Application of Validated Cloud Water Profiles for the investigation of ISM vertical structure

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1. Background

The determination of cloud water content (CWC/LWC) and median drop diameter (MVD) has both practical and theoretical implications for the study of cloud microphysics. Further, knowledge on LWC and MVD could be useful in addressing fundamental questions about the sources, sinks, life span of super-cooled liquid drops and cloud process. Hence, it is important to quantify the spatial distribution of LWC and MVD.

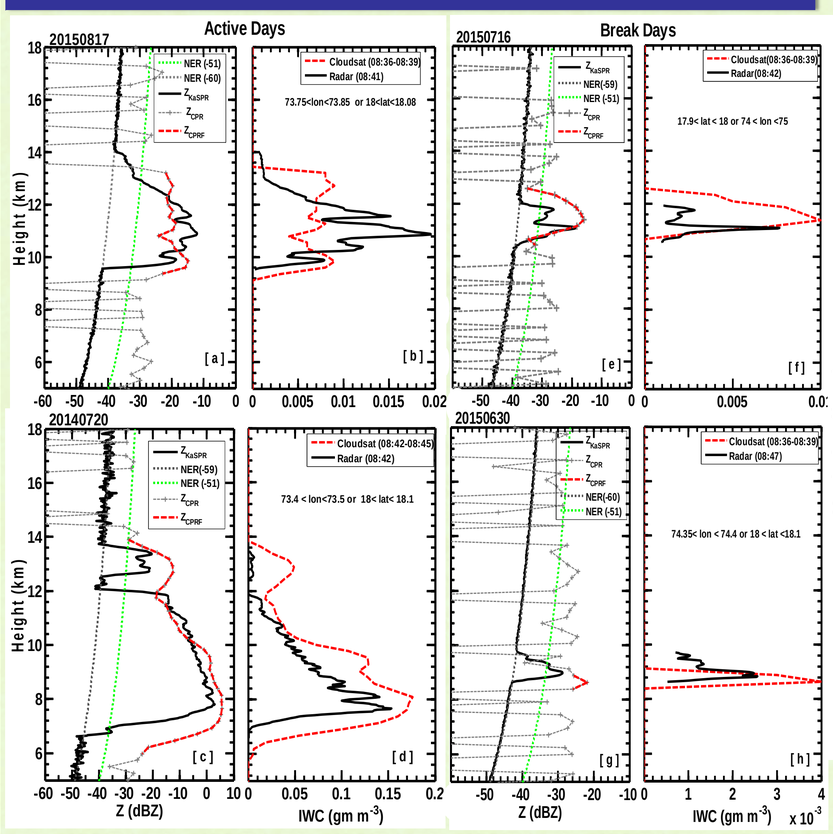
2. Objectives

Retrieval of cloud radar based Cloud Water (Ice and Liquid Water Content :IWC and LWC) to understand the microphysics of tropical cloud system.

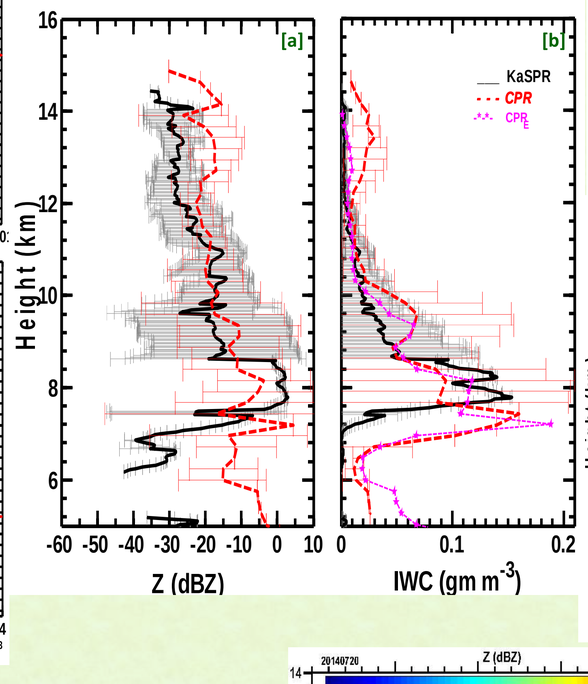
3. Cloud radar system

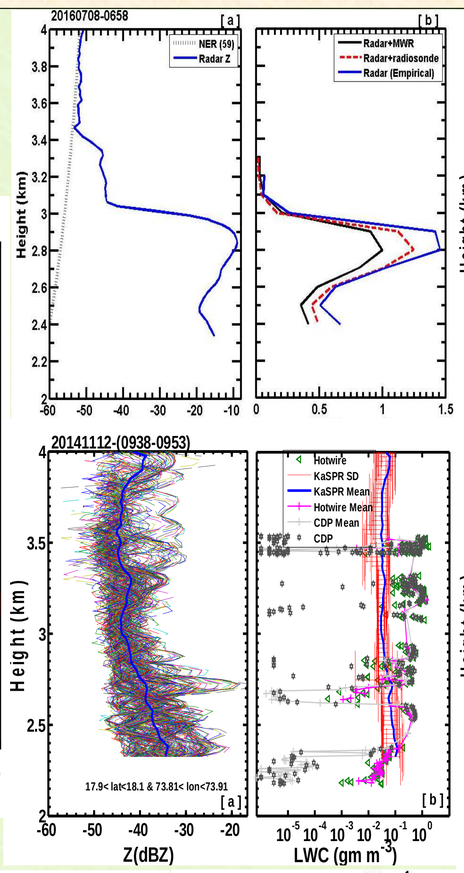
IITM's Mobile Ka-band Scanning Polarimetric Doppler Radar (KaSPR) is a cloud radar that is being operational since May 2013. KaSPR operating at wavelength of 8.5 mm with average powers of 110 W. KaSPR incorporates a conduction cooled Extended Interaction Klystron Amplifier. It is having four foot diameter Ka-band Cassegrain antenna. Antenna on the top of RF unit is mounted on the elevation over azimuth pedestal which is designed to rotate continuously in the azimuth axis and also full 180^0 in the elevation axis (horizon-to-horizon) with a maximum velocity of 20^0/sec and maximum acceleration of $12^0/s^2$. KaSPR uses dual channel 16-bit digital receiver having dynamic range of more than 80 dB with bandwidths 10 MHz. Arbitrary waveform generator capable of generating any user-defined waveform of up to 16K samples in length. It is having sensitivity of the order -45 dBZ at 5 km. KaSPR is capable to make versatile operational and scanning modes. KaSPR has been providing high sensitivity versatile measurements of tropical cloud and precipitation at a tropical site (Mandardev, 18.04^0 N, 73.87^0 E, 1.35 km AMSL) from a scanning mobile platform since June, 2013.

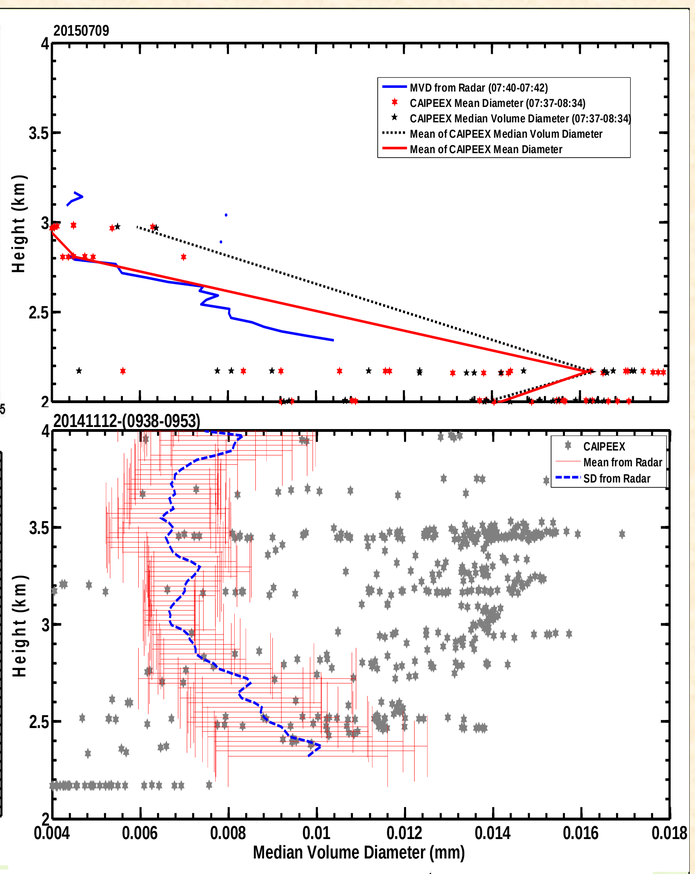
4. Results and Discussions



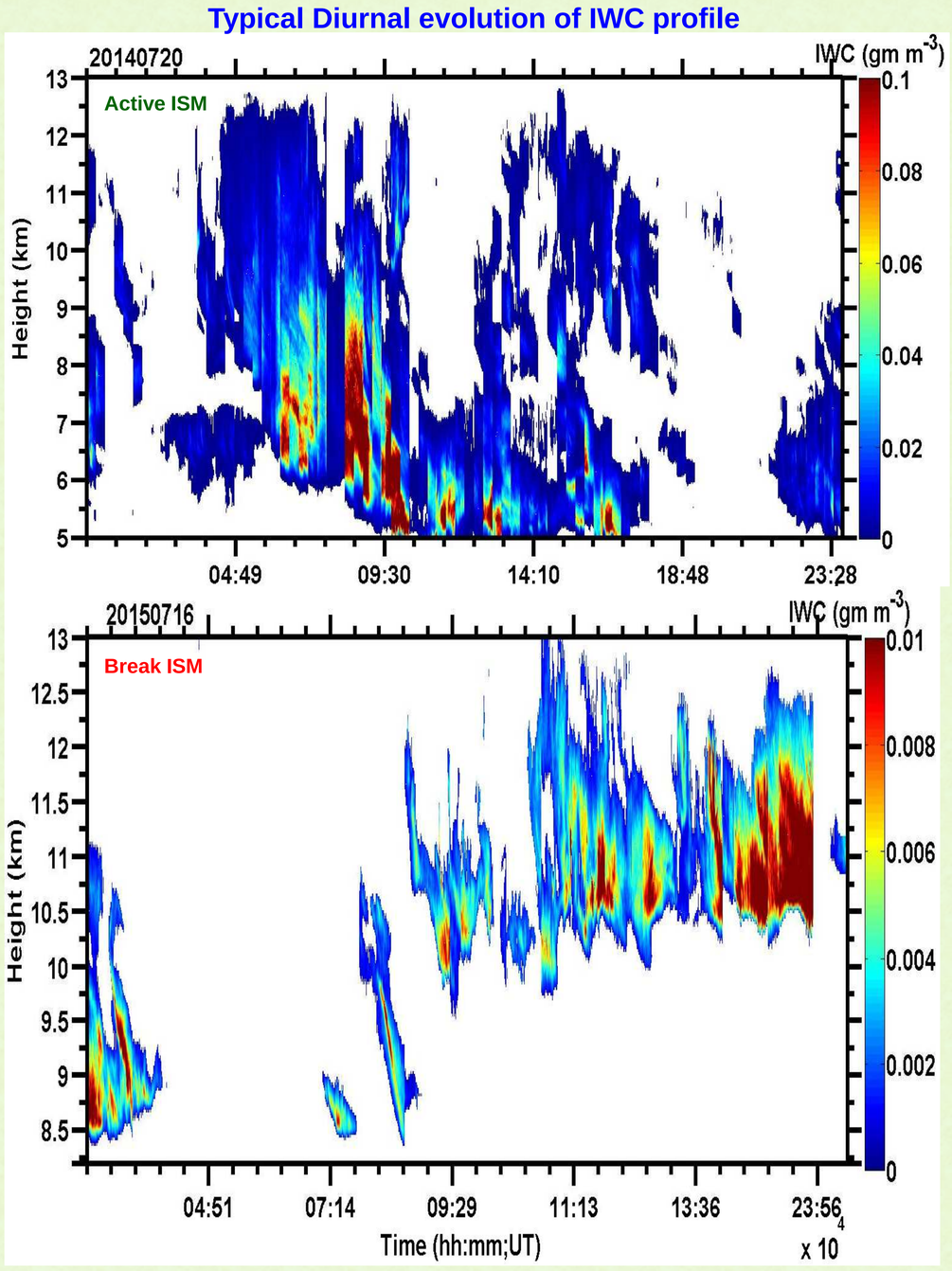
Ice Water Content profile validation with CloudSat Cloud Profiling Radar (CPR)

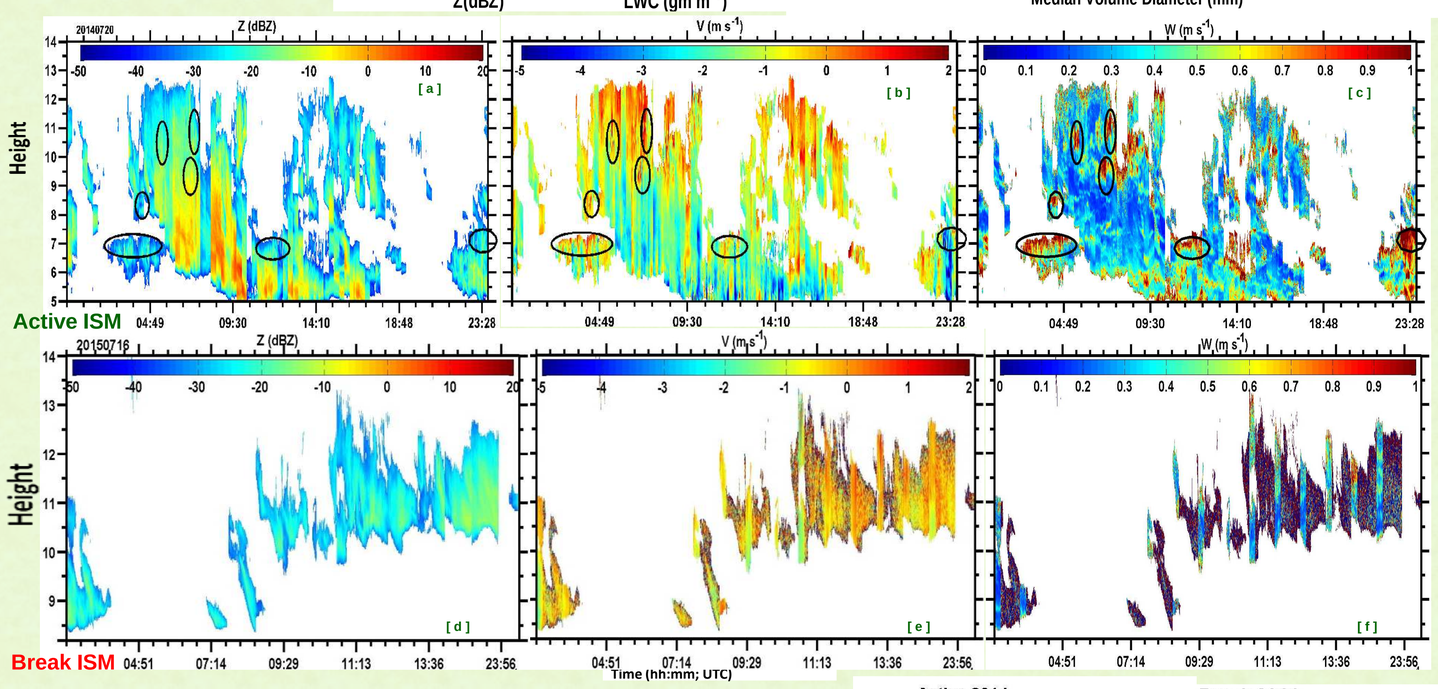




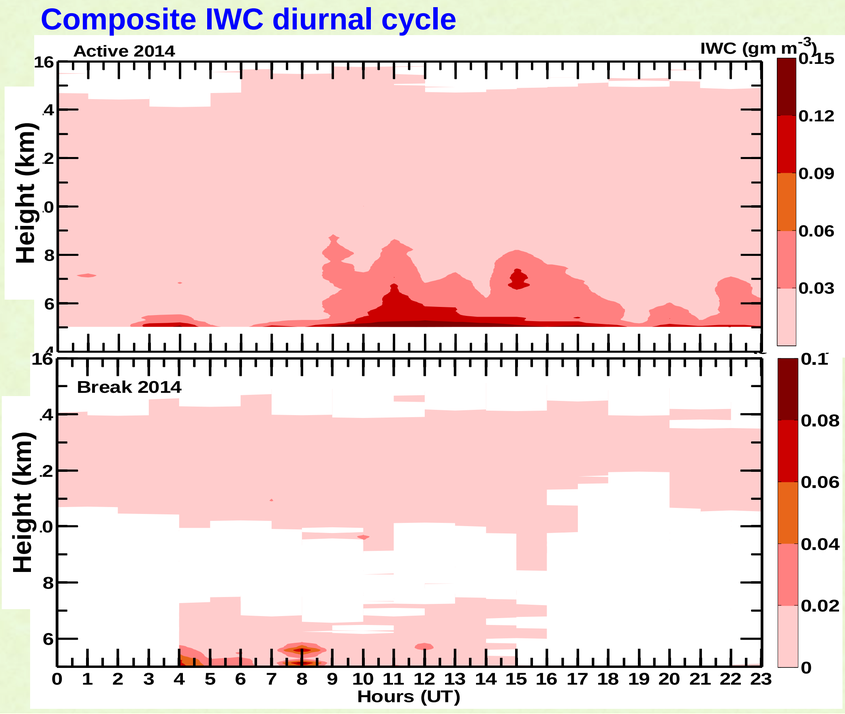


Typical Diurnal evolution of IWC profile

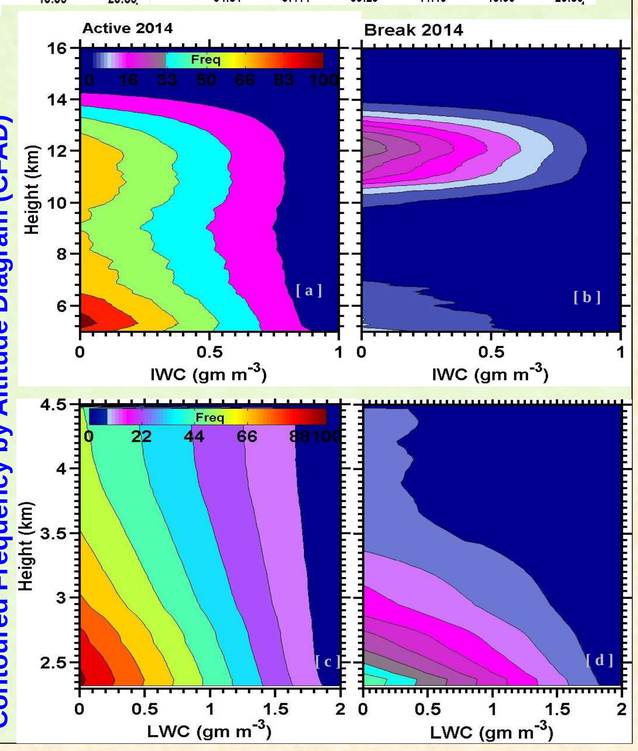




Composite IWC diurnal cycle



Contoured Frequency by Altitude Diagram (CFAD)



5. Summary & Conclusions

i. Versatile validations done on the radar retrieved cloud water content profiles are found to be reliable and consistent. IWC values are around 0.1 (0.01) gm m^{-3} during wet (dry) phase of the ISM.

ii. Strong gradients of CWC are associated with higher velocity variance / Spectral Width measurements that infers the significant role of turbulence and entrainment in triggering the microphysical growth in the ice cloud tops. Highest IWC accumulation are predominantly seen at the calm cloud base portions.

iii. Secondary mode Cirrus cloud presence during weaker ISM phase found to be less than 20% of total frequency.

iv. CWC diurnal cycles confirm the role of convective heating. Mid troposphere drying is one reason for weaker ISM phase.

Acknowledgments

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