Biophysics, Spatial Extent, and Interannual Variability of the Transition Forest (Cerradão).

CMMAP Team Meeting, Fort Collins CO, 3-5 August, 2010

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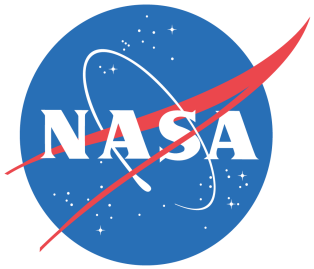

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American Geophysical Union Meeting of the Americas
Foz do Iguassu, Brazil, 8-12 August, 2010

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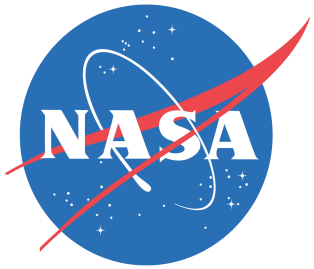
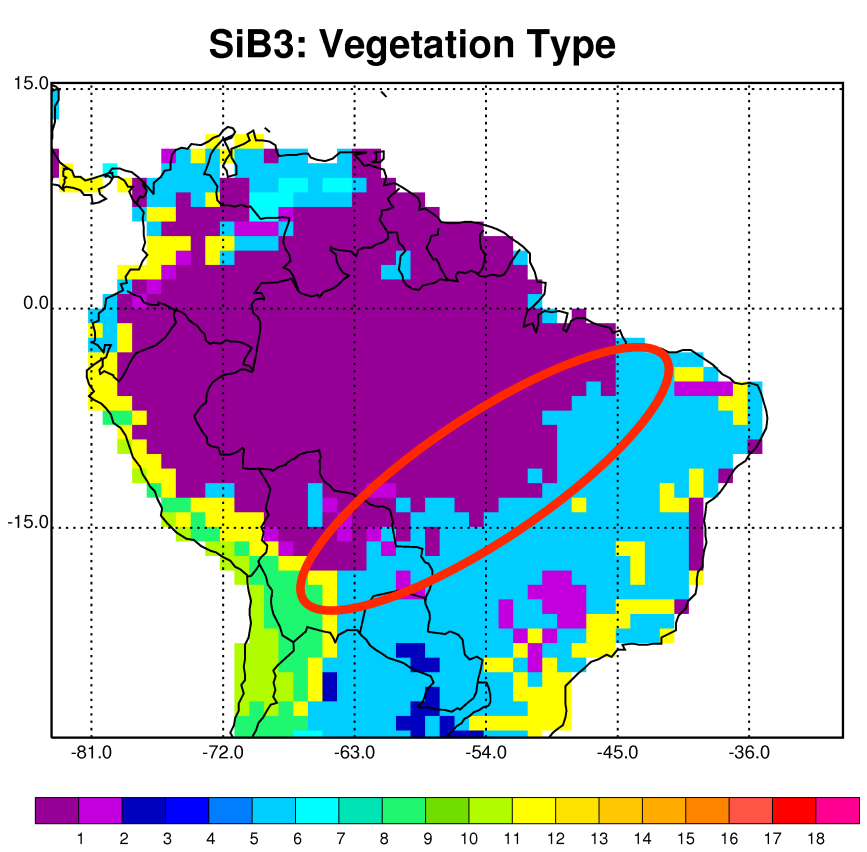


TRANSITION FOREST

- Boundary (forest-savanna)
  - Gradient
    - Transpiration
    - Roughness
    - Carbon flux
  - Bidirectional influence between land-atmosphere
  - Ideal Testbed for MMF

Transitions and Boundaries

- Tropical Forest/Mata Seca/Cerrado



- Ecotone Between Forest and Cerrado (Eiten 1972, Ackerly 1989)

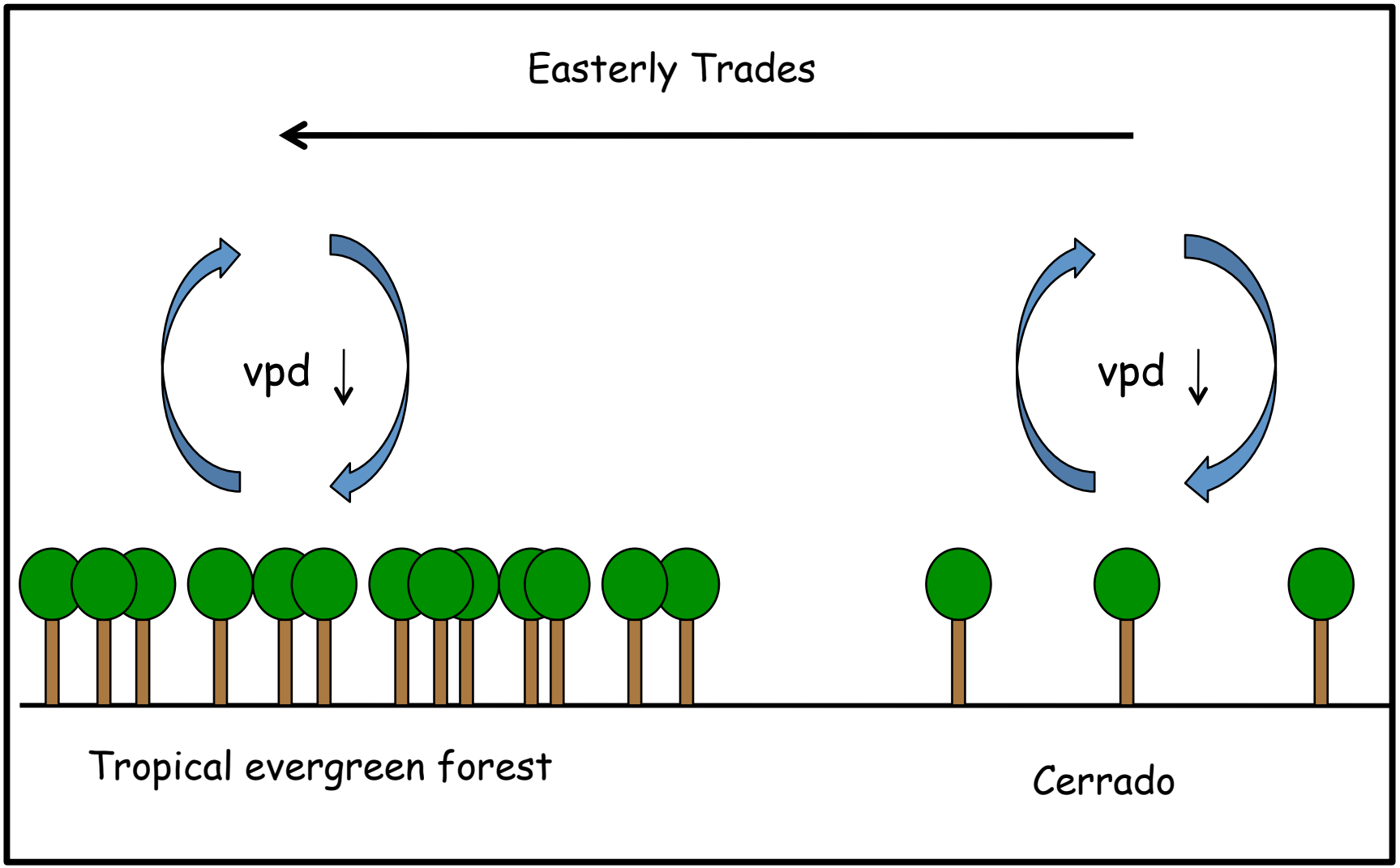
- Transition
  - Combination of Forest/ Cerrado Vegetation
  - Transition Vegetation

- Anthropogenic Influence (LCLUC)

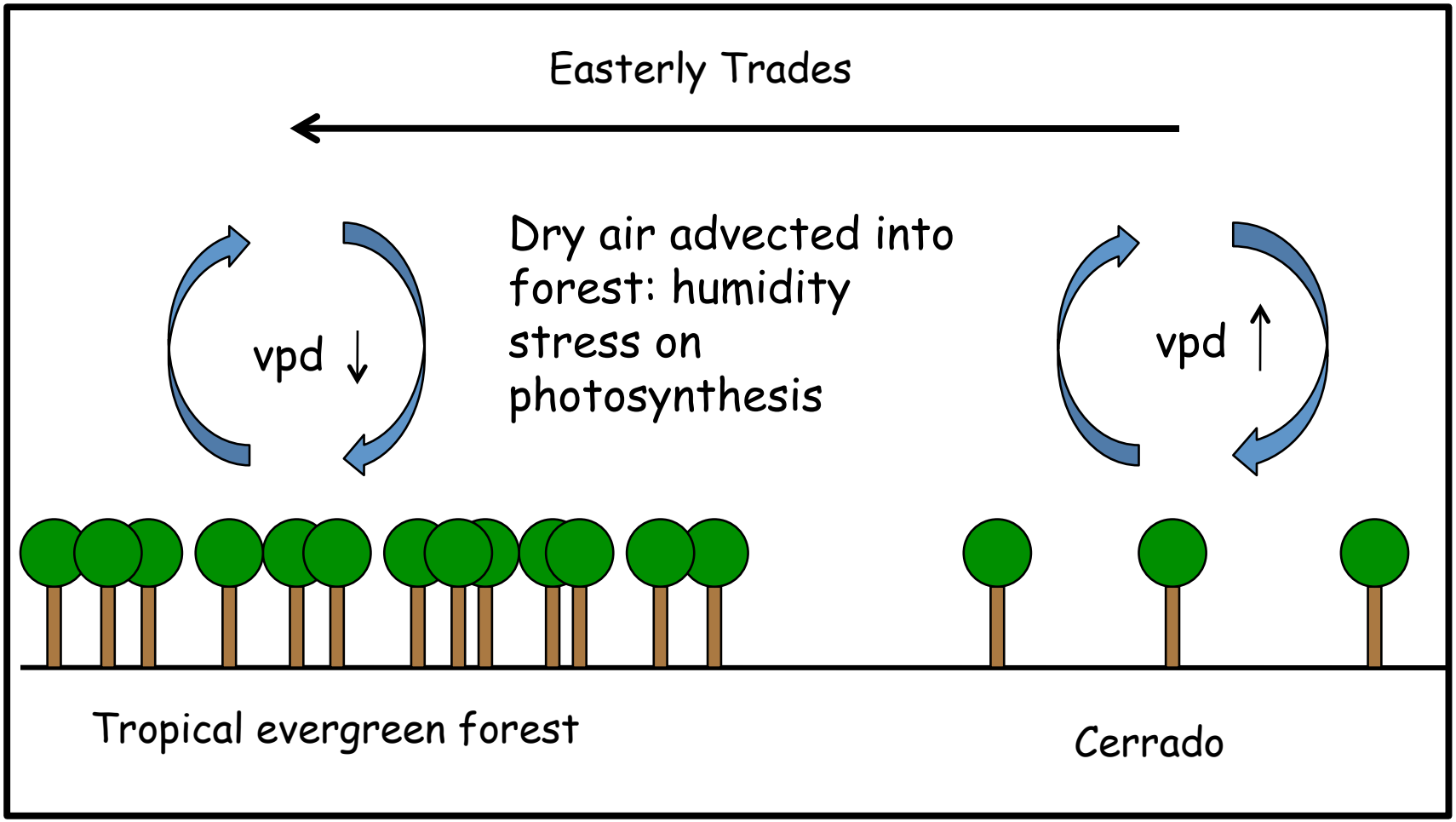
Transition Forest

- Observations *(Vourlitis 2001, 2002, 2004, 2005, 2008)*
  - Carbon Flux:
    - Correlated with water availability
    - Dry Season: in balance
    - Wet Season: net sink
    - Transition Season (dry-to-wet): net source
    - Seasonal trend driven by precipitation and humidity
  - Latent Heat Flux: Correlated with Precipitation

Transition Forest: Conceptual Model (wet season)



Transition Forest: Conceptual Model (dry season)

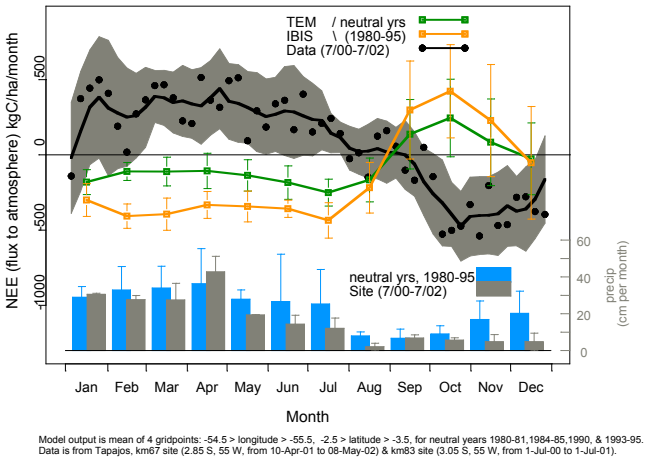


Questions

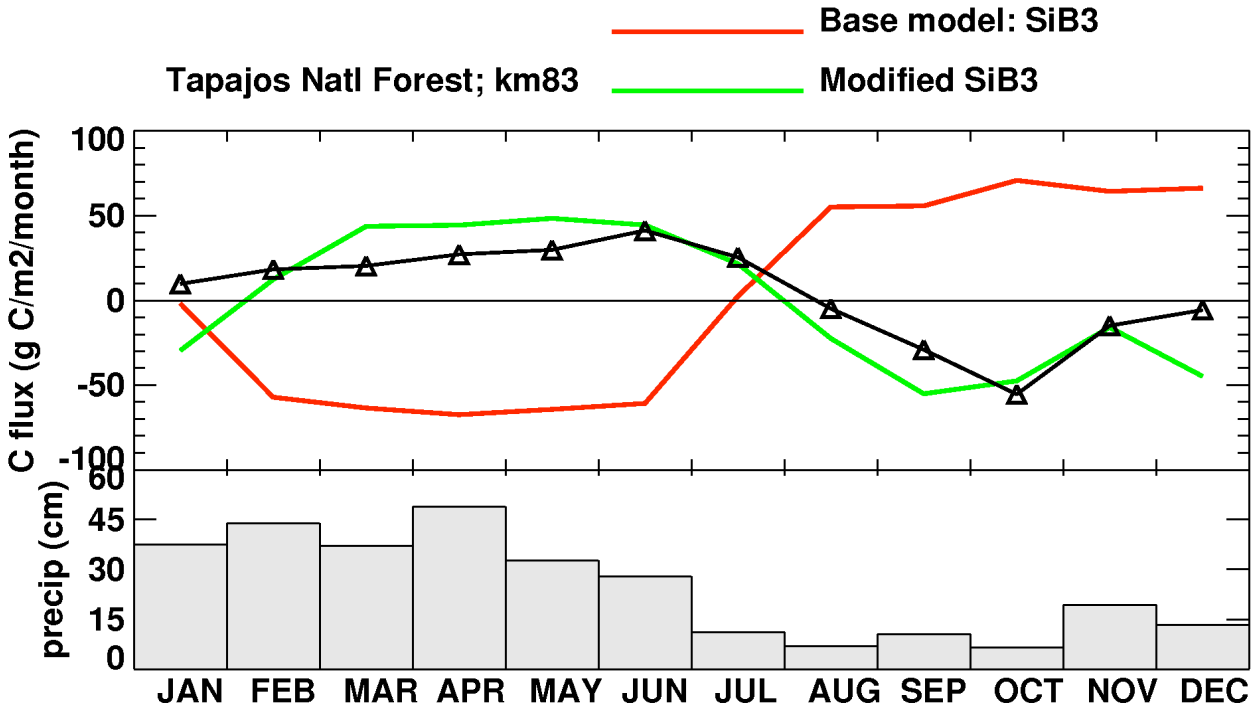
- Can we simulate characteristics of the Transition Forest (TF)?
- Can we use these characteristics to define the spatial extent of the Transition Forest?
- Do we have the tools to perform this analysis?

Method

- Demonstrated Ability to Simulate Surface Behavior at Tower Sites



Saleska et al, 2003, Science



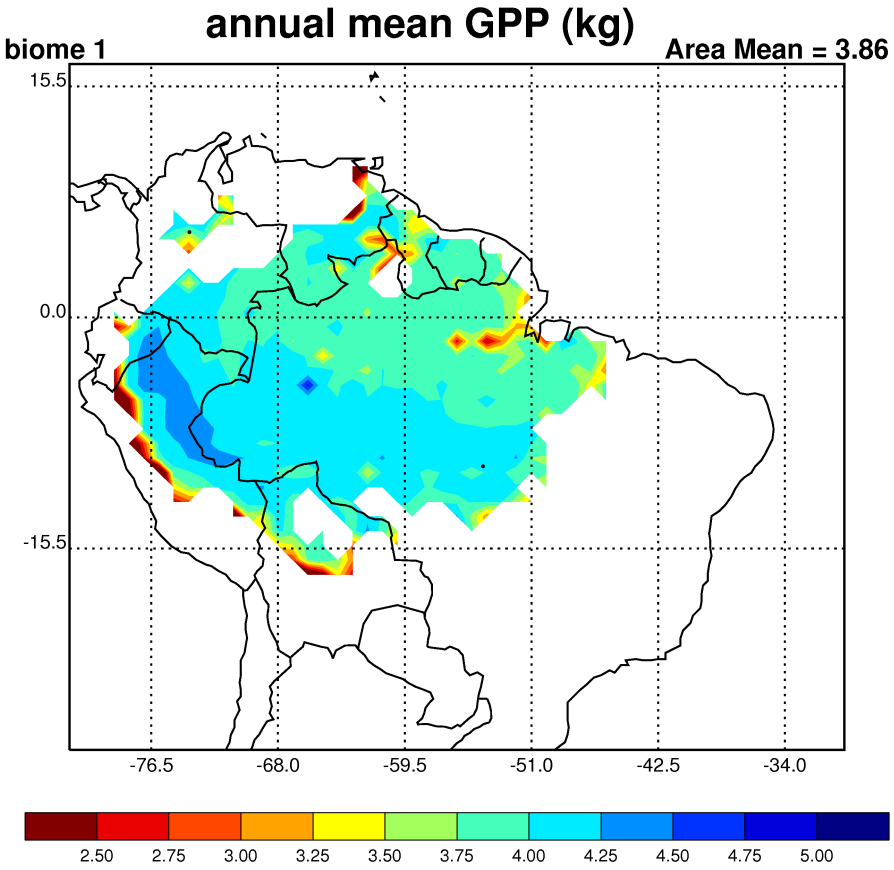
Baker et al., 2008, JGR

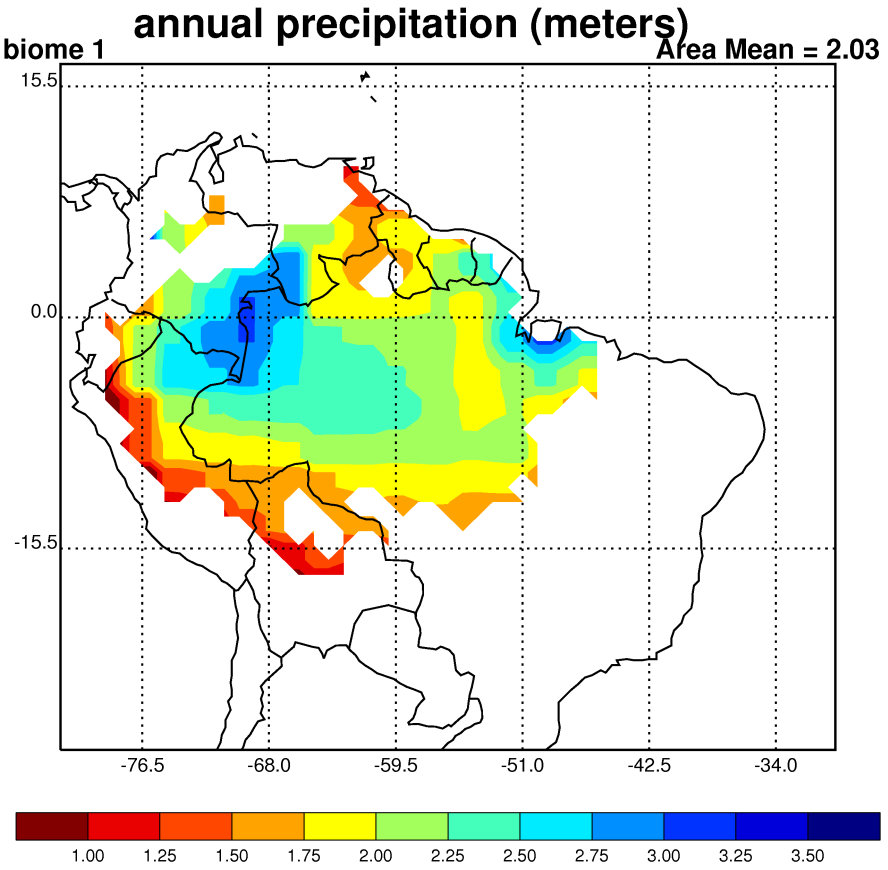
Method

- Regional Model Simulations
  - Offline (non-coupled) simulation
  - SiB3 *(Sellers 1986, 1996ab, Baker 2003, 2008, 2009)*
  - 1x1 Degree Grid Resolution
  - 1983-2006
  - NCEP2 Meteorology *(Kalnay 1996, Kanamitsu 2002, Zhao 2006, Zhang 2007)*
  - GPCP Precipitation *(Adler 2003)*
  - GIMMSg NDVI Phenology *(Tucker 2005, Brown 2004, Pinzon 2006)*

SiB3 Model Runs

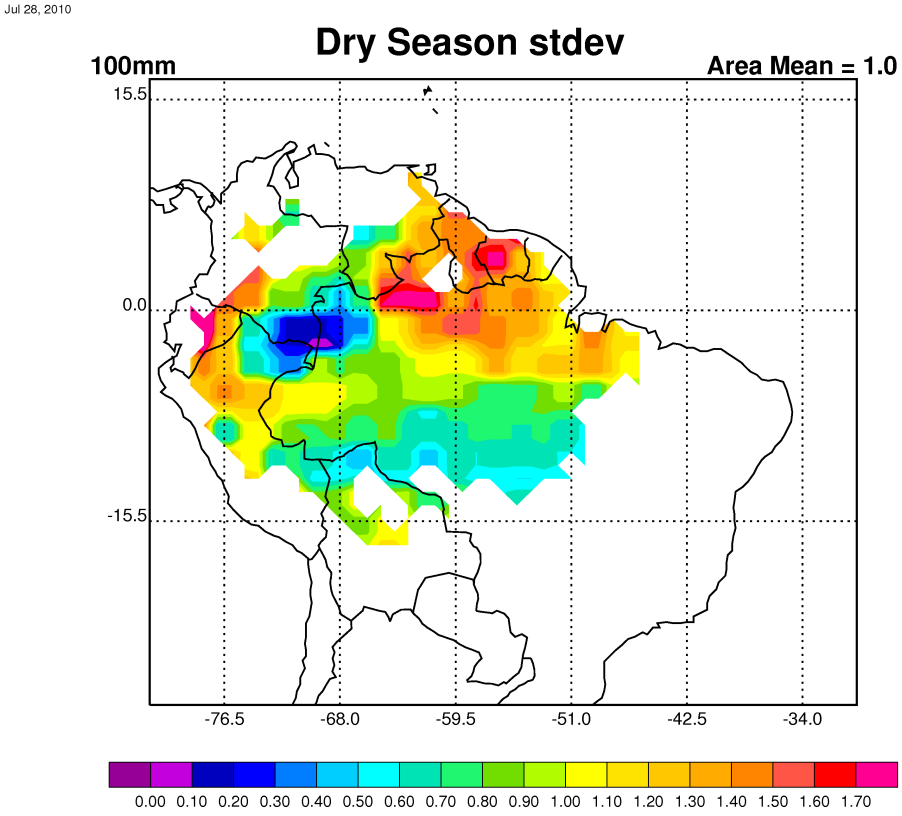
Jul 19, 2010

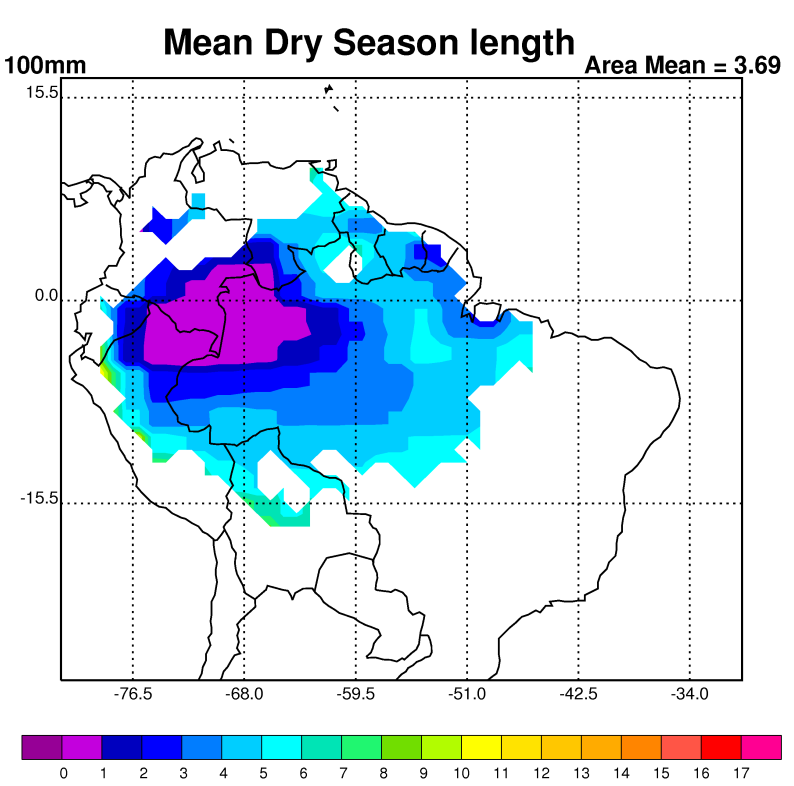


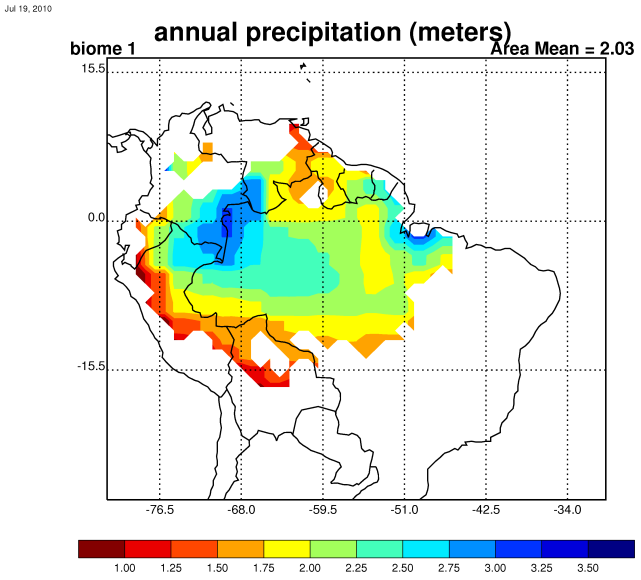


Shown: Evergreen Broadleaf Forest (EBF) only

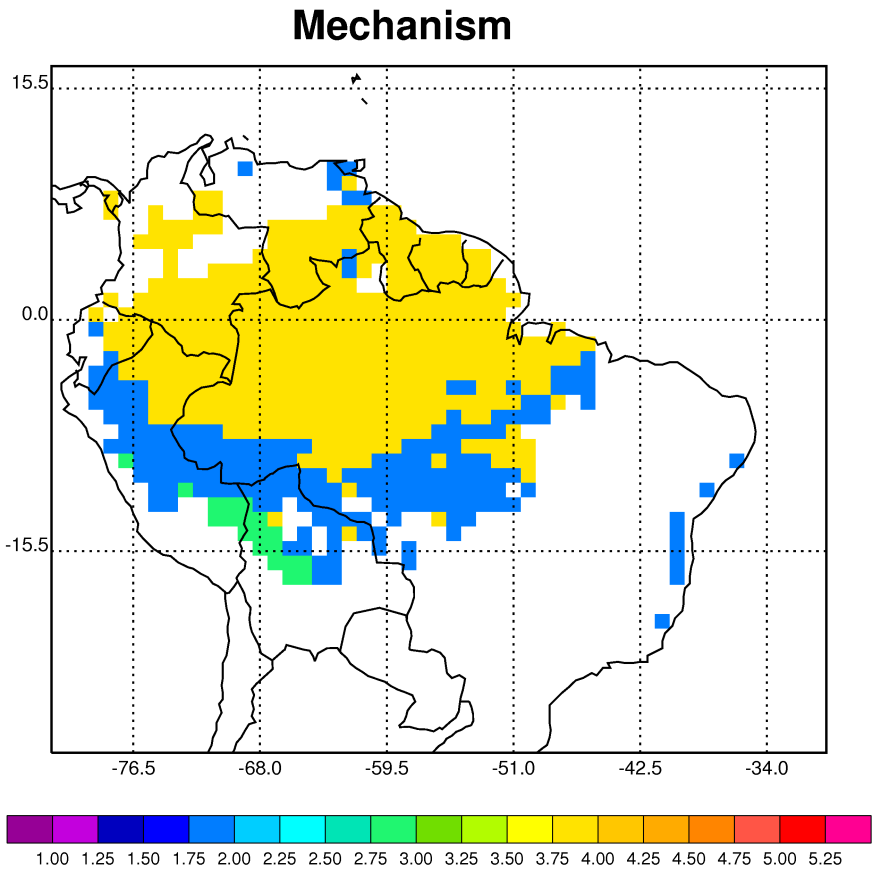
Seasonal Drought

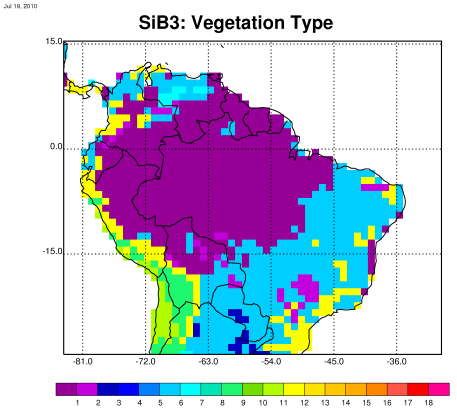


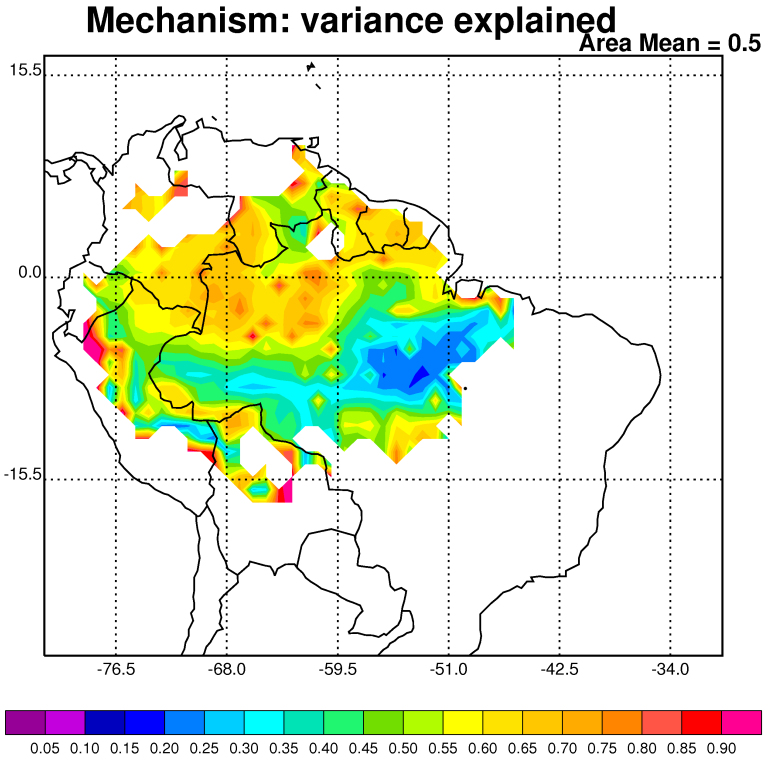




GPP Variability



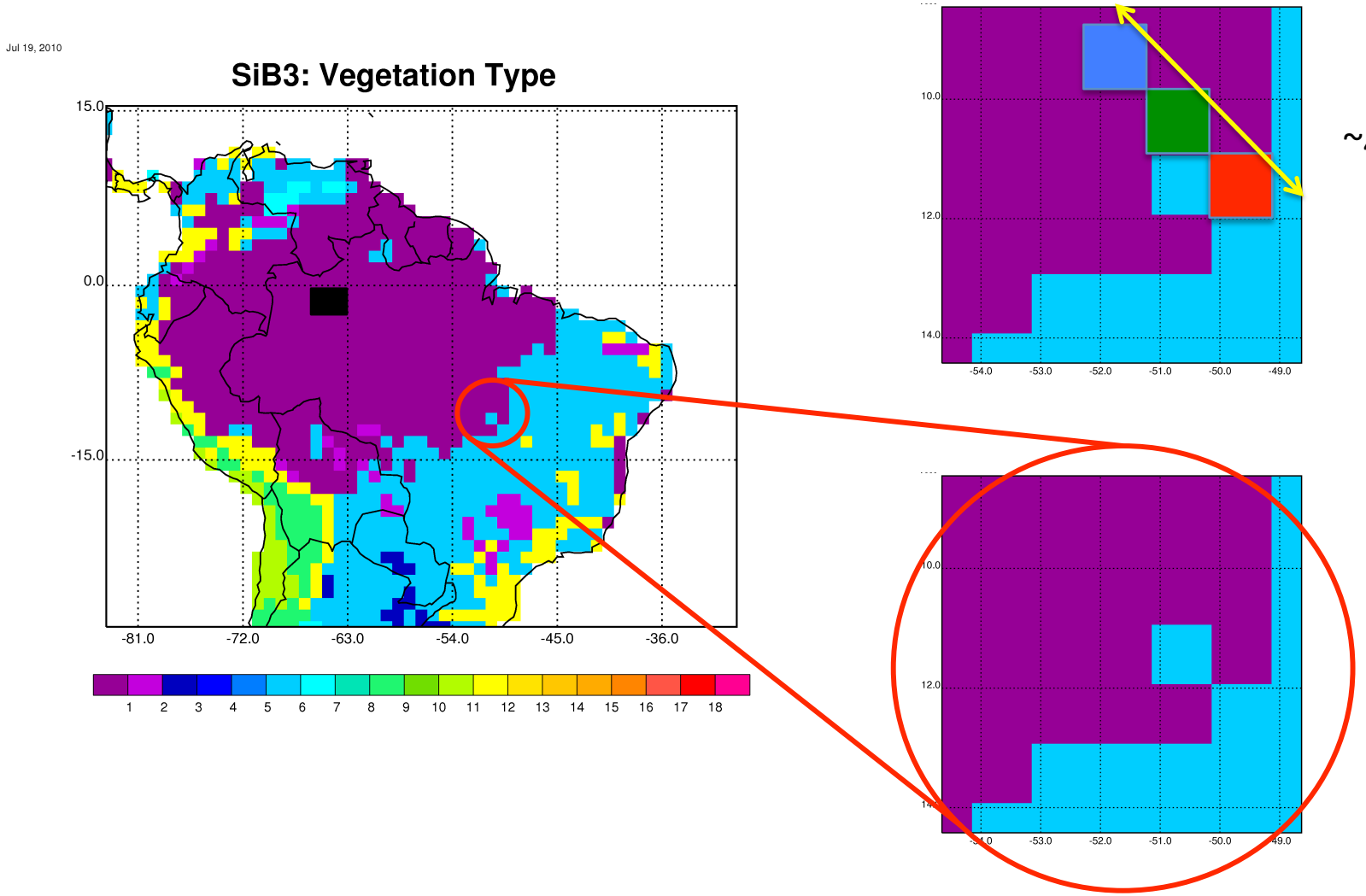


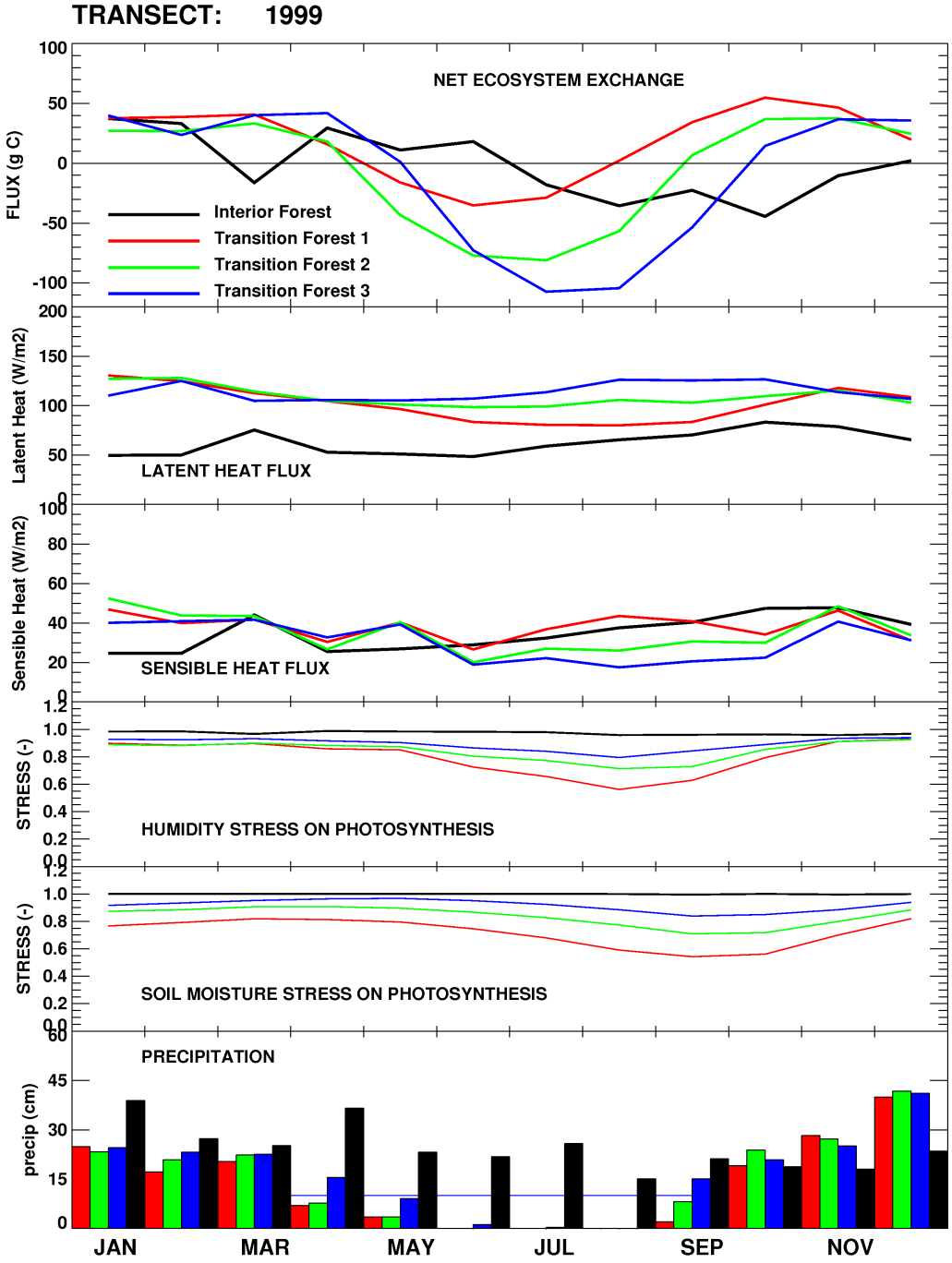


- Interior Forest: Variability Driven by radiation, explains a large fraction of total variance

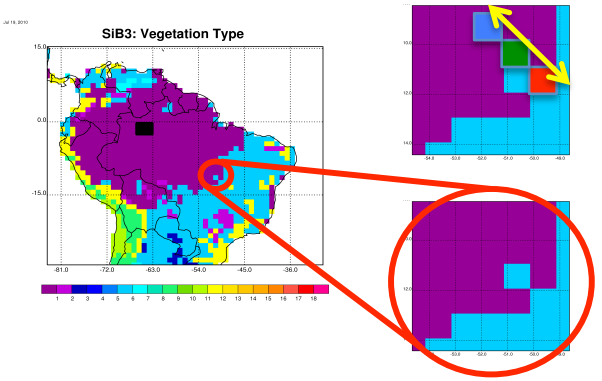
- Southern/Eastern Edge: Water Availability explains the most variability, but a smaller fraction of the total

Annual Cycles: Interior Forest vs. Cerradão





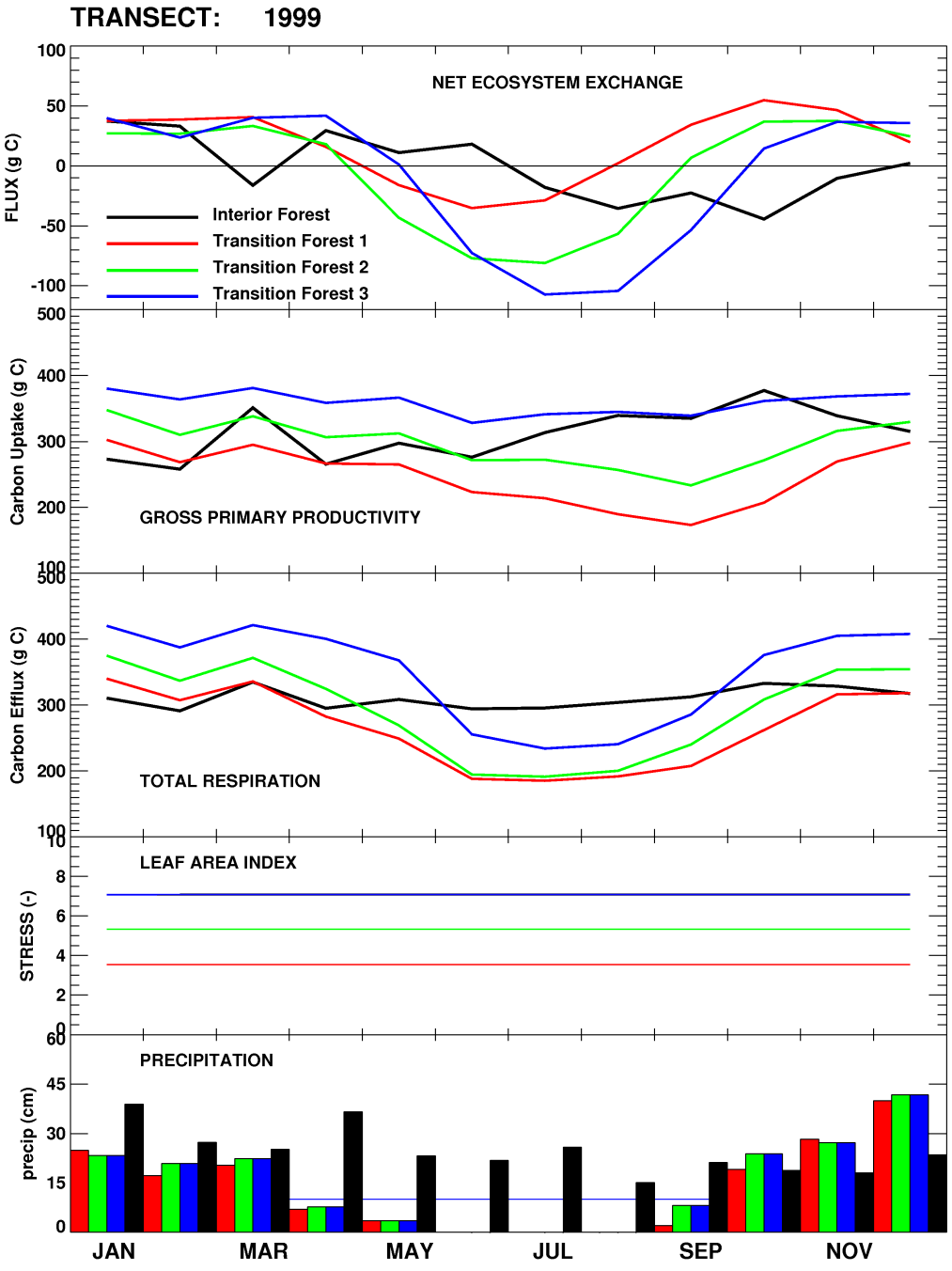
Annual Cycle: Interior Forest vs. Cerradão



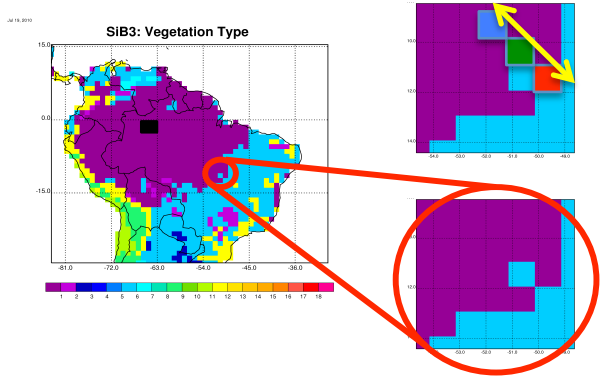
- Carbon Flux: Does not follow Vourlitis; Some resemblance at TF1

- Latent Heat: TF1 correlated with Precip; others, not

- Humidity Stress: Decreases into Forest



Annual Cycle: Interior Forest vs. Cerradão



- LAI: Increases into Forest, no Seasonality
- GPP: Dry Season Impact at TF1, TF2, not at TF3 or Interior
- Respiration: Coupled to Precipitation and Near-Surface Soil Moisture

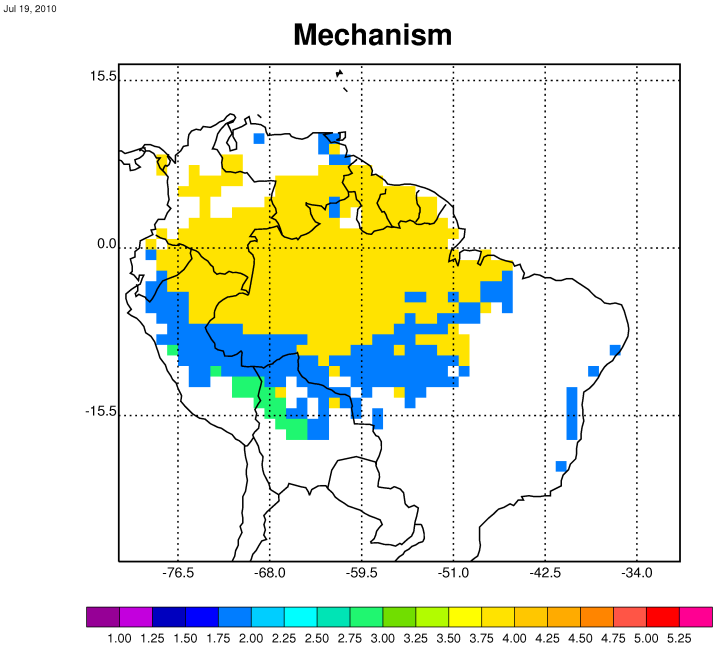
Conclusions

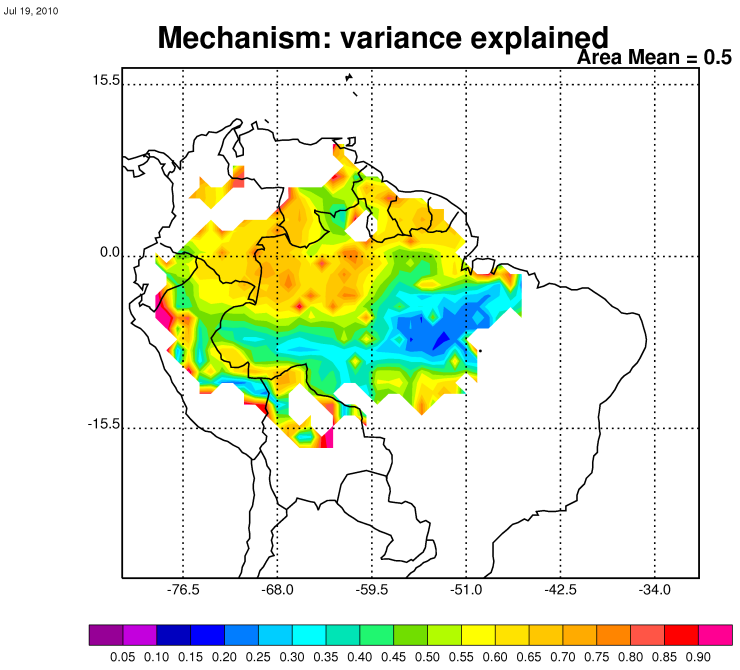
- Intent:
  - Mechanisms in current model version could capture edge behavior
  - Meteorological differences, captured by NCEP
  - NDVI
- Reality:
  - Modeled Carbon Flux is inconsistent w/ Obs
  - Some semblance to observed:
    - Humidity stress
    - LE cycles
  - One single year shown; not all years behave this way, most are not this good

More Conclusions

- Cannot use Mechanism alone to describe TF boundary
  - More mechanisms?
  - Higher resolution?
  - Bidirectional coupling?

- May be able to use Mechanism along with Variance





Still More Conclusions

- Width of Transition Forest is Variable: 1-degree resolution runs may be too coarse to capture this feature

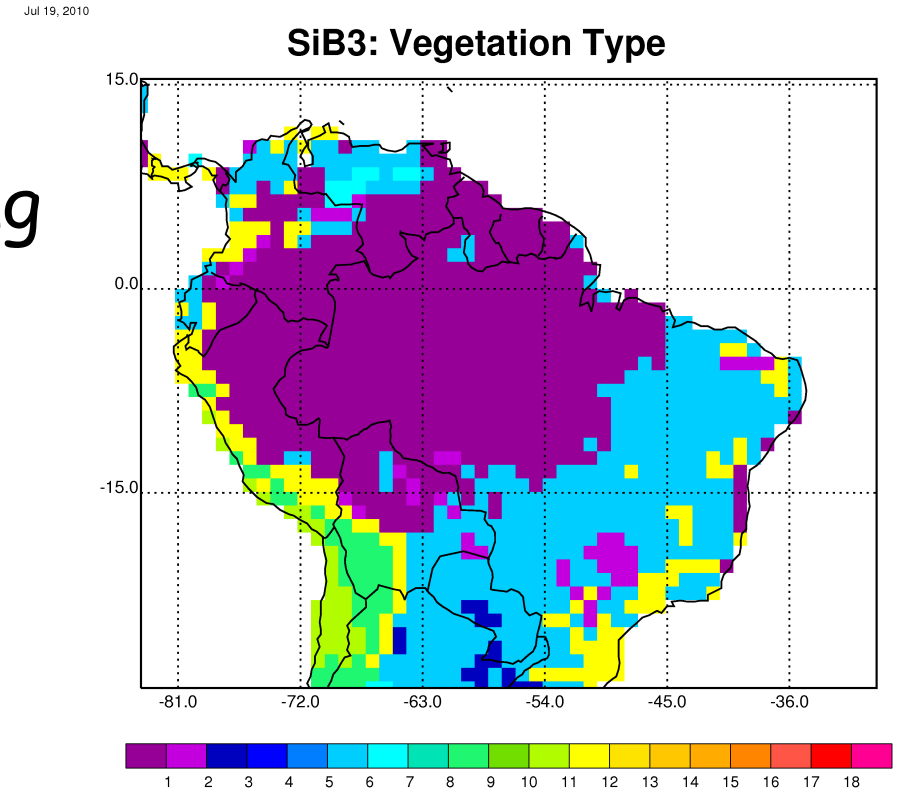
- Current treatment of vegetation is insufficient
  - no seasonality for any vegetation classified as tropical forest
  - Vegetation Parameters in the model (i.e. Vmax)

What Now?

- Identify components, change model
  - Vegetation
    - Seasonality
    - Characteristics
    - Roots
- Transition, or 'Edge' areas require understanding if changing climatic forcing is changing
- More complete understanding of the present can only help predictions of future climate

MMF

- TF is ideal candidate for MMF tests
  - Heterogeneity mainly in vegetation gradient
  - Topography
  - Cyclic BC?
  - Surface-atm coupling
    - 'Preconditioning'
    - SA MJO?



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