

Modeling Isotopes in Sea Ice

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CESM Sea Ice Component

- Los Alamos sea ice model (CICE4)
- Fully prognostic dynamic-thermodynamic sea ice.
- Multiple-scattering shortwave radiation scheme.
- Tracers in the sea ice are affected by transport, mechanical redistribution, subgridscale thickness distribution, snow ice formation, etc.
- Tracers: Black carbon, dust, melt ponds, and iron.

Holland, M. M., D. A. Bailey, B. P. Briegleb, B. Light, and E. C. Hunke, 2012: Improved sea ice shortwave radiation physics in CCSM4: The impact of melt ponds and black carbon. *J. Climate*, 25, 1413-1430. doi:10.1175/JCLI-D-11-00078.1

Black Carbon Aerosol

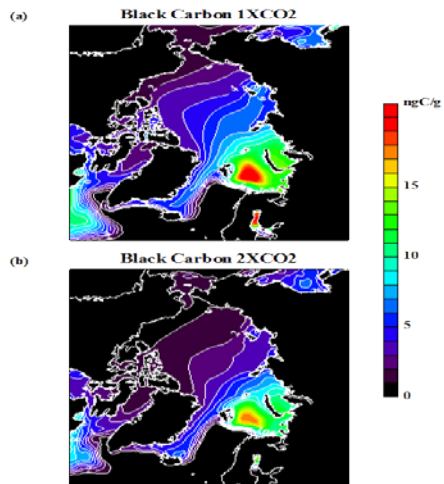


Figure 3. The concentration of black carbon in the interior snowpack over sea ice in ngC/g in April for (a) the 1xCO₂ and (b) the 2xCO₂ control integration

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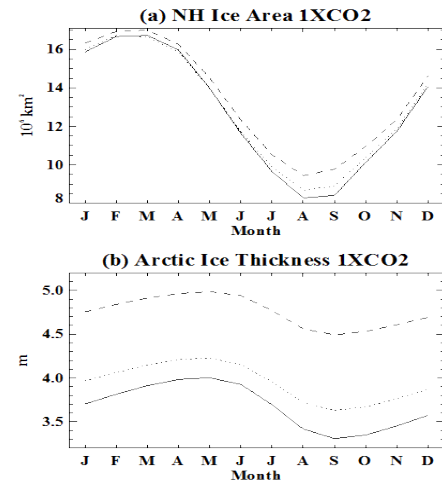
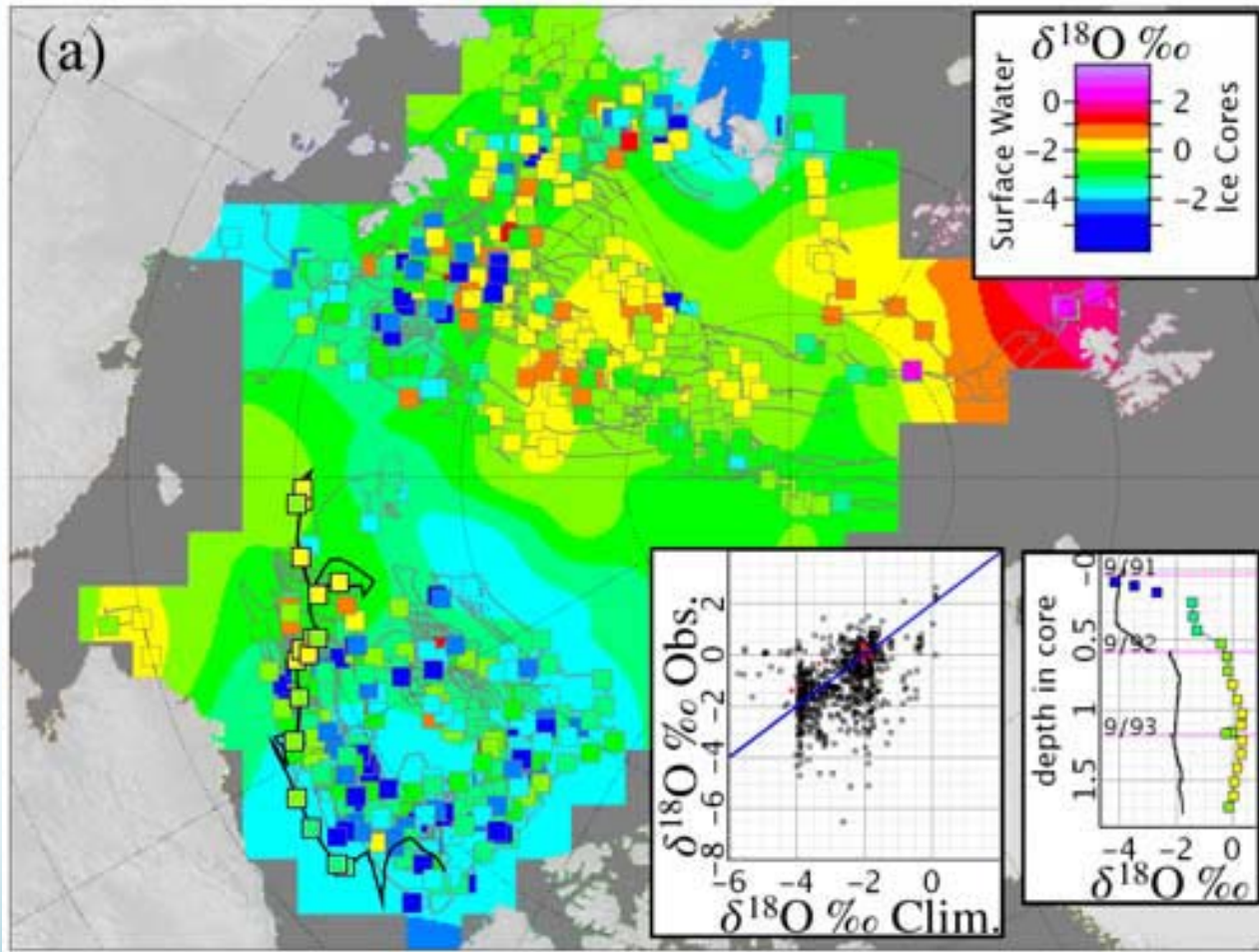


Figure 7. The mean annual cycle of (a) Northern Hemisphere ice area in 10^6 km^2 and (b) Arctic Ocean averaged ice thickness in meters for the control run (solid), the run which excludes aerosols (No_A, dotted) and the run which excludes aerosols and melt ponds (No_AP, dashed). All simulations shown use 1XCO₂ forcing.

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Holland et al. 2012

Observations of Isotopes in Sea Ice

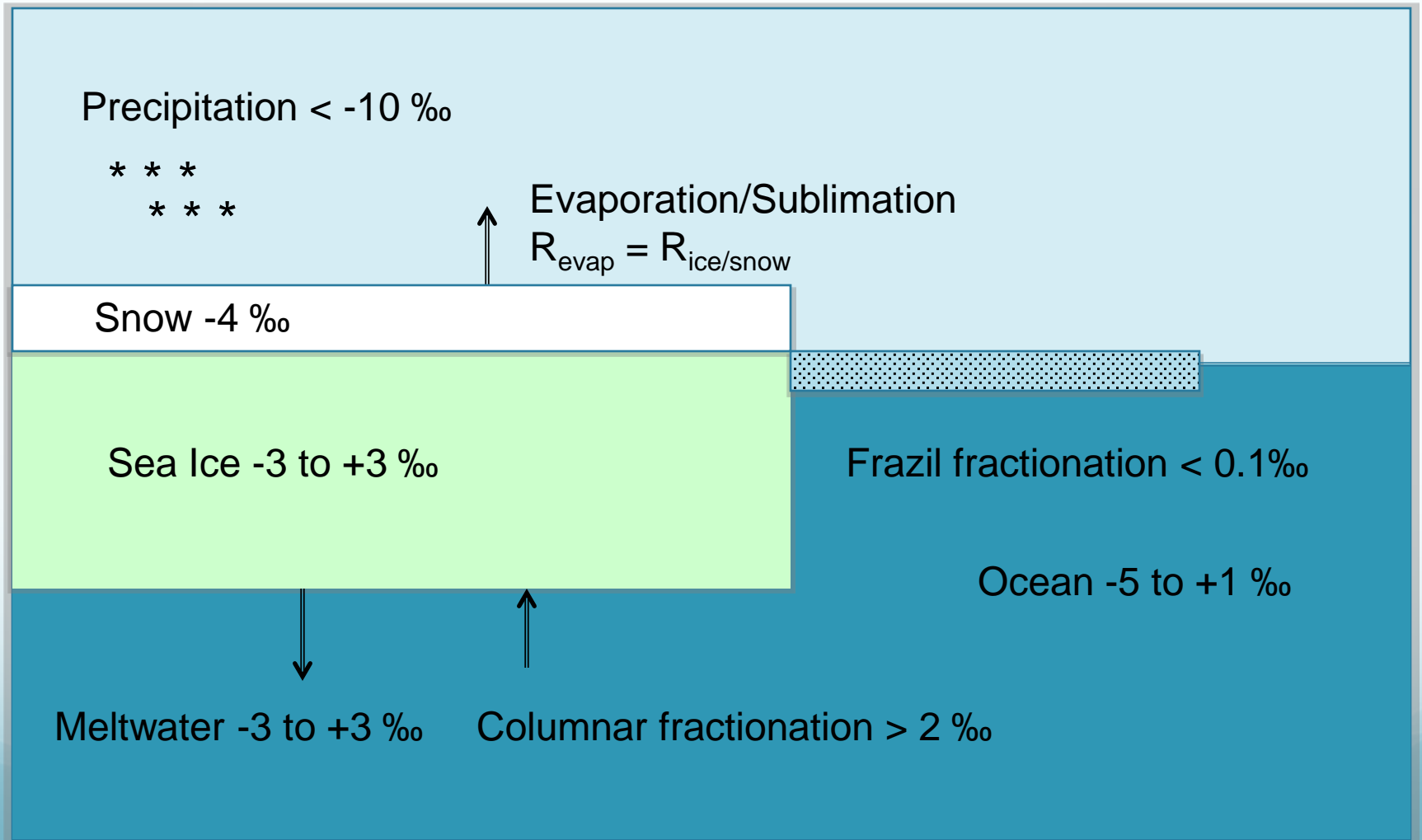


Pfirman et al. 2004

Plan

- Three new isotope tracers in the sea ice: mass/concentration of HDO, H_2^{16}O , and H_2^{18}O . Ratio (R, δ) instead?
- A diagnostic variable for history will be the δ ratios.
- Initially keep track of concentration of isotopes in snow and sea ice. Add vertical profiles later.
- Handled as passive tracers in the sea ice.
- Parameterize the sources and sinks, e.g. fractionation during freezing, precipitation, evaporation, meltwater.

Isotopes in Sea Ice



Summary

- Additional tracers added to CICE code.
- Work in progress to implement sources, sinks, and exchange between snow and sea ice.
- Open to ideas on ways to parameterize fractionation (freezing, evaporation).
- NASA GISS model has done this.