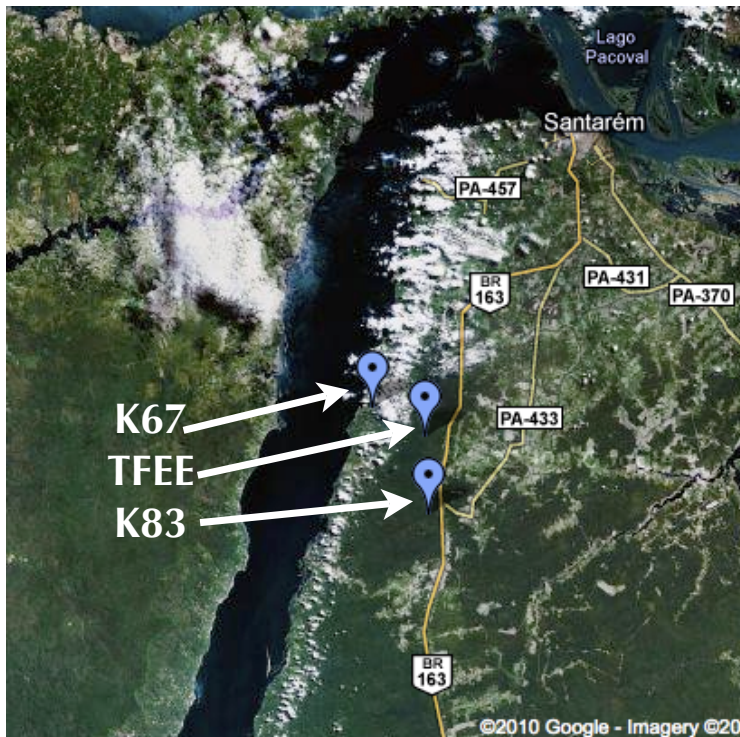# Lessons learned from modeling an artificial drought in the Amazon

Anna Harper
CMMAP Team Meeting, Jan. 2011

Tapajos Forest Exclusion Experiment (TFEE)

- Panels used to divert rainfall from forest floor.

- 50-60% of rainfall was diverted from 2000-2004

- Used observations from K83 tower (2001-2003) to drive SiB3, reduced rain by 60% during wet seasons

How would the Amazon respond to increased drought in the future? How resilient is this ecosystem?

We've spent a few years and many brain cells trying to decrease seasonal drought stress in the Amazon.

1. Did we do too good of a job? (Does the forest still stress when it should?)

2. What are some areas for improvement?

3. Can SiB be used to detect thresholds in ecosystem resilience?
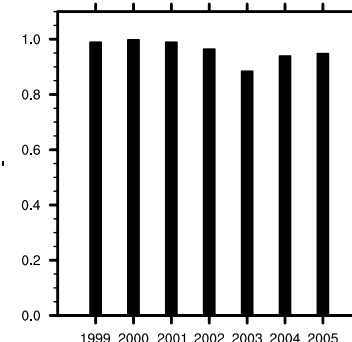
SiB drought response

- SiB overestimates effect of drought on E & ANPP initially but also received less precipitation.

- True response depended on tree size, species, and position in canopy. SiB doesn't differentiate between trees in the grid cell.
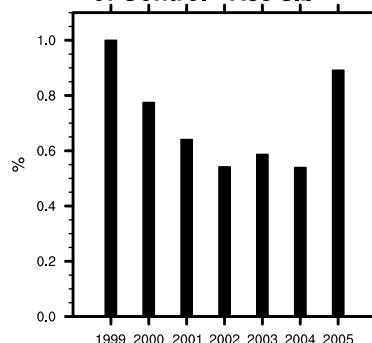
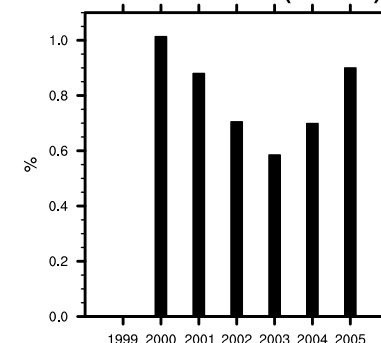**Tmnt Evaporation as fraction of control - K83 SiB**
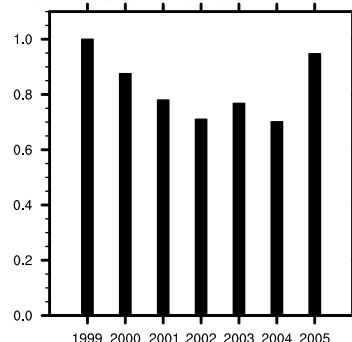
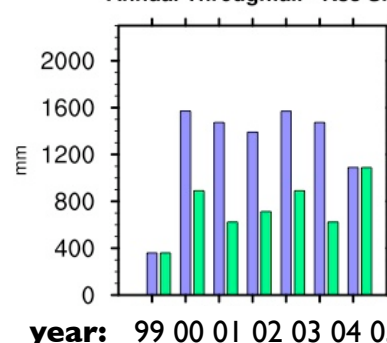**Tmnt Evaporation as fraction of control - M2010**

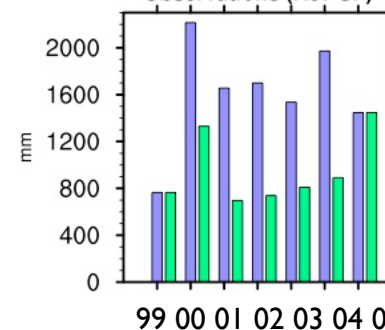**Tmnt ANPP as fraction of Control - K83 sib**

Tmnt ANPP as fraction of Control - Obs (K67 SF)

Annual Throughfall - K83 SiB

Annual Throughfall Observations (K67 SF)

year: 99 00 01 02 03 04 05   99 00 01 02 03 04 05
*1999 only May-Dec throughfall shown, 2005 only Jan-Aug throughfall

Predicted soil moisture

- In the top 3.5 m SiB isn't using enough of the soil moisture.

- Unrealistic wilt point in SiB? - related to porosity, soil texture parameters

- Do the trees have enough access to available water? (ie: root fraction with depth)
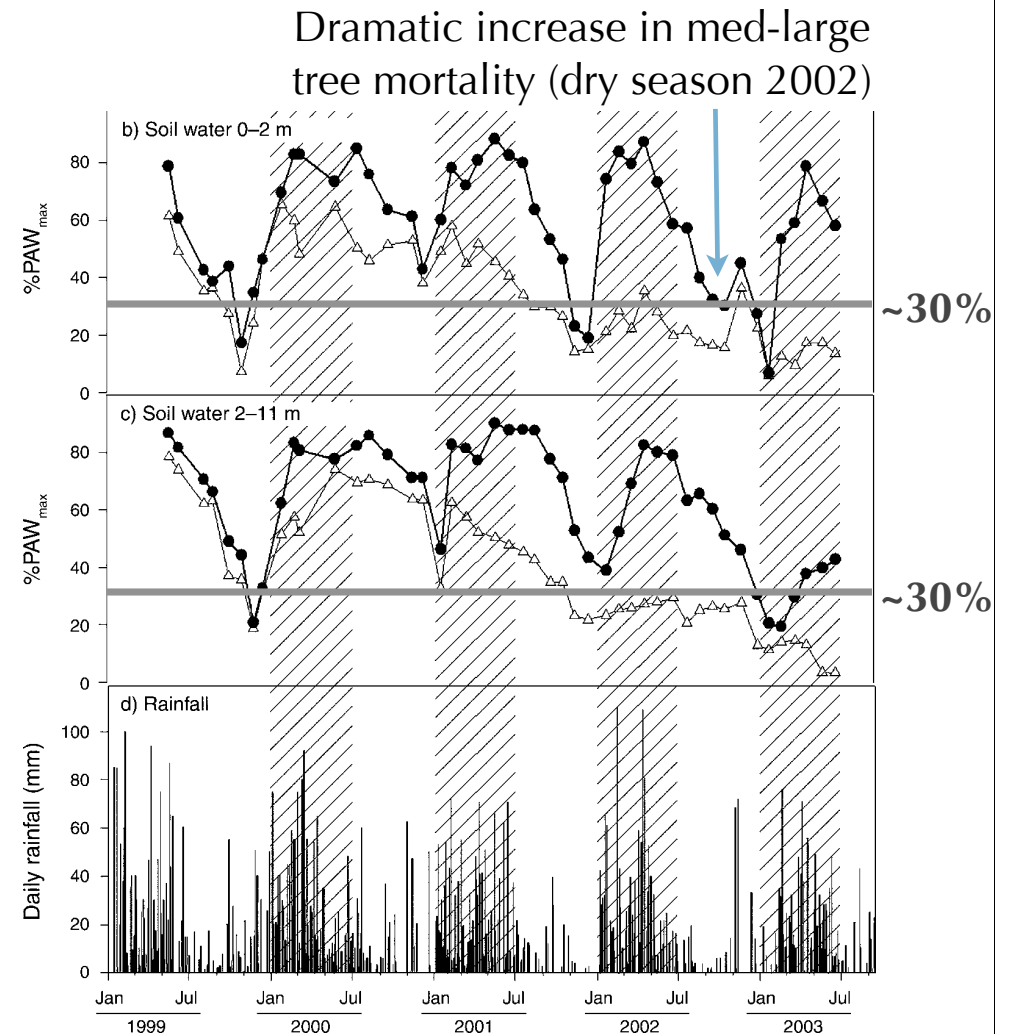

Soil Moisture for Treatment Plot
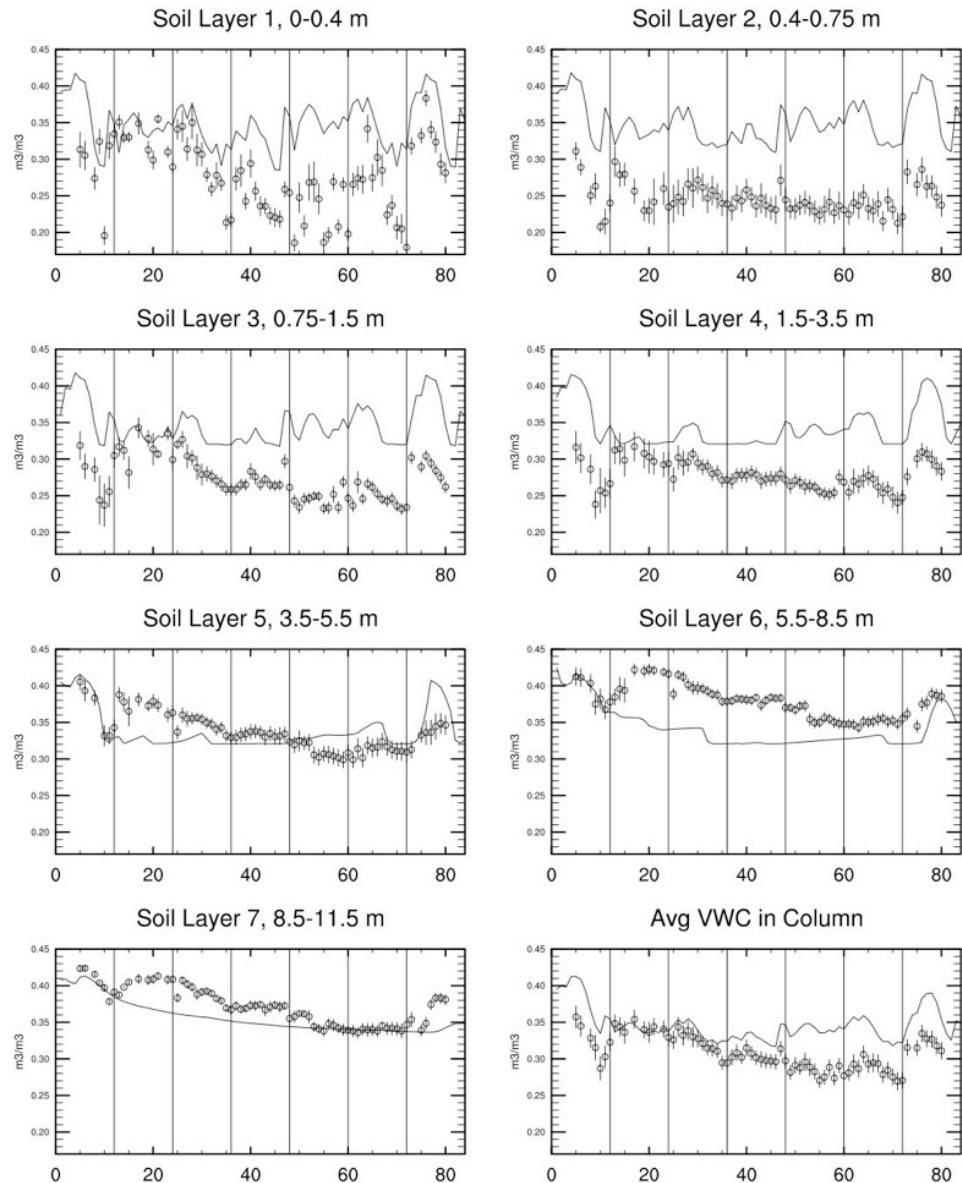
Line = SiB, Circles = observations (w/ std deviation)
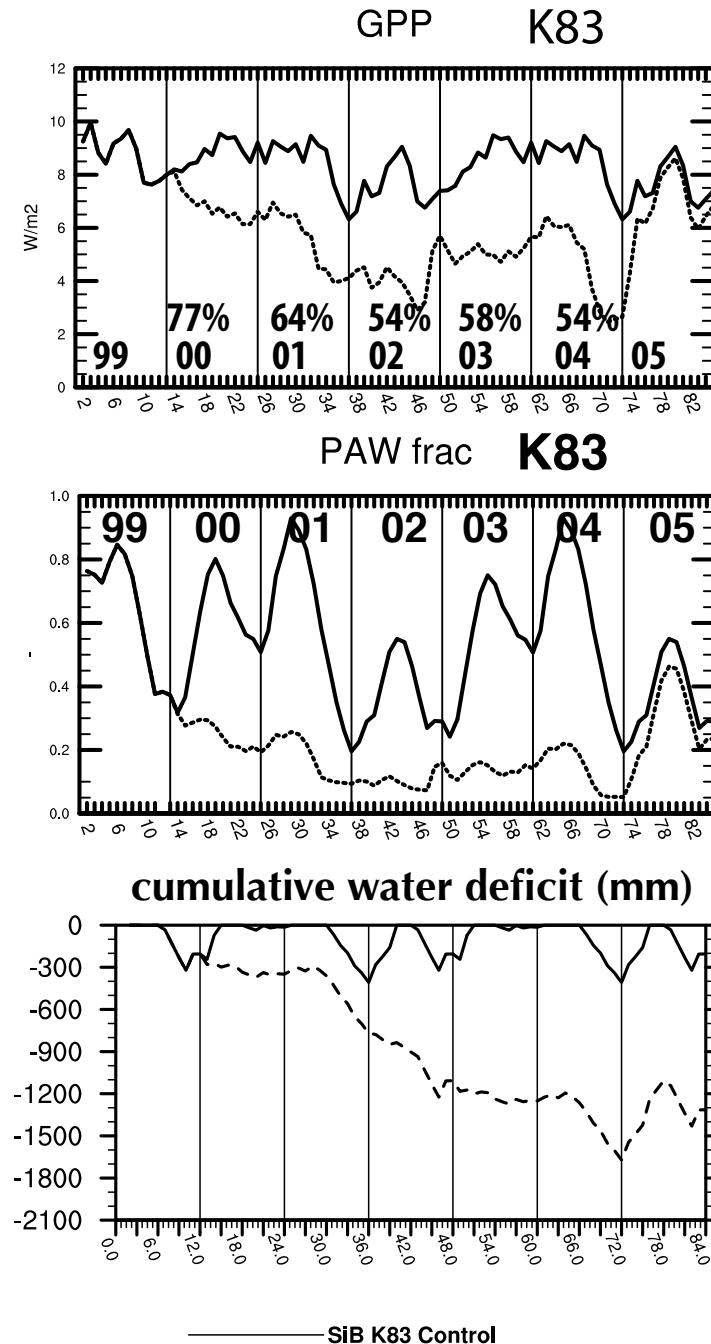
Defining thresholds in resilience

- Plotted: % of maximum plant available water (PAW)

- Observed threshold occurred in Nov. 2002, after PAW was only 30% of its maximum value for over a year.

Dramatic increase in med-large tree mortality (dry season 2002)

From Nepstad et al. 2007

Thresholds in SiB

- Initial decrease in GPP related to PAW: never recovers after first dry season

- 10% drop in GPP in 2001 related to strong increase in water deficit (accumulated P-E)

- Forest shifts from light-limited to water-limited during drought

GPP   K83

77%   64%   54%   58%   54%
99   00   01   02   03   04   05

PAW frac   **K83**

99   00   01   02   03   04   05

cumulative water deficit (mm)

SiB K83 Control

1. Did we do too good of a job? (Does the forest still stress when it should?)

A: The forest stresses after 1 year of decreased rainfall - maybe too soon.

2. What are some areas for improvement?

A: Tiling ... Soil moisture parameters ...

3. Can SiB be used to detect thresholds in ecosystem resilience?

A: Yes, plant available water and water deficit