# Multi-scale Characteristics of Cloud Turbulence during CAIPEEX

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Flight observations conducted at several locations over India during May- September, 2009 as part of the Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX) are used to study multi-scale turbulence characteristics associated with mixing and transport in a monsoon boundary layer. Observations during CAIPPEX depict a variety of dynamical interactions from the large scale to mesoscale and to the small scale turbulence. Horizontal flights over different geographical areas and different elevations are used to investigate size and characteristics of eddy motion and mixing of aerosol and cloud condensation nuclei. Generally an enhancement of spectral variance is noted for observations when clouds were present. An increase in the large scale as well as small scale variance is noted, which sometimes appear as non-linear wave motion. Signature of secondary roll circulations is noted in the boundary layer flights. Spectral energy gap in the vertical velocity is not clearly discernable in the boundary layer due to dominating large scale effects. Spectra of various parameters corresponding to a large-scale updraft (mean $\approx$ 1.34 $ms^{-1}$ and standard deviation of 0.81 $ms^{-1}$ and maximum updrafts and downdrafts exceeding 4.5 $ms^{-1}$) in a highly sheared environment over land are used (Figure 1) here to illustrate interactions. Spectra rolls off with a slope of (-5/3) and the complete inertial subrange of small scale was not represented in data due to low sampling rate. Several intermediate regions of the spectra representing mesoscale showed clear indications for the presence of a buoyancy subrange indicating the influence of waves and convection.

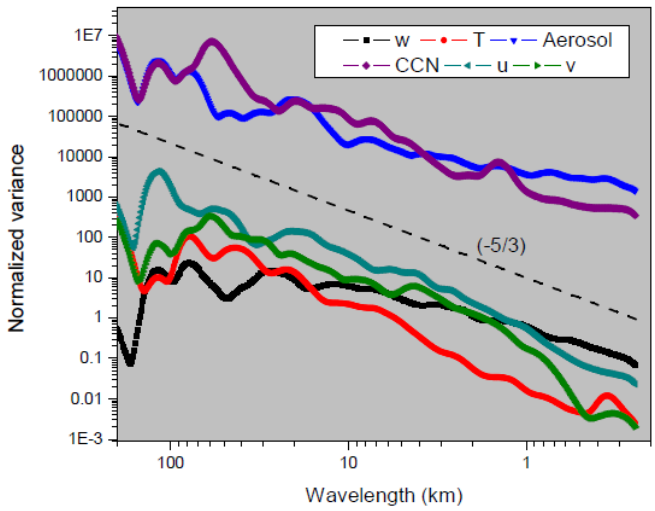


Figure 1. Variance spectra of velocities, temperature, cloud condensation nuclei and aerosol concentration in the presence of a large scale updraft

The information on the scale-interactions between the incloud and environment are illustrated with the help of advanced flux separation methods such as Wavelet and Hilbert-Huang transforms. An effort is also made to validate the inferences against a high resolution cloud resolving model.

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