Snow thermal conductivity and conductive flux variability during the MOSAiC winter

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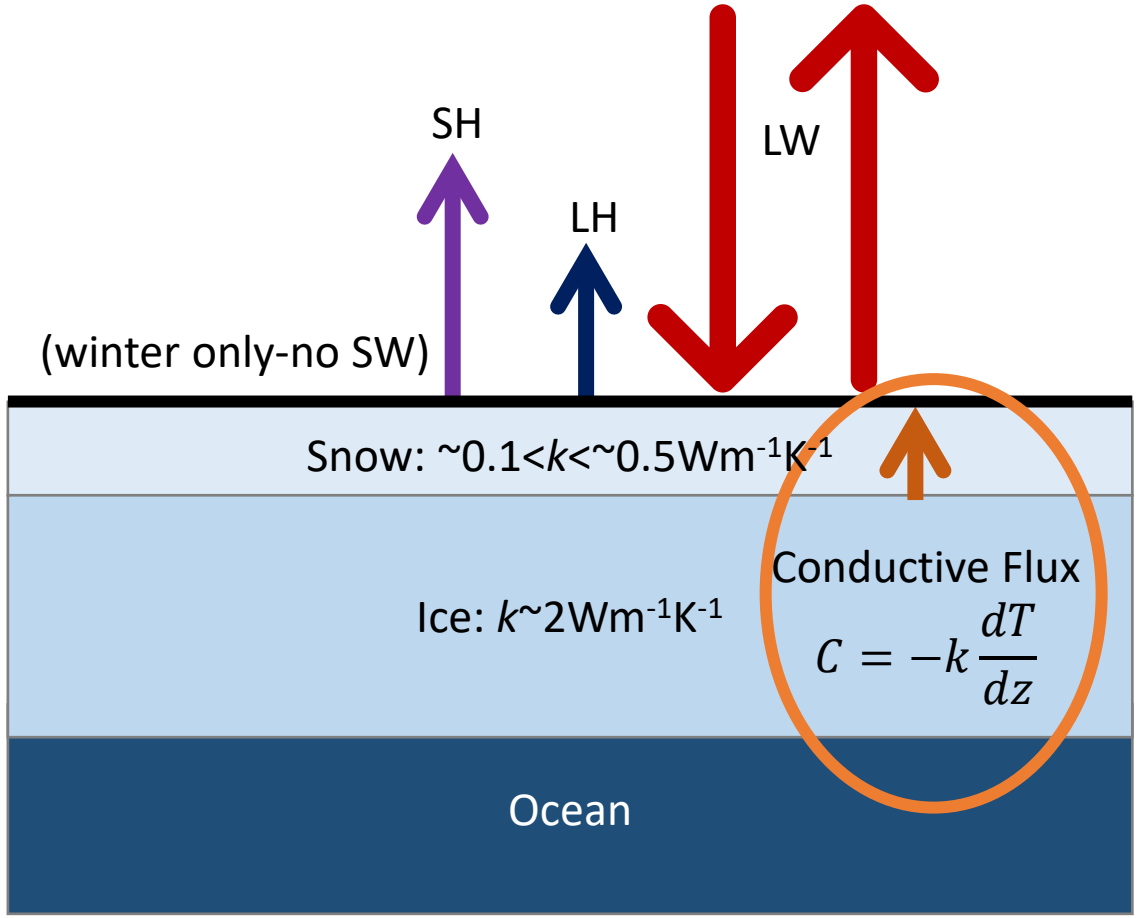
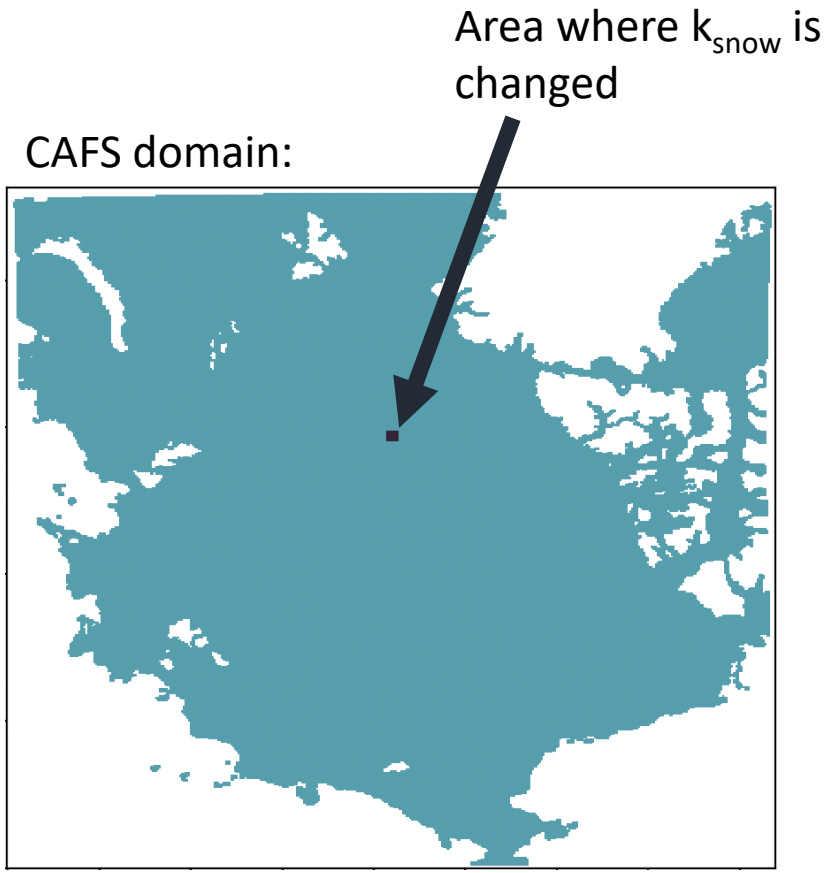
- Questions:
  - What's the impact of changing the snow thermal conductivity in a coupled model?
  - What's the variability of snow thermal conductivity and conductive fluxes in observations?



1. What impact does varying k_{snow} have in a coupled model?

- Coupled Arctic Forecast System (CAFS):
  - WRF for atm, CICE for sea ice w/ 3 snow layers and 7 sea ice layers, based on RASM
  - Run: Jan 30-Feb 8, 2020

- Three runs with different k_{snow} poleward of 89.78N (16 grid cells)
  - 0.3 $Wm^{-1}K^{-1}$ (default)
  - 0.15 $Wm^{-1}K^{-1}$
  - 0.6 $Wm^{-1}K^{-1}$



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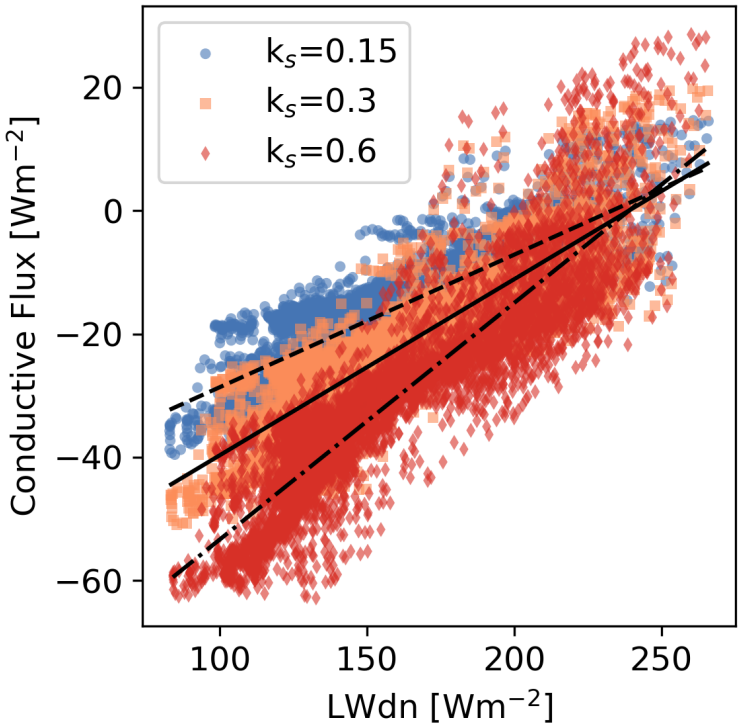

$C = -k_{snow} * dT/dz$

↑k_{snow} → conductive flux more sensitive to LWdn

Fluxes = positive downwards

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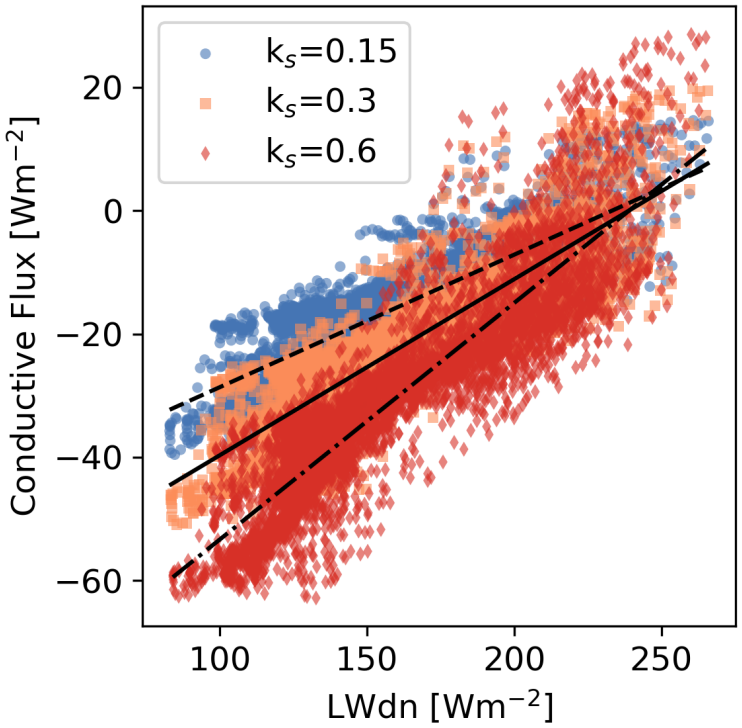

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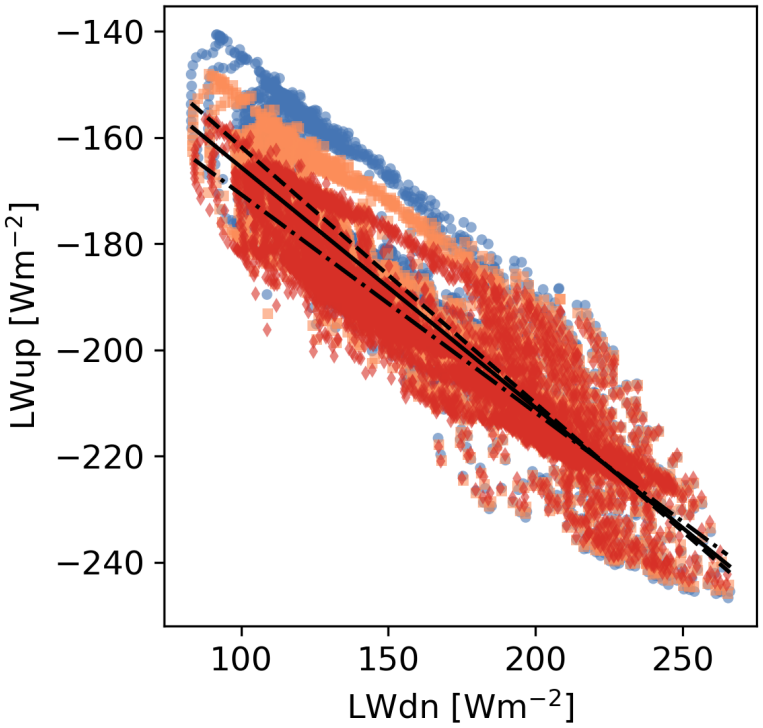
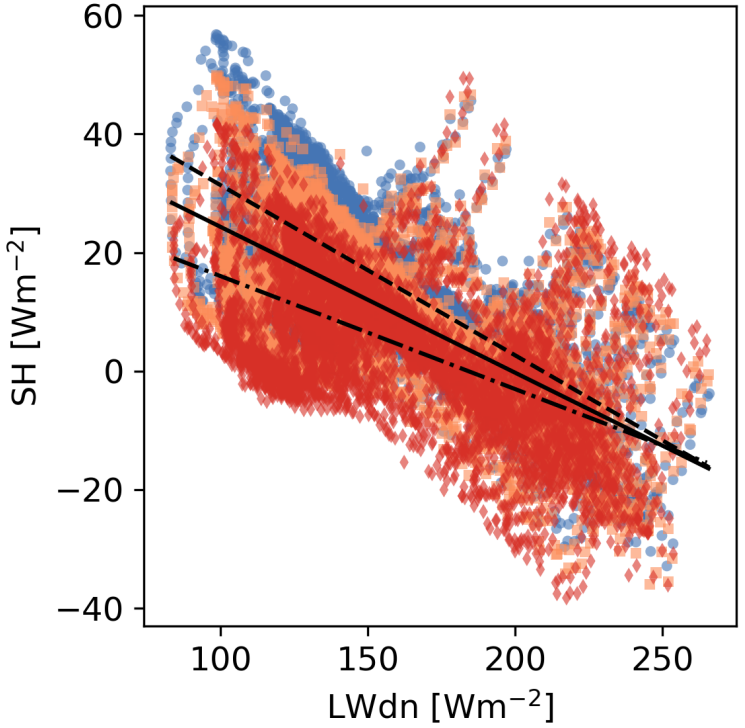


↑k_{snow} → LWup less sensitive to LWdn

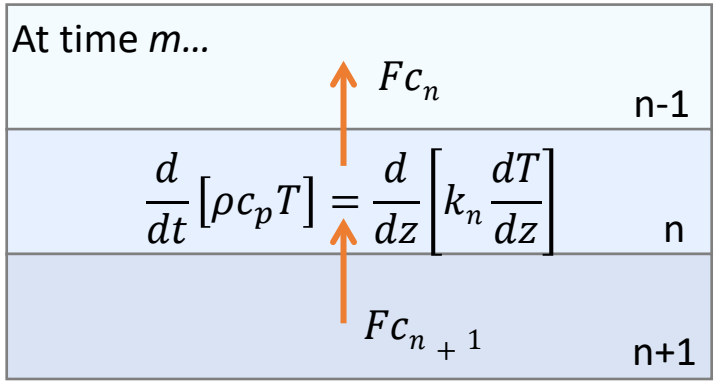


↑k_{snow} → SH less sensitive to LWdn

Fluxes = positive downwards

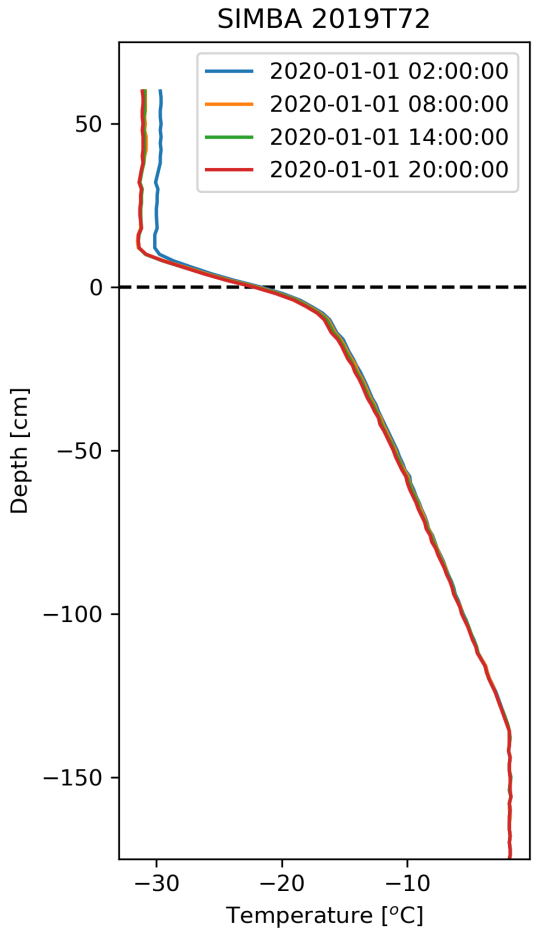
2. What's the variability of snow thermal conductivity and conductive fluxes in observations?

Assume any divergence in vertical conduction (*k*dT/dz*) is equal to the change in temperature (*dT/dt*)



Solve 1D heat equation for thermal conductivity and density given known temperatures

$$\frac{\rho c_p}{\Delta t}\left[T_n^{m+1} - T_n^m\right] = \frac{1}{\Delta z}\left(\frac{k_{n+1}}{\Delta z}\left[T_{n+1}^{m+1} - T_n^{m+1}\right] - \frac{k_n}{\Delta z}\left[T_n^{m+1} - T_{n-1}^{m+1}\right]\right)$$



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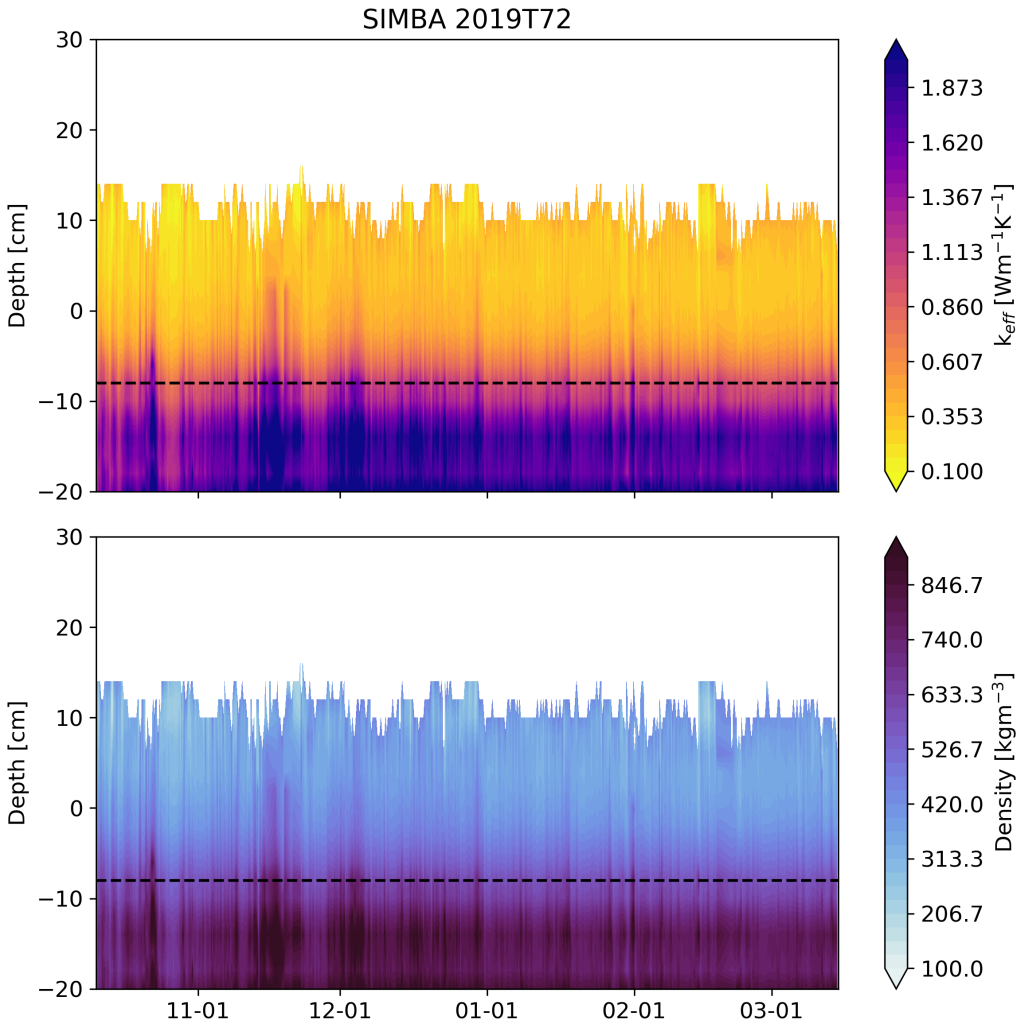

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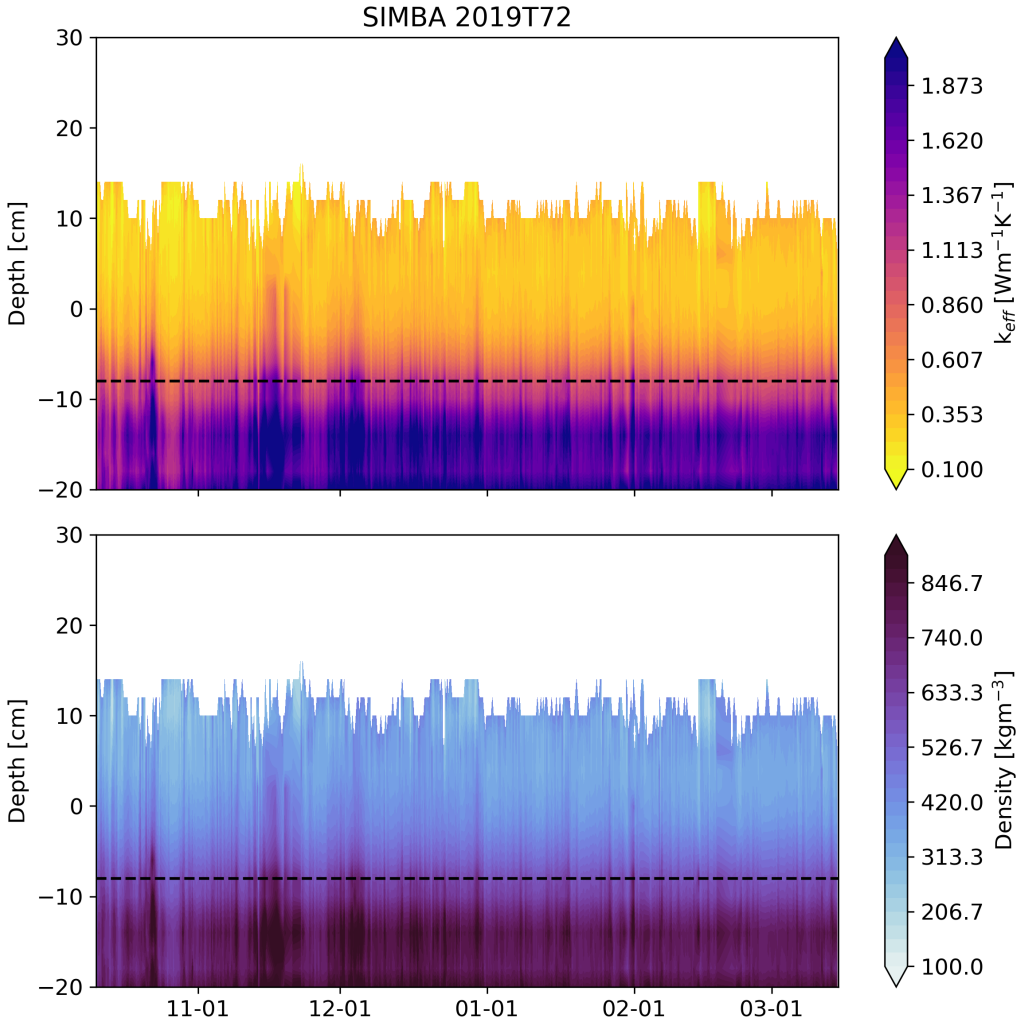

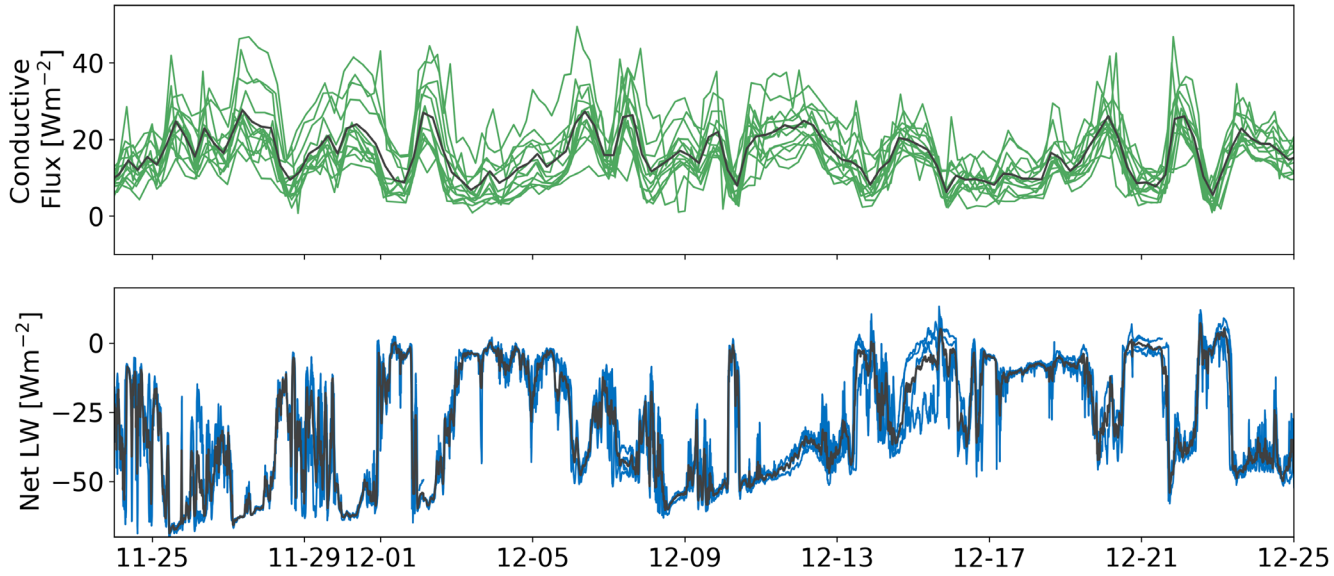

Future work:

Combine with other SEB information to further constrain and assess processes in CAFS

Potential for sensitivity studies with larger scale models to understand model sensitivity to snow/ice thermal properties