

# Regional Arctic Climate System Model: Overview



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## MOTIVATION

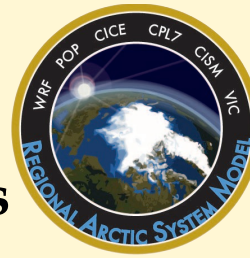
- ❖ Large errors in global climate system model simulations of the Arctic climate system
- ❖ Missing air-sea-ice feedbacks in regional stand-alone models
- ❖ Observed rapid changes in Arctic climate system:
  - Sea ice
  - Greenland ice sheet
  - Temperature
- ❖ Arctic change has global consequences for
  - Thermohaline circulation
  - Global energy balance

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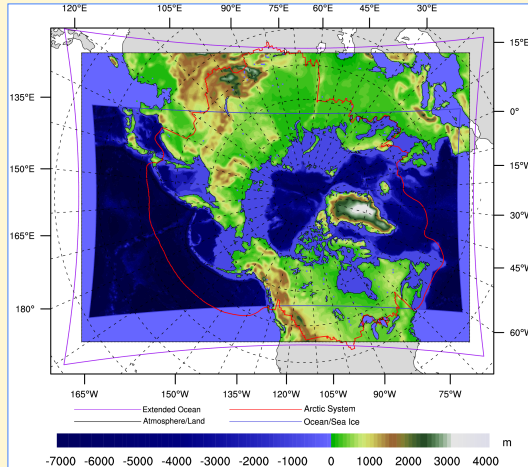
## DEVELOPMENT GOALS

1. Facilitate focused regional studies of the Arctic climate
2. Resolve critical details of land elevation, coastline and ocean bottom bathymetry
3. Improve representation of local physical processes & feedbacks (e.g. forcing & deformation of sea ice)
4. Minimize uncertainties and improve projections of pan-Arctic climate change
5. Develop state-of-the-art Regional Arctic Climate System Model (RASM) including high-resolution atmosphere, ocean, sea ice, and land hydrology, ice sheet and dynamic vegetation components

# Regional Arctic Climate System Model: Structure & Selected Results



## DOMAINS



Region includes:

- ★ All ice-covered ocean in the Northern Hemisphere
- ★ All Arctic river basins
- ★ Critical inter-ocean exchange and transport
- ★ Large-scale atmospheric weather processes

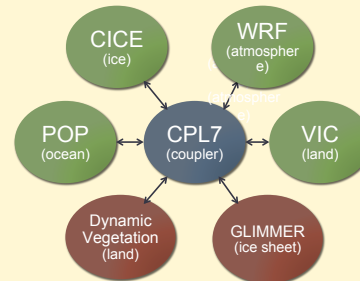
WRF and VIC model domains include the entire colored region.

POP and CICE domains are bounded by the inner blue rectangle. Shading indicates model topobathymetry.

The Arctic System domain (red line) is defined in Roberts et al. (2010).

## COMPONENTS

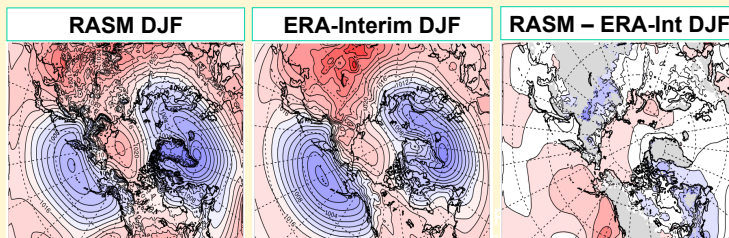
<b>Atmosphere - Polar WRF</b>	(grid spacing $\leq 50\text{km}$ )
<b>Land Hydrology - VIC</b>	(same as WRF)
<b>Ocean - LANL/POP</b>	(grid spacing $\leq 10\text{km}$ )
<b>Sea Ice - LANL/CICE</b>	(same as POP)
<b>Flux Coupler - NCAR CPL7</b>	
<b>Land Ice - GLIMMER</b>	(planned)
<b>Dynamic Vegetation - CLM4NDV</b>	(planned)



NCAR CCSM4 framework used for developing RASM

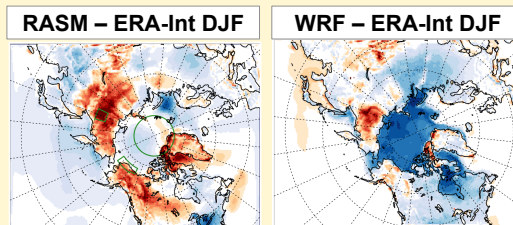
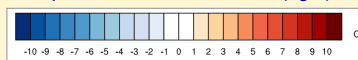
## SIMULATION

We have used RASM to simulate 1990-2001, using ERA-Interim boundary conditions.



(left): Winter sea-level pressure in the Arctic for the RASM (left), ERA-Interim (middle), and the difference between the two (right)

(right): Winter near-surface temperature for RASM minus ERA-Interim (left) and uncoupled, stand-alone WRF minus ERA-Interim (right). RASM simulates large warm bias over land in the winter (left), although near-surface temperature over sea ice is vastly improved in RASM compared to stand alone WRF (right).



- ❄ Fully-coupled RASM produces stable, multi-year climate simulation.
- ❄ Winter T biases need correction; other seasons (not shown) good.
- ❄ Planned simulations include multi-decadal future and retrospective cases.
- ❄ Further implementation will include ice sheets and dynamic vegetation.