Data-Driven Methods for Weather Forecast

Felipe José Acevedo García*†[1] and Elias David Niño Ruiz*[1]

[1]Universidad del Norte, Barranquilla – Área Metropolitana de Barranquilla, Colombie, Colombia

Abstract

Numerical weather forecasts are of extreme importance in different aspects of life, particularly in scenarios wherein human lives can be compromised (i.e., forecasts of storms, floods, hurricanes, and tsunamis). Numerical models are commonly employed to mimic the behavior of actual system dynamics, for instance, the ocean and the atmosphere. Since numerical models are computationally demanding, high-performance computing is necessary to produce forecasts within reasonable computational times, especially for high-resolution grids. We propose efficient and practical data-driven methods for weather forecasts. We exploit the information brought by historical weather datasets to build machine-learning-based models. For instance, the National-Centers-for-Environmental-Prediction Department-of-Energy (NCEP-DOE) Reanalysis II is a data set that holds meteorological information since 1979 onto global grids at varying resolutions. These models are employed to produce numerical forecasts, which can be improved by injecting additional data via data assimilation. Our approaches' general idea is as follows: given a set of time snapshots of some dynamical system, we group the data by time across multiple days. These groups are employed to build first-order Markovian models that reproduce dynamics from time to time. Our numerical models' precision can be improved via sequential data assimilation. Experimental tests are performed by using the NCEP-DOE Reanalysis II dataset. The results reveal that numerical forecasts can be obtained within reasonable error magnitudes in the L_2 norm sense. Even more, observations can improve forecasts by order of magnitudes, in some cases.

Keywords: Data Assimilation, Markovian Model, Machine Learning

*Speaker

†Corresponding author: fjacevedo@uninorte.edu.co