Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2020-434

Anonymous Referee #1

Referee comment on "Climate model-informed deep learning of global soil moisture distribution" by Klaus Klingmüller and Jos Lelieveld, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-434-RC1, 2021

The paper applies a deep neural network to build a relationship between 18 predictors (simulations of rain, surface temperature and humidity, location, seasonality, root depth etc.) and a predictand (soil moisture down to about 5 cm). The simulation data was produced by a global atmospheric chemistry-climate model EMAC nudged to reanalysis data. The predictand's reference data was the ESA CCI Soil Moisture product.

The motivation for the application of a neural network was to replace EMAC's soil moisture parameterization with a better one in a mineral dust emission parameterization. The study shall be seen as a proof of concept (line 195). Yes, it is, but a few issues should be clarified.

The application has very dry areas in its focus. I have in mind that the soil moisture satellite product is especially uncertain in these areas. This should be discussed a bit. The trained prediction is most uncertain in the most interesting regions (Fig. 4: Sahara, Gobi Desert etc.). Why? Quality of the satellite reference or a training period of only 8 years?

The DNN is built with 512 units and four hidden layers. This parameter selection should be motivated a bit. Of more concern is the DNN performance. With location and seasonality as predictors, I expect a high correlation between prediction and reference soil moisture. What is the benefit of using meteorology/climate simulation in the prediction?

Finally, it would be helpful to have short discussions on the applicability of the chosen approach in a changing climate and an alternative DNN training of EMAC parameters (avoiding two parametrizations predicting soil moisture).