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

Exercise 1: Precipitation Characteristics in the Rio Sonora Basin

Precipitation varies in space and time according to both the regional climate patterns and the local site conditions. Understanding the spatial and temporal distribution of precipitation is essential for water resources management, planning and design. The Mexican Federal government collects rainfall data at a daily time step (total rainfall in a day) for many locations in Sonora through the Comisión Nacional del Agua (CNA). Data sets extend back ~ 40 years, depending on the site of interest in the Rio Sonora basin.

In this exercise, we want to estimate the spatial and temporal distribution of precipitation in several locations within the Río Sonora. To do this in a simple fashion, we will calculate the mean annual precipitation (*MAP*) and the mean monthly precipitation (*MMP*), defined as:

$$MAP = \frac{1}{N}\sum_{j=1}^{N}\left(\sum_{i=1}^{J_i} P_i\right) \qquad (1)$$

$$MMP(i) = \frac{1}{N}\sum_{j=1}^{N}\left(\sum_{i=1}^{M_i} P_i\right) \qquad (2)$$

where N is the number of years in the record, J_i is the number of days in each year, M_i is the number of days in a particular month and P_i is the daily precipitation (mm/day). *MAP* is a single value computed over all years and *MMP*(i) consists of 12 monthly averages.

We want to inspect and interpret how *MAP* and *MMP*(i) vary across several sites over the years (2004 to 2006, $N = 3$). This is a short term average that is used to simplify the calculations. Additional years are required to fully understand the precipitation conditions at a particular site. We will carry this out using CNA data at Bacoachi, Banamichi, Cucurpe, El Cajon, El Oregano, Magdalena, Meresichi and Rayon.

1. Utilize the datasets provided in the zip file (CNAPrecipData.zip, see also the readme file README_CNA_Raingauges.doc) to calculate *MAP* and *MMP*(i) for the years 2004-2006 (complete records should be found in files, but no data is flagged as 9999.99).

2. Graph the study results and provide your individual interpretation of why precipitation varies among the sites. Using a map of the locations of the sites, try to explain the factors (elevation, latitude, longitude, etc) that affect precipitation patterns. Then, discuss with your fellow students and arrive toward a consensus. Which regions receive more or less precipitation and why? When does most of the rainfall arrive, why? What controls the amount and spatial distribution of precipitation?