Hydrogeology

Konza LTER Workshop

1 September 2007

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What We've Learned

- Water flux
  - Aquifer-atmosphere link
  - Stream-aquifer interactions
- Chemistry

Aquifer-Atmosphere Link

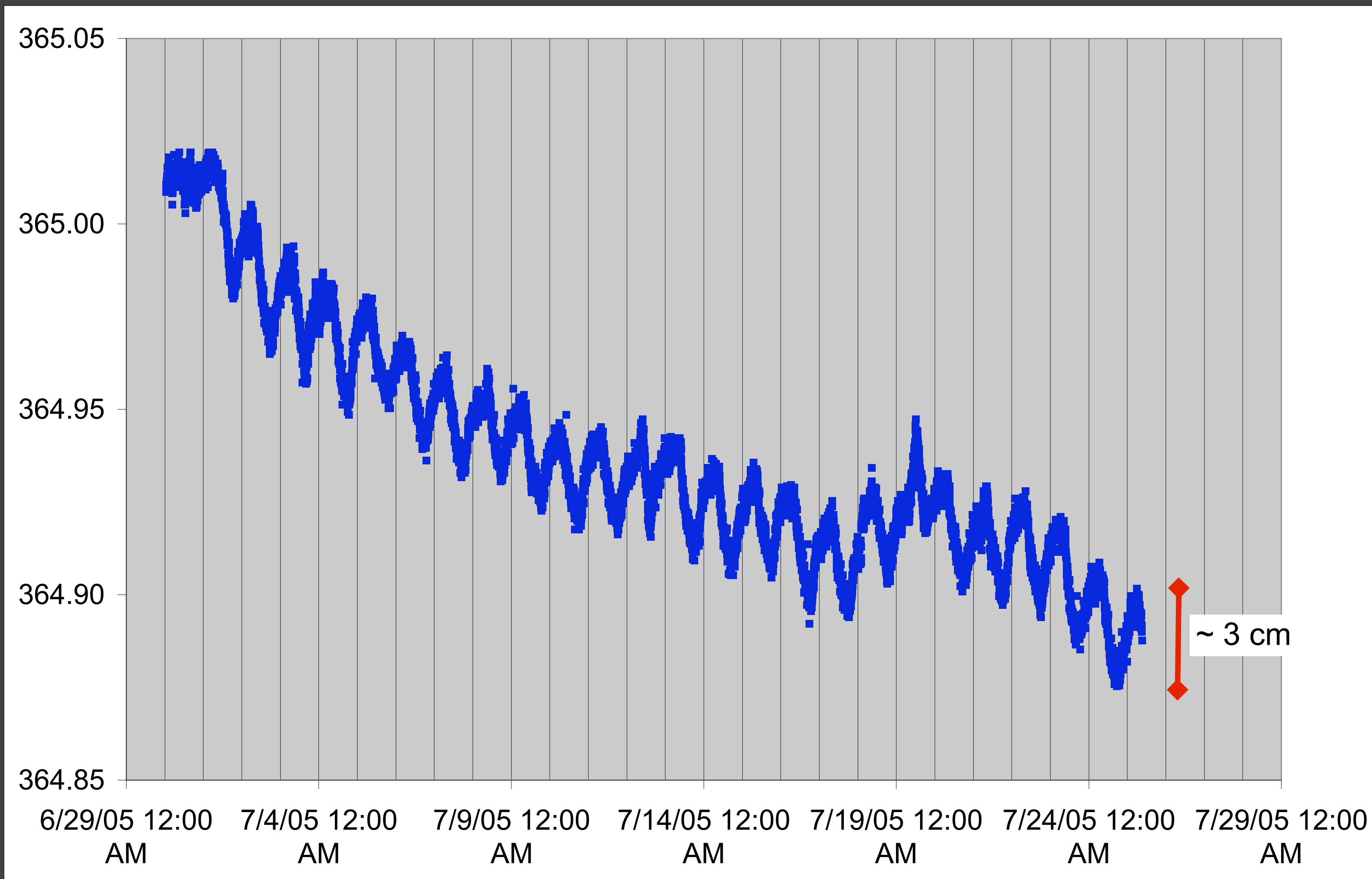
- up to 33% of evapotranspiration is groundwater supported

- **Mill Creek:** York JP et al., 2002, Putting aquifers into atmospheric simulation models: an example from the Mill Creek Watershed, northeastern Kansas: ADVANCES IN WATER RESOURCES 25 (2): 221-238.
  Gutowski WJ et al., 2002, A coupled land-atmosphere simulation program (CLASP): calibration and validation: JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES 107 (D16): Art. No. 4283.

- daily oscillation in groundwater-level occurs during extended dry periods in the growing season

- **Konza Prairie**: Kissing, K. R., and G. L. Macpherson, 2006, Short-term water-level fluctuations and long-term water-level decline at the Konza Prairie—drought or vegetation?: GSA Abstracts with Programs 38 (1): A

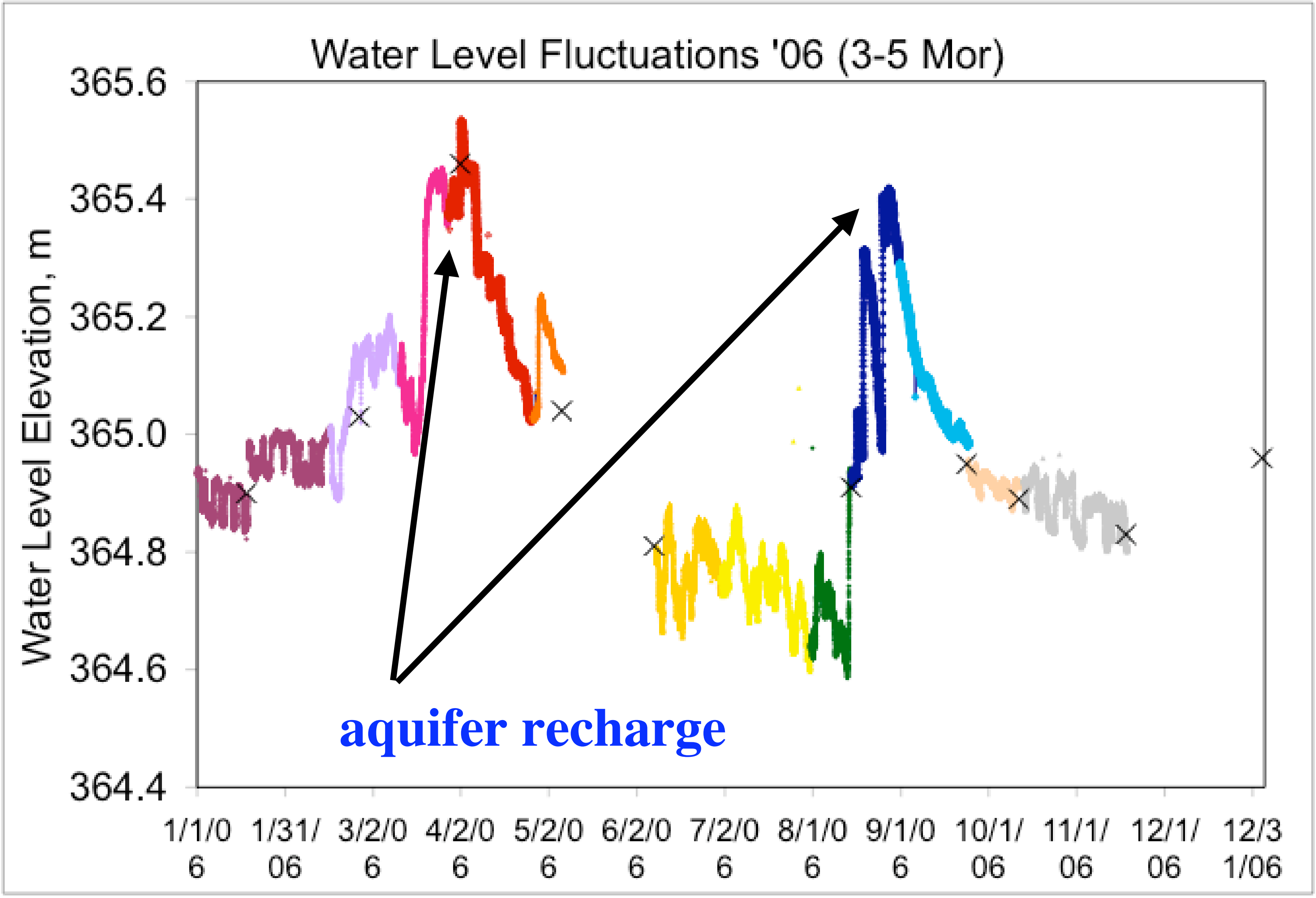
Daily water-level fluctuations: during growing season AND no rainfall

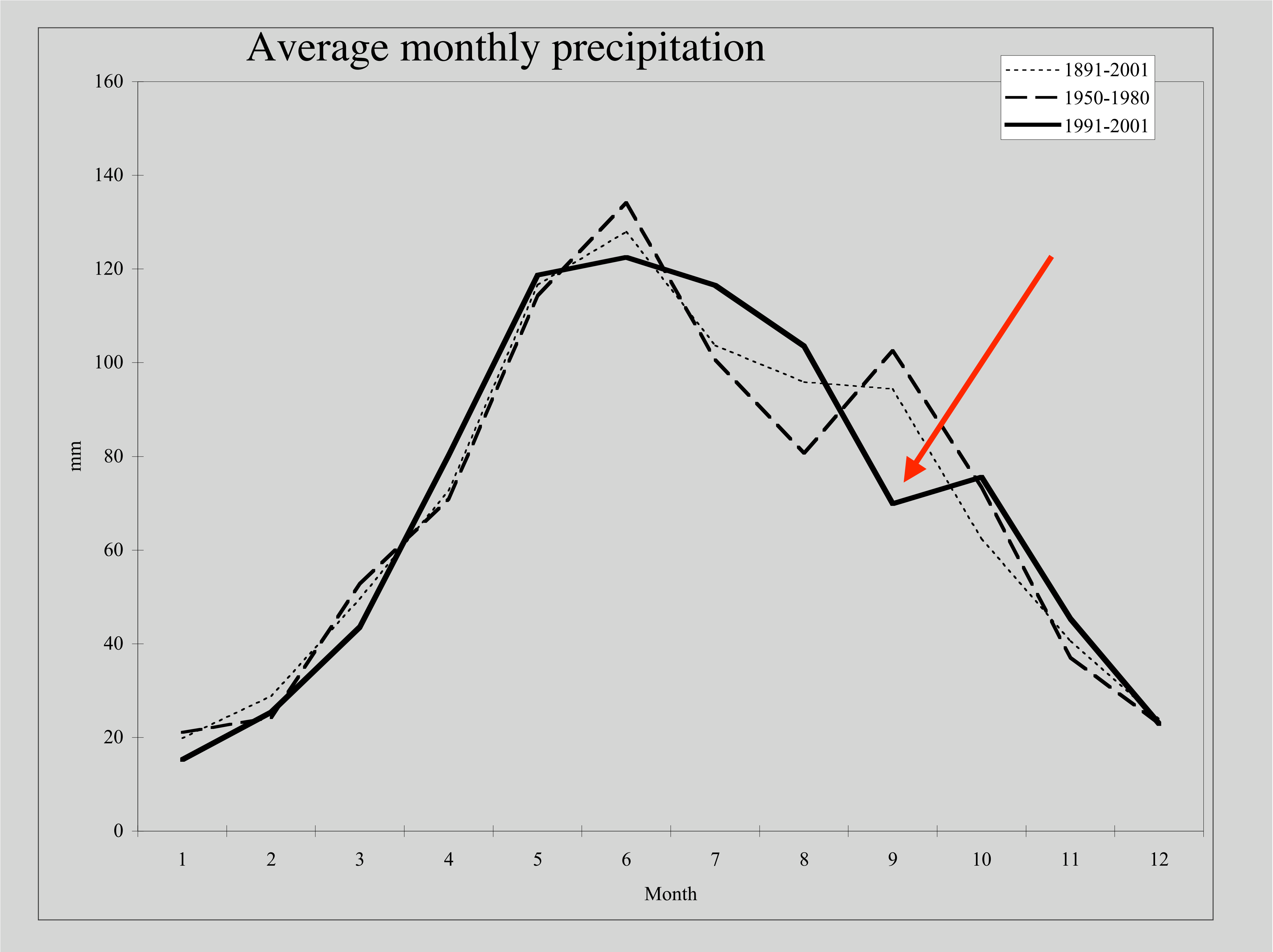


Atmosphere-Aquifer Interactions

- Annual pattern
- Impact of
  - lower annual precipitation
  - timing shift

2006 high-resolution water-level elevation in one well

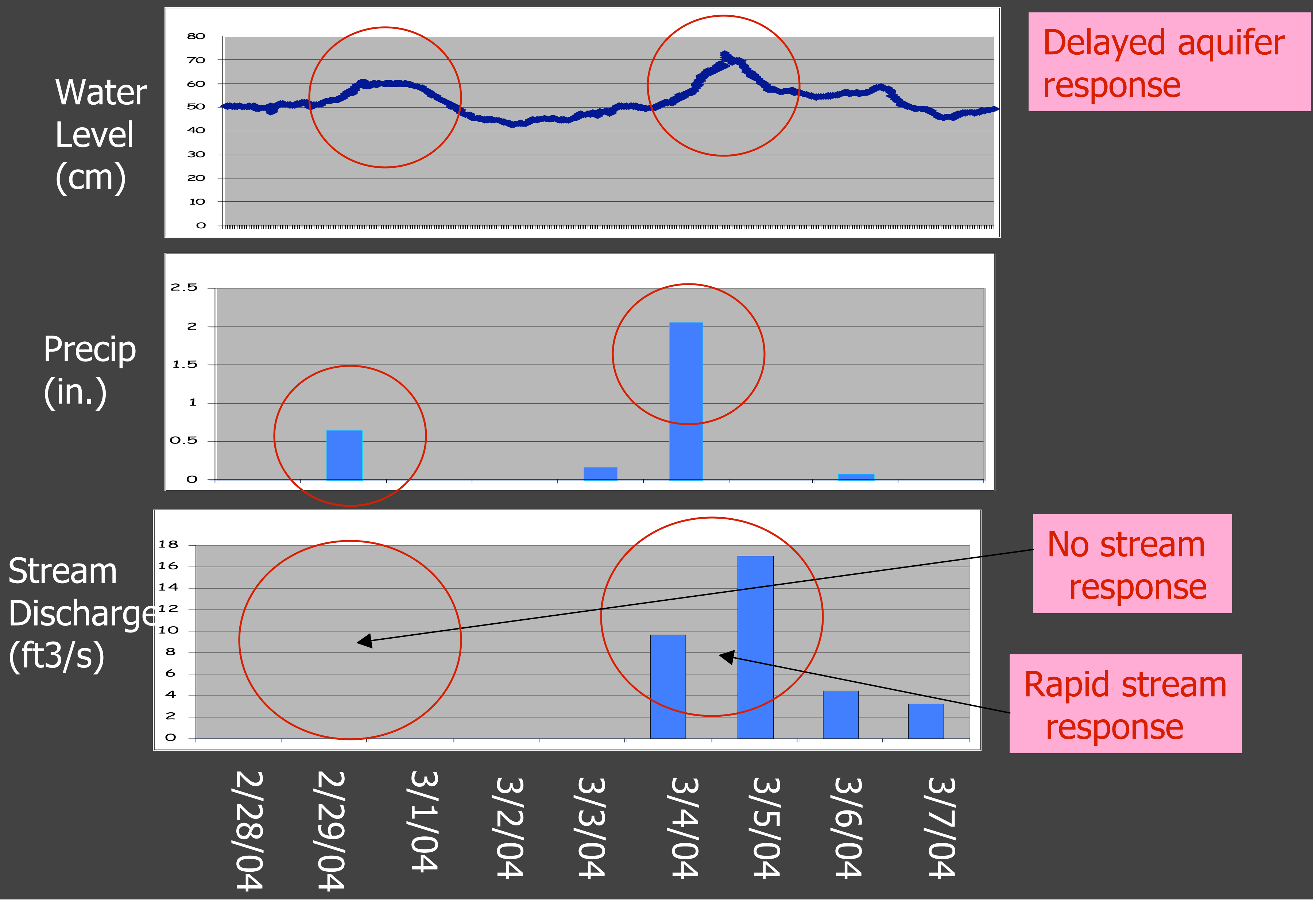



Average monthly precipitation
1891-2001
1950-1980
1991-2001
160
140
120
100
80
60
40
20
0
mm
1
2
3
4
5
6
7
8
9
10
11
12
Month

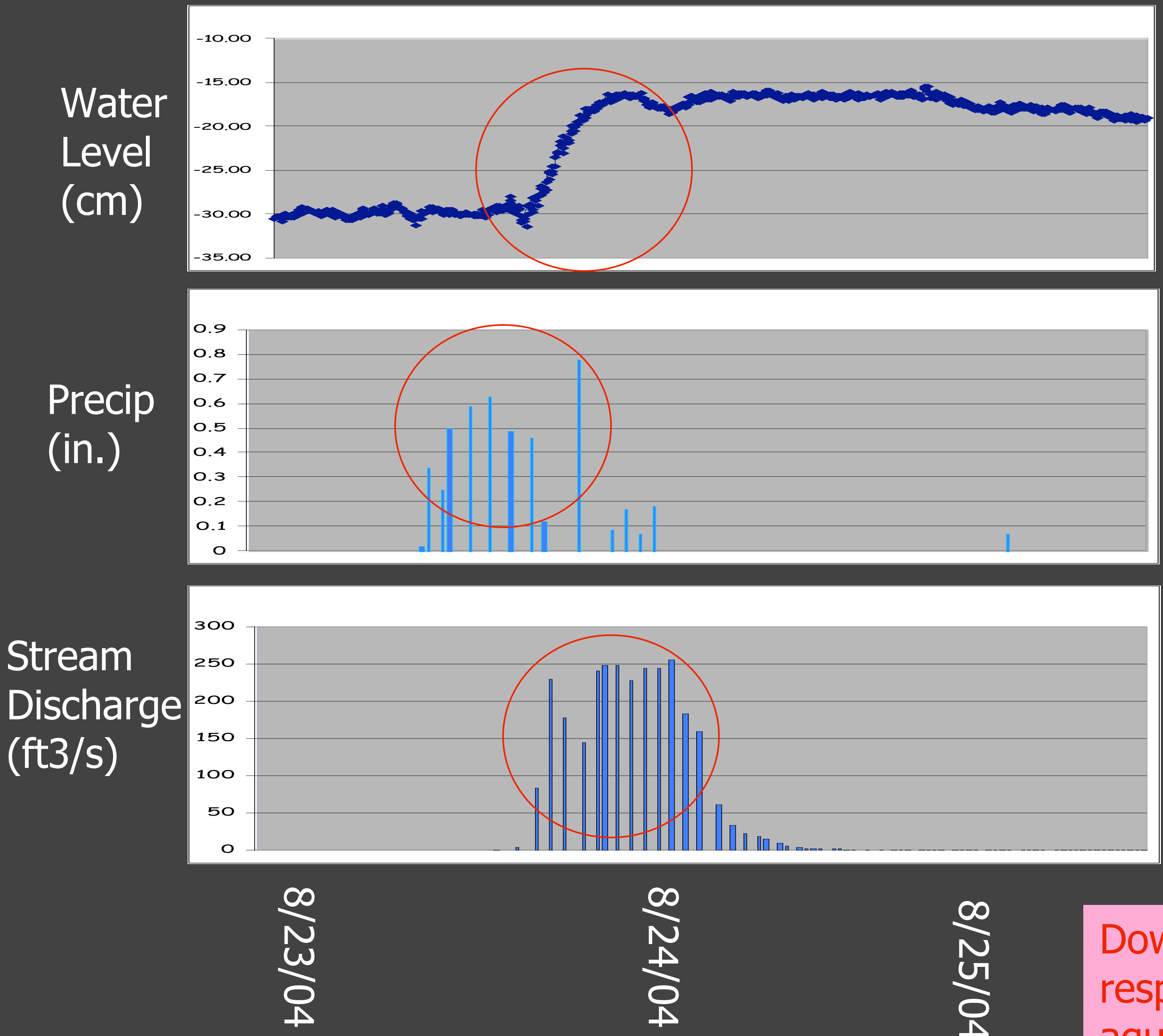
Stream-Aquifer Interactions

- Response times
- Direction

Stream-Aquifer Responses, Types 1 & 2



Stream-Aquifer Response, Type 3



Delayed aquifer response

Downstream stream response after aquifer response

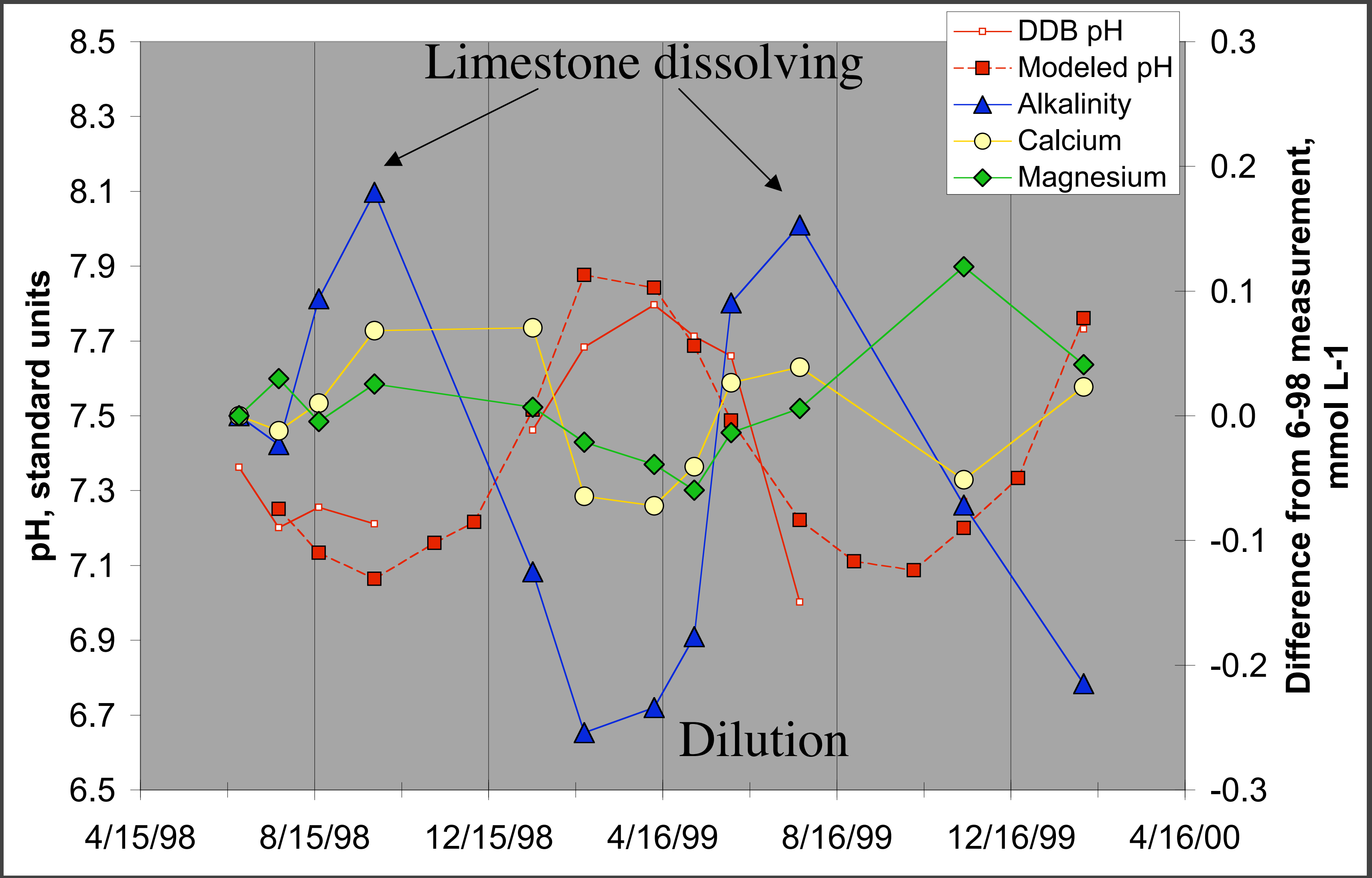
Stream-Aquifer Interactions –the future

- Computer models (D. Steward?)

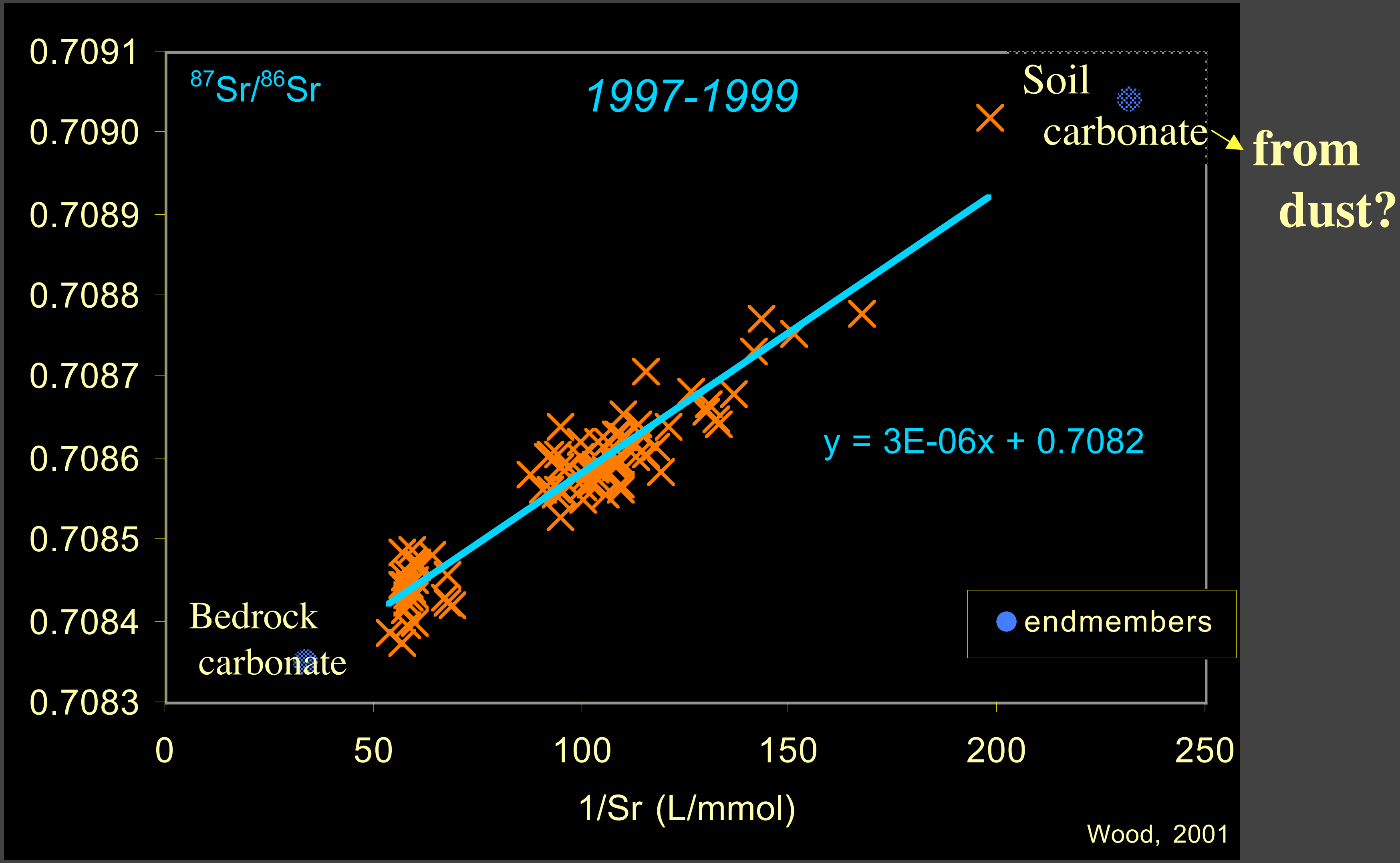
What We Have Learned

- Water flux
  - Aquifer-atmosphere link
  - Stream-aquifer interactions
- Chemistry
  - Annual cycles
  - Solute sources
  - Nutrient export
  - CO_2

Annual chemical cycles

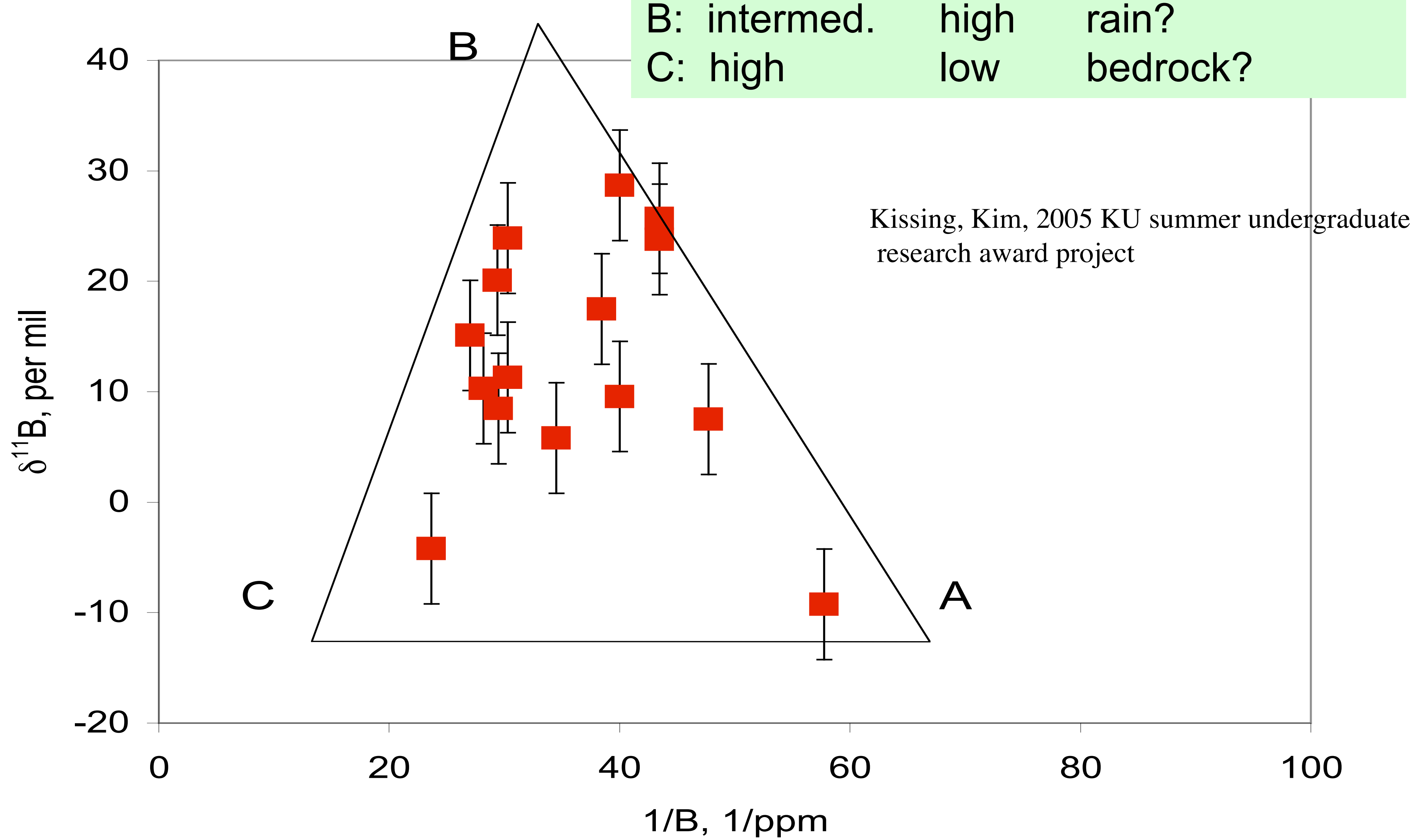


Solute sources

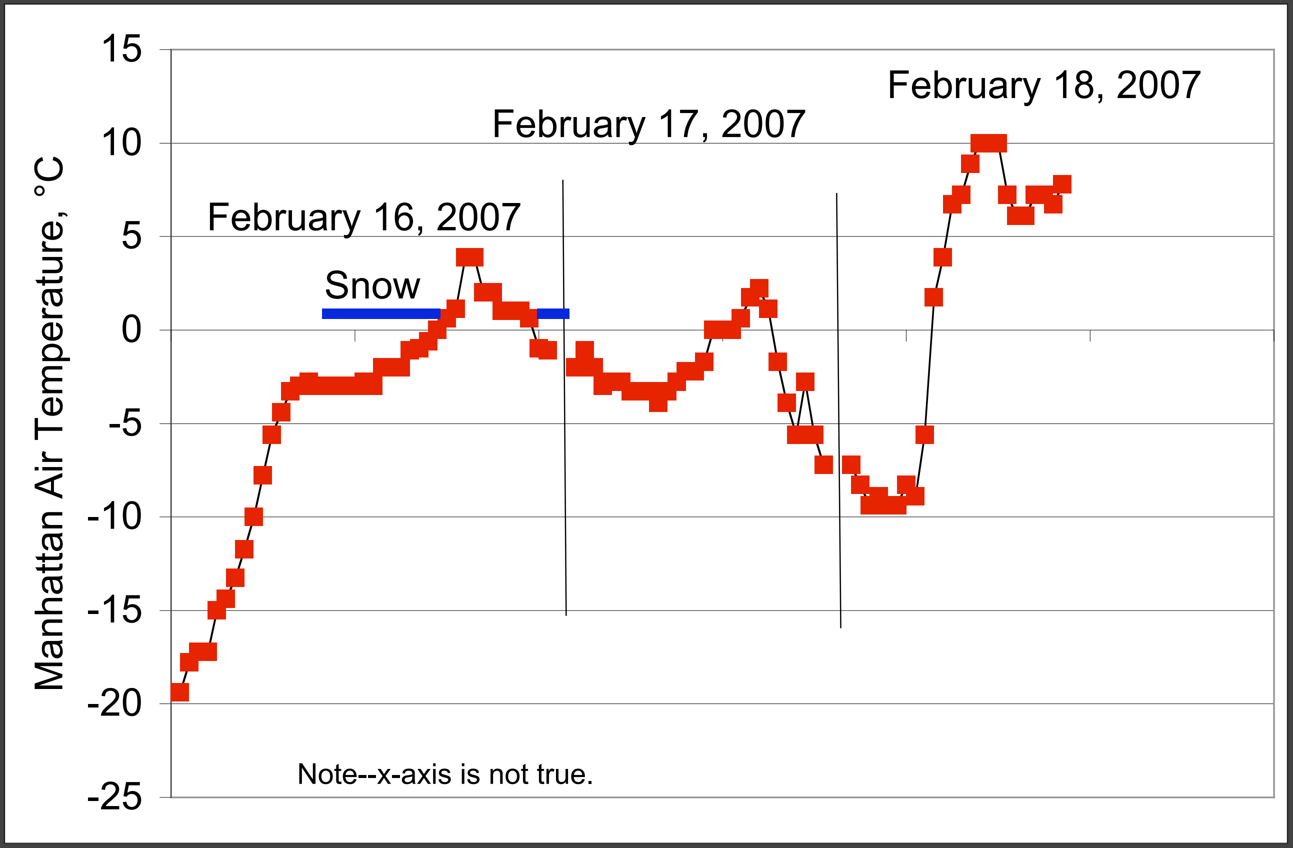


Solute sources, cont.

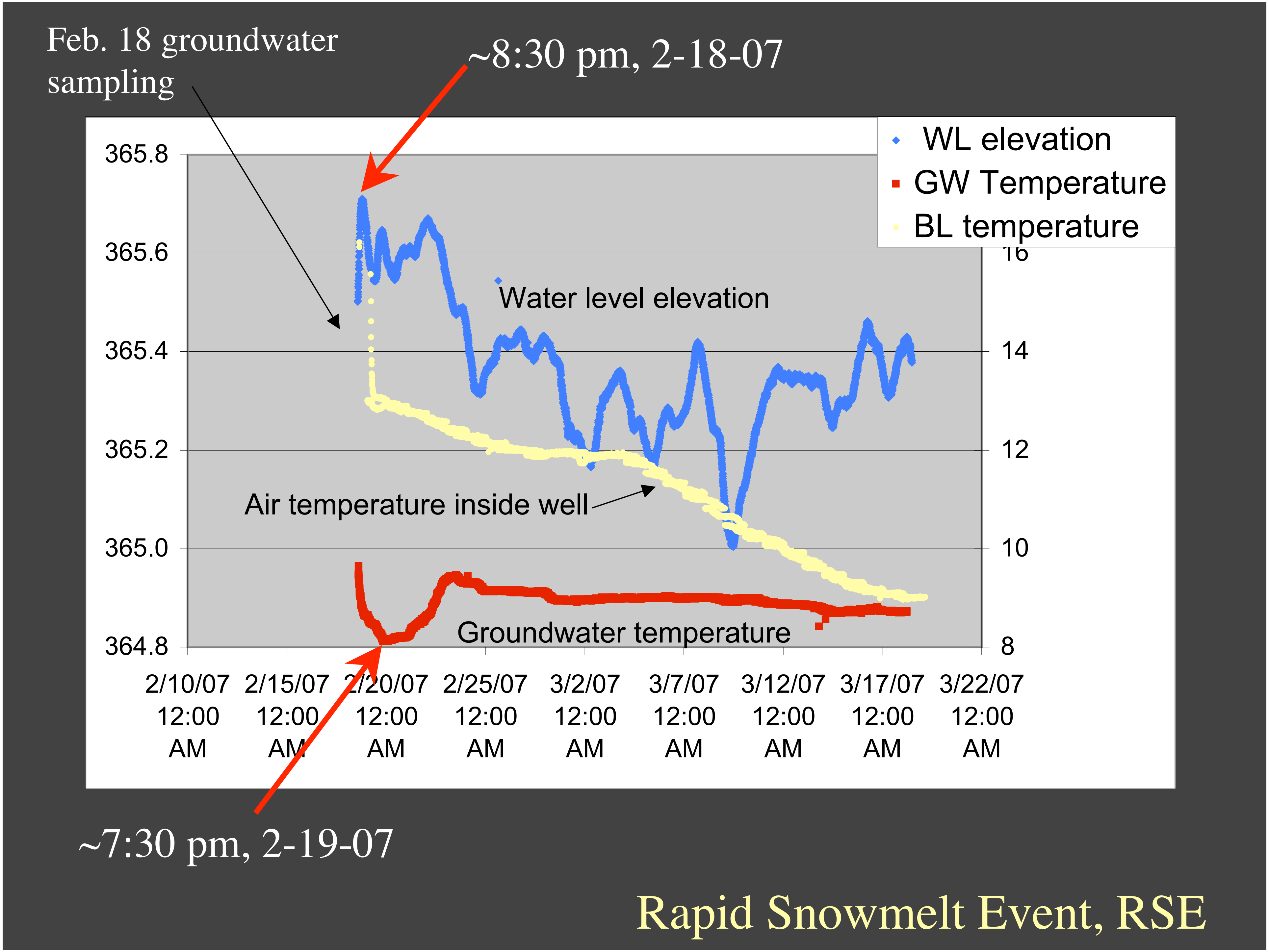
	Boron	$\delta^{11}B$	Source
A:	low	low	grass phytoliths?
B:	intermed.	high	rain?
C:	high	low	bedrock?



Nutrient export

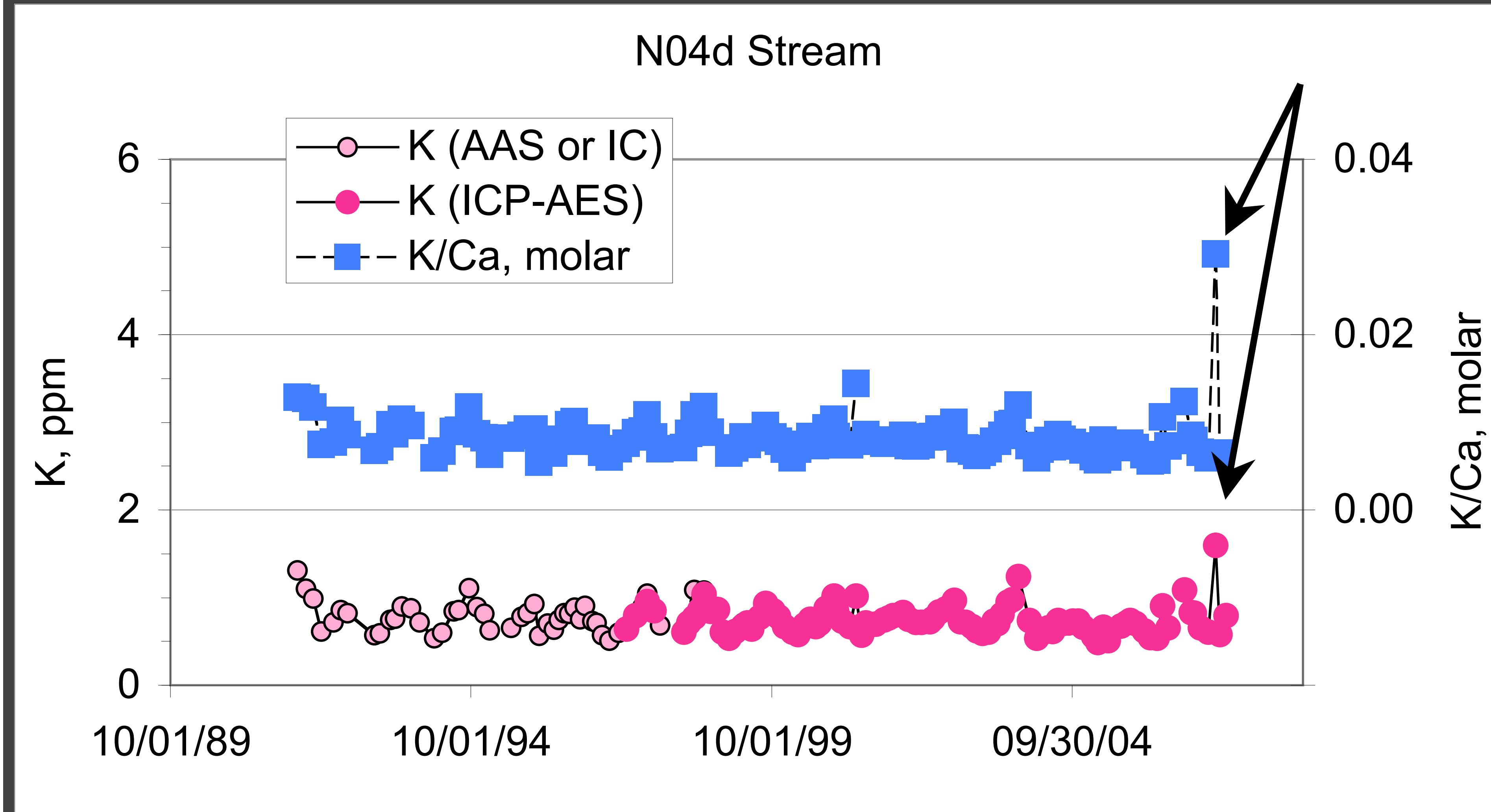


Rapid Snowmelt Event (RSE)

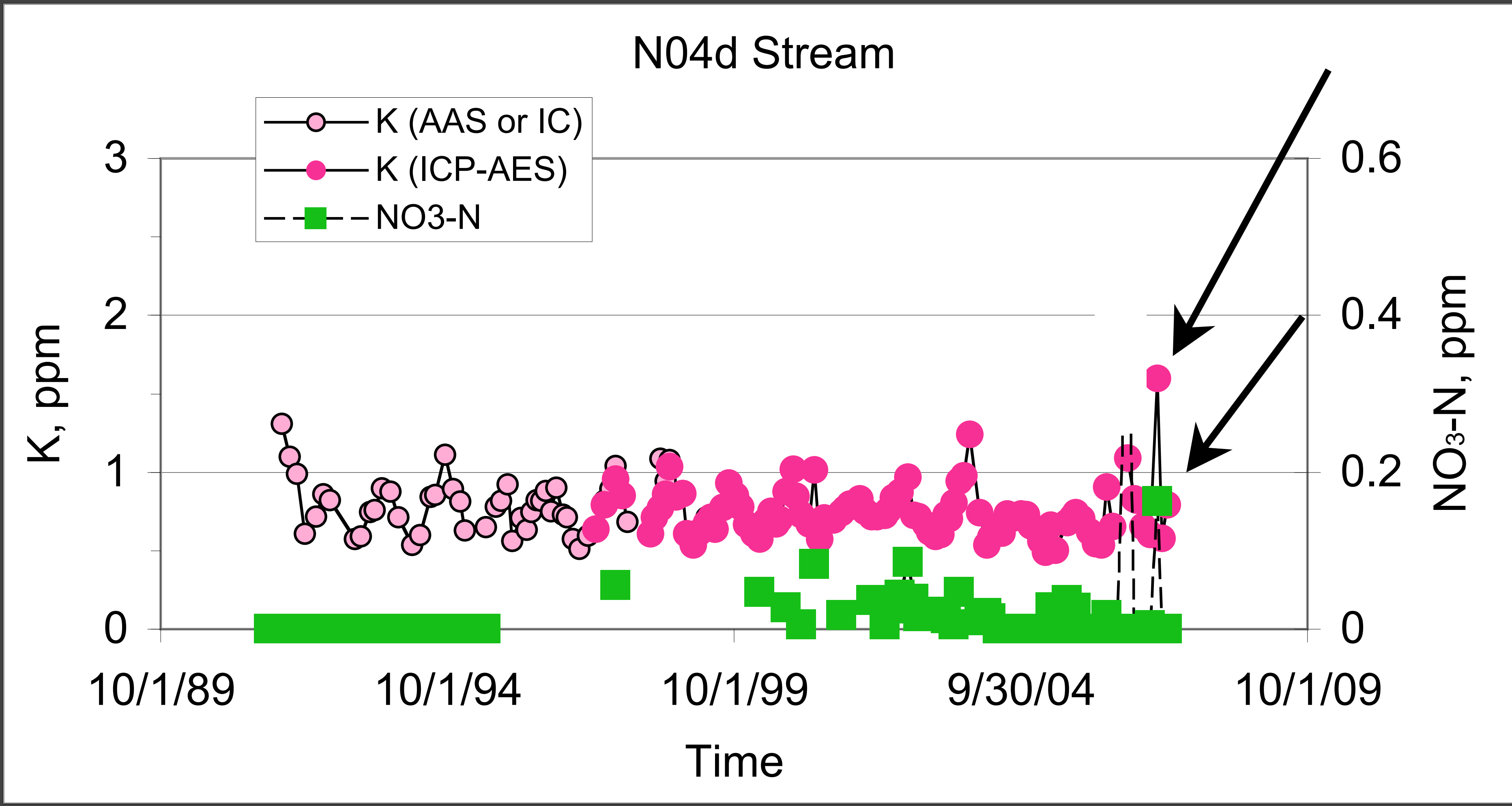


Feb. 18 groundwater sampling
~8:30 pm, 2-18-07
WL elevation
GW Temperature
BL temperature
365.8
365.6
365.4
365.2
365.0
364.8
16
14
12
10
8
Water level elevation
Air temperature inside well
Groundwater temperature
2/10/07 12:00 AM
2/15/07 12:00 AM
2/20/07 12:00 AM
2/25/07 12:00 AM
3/2/07 12:00 AM
3/7/07 12:00 AM
3/12/07 12:00 AM
3/17/07 12:00 AM
3/22/07 12:00 AM
~7:30 pm, 2-19-07
Rapid Snowmelt Event, RSE

Rapid Snowmelt Event, RSE



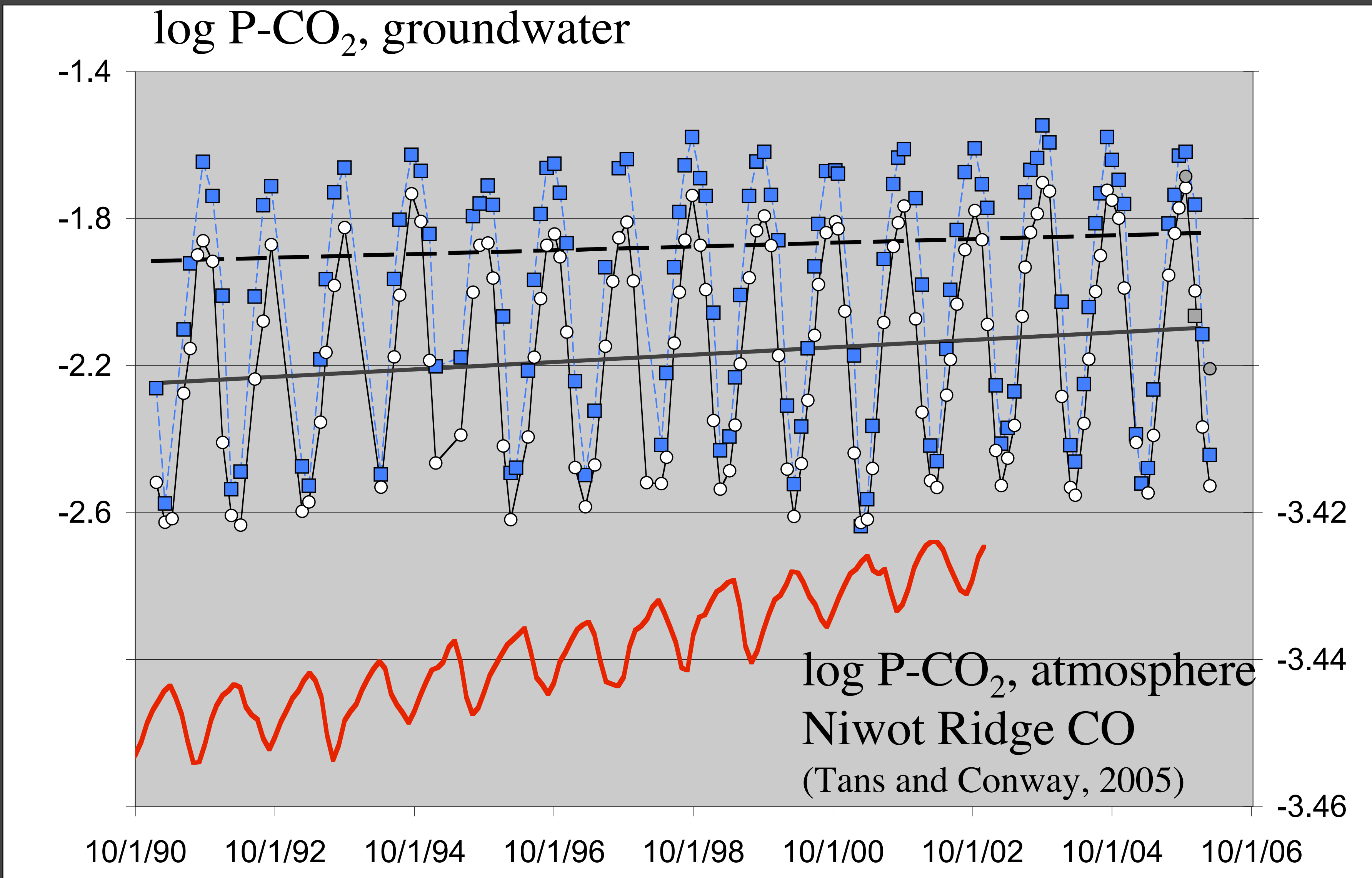
Rapid Snowmelt Event, RSE



CO_2 1990-2005

Groundwater CO_2 increase: ~20% (2100 ppm)

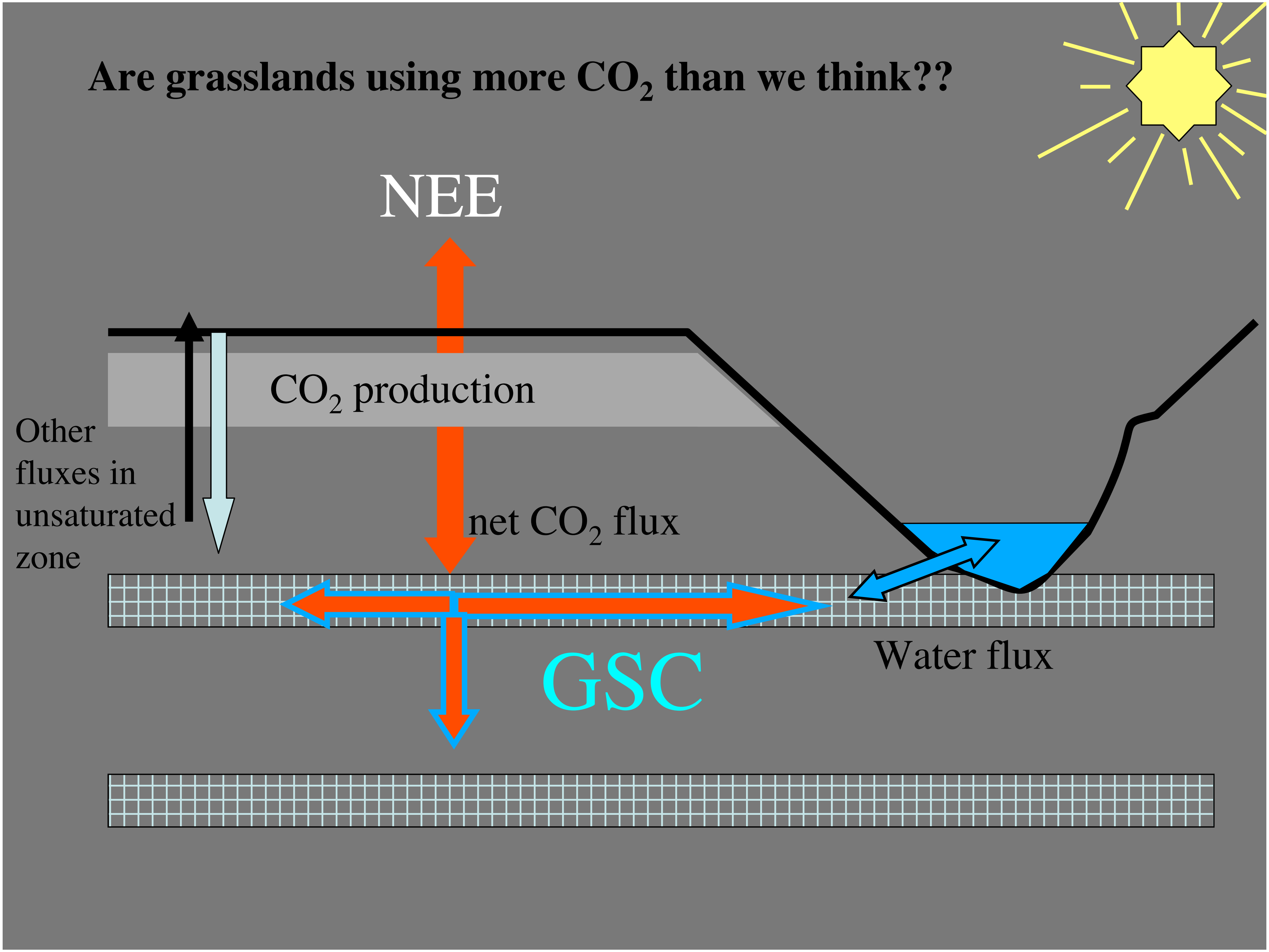
Atmospheric CO_2 increase: ~7% (23 ppm)



Planning for the future (cont'd)…

- Develop new initiatives for LTER VI
  - Grassland responses to chronic N enrichment
  - Chronosequence of sites for restoration studies
  - Bison and fire as drivers of spatial patterns and consumer responses; linkages across temporal and spatial scales
  - Potential changes in fire/grazing treatments (?) to promote new science while ensuring site integrity
  - Groundwater sequestration of grassland CO_2
- Integration of LTER with other major bioscience initiatives (LTER Regional Science Initiative, NEON, KSU Ecological Genomics program)

Are grasslands using more CO_2 than we think??



Hydrogeochemistry –the future

- Will annual cycles change because of changing lengths of seasons?
- With less meteoric precipitation, will chemical weathering affect bedrock relatively more?
- With a drier climate, will dust imports become more important, “restock” the soils with easily weatherable solids?
- With change in flora (more C3’s? or more zerophytes??), will biogeochemical cycling change?
- Is there an atmosphere-groundwater CO_2 link, and will it cause faster chemical weathering?

Approaches

- Watershed-scale measurements:
  - Soil CO_2 to groundwater -- quantify the flux
  - Dust import--quantify the flux
  - Trace element cycling--what is unique about grasslands?
  - Cross-site comparisons toward a global assessment
- Experiments:
  - Isotope-tagged CO_2 transport