

Colorado Dust-on-Snow Program (CODOS)

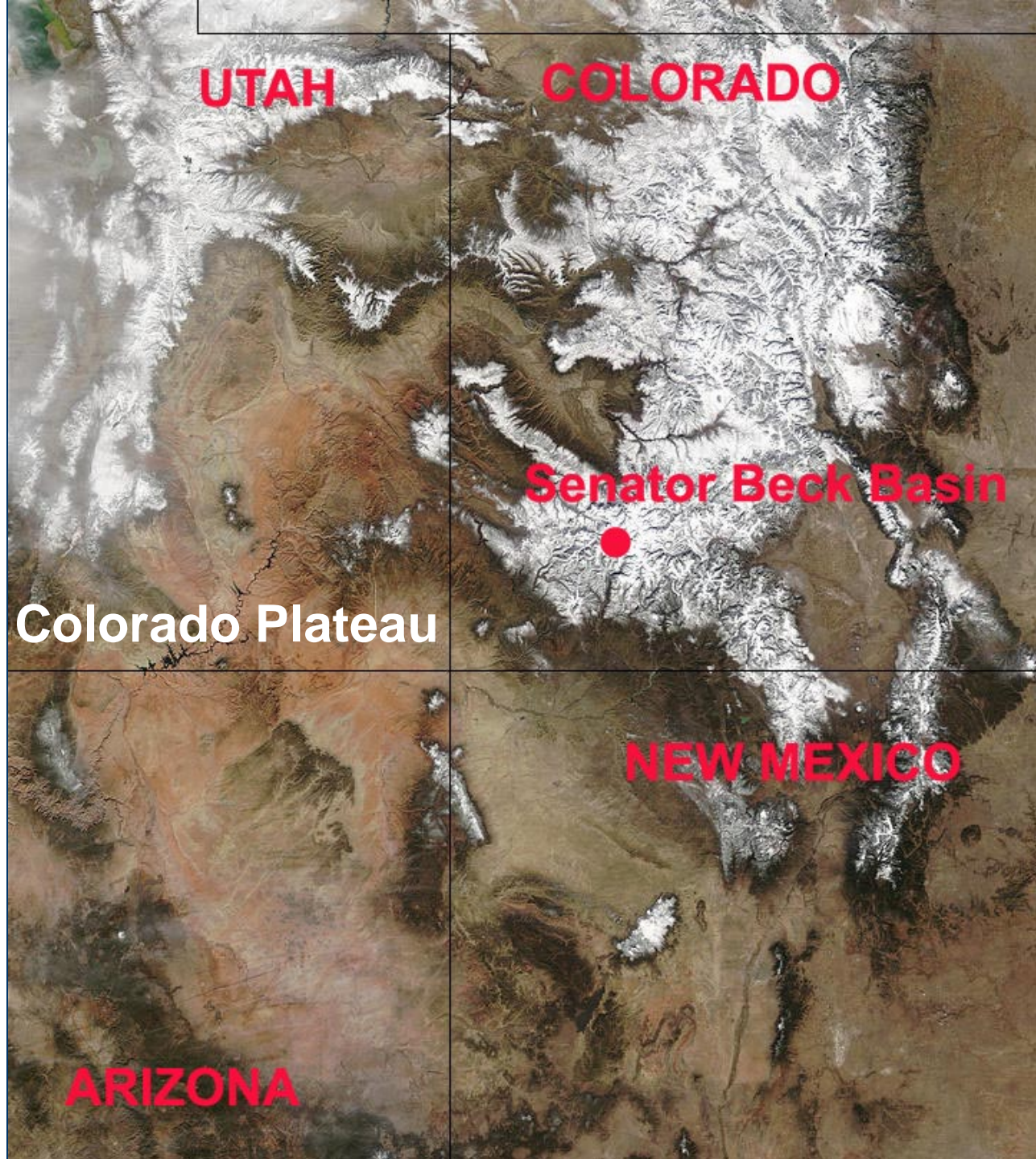
Chris Landry

Center for Snow and Avalanche
Studies
Silverton, CO



in collaboration with
Tom Painter & Students
Jet Propulsion Lab – Cal Tech

Jeffrey S. Deems
Western Water Assessment



Silverton
April 3, 2009

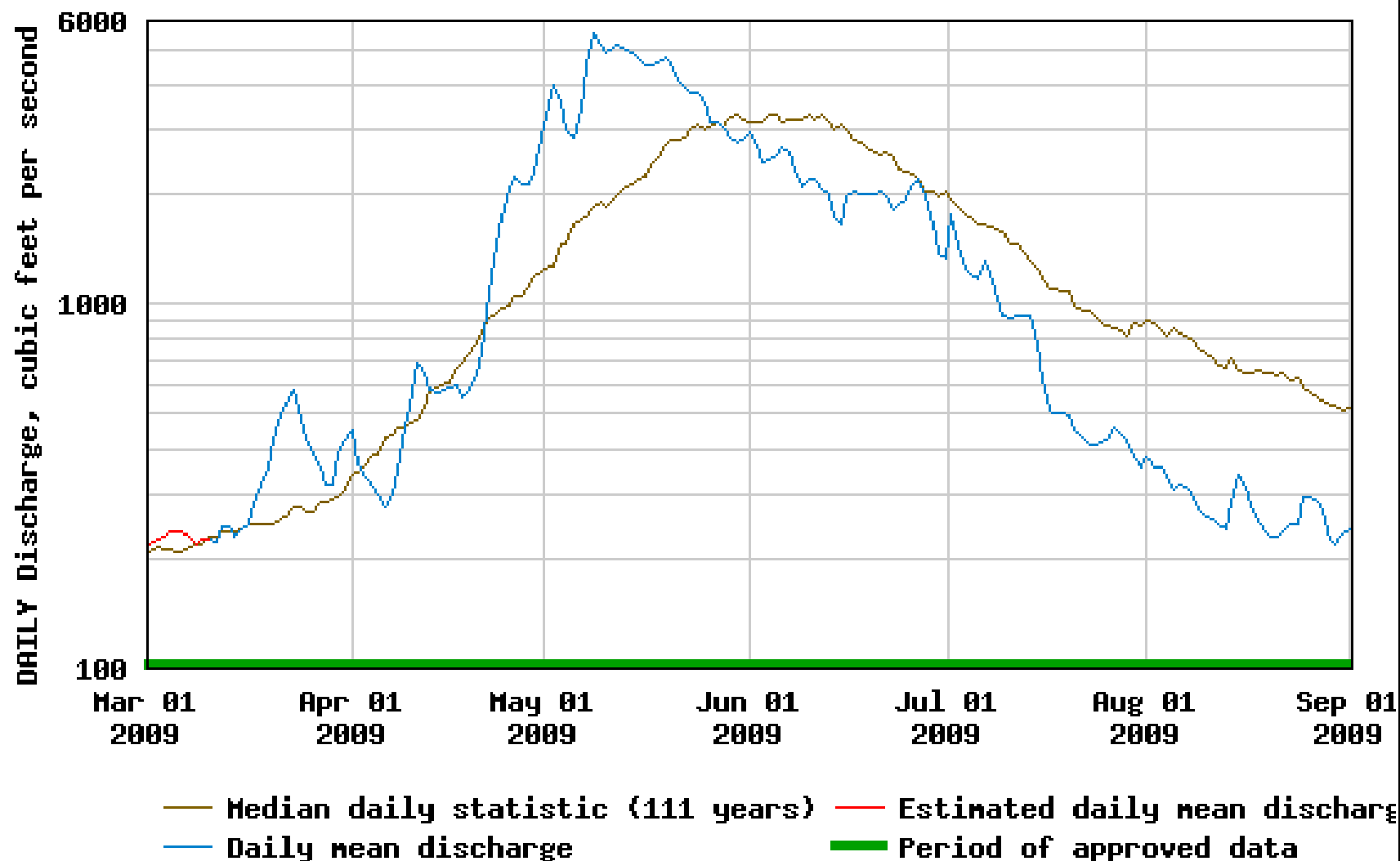


Silverton
April 5, 2010

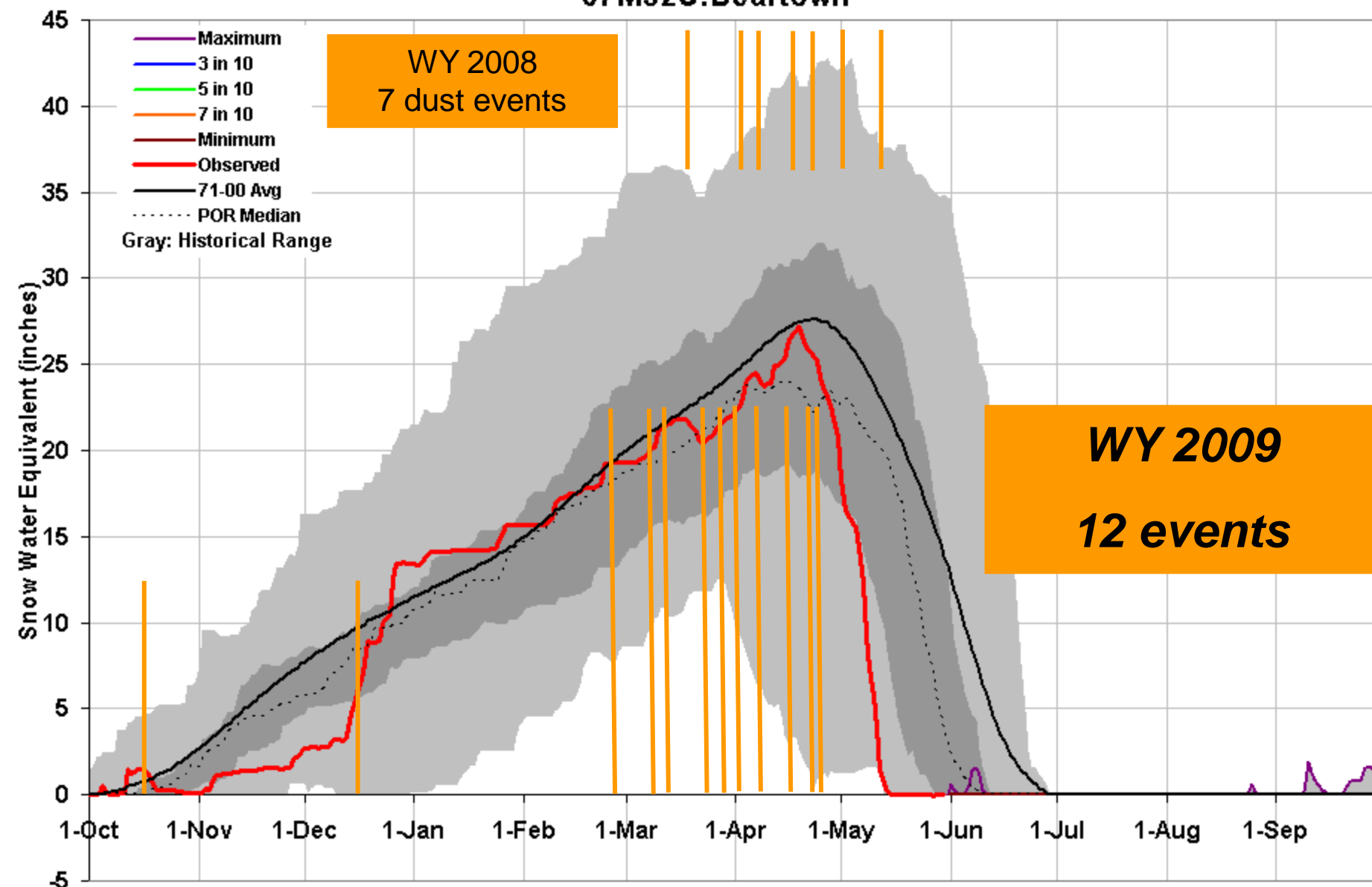




USGS 08220000 RIO GRANDE NEAR DEL NORTE, CO.



07M32S:Beartown



This is an automated product based on SNOTEL data, provisional data are subject to change.

This product combines the historical period of record data (gray background) with the recent daily data (heavy red, left) to project into the future (colored lines, right). This product does not consider climate information such as El Nino or short range weather forecasts and therefore should only be used as a seasonal planning tool. Contact Tom.Pagano@por.usda.gov 503 414 3010

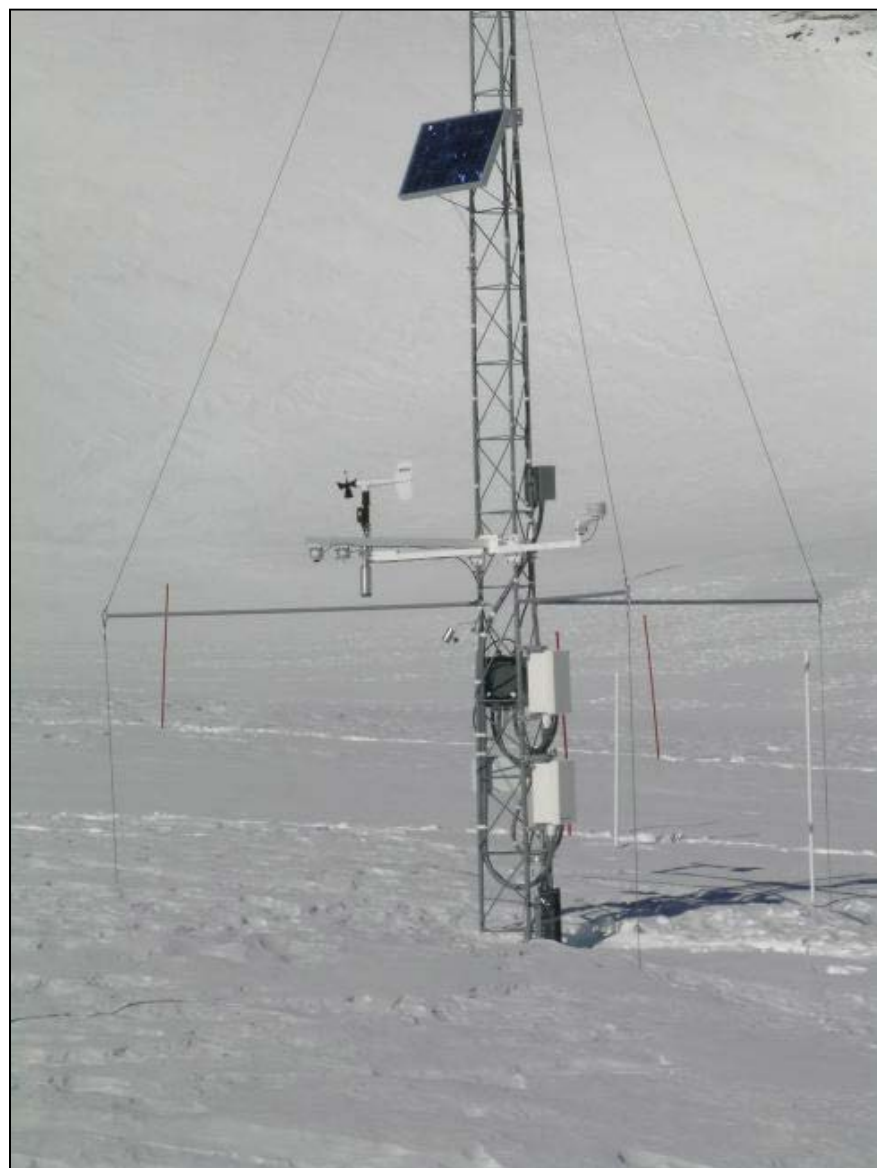
CODOS Dust-on-Snow Deposition Log

Senator Beck Basin Study Area – Red Mountain Pass

Dust-on-Snow Events Documented per Month, by Winter Senator Beck Basin Study Area at Red Mountain Pass – San Juan Mountains										
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2002/2003					2		1			3
2003/2004							2	1		3
2004/2005	0	0	0	0	0	1	2	1	0	4
2005/2006	0	0	1	0	1	1	3	2	0	8
2006/2007	0	0	1	0	1	1	3	1	1	8
2007/2008	0	0	0	0	0	3	3	1	0	7
2008/2009	1	0	1	0	1	4	5	0	0	12
2009/2010	1	0	0	0	0	1	4	3	0	9

Snow Albedo Measurement

Senator Beck Study Plot 12,200'



Senator Beck Basin: March 22, March 29, April 3, April 8, April 15 2009 layers



Below Treeline – April 22, 2009



Above Treeline – April 24, 2009

**Maximum Dust at Top of Snowpack
(all or most layers merged):**

Spring 2008 = 12 gm/m²

Spring 2009 = 55 gm/m²

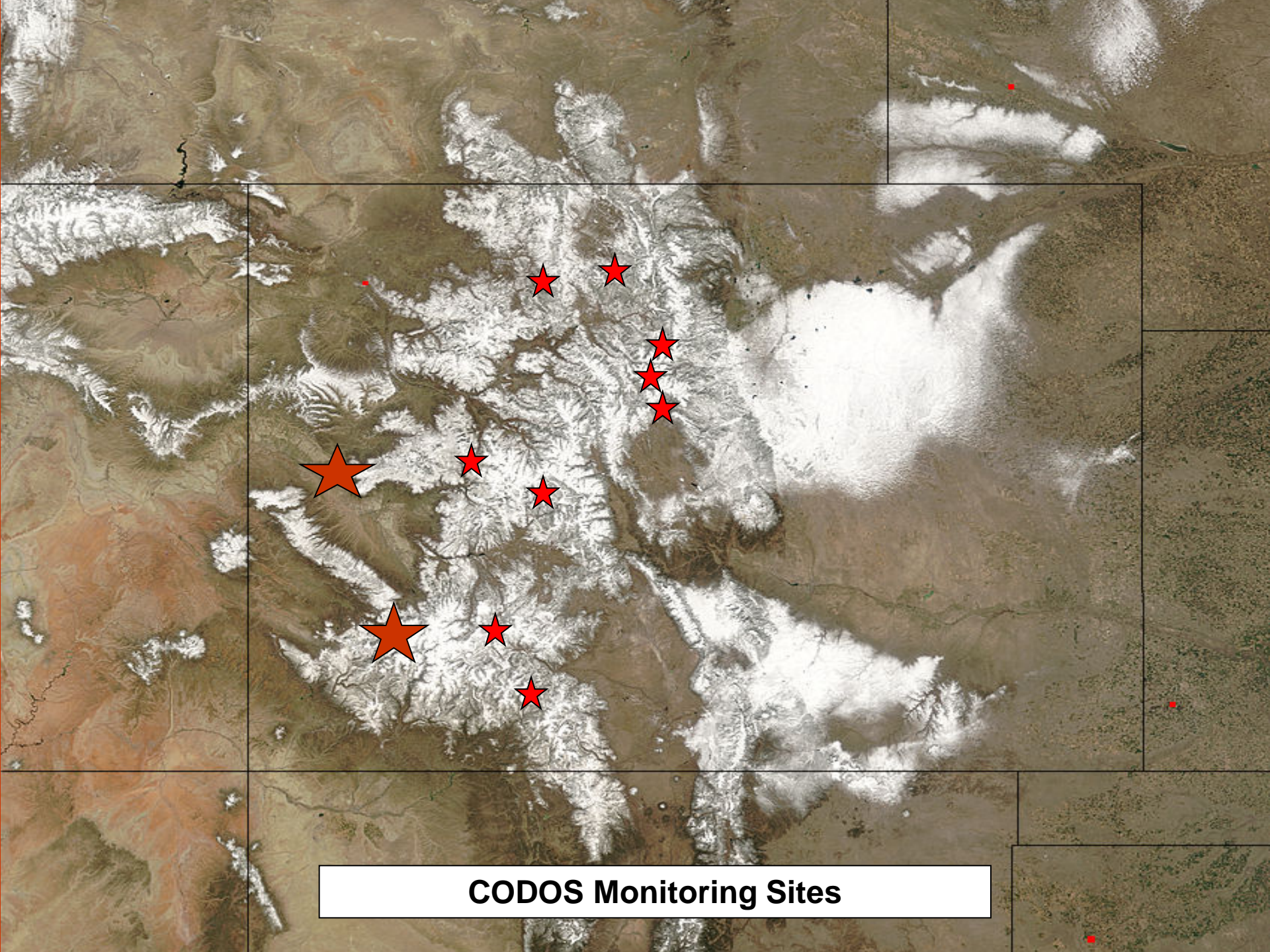
Spring 2010 = ~40 gm/m²

May 28, 2010 – Swamp Angel Study Plot



May 13, 2009 – Swamp Angel Study Plot





CODOS Monitoring Sites

April 10, 2009 – Wolf Creek Pass



May 11, 2009 – Wolf Creek Pass





April 17, 2009 – Berthoud Pass



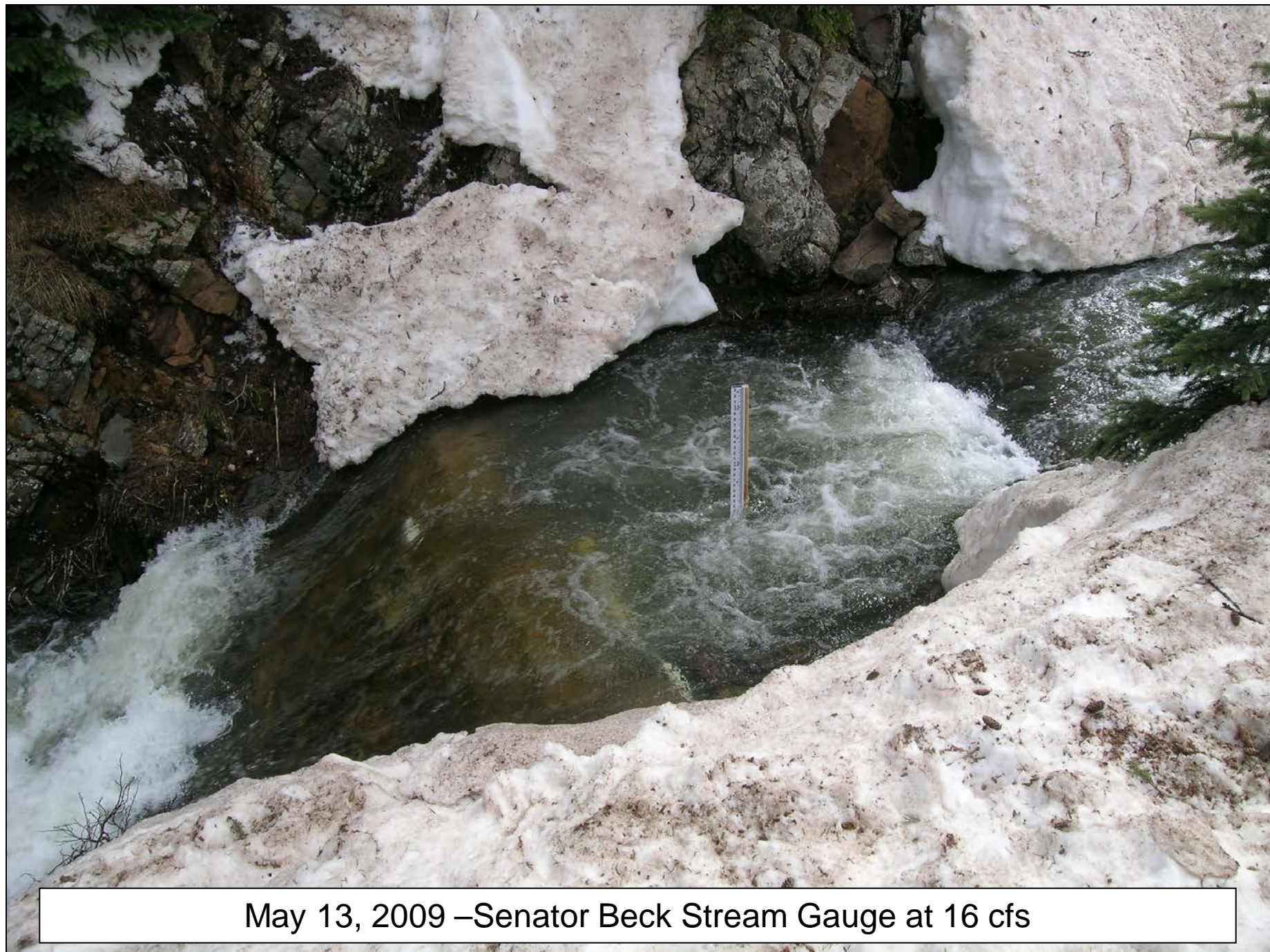
April 18, 2009 – Willow Creek Pass



May 27, 2010 – Grand Mesa

May 26, 2010 – Grizzly Peak Snotel, A-Basin



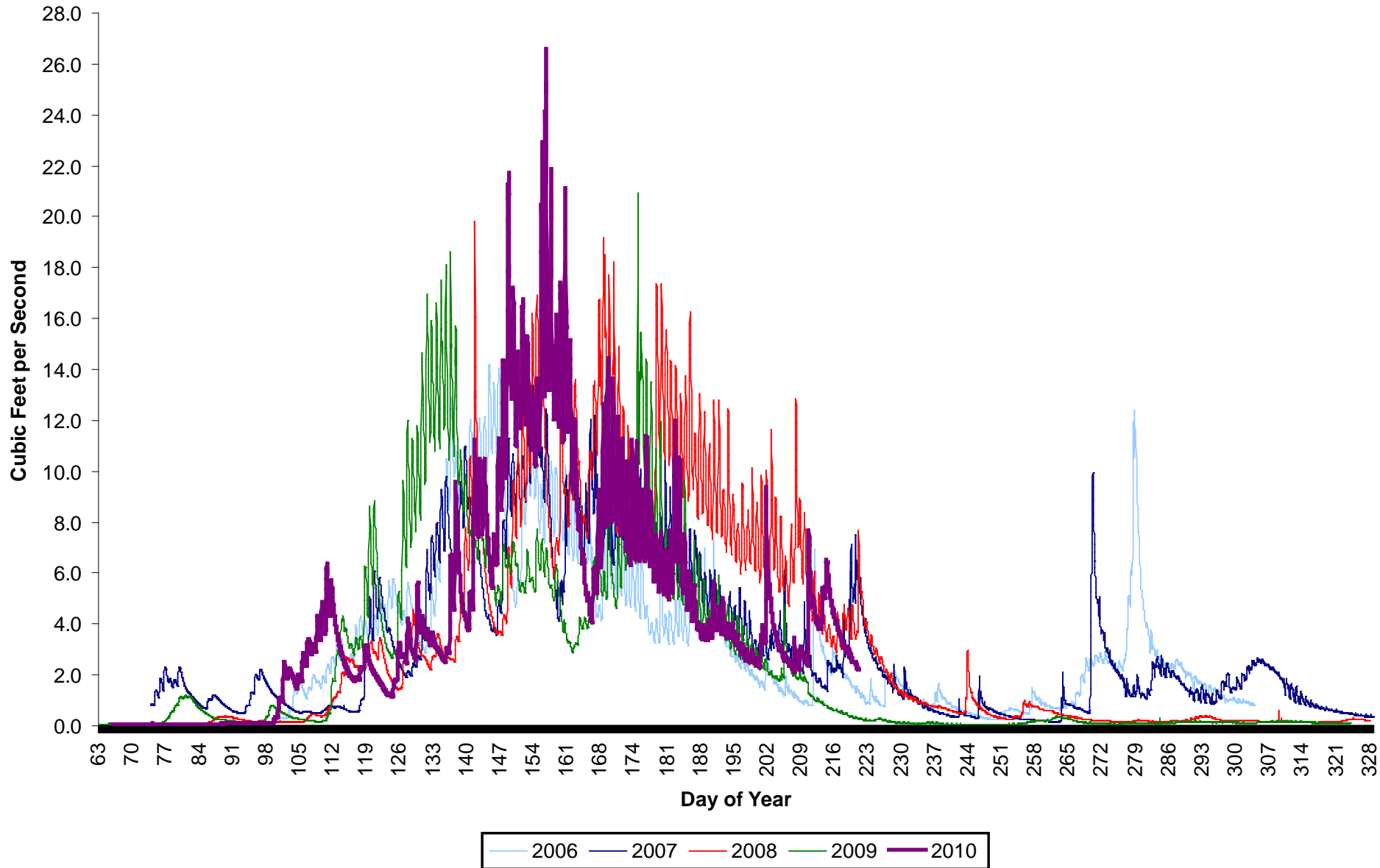


May 13, 2009 –Senator Beck Stream Gauge at 16 cfs

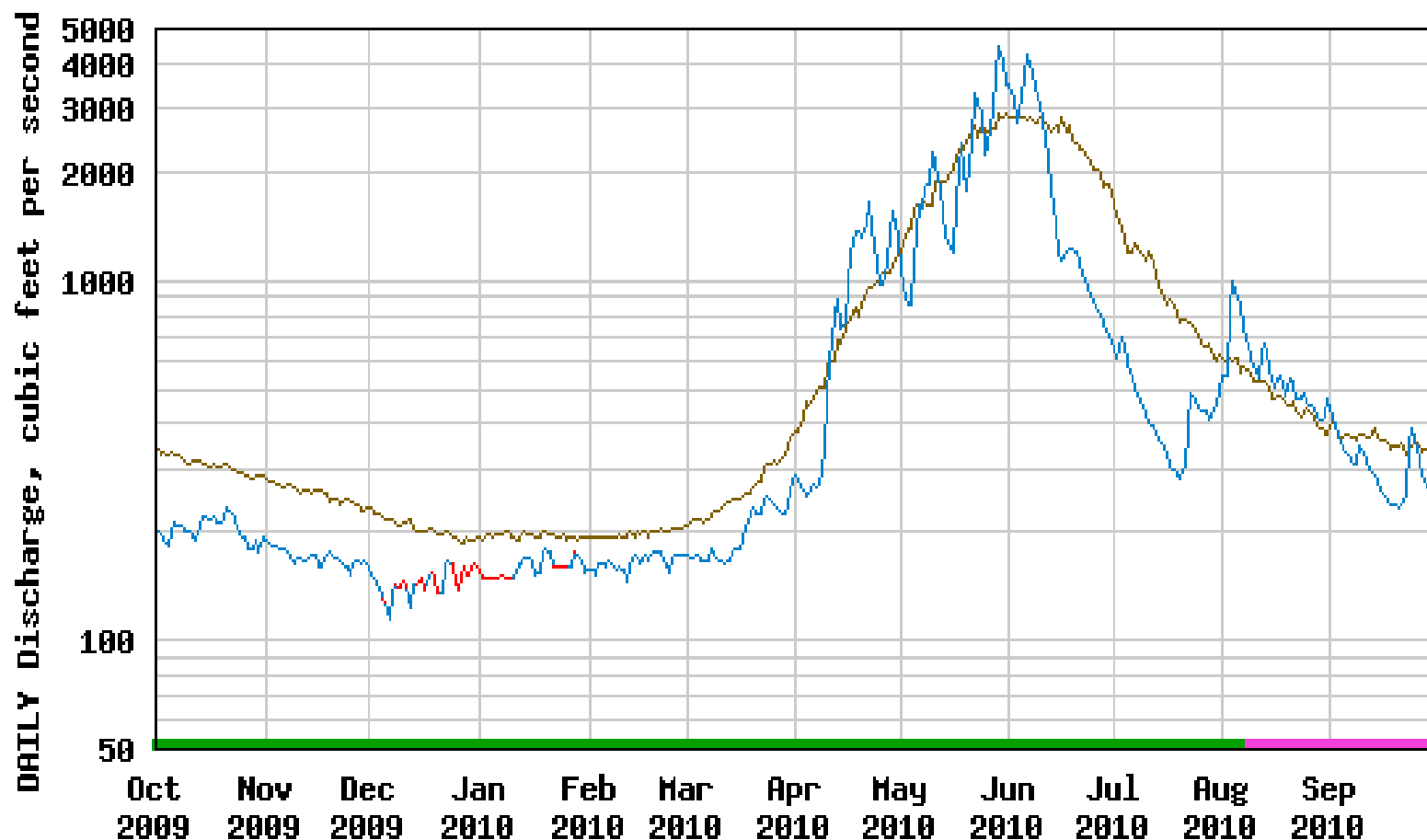


June 5, 2010 –Senator Beck Stream Gauge at 26 cfs

Senator Beck Basin Discharge – WY 2006, 2007, 2008 & 2009, 2010

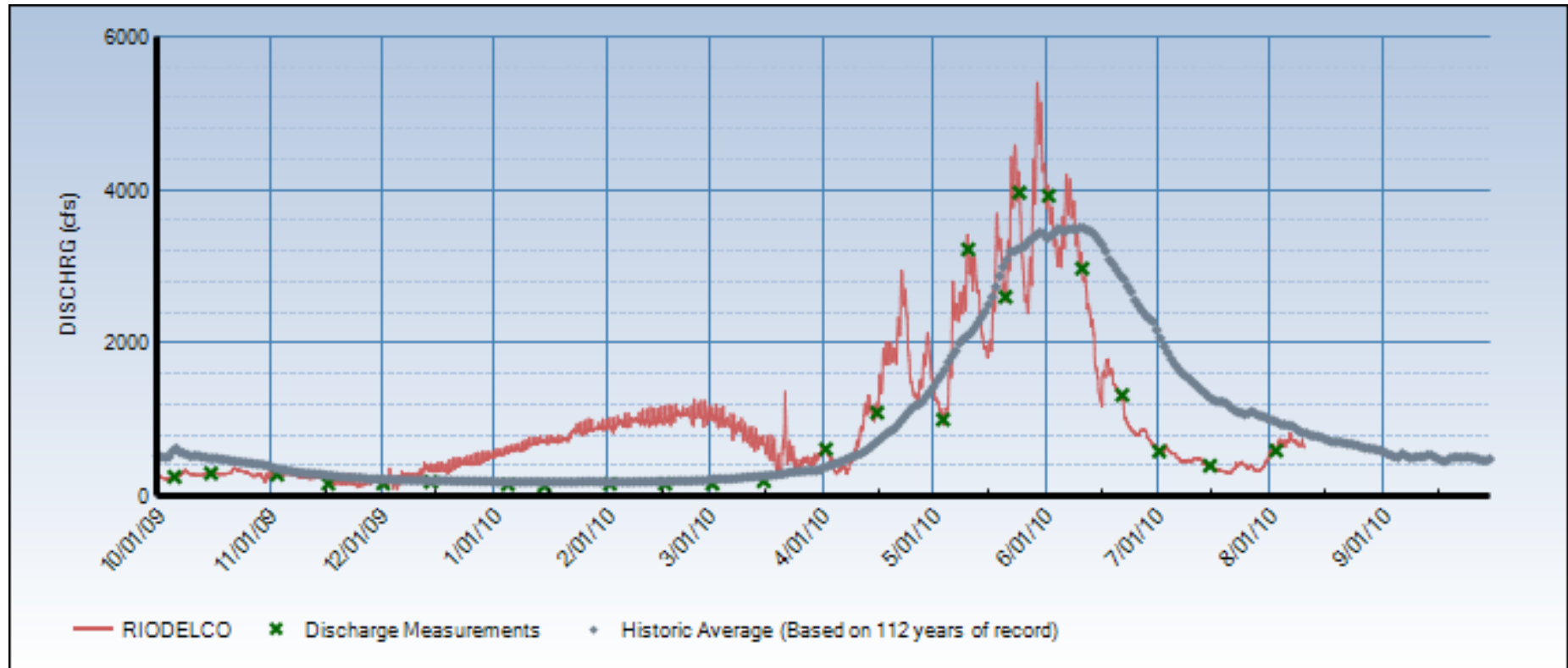


USGS 09361500 ANIMAS RIVER AT DURANGO, CO

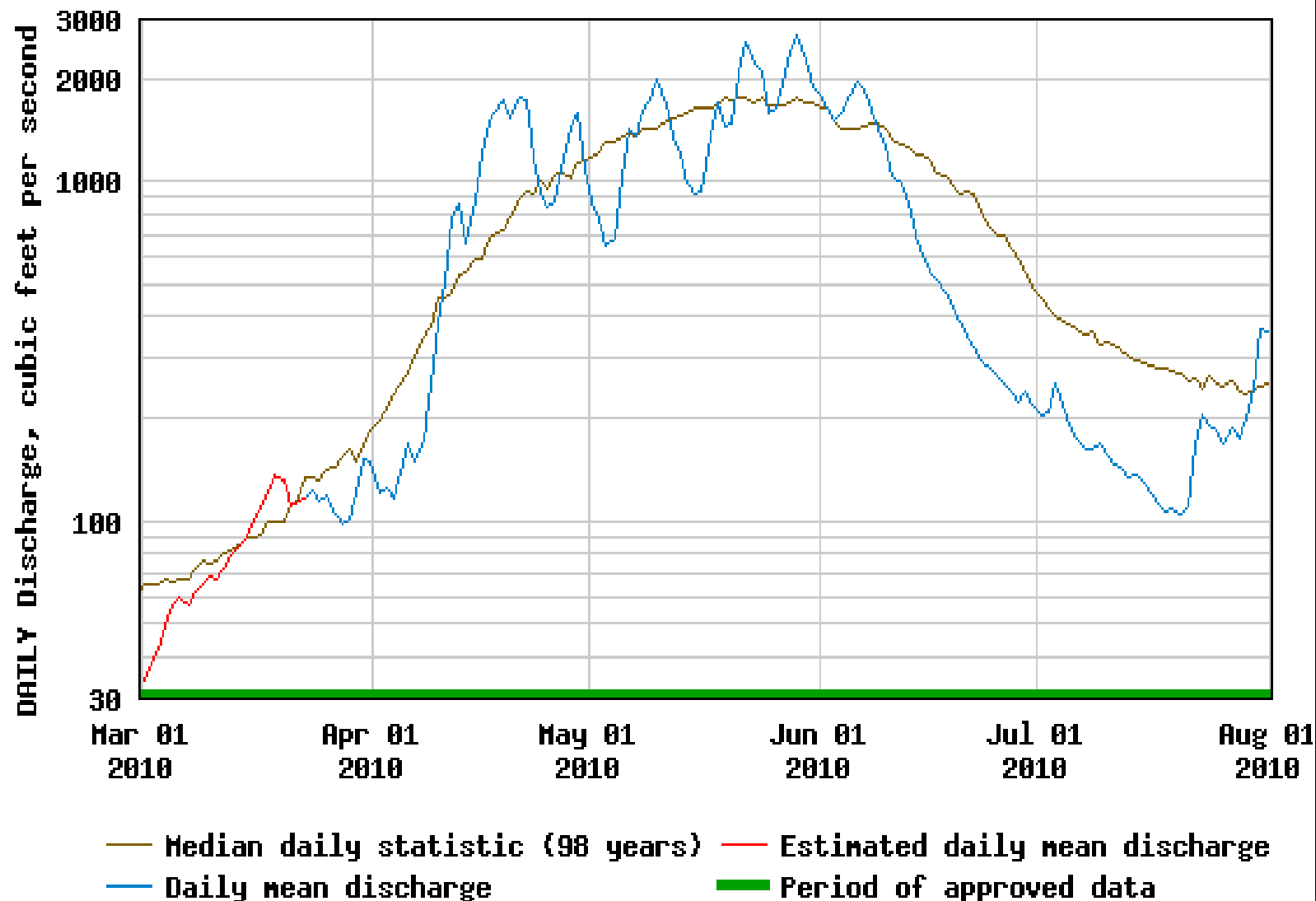


- Median daily statistic (98 years)
- Daily mean discharge
- Estimated daily mean discharge
- Period of approved data
- Period of provisional data

Rio Grande at Del Norte WY 2010

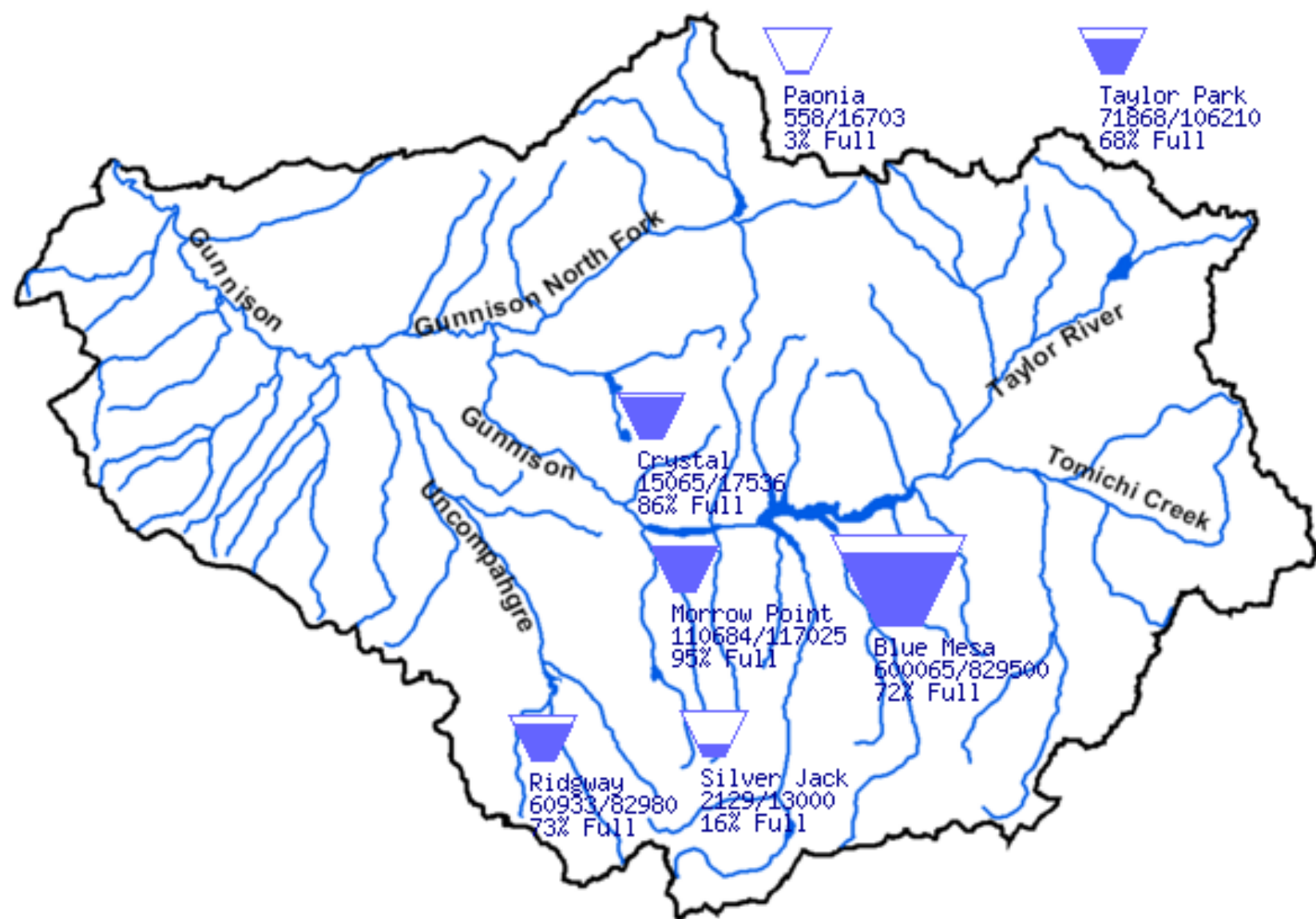


USGS 09166500 DOLORES RIVER AT DOLORES, CO.



Data Current as of:
10/03/2010

Gunnison River Basin, CO



Dust Updates



Colorado Dust-on-Snow Alert #8, June 1, 2008

Following the expected brief pause in snowmelt discussed in Alert #7 of May 24th, all Snotel sites that we've been monitoring this spring have shown a second steep decline in SWE during the past week. All sites showed losses in SWE of equal or greater magnitude than the drop seen earlier, in mid-May, and some sites have reached "Snow All Gone" (SAG). The substantial dust layer (composed of multiple, "merged" layers) that was temporarily covered by clean new snow over the weekend of May 24th and 25th has extensively re-emerged at the snowpack surface, first at lower elevations on all aspects, and more recently at the highest elevations on even northerly aspects. Lingering patches of the May 23/24 storm snow stand in stark, bright white contrast to the surrounding dirty snow, as seen in the May 31st photo below, looking westward at the Senator Beck Basin Study Area (far right) and nearby terrain at Red Mountain Pass, here in the San Juan Mountains.

The direct absorption of solar energy by this dust layer, in tandem with two periods of sunny weather and warm air temperatures, has produced two periods of much-greater-than-average rates of snowmelt, as compared to the 30-year average rate of decline in SWE. This is clearly evident in Snotel 2007/2008 Water Year graphs around the State. Thus, even though all the Snotel sites we monitor reported substantially greater-than-average SWE values this season, most sites are also currently on a snowmelt trajectory that will result in earlier-than-average dates of SAG (Snow All Gone), some perhaps several weeks earlier than average. Some lower elevation sites that have recently reached SAG on/about their average date have done so beginning with a much above-average season maximum SWE, under very high snowmelt rates.



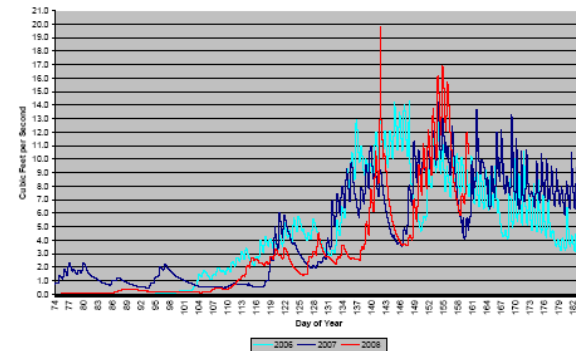
6/1/2008



Colorado Dust-on-Snow Alert #9, June 8, 2008

As anticipated by NWS – Grand Junction, fresh snow and cool air "reset" the snowmelt clock on Wednesday and Thursday of last week; we received 16 mm of SWE in the Senator Beck Basin Study Area, as 4-8" of new snow, varying by elevation. We did not detect any fresh dust with this storm here in our study area, and have received no reports of fresh dust elsewhere. That fresh snow layer resulted in a temporary return to a high albedo that, combined with cooler temperatures, dropped our Basin discharge from near 17 cfs on June 3 to 6 cfs by June 6, as seen below, ending our second major surge of snowmelt and stretching the date of snow-all-gone (SAG) a few days further into the future. Following that low point in streamflow on June 6, however, the new clean new snow quickly succumbed to sunny skies and the absorption of direct solar radiation by the underlying dust, revealing the underlying dirty snow surface once again. Our third surge in flows this season has now begun, as of this writing, despite somewhat cooler air temperatures here in the San Juans over the past weekend.

Senator Beck Basin Hourly Discharge - 2008, 2007, 2006



Based on our first-hand observation of extensive dust layers in mid-May, it is our assumption that a similar return to high albedo (caused by new snow) occurred throughout most of the remaining Colorado mountain snowpack last Wednesday and Thursday, followed by a similar, subsequent ablation of the clean new snow and re-emergence of the underlying dirty snow surface. Some Central and Northern mountain areas may have received additional snow showers on Saturday or Sunday, but not in amounts that will cause a prolonged return to high snowcover albedo values. Therefore, given that the current NWS – Grand Jct. 7-day forecast calls for generally sunny skies through Sunday, June 15th, except for a brief disturbance on Wednesday the 11th, and temperatures at 10,000' in the 60's (except Wednesday and Thursday), another surge of dust-enhanced snowmelt is expected.

6/8/2008

Colorado Dust-on-Snow (CODOS) Program Participants:

Colorado Water Conservation Board, Denver Water, Bureau of Reclamation, Western Water Assessment

Colorado River, Southwestern, and Rio Grande Water Conservation Districts

Upper Gunnison River, Tri-County, Animas-La Plata, Dolores, and Northern Colorado Water Conservancy Districts



Center for Snow &



Avalanche Studies

**WESTERN WATER
ASSESSMENT**

