GROUND AND MODIS GPP 8-D PRODUCTS: INTER-COMPARISON RESULTS ON THE UPPER SPANISH PLATEAU

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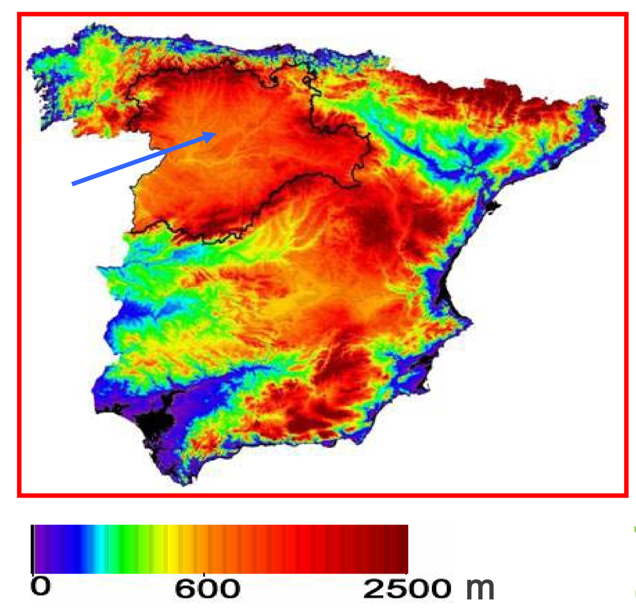
SUMMARY

This paper presents the dynamic evolution of NEE and GPP over the period 2007 to 2012 at the CIB station. The dominant land use is open shrubs. Specifically, we present: a) inter-comparison results of observed GPP 8-d, GPP, with those concurrently retrieved by MODIS, GPP_{MODIS}. b) The results of a LUE model similar to that used by MODIS, GPP_{LUE}, the product of PAR, FPAR and a f stress factor on evaporative fraction, EF, and air temperature, T, to take into account the reduction of the maximum PAR conversion efficiency, ε_0, under limiting environmental conditions. ε_0 was derived through the results of a linear regression fit between GPP and concurrent GPP_{MODIS} as well as GPP_{LUE} estimates.

MEASURINING SITE. DATA



The CIB station is included in the CCGG (flasks) network led by NOAA

- NEE Fluxes
- Energy Fluxes: Latent Heat, LE, Sensible Heat, H, Ground Soil and Net Solar Radiation
- Photosynthetically Active Radiation (PAR), Air Temperature (T) and soil moisture.
- GHG gases

PROCEDURE

Fluxes retrieved from the eddy covariance instrumentation were used to calculate the GPP by using the relationship:

GPP 8-d = -NEE+RE

where NEE is the Net Ecosystem Exchange and RE is the respiration. RE was parameterised using the 8-d 30-min nocturnal data as follows:

RE=c.EF.exp (d.T)

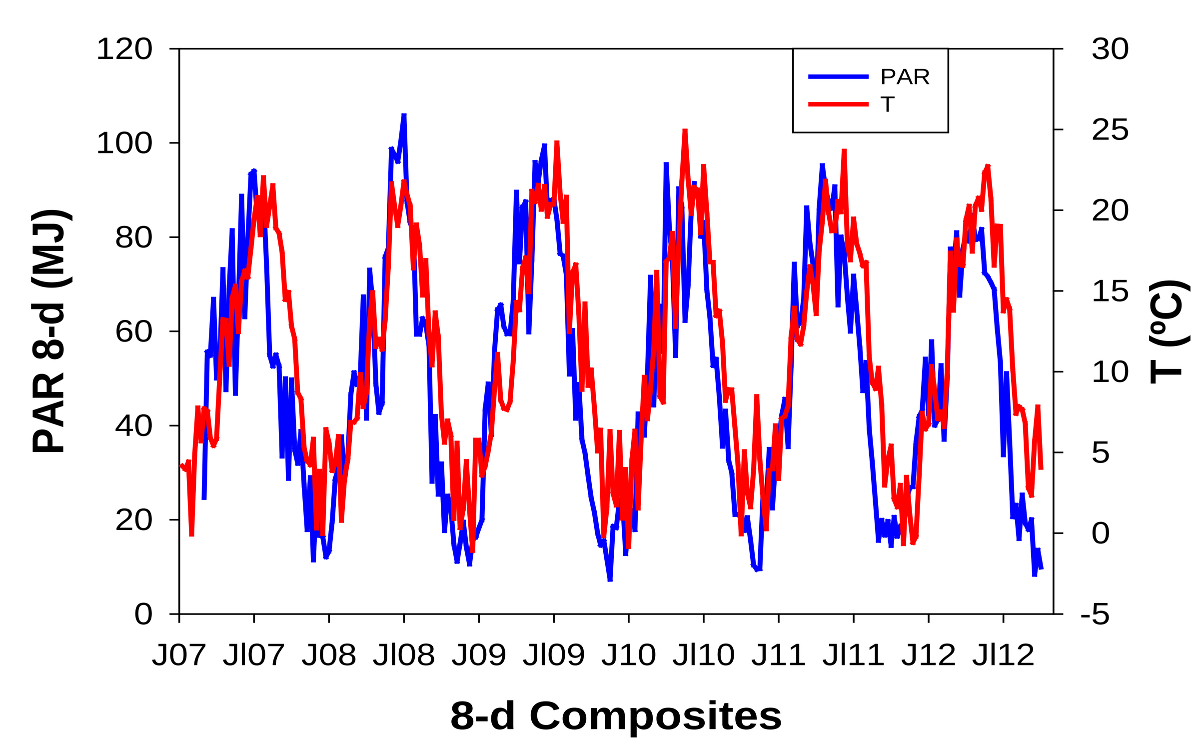
EF is defined as LE/(LE+H). The results used here are 8-d composites calculated using the 30-min values of T and of the diurnal EF values. The GPP_{LUE} model used is:

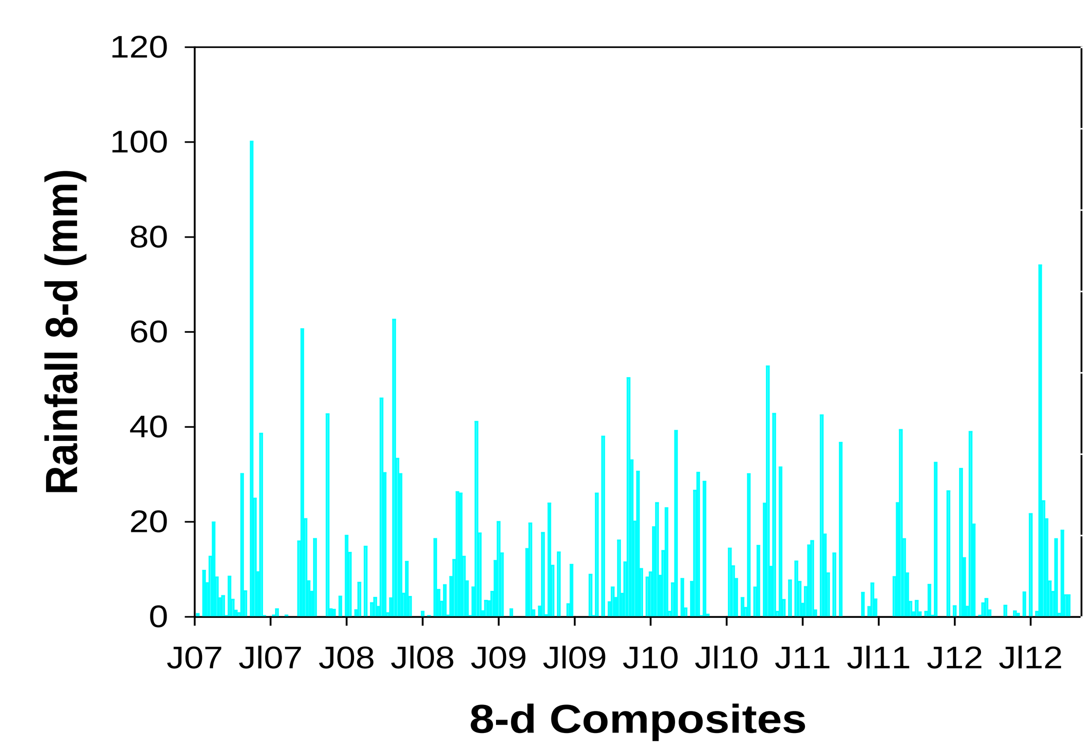
$GPP\ 8\text{-}d_{LUE} = \varepsilon_0 .\ f\ PAR .\ FPAR = \varepsilon_0 .\ GPP_{APAR}$

All the MODIS products correspond to V006 collection. Filling big gaps (outside the growing season) was performed using the results of the linear fit between GPP and GPP_{MODIS} 8-d.

DRIVING METEOROLOGICAL VARIABLES

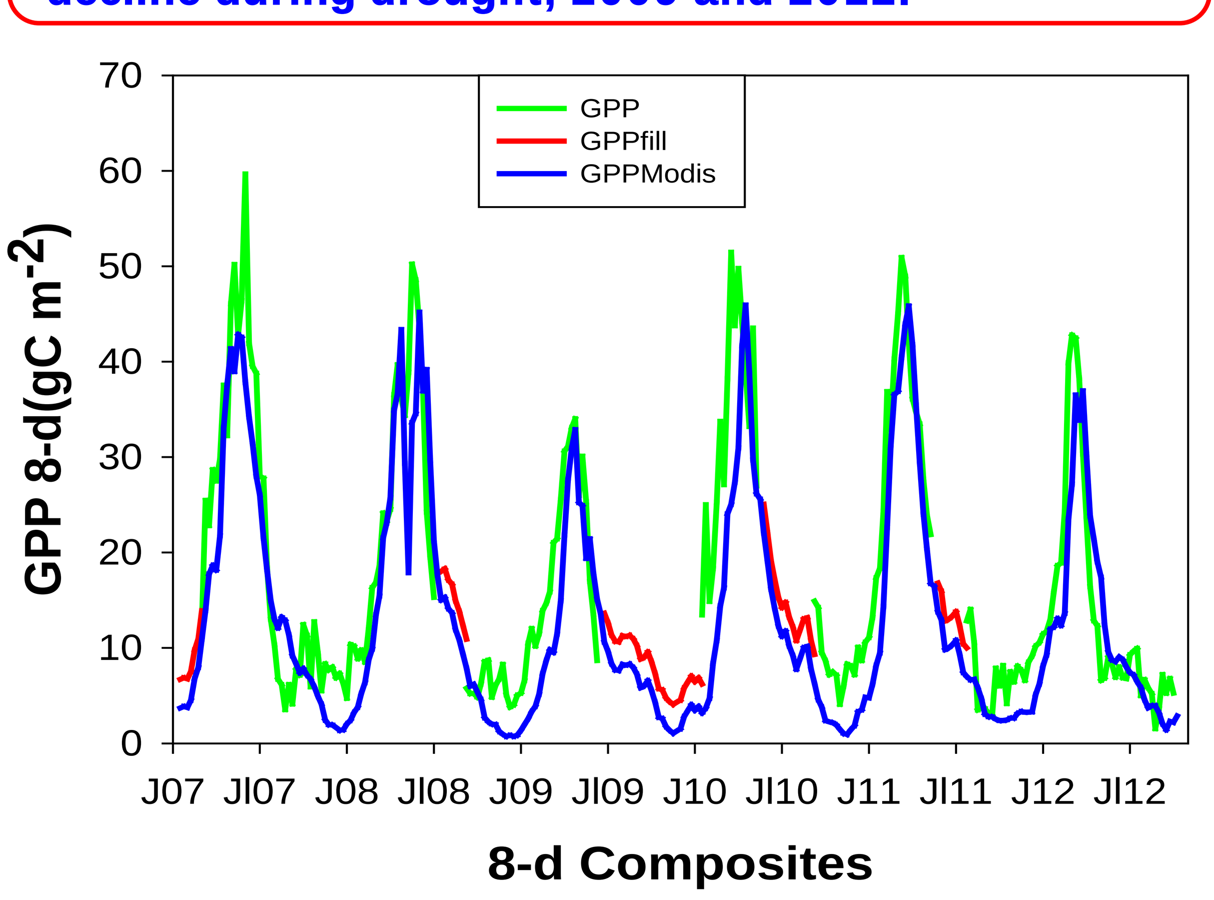
Meteorological variables were rather variable, especially rainfall, R, during the whole year, Y, and growing season, GS. 2009 and 2012 were dominated by drought (see Table below). Units for rainfall and NEE as well as GPP are mm and gC m^{-2}, respectively.

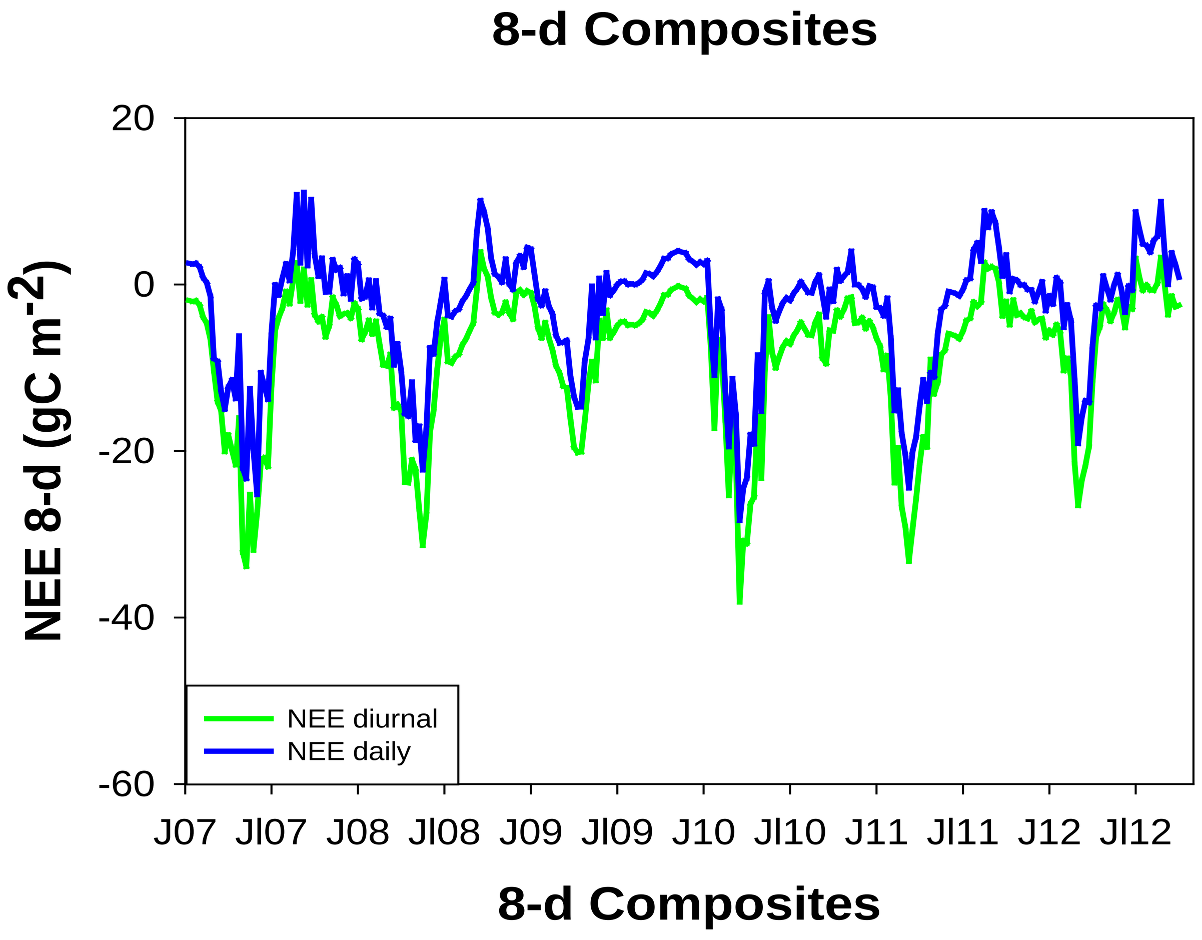




GPP AND NEE RESULTS

GPP red line shows the gaps filled. The same NEE data were filled (not shown). It should be noted the decline during drought, 2009 and 2012.





ACKNOWLEDGMENTS

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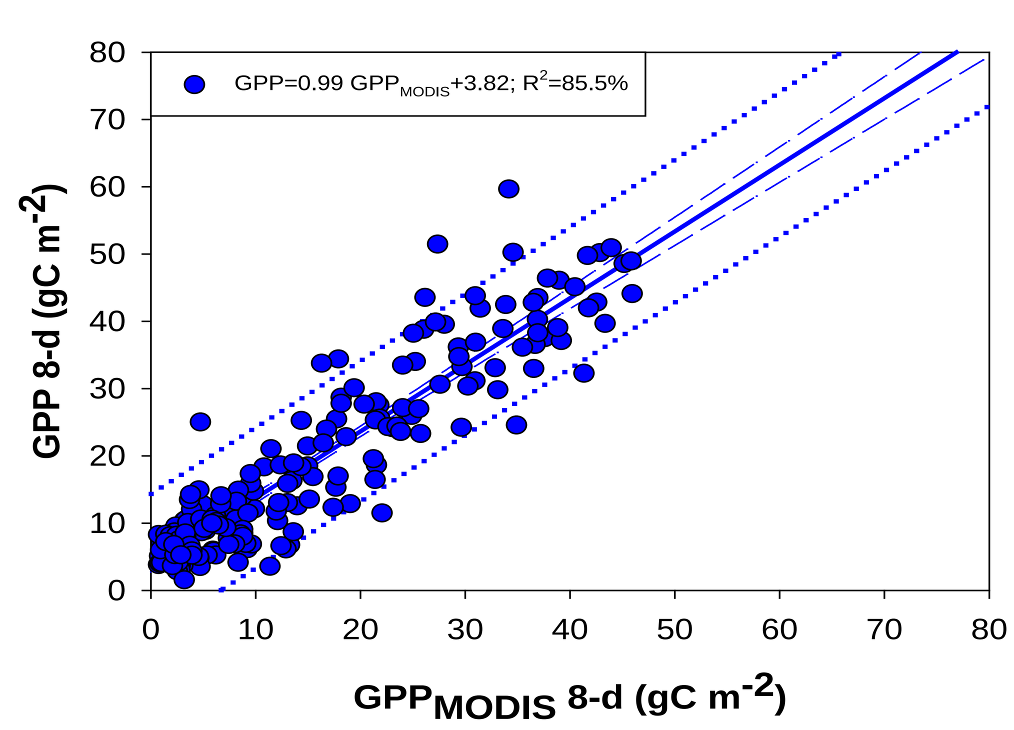
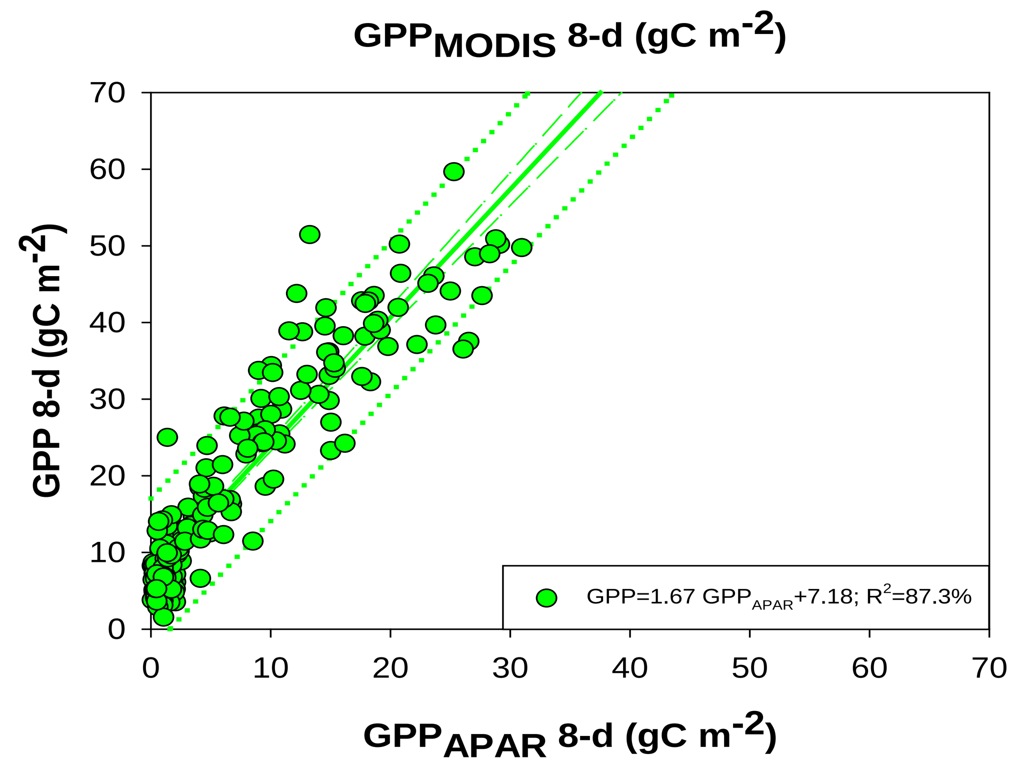
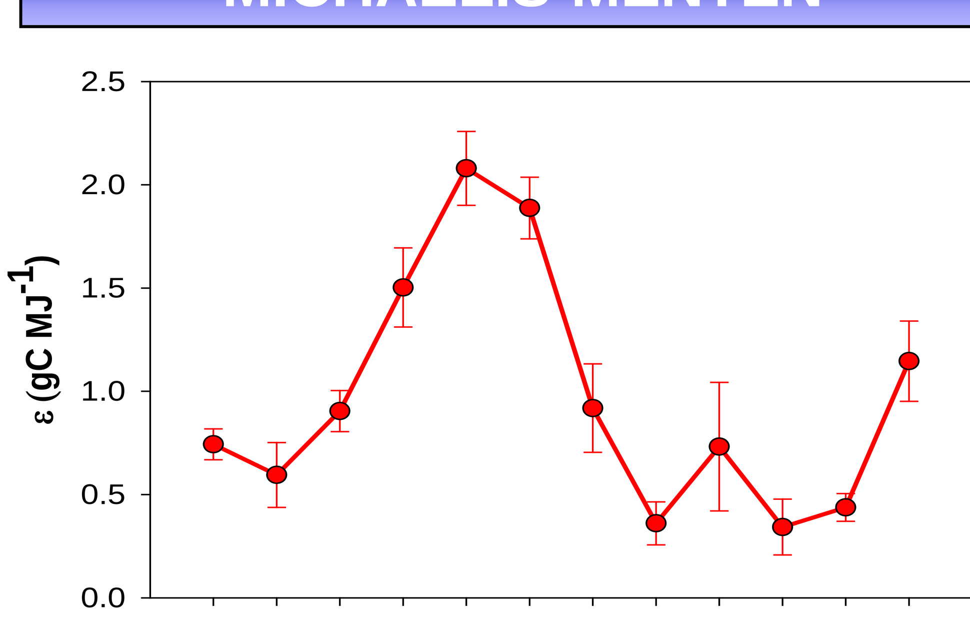
LUE-MODIS RESULTS





ε RESULTS DERIVED FROM Eq. MICHAELIS-MENTEN



FEATURES AND RESULTS

Year	R, GS	R, Y	Features	NEE	GPP
2007	228	468	Normal	-178	879
2008	237	487	Normal	-163	816
2009	104	375	Dry	-82	617
2010	196	539	Rainy	-230	853
2011	158	347	Normal-Dry	-174	817
2012	115	391	Dry	-53	588

CONCLUSIONS

- Annual accumulated GPP exhibited a great variability with values ranging from 879 to 588 gC m^{-2}.
- The influence of climate conditions, especially rainfall, dominated GPP and NEE seasonal evolution. Despite the inter-annual variability the ecosystem behaved as a carbon sink all years. NEE annuals (daily) spread from -230 to -53 gC m^{-2}.
- GPP_{MODIS} proved to be a robust tool for GPP estimates (R^2=85.1%). ε_0 yielded 0.99 gC MJ^{-1} a value fully consistent with the current MODIS Look-up Table.
- The LUE model slightly improved the MODIS results (R^2=87.1%) providing a ε_{0LUE} value of 1.67 gC MJ^{-1}.
- The differences in ε_0 using both approaches must be attributed to the different formulation of the f factor used by MODIS and in this study.
- Based on the comparison between ε_0 with the ε results derived from the Michalis-Menten eq., the value obtained with the LUE model appear to be more realistic at the measuring site.