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Advancing land surface model development with satellite-based Earth observations

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The land surface forms an essential part of the climate system. It interacts with the atmosphere through the exchange of water and energy and hence influences weather and climate, as well as their predictability. Correspondingly, the land surface model (LSM) is an essential part of any weather forecasting system. LSMs rely on partly poorly constrained parameters, due to sparse land surface observations. With the use of newly available land surface temperature observations, we show in this study that novel satellite-derived datasets help to improve LSM configuration, and hence can contribute to improved weather predictability.
We use the Hydrology Tiled ECMWF Scheme of Surface Exchanges over Land (HTESSEL) and validate it comprehensively against an array of Earth observation reference datasets, including the new land surface temperature product. This reveals satisfactory model performance in terms of hydrology, but poor performance in terms of land surface temperature. This is due to inconsistencies of process representations in the model as identified from an analysis of perturbed parameter simulations. We show that HTESSEL can be more robustly calibrated with multiple instead of single reference datasets as this mitigates the impact of the structural inconsistencies. Finally, performing coupled global weather forecasts we find that a more robust calibration of HTESSEL also contributes to improved weather forecast skills.
In summary, new satellite-based Earth observations are shown to enhance the multi-dataset calibration of LSMs, thereby improving the representation of insufficiently captured processes, advancing weather predictability and understanding of climate system feedbacks.

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