Testing of modifications in the land surface scheme HTESSEL

E.L. Wipfler 1, K. Metselaar 1, J.C. van Dam 1, R.A. Feddes 1, E. van Meijgaard 2, B.J.J.M. van den Hurk 2, S.J. Zwart 3, W.G.M. Bastiaanssen 3

Dry summers
The operational version of the Royal Netherlands Meteorological Institute (KNMI) Regional Climate Model RACMO2 tends to predict too high temperatures for dry summers in certain regions of Europe (e.g. Hungary and the Netherlands). The main reason is the desiccation of the soil during summer when transport of moist air from the Atlantic is blocked (Fig. 1). Soil moisture availability in atmospheric models controls the partitioning of the net radiation at the surface into the fluxes of latent heat (QL), sensible heat (QS) and heat into soil (QD). For that reason soil moisture is considered a key parameter to climate models.

Figure 1. Summer temperature difference at 2 m ERA15 - CRU

Sensitivity analysis and modifications
Based on a sensitivity analysis using the detailed 1D soil-water-atmosphere-plant model SWAP (Fig. 2), priorities have been formulated regarding the improvement of the current land surface scheme of RACMO2, referred to as HTESSEL. This scheme is also used in the ECMWF model. HTESSEL has been revised including flexible numerical discretization, a soil depth according to the FAO soil map, a modification of root water uptake parameters, and the effect of shallow groundwater (Fig. 3).

Figure 2. Estimation of effect of individual variables on different water balance terms, such as evapotranspiration, analyzed for two locations in Europe with different climates.

Results
Sensitivity analysis shows that the modifications to the land surface scheme have an enlarging effect on the QL variability (Fig. 5). Especially the variable soil depth class contributes to the enlarged QL variability (Fig. 6).

Ongoing work
The comparison between the model results and the remotely obtained latent heat fluxes is ongoing. Preliminary results show a significant difference between the net radiation of RACMO and the satellite data (Fig. 7). We presently discuss the best evaluation strategy for the modifications in the Land Surface Scheme in an offline mode. Ideas are welcome!

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