VEBEX: Vegetation and surface energy balance experiment for the tropics

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Surface features such as soil moisture and vegetation have a profound impact on the surface energy balance and the atmospheric boundary layer. To quantify this effect for a tropical location, a detailed field experiment, VEBEX, was designed and successfully executed in a tropical site at Bangalore, India. VEBEX was a joint experiment between the North Carolina State University, Indian Institute of Science (IISc), and the University of Agricultural Science (UAS) at Bangalore, India. Continuous surface meteorological measurements were taken over an entire crop period (pre-sowing to post-harvest). During different stages of the plant growth, intensive observations of surface turbulence, and measurements of physiological and soil moisture measurements were also conducted. The results obtained provide an insight into the unusually strong variability for the tropics. Interpretation of the observations and an overview of the analysis procedure and future research initiatives are also presented.

1. Introduction

One of the pivotal components of present research efforts is to improve numerical model performance by accurately understanding and representing the effects of soil moisture and vegetation changes in the boundary layer. Consequently, various vegetation and soil moisture schemes are being used for soil vegetation atmosphere transfer (SVAT) studies. Some examples of such SVAT schemes for general circulation models (GCMs) are, Jarvis (1976); BATS (Dickinson *et al* 1986); SiB (Sellers *et al* 1986); SSiB (Xue *et al* 1991); Viterbo and Beljaars (1995); PLACE (Wetzel *et al* 1995); SiB2 (Sellers *et al* 1996). Examples for the planetary boundary layer (PBL) or mesoscale analysis include, Deardorff (1978); Noilhan and Planton (1989); Acs (1994); and Alapaty *et al* (1997a). Some of the recent studies are at the microscale, to evaluate the plant-to-plant response and leaf-scale interactions, using observational (Niyogi and Raman 1997; Katul *et al* 1997) as well as modeling approaches (cf. Baldocchi 1994; Nikolov *et al* 1995; Su *et al* 1996; Niyogi *et al* 1997a). The SVAT schemes, though developed from sound physics and understanding of the biosphere-atmosphere mechanisms, need to be simplified (and often tuned) through empirical equations, 'constants', and regionally representative features. For example, in Noilhan and Planton (1989), much of the physiological simplification and 'tuning' is done based on the empirical relations developed from HAPEX-MOBILHY observations (André *et al* 1986). Such a scheme could thus be a better representative of a mid-latitudinal geography and pasture-like landscape with relatively abundant moisture availability (consistent with HAPEX). Such empirical simplifications however, may not have an ubiquitous applicability, for they represent a somewhat limited (as against global) hydrological and landscape regimes. Thus, any biospheric scheme developed needs to be evaluated tested with global datasets. Unfortunately, such a global dataset is not available with the same information and high resolution, so as

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