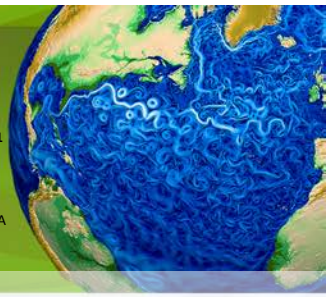
# R:

# Biophysical feedbacks of vegetation to the global climate change for the past three decades

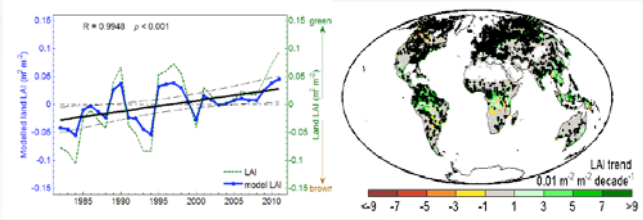
Xiaoying Shi[1], Jiafu Mao[1], Zhenzhong Zeng[2], Peter Thornton[1], Forrest Hoffman[3], and Daniel Ricciuto[1]

1 Climate Change Science Institute /Environmental Science Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA
2. Sino-French Institute for Earth System Science, College of Urban and Environmental Sciences, Peking University, Beijing 100871, China
3 Climate Change Science Institute /Computer Science & Mathematics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA



## Objective

Vegetation biophysical feedbacks are well known for the extreme "cases" of land cover change. In general, previous studies indicated that tropical afforestation attenuates warming through increasing evapotranspiration, while boreal afforestation exacerbates warming through decreasing albedo. We can hypothesize that the enhanced vegetation growth in boreal regions will induce a warming, just as afforestation does. Evidences from remote sensing products show that the Earth is becoming greener during the past three decades. Biophysical feedbacks caused by LAI trends should be less extreme and more widespread than those extreme land cover change cases, have not been quantified to date. We designed and conducted the ensemble simulations with ACME land-atmosphere coupled mode to investigate the responses of climate to changes in LAI during the last 30 years




The trend of Leaf area index (LAI) for the past three decades (1982-2011)

## Approach

### Experimental Design

**Model : ACME V0 land –atmosphere coupled mode**

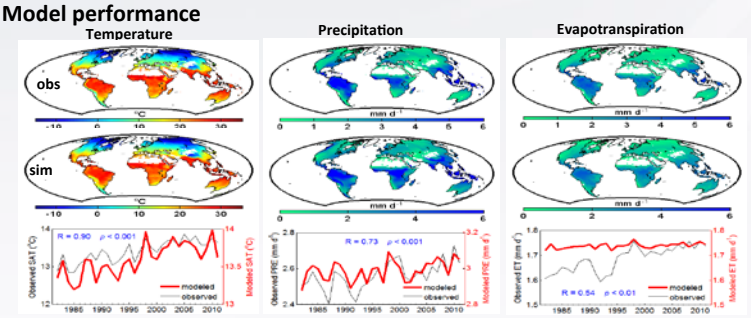
**Simulation period: 1982-2011; Resolution: 2 degree**

Model spinup is driven by SST climatology, LAI climatology and fixed atmospheric $CO_2$ (the value at 1982). When the equilibrium is met, the control simulation continued to another 30 years to generate the different initial conditions. There are 30 members for each ensemble simulation (S1, S2 and S3), and each simulation has 30 model years.

| Experiment | LAI | SST | $CO_2$ |
|---|---|---|---|
| CTRL | Climatology | Climatology | Constant |
| S1 | Climatology | Transient | Transient |
| S2 | Transient | Transient | Transient |
| S3 | Transient | Climatology | Constant |

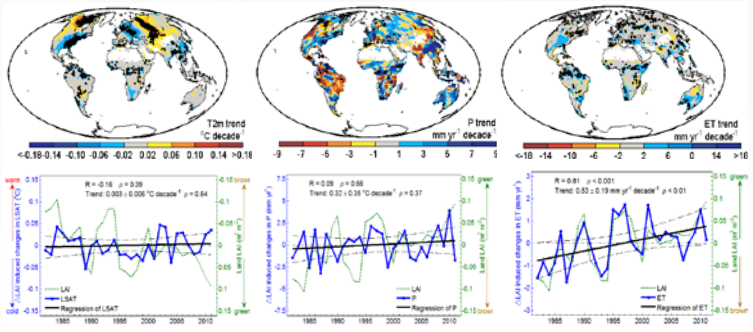
## Initial Results

### Model performance




The comparison of selected climatic variables for the past three decades

### Climate effect




The trend of selected climatic variables for the past three decades

The ratio of transpiration + canopy evaporation to evapotranspiration

| model | CLM4C | CLM4CN | ORCHIDEE | ALM45SP |
|---|---|---|---|---|
| ratio | 77% | 77% | 87% | 39% |

### Summary

- ACME land-atmosphere coupled model can reproduce the spatial pattern and the variability of temperature and precipitation quite well, but not for ET variability
- The Earth's land surface is becoming greener, and this greening induces increases of global ET and atmospheric precipitable water, and then cause P change, but very slight impact on global averaged air temperature.
- The simulated smaller variability and weaker trend of ET could be related to the incorrect partitioning of ET

Oak Ridge National Lab.
(865) 241-9199
shix@ornl.gov

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