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Cold Surge Episodes over Southeastern Brazil and their Relation to Rossby-Wave Breaking

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The upper-level flow during Intense cold surges and associated frost events in southern Brazil is usually characterised by a large amplitude trough over South America extending toward tropical latitudes and a ridge to the west of it over the Pacific ocean. In this study, we adopt the PV perspective to shed further light on the mechanisms leading to strong cold surges. The formation of the trough/ridge pattern is strongly related to the formation of so-called PV streamers. These narrow filaments of high (low) potential vorticity (PV) extending equatorward (poleward) are irreversible distortions of the dynamical tropopause. As a key question we ask: How do the strong deformations of the dynamical tropopause form prior and at the time of the cold surge epsiodes?

In a first part, we compile a southern-hemispheric climatology of PV streamers on a stack of isentropic surfaces from 300 to 350 K (upper troposphere/lower stratosphere). Then it will be shown that cold-surge episodes are associated with a statistically anomaluous occurrence of PV streamers in the South American and Southern Pacific region. A more refined PV anaylsis will be presented for several cold surge episodes.

A second part considers the forcing mechanisms leading to the strongly deformed dynamical tropopause (or waveguide). Four different mechanisms will be discussed: (a) diabatic heating due to latent heat release; (b) isolated mesoscale high-PV anomalies moving along the waveguide; (c) interactions of the 2 pvu waveguide with intrusions of polar high-PV air; and (d) Rossby wave precursors originating from Australia and even further upstream. For each of the four cases, a typical example will be presented.