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9.1.1 ON THE USE OF COLOUR REFLECTIVITY PLOTS TO MONITOR THE STRUCTURE OF THE TROPOSPHERE AND STRATOSPHERE

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The radar reflectivity, defined as the range-squared corrected power of VHF radar echoes, can be used to monitor and study the temporal development of inversion layers, frontal boundaries and convective turbulence. These observations as well as possible conclusions were discussed in more detail for instance by GAGE and GREEN (1979), ROTTGER (1979), and LARSEN and ROTTGER (1982, 1985). Also, the development of convective turbulence can be observed (ROTTGER, 1980). Such measurements can most conveniently be done with VHF radars operating with vertical beams.

From typical features of upward (cold front) or downward (warm front) motion of reflectivity structures, the advection/convection of cold and warm air can be predicted. Whereas, inversion layers, the tropopause and frontal zones evolve as fairly stratified, stable and often thin laminated structures on the height-time-reflectivity plots, convective turbulence is clearly characterized by upwelling, nonstratified structures.

High resolution colour plots appear to be useful to trace and to study the life history of these structures, particularly their persistency, descent and ascent. These displays allow an immediate determination of the tropopause height as well as the determination of the tropopause structure (e.g., highly stratified, split into multiple layers, fairly dissolved, or indications of potential temperature gradient deduced from reflectivity magnitude, etc.). The life history of warm fronts, cold fronts, and occlusions can be traced, and these reflectivity plots allow detection of even very weak events which cannot be seen in the traditional meteorological data sets. The life history of convective turbulence, particularly evolving from the planetary boundary layer, can be tracked quite easily. Its development into strong convection reaching the middle troposphere can be followed and predicted.

In a cooperative project of the Max-Planck-Institut-fur Aeronomie, the University of Illinois and the National Central University in Chung-Li, data taken with the SOUSY-VHF-Radar (ROTTGER, 1980) were analyzed in terms of reflectivity and further processed with the VAX 11/750 image processor of the Centre for Remote Sensing and Space Physics of the National Central University.

Figure 1 shows two examples of black-white copies of colour height-time-reflectivity plots. The abscissa is time, covering 6 hours for each plot, and the ordinate is altitude from 1.5 km to 16.5 km MSL. Whereas, gray-shade or contour plots and also these black-white copies can only barely cope with the large dynamic range of 60 dB of the reflectivity throughout the troposphere and lower stratosphere, but the colour plots indicate a lot of interesting fine structure as well as allow an immediate detection, tracing and interpretation of relevant structures.

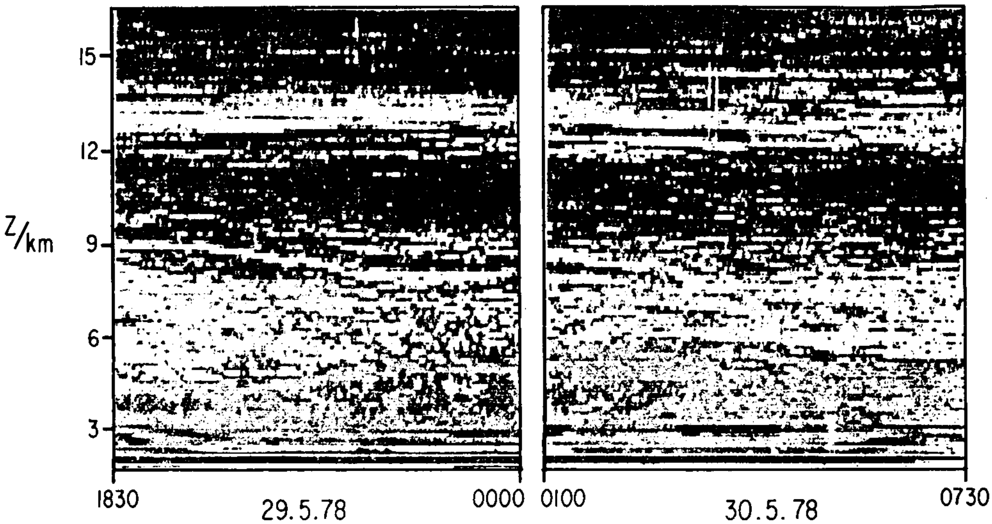

Figure 1. Copies of colour prints of height-time-reflectivity plots obtained by image processing of VHF radar reflectivity, measured with vertical beam and 150 m height resolution. Time coverage is 2 x 6 hours, and altitude coverage from 1.5 to 16.5 km.

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