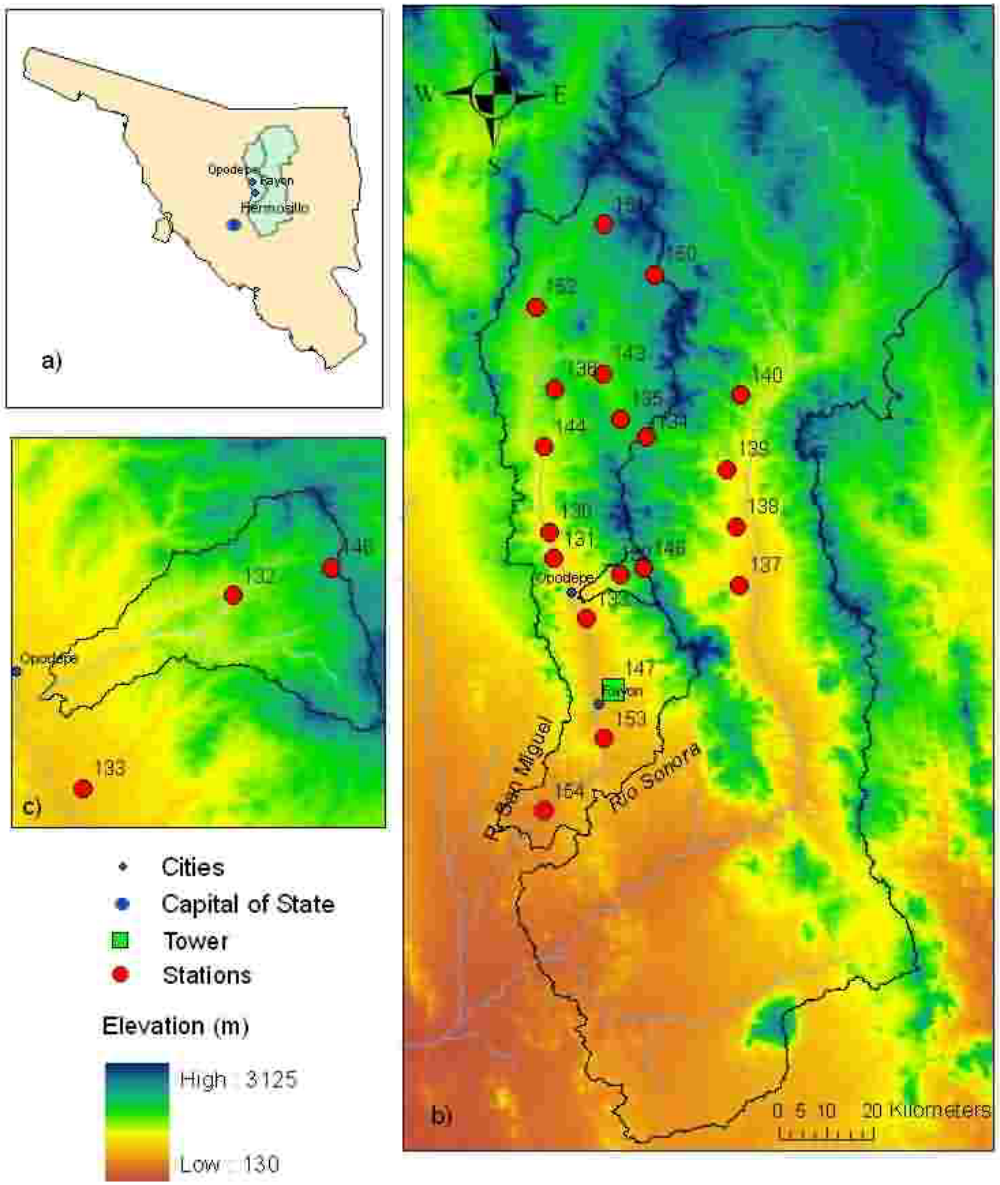
Summer Campaign 2007
San Miguel Basin, Sonora

Luis Mendez-Barroso
Soni Yatheendradas
Whitney Lauren DeFoor
Alexis Martinez

1. STUDY SITE

a) Location of San Miguel and Sonora basins
b) Regional stations
c) Sierra de los Locos Basin



Activities and experiments during Summer campaign 2007

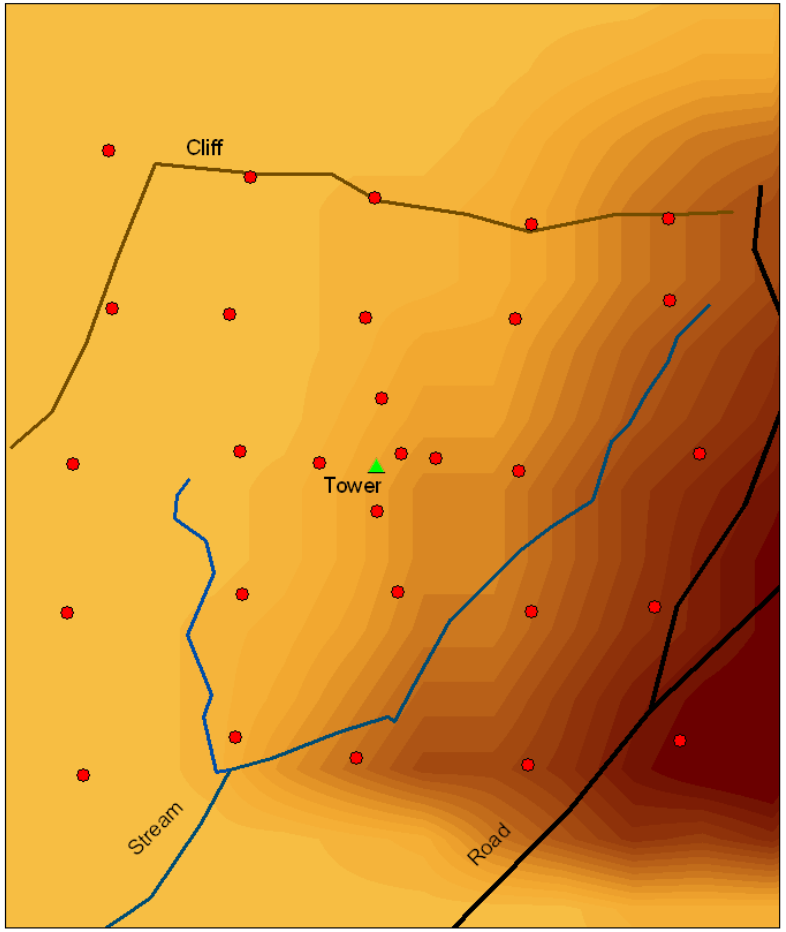
- Soil moisture and temperature measurements around tower
  - Daily
  - Continuous
- Rain gauges:
  - Installation of 20 rain gauges in Sierra "Los Locos"
  - Deployment of 5 new continuous stations in San Miguel basin
  - Calibration of rain gauges
- Soil pits and surface soil samples in Sierra "Los Locos"
- Evapotranspiration partitioning
- Leaf Area Index and reflectance readings

Soil moisture measurements around the tower

Goal: To understand the variability of soil moisture/temperature in an area equivalent to one MODIS pixel around a fluxes tower

<u>Daily soil moisture measurements</u>

- 29 plots around the flux tower
- Plot dimension 1x1 m
- 5 sampling sites per plot



Soil moisture measurements around the tower

Equipment used for this experiment:

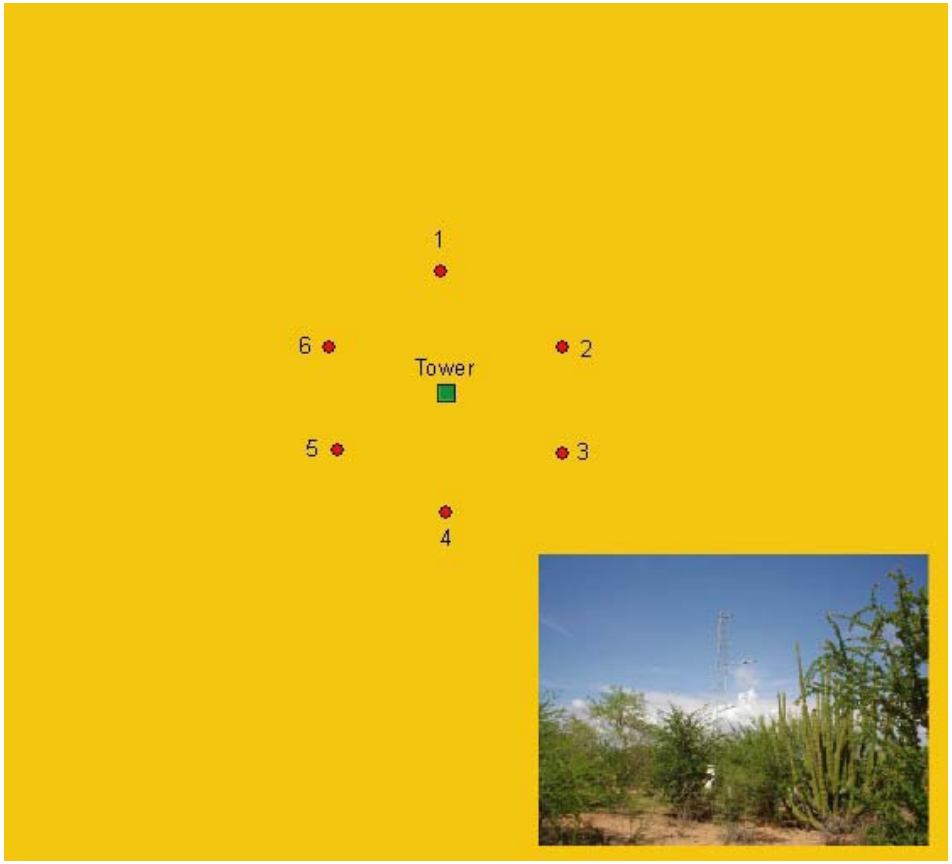
1. Thermometer
2. Theta probe
3. Infrared thermometer
4. Portable Weather station
5. GPS

Soil moisture measurements around the tower

- one soil moisture measurements in 5 different sampling sites inside the plot
- Three different soil temperature readings (1, 5, 10 cm depth) in every sampling sites
- One surface temperature measurement by sampling site

Soil moisture measurements around the tower

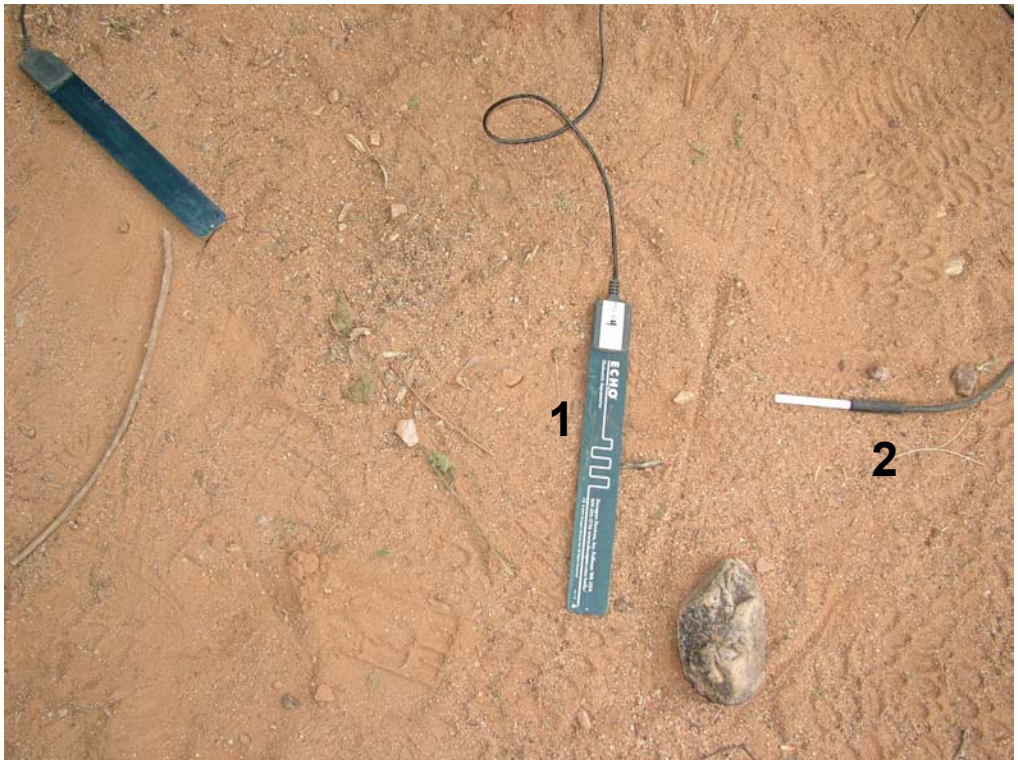
Continuous soil moisture measurements



- 6 soil moisture probes located at 5 cm depth and 6 at 10 cm depth
- 6 soil temperature sensors located at the same depths
- Sensor are connected are connected to a CR10 datalogger

Soil moisture measurements around the tower

Equipment installed:



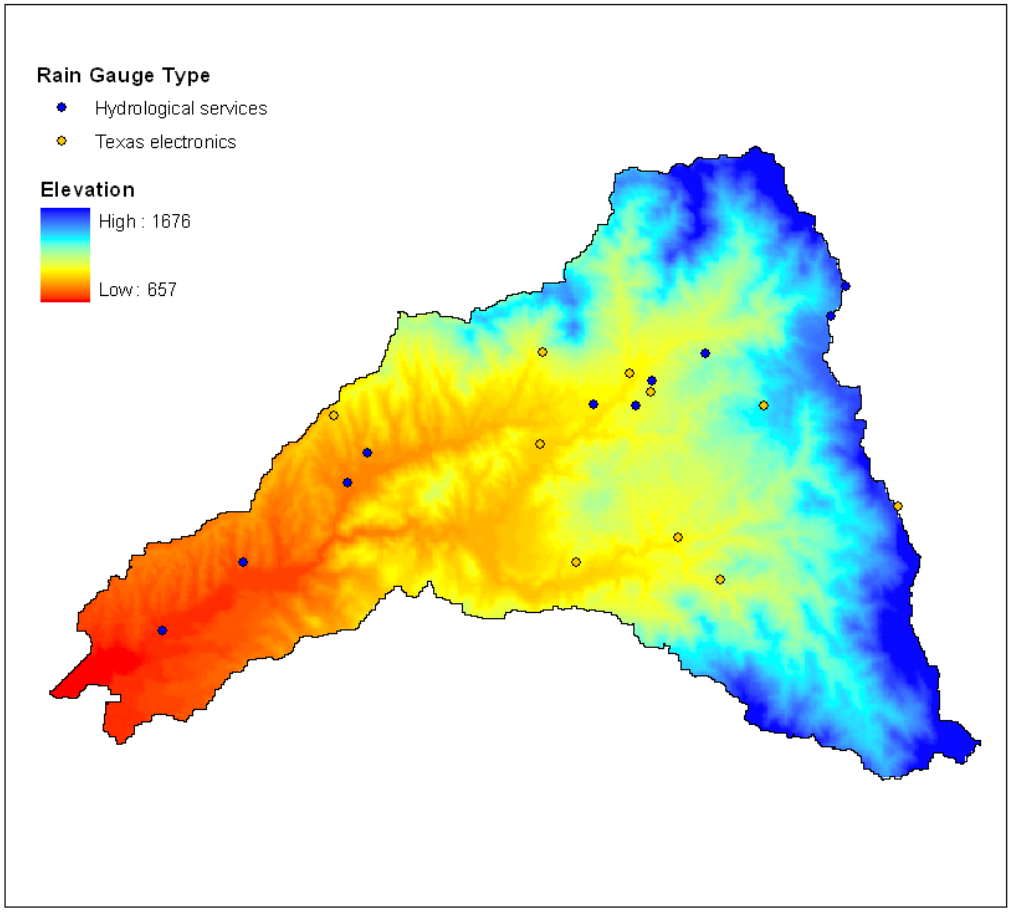
1. Decagon Echo probe (20 cm long)

2. Soil temperature sensor Campbell Model 107

Soil moisture measurements around the tower

Installation of 20 rain gauges in Sierra "Los Locos"

Goal: Spatial distribution of rain in a complex terrain basin.



- Elevation goes from 657 to 1670 m above sea level inside a transect of 19 km.
- It contains different ecosystems: Subtropical scrubland, riparian (mesquite) and oak forest.
- Complex topography.

Rain gage types, funnel diameters & tipping bucket depths

Texas Electronics, Inc.

- HOBO compact datalogger
- Funnel diameters: 6", 8", 9.66"
- Bucket tip depths: 0.01 ", 0.1 mm

Hydrological Services TB01 (NCAR)

- Deployment following a elevation gradient
- Contains a temperature and RH sensor
- Funnel diameter: 8"
- Bucket tip depth: 0.01 "

Sources of rain measurement error & correction

- Leaves, dust, etc. that obstruct the funnel (& bucket tip): cleaning

- Destabilization of gage: checking with spirit level
- Incorrect volume for every bucket tip: static calibration
- water that falls during the tip
- water that stays on the balance

} Dynamic calibration

Different funnel diameters

Static calibration

Shielding from rain during calibration

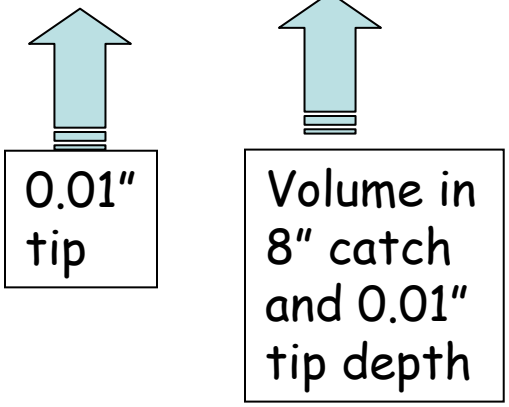
Checking tip volume in both buckets of rain gage & adjusting bucket tip volume with a wrench

Dynamic calibration consideration: different funnel rain catch diameters

- Example intensity calculation for 500 mm/hr nozzle flow on 8" gage:

Actual rain intensity is:

$$P = (200\,ml / 51\,\text{sec}) * (3600\,\text{sec/hr}) * (0.254\,\text{mm}/8.24\,\text{ml}) = 429.6\,\text{mm/hr}$$



Rain gage diameter, depth configurations

Interesting!

What!!

Manufacturer	Rain catch diameter	Tipping depth
TE	6"	0.01"
TE	8"	0.01"
TE	9.66"	0.01"
TE	9.66"	0.1 mm
HS	8"	0.01"

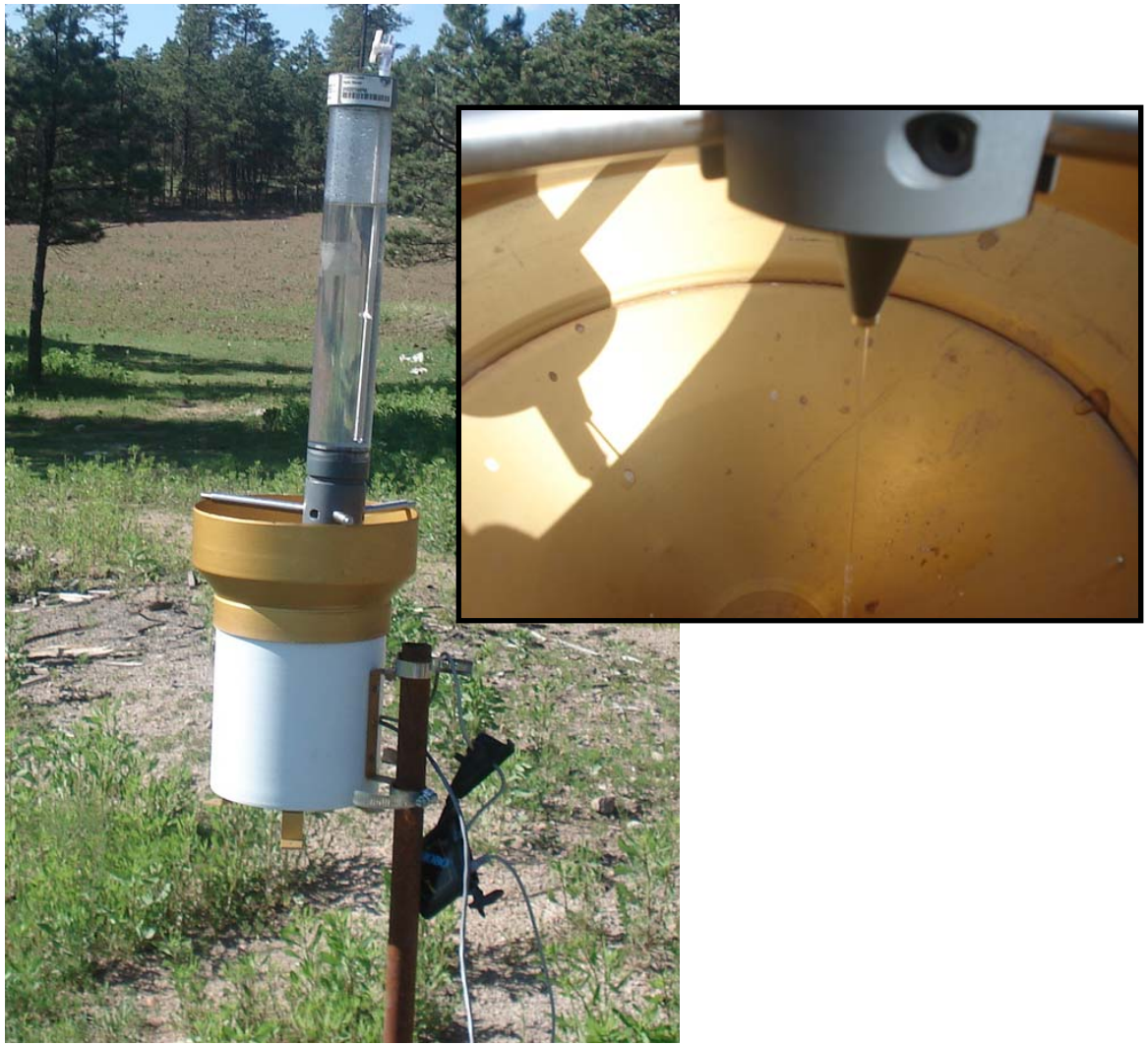
Really?!

MODELING PROCESS INPUT ADJUSTMENT

OH NOOOoo..

Dynamic calibration

Done over a wide range of intensities: 50 – 500 mm/hr



Terminology & regression equation used

Definitions

- P mm h^{-1} Actual Precipitation
- P_m mm h^{-1} Measured Precipitation
- N h^{-1} Number of tips per hour
- T h Time for each tip
- L_0 mm Manufacturer-specified tip volume depth over funnel area
- L mm Actual tip volume depth over funnel area

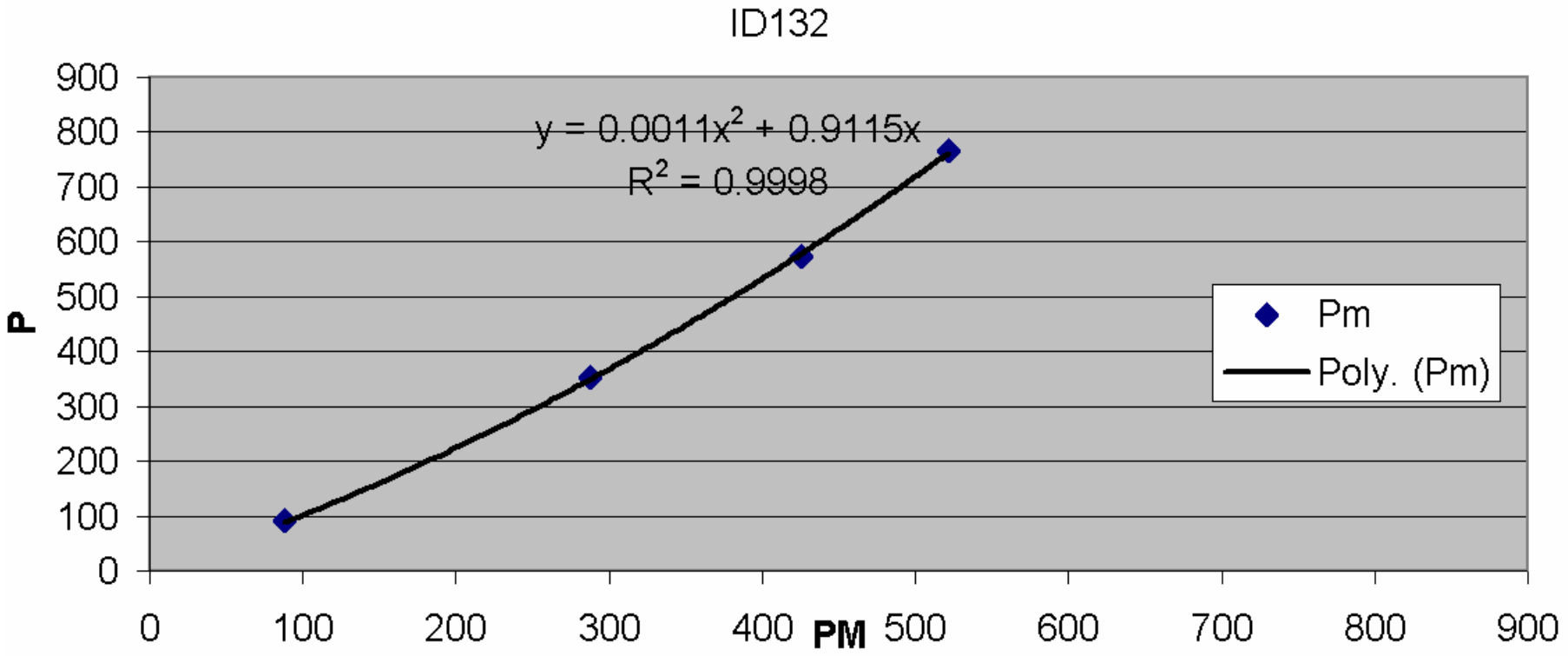
$$P_m = L_0 N$$

$$\boxed{P = aP_m + bPP_m}$$

$$a = L/L_0 \qquad b = T/L_0 \; s\,mm^{-1}$$

$$\boxed{P = \frac{aP_m}{1 - bP_m} \approx aP_m\left(1 + bP_m\right)}$$

Example calibration figure for ID 132



Soil Pits and surface samples in Sierra " Los Locos"

Soil pits

- Soil information will be used for basin modeling
- Site selection based on different land cover, elevation and aspect

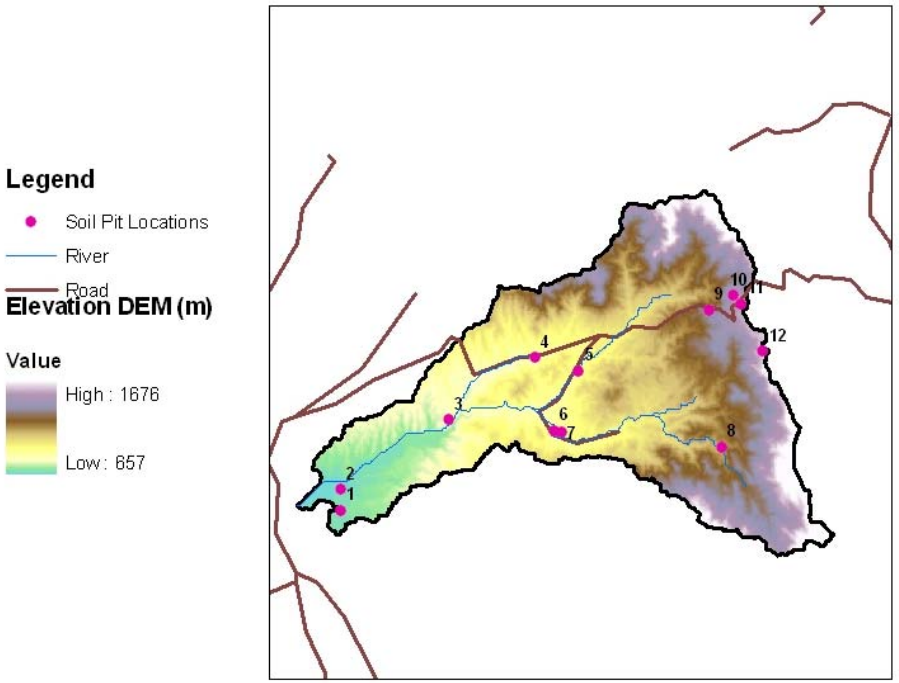


Figure 1

Site #	UTM Coordinates Northing	Easting	Description	Elevation (m)
1	3309276	538412	Flat, desert	680
2	3309944	538404	Flat, riparian	657
3	3312188	541886	South facing, slope between 20 and 30, subtropical	784
4	3314176	544640	Flat, riparian	835
5	3313763	546048	Flat, subtropical	877
6	3311837	545257	South facing, slope between 20 and 30, subtropical	840
7	3311795	545506	North facing, slope between 20 and 30, subtropical	878
8	3311313	550640	South facing, slope between 20 and 30, subtropical	1062
9	3315717	550226	North facing, slope between 20 and 30, subtropical	1189
10	3316189	551028	North facing, slope between 20 and 30, oak	1359
11	3315920	551271	Flat, oak	1380
12	3314398	551959	Flat, oak	1460

Soil Pits and surface samples in Sierra “ Los Locos”

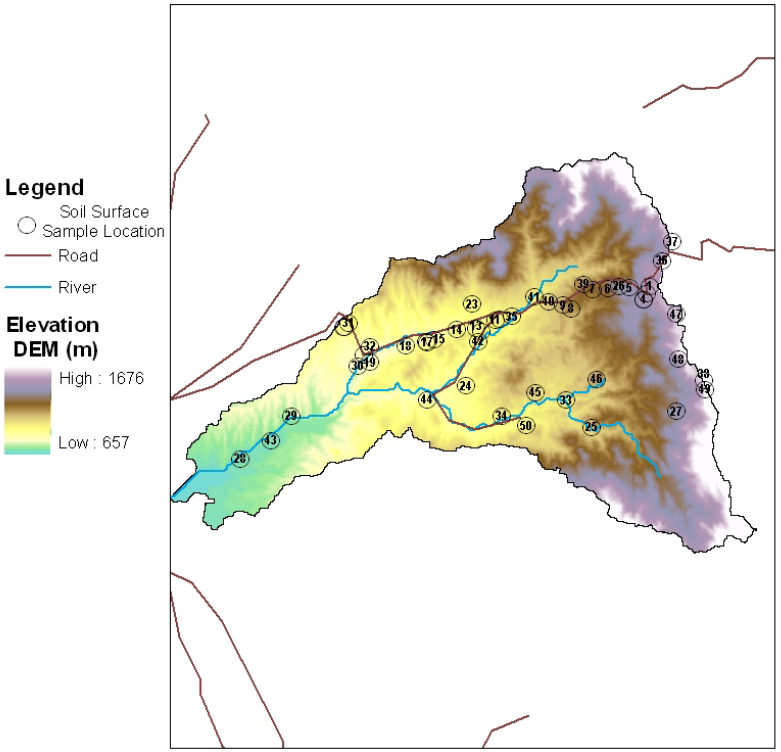
- Soil pits were dug until 1.20 m or when bedrock was reached

Soil Pits and surface samples in Sierra “ Los Locos”

- Soil horizons were identified.
- Soil color, structure, consistence, plasticity, boundary topography and texture.
- Soil samples were taken every 10 cm. After 40 cm depth soil samples were taken every 20 cm.

Soil Pits and surface samples in Sierra " Los Locos"

Surface samples



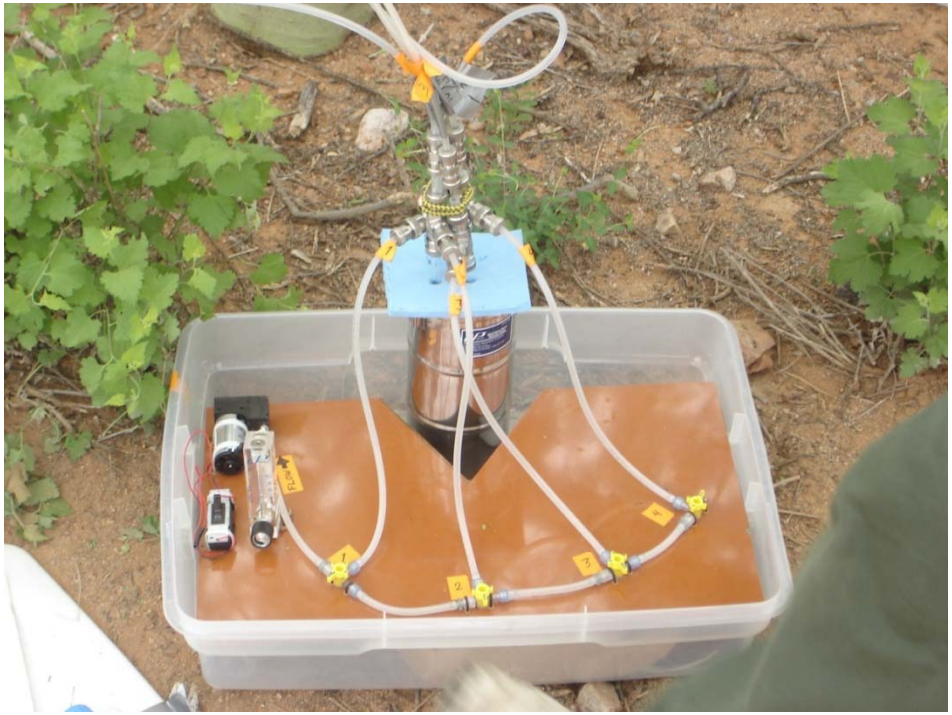
- 43 surface soil samples (10 cm depth) were taken in several locations
- Soil texture and another soil properties will be determined

Goal of evapotranspiration flux partitioning using isotopes

- Collect samples of vapor, soils, and transpiring vegetation
- to determine the relative proportion of evaporation and transpiration in the total evapotranspiration flux measured by eddy covariance in dry shrublands (based on their unique isotopic signatures).

Equipment

- Markers, vials, field notebook, scissors, aluminium foil, parafilm, watch, soil auger, ziploc, GPS, Metal file, portable weather station, Vapor Trapping System(Glass tubes, Ethanol, Liquid Nitrogen, Dewar Flask, Thermometer, Valves, Tubing, Pump) CHAIRS, WATER AND A LOT OF PATIENCE!!!!!



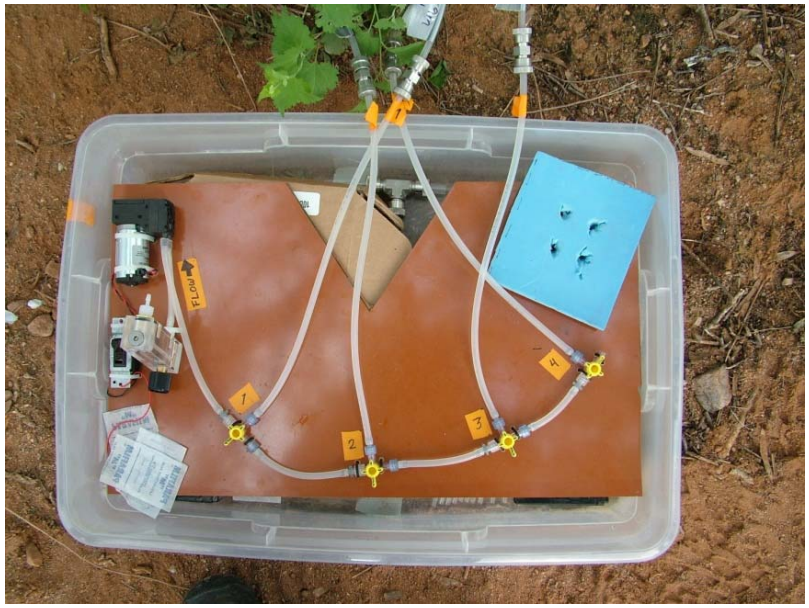
Partitioning equation used

$$T / ET = \frac{\delta_{ET} - \delta_E}{\delta_T - \delta_E}$$

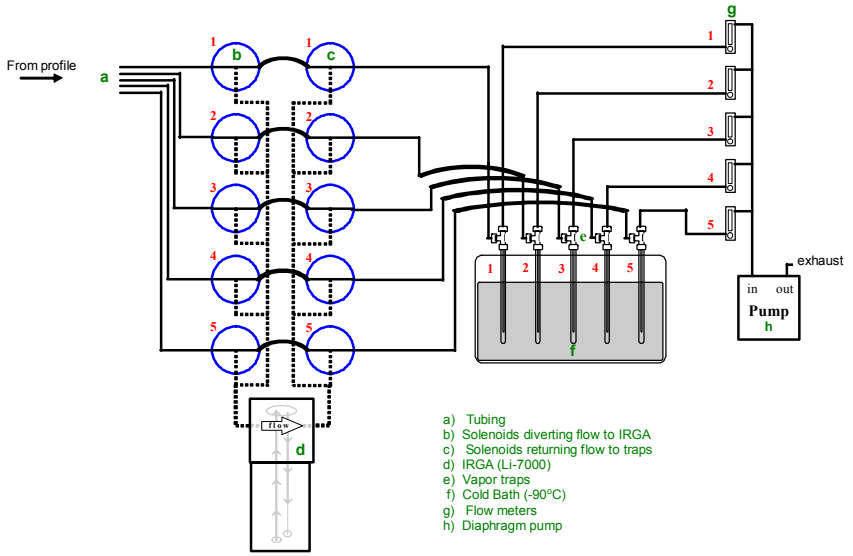
Where:
T is the transpiration flux,
ET is the evapotranspiration flux,
δ_{ET} is the isotopic composition of Evapotranspiration
δ_E is the isotopic composition of soil evaporation, and
δ_T is the isotopic composition of transpiration

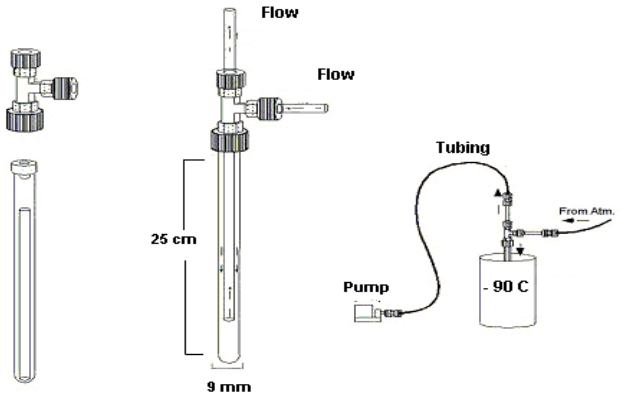
Initial setup

- A miniature diaphragm pump pulls air (at 0.5 L min^{-1} flux using a flow meter) from 4 heights on the Eddy Covariance Tower
- This air passes through a cryogenic vapor trap (resting in a cold bath at -80°C) to condense out the water vapor for sampling.



System for Capturing Vapor





Yepez et al., 2003 ag & for. met.

Vapor samples collection

- Time of vapor collection: 6 periods, of 30-min duration every 2 hours, for representing the diurnal cycle.

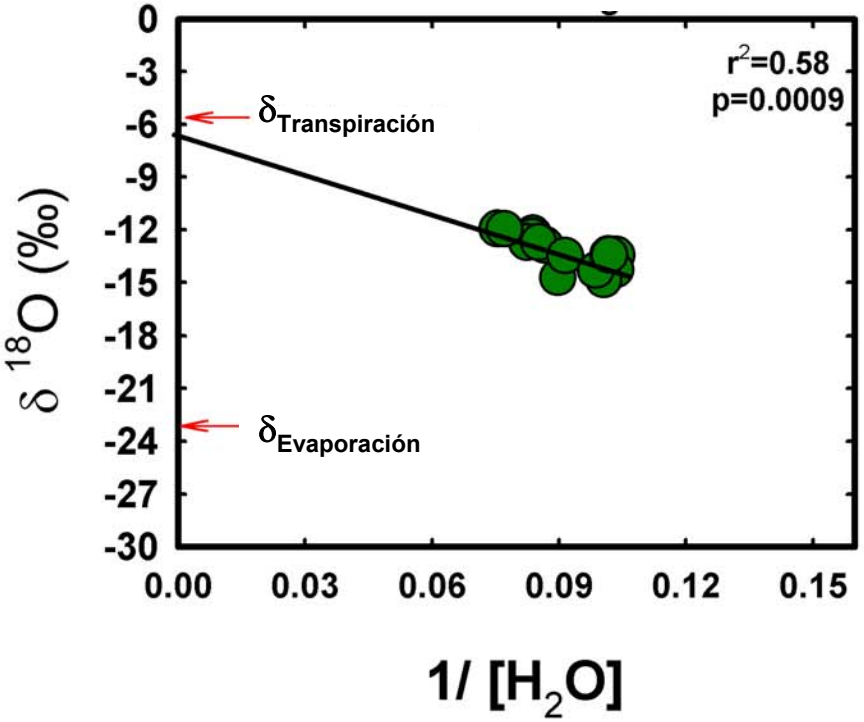
Soil Water Samples Collection

- Once daily
- Hand soil auger used to collect samples at 5 cm increments
- Measurements of soil temperature and air relative humidity every sampling period

Stem and leaves samples collection

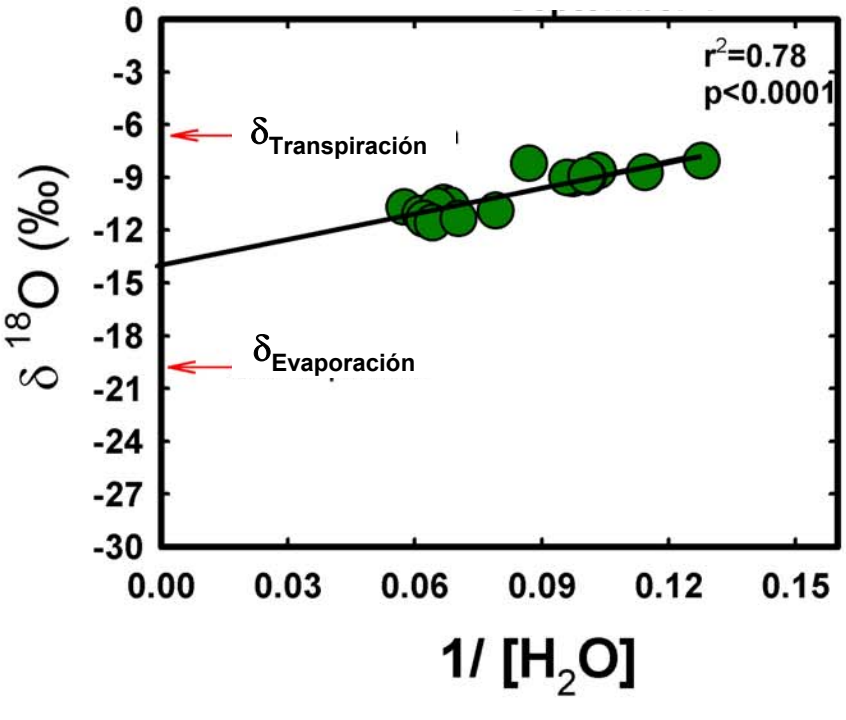
- Trees samples collected from:
  - 9 plants, 3 acaccia, 3 ocotillo, and 3 paloverde
- Stems were collected once a day and usually from all trees
- Leaves were collected every sampling period and usually from only 2 plants of each species.
- 2 vials for each plant (A & B)

Future analysis: Example Keeling plots of isotopic mix of water vapor



Dry period

T/ET = 0.95



Humid period

T/ET = 0.65

LAI and Spectroradiometer

Future work

- Quality control of all data
- Soil pits field quality control
- Pre-processing and analysis of soil samples
- Analysis of all data

Thank you