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Commentary

Numerical Weather Prediction: Synopsis

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COMMENTARY

With the advancement in computer technology, Numerical Weather Prediction (NWP) is becoming a paramount tool in weather forecasting. The basic exemplar of this, the daily weather forecasting using supercomputers at National Oceanic and Atmospheric Administration in Washington, DC, US. Many countries around the globe are using NWP as key apparatus for operation weather prediction.

Numerical Weather Prediction models solve complex set of mathematical equations (partial differential equations) based on how heat, moisture and air are exchanged in the atmosphere or in other words, we can say, based on atmospheric motion and evolution. The set of partial differential equations express the conservation laws including mass, conservation of momentum, energy and water vapor. To predict the atmospheric conditions in future, the set of equations must be integrated forward.

NWP uses complex computer programs, also called forecast models that run on super-computers to make the forecast in accordance with many atmospheric models such as wind, temperature, rainfall, pressure. Based on the interaction of these parameters using the computer, the forecaster makes the prediction of weather. The data used in weather forecasting is obtained using satellites, radars, buoys, weather balloons, etc. and saved in the supercomputers.

In Computer generated forecast, the earth's surface is divided into gridboxes and one value per gridbox is predicted. A new statistical post-processing method, anticipates two gridbox-weather-dependant factors, using ensemble forecasts as input: bias on the gridbox scale and degree of variation in each gridbox. Due to computational limitations, about 20 km by 20 km current spans are ensemble in horizontal in best operational global in gridbox. Therefore, NWP forecasts do not output rainfall at specific sites, but instead "average rainfall" for much larger gridboxes. To mean the variation seen at all points observed within the same grid box, another term, "sub-grid variability" has been introduced. NWP forecasts provide accurate forecasts for points, if sub-grid variability is low. But in case of high sub-grid variability, forecasting inevitably fails.

There are two well-known NWP models namely, National Weather Service's Global Forecast System (GFS) and the European Centre for Medium-Range Weather Forecast, known as ECMWF model. These models are also known as the American and European Models, respectively. It is generally mentioned at some context that European models has produced most accurate global weather forecasts.

Numerical forecast is known for the accurate data as observed during the forecast at the beginning of its run or at initial conditions we can say. As it is known that weather changes rapidly from one place to another, tomorrow's weather is definitely influenced by today's weather, and similarly next week's weather can be affected by today's weather a continent away. Therefore, lots of worldwide data is required to make the predictions.

Numerical Weather Prediction is imprecise because the equations used by the models to simulate the atmosphere are not accurate. It leads to some error in predictions. Moreover, as we do not receive many weather observations from mountain regions or over the oceans, therefore, many gaps persist in the initial data. And so, the computer's prediction of how that initial state will evolve will not be entirely accurate if initial conditions were not completely known.

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