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Running global Machine Learning weather models - challenges, observations and conclusions

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Machine Learning (ML) became pervasive in every domain of the research, providing opportunities of modeling phenomena that were difficult to capture using known equations. From small models running on student computers, to giant LLMs trained on the whole Internet, ML models come in all shapes and sizes. To the meteorological community, one branch of this research stands out as revolutionary - ML-based global weather models.

ML-based global weather models lie on the opposite end of the spectrum compared to numerical weather prediction (NWP) models. Instead of representing the physics in a form of equations and solving these equations on the model grid, ML models are purely data-driven - even if they managed to represent physics internally, the inference of that physics would remain a black box.

Yet, these models underwent significant advancement in the past year - and three of them stand out - GraphCast (Google), ClimaX (Microsoft) and MetNet (Google). The former two, open-sourced for research purposes, are being tested currently at Belgingur. Having many years of experience with running and deploying NWP weather models, we notice how working with these models differs from working with the new class of ML-based (or data-driven) models.

This talk discusses essential differences between working with NWP and ML-based weather models. What we can, and what we cannot control? What does the process of working with such an ML model look like? What is the main advantage of an ML model run in production? What are the main obstacles in deploying an ML model and running it operationally?

With the current pace of the growth of Machine Learning models, we will be encountering them in our everyday work sooner or later. Knowing the challenges and opportunities of them will help us understand how to use them to our advantage.