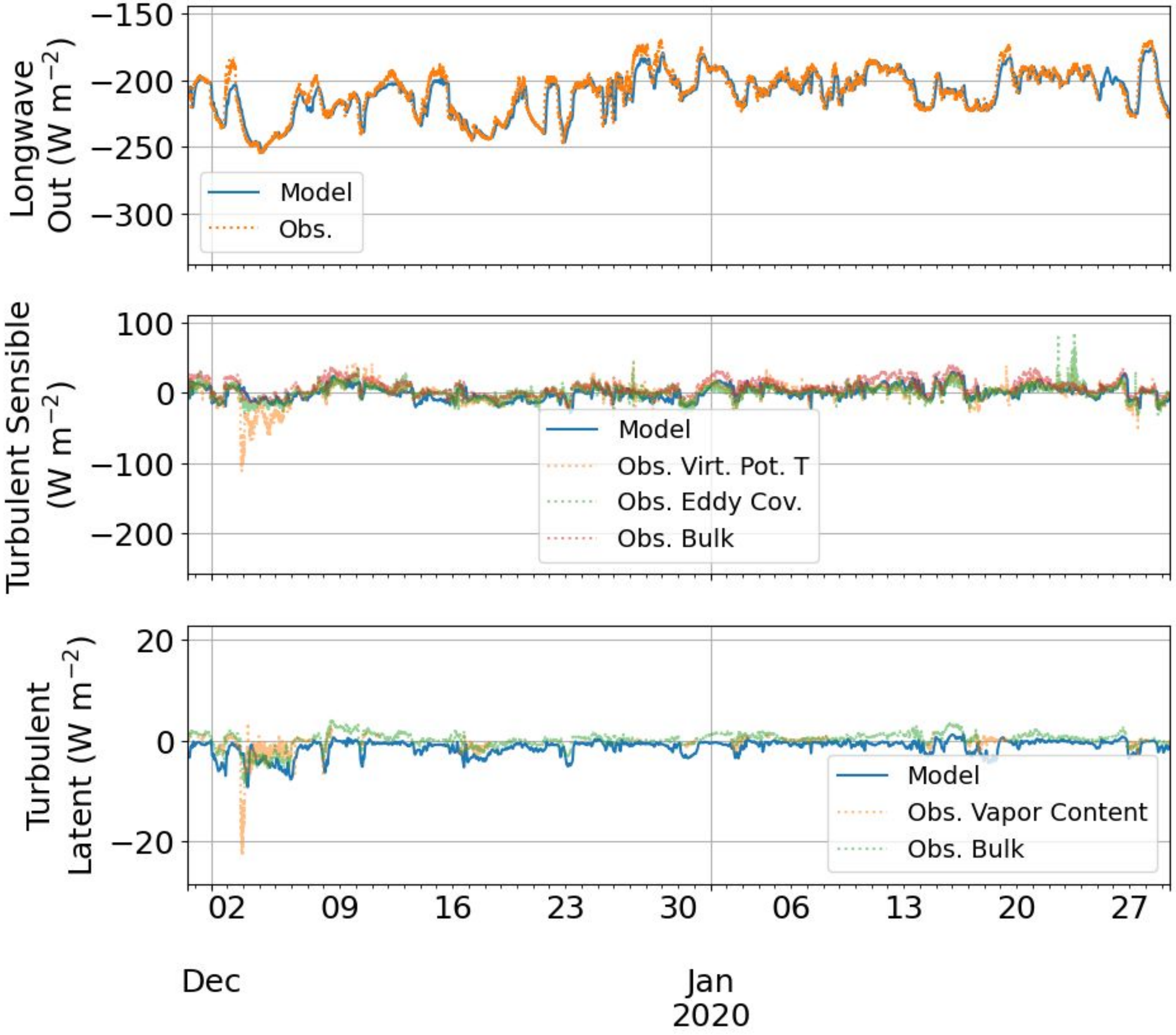
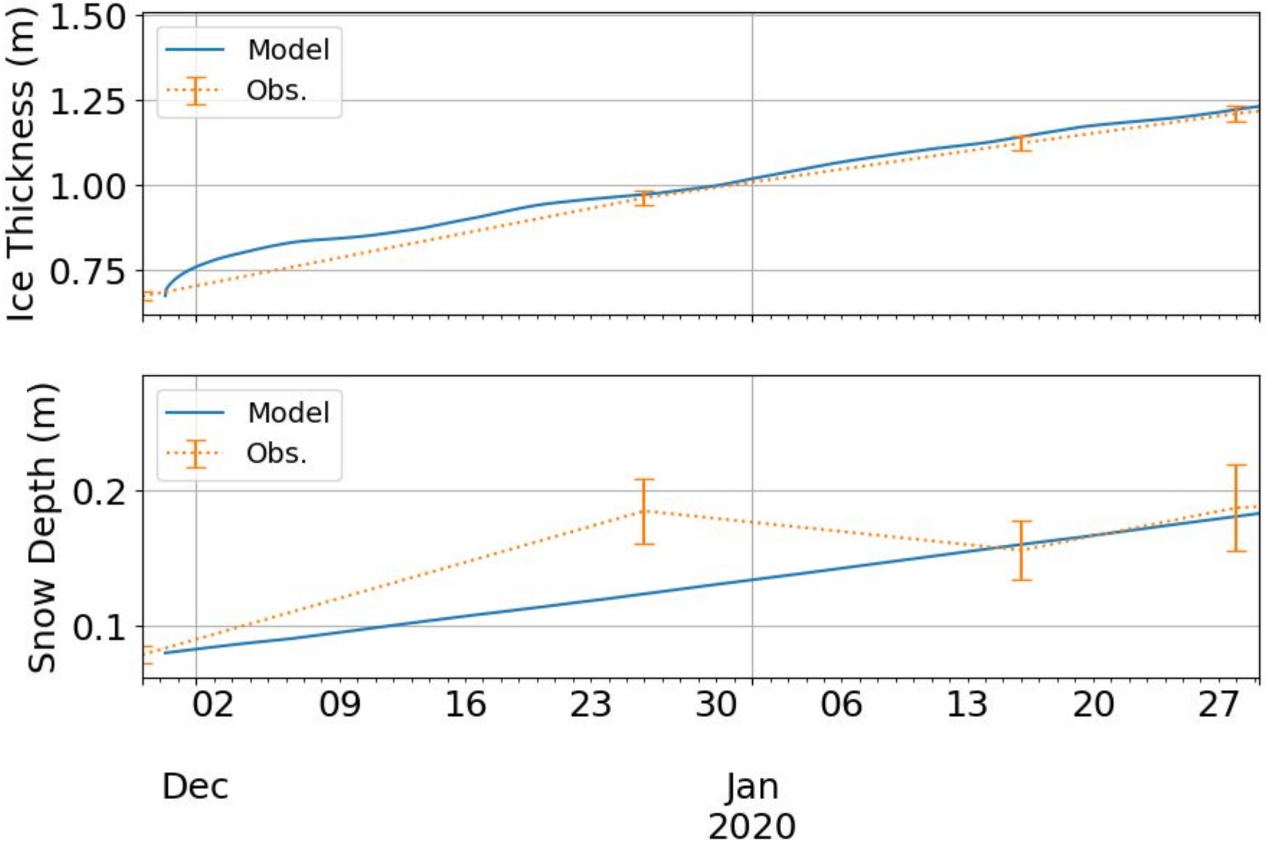


Photo: C. Rohleder



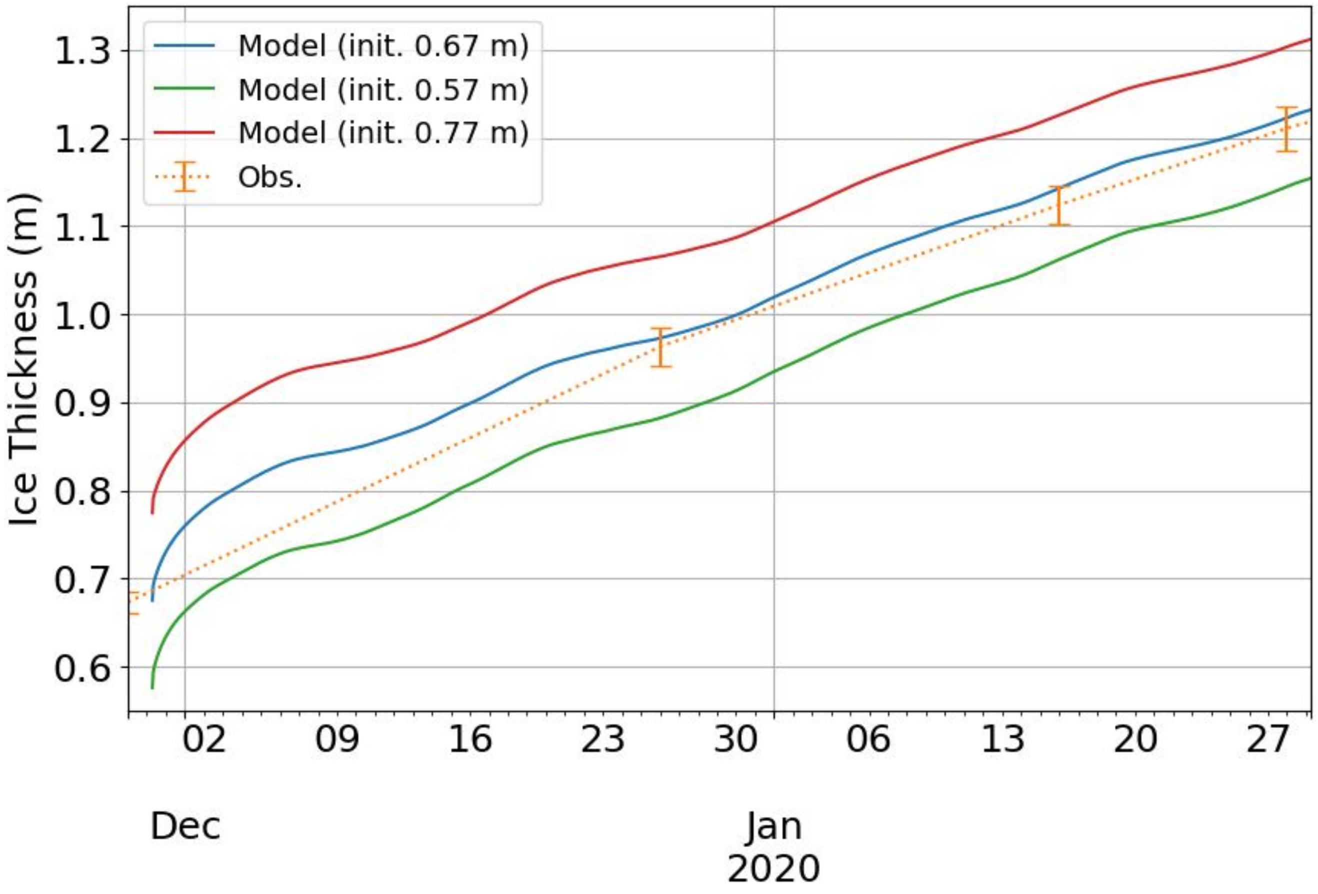
Results



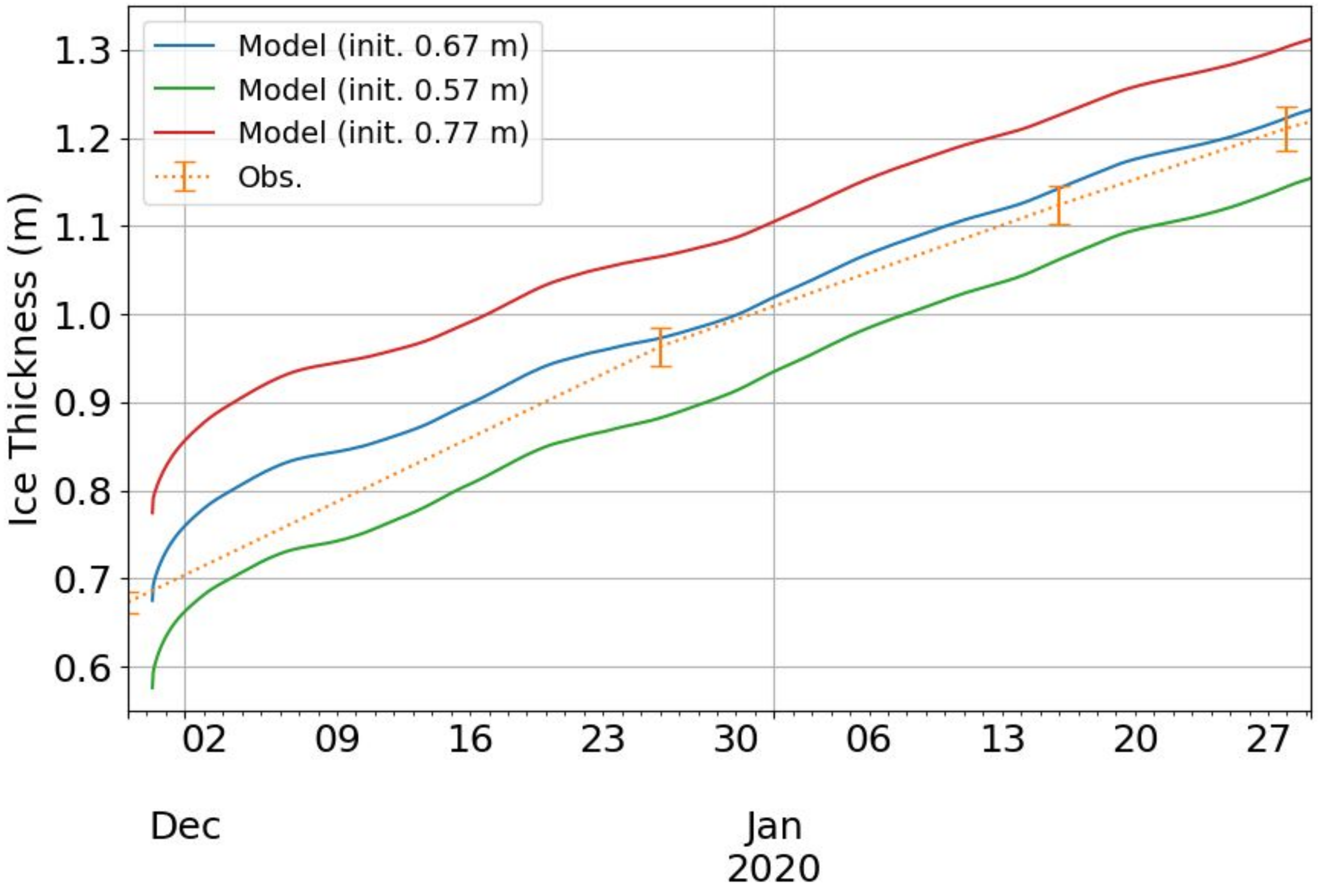


Stakes 3 Mass Balance Site
Errorbars show standard error of mean
Prescribed snowfall rate to match net accumulation.

Sensitivity to initial conditions

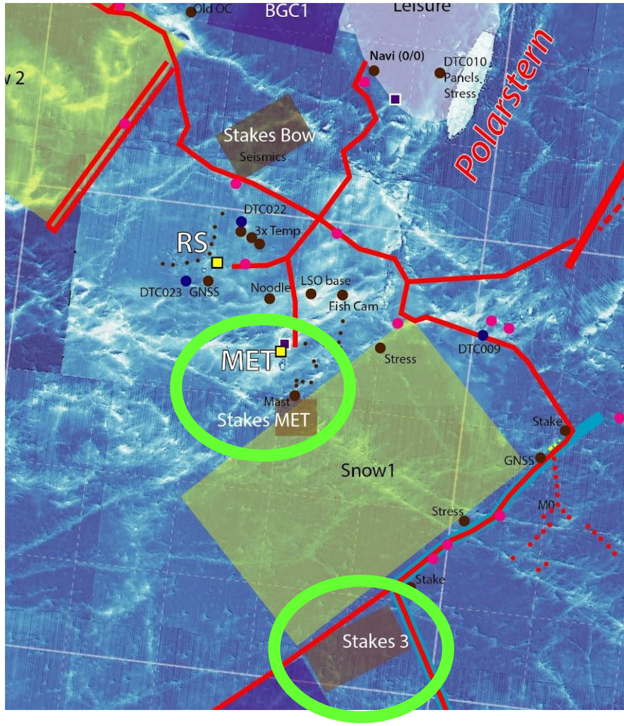


Sensitivity to initial conditions

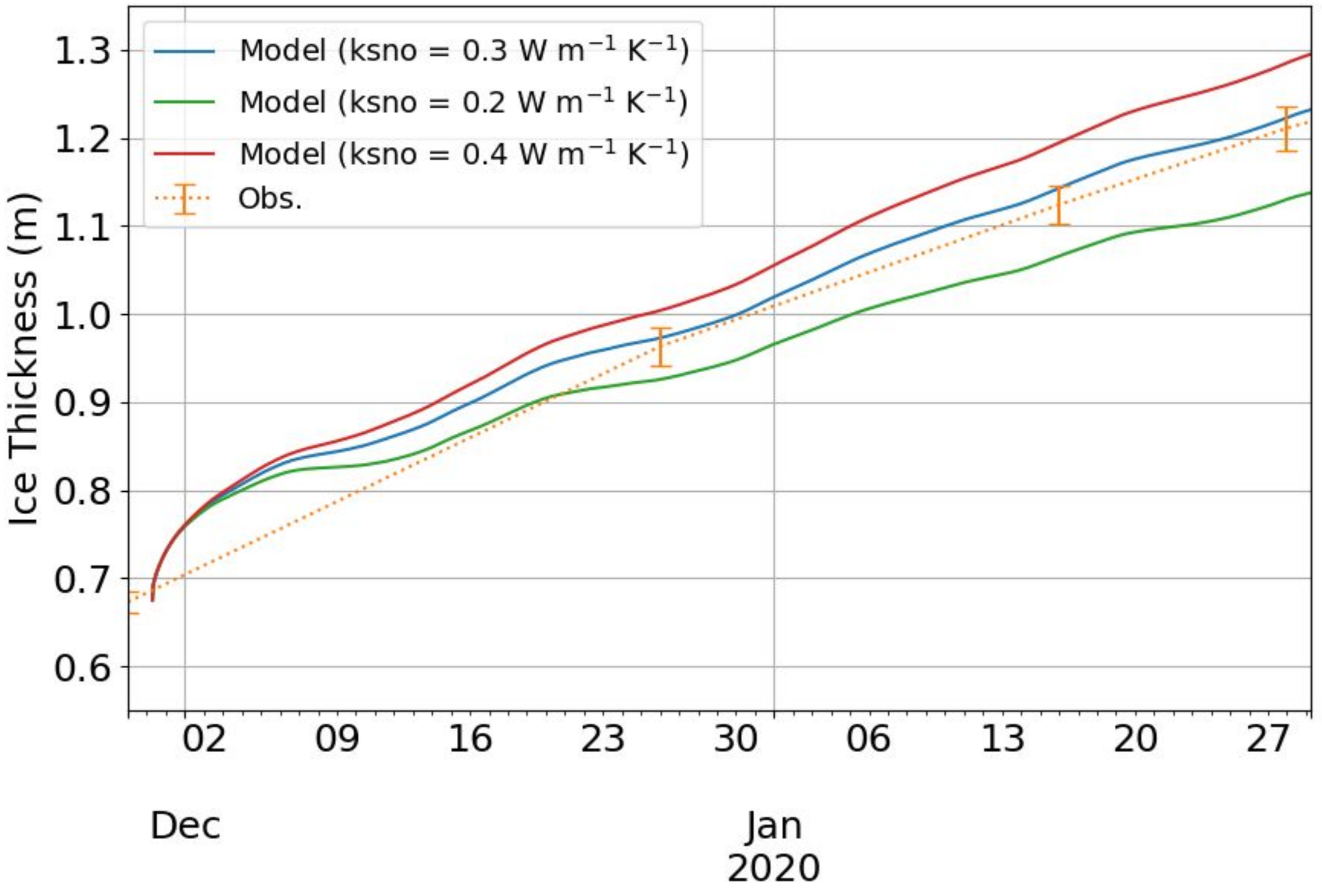


Potential uncertainties:

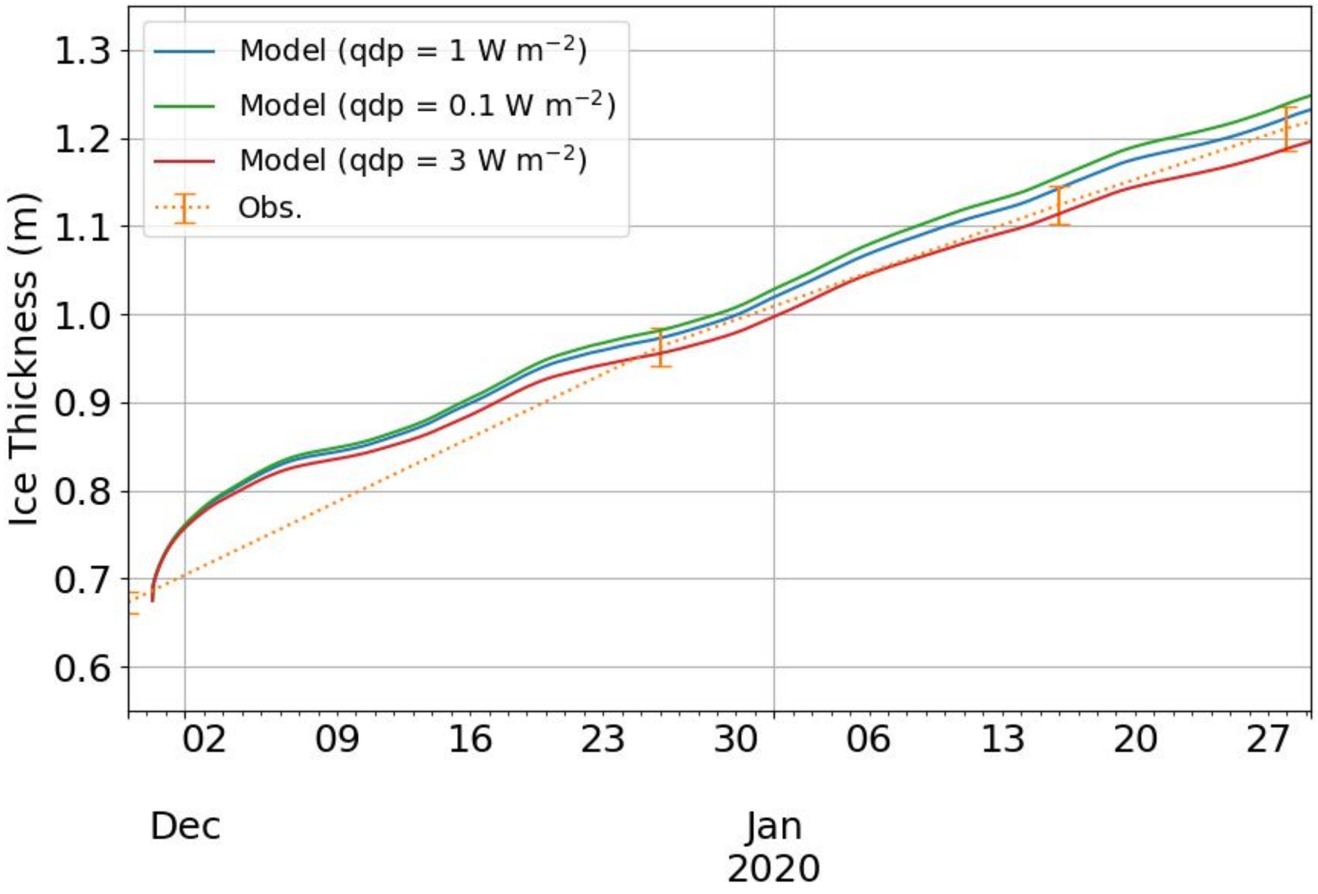
- Measurement error
- Spatial variability



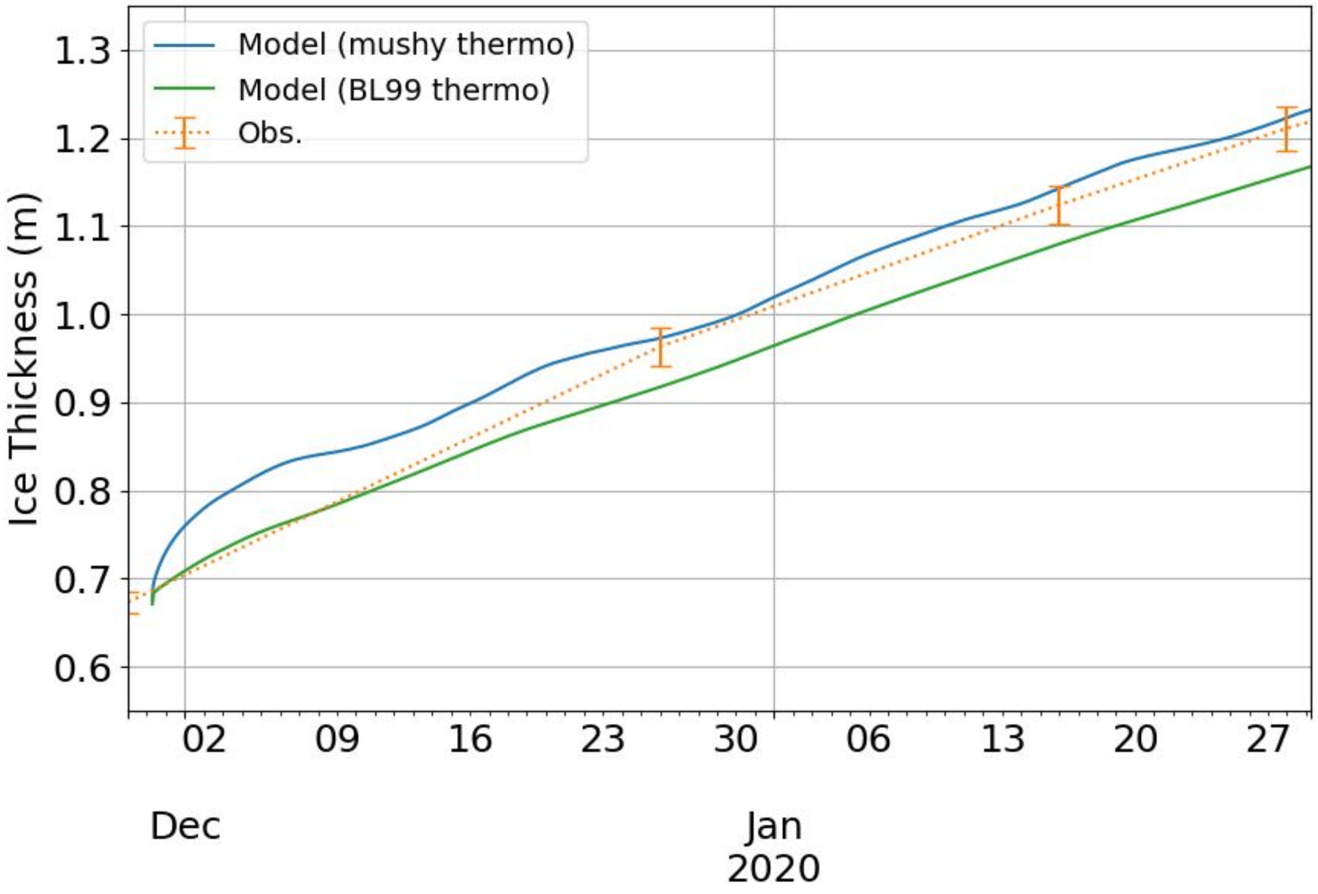
Sensitivity to snow thermal conductivity



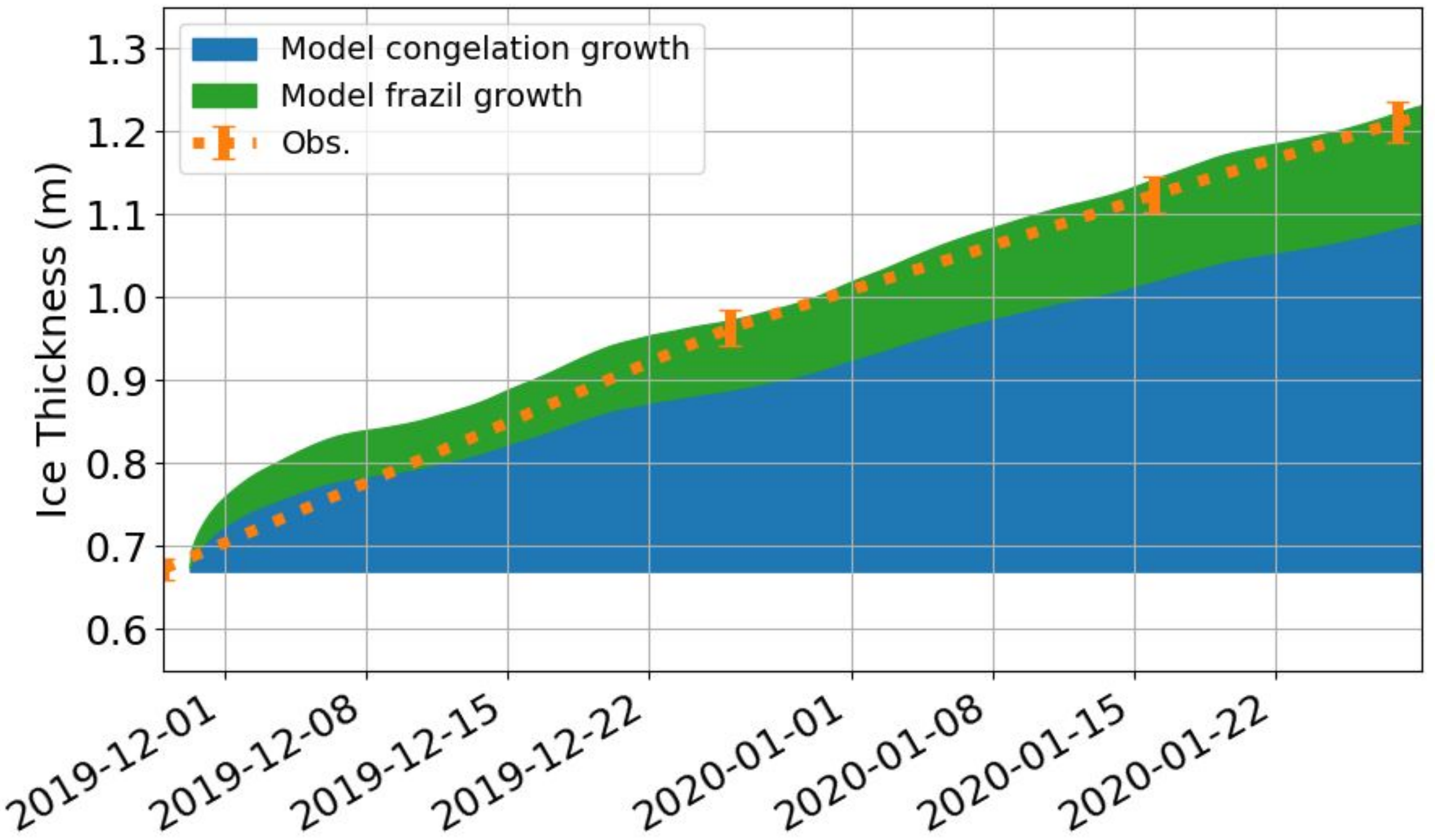
Sensitivity to oceanic forcing



Different Parameterizations

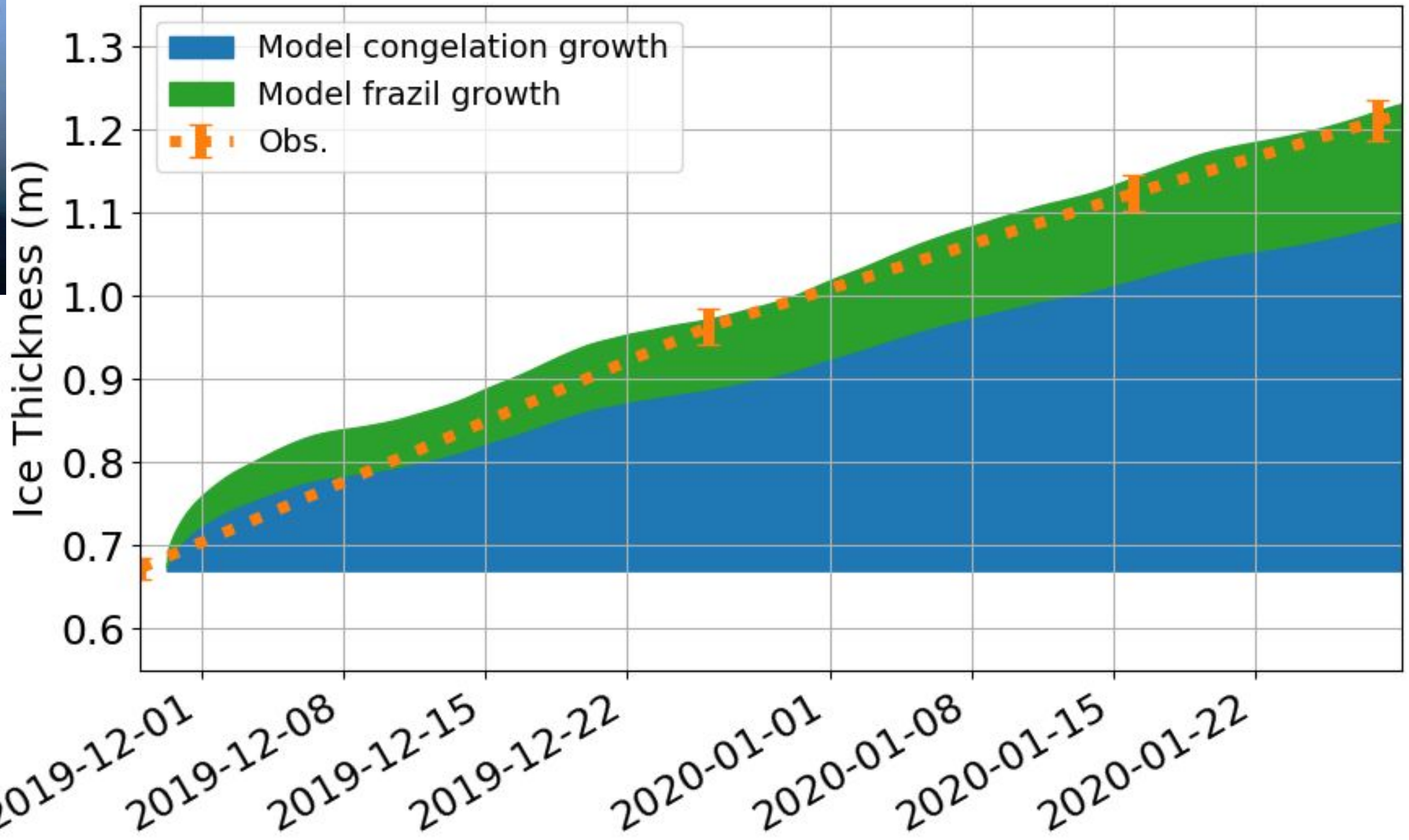


Offsetting errors



Offsetting errors

Katlein 2020



Conclusions and next steps

- Conclusions:
  - Amount of ice growth simulated by Icepack is consistent with MOSAiC observations (when prescribing snow).
  - Using a consistent ice thickness dataset is critical to interpretation.
  - Surprisingly low sensitivity to heat flux convergence into mixed layer.
  - Too little congelation growth is offset by too much frazil growth.
- Next steps:
  - Snow redistribution on variable snow and ice topography
  - Dynamics forcing
  - Melt season processes
- Contact: dcsewall@ucar.edu

Backup

ktherm	init_ice	init_sno	qdp	ustar_min	fhocn	frazil	congel	growth
2	0.67	0.08	0	0.0005	-2.84	0.19	0.39	0.58
2	0.67	0.08	-0.1	0.0005	-2.86	0.18	0.39	0.57
2	0.67	0.08	-1	0.0005	-3.1	0.14	0.42	0.56
2	0.67	0.08	-10	0.0005	-5.5	0.02	0.47	0.49
2	0.67	0.08	-0.1	0.005	-2.86	0.18	0.39	0.57
2	0.67	0.08	-1	0.005	-3.1	0.14	0.42	0.56
2	0.67	0.08	-3	0.005	-3.6	0.05	0.47	0.52
2	0.67	0.08	-10	0.005	-8.81	0.02	0.4	0.42
2	0.67	0.08	-0.1	0.05	-2.86	0.18	0.39	0.57
2	0.67	0.08	-1	0.05	-3.1	0.14	0.42	0.56
2	0.67	0.08	-10	0.05	-10	0.02	0.38	0.4
2	0.57	0.08	-1	0.005	-3.2	0.17	0.44	0.61
2	0.77	0.08	-1	0.005	-2.96	0.13	0.41	0.54
2	0.67	0.06	-1	0.005	-3.26	0.15	0.45	0.6
2	0.67	0.1	-1	0.005	-2.89	0.13	0.4	0.53
1	0.67	0.08	-1	0.005	-0.84	0.01	0.49	0.5