High temporal resolution VHF radar observations of stratospheric air intrusions in to the upper troposphere during the passage of a tropical mesoscale convective system

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Abstract

A high temporal resolution VHF radar experiment, which was carried out to divulge the clear-air structure of mesoscale convective system (MCS) at finer time scales over Gadanki, is discussed. The VHF radar was continuously operated for four hours with 11 seconds time resolution on 19 June 2006, which facilitated to study the finer details of stratospheric air intrusions into the upper troposphere during the passage of a MCS. Simultaneous GPS sonde and ground based optical rain gauge measurements are also made use of for the present study along with radar observations. The height-time section of range corrected signal to noise ratio (RSNR) revealed the convective cells reaching as high as 14 km altitude and the signature of tropopause as a layered structure at around 16.5 km. The important observation from the radar RSNR is the time localized inclined echoes in the height region of 12-16 km region giving the evidence for stratospheric air intrusion into the upper troposphere. Further, this observation is confirmed by the height–time section of vertical velocity, which showed the intense downdrafts in the height region of inclined radar echoes. A detailed examination of this down draft revealed an episode of high frequency gravity wave excitation, which is believed to be the consequence of intrusion of stable stratospheric air into the upper troposphere. Thus, the present study brings out for the first time how the stratospheric intrusions will appear in the radar height–time sections and the consequences of such intrusions in the upper troposphere. At this juncture, where atmospheric community is showing renewed interest in the stratosphere-troposphere interactions, the present observations assumes importance.