

# Radiation Variability and Ecosystem Behavior at Two Forest Sites in Brazil

I.T. Baker<sup>1</sup>, A.B. Harper<sup>1</sup>, J.A. Berry<sup>2</sup>, A.S. Denning<sup>1</sup>

## Tower Pls:

K83: M.L. Goulden, S.D. Miller, H.R. da Rocha

K67: S.C. Wofsy, S.R. Saleska, P.B. de Camargo

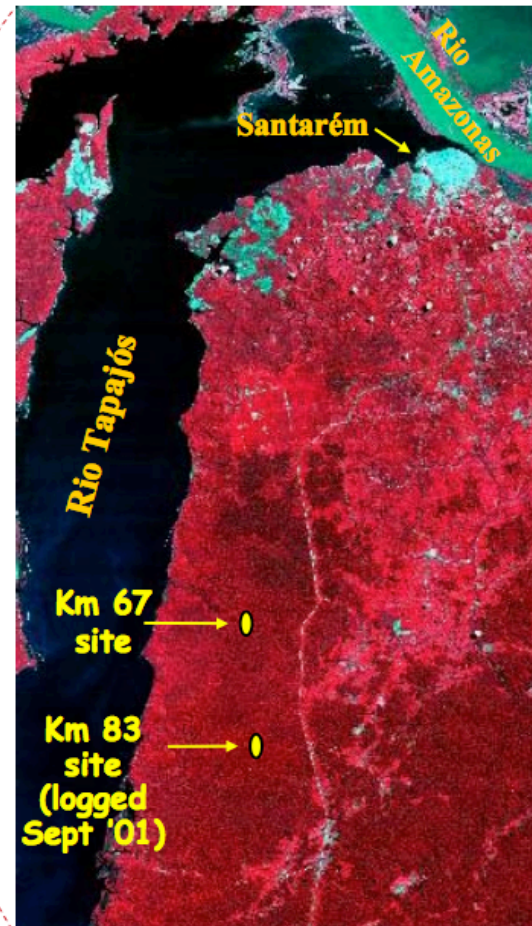
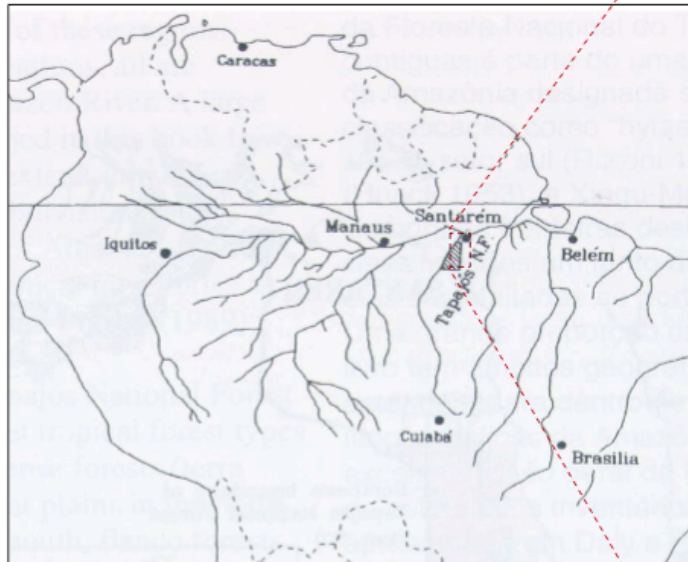
And the **LBA-DMIP** Modeling Teams

1: Atmospheric Science Department, Colorado State University [Corresponding author: baker@atmos.colostate.edu](mailto:baker@atmos.colostate.edu)

2: Department of Global Ecology, Carnegie Institution for Science

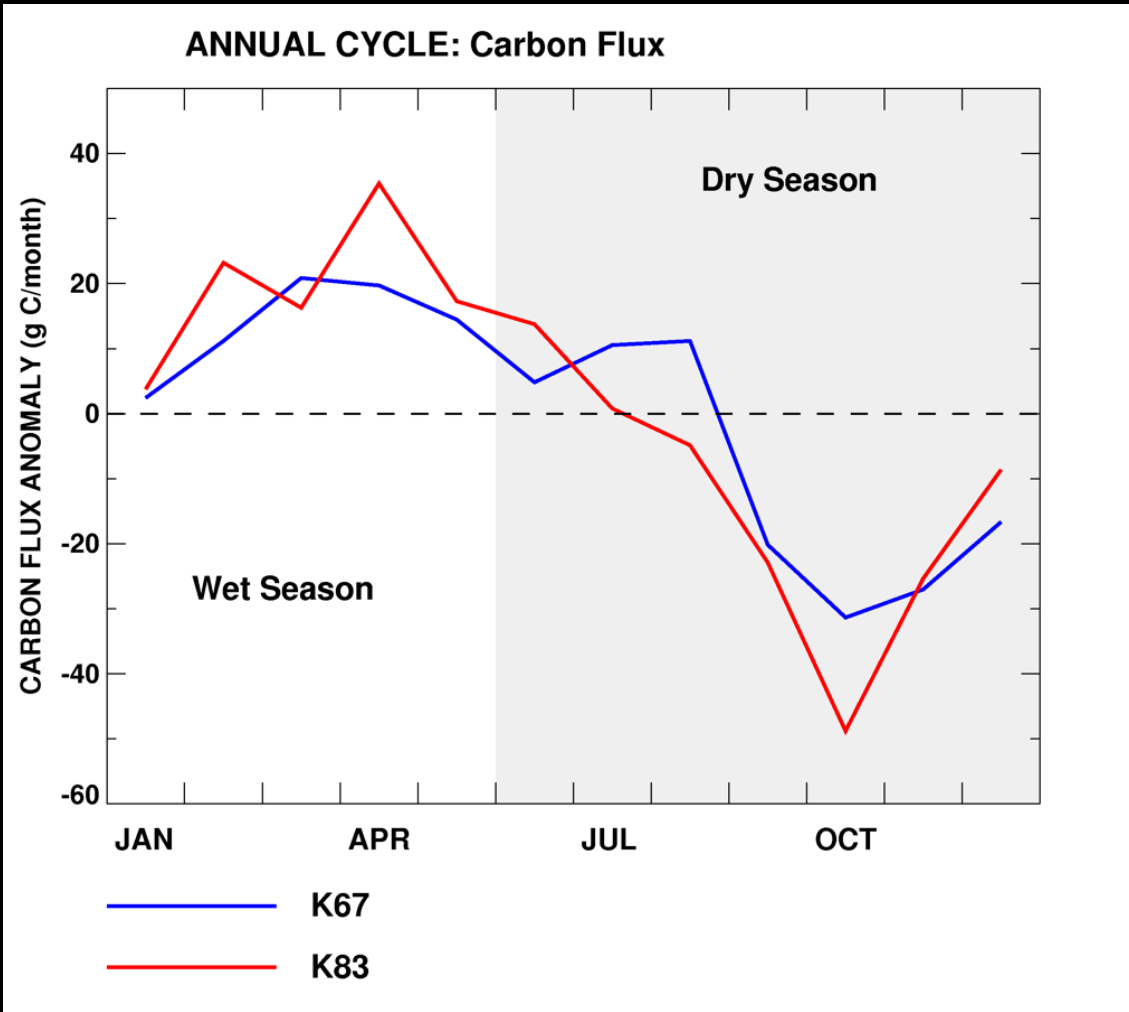
# Location

**Fig. S1.** Locations of Km 67 and Km 83 study sites in the Tapajós National Forest, in Para, Brazil.



Convention:  
K67 = Blue  
K83 = Red

# Carbon Flux



- Plot: Anomalies around annual mean carbon flux

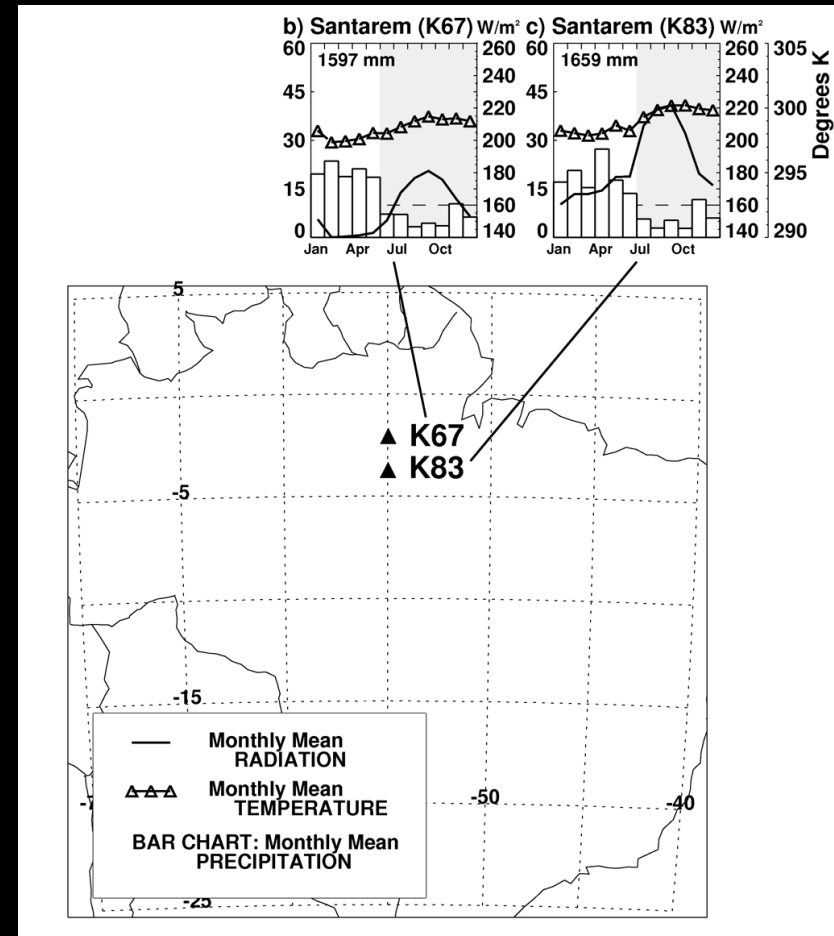
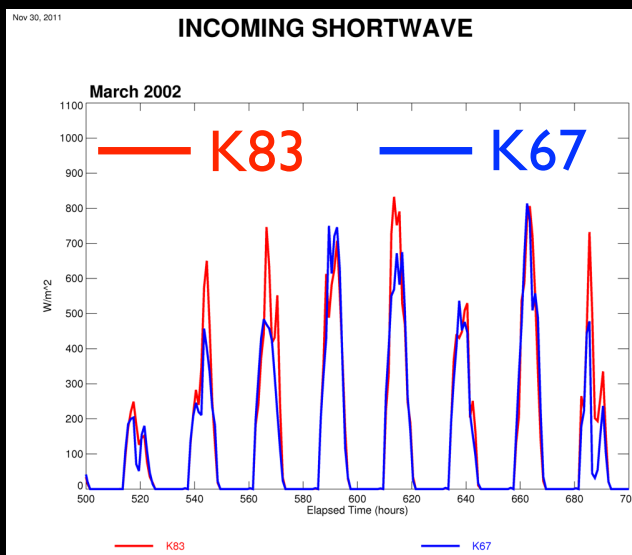
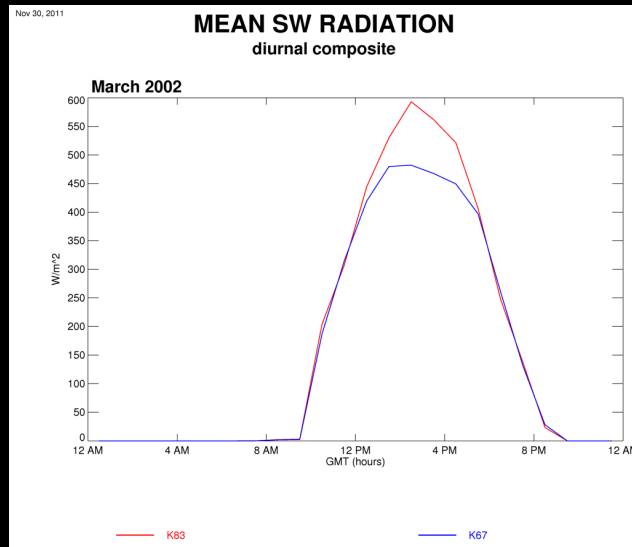
- Positive = efflux into atmosphere

- Negative = uptake by surface

- K67 and K83 sites have been combined for analysis in previous studies (Saleska et al., 2003, Costa et al., 2010)

- Selective logging at K83: minimal importance for carbon and energy exchange (Miller et al., 2011)

# Radiation



- ~20% less incoming radiation at K67
- K67 insolation reduced at midday (but not all days!)
- Consistent across all months

# What's Going On?

- River Breeze (Silva Dias et al. 2004)
- Convergence line (Lu et al. 2005)
- **K67 is 'shaded' by this quasi-persistent cloud more frequently than K83!**
- Decreased total radiation, larger fraction of diffuse at K67
- K67 cooler, more moist

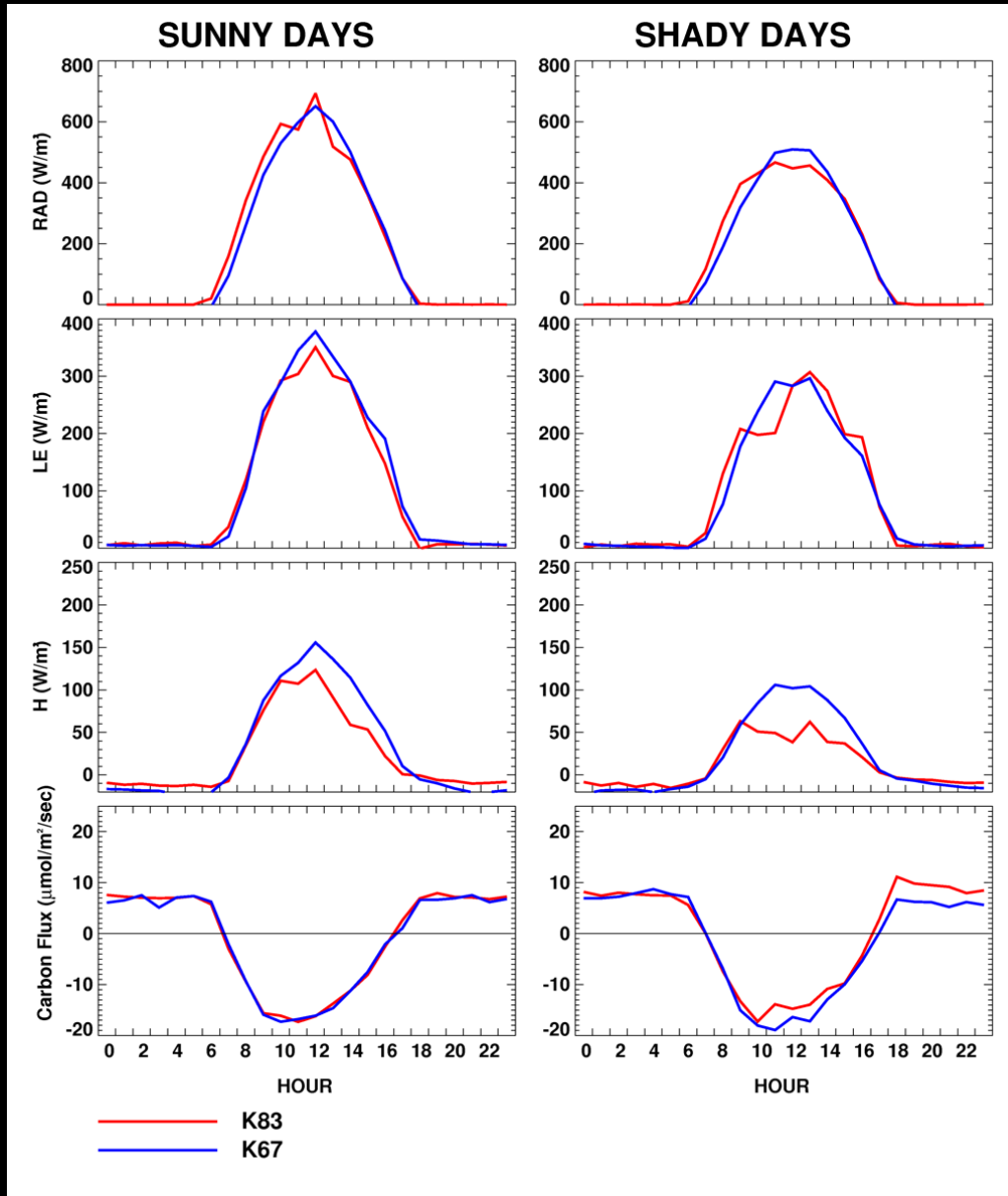


**Figure 9.** Satellite image obtained from LandSat 7 ETM+ scene for path 227 and row 62, on 31 July 2001. It shows that during a clear day, the low-level cumulus clouds favor the east bank of Tapajós River. The image is located at the Web site of Tropical Rain Forest Information Center (TRFIC), which is jointly hosted by LBA-ECO and Michigan State University.

From Lu et al., 2005

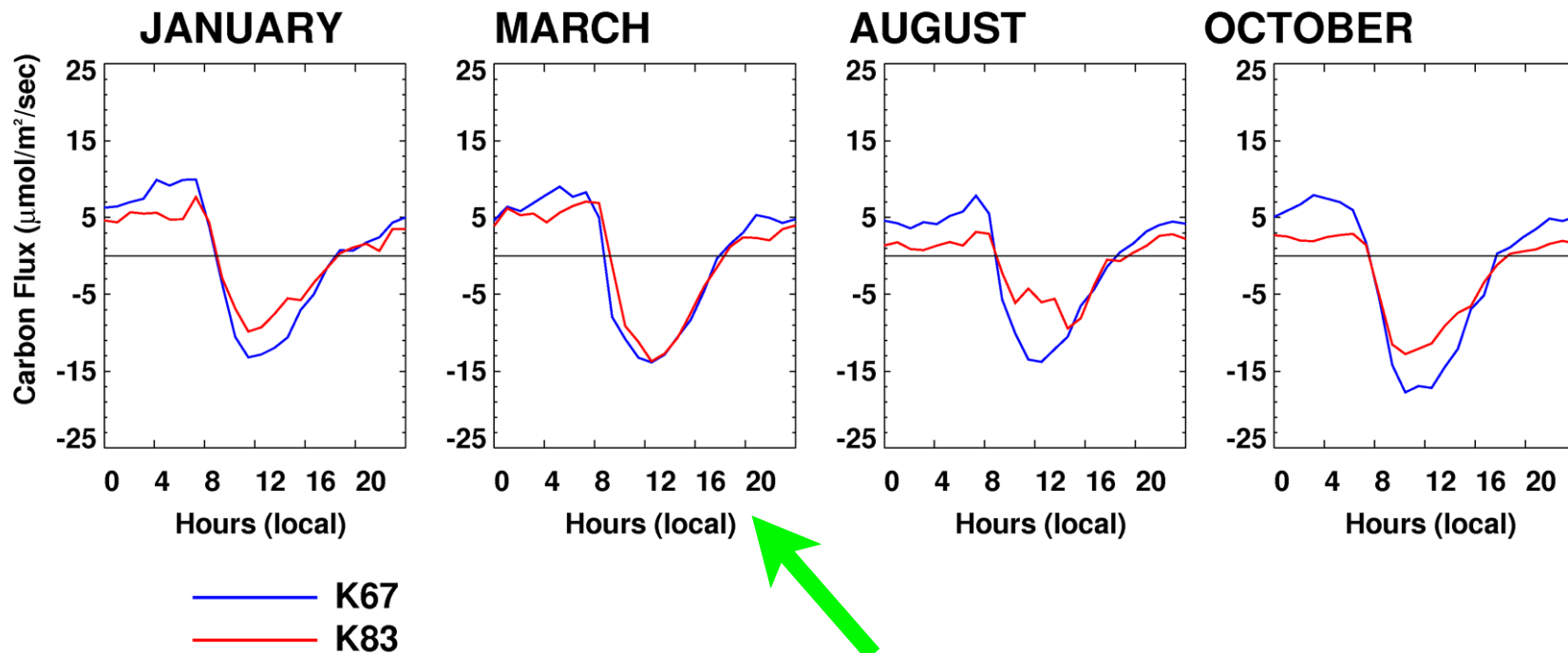
# Are the Sites Fundamentally Different?

- Objectively selected days from 2002-2003 with similar midday radiation at both sites
- Slightly less Sensible Heat at K83
- Latent Heat, Carbon Flux similar
- Sites behave in a consistent fashion when forcing is similar



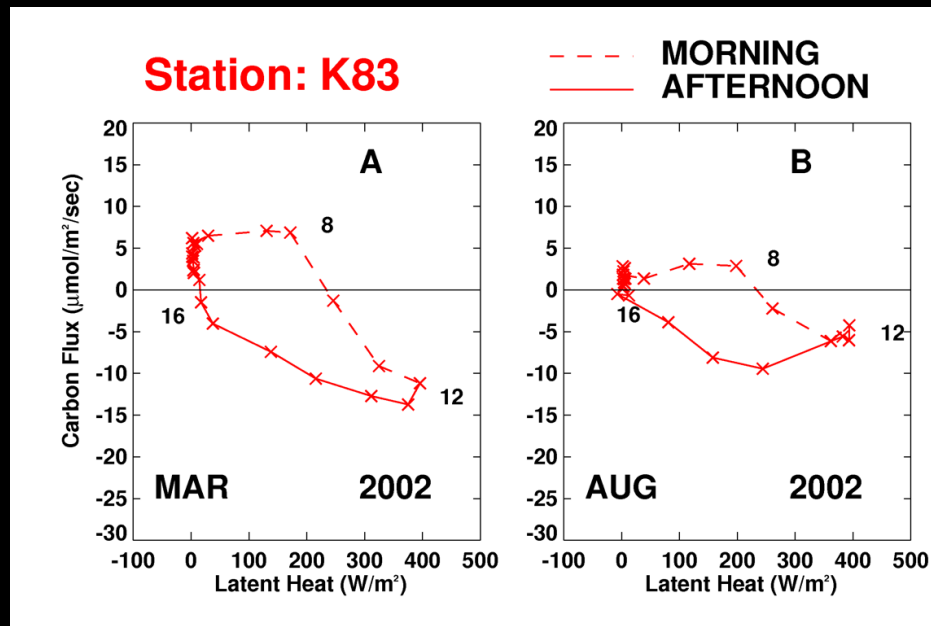
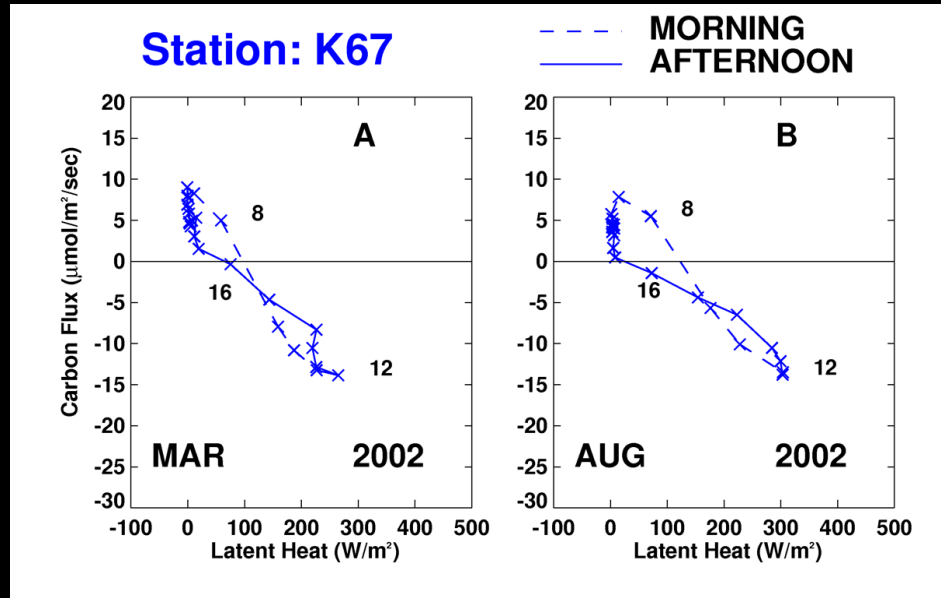


# Carbon Flux, Both Sites



- Monthly-mean diurnal composite
- **All days**; Reflects the influence of the river breeze/convergence cloud
- K67: larger amplitude in the carbon cycle

# Combination: Latent Heat and Carbon Flux



- K67 (cloud feature: reduced radiation, shaded): almost linear response
- K83: hysteresis between morning and afternoon processes



# What are the Differences?

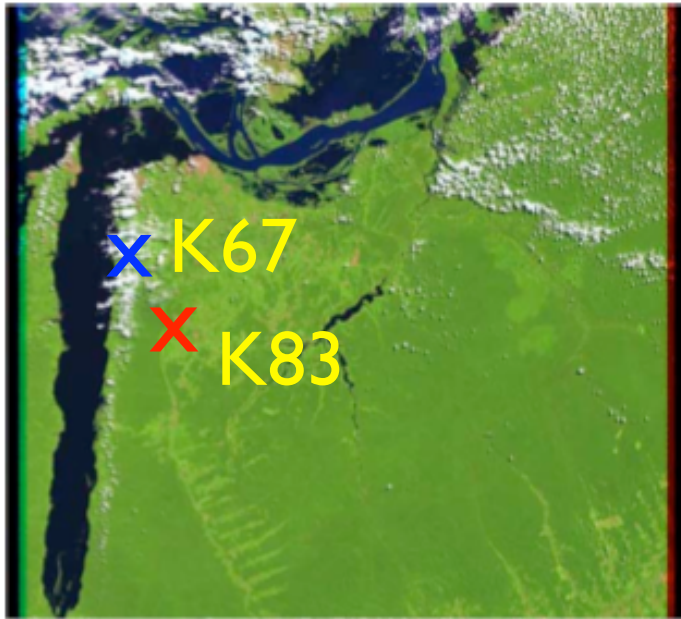
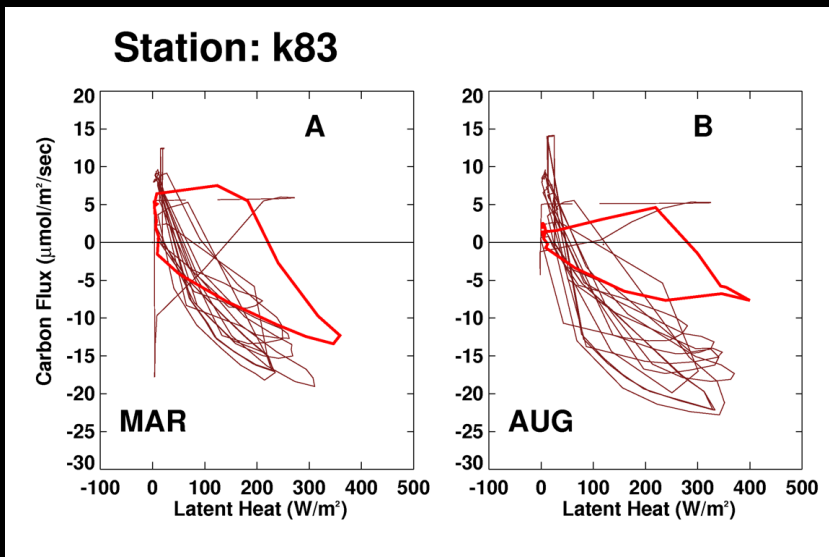
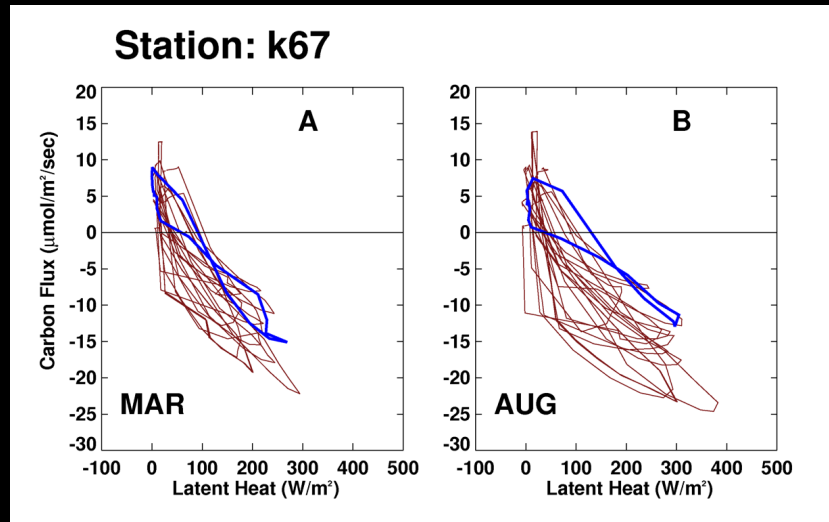


Figure 9. Satellite image obtained from LandSat 7 ETM+ scene for path 227 and row 62, on 31 July 2001. It shows that during a clear day, the low-level cumulus clouds favor the east bank of Tapajós River. The image is located at the Web site of Tropical Rain Forest Information Center (TRFIC), which is jointly hosted by LBA-ECO and Michigan State University.

From Lu et al., 2005

- K67: Frequently reduced midday radiation; cooler, higher vapor pressure
- K67: Higher amplitude in diurnal carbon cycle
- K67: linear response in carbon flux-latent heat diurnal cycle
- K83: Hysteresis in diurnal carbon flux-LE cycle

# Models: Diurnal Cycle



- Models over-estimate carbon uptake, underestimate rate of LE increase
- Stability? Turbulent Exchange?
- Simulations at K67 better than at K83

# Conclusions

- This is an opportunity to quantify ecosystem response to changes in radiation (beam/diffuse partitioning)
- Has implications for simulations of future climate (cloud fraction, aerosol loading)
- Valuable testbed for studying details of model behavior
- Requires collaboration between modeling and observational communities