2010-2012: 22 months of flux measurements on grassland, at the Pyrénées foothills (600m)

F. Saïd, S. Derrien, M. Lothon, F. Lohou, M. Abadie, E. Pique, Y. Bezombes, R. Rechal, J.P. Cazes, Y. Meyerfeld, E. Bargain, S. Prieur, C. Jarnot and J.M. Martin

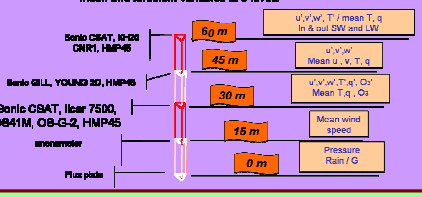
FLUXPYR Global Change in the Pyrenees

Unión Europea — Fondo Europeo de Desarrollo Regional

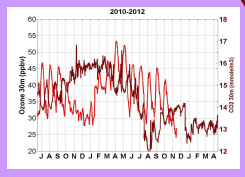
Site and mast characteristics

20 km, north to the Pyrénées, a grassland site in an environment of grassland and forest

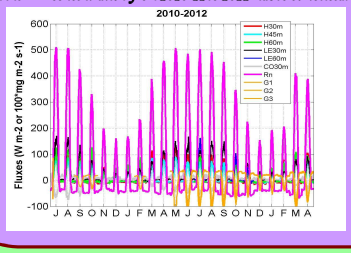
65-m, instrumented tower : Measurements of meteorological mean and turbulent variables at 5 levels

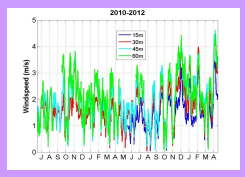


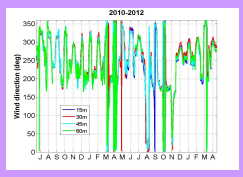
Some results



22 months (July 2010 to April 2012) of temperature (temp), water vapor content (WVMR), wind speed and direction, sensible heat flux (H), latent heat flux (LE) at various levels; ozone and CO2 concentrations at 30m, radiative flux at 60 m (Rn), CO2 flux at 30m and ground heat flux (G) illustrating marked diurnal cycles, including wind, and few differences from one level to the other (except for windspeed). The annual cycle is also obvious on radiative flux, temperature and humidity. The decrease in the CO2 concentration from 2010-11 to 2012 has to be noticed.

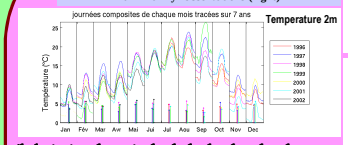


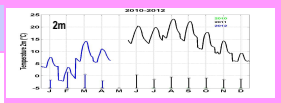


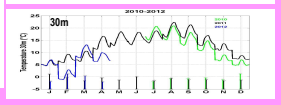


Very first steps towards climatic tendencies

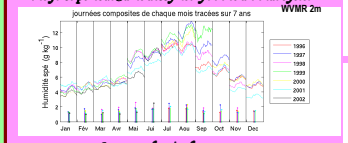
Monthly composite days and associated standard deviations (std) for the 1996-2002 period (left) and 2010-2012 FluxPyr observations (right)

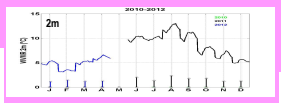




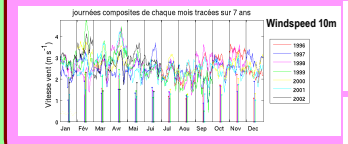


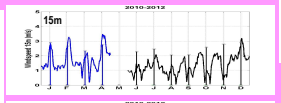
The beginning of 2012 is clearly fresher than the other years. The other month diurnal cycles and std are in the range of the first period. Same dissymetry in the annual cycle.

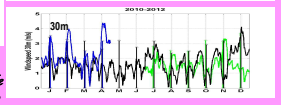




Same tendencies for WVMR.





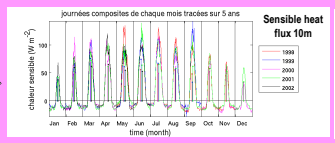


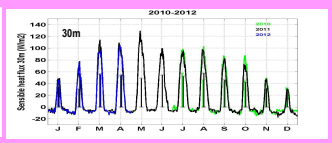
Winds are far weaker during the last period (at least 1 m/s less). Std has also become larger. Clear diurnal cycle in 2012 with stronger winds during daytime, like for some months of the first period. During sept to oct, winds are stronger at nighttime in 2011 and 2012.

2m and 15m sensors were not installed on the FluxPyr mast before June 2011, that is why we also present 30m observations to enlarge the period.

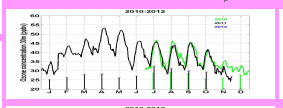
Peak maxima are of the same order whatever the period. Std are a little lower for the FluxPyr period

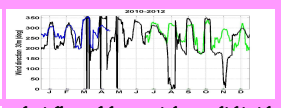
Wind direction, ozone and CO2 concentrations are also available with the FluxPyr measurements.

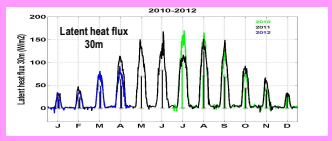




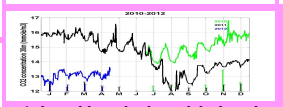
Monthly composite days and associated standard deviations for the 1996-2002 period (left) and 2010-2012 FluxPyr observations (right)





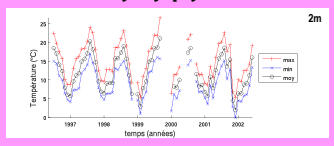


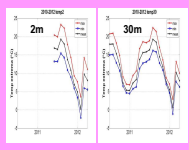
Latent heat fluxes were not measured before 2010. Bowen ratios < 1 from March to September and larger std during this period.



Weak variability within the months but larger from one year to the other

Clear influence of the mountain breeze which is either pure slope wind or a disturbance of the synoptic flow

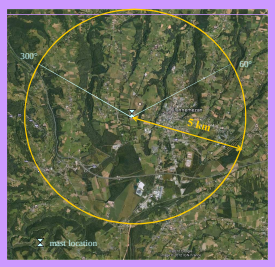




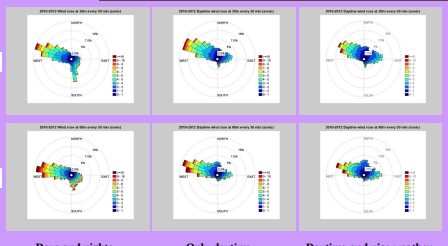
The slight decreasing tendency of the temperature extrema observed during the first period is not confirmed 13 years after, in 2010 and 2011, even if the 2012 winter is particularly cold.

Evolution of the temperature extrema (min and max from monthly composite days) and of the mean temperature for the 1996-2002 period (left) and 2010-2012 period (right)

Any influence of the wind direction on the flux values?

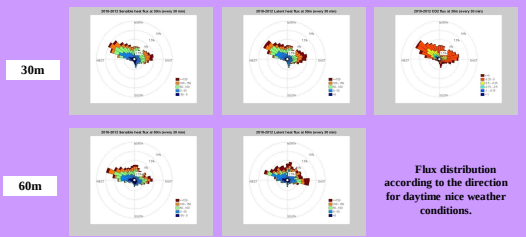


Google view of the area. The circle radius corresponds to the air mass travel due to a 2.8 m/s wind during 30 min (samples size).



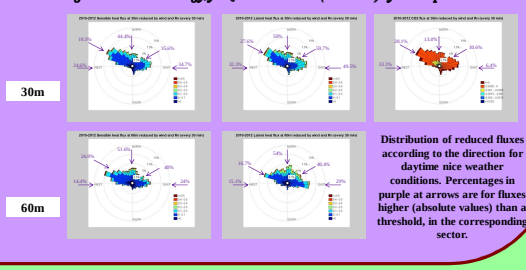
Days and nights | Only daytime | Daytime and nice weather (Rn > mean monthly Rn)

Windroses are bi-directionnal but the south-south-east direction disappears at daytime. Stronger winds disappear when nice weather situations are selected. Winds are expectedly stronger at 60 m. The prevailing direction (nort-west) is the same as at 30m. A little more northern winds at 60m.



Flux distribution according to the direction for daytime nice weather conditions.

No prevailing direction. Slightly higher heat fluxes in the 90° sector. This sector also corresponds to weaker winds. To help discriminate according to the wind speed and according to the available energy, fluxes were reduced (see below) by windspeed and Rn.



Distribution of reduced fluxes according to the direction for daytime nice weather conditions. Percentages in purple at arrows are for fluxes higher (absolute values) than a threshold, in the corresponding sector.

Conclusion: north wind conditions (and also north-eastern ones) correspond to higher heat fluxes. They also are the conditions when the wind is the weakest, which means that the air mass stayed longer over the same area (note that the peat sector is in the north-north-east direction). Large CO2 fluxes are preferentially from the western and north-western sectors.

To be done

- GO AHEAD to collect a larger period!
- study the footprint. Compare to model outputs.
- compare with the 10m mast in the meadow when available

Support

This work is supported by FluxPyr,/POCTEFA, CNRS/INSU and University Paul Sabatier