The State of Western Water: Summer 2005

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During the 2005 water year, indicators of hydrologic conditions improved in many parts of the Intermountain West. Drought status has eased or reversed in Colorado and Utah, streamflows are in the near-normal range in much of the region, and the standardized precipitation indices are normal to wet everywhere but parts of Wyoming. An active southern storm track during some of the 2005 water year brought above average precipitation in the fall and winter, especially in the southern and western parts of the Intermountain West. The above average snowpack, in addition to a late warming at the end of May, resulted in flooding and high peak flows at levels not seen in the recent past. This article is a short synopsis of Water Year 2005 to date, and it explores the cause of the precipitation pattern and effects of the above average runoff in Colorado, Wyoming, and Utah.

Is El Niño responsible for the 2005 precipitation pattern?

According to the NOAA Climate Prediction Center, there was a weak El Niño through this past winter and early spring. El Niño is associated with the precipitation pattern that occurred this winter: a gradient from below normal in the northern part of the West to above normal in the southern part (Figure 1a). The association is based on the tendency of El Niño to shift the upper tropospheric jet stream further south, steering the incoming storm track from over the Pacific Ocean to a more southern path and causing above average precipitation across the southwest.

Climate Diagnostics Center scientists Martin Hoerling and colleagues conducted studies to see if the weak El Niño was a factor in causing the storm track to move further south this year. The scientists used multiple runs on five different widely used climate models (NCEP, NSIPP, CCM3, ECHAM, and GFDL models) that were initialized with sea surface temperatures associated with the recent, weak El Niño. They found that a blocking high-pressure system located in the Gulf of Alaska was responsible for shifting the jet stream, and there was no significant correlation with the blocking high and El Niño. The scientists concluded that El Niño was not the cause of the 2005 water year's precipitation abnormalities in the West.

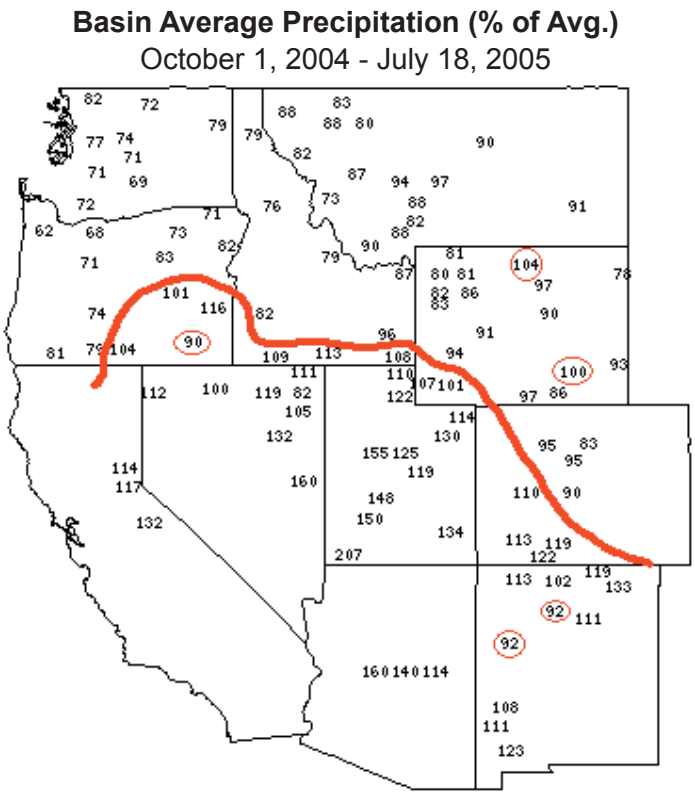

Figure 1a. The basin average precipitation numbers are the total precipitation as a percent of average for the 2005 water year thus far (October 1, 2004 through July 18, 2005). The average value is based on 1971 to 2000 conditions. The red contour indicates the approximate position of the 100% of average contour with the small red circles indicating the outliers. This map is a product of the Western Regional Climate Center with data from NRCS SNOTEL sites.

Water year 2005.

Three related climatological factors contributed to an above average water year in the Intermountain West: above average fall precipitation, above average winter snowfall, and below average spring temperatures changing to extreme high temperatures at the end of May. The heavy rains in the fall of 2004 helped to

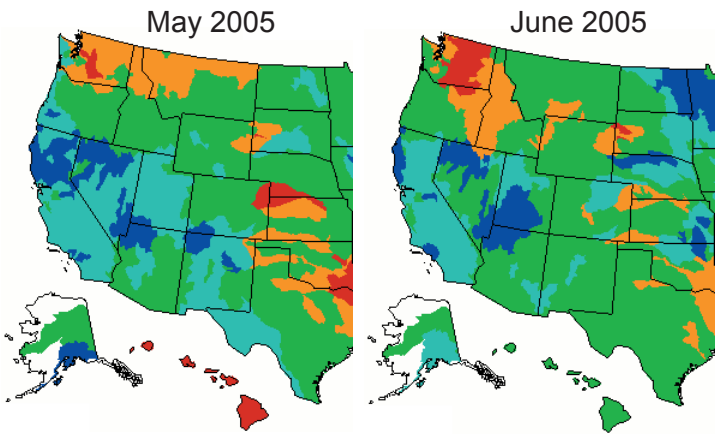

Figure 1b. USGS monthly-average streamflow for the West in May and June 2005 indicating normal to above normal streamflows in the Intermountain West. The colors represent monthly average streamflow compared to percentiles of historical streamflow for the calendar month. The green areas had normal streamflow. The orange, brown, and red areas had below normal streamflows and can be considered dry. Blue areas had above normal streamflows and can be considered wet.

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improve the soil moisture deficits that had accumulated over the past few years of drought. Then, in winter 2005 the Intermountain and southwestern U.S., including the Sierra Nevada Mountains, experienced above average snowpack. According to the NOAA 2005 Spring Outlook, "Preliminary data show the Southwest had its wettest September-February in 110 years of record keeping." For example, the snowpack throughout Utah was above normal, and in the southern half of the state it was more than double the average in some areas.

Higher streamflows this spring were a result of the increase in soil moisture and above average snowpack. In May and June 2005, Utah had above average streamflows while most of Wyoming and Colorado had nearly average flows for that time of year (Figure 1b). Governor Jon Huntsman, Jr. of Utah began a Spring 2005 flood and spring runoff preparedness campaign in April to promote awareness of the high flooding potential throughout the state. Despite many preparations for high streamflows due to high soil moisture and snowpack, flooding during high peak flows throughout Utah still caused some unavoidable damage, although not nearly the amount it would have without the early awareness of the flood risk (Figure 1c).

Figure 1c. Spring flooding in Pleasant Grove, Utah near Utah Lake. Pleasant Grove citizens are sandbagging at the start of a potential flood risk for their town. Photo from 5-KSLTV in Utah.

Figure 1d. Peak Flows -- Chart right & Data Table below. The peak flow values above are in cubic feet per second from 2000 through 2005 for seven different sites in the Colorado River Basin. At the bottom of the table are comparisons of the 2005 peak flows with 2004 peak flows, the 2000-2004 average (drought years), and the historical average. Data is from the Colorado Basin River Forecasting Center.

Peak Flows

Mean daily flows in cubic feet per second (cfs) Rivers in order from North to South as read from left to right.

River	Bear	Green	Yampa	Green	Colorado	Gunnison	San Juan
City	UT-WY Stateline	Green River	Maybell	Green River	CO-UT Stateline	Somerset	Bluff
State	UT, WY	WY	CO	UT	CO, UT	CO	UT
2000 Peak	1,240	1,660	9,830	18,400	17,000	2,130	5,120
2001 Peak	1,500	1,600	7,900	18,100	13,000	1,820	7,940
2002 Peak	830	1,400	3,300	7,300	4,470	655	847
2003 Peak	1,600	1,430	14,500	21,500	24,500	3,250	3,540
2004 Peak	680	3,220	5,950	11,100	9,230	1,700	4,420
Avg Drought Peak 2000-2004	1,170	1,862	8,296	15,280	13,640	1,911	4,373
Average Peak 1971-2000	1,610	7,110	10,475	22,560	26,150	3,310	7,340
2005 Peak	1,820	7,000	12,500	33,200	26,200	4,480	12,100
Compare to 2005:							**Total Averages:**
2005 Peak/ 2004 Peak	268%	217%	210%	299%	284%	264%	274%	259%
2005 Peak/ Avg Drought Peak	156%	376%	151%	217%	192%	234%	277%	229%
2005 Peak/Avg Peak 1971-2000	113%	98%	119%	147%	100%	135%	165%	125%

Peak Flows.

Peak flow refers to the highest average flow for an entire day at a location during the runoff season during the April through July runoff period. Temperatures in April and early May were cooler than usual, causing a delay in the snowmelt and a buildup of more snow in higher elevations. A quick warming in late May caused rapid snowmelt and above average peak flows, which were associated with flooding around the region.

We compared the 2005 peak flows from seven stations in Wyoming, Utah, and Colorado to their averages and to the peak flows of the last five years using data from the Colorado Basin River Forecasting Center (Figure 1d). 2005 peaks were generally over 200% of average peak flows for the previous five years of drought. In Wyoming the Green River peak flows were near the historical average, but were almost four times the average peak flows for the recent drought years. Peak flows in central and southern Utah were the highest compared to average in the Intermountain West, corresponding to very high snowpack observed across Utah this winter. Colorado also experienced some above average peak flows in basins with higher than average snowpack such as the San Juan River in southwestern Colorado (Figure 1e).

Figure 1e. Flooding along the San Juan River in Pagosa Springs, Colorado from May 24-25, 2005, just before the peak flow. Notice that the picnic tables on the lower level of the hot springs are underwater. Photo courtesy of the CWCB.

Reservoir levels.

During the late May peak flows, some reservoirs were filling at almost a foot a day. As high volumes of water from the rivers rushed in, some reservoirs in the Intermountain West filled or nearly filled in 2005 (see page 8 for more information on current reservoir levels). Lake Powell, however, did not. According to the Bureau of Reclamation, Lake Powell has been on a steady decline since 1999 due to the low inflows during the recent drought. It was 95% full at the end of the 1999 water year, but by April 8, 2005 it had reached a low elevation of 3,555 feet, which was 33% of live capacity. The last time the storage level was that low was when it was still filling in 1969 (Figure 1f). Since the spring runoff began in April this year, Lake Powell has had above average inflows, reaching an elevation of 3608.38 feet on July 12, with storage of 52% of live capacity. Many other reservoirs have filled or nearly filled, including Flaming Gorge, Utah Lake, and Dillon Reservoirs.

In Conclusion.

In the critical precipitation accumulation period of the 2005 Water Year, a Pacific storm track was pushed southward by a blocking high in the Gulf of Alaska, bringing high levels of precipitation to parts of the Intermountain and Southwestern U.S. Flooding, above average peak flows, and recovery of reservoirs were all associated with not only the increased precipitation, but also the somewhat unusual timing of a cool spring and rapid warm up.

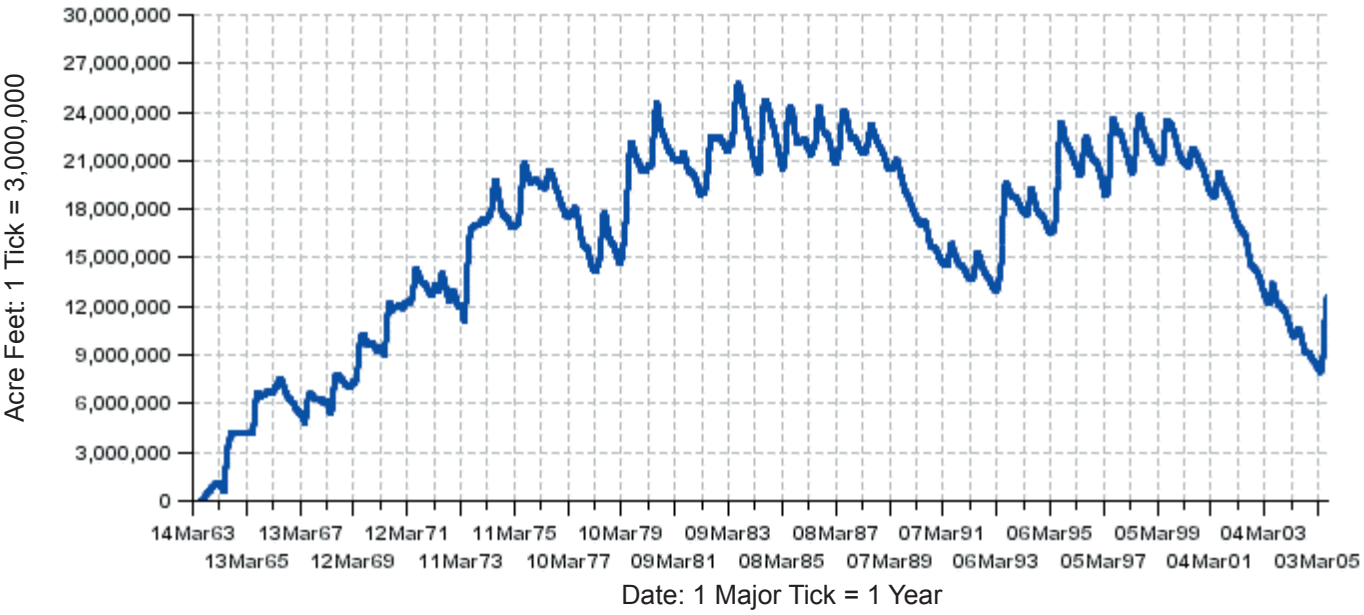

Figure 1f. Lake Powell storage in acre-feet from 1963 through 2005 indicating that 2005 pre-runoff storage reached levels not seen since the filling of the reservoir in the late 60's. Source: Bureau of Reclamation Upper Colorado Region.