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Genesis of Southwest Vortices and its relation to Tibetan Plateau Vortices

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Southwest vortices (SWVs) are important summer rain-producing systems at 700 hPa occurring over the eastern flanks of the Tibetan Plateau, leading to heavy rainfall over southwestern China and even wider areas in eastern China when they move eastward. Tibetan Plateau vortices (TPVs) are the mesoscale systems forming over the Tibetan Plateau defined at 500 hPa, which have important influence on SWVs when they move off the Tibetan Plateau. However, only a few studies discussed the effects of TPVs on the genesis of SWVs, but by considering just one case, which obtained contradictory results.

The present work compares three situations which including 9 cases, respectively, by reanalysis data diagnosis, to investigate the role played by TPVs in the genesis process of SWVs. The genesis mechanisms of SWVs accompanied by the moving-off TPVs (Situation A) are explored, and then the mechanisms are further verified by comparison with situations of moving-off TPVs that are unaccompanied by the generation of SWVs (Situation B) and genesis process of SWVs without the moving-off TPVs (Situation C). It is revealed that the TPVs moving off the Tibetan Plateau (moving-off TPVs) can exert significant effects on the genesis of SWVs through both dynamic and thermodynamic processes. The moving-off TPVs are favorable for the generation of SWVs through strengthening the cyclonic vorticity, convergence and ascending motion. Diagnoses of the potential vorticity budgets reveal that the condensational latent heat has the greatest contribution to the generation of SWVs. The SWVs under the influence of TPVs (Situation A) are stronger and have longer lifespans. Analysis of the water vapor budget indicates that the water vapor is mainly transported from south of the genesis region of SWVs associated with strong southerlies. It is demonstrated that the southerlies and associated water vapor transport are another prominent factor affecting the genesis of the SWVs.