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Relative Humidity Observations in the Tropopause Saturation Layer over Costa Rica and the Influence of Upstream Convection

Henry Selkirk (1,3), Mark Schoeberl (2), Donifan Barahona (3), and Leonhard Pfister (4)

(1) Universities Space Research Association, GESTAR, Greenbelt, MD, USA (henry.b.selkirk@nasa.gov), (2) Science and Technology Corporation, Columbia, MD, USA (mark.schoeberl@mac.com), (3) NASA Goddard Space Flight Center, Greenbelt, MD, USA (donifan.o.barahona@nasa.gov), (4) NASA Ames Research Center, Moffett Field, CA USA (Leonhard.Pfister@nasa.gov)

The tropical tropopause separates two very different atmospheric regimes: the stable lower stratosphere where the air is both extremely dry and nearly always so, and a transition layer in the uppermost tropical troposphere, where humidity on average increases rapidly downward but can undergo substantial temporal fluctuations. The processes that control relative humidity in this layer below the tropopause include convective detrainment (which can result in either a net hydration or dehydration), slow ascent, wave motions and advection. Together these determine the humidity of the air that eventually passes through the tropopause and into the stratosphere, and we refer to this layer as the tropopause saturation layer or TSL.

We know from in situ water vapor observations such as Ticosonde's 12-year balloonsonde record at Costa Rica that layers of supersaturation are frequently observed in the TSL. While their frequency is greatest during the local rainy season from June through October, supersaturation is also observed in the boreal winter dry season when deep convection is generally well south of Costa Rica. In other words, local convection is not a necessary condition for the presence of supersaturation. Furthermore, there are indications from airborne measurements during the recent POSIDON campaign at Guam that if anything deep convection tends to 'reset' the TSL locally to a state of just-saturation. Conversely, it may be that layers of supersaturation are the result of slow ascent.

To explore these ideas we begin with a seasonal comparison of Ticosonde and MLS observations of relative humidity from the TSL over Costa Rica. We then report on the differences in the history of upstream convective influence between supersaturated parcels and those that are not. We estimate convective influence along parcel trajectory paths using both satellite IR imagery and cloud fraction from the GEOS-5 AGCM and address the degree to which upstream convection 'resets' the TSL locally over Central America.