Impacts of Root Hydraulic Redistribution on Global Evapotranspiration Predictions Using CLM4.5

Carbon Cycle Feedback Uncertainties

W.J. Riley and J.Y. Tang

EARTH SCIENCES DIVISION

BERKELEY LAB

SCIENCE DRIVER

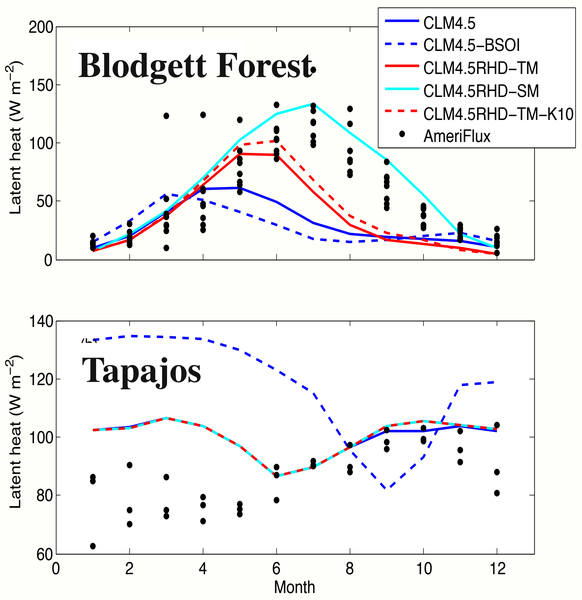
- **Root hydraulic redistribution can strongly impact surface energy budgets, yet this mechanism is absent from most climate-scale land models**
  - ➢ **May be critical for tropical systems**
- **We implemented the Amenu-Kumar model in CLM4.5**
- **We analyzed impacts on site and global ET and tested two numerical implementations of the model**

METHODS

We modified CLM4.5 by:

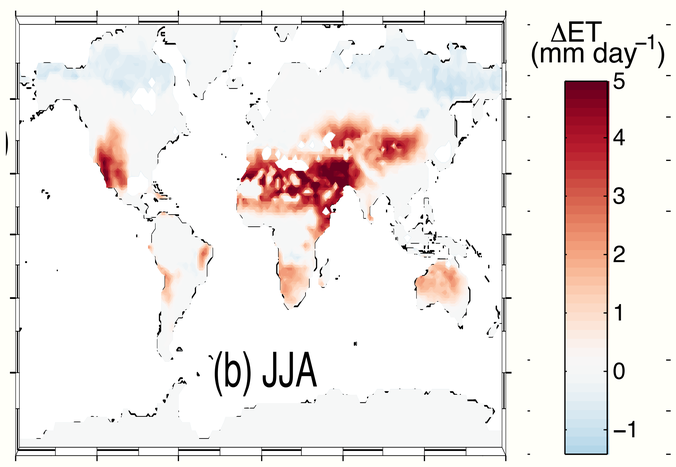
- **Using soil water retention curve and bare soil resistance formulation from *Tang and Riley* [2013a, b]**
- **Integrating the big-root model of plant root hydraulic redistribution [*Amenu and Kumar*, 2008]**
- **Using three pedotransfer functions**
- **Sequential and tightly coupled numerical solvers**

RESULTS

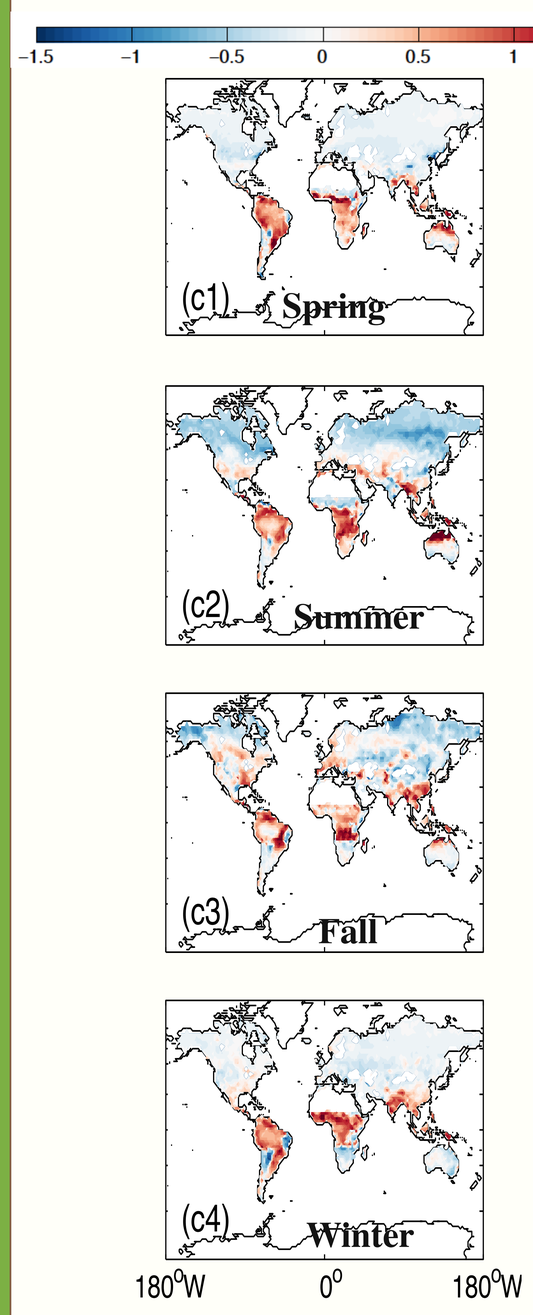


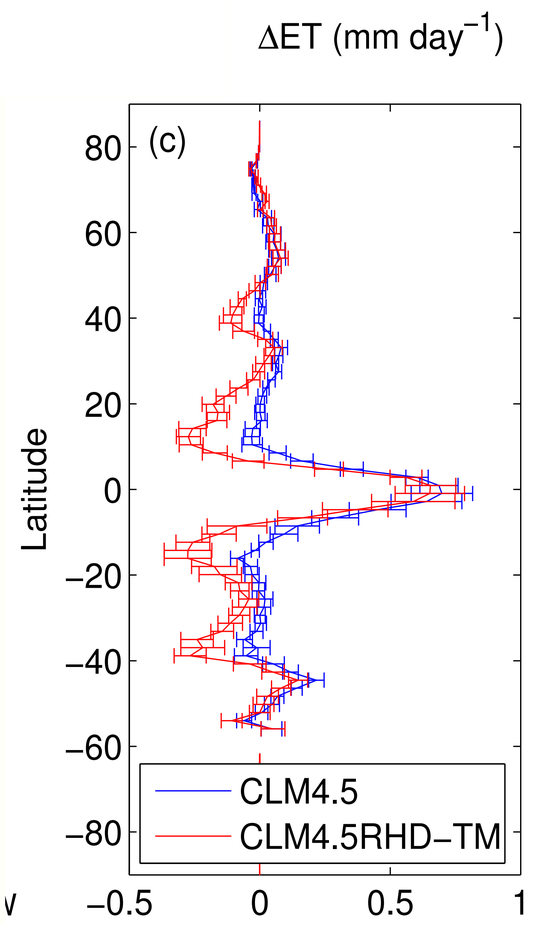
- **At Blodgett Forest, the improper numerical solution gave predictions closer to observations**
- **At Tapajos, no combination of parameters produced a good match with observations**

Differences in the 10-y mean ET in JJA from the two numerical schemes (sequential and tightly coupled).



Seasonal ET differences between FLUXNET-MTE and CLM4.5 with tightly coupled root hydraulic redistribution.





Impact of vegetation removal with the default and tightly coupled schemes.

Conclusions

- **Sequential implementation is numerically incorrect**
  - **However, it performed better compared to measurements than correct implemementation**
- **Compared to FLUXNET-MTE predictions, including root hydraulic redistribution in CLM4.5 resulted in:**
  - **Poor tropical ET predictions, regardless of pedotransfer function or climate forcing**
- **Vegetation removal still increases ET in Tropics**
- **These results imply substantial work remains for hydrological modeling in NGEE-Tropics**

DOE BER Climate Modeling PI Meeting, Potomac, Maryland, May 12-14, 2014

Funding for this study was provided by the US Department of Energy, BER Program. Contract # DE-AC02-05CH11231