Assignment 3 Question 2

Find a scientific paper that discusses an aspect of a large-scale weather simulation and summarize it in your own words (roughly 250 words, 5 marks). Find one specific aspect of the paper you like and one aspect you question and describe each (roughly 150 words each, 2.5 marks each)

Paper:

A Baseline for Global Weather and Climate Simulations at 1km Resolution

This paper talks about a four-month global simulation done by a group of researchers using European Centre for Medium Range Weather Forecasts' (ECMWF's) hydrostatic Integrated Forecasting System (IFS) at an average grid spacing of 1.4 km and also 137 vertical levels using Summit. The reason of doing this simulation was to understand the weather and climate system and how it gets affected by deep convection parametrization at different resolution. The final model output from this simulation offers a source and assistance for any potential future simulations.

Whenever we are trying to consider any weather or climate projections, analyze data, we tend to consider limited spatial and temporal resolution, when in reality, Earth offers a wide range of scales from micro to synoptic scales. There are various factors that are influencing and affecting the weather. One such important process and factor is the atmospheric deep convection. Deep convection plays a vital role in energy flow over in the tropical areas and thus also affects the global atmospheric circulation like the Intertropical Convergence Zone (ITCZ). The purpose of this simulation model was to resolve convection explicitly to be able to increase the accuracy of their affects in global models. There are a few storm-resolving simulations with 3-5km grid spacing in which deep convection does get resolved. However, it does not get resolved completely. Even then, these models supported the hypothesis that resolving deep convection does explicitly improve the model accuracy. One observation however was that to be able to resolve deep convection globally, simulations at horizontal resolutions finer than 2-3km are ideally desirable.

Model:

The model is set up such that they compare the outputs from a 1.4km & a 9km simulation for a 10-day forecast. They perform explicit representation of deep convection for 9km simulation to validate that the difference in the values are not just due to the deep convection parametrization not turned on for 1.4 km simulation. This means there are two 9km models – '9km parametrized' & '9km explicit'. The 3 simulations are ran with the IFS model and for 4 months starting 1 November 2018 00 UTC until February 2019.

The data extracted form this simulation model was Kinetic Energy Spectrum And Nonlinear Spectral Energy Fluxes, zonal mean temperature, and averaged winds. After scientific assessment of the results – it confirmed the hypothesis that 1.4km simulation does show improvement in some aspects of the atmosphere model like the representation of convective storms and the eddy driven jet when compared to the 9km simulations.

An aspect of paper I liked:

One thing I observed in the paper is that the paper went over all the details, factors and conditions considered in this model. The factors affecting weather, creating a proper simulation to match the reality using previous simulation models – everything was taken into consideration. Even in the part of the paper describing the process of the extraction of data from the model output, the clear fact of how 2 results, very different from each other yields to the same final conclusion is explained properly. As a person with no knowledge on what a weather simulation is or how exactly these simulations work, one can still understand this paper and the entire process.

An aspect of paper I questioned:

The process and method they take is interesting and impressive – they consider all conditions, take in account the wave numbers in all simulations, and also the time step for every transfer of calculations. For instance, the 9km model uses 1279 wave numbers while the 1.4km uses 7999 wave numbers. Similarly, 1.4km uses a time step of 60s while the 9km simulations uses time step of 450s. One thing I do think they could have also added and considered is the 1.4km parametrized simulation. It might have produced an even detailed information and dive into the data and effect of switching off the deep convection. Considering two 9km models were a good observation but considering another 1.4km parametrized model would also have been a good addition to the data collected. ' A training data can also be improved' – an additional model would have only resulted in better observation that would not only improve the way weather and climate simulations are done, but also aid the future simulations greatly.

Reference/ Citation for the paper

Wedi, N. P., Polichtchouk, I., Dueben, P., Anantharaj, V. G., Bauer, P., Boussetta, S., et al. (2020). A baseline for global weather and climate simulations at 1 km resolution. Journal of Advances in Modeling Earth Systems, 12, e2020MS002192. https://doi.org/10. 1029/2020MS002192