Sonora 2008 Field Campaign
International Research Experience for Students (IRES)

Exercise 2: Spatial Variability in Soil Moisture and Soil Temperature around Tower Site

In general, the spatial variations of surface soil moisture and temperature around instrument locations or within remote sensing pixels are not well understood. We have developed an experiment in the Sonora IRES Field Campaigns to address this issue by sampling at 29 locations around the eddy covariance tower in Rayón within an area of approximately 250-m by 250-m, similar in size to a remotely-sensed MODIS pixel. Data sets are available on soil moisture and soil temperature for different periods in 2006 and 2007 and we are collecting a third set of data this summer in 2008.

In this exercise, we want to estimate the amount of spatial variation of soil moisture and soil temperature using the data sets collected in 2006 and 2007. To do this in a simple fashion, we will utilize the concept of the coefficient of variation (CV) of soil moisture as a function of the mean soil moisture content. We are interested in the coefficient of variation in space (CV_s) for all sites around the tower, defined as:

$$CV_s = \frac{\sigma_s}{\mu_s} \qquad (1)$$

where σ_s is the spatial standard deviation and μ_s is the spatial mean. These are calculated for each sampling date (N number of total sampling dates), so that there are N different values of CV_s for each summer (2006 and 2007).

The relation between CV_s and μ_s is a valuable diagnostic metric of the soil moisture and soil temperature variability in space. If CV_s increases with μ_s, this implies that the spatial variability is greater for wet or hot conditions. If CV_s decreases with μ_s, this implies that the spatial variability is greater for drier or cold conditions.

1. Utilize the datasets provided in the zip file (RayonTowerData.zip, see also the readme file README_RayonTower.doc) to calculate the relationship between CV_s and μ_s for each summer and for both soil moisture and soil temperature. Utilize all of the data provided in the calculations (e.g. all 5 daily samples in each plot). For the soil temperature, only carry out the analysis for the 1-cm depth.

2. Graph the study results and provide your individual interpretation. Then, discuss with your fellow students and arrive toward a consensus. Are the spatial fields of soil moisture around the tower more variable for wet or dry conditions? Are the spatial fields of surface soil temperature around the tower more variable for hot or cold conditions?

3. Discuss how your results affect estimating soil conditions around an eddy covariance tower and within remote sensing pixels.