

# Acknowledgements

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**A. SANDEEP**

# Preface

Understanding of atmospheric boundary layer (ABL) processes and their variability remained an active area of research for several years through intense field campaigns and routine measurements. Most of these studies are done in isolation by focusing either on ABL variability near the surface using meteorological tower observations or on variability aloft using remote sensing devices. While these studies advanced our understanding of ABL to a great extent, several key research problems are unexplored, particularly in the tropics. In spite of its importance in fundamental and operational research, ABL measurements are available only in sparse locations in the tropics, in general, in India, in particular. Though, ABL is having macro-physical diurnal structure and is controlled by surface forcings. These surface forcings are not same around the globe, in particular over the tropics. As a result, ABL characteristics are modulated significantly. Added to that, efficacies of the variabilities of the ABL are not same throughout in India, in general, in Southeast India, in particular. This forms the main focus of this thesis. It deals with the variability of ABL as a function of space, time and region. The doctoral thesis entitled “**A comprehensive study on the variability of the atmospheric boundary layer over southeast India**” contains seven chapters.

A brief introduction to the structure of atmospheric boundary layer, significance of ABL, pros and cons of different probing techniques to measure the height of ABL and the important scientific findings and the on-going research on ABL are reviewed with a special emphasis on investigations in India are included in **Chapter 1**. The gap areas and scope of the thesis are also presented. The description of surface based measurements (AWS, 50 m Tower, 15 m Tower), upper air in situ measurements (GPS radiosonde), upper air remote sensing instruments (3 Wind Profiling Radars, 1 SODAR) and satellite-based measurements are discussed. A short description on IMD's gridded rainfall, NCEP-NCAR reanalysis, ERA-Interim reanalysis and TRMM-3B42 high-resolution rainfall data is also included in **Chapter 2**.

The differences and similarities in ABL characteristics, in particular its height, evolution and wind field; between two contrasting episodes (wet vs dry) of Indian summer monsoon has been studied briefly in **Chapter 3**. The observed differences are

discussed in light of various forcing mechanisms, in particular the effect of soil moisture on the surface energy balance and ABL by using flux tower, radiosonde, wind profiling radars and satellite based observations. It also contains identification of wet and dry episodes of the Indian summer monsoon.

The transitory nature of the ABL few hours before and after the time of sunset over Gadanki has been presented in **Chapter 4**. This study addresses the fundamental and important issues related to the afternoon transition (AT) regarding its definition, identification and distributions as a function of season and height. The forcing terms (surface, entrainment) are quantified using a unique high-resolution data set to understand their variation in light of the intriguing height dependency of the start time of AT.

A quantitative study on the nature and origin of the PST characteristics in ABL, measurements made with tower, WPR's, SODAR, are discussed briefly in **Chapter 5**. For the first time, an attempt has been made to address several key questions regarding PSTs: their occurrence, start time and duration statistics and their dependency on height and season. The statistical characteristics obtained at Gadanki are discussed in light of surface forcings and local circulation. **Chapter 6** discusses the similarities and differences in characteristics of ABL (evolution, transitions, and turbulence) from inland to coastal region over southeast India. The observed differences are lightly discussed with various forcing mechanisms especially with the effect of surface properties/conditions (soil moisture, temperature, winds, humidity) and impact of sea-breeze circulation (formation of internal boundary layer).

Finally, **Chapter-7** summarizes all the results on the structure and variability of ABL over southeast India obtained from chapters 3-6 and also presents the scope for the extension of this work that is instigated from the present work.