ECMWF

European Centre for Medium-Range Weather Forecasts

Machine learning at ECMWF: A roadmap for the next 10 years

Peter Dueben et. al

Executive summary

During the last decade, artificial intelligence (AI), machine learning, and data volume have developed at an unprecedented pace, and it is now evident that many scientific disciplines will need to revise their work modes to become more data centric in order to make the most out of these developments. AI and machine learning offer great opportunities throughout the workflow of numerical weather prediction (NWP) and climate services, and the science community is currently exploring how the new capabilities of AI and machine learning will change the future of Earth system science. First results show great potential.

However, the scope and speed of developments also generate challenges for weather and climate modelling centres such as ECMWF, in particular regarding the necessary know-how that needs to be established, the software and hardware infrastructure that needs to be developed, and the integration of machine learning and conventional tools within the prediction workflow. These challenges need to be addressed within a comparably short period of time to keep up with changing needs of the weather and climate modelling community and ECMWF's Member and Co-operating States. This document therefore sets out a roadmap for the next ten years that identifies the challenges, provides potential solutions, and defines steps to channel the many distributed science and technology projects that study machine learning for weather and climate predictions into a coordinated effort. While the roadmap does not provide a scientific workplan for machine learning activities, due to the number and diversity of the application areas, it outlines the path towards more coordinated solutions for the challenges ahead, and to generate synergies between the different machine learning efforts.