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Hydrology and Earth System Sciences Discussions

Interactive comment on "A conceptual dynamic vegetation-soil model for arid and semiarid zones" *by* D. I. Quevedo and F. Francés

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General Comments

The aim of this paper is to represent the vegetation dynamics with a conceptual dynamic vegetation-soil model (CDVSM). The review of the vegetation modelling is quite exhaustive as well as the model description. The key point of the paper is the relation which links the relative biomass production with the effective transpiration T and the vegetation water stress (VWS) [Daly, et al., 2004]. The model parameter was calibrate using annual relative biomass data. Then a sensitive analysis of CDVSM is proposed in order to investigate on the role of soil types, effective root depth, precipitation and potential evapotranspiration on the relative biomass production. Further analysis shows the variations of relative biomass production along the year, recording its maximum

value in spring and minimum in autumn.

Specific Comments

Two tanks interconnected were considered using the water balance equation and the appropriate dynamic equation for all considered fluxes. The first for the interception and the second for the upper soil moisture modelling. In my opinion the use of the first tank is not necessary. In many works [Laio, et al., 2001] a simple threshold is used for this purpose.

While the model calibration is carried out at annual scale, nothing is said about the seasonal variability of the rain, the maximum net assimilation and the potential transpiration rate. It is not clear if the seasonal variability is considered (or not?) at monthly scale (as shown in figure 3) or if 4 seasons are considered (as in figure 6). Those information are fundamental for the soil moisture reproduction and consequently for the estimation of vegetation water stress. The model gives the same order of magnitude of the relative biomass production (figure 4). It does not seem to reproduce the historical sequence and consequently the dependence from the soil moisture dynamics. Moreover must be pointed out that the VWS as defined in eq. (8) is a static definition of vegetation water stress. Since the calibration is done at annual scale, the dynamic water stress [Porporato, et al., 2001] seems to be more appropriate.

The sensitive analysis, which is the core of this study, is very interesting. Here, a single mean annual potential evapotranspiration (PET) of 1250mm and a single value of annual precipitation (P) of 514 mm are used. It is not specified if and how a seasonal variability of the latter is considered. If not, the results could differ a lot. The results concerning the PET influence should be emphasized. Reducing the PET the mean soil moisture content increase exponentially, thus producing a reduction of VWS. The latter should imply an increase of R, while it seems insensitive.

In the section 5 a seasonal vegetation behaviour is discussed, so the rain, the temperature the maximum net assimilation are implicitly considered as time dependent. Please

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specify those climate parameters (the same as in figure 3?). The seasonal assimilation dynamic is conceptually well reproduced, but there are no data to demonstrate this result. The R minimum should be in the winter season because of the dormancy. Instead the authors find a minimum in autumn. This particular behaviour could be related to the seasonality of the maximum net assimilation, which is not declared.

Technical Corrections

The figure 2 is not necessary. Cite [Rodriguez-Iturbe and Porporato, 2004] In figure 4 it would be useful to specify the (RMSE) of annual relative biomass simulated with CDVSM compared with biomass field observations (also in the text)

Daly, E., et al. (2004), Coupled dynamics of photosynthesis, transpiration, and soil water balance. Part II: Stochastic analysis and ecohydrological significance, Journal of Hydrometeorology, 5, 559-566. Laio, F., et al. (2001), Plants in water-controlled ecosystems: active role in hydrologic processes and response to water stress - II. Probabilistic soil moisture dynamics, Advances in Water Resources, 24, 707-723. Porporato, A., et al. (2001), Plants in water-controlled ecosystems: active role in hydrologic processes and response to water stress - III. Vegetation water stress, Advances in Water Resources, 24, 725-744. Rodriguez-Iturbe, I., and A. Porporato (2004), Ecohydrology of water-controlled ecosystems: soil moisture and plant dynamics, Cambridge University Press, Cambridge.

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