U-Net type convolutional neural network for data assimilation

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Abstract

In prediction systems, an initial value problem, identifying the best initial condition is an essential task. The result from a procedure for combining a previous prediction ("background") with observation is called analysis. Data assimilation is the process of computing the analysis. Here, a machine learning (ML) approach is the method for the Data Assimilation (DA). For a limited area meteorological model, the boundary condition is obtained by a dynamical downscaling from a global model. The DA scheme is applied to the mesoscale atmospheric model: WRF (Weather Research and Forecasting). A type of deep convolutional neural network (CNN) is proposed to emulate the 3D variational method (3D-Var). The CNN architecture is a type of a U-Net neural network. The goal is to have an alternative method for DA, with similar performance, but with a significant reduction of the computational effort. The training dataset consists of 3D-Var analysis for many different sets of initial conditions from the output of the WRF data by its assimilation module, and a set of observations is used.After training, the DA by U-Net is evaluated by executing the WRF forecasting example. Two analyses produced very similar results, indicating that the application of the U-Net for DA is an effective method for DA.

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