

Why an NACP carbon cycle prediction synthesis activity?

# Proposed logic

- C cycle forecasts, especially for terrestrial ecosystems, stink, **AND** aren't obviously improving. (Friedlingstein et al 06, 14)
- **BUT** the NACP interim synthesis activities were very fruitful (see lots of publications, data sets, model-data syntheses and comparisons, etc)
- And we (the NACP) are creating a lot of good data that can be used to test prognostic models.
- **THEREFORE** a prognostic synthesis activity could greatly advance our ability to predict the future carbon cycle and show us more observations, experiments and models that would improve this field even more.

- True? Or am I wrong?
- If true, who wants to lead? What would the details be? How should we proceed?
- I have been trying to promote this idea, but I can't get a group to pick up this ball and run with it. I'm not the guy to do this.

- Mstmip phase 2 funded. Models out to 2100. 7 core models, inviting participation from outside. Does this activity include vigorous model-data comparisons? Experimental and observational?
- Focus more on model development. What processes are critical? How can you tell?
- FACE and other manipulative experiments are a source for prognostic model evaluations.
- Comparisons alone are limited – need interpretation of the cause of the spaghetti.

- Do we have the data needed to evaluate these models? There is a gap in the data.
  - Inverse flux estimates?
  - Experiments
  - Flux tower records
  - Biomass carbon pool records, isotopic records
  - Define data performance benchmarks
    - Didn't ILAMB do this? At a global scale? coupled carbon – climate models – not a focus specifically on terrestrial ecosystem models, for example.
- How do we fix the spaghetti?
  - Data assimilation
  - Model development
  - Model pruning
  - Model uncertainty characterization and model design
    - theoretical analyses of model structure.

- Interannual variability – difficult to reproduce.
- What is the appropriate spatial domain for model-data comparisons? (Multiple domains, likely, right?)
  - Regional level data are not available.
  - Site level data are available. Careful – one site doesn't represent the globe or a region. Many sites? Atmospheric inversions? Joint parameter optimization using atmospheric and ecosystem data?
  - Extreme events provide opportunities for model evaluation.
- McGuire did this 20 years ago?
- Model sensitivity studies are a route to determining the critical observations or experiments needed to improve predictions.
- Predictive models – no observations of the future exist...working groups on model process development suggested. Soil carbon, dynamic vegetation, for example.
- Climate extremes are good test beds. Models need appropriate processes, including disturbance. And disturbance data.

- Existing climate change in the instrumental record can be used to test models. Flux towers, remote sensing data are regional. Remote sensing doesn't cover all variables, but it is regional!
- Paleorecords.

# synthesis

- Is more needed? Or are enough efforts already underway?
- How could we contribute most effectively?
  - Focused process working groups. Kevin worries about portability across models.
  - Site and regional tests with existing data of past climate events in the observational record (make benchmarks)
  - Participate in how to improve MsTMIP phase 2 – future runs will happen, including model comparisons, and comparisons to FACE. Plan for some comparisons to past events. Just starting.
  - Develop better regional data, and broader types of site data
  - Diagnose / solve spaghetti
  - Multiple, simultaneous data constraints
  - Relationships between data / observations...data connect to particular model processes and are linked.
  - Improve communications among modeling teams – tools to share resources, make models easier to run and share and develop. Like Mike Dietze said.
  - We should list data that are good to compare. What should we compare?
  - Advance model and data uncertainty quantification