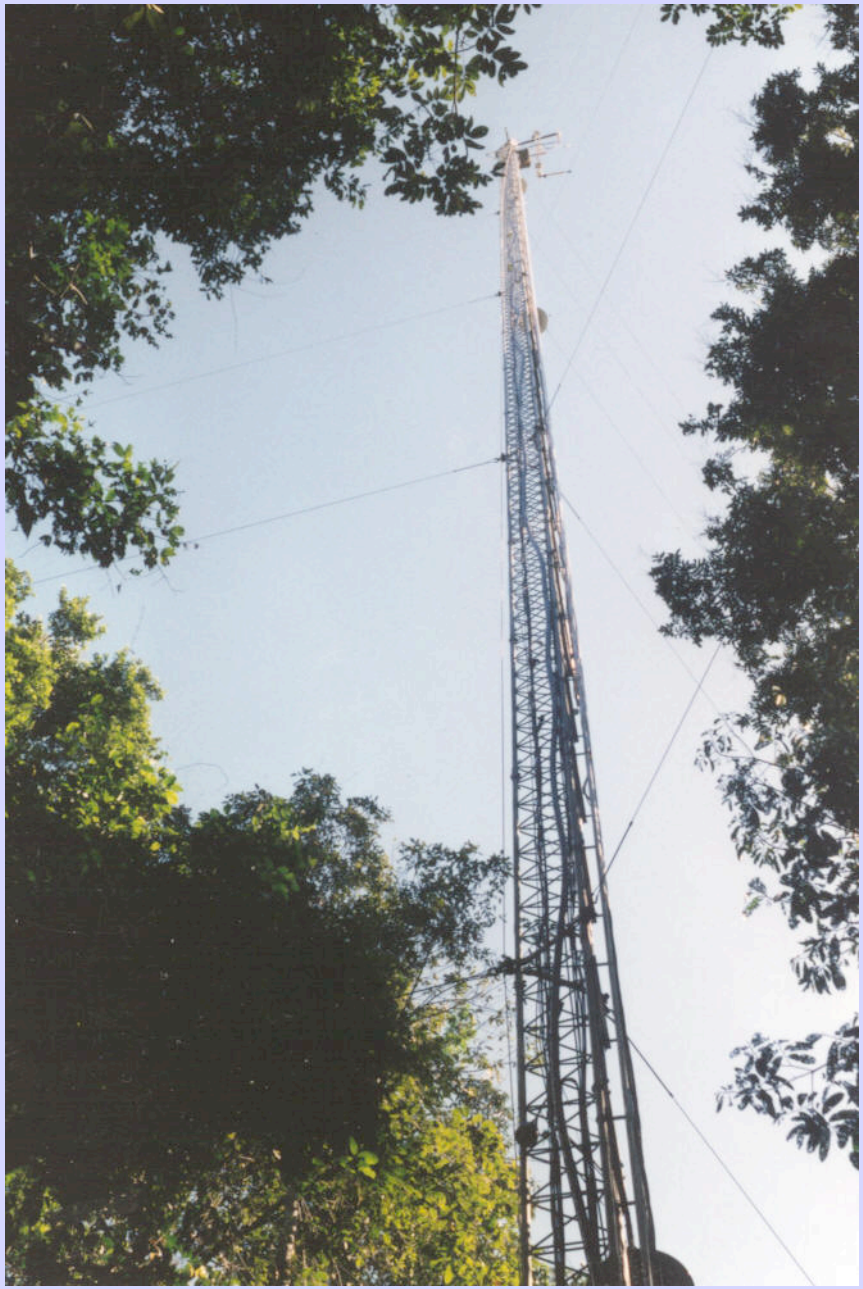


What tower "observation" has received the most attention within LBA?

"Towers indicate a high uptake of CO_2, ranging between 3 to 7 ton C ha^{-1} y^{-1}"

This is unfortunate

- **Weak evidence –** The evidence supporting this claim is weak.

- **A distraction –** These claims have received so much attention that other exciting results have gone unnoticed.

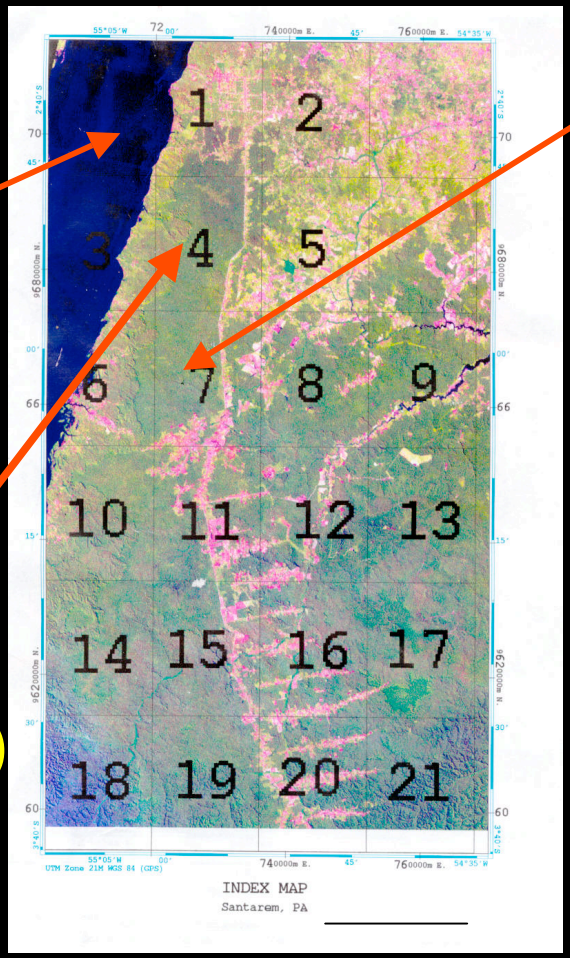
The Carbon Cycle at Santarem km 83 site
CD-04 (Goulden/da Rocha/Miller)

Experimental Plan

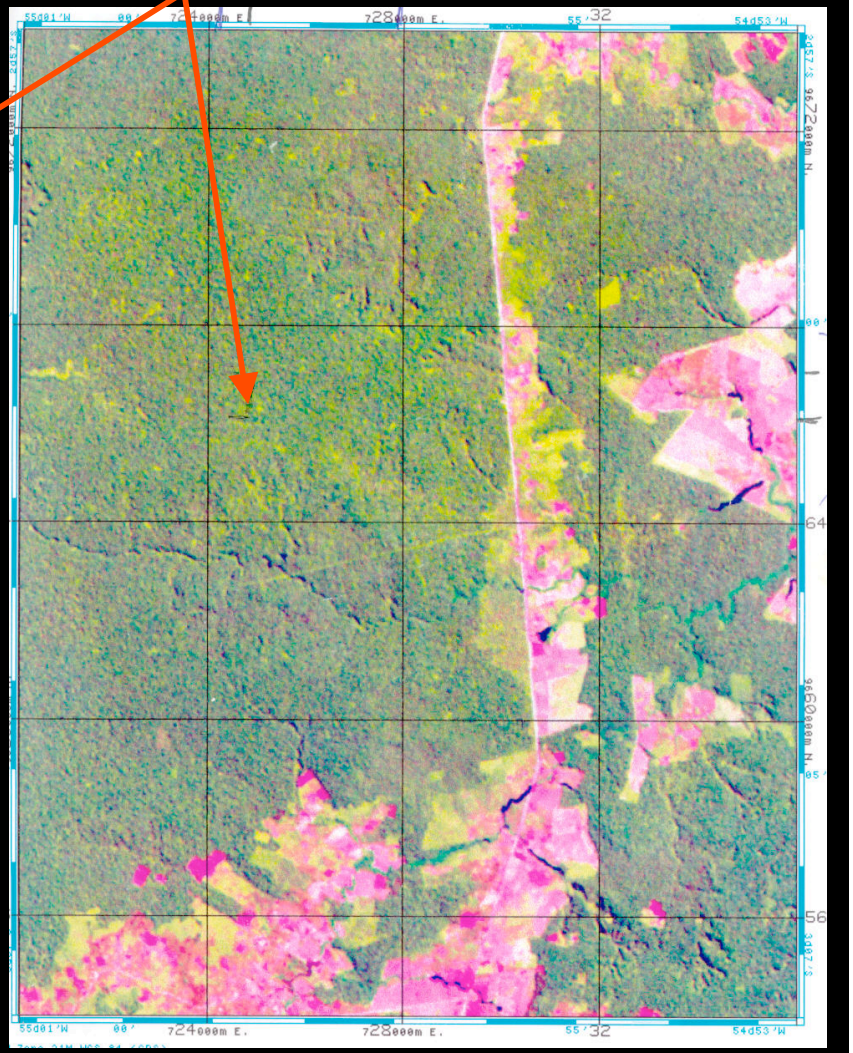
Logged Site (km 83, USP/UCI)

Tapajos River

Control Site (km 67, Harvard)



Wind dir



60 km

16 km

Tower Measurements

METEOROLOGY

PAR (up/down)
Radiation (short and long wave, up and down)
Rain

PROFILES

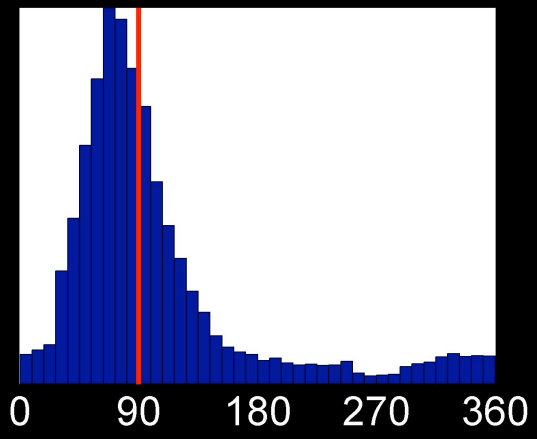
Wind (6 levels cups and 2D Sonics)
Temperature (6 levels)
CO_2/H_2O (12 levels)

FLUXES (64 meters)

Momentum/Heat	sonic anemometer
CO_2/H_2O	Infrared Gas Analyzer

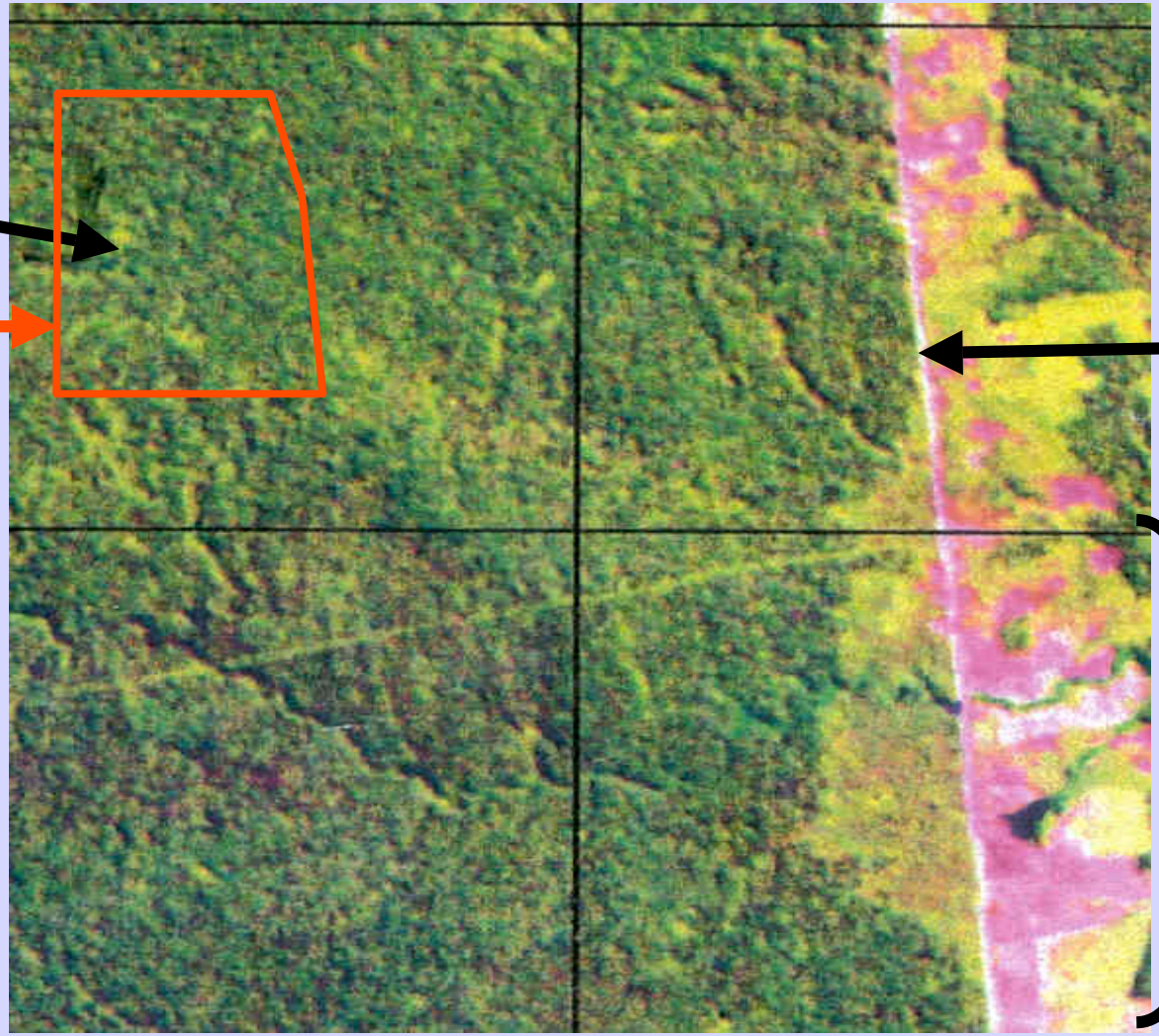
Air Inlet for **Closed Path IRGA**

Open Path IRGA



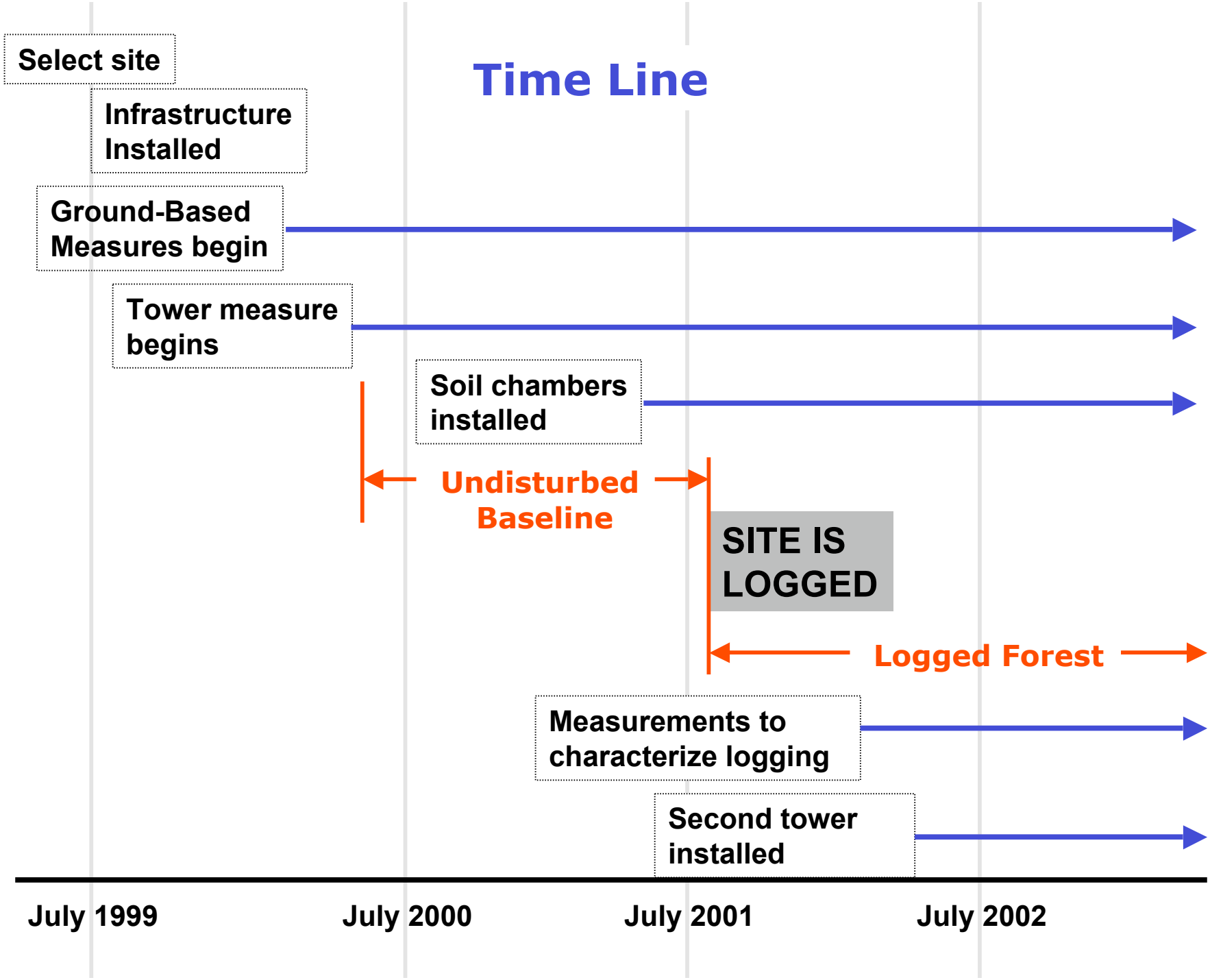
Sonic anemometer looks **East**,
the most common wind direction

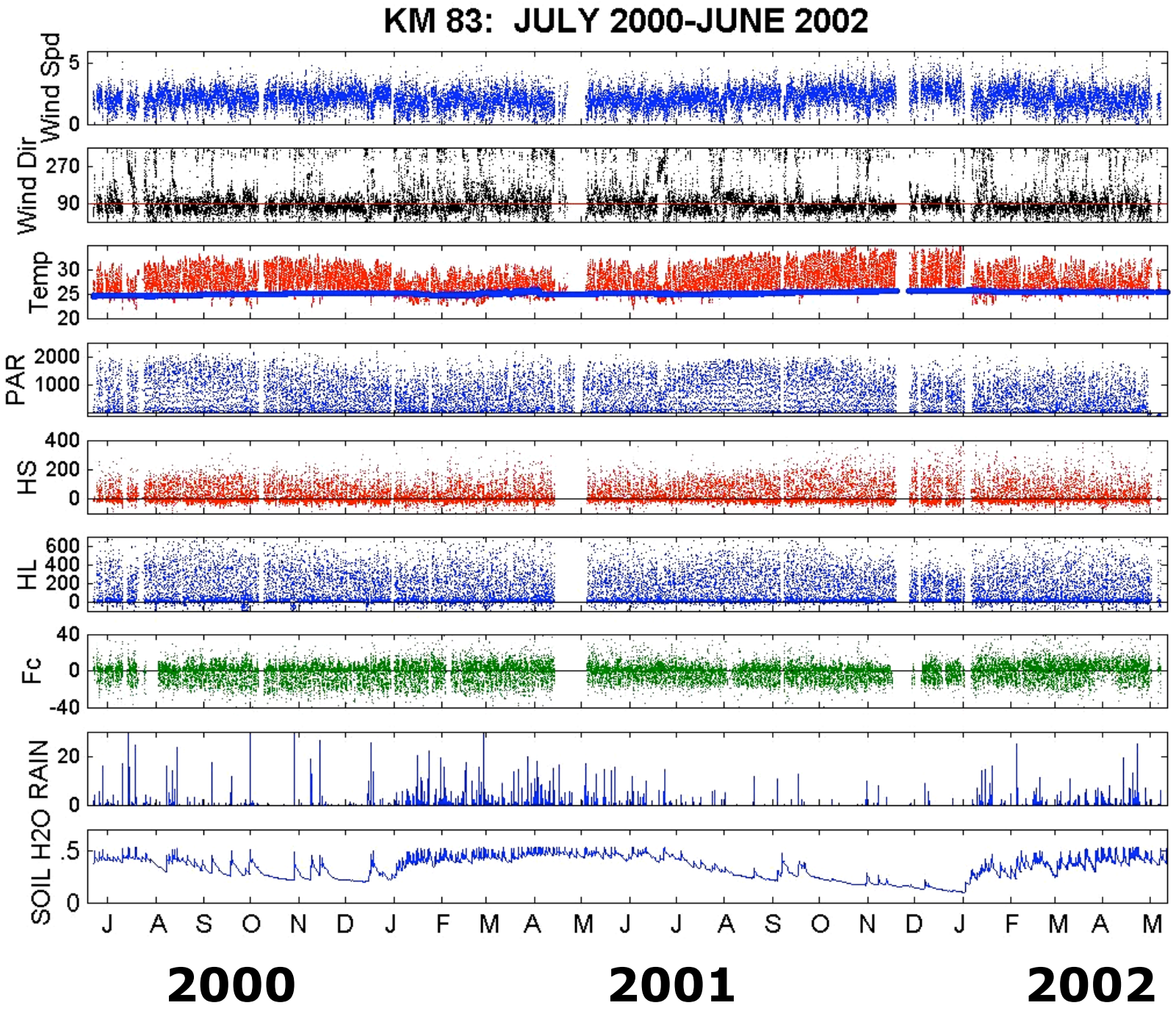
Logging Detail



Effects of selective logging on Forest CO_2 exchange

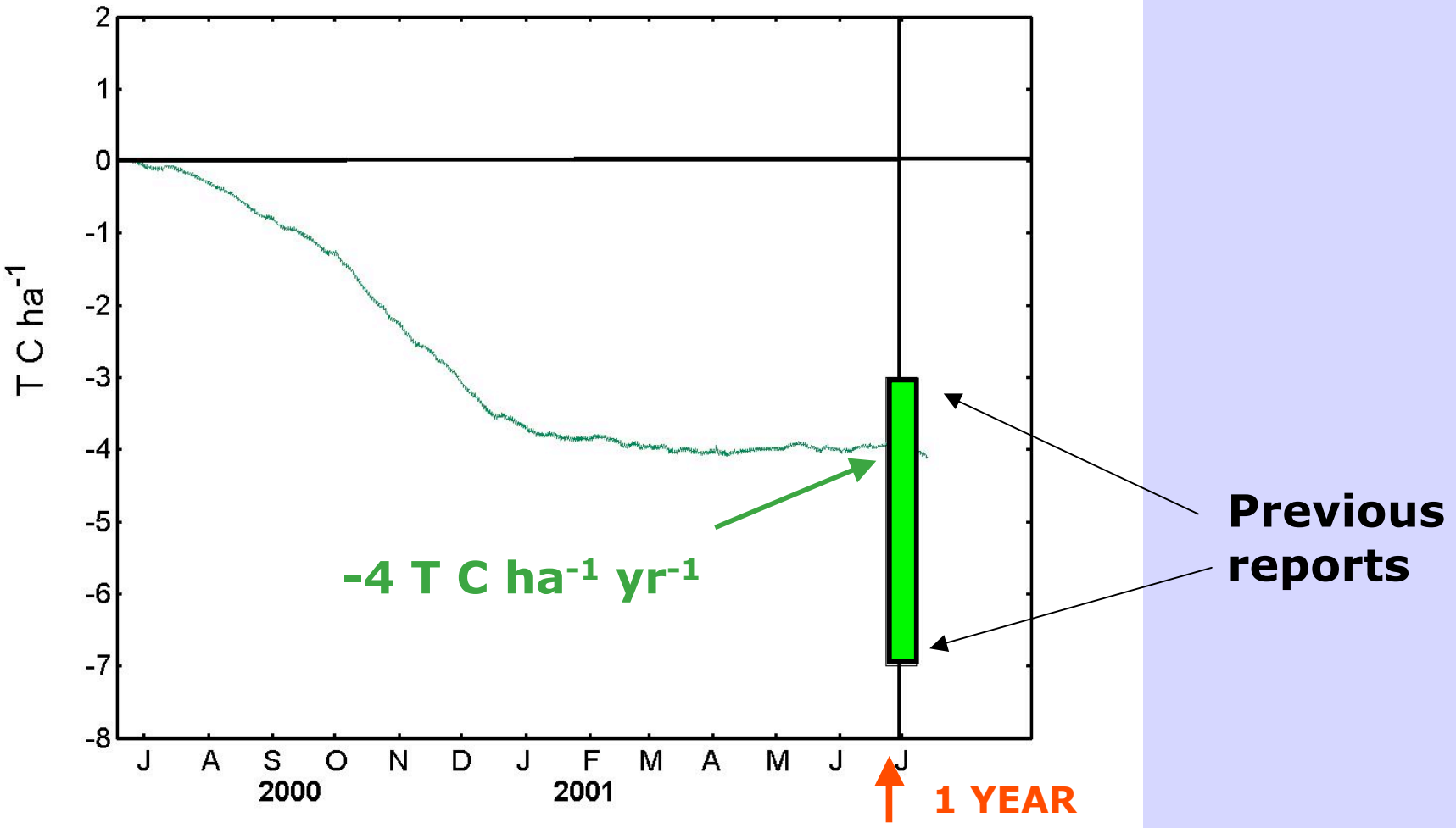
- 2-3 trees ha^{-1} removed


Time Line
Select site
Infrastructure Installed
Ground-Based Measures begin
Tower measure begins
Soil chambers installed
Undisturbed Baseline
SITE IS LOGGED
Logged Forest
Measurements to characterize logging
Second tower installed
July 1999
July 2000
July 2001
July 2002


KM 83: JULY 2000-JUNE 2002
Wind Spd
5
0
Wind Dir
270
90
Temp
30
25
20
PAR
2000
1000
HS
400
200
0
HL
600
400
200
0
Fc
40
0
-40
SOIL H2O RAIN
20
0
.5
0
J A S O N D J F M A M J J A S O N D J F M A M
2000
2001
2002

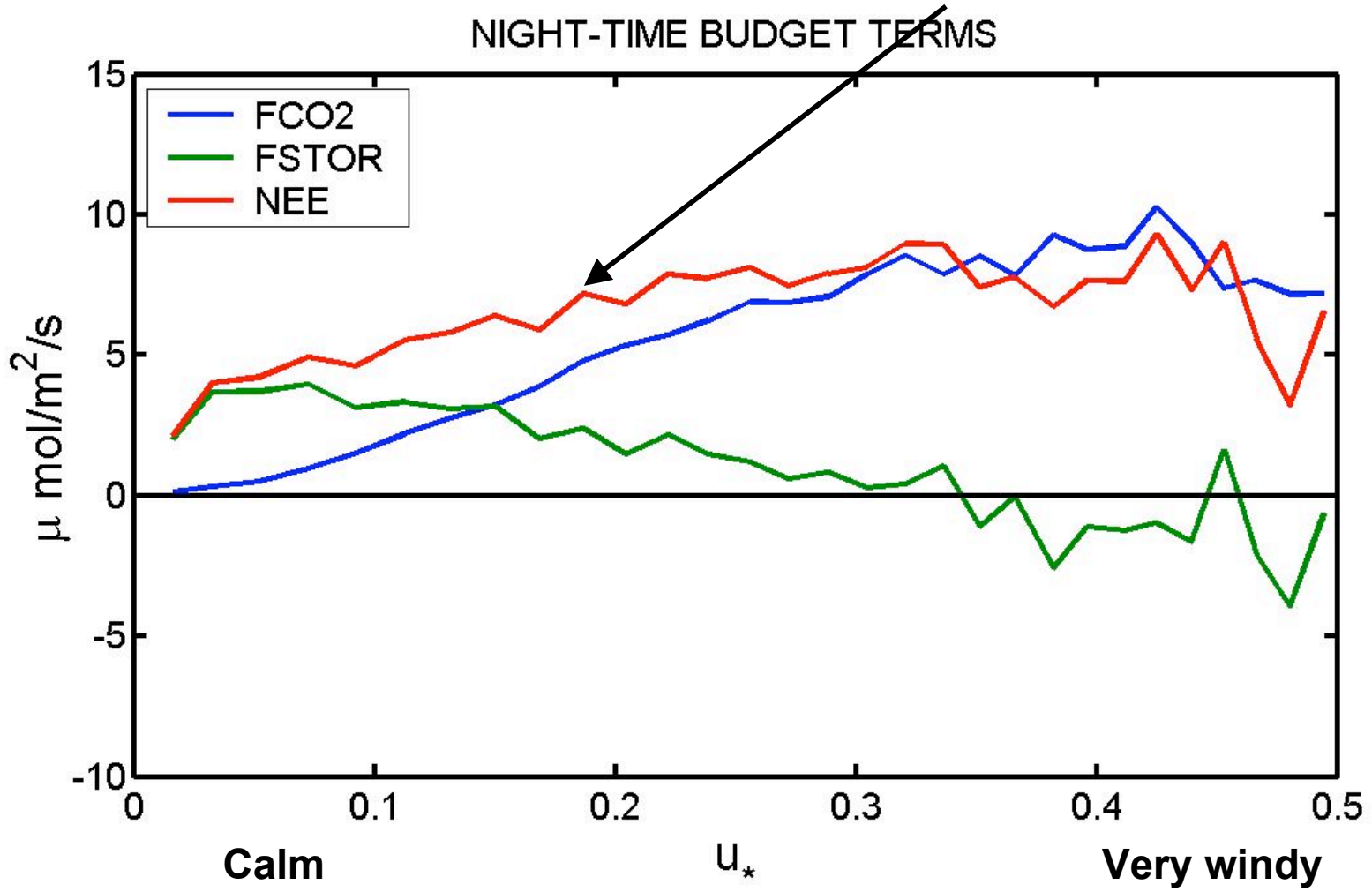
Carbon Balance during undisturbed phase:
Was the primary forest a large Carbon sink?

The **Uncorrected calculation** indicates a large carbon sink, similar to previous reports.



However, the uncorrected observations underestimate CO_2 loss on calm nights

CO_2 efflux measured with the tower rolls off on calm nights

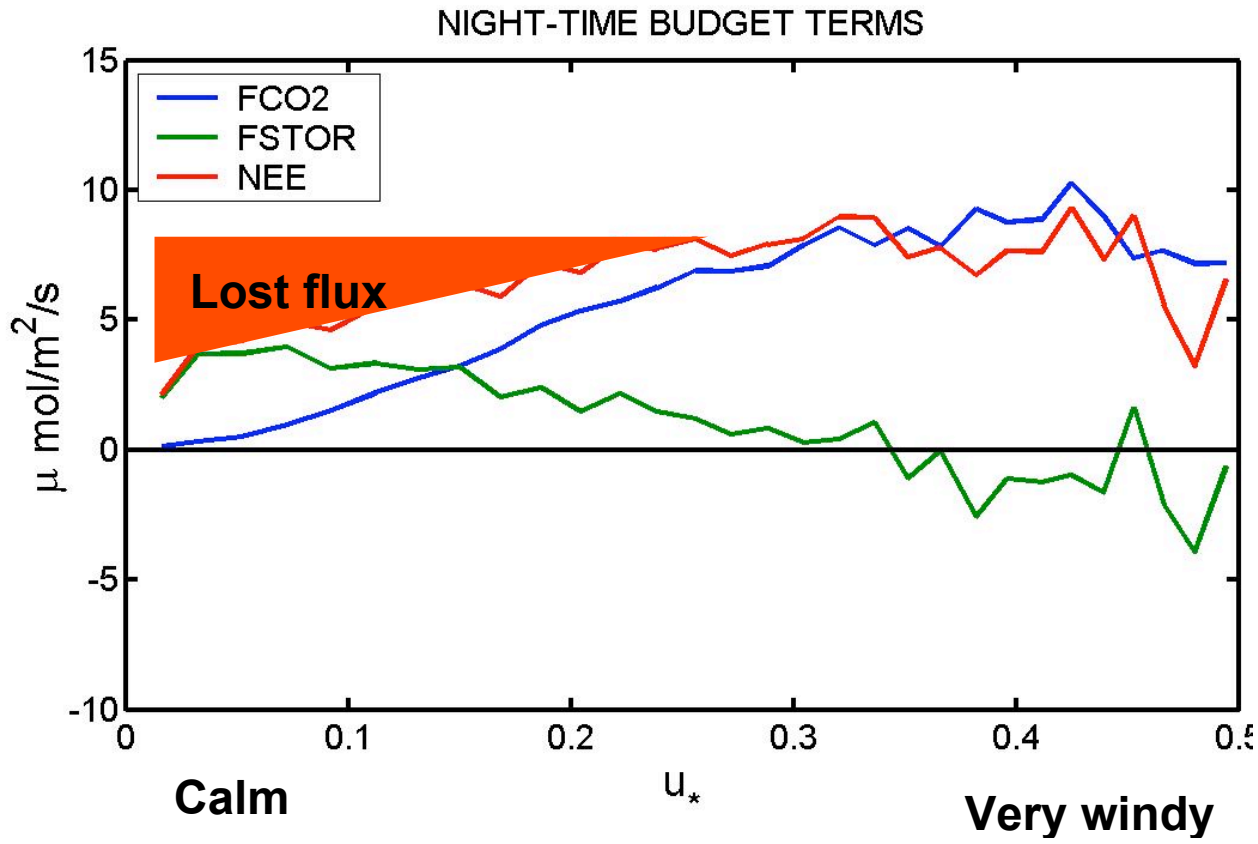


There is no evidence that biotic CO_2 production decreases on calm nights.

Most researchers believe CO_2 escapes on calm nights undetected by the tower.

The underestimation of CO_2 loss results in a large overestimation of annual CO_2 gain.

This effect must be corrected, typically using a u* filter.

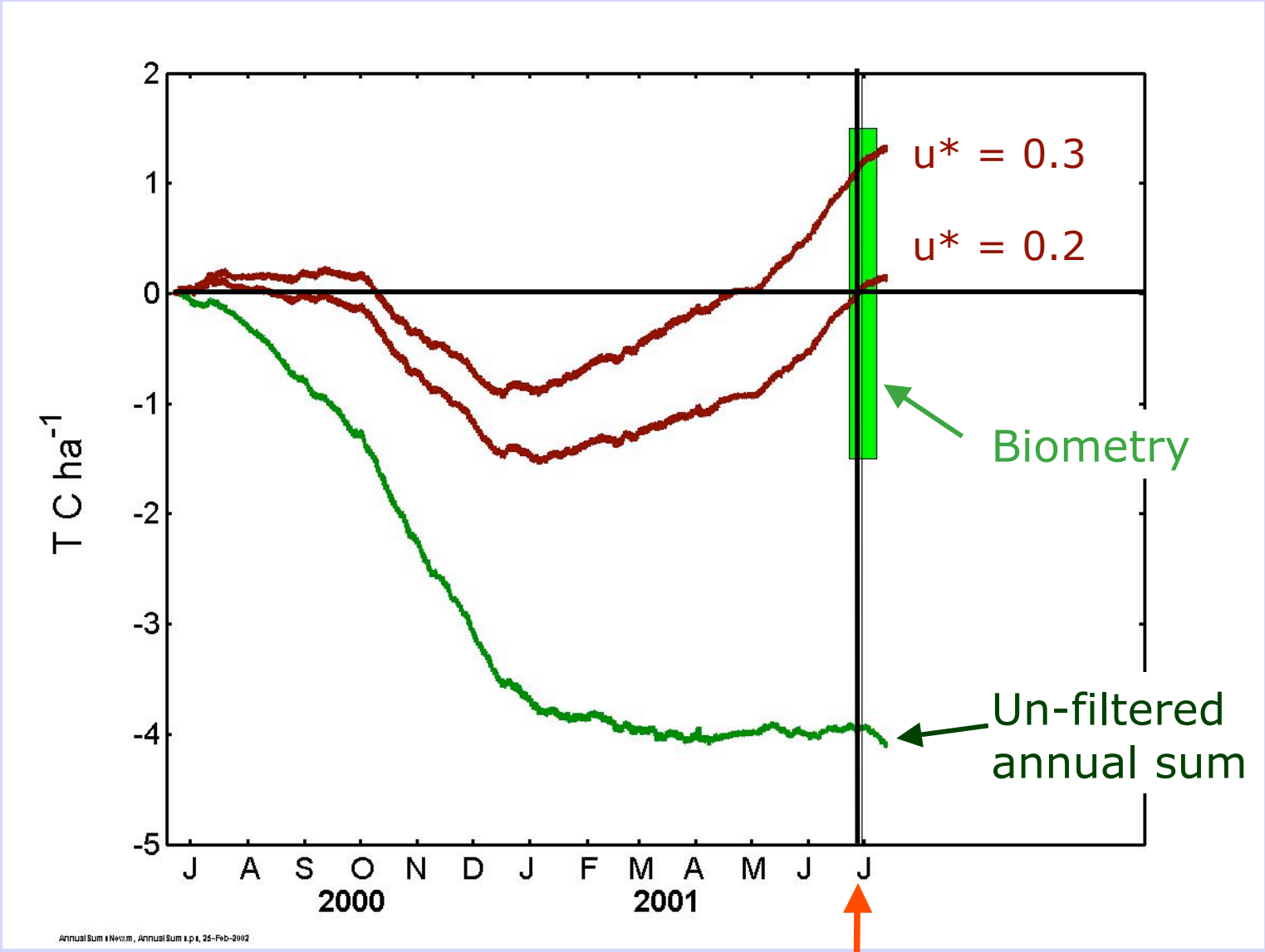


The u* filter is widely used for calculating annual sums

Published reports using u* filter	
Valentini (1996)	Italy
Valentini (2000)	Italy
Pilegaard (2001)	Denmark
Cited in Valentini (2000)	Iceland
Black (1996)	Saskatchwan
Lee (1999)	Borden, Ontario
Schmid (2000)	Indiana
Aubinet, M Cited in Valentini	Belgium
Lindroth (1998)	Sweden
Valentini PI	Italy
Berbigier (2001)	France
Valentini (2000)	Germany
Bernhofer PI Cited in Valentini	Germany
A Ibrom PI Cited in Valentini	Germany
Dolman PI Cited in Valentini	Netherlands
Moncrieff PI Cited in Valentini	UK
Vesala PI Cited in Valentini	Finland
Hollinger (1999)	Howland
Goulden (1996)	Boreas
Malhi (1999)	Saskatchwan
Valentini (2000)	Italy
Suyker (2001)	Oklahoma
Barford (2001)	Harvard

Published reports not using u* filter	
Malhi (1998)	Amazon
Grace (1996)	Amazon

u* corrected tower flux agrees with Biometry – There is no evidence that the primary forest was a large Carbon sink.



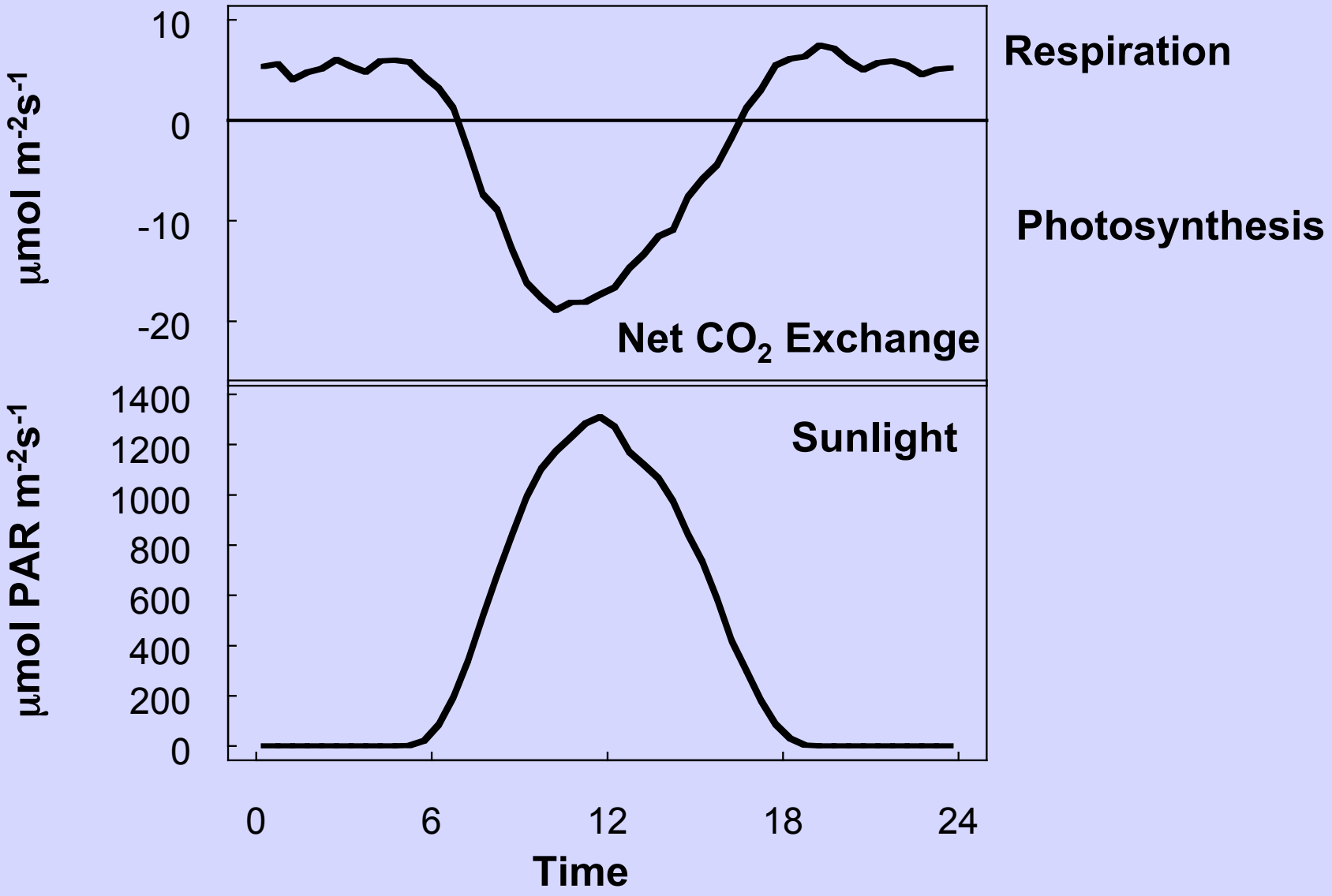
See poster by Miller et al.

- **Weak evidence for large C uptake –** The decision whether or not to use a u* filter is the main determinant of whether or not a group reports a large amount of annual CO_2 uptake

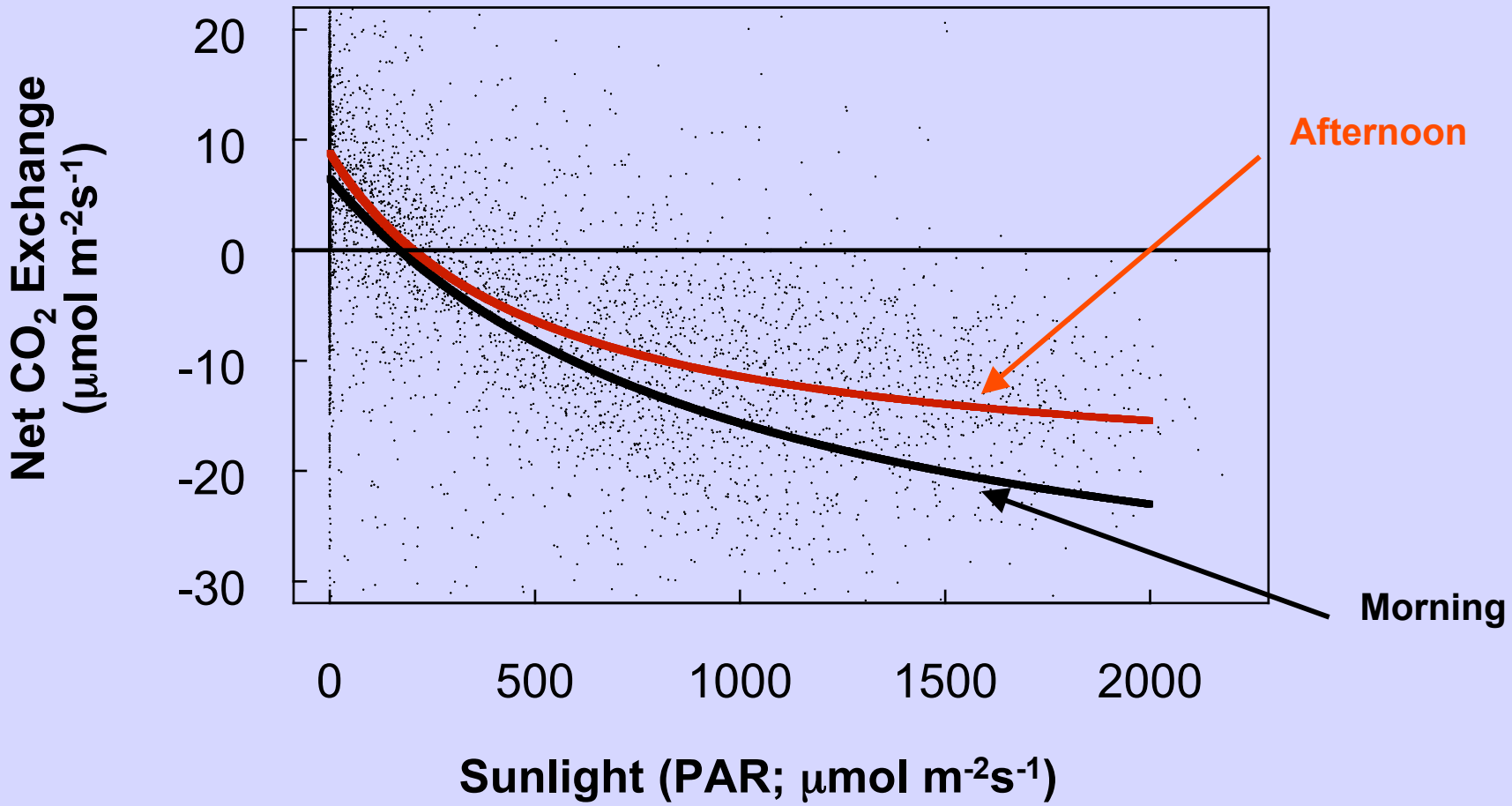
- We need to move beyond this distraction and begin focusing on the **Surprising Results**

- **Three ways CO_2 exchange differs from our expectations**
  (1) The daily pattern of CO_2 exchange
  (2) The seasonal pattern of CO_2 exchange
  (3) The effect of logging on CO_2 exchange

What controls the daily pattern of CO_2 exchange?

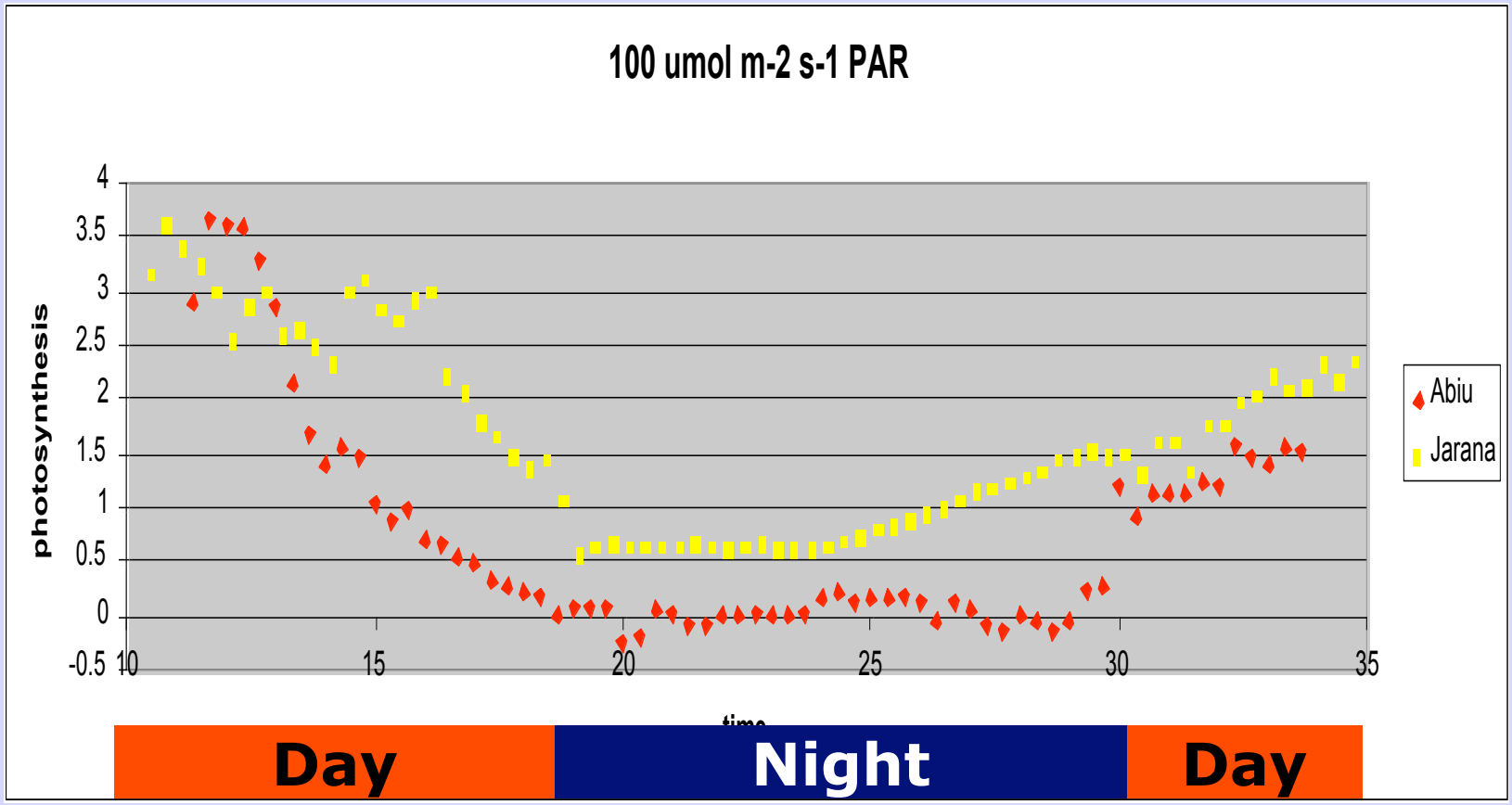


Canopy photosynthesis is lower in the afternoon than the morning.



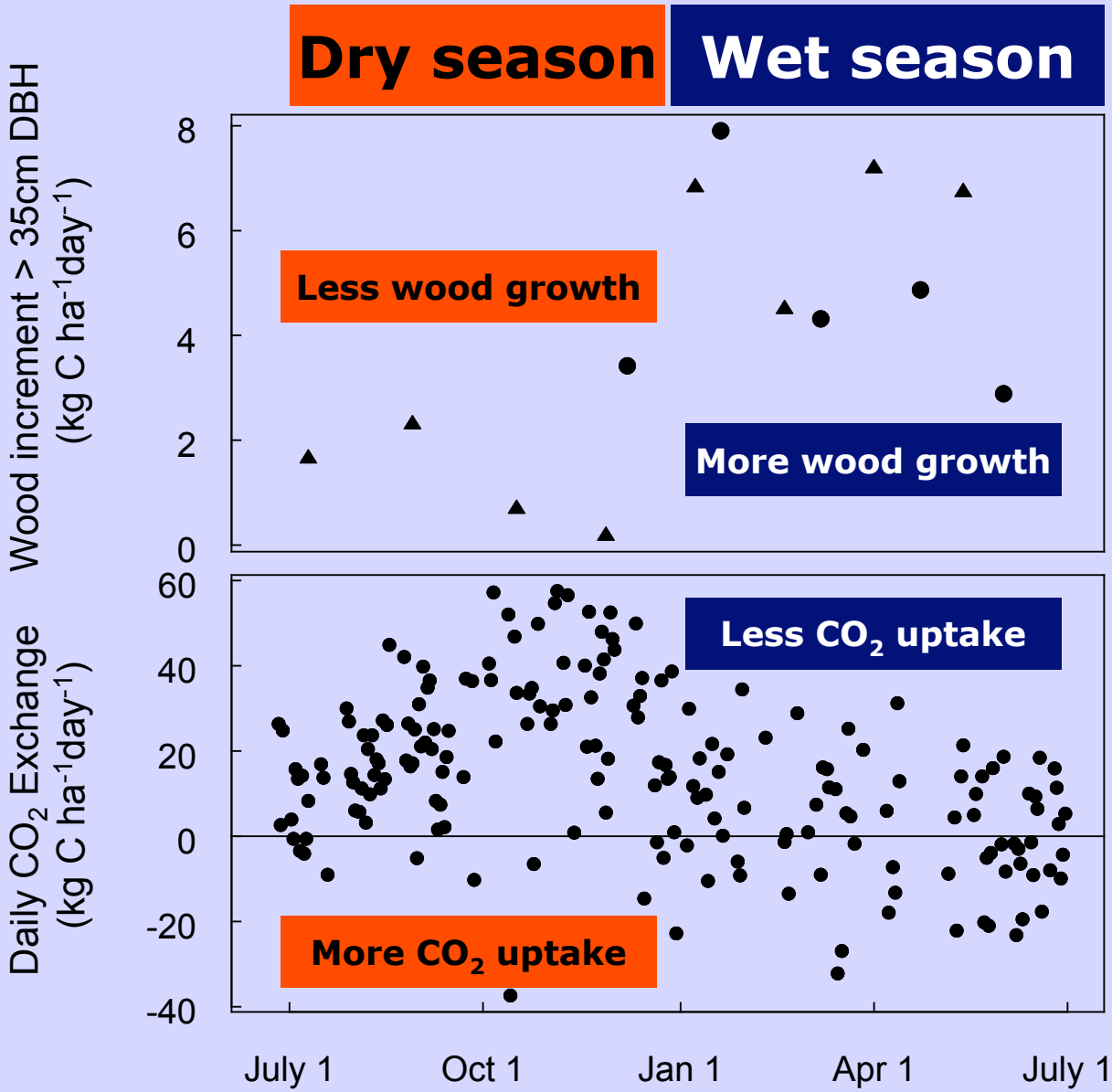

9. 5. 2002

Canopy leaves in constant light and temperature still show a decline in photosynthetic uptake during the afternoon and a partial recovery the next day.
The reduction in canopy photosynthesis during the afternoon may be caused by a circadian rhythm.



See poster by Doughty et al. for details

What controls the seasonal pattern of CO_2 exchange?

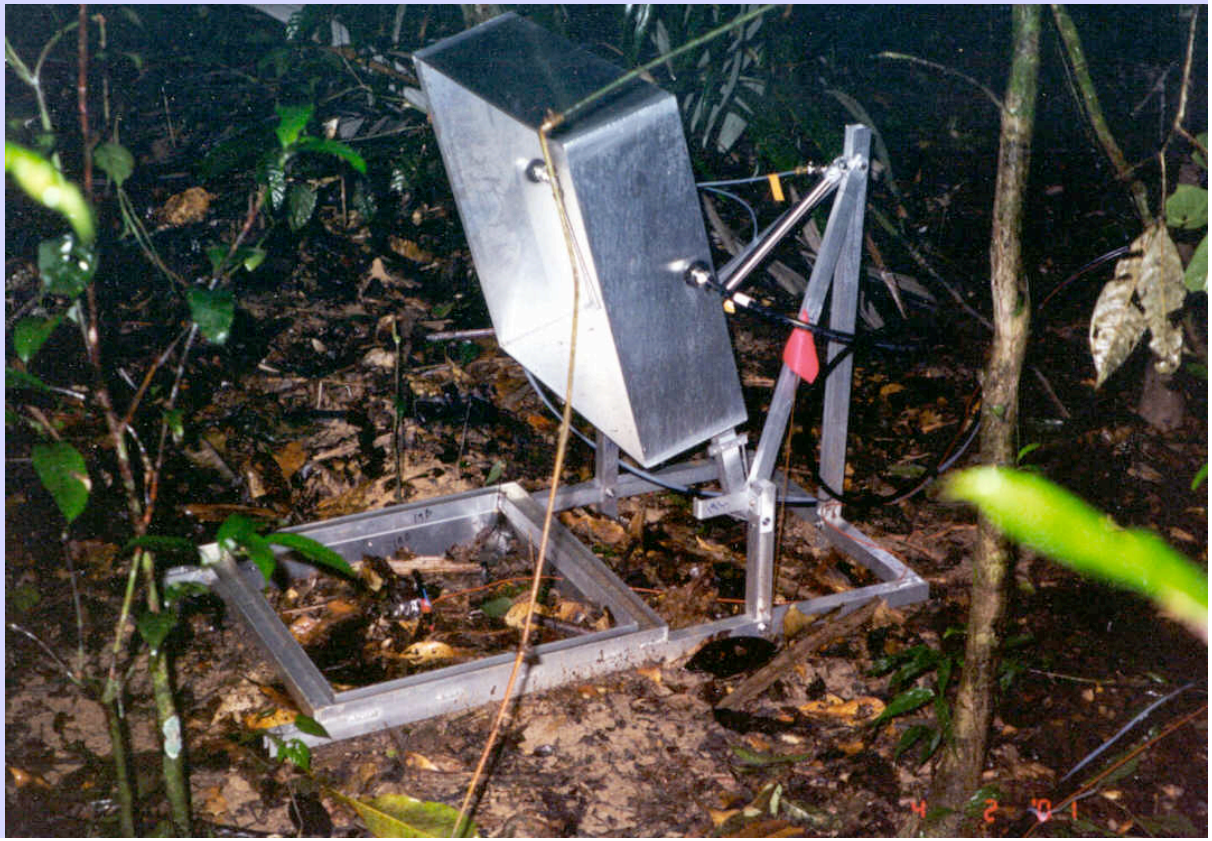


See also posters by Figueira et al. and Sousa et al.

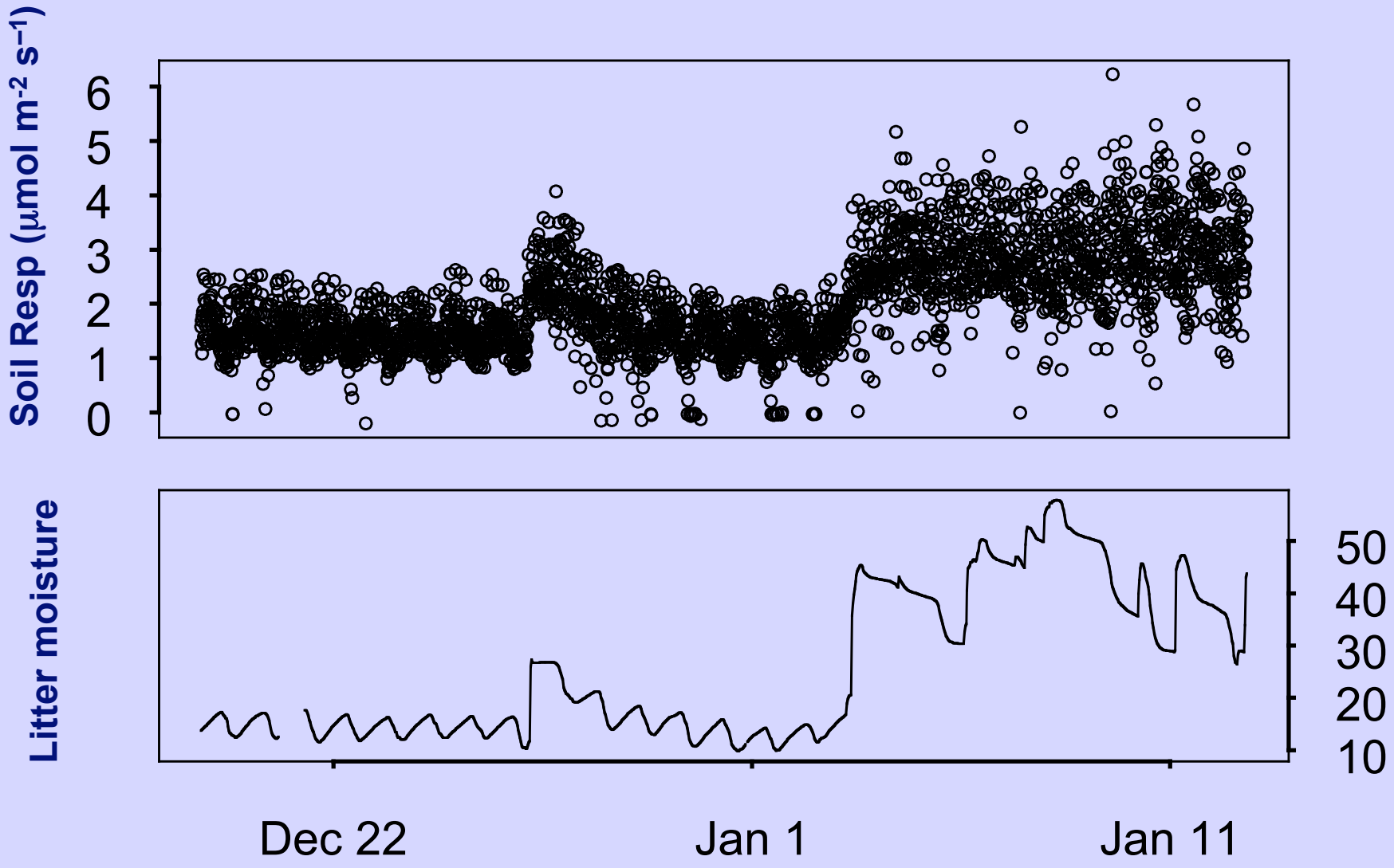
Soil respiration is a key

More soil respiration in the wet season ⇨
Less C gain measured by tower

Less soil respiration in the dry season ⇨
More C gain measured by tower



The effect of litter moisture on soil respiration is particularly obvious at the start of the rainy season



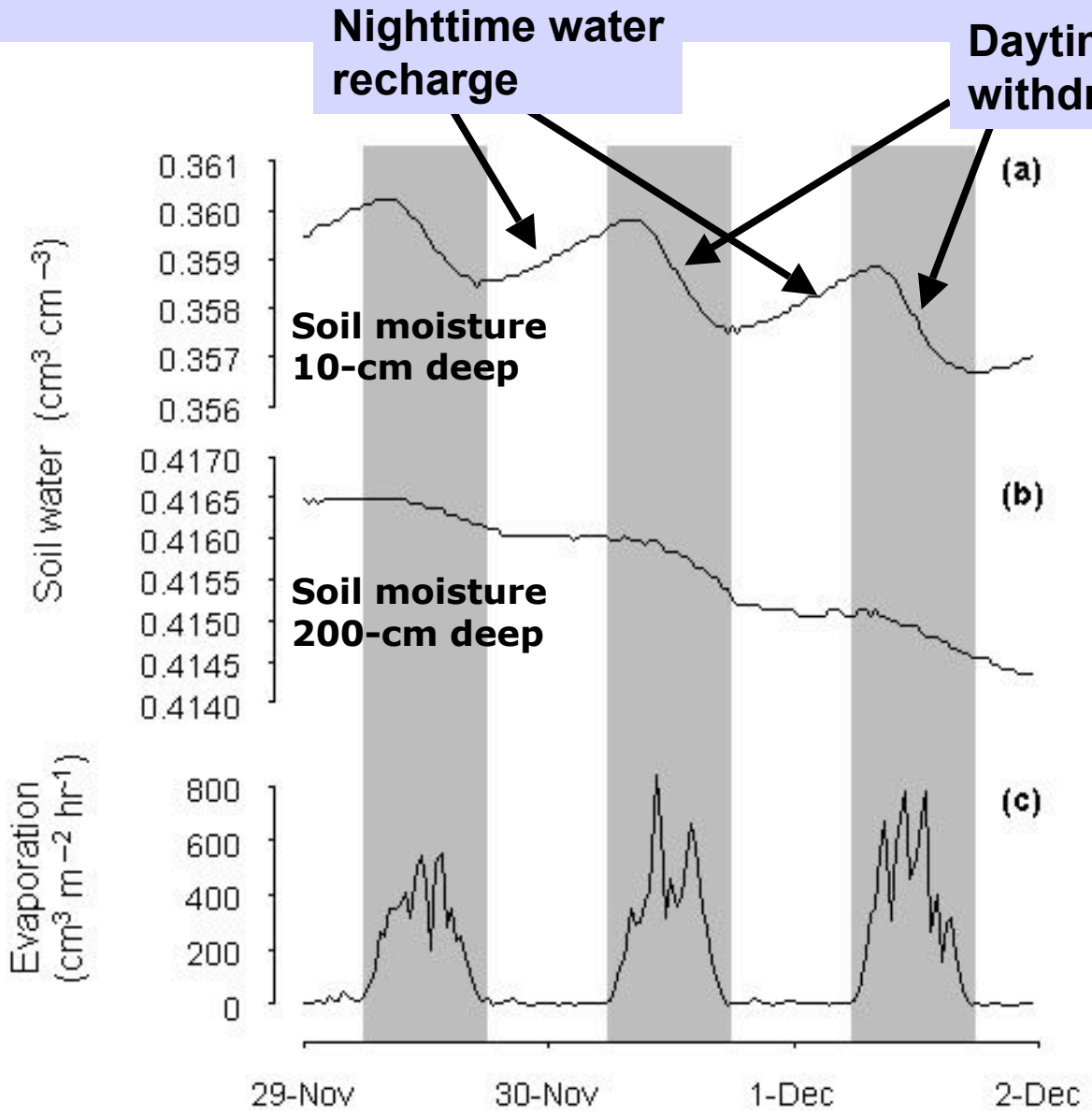


FIGURE 4

Photosynthesis does not decline markedly during the dry season.

The trees are deeply rooted, and may use hydraulic lift to avoid drought stress.

See also poster by da Rocha et al.

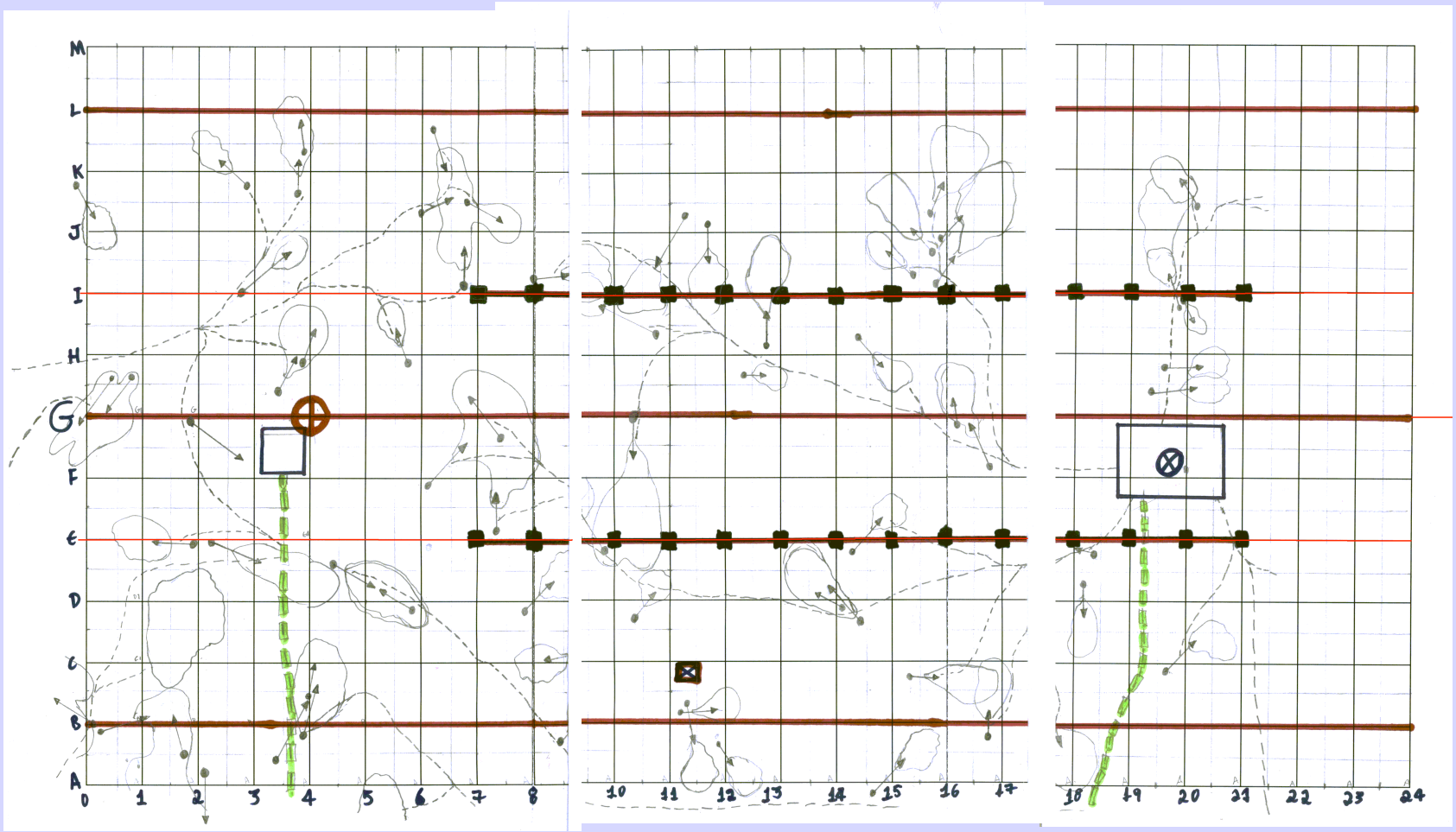
Effects of selective logging on Forest CO_2 exchange

- 2-3 trees ha^{-1} removed
- 5 T C ha^{-1} wood removed


•15 T C ha-1 slash introduced

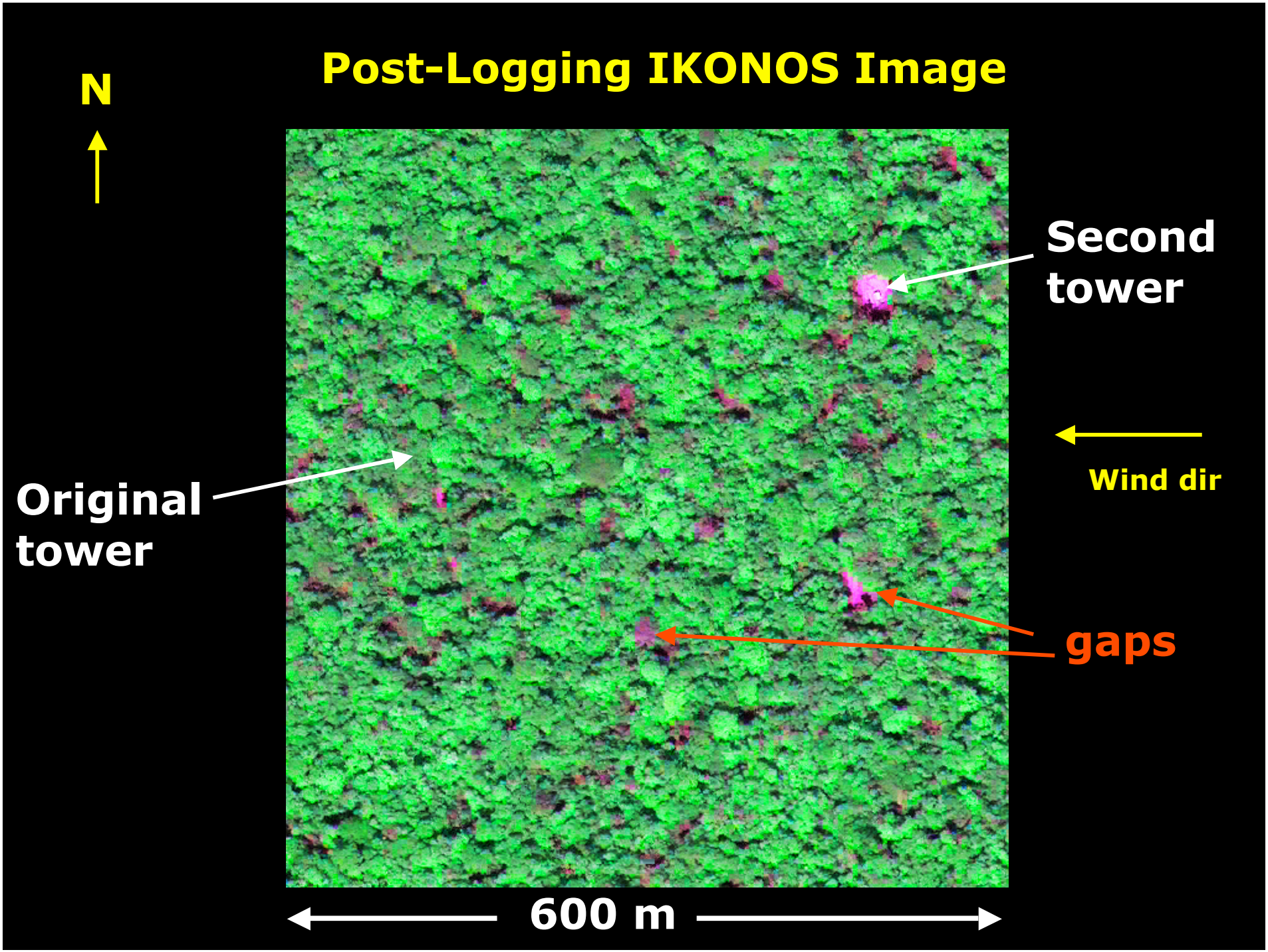
GAP MAP

- 10-15% gaps created



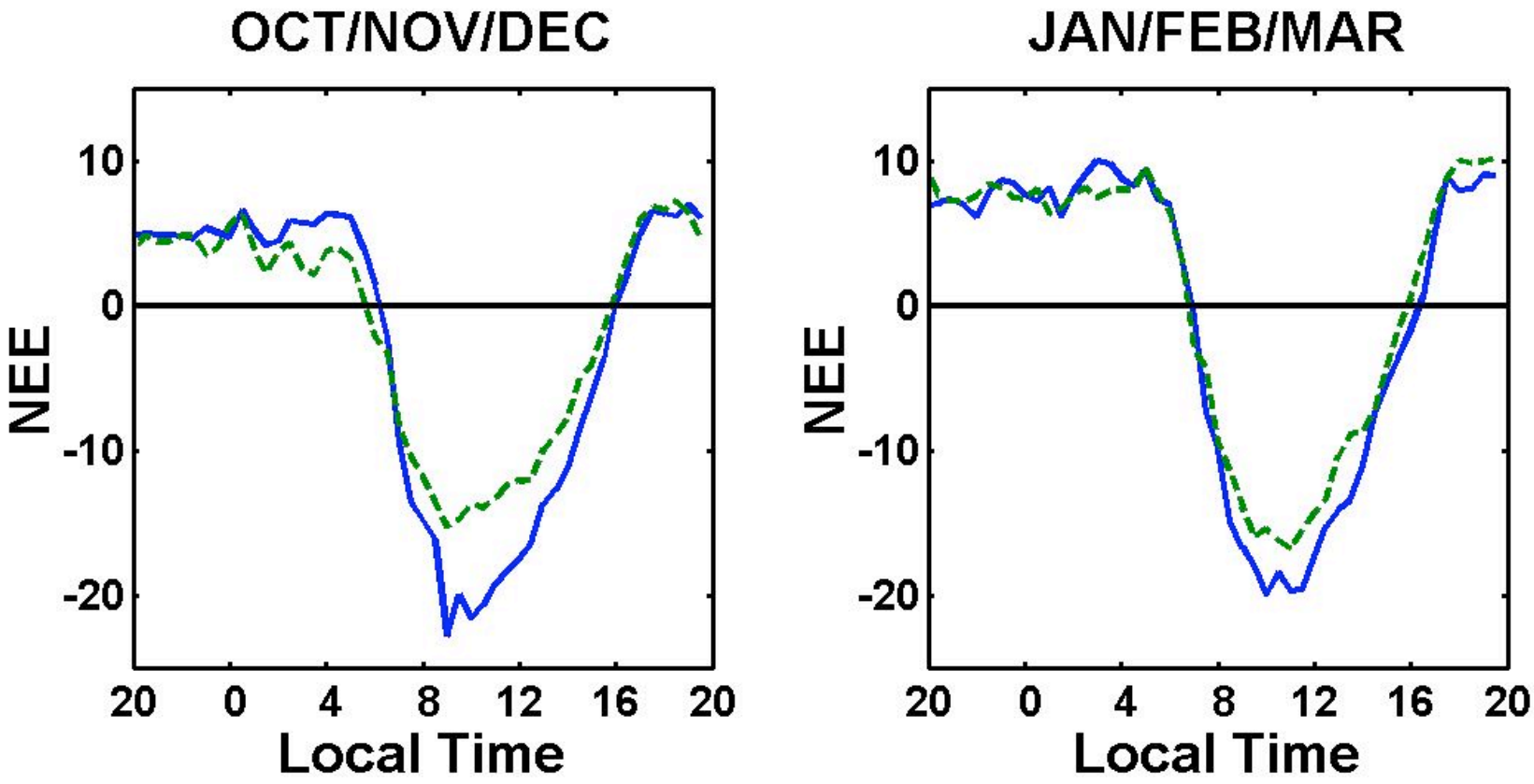
600 m

Post-Logging IKONOS Image



Average Daily Cycles of NEE

BLUE: PRE-LOGGING
GREEN: POST-LOGGING

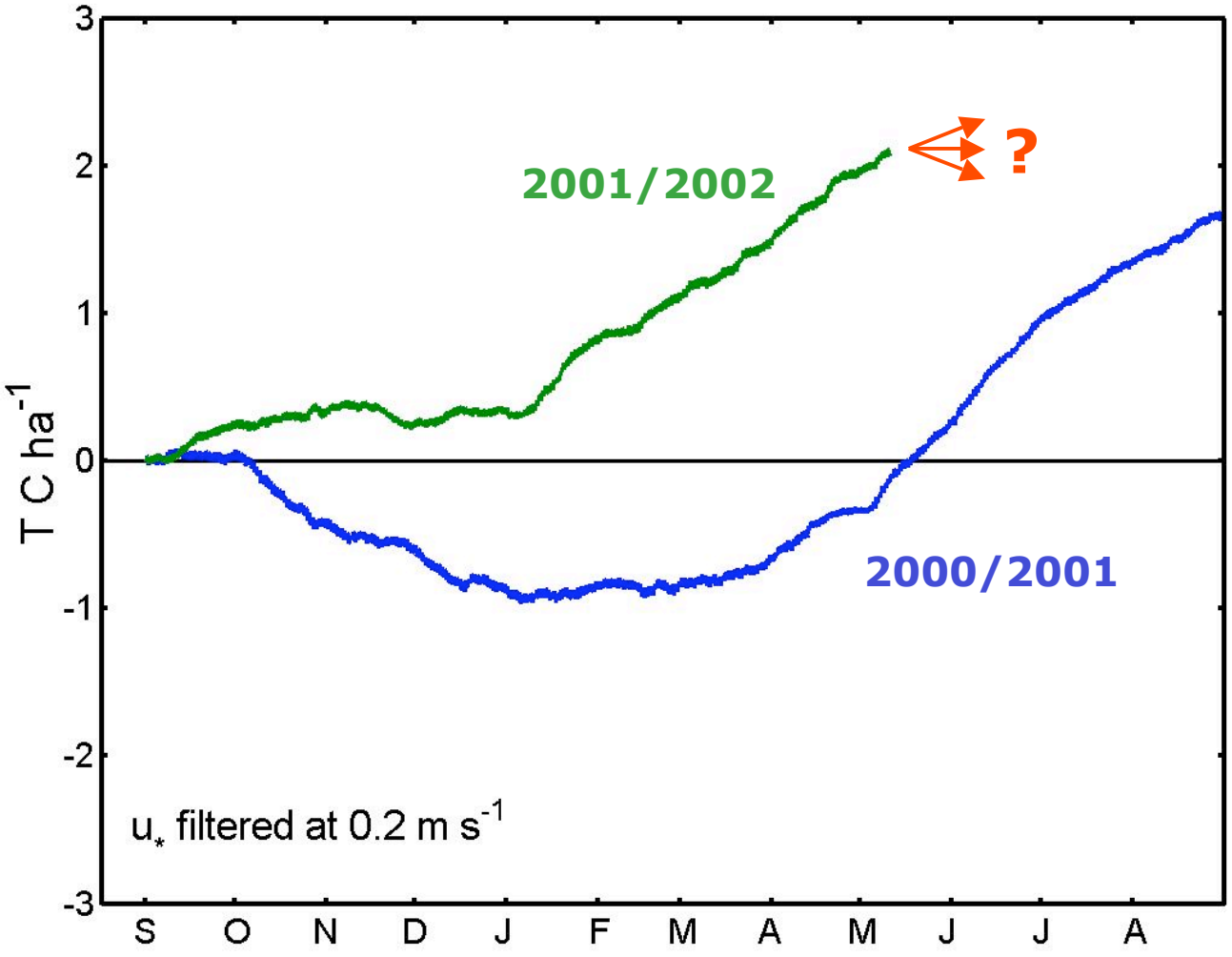


Dry Season

Wet Season

Cumulative NEE

BLUE: PRE-LOGGING
GREEN: POST-LOGGING



Subjects needing more attention, both experimentally and in model development

- What causes the afternoon reduction in canopy photosynthesis? Is it a circadian rhythm?
- What controls the seasonal patterns of LAI and canopy photosynthesis? What determines phenology?
- What determines the forest's ability to avoid drought stress? Can the forest avoid stress in unusually dry years?
- How does the dry season control decomposition?
- The magnitude and causes of the logging effect