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UTILIZING THE IHOP 2002 DATA TO STUDY THE VARIABILITY IN SURFACE EVAPORATION, RUNOFF, AND PRECIPITATION FOR THE SGP

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1. INTRODUCTION

The overall goal of International H2O Project (IHOP 2002) is to understand the distribution and variability of water vapor in time and space. It is critical component of this mission to investigate 1) the variability of water vapor near the surface as function of land-use type and their growing cycle; and 2) their influence on the thermodynamic structure of boundary layer.

It has been known that land surface conditions (including terrain, soil, land-use, soil moisture, albedo) affect the partition of surface radiation flux into latent and sensible heat flux, which affect the deep convection initiation and development. However, it remains a difficult task to model the soil hydrology and vegetation in land surface models, and to treat the transport of water vapor in the boundary layer. A number of soil and surface variables are identified as highly desirable key parameters by a number of IHOP PI's. Therefore, nine NCAR surface flux stations plus one additional flux station, operated by the University of Colorado group, were set up to support the IHOP 2002 atmospheric boundary layer mission in the Southern Great Plains for the period of May 13-June 26 2002.

2. IHOP/NCAR/CU SURFACE, SOIL, AND VEGETATION NETWORK

Those ten flux-tower stations were strategically located along three boundary-layer-mission flight tracks (western, central, and eastern flight legs, as seen on Fig. 1)

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and over various land-use types that include winter wheat, grassland, sparsely vegetated surface, and bare ground.

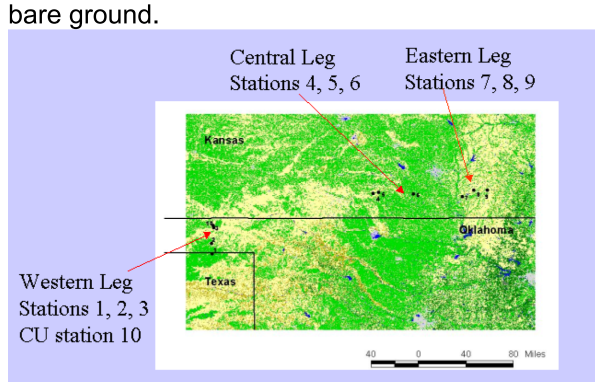

Fig. 1. Location of HOP/NCAR/CU flux-tower stations

Table 1 below describes the geographical feature, dominant land cover, and surface soil texture of the nine NCAR stations. In addition to the differences in land-use types, the prolonged drought in the Oklahoma panhandle intensified the gradient in surface evaporation between the dry and sparsely vegetated in the panhandle and wet prairie lands in eastern Kansas.

Table 1: Summary of IHOP surface, soil, and vegetation network

IHOP No	Land Cover	Lat.	Long.	Z (m)	Soil type
1	Winter wheat	36°28	100°37	871	sandy clay loam
2	CRP grass	36°37	100°38	859	sandy clay loan

3	Sagebrush, mesquite, cactus	36°52	100°36	780	sandy loam
4	Grass	37°22	98°15	**509**	loam
5	Winter wheat	37°23	98°10	**506**	loam
6	Winter wheat	37°21	97°39	417	clay loam
7	Grass, grazed	37°19	96°56	382	clay loam
8	Grass, May be burned	37°24	96°46	430	silty clay loam
9	Grass, grazed	37°25	96°34	447	silty clay loam

Nine of these ten flux stations were enhanced by adding soil and vegetation sensors. One profile of soil moisture and temperature sensors was installed at seven stations, and three profiles of soil sensors were deployed for each of the two 'super' stations (1 and 9) to investigate the heterogeneity within a site. For each profile, soil moisture and temperature sensors were installed at six soil depths (with the deepest layer at about 90 cm). Decagon ECH_2O Dielectric Aquameters and Campbell Heat dissipation Matric Water Potential (C229) were used to measure soil moisture and soil water tension. Licor LAI-2000, Cropscan MSRSYS5 radiometer, Licor LI-1600 Porometers, and Infred-Red Thermocouple were employed to measure leaf area index, NDVI, stomatal resistance, and temperature profile within canopy, respectively, on the weekly basis.

3. PRELIMINARY RESULTS

The measurement at those surface stations will provide a full array of surface and near-surface data, CO2 concentration at two stations, soil moisture and temperature at six soil depths for each station, various soil properties, weekly measurement of vegetation parameters, and the diurnal cycle of stomatal resistance at a few selected sites.

Fig. 3 shows that the maximum rainfall accumulation was close to 270 mm at station 8 and only about 50 mm at stations 2 and 3. In general, the western leg is drier than the central and eastern leg during the IHOP field experiment. Also observed is the large variation in rainfall and evaporation at stations located at the same flight leg. Note that even though the soil was wet at three eastern stations, significant evaporation only occurred after late-May (for station 9) and mid-June (for stations 7 and 8). The dominant land-use type for eastern leg is grassland. This type of surface evaporation evolution may be largely due to the seasonal variation of vegetation characteristics. Showing on Fig. 4 is the weekly measurement of leaf area index (LAI) at a wheat site (station 5) and at a grass site (station 8). LAI was measured along a transect, which is typically 50 to 100 feet long at each station. The wheat was at its peak growing season at the beginning of the experiment, but the grass was dormant at the beginning but experienced a rapid greening process in late may. This explains the late surge of evaporation at station 8. However, it seems, from the preliminary results, that other processes, in addition to rainfall and vegetation greening, also influence the evolution of surface evaporation and plant transpiration.

In summary, this comprehensive and unique surface, soil, and vegetation data set will be useful to investigate temporal and spatial distribution of surface water vapor during vegetation growing season. Continuous measurements of soil moisture content, soil water tension (potential), and soil temperature profiles at six soil depths, together with weekly vegetation and stomatal canopy resistance will help improve soil hydraulic conductivity and vegetation parameterization schemes used in land surface models.

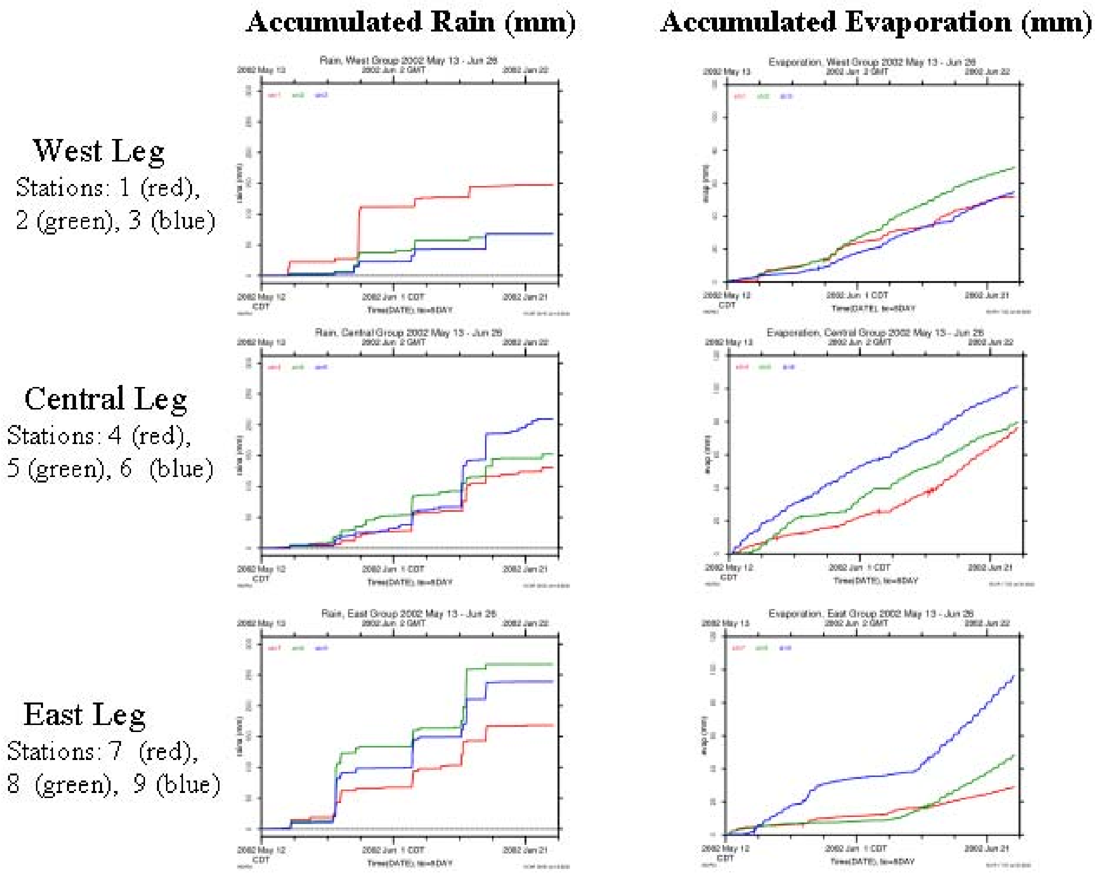

Fig. 3: Comparison of accumulated rain and surface evaporation measured at stations 1-9. Note that results shown here are based on raw data, which have not been quality controlled.

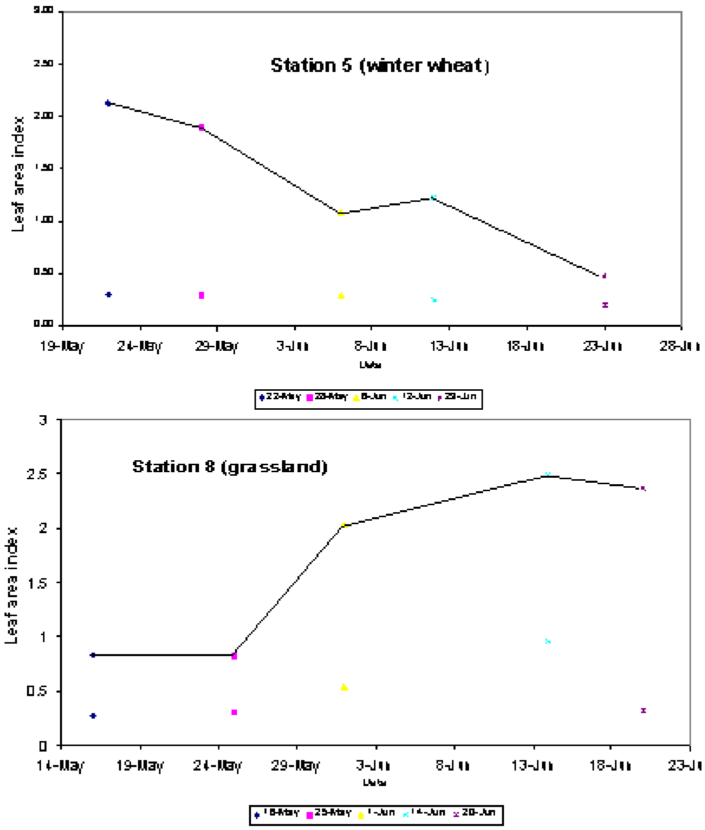

Fig. 4: Leaf area index (LAI) measured at stations 5 and 6. The line represents the averaged along a transect at the station, while the dots represent the standard deviation of these measurements along the transect for a given time.