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Numerical evaluation of potential vorticity anomaly at upper levels on the secondary cyclogenesis event

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On the east coast of South America develops a particular type of cyclone, which is characterized by secondary formation. The secondary cyclone is a system that develops after a primary system within an only wave of higher levels. This system results from the coupling between heat and moisture turbulent fluxes from the ocean surface and the presence of an intense potential vorticity anomaly at upper-levels. The heat and moisture turbulent fluxes from the surface make instable the environment, promoting the formation of cyclonic systems on surface. Potential vorticity anomaly at upper-levels has an important role in the development of surface cyclones, bringing upper-level cyclonic vorticity to the lowest level that can force thermal advection and pressure drop on surface. The technique of piecewise potential vorticity inversion has been applied very successfully to evaluate the influence of the potential vorticity anomaly at upper-levels to cyclogenesis. The use of this technique to an event of secondary cyclogenesis on the south/southeast coast of South America is efficient. The inversion technique properly recovered the fields of geopotential height and wind velocity associated with the non-divergent field of potential vorticity, showing that the non-divergent field is a good approximation of the total field. The difference between the original and inverted fields consistently represented the divergent field of total velocity wind, identifying properly the regions of divergence/convergence of mass and intense vertical movements. The fields associated with the inverted potential vorticity anomaly were also consistent with the synoptic and dynamic situation of the event under study. The fields obtained from the inversion of the potential vorticity anomaly were subtracted from the original field and inserted as an initial condition for the Weather Research and Forecasting model (WRF). Results of numerical simulation to the evaluation of heat and moisture turbulent fluxes for cyclogenesis showed that the absence of fluxes weakens, delays the development of system and changes the location of formation. In the absence of potential vorticity anomalies at upper-level, partial results showed that the primary cyclone develops and it follows typical trajectory to the southeast, but the secondary cyclone behind the primary cyclone does not occur and the high pressure of rear moves quickly eastward. Therefore, a partial conclusion of this work shows that the dynamic forcing of upper-levels appears to be much more important and decisive in the development of secondary surface cyclone, however the presence of heat and moisture turbulent fluxes between sea-air interface enhance the cyclone development on surface.