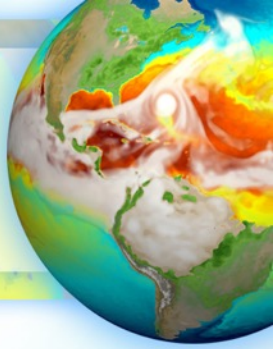

E3SM Simulation Coordination

L. Ruby Leung

Overview

- Survey questions:
  - What science questions will your projects address using E3SM?
  - What is your simulation plan? (e.g., model version, model configurations, major code changes, resolution, simulation period and length)
  - What computational resources are needed for your simulations and how will you obtain the resources?
  - Will you develop a modeling hierarchy using E3SM?
  - Will you produce or need any spun-up states for initializing your simulations?
  - Will you compare E3SM simulations with those from other models?
- PIs of 20 projects responded
  - SFAs (HiLAT, WACCEM, PCMDI, RUBISCO, ICoM, InteRFACE)
  - 14 university projects

Science questions (topics)

- **Modes of climate variability:**
  - Air-sea interactions and MJO
  - MJO propagation across Maritime Continent
  - ENSO and connections to other modes of variability
- **Arctic and Antarctic:**
  - Heat transport, connections to lower latitudes, polar amplification, sea ice loss and atmospheric response
  - Delivery of warm water to Antarctic and Greenland ice shelves
  - Arctic region storms
  - Permafrost, benthic habitats, wave attenuation in Arctic coastal regions
- **Tropical cyclones:**
  - AEW and Atlantic TC
  - Factors controlling landfalling TC and genesis
  - Effects of air-sea interactions on landfalling TC
- **Extreme precipitation and weather events:**
  - Processes controlling extreme precipitation
  - Impacts of model biases and resolution on simulation of weather extremes
  - Extreme weather events and future changes
- **Cloud and radiation:**
  - ITCZ and cloud-radiative interactions
  - Role of coupling between dynamics and radiation on weather extremes and climate sensitivity
  - Climate sensitivity and cloud feedback
- **Biogeochemistry:**
  - Ocean carbon uptake
  - Carbon cycle feedback, CO2 fertilization effect
  - Impacts of plant biogeochemical responses on water cycle processes

Simulation plan

- Low resolution coupled:
  - Modified cloud feedbacks (PCMDI)
  - 100 members of 14-month runs with prescribed Arctic/Antarctica sea ice loss (Magnusdottir)
  - Hypothesis-testing simulations: changing insolation or parameters in ZM scheme; nudged atmosphere (Kim)
- RRM simulations coupled:
  - E3SM v2: Arctic coupled (ARRM and WC14) (HiLAT; Walsh-Roesler)
  - E3SM v2 WC14 mesh - HighResMIP type simulations with 10 ensemble members (1950-2015) (InteRFACE)
- Biogeochemistry simulations (LR):
  - Require long spinup (e.g., 200 years)
  - Long simulations (e.g., 140 years)
  - Partially coupled with ELM and ELM-FATES hypothesis testing (Swann; RUBISCO)
  - DECK type simulations with land and ocean BGC and different scenarios (e.g., various SSPs) (RUBISCO)

Simulation plan

- Atmosphere-only runs:
  - 10-year AMIP runs at LR and HR (Saravanan)
  - ~ 100 seasonal-to-annual simulations at HR (Patricola)
  - Radiation feedback suppression at HR (Soden)
  - Various ways to suppress cloud-radiation feedback (each 11 years), and with 4K warming and 4xCO2 forcing and 4xCO2 SST pattern (WACCEM)
  - Cloud feedback experiments with prescribed SST (e.g., AMIP-p4K, AMIP-p4xCO2, etc) (PCMDI)
  - 100 members of 14-month runs with PI/future Antarctic sea ice at LR (Magnusdottir)
  - WC14; comparison with WRF-Arctic (Walsh-Roesler)
- Ocean-ice only runs:
  - Arctic with marine BGC (HiLAT)
  - Freshwater flux release in Greenland and Antarctica (McClean)
- E3SM coupled to a 1D mixed layer ocean: several 30-year simulations (DeMott; Klingaman; HiLAT)

Simulation plan

- Shorter simulations (atmosphere-only):
  - Storyline simulations (multiple < 10 days): large ensemble (O(100)) atmosphere-only at multiple resolutions (110km, 28km, 14km) (Zarzycki-Reed)
  - Short-term (2-4 week) forecast ensemble equivalent to 10 years at LR and HR (Saravanan)
  - Multi-year, short-range (5-day long) hindcasts initialized every day at 00Z from Jan 1, 2010 to Dec 31, 2018, with EAM v1 and v2 (ne30) (PCMDI)
- Comparison of coupled simulations at LR (1.5 deg), HR (0.3 deg), and MMF (1.5 deg) 5 years each (Kooperman and Hannah)
- Repeat E3SM v1 LR / HR simulations for higher frequency / special outputs (DeMott; Ito; Jin; ICoM)

Computational resources

- NERSC
- PNNL Compy
- LLNL computing facility (PCMDI)
- Cheyenne (Soden)
- Institutional cluster (RUBISCO)
- Institutional cluster (LANL)
- ARCHER (UK national supercomputing facility) (Klingaman)
- Similar to Compy but dedicated for coastal projects (ICoM)

Comparison with other models / contribution to model intercomparison

- CMIP6 (e.g., DECK, **C4MIP, CFMIP**, HighResMIP, **PAMIP**)
- WRF-Arctic (Walsh)
- GFDL (Soden)
- CAM (Saravanan)
- CESM (Zarzycki; DeMott)
- ATS-MOSART (InteRFACE)
- CAM-MPAS (WACCEM)
- UK Met Office Unified Model (Klingaman)
- RASM (HiLAT)
- UWIN-CM (ICoM)

Ideas for coordination of simulations

- Coordinate model output requirements
- Communicate channel to update progress and data availability
- ?