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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Using data assimilation to optimize pedotransfer functions using large-scale in-situ soil moisture observations" *by* Elizabeth Cooper et al.

Anonymous Referee #3

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General Comments Authors present an approach which combines soil moisture predictions from the JULES land surface model with in-situ field scale observational data measured by cosmic ray neutron sensors of 16 sites. Cosby et al. (1984) pedotranfer functions were used to compute soil hydraulic parameters for the JULES model. The manuscript shows that JULES model performs better in the prediction of soil moisture if the constants of the pedotranfer functions are calibrated based on field-scale soil moisture observations. This way soil physics parameters of the JULES are not directly optimized. The manuscript presents a new approach to improve performance of JULES model in soil moisture prediction. It is a high quality research, has interesting results and is well structured. Only one aspect could be explicitly clarified, if soil textural infor-

mation was derived from a course resolution raster dataset in the presented analysis. If that is the case, it would be important to discuss how uncertainty of soil textural data influences the performance of the prior JULES run. Please find the detailed review under the Specific Comments and Technical Corrections.

Specific Comments

Title, L126, L252 and L262: In most of the text COSMOS-UK observations was mentioned as field-scale observations, except in the title, L126, L252 and L262, where large-scale is written. It might be better to call it field-scale. Please revise entire text to be consistent in using filed-scale and large-scale.

L80: In the original Cosby et al. (1984) paper (Table 4 on page 686), the multiple linear regression of the "Absolute value of the soil matric suction at saturation" uses silt% and sand%, but the equation 6 of the manuscript includes clay% and sand%. Please recheck the equation or add further reference if a modified version of Cosby et al. (1984) pedotransfer functions are used.

L84-90: Reference of equations 8-11 is not clear, could you please clarify it or add the reference?

Table 2: The constants needs a further check, compared to Table 4 of Cosby et al. (1984), because of the following. It is not clear: - why k2 and k3 are multiplied by 100; - why k4 is divided by 100 and in the same time the original values of k5 and k6 are kept; for predicting volumetric water content in m3/m3: also k5 and k6 has to be divided by 100 or do you consider sand and clay content as g/g (not weight %); - why k7, k8, k9 constants differ from the original constants, please note that in the original PTF silt% and sand% are the predictors as mentioned above, please clarify in the text why the constants differ from that of Cosby et al. (1984); - why k11 and k12 are multiplied by 100, do you consider sand and clay content as g/g (not weight %)? If you find after the check that constants of Cosby PTF is are those are built in the JULES model it might be helpful to check those also in the model code. Please add the units and fraction

limits of clay, silt and sand content in line 91.

L95-97: Please list meteorological data required by JULES to derive soil moisture prediction.

L110-112: Please consider that CHIMN, PORTN, HARTW, LULLN are mineral soils too based on Table 3, therefore the sentence starting with “The Cosby pedotransfer function . . .” needs to be revised.

Table 3: Instead of the basic soil description it would be more informative to provide soil taxonomical information, i.e. name of soil suborders (USDA, Soil taxonomy) or reference soil groups with principal qualifiers (WRB, 2014). If soil taxonomical information cannot be added, soil texture, organic carbon content and bulk density of topsoil and subsoil could be shown, if that is available for the COSMOS-UK sites.

L119-120: sentence starting with “We have used . . .” is repetition of the first part of the sentence starting with “In this paper . . .” in line 95-96.

L120: Are measured soil chemical and physical properties available for the COSMOS-UK sites.

L124: The reference for LaVEnDAR is given, but it might be helpful for the readers if a very short description of the data assimilation technique would be given in the text.

L133: Please add the meaning of “75m” or delete it if it is not important.

L148: Is not measured soil texture available at the COSMOS sites? Uncertainty of texture taken from the Harmonised World Soil Database (HWSD) can be high, because its resolution is 30 arc-second. If texture is derived from a course resolution dataset the lower performance of prior JULES run can come from the uncertainty of clay, silt and sand content. It would be interesting to analyse the performance of prior JULES run at a site where measured soil texture can be used in the Cosby pedotransfer functions. If there is no measured soil texture data, better resolution national soil texture maps or 250 m resolution SoilGrids could provide more accurate soil textural information than

HWSD does. Please consider to rerun analysis based on a more accurate soil texture dataset or explain why HWSD was used. It would be good to highlight importance of using measured soil texture if that is available.

L158-161: Does it mean that higher observation error was used when results of soil moisture predictions was assessed than the error computed based in the measured data? The reasoning of it is not clear, could you please describe it? Sorry if I miss something.

Figure 2. Maybe the following could be added: - Data assimilation (LaVenDAR), - 16 sets of field-scale obs,

L185: Please add which software was used to compute the metrics and prepare plots.

L197: Please add under Materials and methods section which method was used to analyse if difference was significant.

L205-206: It would be informative to roughly add the soil organic content of MOORH site, if measured value is available that would be the best. Could you please add reference to the CRNS regarding soil organic carbon content and texture that can be reliably measured?

L208-209: It could be mentioned that it is a disadvantage that CRNS measurement considers water held on the canopy to be soil moisture. Is there any solution for correcting the COSMOS soil moisture values if that happens?

Figure 8. Please add soil depth that you consider topsoil.

L240: Do you think the profile-scale measurements could be successfully used in the presented data assimilation method?

L274: The code is available only for those who are registered for a Met Office account, it might be mentioned.

Technical Corrections:

L91: . . . where fclay, fsilt and fsand are fractions of clay, silt and sand in the soil . . .

L126: In the above text COSMOS-UK observations was mentioned as field-scale observations, here “large-scale” is written. It might be better to call it field-scale. Please revise it.

L143: Do you mean: “the value given in table 2”? Please revise it.

L193: . . . high soil organic carbon content . . .

L229: . . . 12 PTF . . .

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