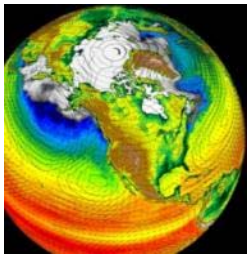

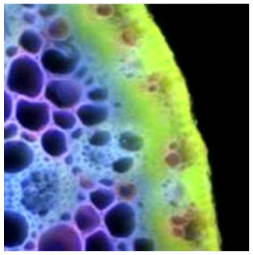

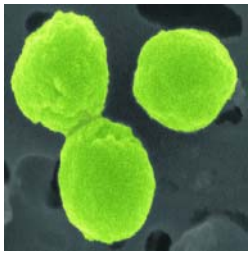

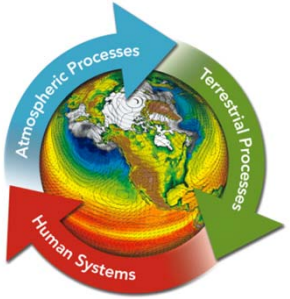

Community Modeling and Long-term Predictions of the Integrated Water Cycle

Breakout Group #4

Washington DC

September 24-26, 2012

Priority questions

- Develop hierarchy of numerical experiments to evaluate models and diagnose modeling deficiencies
- Evaluate coupled systems (including the human component)
- Develop datasets necessary for meaningful model evaluation

PRD1: Develop hierarchy of numerical experiments to evaluate models and diagnose modeling deficiencies

- Develop methods that effectively discriminate among competing models, given large uncertainties in model parameters and forcing data
  - Include parameter estimation/sensitivity as part of model evaluation?
  - Account for uncertainty in forcing data as part of the model evaluation process?
  - Exploit probabilistic evaluation methods – evaluate the envelope of behavior for competing modeling approaches
- Develop model analysis methods that isolate errors in different parts of the modeling system (provide insight into individual processes)
  - e.g., change one model component at a time
- Use simplified and idealized simulations to diagnose the representation of processes within complex modeling systems
- Analyze analysis increments in data assimilation systems

PRD1: Develop hierarchy of numerical experiments to evaluate models and diagnose modeling deficiencies

- Use multiple datasets (including satellite data) to provide insight into individual processes and their interactions
  - Avoid incorrect inferences associated with compensatory errors and blind calibration
  - Include inter-variable relationships as part of model evaluation metrics
    - e.g., elasticities
- Use Bayesian methods to infer the extent to which the data conflicts with our a-priori expectations (insights into structural problems, parameter values)
- Use a mix of model benchmarking and model diagnostics
  - How good is a model (PALS, iLAMB)
  - Why do models behave badly?

PRD1: Develop hierarchy of numerical experiments to evaluate models and diagnose modeling deficiencies

- Develop model evaluation strategy for IAM models
  - Define set of simple experiments and basic test cases
  - Develop testing environment to include hindcasting
  - Evaluate models across multiple modeling contexts – metrics for IAM include economics, consumption, damages
  - Evaluate both the sensitivity to model inputs, as well as the fidelity of the model itself
    - Consider elasticities
  - Give the model scenarios where you expect it to fail
    - Drought of 2012, etc.
    - Evaluate models w.r.t. contrasting extremes
- Evaluate model representations of uncertainty
  - Does model coupling constrain capabilities to represent propagation of uncertainties throughout a chain of models?

PRD2: Evaluate coupled systems (including the human component)

- Land-atmosphere coupling: No direct way to assess if the coupling is "correct"
  - Is the rain causing soil moisture anomalies, or soil moisture causing precipitation anomalies
  - Nicest thing – demonstrate that you have predictive skill.
  - LOCO diagnostics – covariance of temperature and humidity throughout the day – tells you a lot about local effects of land-surface anomalies.
- Incorporating saturated flow processes in land models
  - Multiple approaches currently being trialed
  - Different complexity, parameter requirements, etc.
  - Different sensitivities – what sensitivity is "correct"?
- IAM coupling with Earth System Models: large differences in model complexity and model time step
  - One-way coupling – matters what variables are transferred and which model computes different variables (e.g., carbon stock)

PRD3: Develop datasets necessary for meaningful model evaluation

- Need to coordinate the data that we do have – NAWP
  - Data integration (common data formats, coordinate data in the cloud)
  - Identify data gaps
- Multi-scale field experiment to estimate regional ET (~100-km)
  - So much uncertainty because we don't understand ET
  - Consider establishing
    - Soil moisture arrays, COSMOS
    - Multiple eddy correlation sites
    - Aircraft
- Identify different types of data that is meaningful at different scales. Get at the inherent variability of the system due to non-linear dynamics.
- Need multiple variables to constrain the system
- Quantify data uncertainty, yes, even for variables we think are "good"
  - e.g., streamflow, changes in channel bathymetry etc., shifts in data

PRD3: Develop datasets necessary for meaningful model evaluation

- Global energy and water and energy budgets
  - Errors in the global mean state, location of the ITCZ etc. greatly influence the type of errors in the model
  - convergence of moisture at monthly/seasonal time scale useful diagnostic at the global scale.
- Closure of the water budget in selected regions can target different scales. Cannot do all – but for selected regions can conduct very focused studies. For example ET

Thank you!