Treasure Valley Comprehensive Aquifer Management Plan

Advisory Committee Meeting #2

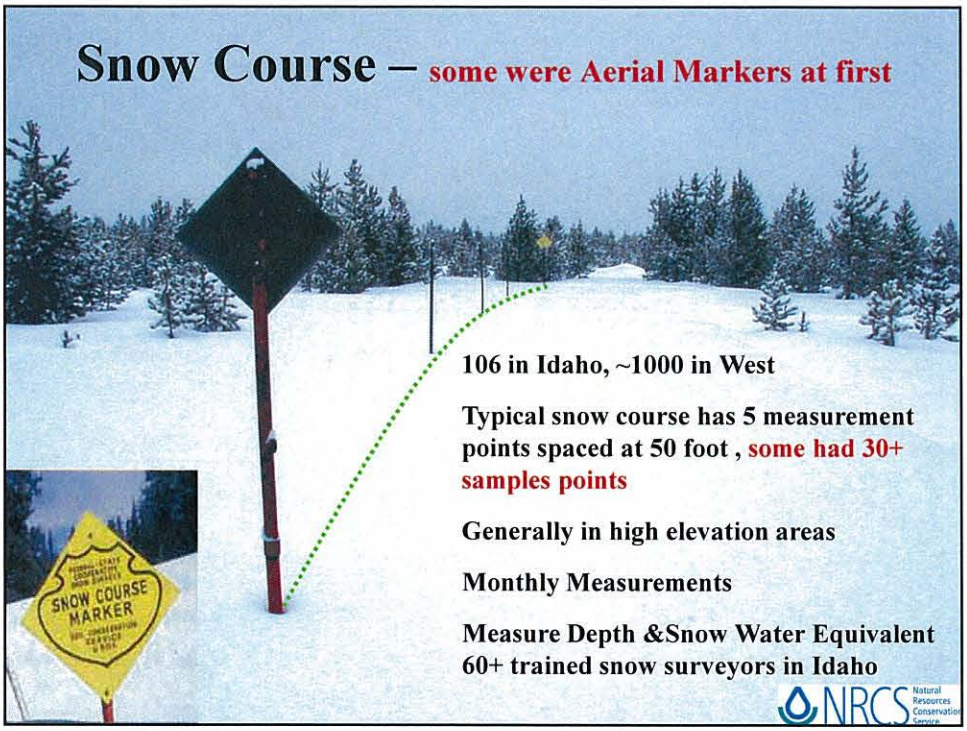
20 May 2010

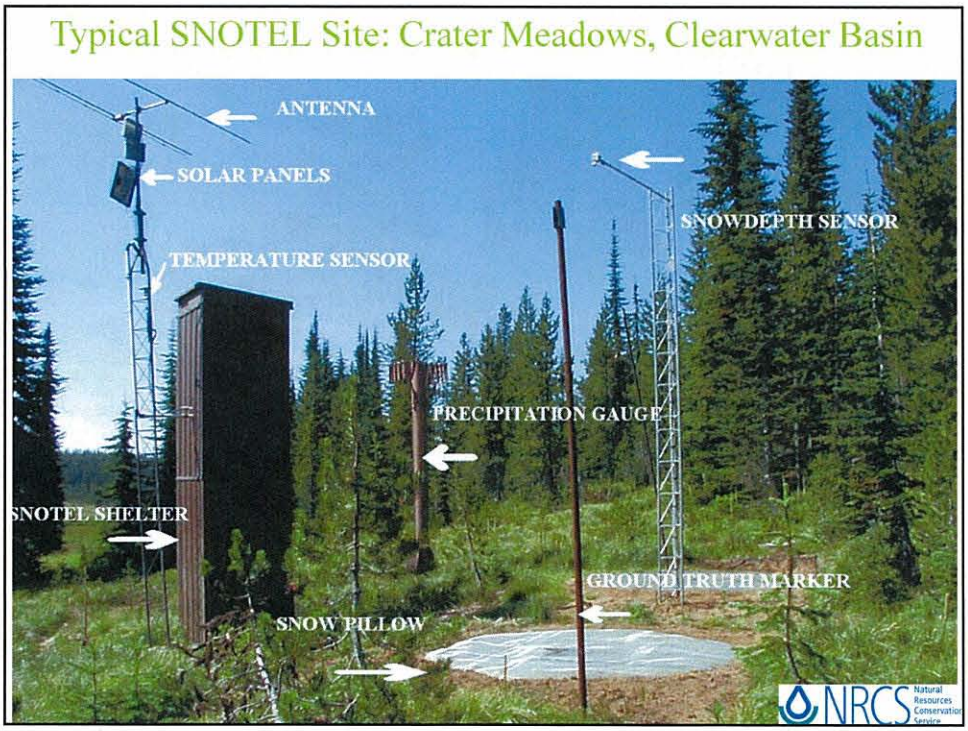
What is our Water Source?
The Facts of Source Water for the Valley

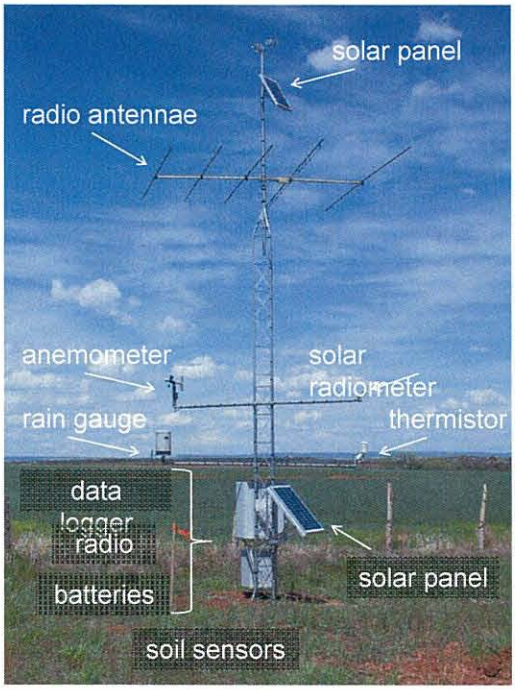
Snow Survey Data & Water Supply Forecasting

Ron Abramovich, USDA NRCS Snow Survey

NRCS Natural Resources Conservation Service


Snow Course – some were Aerial Markers at first
106 in Idaho, ~1000 in West
Typical snow course has 5 measurement points spaced at 50 foot , some had 30+ samples points
Generally in high elevation areas
Monthly Measurements
Measure Depth &Snow Water Equivalent
60+ trained snow surveyors in Idaho
SNOW COURSE MARKER
NRCS


Typical SNOTEL Site: Crater Meadows, Clearwater Basin
ANTENNA
SOLAR PANELS
TEMPERATURE SENSOR
SNOWDEPTH SENSOR
PRECIPITATION GAUGE
SNOTEL SHELTER
GROUND TRUTH MARKER
SNOW PILLOW
NRCS



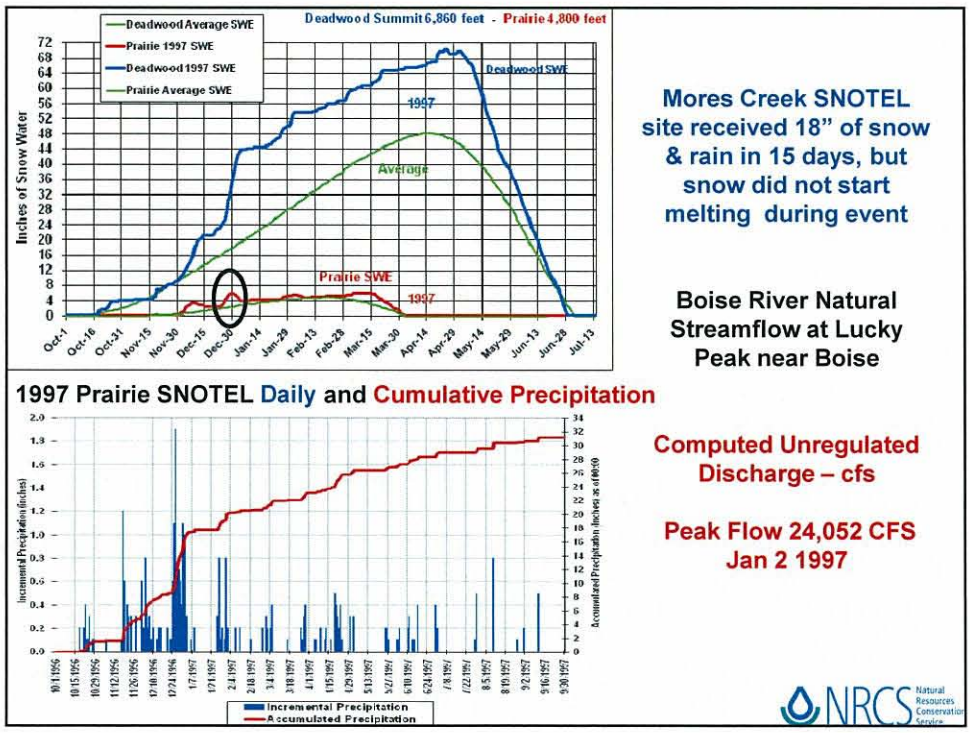
Standard SCAN site (Soil Climate Analysis Network)

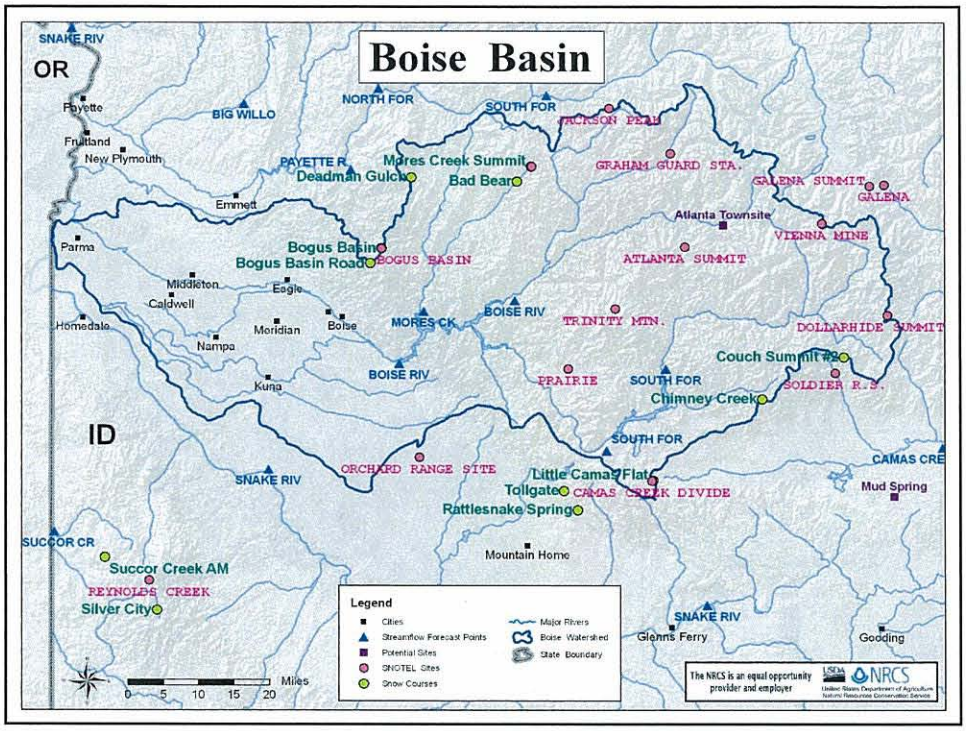
- rainfall
- air temperature
- relative humidity
- barometric pressure
- solar radiation
- wind speed & direction
- soil temperature and moisture at 5, 10, 20, 50, and 100 cm

SCAN site locations

- Focus on improving irrigation efficiency and rangeland productivity.
- Primarily located on agricultural and range lands.
- Installed on spatially representative soils.

Looking into Salmon River headwaters June 12, 2008
Typical Snow Courses and SNOTEL sites in Boise basin are between 6,000 – 8,000 feet which is where the seasonal snow accumulates and is stored in the mountains that GRADUALLY melts each spring providing our annual water supply.
We've learned weather happens above & below these elevation bands – additional sites may be needed in these data voids areas that are critical for monitoring rain-on-snow events or late season snowmelt / streamflow.
NRCS Natural Resources Conservation Service


Deadwood Summit 6,860 feet - Prairie 4,800 feet
Deadwood Average SWE
Prairie 1997 SWE
Deadwood 1997 SWE
Prairie Average SWE
Inches of Snow Water
Deadwood SWE
1997
Average
Prairie SWE
1997
Mores Creek SNOTEL site received 18" of snow & rain in 15 days, but snow did not start melting during event
Boise River Natural Streamflow at Lucky Peak near Boise
1997 Prairie SNOTEL Daily and Cumulative Precipitation
Incremental Precipitation (inches)
Accumulated Precipitation (inches as of 9/30)
Incremental Precipitation
Accumulated Precipitation
Computed Unregulated Discharge – cfs
Peak Flow 24,052 CFS
Jan 2 1997
NRCS Natural Resources Conservation Service



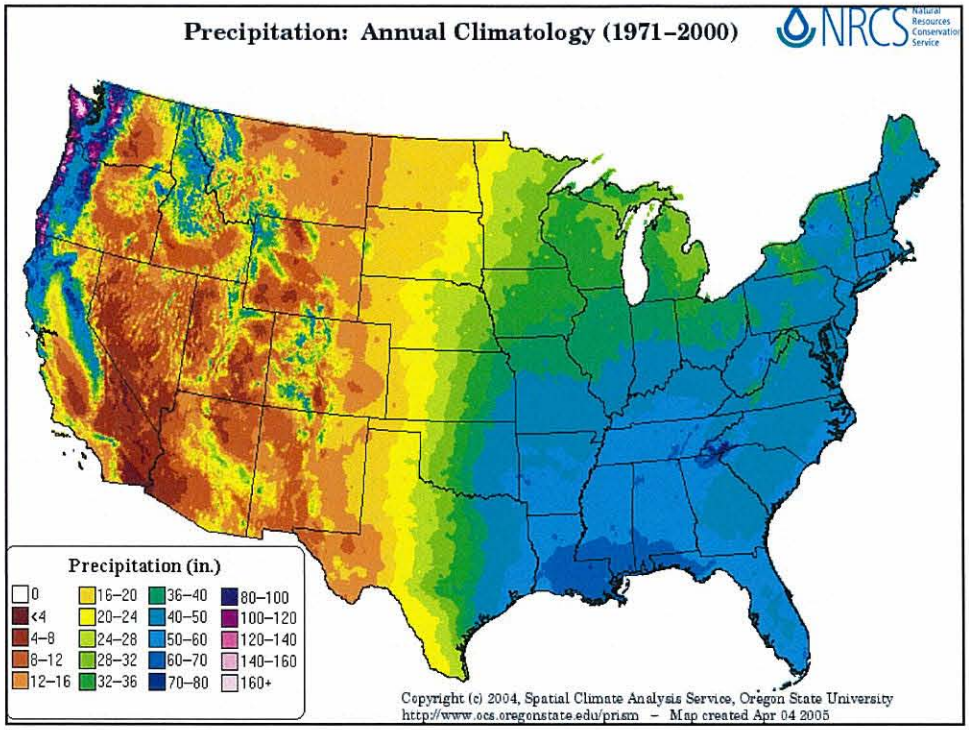
Idaho Snow Survey Advisory Team

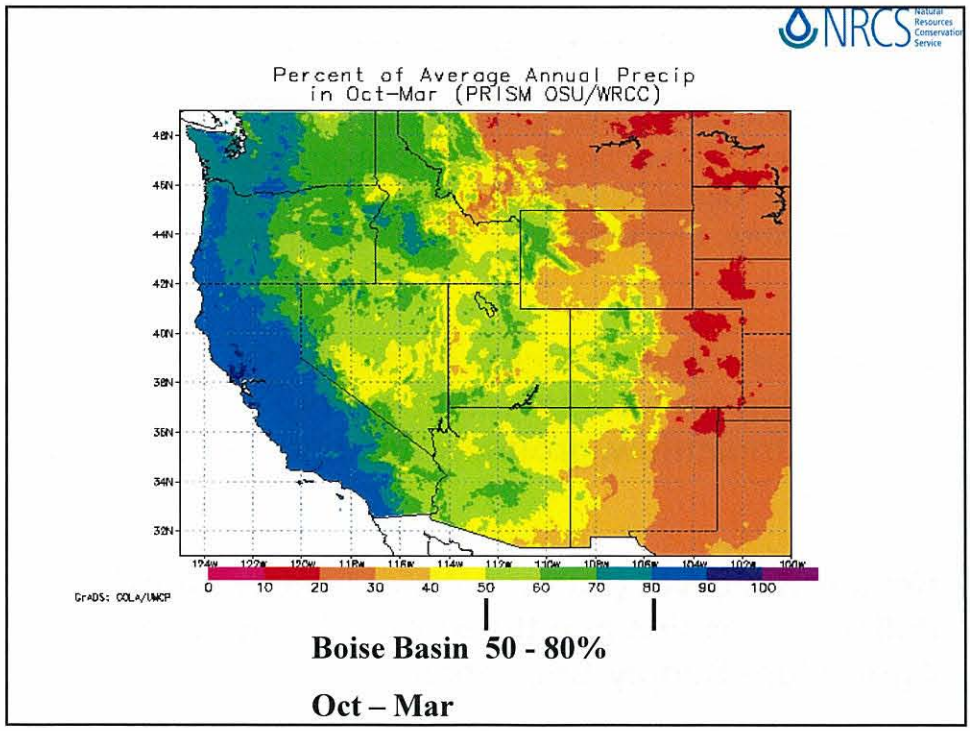
NRCS, IDWR, COE, NWS, USBR, BLM, USDA Risk Management, Forest Service, Soil Conservation District, Idaho Water Users Association, Idaho Ground Waters Appropriators, and University or EPSCoR personnel.

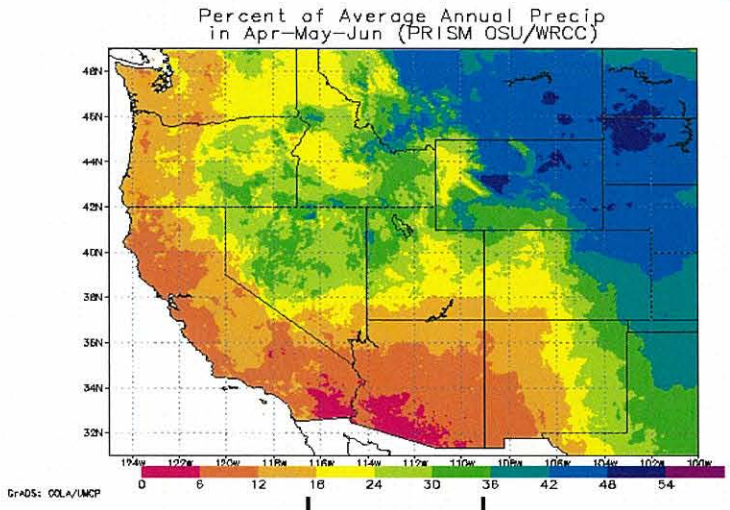
Committee will investigate data sites for possible automation for a 5-Year Initiative, and should also look at streamflow, groundwater, and soil moisture stations.

Review the SWSI (Surface Water Supply Index) delineated basins and thresholds for Surface Agriculture Supply Shortages

NRCS Natural Resources Conservation Service

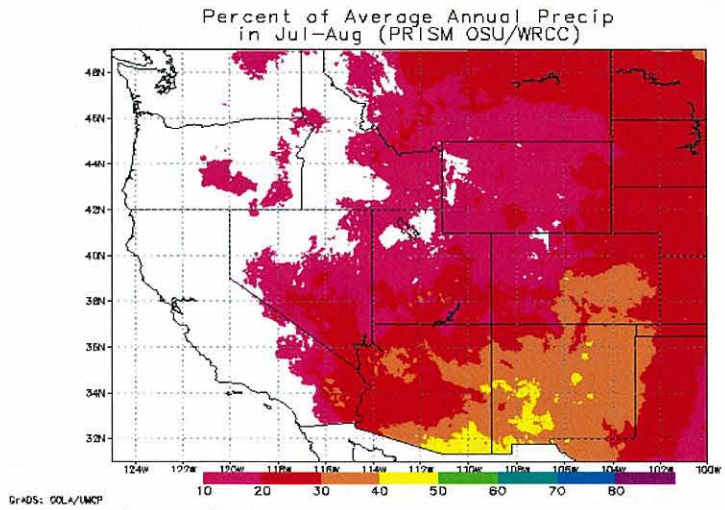

Precipitation: Annual Climatology (1971–2000)
NRCS
Precipitation (in.)
0
<4
4–8
8–12
12–16
16–20
20–24
24–28
28–32
32–36
36–40
40–50
50–60
60–70
70–80
80–100
100–120
120–140
140–160
160+
Copyright (c) 2004, Spatial Climate Analysis Service, Oregon State University
http://www.ocs.oregonstate.edu/prism – Map created Apr 04 2005


NRCS
Percent of Average Annual Precip
in Oct–Mar (PRISM OSU/WRCC)
48N
46N
44N
42N
40N
38N
36N
34N
32N
124W
122W
120W
118W
116W
114W
112W
110W
108W
106W
104W
102W
100W
0
10
20
30
40
50
60
70
80
90
100
GrADS: COLA/UMCP
Boise Basin 50 - 80%
Oct – Mar



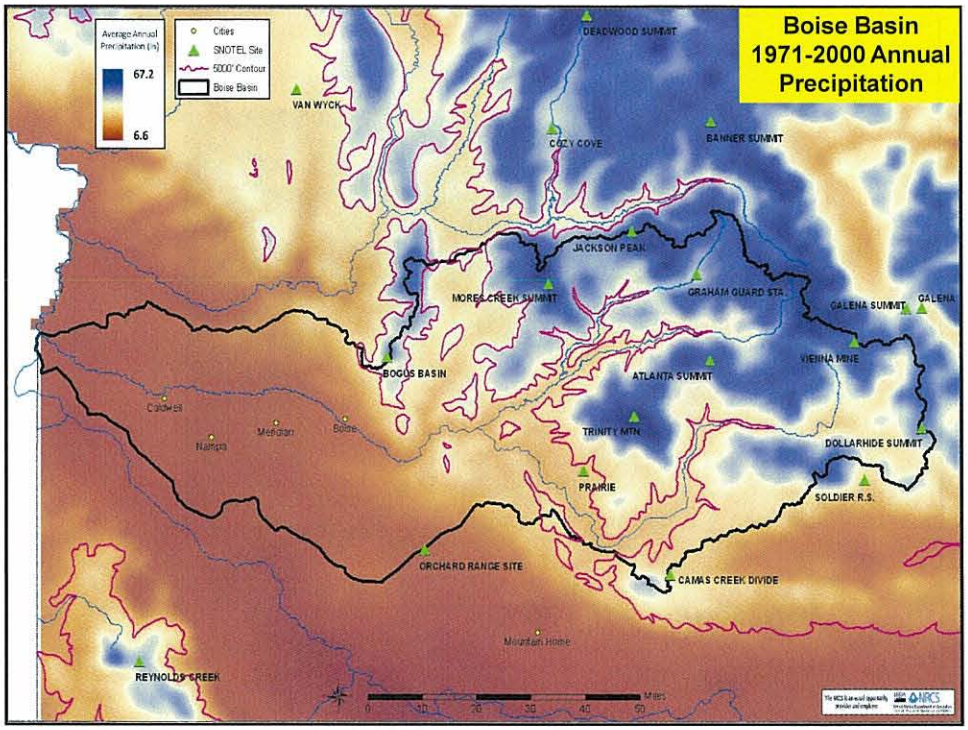
Boise Basin 15 - 35%

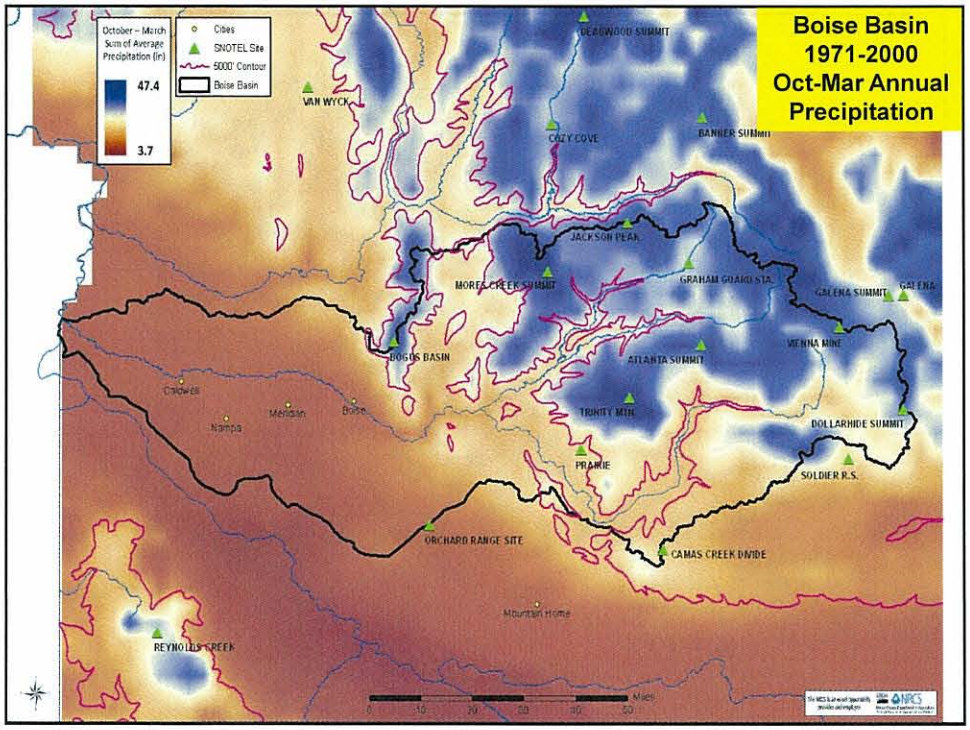
Apr-May-Jun



0 – 10%

Jul - Aug


Boise Basin
1971-2000 Annual
Precipitation
Average Annual Precipitation (in)
67.2
6.6
Cities
SNOTEL Site
5000' Contour
Boise Basin
DEADWOOD SUMMIT
VAN WYCK
COZY COVE
BANNER SUMMIT
JACKSON PEAK
MORES CREEK SUMMIT
GRAHAM GUARD STA.
GALENA SUMMIT
GALENA
VIENNA MINE
BOGUS BASIN
ATLANTA SUMMIT
TRINITY MTN
DOLLARHIDE SUMMIT
PRAIRIE
SOLDIER R.S.
ORCHARD RANGE SITE
CAMAS CREEK DIVIDE
Caldwell
Nampa
Meridian
Boise
Mountain Home
REYNOLDS CREEK
Miles


Boise Basin
1971-2000
Oct-Mar Annual
Precipitation
October – March Sum of Average Precipitation (in)
47.4
3.7
Cities
SNOTEL Site
5000' Contour
Boise Basin
DEADWOOD SUMMIT
VAN WYCK
COZY COVE
BANNER SUMMIT
JACKSON PEAK
MORES CREEK SUMMIT
GRAHAM GUARD STA.
GALENA SUMMIT
GALENA
VIENNA MINE
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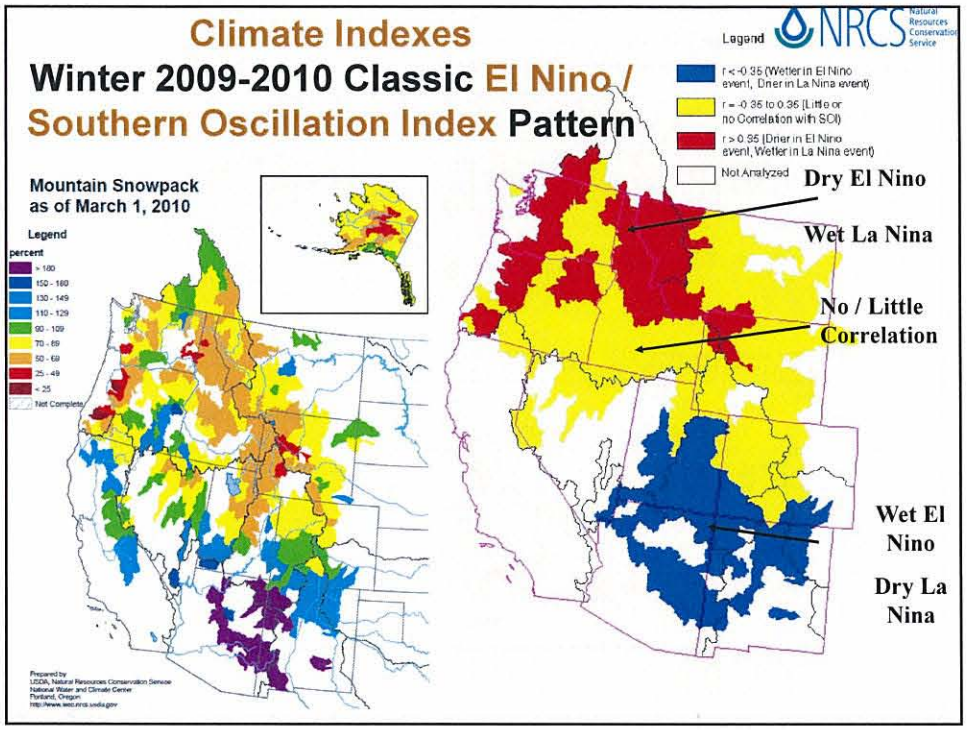

La Nina and Pacific Decadal Oscillation (PDO)

Cooling in the Pacific Ocean

Don J. Easterbrook, Dept. of Geology, Western Washington University, Bellingham, WA

The announcement by NASA's Jet Propulsion Laboratory that the Pacific Decadal Oscillation (PDO) had shifted to its cool phase (Fig. 1) is right on schedule as predicted by past climate and PDO changes (Easterbrook, 2001, 2006, 2007). It is *not* an oddity superimposed upon and masking the predicted severe warming by the IPCC.

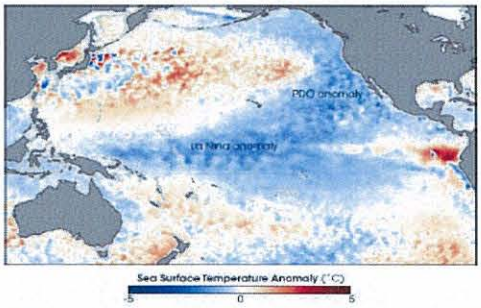

Figure 1. Cooling of the Pacific Ocean and setting up of the PDO. Sea surface temperature anomaly in the Pacific Ocean from April 14–21, 2008. The anomaly compares the recent temperatures measured by the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) on NASA's Aqua satellite with an average of data collected by the NOAA Pathfinder satellites from 1985–1997. Places where the Pacific was cooler than normal are blue, places where temperatures were average are white, and places where the ocean was warmer than normal are red. The cool water anomaly in the center of the image shows the lingering effect of the year-old La Niña. However, the much broader area of cooler-than-average water off the coast of North America from Alaska (top center) to the equator is a classic feature of the cool phase of the Pacific Decadal Oscillation (PDO). The cool waters wrap in a horseshoe shape around a core of warmer-than-average water. (In the warm phase, the pattern is reversed). Unlike El Niño and La Niña, which may occur every 3 to 7 years and last from 6 to 18 months, the PDO can remain in the same phase for 20 to 30 years. (NASA image by Jesse Allen, AMSR-E data processed and provided by Chelle Gentemann and Frank Wentz, Remote Sensing Systems. Caption by Rebecca Lindsey, adapted from a press release from NASA JPL).

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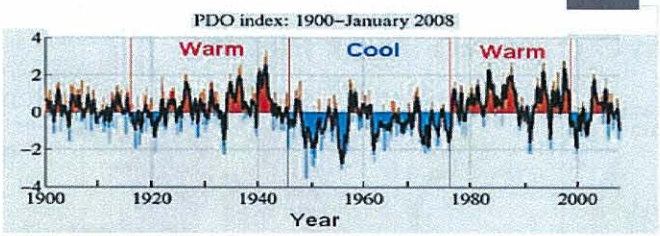
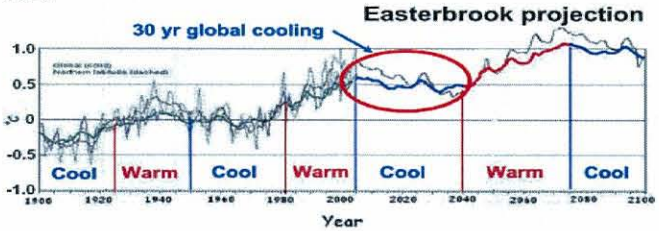


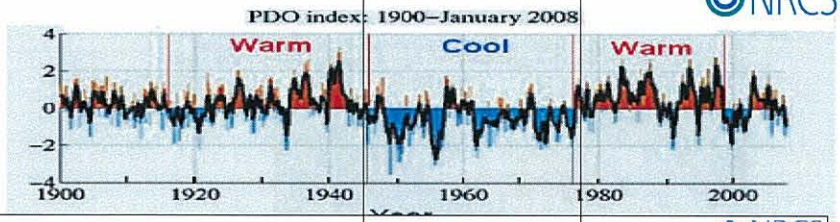
Figure 2. PDO indices, 1900

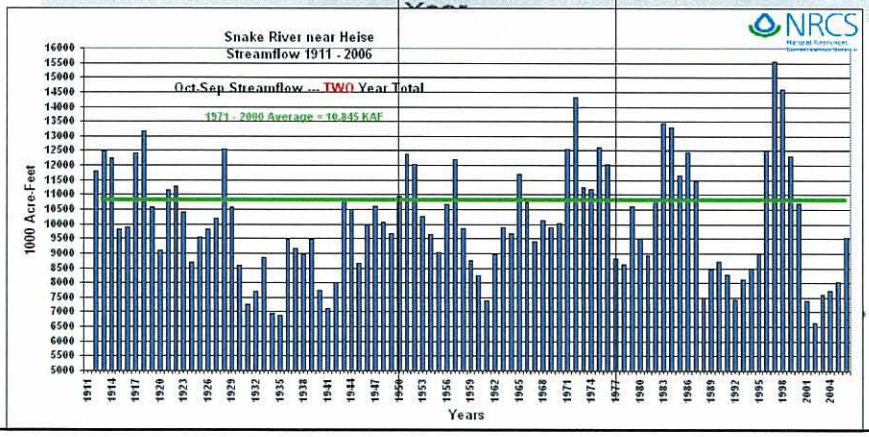
Global temperatures peaked in 1998 and have not been exceeded since then. Pacific Ocean temperatures began a cooling phase in 1999 that was briefly interrupted by El Nino and dramatic cooling in 2007-2008 appears to be a continuation of a global cooling trend set up by the PDO cool phase (Fig. 1) as predicted (Fig. 3).

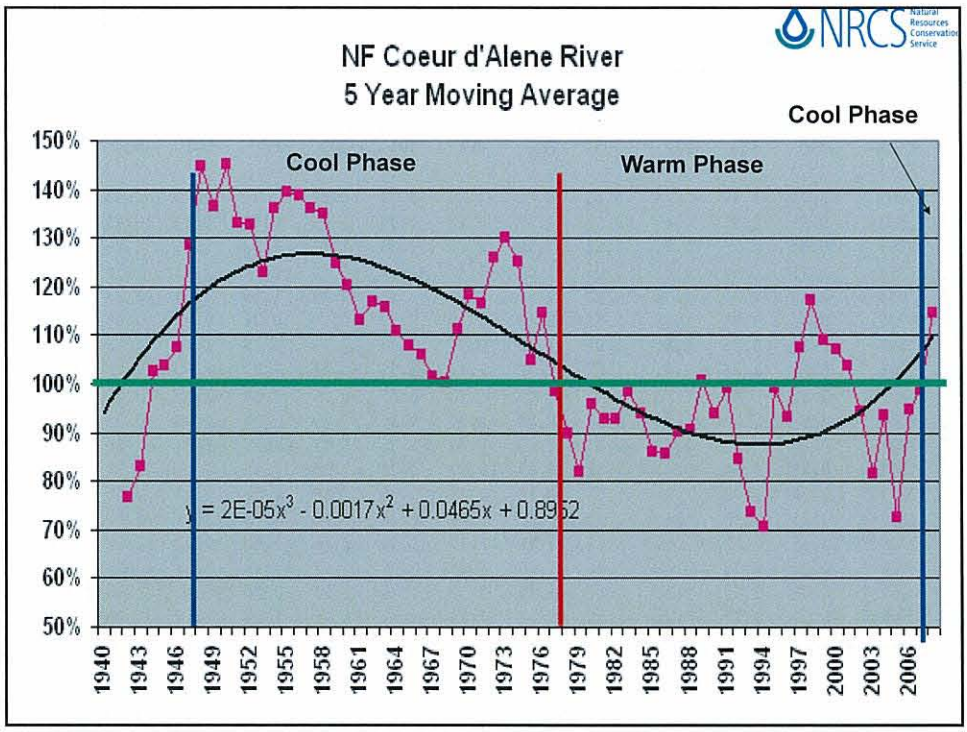


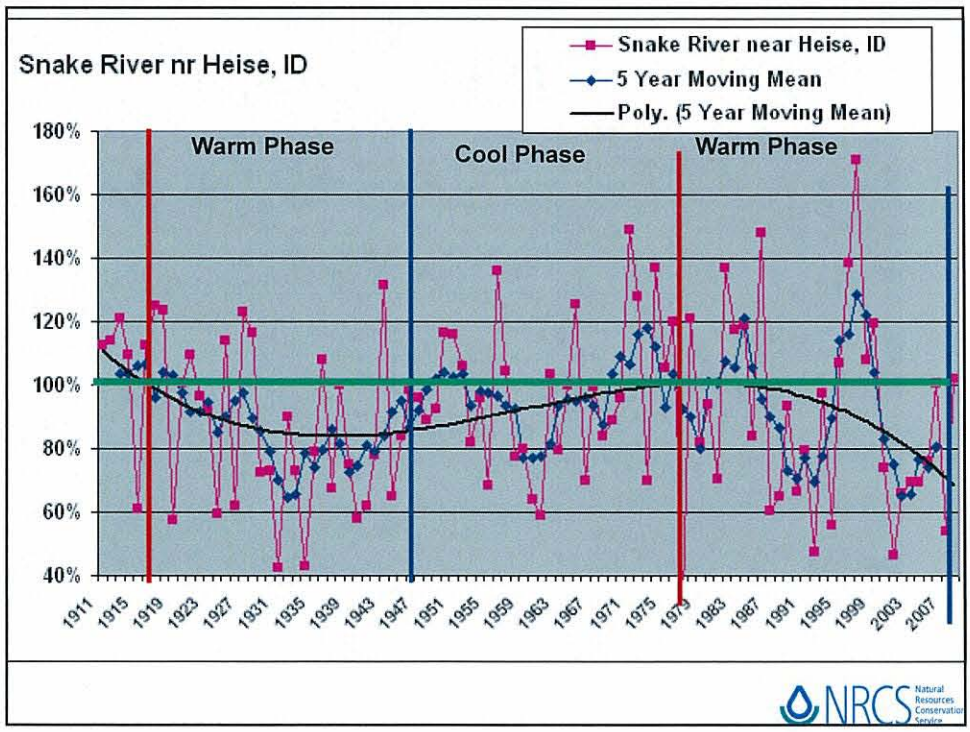
Thus, we seem to be headed toward several decades of global cooling, rather than the catastrophic global warming predicted by IPCC.

As shown by the historic pattern of PDOs over the past century (Fig. 2) and by corresponding global warming and cooling, the pattern is part of ongoing warm/cool cycles that last 25-30 years



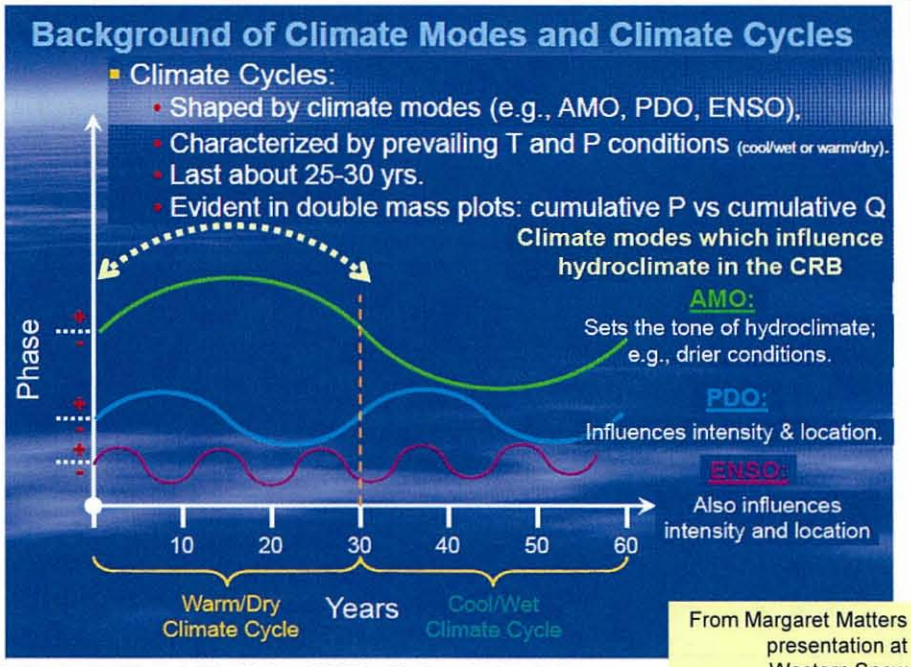



NRCS
NF Coeur d'Alene River
5 Year Moving Average
Cool Phase
Cool Phase
Warm Phase
y = 2E-05x³ - 0.0017x² + 0.0465x + 0.8952
150%
140%
130%
120%
110%
100%
90%
80%
70%
60%
50%
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006


Snake River nr Heise, ID
Snake River near Heise, ID
5 Year Moving Mean
Poly. (5 Year Moving Mean)
Warm Phase
Cool Phase
Warm Phase
180%
160%
140%
120%
100%
80%
60%
40%
1911
1915
1919
1923
1927
1931
1935
1939
1943
1947
1951
1955
1959
1963
1967
1971
1975
1979
1983
1987
1991
1995
1999
2003
2007
NRCS

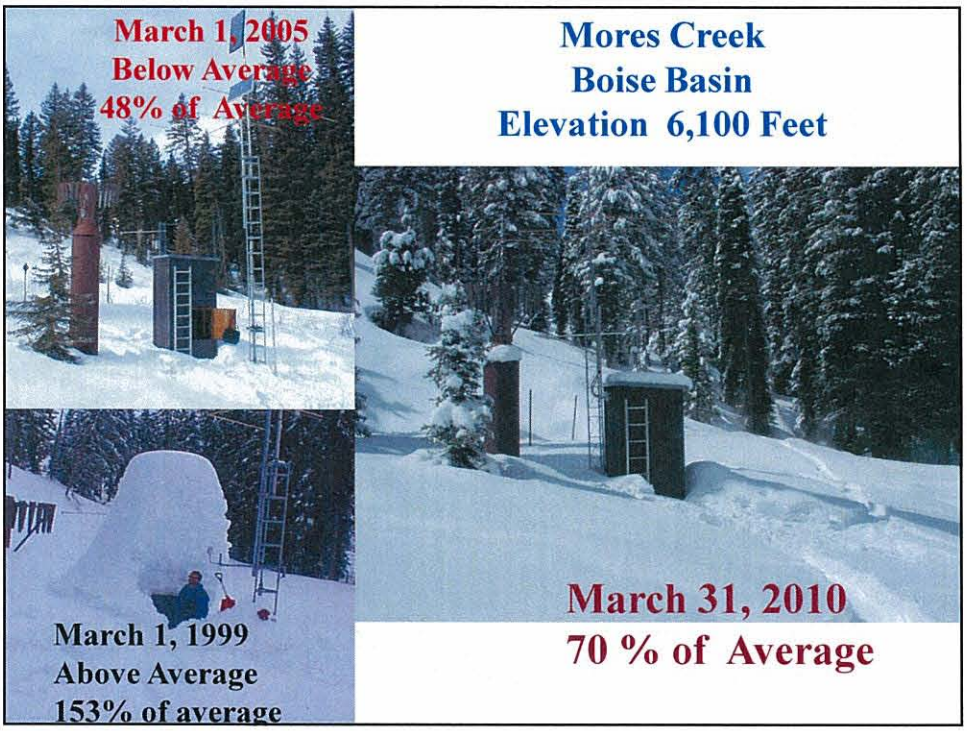
PDO INDEX Pacific Decadal Index

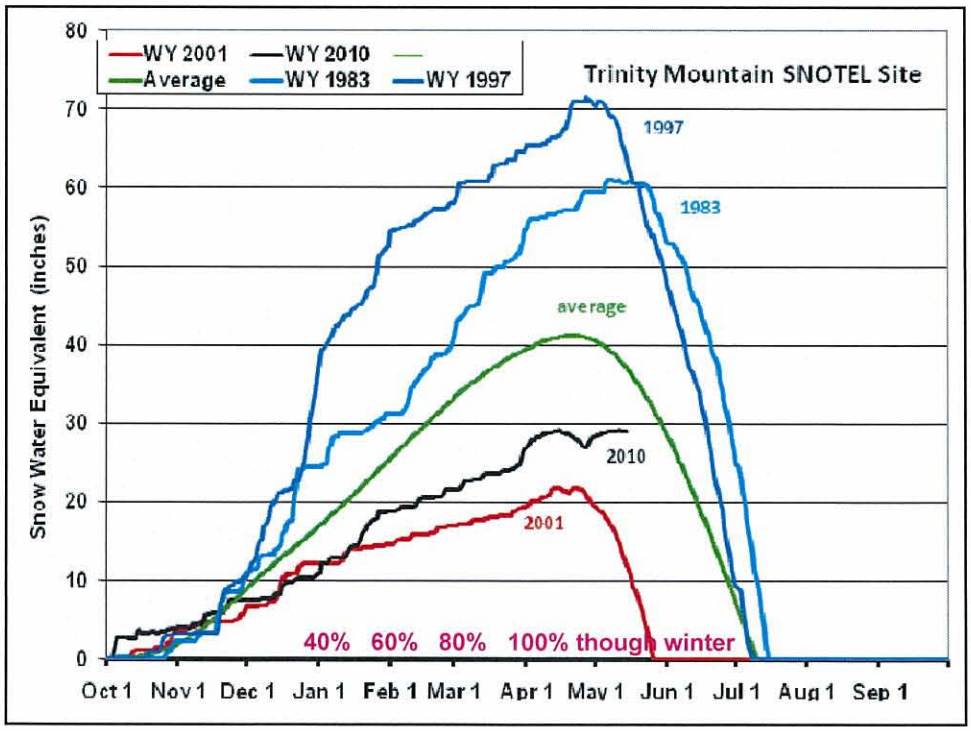
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1991	-2.02	-1.19	-0.74	-1.01	-0.51	-1.47	-0.10	0.36	0.65	0.49	0.42	0.09
1992	0.05	0.31	0.67	0.75	1.54	1.26	1.90	1.44	0.83	0.93	0.93	0.53
1993	0.05	0.19	0.76	1.21	2.13	2.34	2.35	2.69	1.56	1.41	1.24	1.07
1994	1.21	0.59	0.80	1.05	1.23	0.46	0.06	-0.79	-1.36	-1.32	-1.96	-1.79
1995	-0.49	0.46	0.75	0.83	1.46	1.27	1.71	0.21	1.16	0.47	-0.28	0.16
1996	0.59	0.75	1.01	1.46	2.18	1.10	0.77	-0.14	0.24	-0.33	0.09	-0.03
1997	0.23	0.28	0.65	1.05	1.83	2.76	2.35	2.79	2.19	1.61	1.12	0.67
1998	0.83	1.56	2.01	1.27	0.70	0.40	-0.04	-0.22	-1.21	-1.39	-0.52	-0.44
1999	-0.32	-0.66	-0.33	-0.41	-0.68	-1.30	-0.66	-0.96	-1.53	-2.23	-2.05	-1.63
2000	-2.00	-0.83	0.29	0.35	-0.05	-0.44	-0.66	-1.19	-1.24	-1.30	-0.53	0.52
2001	.60	.29	0.45	-0.31	-0.30	-0.47	-1.31	-0.77	-1.37	-1.37	-1.26	-0.93
2002**	0.27	-0.64	-0.43	-0.32	-0.63	-0.35	-0.31	0.60	0.43	0.42	1.51	2.10
2003**	2.09	1.75	1.51	1.18	0.89	0.68	0.96	0.88	0.01	0.83	0.52	0.33
2004**	0.43	0.48	0.61	0.57	0.88	0.04	0.44	0.85	0.75	-0.11	-0.63	-0.17
2005**	0.44	0.81	1.36	1.03	1.86	1.17	0.66	0.25	-0.46	-1.32	-1.50	0.20
2006**	1.03	0.66	0.05	0.40	0.48	1.04	0.35	-0.65	-0.94	-0.05	-0.22	0.14
2007**	0.01	0.04	-0.36	0.16	-0.10	0.09	0.78	0.50	-0.36	-1.45	-1.08	-0.58
2008**	-1.00	-0.77	-0.71	-1.52	-1.37	-1.34	-1.67	-1.70	-1.55	-1.76	-1.25	-0.87
2009**	-1.40	-1.55	-1.59	-1.65	-0.88	-0.31	-0.53	0.09	0.52	0.27	-0.40	0.08
2010**	0.83	0.82	0.44									

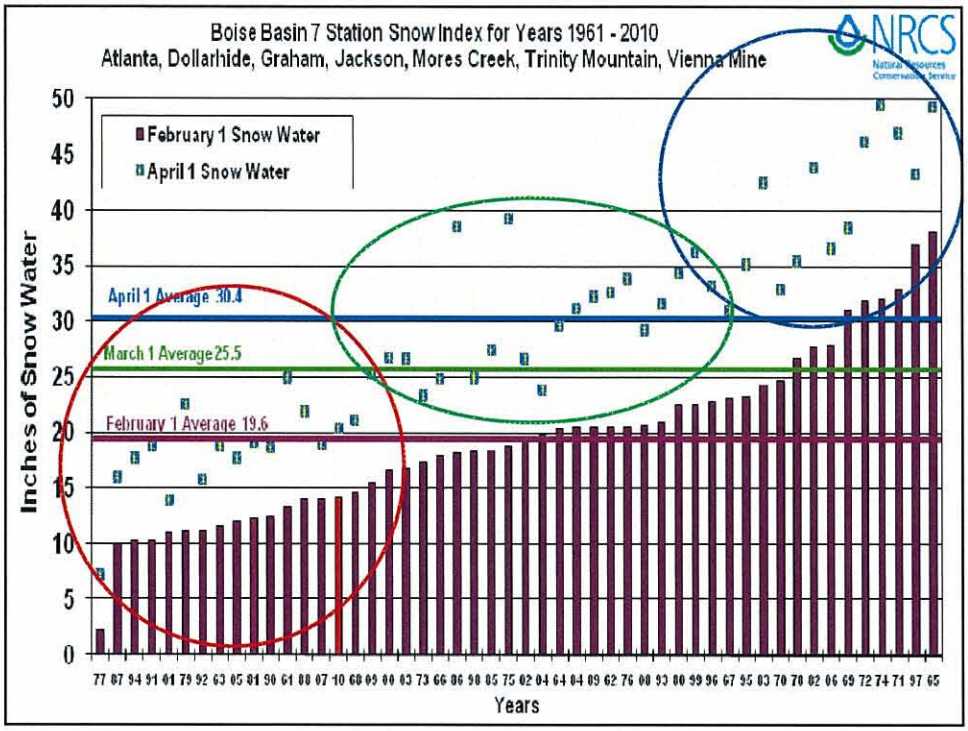


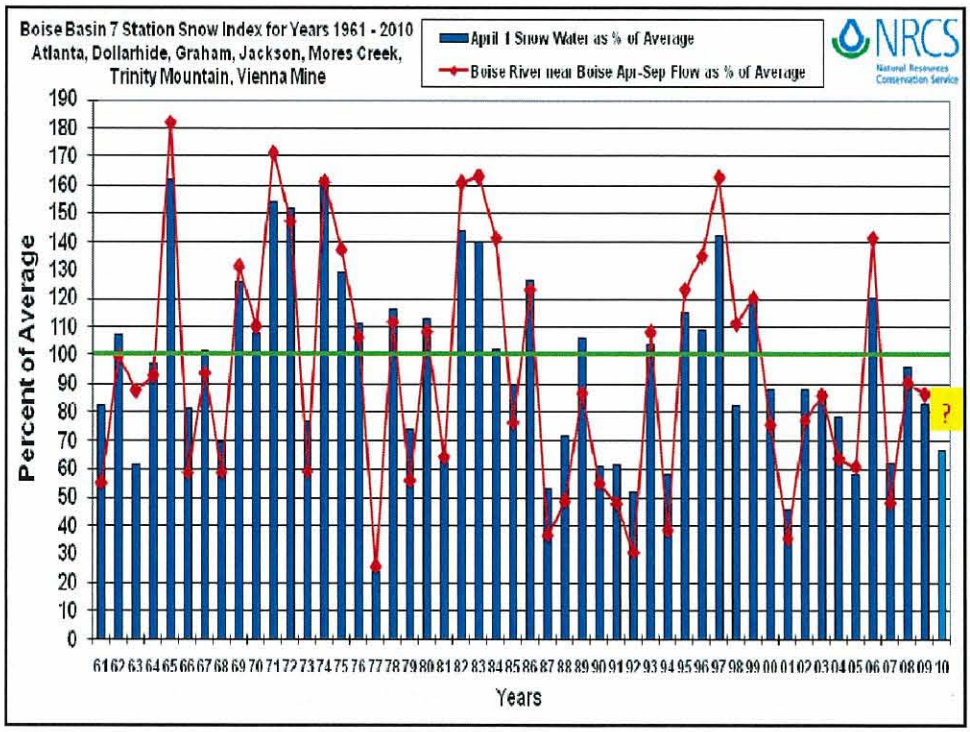
From Margaret Matters presentation at Western Snow Conference April 2010

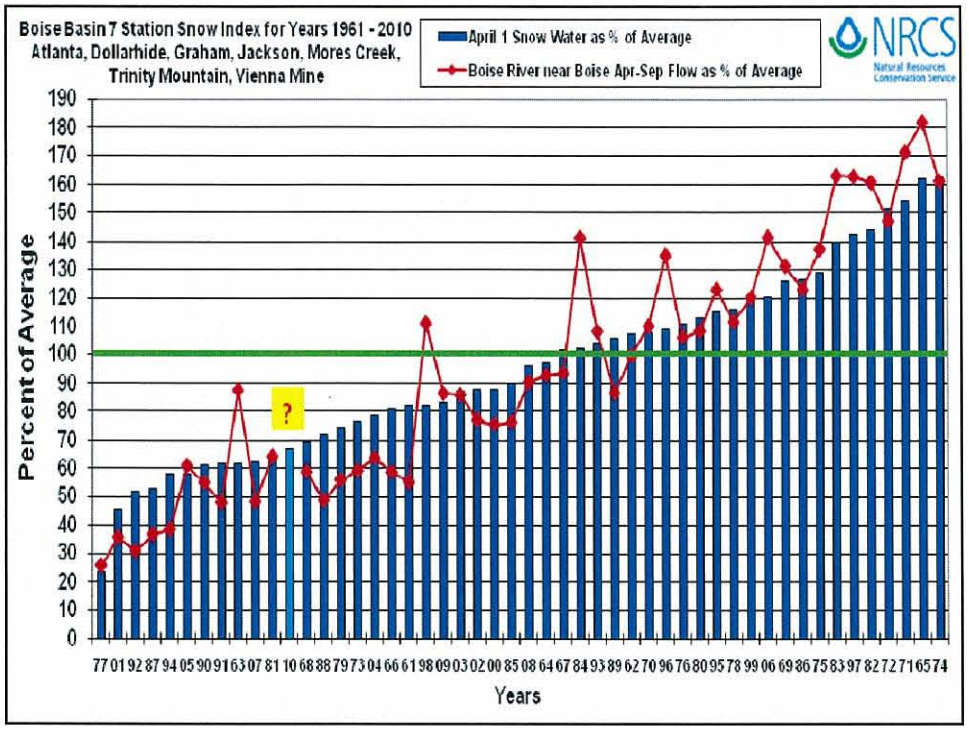
AMO Atlantic Multidecadal Oscillation PDO Pacific Decadal Oscillation ENSO El Nino Southern Oscillation

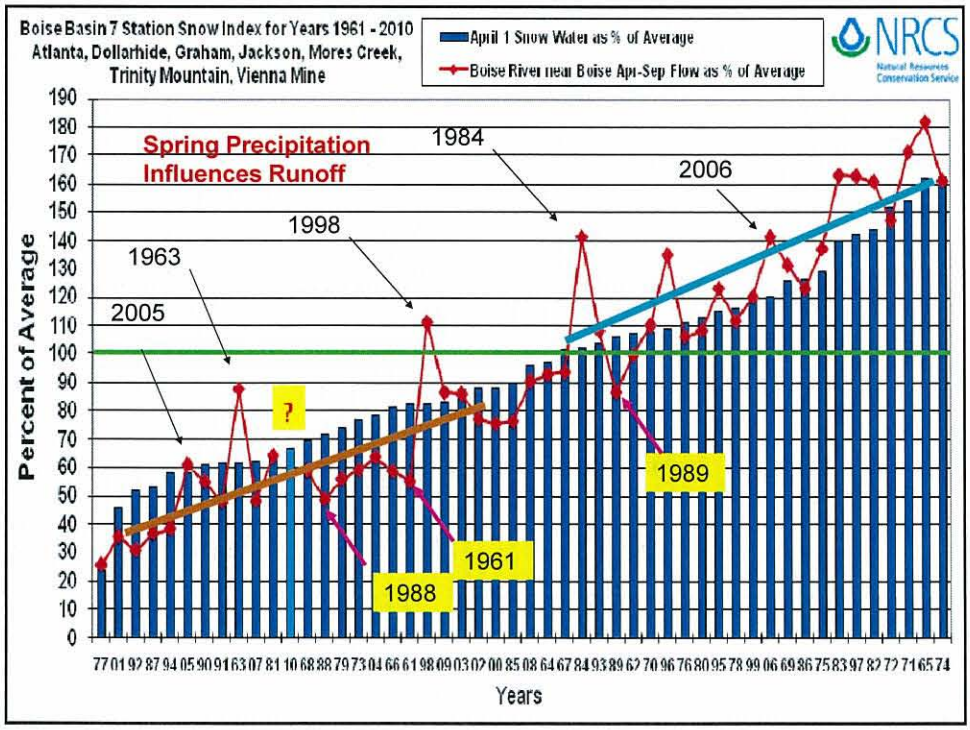

March 1, 2005
Below Average
48% of Average
Mores Creek
Boise Basin
Elevation 6,100 Feet
March 1, 1999
Above Average
153% of average
March 31, 2010
70 % of Average

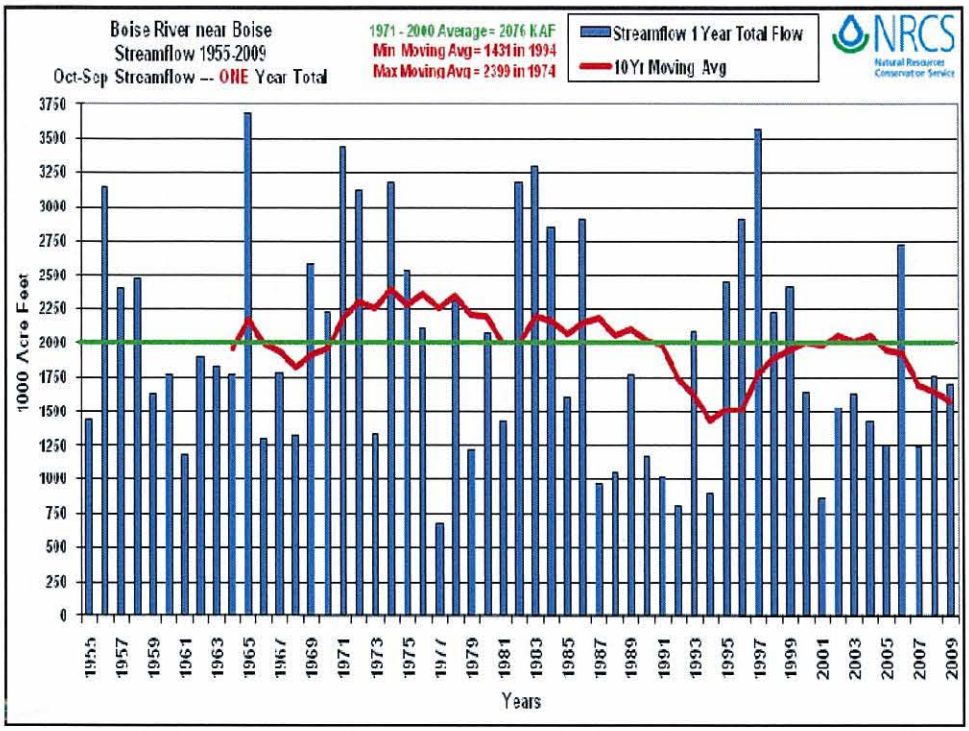

WY 2001
WY 2010
Average
WY 1983
WY 1997
Trinity Mountain SNOTEL Site
Snow Water Equivalent (inches)
80
70
60
50
40
30
20
10
0
1997
1983
average
2010
2001
40% 60% 80% 100% though winter
Oct 1 Nov 1 Dec 1 Jan 1 Feb 1 Mar 1 Apr 1 May 1 Jun 1 Jul 1 Aug 1 Sep 1

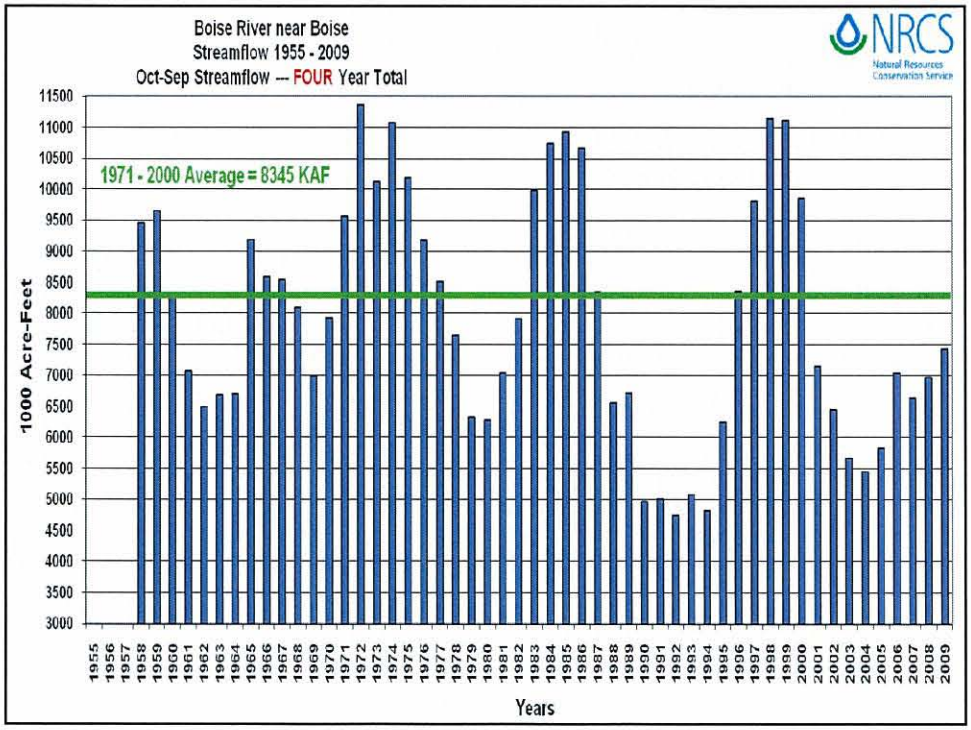

Boise Basin 7 Station Snow Index for Years 1961 - 2010
Atlanta, Dollarhide, Graham, Jackson, Mores Creek, Trinity Mountain, Vienna Mine
NRCS
February 1 Snow Water
April 1 Snow Water
April 1 Average 30.4
March 1 Average 25.5
February 1 Average 19.6
Inches of Snow Water
Years

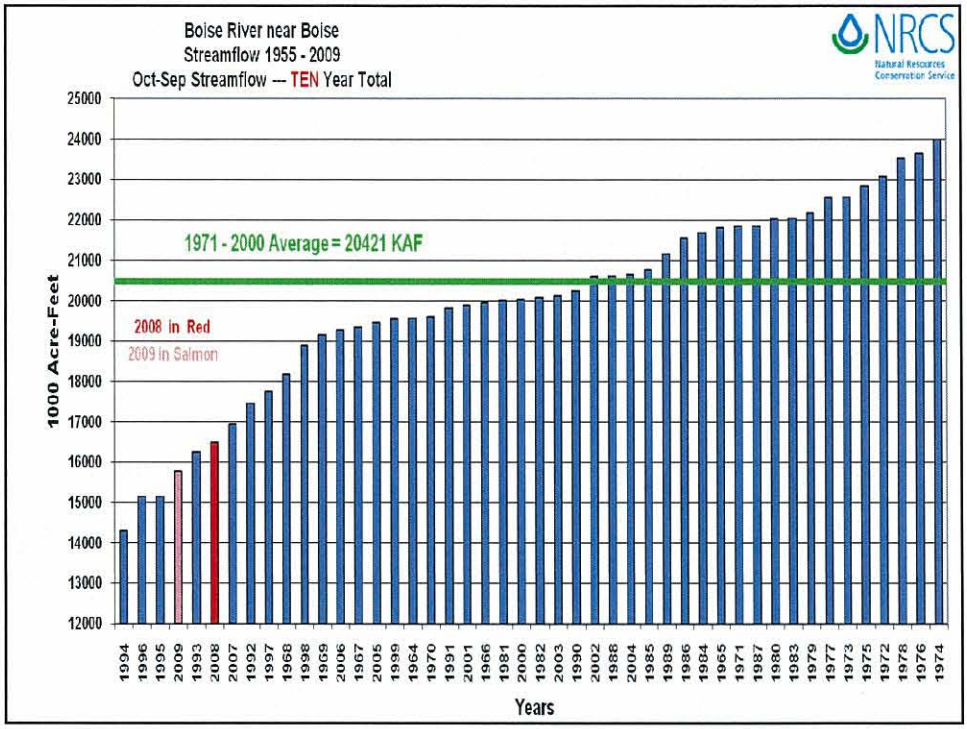

Boise Basin 7 Station Snow Index for Years 1961 - 2010
Atlanta, Dollarhide, Graham, Jackson, Mores Creek, Trinity Mountain, Vienna Mine
April 1 Snow Water as % of Average
Boise River near Boise Apr-Sep Flow as % of Average
NRCS
Percent of Average
Years

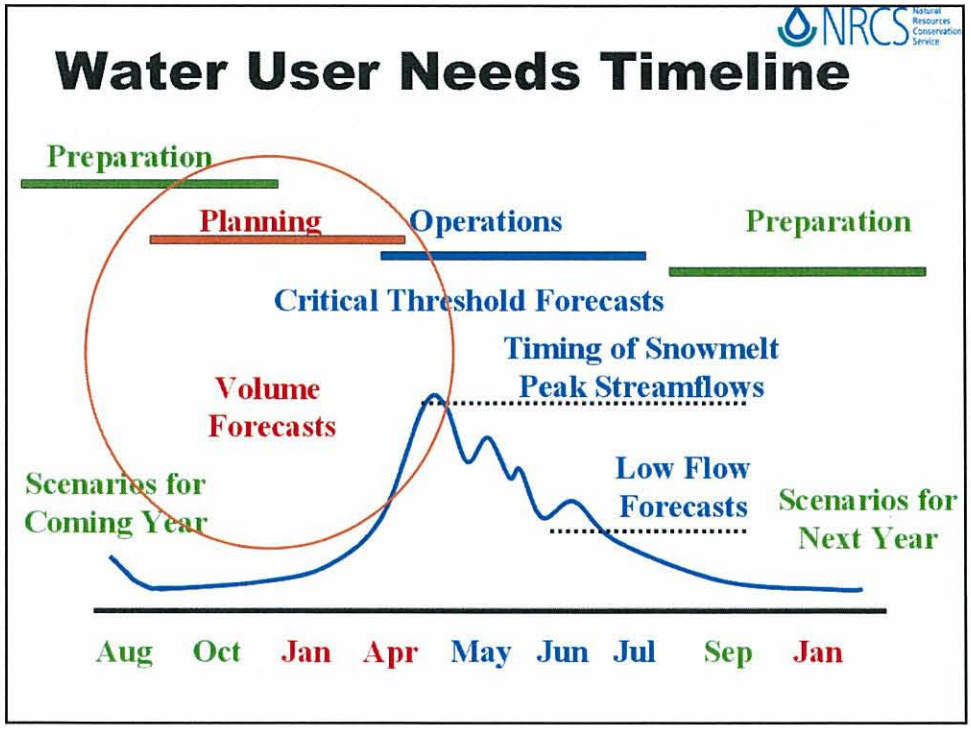

Boise Basin 7 Station Snow Index for Years 1961 - 2010
Atlanta, Dollarhide, Graham, Jackson, Mores Creek,
Trinity Mountain, Vienna Mine
April 1 Snow Water as % of Average
Boise River near Boise Apr-Sep Flow as % of Average
NRCS
Natural Resources Conservation Service
Percent of Average
Years
?

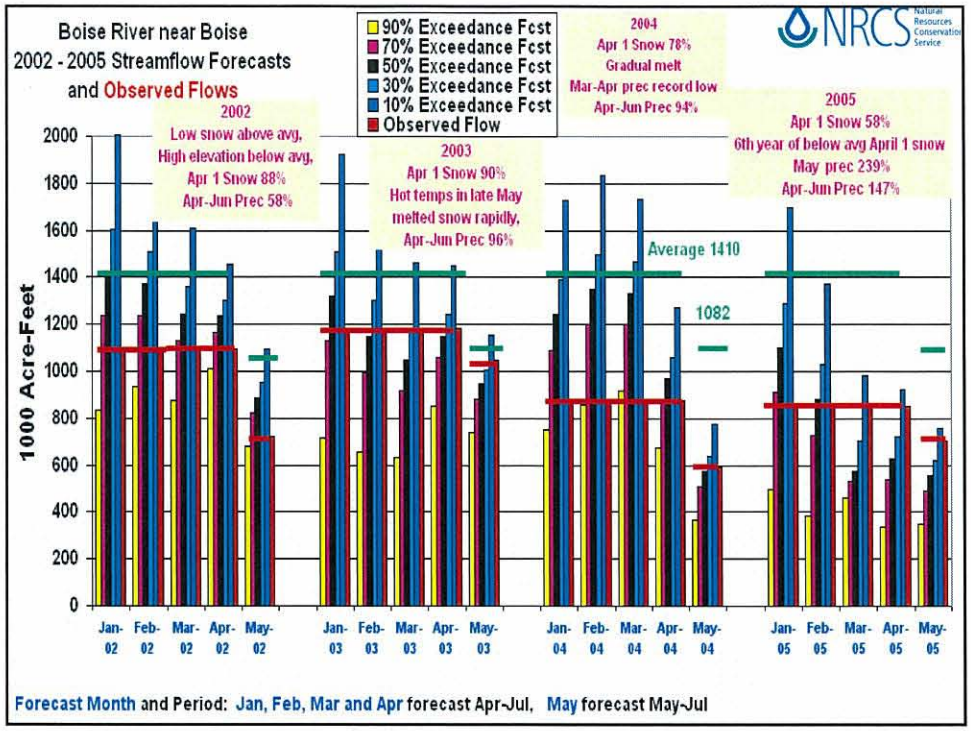

Boise Basin 7 Station Snow Index for Years 1961 - 2010
Atlanta, Dollarhide, Graham, Jackson, Mores Creek,
Trinity Mountain, Vienna Mine
April 1 Snow Water as % of Average
Boise River near Boise Apr-Sep Flow as % of Average
NRCS
Natural Resources Conservation Service
Spring Precipitation
Influences Runoff
1984
2006
1998
1963
2005
?
1989
1961
1988
Percent of Average
Years

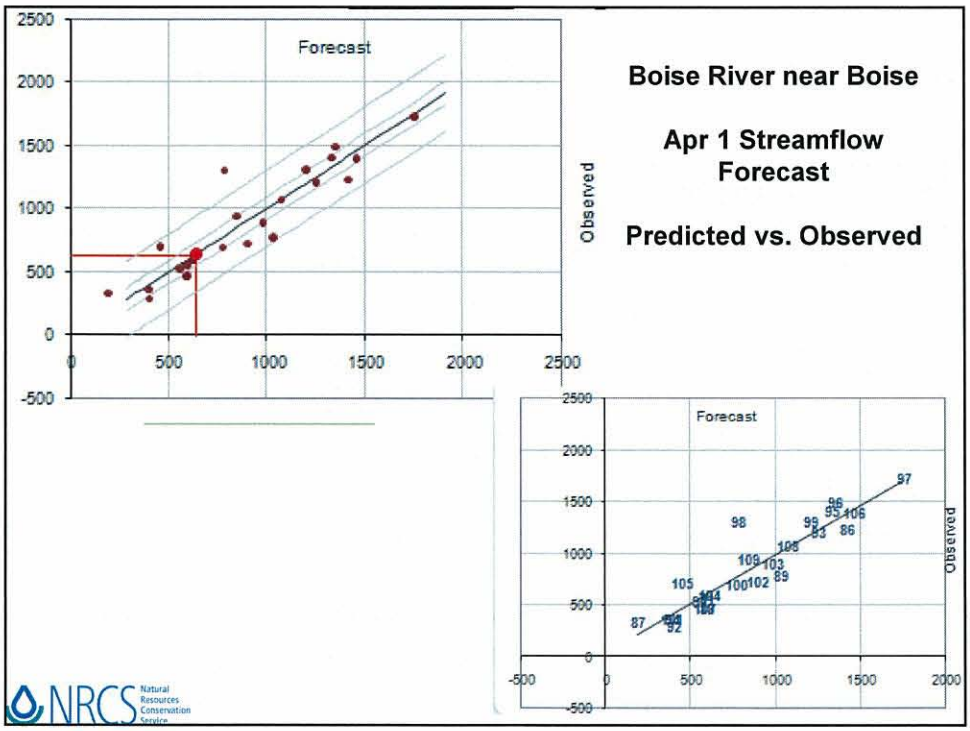

Boise River near Boise
Streamflow 1955-2009
Oct-Sep Streamflow -- ONE Year Total
1971 - 2000 Average = 2076 KAF
Min Moving Avg = 1431 in 1994
Max Moving Avg = 2399 in 1974
Streamflow 1 Year Total Flow
10 Yr Moving Avg
NRCS
Natural Resources Conservation Service
1000 Acre Feet
Years

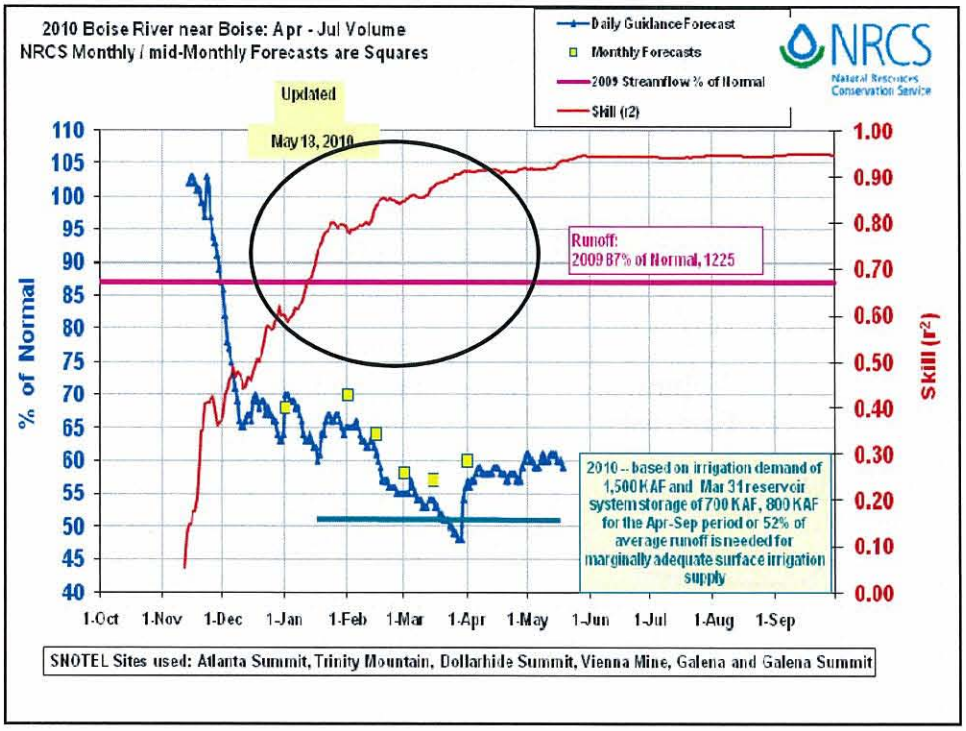

Boise River near Boise
Streamflow 1955 - 2009
Oct-Sep Streamflow -- FOUR Year Total
NRCS
Natural Resources Conservation Service
1971 - 2000 Average = 8345 KAF
1000 Acre-Feet
Years

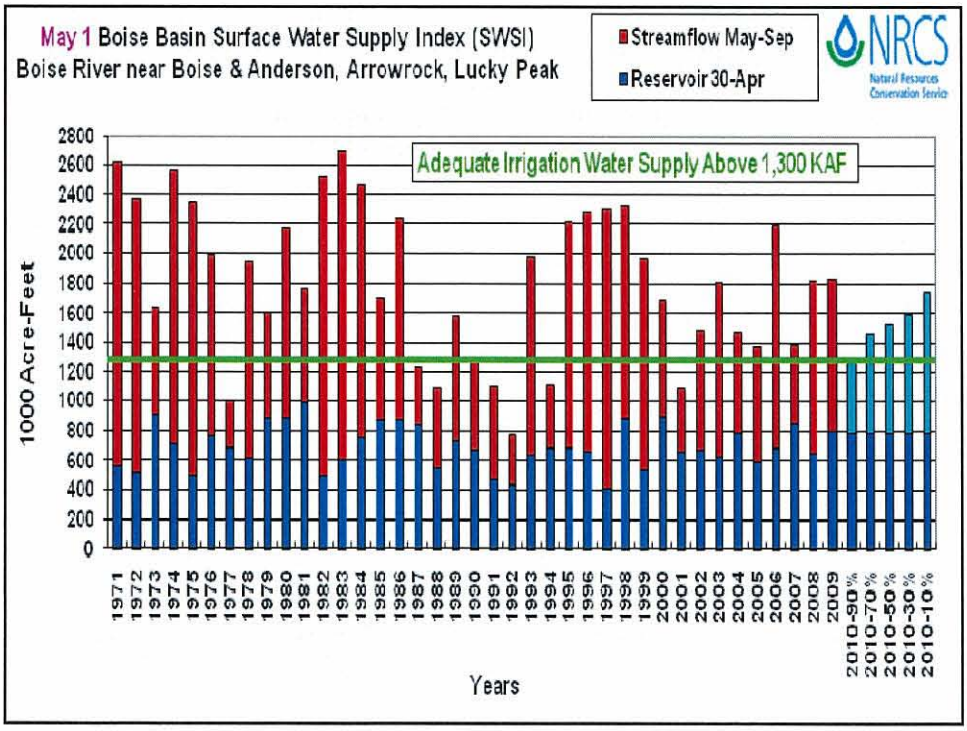

Boise River near Boise
Streamflow 1955 - 2009
Oct-Sep Streamflow -- TEN Year Total
NRCS
Natural Resources Conservation Service
1971 - 2000 Average = 20421 KAF
2008 in Red
2009 in Salmon
1000 Acre-Feet
25000
24000
23000
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
1994 1996 1995 2009 1993 2008 2007 1992 1997 1968 1998 1969 2006 1967 2005 1999 1964 1970 1991 2001 1966 1981 2000 1982 2003 1990 2002 1988 2004 1985 1989 1986 1984 1965 1971 1987 1980 1983 1979 1977 1973 1975 1972 1978 1976 1974
Years

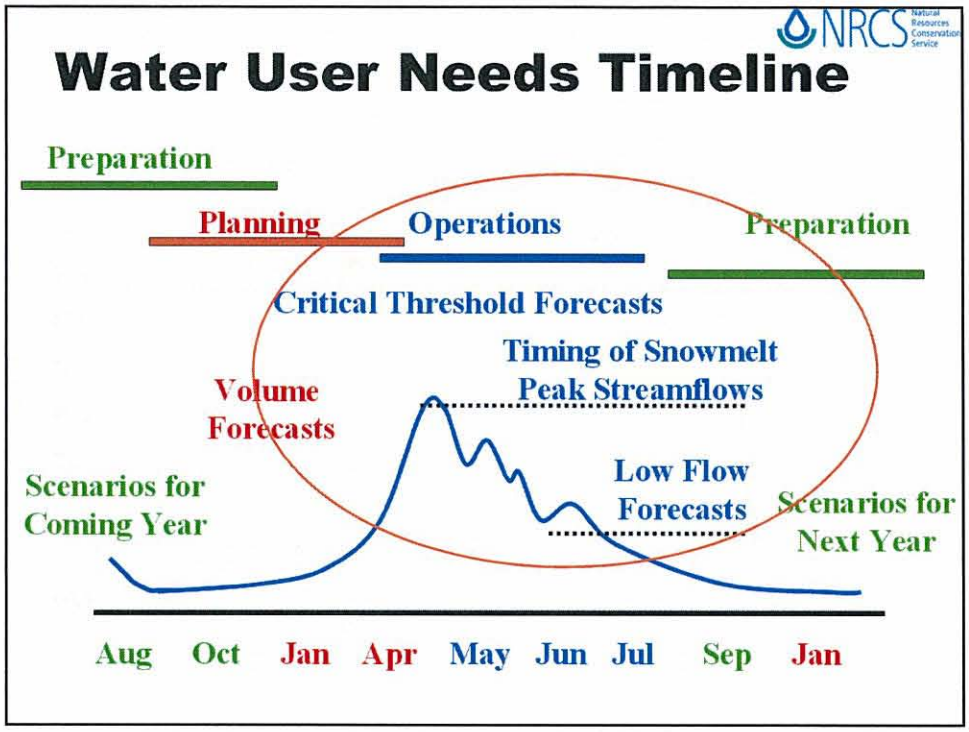

NRCS
Natural Resources Conservation Service
Water User Needs Timeline
Preparation
Planning
Operations
Preparation
Critical Threshold Forecasts
Timing of Snowmelt
Peak Streamflows
Volume
Forecasts
Scenarios for
Coming Year
Low Flow
Forecasts
Scenarios for
Next Year
Aug
Oct
Jan
Apr
May
Jun
Jul
Sep
Jan


Boise River near Boise
2002 - 2005 Streamflow Forecasts
and Observed Flows
90% Exceedance Fcst
70% Exceedance Fcst
50% Exceedance Fcst
30% Exceedance Fcst
10% Exceedance Fcst
Observed Flow
2002
Low snow above avg,
High elevation below avg,
Apr 1 Snow 88%
Apr-Jun Prec 58%
2003
Apr 1 Snow 90%
Hot temps in late May
melted snow rapidly,
Apr-Jun Prec 96%
2004
Apr 1 Snow 78%
Gradual melt
Mar-Apr prec record low
Apr-Jun Prec 94%
2005
Apr 1 Snow 58%
6th year of below avg April 1 snow
May prec 239%
Apr-Jun Prec 147%
Average 1410
1082
1000 Acre-Feet
Jan-02 Feb-02 Mar-02 Apr-02 May-02
Jan-03 Feb-03 Mar-03 Apr-03 May-03
Jan-04 Feb-04 Mar-04 Apr-04 May-04
Jan-05 Feb-05 Mar-05 Apr-05 May-05
Forecast Month and Period: Jan, Feb, Mar and Apr forecast Apr-Jul, May forecast May-Jul


Boise River near Boise
Apr 1 Streamflow
Forecast
Predicted vs. Observed
Forecast
Observed

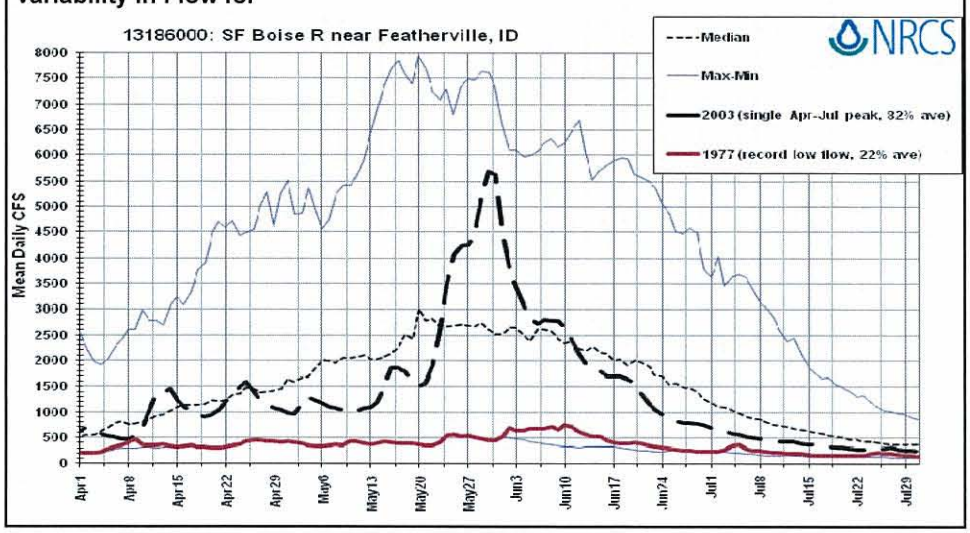

2010 Boise River near Boise: Apr - Jul Volume
NRCS Monthly / mid-Monthly Forecasts are Squares
Daily Guidance Forecast
Monthly Forecasts
2009 Streamflow % of Normal
Skill (r2)
NRCS
Natural Resources Conservation Service
Updated
May 18, 2010
Runoff:
2009 87% of Normal, 1225
2010 -- based on irrigation demand of 1,500 KAF and Mar 31 reservoir system storage of 700 KAF, 800 KAF for the Apr-Sep period or 52% of average runoff is needed for marginally adequate surface irrigation supply
% of Normal
Skill (r2)
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
SNOTEL Sites used: Atlanta Summit, Trinity Mountain, Dollarhide Summit, Vienna Mine, Galena and Galena Summit


May 1 Boise Basin Surface Water Supply Index (SWSI)
Boise River near Boise & Anderson, Arrowrock, Lucky Peak
Streamflow May-Sep
Reservoir 30-Apr
NRCS
Natural Resources Conservation Service
Adequate Irrigation Water Supply Above 1,300 KAF
1000 Acre-Feet
Years



Is that all there is? **Have the streams peaked?**
Is there enough snow up there to produce one more peak?
Will the next peak be higher than the last?
Can we close the gates on the reservoir and do final fill?
Is it safe for whitewater river runners to put their boats on the river?

Variability in Flow for



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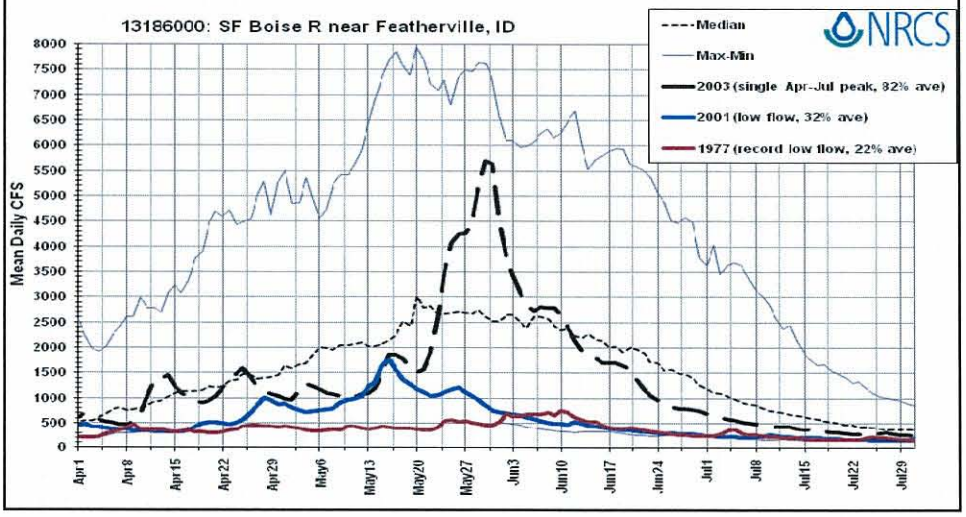

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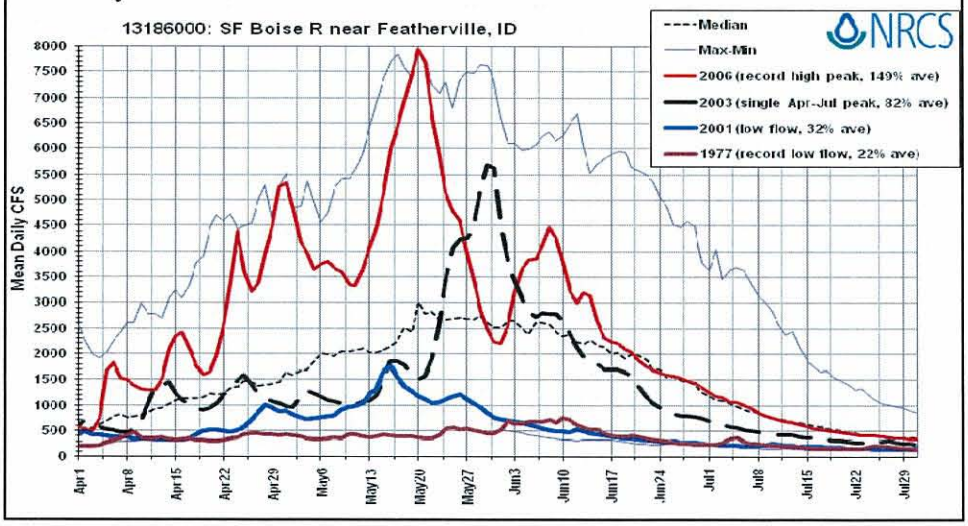
Variability in Flow for



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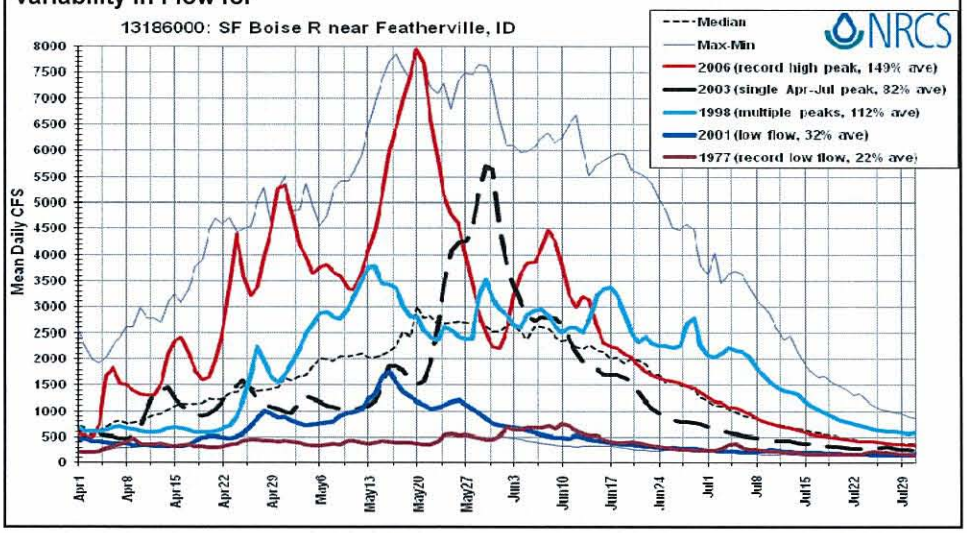
Variability in Flow for



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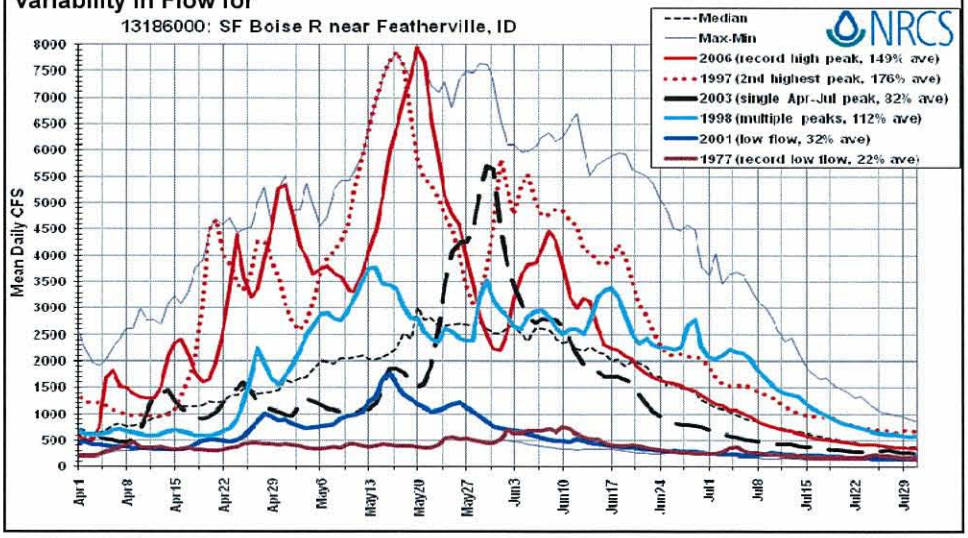
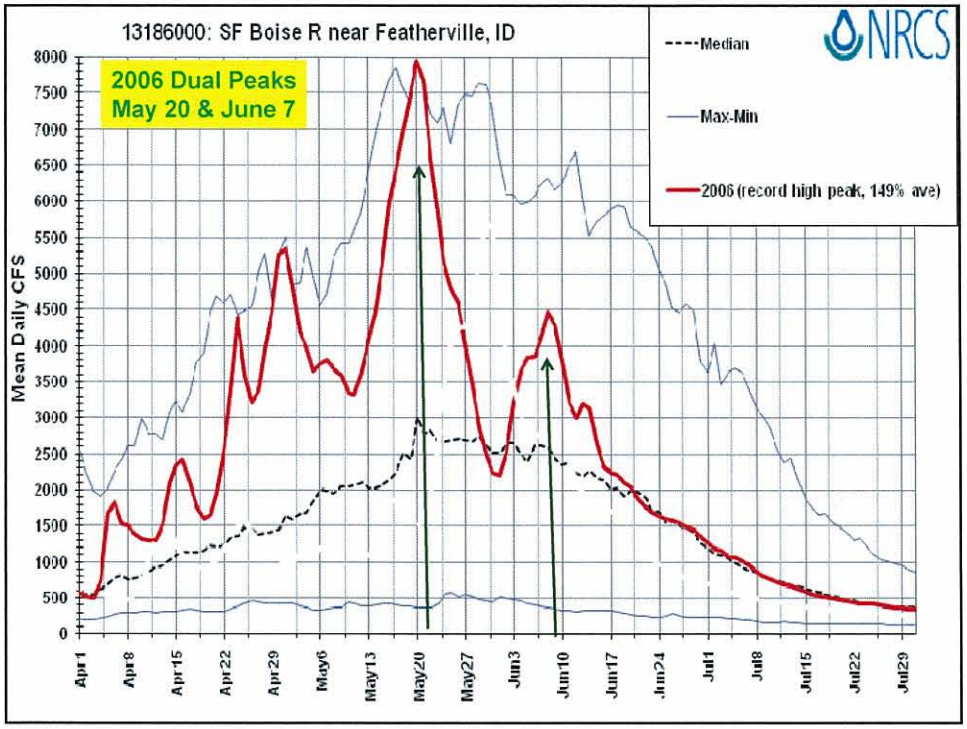
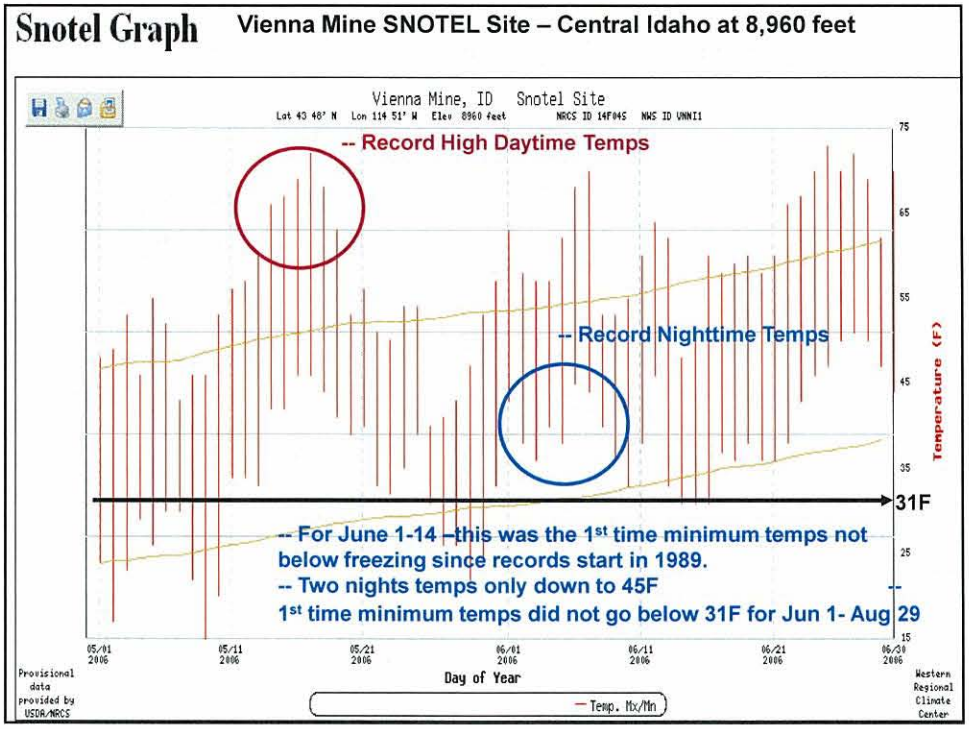
Variability in Flow for




13186000: SF Boise R near Featherville, ID
2006 Dual Peaks
May 20 & June 7
Median
Max-Min
2006 (record high peak, 149% ave)
NRCS
Mean Daily CFS
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Apr1
Apr8
Apr15
Apr22
Apr29
May6
May13
May20
May27
Jun3
Jun10
Jun17
Jun24
Jul1
Jul8
Jul15
Jul22
Jul29


Snotel Graph
Vienna Mine SNOTEL Site – Central Idaho at 8,960 feet
Vienna Mine, ID Snotel Site
Lat 43 48' N Lon 114 51' W Elev 8960 feet NRCS ID 14F04S NWS ID VNNI1
-- Record High Daytime Temps
-- Record Nighttime Temps
31F
-- For June 1-14 –this was the 1st time minimum temps not below freezing since records start in 1989.
-- Two nights temps only down to 45F
1st time minimum temps did not go below 31F for Jun 1- Aug 29
Temperature (F)
75
65
55
45
35
25
15
05/01 2006
05/11 2006
05/21 2006
06/01 2006
06/11 2006
06/21 2006
06/30 2006
Day of Year
Temp. Mx/Mn
Provisional data provided by USDA/NRCS
Western Regional Climate Center

Lynn Harmon, manager of the Big Wood Canal Company, best summarized the need for snowmelt timing runoff products when…..

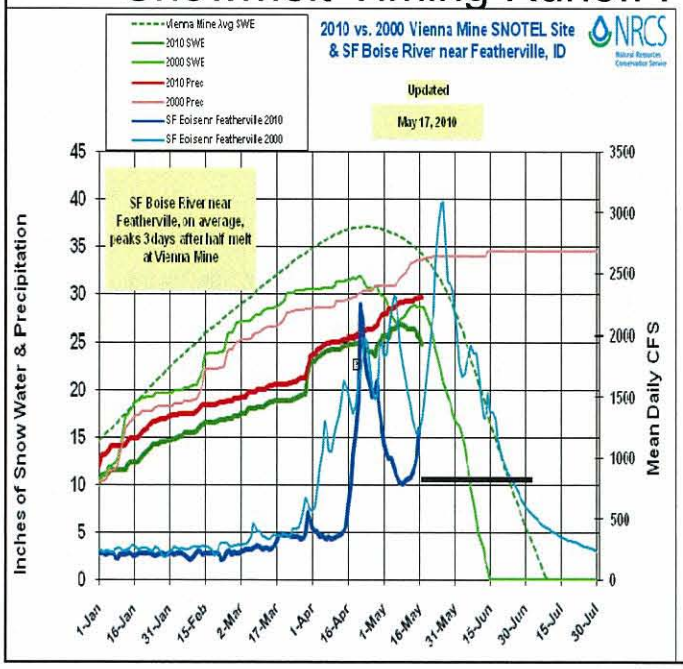
…Asked him if he had seen the mid-April volume forecasts….. Lynn mentioned that they have a good idea on the volume of runoff and type of year it is going to be.

Now, it all comes down to, how long the streams will stay high and when will inflows decrease below irrigation demand.

Boise River ~1800 cfs for water right, Big Lost & Snake River -- natural flow water rights above reservoir.

KV2

Snowmelt Timing Runoff Products



Peak Flow Prediction for:

- River runners
- Reservoir operations
- Manage excess water
- Hydropower
- Flood mitigation
- Planting hatchery fish in low snow runoff years

Slide 48

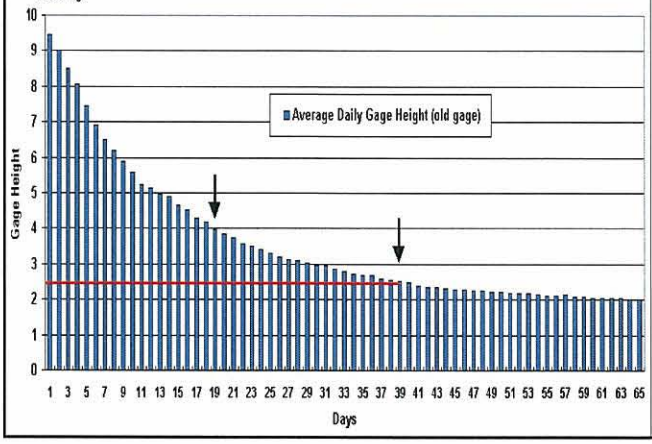
KV2 blurry
Karen Vaughan, 4/15/2010

Recession Streamflow Relationship / Low Flow Forecasts

Middle Fork Salmon River at MF Lodge Recession Analysis - analysis is based on 12 years of data between 1981-1993 (OLD STREAMFLOW GAGE DATA). There may be multiple peaks each year on the MF Salmon River. The average recession Gage Height analysis is based only on when stream is receding. Increases in streamflow were ignored. If rain event or additional snowmelt generated streamflow increase, rising part of hydrograph was ignored, and only recession flow was used to determine average receding gage height.

Analysis is a guide to assist with recession flow determination, results vary and depend upon future streamflow peaks and past, current and future climatic conditions (additional rain and / or extreme hot or cool air temperatures).

To use: if today's average gage height is 4.0 feet (Day 19) and launch date is 20 days out, gage height may be about 2.5 feet (Day 39) on launch date. If streamflow increase occurs between now and launch date, start over when stream starts receding.



Low Flow Prediction for:

- Water rights for irrigation supply
- Reservoir operators
- Hydropower
- River runners
- Limit fish harvest in MT, salvage fishing

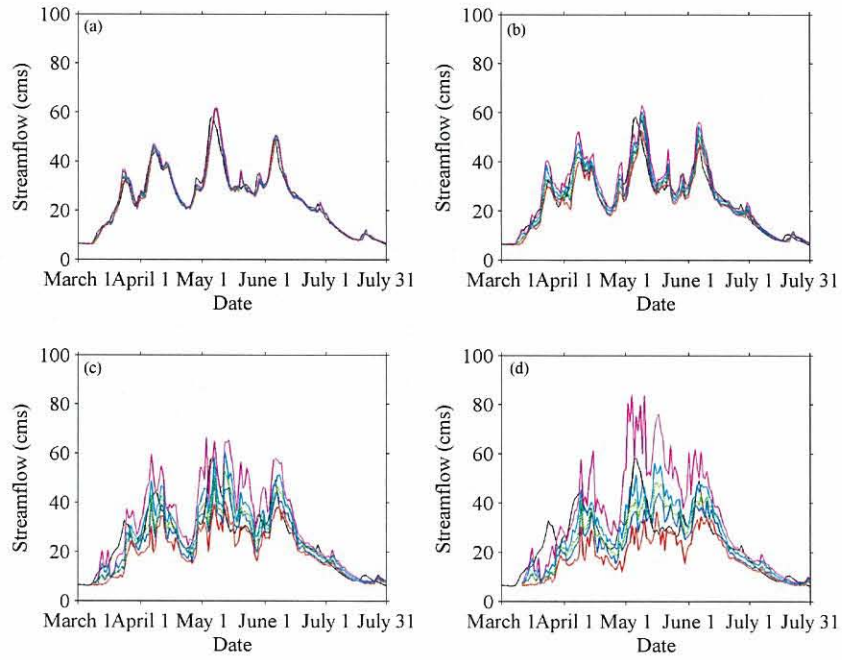
Climatic Parameters to Watch that Produce the Snowmelt Streamflow Peaks each Year

- **If Galena Summit SNOTEL has snow; Big Wood River can reach or sustain flood stage flows with Boise air temperatures in the 80's**
- **Cumulative Degree Days to peak flows – Camas Creek**
- **Number of Days or Volume above 5000 CFS for Snake River near Flagg Ranch - developed after 1997 floods.**

Uofl Using SNOTEL Data

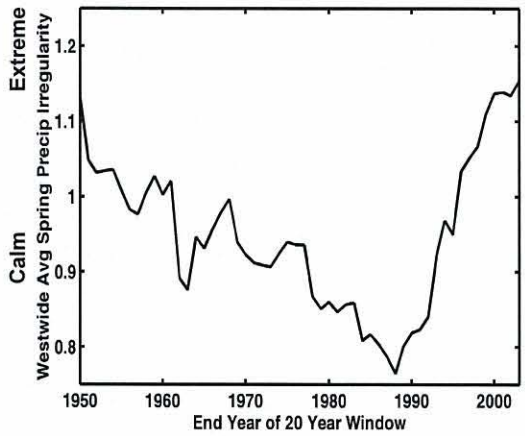
- Enhanced Snowmelt Runoff Model using MODIS snow covered data and SNOTEL data for SF Boise River near Featherville
- Downscaling Medium-Range forecasts
  - Requires long complete record of observations
    - Temperature and precipitation
  - Completed for 127 SNOTEL stations across Idaho and western Montana

2006 Big Wood River Calibration Runs 1-day, 3-day, 7-day, and 14-day forecast



Spring Precipitation Variability Study by Tom Pagano NRCS

Westwide average of 29 basins

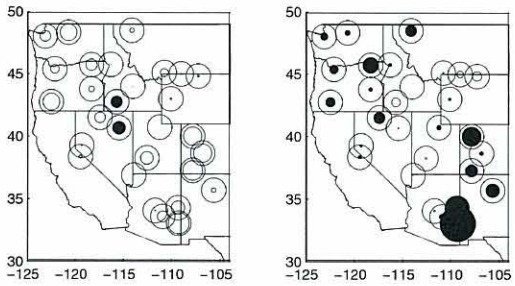


20-year moving window Spring precipitation "irregularity"

More than 1 = more extreme than usual

Less than 1 = Calm, reliably near-normal

1961-80 **1981-00**

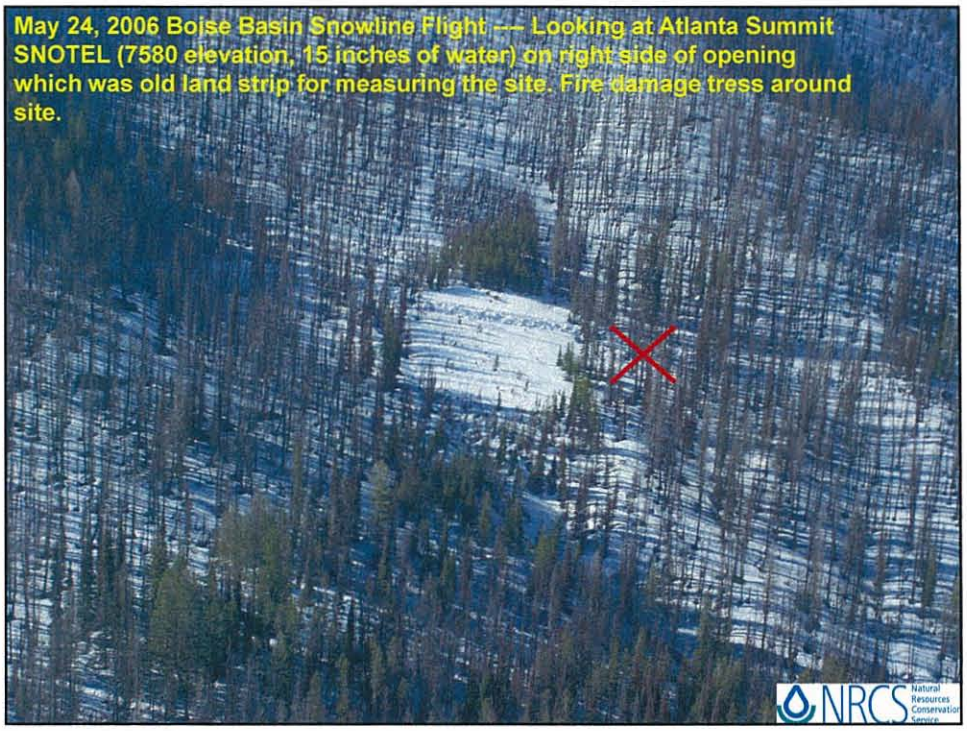


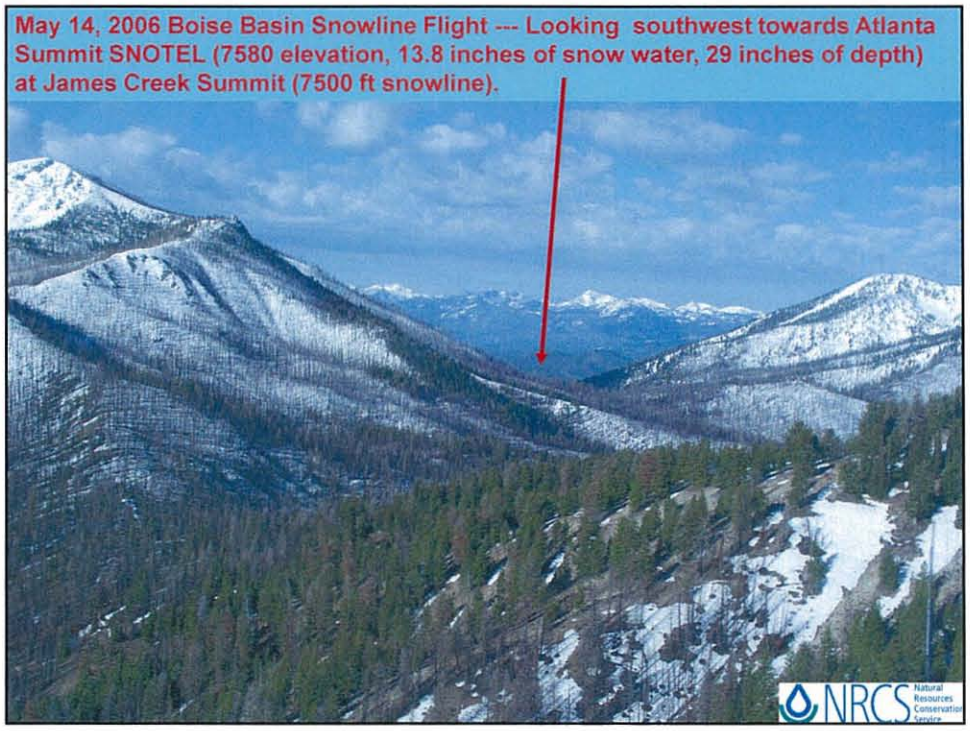
Calm **Typical** **Extreme**

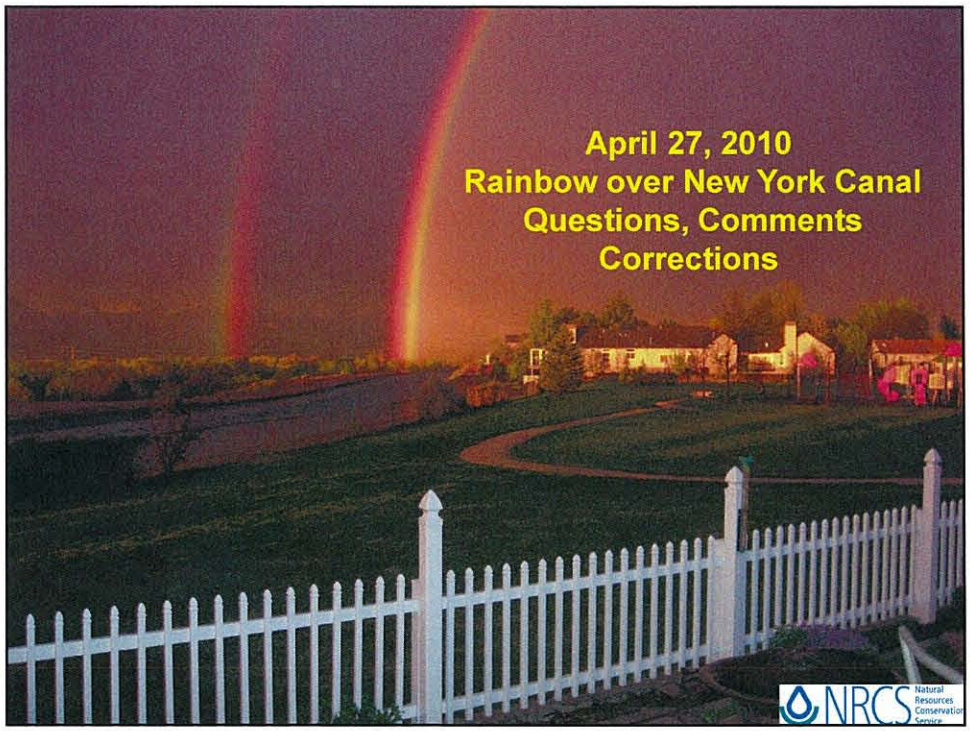
Where is spring precip more irregular?

Now, especially in PNW and Southwest, whereas before it was very calm

This matches decline in forecast skill

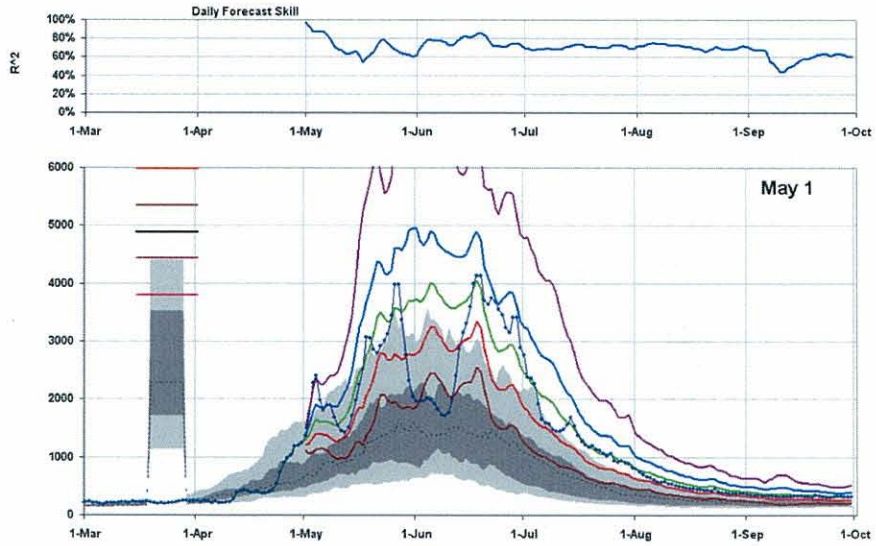

May 24, 2006 Boise Basin Snowline Flight --- Looking at Atlanta Summit SNOTEL (7580 elevation, 15 inches of water) on right side of opening which was old land strip for measuring the site. Fire damage tress around site.
NRCS

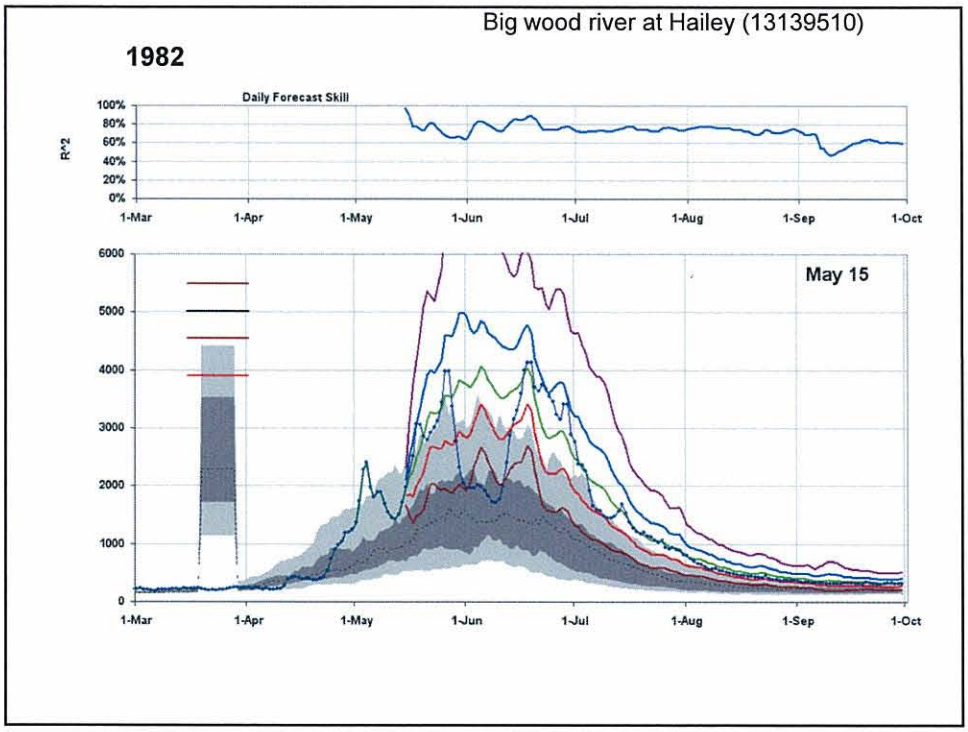

May 14, 2006 Boise Basin Snowline Flight --- Looking southwest towards Atlanta Summit SNOTEL (7580 elevation, 13.8 inches of snow water, 29 inches of depth) at James Creek Summit (7500 ft snowline).
NRCS

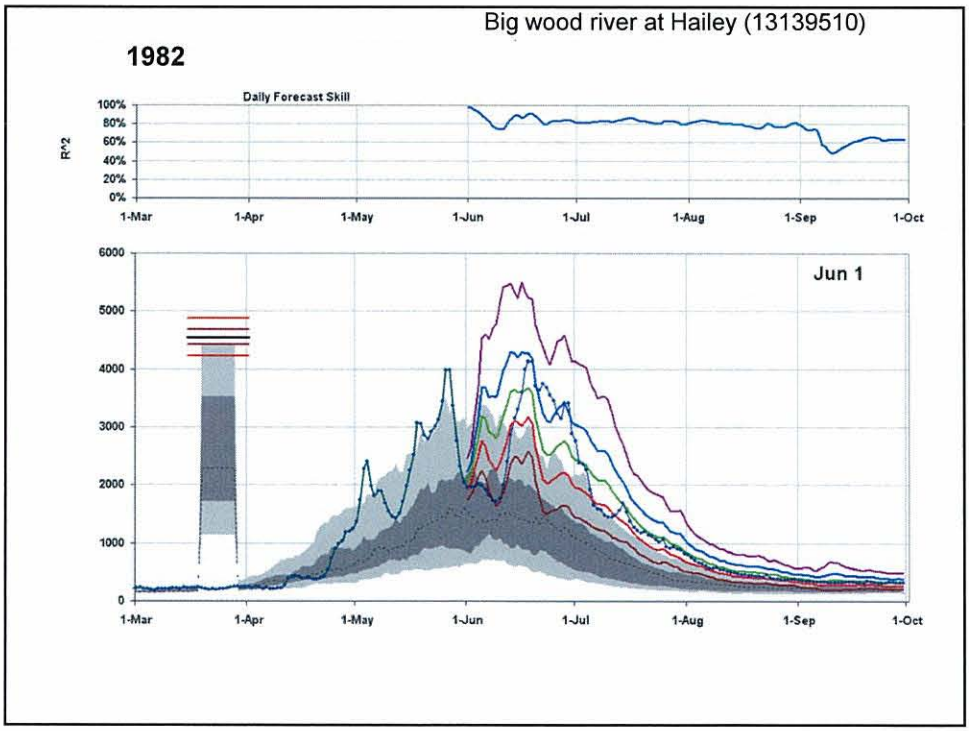

April 27, 2010
Rainbow over New York Canal
Questions, Comments
Corrections
NRCS

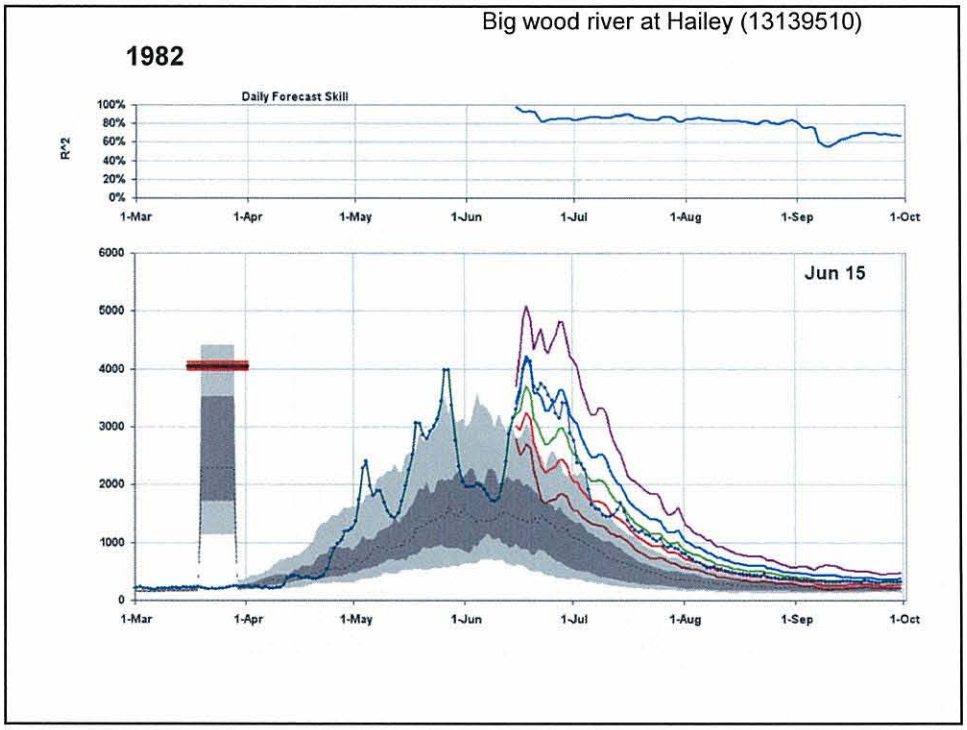
Extra slides

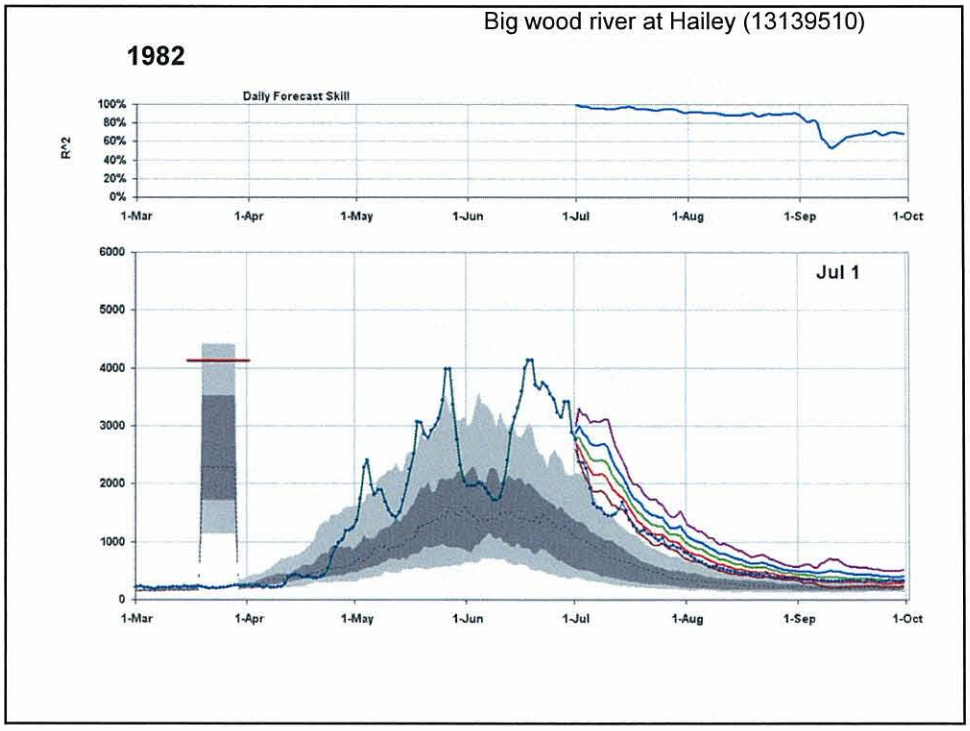
Peak Flow Potential for Big Wood River at Hailey (13139510) 1982

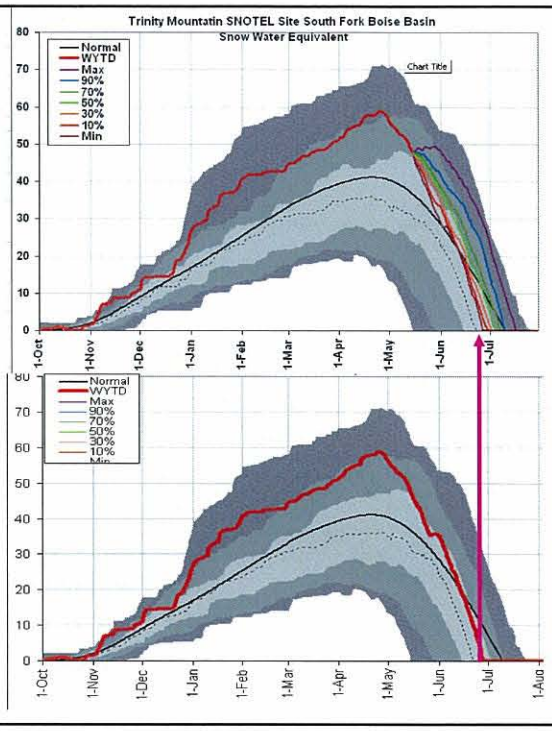



Big wood river at Hailey (13139510)
1982
Daily Forecast Skill
R^2
100%
80%
60%
40%
20%
0%
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
6000
5000
4000
3000
2000
1000
0
May 15


Big wood river at Hailey (13139510)
1982
Daily Forecast Skill
R^2
100%
80%
60%
40%
20%
0%
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
6000
5000
4000
3000
2000
1000
0
Jun 1


Big wood river at Hailey (13139510)
1982
Daily Forecast Skill
R^2
100%
80%
60%
40%
20%
0%
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
Jun 15
6000
5000
4000
3000
2000
1000
0


Big wood river at Hailey (13139510)
1982
Daily Forecast Skill
R^2
100%
80%
60%
40%
20%
0%
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
Jul 1
6000
5000
4000
3000
2000
1000
0



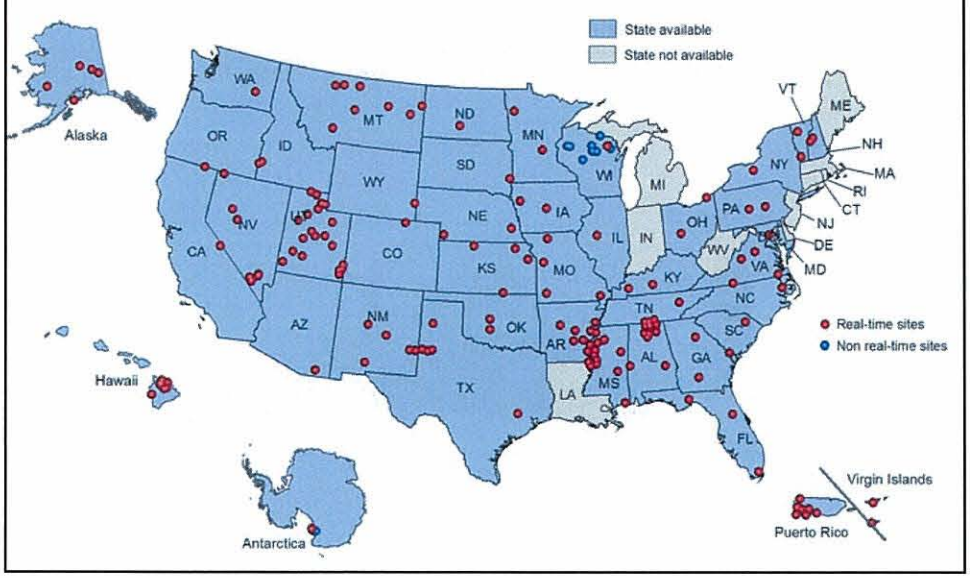
2006 --- Hot temps from mid-May on melted the snow at <10% chance of occurring

NRCS Natural Resources Conservation Service

Soil Climate Analysis Network (SCAN)

170 sites nationwide

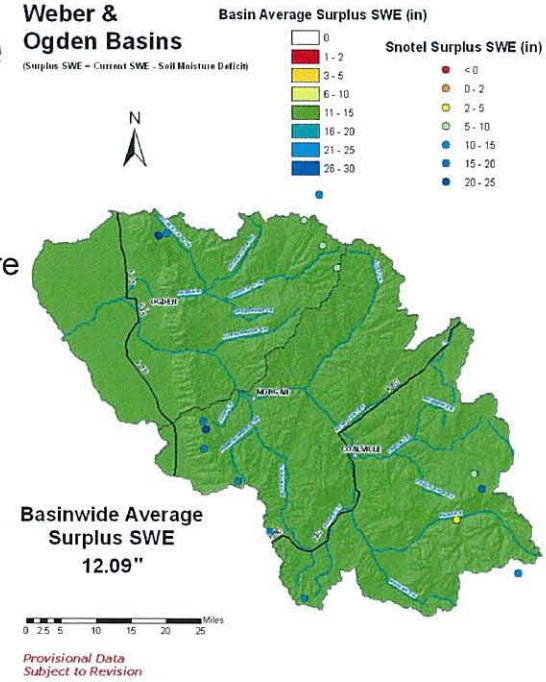
Apr 2010- New SCAN request guidelines



Soil Moisture

Surplus SWE =

Current SWE – Soil Moisture Deficit

UT /NWCC products

FTE Position on UT Staff funded by Snow, Soils & 01