

Introduction of the operational data assimilation system for the numerical weather prediction in JMA

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The Japan meteorological agency operates and develops the numerical weather prediction system to produce the core material for the weather forecast. The operational numerical prediction system in Japan began around in 1960. This was 40 years later after Dr. L.F. Richardson proposed an idea of 'Weather prediction by numerical processes'. During this period, the environment for a numerical prediction has been prepared: the enhancement of an upper-air observation, an establishment of the atmospheric dynamics, the development of an electronic computer and so on.

The first operational numerical prediction system was the north hemisphere barotropic model. Since then, the super computer has been upgraded 6 times and the numerical prediction system has been also upgraded. The number of vertical layers increases from 1 to 40 and the horizontal resolution also increases from about 400km to about 55km. The physics processes including the moist processes are considered in the governing equations.

The numerical prediction is one of the initial value problems. An initial field is required to run a forecast model. While a forecast model has been improved, an analysis has also been upgraded. The development of an upper-air observation instrument, rawinsonde, enabled us to capture the 3 dimensional structure of the atmosphere. First an analysis was done using only these observation data. However, there was a problem about the quality of the analysis field over the area where the observation density was sparse, like ocean. To solve this problem, a forecast field began to be used as the first guess. The observation data are used to modify this field. The analysis algorithm has been changed to correction method and then to an optimal interpolation method.

Recently many kinds of satellite observation data became available and began to be assimilated. The advantage is that the satellite data covers all over the earth. However, the optimal interpolation method is not appropriate to assimilate this kind of observation data in the point that the data are related nonlinearly with the analysis variables. A variational method started to be adopted as a data assimilation algorithm since this can handle this kind of nonlinearity.

Nowadays, it is a main stream to construct the operational data assimilation system using the variational algorithm. Although only the spatial balance was considered in the system in the beginning, the system was expanded to consider the balance in time by adopt a forecast model as a constraint conditions.

This time, we would like to discuss about the relationship of observation, analysis and prediction as we introduce our operational variational data assimilation system.