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The Argentinean Col, Separatrices, Frontogenesis and Strong Rainfall in Subtropical South America

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The relation between cols in the low level pressure field and frontogenesis was first noted in the midlatitudes, between extratropical ciclones, by Petterssen (1956). That author observed that the angle between the col's contraction axis and the isotherms in the neighborhood of the col should be at least 45° for there to be frontogenesis. In the South American subtropics we found a col that becomes very frontogenetic in equivalent potential temperature, during summertime incursions of cold fronts from the Pacific, leading to strong rainfall in its neighborhood. It separates the North Western Argentinean Low (NAL) from the region of westerlies to its south, and is here termed the Argentinean Col. ECMWF ERA40 and GPCP rainfall data were used to study these systems over 22 summers (1980 – 2001). We noted that the separatrices of the col, isobars that intersect at the col, summarize the relevant information about the large-scale wind pattern. In this case, at 850hPa, one of the separatrices always extends from the midlatitudes to the col and then into the tropics, either forming a self-connection, or extending almost meridionally to the deep tropics. Wind flows from the deep tropics and from the midlatitudes, bringing contrasting air masses to the neighborhood of the col. The local gradient of equivalent potential temperature is increased, and the deformation field in the neighborhood of the col acts to thrust the contrasting air masses against each other. By noting the importance of the separatrices, in addition to the dilation and contraction axis, to frontogenesis over cols in the subtropics, we add to the work done by Petterssen. The incoming cold front intensifies the subtropical jet, which is flowing over the Andes, giving rise to Fohen effect on the lee side, locally called the Zonda wind. This is a known mechanism of adiabatic intensification of the NAL, which is a thermal low. Northerly, moisture laden and warm, winds are geostrophically accelerated towards the col region and also to the South of it. Once the frontal trough in the low levels crosses the Andes, the southwesterly winds to its west produce cold advection, which is strongest near the col. Intense frontogenesis ensues. This leads to geostrophic acceleration of the subtropical jet (thermal wind relation), and high level divergence. The clash between air masses also produces low level convergence. The result is intense rainfall, particularly in the neighborhood of the col. Two categories of fronts were identified. In one of them the disturbance intensifies, leading the frontal trough to grow. Combined with its eastward displacement this leads to the front to travel northeastwards. In the other category the high level trough does not cross the Andes, but remains quasi-stationary off the Pacific coast. Without support from the high levels, the low level disturbance quickly looses strength, and it remains quasi-stationary or moves to the east while it dissipates.