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Towards a Digital Twin of the Earth System

Monday, 14 September 2020 10:00 (45 minutes)

In this talk I will briefly review the development and state-of-the-art of the Integrated Forecasting System (IFS) model as well as steps taken to secure the future efficiency of IFS in view of emerging HPC architectures, and in view of increasing demand for complex coupled data assimilation and simulations of the hydrological and carbon cycle. Exploring the limits of IFS for simulations with an explicit representation of deep convection, we have recently completed the world's first seasonal timescale global simulation (DJF 2019) of the Earth's atmosphere with 1.4 km average grid-spacing using the power of Summit (No2, Top 500) as part of an INCITE award. Despite the significant cost, global simulations at resolutions of about 1 km have been advocated as a way forward commensurate with the challenges posed by climate change. The achieved simulation represents a milestone in atmospheric modelling and the resulting output will serve as a benchmark dataset for a number of scientific studies, including the support of future satellite mission planning. The achieved simulation may be seen as a prototype contribution to a future "digital twin" of our Earth. Results show that the hydrostatic NWP model configuration of the IFS performs well even at an average 1.4 km grid-spacing. This seems to challenge a common belief in dynamical meteorology that assumes that non-hydrostatic equations would be required at this level of resolution. The impact of non-hydrostatic effects is not known, but our simulation provides a baseline against which future non-hydrostatic simulations can be measured. In this sense, the performed simulation provides factual numbers of what it takes to reach the advocated goal of km-scale weather and climate predictions.

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