Arctic Processes Breakout

Charge to the Group: What are top three priorities to be addressed over the next three years? And what would be the benefit of succeeding in each of these priorities.

Proposed self-organization: We frame the discussion from the perspectives of the seven modeling groups represented at this workshop. Navy, NOAA/GFDL, NOAA/NWS, DOE, NCAR, NASA-GISS, NASA-GMAO

Proposed Framing Questions:

What is the most pressing near-term bias that you expect to resolve (1 to 3 yr)?

-Arctic albedo, snowmelt timing, centennial scale of vegetation and associated diagnostics and physics
--often, error historically thrown into land model tunings
--now, these are becoming more important to understand
--(Bill Riley, LBNL): thermokarst lake simulation, albedo impacts of vegetation changes, permafrost thaw
-JF Francois (NCAR): representation of Arctic clouds & cloud droplets. In general, phase of precipitation reaching surface
-Gavin Schmidt: NASA: clouds! Radiation scheme, which may not be tuned to Arctic atmosphere
-Phil Rasch: clouds. Aerosols at high latitudes, and their impact on cloud characteristics
-Biggest cloud challenges:
---Phil R. (ACME): impact of clouds on radiative fluxes, water fluxes to high latitudes. Cloud phase important for both.
-Ruby Leung: useful to distinguish particular cloud issues. One issue may be resolution.
-Bin Zhoa: coupled biases, and the impact of ice-ocean coupling
--W. Maslowski: for various reasons, upper ocean structure (~150m) can be misrepresented, which impacts seasonal evolution of coupled ocean/ice/atm. System.
---mixed layer too deep
-----need eddy-resolving
-----need sufficient vertical resolution
-----virtual salinity fluxes may cause problems in Arctic regime (negative salinities)
--W. Maslowski: inconsistencies in models (e.g. fixed salinity melt temperature in sea ice) could impact coupled evolution
--JF Francois: in CESM, recent issue was too much Lab Sea sea ice. Vastly a resolution issue (lack of resolution of eddies)
-Wilbert Weijer: how is river runoff treated?
--all present models DO include a routing scheme to send water from land to ocean
--volume conserving: 1
--mass conserving: 1111

--Todd Ringler: rivers include more than mass fluxes (e.g. temperature). Tracking these may be important, but difficult
--distribution of water into ocean, also important (W. Weijer)
-Todd Ringer: processing salt through sea ice/ocean system:
--Adrian Turner:
----in CESM: sea ice assumed to be at constant salinity (so freeze/melt T fixed)
----in ACME: salinity now prognostic. But incompletely represented in coupled system, currently
----Gavin S.: in GISS Model, this problem is better resolved in due to reformulating ocean to accept sea ice salinity fluxes, within ocean boundary conditions
----In SIS1, salinity is constant, but SIS2 it may be prognostic
-Bill Riley: precipitation T important for land processes
---G. Schmidt: being worked on in GISS. But problem of tracking energy flux in precipitation is surprisingly complex.

-Ruby Leung: are aerosols important in Arctic?
---Phil R.: biases are large and a function of altitude
---amount reaching high latitudes strongly a function of scavenging on the path from mid-latitudes
---also function of high latitude flaring

-JF Francois: latitudinal distribution of precipitation, particularly across Greenland, hard to get correct. Partly due to local issues, partly due to broader circulation patterns
--Gavin S.: downscaling important for getting ice sheet surface mass balance

Top 3 challenges:

What is the largest technical challenge for improving the fidelity of Arctic simulations? Provide context to the answer: time scale, spatial scale, model component(s), other ….

-technical challenges depend on which timeframe you're interested in. E.g. subseasonal prediction versus tipping point timeframes.
-land is be important on fast timescales. So, improving land processes could be important to improve, on near-terms
-need to better simulate Arctic, to better understand Arctic->mid-latitude connections
-short-term timeframes may have more success in funding due to current weather bill
-MOSAIC: new dataset constraining energy transfer through atm/sea ice/ocean system. Could be good for quantifying compensating errors

Biggest challenges, by modeling center, over next 3 years

Biggest challenges over next ~3 years

-RASM:
--improve coupling of momentum transfer from atm through sea ice into ocean
--radiative budget of Arctic ocean surface
-CESM:
--CMIP6 simulations
--clouds
-GFDL:
--completing CMIP6 models
--evaluating new coupled system
--dynamic veg
-ACME:
--clouds; ice nucleation in mixed-phased clouds
--land surface processes: thermal hydrology, runoff, subgrid topography in land model
--melt pond drainage in sea ice
-GISS model:
--cloud processes; mixed phase, aerosol cloud nucleation
--methane hydrates (as a subset of composition changes due to climate change)
-GMAO:
--initialization of ocean/sea ice over polar ocean (seasonal/sub-seasonal timeframes)
-EMC:
--metrics to measure fidelity of Arctic simulations (over very short timescales, 3-5 days)

Major themes found:
--room for improvement in all areas, and many processes are under-represented
--clouds in Arctic, for their effect on:
----surface radiative budget over land, sea ice, ocean
----the Arctic hydrological cycle
--good discussion around:
----improving representation of cycling of salinity/freshwater/carbon and other constituents through Arctic coupled system
----improving land models may uncover compensating biases, because of historical use of land to absorb broader errors
----upper Arctic ocean representation of stratification, and related impacts on surface fluxes and exchanges of mass/properties with lower latitude oceans
----Arctic to midlatitude understanding will improve from improved Arctic representation
----Scientific/operational interest across timescales, from a few days to climate projections
----other specific topics will be included in draft report