New Methods for Estimating Streamflow Patterns in Ephemeral Channels in the Southwest

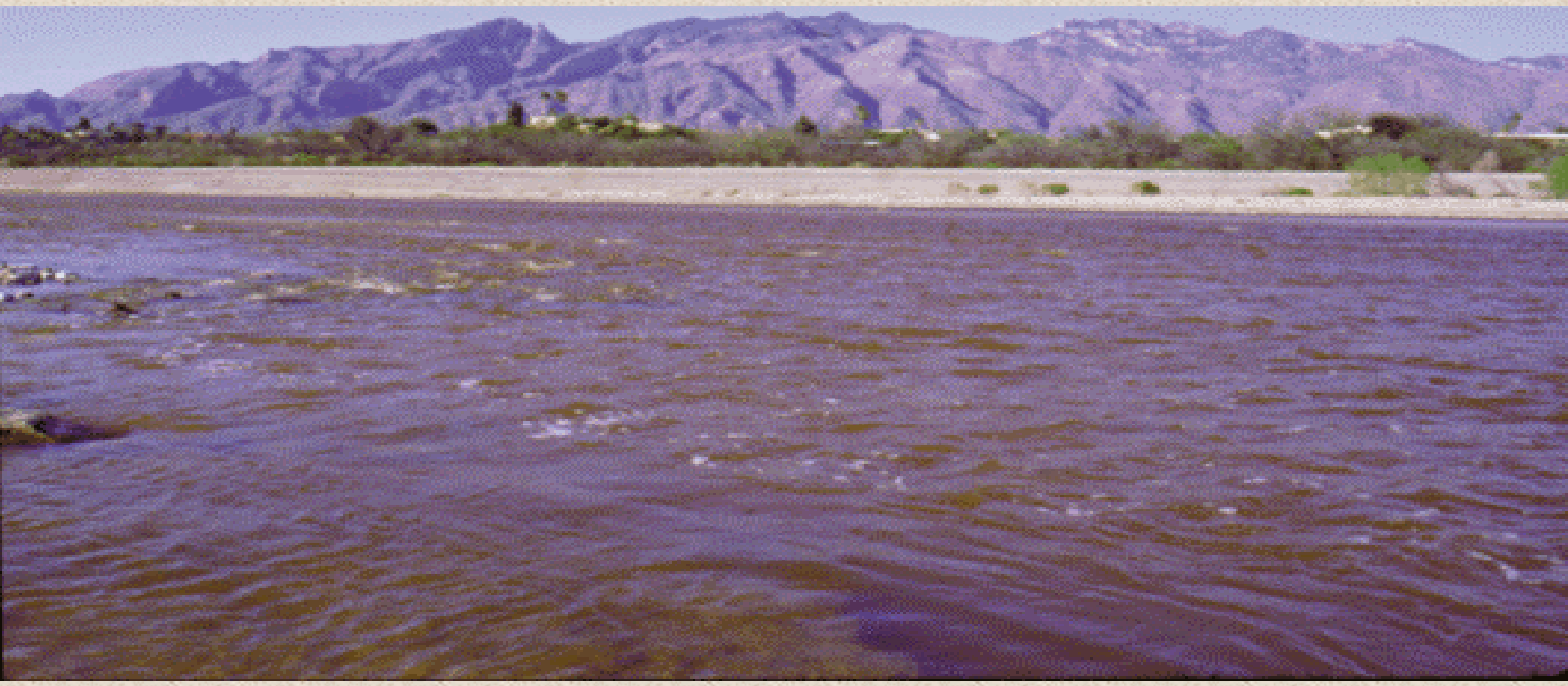
Jim Constantz, Amy Stewart, Rich Niswonger,
Lisa Sarma, and Stephanie Moore

U.S. Geological Survey
Menlo Park, California

USGS
science for a changing world

Problems with Direct Measurement of Streamflows in Ephemeral Channels

1. Steamflows are often flashy, i.e., 0 → 300 → 0 m^3/s in 8 hours
2. Flashy streamflows often are quite destructive, requiring equipment that is both robust and sensitive
3. The stream channel changes with every flashy streamflow event, requiring a new streamflow rating curve after every event



July 15, 1999

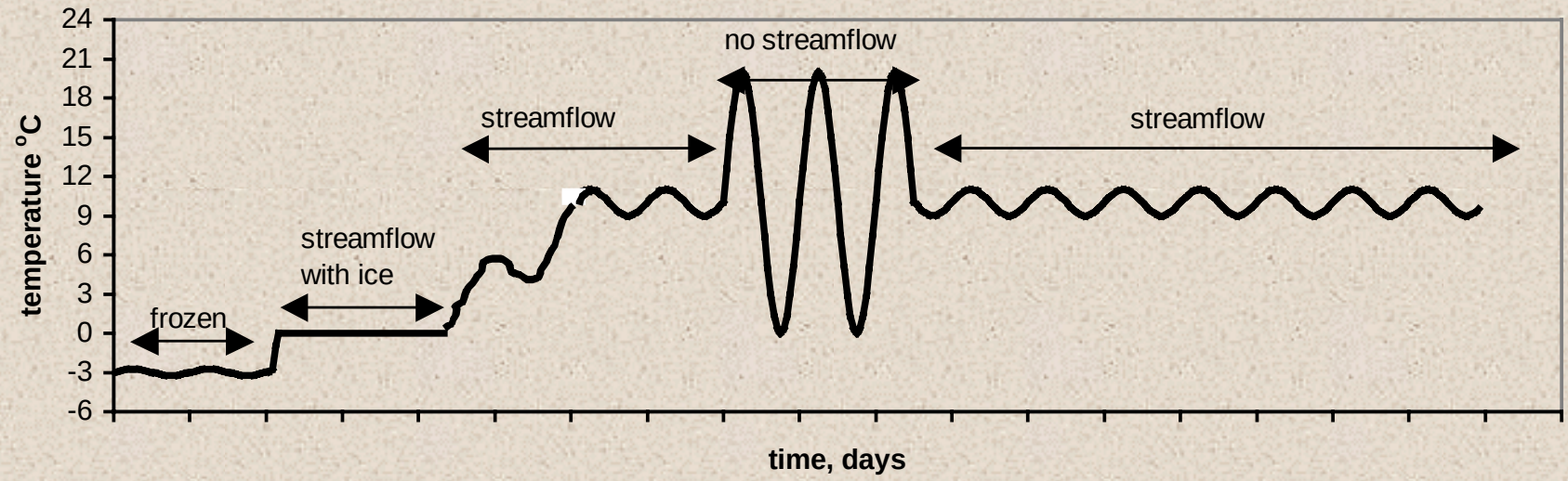
Nov. 9, 1999

Dodge Blvd. Web Cam

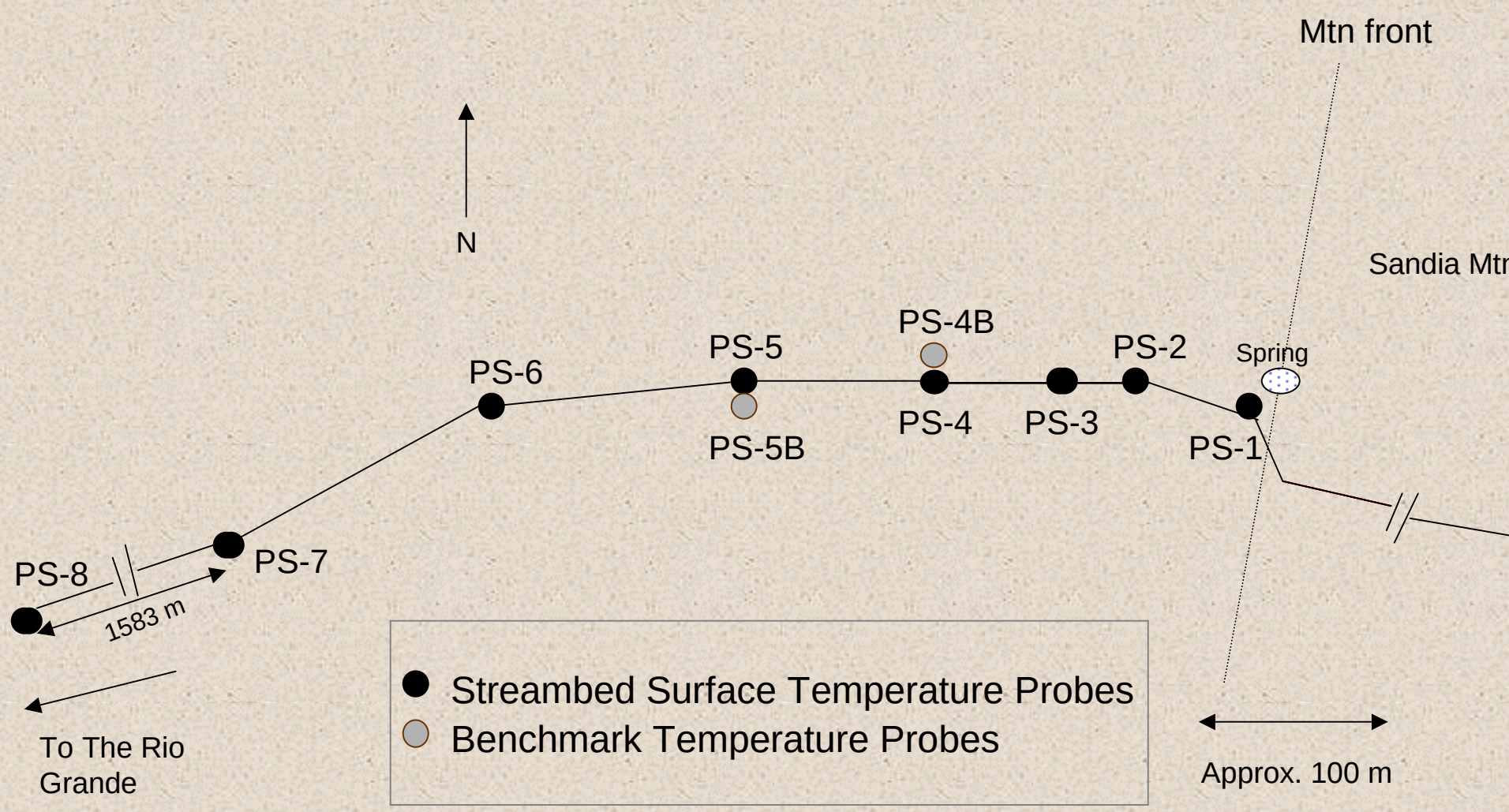
Several new methods for the indirect measurement of streamflow patterns

1. Streambed surface temperature analysis
2. Automated crest stage gages
3. Portable streamgages

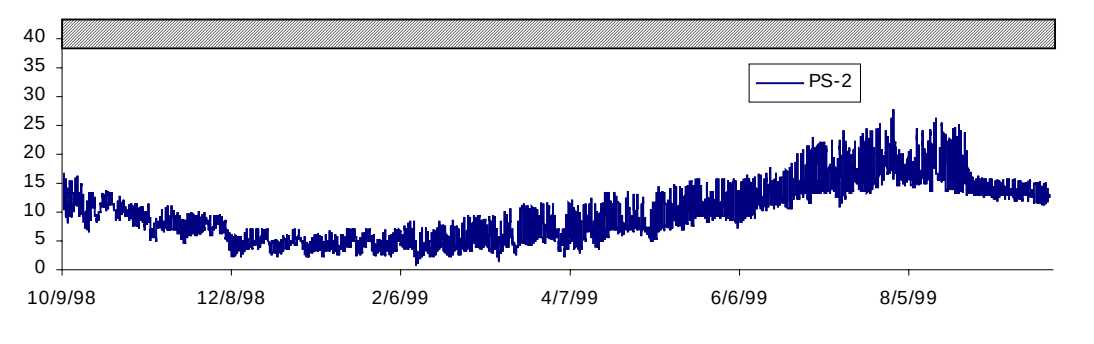
Hypothetical Response of the Streambed Surface to a Range of Hydrological Conditions

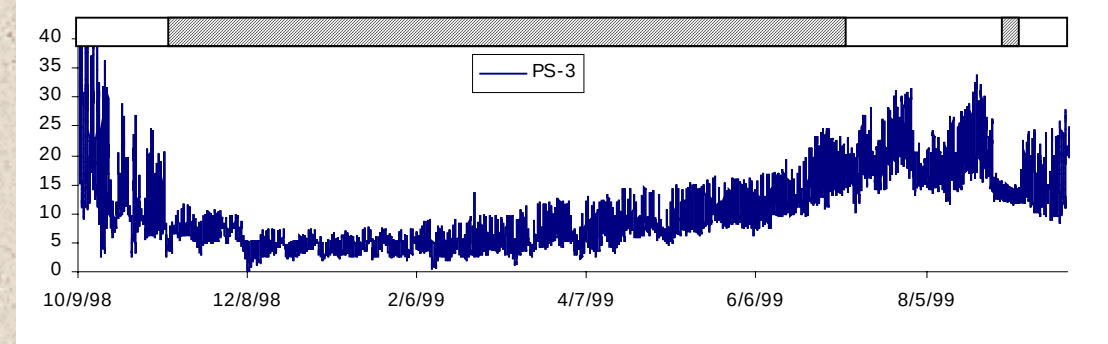


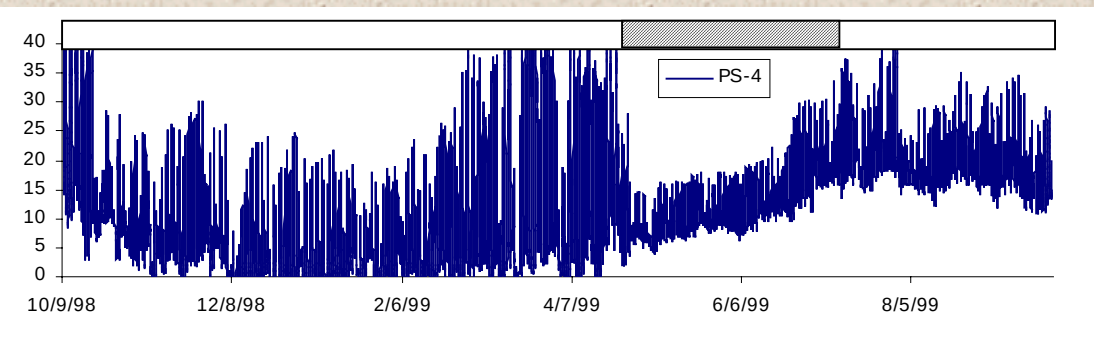
Stewart
USGS
Optic Shuttle

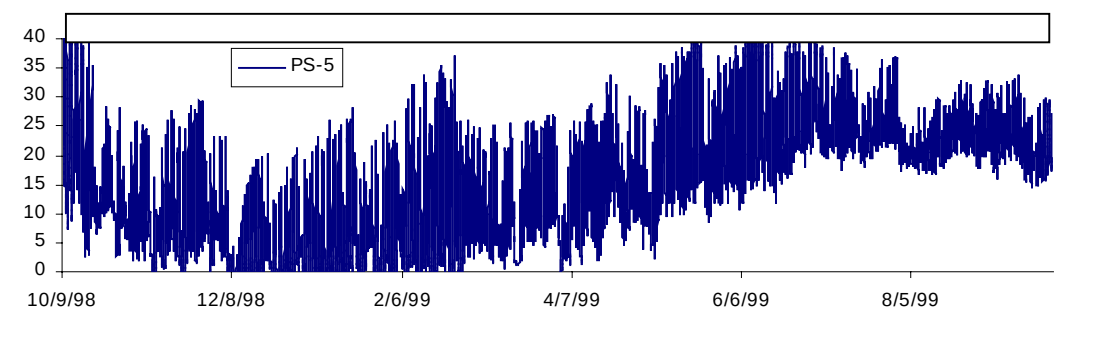


Bear Canyon, NM

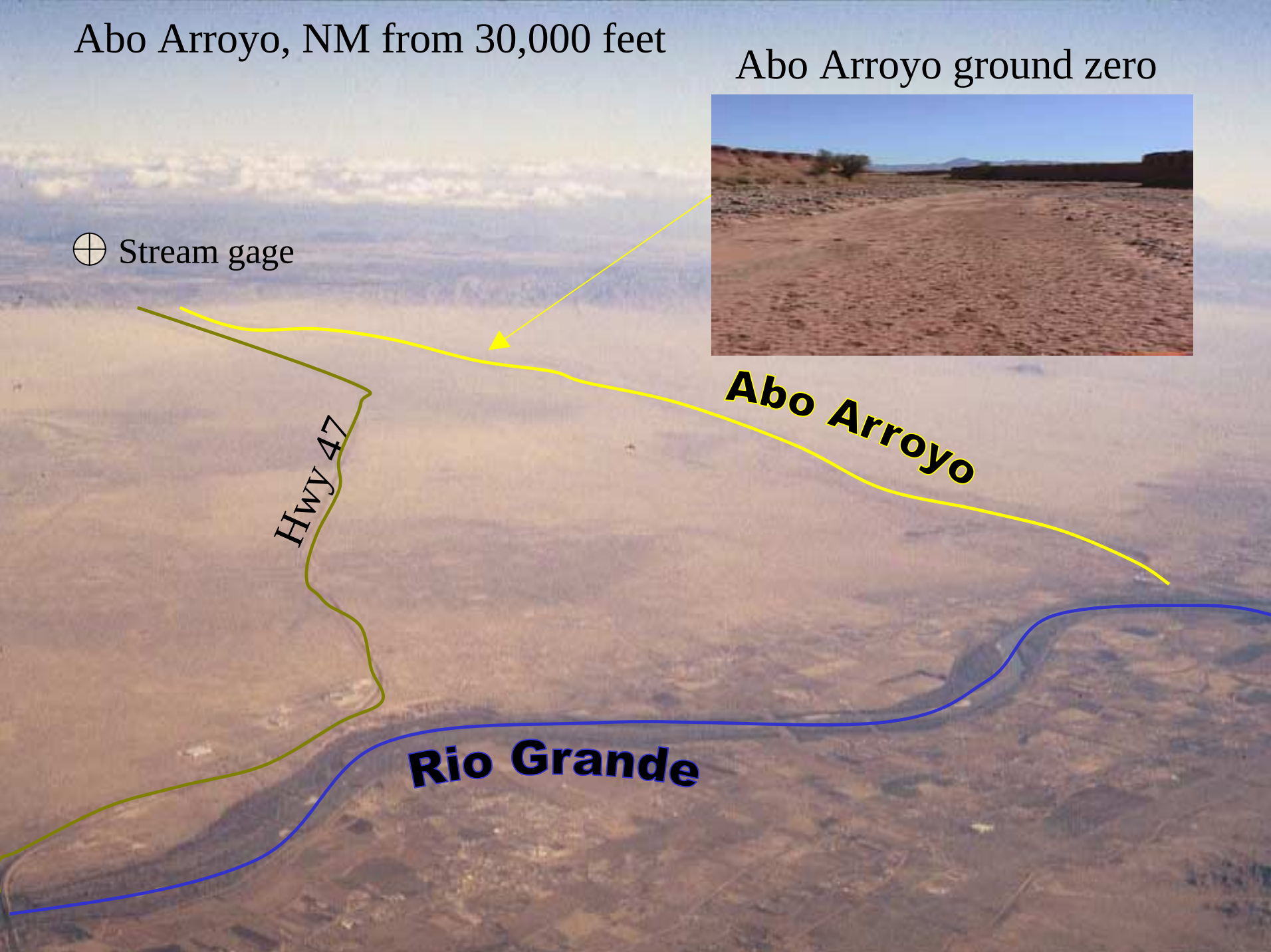

PS-2
40
35
30
25
20
15
10
5
0
10/9/98
12/8/98
2/6/99
4/7/99
6/6/99
8/5/99

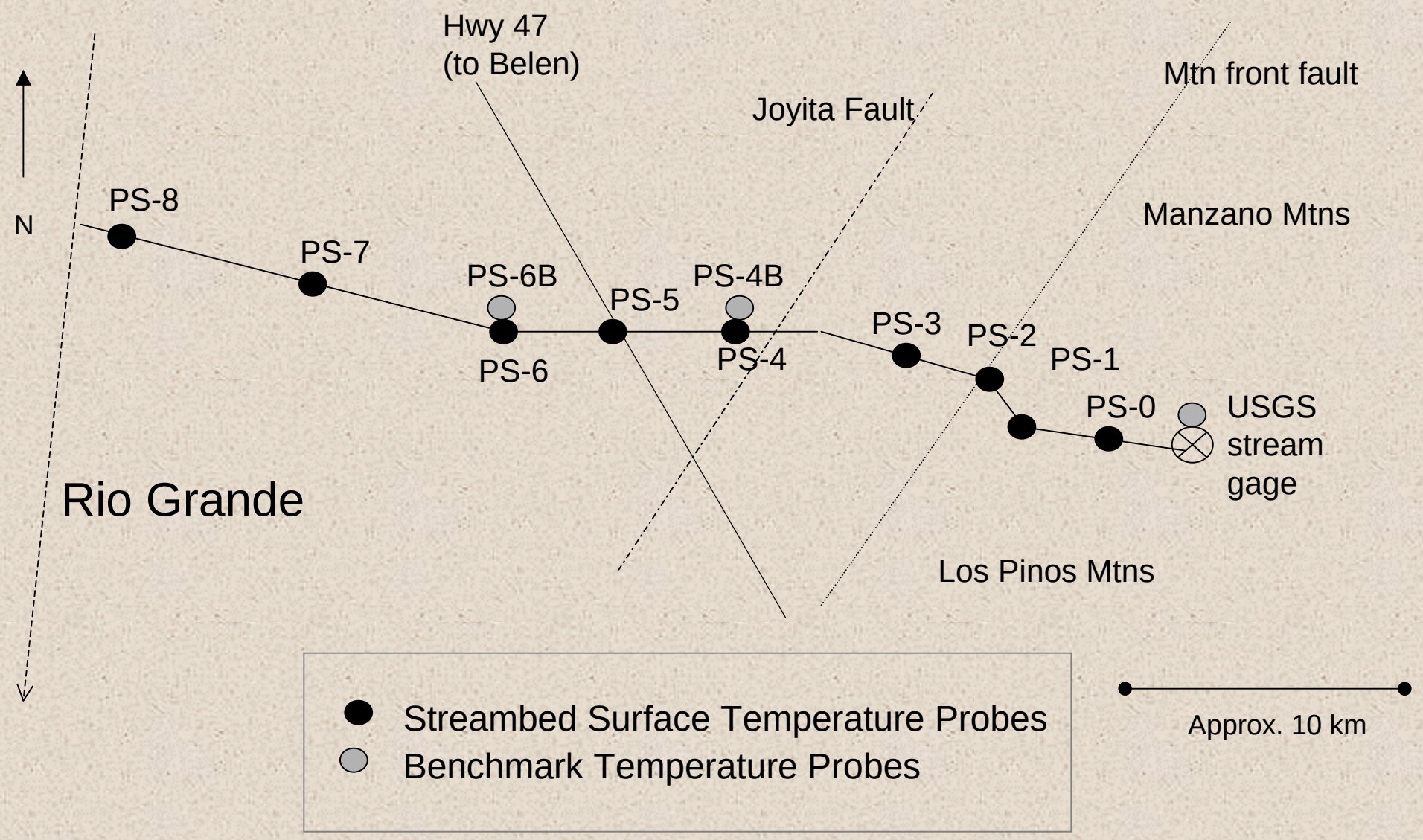

PS-3
40
35
30
25
20
15
10
5
0
10/9/98
12/8/98
2/6/99
4/7/99
6/6/99
8/5/99


PS-4
40
35
30
25
20
15
10
5
0
10/9/98
12/8/98
2/6/99
4/7/99
6/6/99
8/5/99

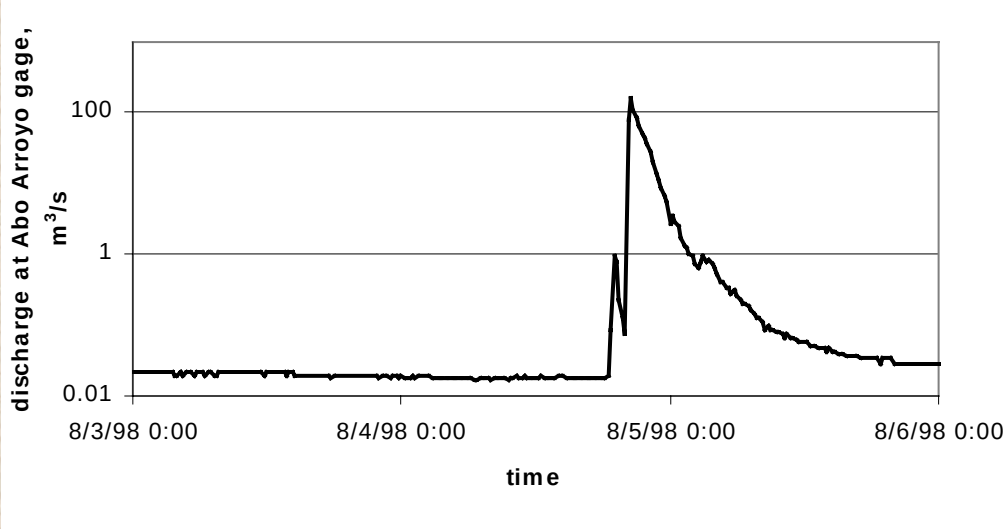

PS-5
40
35
30
25
20
15
10
5
0
10/9/98
12/8/98
2/6/99
4/7/99
6/6/99
8/5/99

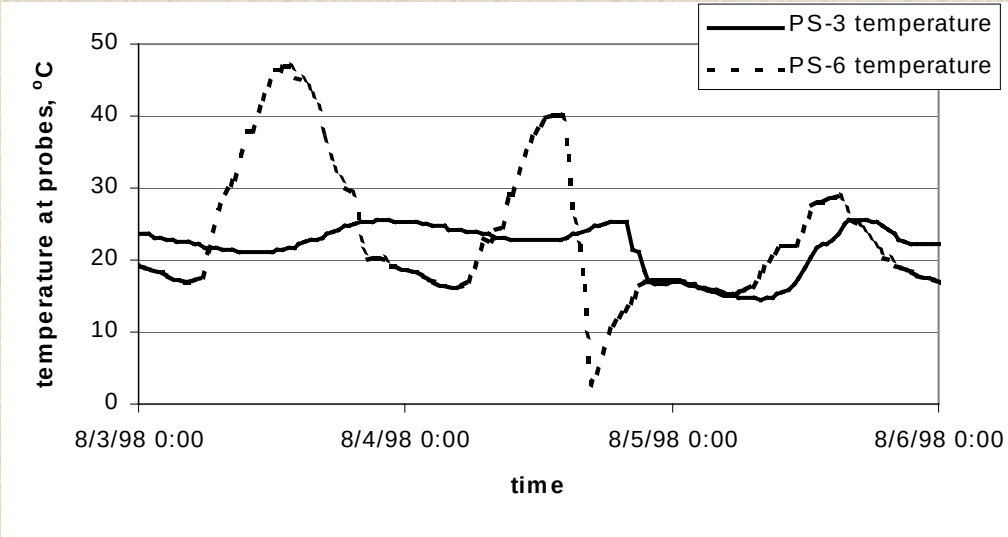
Abo Arroyo, NM from 30,000 feet

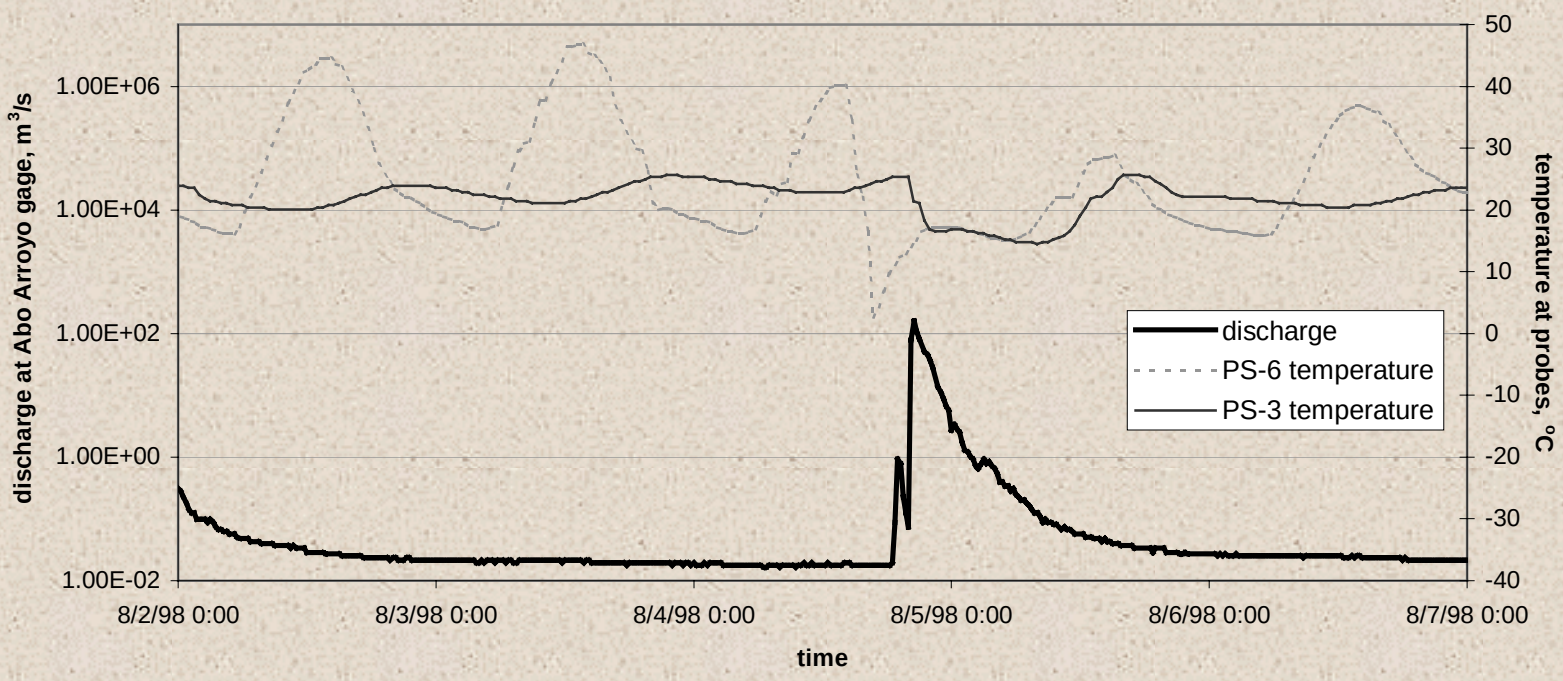

Abo Arroyo, NM from 30,000 feet
Abo Arroyo ground zero
Stream gage
Hwy 47
Abo Arroyo
Rio Grande

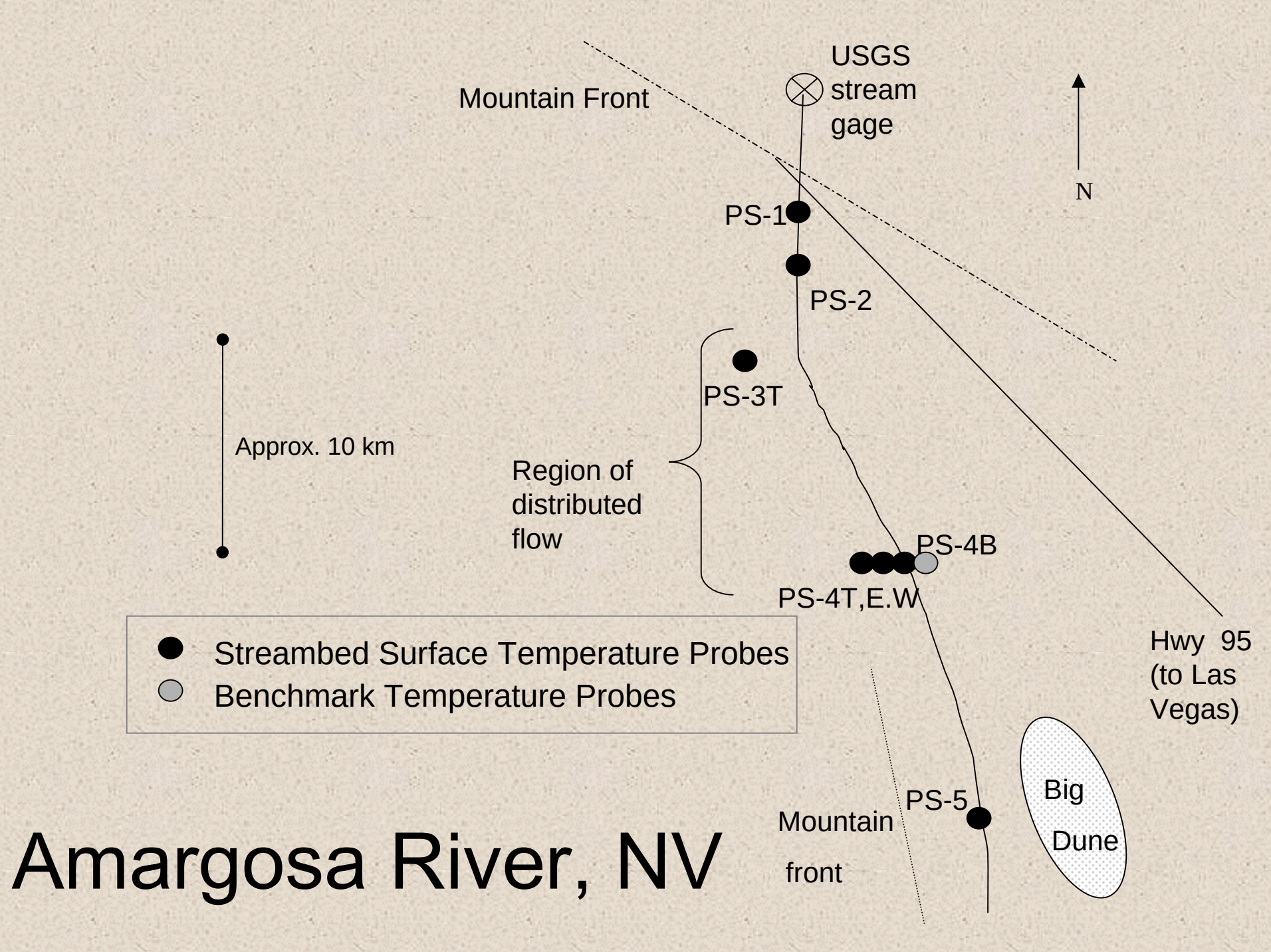


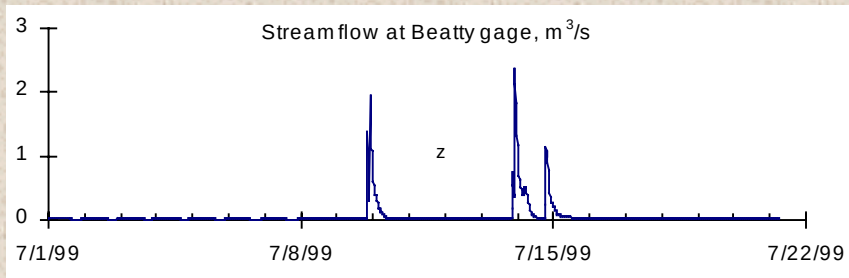
Abo Arroyo, NM

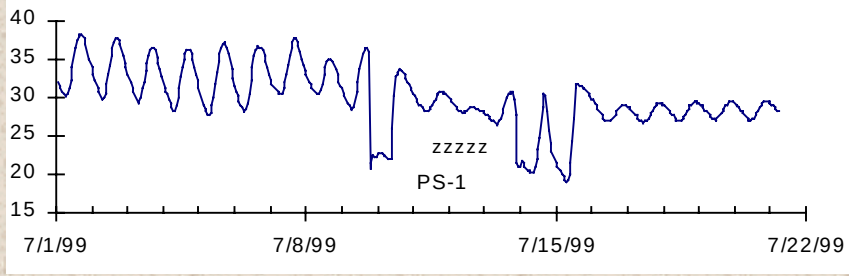

discharge at Abo Arroyo gage, m3/s
100
1
0.01
8/3/98 0:00
8/4/98 0:00
8/5/98 0:00
8/6/98 0:00
time

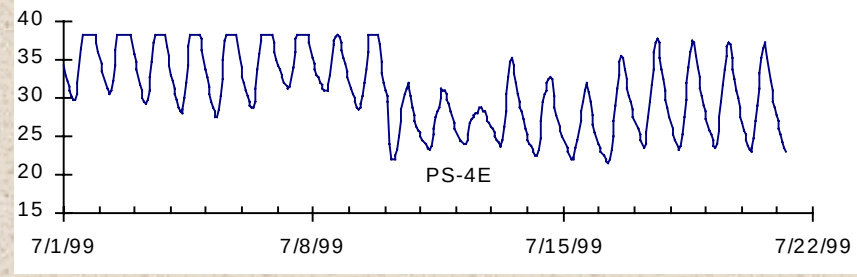

PS-3 temperature
PS-6 temperature
temperature at probes, °C
50
40
30
20
10
0
8/3/98 0:00
8/4/98 0:00
8/5/98 0:00
8/6/98 0:00
time

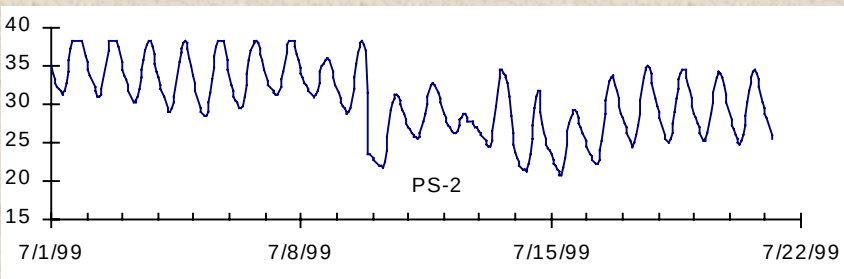

discharge at Abo Arroyo gage, m3/s
1.00E+06
1.00E+04
1.00E+02
1.00E+00
1.00E-02
temperature at probes, °C
50
40
30
20
10
0
-10
-20
-30
-40
8/2/98 0:00
8/3/98 0:00
8/4/98 0:00
8/5/98 0:00
8/6/98 0:00
8/7/98 0:00
time
discharge
PS-6 temperature
PS-3 temperature

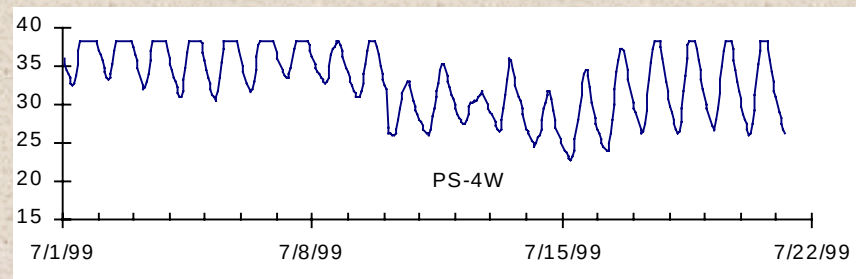

Mountain Front
USGS stream gage
N
PS-1
PS-2
PS-3T
Approx. 10 km
Region of distributed flow
PS-4B
PS-4T,E.W
Hwy 95 (to Las Vegas)
Streambed Surface Temperature Probes
Benchmark Temperature Probes
Big Dune
PS-5
Mountain front
Amargosa River, NV

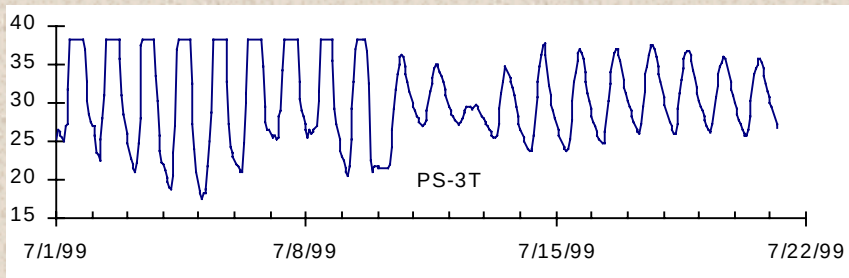

Streamflow at Beatty gage, m3/s
z
3
2
1
0
7/1/99
7/8/99
7/15/99
7/22/99

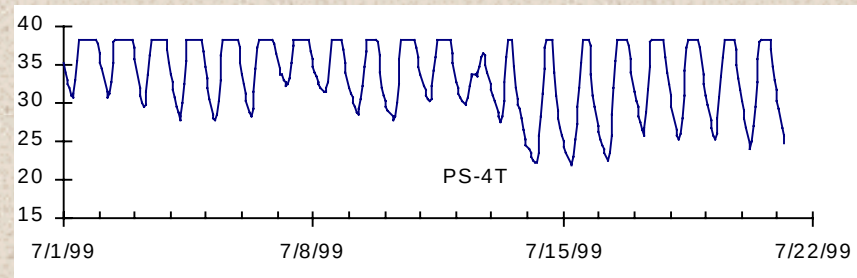

zzzzz
PS-1
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99

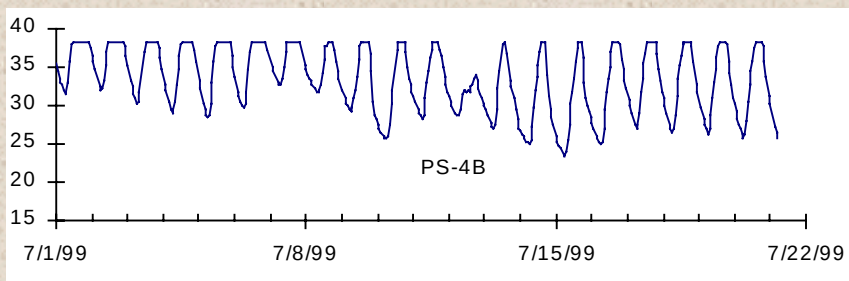

PS-4E
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99

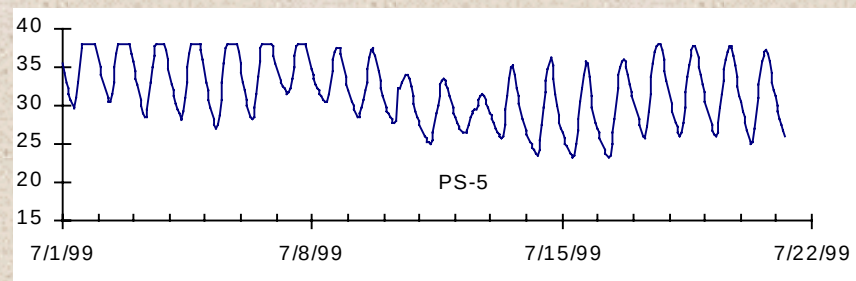

PS-2
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99


PS-4W
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99

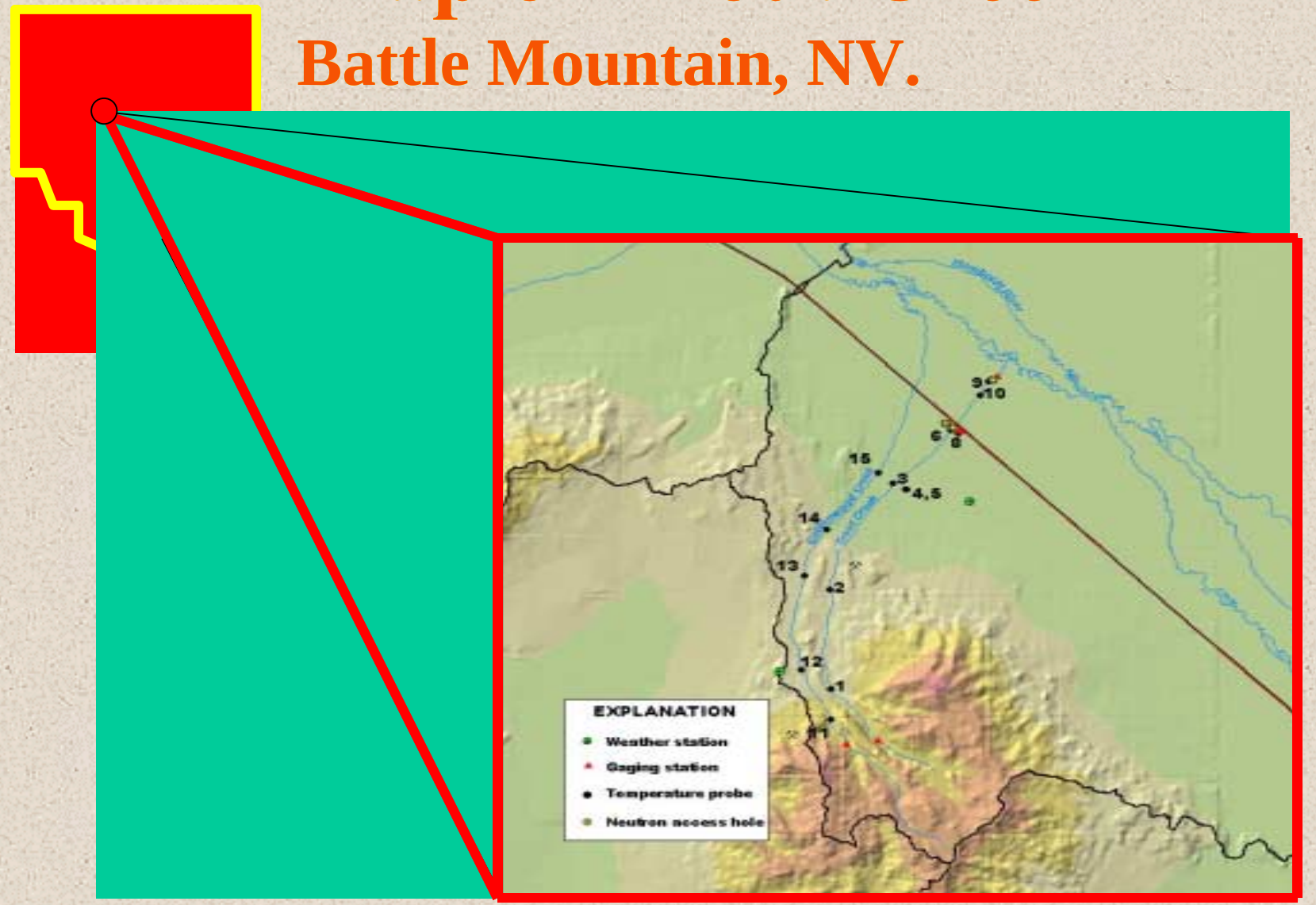

PS-3T
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99

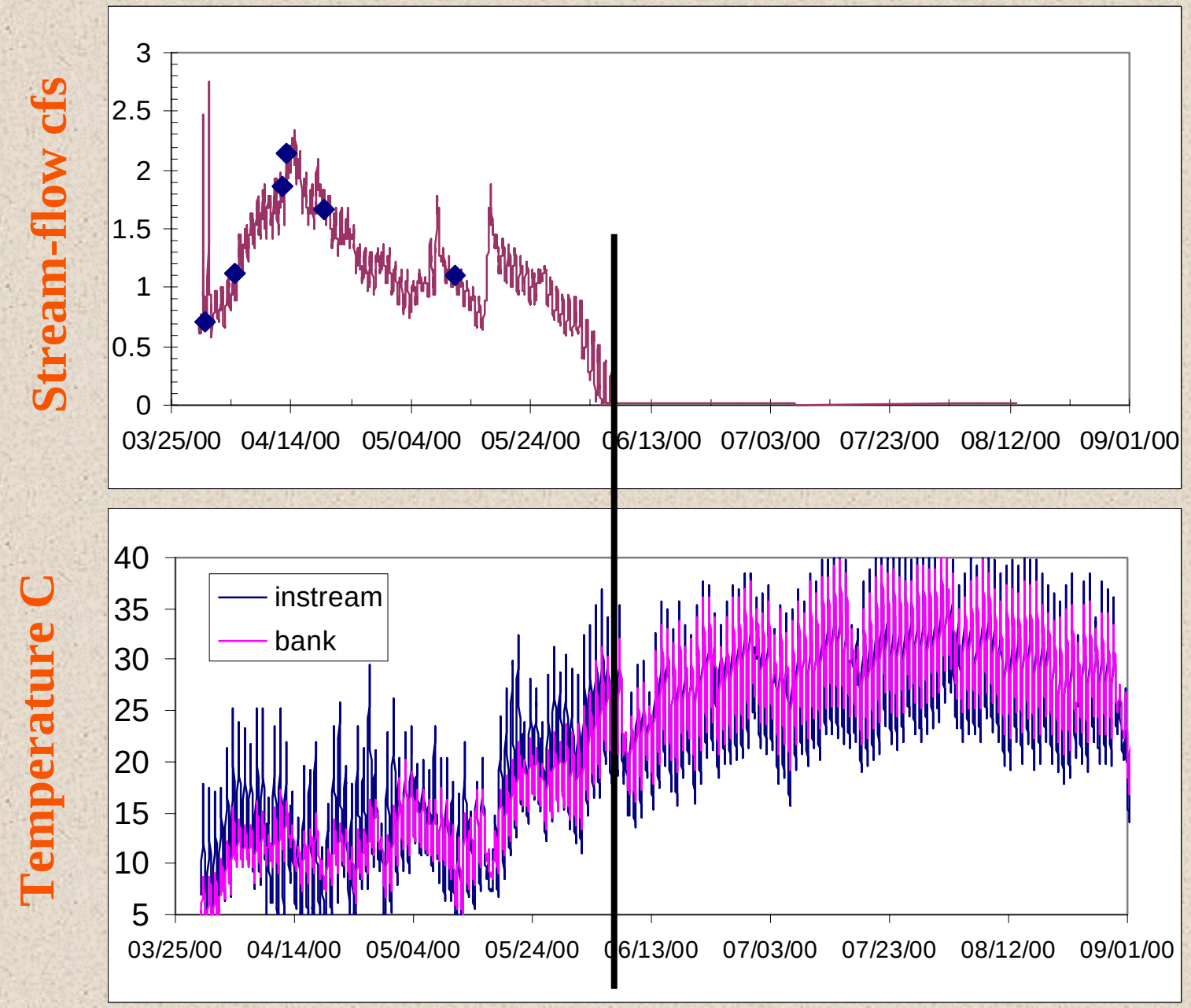

PS-4T
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99

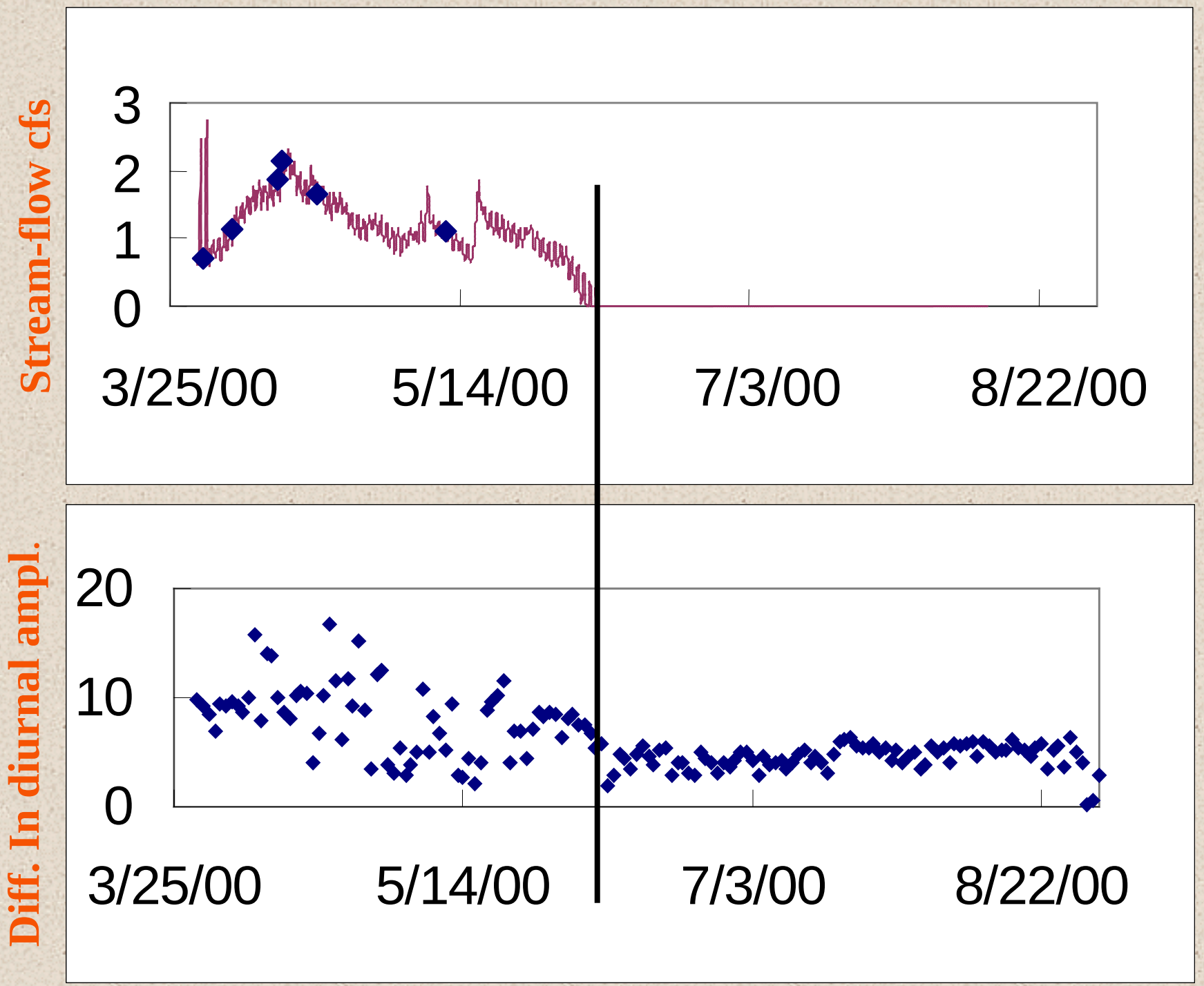

PS-4B
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99


PS-5
40
35
30
25
20
15
7/1/99
7/8/99
7/15/99
7/22/99

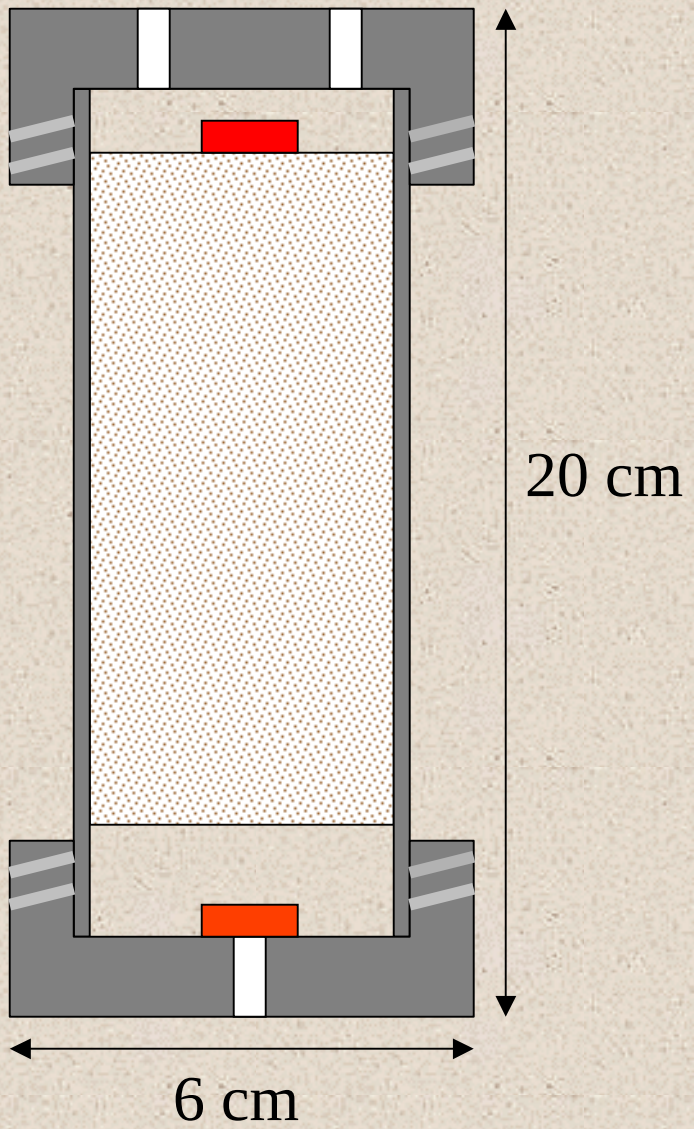
Map of Trout Creek
Battle Mountain, NV.

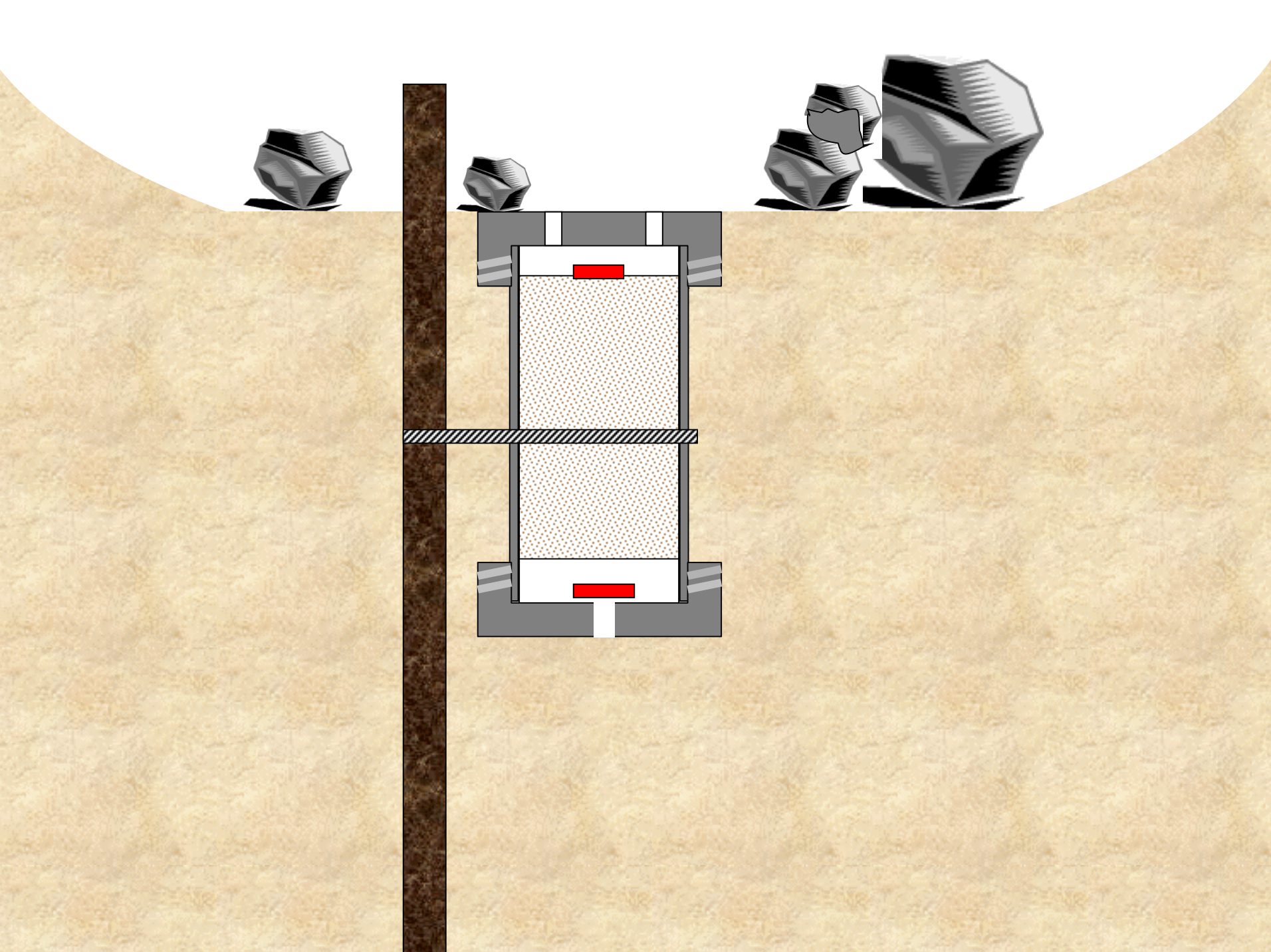


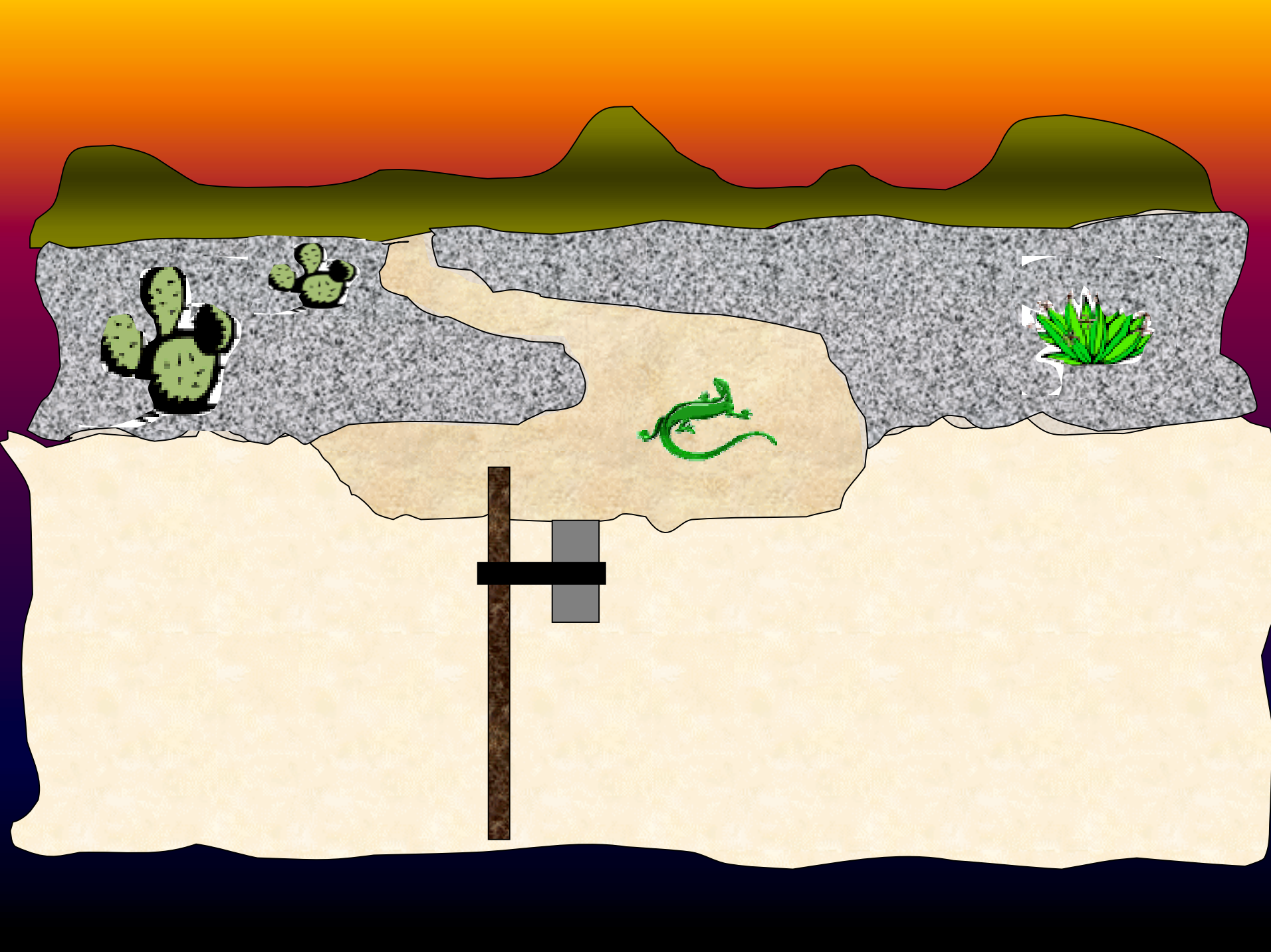

Stream-flow cfs
3
2.5
2
1.5
1
0.5
0
03/25/00
04/14/00
05/04/00
05/24/00
06/13/00
07/03/00
07/23/00
08/12/00
09/01/00
Temperature C
40
35
30
25
20
15
10
5
instream
bank
03/25/00
04/14/00
05/04/00
05/24/00
06/13/00
07/03/00
07/23/00
08/12/00
09/01/00


Stream-flow cfs
3
2
1
0
3/25/00
5/14/00
7/3/00
8/22/00
Diff. In diurnal ampl.
20
10
0
3/25/00
5/14/00
7/3/00
8/22/00

Dual-Temperature Probe





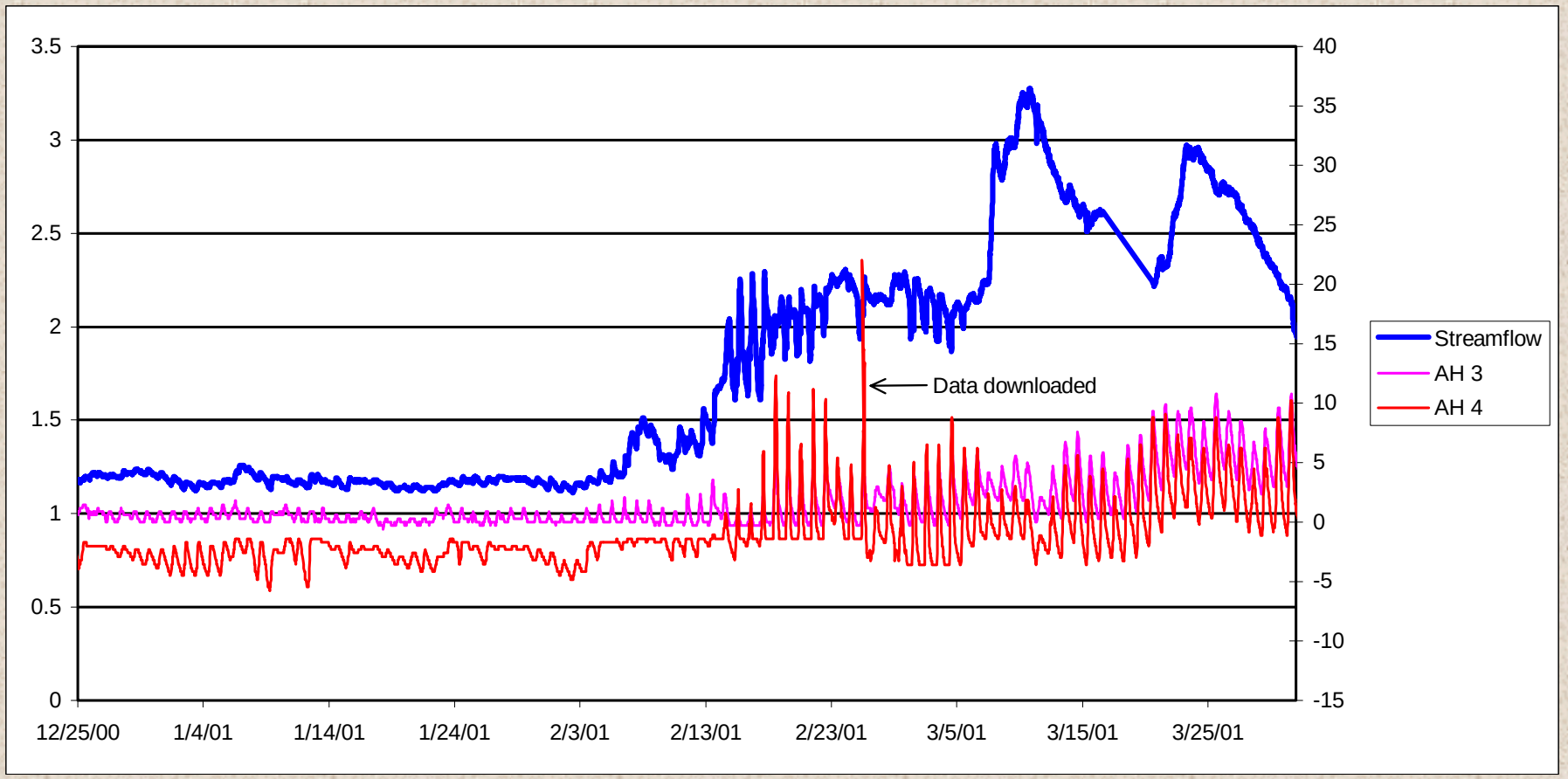


Automated Crest-Stage Gages

1. Replacement of staff in CSG with data-logger/ pressure-transducer
2. Synthetic rating curve used to determine streamflow

Portable Streamgage

1. Data-logger/Pressure-transducer used to determine stage
2. Rating curve determined by periodic flow measurements


3.5
3
2.5
2
1.5
1
0.5
0
40
35
30
25
20
15
10
5
0
-5
-10
-15
12/25/00
1/4/01
1/14/01
1/24/01
2/3/01
2/13/01
2/23/01
3/5/01
3/15/01
3/25/01
Data downloaded
Streamflow
AH 3
AH 4

Conclusions

1. Streambed surface temperature analysis
2. Automated crest stage gages
3. Portable streamgages