



The adjoint sensitivity of heavy rainfalls to initial conditions in debris flow areas in China

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What would cause the heavy rainfall in debris flow areas is an interesting topic. By studying three heavy rainfalls that accompanied with debris flows and occurred in Sichuan province, China in the summer seasons, we find that the largest sensitivity of the 24h accumulated rainfalls to the initial conditions is respect to the temperature field. While the sensitivities to wind, surface pressure, and specific humidity are generally smaller. Moreover, the higher levels had been identified as sensitive levels and the main sensitive areas are located at the heavy-rainfall areas. All the above results suggest that the short-term rainfalls in Sichuan Province in China are mainly influenced by the local perturbations, and the local temperature perturbation at higher levels (above 500hPa) is a signal of heavy rainfalls. The development of the optimal perturbation confirms the results. Possible reasons for the above results have been discussed and analyzed preliminarily.