EMPIRICAL RELATIONSHIPS AMONG ATMOSPHERIC VARIABLES FROM RAWINSONDE AND FIELD DATA AS SURROGATES FOR AVIRIS MEASUREMENTS: ESTIMATION OF REGIONAL LAND SURFACE EVAPOTRANSPIRATION

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Empirical relationships between variables are ways of securing estimates of quantities difficult to measure by remote sensing methods. We explore the use of empirical functions between: (1) atmospheric column moisture abundance W (gm H_2O/cm^2) and surface absolute water vapor density $\rho\bar{q}$ (gm H_2O/cm^3), with ρ density of moist air (gm/cm^3), $\bar{q}$ specific humidity (gm H_2O/gm moist air) and (2) column abundance and surface moisture flux E (gm $H_2O/(cm^2sec)$) to infer regional evapotranspiration from AVIRIS water vapor mapping data. AVIRIS provides, via analysis of atmospheric water absorption features, estimates of column moisture abundance at very high mapping rate ($\approx$ 100 km^2/40 sec) over large areas at 20 m ground resolution.

To generate surrogates in place of direct AVIRIS observations that represent climatological regimes more diverse than have been available with existing AVIRIS data sets, we examined large collections of rawinsonde soundings - nearly 8500 flights, 1985-1991 - from San Nicholas Island (marine), Pt. Mugu (marine/coastal) and Edwards Air Force Base (arid interior), California, and more than 400 radiosonde soundings taken as part of FIFE (Konza tall grass prairie) in eastern Kansas (Brutsaert and Sugita, 1990). From each of these data sets, empirical relationships were derived between total column water abundance and surface absolute humidity, with correlation coefficients between these variables of ~ 0.90 and standard errors of 20%. In addition, for the very important Kansas data sets, Brutsaert and Sugita (1990) and Sugita and Brutsaert (1990) assembled more than 120 observations of surface latent heat flux (moisture flux) derived from the FIFE network of eddy correlation and Bowen ratio measurement stations that are correlative in time with their radiosonde flights. We calculated the total column moisture from the FIFE radiosonde data and sought further empirical relationships between these column abundances and the observed latent heat (LE) and sensible (H) heat fluxes, as well as friction velocity u_*, and the Obukhov length L, both of which had been calculated from the corresponding radiosonde profiles and surface fluxes by Sugita and Brutsaert (1990) and Brutsaert and Sugita (1990). We expected a good correlation between what we term the net column abundance (difference between the column abundance derived from the surface specific humidity integrated over the column and the observed column abundance) and the surface flux, to emerge if net moisture in the column was derived from local fetchs. This view was reinforced by good to excellent correlations found by Brutsaert and Sugita (1990) and Sugita and Brutsaert (1990) between surface fluxes derived from individual profiles and the observed surface fluxes. In practice, we got poor correlations between W and LE suggesting that the bulk of atmospheric water present over Konza Prairie during these observations represented advected moisture, and was therefore not of "local" origin. The anticipated simple strategy of using column moisture abundances to estimate surface flux was not applicable to this data set.

Some approximate atmospheric diffusion calculations of column abundance vs fetch, based on atmospheric moisture distributions above surfaces with concentration and with flux boundary conditions and power law vertical dependences of horizontal wind speed and vertical eddy diffusivity, will also be illustrated.

References:

Brutsaert, W., and M. Sugita, 1990, The extent of the unstable Monin-Obukhov layer for temperature and humidity above complex hilly terrain, *Boundary-Layer Meteorology,* **51**, 383-400.

Sugita, M., and W. Brutsaert, 1990, Regional surface fluxes from remotely sensed skin temperature and lower boundary layer measurements, *Water Resour. Res.*, **26(12)**, 2937-2944.