Hydrol. Earth Syst. Sci. Discuss., 5, S782–S786, 2008
www.hydrol-earth-syst-sci-discuss.net/5/S782/2008/


Hydrology and Earth System Sciences Discussions

HESSD

5, S782–S786, 2008

Interactive Comment

# *Interactive comment on* "Vegetation dynamics and soil water balance in a water-limited Mediterraneanecosystem on Sardinia, Italy" *by* N. Montaldo et al.

**N. Montaldo et al.**

Received and published: 28 July 2008

The comments were helpful and have been addressed in the revised manuscript. We are pleased with the result and feel the manuscript is stronger. A point-by-point response to the comments, including a summary of the corresponding modifications to the paper, is included below.

Referee Guido D'Urso

Reviewer comment (RC S145 : 'Reviewer comment' , Guido D'URSO)

General Comment: As this paper of Montaldo et al. clearly demonstrate, modern hydrology is paying more and more attention to the influence of vegetation dynamics on land surface processes. The methodology proposed in this paper and tested in a typical Mediterranean ecosystem is appealing for its simplicity and the relatively limited number of parameters needed. It is also appreciable the inclusion of remotely-sensed input to infer the spatial distribution of vegetation over the area of interest. The coupled LSM-VDM model includes algorithms and relationships described in cited papers; as such, it sometimes difficult to trace the whole structure of the coupled model without carefully reading the cited references. For example, the equations for the energy balance components are taken from a simplified schematization not widely acknowledged or simply not easily available, i.e. Noilhan and Planton (1989). Response: we thank the reviewer for the helpful suggestions. As suggested by the reviewer we have added a new Table 3 where we reported the equations related to the energy balance. We have also add a new Table 2 with all model meteorological inputs, such as suggested by the reviewer in the specific comment 3).

Specific comments 1) Comment: Section 1: Par.25 pag. 221: the sentence seems inconclusive; the approach proposed in this paper is highly empirical; explain main differences and advantages of proposed methodology compared to previous ones. Response: We added the suggested clarification to the manuscript. The text was deeply revised: "A set of efforts for coupling VDMs and LSMs used ecological models that require a wealth of detailed information that is often unavailable in operational hydrological applications, mainly computing photosynthesis through the biochemical approach and complex versions of the carbon assimilation approach (Kemp et al., 1997; Calvet et al., 1998; Cox et al., 1999; Reynolds et al., 2000; Arora, 2003), while another set of efforts used mainly empirical and site-specific ecological models, computing photosynthesis through the LUE approach and simplified versions of the carbon assimilation approach (Haxeltine et al., 1996; Vertessy et al., 1996; Walker and Langridge, 1996; Gerten et al., 2004). Attractive compromises are the coupled VDMs and LSMs of Cayrol et al. (2000) and Nouvellon et al. (2000). These models mainly differ in their photosynthesis computations, which are, however, both based on a carbon assimilation approach. In the spirit of the models of Cayrol et al. (2000) and Nouvellon et al.



HESSD

5, S782–S786, 2008

Interactive Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

(2000), Montaldo et al. (2005) developed a parsimonious and robust coupled model for grass dynamics only";

2) Comment: Section 2.3: It is not clear the usage of remotely sensed images in the context of the present application: is it really needed only to determine the fractional vegetation cover in the footprint area of the EC tower, or it was meant for other purposes ? Please, specify. Response: the two satellite images are used only for determining the fraction of vegetation cover in the site. For clarifying this point, the following text has been revised: "For estimating the fraction of vegetation cover distribution of the site, two multispectral high spatial resolution (2.8 m x 2.8 m per pixel) Quickbird satellite images (DigitalGlobe Inc.) were acquired";

3) Comment: Section 3.1: 1) it is not straightforward to identify the input variables; add a table, similar to Tab.1, indicating which are the input variables needed; Response: A new Table 2 with input variables has been added.

4) Comment: Section 3.1: 2) the bottom boundary condition, represented by qD in Eq.(1), is considered as a unit gradient; justify this assumption, considering that the soil has been described of limited depth (thin, paragraph 15, pag.229); according to my experience, very often in presence of thin soils, the bottom layer is impervious (rock or compact clay); Response: yes, the soil is of limited depth, but the bottom layer is a partially fractured basalt. Moreover the field is slightly sloping (approximately 3° from NW to SE), so that both a downward flux and lateral flow need to be simulated. For clarifying this point, the following text has been added: "The qD rate is estimated using the unit head gradient assumption (Albertson and Kiely, 2001), which is justified for the case study because it allows to account for both the downward flux into the partially fractured basalt and the lateral water flux due to the field slope (see § 2. 1)";

5) Comment: Section 3.1: 3) the LSM consider 3 different sources of water vapor fluxes from the surface (bare soil; grass and vegetation); in this case, it appears quite troublesome to consider the Penman-Monteith schematisation of a "big-leaf" for estimating the

transpiration, especially if the resistance terms are calculated as described in Appendix A. Authors should have considered here a two-source approach (i.e. Shuttleworth and Wallace); justify the underlying assumptions. Response: Much as the Shuttleworth & Wallace approach extended the Penman-Monteith to two sources (vegetation and Soil), we adopt an approach that extends the Penman-Monteith to three distinct cover types (Bare Soil, Grass, Woody vegetation). We connect each of these three cover types separately to the lower atmosphere (i.e. in parallel) as is accepted to be appropriate for landscapes such as the one we are studying with pronounced horizontal patchiness. For clarifying this point, the following text has been added "The Shuttleworth and Wallace (1985) approach extended the Penman-Monteith equation to two sources (vegetation and soil), we adopt an approach that extends the Penman-Monteith equation to three distinct cover types (Bare Soil, Grass, Woody vegetation)"; and "The total evapotranspiration, ET, is equal to fbsEbs+fv,wv+Ewv+fv,grEgr..."

6) Comment: Section 3.1: 4) The LSM model runs with an half-hour time step, while the VDM model runs with daily steps. Considering that during night hours the shortwave radiation is null, the effect of step-wise change in vegetation parameters like LAI should not affect the numerical integration; however, some clarification might be needed to explain the choice of different time steps in the two models and their implications. Response: Thanks to the reviewer for this suggestion. Time resolution of the VDM is daily because below that time scale vegetation cover dynamics are negligible. Indeed it is the common time resolution in current VDMs (e.g., Nouvellon et al., 2001; Caylor et al., 2000). Moreover that coarse time resolution allows less computation effort. Instead LSM time resolution needs to be at least hourly for simulating correctly the energy balance and surface temperature dynamics, which significantly depend on diurnal variations. For clarifying this point, the following text has been added: "The LSM is then coupled with the VDM. VDM provides LAI values of WV and grass daily by (8), which are then used by the LSM for computing the evapotranspiration estimate (e.g., equation A1), energy flux and the soil water content in the root-zone by (1) at a half-hour time step. Indeed, while the daily VDM time step is appropriate for pre-

dicting vegetation cover dynamics and, at the same time, it allows less computation efforts, a sub-hourly time resolution is necessary for the LSM for predicting correctly the energy balance and surface temperature dynamics, which are highly dependent to diurnal variations"

7) Comment: Section 4: Par.5, pag.233: Again, here it is claimed that the coupled LSM-VDM model outputs energy balance terms, but no description is given about the way the algorithm proposed by Noilhan and Planton (1989) has been implemented. Response: Equations of the energy balance and surface temperature dynamics are reported in the new Table 3. The text has been also revised in many parts for better describe the model. For instance: "Equations for surface temperature and three components (H, G and the net radiation, Rn) of the energy balance are the same as Noilhan and Planton (1989) and are reported in Table 3. They are applied separately for each land cover component, so that the model predicts the energy balance distinctly for each land cover component"

8) Comment: Par.15, pag.235: it is not clear in the last sentence the link between the potential evaporation Ep (which only depends on canopy and atmospheric conditions) and soil moisture conditions. Response: the sentence has been removed and the section "analysis of inter-annual variability of vegetation dynamics" has been deeply revised.

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 219, 2008.