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Inferring precipitation from atmospheric general circulation model variables

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The accurate prediction of precipitation, in particular of extremes, remains a challenge for numerical weather prediction (NWP) models. A large source of error are subgrid-scale parameterizations of processes that play a crucial role in the complex, multi-scale dynamics of precipitation, but are not explicitly resolved in the model formulation. Recent progress in purely data-driven deep learning for regional precipitation nowcasting [1] and global medium-range forecasting [2] tasks has shown competitive results to traditional NWP models.
Here we follow a hybrid approach, in which explicitly resolved atmospheric variables are forecast in time by a general circulation model (GCM) ensemble and then mapped to precipitation using a deep convolutional autoencoder. A frequency-based weighting of the loss function is introduced to improve the learning with regard to extreme values.
Our method is validated against a state-of-the-art GCM ensemble using three-hourly high resolution data. The results show an improved representation of extreme precipitation frequencies, as well as comparable error and correlation statistics.

[1] C.K. Sønderby et al. "MetNet: A Neural Weather Model for Precipitation Forecasting." arXiv preprint arXiv:2003.12140 (2020).
[2] S. Rasp and N. Thuerey "Purely data-driven medium-range weather forecasting achieves comparable skill to physical models at similar resolution." arXiv preprint arXiv:2008.08626 (2020).