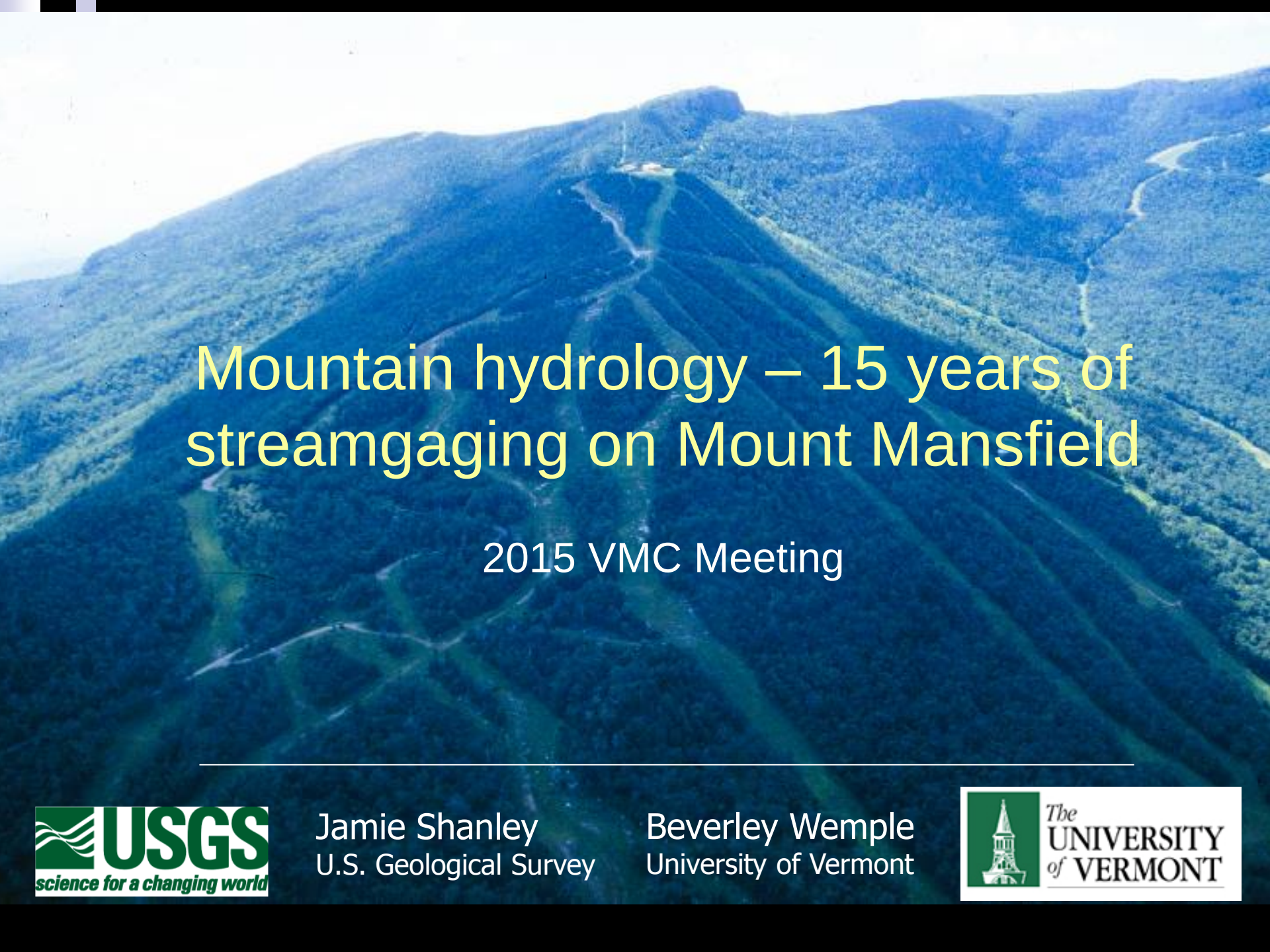


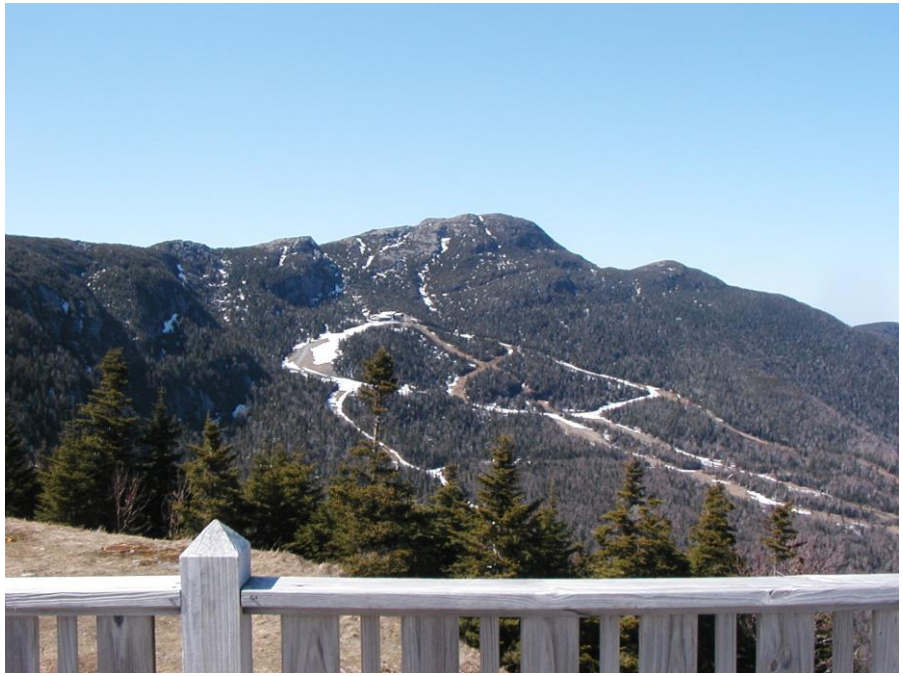
Mountain hydrology – 15 years of streamgaging on Mount Mansfield

2015 VMC Meeting

Jamie Shanley
U.S. Geological Survey

Beverley Wemple
University of Vermont

Outline

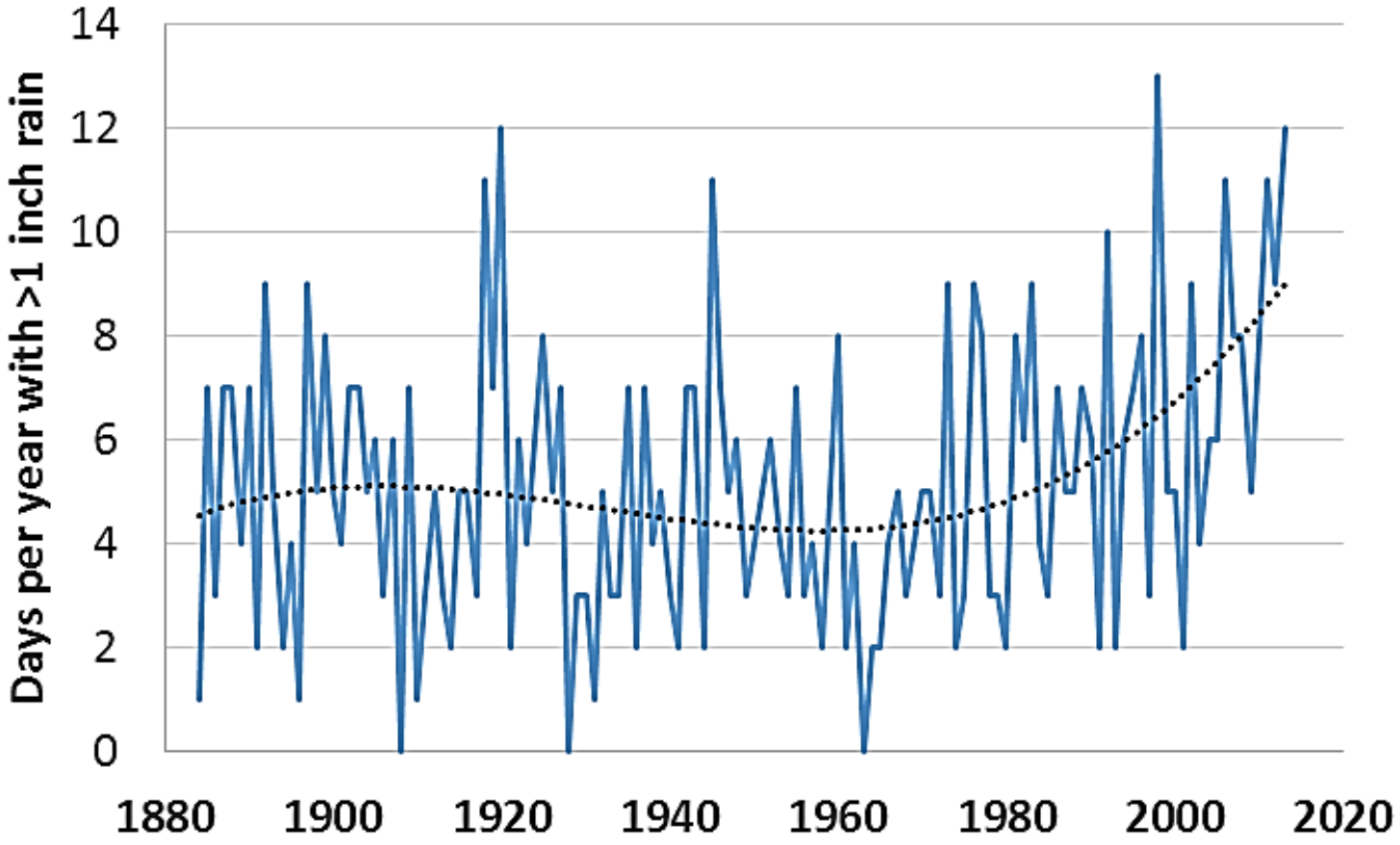


- 1. Need for water science in the high elevations
- 2. Paired watershed study background
- 3. Differences in flow
- 4. Extreme events
- 5. Water quality

High elevation pressures

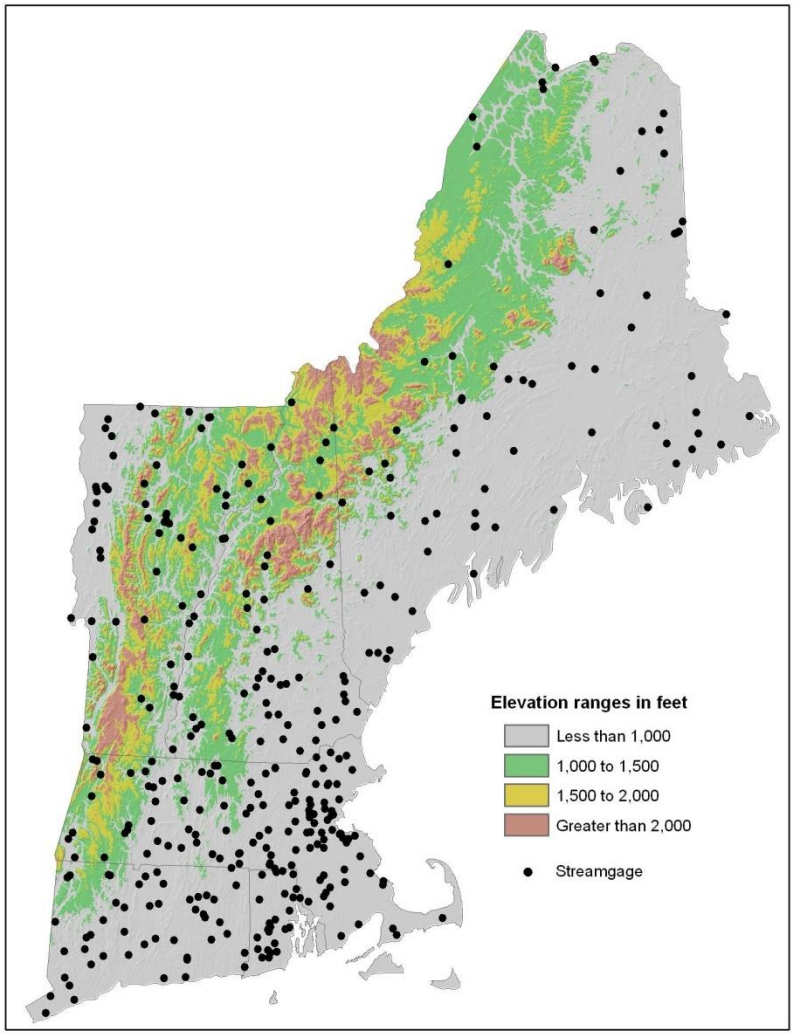
Climate pressures

Number of days per year with greater than 1" of precipitation (BTV station).



Vermont Climate Assessment, 2014

The need for science



In New England….

One-third of the land area is over 1000', but only 4% of the USGS stream gages.

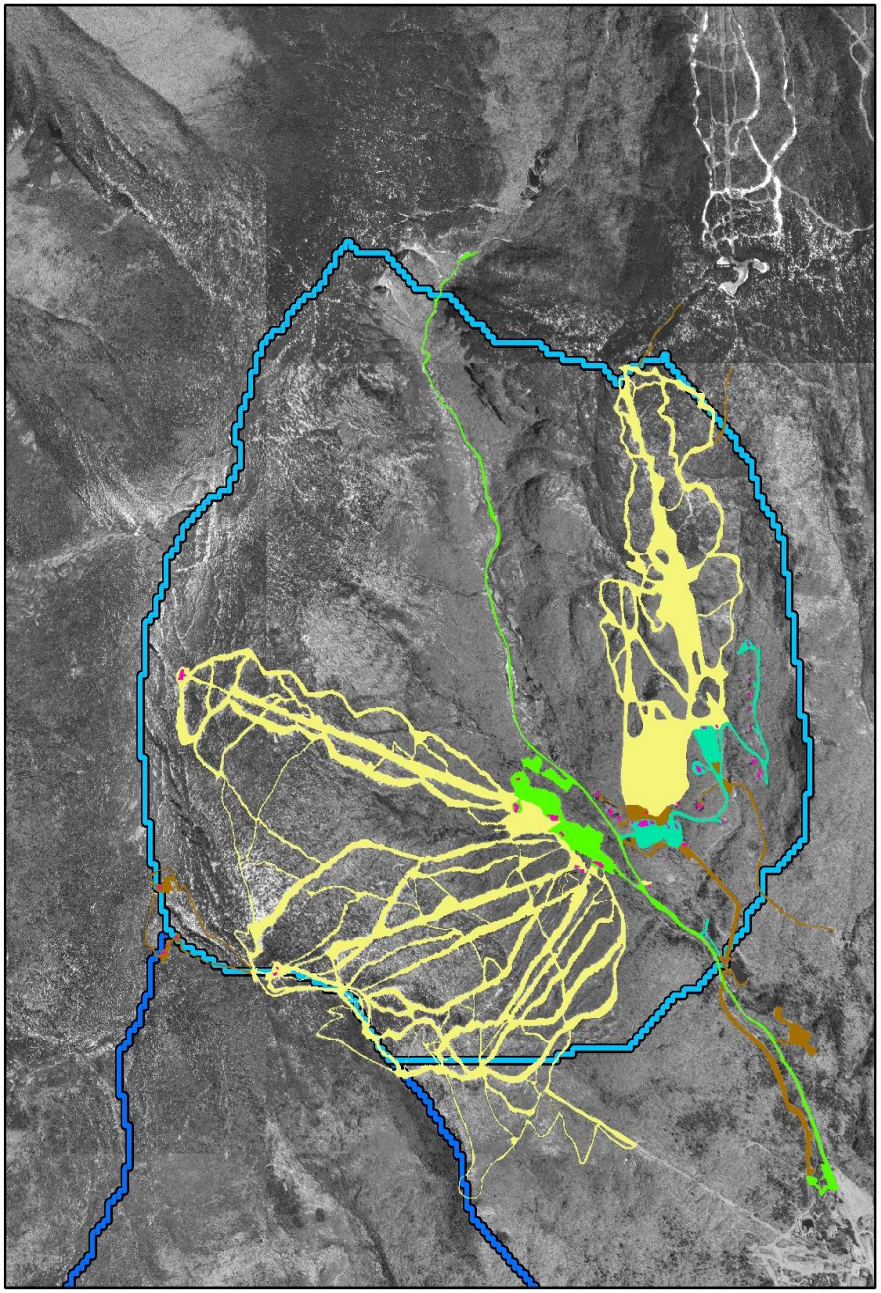
Water - a unifying theme

Many high-elevation stressors center on water

- Too much (flooding, erosion)
- Too little (snowmaking withdrawals)
- Aquatic habitat degradation (in-stream flow, embeddednes
- Water quality degradation (sediment, acid rain, salt)
- Water supply (quantity and quality)
- Wastewater disposal (thin soils)

Mt. Mansfield paired-watershed study

Paired Watershed Stowe Trail/Road Map



Surface Type

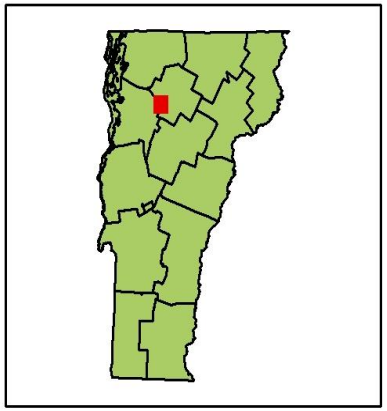
- Building
- Exposed Soil Surface
- Gravel Surface
- Paved Surface
- Ski Trail
- West Branch Watershed
- Ranch Brook Watershed

Roads, trails, parking lots, and buildings for the Stowe ski resort mapped from 1:5000 digital orthophotographs. Surface type was determined by a combination of visual interpretation of the ortho-photographs along with ancillary information from statewide trans-portation data. No accuracy assessment of any kind was performed.

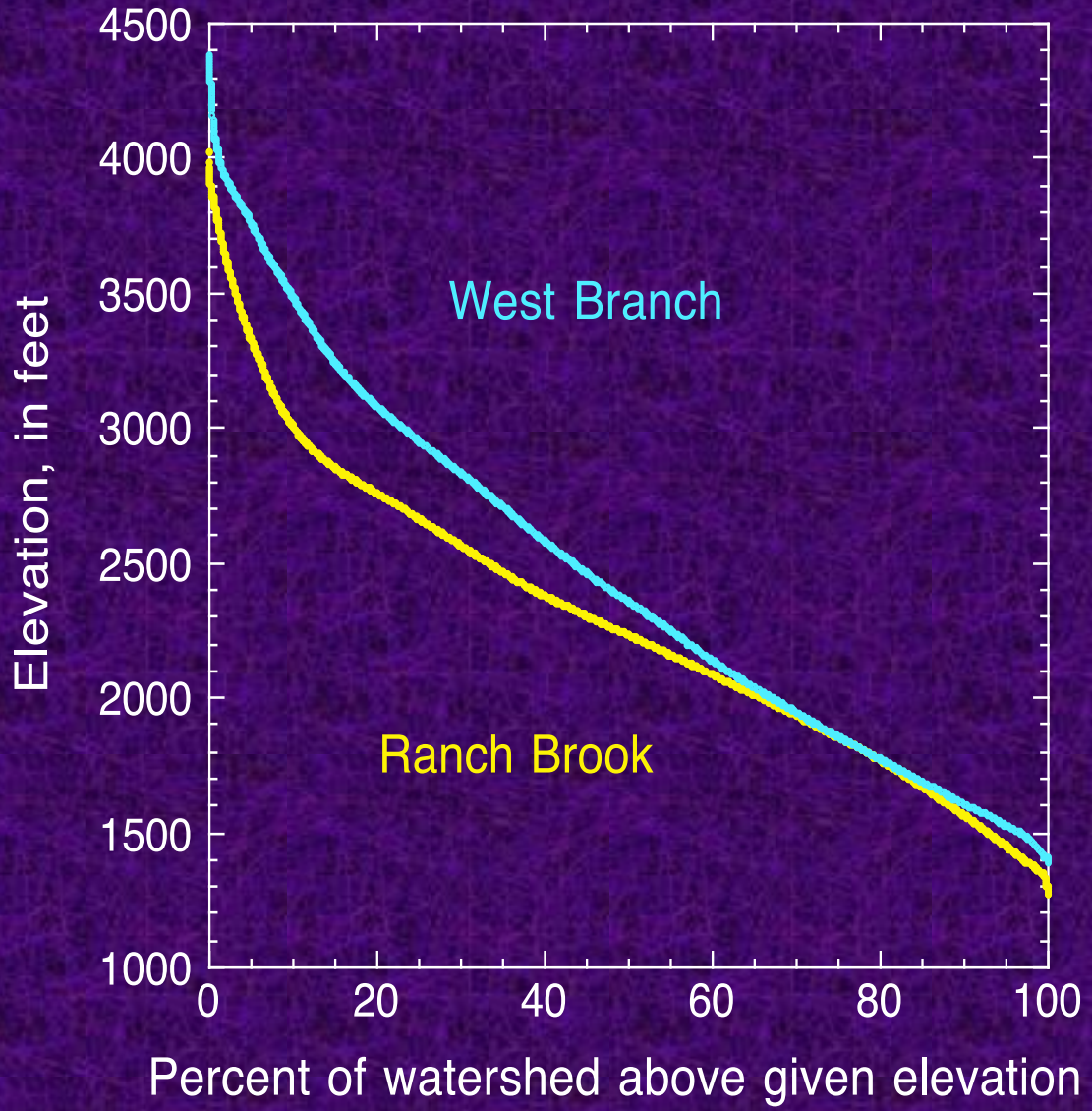
Produced by:
Jarlath O'Neil-Dunne
UVM Spatial Analysis Lab
22 May 02

N

0 0.25 0.5 1 1.5 km

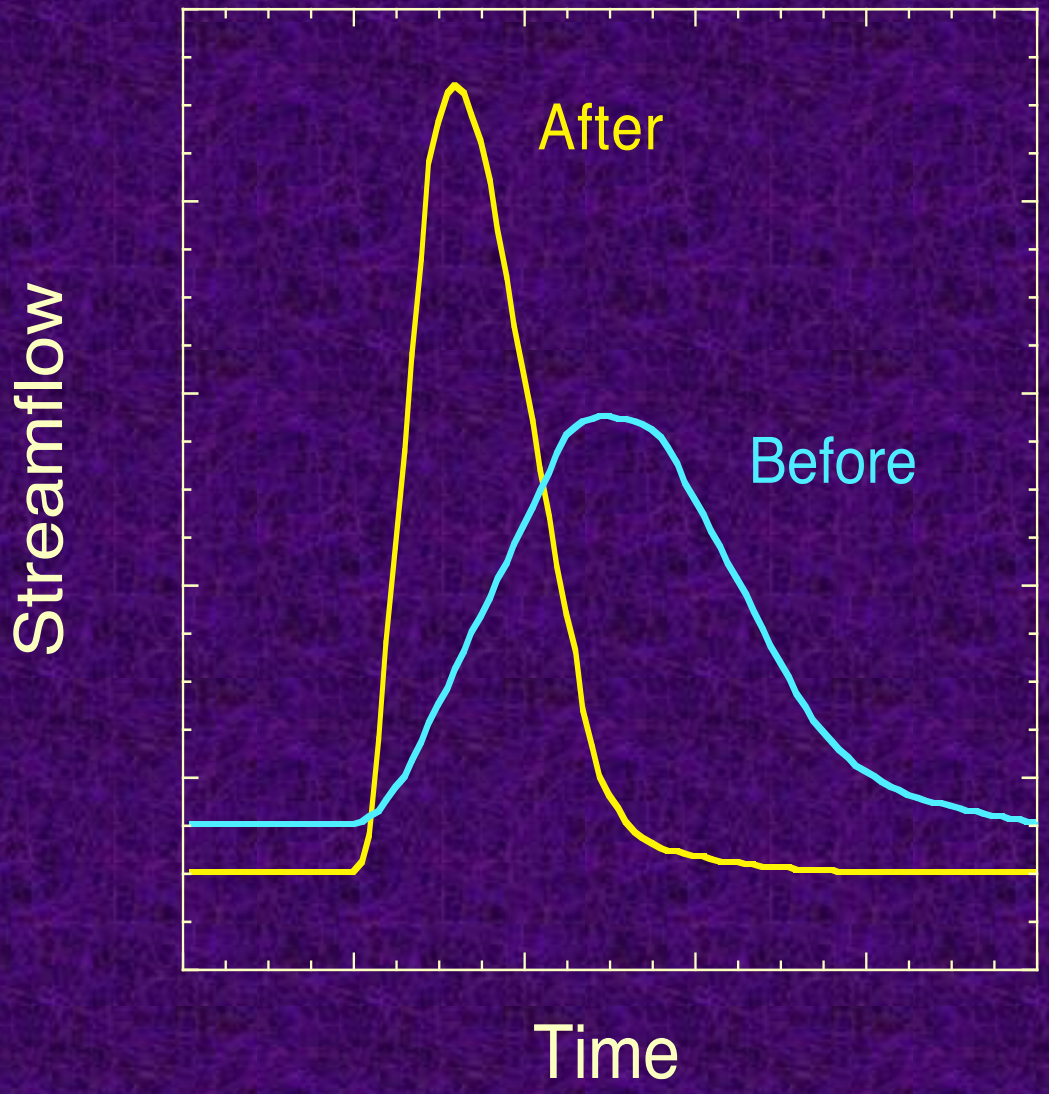


Hypsometric curves

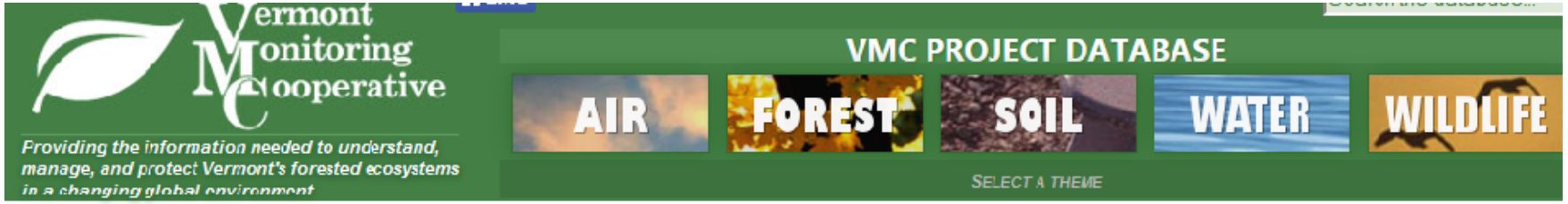



Ranch
Brook

Effect of Development



VMC website



Paired Watershed Study on the East Slope of Mount Mansfield: Hydrologic Monitoring

SUMMARY | METADATA | DATA | DOCUMENTS

CURRENT PARTICIPANT(S)	E. Perry Thomas Jon Denner (Principal Investigator) Beverley Wemple James Kellogg Jamie Shanley (Principal Investigator) Donald Ross
PAST PARTICIPANT(S)	Tim Scherbatskoy (1969 - 2000)
PROJECT DESCRIPTION	(2000 07 01 Current) Establish stream gages on Ranch Brook and West Branch to initiate long-term hydrology and water quality program including: baseline conditions, trends in stream acid/base status, and suspended sediment output. To provide a watershed framework for other VMC efforts including nutrient cycling, forest health assessments, and biological monitoring.
LINK TO DATA	West Branch - Live feed of stream gage data Ranch Brook - Live feed of stream gage data

USGS real-time streamflow website

West Branch

USGS 04288225 W BRANCH LITTLE R ABV BINGHAM FALLS NEAR STOWE, VT

PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site Time-series: Current/Historical Observations GO

Available Parameters	Available Period
All 4 Available Parameters for this site	
00065 Gage height	2007-10-01 2012-11-18
00060 Discharge	2007-10-01 2012-11-18
70969 DCP battery voltage	2012-08-08 2012-11-18
99234 Autosampler count	2012-07-26 2012-11-18

Output format: Graph / Graph w/ stats / Graph w/o stats / Table / Tab-separated

Days (7) -- or -- Begin date 2012-11- End date 2012-11-

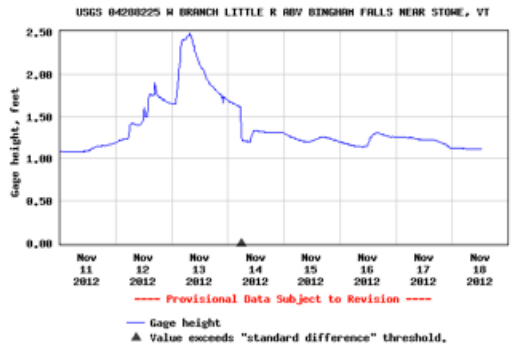
GO

Summary of all available data for this site

Instantaneous-data availability statement

Gage height, feet

Most recent instantaneous value: 1.11 11-18-2012 12:35 EST



Ranch Brook

USGS 04288230 RANCH BROOK AT RANCH CAMP, NEAR STOWE, VT

PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site Time-series: Current/Historical Observations GO

Boating safety tips

This station managed by the Montpelier, VT Field Office.

Available Parameters	Available Period
All 2 Available Parameters for this site	
00065 Gage height	2007-10-01 2012-11-18
00060 Discharge	2007-10-01 2012-11-18

Output format: Graph / Graph w/ stats / Graph w/o stats / Table / Tab-separated

Days (7) -- or -- Begin date 2012-11- End date 2012-11-

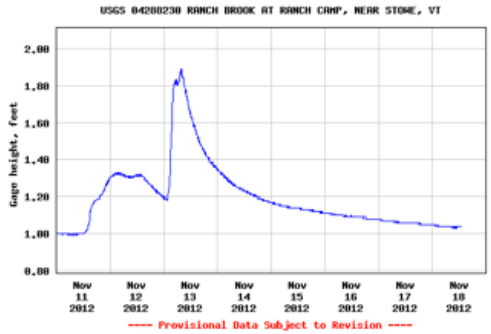
GO

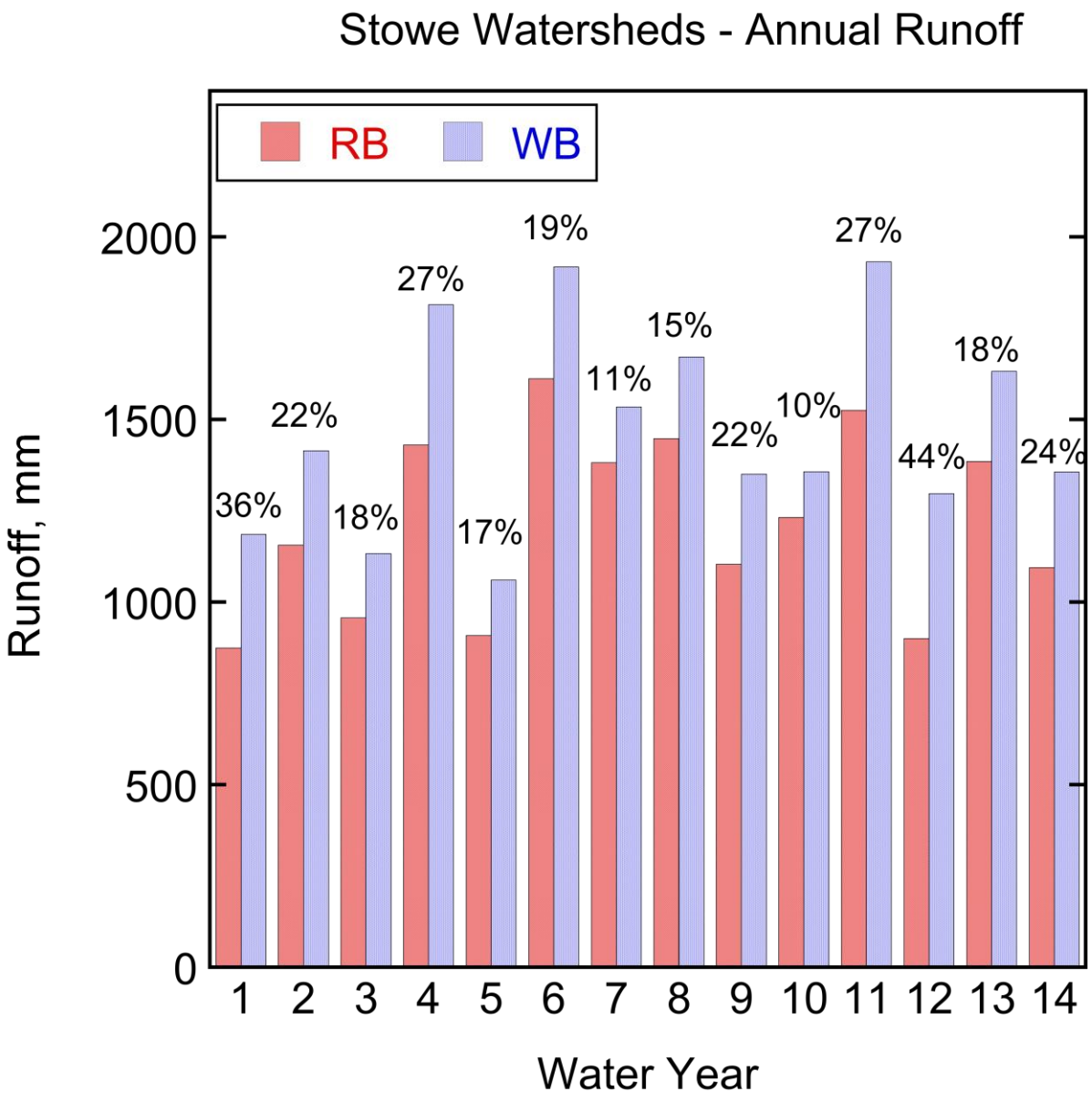
Summary of all available data for this site

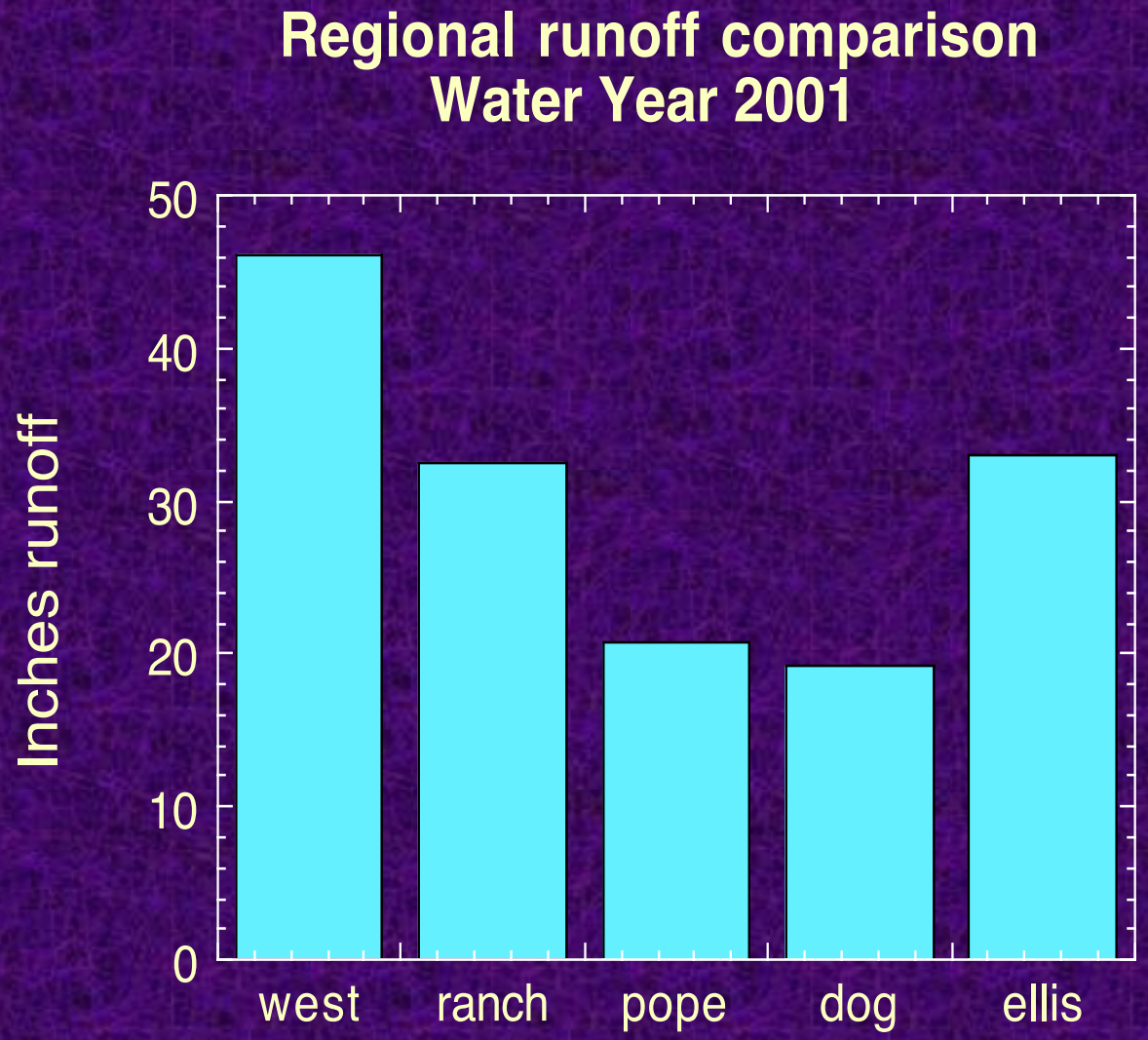
Instantaneous-data availability statement

Gage height, feet

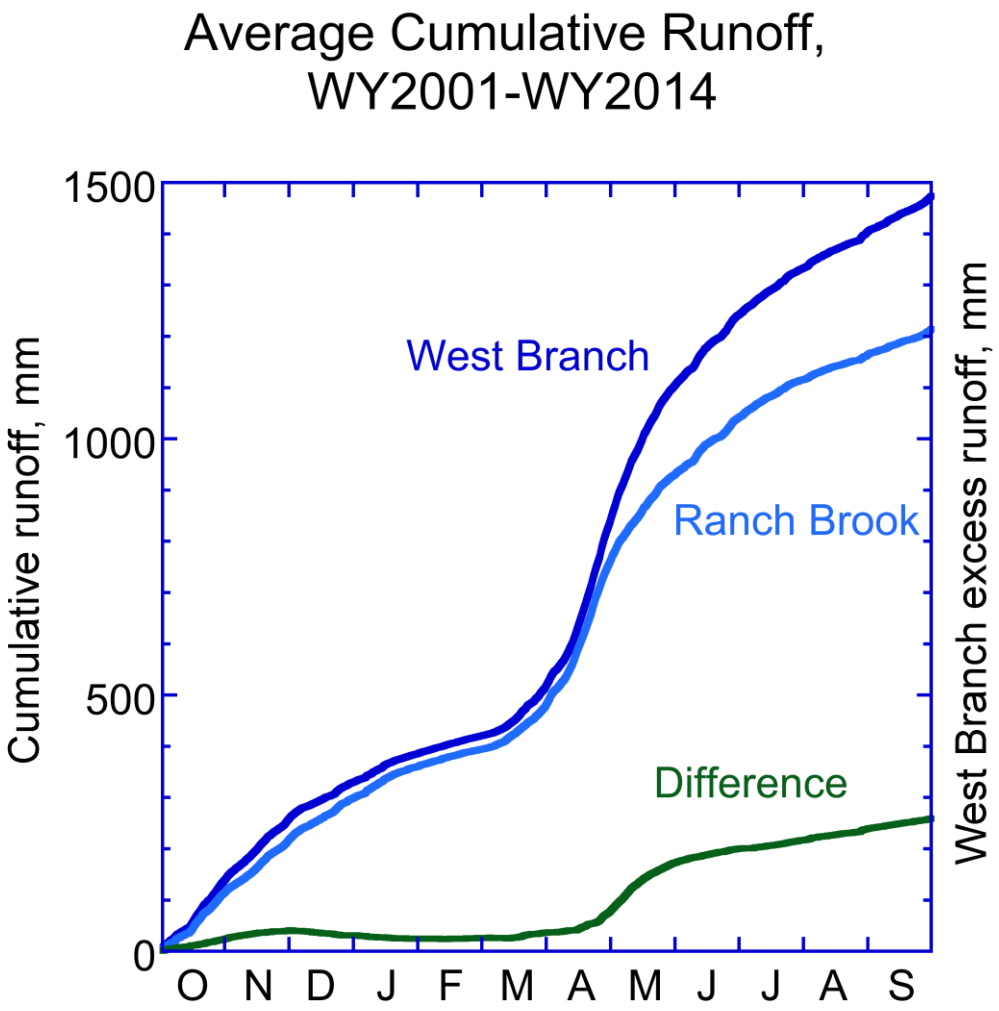
Most recent instantaneous value: 1.04 11-18-2012 12:55 EST

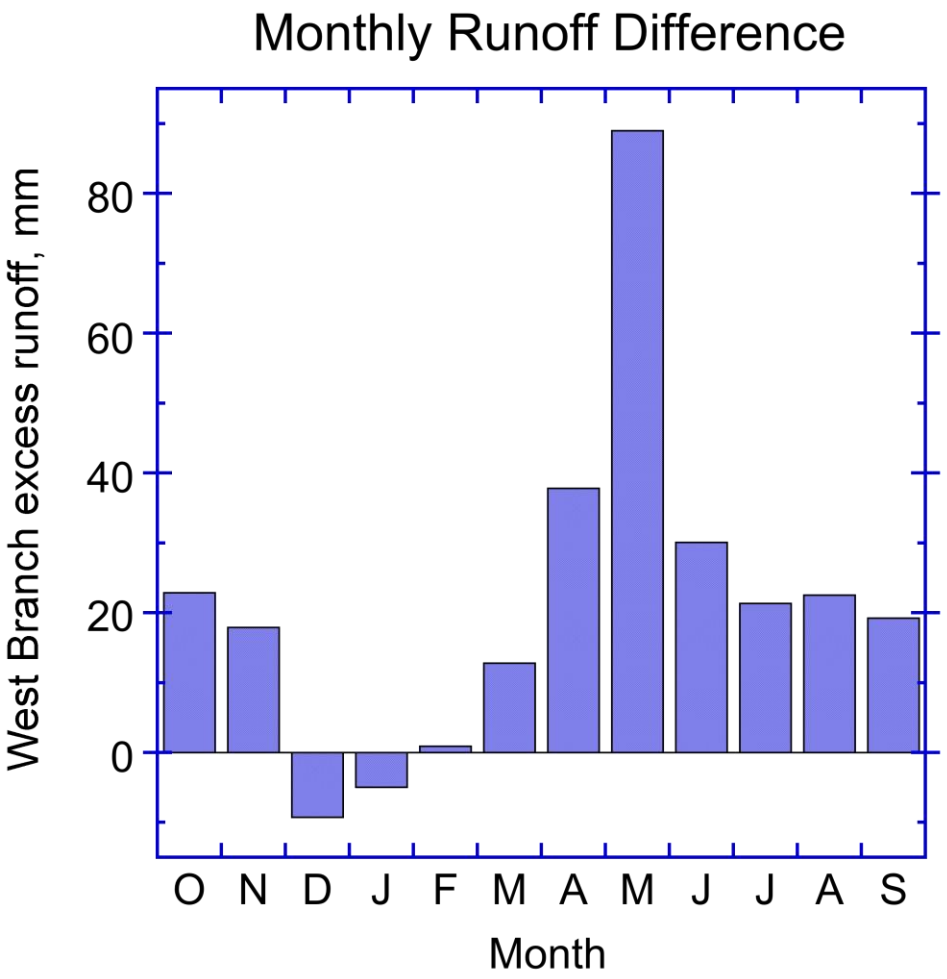


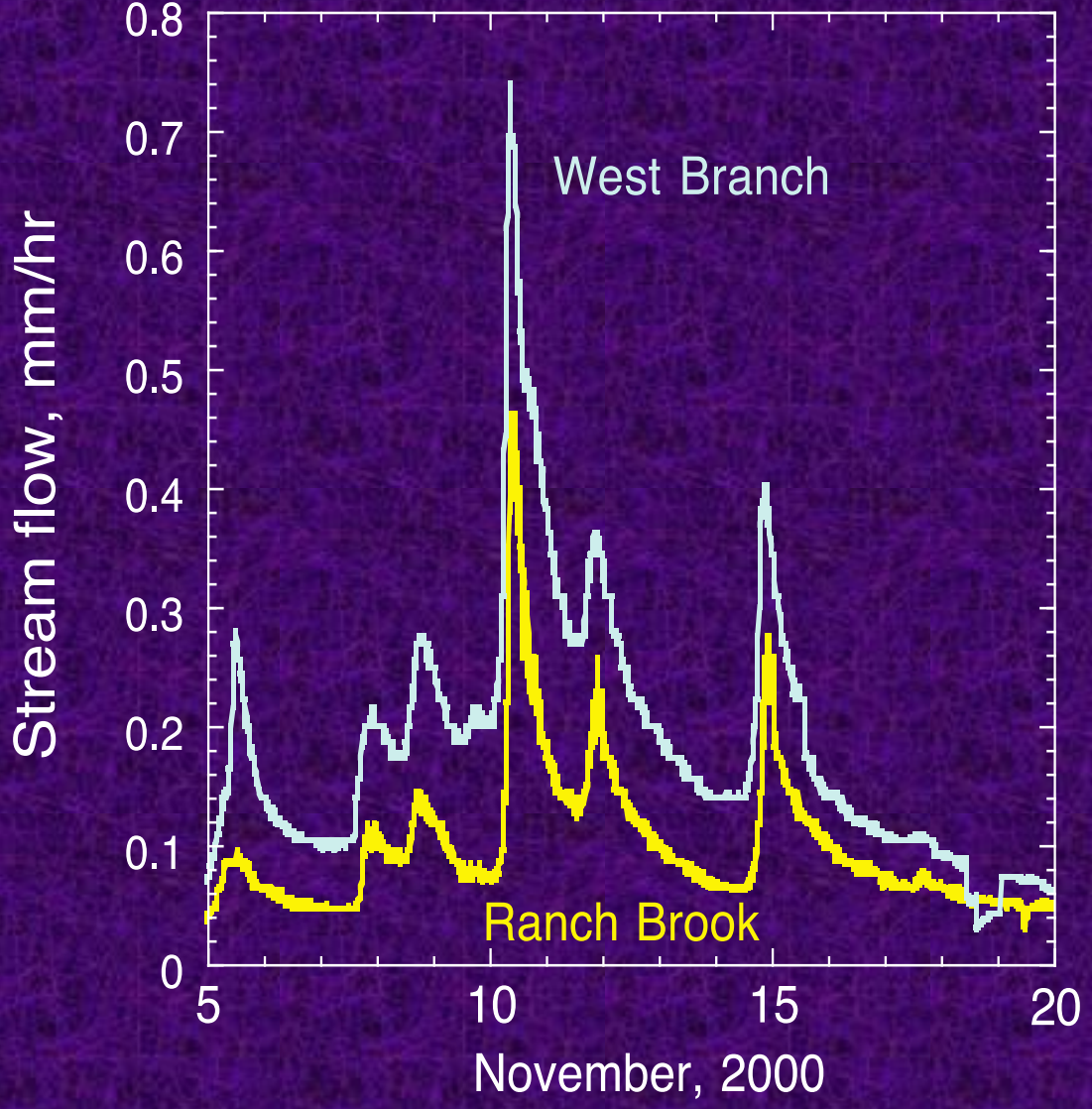

Stowe Watersheds - Annual Runoff
RB
WB
Runoff, mm
2000
1500
1000
500
0
36%
22%
18%
27%
17%
19%
11%
15%
22%
10%
27%
44%
18%
24%
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Water Year

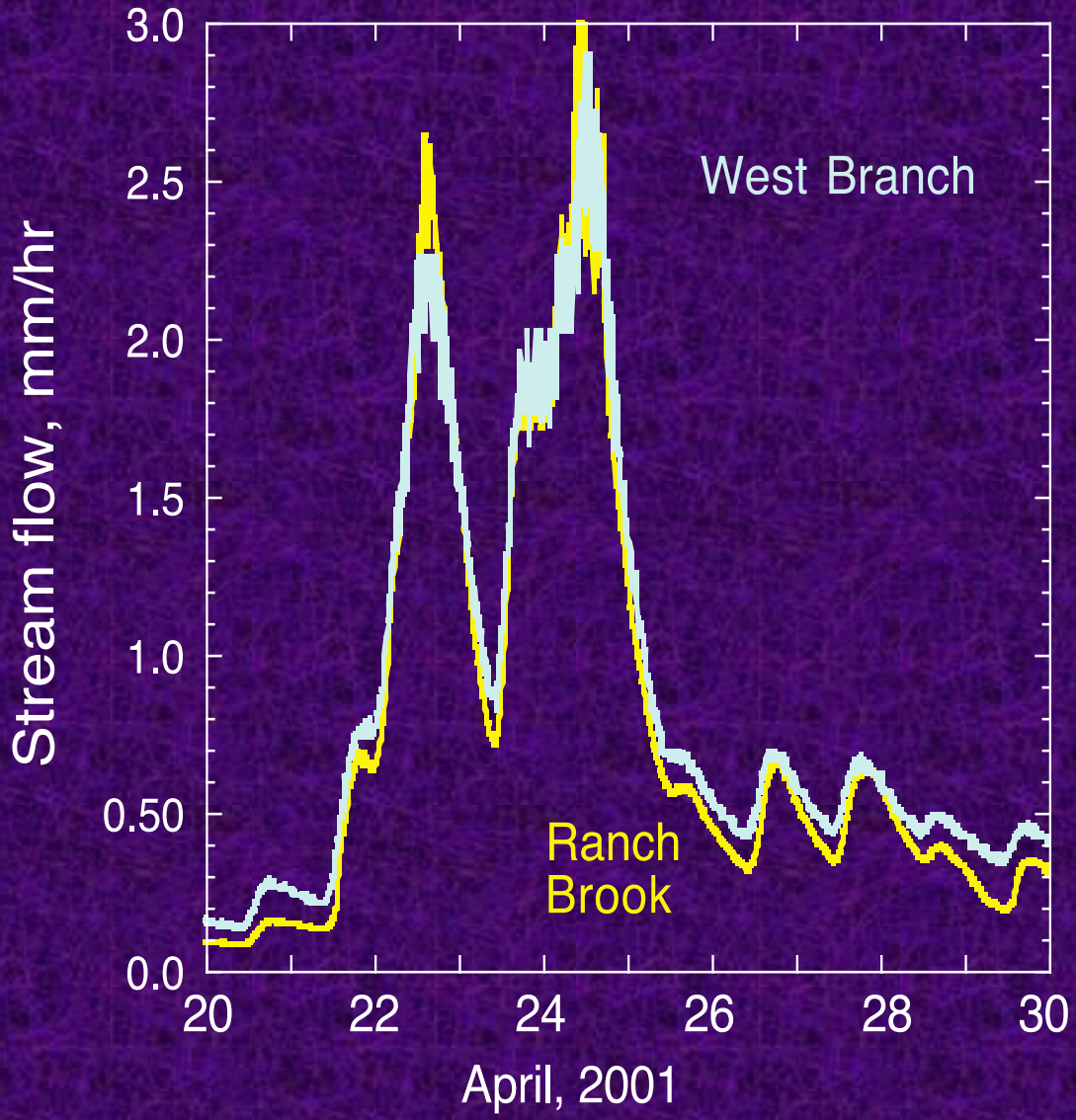

Regional runoff comparison
Water Year 2001
Inches runoff
50
40
30
20
10
0
west
ranch
pope
dog
ellis

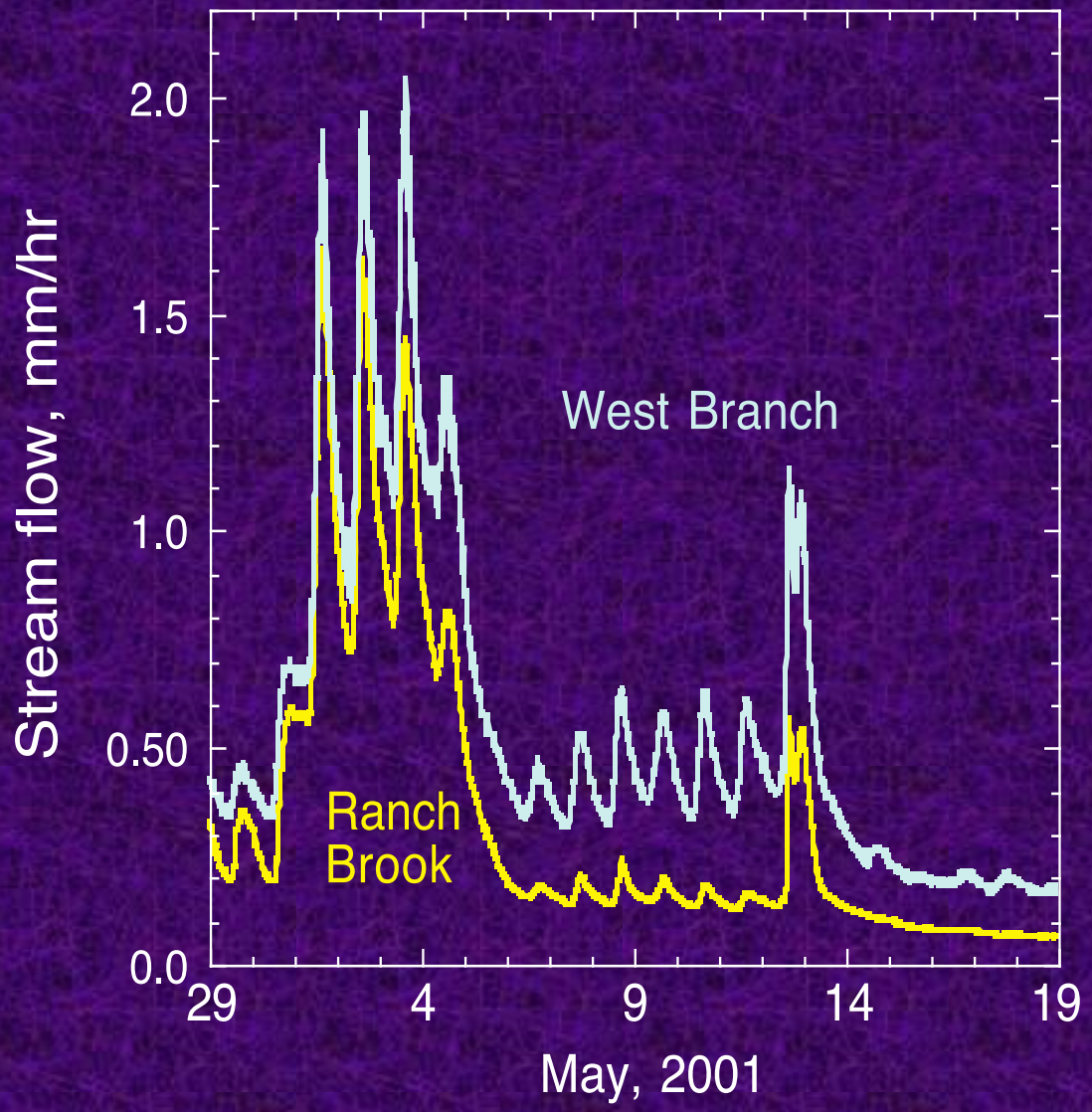
Pattern through the Year

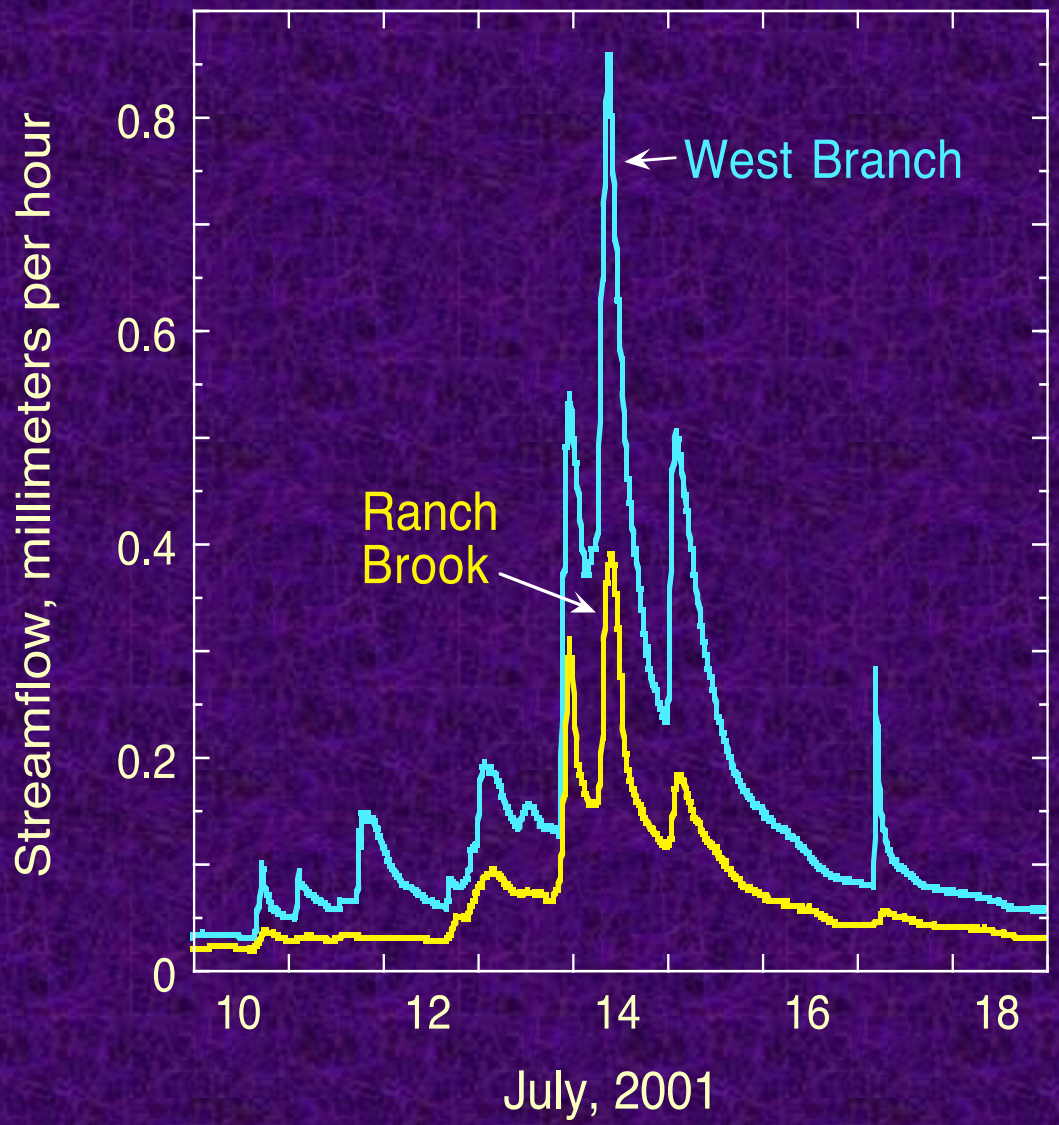




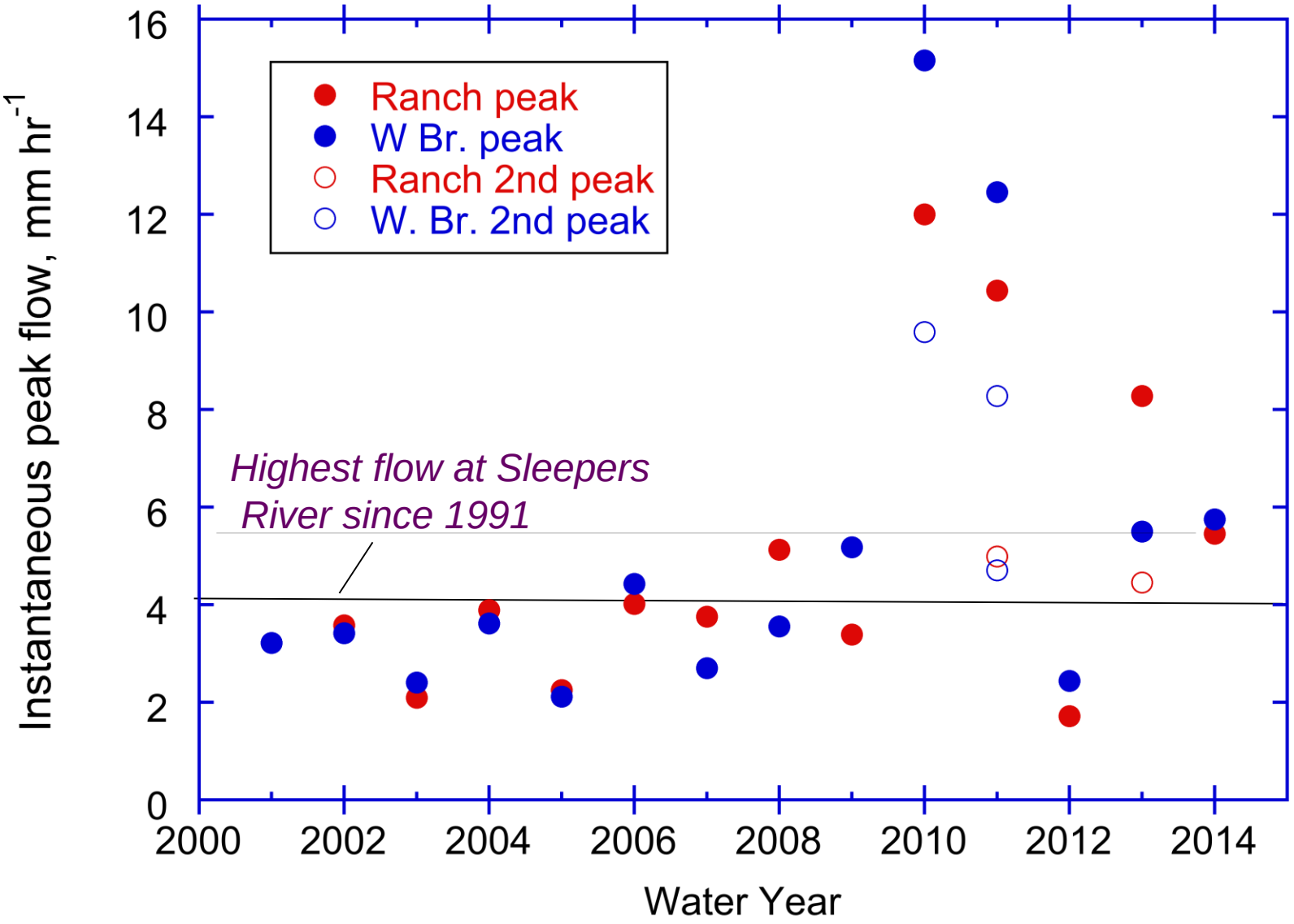

Stream flow, mm/hr
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
West Branch
Ranch Brook
5
10
15
20
November, 2000


Stream flow, mm/hr
3.0
2.5
2.0
1.5
1.0
0.50
0.0
20
22
24
26
28
30
April, 2001
West Branch
Ranch
Brook

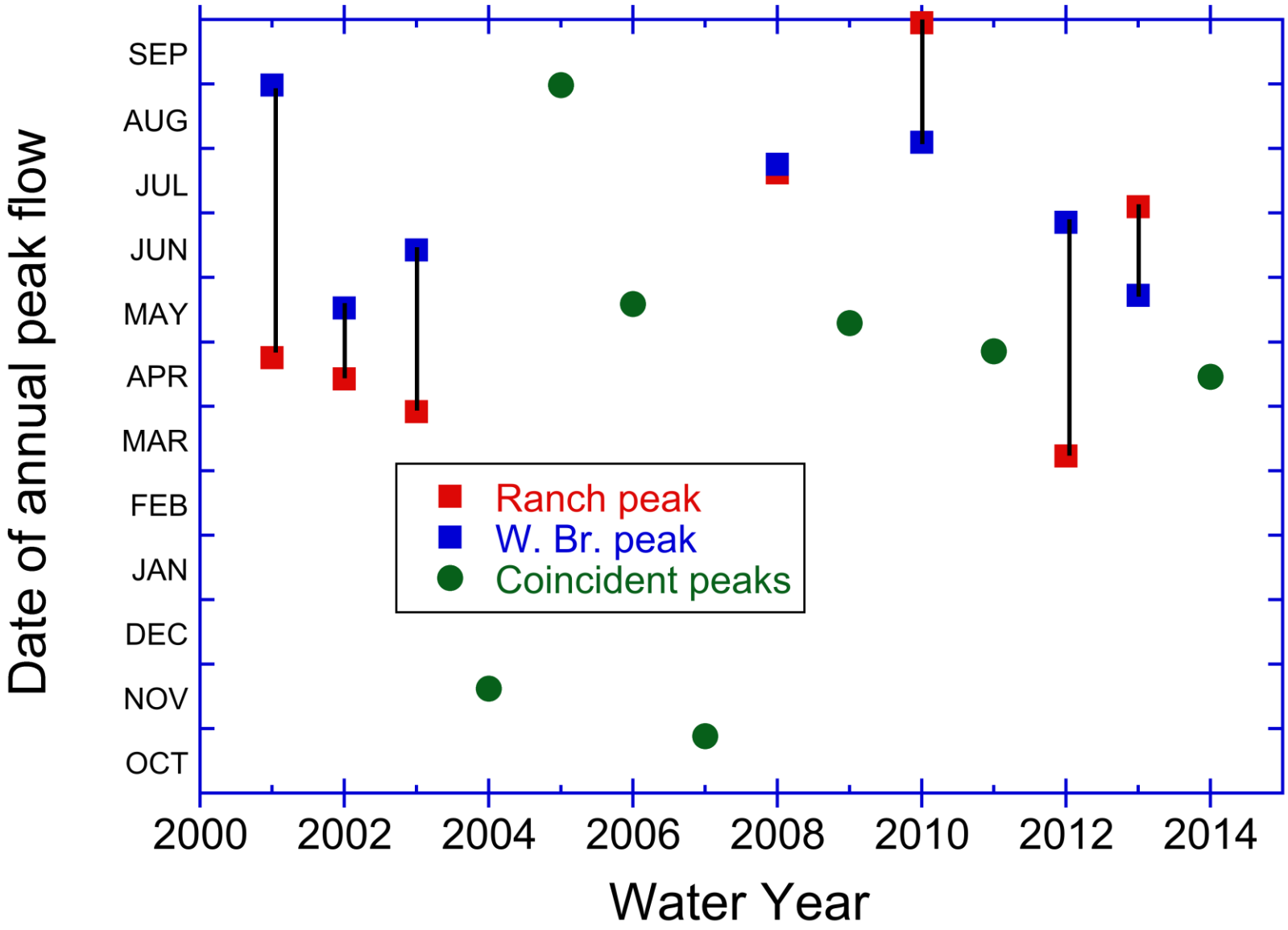

Stream flow, mm/hr
2.0
1.5
1.0
0.50
0.0
West Branch
Ranch
Brook
29
4
9
14
19
May, 2001


Streamflow, millimeters per hour
0.8
0.6
0.4
0.2
0
West Branch
Ranch
Brook
10
12
14
16
18
July, 2001

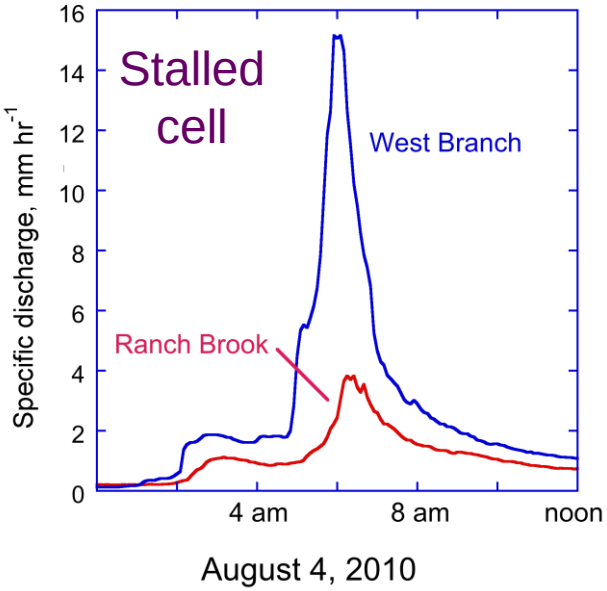
Increasing peak flows



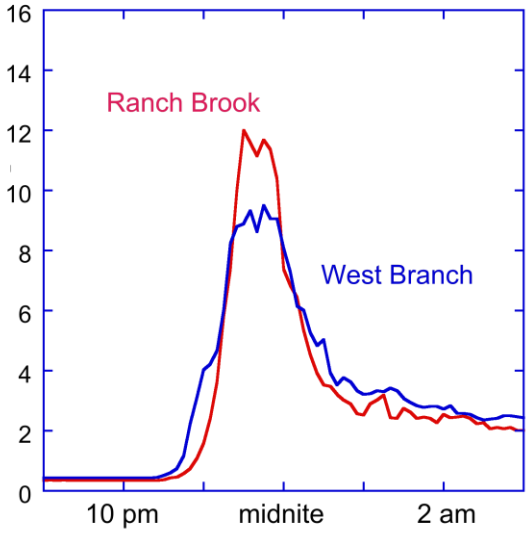
Annual peaks from different storms



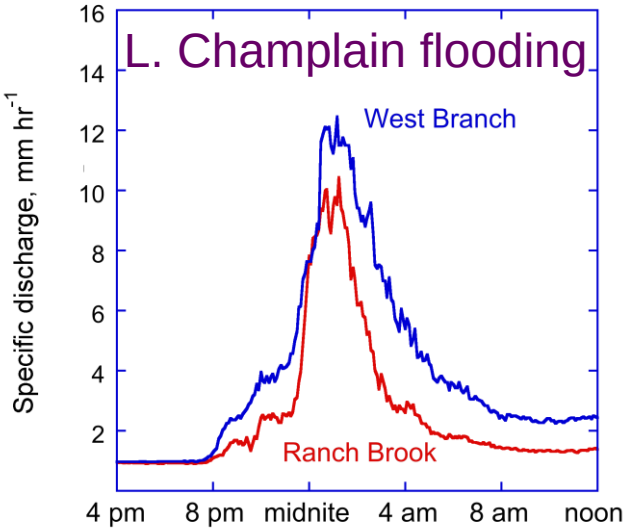
Five large peaks in 2010-2011



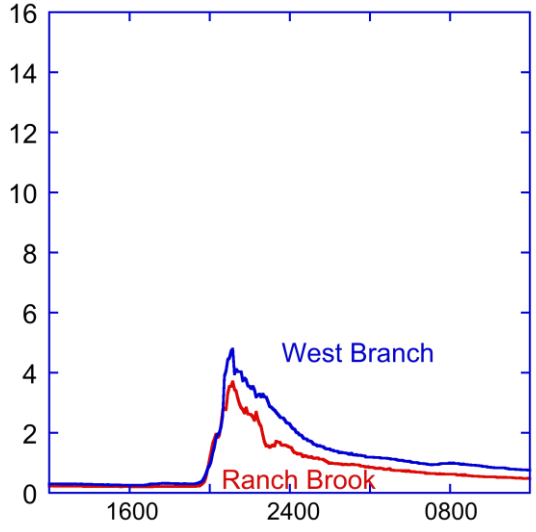
August 4, 2010



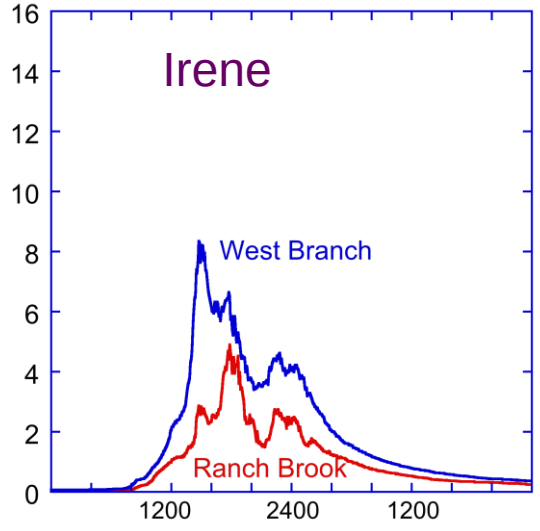
Sept. 30 - Oct 1, 2010



April 26-27, 2011

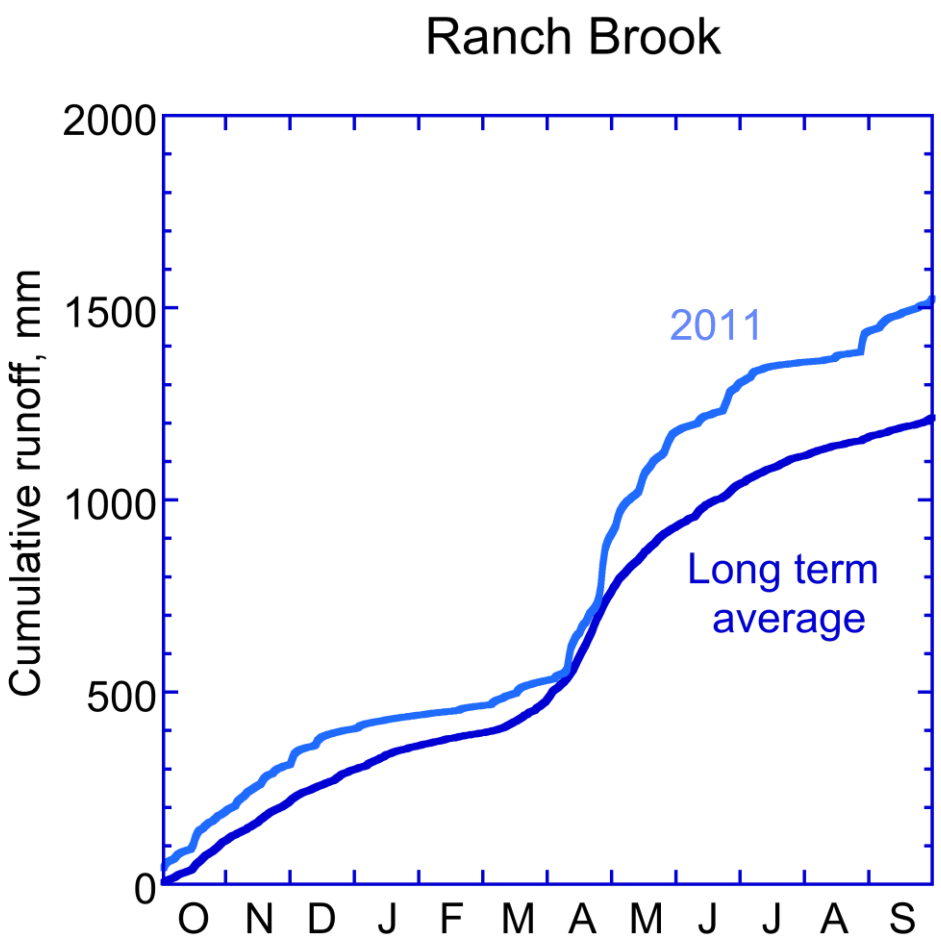


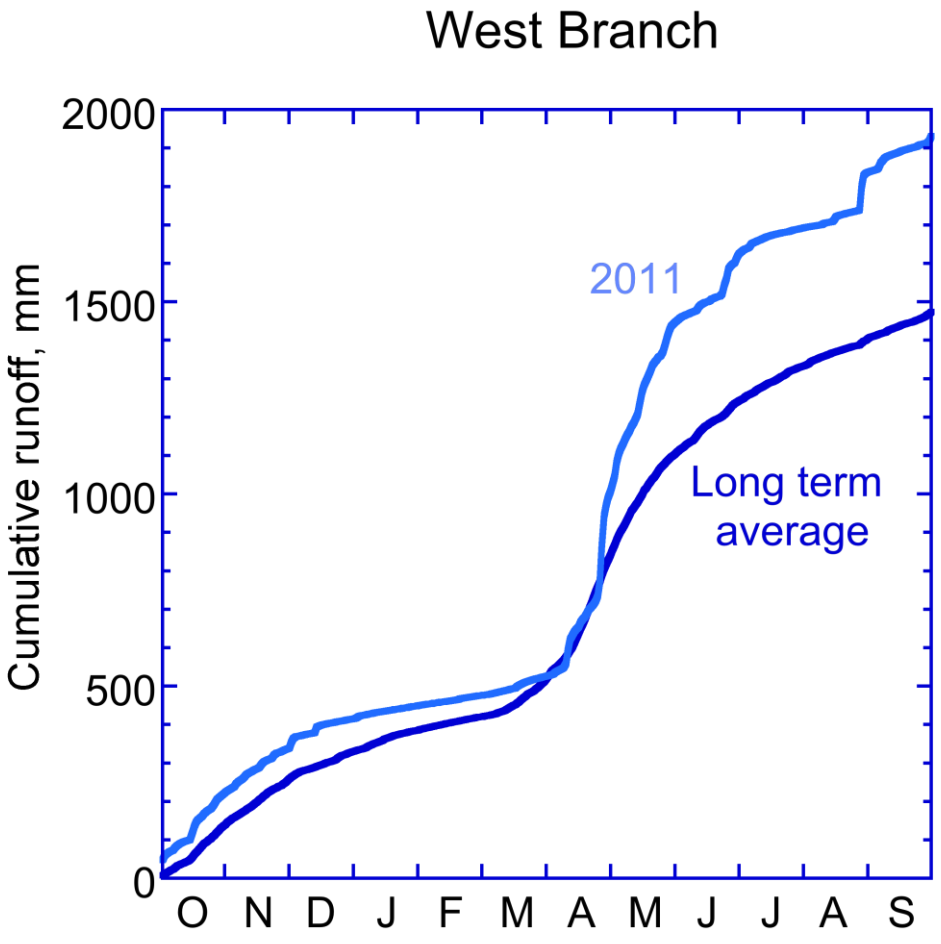
June 25 June 26



August 28 August 29

WY2011 on long-term average



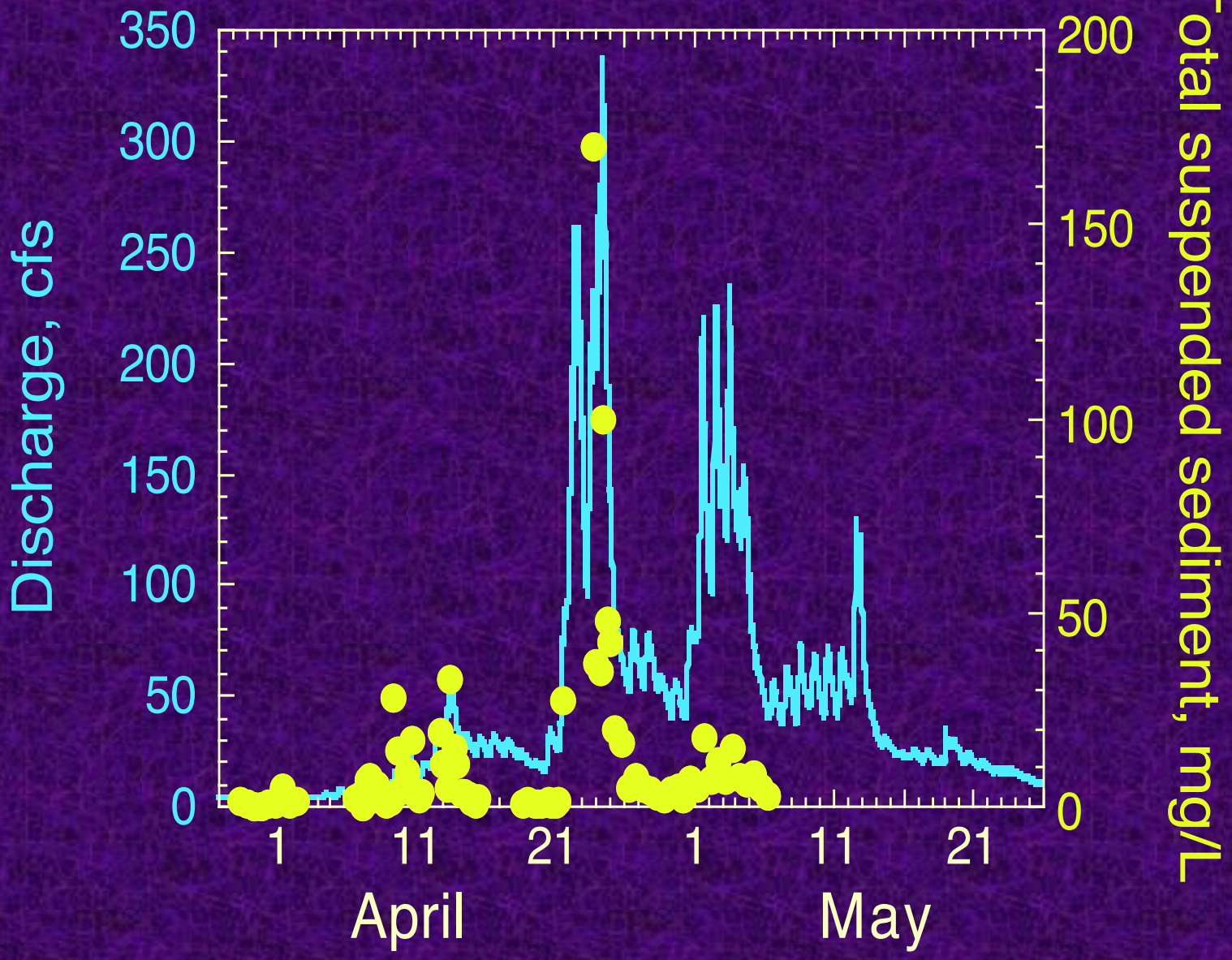


Extreme events

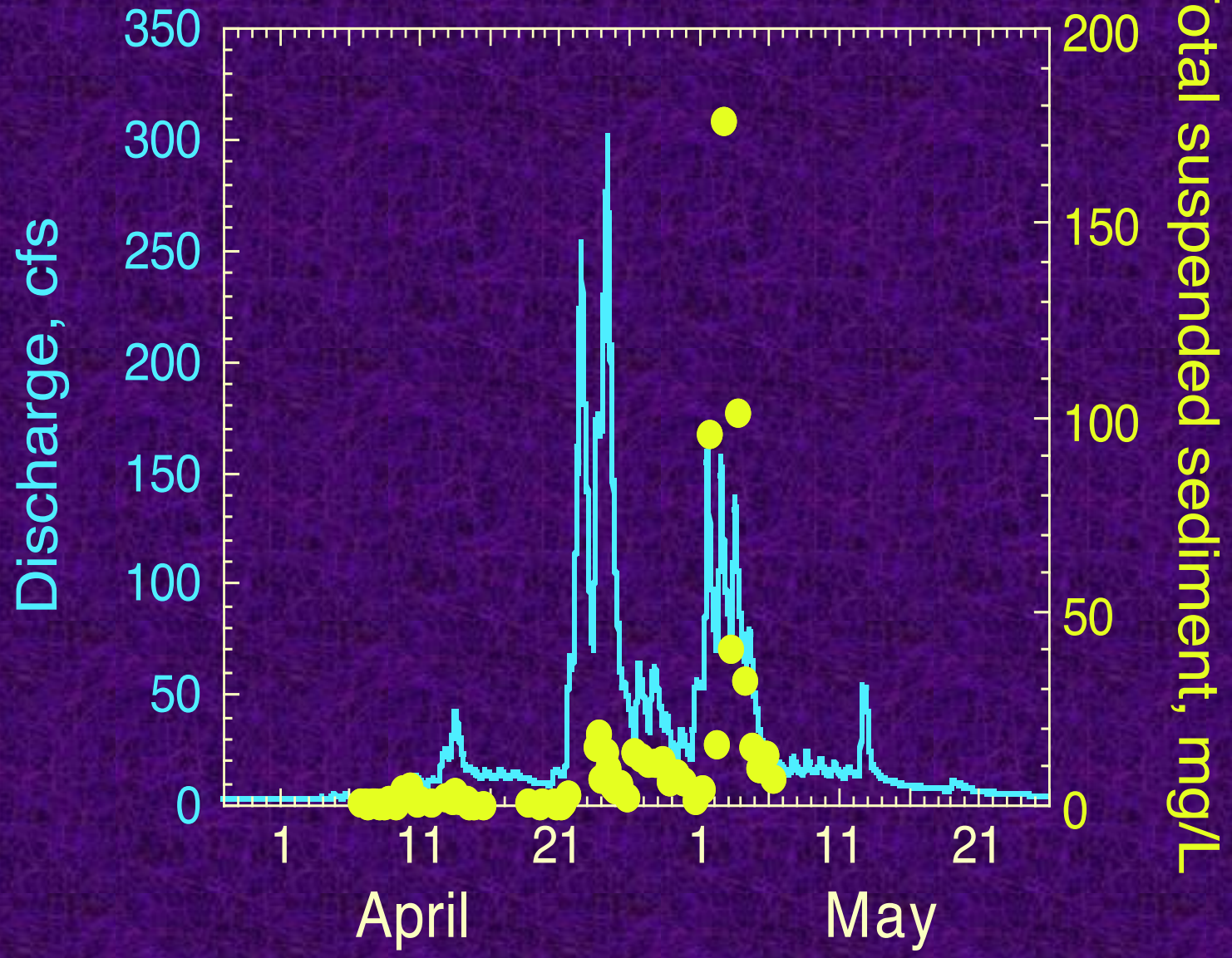
- High elevation hydrology is under-monitored.
- In 14 years of record, 4 to 6 of the largest storms at each gage have occurred since 2010.
- In this high-elevation environment, flow peaks (per unit area) are extremely high.
- Relative peak size varies among storms between basins.
- The annual peak can occur at nearly any time of year and often on different dates between basins.

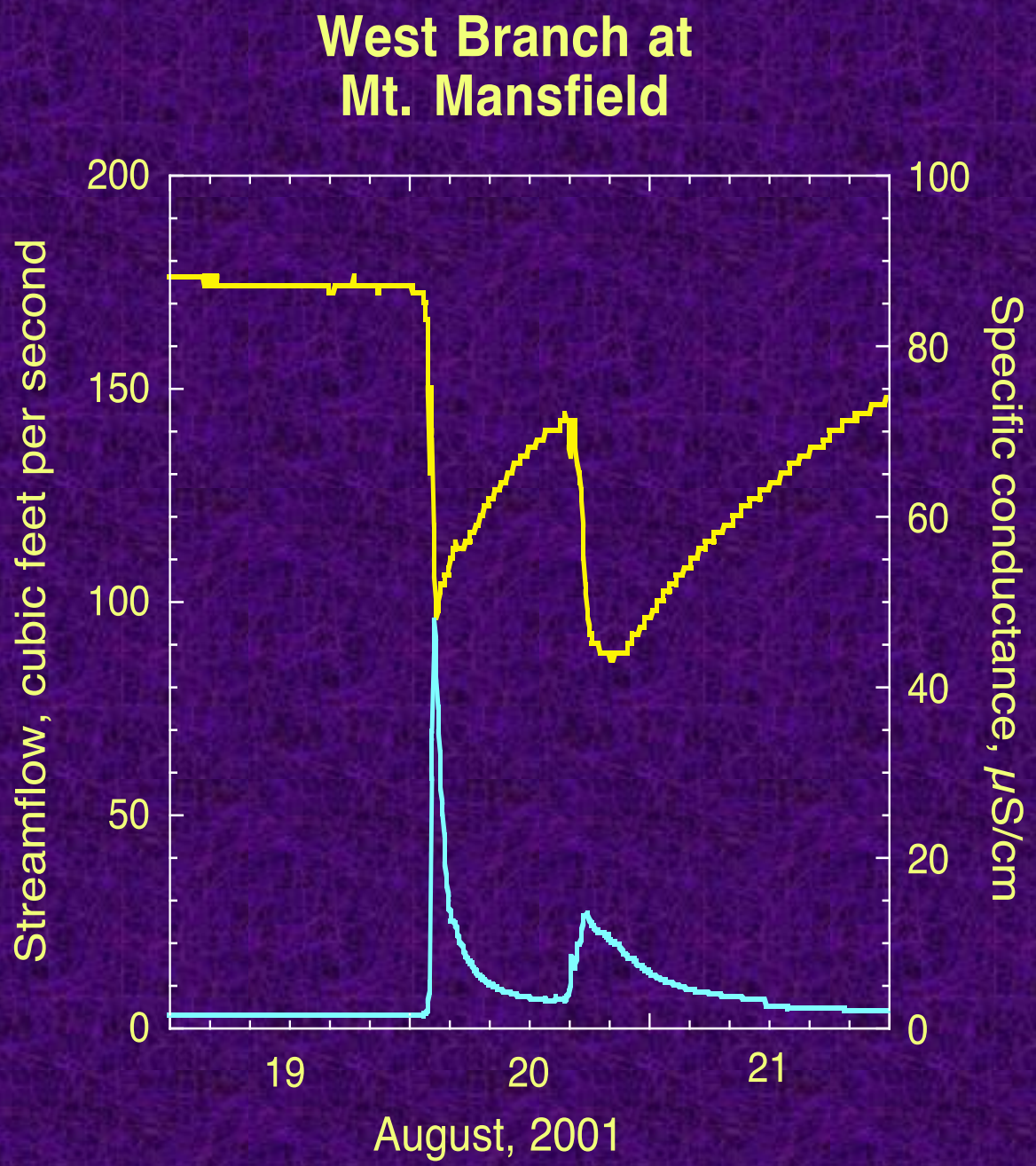
Water Quality

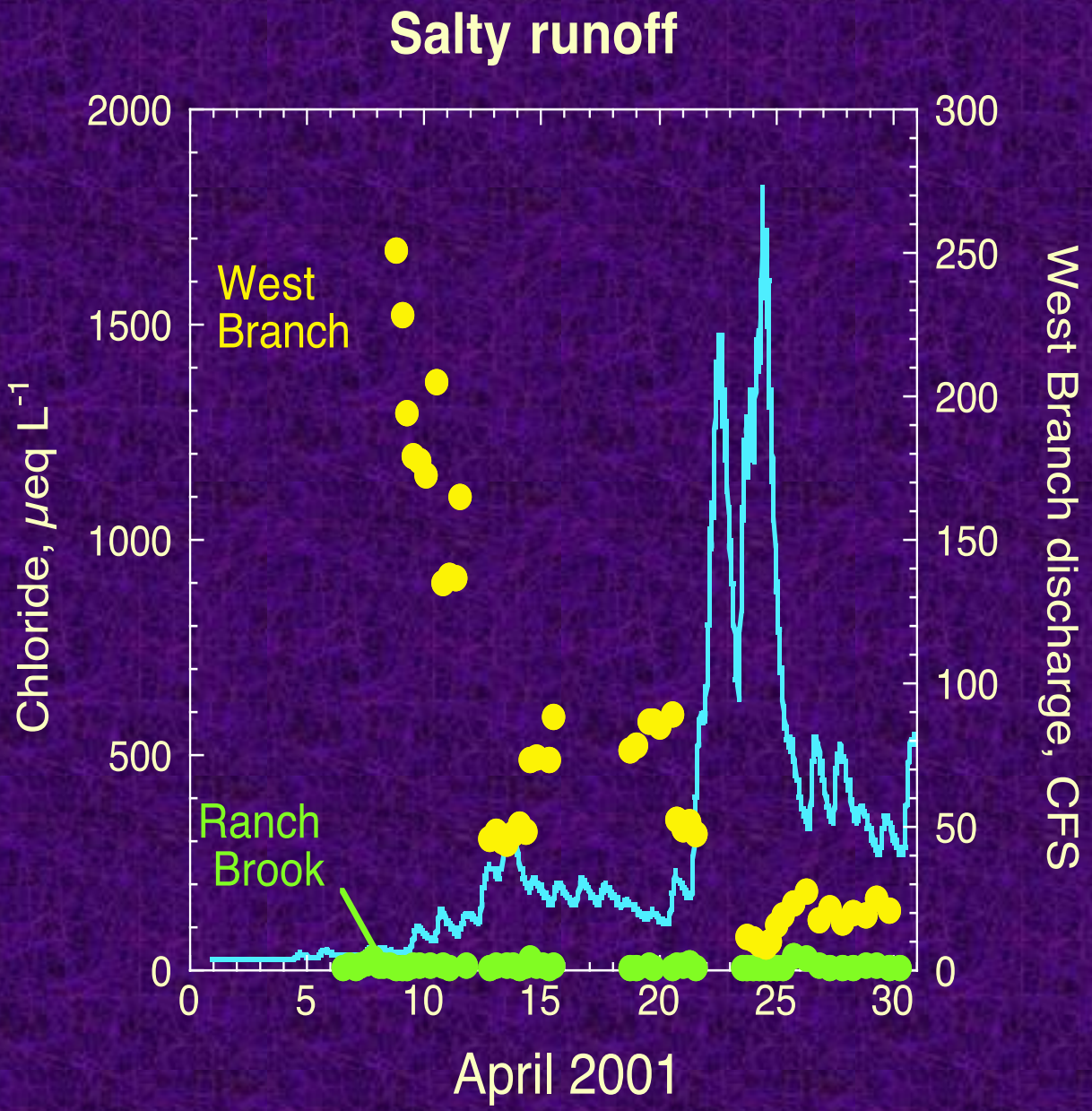
West Branch

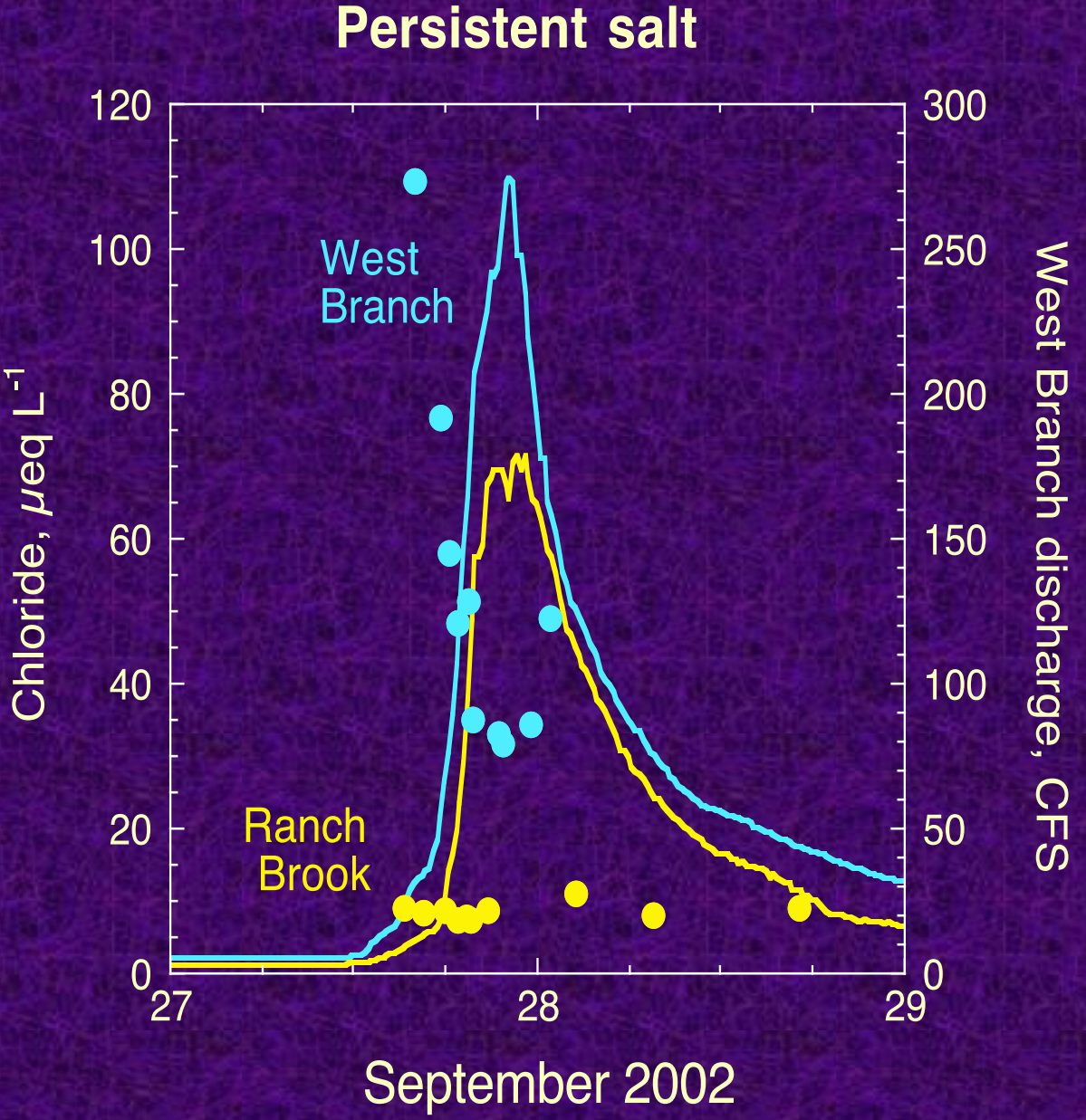

Discharge, cfs
350
300
250
200
150
100
50
0
200
150
100
50
0
Total suspended sediment, mg/L
1
11
21
1
11
21
April
May

Ranch Brook


Discharge, cfs
350
300
250
200
150
100
50
0
Total suspended sediment, mg/L
200
150
100
50
0
1
11
21
1
11
21
April
May


West Branch at
Mt. Mansfield
Streamflow, cubic feet per second
Specific conductance, µS/cm
200
150
100
50
0
100
80
60
40
20
0
19
20
21
August, 2001


Salty runoff
2000
1500
1000
500
0
300
250
200
150
100
50
0
0
5
10
15
20
25
30
April 2001
Chloride, μeq L-1
West Branch discharge, CFS
West Branch
Ranch Brook


Persistent salt
120
100
80
60
40
20
0
300
250
200
150
100
50
0
West Branch
Ranch Brook
Chloride, μeq L-1
West Branch discharge, CFS
27
28
29
September 2002

Key findings

- The developed basin - West Branch has ~20% greater runoff per unit area
- The greatest difference occurs late in snowmelt and through the summer
- This mountain environment has isolated extreme events -- frequency and severity is increasing
- Analysis and journal paper planned for 2016

Proposal: a high-elevation monitoring and assessment network

- High elevation hydrology is unique and poorly understood
- We need science to guide management decisions
- We need replication
- We seek supporters, collaborators, and funders, but….
- We are scrapping just to keep the Mansfield gages running!