Combined machine learning model of aeolian dust and surface soil moisture

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Atmospheric mineral dust has significant impacts on climate, public health, infrastructure and ecosystems. To predict atmospheric dust concentrations and quantify dust sources, we have previously presented a hybrid aeolian dust model using machine learning components and physical equations. In this model, trained with dust aerosol optical depth retrievals from the Infrared Atmospheric Sounding Interferometer on board the MetOp-A satellite and using atmospheric and surface data from the European Centre for Medium-Range Weather Forecasts fifth generation atmospheric reanalysis (ERA5), surface soil moisture is one of the most important predictors of mineral dust emission flux. Here we present the combination of the aeolian dust model with a deep learning model of surface soil moisture. The latter has been trained with satellite retrievals from the European Space Agency's Climate Change Initiative and provides results that are more consistent with these observations than ERA5. The combination of the two models is a step towards a comprehensive hybrid modelling system that complements and improves traditional process-based aeolian dust models.