Convective response due to a potential vorticity intrusion in tropical latitudes

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A case study is presented which shows that a potential vorticity (PV) intrusion into the tropical troposphere over South India on 10 April 2011 results in descending of patches of high PV from the upper troposphere to below 600 hPa leading to the formation of atmospheric lid (dry layer), which helps to inhibit convection and precipitation. The dry layers are identified from the formation of a layer of relatively high PV and low relative humidity (RH) at 600 hPa and below in the European reanalysis data sets and also from high signal-to-noise ratio (SNR) low RH profiles obtained from the MST radar and radiosonde observations over Gadanki, a South Indian site. It is found that the lid, which inhibits convection for the first 3 days (11-13 April) below the PV intrusion region, finally allows the accumulated potential energy beneath the lid to overshoot it, resulting in the development of deep convection. The developed convection again gets inhibited during 16-18 April and a trajectory analysis suggests that the dry layer formed in this case is due to a different branch of dry patches descending from a height of 10 km since 11 April. The convectively available potential energy (CAPE) decreases and increases in response to the formation and weakening of dry layers respectively, whereas the convective inhibition (CIN) shows variation opposite to that of CAPE. The significance of this study lies in demonstrating in detail the dual role of the PV intrusions, namely, convective inhibition and convective promotion over Indian sector.

Key words: PV intrusion, convective inhibition, atmospheric lids.