Contribution ID: **39** Type: **Talk**

Dependency of precipitation and cloud radiative feedback on subgrid scale clouds structure; a machine learning approach

Wednesday, 18 May 2022 11:30 (15 minutes)

The organization of convective clouds has been argued to have a significant impact on the atmospheric humidity and circulation, as well as precipitation and cloud radiative feedback, yet global models do not include a parameterization of unresolved subgrid cloud structure. In this study, we investigate the necessity of including subgrid scale cloud structure in the model and whether it improves the prediction of precipitation and cloud radiative feedback. We use neural networks (NN), trained on coarse-grained data from the DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains (DYAMOND) intercomparison project, to learn about the dependency of precipitation, cloud cover and cloud radiative feedback on the cloud structure. Our preliminary results suggest that NNs accurately predict the mean precipitation and cloud cover by only having access to resolved state variables, yet this prediction can be improved by adding information about the subgrid structure or its previous state. Using explainable artificial intelligence, we seek to understand the underlying dynamics discovered by NNs so as to improve the conventional parameterizations, such that they include information about subgrid-scale cloud structure when necessary.

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Session Classification: Deep convection and more