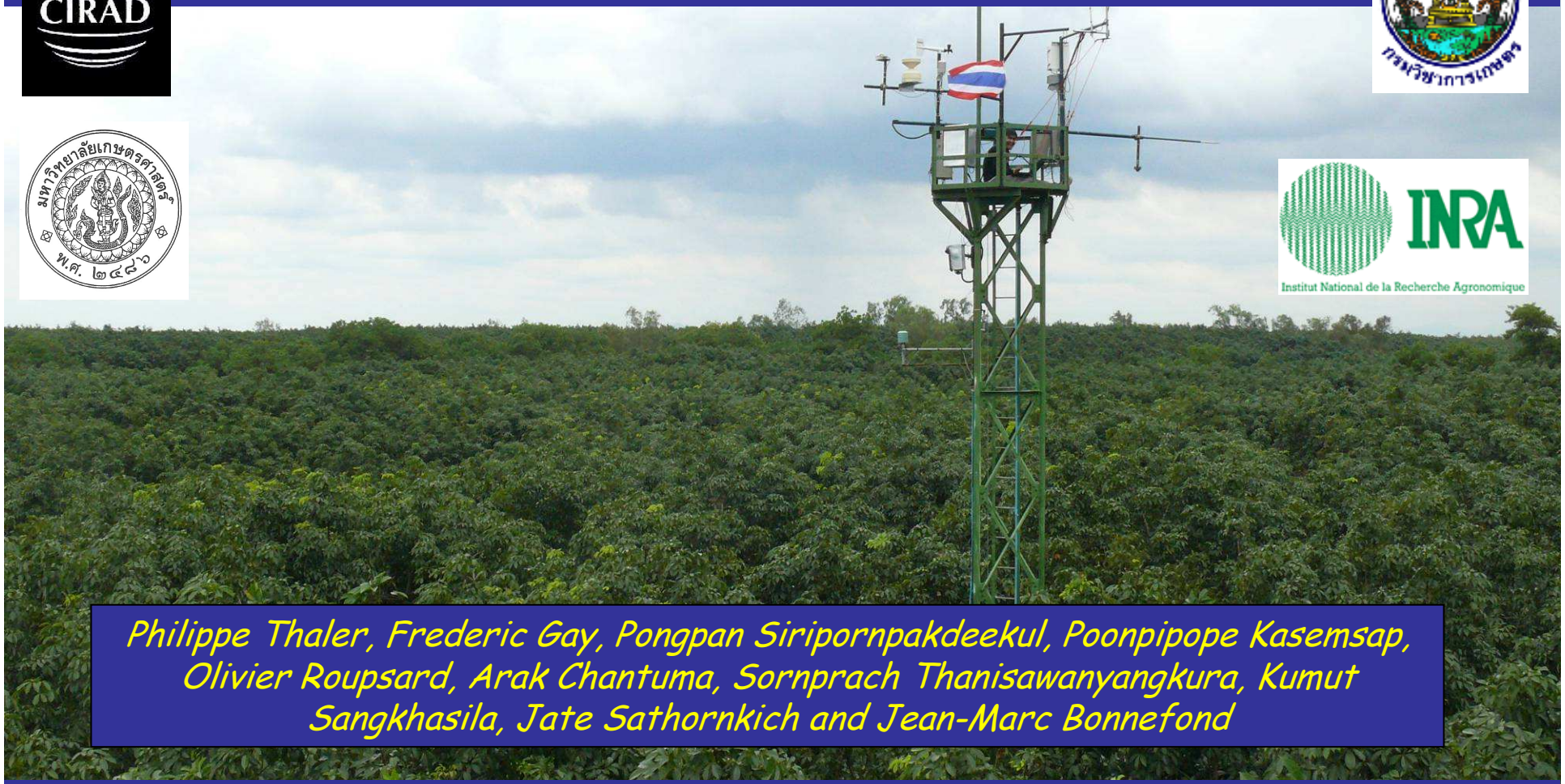
Carbon, water and energy balance of Rubber ecosystem



Philippe Thaler, Frederic Gay, Pongpan Siripornpakdeekul, Poonpipope Kasemsap, Olivier Roupsard, Arak Chantuma, Sornprach Thanisawanyangkura, Kumut Sangkhasila, Jate Sathornkich and Jean-Marc Bonnefond

Hevea Research Platform in Partnership

a Thai-French co-operation

Scientific Purposes

- Assessment of C, H_2O and nutrient cycling in the ecosystem
- Upscaling and downscaling
- Modelling ecosystem C, H_2O and energy exchange, as a function of climate

Thailand
Chachoengsao
province

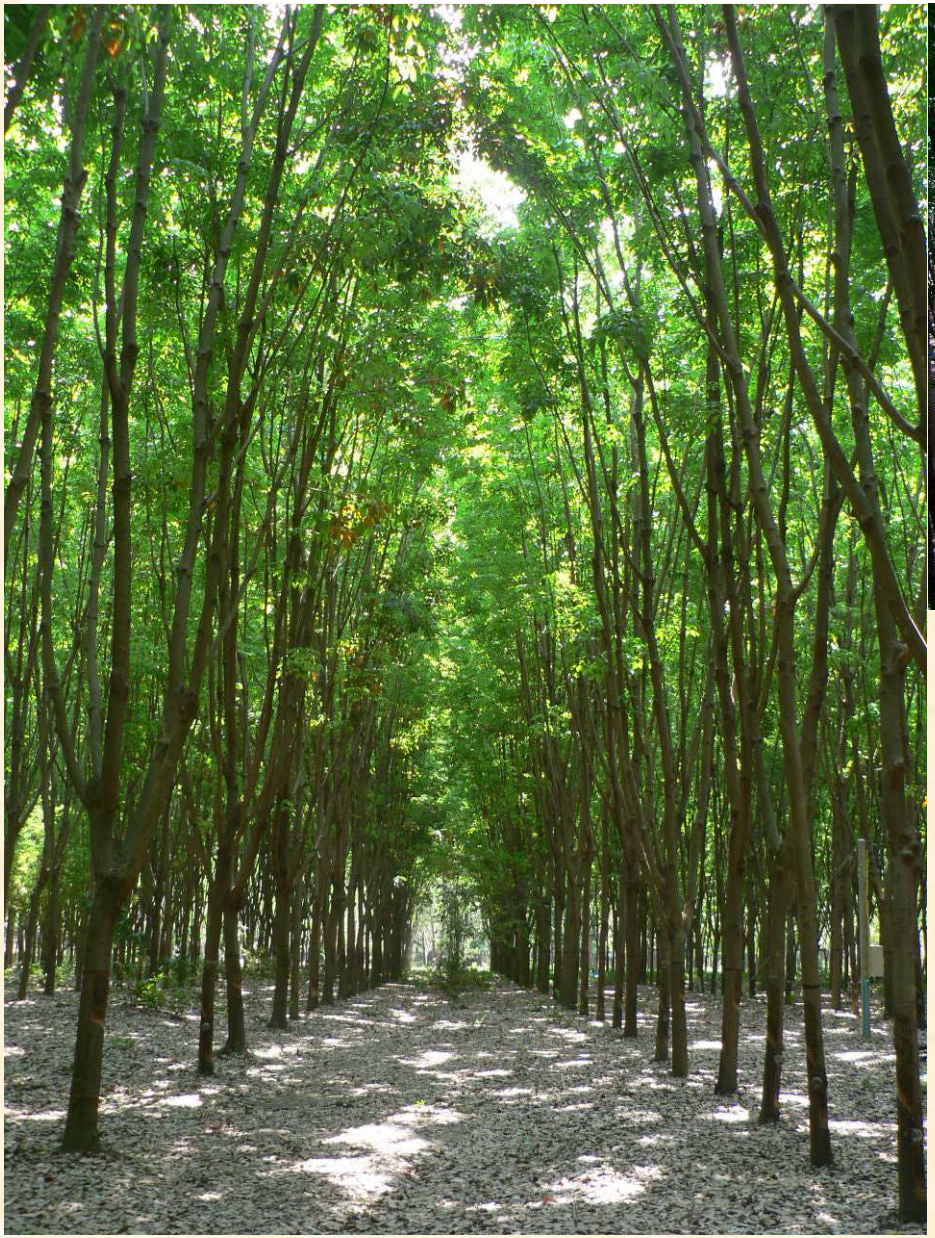
Site:
Chachoengsao
Rubber Research
Centre
(DOA)

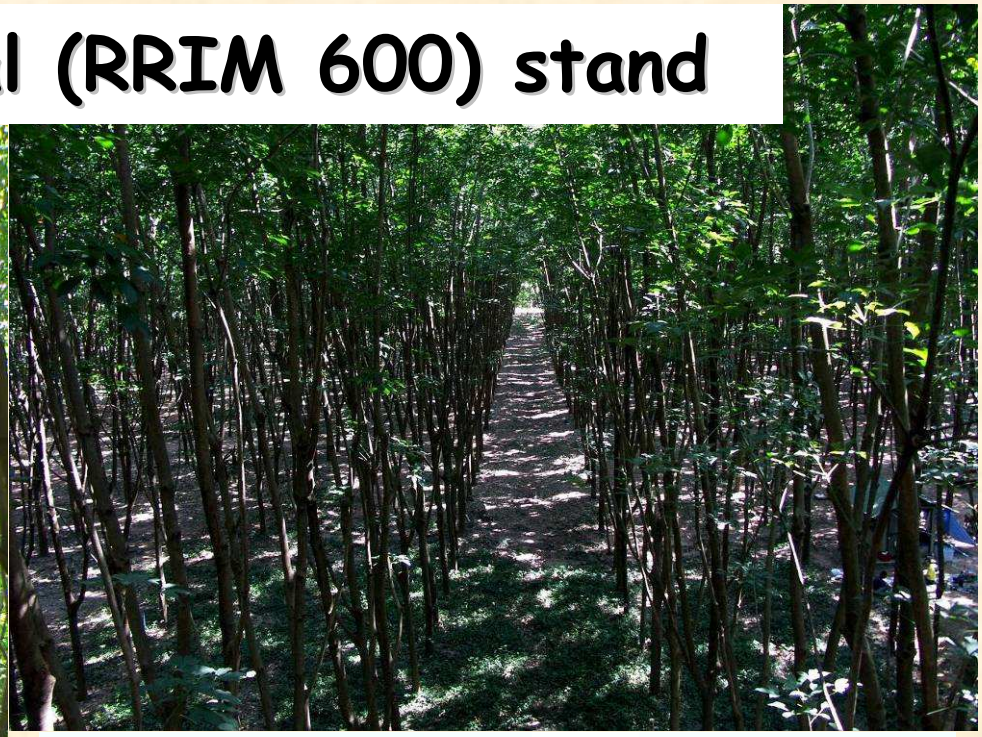
Landscape: transition between
central lowlands and eastern hills

Experimental site

- Annual rainfall: 1300 mm
- Rubber tree monoclonal (RRIM 600) stand
- Current density 454 t/ha
- 14 y old in 2008
- LAI 3.2
- Height 20 m
- Several tapping systems

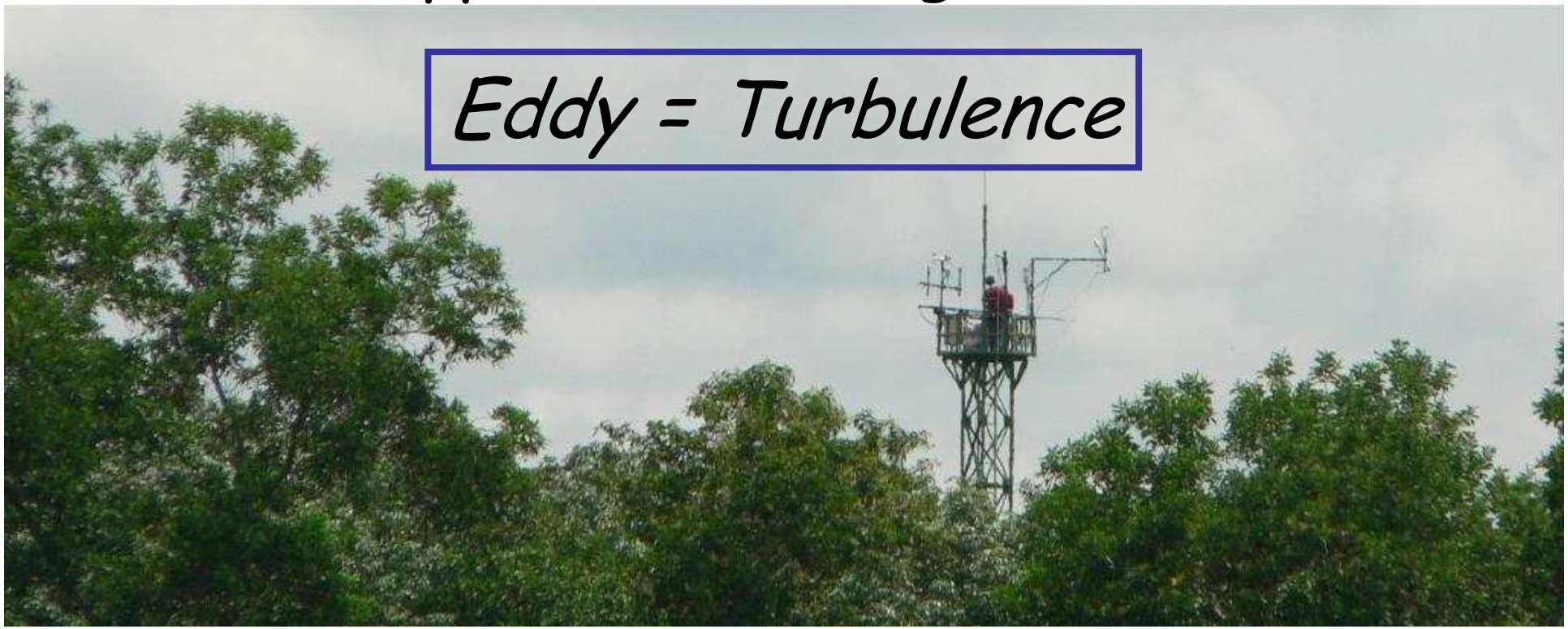
Rubber tree monoclonal (RRIM 600) stand





Eddy Covariance Method

- A method of measuring turbulent fluxes generally applied above the atmosphere/vegetation interface, but it can be applied within vegetation, too.



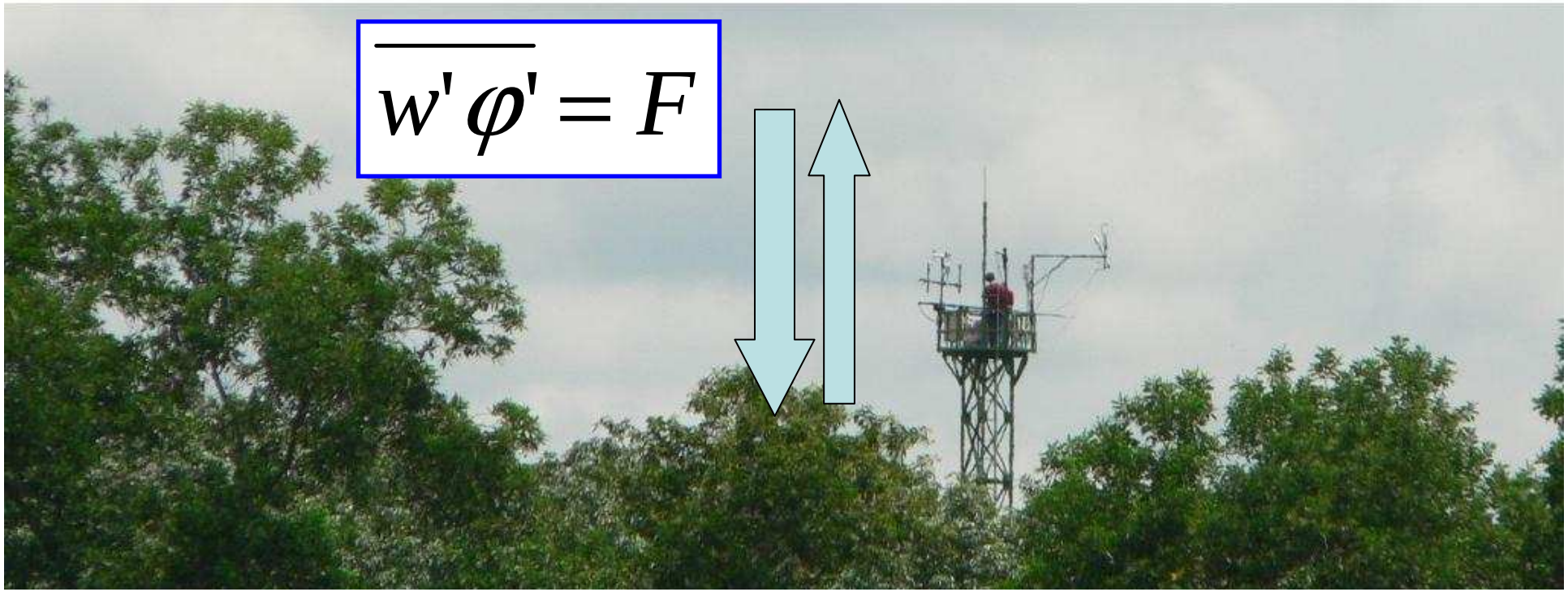
Eddy Covariance Method

The technique has many advantages over other methods.

- It is direct measure of the flux density,
- It is in situ,
- It introduces no artifact on the system it is measuring,
- It is quasicontinuous

Basics of the method

The flux through the measurement plane is the covariance of the volumetric density and vertical wind density



Applications in ecophysiology

- Sensible heat flux, where θ' is temperature fluctuation and c_p the specific heat of the air

$$c_p \overline{w' \rho\theta'}$$

- Latent heat flux, where λ is the latent heat of vaporization, ρq' is the fluctuation in specific humidity.

  ≈ evapotranspiration

$$\lambda \overline{w' \rho q'}$$

- CO_2 flux, where ρc' is the variation in CO_2 concentration

$$\overline{w' \rho c'}$$

Operating

- Measurements rate must fit to frequency of eddies participating to flux, ie about 10Hz.
- Averaging time (duration of observation to calculate mean and fluctuations) is generally 30 or 60 min.

A 25 m high tower 5 m above canopy. Set up in 2006

CO2, H2O concentration
Li-Cor 7500

Winspeed, 3 directions,
20 Hz – Young 8100

Issues and corrections

Processing: Correction of the signal from sonic anemometer and gas analyser. Distortion of signal (time lag, sonic T°,…)

- Corrections for air moisture, buoyancy
- Correction for air density (for CO_2)
- Correction for non-zero vertical wind, due to anemometer tilt and surface accidents (planar fit)
- Removing spikes (electronics, vibrations…)
- Removing trends (to keep stationary, by block averaging)

EddyRe Software, CarboEuroFlux Procedure

Issues and corrections

- **Quality check** by Spectral analysis in EdiRe

Analysing the repartition (frequency) of data recorded along the wavelength space that are significant for our kind of measurement.

Too high frequencies : signal (vibration, transducers)

Too low frequencies : natural changes (T¶ncrease,…)

There are several graphical methods to compute and analyse the spectra.

Issues and corrections

Post-processing: Control of the validity of the data, according to of climatic conditions.

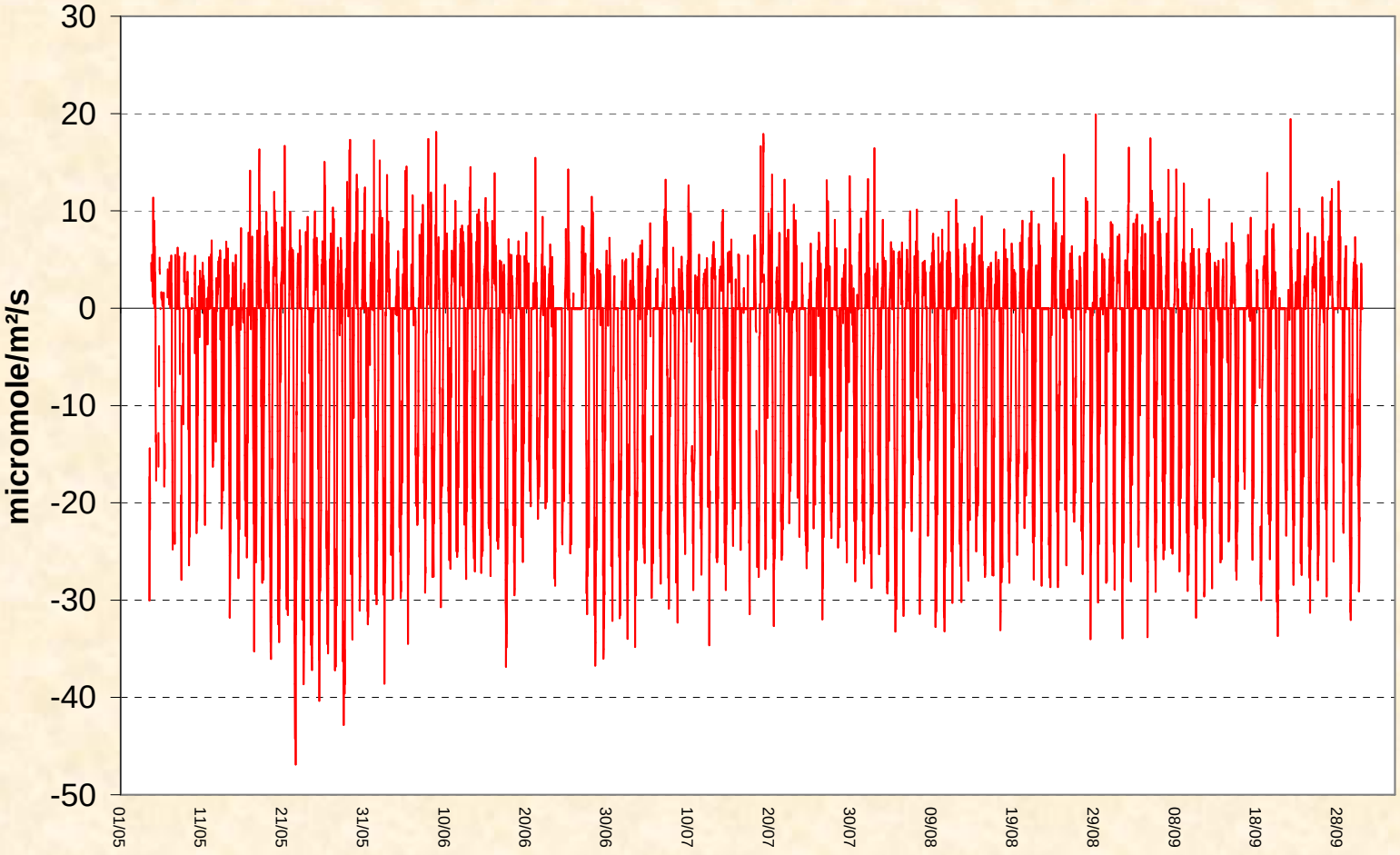
- Is atmospheric stability approriate?
- Consistency of CO_2, water and wind data (skewness, kurtosis,…)
- Friction velocity U*,…

INRA Ephyse template, CarboEuroFlux Procedure

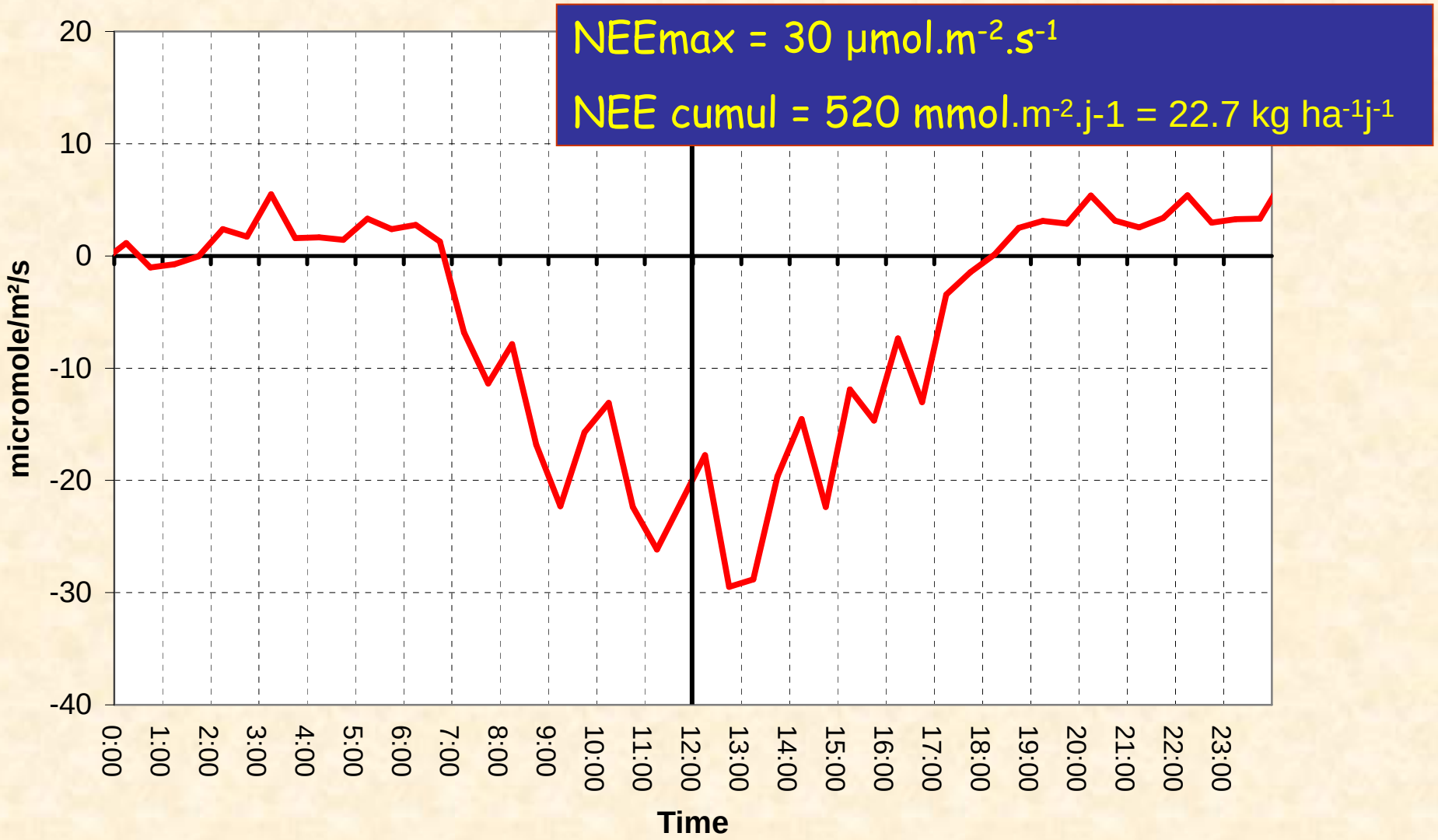
- ➢ correction to the raw data
- ➢ quality control, flag.

  Data receiving flag 0 are accepted, flag 1 accepted for long-term balance, flag 2 rejected

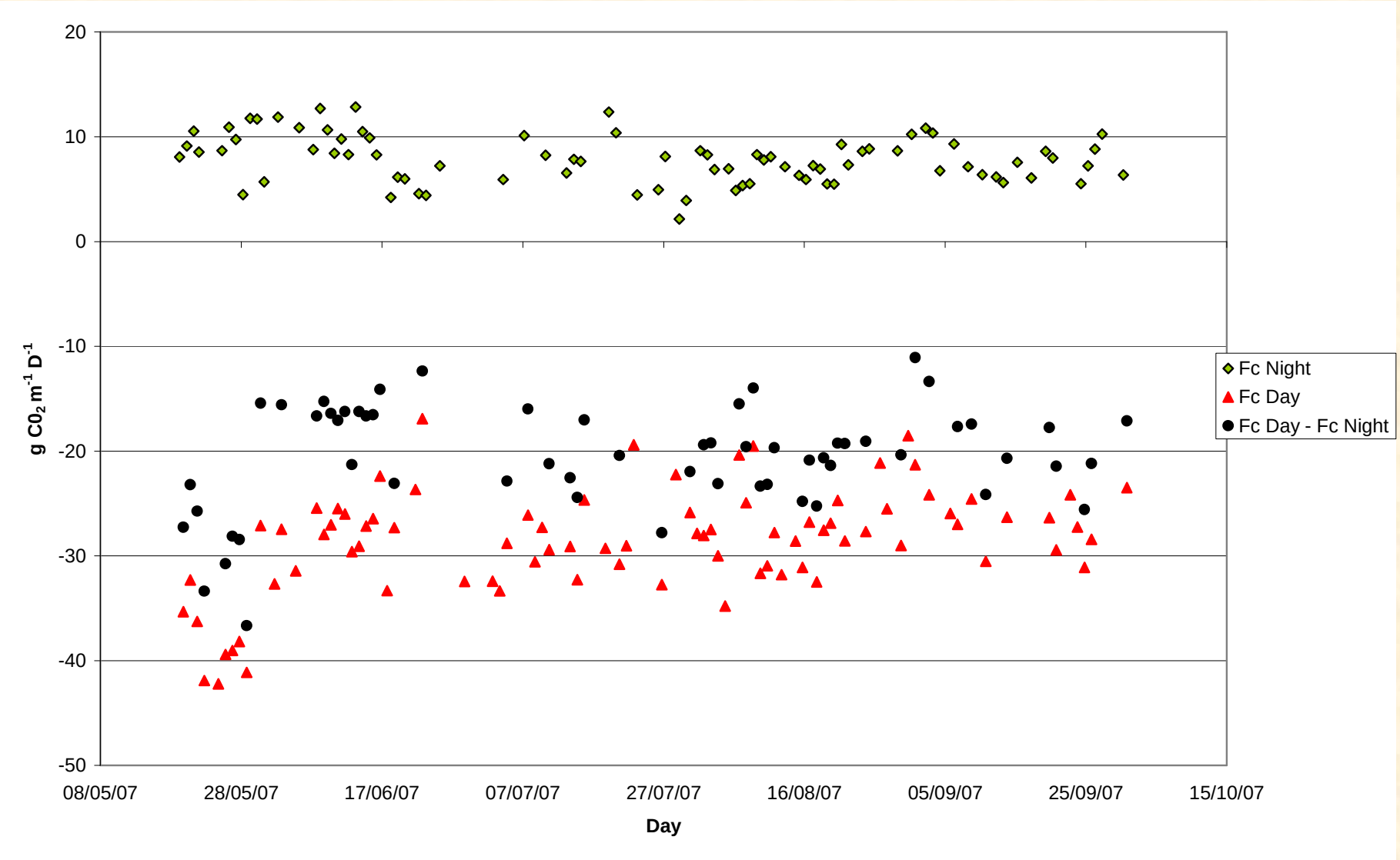
CO_2 flux
May-Sept 2007, corrected, no gap filling



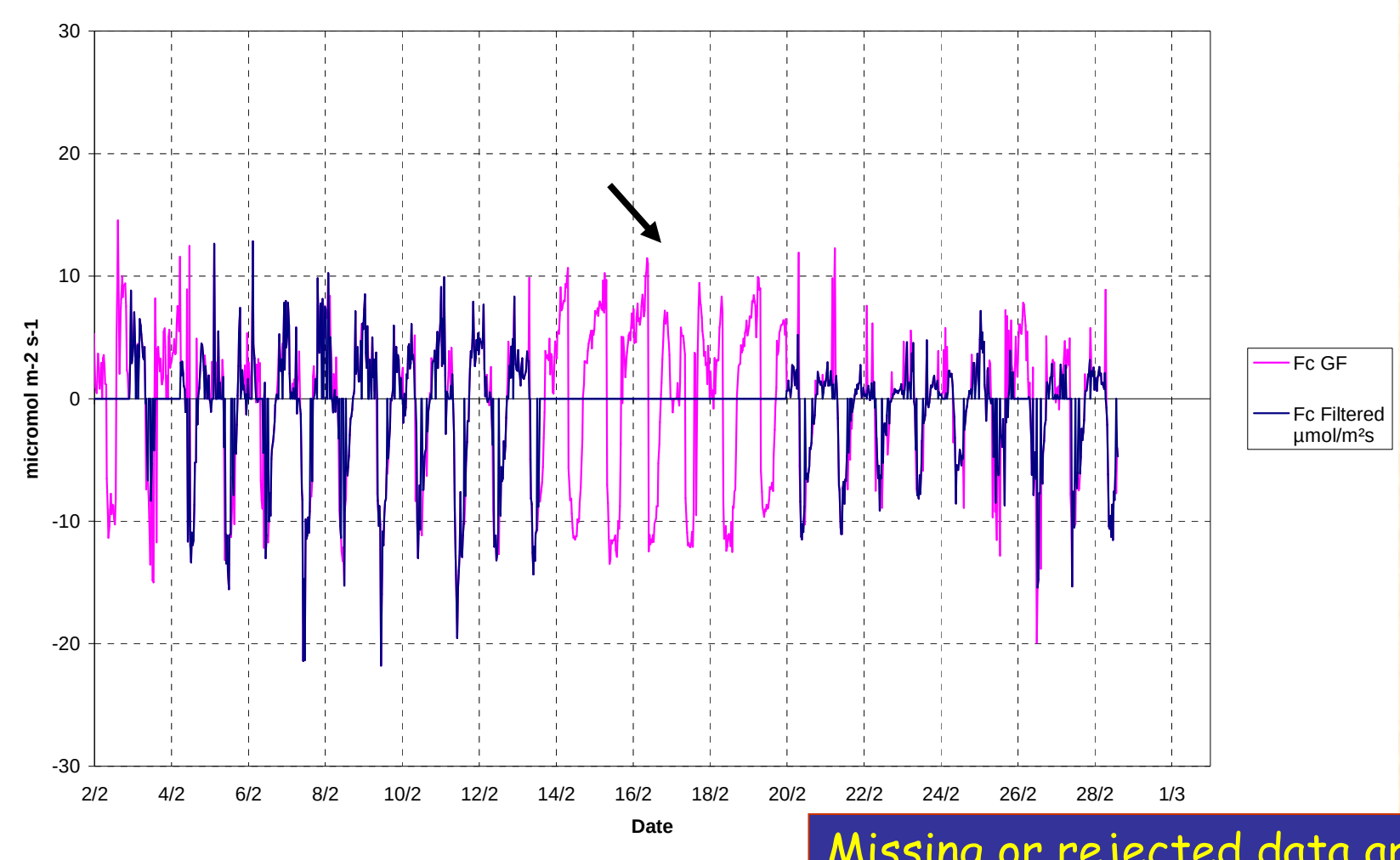
Daily CO_2 flux 18/06/07



$C0_2$ daily flux May-Sept 2007, corrected, no gap filling

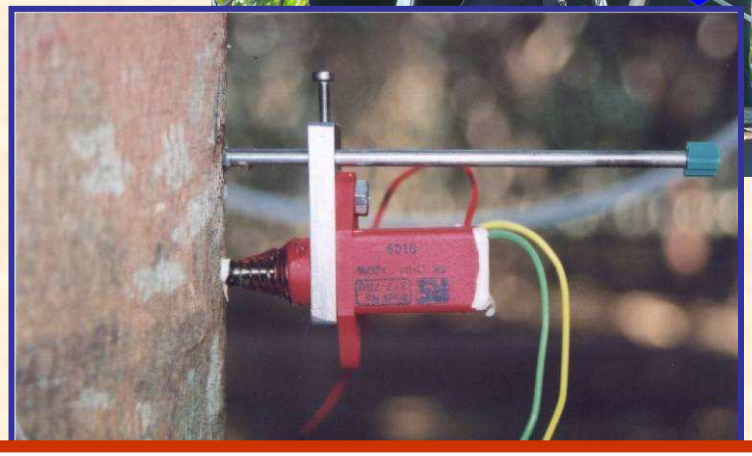


Next step: gap filling (ex Feb 2008)



Missing or rejected data are replaced by modelled data, as a function of climate

Ecophysiological processes



Impact of tapping?

Thank you for attention
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