

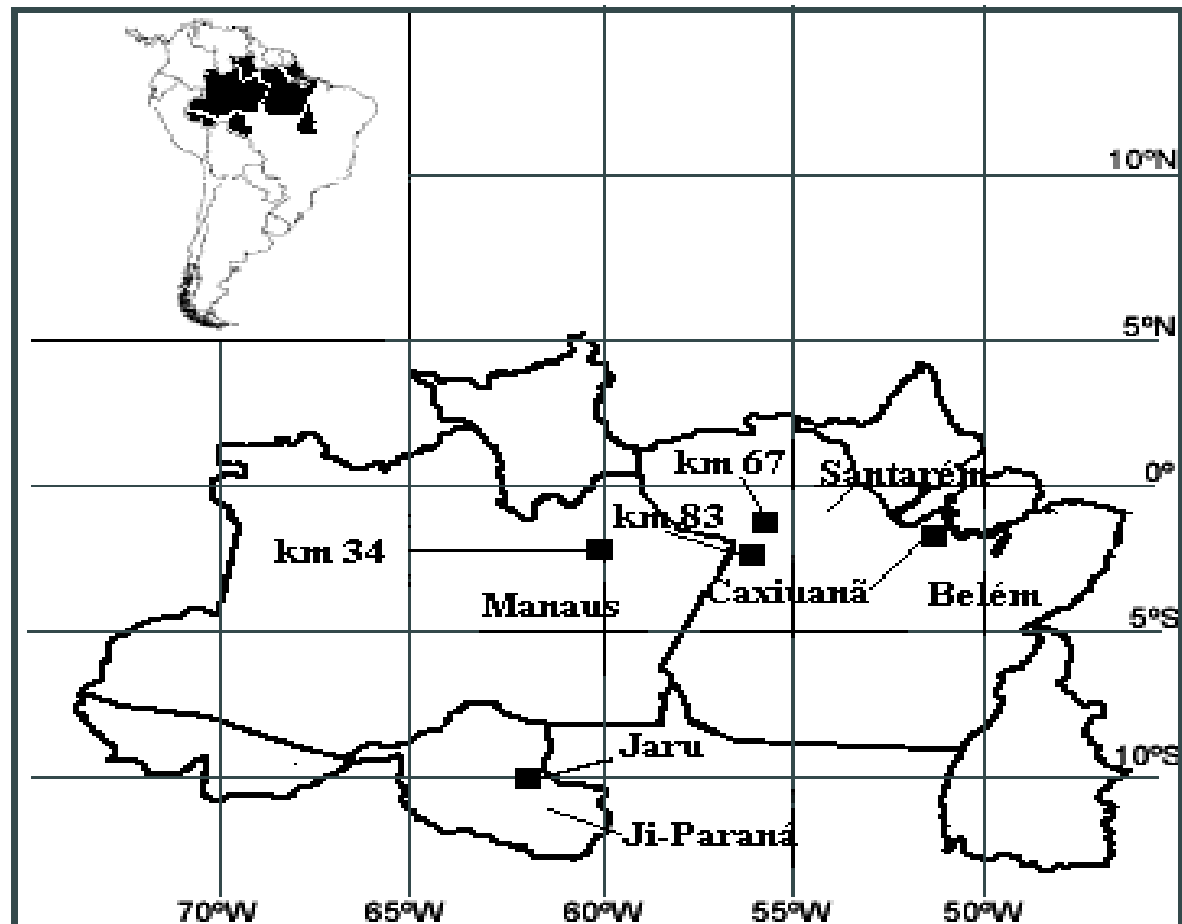
# Calibration of IBIS against data from four primary forest sites in Amazonia

Marcos Heil Costa, Hewlley M. A. Imbuzeiro,  
Gleudson C. B. Baleeiro, Humberto R. da Rocha,  
Antonio Manzi, Scott Saleska, Steve Wofsy,  
Lucy Hutira, Michael Goulden, Scott Miller

# 1. Introduction

- Land surface/ecosystem models, like IBIS, simulate the fluxes of energy, water and CO<sub>2</sub> between the surface and the atmosphere
- Traditionally in the field, these models are usually calibrated against data collected in one single site per ecosystem

- Given the availability of LBA data for Amazonia, in this study, we calibrate IBIS against data from four primary rainforest sites in Amazonia?
  - Flona Tapajós km 67
  - Flona Tapajós km 83
  - Reserva do Cuieiras km 34
  - Rebio Jaru
- The process of calibration aims at minimizing the RMSE for latent and sensible heat fluxes, as well as carbon fluxes



- Model input variables
  - $S_{in}$  (solar incoming radiation)
  - $L_{in}$  (infrared incoming radiation)
  - $T_a$  (air temperature)
  - $h_a$  (air relative humidity)
  - $u_a$  (wind speed)
  - $P$  (precipitation)
- Model validation
  - $R_n$  (net radiation)
  - $H$  (sensible heat flux)
  - $LE$  (latent heat flux)
  - $NEE$  (net ecosystem exchange)

# Data filtering

- Input data
- Turbulence threshold ( $u_0^* = 0.1$  m/s)
- Energy balance closure ( $\delta = 0.4$ ), on a daily basis

$$(1 - \delta) \leq \left| \frac{H + LE}{Rn - G} \right| \leq (1 + \delta)$$

# Parameters calibrated

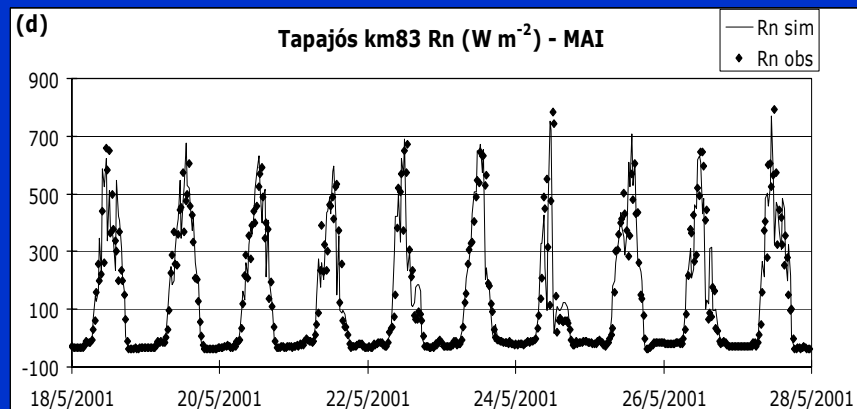
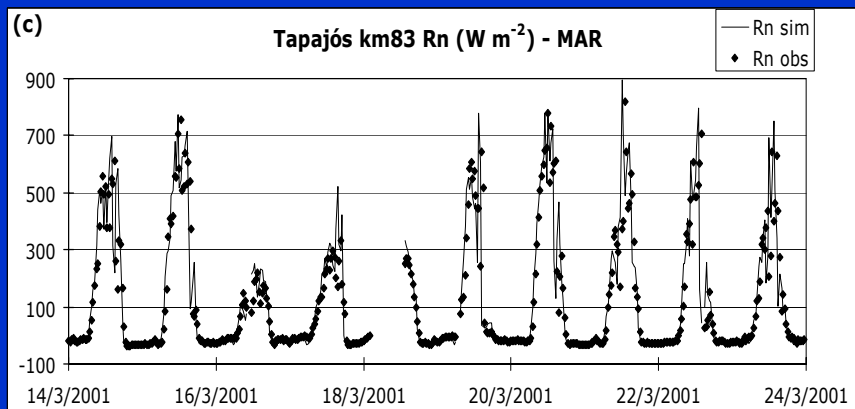
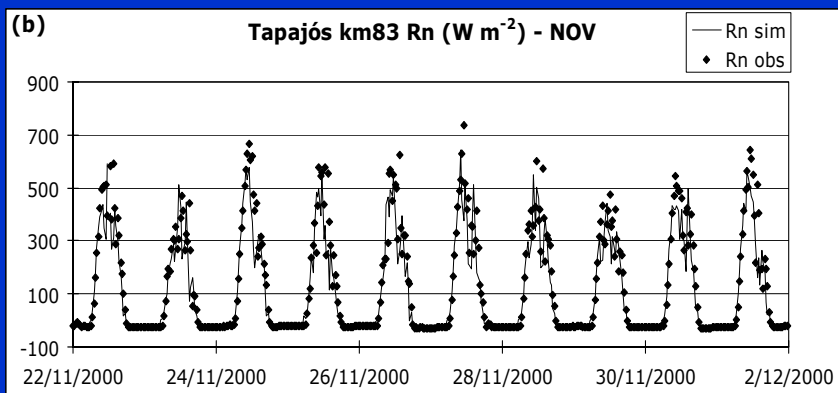
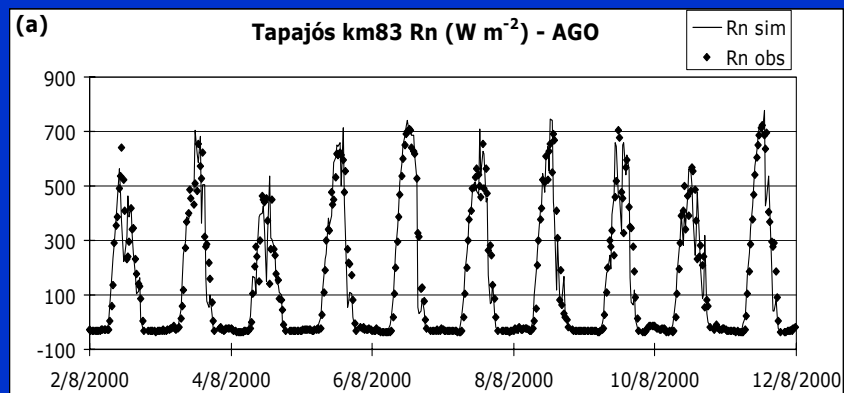
- Fine root distribution ( $\beta_2$ )
- Maximum capacity of Rubisco enzyme ( $V_{max}$ )
- Angular coefficient related to stomatal conductance ( $m$ )
- Heat capacity of stems ( $C_{HS}$ )

## 2. Initial results

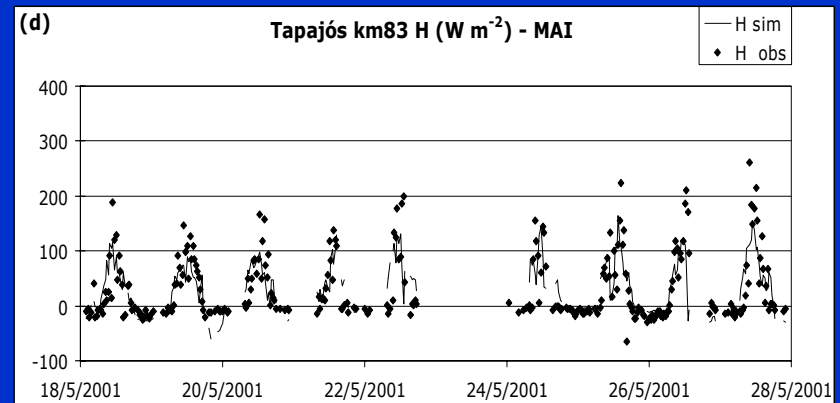
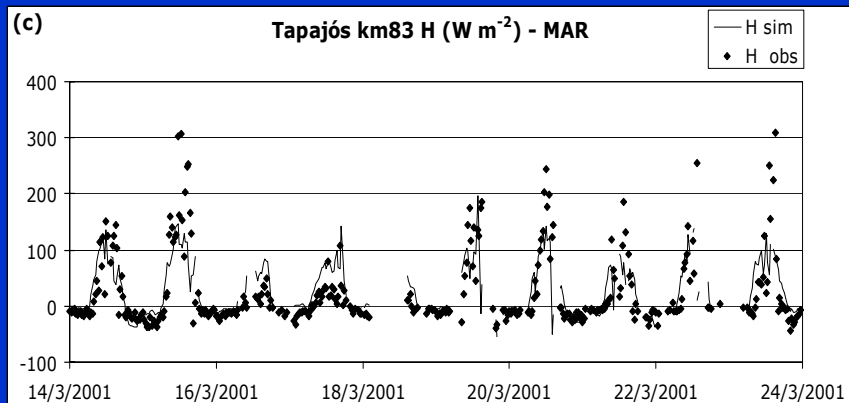
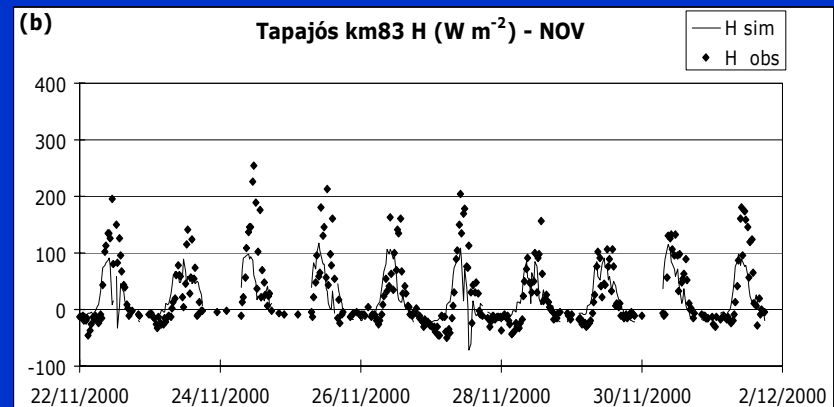
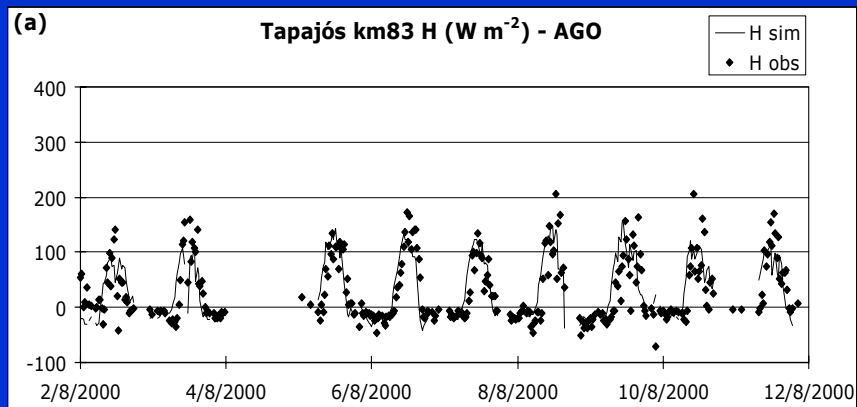
Flona Tapajós km 83



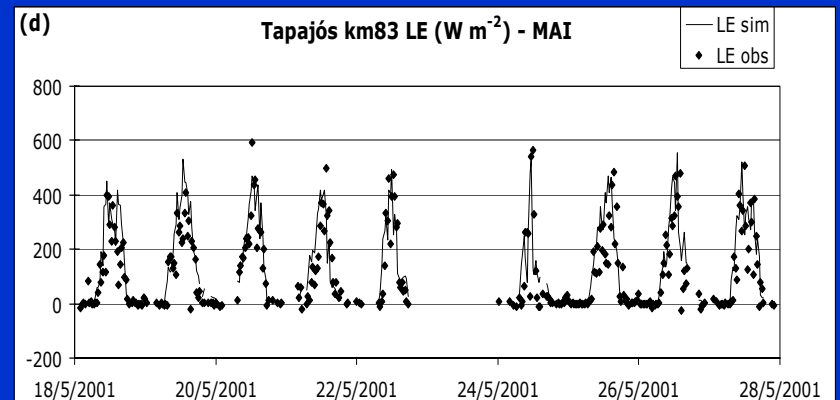
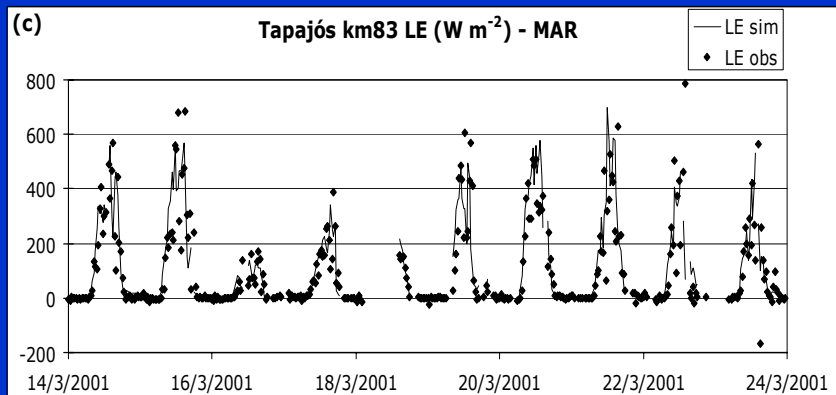
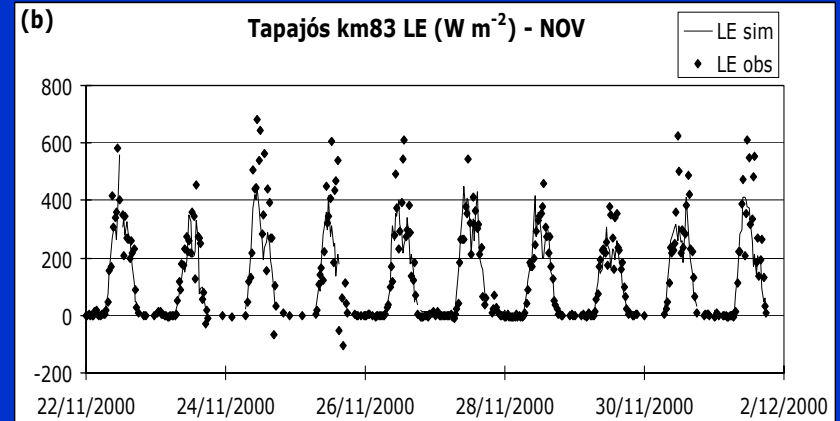
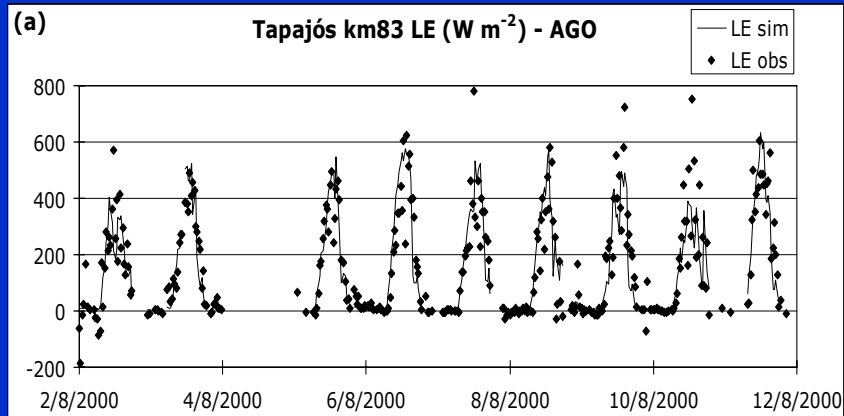
# Flona Tapajós km 83 - Rn



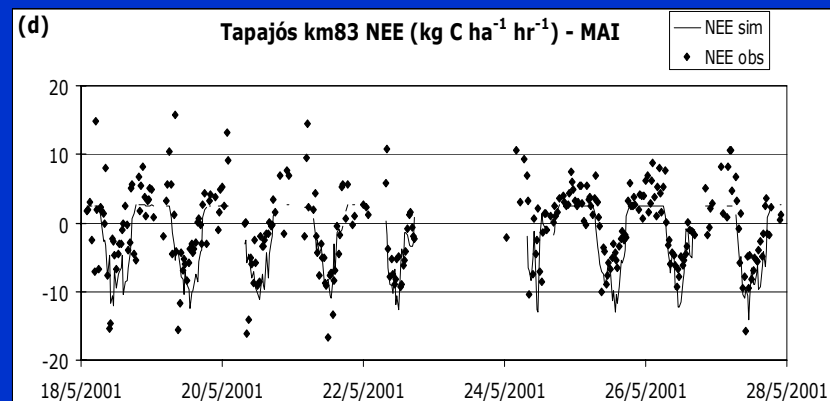
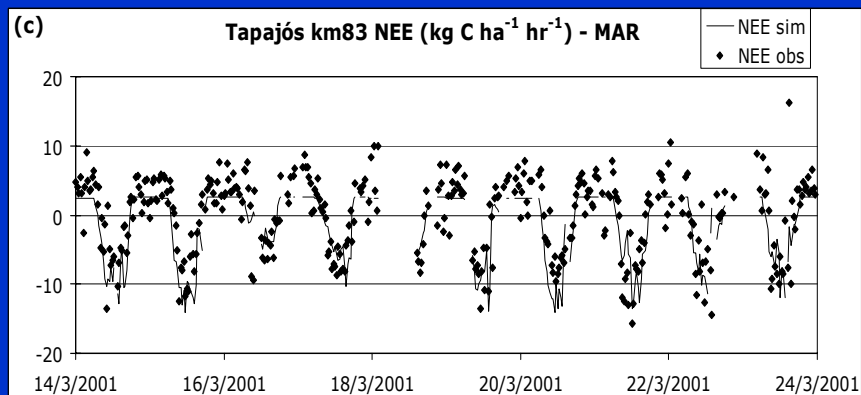
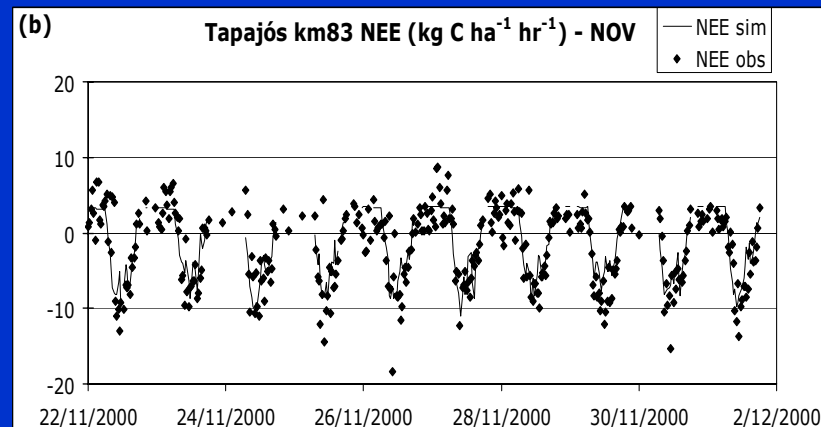
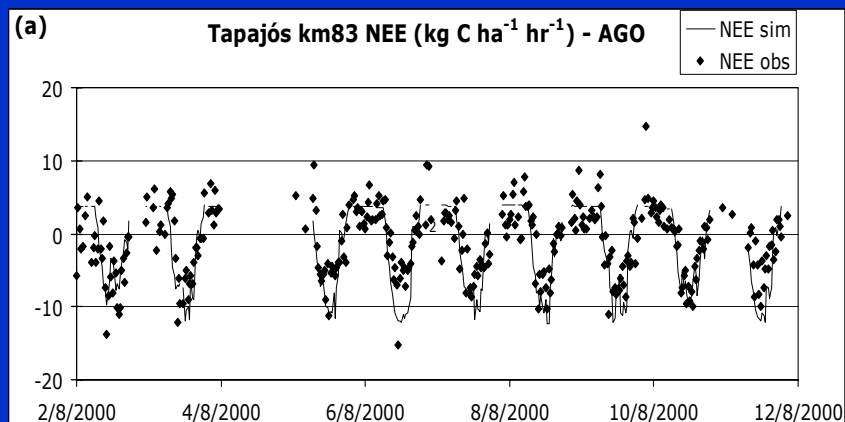
# Flona Tapajós km 83 - H



# Flona Tapajós km 83 - LE

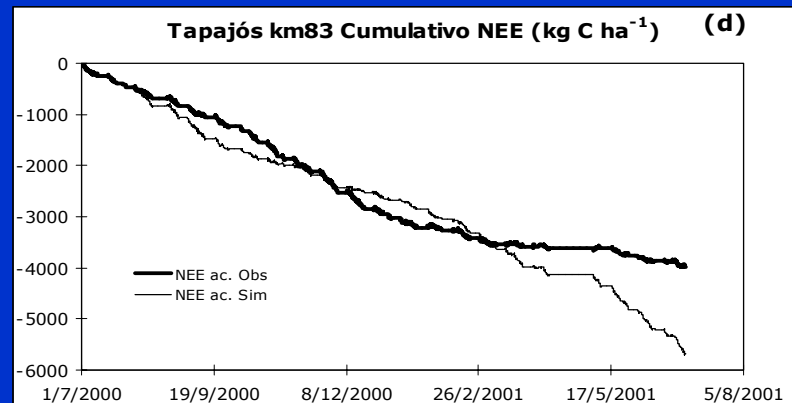
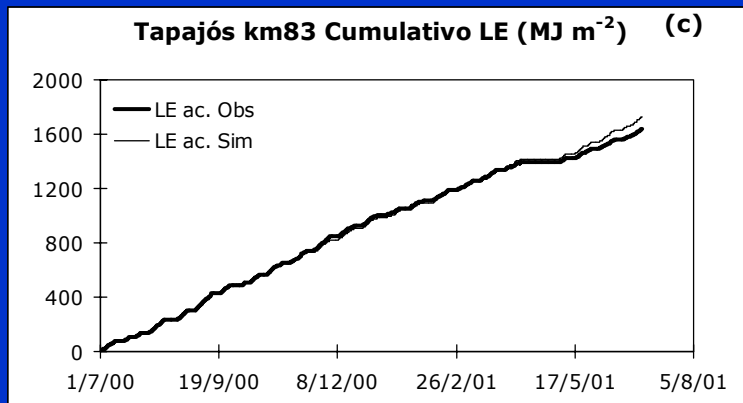
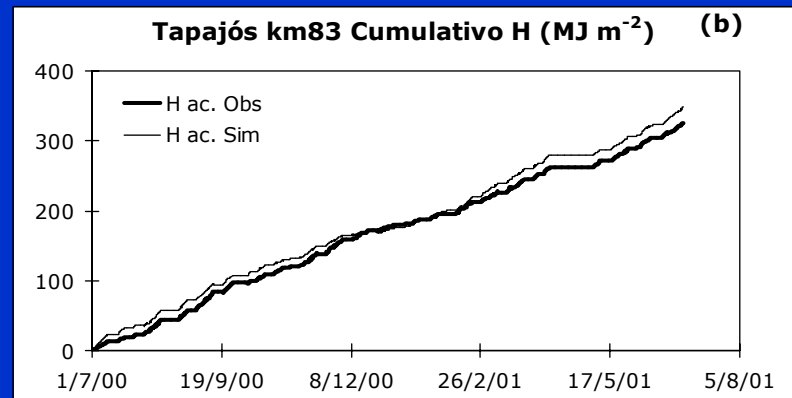
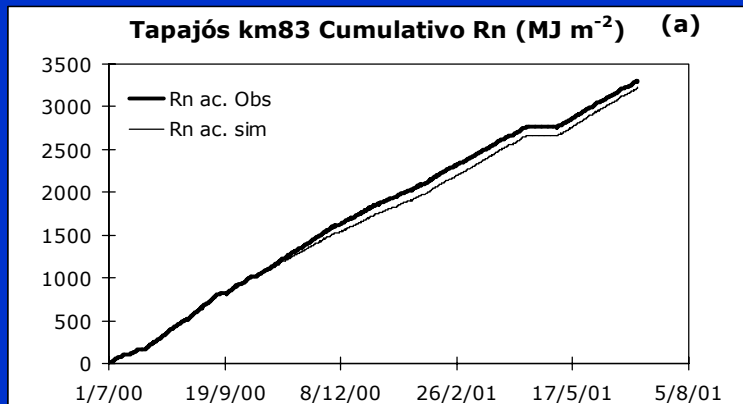


# Flona Tapajós km 83 - NEE



# Flona Tapajós km 83

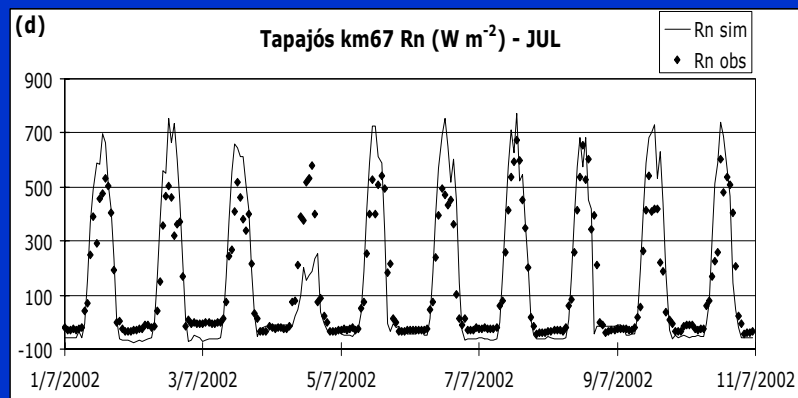
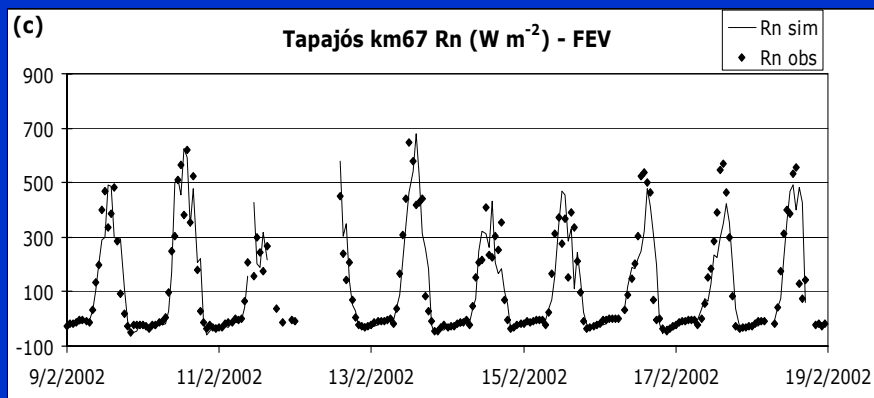
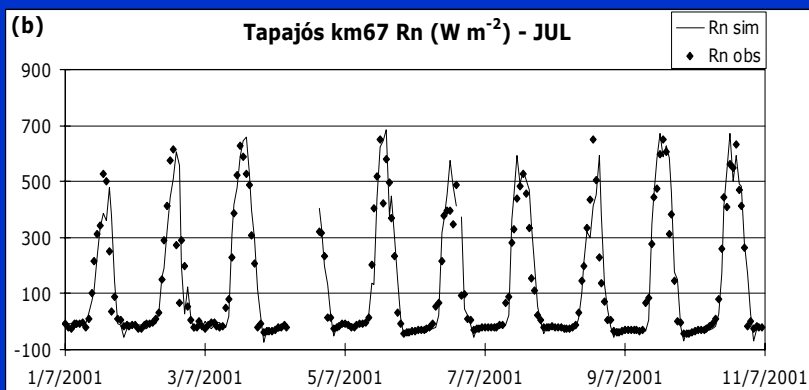
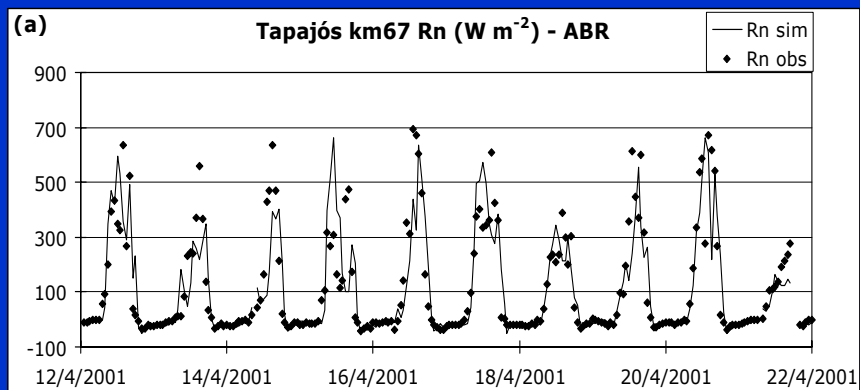
## Cumulative fluxes



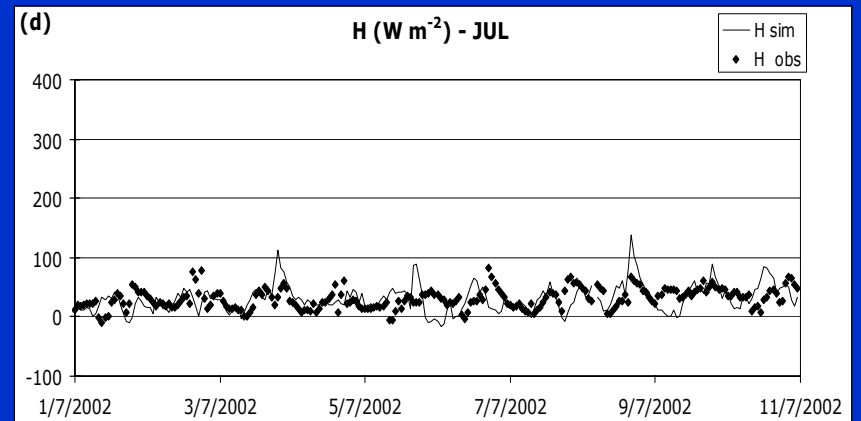
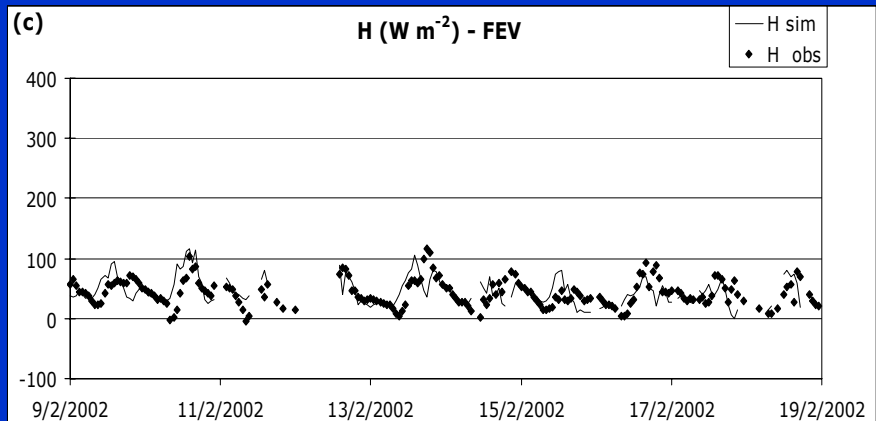
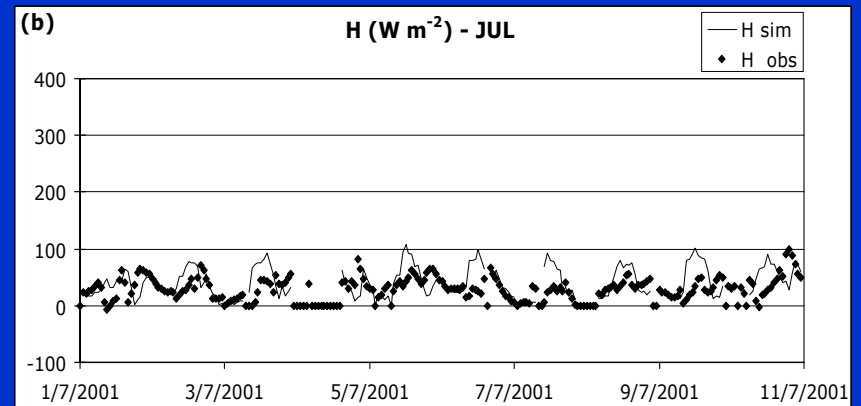
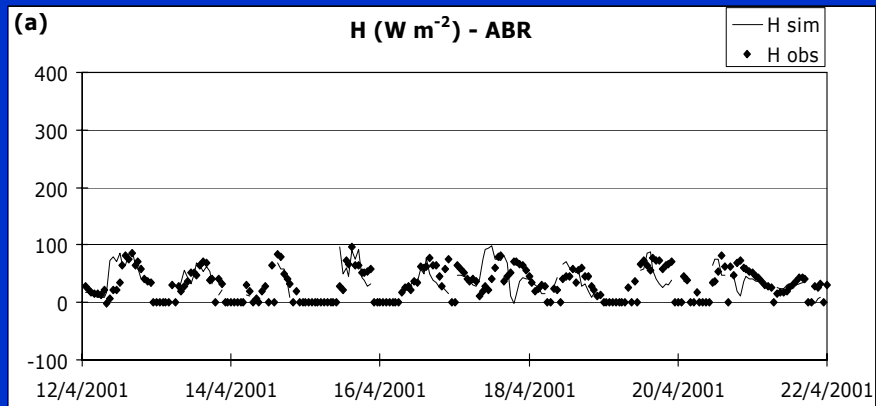
Initial results

Flona Tapajós km 67

# Flona Tapajós km 67 - Rn

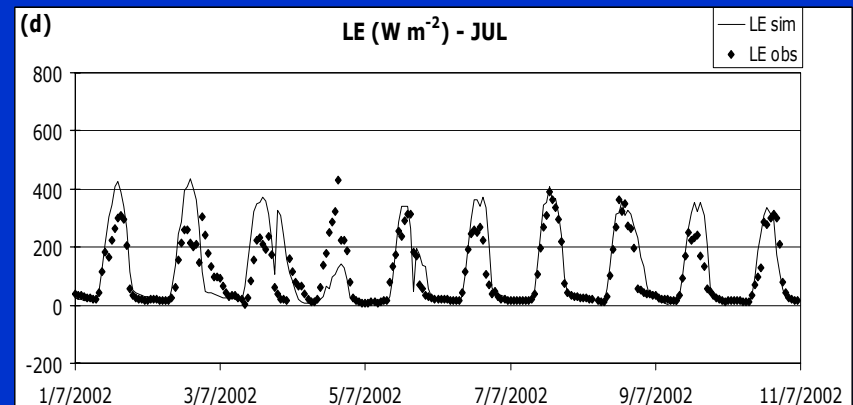
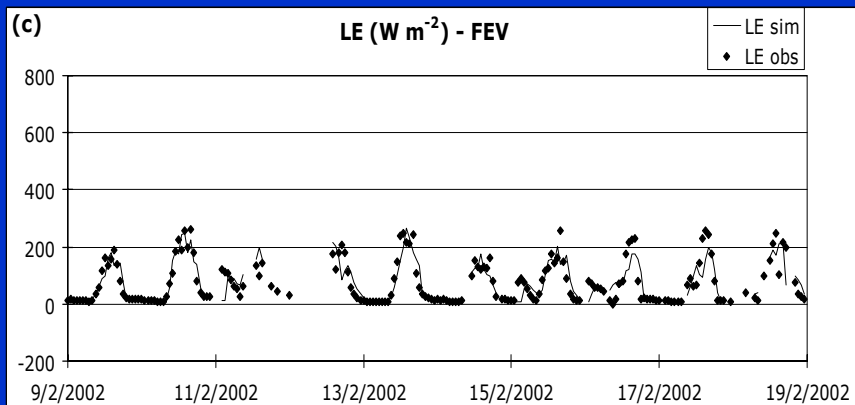
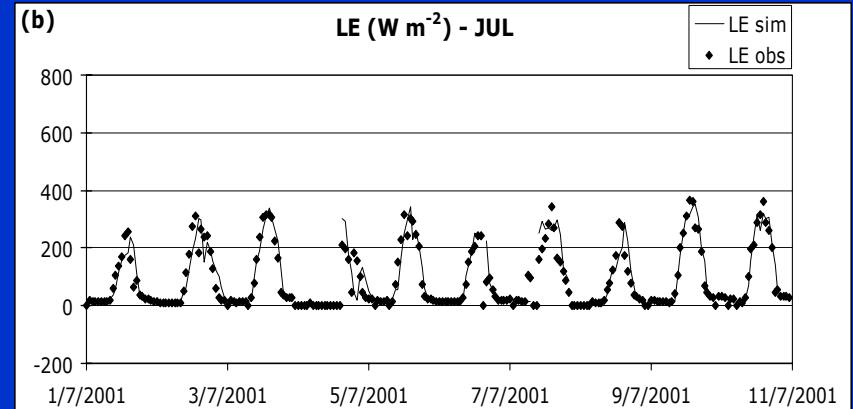
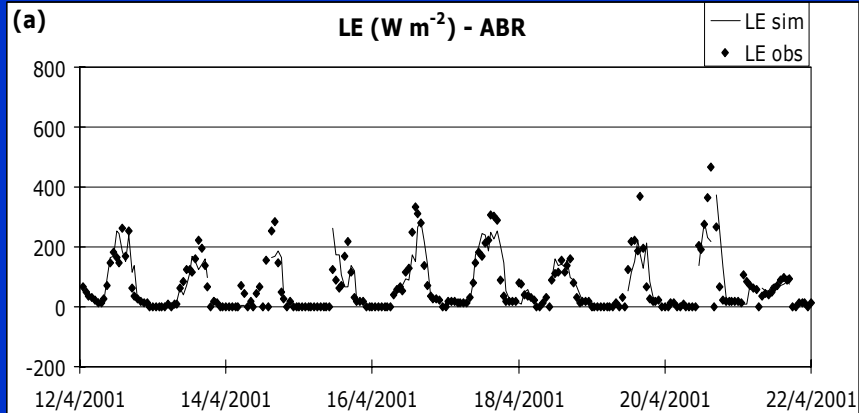


# Flona Tapajós km 67 - H

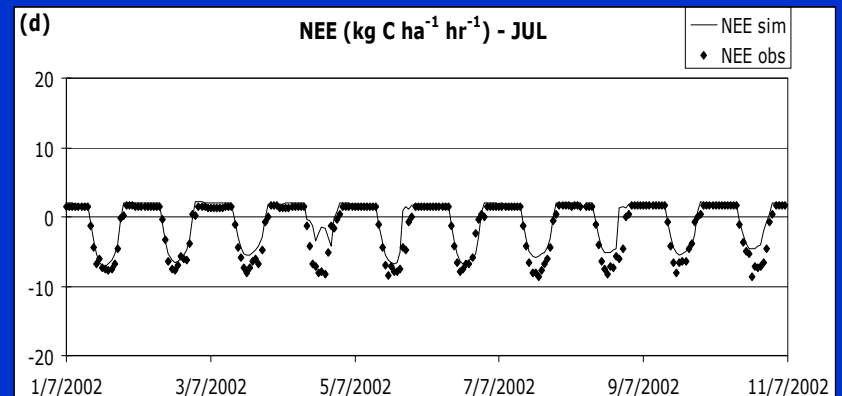
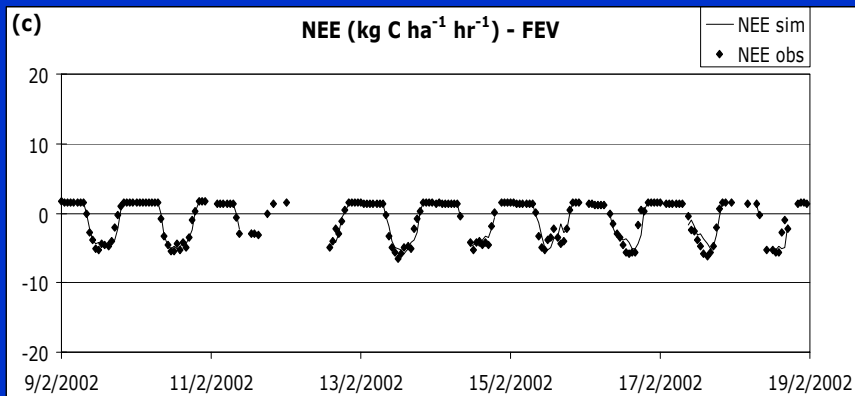
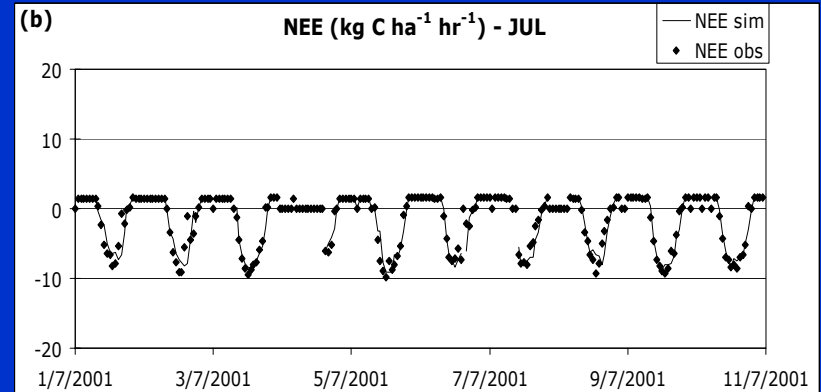
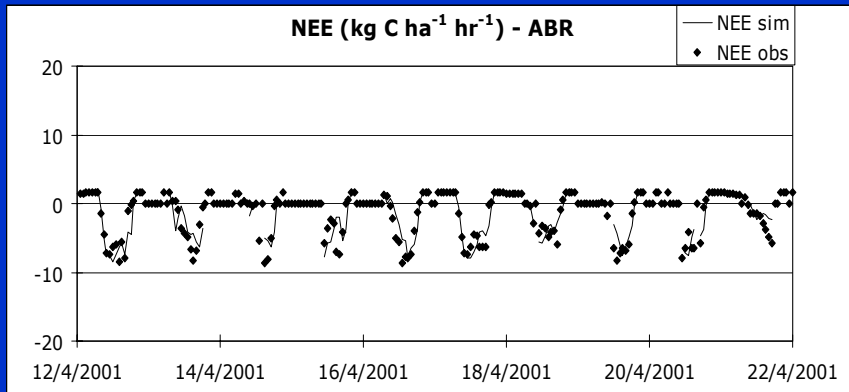




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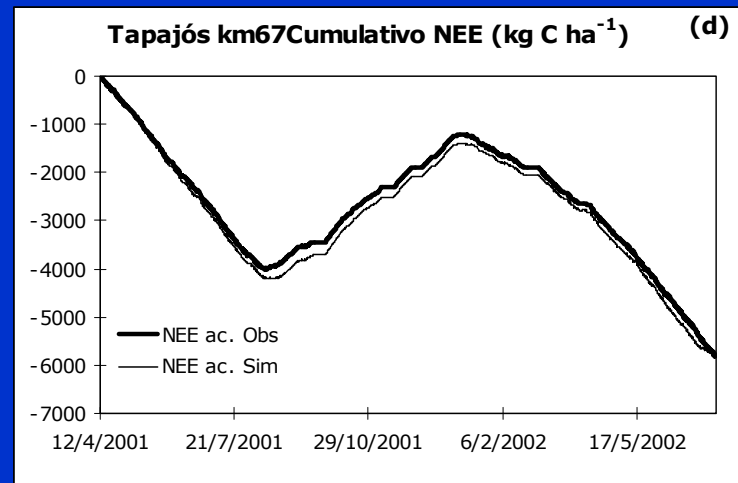
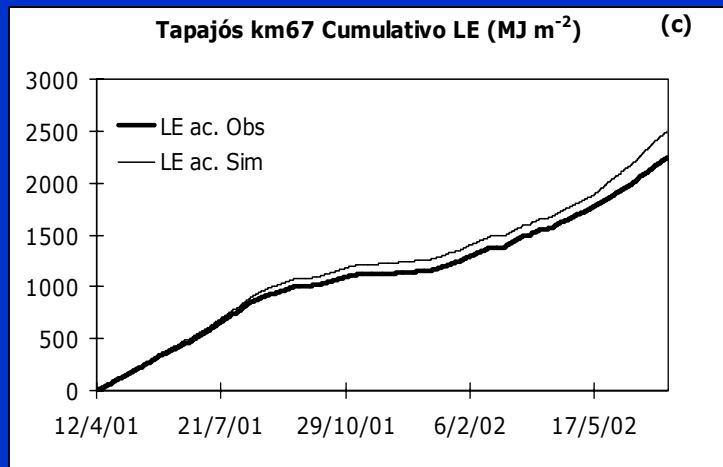
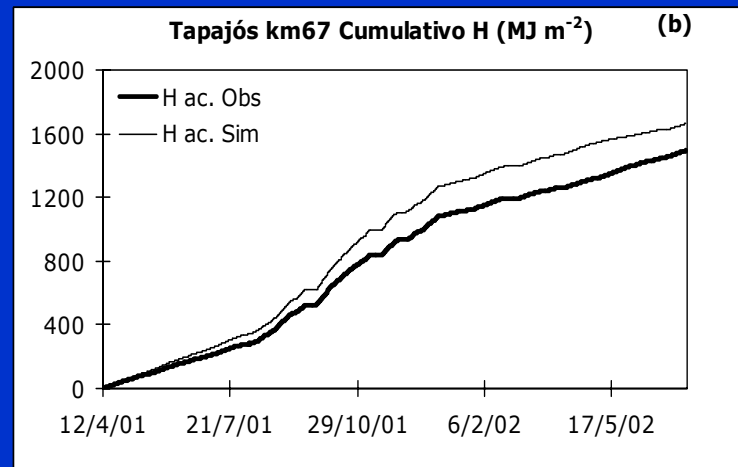
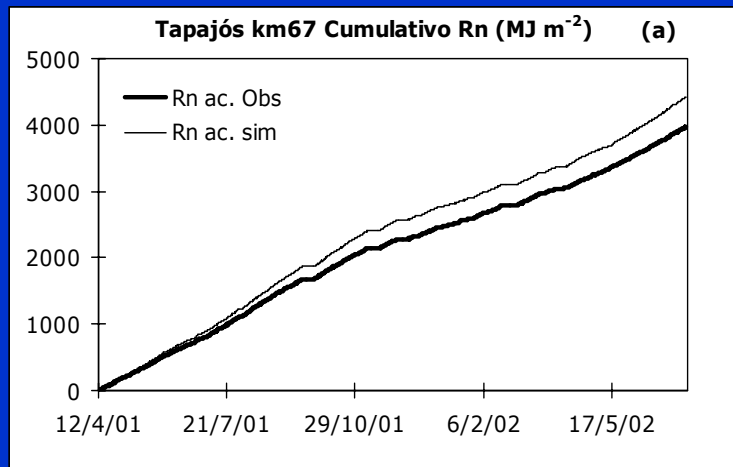


# Flona Tapajós km 67 - NEE



# Flona Tapajós km 67

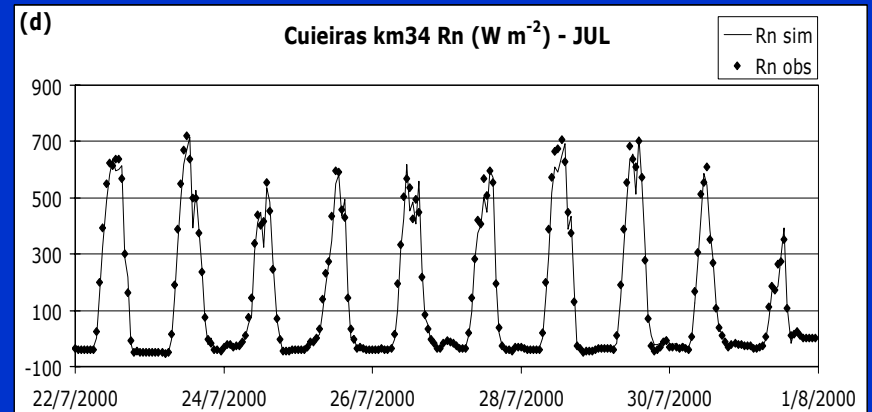
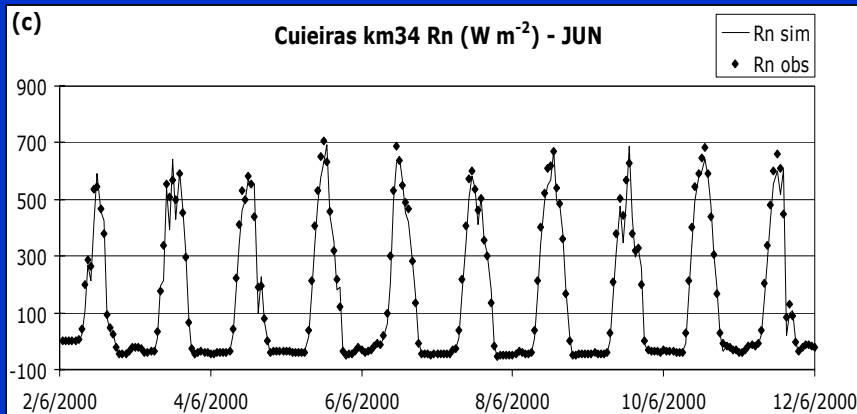
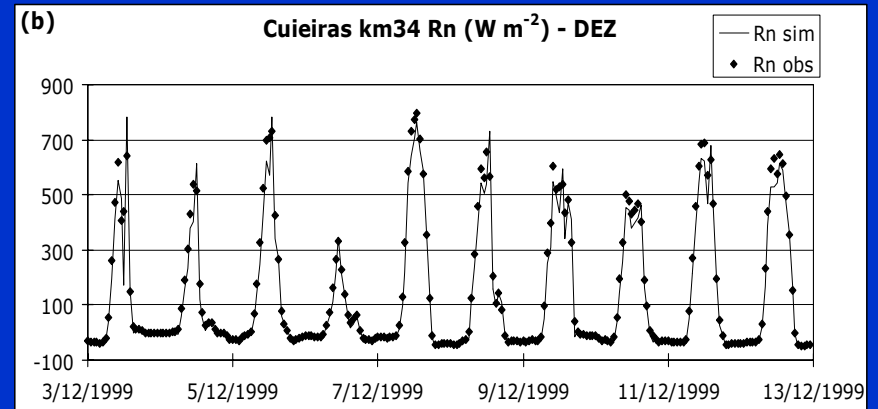
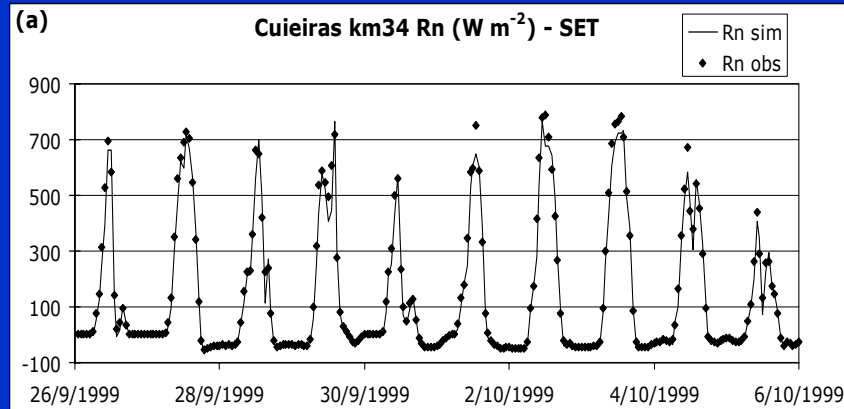
## Cumulative fluxes



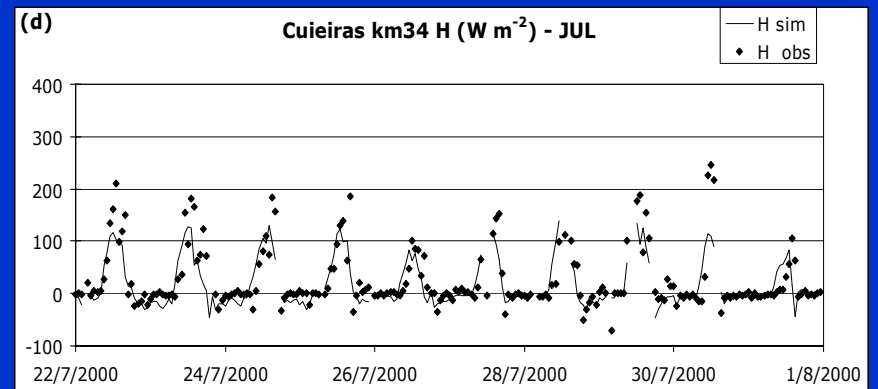
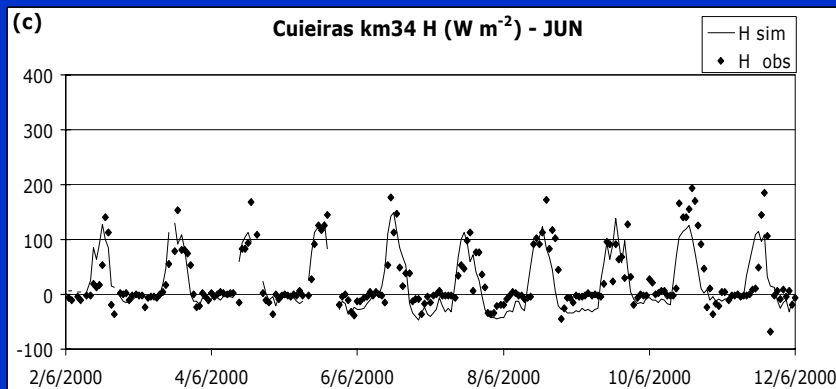
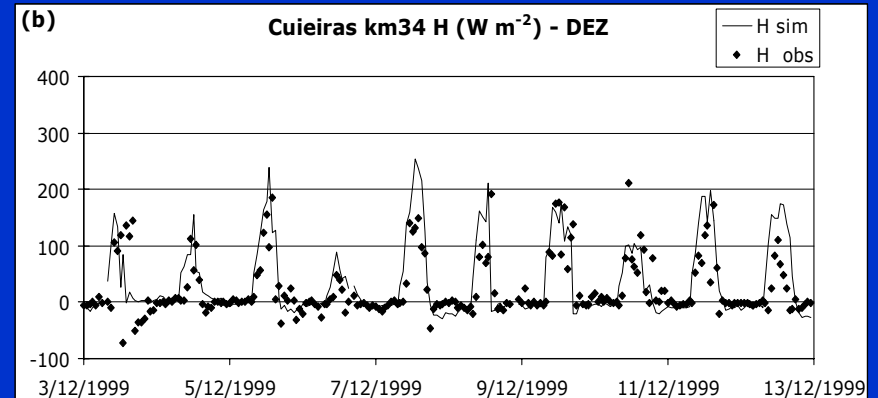
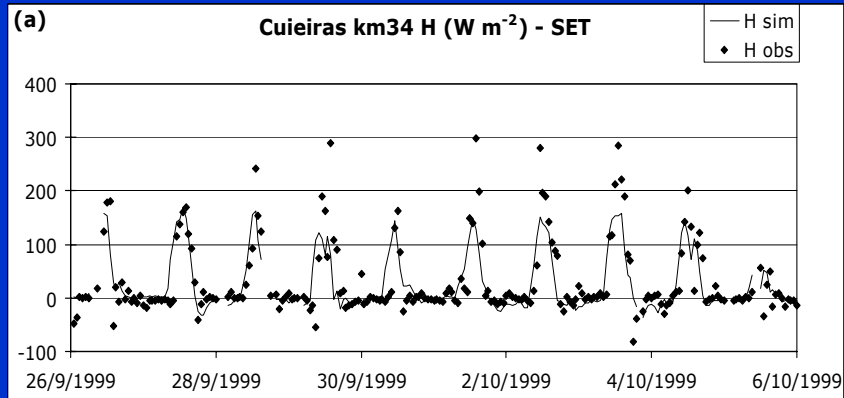
Initial results

Reserva do Cuieiras km 34

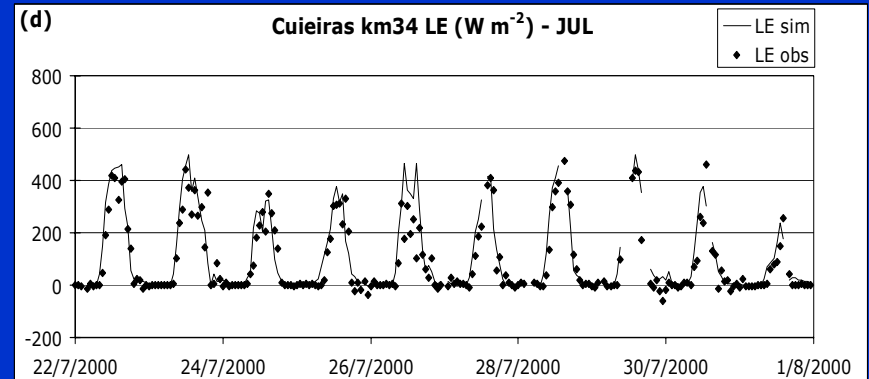
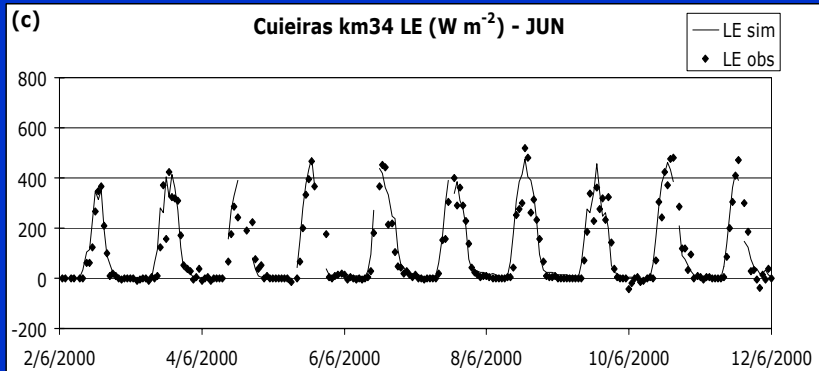
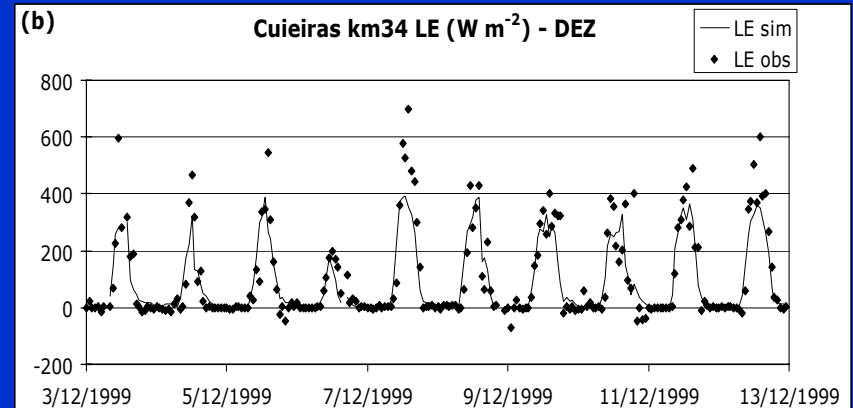
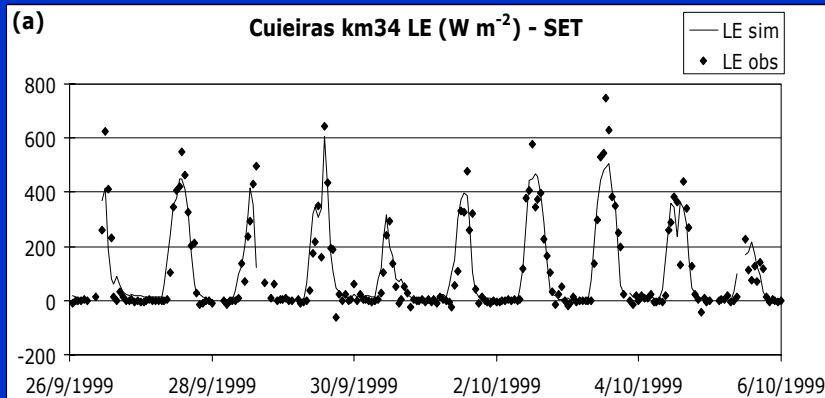
# Reserva do Cuieiras km 34 - Rn



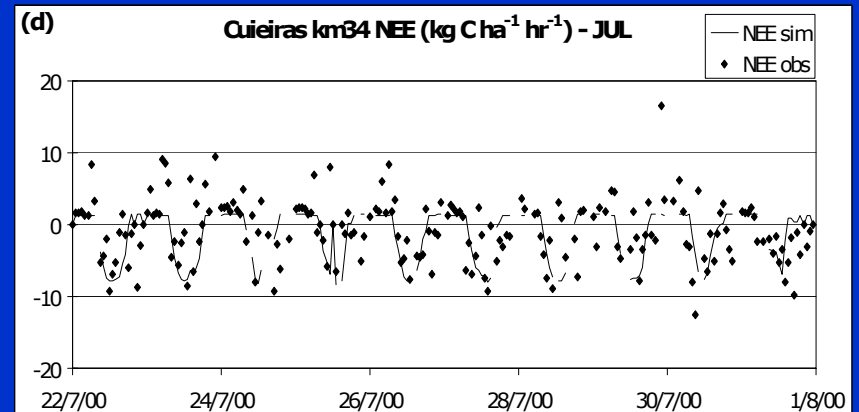
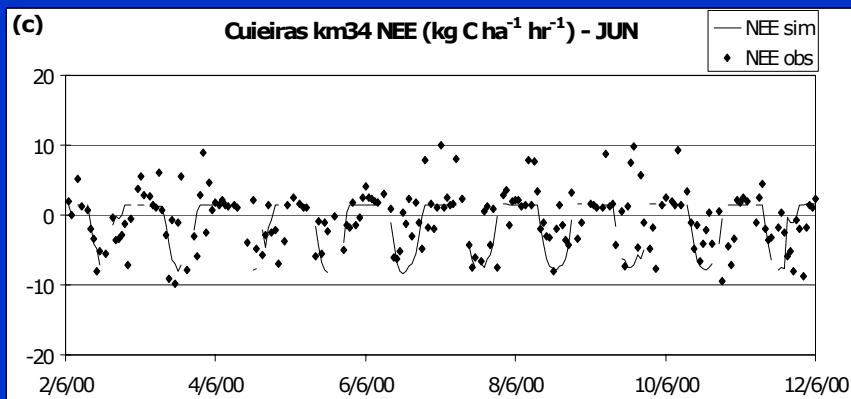
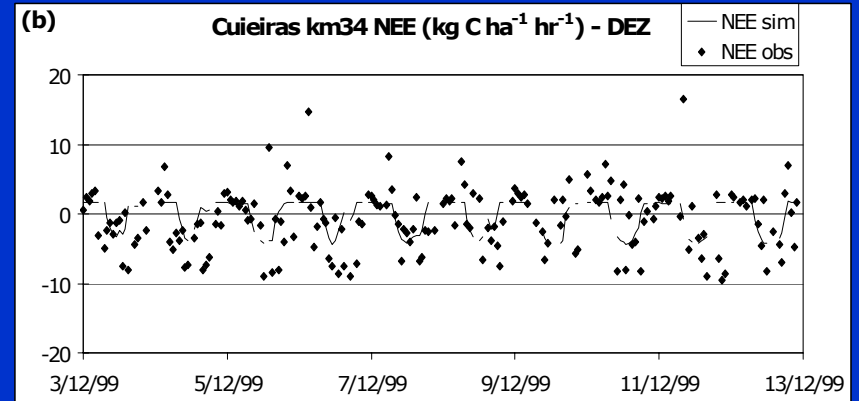
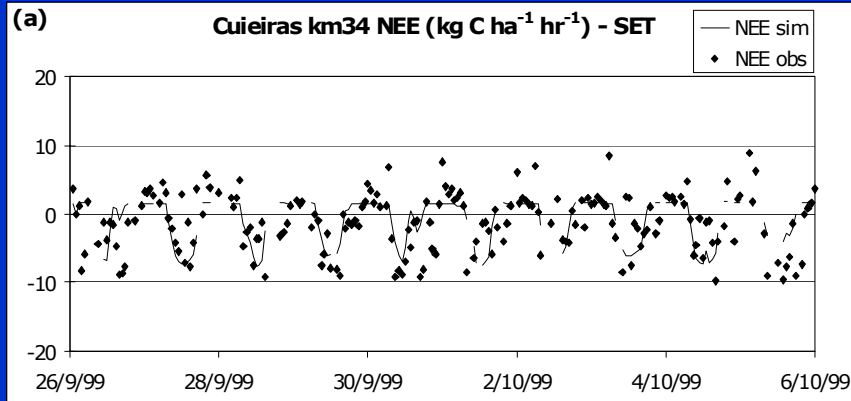
# Reserva do Cuieiras km 34 - H



# Reserva do Cuieiras km 34 - LE



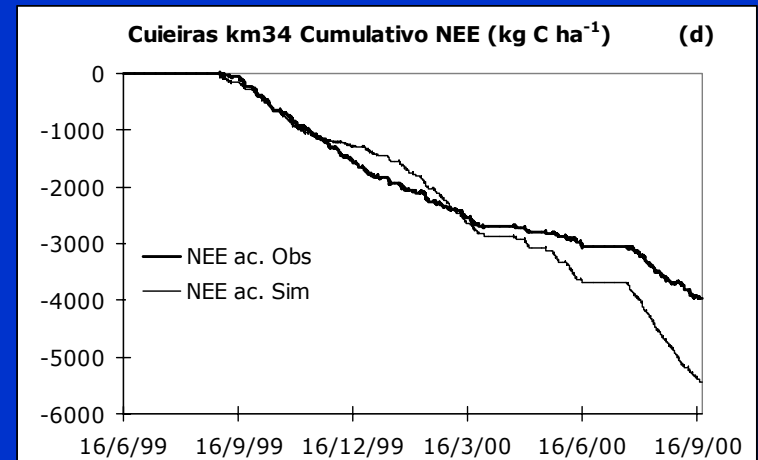
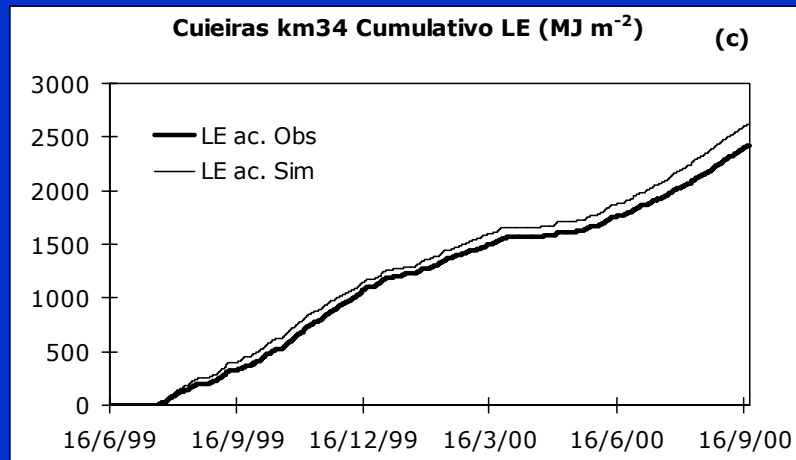
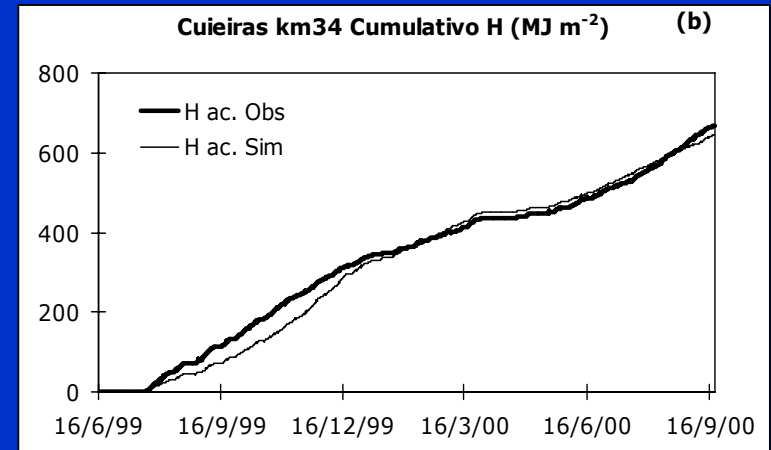
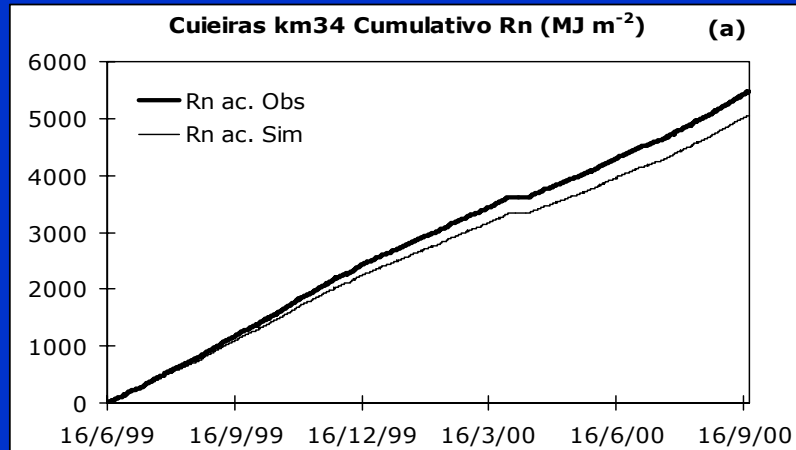
# Reserva do Cuieiras km 34 - NEE





# Reserva do Cuieiras km 34

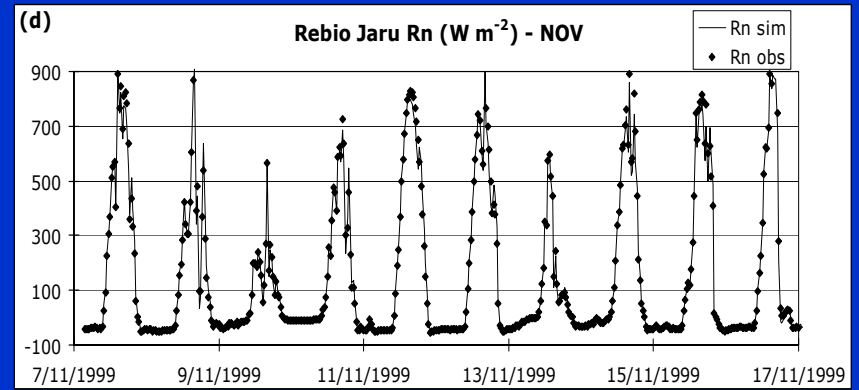
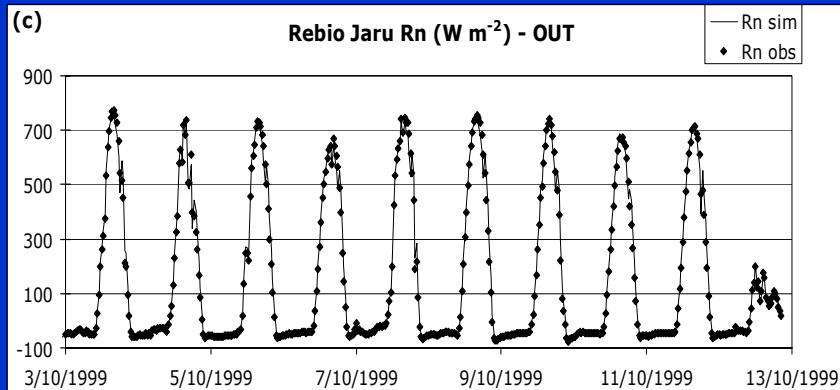
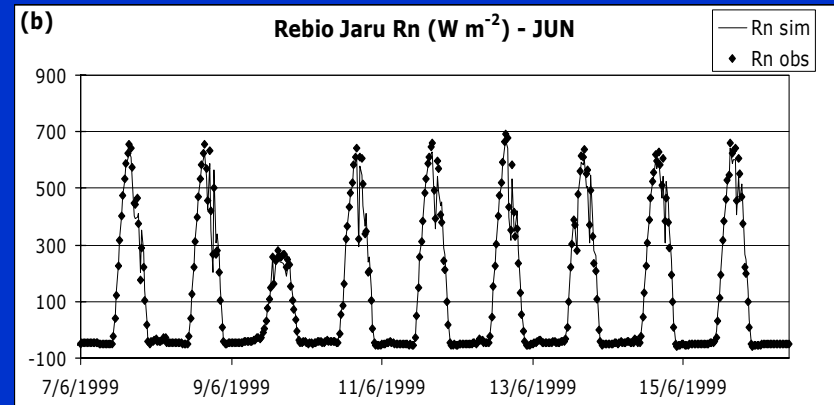
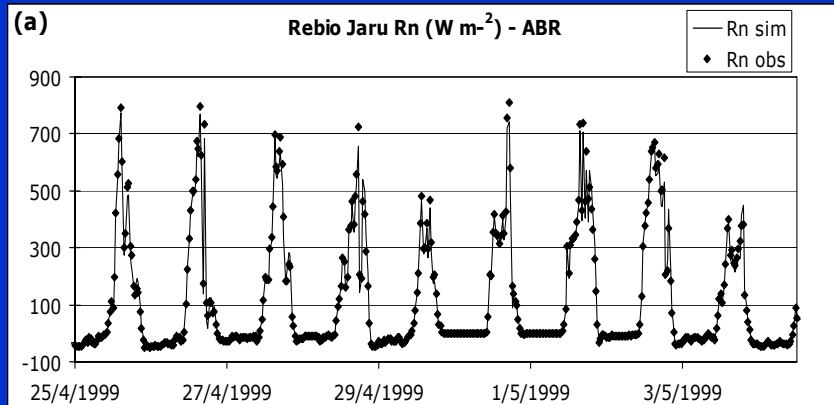
## Cumulative fluxes



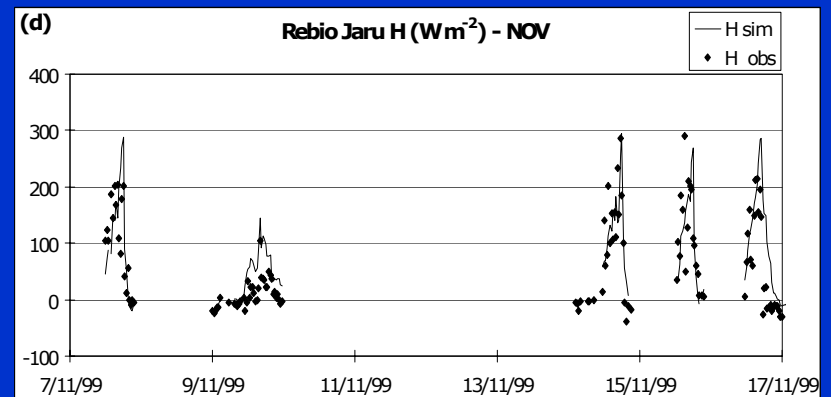
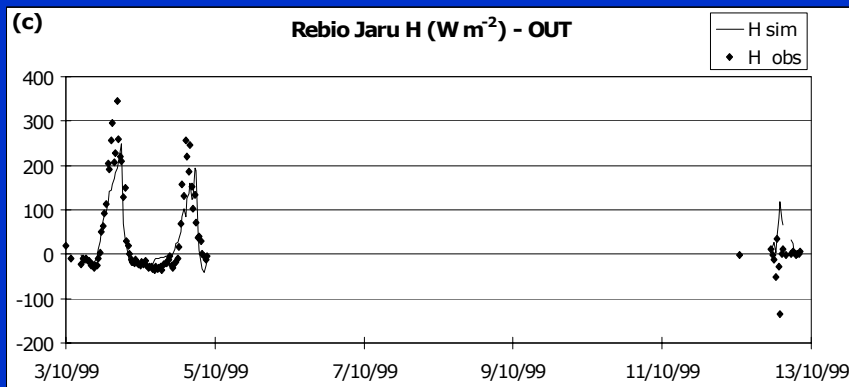
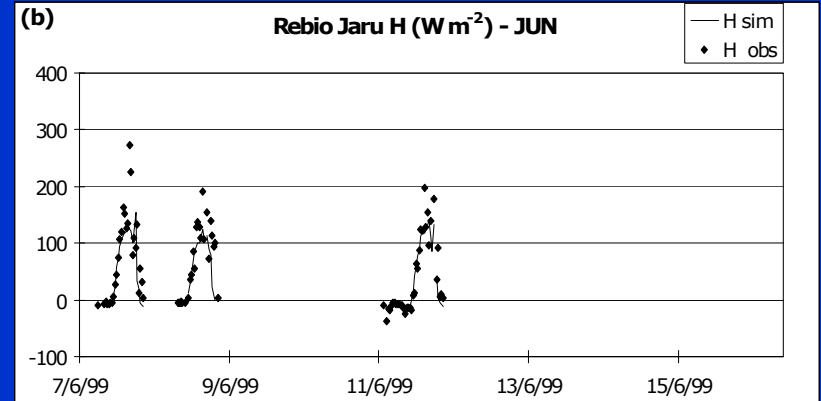
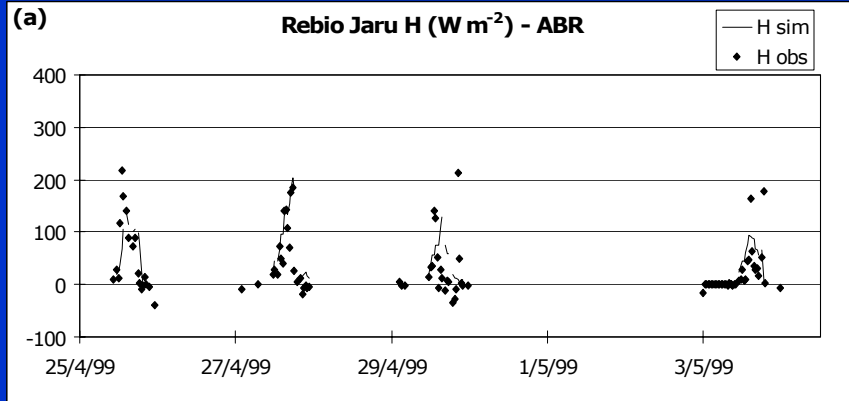
# Initial results

## Rebio Jaru

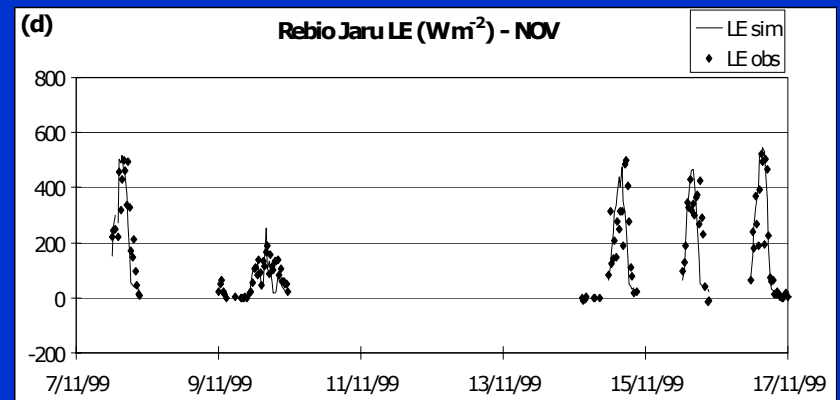
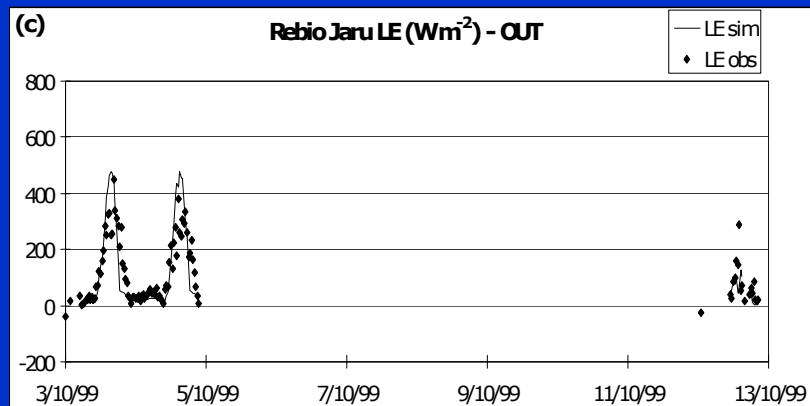
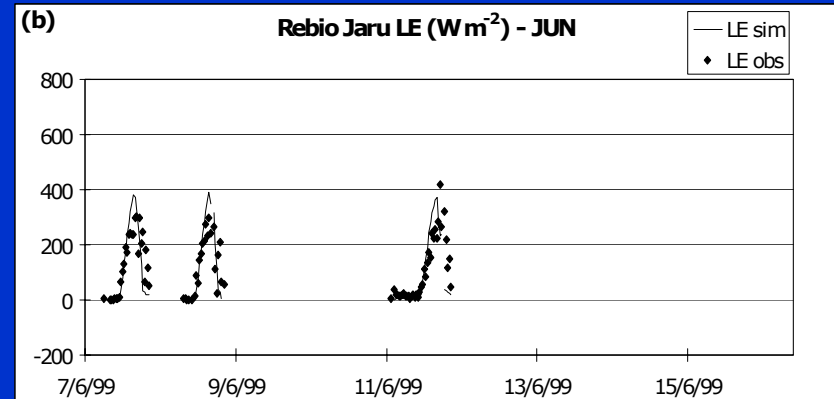
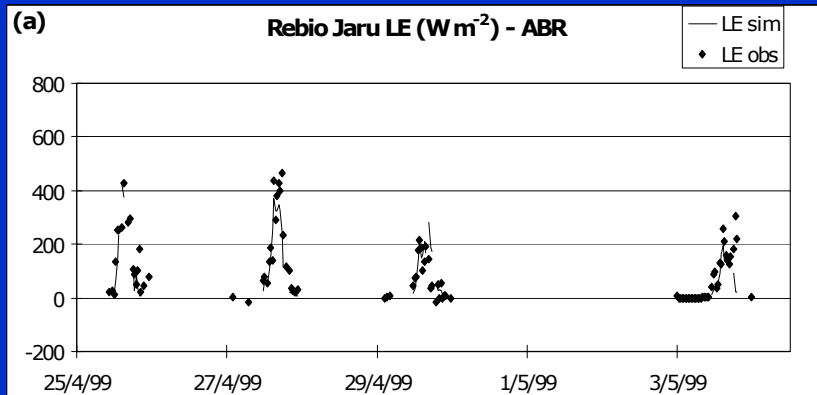
# Rebio Jaru - Rn



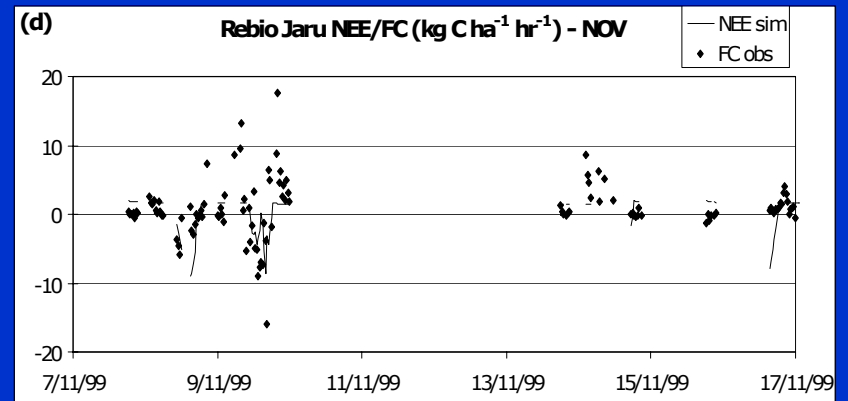
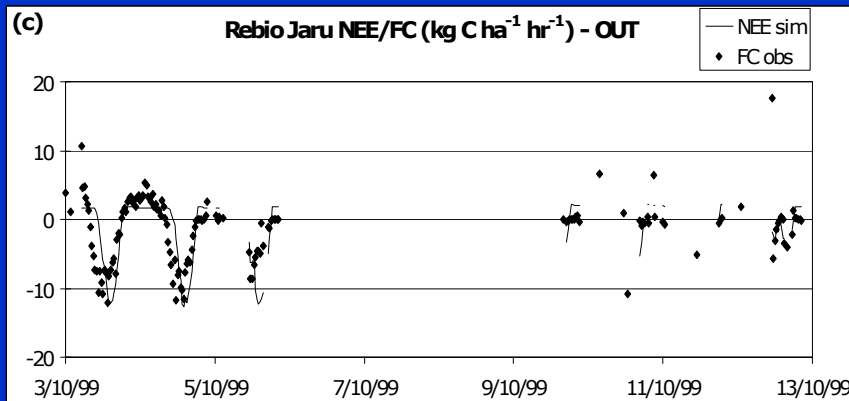
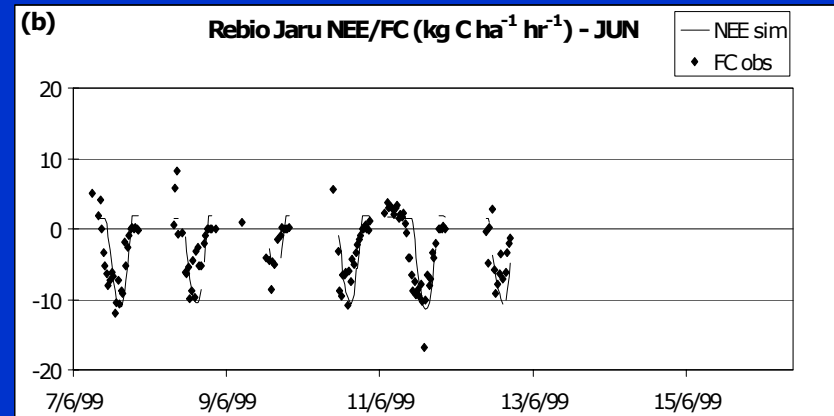
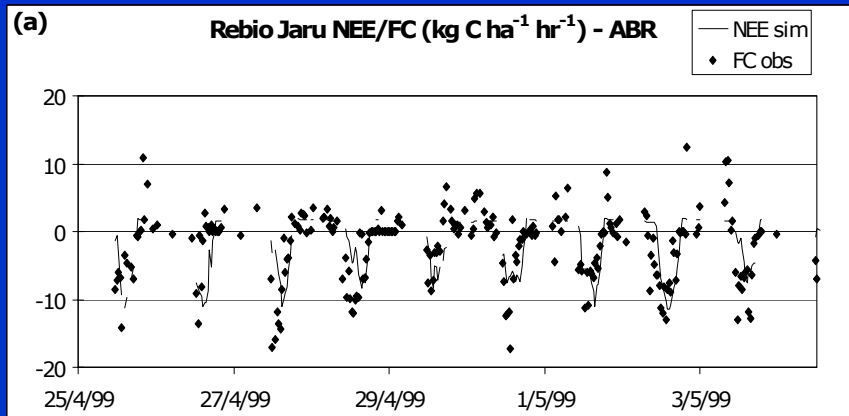
# Rebio Jaru - H



# Rebio Jaru - LE

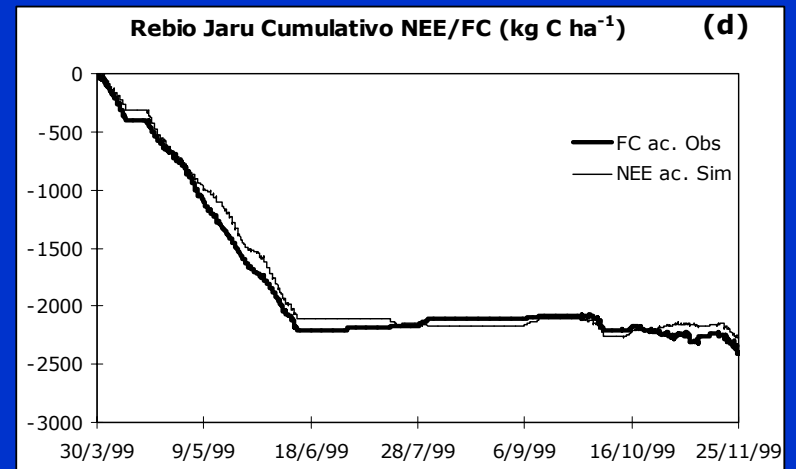
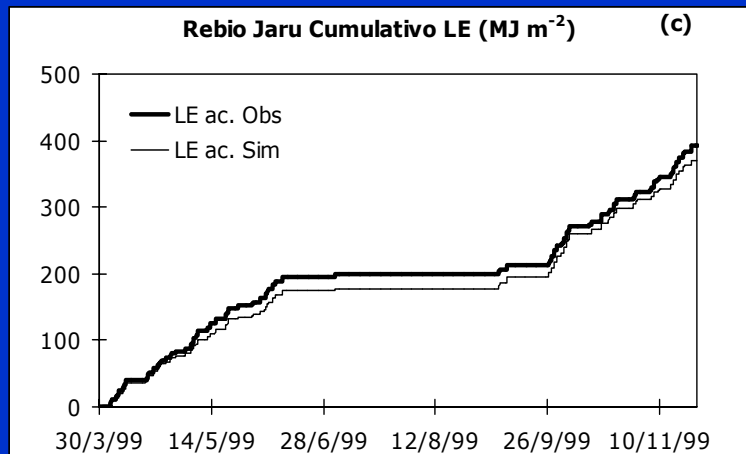
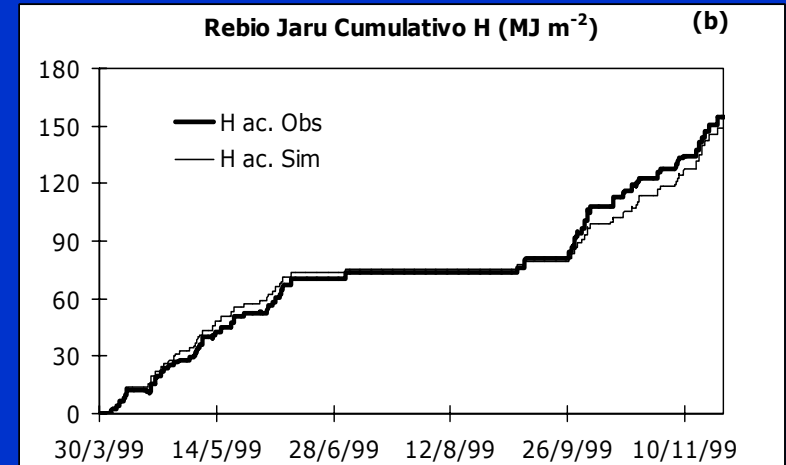
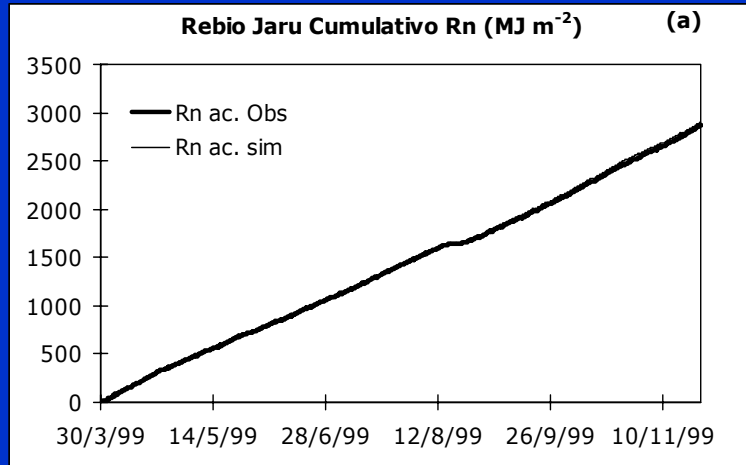


# Rebio Jaru - NEE



# Rebio Jaru

## Cumulative fluxes



# Initial results – summary

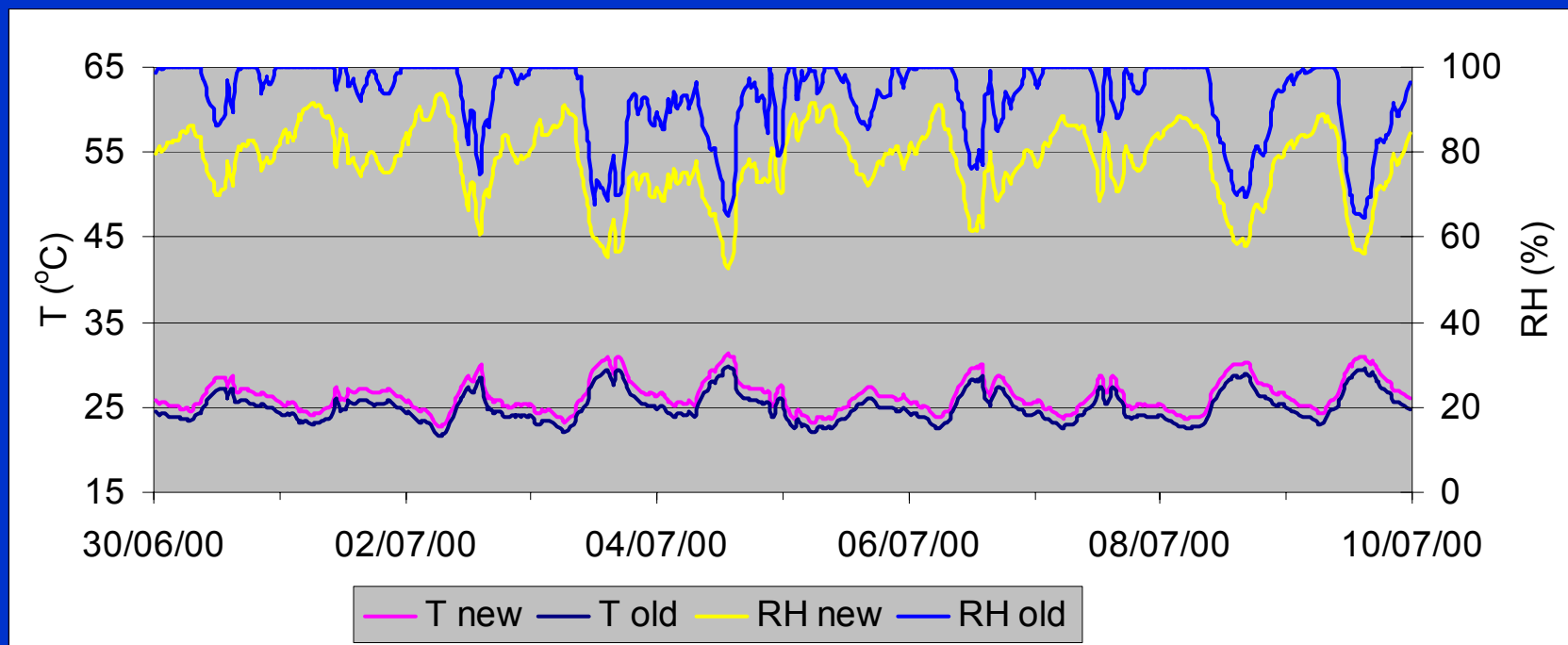
	$\beta_2$	$V_{\max}$ ( $\mu \text{ mol m}^{-2} \text{ s}^{-1}$ )	m	$C_{\text{HS}}$ ( $\text{J m}^{-2} \text{ }^{\circ}\text{C}^{-1}$ )
km 83	0.997	120	11	$0.325 \cdot 10^5$
km 67	0.980	65	9	$2.109 \cdot 10^5$
km 34	0.985	70	9	$0.263 \cdot 10^5$
Rebio Jaru	0.997	120	10	$0.527 \cdot 10^5$



# 3. New results

- Flona Tapajós km 83 and km 67 only
- Same period for km 83, but with revised meteorological station and flux data
- Errors reported in water vapor at the initial time series initially used
- Used different period for km 67

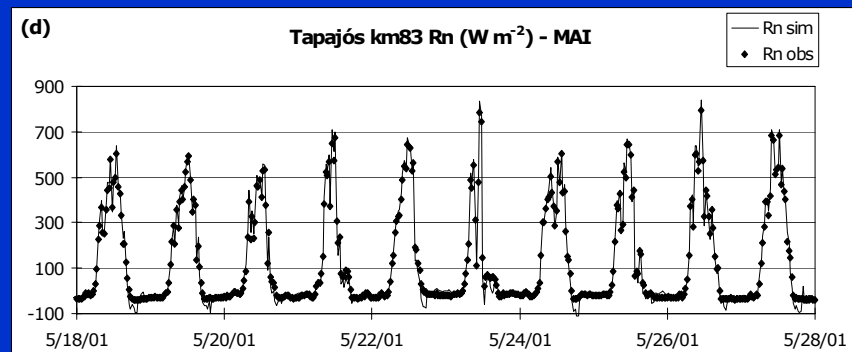
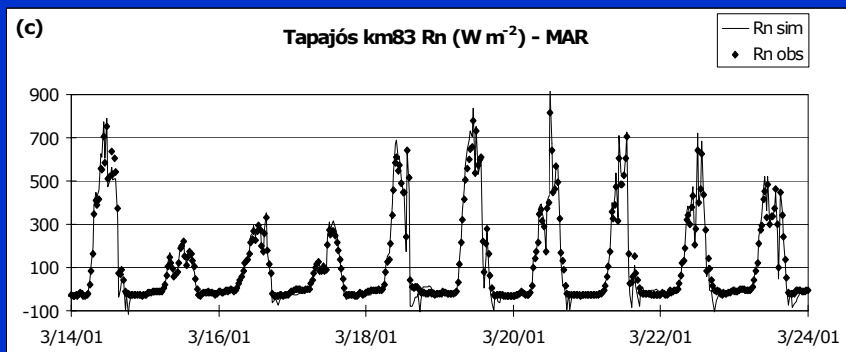
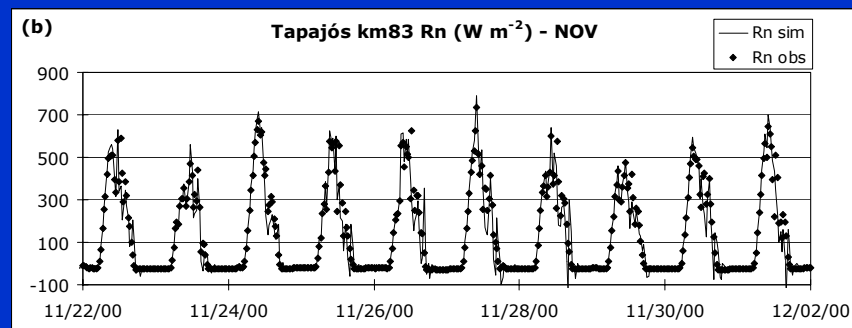
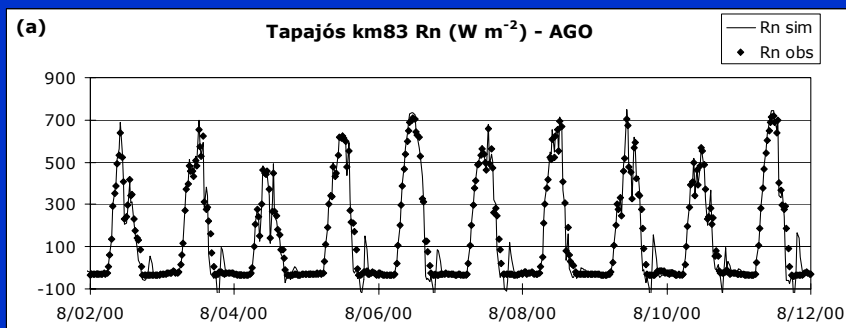
# Flona Tapajós km 83



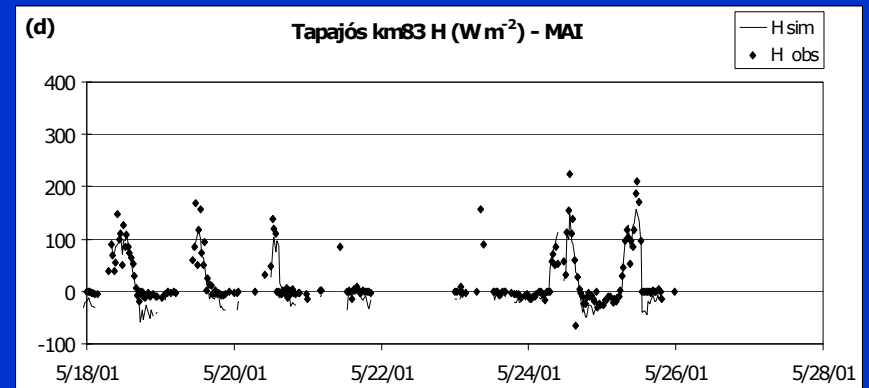
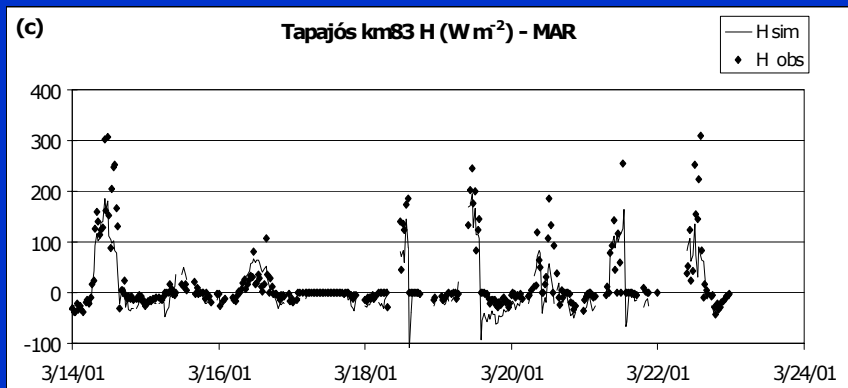
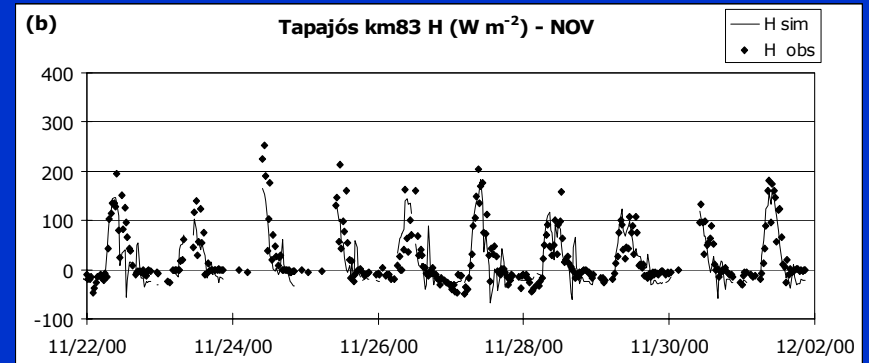
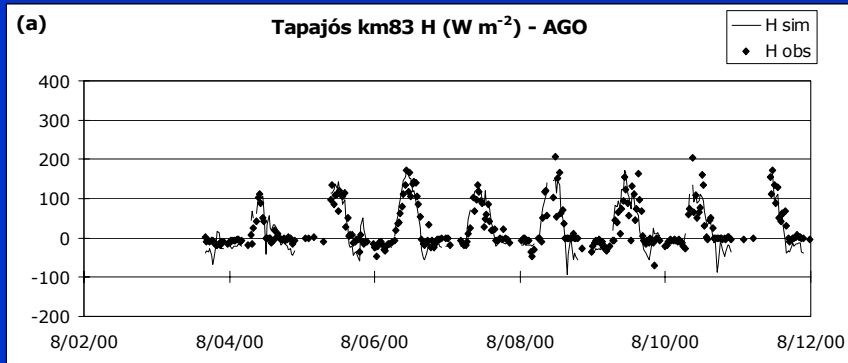
### 3. New results (still preliminary)

Flona Tapajós km 83

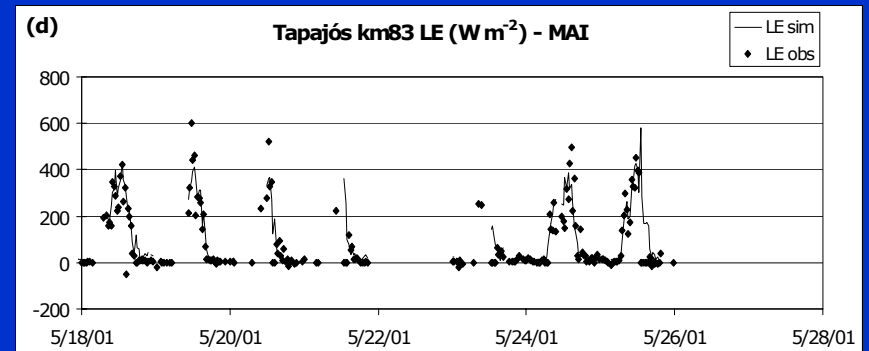
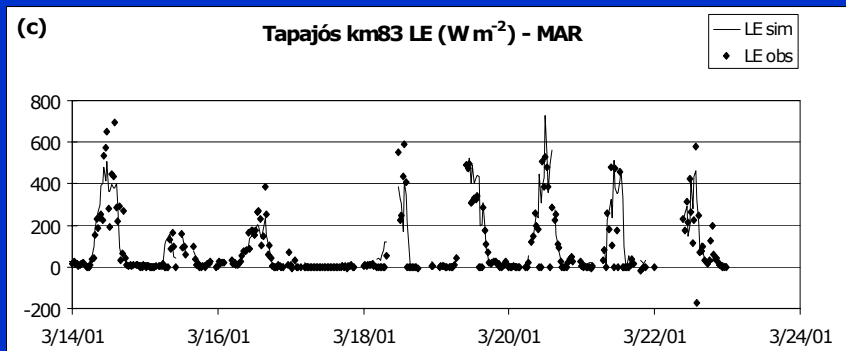
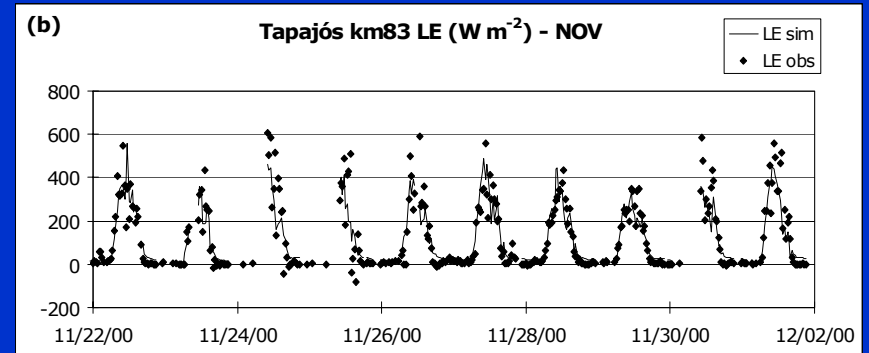
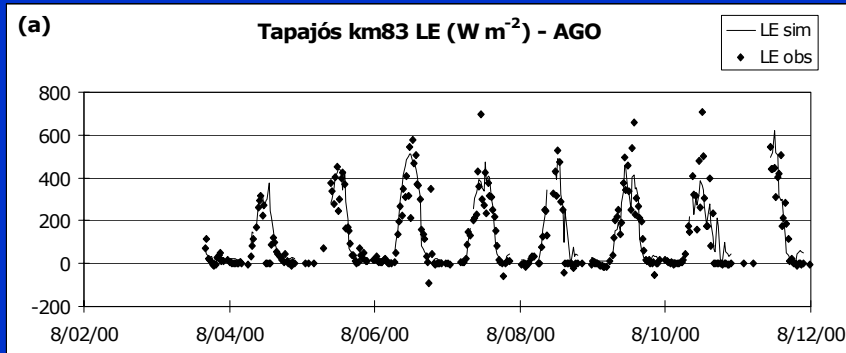
# Flona Tapajós km 83 - Rn



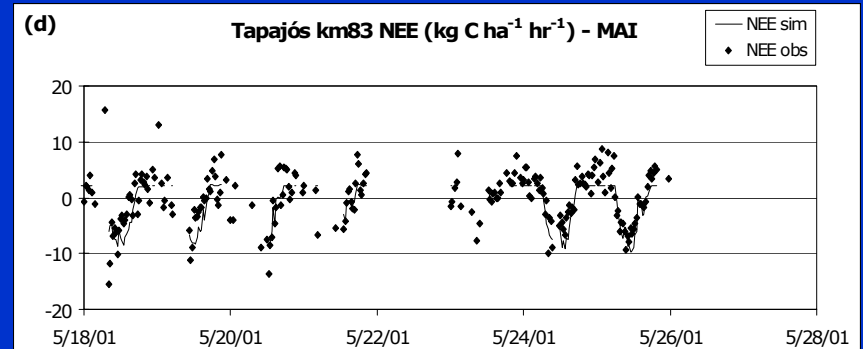
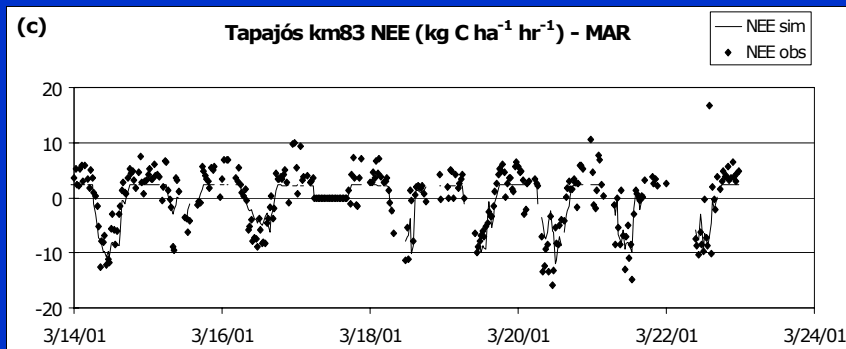
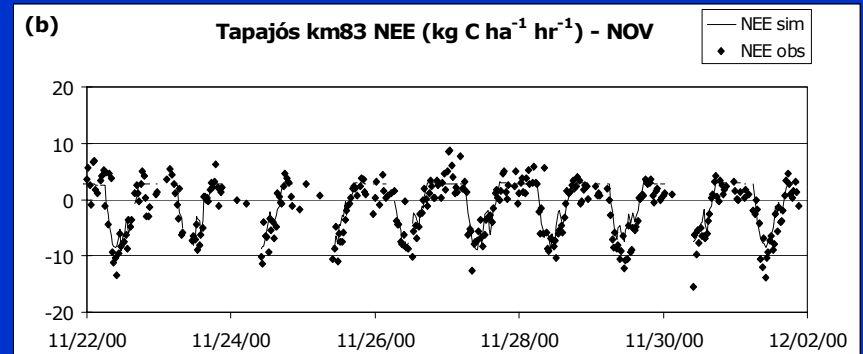
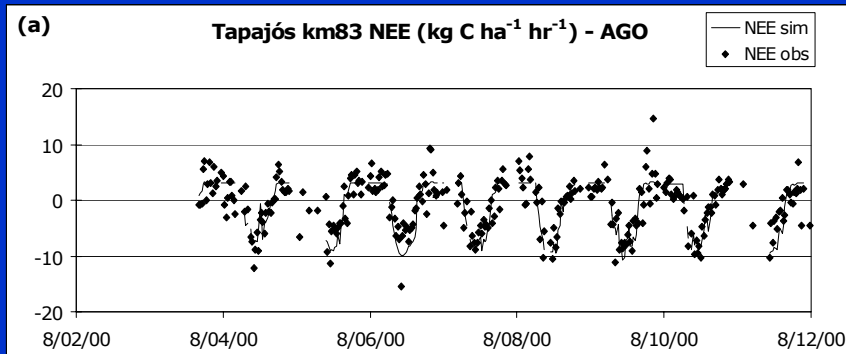
# Flona Tapajós km 83 - H



# Flona Tapajós km 83 - LE



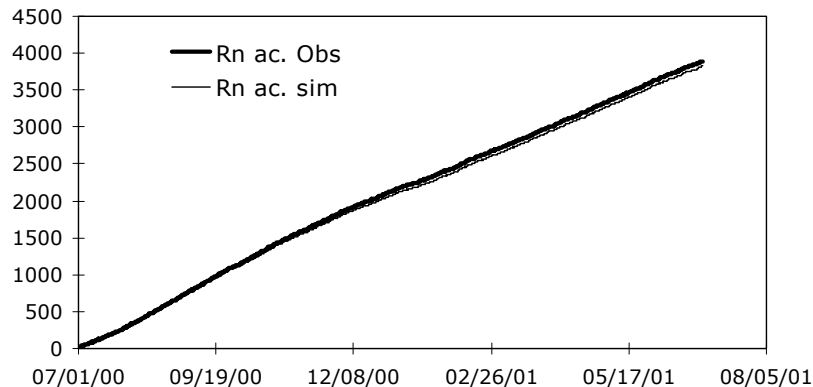
# Flona Tapajós km 83 - NEE



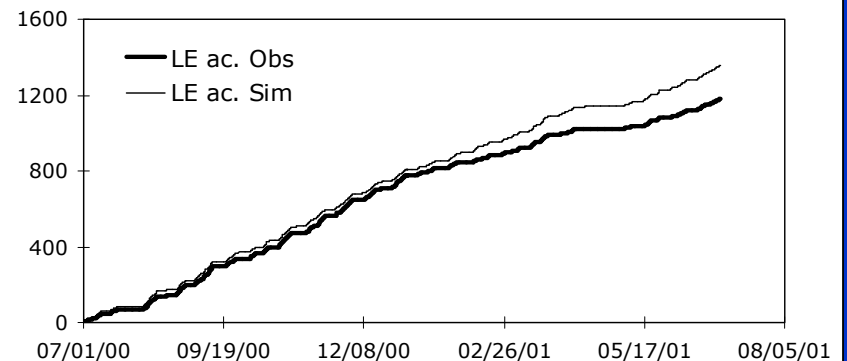
# Flona Tapajós km 83

## Cumulative fluxes

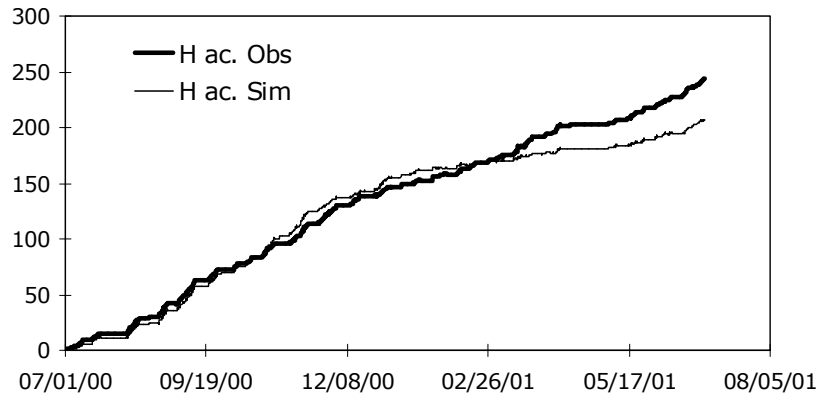
Tapajós km83 Cumulative Rn ( $\text{MJ m}^{-2}$ ) (a)



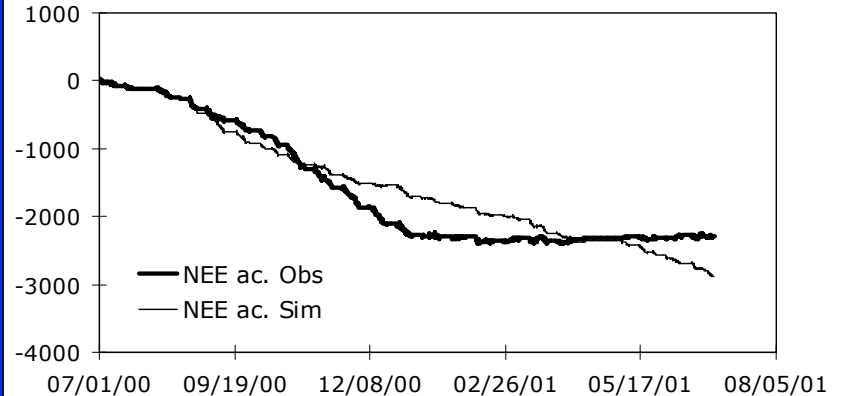
Tapajós km83 Cumulative LE ( $\text{MJ m}^{-2}$ ) (c)



Tapajós km83 Cumulative H ( $\text{MJ m}^{-2}$ ) (b)



Tapajós km83 Cumulative NEE ( $\text{kg C ha}^{-1}$ ) (d)

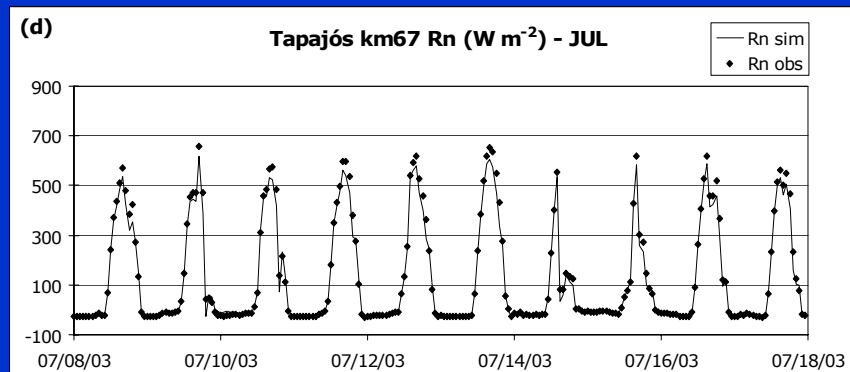
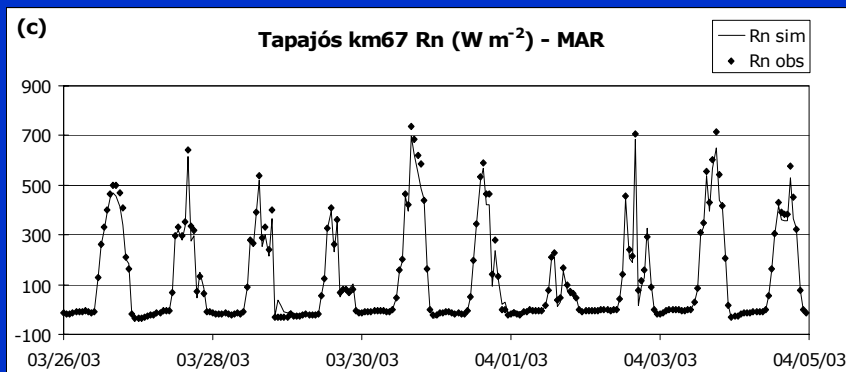
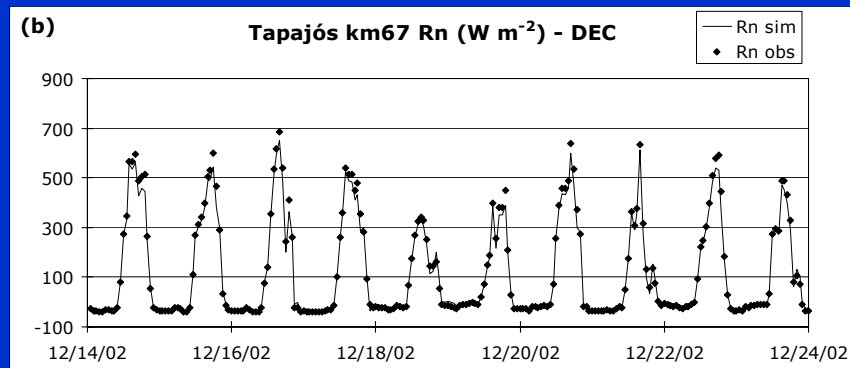
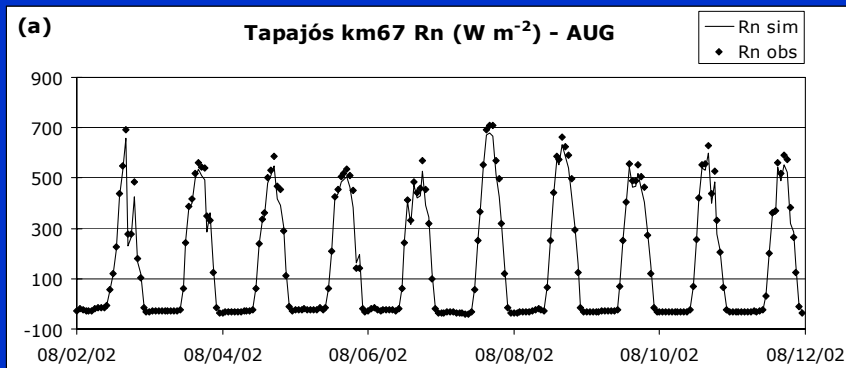




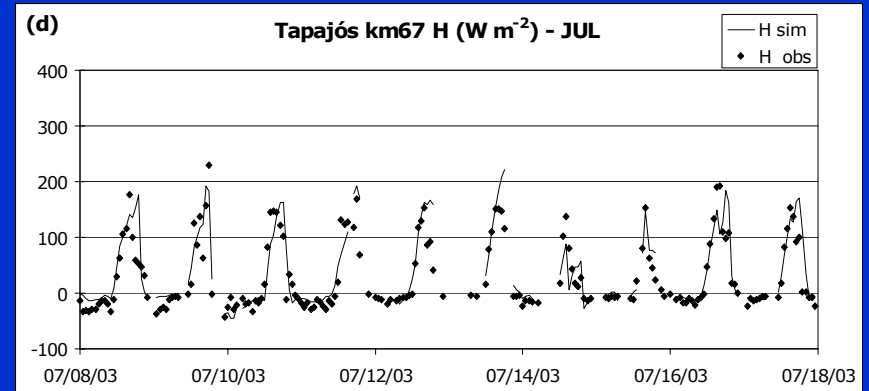
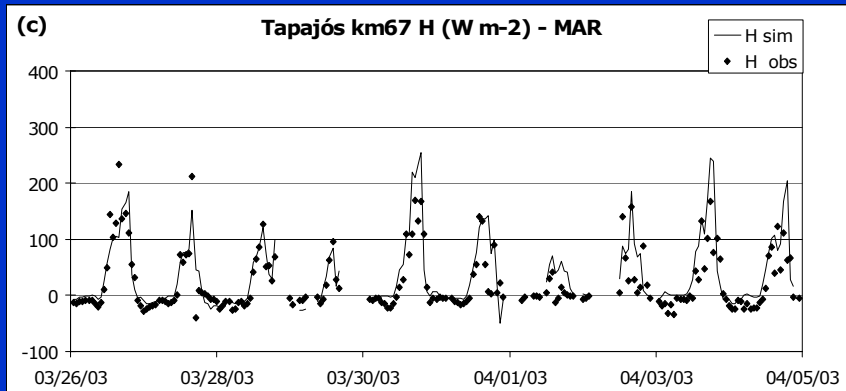
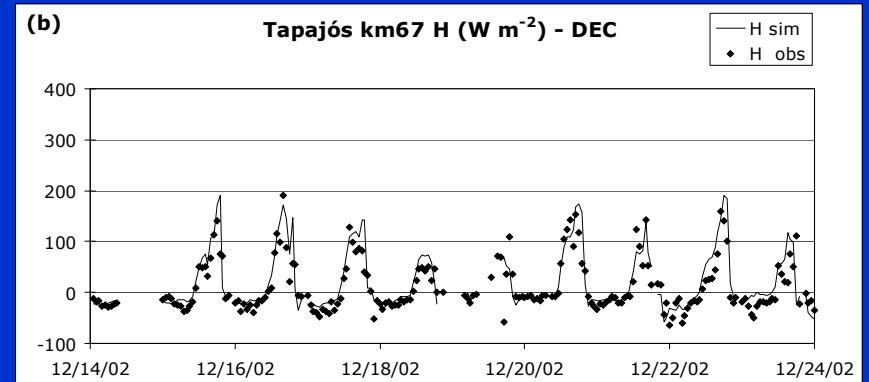
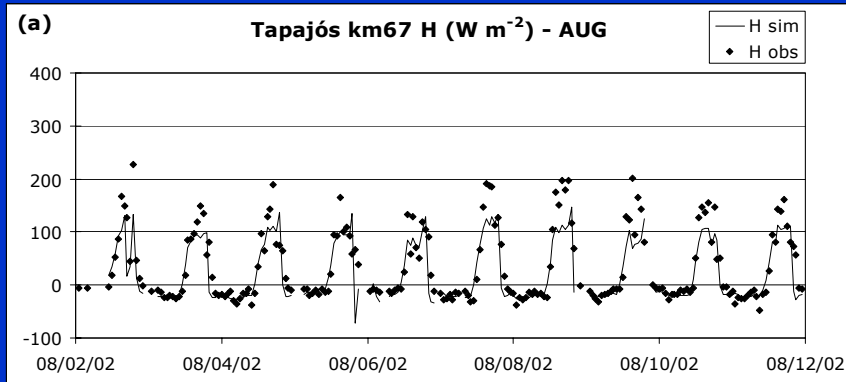
# New Results

## Flona Tapajós km 67

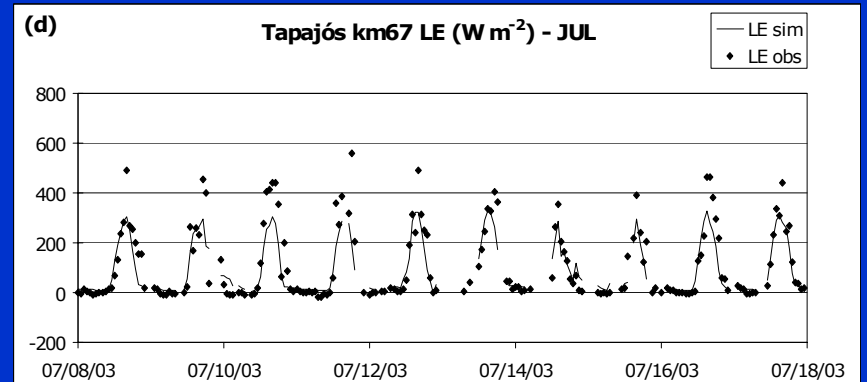
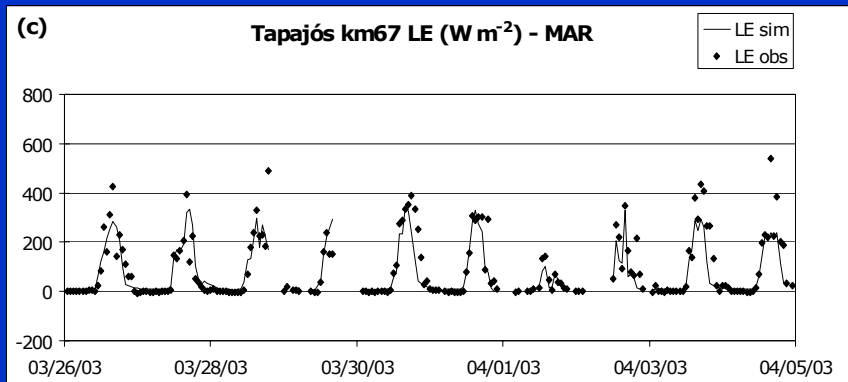
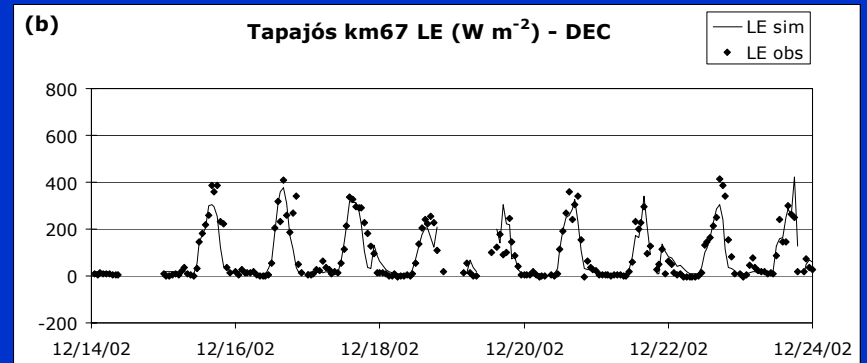
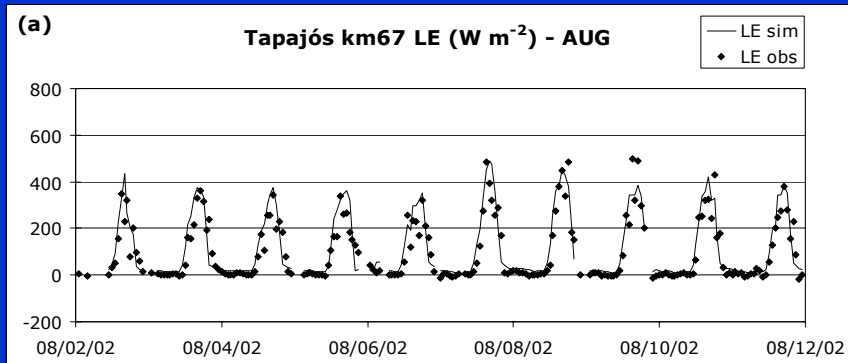
# Flona Tapajós km 67 - Rn



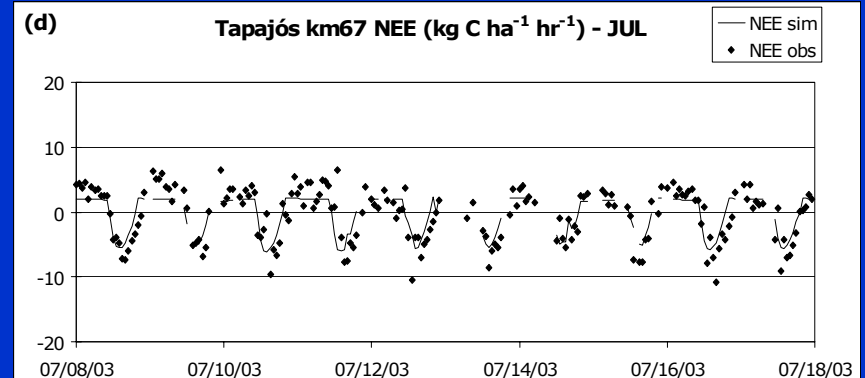
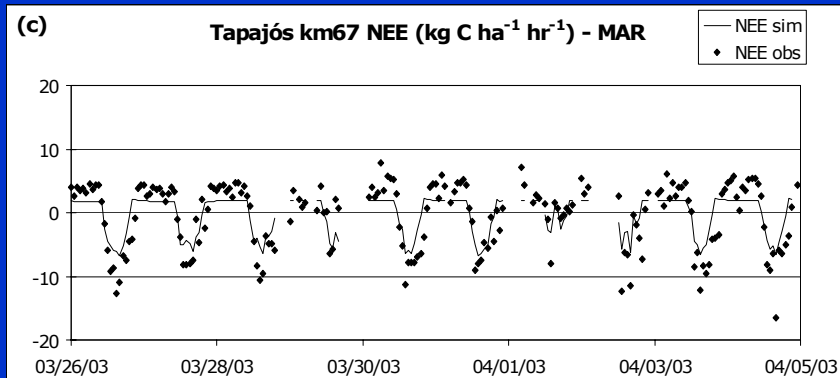
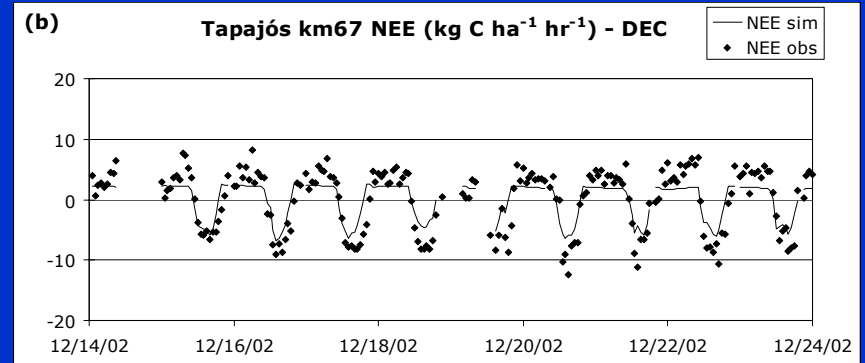
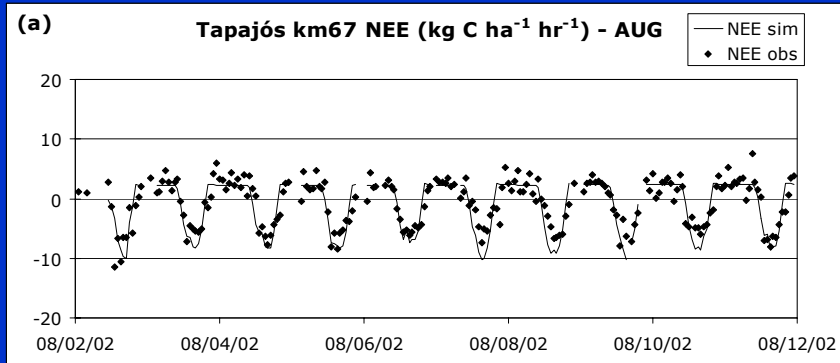
# Flona Tapajós km 67 - H



# Flona Tapajós km 67 - LE

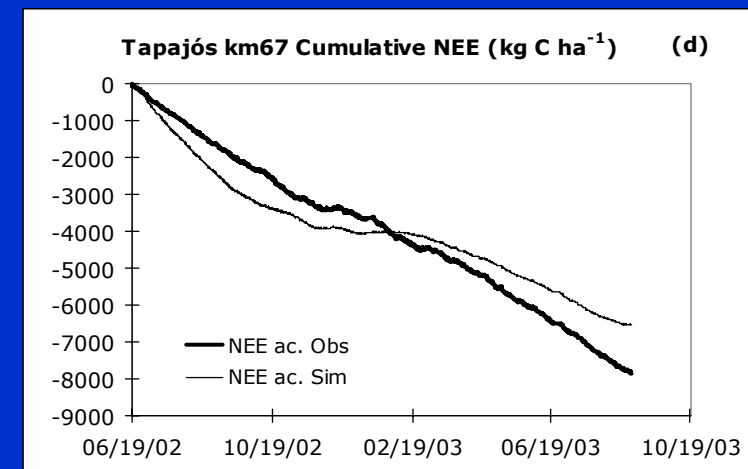
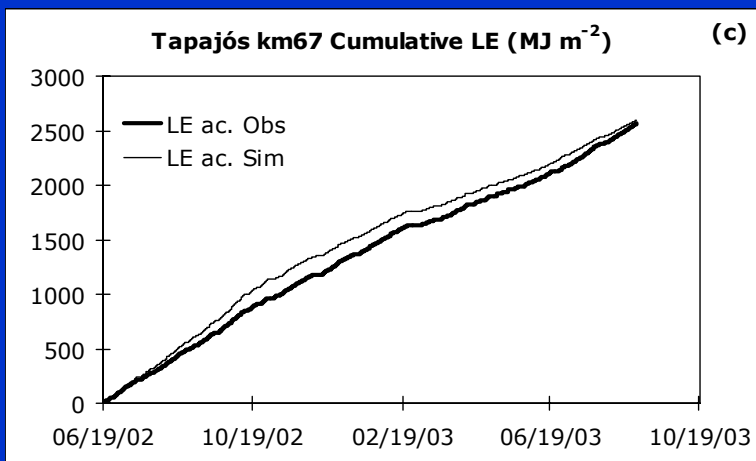
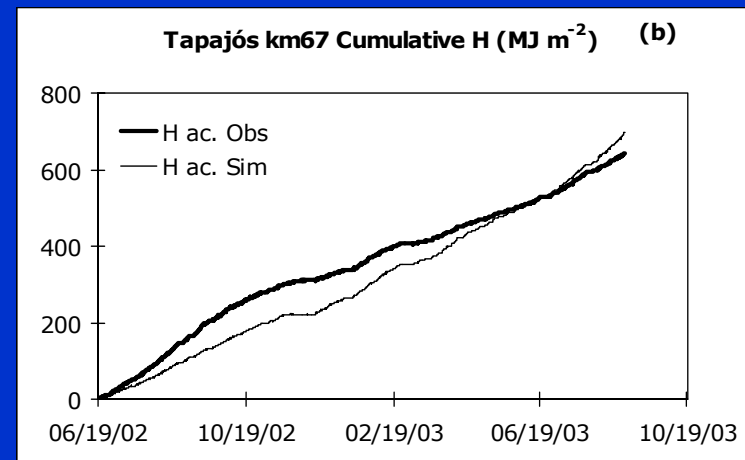
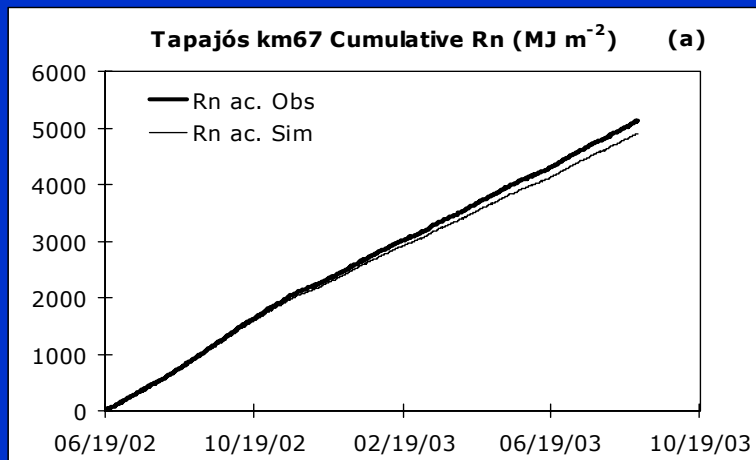


# Flona Tapajós km 67 - NEE



# Flona Tapajós km 67

## Cumulative fluxes



$u^*_0 = 0.2 \text{ m/s}$

# New results – summary

	$\beta_2$	$V_{\text{máx}}$ ( $\mu \text{ mol m}^{-2} \text{ s}^{-1}$ )	m	$C_{\text{HS}}$ ( $\text{J m}^{-2} \text{ }^{\circ}\text{C}^{-1}$ )
km 83	0.997	120	11	$0.325 \cdot 10^5$
km 67	0.980	65	9	$2.109 \cdot 10^5$
km 83	0.997	120	8	$0.263 \cdot 10^5$
km 67	0.997	120	8.5	$0.325 \cdot 10^5$
km 34	0.985	70	9	$0.263 \cdot 10^5$
Rebio Jaru	0.997	120	10	$0.527 \cdot 10^5$

## 4. Conclusions (1/2)

- Calibrated IBIS against data for 4 LBA primary forest sites
- Expected similar parameters for all sites
- Initial results shows 2 sets of parameters
- Errors in the meteorological or flux datasets reported in 2 sites
- New results (preliminary) indicate that 3 of the 4 sites show similar parameters
- Model results very sensitive to errors in input data



## 4. Conclusions (2/2)

- Model results across sites also sensitive to inconsistencies in input data across sites
- Inconsistencies in input data very likely, given the different design and operation of LBA sites
- Collaboration with field scientists essential to eliminate inconsistencies among datasets
- Representative parameters to all rainforest sites may depend on elimination of inconsistencies