Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

MSD030-P01 Room: Convention Hall Time: May 27 17:15-18:45

Data assimilation of side-looking radio occultation by observing system simulation experiment

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In GPS Radio Occultation (GPS RO) observation, low earth orbit satellite (LEO) observes the signals of GPS satellites that came from the moving direction of LEO satellite, because the short shift of tangent point is required for precise estimation of atmospheric profile at each tangent point. If path data is assimilated, occultation data of which the angle from the moving direction of LEO satellite (AFL) is large can be used in assimilation. In general, for mesoscale numerical weather prediction, impact of each RO data is not so strong because the length of path data reaches several hundred kilometers. For this reason, the total number of assimilation data should be increased by using 'side-looking' data. In this study, impact of side-looking data is investigated by an OSSE.

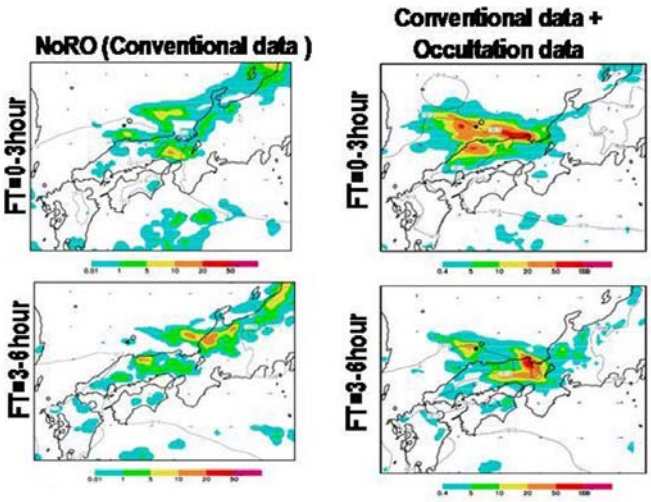

Fig. Assimilation results of simulated side-looking observation data.

We checked frequency distribution of the AFL of the COSMIC data retrieved by COSMIC Data Analysis and Archive Center (CDAAC). We confirmed that signals of which AFL were less than 60 degrees were analyzed. However, about half of profiles were not provided from the data of which AFL were larger than 50 degrees. The rate of occultation data that retrieved from positions of GPS satellite and LEO, of which AFL was larger than 60 degrees, is about 11% on 28 July 2008. Thus, the total data that is expected to be received by side-looking observation becomes about 18%.

We adopted the intense rainfall that occurred at Kobe City on 28 July 2008 as the target of the OSSE. Intense rainfall raised the water level of Toga River, and then five people were drowned in the riverside park. In OSSE, truth data of atmospheric condition is needed to produce 'simulated path data'. We used the analysis fields obtained by assimilation of PWV derived from ground GPS network and conventional data (Shoji et al. 2009) as the truth. There were several occultation data of which AFL were larger than 60 degrees near Alaska. We used information of these occultation points after shifting them to Japan area. Then, 'simulated path data', that is, simulated path-averaged refractivity were obtained from the truth field. When the first guess and 'simulated path data' were compared, it was found that 'simulated path data' was larger than that of the first guess below the height of 3 km. The reinforcement of rainfall is expected when this data is assimilated.

Figure is the assimilation results of 'simulated path data'. The intense rainfall was reproduced when the forecast was performed from the analysis field that was obtained by the assimilation of conventional data and 'simulated path data'. Intensity and area of the rainfall became comparable to the observed ones though the position of intense rainfall was shifted westward.

Result of this study is summarized as follows: (1) when the side-looking data are included in assimilation data, the analyzed fields is further improved, (2) however, the difficulties of the side-looking observation due to antenna gain etc. are not considered. So, more experiment is needed under the more actual condition.

Keywords: GPS, occultation, assimilation, heavy rainfall