

An overview of Mediterranean forests in Italy: opportunities for networking and transnational access

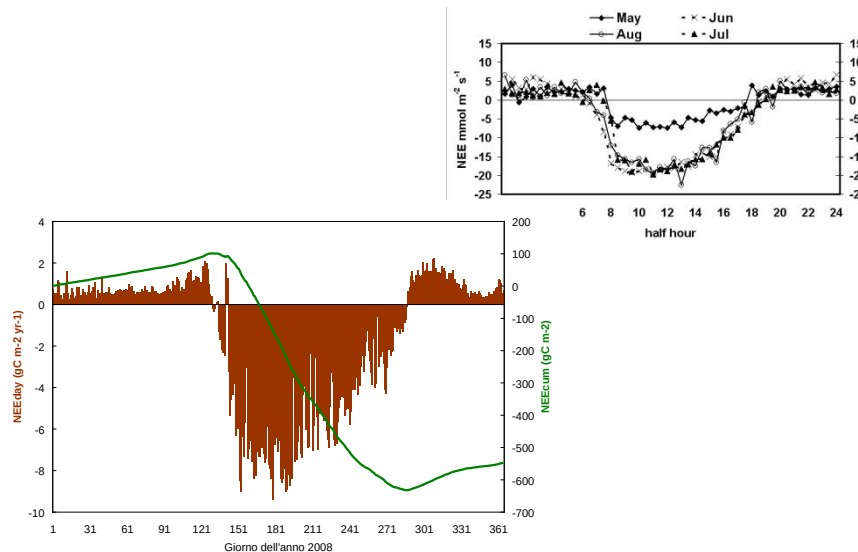
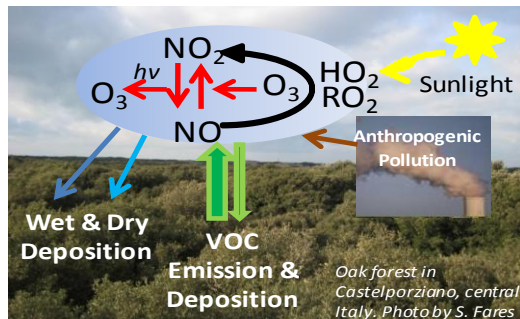
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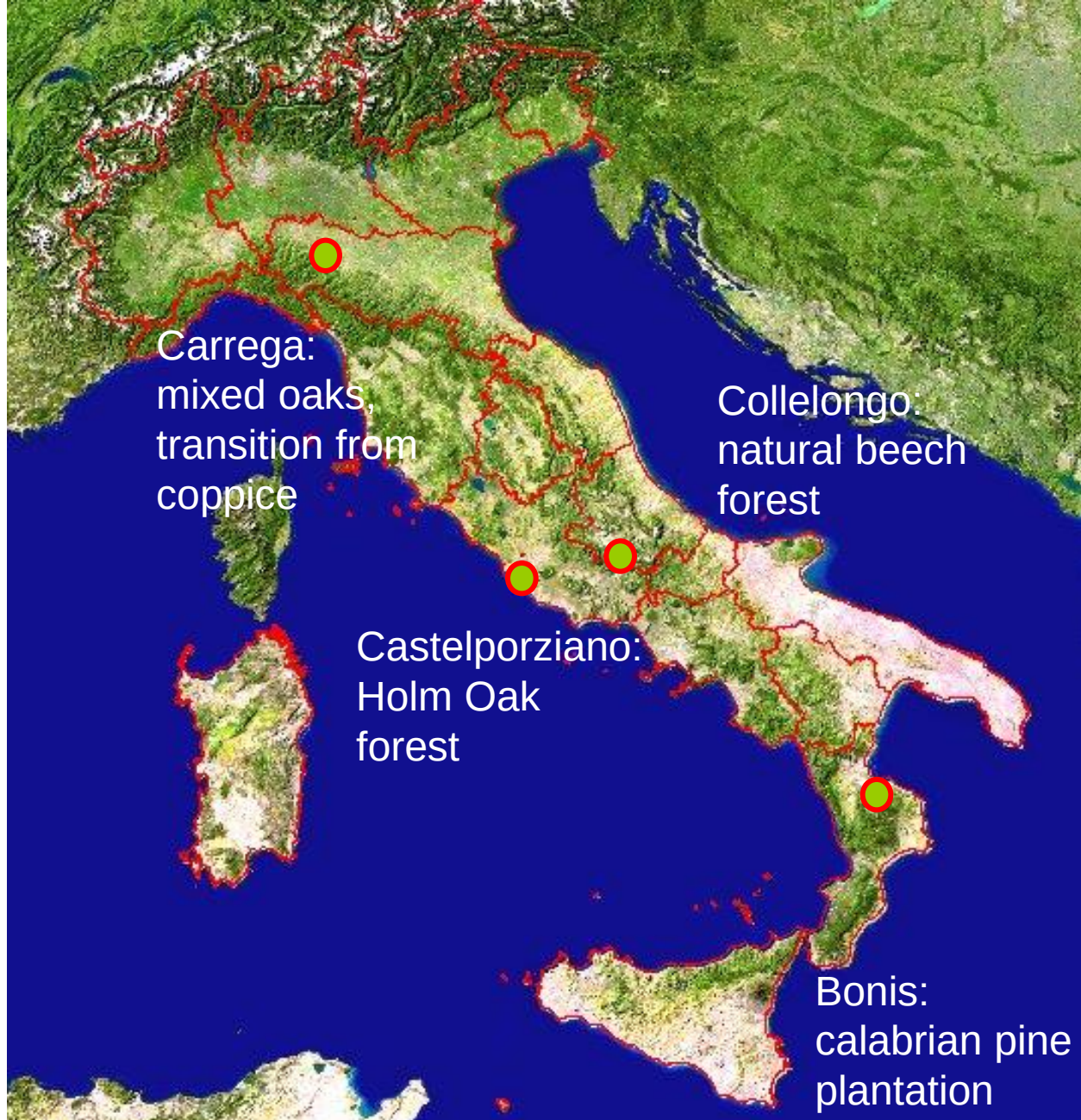
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FORESTERRA NETWORKING workshop. Marseille, 12-13/12/2013

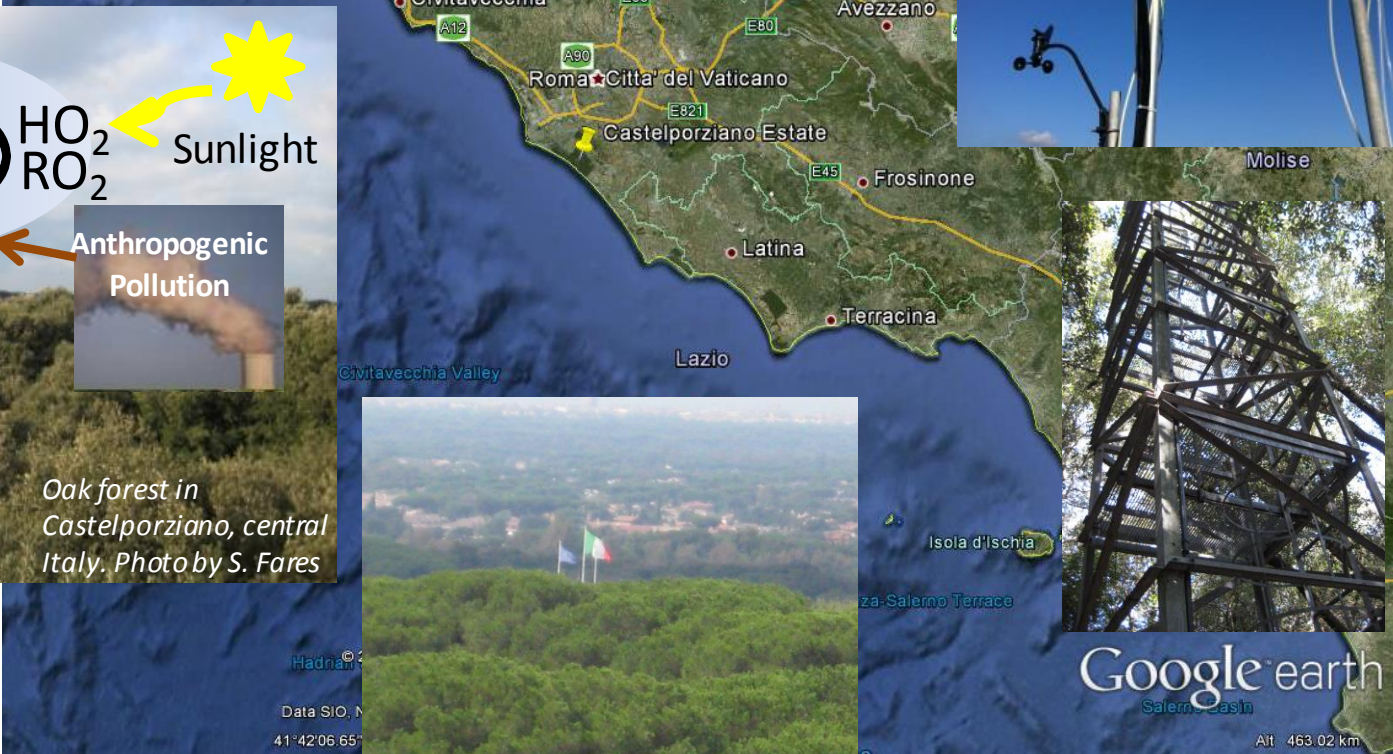
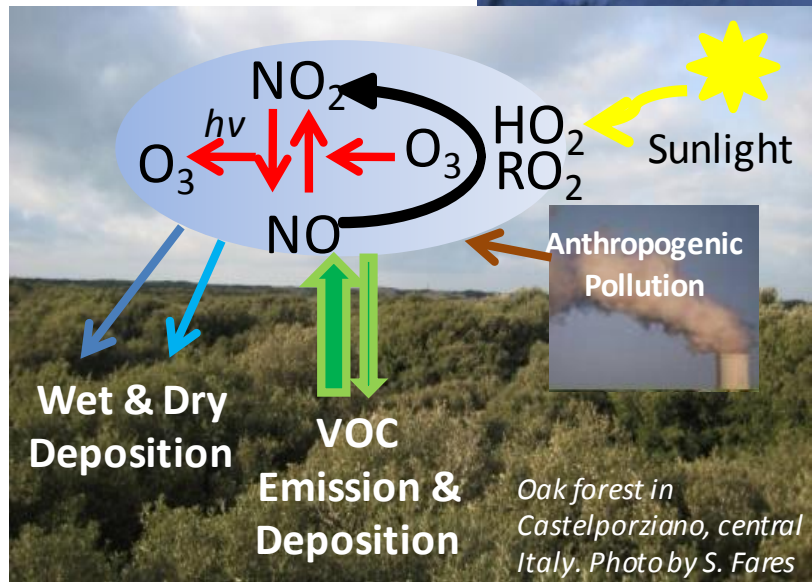


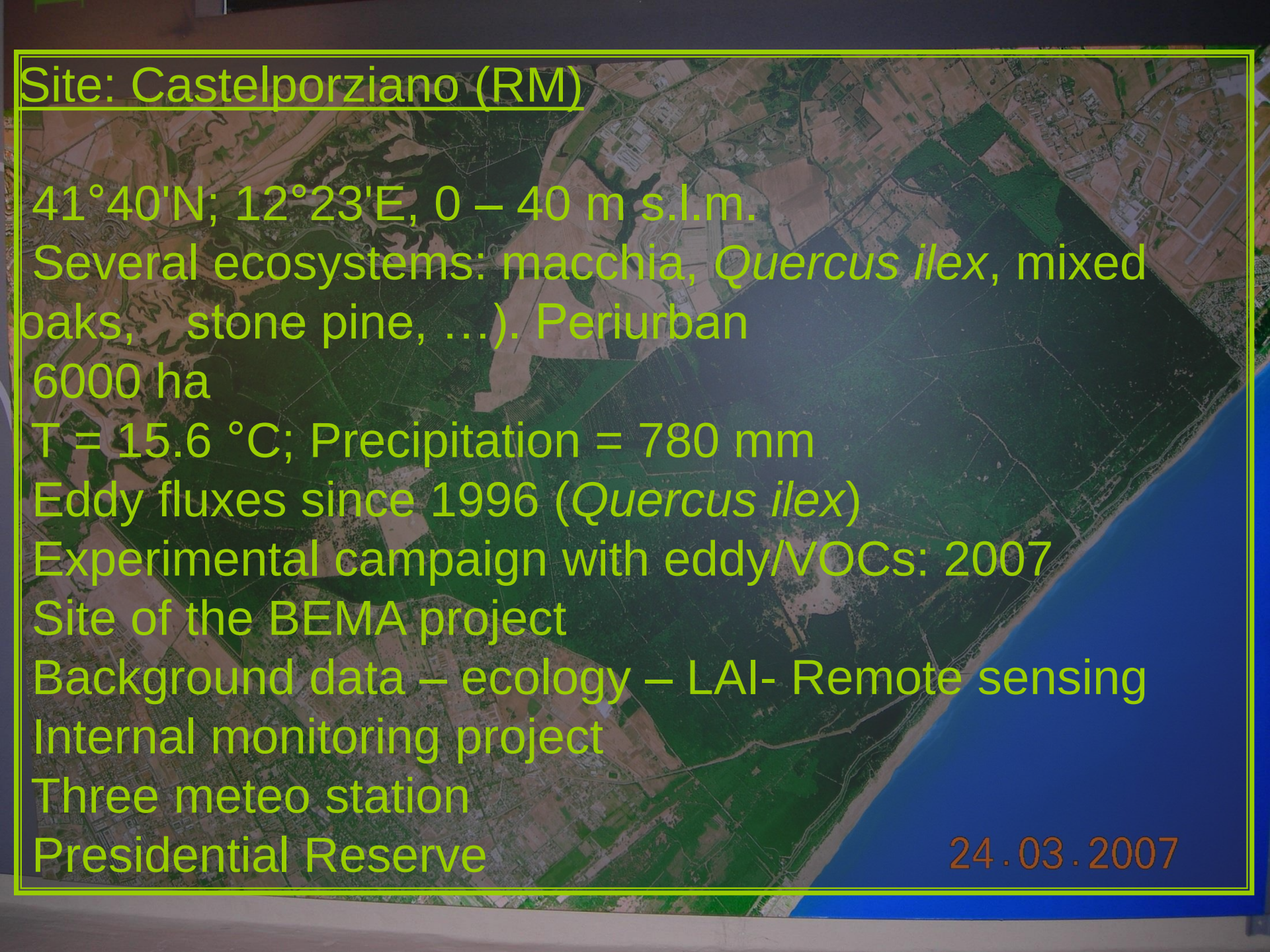


Flux sites potentially available for a networking project

Testing the capacity of plants to remove pollutants: The supersite of Castelporziano, Rome

~ 6000 ha, 25 km from Rome downtown





Site: Castelporziano (RM)

41°40'N; 12°23'E, 0 – 40 m s.l.m.

Several ecosystems: macchia, *Quercus ilex*, mixed oaks, stone pine, ...). Periurban
6000 ha

T = 15.6 °C; Precipitation = 780 mm

Eddy fluxes since 1996 (*Quercus ilex*)

Experimental campaign with eddy/VOCs: 2007

Site of the BEMA project

Background data – ecology – LAI- Remote sensing

Internal monitoring project

Three meteo station

Presidential Reserve

24.03.2007



Eddy Covariance measurements in Castelporziano

Sample Air inlet
& Sonic
anemometer

35 m

Fluxes are measured from the eddy covariance (EC) between vertical wind speed and gas concentration (ozone, CO₂, PM, H₂O), with observations 10 times per second

$$\Phi_x = \overline{w' X'}$$

Water flux: **Stomatal conductance** is calculated by inversion of Monteith equation, therefore an estimate of stomatal ozone fluxes is possible

$$R_{sto} = \frac{c_p \cdot \rho \cdot VPD}{\lambda \cdot \gamma \cdot E_L} - (R_a + R_b)$$

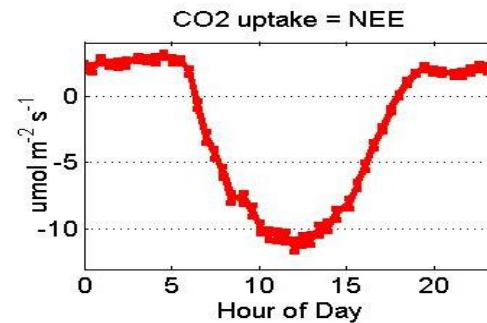
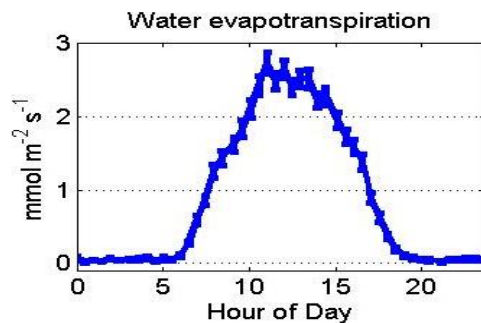
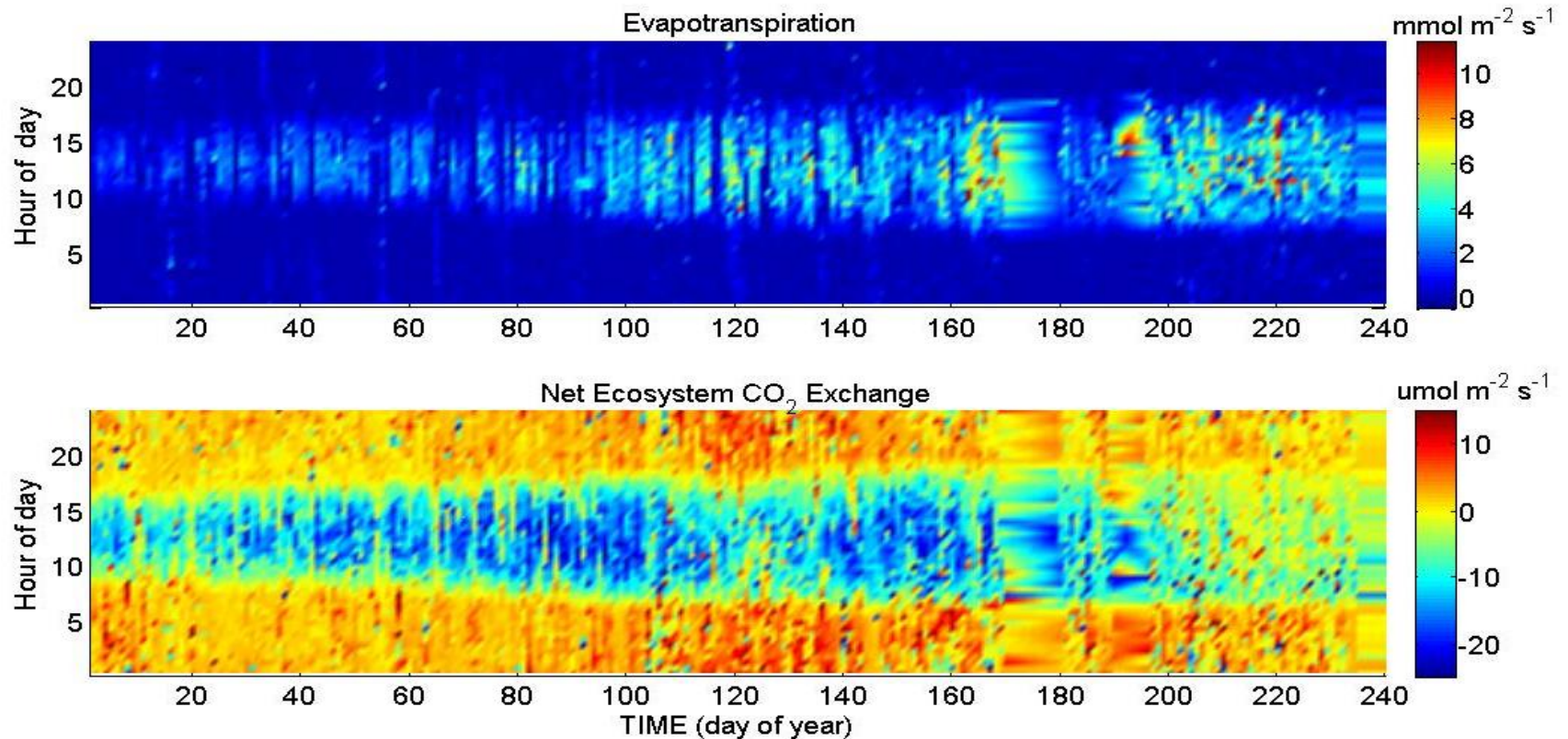
CO₂ flux: Subtracting modelled ecosystem respiration to the Net Ecosystem Exchange (NEE), **Gross Primary Productivity (GPP)** is calculated



CO₂, O₃, PM fast
sensors

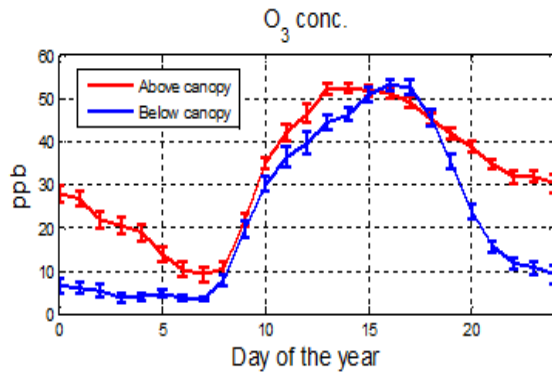


Continuous measurements show seasonality of ecophysiological properties of Holm Oak



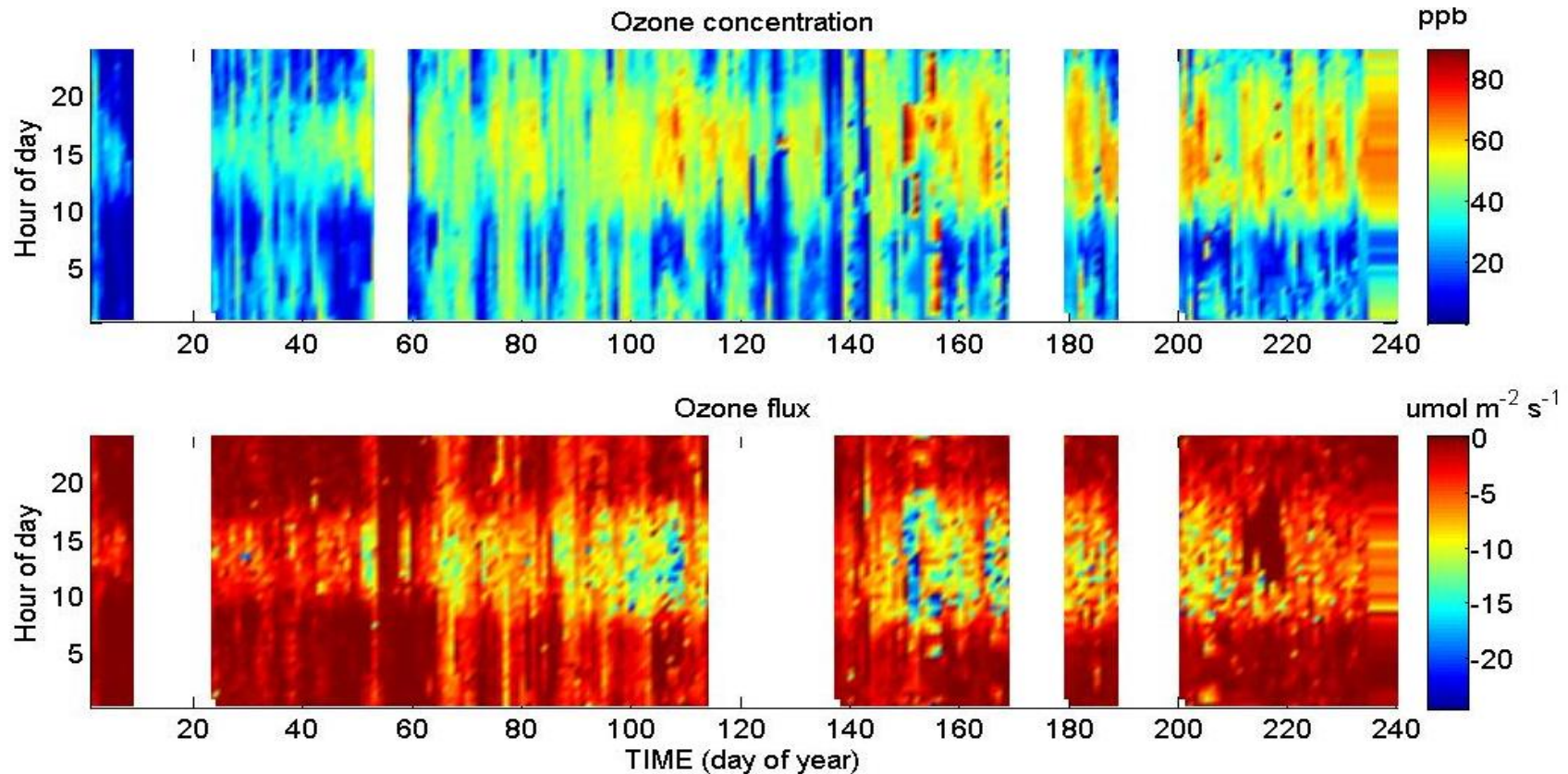
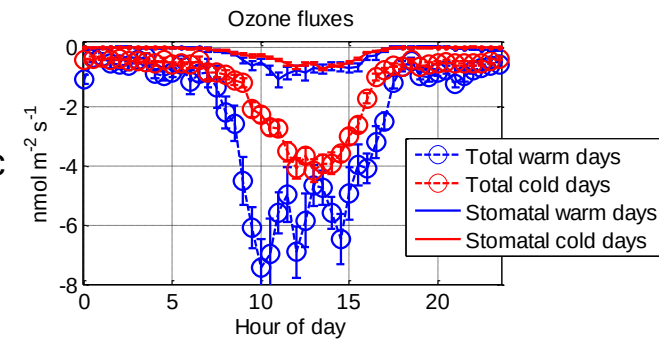
Water is pumped into the atmosphere,
and large carbon uptake is driven by
photosynthesis

Ozone concentration & fluxes

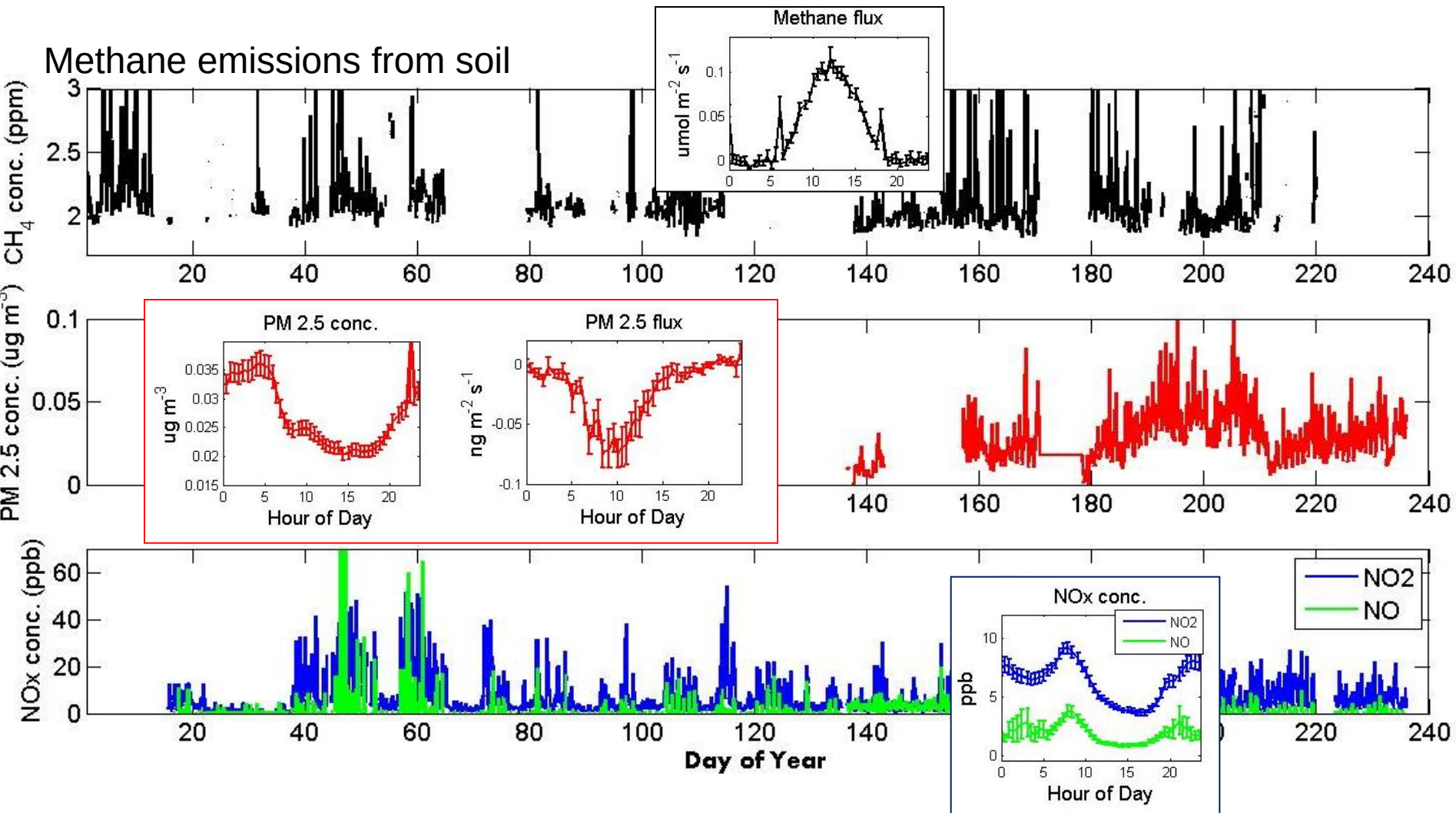


High temperatures and anthropogenic emissions promote photochemical ozone production

Ozone fluxes are higher during warm days, when non-stomatal sinks (e.g. gas-phase chemistry) are higher



Concentrations and fluxes of other non-CO2 trace gases

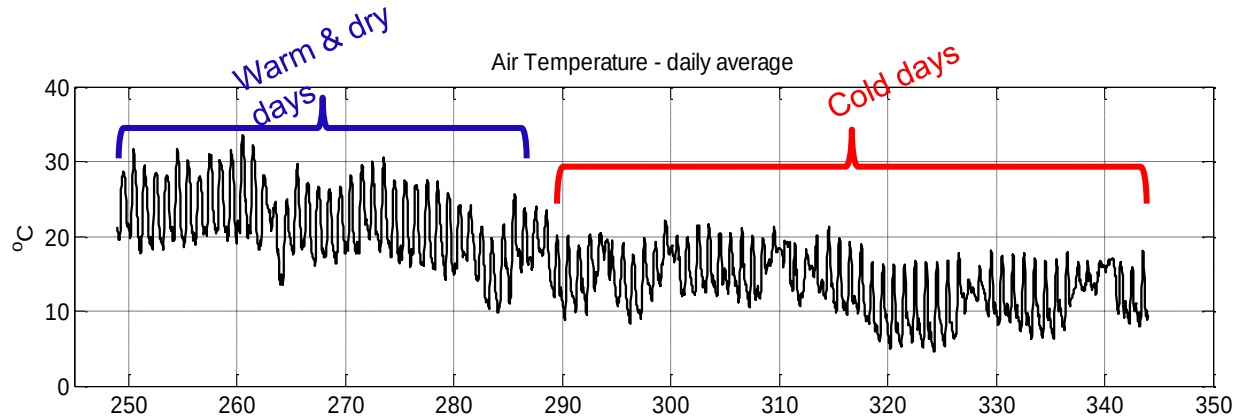


Turbulence and leaf uptake maximize fluxes during the central hours of the day

12/12/2013

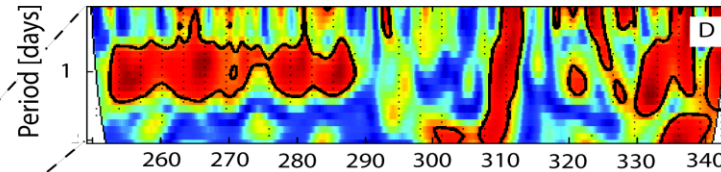
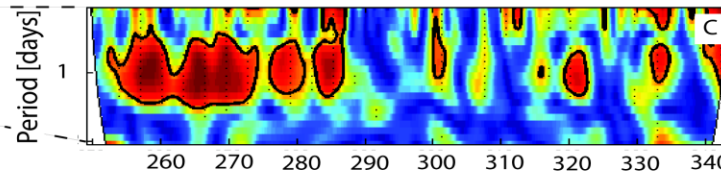
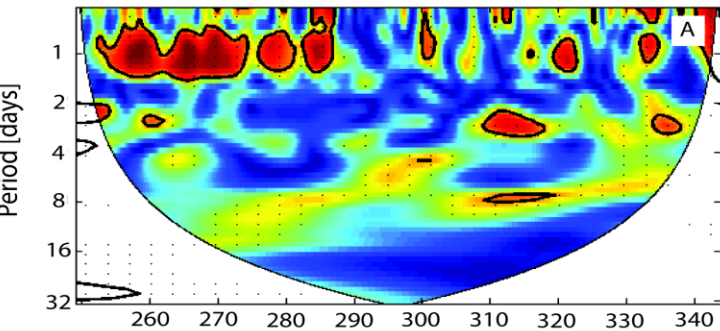
A study using wavelet analysis highlighted regions of significant temporal correlations between ozone (concentration and stomatal fluxes) and GPP

High
Correlations
especially
during the
warm days

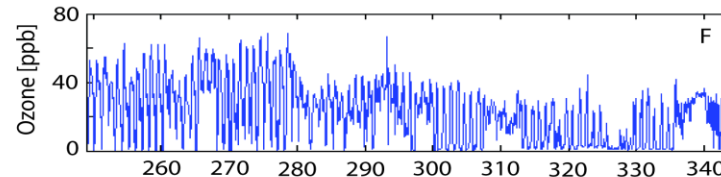
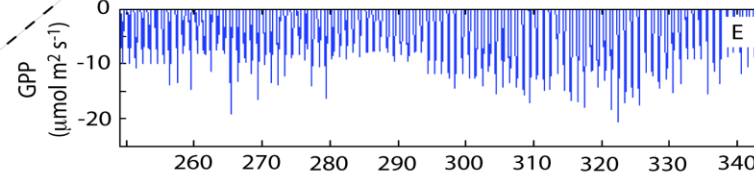
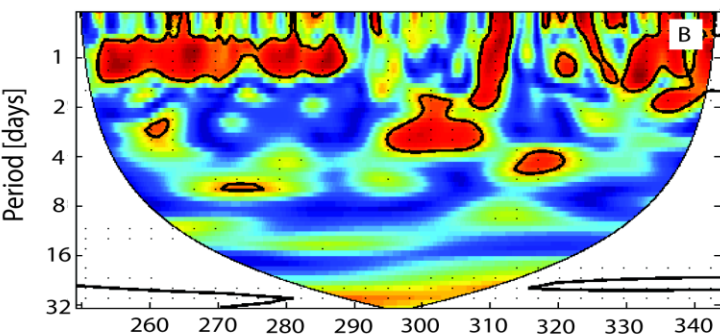


GPP is
negatively
correlated to
ozone!

Correlation between GPP and O₃ concentration



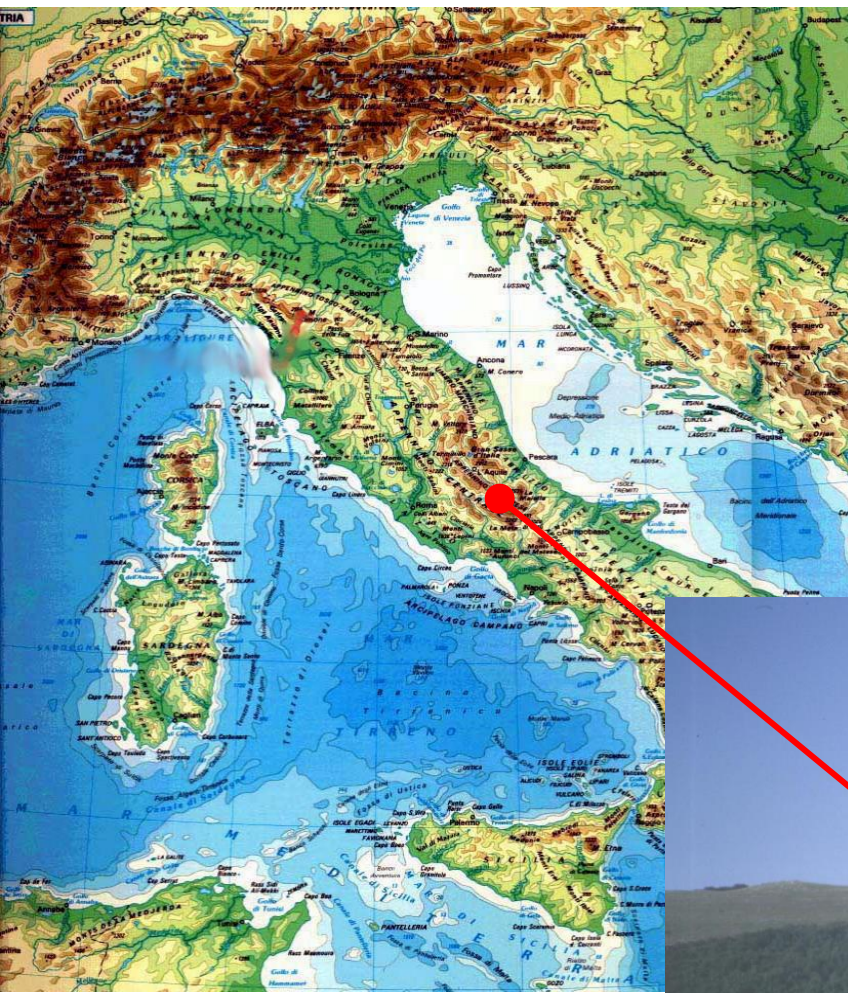
Correlation between GPP and O₃ fluxes



Current
research
focuses on
particle
effects

*Fares et
al. Global
Change
Biol. 2013*

The test site of Collelongo, central Italy



Site: Collelongo – Selva Piana (AQ)

41°52 N 13°38 E, 1560 m s.l.m.

Pure beech forest (*Fagus sylvatica* L.)

110-115 years; 830 trees ha⁻¹

Height: 20-25 m; Basal area 39.4 m² ha⁻¹

Total biomass: 268 t ha⁻¹; LAI: 4.5-6 m² m⁻²

T = 7.1 °C; Precipitation = 1206 mm

Level II since 1996 (passive O₃ sampling)

Eddy fluxes and ecology since 1993, 1996 -

LTER Site, ENFORS Site

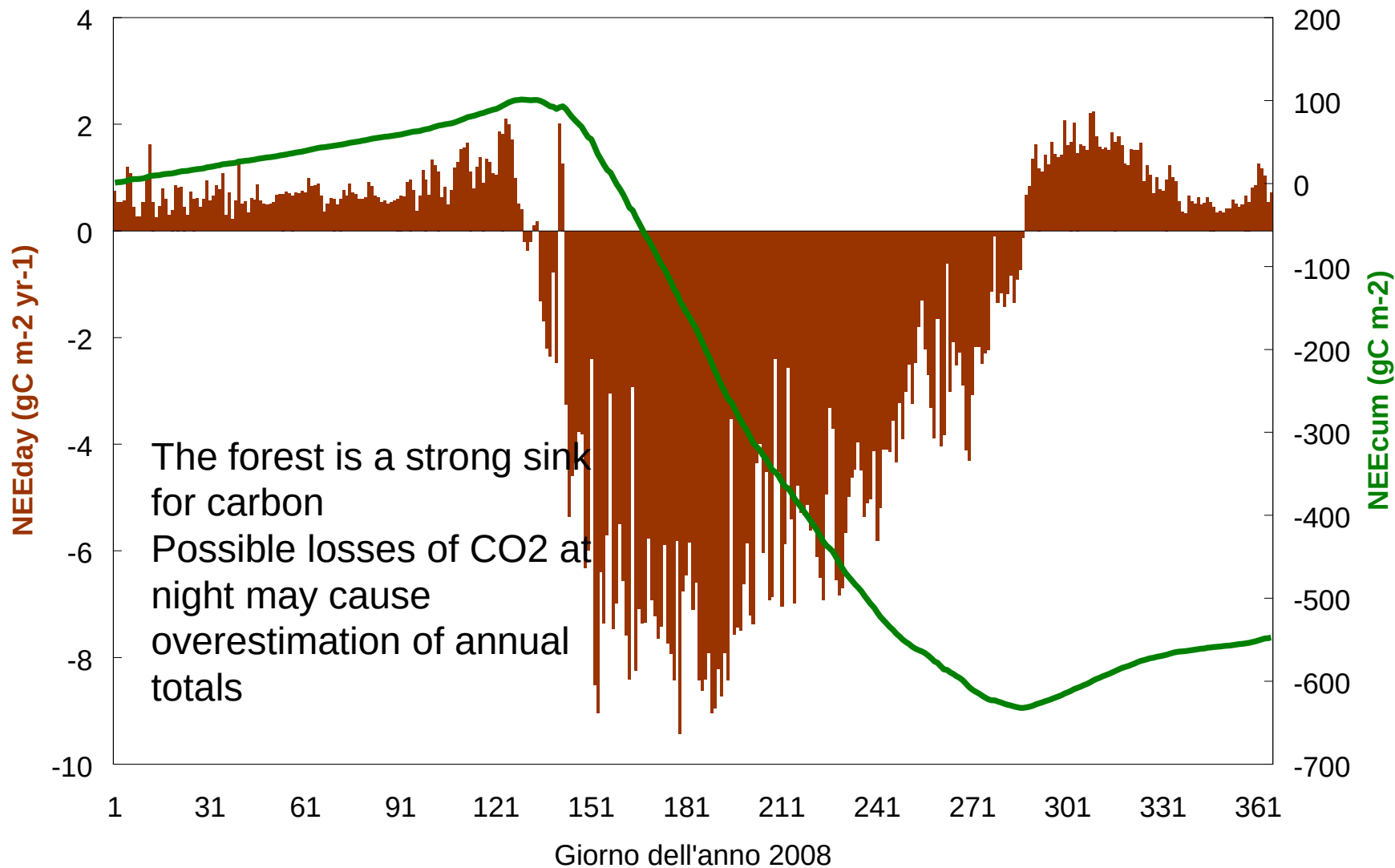
VOC: campaigns (2008.....)

Sapflow: 1996-97, instrument available for 2008...

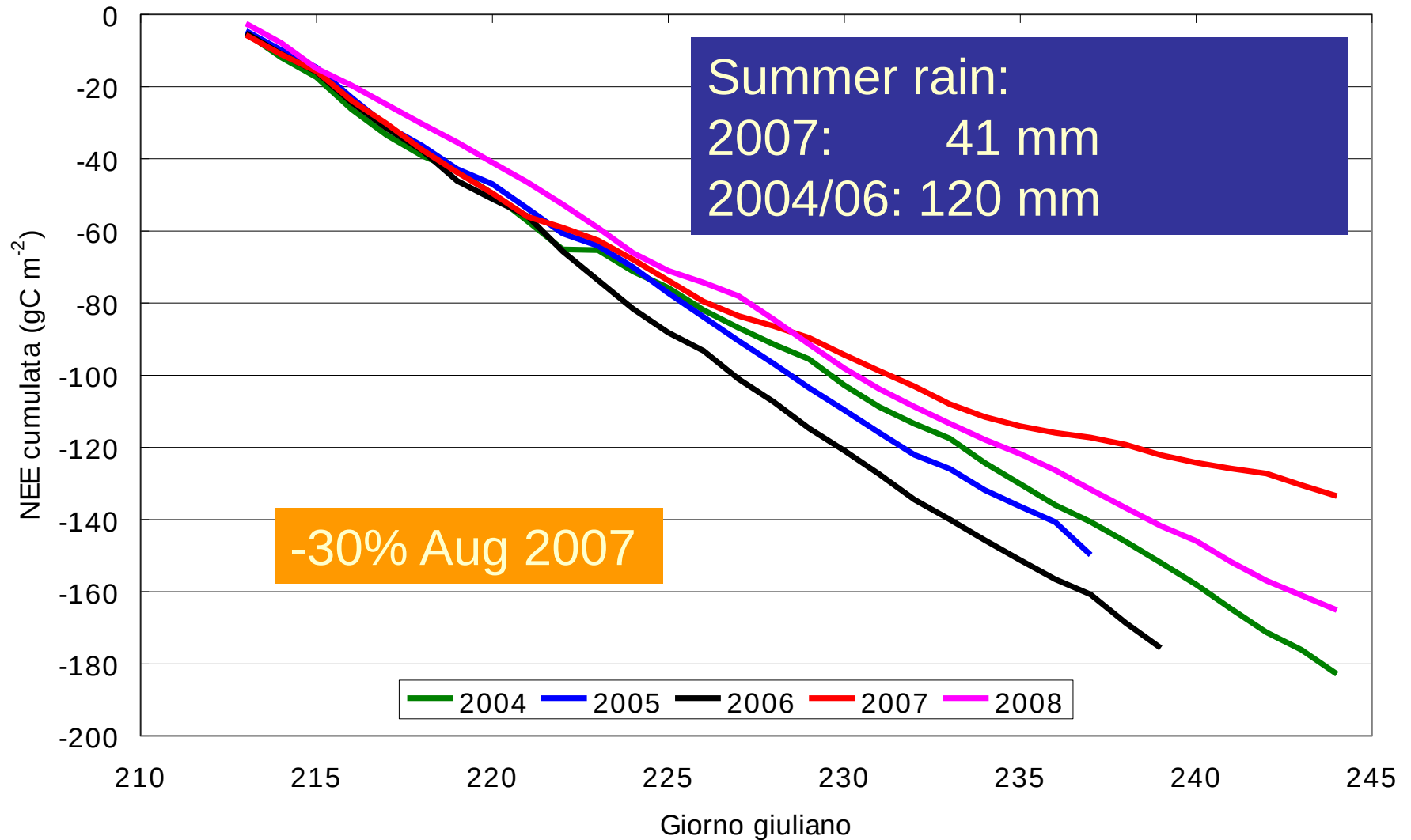
Set-up for flux measurements



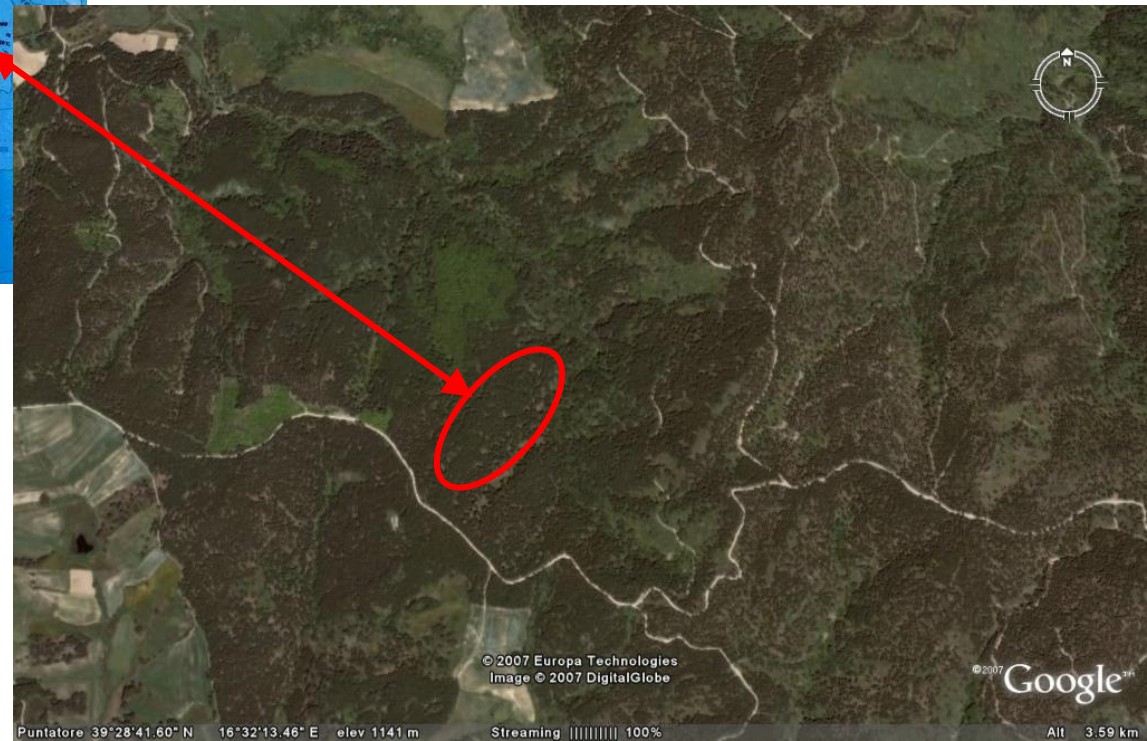
Annual trend of Net Ecosystem Exchange 2008



Role of extreme years and drought



The test site of Bonis, southern Italy



Site: Bonis – Sila (CS)

Cooperation with CNR-ISAFOM

39°28'N; 16°31'E, 1100 m s.l.m.

Pure calabrian pine plantation (*Pinus nigra* Var. *Laricio*)

40 years; 640 trees ha⁻¹

Height: 21-22 m; Basal area 45.4 m² ha⁻¹

Total biomass: 145 t ha⁻¹; LAI: 6 m² m⁻²

T = 8.9 °C; Precipitation = 1179 mm

Eddy fluxes since 2003 -

Forest Hydrology

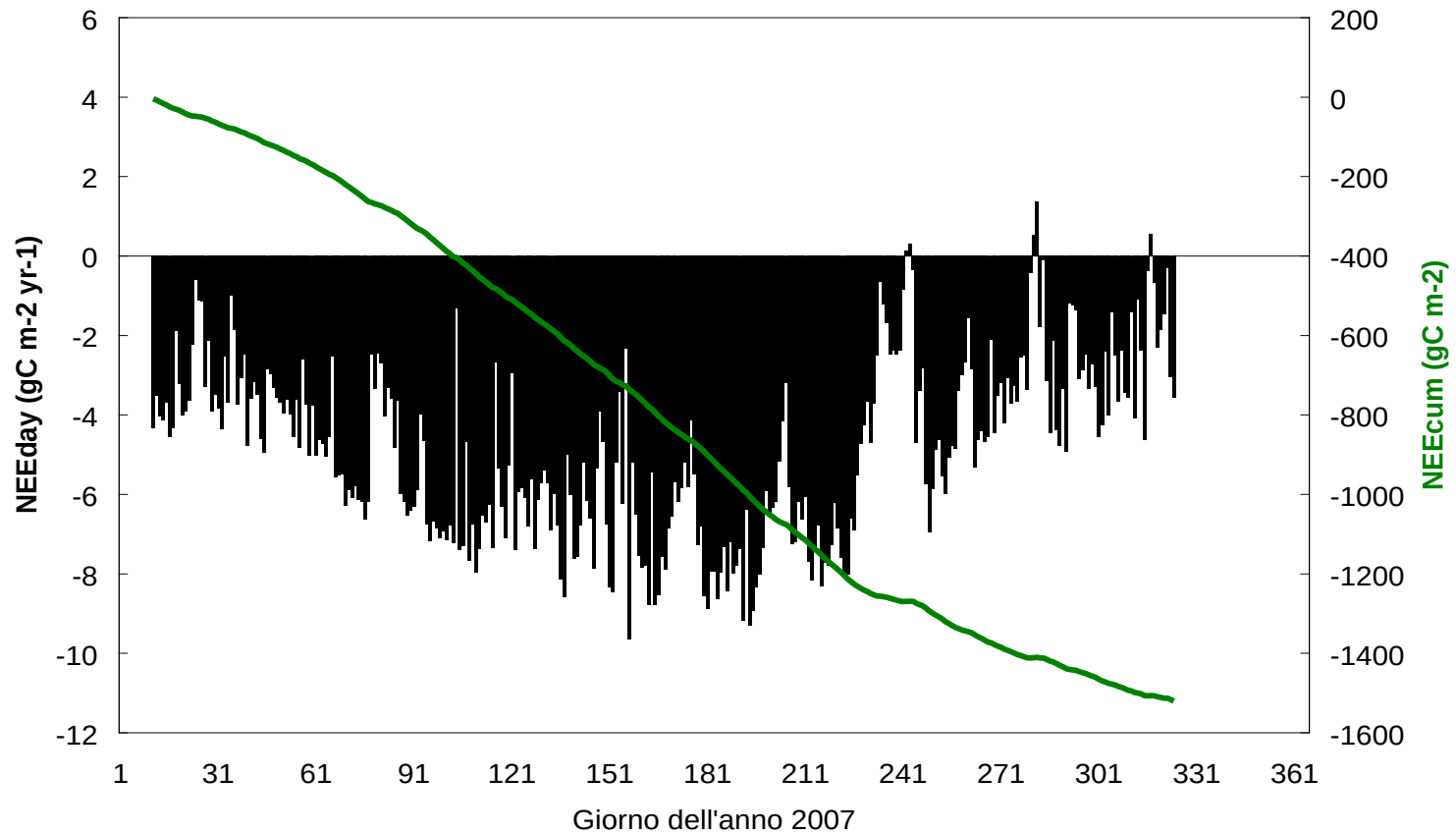
ENFORS Site

Sapflow: 1995-98, instrument available for 2008...

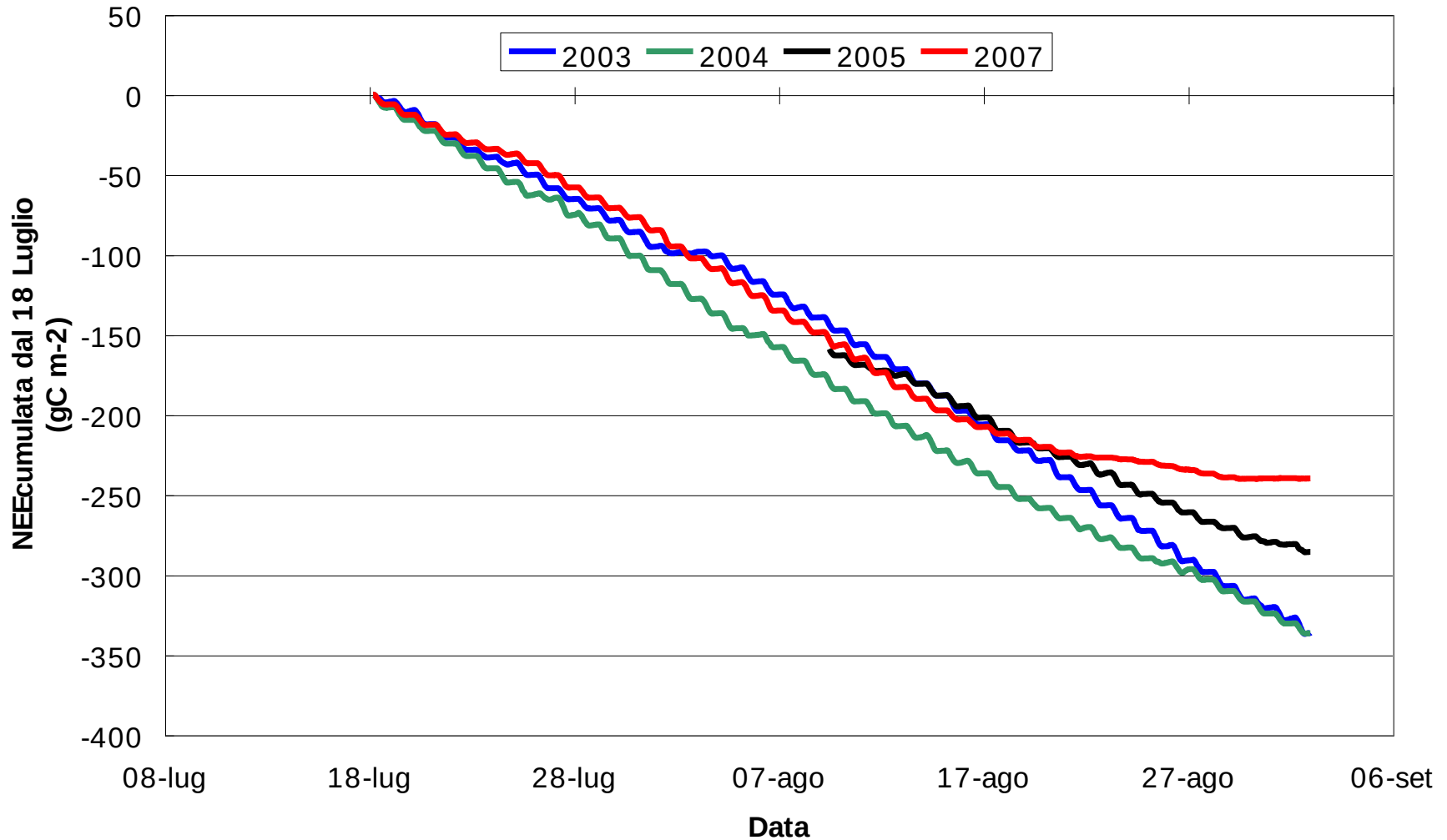
VOCs: campaigns possible

06.09.2005

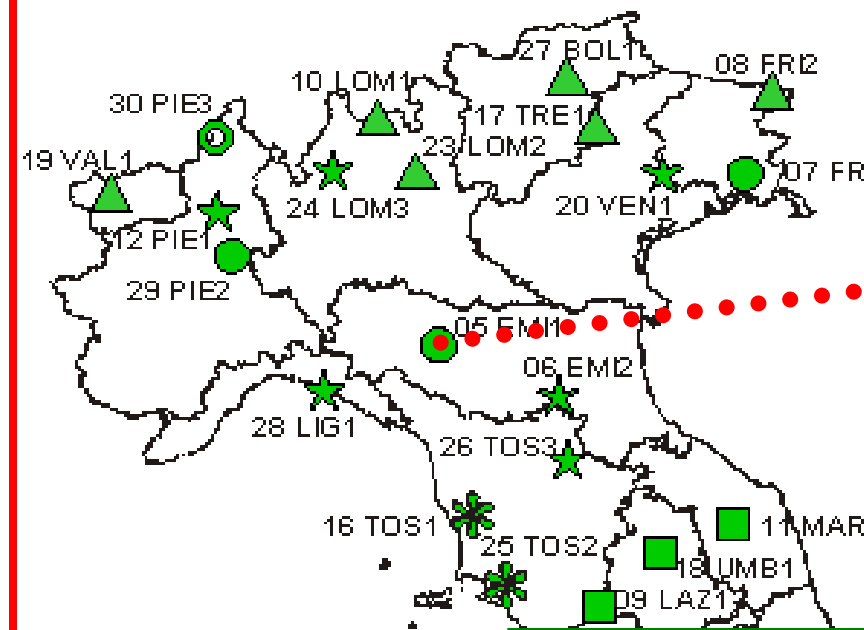
2007 CO2 fluxes



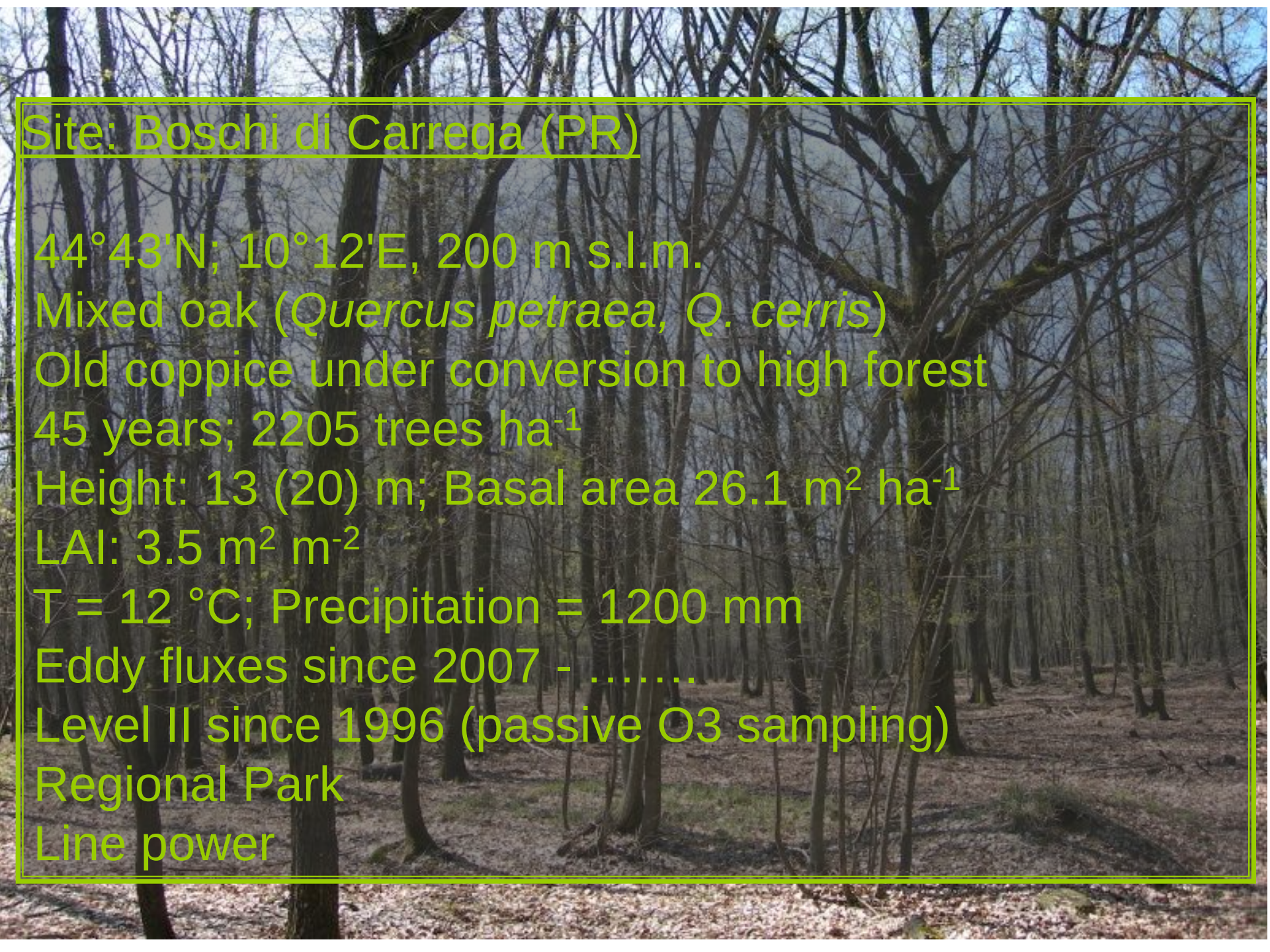
The role of anomalous year: drought in August 2007



Matteucci G., Scarascia Mugnozza G. (2008). Le foreste difendono il pianeta dai gas serra: ma l'uomo deve aiutarle. Sylvae III-9: 49-65



The test site of
Carrega, northern
Italy



Site: Boschi di Carrega (PR)

44°43'N; 10°12'E, 200 m s.l.m.

Mixed oak (*Quercus petraea*, *Q. cerris*)

Old coppice under conversion to high forest

45 years; 2205 trees ha⁻¹

Height: 13 (20) m; Basal area 26.1 m² ha⁻¹

LAI: 3.5 m² m⁻²

T = 12 °C; Precipitation = 1200 mm

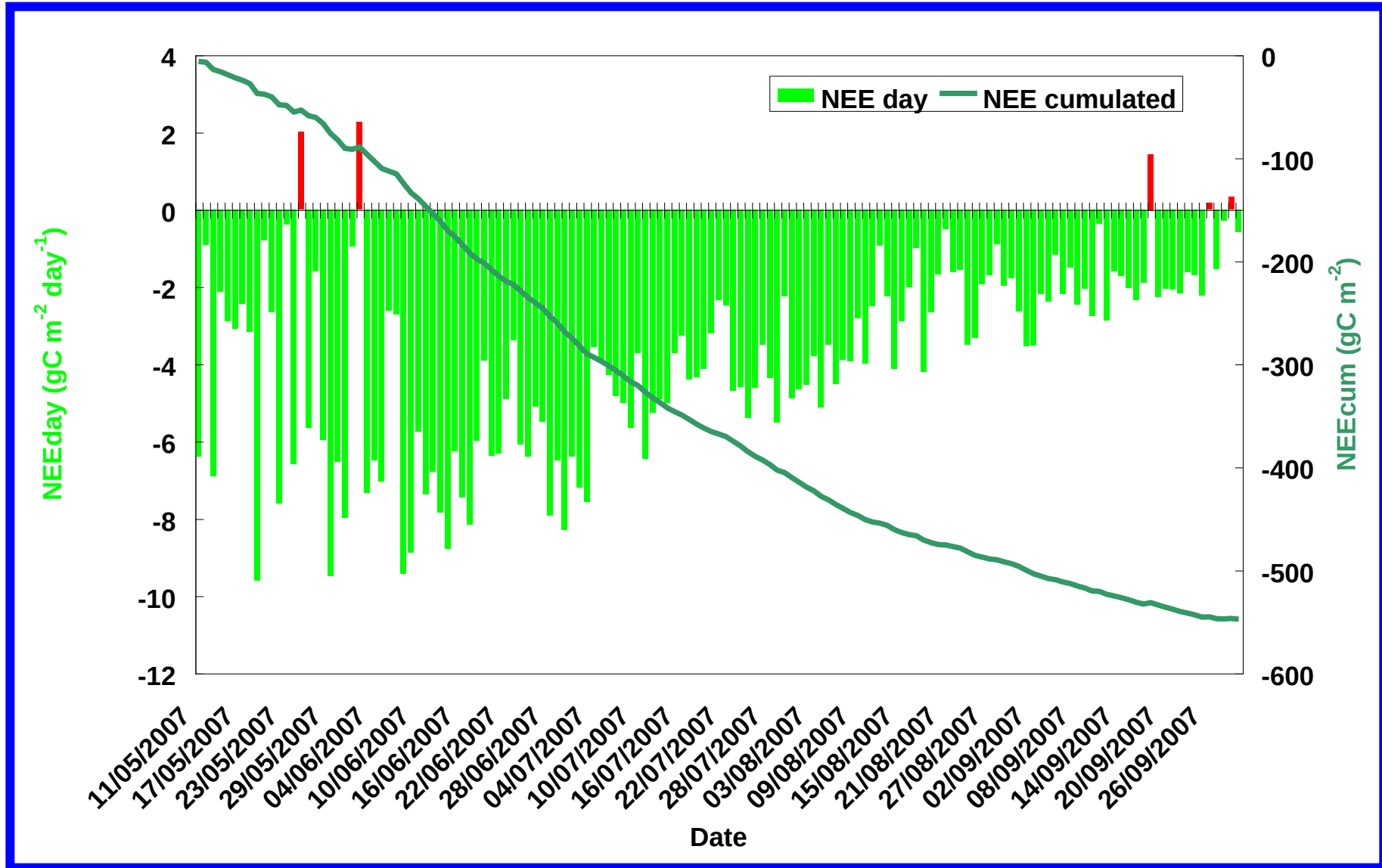
Eddy fluxes since 2007 -

Level II since 1996 (passive O₃ sampling)

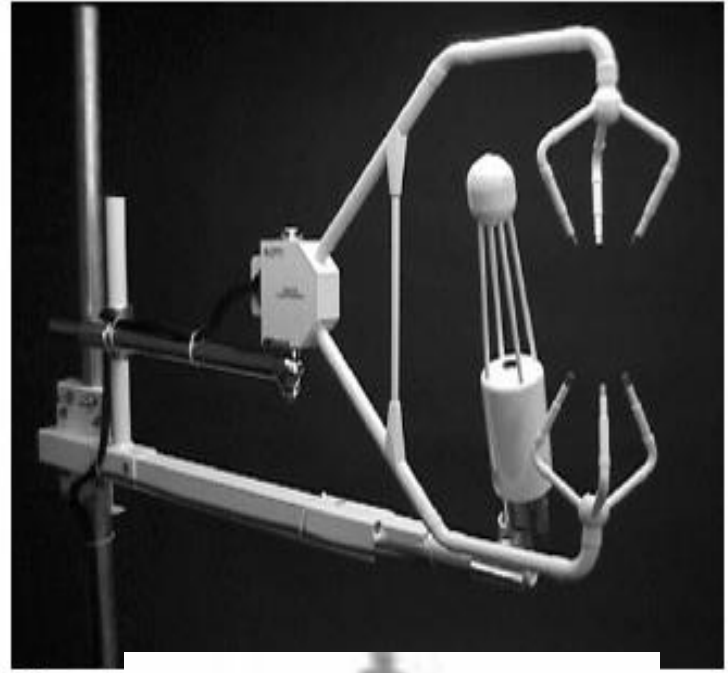
Regional Park

Line power

Results from the level II plot Forest Focus CarbonFlux pilot project



“Everywhere”: the mobile system



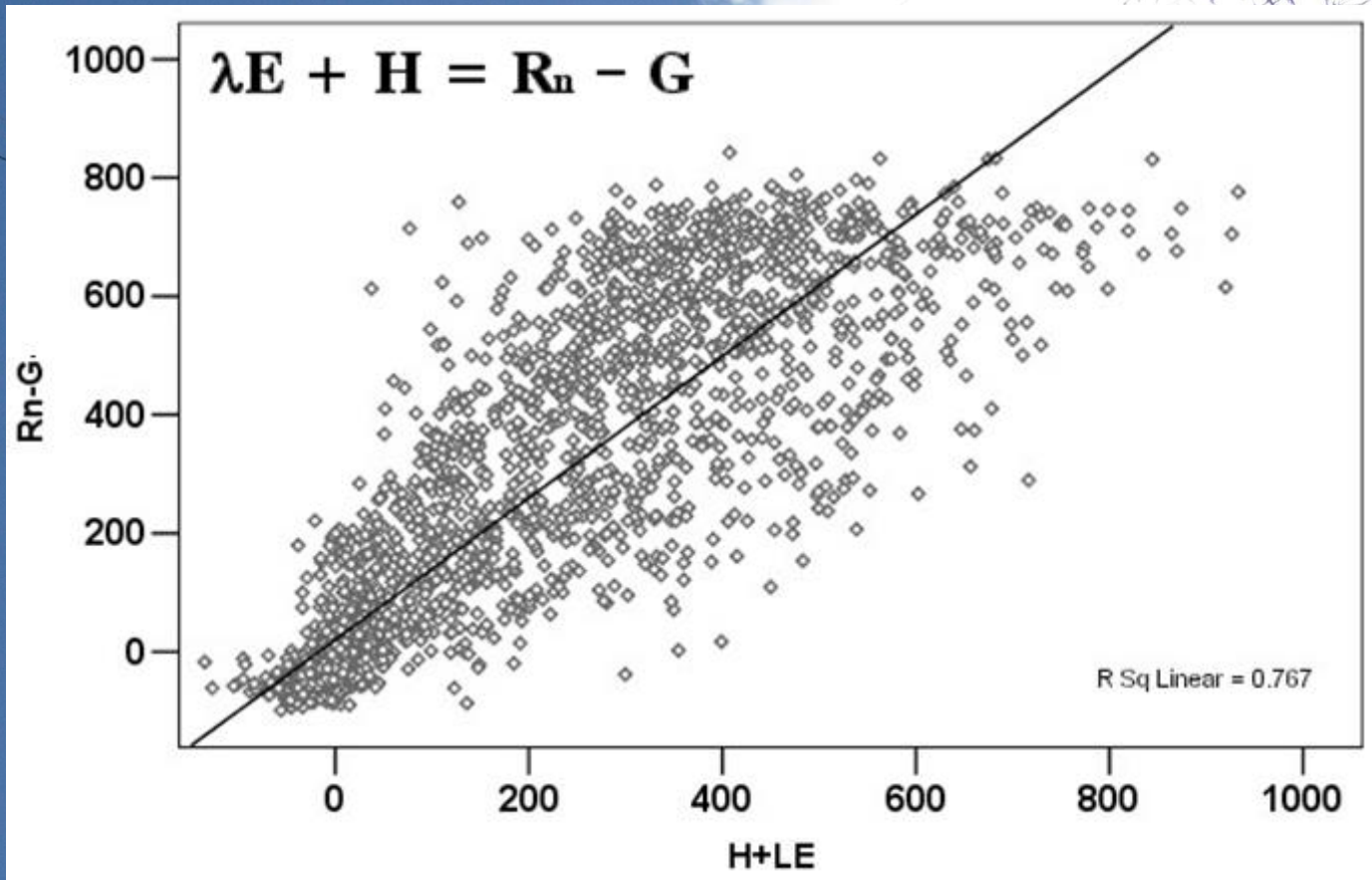
Installation at Feudozzo test site, Castel di Sangro, central Italy



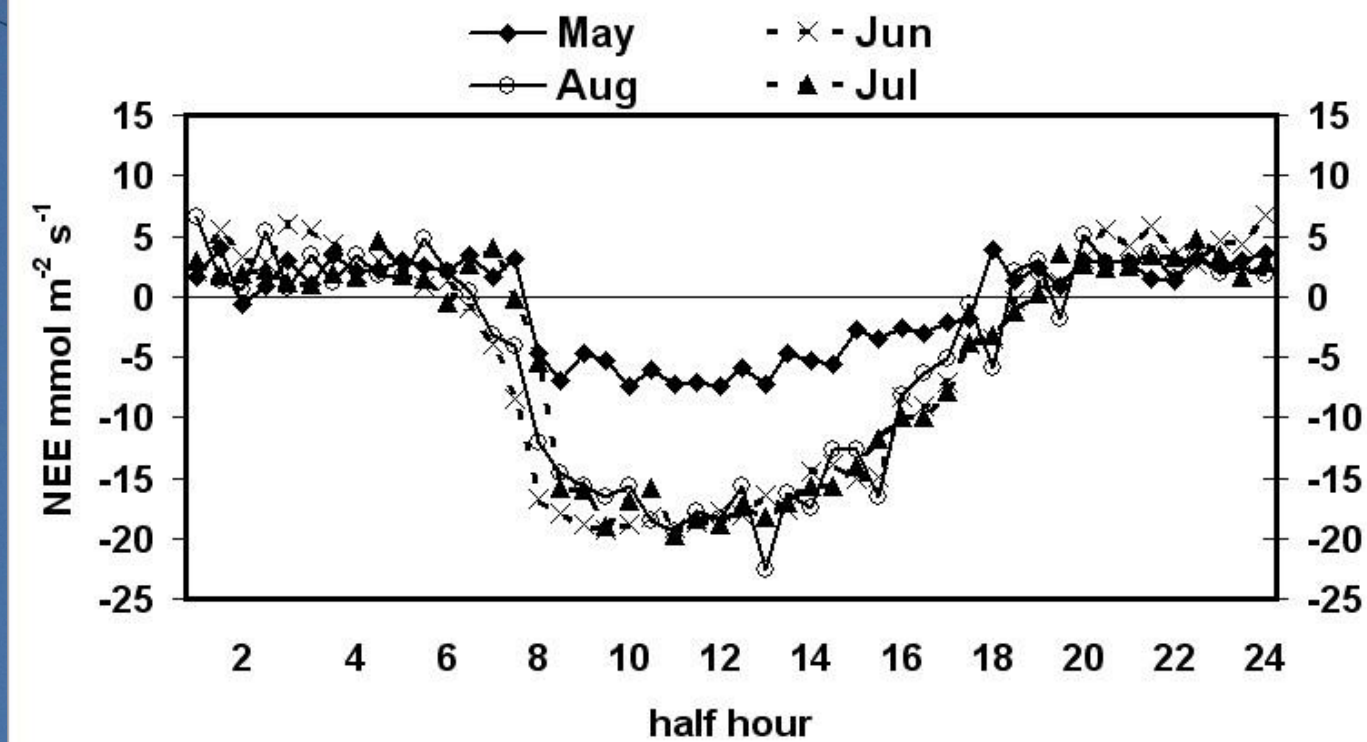
Footprint in two different tower locations



Energy Balance



Fluxes of CO₂ in a typical day



Conclusions

- Long-term continuous measurements are needed in order to:
 1. Quantify the annual contribution of plants to carbon and pollutant removal
 2. Understand the effect of climate changes on vegetation. These include extreme events like drought, high temperatures and pollution exposure
- An already established network of long-term monitoring sites allow quantification of carbon and water balance, and pollutant deposition in representative Mediterranean forest sites in Italy.
- A network of supersites in the Mediterranean regions and different ecosystems can help understanding climate change processes at regional scales, FORESTERRA can play a major role in this coordination action

Thanks:

Prof. Giuseppe Scarascia Mugnozza (University of Tuscia)

Dr. Mauro Centritto (CNR)

Dr. Francesco Loreto (CNR)



and all of you for your attention!