Advancing Data Assimilation as a Science Hub: From Weather Forecasting and Beyond

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Abstract: Data assimilation plays a key role in numerical weather prediction, combining computer models with real-world data through dynamical systems theory and statistical mathematics. Computing, sensing, and information/communication technologies are advancing rapidly, and data assimilation is becoming more popular as a means of cyber-physical fusion in broader science and technology fields. At RIKEN, the Japan's flagship research institute for all sciences, we have been pioneering the future possibilities of numerical weather prediction by taking advantage of the powerful K computer and Big Data from advanced sensing technologies such as the phased array weather radar and Himawari-8 geostationary satellite, at the scales ranging from global to convective with the resolution as refined as 100 m (Figs. 1 and 2) [1,2,3,4]. We have been further exploring new applications of data assimilation to brain, medical, biological, and ecological sciences [5] as well as engineering applications, and identified common denominators. To expand the community, we organized educational programs highlighted by the RIKEN International School on Data Assimilation (RISDA 2018) [6], January 22-26, 2018, the first of the series to be held every other year in Germany (2020) and San Diego, CA (2022). I will talk about some excitement of RIKEN's activities on data assimilation as a science hub – from severe weather forecasting and beyond. Although we have not worked on Mars and other planets at RIKEN so far, we have many things in common about data assimilation methods and theories.

Figures:

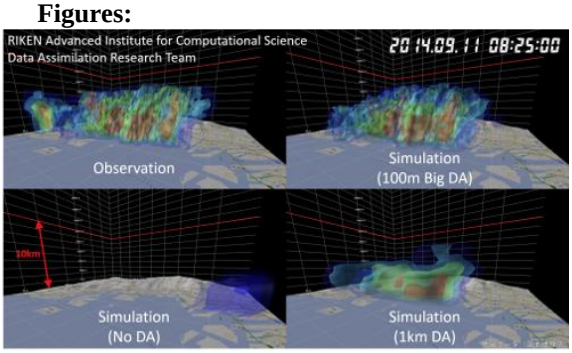

Fig. 1. Distribution of thunderclouds on September 11, 2014. Top left: Observational data from the phased array weather radar; Bottom left: The simulation without integration of observational data; Top right: Results of a simulation with big data assimilation on a 100-meter grid; Bottom right: Results of a simulation with data assimilation on a 1-kilometer grid. Adopted from RIKEN press release on August 9, 2016 (http://www.riken.jp/en/pr/press/2016/20160809_1/)

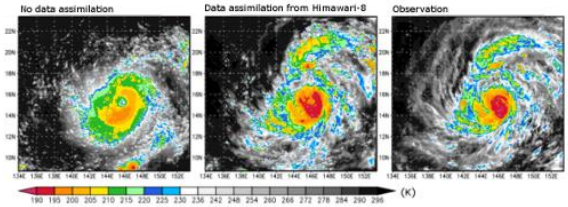

Fig. 2. Simulation of Typhoon Soudelor at 22:00 on August 2, 2015. Left: simulation without Himawari-8 data; Middle: simulation with Himawari-8 data; Right: actual Himawari-8 observation. Adopted from RIKEN press release on January 18, 2018 (http://www.riken.jp/en/pr/press/2018/20180118_1/)

References:

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