APPLICATION OF A LUE MODEL TO ESTIMATE GPP 8-d BY USING MERIS PRODUCTS IN AN AGRICULTURAL ECOSYSTEM

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SUMMARY

We present the results of the GPP 8-d derived from f_{APAR} MERIS product using a LUE model in an agricultural ecosystem located in the geographical centre of the Spanish plateau over selected periods (mainly the growing season, GS) in 2003, 2004, 2005 and 2006.

MERIS images were accessed through the MERCI interface and processed using BEAM VISAT software, version 3.7, from ESA (TOC Vegetation Processor) in the 1040 m x1160 m pixel centred on the measuring site. Minor differences between the TOC and TOA data sets, also analysed in this paper, were obtained.

The maximum light use efficiency value, ε_{max} , at the measuring site was fitted through a linear regression fit between the calculated and observed GPP 8-d composites.

PROCEDURE

GPP 8-d $_{observed}$ = NEE+RE, where RE is the respiration. RE was parameterised using the 8-d means nocturnal data as follows:

$$RE=a.EF.(bT_s\text{-}cT_s^2)$$

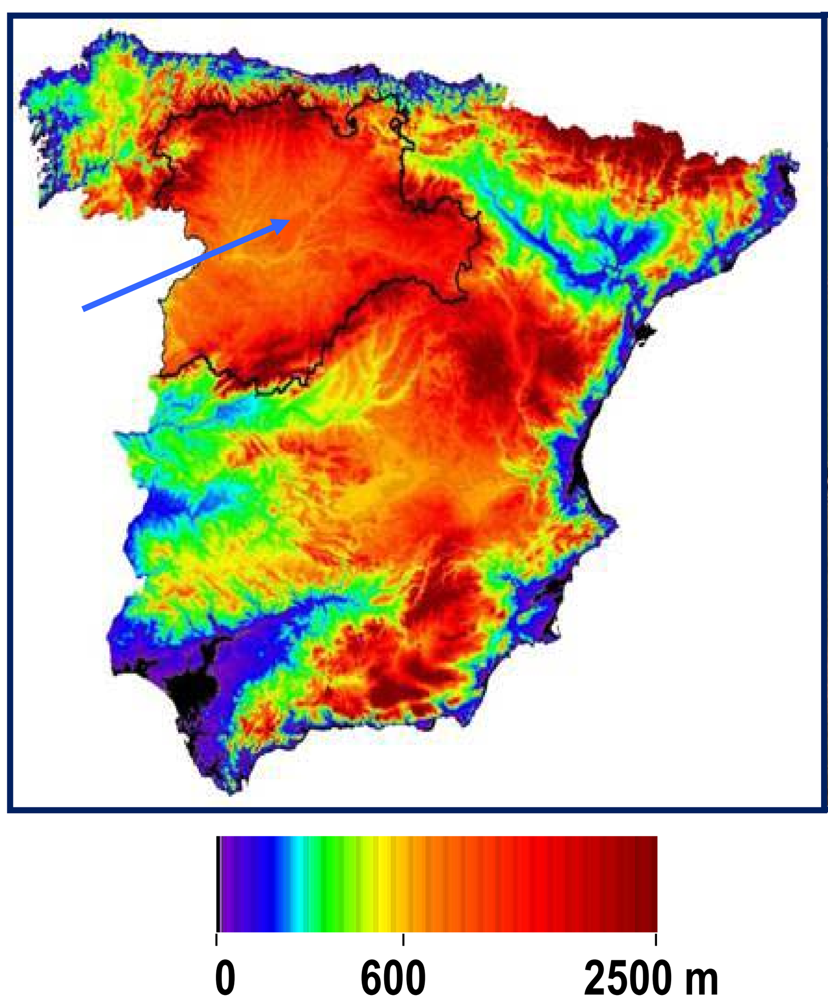
where EF is the evaporative fraction, LE/(LE+H), the latent, LE, and sensible heat, H, fluxes, respectively, and T_s, soil temperature. The 8-d RE composites were then calculated using the diurnal T_s and EF mean values.

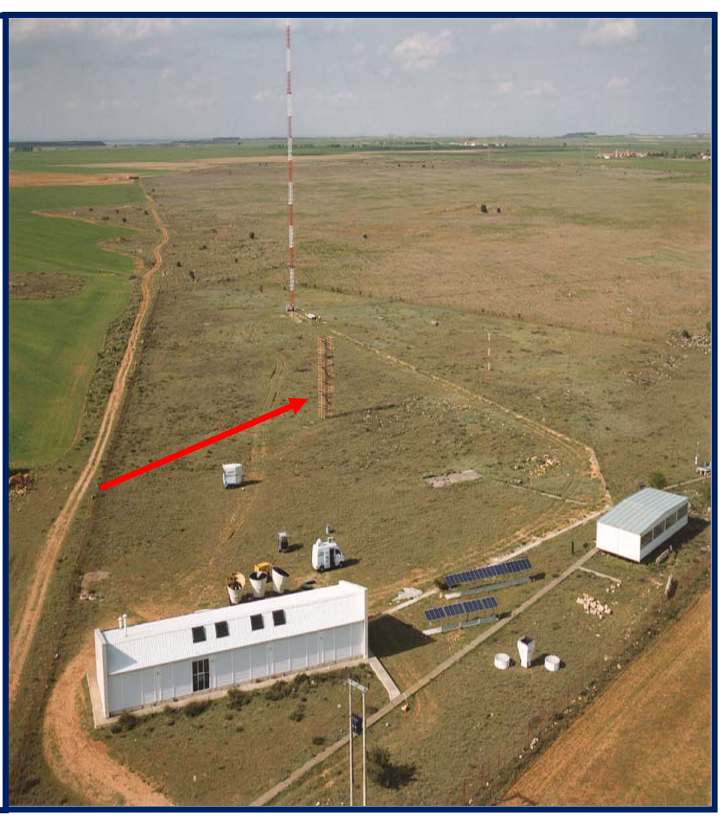
$$GPP\ 8\text{-}d_{modelled} = \varepsilon_{max}.f.PAR.f_{APAR} = \varepsilon_{max}.GPP_{PAR}$$

f was assumed to be equal to the evaporative fraction.

Major gaps (e.g., those outside the growing season in 2003, 2005 and 2006 were refilled using the results GPP$_{observed}$- LAI linear regression.

MEASURING SITE LOCATION





Aerial View

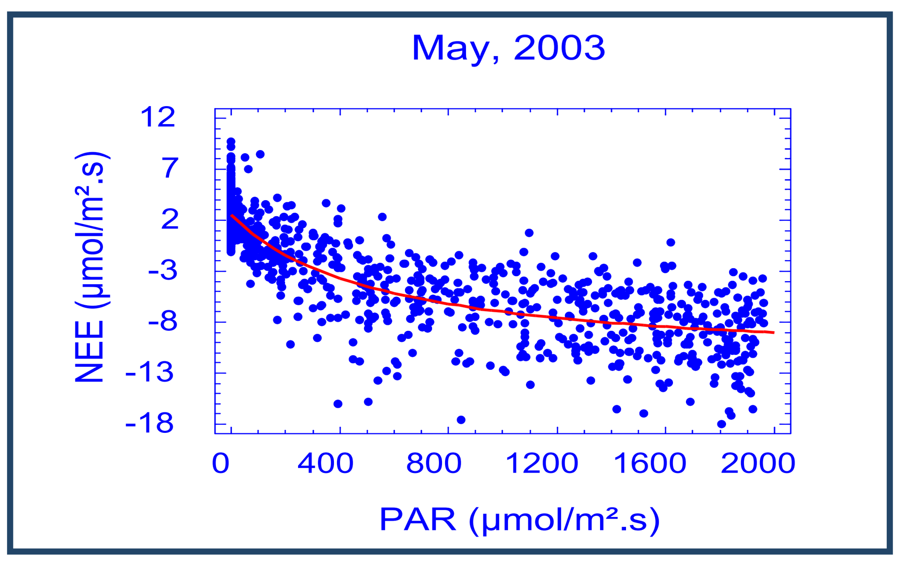
MEASUREMENTS

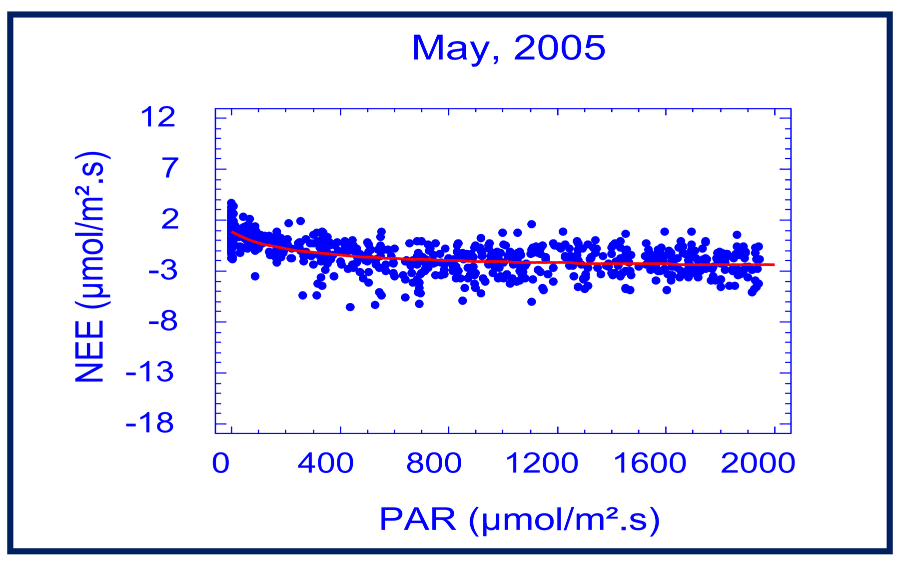
- NEE fluxes
  - LI-6262
  - Campbell CSAT3 sonic
- Energy fluxes:
  - Latent flux
  - Sensible heat flux
  - Soil fluxes
  - Net solar radiation
- PAR, global radiation
- Soil temperature

DATA

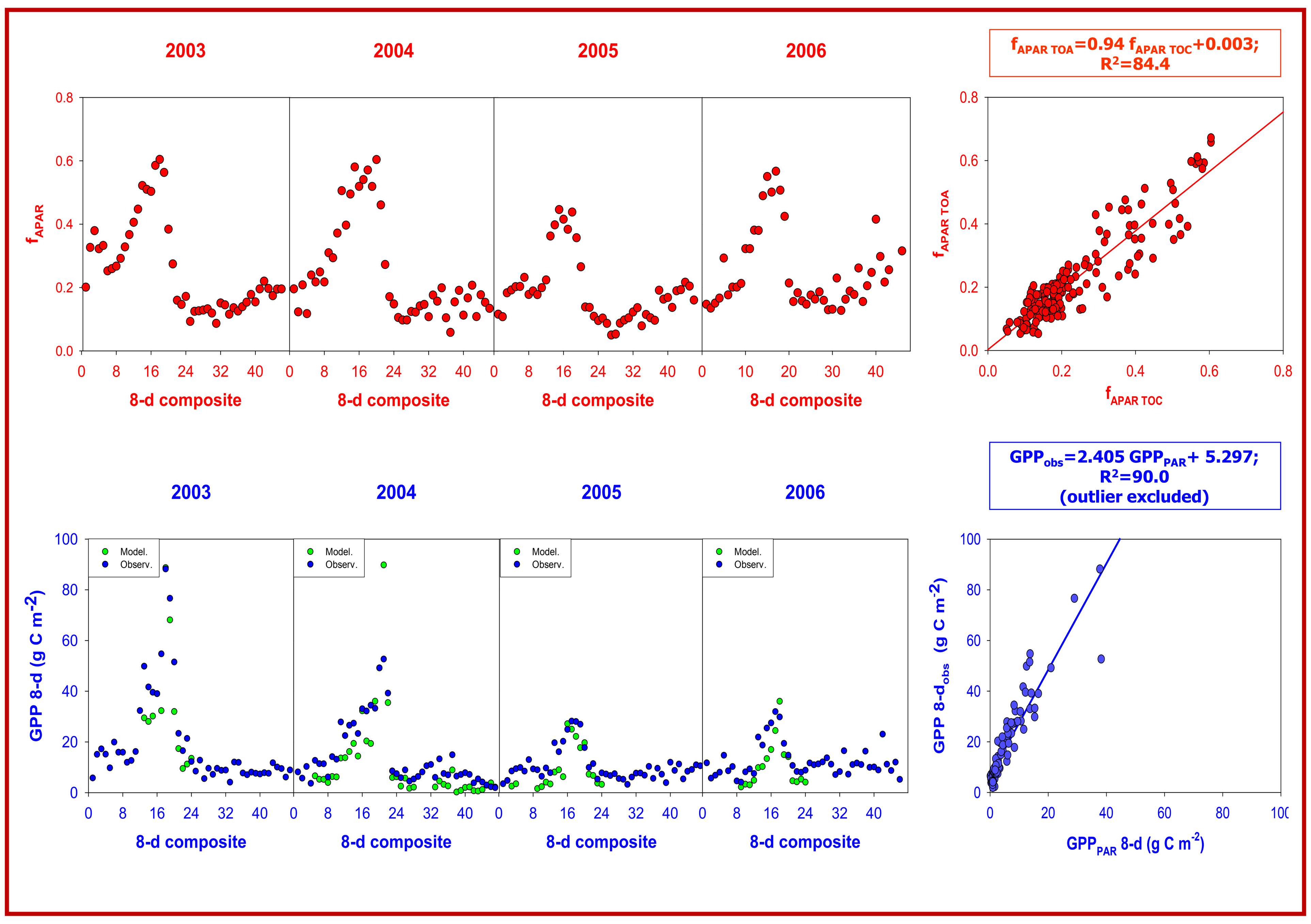
YEAR	NEE FLUX MEASUREMENTS MONTHS	TYPE OF YEAR	YEAR ACCUMULATED RAINFALL (mm)	RAINFALL ANOMALIES IN GS (mm)
2003	April-June	rainy	609	+37.7
2004	Whole year (except January and August)	dry	323	+11.2
2005	January and March-June	very dry	276	-49.3
2006	March-June	slightly rainy	522	-15.1

NEE - PAR





INTER-ANNUAL VARIATION OF f_{APAR} AND GPP 8-d



CONCLUSIONS

- The f_{APAR} 8-d composites processed using the TOA and TOC processors yielded a satisfactory correlation, R^2=84.4% . The slope, 0.94, and intercept of the linear fit, 0.003, showed very weak differences between both data set.
- The inter-annual f_{APAR} variation was fairly consistent with the general climatological conditions, maximum values falling from 0.604 in 2004 to 0.446 in 2005, affected by a severe drought. However, the evolution was not so closely followed in the rainy year, 2003, during which the maximum f_{APAR} value did not vary with respect to that obtained in 2004 (0.604).
- The annual GPP_g estimates in 2003, 2004, 2005 and 2006 was 913, 604, 499 and 588 g C m^{-2}, respectively. The dramatic decline in 2005 proves the significant impact of drought.
- The LUE model applied using EF as a factor to take into account water stress in combination with the f_{APAR} MERIS 8-d product and ground PAR measurements properly fitted the GPP 8-d observed (R^2=90.5%). The ε_{max} value obtained, 2.405 g C m^{-2} MJ^{-1}, was considerably higher than typically reported for crops.
- Bearing in mind the prevailing drought affecting the study period, especially in May, additional measurements covering wider climatological conditions are required.

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