Impacts of Retrieved Rainrates on Numerical prediction of Typhoons

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Abstract

Special Sensor Microwave/Imager(SSM/I)-retrieved rainfall rates were assimilated into a limited-area numerical prediction model in an attempt to improve the initial analysis and forecast of tropical cyclone. Typhoon Flo of 1990, which was observed in an Intensive Observation Period of the Tropical Cyclone Motion Experiment-1990,was chosen for this study. The SSM/I retrieved rainfall rates within 888km(8° latitude) of the storm center were incorporated into the initial fields by a reversed Kuo cumulus parameterization. In the procedure we used, the moisture field in the model is adjusted so that the model generates the SSM/I-observed rainfall rates. This scheme is applied through two different assimilation methods. The first method is based on a dynamic initialization in which the prediction model is integrated backward adiabatically to t=−6h and then forward diabatically for 6h back to intial time. During the diabatic forward integration,theSSM/I rainfall rates are incoporated using the reversed Kuo cumulus parameterization. The second method is a forward data assimilation integration starting from t =−12h. From t=−6h to t= 0, the SSM/I rainfall rates are incorporated, also using the reversed Kuo scheme. During this period, the momentum fields are relaxed to the initial(t=0) analysis to reduce the initial position error generated during the pre-forecast integration. Five cases for which SSM/I overpasses were available were tested, including two cases before and three after Flo's recurvature. Forecasts at 48h are compared with the actual storm track and intensities estimated by the Joint Typhoon Warning Center. For the five cases tested, the assimilation of SSM/I retrieved rainfall rates reduced the average 48h forecast distance error from 239km in the control runs to 81km in the assimilation experiments. It is postulated that the large positive impact was a consequence of the improved froecast intensity and speed of the typhoon when SSM/I rain data were assimilated.

SSM/I sensors have narrow swaths and are onboard polar orbiting satellites. A technique is devised to infer rainfall rates from infrated(IR) sensors for wide and more frequent coverage. The method involves a pattern matching of IR brightness temperatures wtih overlapping SSM/I rainrates. The correlation function obtained can be used when SSM/I rainrates is not available. Rainrates of Typhoon Flo estimated form IR and retrieved from SSM/I are compared an found to be very close. Forecast experiments with IR rainrates result in improvemants similar to those with SSM/I rainrates.