

Integrating the observing system and numerical modeling

Taikan Oki[1]

[1] IIS/UT

<http://hydro.iis.u-tokyo.ac.jp/~taikan/taikanJ.html>

Data assimilation should be the closest integration of modeling systems and modeling. It is a method to calculate the optimal estimates which minimizes the error between observed physical quantity and model prediction.

Such a data assimilation technique is valuable to develop proper initial values for numerical weather prediction, and further it has a merit being able to create grid point values by temporal and spatial interpolation of observed values with estimates of numerical predictions.

Data assimilation technique has been particularly developed well in the field of meteorology in order to improve the accuracy of numerical weather prediction; in addition to that, reanalysis has been carried out in Japan, Europe, and US meteorological agencies, which apply the data assimilation technique for as many as possible observational data in the past.

Such an assimilated data (reanalysis data) has become popular in the field of atmospheric sciences, and even sometimes regarded as an observation. Even though information propagates from observed point and time to the region where no observations are reported, physical quantities without real observation is mainly filled with model estimates. Further, fluxes such as precipitation and land surface fluxes are not easy to assimilate and basically the quantities in reanalysis dataset of them are model prediction themselves. Since their satirical characteristics could be quite different from reality, serious cautions are required when they are compared with other numerical simulations even as a reference.

There could be weak integration between observing system and modeling. That is a classical way of science that better understanding of physical process and conceptual modeling of the process. Modern observation and modeling are not linked by accidents but more strategic observations are planned which sharply focusing on the unknown process to be observed.

Researchers of observers and modelers are often separated, and it seems observational studies tend to have its own objective by itself. On the contrary, modeling research always requires observational data for validation and evidence, observational research framed and planned by modelers would be more focused and prone to produce achievements efficiently in short term.

Nonetheless, long-term monitoring is required for detecting the climate change, however, it is not easy to continue an observational research which would have a great result in 100 years. Strategic plan would be required to continue long-term monitoring with a set of short research projects that can produce achievements within at most a few years.

Further weaker integration between observational system and modeling exists, which is the integration through research papers and data centers. The development of internet and the advance of information and communication technology, such a weak integration of observation and modeling has become easy through database on a Web.

Such a weak integration has been popular in the field of meteorology because of the international framework for exchanging real time observational data among countries. In the field of land atmosphere interactions, this in between meteorology and hydrology, such a framework to exchange observational dataset became popular through international research projects such as GEWEX/GAME and Asian Flux Net.

Observational dataset on field scale regarding the vegetation growth and environmental changes, such as temperature, precipitation, and carbon dioxide, are not easily accessible yet even though FACE experiments are challenging, however, such a dataset is invaluable for assessing future impact of global warming on crop yield. Developing such an international integrated data center of bio-geo-chemical cycles are expected.

Finally, models should be ready to be used for observational researchers as a tool to understand the phenomena. Predictive ability is not only the advantage of numerical models.