NCAR Junior Faculty Forum 2009

Summary of Breakout Session II:

Strategies for balancing the competing needs of resolution, domain size, duration of simulation, ensemble size

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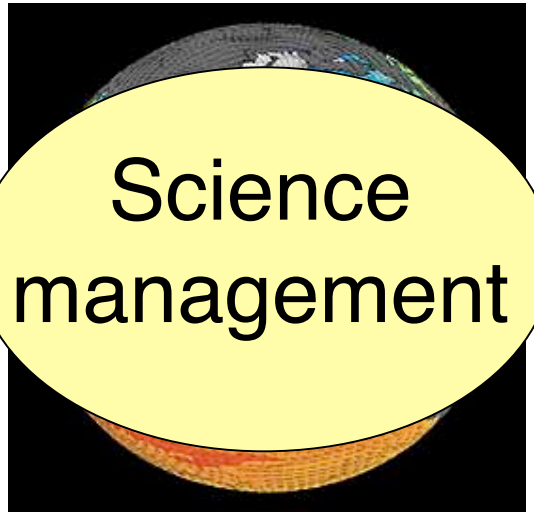
Provided limited computing and human resources what are the competing needs?

duration of simulation

resolution



ensemble size

complexity

domain size

There are interdependencies!

Science Management

- Needs of individual researchers at universities may be different from the needs of a cutting edge community project (e.g. NCAR's CCSM project)

- Needed: Management structures that promote sharing results to help individual researchers
- Community center tasks versus users needs: Can we ask centers for specific model runs?
- Maybe a lot could be gained by making diagnostics of existing datasets/model runs easier

Complexity & Understanding

- Hierarchical models versus integrative models
- Do simple model give us already answers? E.g. is a high-resolution GCM necessary for better ENSO predictions or does a model with stochastic forcing give us comparable (and trustworthy) answers?
- Simple models help understanding, support process studies, but the results need to be confirmed in complex models
- Danger to over-interpret simple models or pre-determine the solution by e.g. specifying SST (may be very different from coupled model runs)
- Who overwrites whom: Natural climate variability versus anthropogenic effects

Ensemble size

- Can we define a-prioiri estimates for ensemble sizes that accurately span the uncertainty range?
- What are the metrics for this estimate?
- Assessment of extreme events requires huge ensemble sizes
- Do we need bigger ensembles sizes for runs at higher resolution to estimate the uncertainty reliably?
- Uncertainty does not decrease at higher resolutions

Duration of Simulation

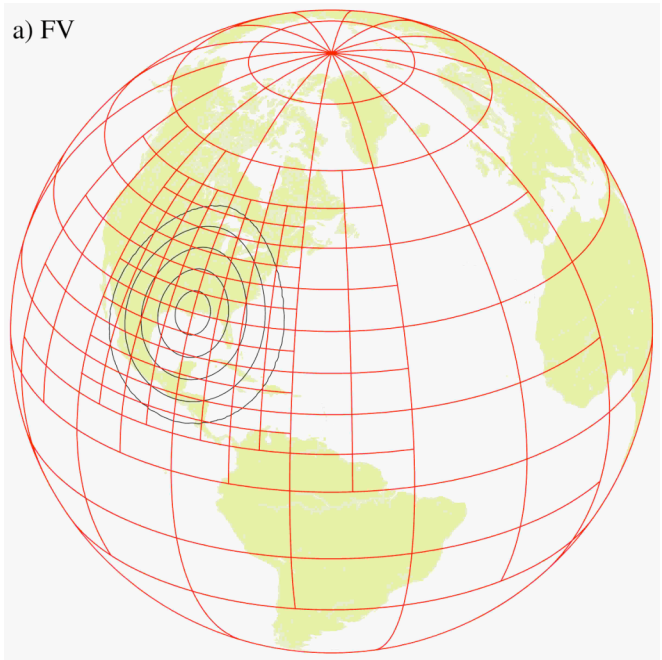
- Multi-decadal at high resolutions (> 30 years)
- Thousands of years at low resolutions

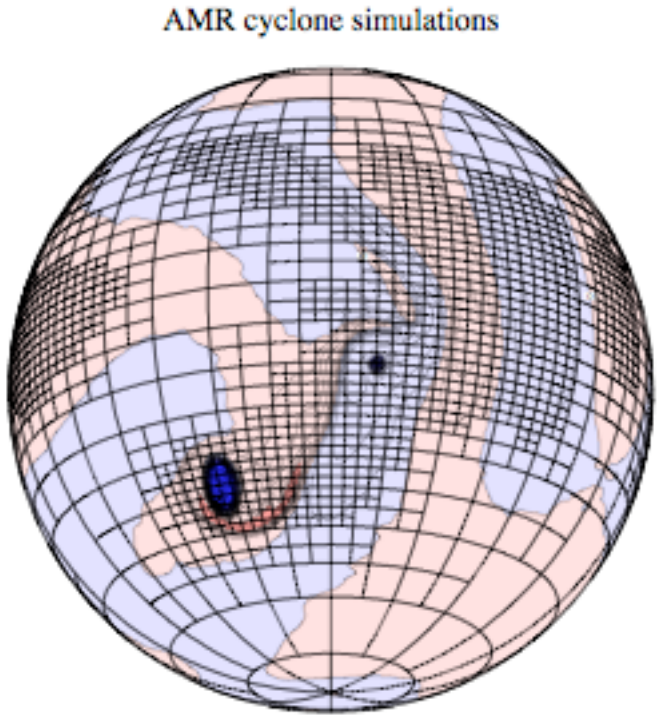
Resolution

- High-resolution climate models are requested by application community
- Can we produce DNS-like simulations for climate (extreme high resolution) to help improve simpler models? But
  - how do we know a single model is correct
  - model error uncertain
  - cloud resolving resolution might still not be enough
  - how high is the ‘high’ resolution?
- Increasing resolution does not help if processes are not represented at all, e.g. soil moisture

Domain size & Resolution

- There is a need for regional climate & weather models in the user community
- One model with embedded high resolution nests





Weather-Climate Interface

- Climate: average statistics of weather ?
- Initialization versus boundary value problem
- Weather models often perform poorly as climate models (e.g. drift), due to insufficient design or missing processes (like soil, land-surface processes)
- Definitions:
  - Seamless: the same model for all spatial and time scales
  - Unified: collection of GCMs with similar characteristics (e.g. dynamical core), but e.g. different parameterizations for weather or climate applications?
- Artificial boundaries should be broken, how soon can we do this?
- Model designs must incorporate all scales

If we had a supercomputer …

- Nature run: High-resolution Earth System Model (T2047, 10 km, ideally finer), highest complexity possible, at least 1 decade, deterministic, cloud-permitting, with CO_2 forcing
- 10000-year runs, low resolution 2x2 degrees mesh refinement (nests) over land, look at extreme events (heat waves, droughts)
- Can we introduce interactive changes in climate model (during the model run) to play with sensitivity?
- Assessment of the climate with multiple models, international labs, multiple center (NCAR, universities), multidecadal > 30 years, with initialized (observed) ocean

Funding & Science Support

- NSF?
- NCAR, NOAA, NASA, DoE?