CARBON FLUXES AND LAI EVOLUTION IN THE ECMWF LAND SURFACE SCHEME

M.H. Voogt[1], L. Jarlan[2] and B.J.J.M. van den Hurk[3]

[1]*Royal Netherlands Meteorological Institute, PO Box 201, 3730 AE De Bilt, The Netherlands; voogt@knmi.nl*

[2]*Météo France, CNRM, 42 Av. Coriolis, F-31057 Toulouse Cedex 1, France; lionel.jarlan@cnrm.meteo.fr*

[3]*Royal Netherlands Meteorological Institute, PO Box 201, 3730 AE De Bilt, The Netherlands; hurkvd@knmi.nl*

ABSTRACT

The Ags parameterization of canopy conductance from ISBA-Ags is implemented in TESSEL, the ECMWF land surface scheme. We present first results of the investigation of the model behavior in view of an operational use in a data assimilation system. It is shown that the performance of the Ags module is sensitive to the land surface model in which it is embedded.

AGS PARAMETRIZATION

The present ECMWF land surface scheme TESSEL distinguishes 6 tiles over land surfaces. Vegetation is represented by a dominant high type and dominant low type [*Van den Hurk et al.,* 2000]. The canopy conductance is calculated using a Jarvis-type parameterization, which assumes that environmental factors act independently on the conductance.

A more realistic, physiological way to parameterize the canopy conductance is to derive it from the CO_2 assimilation by the vegetation [*Jacobs et al.,* 1996]. This so-called Ags scheme is implemented within the ISBA soil-vegetation-atmosphere transfer (SVAT) scheme at Meteo France, including a biomass evolution scheme [*Calvet et al*., 1998]. Biomass growth directly depends on CO_2 assimilation, whereas biomass decline is based on nitrogen dilution [*Calvet and Soussana*, 2001]. Through the dynamic representation of LAI, the model can account for interannual variability, droughts in particular.

We implemented the Ags module in TESSEL, referring to as C-TESSEL. For that purpose, we increased the number of vegetation tiles to represent the 7 plant functional types of ISBA-Ags (deciduous, coniferous and evergreen trees, C3 and C4 grass, C3 and C4 crops).

We present first results of the investigation of the model behavior in view of an operational use in a data assimilation system using leaf area index (LAI) data from satellite measurements.

MODEL INTERCOMPARISON

The performance of the Ags module has first been investigated by an offline model intercomparison study between C-TESSEL and ISBA-Ags. For 2003, this has been done for the SMOSREX site, located in the south-west of France, fully covered with C3 grass. Several parameters are prescribed based on site data. However, no data is available on e.g. the soil hydraulic conductivity, so that is part of the model parameterization itself. Fig.1. presents the simulation of the soil moisture stress function and LAI by C-TESSEL and ISBA-Ags. C-TESSEL shows higher CO_2 assimilation in the beginning of the year, and as a consequence, also a larger biomass and LAI evolution. The divergence is due to complex interactions between soil moisture, atmospheric humidity, CO_2 assimilation, LAI evolution and evaporation. The different soil moisture dynamics in the two models affect the intensity of the soil moisture stress and thereby the CO_2 assimilation. *Calvet* (2000) and *Calvet et al*. (2004) give a description of two types of stress strategies plants can adopt.

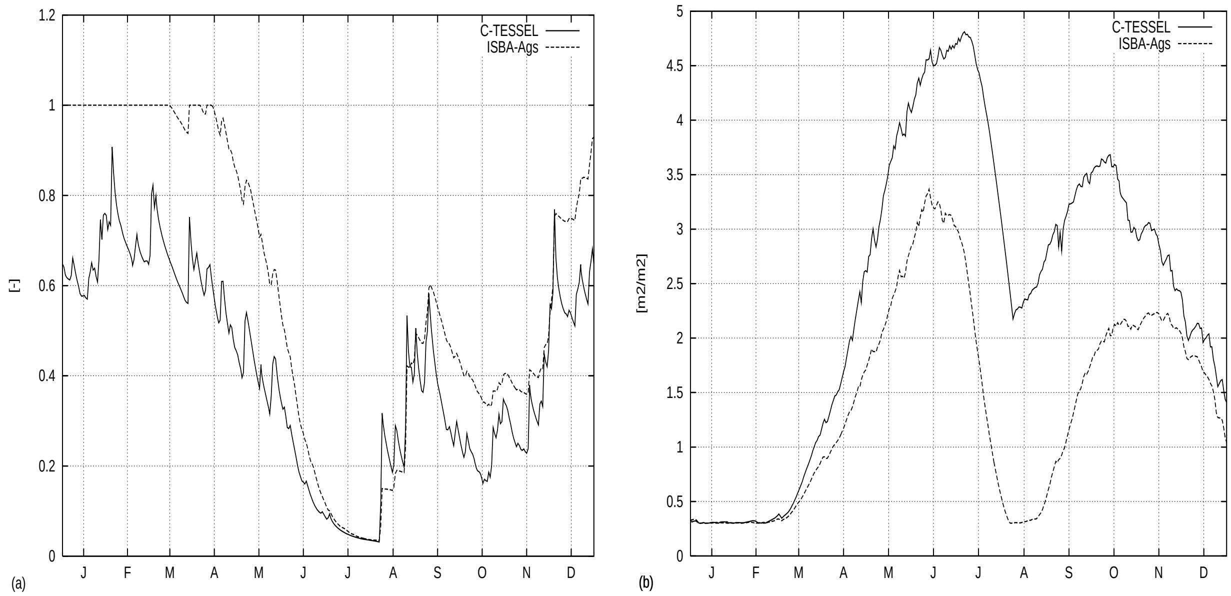

Fig.1. Model output of C-TESSEL compared with ISBA-Ags for SMOSREX 2003: a. Soil moisture stress function, $(\theta-\theta_{pwp})/(\theta_{cap}-\theta_{pwp})$; b. LAI.

The representation of the soil and its characteristics determines for a large part the availability of soil water. We have seen that the Ags module is sensitive to soil moisture, so it is obvious that the performance of the Ags module depends on the land surface model in which it is implemented. Apart from the soil, other differences in representations and parameterizations may influence the Ags behavior both directly and indirectly. Examples are the surface climatology (albedo, roughness length) and the interception reservoir.

REFERENCES

Calvet, J.-C., J. Noilhan, J.-L. Roujean, P. Bessemoulin, M. Cabelguenne, A. Olioso, and J.-P. Wigneron (1998), An interactive vegetation SVAT model tested against data from six contrasting sites, *Agric. For. Meteorol*, *92*, 73-95.

Calvet, J.-C. (2000), Investigating soil and atmospheric plant water stress using physiological and micrometeorological data, *Agric. For. Meteorol*, *103*, 229-247.

Calvet, J.-C., and J.-F. Soussana (2001), Modeling CO_2-enrichment effects using an interactive vegetation SVAT scheme, *Agric. For. Meteorol*, *108*, 129-152.

Calvet, J.-C., V. Rivallad, C. Picon-Cochard, and J.-M. Guehl (2004), Modelling forest transpiration and CO_2 fluxes — response to soil moisture stress, *Agric. For. Meteorol*, *124*, 143-156.

Jacobs, C. M. J., B. J. J. M. Van den Hurk, and H. A. R. De Bruin (1996), Stomatal behaviour and photosynthetic rate of unstressed grapevines in semi-arid conditions, *Agric. For. Meteorol.*, *80*, 111-134.

Van den Hurk, B. J. J. M., P. Viterbo, A. C. M. Beljaars, and A. K. Betts (2000), Offline validation of the ERA40 surface scheme, ECMWF TechMemo. 295, 42 pp., ECMWF, Reading.