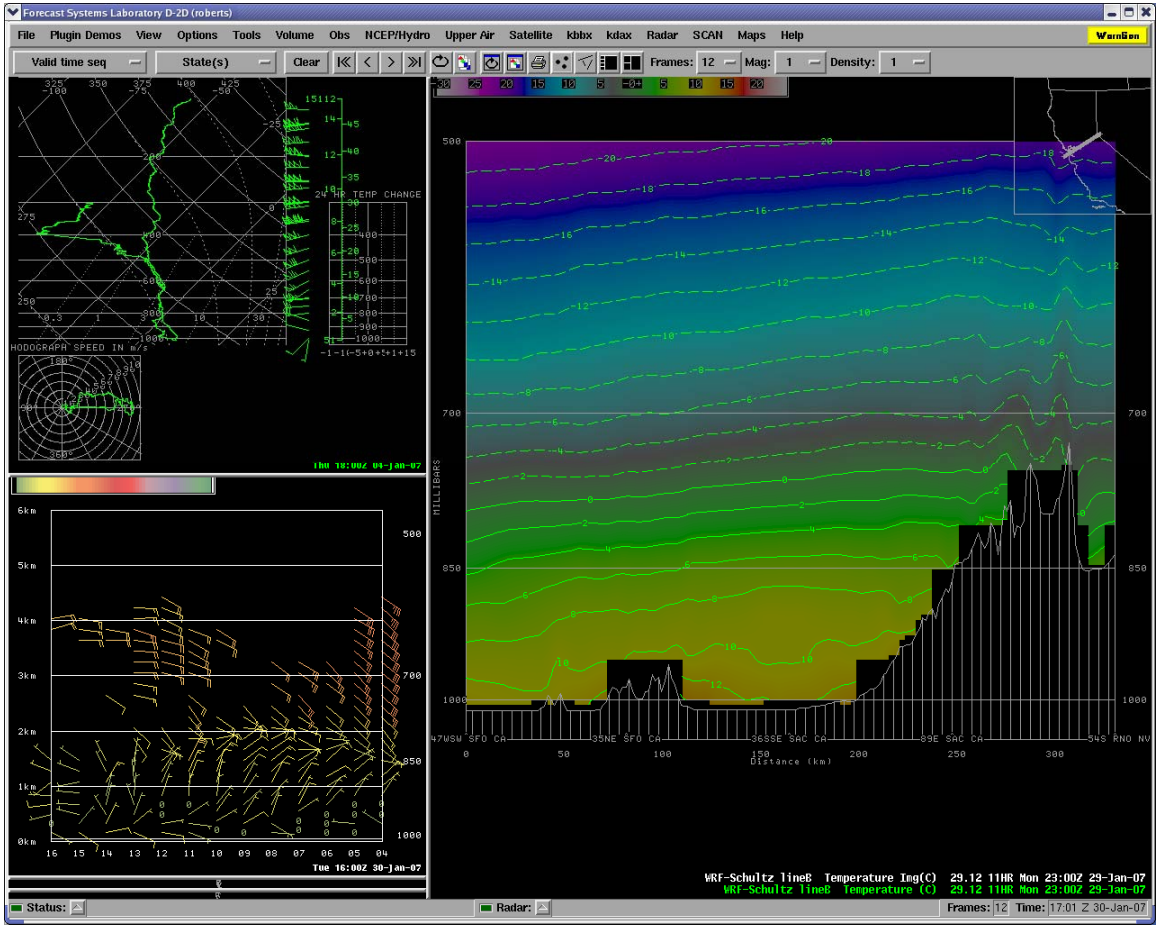
ALPS - Advanced LINUX Workstations



- **Remote access to special HMT datasets in field offices along with regular product streams**
  - **Local ensemble**
  - **MADIS: surface data, profilers, special RAOBs**

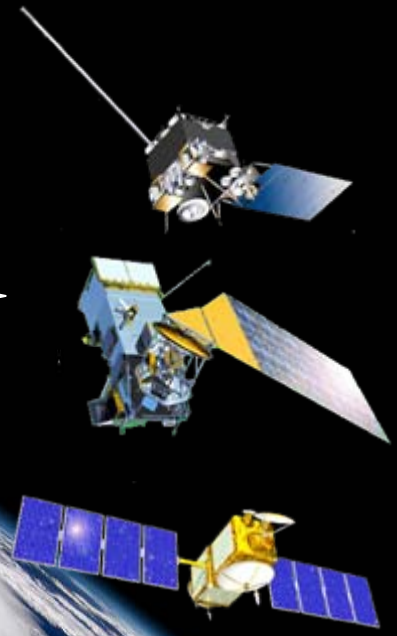
- **Workstations successfully deployed at four offices (Sacramento WFO and RFC, Monterey WFO and Reno WFO) during the last two field seasons.**

Atmospheric Moisture

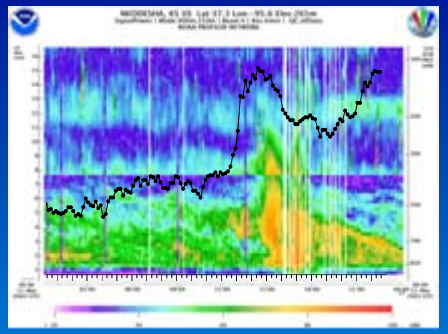
GPS IPW

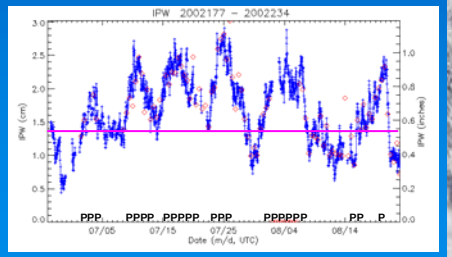
ZTD ➤ IPW
Accurate
Reliable
All weather
Inexpensive

Satellite Cal/Val

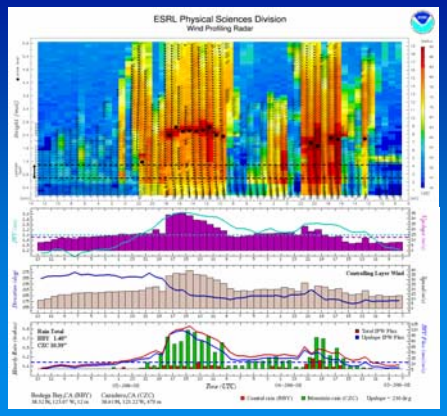


Regional Fcsting

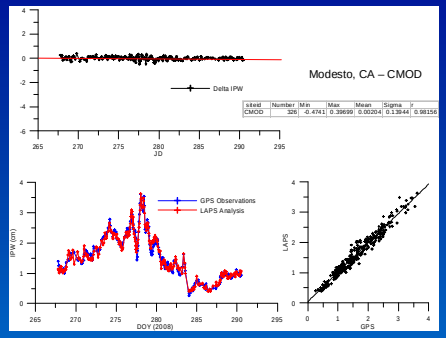


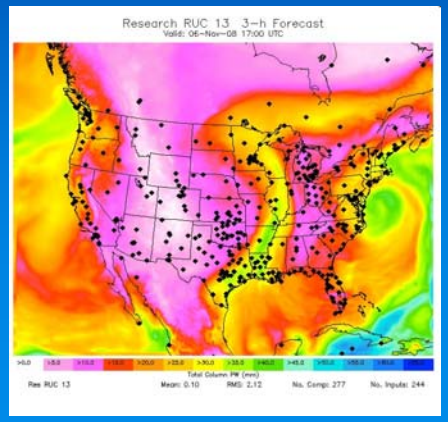


WV Flux Tool

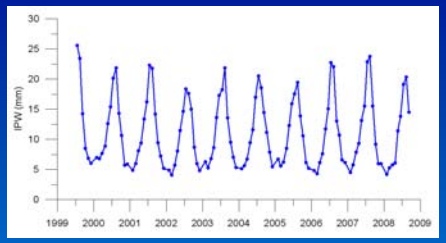


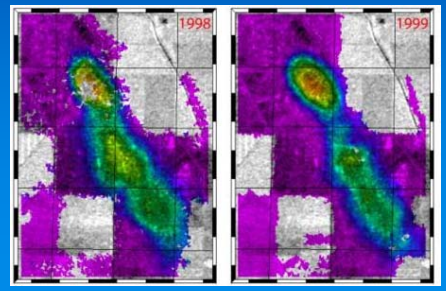
DA / NWP





Other Applications



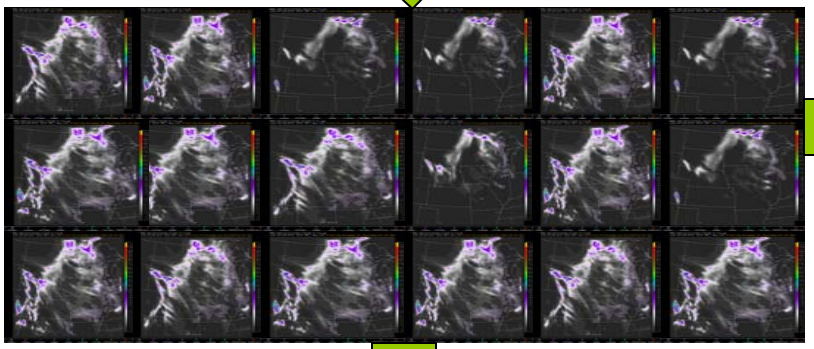


How an Ensemble-Based System Works

Observations

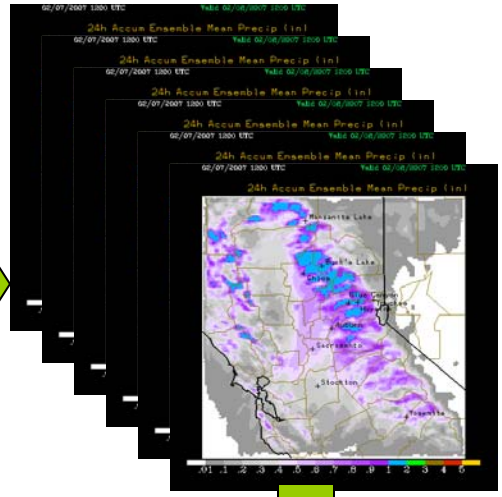
18-Model Ensemble

18 weather opinions



AHPS

18 Basin Rainfall Forecasts

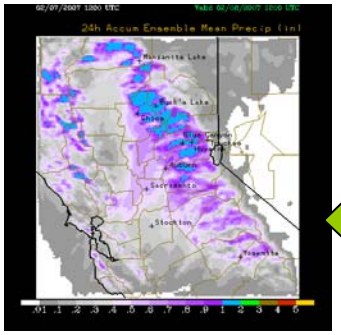


54 Stream/River Flow Scenarios

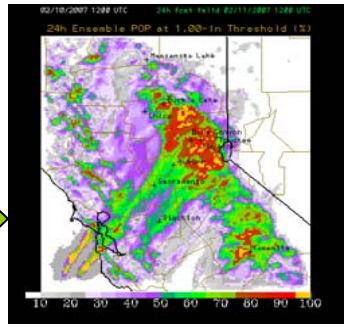
3 Hydro Runoff Models

Flow rate Probability

Ensemble Mean



Threshold Probabilities

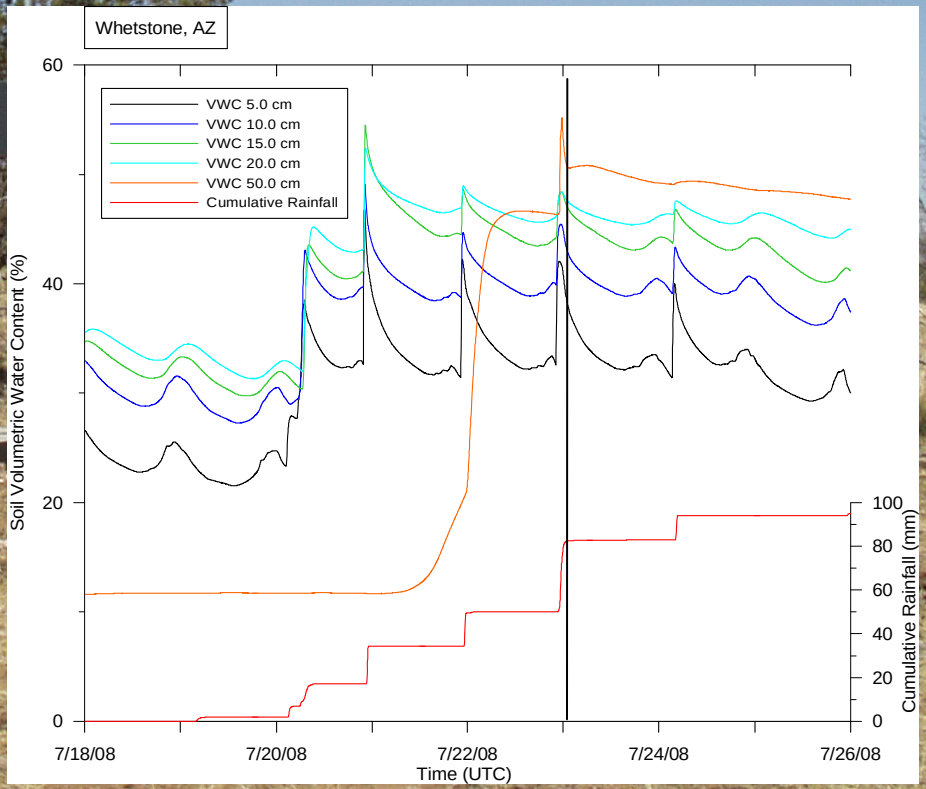


Post processing

HMT Soil Moisture Observations

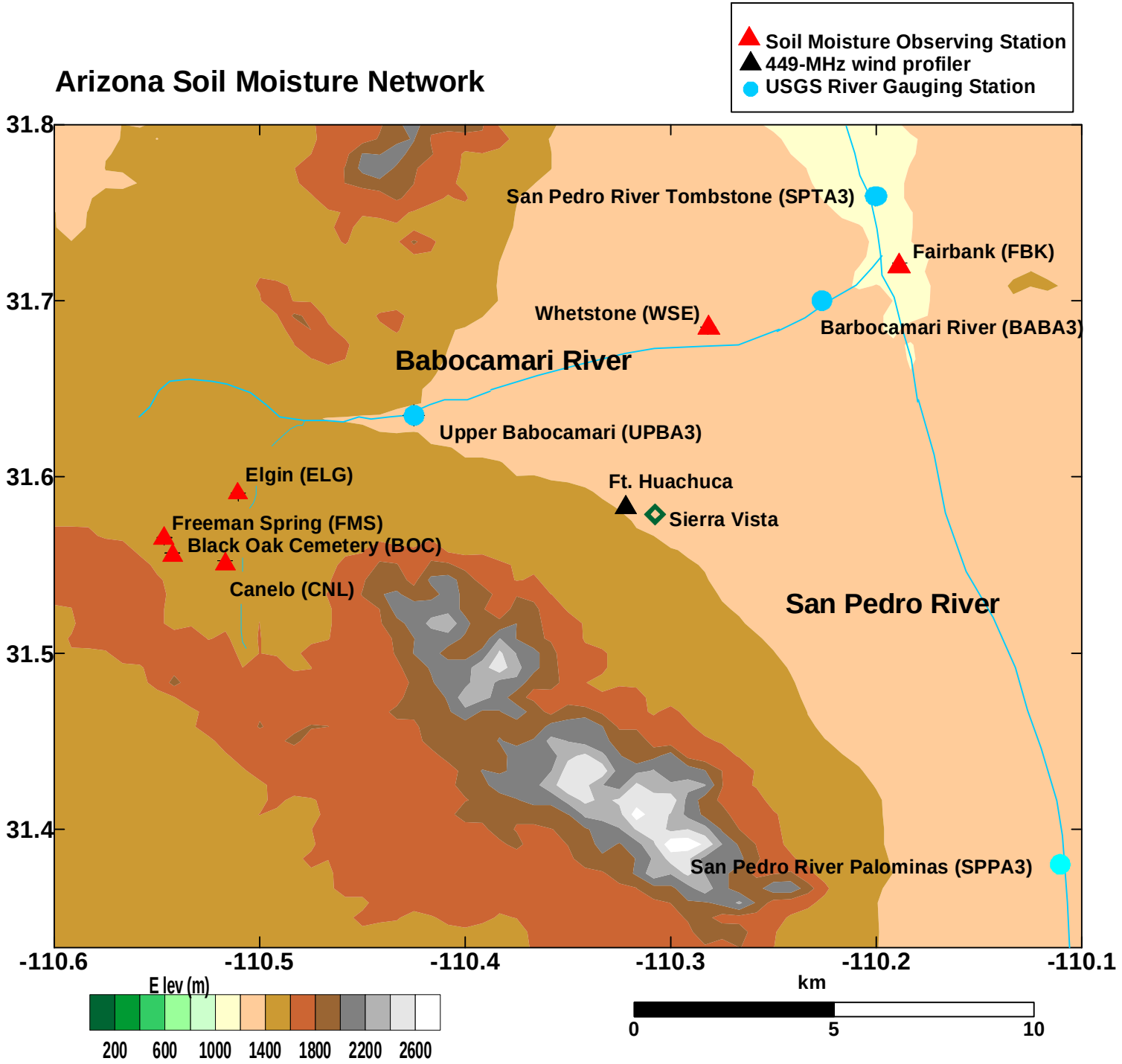
Accomplishments and Plans for the future.

- Instrumentation of the Russian (3), American (11) and San Pedro River Basins (6)
- Developed Calibration and QC Algorithms for the Time Domain Reflectometer data
- Arizona Network soil data being ingested in real-time by the CBRFC
- Preliminary Evaluation of the SAC-HT Distributed Hydrological Model in the Babocamari River
- Continue the evaluation of the SAC-HT with CBRFC on both Basin and HRAP scales
- Work with OHD to develop a system for assimilation soil moisture observations into SAC-HT
- Instrumentation of the Upper Colorado River Basin. FY-09
- Begin comparing soil moisture forecasts made using NMM and the Noah LSM with PSD soil moisture observations.



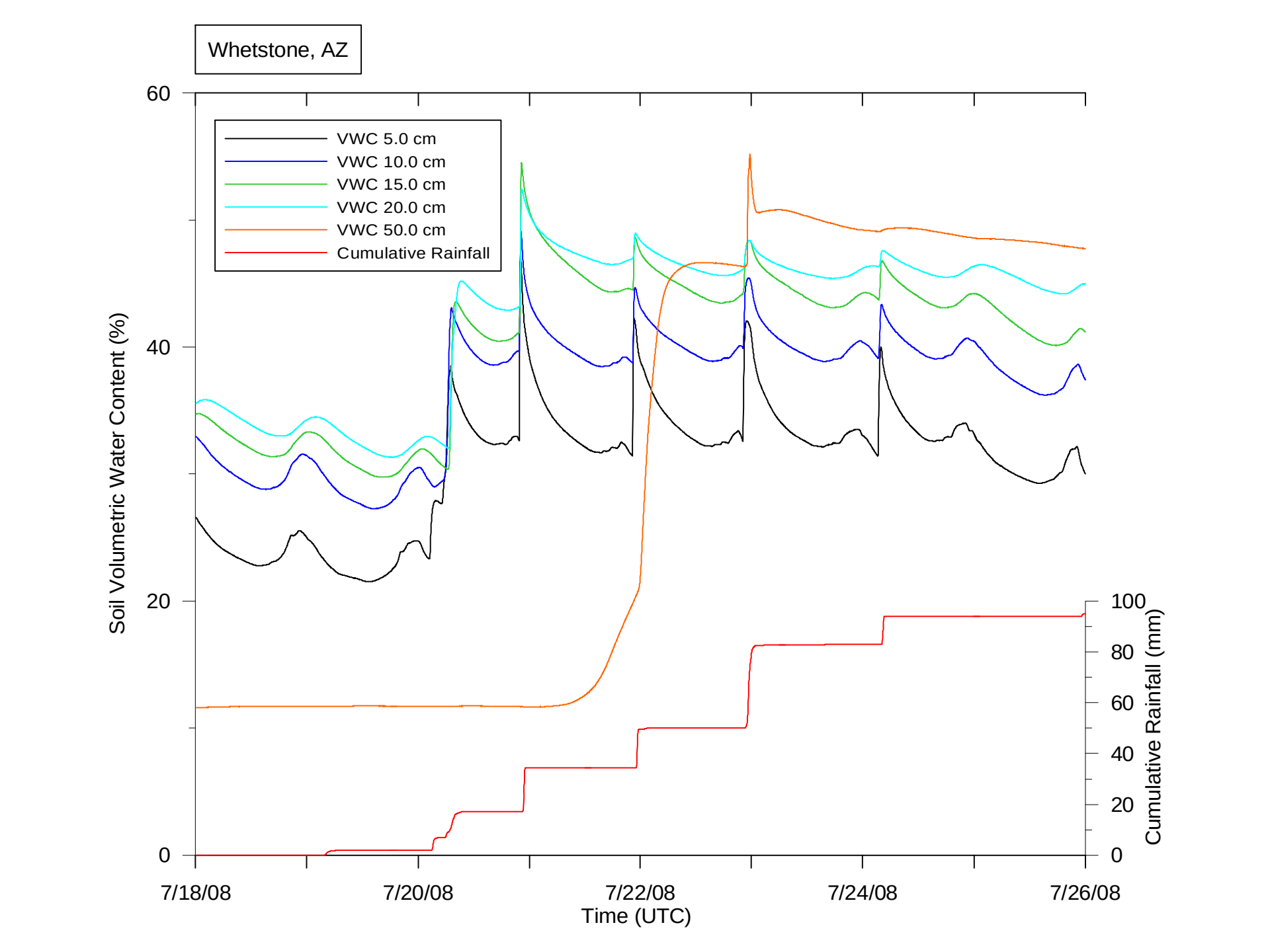
Installed and Operational

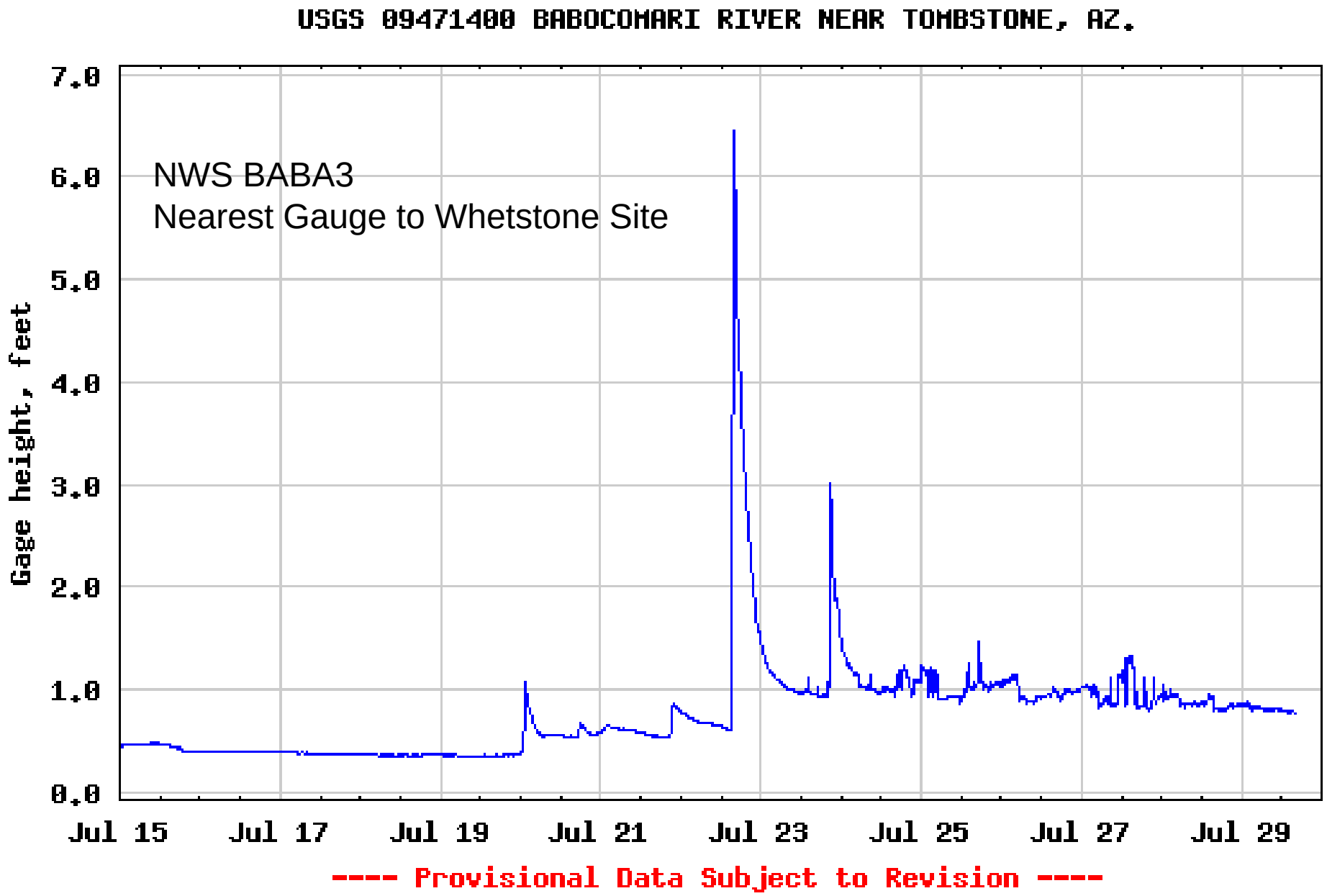
- Freeman Spring (FMS) 5/18/08
- Canelo Fire Station (CNL) 5/19/08
- Elgin (ELG) 5/20/08
- Black Oak Cemetery (BOC) 5/21/08
- Whetstone (WST) 5/22/08

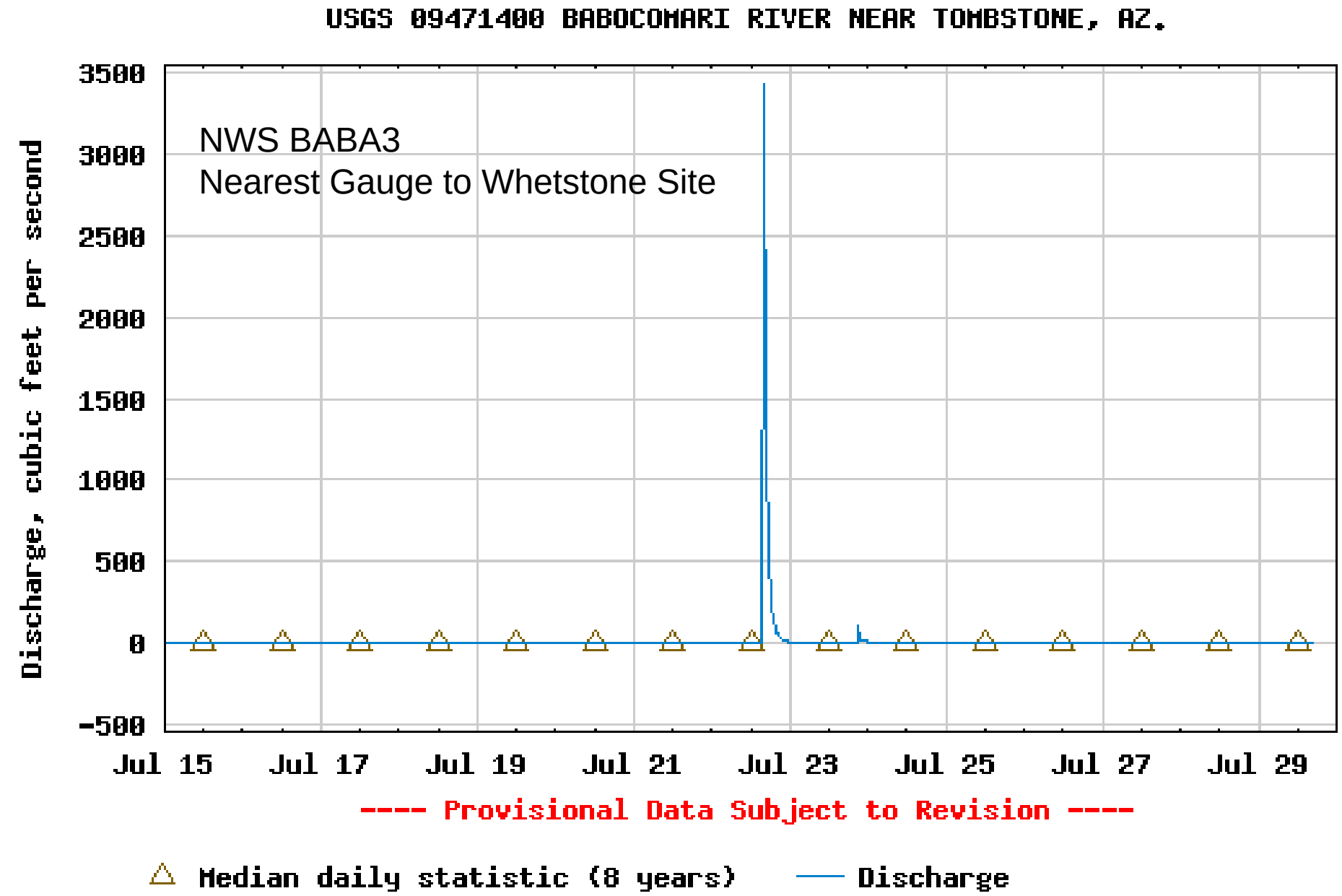

Arizona Soil Moisture Network
Soil Moisture Observing Station
449-MHz wind profiler
USGS River Gauging Station
San Pedro River Tombstone (SPTA3)
Fairbank (FBK)
Whetstone (WSE)
Barbocamari River (BABA3)
Babocamari River
Upper Babocamari (UPBA3)
Elgin (ELG)
Ft. Huachuca
Sierra Vista
Freeman Spring (FMS)
Black Oak Cemetery (BOC)
Canelo (CNL)
San Pedro River
San Pedro River Palominas (SPPA3)
31.8
31.7
31.6
31.5
31.4
-110.6
-110.5
-110.4
-110.3
-110.2
-110.1
Elev (m)
200
600
1000
1400
1800
2200
2600
km
0
5
10

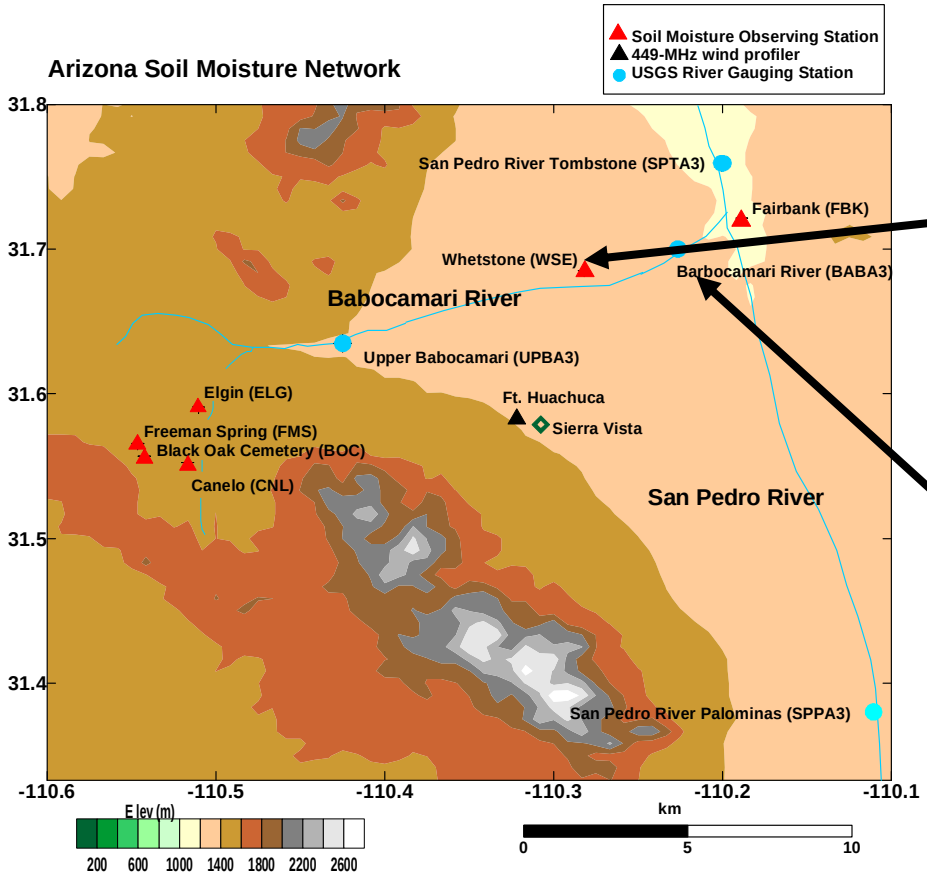
Preliminary data from 1st Event

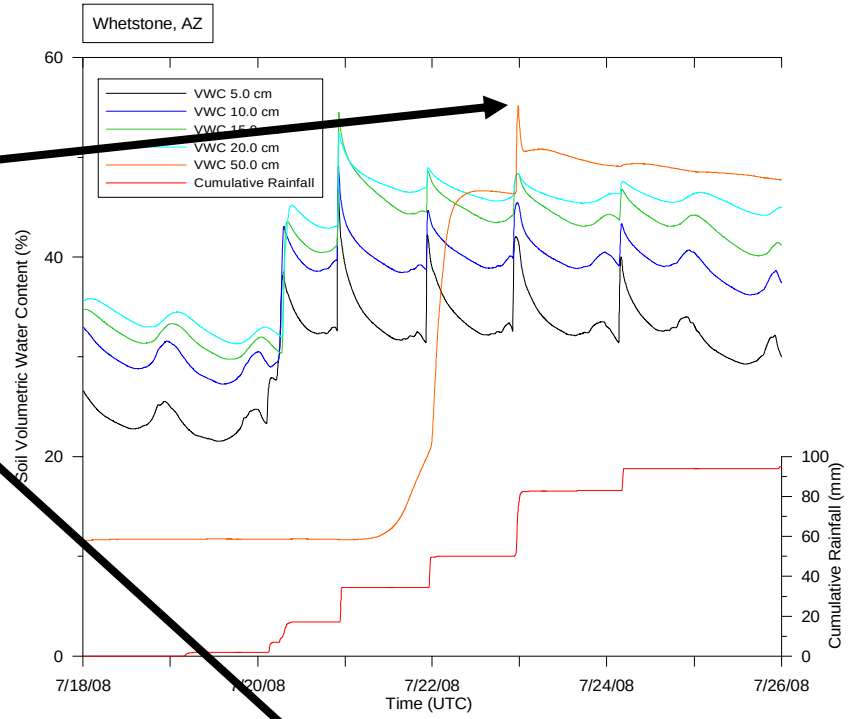
- Active monsoon period over 4 days (19-24 Jul 2008)
- Whetstone site used to highlight the event
- ~100 mm (4 inches) of rain fell in 4 storms over the 4 days
- Evidence of gradual moistening to greater depths over time
- After a 2-day delay for the rain from the first storm to reach 50 cm, the response to the next storm occurred within 1 h.
- A significant runoff event was associated with this storm; streamflow went from near zero to 3500 cfs, and flow exceeded 5 feet in depth, i.e., a flash flood occurred

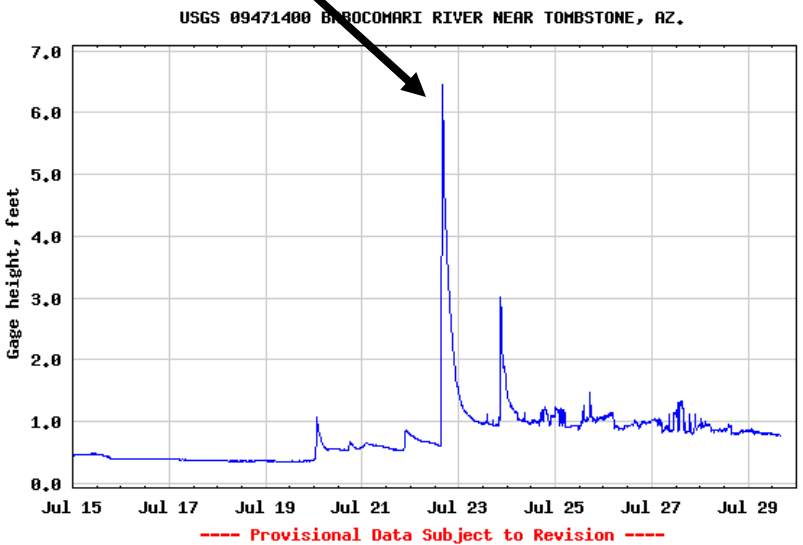

Whetstone, AZ
VWC 5.0 cm
VWC 10.0 cm
VWC 15.0 cm
VWC 20.0 cm
VWC 50.0 cm
Cumulative Rainfall
Soil Volumetric Water Content (%)
60
40
20
0
Cumulative Rainfall (mm)
100
80
60
40
20
0
7/18/08
7/20/08
7/22/08
7/24/08
7/26/08
Time (UTC)


USGS 09471400 BABOCOMARI RIVER NEAR TOMBSTONE, AZ.
NWS BABA3
Nearest Gauge to Whetstone Site
Gage height, feet
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jul 15
Jul 17
Jul 19
Jul 21
Jul 23
Jul 25
Jul 27
Jul 29
---- Provisional Data Subject to Revision ----


USGS 09471400 BABOCOMARI RIVER NEAR TOMBSTONE, AZ.
NWS BABA3
Nearest Gauge to Whetstone Site
Discharge, cubic feet per second
3500
3000
2500
2000
1500
1000
500
0
-500
Jul 15
Jul 17
Jul 19
Jul 21
Jul 23
Jul 25
Jul 27
Jul 29
---- Provisional Data Subject to Revision ----
Median daily statistic (8 years)
Discharge





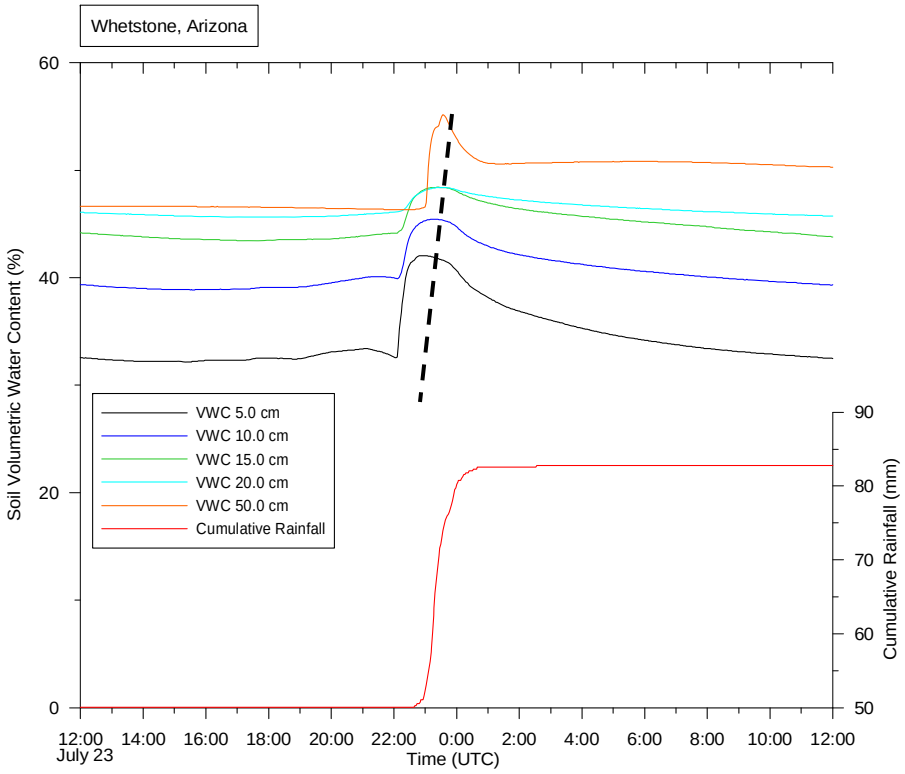


Three precipitation events brought the soil at Whetstone to saturation from 5.0 cm to 50 cm.

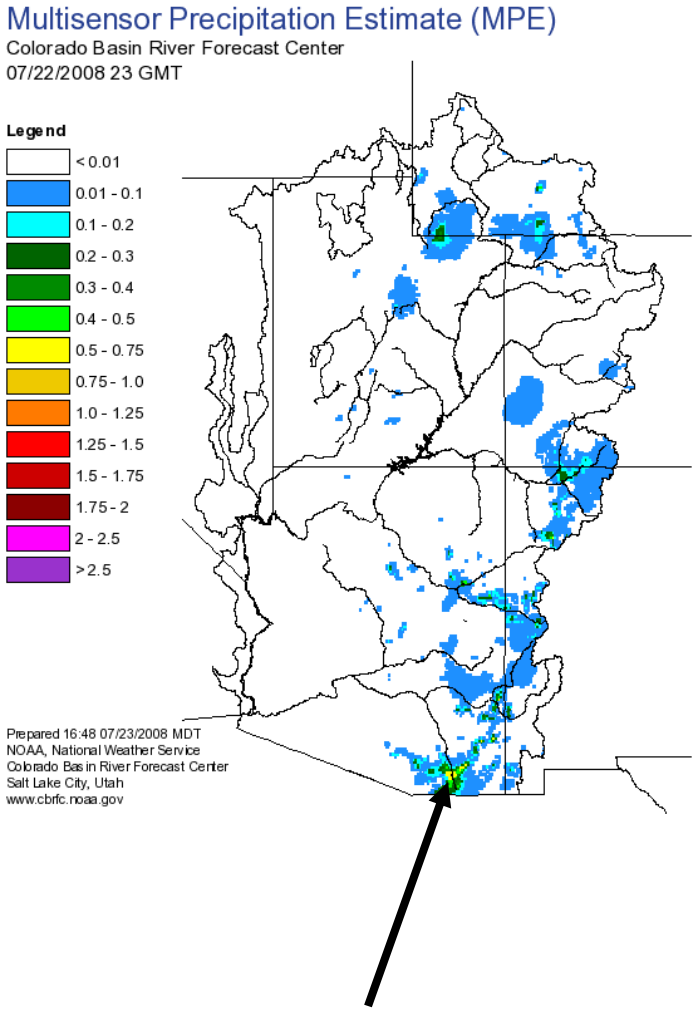
The 33 mm rainfall event on July 23-24 was felt through the depth of the soil layer and caused an immediate response in the Babocamari River flow measured at the BABA3 river gauge.

A closer look at the infiltration

- The soil moisture observations captured the movement of rainfall is it penetrated deeper into the soil.
- The water takes ~ 20 minutes to move from the surface to 50 cm depth in the nearly saturated layer.



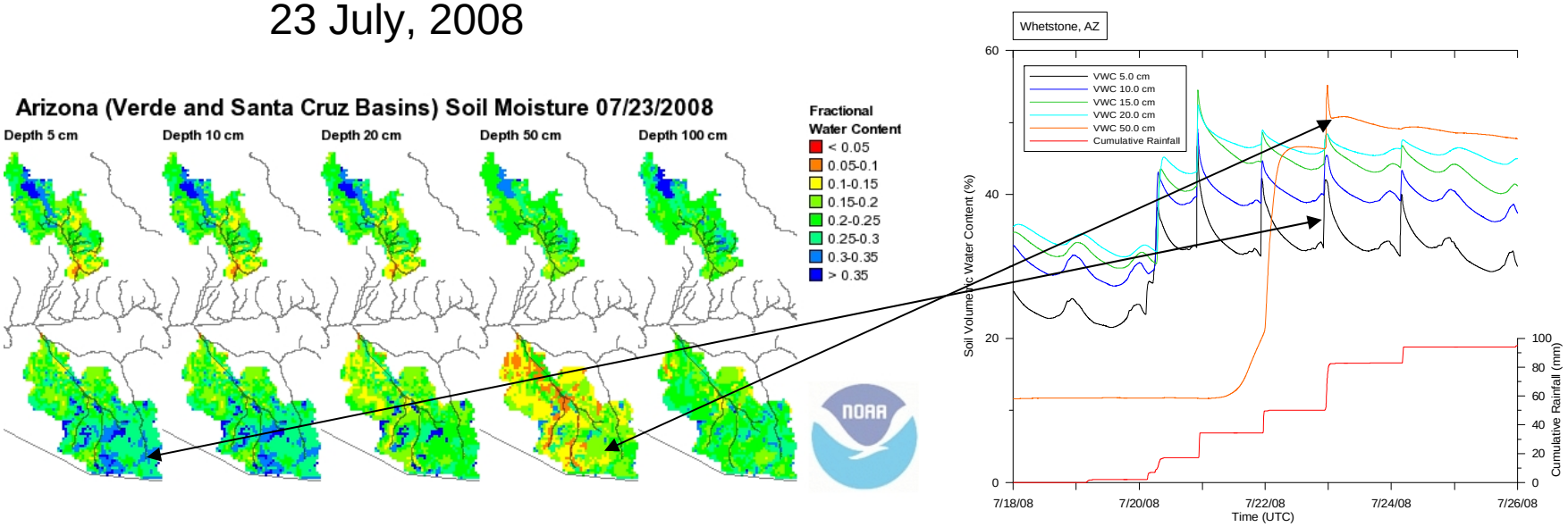
- Without radar bias corrections the MPE significantly underestimated the amount of precipitation input to the SAC-SMA-HT.



Max MPE Over Whetstone ~ 0.75”

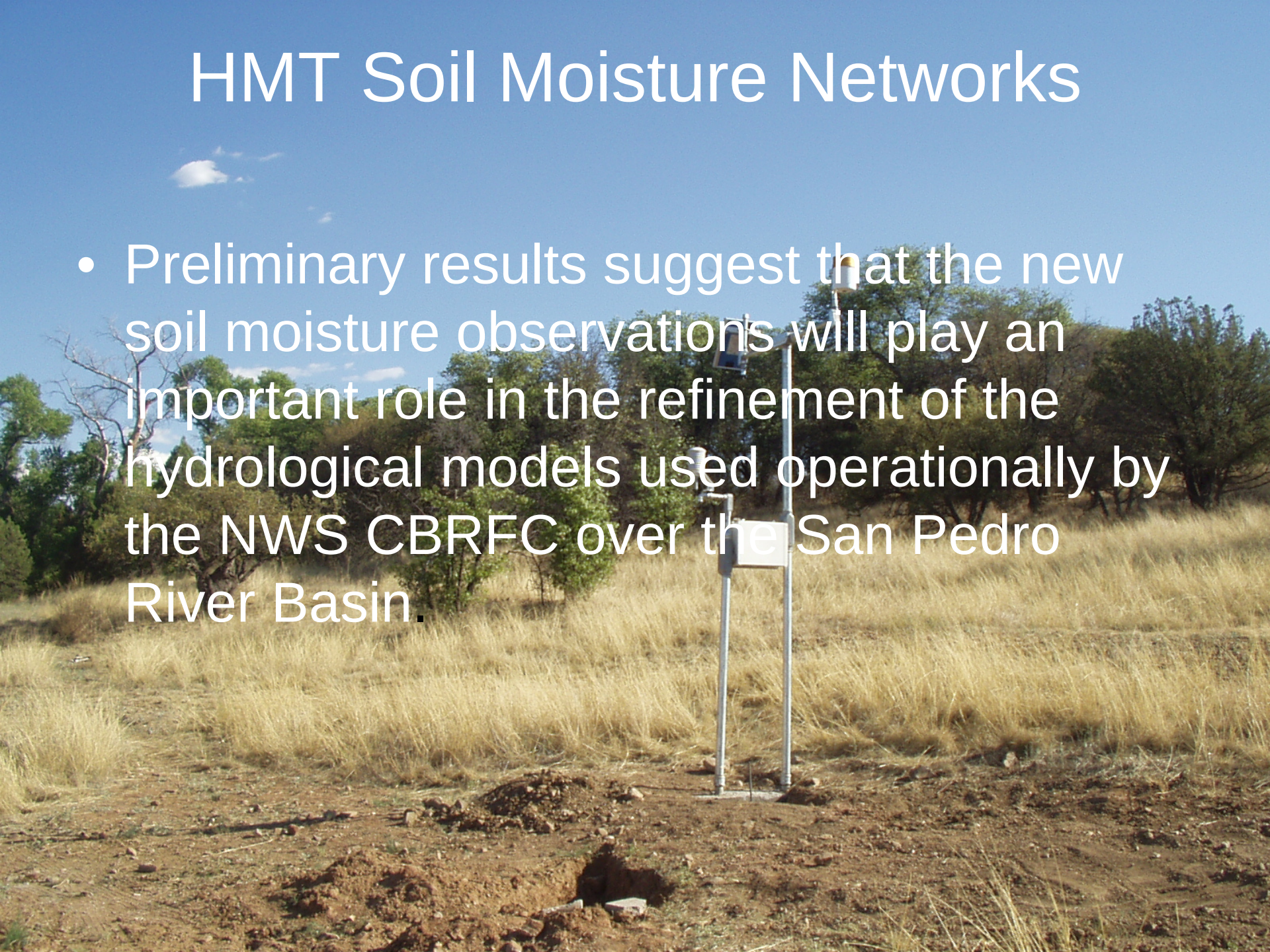
Observed at Whetstone ~ 1.29”

CBRFC Simulated Soil Moisture for
23 July, 2008



- Simulated soil moisture values have a dry bias.
- Observed values appear to have a wet bias based on USGS field capacity estimates in the San Pedro River Basin.

HMT Soil Moisture Networks



- Preliminary results suggest that the new soil moisture observations will play an important role in the refinement of the hydrological models used operationally by the NWS CBRFC over the San Pedro River Basin.

Recent Accomplishments

- Dan Gottas PSD has completed ingesting and archiving the Arizona Soil Moisture Network observations in Boulder and making them available to the NWS by FTP.
- Ed Clark CBRFC has calibrated the San Pedro River Basin and begun bringing the PSD precipitation, soil temperature and soil moisture data into the River Forecast Center.
- Bob Zamora and Ed Clark have made the initial comparisons between the CBRFC soil moisture and precipitation estimates and the PSD observations.
- Pedro Restrepo (OHD) has obtained the July 18-25, 2008 data set from Whetstone and with Bob Zamora is evaluating the infiltration rates for the event.

Future Plans

- Complete the installation of the Fairbank, AZ site.
- Ed Clark plans on ingesting the PSD precipitation data into the Distributed Hydrological Models at CBRFC.
- Ed Clark will begin updating the CBRFC models with USGS soil texture data.
- Bob Zamora will obtain in-situ dry and weight soil samples at the end of the monsoon season and update the calibration for each Arizona site.
- Ed Clark and Bob Zamora will begin detailed evaluations of the CBRFC simulated soil moisture products with the PSD observations.
- Ed Clark and Bob Zamora will start evaluating the heterogeneity of precipitation and soil moisture in the Upper Babacomari using the three HRAP scale stations: Black Oak Cemetery, Canelo and Freeman Spring.

Partners

- Ed Clark and Dave Brandon NWS/CBRFC
- Pedro Restrepo and Victor Koren NWS/OHD
- Ken Mitchell and Michael Ek NWS/NCEP/EMC
- Tilden Meyer OAR/ARL

The Bigger Picture

- The collaboration between CBRFC and PSD can be used as an example of how NOAA operations and NOAA research can partner to refine and improve services that are crucial to NOAA's mission.

The Future

- Improvements in QPF cannot be accomplished without a better understanding of how hydrological processes impact the evolution of the atmospheric boundary layer. In turn we cannot expect improvement in hydrological forecasts without better QPF.

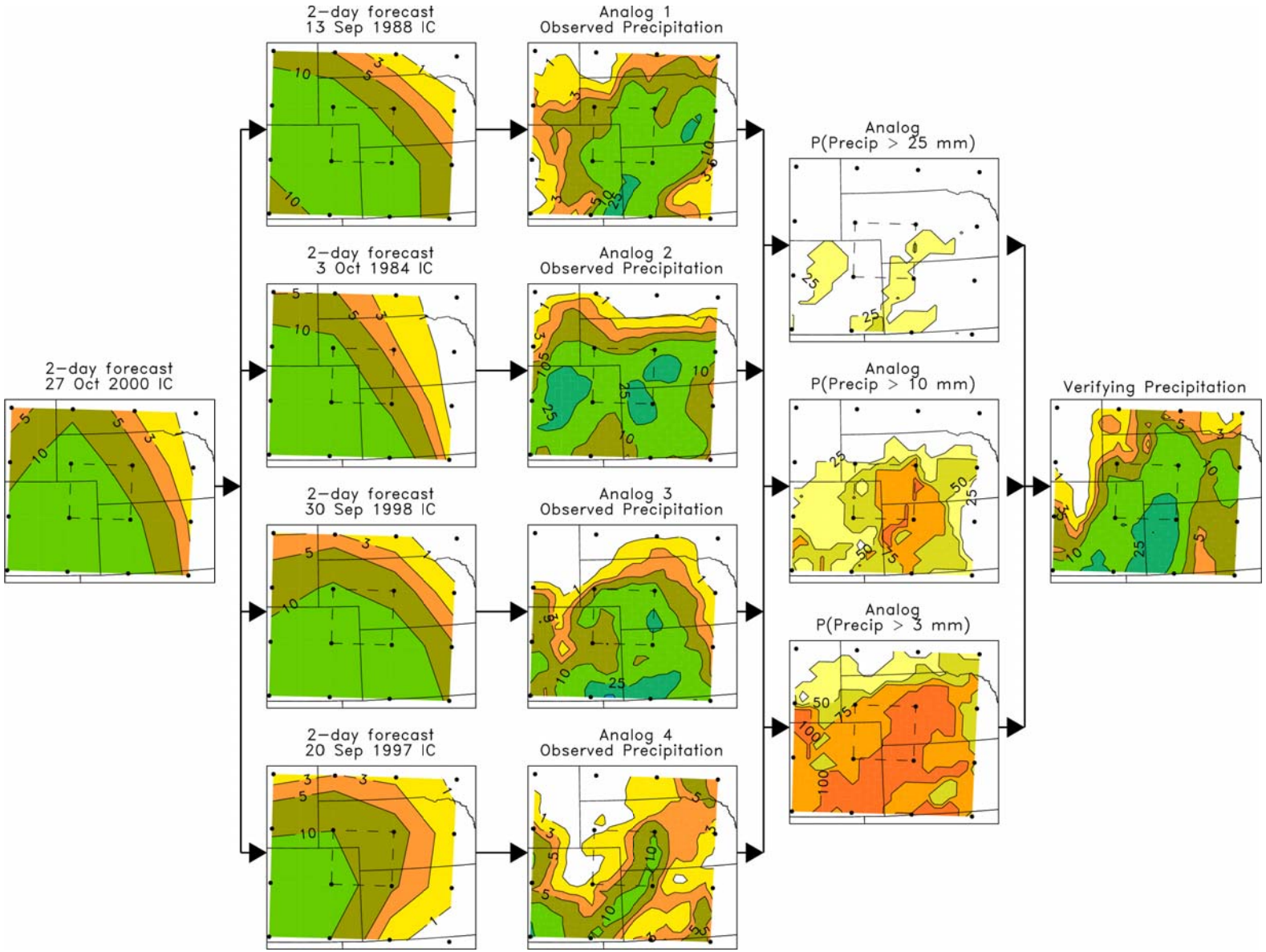
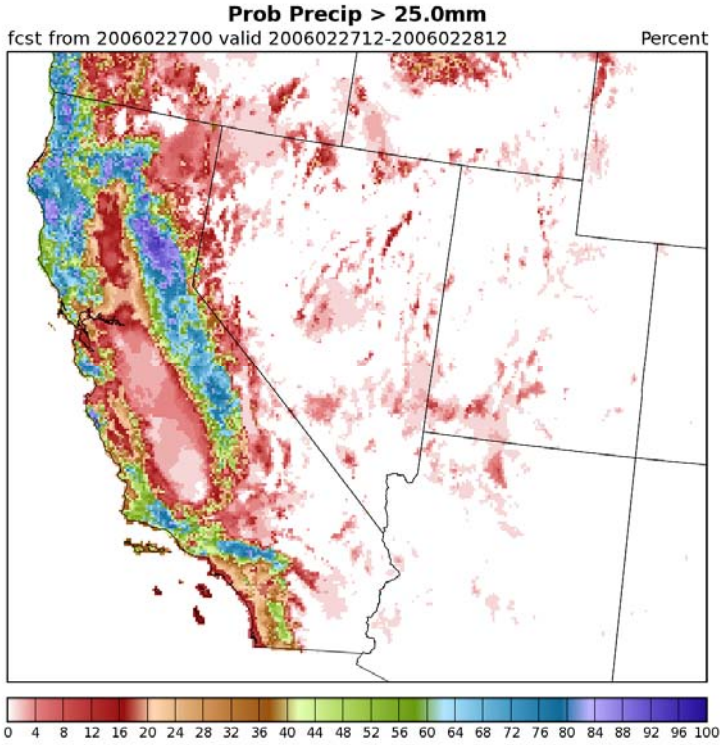
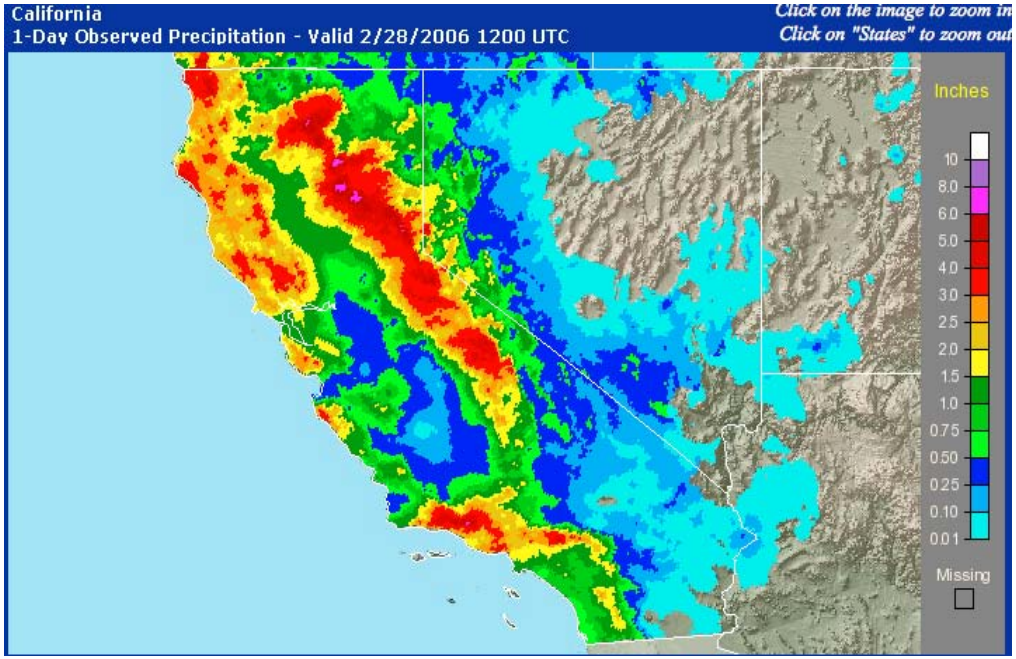
Plans for the Upper Colorado

- Gunnison and Upper Colorado Basins have been calibrated by CRBFC 2008
- Install soil moisture and temperature instrumentation at Granby, CO (Spring 09)
- Install soil moisture and temperature instrumentation at Gunnison,CO (Spring 09)

PQPF Issues

- Ensembles don’t sample the range of possibilities (typically they are overconfident).
- “Drizzle” problem - overestimate prob of light rain.
- Extremes under-represented - underestimate probability of flooding rains.

PQPF Calibration using reforecasts



“statististical downscaling”