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Cloud, radiation, and surface heat flux simulations using Polar WRF with 3DVAR

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In the Arctic region, cloud is an important factor affecting surface radiation and heat flux. Despite the development of cloud microphysics schemes in the Polar WRF, clouds in the Arctic region still have uncertainties. In this study, the possibility of improving cloud simulations by using data assimilation (DA) and its effects on the enhancement of the forecast accuracy for surface fluxes and meteorological variables are evaluated. The experimental period is from 1 to 19 September 2017.

Forecasts from both the cold start experiment without DA and the warm start experiment with DA underestimated summer arctic clouds. When satellite radiances (AMSU-A and MHS) were assimilated at the analysis time, the distribution and quantity of water vapor were simulated more realistically, which results in the improvement of cloud simulations at the forecast time. As a result, the 25–30 hour forecast error of the downward shortwave (longwave) radiation flux in the warm start experiment which assimilated both conventional observations and satellite radiance data was reduced by 8.1% (12.7%), compared to that in the cold start experiment. The 25–30 hour forecast error of the upward latent (sensible) heat flux in the warm start experiment was also reduced by 7.8% (3.3%), compared to that in the cold start experiment. For the 2 m temperature and 10 m wind, the forecast error with DA was less than that without DA at almost all observation stations. More detailed results will be presented in the conference.

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