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Impact of the Snowfall and Snow Properties Predictions with Multiple Data Assimilation Strategies Digesting GPM Precipitation and Himawari-8/AHI water vapor radiance into Reg_NWPs over TP plateau

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As a form of solid precipitation, snow plays a crucial role in climate regulation by reflecting solar radiation and insulating the ground. Additionally, it serves as a vital water resource, influencing hydrological cycles through its seasonal melting process. So, accurate predictions of snowfall and the subsequent evolution of the snowpack are essential. In this study, some investigations are made to reveal the impact of multi-strategically assimilating Global Precipitation Measurement (GPM) precipitation and Himawari-8/Advanced Himawari Imager (AHI) water vapor radiances (WVR) on forecasting a heavy snowfall event and snow properties on the ground over the Eastern Qinghai-Tibet Plateau employing the Weather Research and Forecast model (WRF) and the Four-Dimensional Variational assimilation system. DA strategies includes two aspects: the initial time of Reg_NWPs runs and the type of observations used. The initial times of Reg_NWPs are 0000 UTC, 0600 UTC, and 1200 UTC on October 28, 2022. Separate and combined DA tests are conducted to forecast. For the process of snowfall, the joint assimilation of the two not only yields multi-dimensional atmospheric insights but also addresses the limitations of individual assimilation. Assimilation GPM and AHI are respective sensitivity to the lower layers (about 800hpa) and upper layers (about 400hpa) of model. The individual assimilation GPM has the greatest effect on near-surface humidity field, and AHI plays a dominant role in the joint assimilation. In addition, we further compare the 12-hourly cumulative snowfall with in-situ meteorological station observations. The predictions of snowfall from DA_G&A perform much better with the correlation coefficient and root-mean-square error 0.36 and 3.14mm, respectively. As for different initial times of NWPs, the best snowfall forecast is 0600 UTC on October 28, 2022, and the CC is 0.4. For the snow properties on theground, the results indicate that the predictions of snow properties, such as snow depth (SD), snow cover fraction (SCF) and snow albedo (SAL), are influenced by both the initial time of Reg_NWPs and the type of observations. DA_G&A showed a significant increase in deep snow area (SD >15cm), and a decrease in shallow snow area (SD<5cm). Comparing with some reanalyzed and remote sensing inversion datasets, the predictions exhibit good physical consistency between snow parameters and fine temporal-spatial resolution.

However, the land surface scheme of Reg_NWPs tends to overestimate SCF and SAL. So, in the future, the integration of a land surface DA system (LDAS) into Reg_NWPs will be considered for on-line coupling.