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Hydrology and Earth System Sciences Discussions

Interactive comment on "Improvement, calibration and validation of a distributed hydrological model over France" *by* P. Quintana Seguí et al.

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Answer to the Editor's Comments

All the references to equations in this answer correspond to the edited version of the paper, after the responsers of the reviewers.

What is meant with diffusion between different layers, diffusive water flow? Normally this is driven by potential gradients not by gradients in water content. Capillary rise will e.g. have the same velocity in sandy and loamy soils, as long as the water content difference is the same (Eq. 4-7)?

The three layered version of ISBA, used in this study, uses a modified force restore method. Eq. 1-3 describe the exchanges of water between the layers and between the

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soil and the atmosphere. The exchanges of liquid water between layers are produced by two different processes: (1) diffusion (D) and (2) gravitational drainage (K).

In this model, diffusion between the root zone and the deep soil is driven by the difference between the water content of the layers (Eq. 7). On the other hand, diffusion between the superficial layer and the root zone depends on the difference between w_1 and w_{eq}, which depends on the equilibrium between the respective potentials (Noilhan and Planton, 1989).

Concerning the soil texture, the parameters of the model C_i depend on soil texture, hence, the velocity in different soils will be different.

The adequacy of such an approach was shown by Noilhan and Planton (1989), Noilhan and Mahfouf (1996), Boone et al (1999), etc.

Beta is named slope of the soil retention curve. However, Eq. 8 is no retention curve, it describes how hydraulic conductivity depends on water content?

Yes, Eq. (8) describes how hydraulic conductivity depends on the water content. The parameter beta is the same parameter found in the soil retention curve (Eq. 1-2 of Noilhan and Planton 1989).

I am not convinced that the topmodel like exponential decrease of ks is necessary for improving your model. Originally this is an elegant work around to avoid a vertically resolved soil zone but to account for the presence of an impermeable layer. Your model is vertically resolved, which not including an impermeable layer by reducing ks of the lower soil store.

In our approach, there is not an impermeable layer at the bottom of the soil, as there is a drainage at the bottom of it. Fig. (3) shows the relative importance of runoff and drainage. The introduction of the exponential profile is a way of changing the properties of the layers in taking into account a reduction of conductivity with depth. The result of introducing this profile is that the C_3 parameter is no more the same in both the root

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zone and the deep soil. The new values of the C_3 parameters are calculated according to the new hydraulic conductivity. All the details about the introduction of this profile to ISBA are explained in Decharme et al (2006).

By making ksat dependent on z, C3 becomes also dependent on z (exponentially). To me it is not clear how you calculate diffusive water flows. Do you use an average of k and C3, which one? Topmodel avoids this problem by assuming that u-zone processes can be regarded as quasi steady. This is for sure not the case in entire France?

In this model, water flows are between layers. Each layer is a reservoir of water. As a consequence, C_3 is constant in each layer. After the introduction of the exponential profile the new values of C_3, which are different for each layer, depend on the mean value of k_{sat} for each layer (Eq. 9 of Decharme et al (2006)). Concerning the other C_i parameters, those that control diffusion (C_2 and C_4) and the one that controls the exchanges with the atmosphere (C_1), these are also modified in accordance with the new exponential k_{sat} (Decharme et al, 2006).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 1319, 2008.