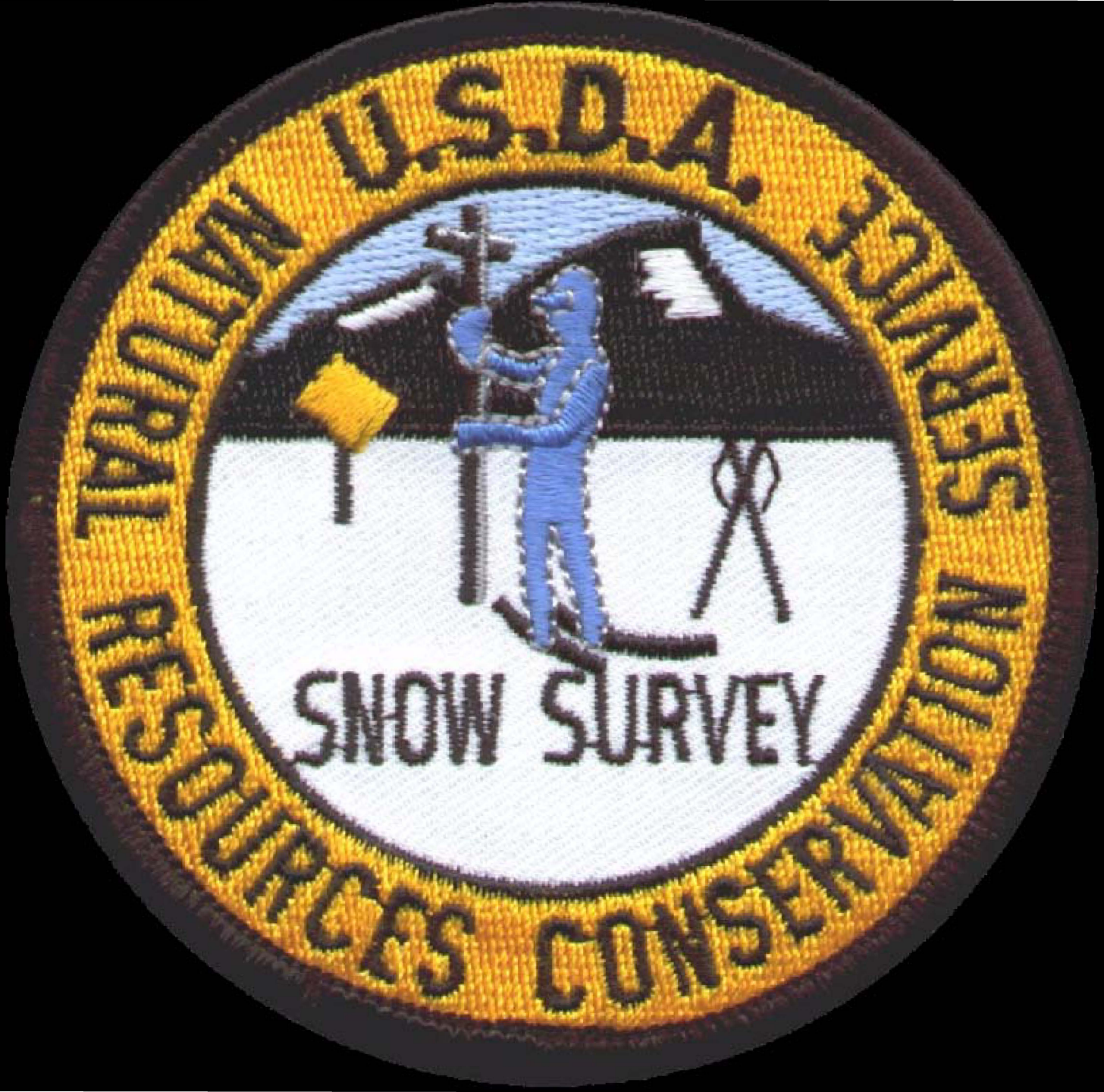
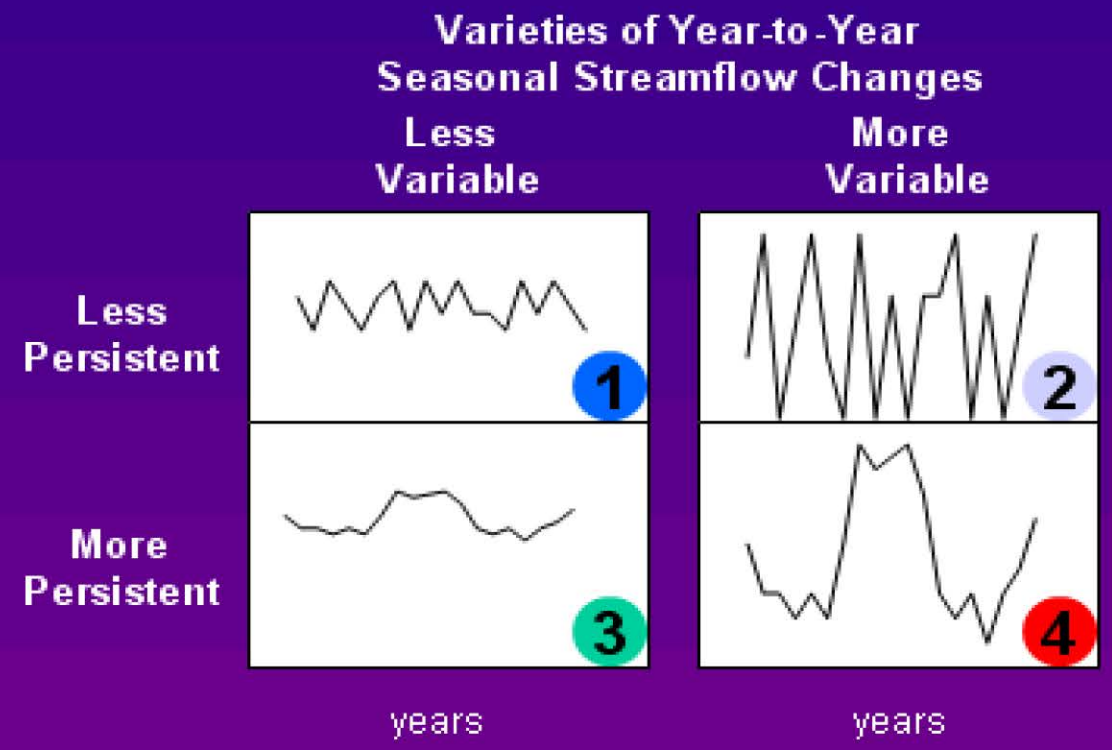

U.S.D.A. FOREST SERVICE
NATURAL RESOURCES CONSERVATION
SNOW SURVEY

Harmon to Moen to Rogers to Garner to Rogers to Ford to Moen who runs over Tyrrell the trombone player in the Stanford end zone

Recent Streamflow Variability and Persistence

(Pagano, Garen, 2005, Journal of Hydrometeorology)

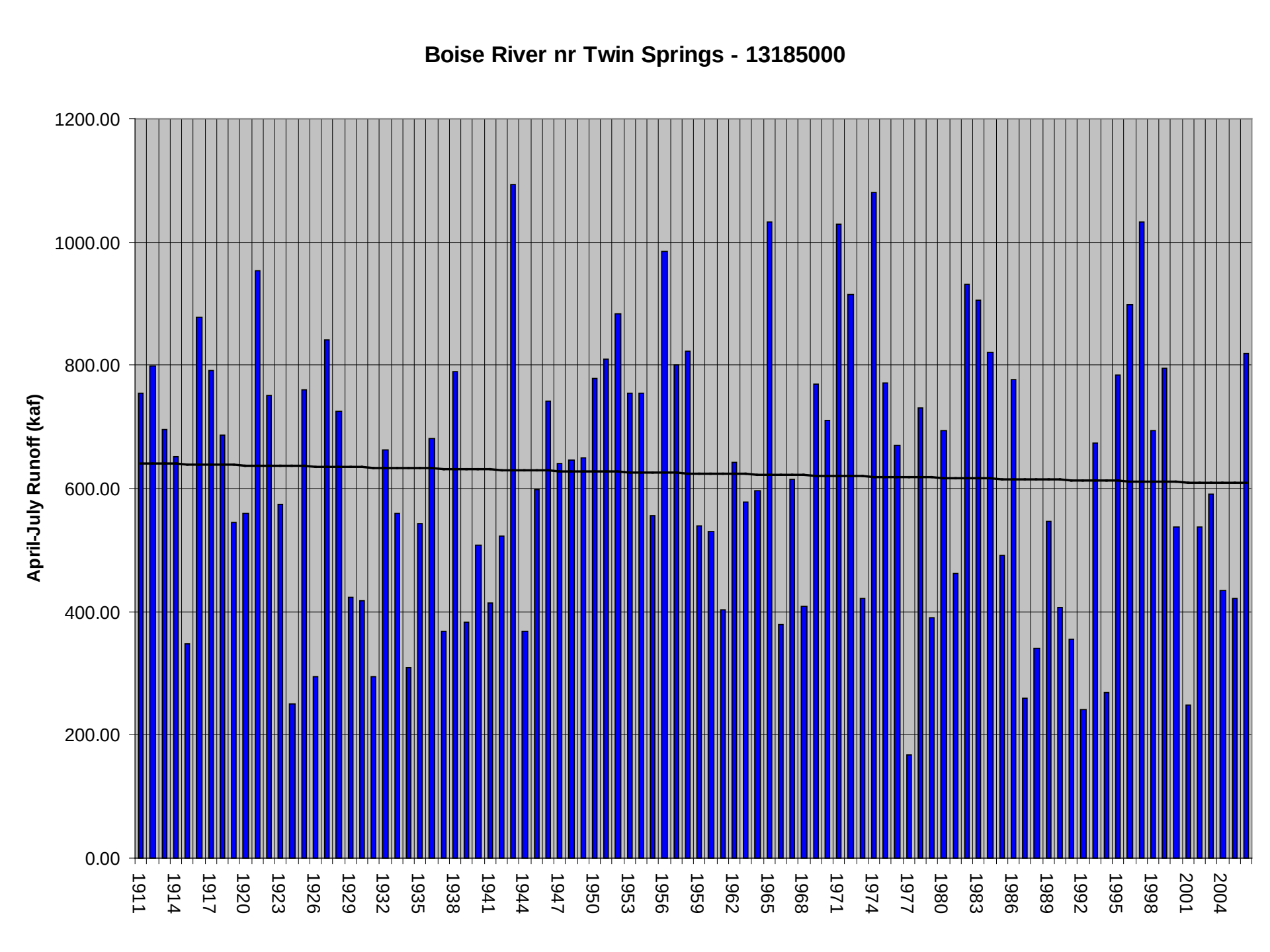
In the last 20 years, a region from California to Colorado & Idaho to Arizona has seen a shift towards multi-year extreme dry and wet periods, a kind of sequencing never seen before in at least 80 years.



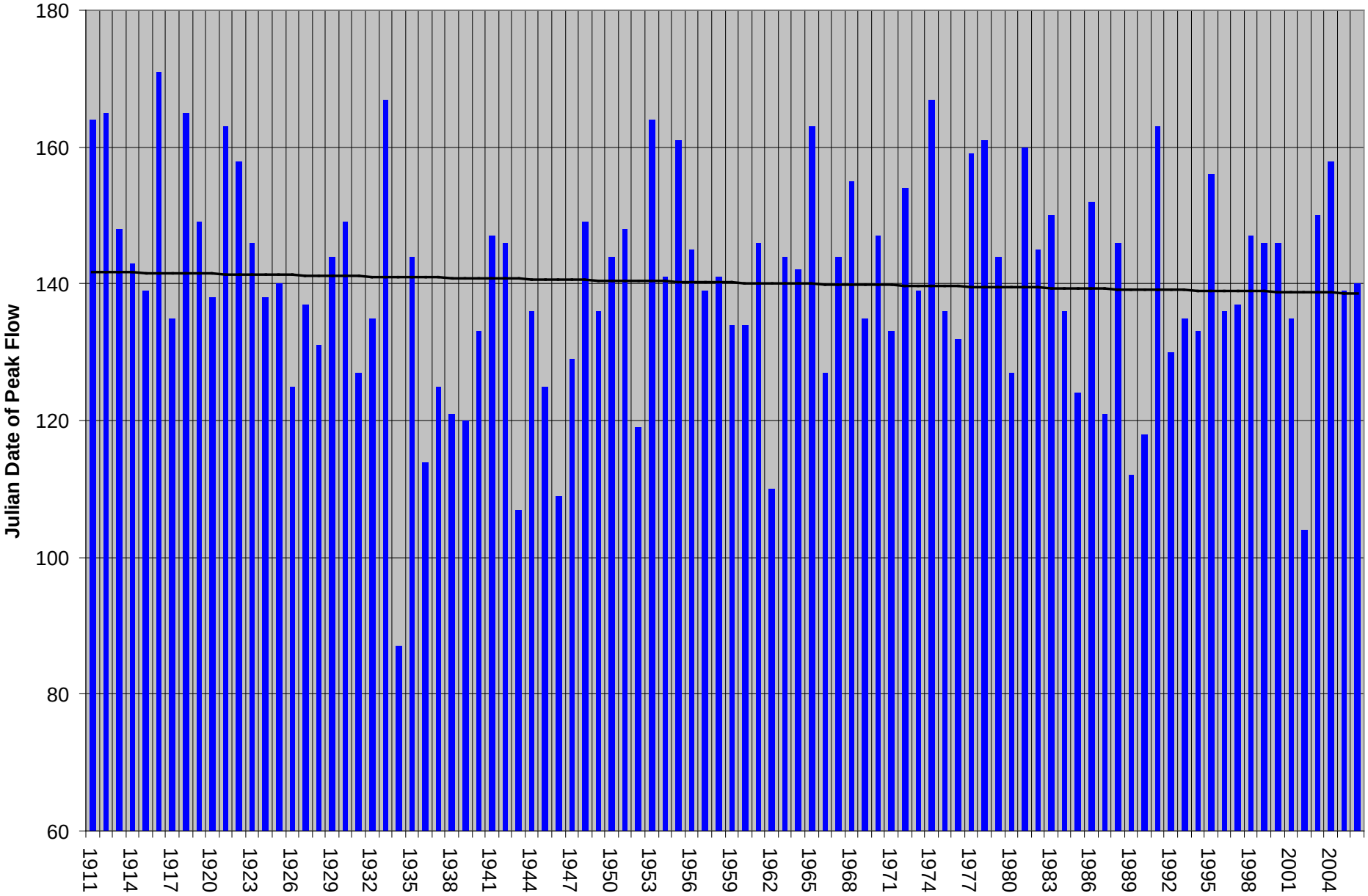
1930s-1950s: low variability, high persistence.

1950s-1970s: low variability, anti-persistence.

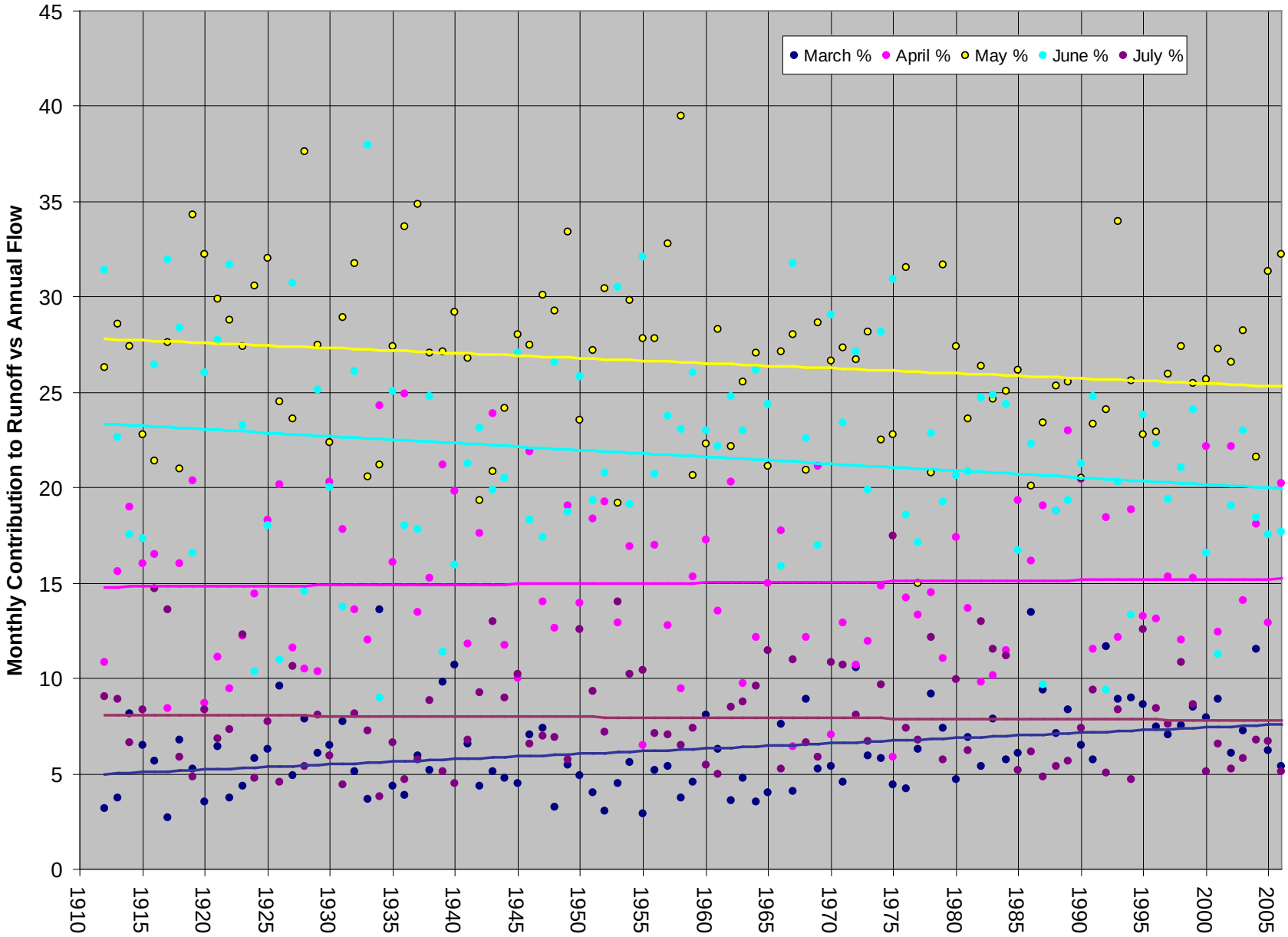
1980s-present: high variability, high persistence.

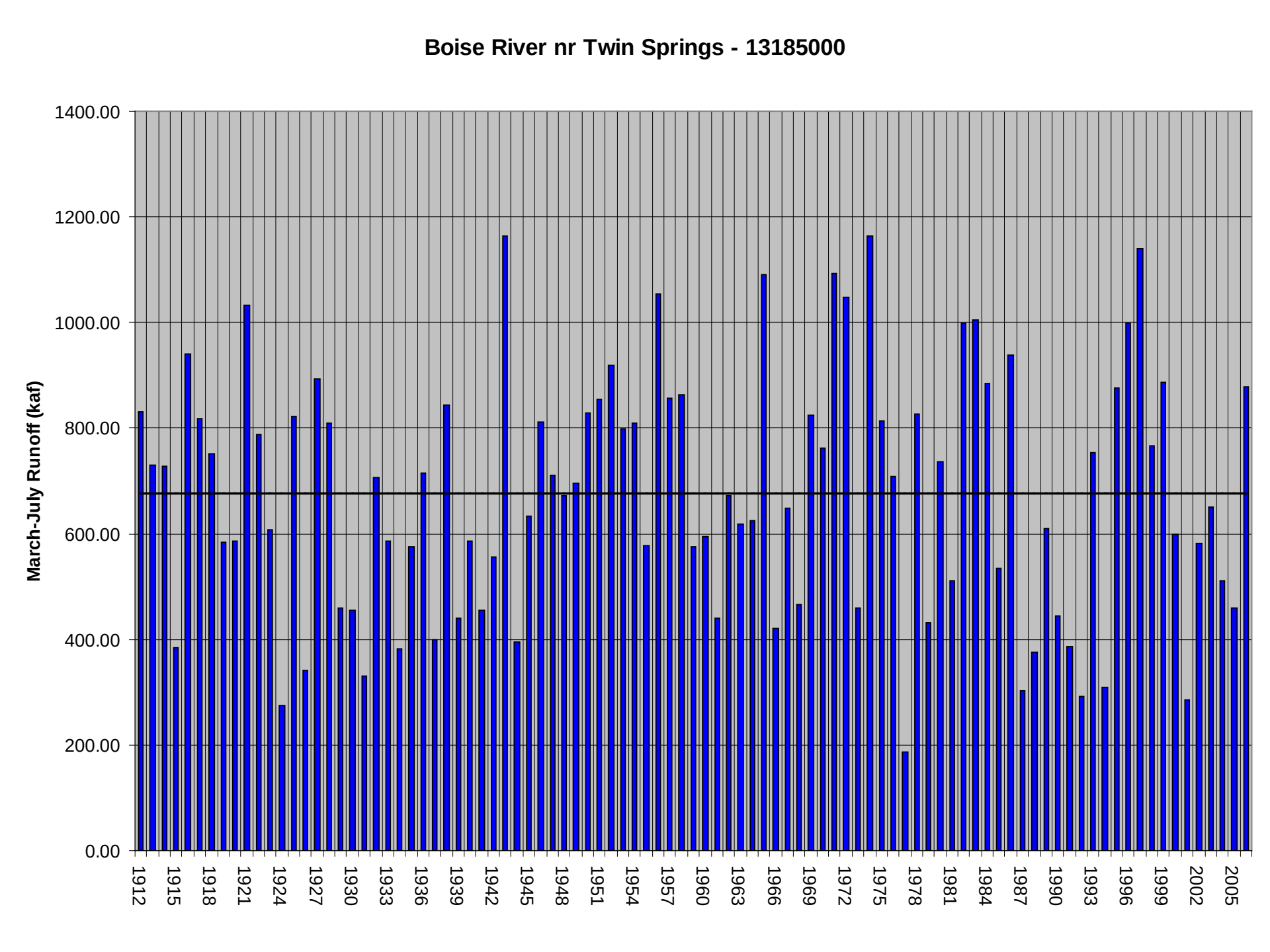

Boise River nr Twin Springs - 13185000
April-July Runoff (kaf)
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
1911
1914
1917
1920
1923
1926
1929
1932
1935
1938
1941
1944
1947
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004

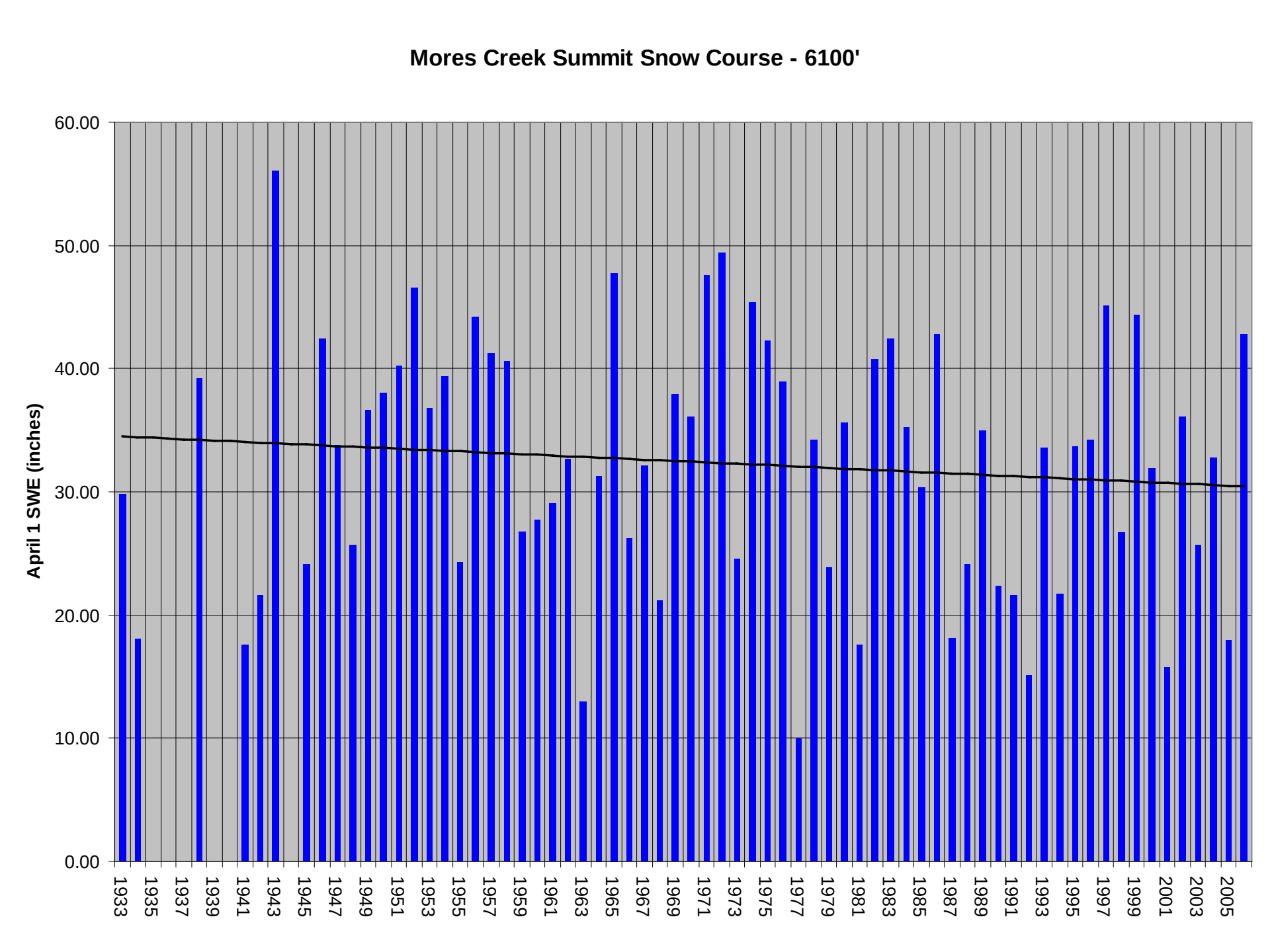
Boise River nr Twin Springs - 13185000

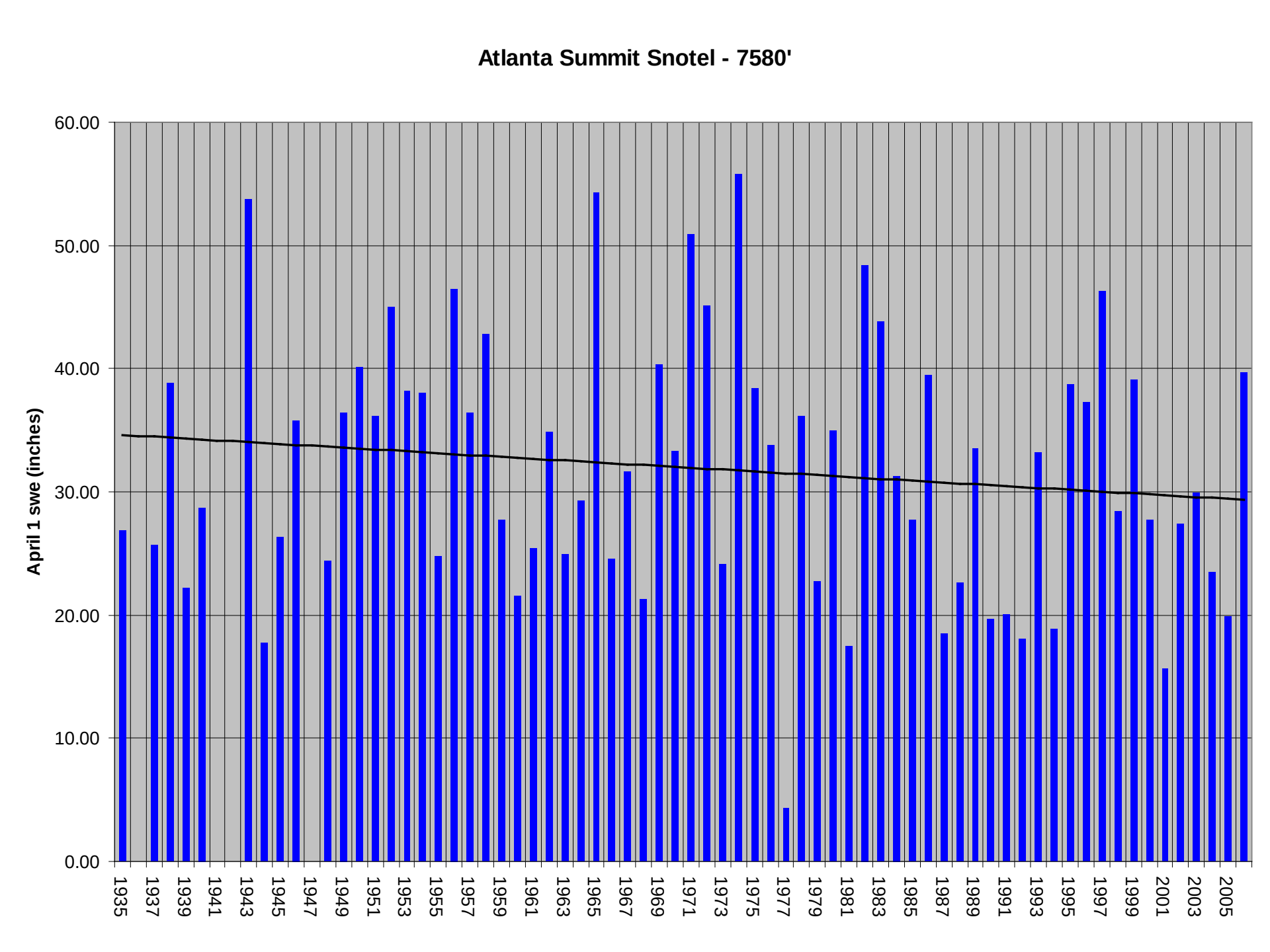


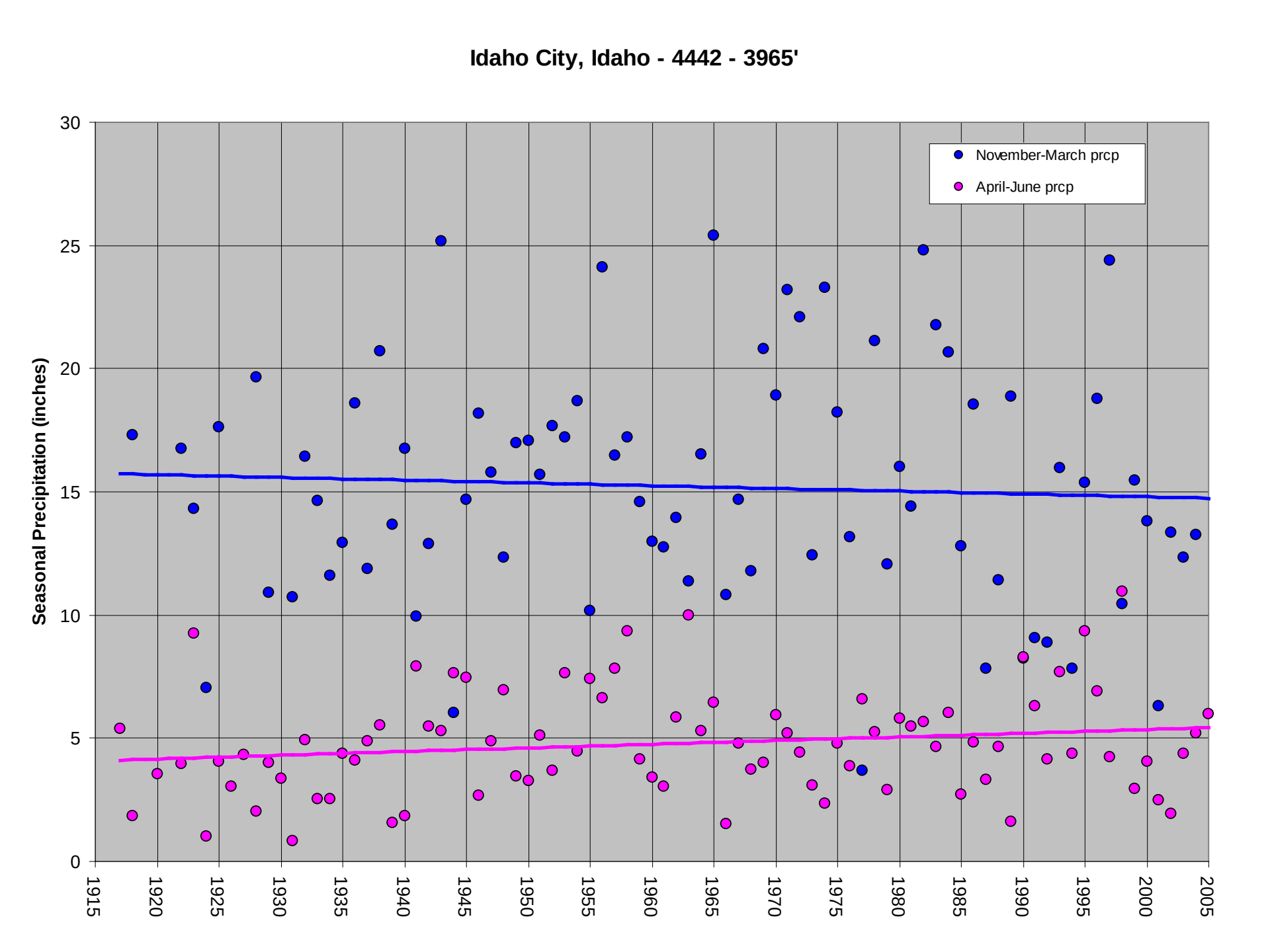
Boise River nr Twin Springs - 13185000

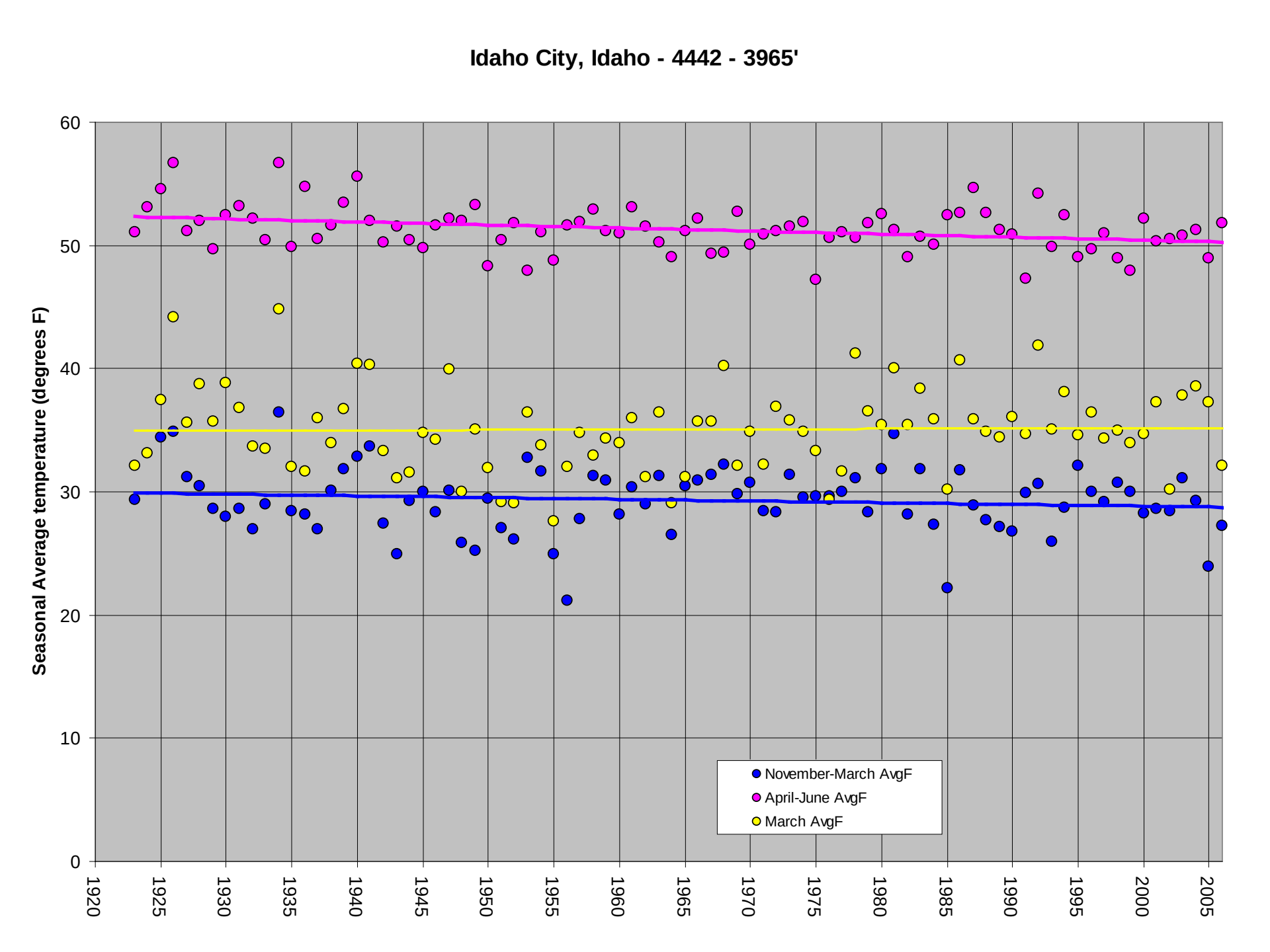


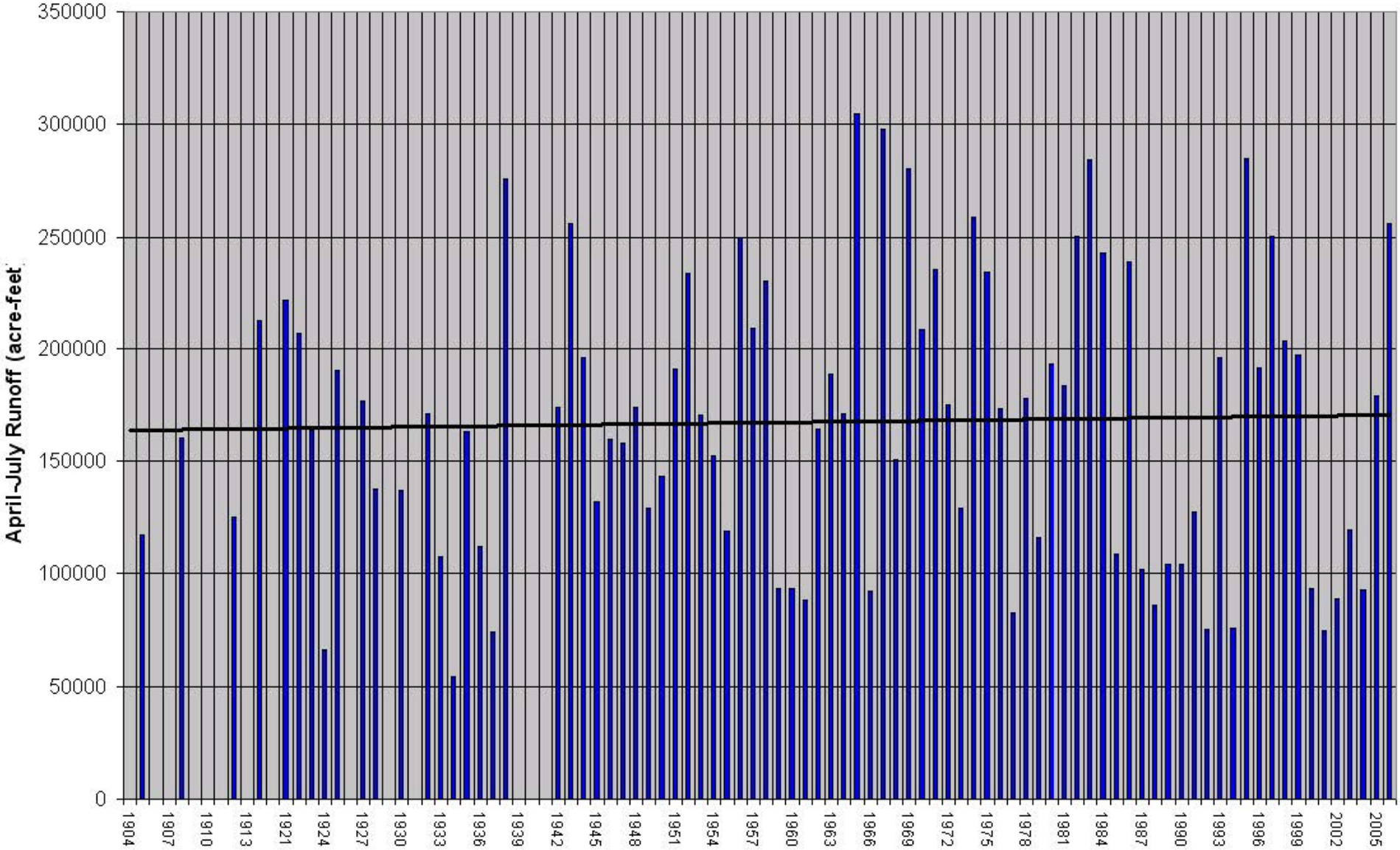

Boise River nr Twin Springs - 13185000
March-July Runoff (kaf)
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
1912
1915
1918
1921
1924
1927
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005


Mores Creek Summit Snow Course - 6100'
April 1 SWE (inches)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1933
1935
1937
1939
1941
1943
1945
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


Atlanta Summit Snotel - 7580'
April 1 swe (inches)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1935
1937
1939
1941
1943
1945
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


Idaho City, Idaho - 4442 - 3965'
Seasonal Precipitation (inches)
November-March prcp
April-June prcp
0
5
10
15
20
25
30
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005


Idaho City, Idaho - 4442 - 3965'
Seasonal Average temperature (degrees F)
60
50
40
30
20
10
0
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
November-March AvgF
April-June AvgF
March AvgF


Big Lost River @ Howell Ranch - 13120500
April-July Runoff (acre-feet)
350000
300000
250000
200000
150000
100000
50000
0
1904
1907
1910
1913
1921
1924
1927
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005

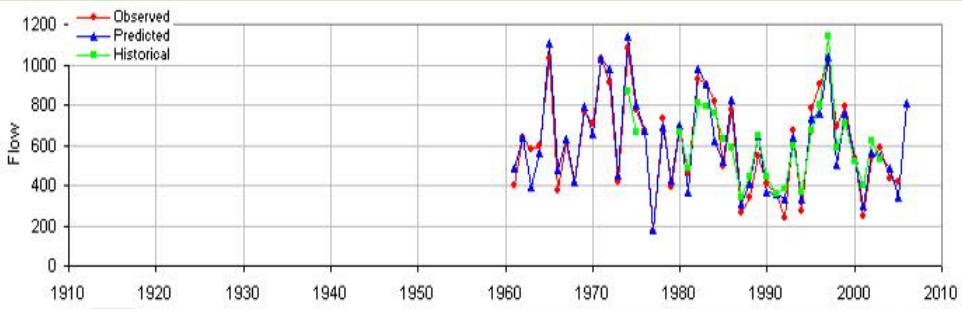
	Type	Target	Start	End
>	Forecast Point	13185000, ID, Boise River Near Twin Springs, I	Apr	Jul

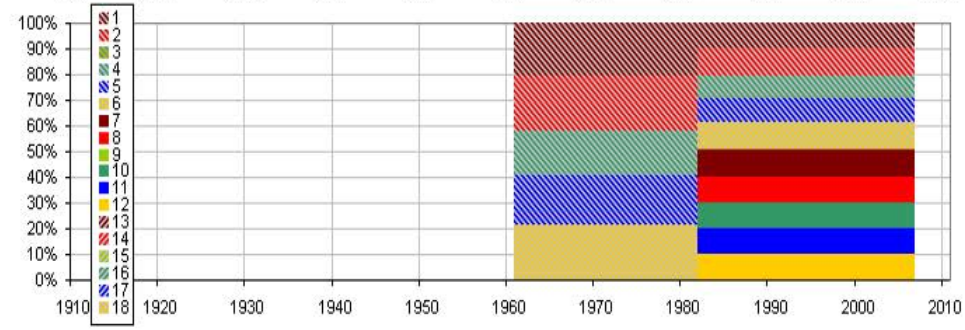
		Type	Predictors	Start	End	
1	☑	SnotelSwe	830, ID, Trinity Mtn.	Apr F	Apr F	1
2	☑	SnotelSwe	306, ID, Atlanta Summit	Apr F	Apr F	2
3	☐	SnotelSwe	496, ID, Graham Guard Sta.	Apr F	Apr F	3
4	☑	SnotelSwe	637, ID, Mores Creek Summit	Apr F	Apr F	4
5	☑	SnotelSwe	550, ID, Jackson Peak	Apr F	Apr F	5
6	☑	SnotelSwe	845, ID, Vienna Mine	Apr F	Apr F	6
7	☑	SnotelPrcp	830, ID, Trinity Mtn.	Oct-1 F	Mar L	7
8	☑	SnotelPrcp	306, ID, Atlanta Summit	Oct-1 F	Mar L	8
9	☐	SnotelPrcp	496, ID, Graham Guard Sta.	Oct-1 F	Mar L	9
10	☑	SnotelPrcp	637, ID, Mores Creek Summit	Oct-1 F	Mar L	10
11	☑	SnotelPrcp	550, ID, Jackson Peak	Oct-1 F	Mar L	11
12	☑	SnotelPrcp	845, ID, Vienna Mine	Oct-1 F	Mar L	12
13	☐			Apr F	Apr F	13
14	☐			Feb F	Feb F	14
15	☐			Feb F	Feb F	15
16	☐			Feb F	Feb F	16
17	☐			Feb F	Feb F	17
18	☐			Feb F	Feb F	18

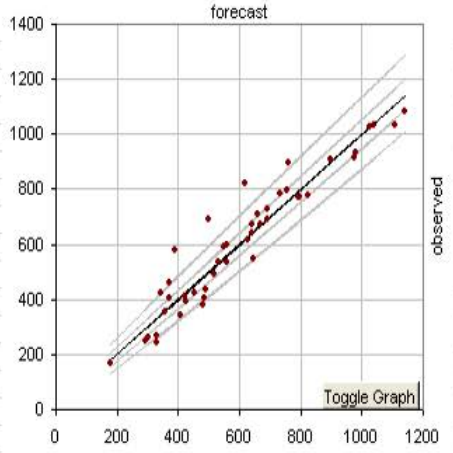
Station	1	2	3	4	5	6
Correl	0.938	0.946		0.867	0.908	0.953
Years	45/46	45/46		45/46	45/46	45/46
CurrZ						
Station	**7**	**8**	**9**	**10**	**11**	**12**
Correl	0.951	0.956		0.933	0.945	0.931
Years	24/25	24/25		24/25	24/25	24/25
CurrZ						
Station	**13**	**14**	**15**	**16**	**17**	**18**
Correl						
Years						
CurrZ						

Group	SnotelSwe	SnowSwe	SnotelPrcp	CoopPrcp	USGSStrm	All
Correl	0.943		0.951			0.951
Years	45		24			45
CurrZ						
Pred						0

Group	NRCSStrm	SOI	Reservoir	Routed	BEARStrm
Correl					
Years					
CurrZ					
Pred					







Analysis Type: Z-Score

Clear

Transformation	Sqrt	More Predictors... (none active)	
First Year Used	1961	Advanced Settings... (none active)	
Last Year Used	9999	Helper Predictand... (not active)	
Target Data Src	USGS		
Publication Date	2/1/07	Start Inst	Start Acc / End Acc
Published?	☑	Apr F	Oct-1 F / Mar L

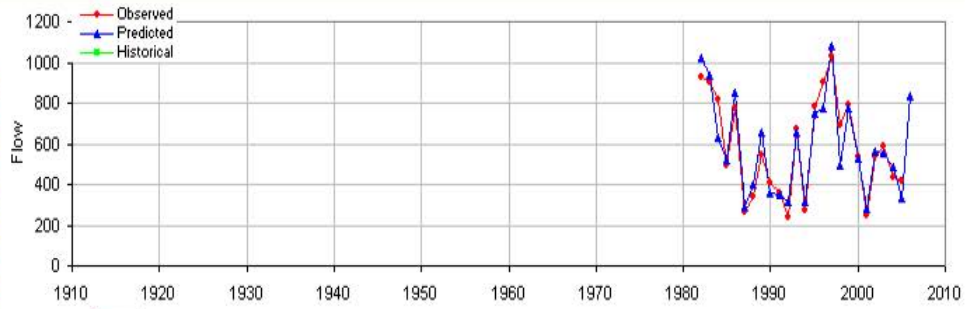
	Type	Target	Start	End
>	Forecast Point	13185000, ID, Boise River Near Twin Springs, I	Apr	Jul

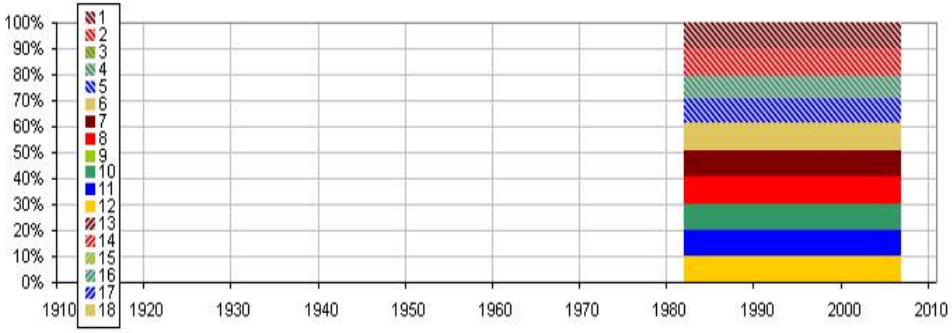
		Type	Predictors	Start	End	
1	✓	SnotelSwe	830, ID, Trinity Mtn.	Apr F	Apr F	1
2	✓	SnotelSwe	306, ID, Atlanta Summit	Apr F	Apr F	2
3		SnotelSwe	496, ID, Graham Guard Sta.	Apr F	Apr F	3
4	✓	SnotelSwe	637, ID, Mores Creek Summit	Apr F	Apr F	4
5	✓	SnotelSwe	550, ID, Jackson Peak	Apr F	Apr F	5
6	✓	SnotelSwe	845, ID, Vienna Mine	Apr F	Apr F	6
7	✓	SnotelPrcp	830, ID, Trinity Mtn.	Oct-1 F	Mar L	7
8	✓	SnotelPrcp	306, ID, Atlanta Summit	Oct-1 F	Mar L	8
9		SnotelPrcp	496, ID, Graham Guard Sta.	Oct-1 F	Mar L	9
10	✓	SnotelPrcp	637, ID, Mores Creek Summit	Oct-1 F	Mar L	10
11	✓	SnotelPrcp	550, ID, Jackson Peak	Oct-1 F	Mar L	11
12	✓	SnotelPrcp	845, ID, Vienna Mine	Oct-1 F	Mar L	12
13				Apr F	Apr F	13
14				Feb F	Feb F	14
15				Feb F	Feb F	15
16				Feb F	Feb F	16
17				Feb F	Feb F	17
18				Feb F	Feb F	18

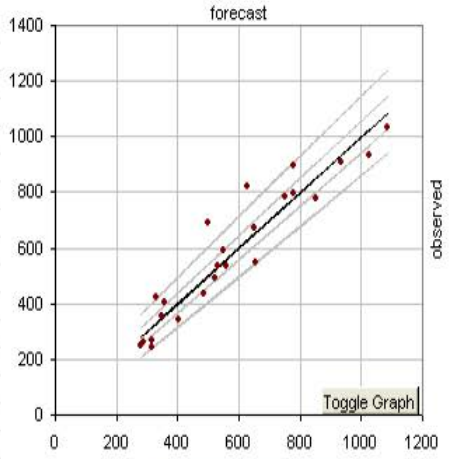
Station	1	2	3	4	5	6
Correl	0.930	0.942		0.864	0.916	0.941
Years	24/25	24/25		24/25	24/25	24/25
CurrZ						
Station	**7**	**8**	**9**	**10**	**11**	**12**
Correl	0.951	0.956		0.933	0.945	0.931
Years	24/25	24/25		24/25	24/25	24/25
CurrZ						
Station	**13**	**14**	**15**	**16**	**17**	**18**
Correl						
Years						
CurrZ						

Group	SnotelSwe	SnowSwe	SnotelPrcp	CoopPrcp	USGSStrm	All
Correl	0.936		0.951			0.946
Years	24		24			24
CurrZ						
Pred						0

Group	NRCSStrm	SOI	Reservoir	Routed	BEARStrm
Correl					
Years					
CurrZ					
Pred					







Analysis Type	Z-Score	Transformation	Sqrt	More Predictors... (none active)	
		First Year Used	1982	Advanced Settings... (none active)	
Clear		Last Year Used	9999	Helper Predictand... (not active)	
		Target Data Src	USGS		
		Publication Date	1/0/00	Start Inst / Start Acc / End Acc	
		Published?	✓	Apr F / Oct-1 F / Mar L	

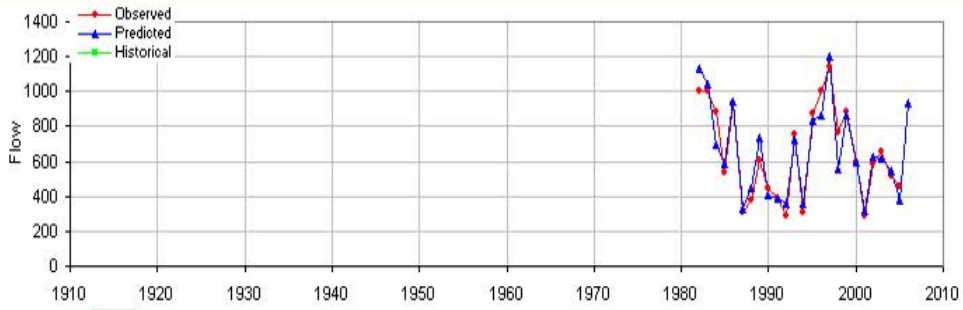
	Type	Target	Start	End
>	Forecast Point	13185000, ID, Boise River Near Twin Springs, I	Mar	Jul

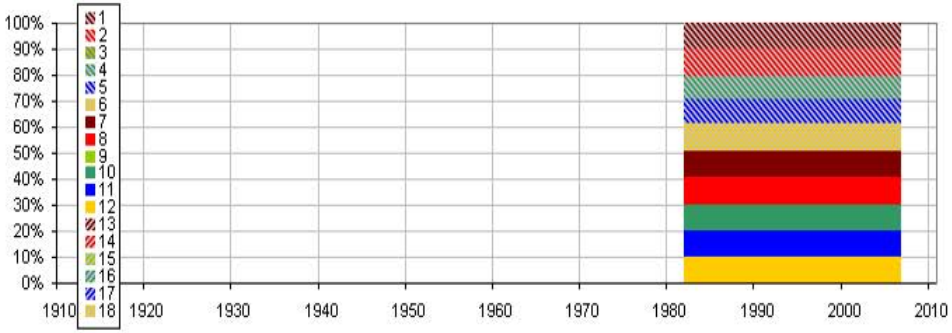
		Type	Predictors	Start	End	
1	✓	SnotelSwe	830, ID, Trinity Mtn.	Apr F	Apr F	1
2	✓	SnotelSwe	306, ID, Atlanta Summit	Apr F	Apr F	2
3		SnotelSwe	496, ID, Graham Guard Sta.	Apr F	Apr F	3
4	✓	SnotelSwe	637, ID, Mores Creek Summit	Apr F	Apr F	4
5	✓	SnotelSwe	550, ID, Jackson Peak	Apr F	Apr F	5
6	✓	SnotelSwe	845, ID, Vienna Mine	Apr F	Apr F	6
7	✓	SnotelPrcp	830, ID, Trinity Mtn.	Oct-1 F	Mar L	7
8	✓	SnotelPrcp	306, ID, Atlanta Summit	Oct-1 F	Mar L	8
9		SnotelPrcp	496, ID, Graham Guard Sta.	Oct-1 F	Mar L	9
10	✓	SnotelPrcp	637, ID, Mores Creek Summit	Oct-1 F	Mar L	10
11	✓	SnotelPrcp	550, ID, Jackson Peak	Oct-1 F	Mar L	11
12	✓	SnotelPrcp	845, ID, Vienna Mine	Oct-1 F	Mar L	12
13				Apr F	Apr F	13
14				Feb F	Feb F	14
15				Feb F	Feb F	15
16				Feb F	Feb F	16
17				Feb F	Feb F	17
18				Feb F	Feb F	18

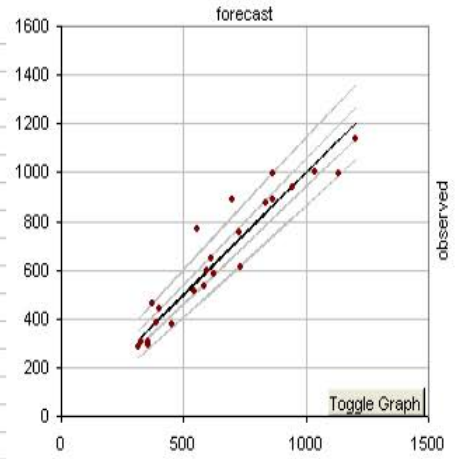
Station	1	2	3	4	5	6
Correl	0.936	0.946		0.872	0.924	0.945
Years	24/25	24/25		24/25	24/25	24/25
CurrZ						
Station	**7**	**8**	**9**	**10**	**11**	**12**
Correl	0.954	0.964		0.940	0.951	0.933
Years	24/25	24/25		24/25	24/25	24/25
CurrZ						
Station	**13**	**14**	**15**	**16**	**17**	**18**
Correl						
Years						
CurrZ						

Group	SnotelSwe	SnowSwe	SnotelPrcp	CoopPrcp	USGSStrm	All
Correl	0.942		0.957			0.952
Years	24		24			24
CurrZ						
Pred						0

Group	NRCSStrm	SOI	Reservoir	Routed	BEARStrm
Correl					
Years					
CurrZ					
Pred					







Analysis Type	Z-Score	Transformation	Sqrt	More Predictors... (none active)	
		First Year Used	1982	Advanced Settings... (none active)	
Clear		Last Year Used	9999	Helper Predictand... (not active)	
		Target Data Src	USGS		
		Publication Date	1/0/00	Start Inst / Start Acc / End Acc	
		Published?	☑	Apr F / Oct-1 F / Mar L	

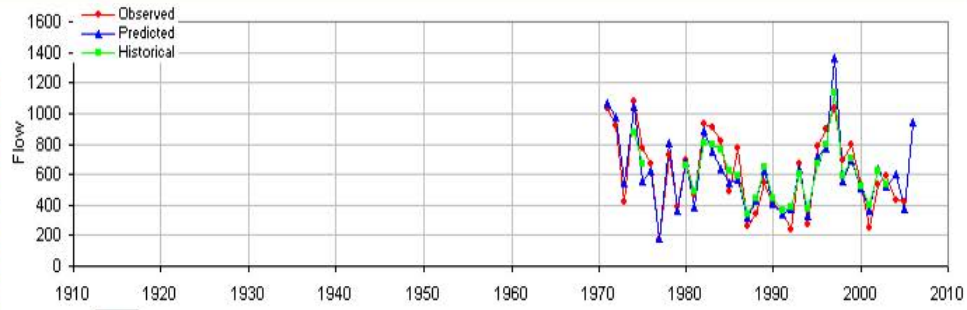
	Type	Target	Start	End
>	Forecast Point	13185000, ID, Boise River Near Twin Springs, I	Apr	Jul

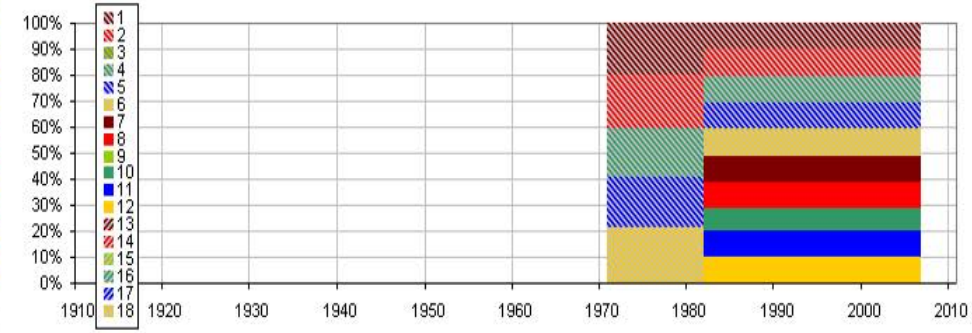
		Type	Predictors	Start	End	
1	✓	SnotelSwe	830, ID, Trinity Mtn.	Feb F	Feb F	1
2	✓	SnotelSwe	306, ID, Atlanta Summit	Feb F	Feb F	2
3		SnotelSwe	496, ID, Graham Guard Sta.	Feb F	Feb F	3
4	✓	SnotelSwe	637, ID, Mores Creek Summit	Feb F	Feb F	4
5	✓	SnotelSwe	550, ID, Jackson Peak	Feb F	Feb F	5
6	✓	SnotelSwe	845, ID, Vienna Mine	Feb F	Feb F	6
7	✓	SnotelPrcp	830, ID, Trinity Mtn.	Oct-1 F	Jan L	7
8	✓	SnotelPrcp	306, ID, Atlanta Summit	Oct-1 F	Jan L	8
9		SnotelPrcp	496, ID, Graham Guard Sta.	Oct-1 F	Jan L	9
10	✓	SnotelPrcp	637, ID, Mores Creek Summit	Oct-1 F	Jan L	10
11	✓	SnotelPrcp	550, ID, Jackson Peak	Oct-1 F	Jan L	11
12	✓	SnotelPrcp	845, ID, Vienna Mine	Oct-1 F	Jan L	12
13				Apr F	Apr F	13
14				Feb F	Feb F	14
15				Feb F	Feb F	15
16				Feb F	Feb F	16
17				Feb F	Feb F	17
18				Feb F	Feb F	18

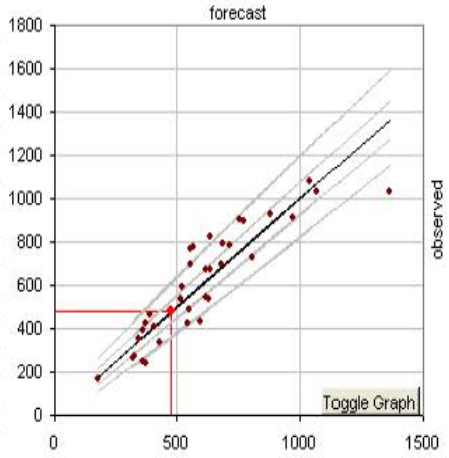
Station	1	2	3	4	5	6
Correl	0.890	0.895		0.869	0.871	0.913
Years	35/36	35/36		35/36	35/36	35/36
CurrZ	-0.636	-0.524		-0.609	-0.732	-0.632
Station	**7**	**8**	**9**	**10**	**11**	**12**
Correl	0.875	0.893		0.845	0.870	0.885
Years	24/25	24/25		24/25	24/25	24/25
CurrZ	-0.438	-0.361		-0.318	-0.123	-0.291
Station	**13**	**14**	**15**	**16**	**17**	**18**
Correl						
Years						
CurrZ						

Group	SnotelSwe	SnowSwe	SnotelPrcp	CoopPrcp	USGSStrm	All
Correl	0.906		0.883			0.910
Years	35		24			35
CurrZ	-0.626		-0.307			-0.470
Pred						477.93954

Group	NRCSStrm	SOI	Reservoir	Routed	BEARStrm
Correl					
Years					
CurrZ					
Pred					



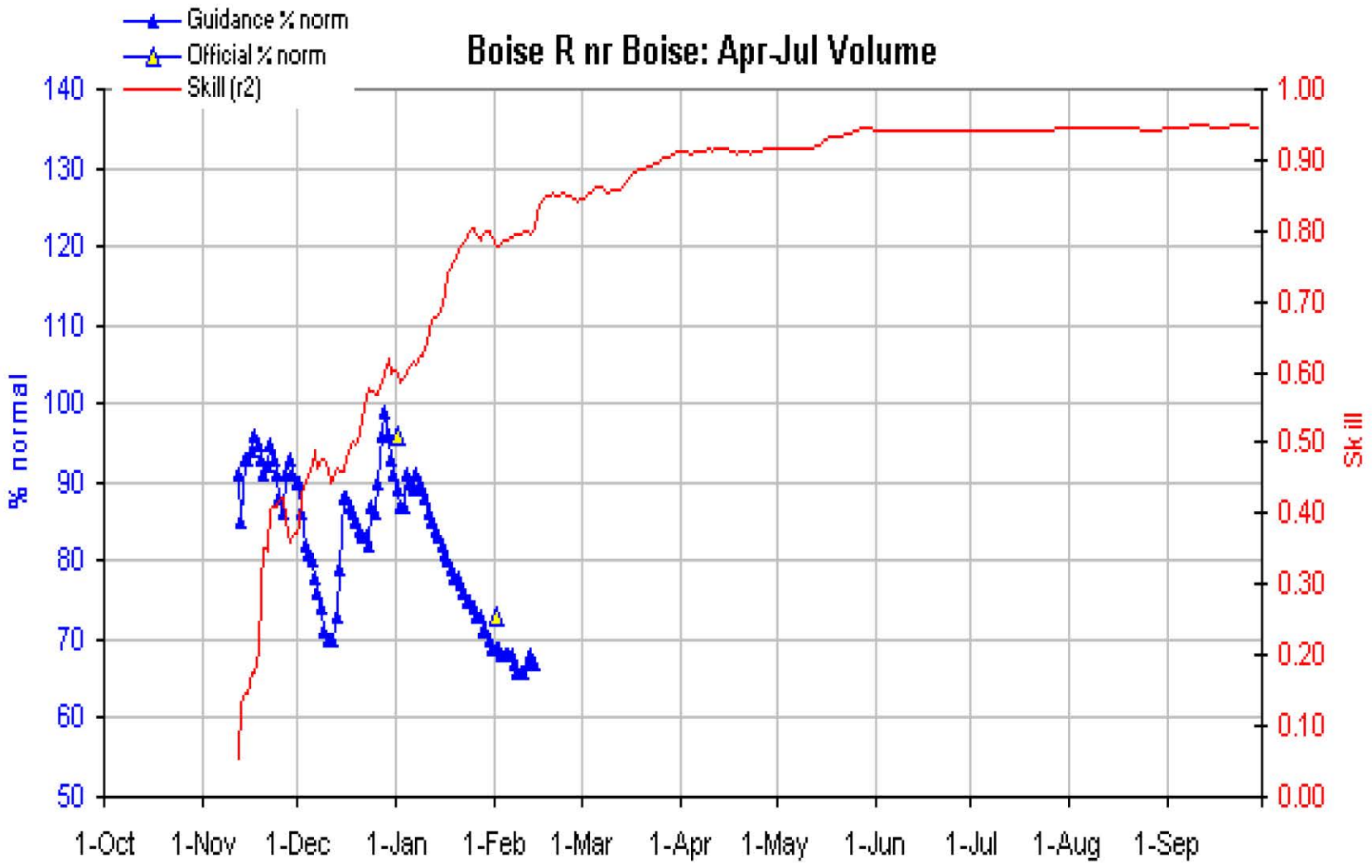


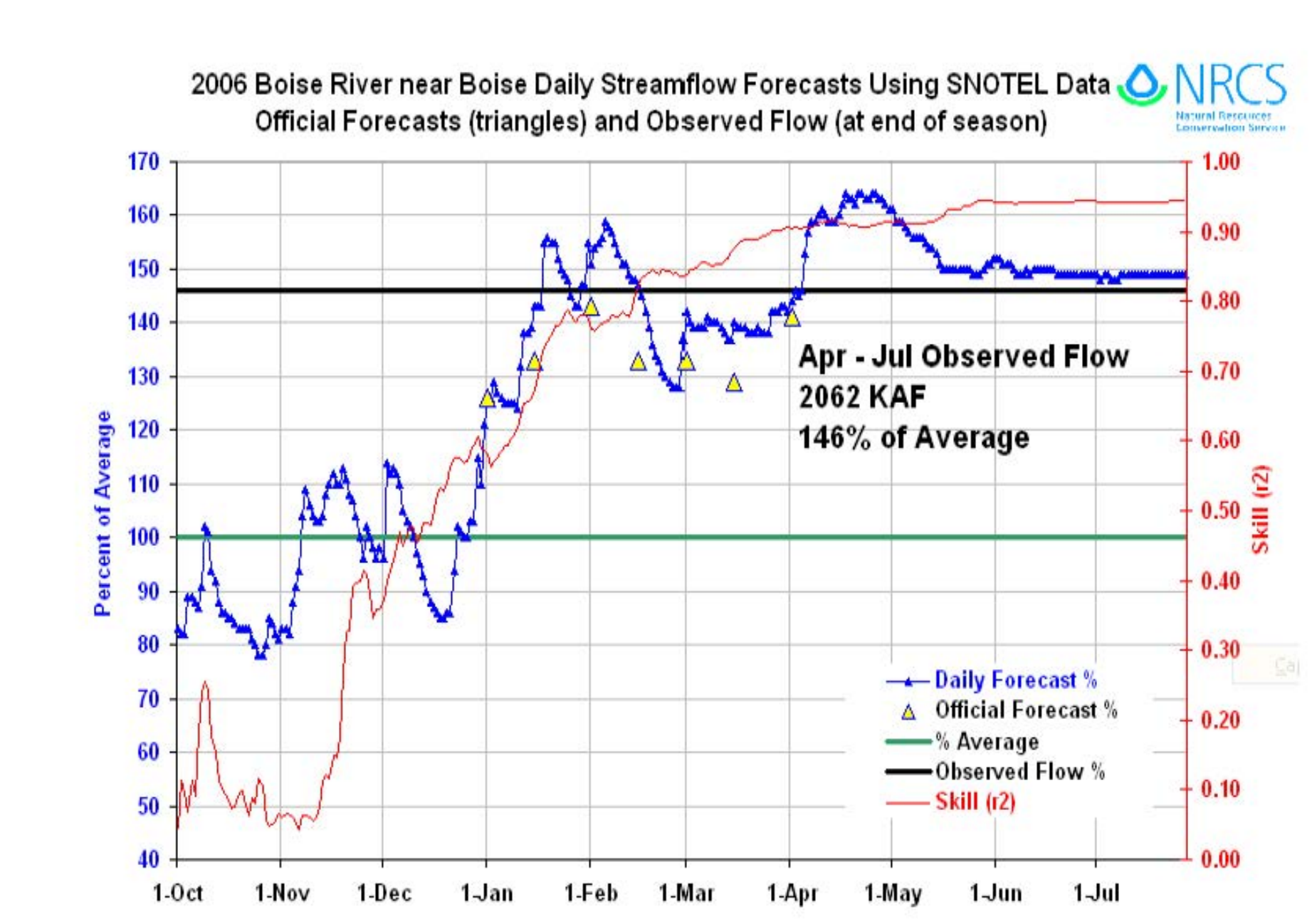


Analysis Type	Z-Score	Transformation	Sqrt
		First Year Used	1971
		Last Year Used	9999
Clear		Target Data Src	USGS
		Publication Date	2/1/07
		Published?	☑

More Predictors... (none active)
Advanced Settings... (none active)
Helper Predictand... (not active)

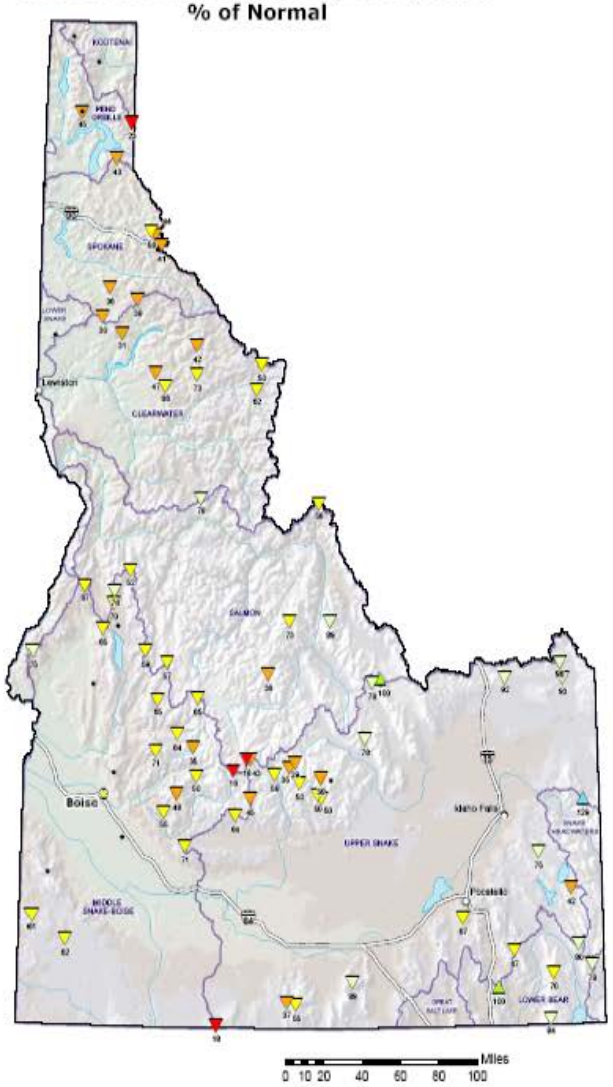
Start Inst	Start Acc	End Acc
Feb F	Oct-1 F	Jan L


Guidance % norm
Official % norm
Skill (r2)
Boise R nr Boise: Apr-Jul Volume
% normal
Skill
140
130
120
110
100
90
80
70
60
50
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep


2006 Boise River near Boise Daily Streamflow Forecasts Using SNOTEL Data
Official Forecasts (triangles) and Observed Flow (at end of season)
NRCS
Natural Resources Conservation Service
Percent of Average
Skill (r2)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
Apr - Jul Observed Flow
2062 KAF
146% of Average
Daily Forecast %
Official Forecast %
% Average
Observed Flow %
Skill (r2)

Idaho
SNOTEL Month to Date (MTD) Precipitation
% of Normal

Feb 14, 2007



Current
MTD Precip.
% of Normal

- > 200%
- 150-200%
- 125-149%
- 100-124%
- 75-99%
- 50-74%
- 25-49%
- 1-24%
- 0%
- Unavailable*

Provisional Data Subject to Revision

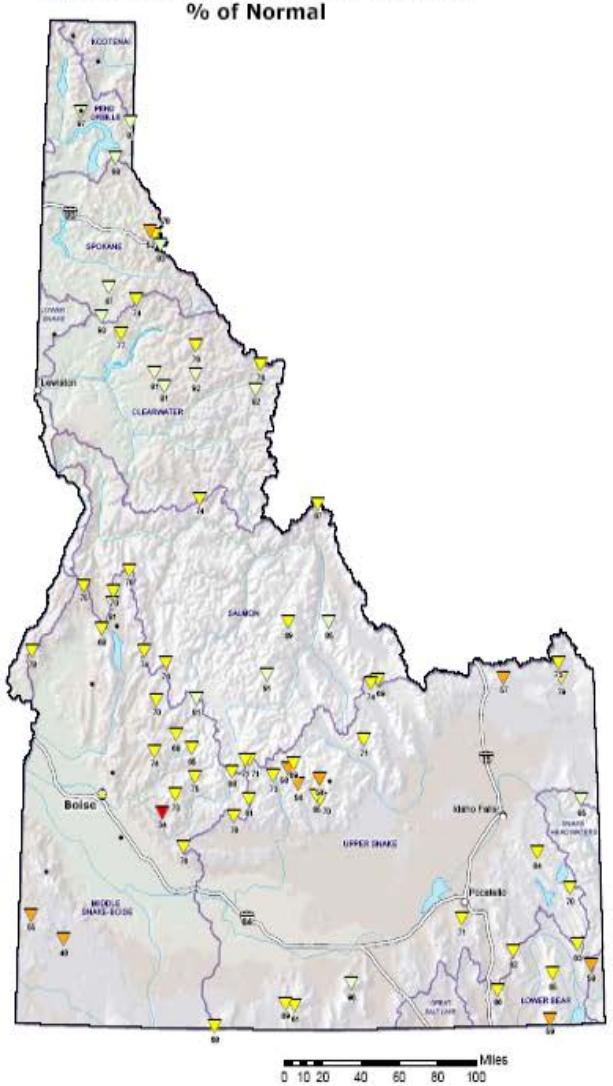
USDA NRCS

Prepared by the
USDA/NRCS National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov/gis/

** Data unavailable at time of posting or unavailable long-term normal.*

Idaho
SNOTEL Snow Water Equivalent (SWE)
% of Normal

Feb 14, 2007



Current SWE
% of Normal

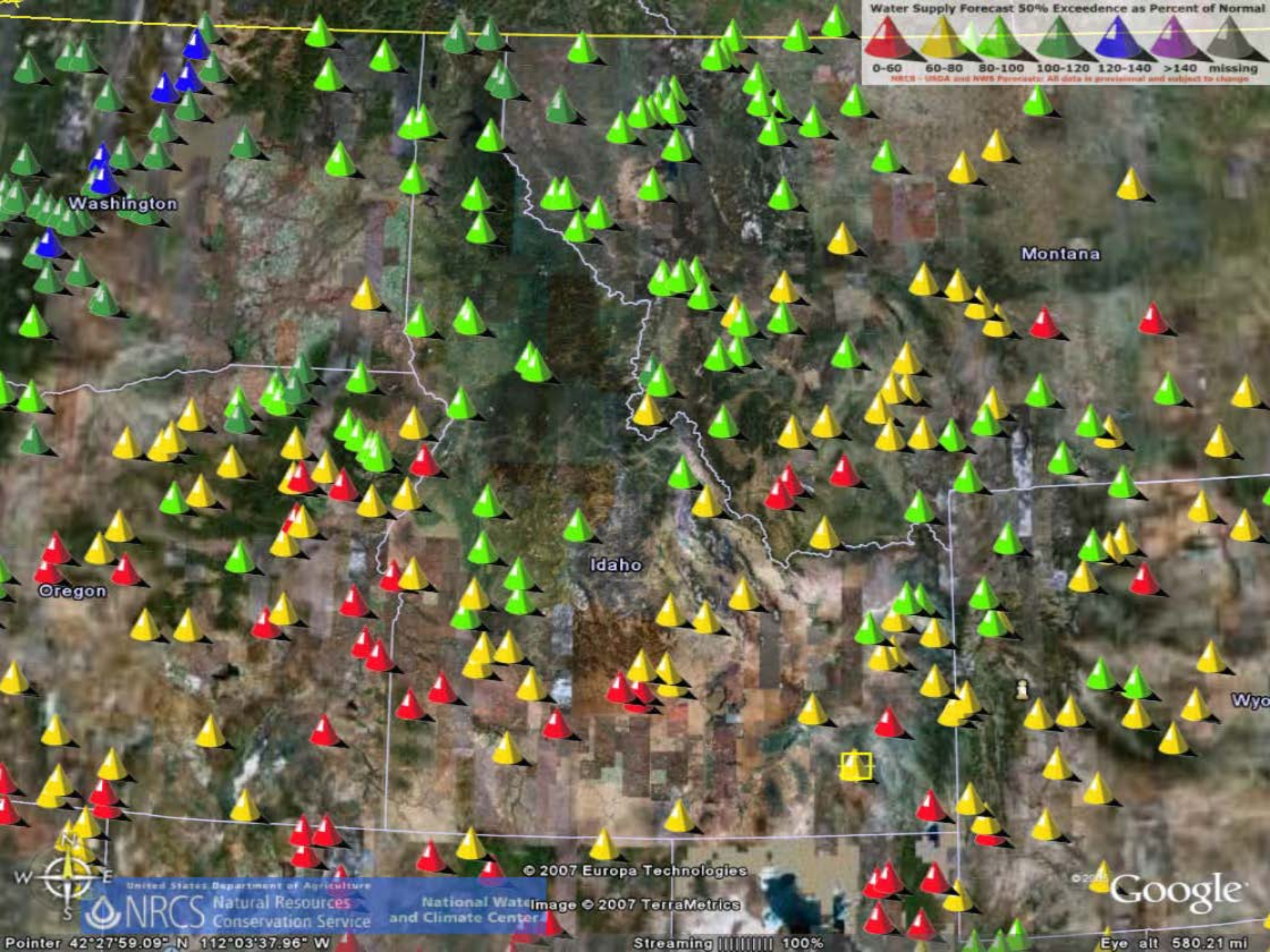
- > 160%
- 140-160%
- 120-139%
- 100-119%
- 80-99%
- 60-79%
- 40-59%
- 1-39%
- 0%
- Unavailable*

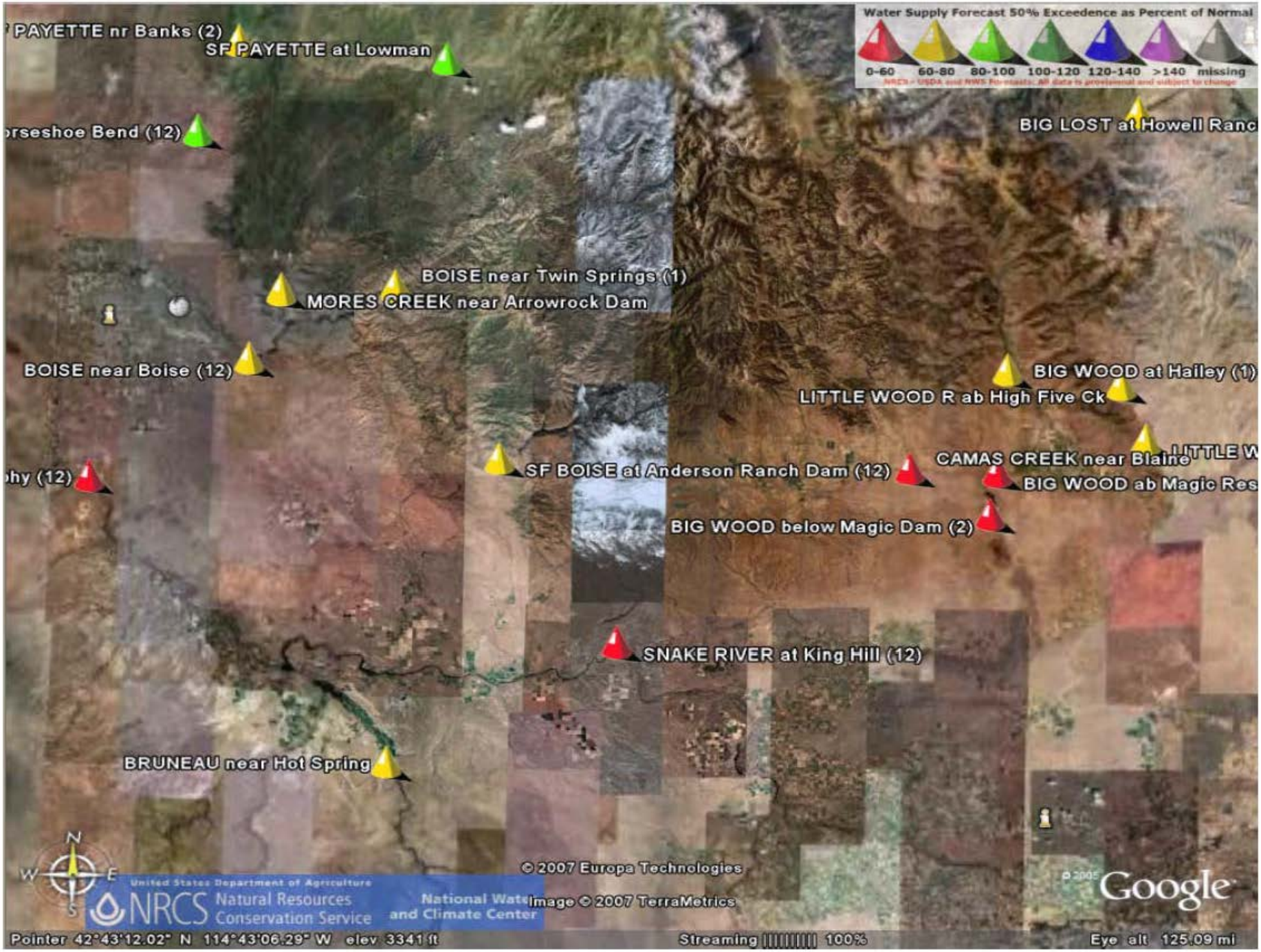
Provisional Data Subject to Revision

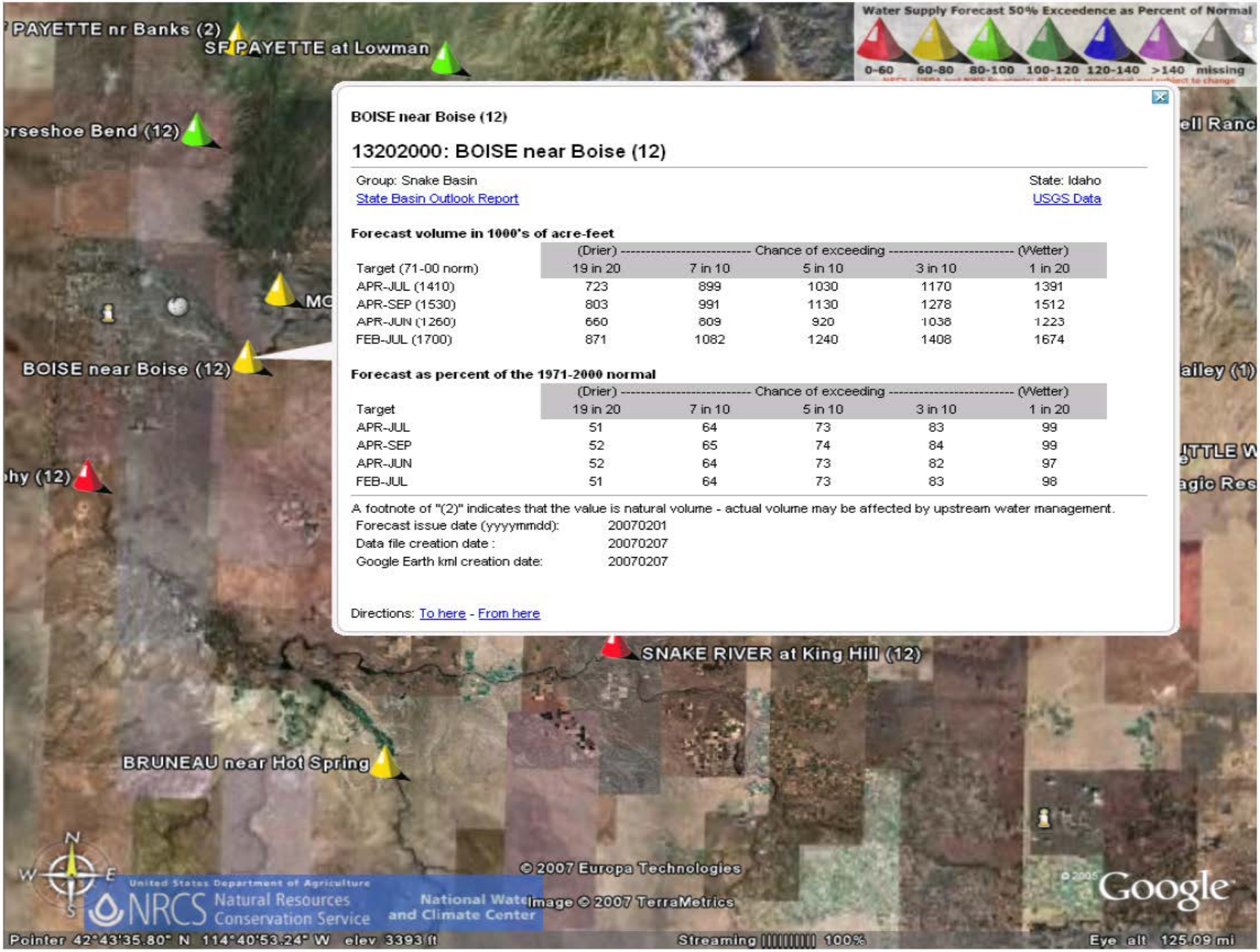
USDA NRCS

Prepared by the
USDA/NRCS National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov/gis/

** Data unavailable at time of posting or unavailable long-term normal.*


Water Supply Forecast 50% Exceedence as Percent of Normal
0-60
60-80
80-100
100-120
120-140
>140
missing
Washington
Montana
Idaho
Oregon
Wyo
© 2007 Europa Technologies
Image © 2007 TerraMetrics
United States Department of Agriculture
NRCS Natural Resources Conservation Service
Google
Pointer 42°27'59.09" N 112°03'37.96" W
Streaming 100%
Eye alt 580.21 mi


Water Supply Forecast 50% Exceedence as Percent of Normal
0-60
60-80
80-100
100-120
120-140
>140
missing
PAYETTE nr Banks (2)
SF PAYETTE at Lowman
rseshoe Bend (12)
BIG LOST at Howell Ranc
BOISE near Twin Springs (1)
MORES CREEK near Arrowrock Dam
BOISE near Boise (12)
BIG WOOD at Hailey (1)
LITTLE WOOD R ab High Five Ck
hy (12)
SF BOISE at Anderson Ranch Dam (12)
CAMAS CREEK near Blaine
BIG WOOD ab Magic Res
BIG WOOD below Magic Dam (2)
SNAKE RIVER at King Hill (12)
BRUNEAU near Hot Spring
United States Department of Agriculture
NRCS Natural Resources Conservation Service
National Wate and Climate Center
© 2007 Europa Technologies
Image © 2007 TerraMetrics
Google
Pointer 42°43'12.02" N 114°43'06.29" W elev 3341 ft
Streaming 100%
Eye alt 125.09 mi



BOISE near Boise (12)

13202000: BOISE near Boise (12)

Group: Snake Basin
State Basin Outlook Report

State: Idaho
USGS Data

Forecast volume in 1000's of acre-feet

	(Drier) ---------- Chance of exceeding ---------- (Wetter)				
Target (71-00 norm)	19 in 20	7 in 10	5 in 10	3 in 10	1 in 20
APR-JUL (1410)	723	899	1030	1170	1391
APR-SEP (1530)	803	991	1130	1278	1512
APR-JUN (1260)	660	809	920	1036	1223
FEB-JUL (1700)	871	1082	1240	1408	1674

Forecast as percent of the 1971-2000 normal

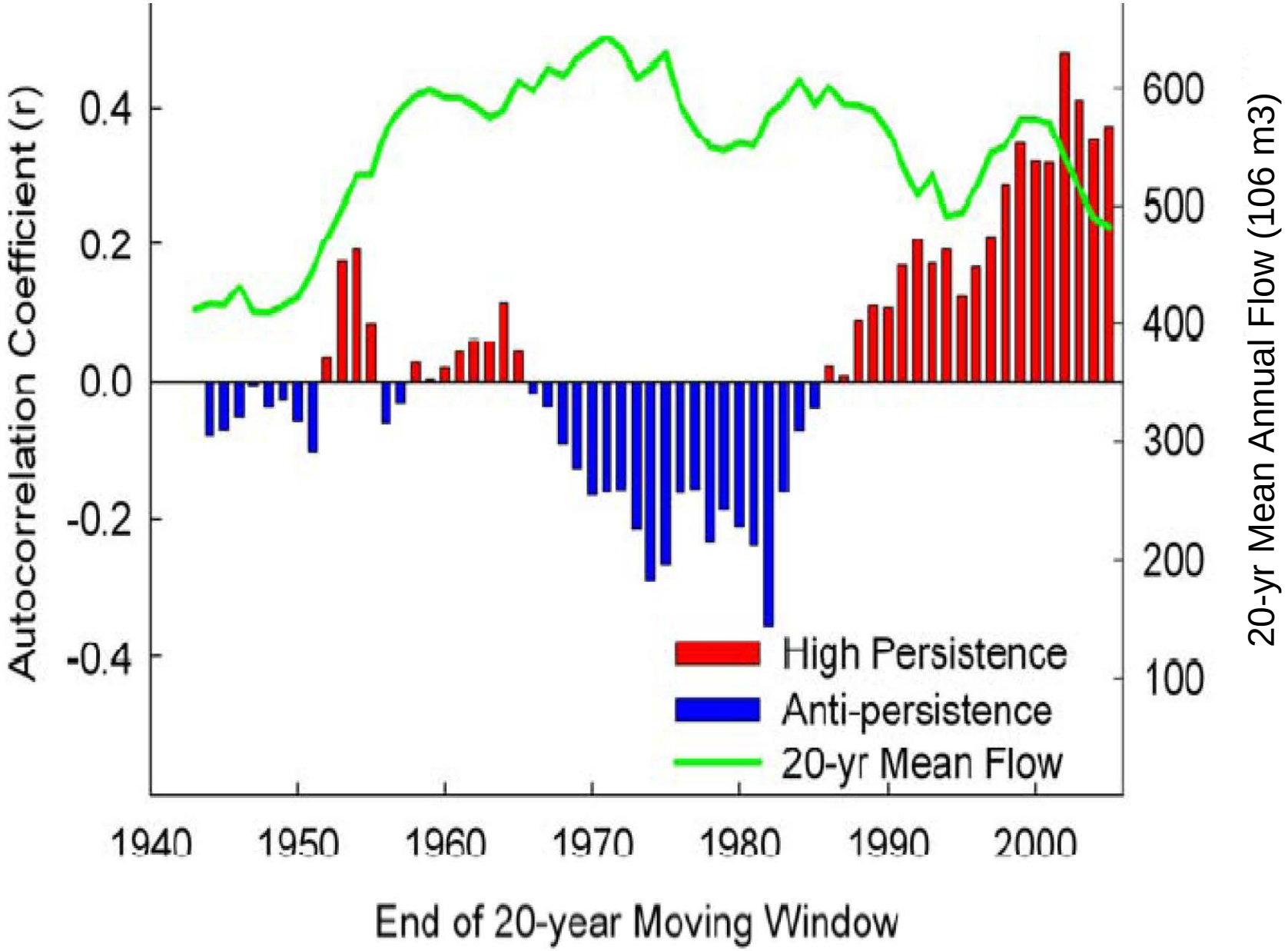
	(Drier) ---------- Chance of exceeding ---------- (Wetter)				
Target	19 in 20	7 in 10	5 in 10	3 in 10	1 in 20
APR-JUL	51	64	73	83	99
APR-SEP	52	65	74	84	99
APR-JUN	52	64	73	82	97
FEB-JUL	51	64	73	83	98

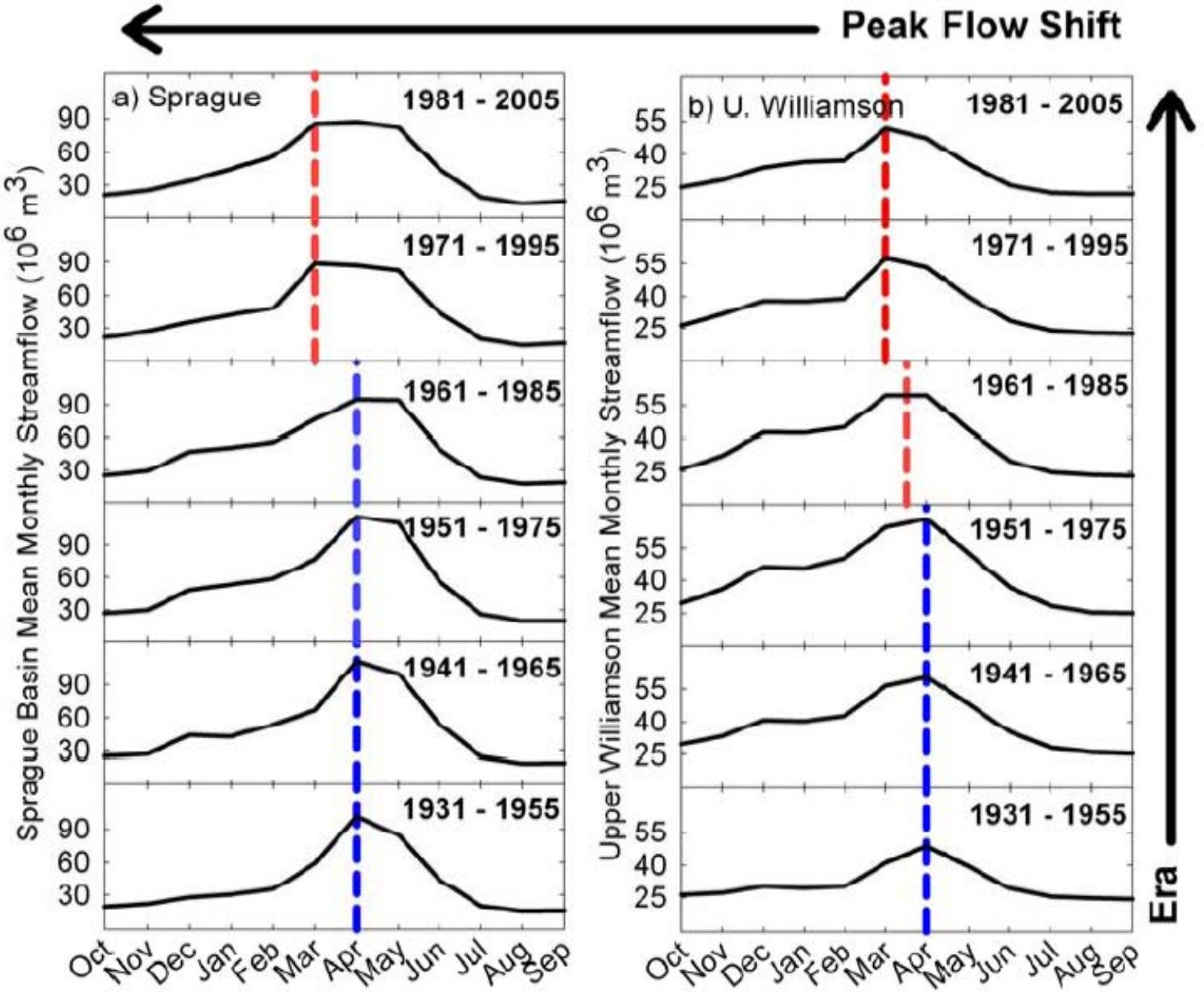
A footnote of "(2)" indicates that the value is natural volume - actual volume may be affected by upstream water management.

Forecast issue date (yyyymmdd): 20070201
Data file creation date : 20070207
Google Earth kml creation date: 20070207

Directions: To here - From here

N1953


Autocorrelation Coefficient (r)
0.4
0.2
0.0
-0.2
-0.4
600
500
400
300
200
100
20-yr Mean Annual Flow (106 m3)
High Persistence
Anti-persistence
20-yr Mean Flow
1940
1950
1960
1970
1980
1990
2000
End of 20-year Moving Window


Peak Flow Shift
a) Sprague
b) U. Williamson
1981 - 2005
1971 - 1995
1961 - 1985
1951 - 1975
1941 - 1965
1931 - 1955
Sprague Basin Mean Monthly Streamflow (10^6 m^3)
Upper Williamson Mean Monthly Streamflow (10^6 m^3)
90
60
30
55
40
25
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Era