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AEROSOL LAYER NEAR TROPICAL TROPOPAUSE

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MST radar observations at Gadanki (Tirupati, India, 13°47^{1}N, 79°18^{1}E) generally show a layer of intense reflectivity (for example Figure-1), about 2 km thick around the tropopause. As seen by the naked eye, this layer appears as a haze layer, occassionally becoming more visible through high cirrus cloud. This moist haze layer can be treated as "sub-visual" cloud layer. Under disturbed weather conditions, the cloud tops are seen near tropopause level through satellite pictures also.

Such features near the tropopause have also been reported for mid-latitude regions (John Powell,1997, personal communication).

Recent analysis of satellite observations shows high values of relative humidity, greater than 70%, within a few kilometers around the tropopause in the tropical regions (Newell et.al., 1997).

These and other observations can be fitted into the following hypothesis:-

i) In the tropics, Inter Tropical Convergence Zone (ITCZ) and other semi-permanent convergence zones in the troposphere are continuously pumping aerosols and moisture from the lower troposphere into the upper troposphere(Asnani, 1993). In case of deep cumulus convection, they spread in the form of thick cirrus and cirro-stratus layer clouds generally below the tropopause level but occasionally breaking through the tropopause into the stratosphere.

ii) When the cirrus clouds dissolve, water vapour and aerosols separate, giving large realtive humidity and high aerosol content in the air layer around the tropopause.

iii) Due to high values of static stability in this layer, vertical turbulent mixing of aerosols and water vapour is inhibited and aerosols largely remain trapped in this layer, which we call **"Mother Layer"**.

iv) At very low temperatures (about -70°C), prevaling near the tropical tropopause level and in the presence of high relative humidity, aerosols and water vapour also coagulate, or get frozen into ice cloud particles.

v) Ice cloud particles and coagulated aerosol material go up and down inside the Mother Layer, due to Brunt-Vaisala oscillations, Kelvin-Helmholtz waves, precipitation-loading and gravity.

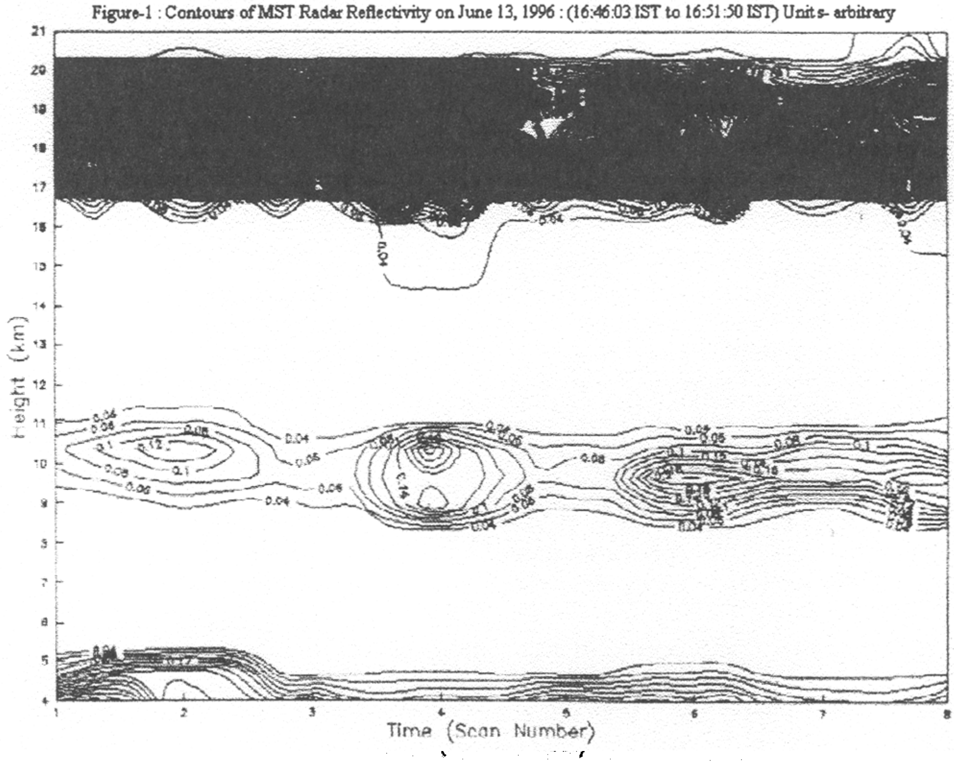
vi) In these small-scale upward and downward motions of ice-aerosol particles, thin sheets of temperature and humidity discontinuity get formed inside the Mother Layer, through contact cooling, melting, evaporation, condensation and freezing. Melting and freezing at low temeperatures also generate electrical charges in these thin sheets. These thin sheets have vertical dimensions ranging from a few centimeters to several meters (Dalaudier et.al., 1994).

vii) These thin sheets have corresponding discontinuities and steep vertical and horizontal gradients in refractive index for the MST radar beam.

viii) These discontinuities and steep gradients in refractive index show up in the form of high values of reflectivity from the Mother Layer 1 to 2 km thick around the tropopause.

ix) Elsewhere, we are showing that this 1 to 2 km thick layer around the tropopause is one of a few (generally three) layers of high humidity and aerosol content in the troposphere, caused by inertio-gravity waves in the tropics.

Figure-1 : Contours of MST Radar Reflectivity on June 13, 1996 : (16:46:03 IST to 16:51:50 IST) Units- arbitrary



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