Evaluation of Climate Monitoring Needs in Southwestern National Parks: The Saguaro National Park Pilot Study

M. Crimmins1, T. Mau-Crimmins2, J. A. Hubbard3
1) Department of Soil, Water, and Environmental Sciences, University of Arizona, Tucson, AZ 85721
2) Sonoran Desert Network Inventory and Monitoring Program, National Park Service, Tucson, AZ 85710

Importance of Climate Monitoring in National Parks
Climate variability is strongly linked to ecosystem function. Spatial and temporal patterns in precipitation can limit or promote the growth of different plant species while patterns in temperature can induce mortality in vegetation and wildlife during hard freezes. Current climate monitoring systems capture variability at scales too coarse to be utilized in park level natural resource and ecosystem management. Many different management activities would benefit greatly from climate information collected at much higher spatial and temporal resolutions within park management units. Such activities include:

- Wildlife studies: Predicting amphibian movement patterns based on high-resolution precipitation data.
- Hydrological monitoring: Addressing water rights issues and maintaining baseflows in critical riparian habitats.
- Wildfire Management: Monitoring spatially explicit fuel moisture conditions and predicting fine fuel accumulations.
- Invasive Species Management: Establishing links between climatically induced disturbances and invasions of non-native species.
- Air Quality Management: Monitoring airflow patterns from urban airsheds carrying harmful pollutants; understanding smoke dispersion during prescribed burns for fuel management.
- Education: Providing the opportunity for park visitors to learn about the importance of climatic variability on different ecosystem processes and about coupled ecosystem-climate monitoring.

Preliminary Data
Preliminary data for the Saguaro National Park Climate Monitoring Pilot Study at Station #1 indicates the following:

- Wind Regime at Station #1
  - Day: Light winds from the north, reaching speeds up to 5 m/s.
  - Night: Calm conditions.

- Soil Moisture and Precipitation at Station #1
  - Soil Moisture: 0.1 m³/m³.
  - Precipitation: 10 mm.

Sonoran Desert Network & M
The Sonoran Desert Network covers a geologically and biologically diverse region. The basin and range topography is characterized by lower desert and grasslands and "sky islands", isolated mountain ranges.

Skylines are composed of many biological communities organized along an elevation gradient. Increasing in elevation is biologically similar to increasing in latitude; conifer forests found on mountain tops in the southwest are similar to those occurring in the northwest and Canada.

The great diversity in habitats results in remarkable biological diversity. This region contains:
- at least 60 species of mammals
- more than 350 bird species
- 20 amphibians
- over 100 reptiles
- about 30 species of native fish
- more than 2,000 species of plants

Monitoring Sites
Monitoring sites were chosen to satisfy several different research and resource management needs. Stations 1 through 5 represent a transition through the dominant ecological communities found in the park. They are also in an important watershed that supplies water to Rincon Creek and recharges local groundwater sources used by communities adjacent to the park.

Saguaro National Park Climate Monitoring Pilot Study
The east park unit of Saguaro National Park encompasses one of the unique "sky islands" that characterize the landscape of southern Arizona. The Rincon Mountains make up most of the 27,000 ha east unit with elevations ranging from 600 to over 2,700 meters. This range in elevation produces a steep gradient of climatic conditions and ecological community types. The broad floral and faunal diversity in the park poses unique natural resource management challenges that are strongly tied to climatic variability. Activities from prescribed burning to wildlife tracking depend on the local scale variability in climatic conditions in a specific ecological community type. Climate monitoring is fundamentally important to resource management at Saguaro National Park, making this an ideal setting to introduce and evaluate new and higher resolution monitoring techniques.