Data Assimilation Experiments with Himawari-8 Optimal Cloud Analysis (OCA) Products

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Abstract

The OCA is an algorithm used to extract the cloud parameters such as phase, cloud top pressure (CTP), cloud optical thickness (COT), and effective radius using an optimal estimation method (EUMETSAT 2011). Hayashi (2016) developed the OCA retrieval scheme using all the AHI (Advanced Himawari Imager) spectral measurement and evaluated them in comparison with A-train data sets and showed they were of sufficiently good quality. Himawari-8 OCA products can provide useful information on water vapor in the form of clouds with good horizontal resolution (0.02 degrees) and coverage including over the ocean. Our main purpose is to exploit them in mesoscale data assimilation and to improve initial conditions for short range forecasts of precipitation.

Cloud occurrence matchups against surface observation and sonde observations indicated that OCA detected clouds better at high levels than at middle and low levels. Cloud layers inferred from sonde observations were determined using threshold values of relative humidity (RH) depending on heights (Zhang et al. 2010). Cloud fractions of OCA and surface observations were well correlated with a correlation coefficient of 0.78. Cloud types observed at surface observations overall corresponded with OCA COT and CTP values as described in ISCCP classification (Rossow and Schiffer 1991) in case of no overlapping cloud layers.

OCA data were assimilated as pseudo RH. While cloud top heights (CTH) were estimated by OCA, corresponding cloud base heights (CBH) were inferred by subtracting cloud geometric thickness (CGT) from CTH. For liquid clouds, CGT is obtained as the ratio between the liquid water path (LWP) and the cloud-averaged liquid water content (LWC). Where cloud layers were detected from CBH to CTH,

pseudo RH values were set around 90 % slightly varied with heights (Zhang et al. 2010). Only liquid clouds having COT below 50 and CTP below 440 hPa level were targeted for assimilation in order to avoid OCA data with large uncertainties in the presence of multilayered clouds or deep convections.

Assimilation experiments were conducted with JNoVA (JMA-NHM based variational analysis data assimilation) using pseudo RH derived from Himawari-8 OCA for a heavy rainfall event on 9 -10 Sep. 2015. In TEST experiment, the pseudo RH were assimilated for four forecast-analysis cycles of JNoVA (21:00 on 8th to 09:00 UTC on 9th), during which one typhoon was passing over and another was approaching to Japan, together with other observational data used for operational JMA NWP. Only operational data were assimilated in CNTL experiment. The analyses after the four cycles of TEST showed significant increase in water vapor at low to middle levels where OCA pseudo RH were assimilated. The extended 39-h precipitation forecasts also showed differences in intensity and distribution of rainfalls from CNTL, suggesting a promising impact of OCA data.

References:

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