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Adjoint-derived Forecast Sensitivities Related to a Meiyu Heavy Rainfall Event

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The mesoscale moist adjoint-derived forecast sensitivities related to the initiation of mesoscale convective systems are evaluated for a Meiyu heavy rainfall event with MM5 adjoint modeling system. Three response functions are selected here: 3-hour accumulated rainfall within the heavy rainfall center, the vertical component of relative vorticity over the heavy rainfall center, and the horizontal wind speed over the low level jet core. The sensitive regions are mainly located upstream of the heavy rainfall center and are remarkable in the lower troposphere. This vertical distribution of sensitivities is similar to the characteristics of Meiyu front. The magnitudes of sensitivities to the temperature and moisture fields are much larger than that to the horizontal winds. And the moist diabatic physics and latent heat release can enhance the magnitudes of all the forecast sensitivities. The results show that the sensitivities at the mesoscale range can capture the initial factors affecting the initiation of MCSs, which is usually hardly obtained from the sensitivity analysis at synoptic-scale range with dry physics. These results also give some hints to improve the QPF of Meiyu heavy rainfall, such as conducting mesoscale targeted observations via the adjoint-based method to reduce the low-level initial temperature and moisture errors.