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A dehydration mechanism in the lower tropical stratosphere

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We use WB57F high resolution profiles of water vapour, methane, ozone and temperature from the surface to 18 km above Central America in January to deduce that the last of four recognizable stages in lowering the water vapour from about 10 ppmv to about 3 ppmv takes place above the thermal tropopause in air with stratospheric ozone content. The minimum in the water vapour profile invariably overlies the temperature minimum and an adiabatic layer of saturated or apparently supersaturated air whose top is about 200-300 metres below. Using probability distributions of temperature, which are highly asymmetric with a cold most probable value and a long warm tail, combined with literature results on the heating of small ice particles by solar radiation, we argue that the mechanism for producing the lowest water vapour values is thermal and solar evaporation of the smallest particles, followed by the adhesion of the resulting vapour molecules to larger particles having significant fall speeds. It is pointed out that the presence of stratospheric methane mixing ratios between 13 km and the tropopause about 4 km above, coupled with the dehydration mechanism in the stratosphere, involves stratospheric processes in determining the water content of the upper tropical troposphere, so entailing a role for them in this climatically critical region.