R: Deposition and Radiative Impact of Light-Absorbing Particles in Snowpack and Sea Ice

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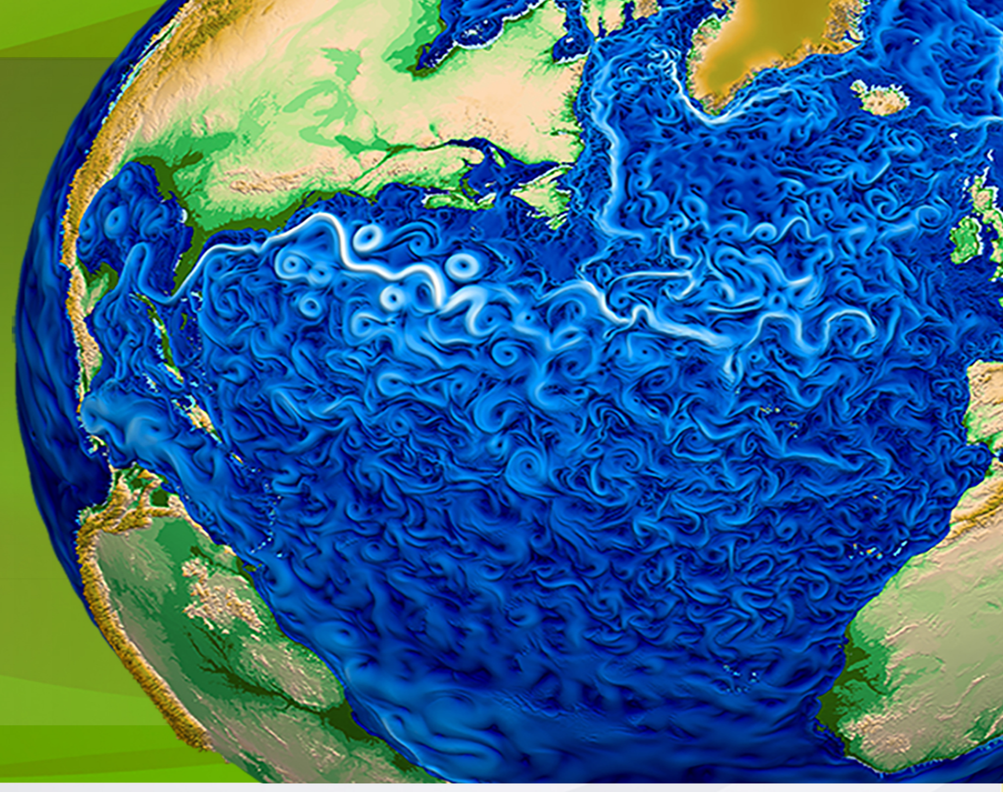


Objective and Summary

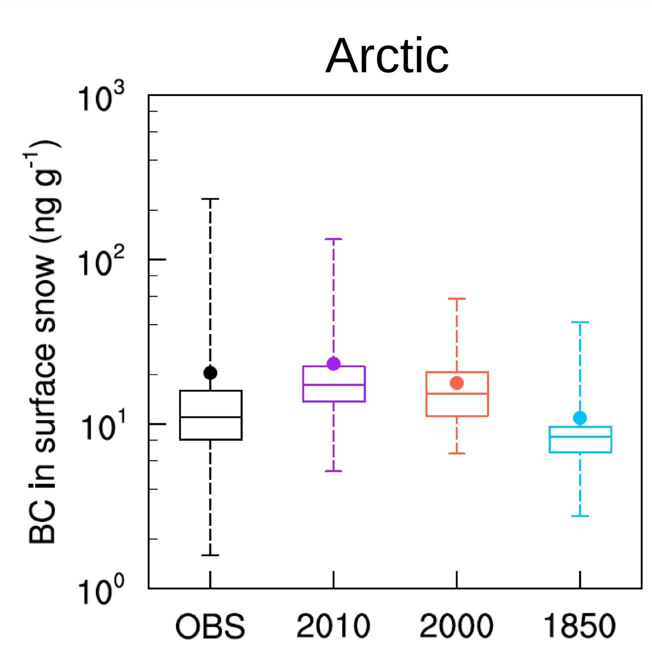
Objective:

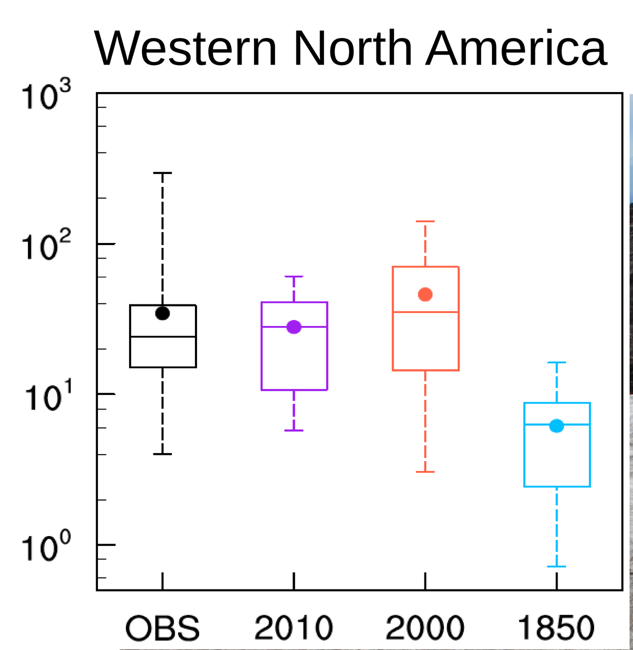
Several new treatments of light-absorbing particles (LAPs) in snow/ice and their radiative impact have been implemented in the ACME v1. Here we quantify the overall effect of LAPs and impact of the new treatments on radiation and climate, using nudged low-resolution (ne30) simulations.

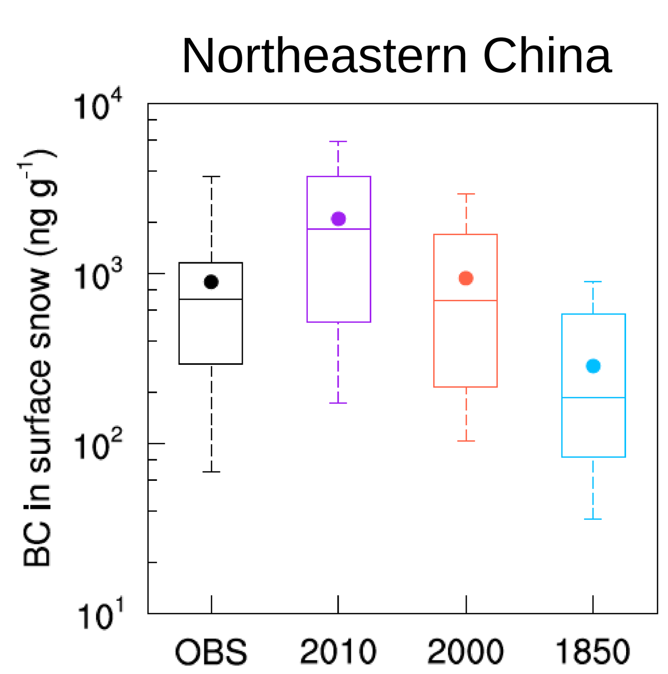
Summary:

- Present-day black carbon (BC) concentrations in snow simulated in ACME v1, in the range from **5** to **5000 ng g^{-1}**, are comparable to those observed at three different locations.
- LAPs in snow/ice have an annual mean warming effect of **1.3** and **0.3 W m^{-2}** over the Arctic and the entire globe, respectively, with a peak impact in late spring and early summer. Our new treatments enhance the warming by **40%**, and LAPs in sea ice and snowpack atop are also important.
- The warming at the surface increases the near-surface air temperature by **0.18 K** (annual mean) in the Arctic and **0.05 K** for global mean.
- Heating to snow/ice induced by LAPs also increases snow melting and the surface evaporation, further affecting the atmospheric water cycle and hydrologic processes at the surface.
- Further improvements to the representation of soil/dust and brown carbon are recommended.

Evaluation of Modeled LAPs in Snow





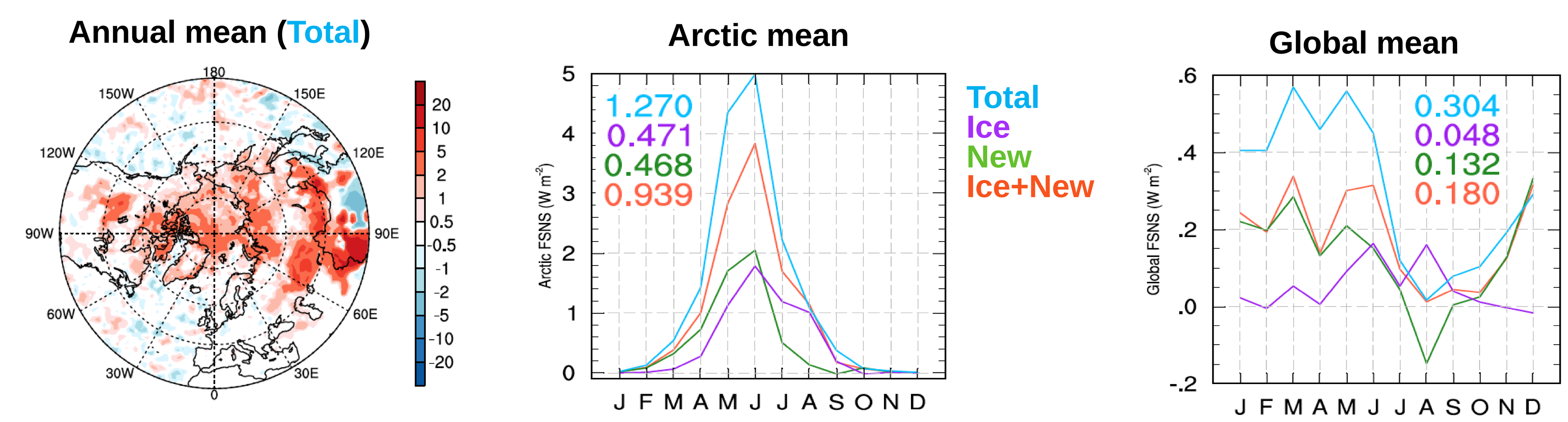


Picture: Dust/soil, BC and other impurities in snow speed up the melting and increase their concentrations in the top snow layer

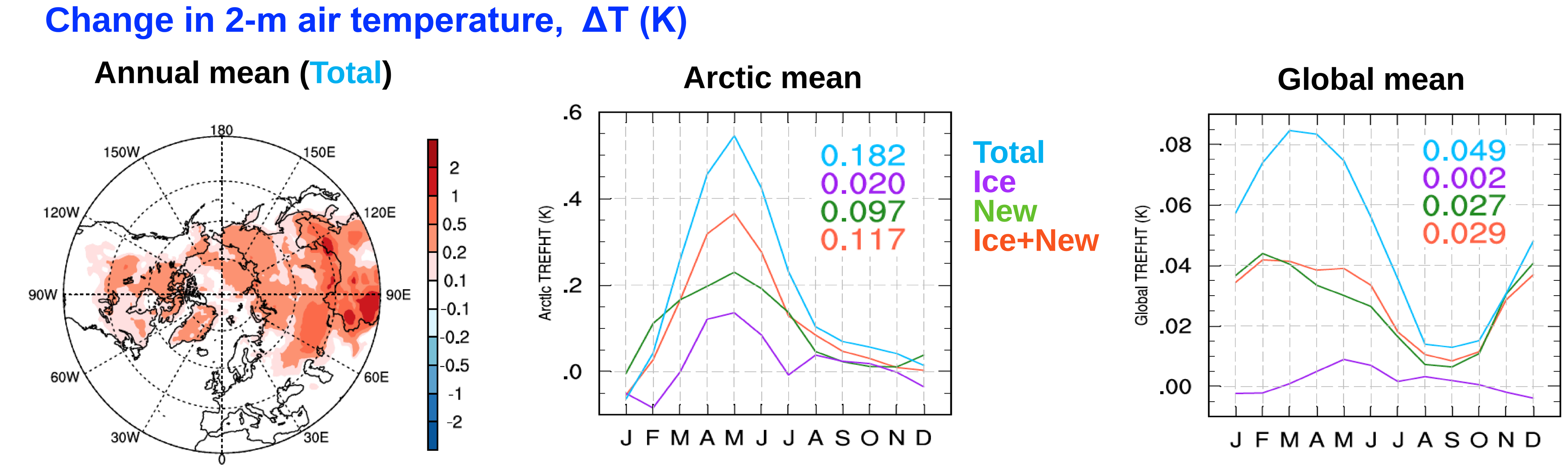
Figures: Model simulated BC-in-snow concentrations are comparable to those observed in the three different regions

Impact on Radiation and the Water Cycle

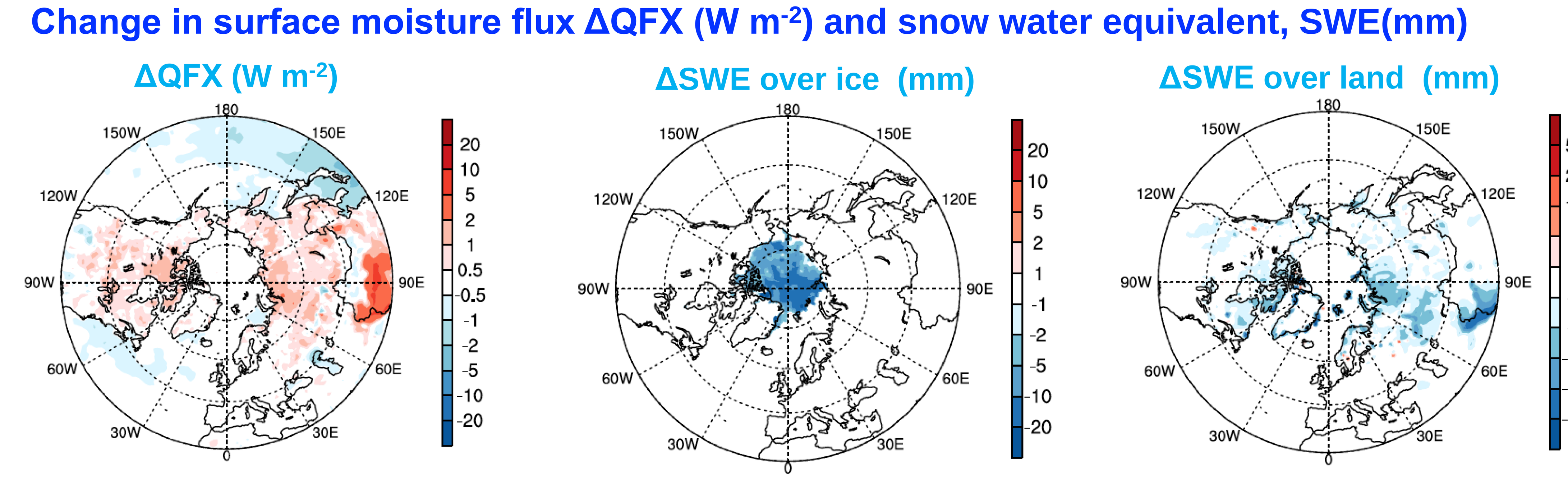
Change in all-sky SW radiative flux at the surface, ΔFSNS (W m^{-2})

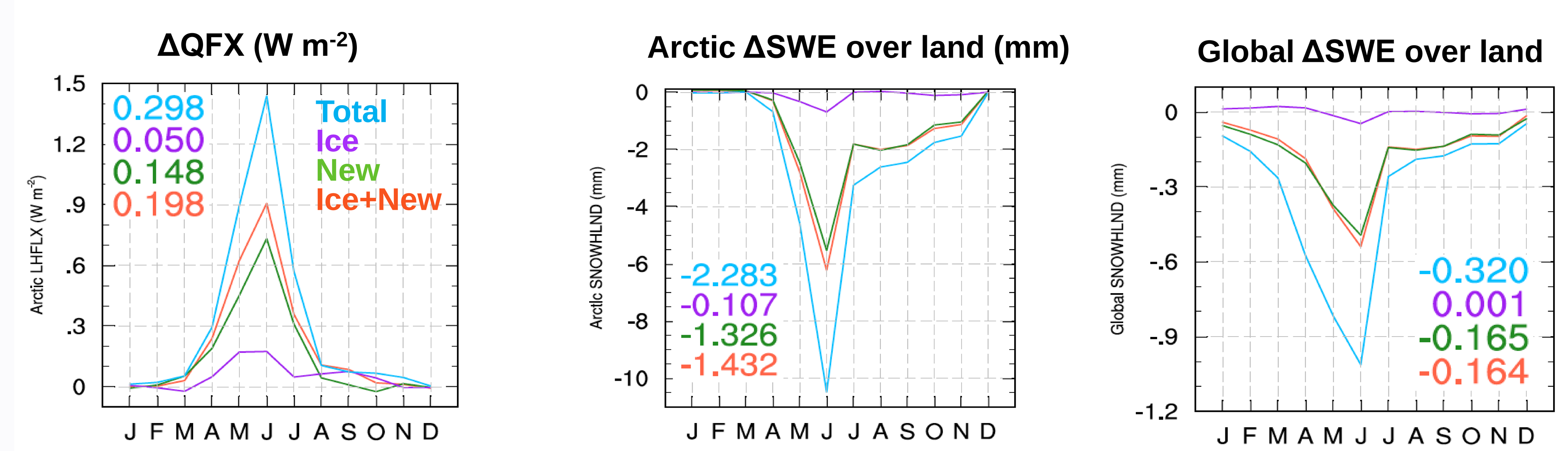


Change in 2-m air temperature, ΔT (K)



Change in surface moisture flux ΔQFX (W m^{-2}) and snow water equivalent, SWE(mm)





ACME Accelerated Climate Modeling for Energy

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