

# Blended observations and models of snow water equivalent for water resources applications

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Guan

*Water Ed*  
9/27/2012

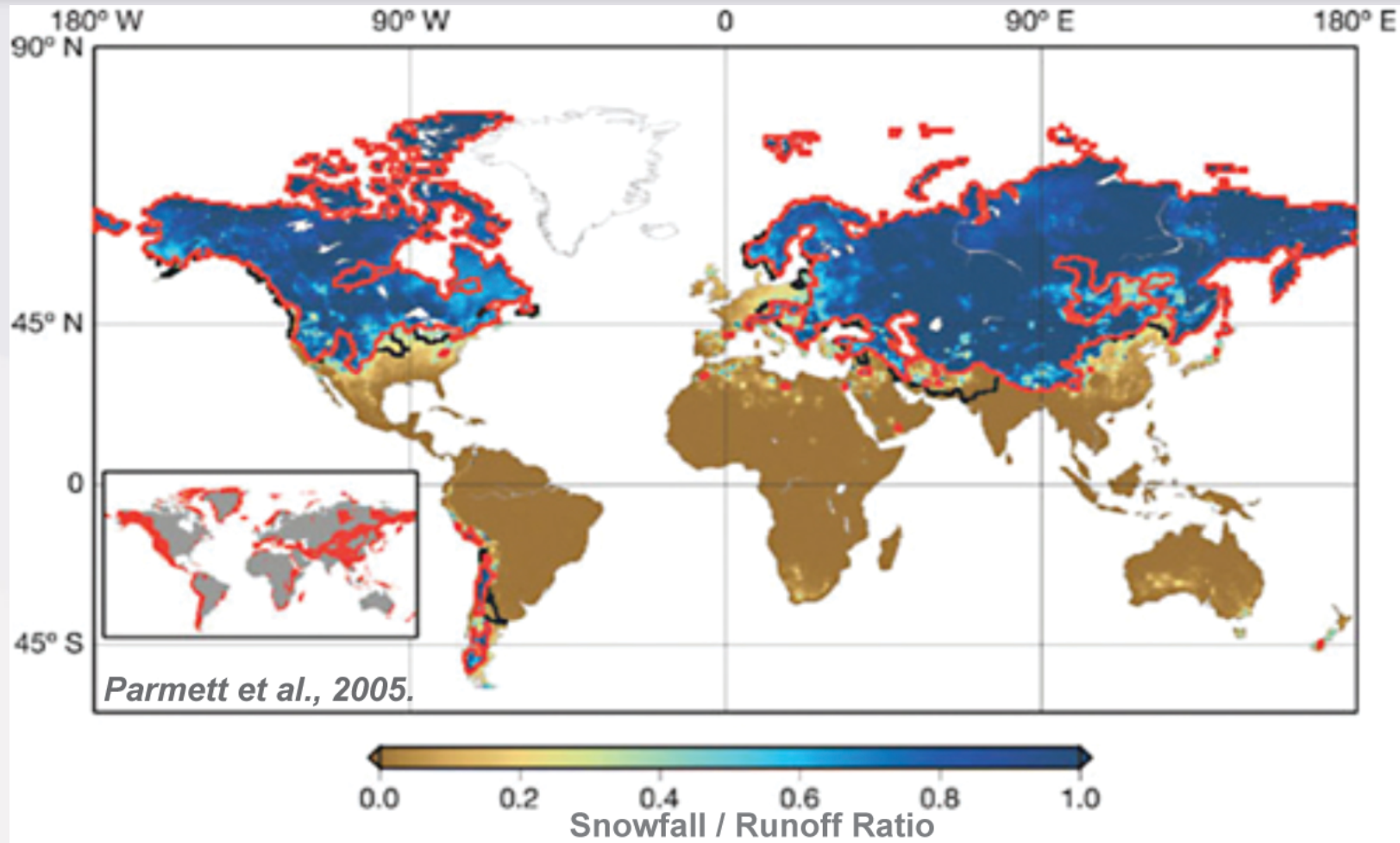
Institute of Arctic &  
Alpine Research /  
Geography

University of Colorado  
at Boulder

JPL Cal Tech



# Snow and Water Availability



- 60 Million People in US & 1 Billion People Globally
- 1/4<sup>th</sup> Global GDP





# Remotely sensed snowpack reconstruction improves Sierra Nevada water storage estimates

Snowmelt model runs backwards

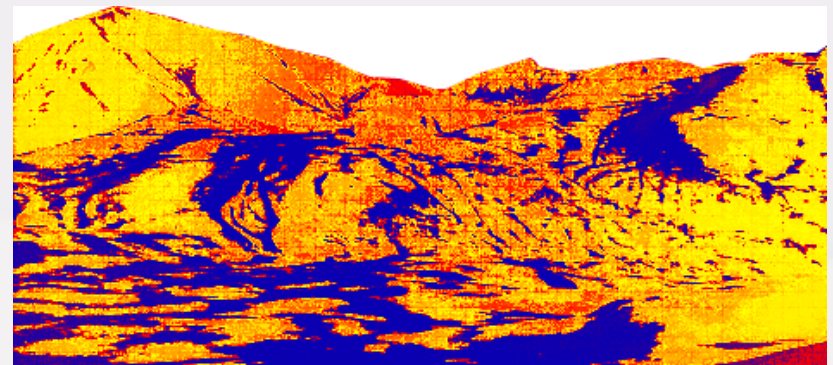
We integrate model snowmelt from time of maximum snow to snow disappearance

Satellite tells us when snow disappears

snow covered area



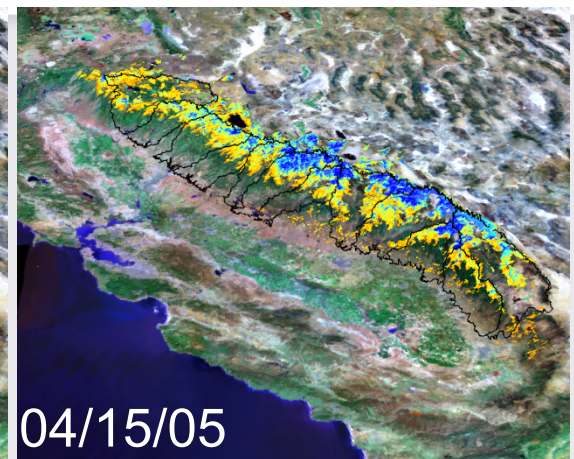
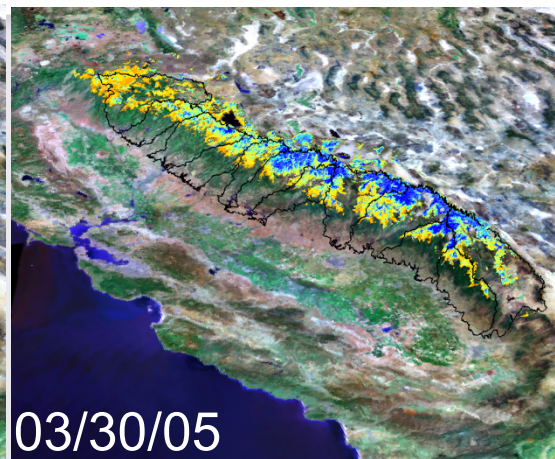
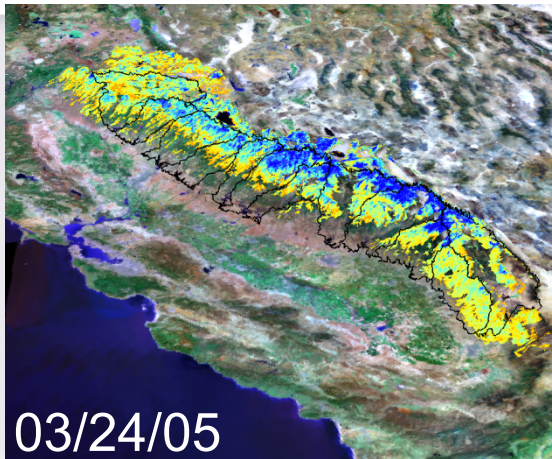
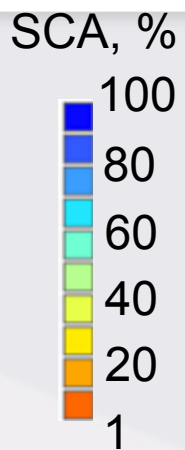
daily snowmelt, cm



*Cline et al., 1998a,b; Liston, 1999; Molotch et al., 2004b; Molotch & Bales, 2005;2006; Durand et al., 2007; Molotch, 2008.*



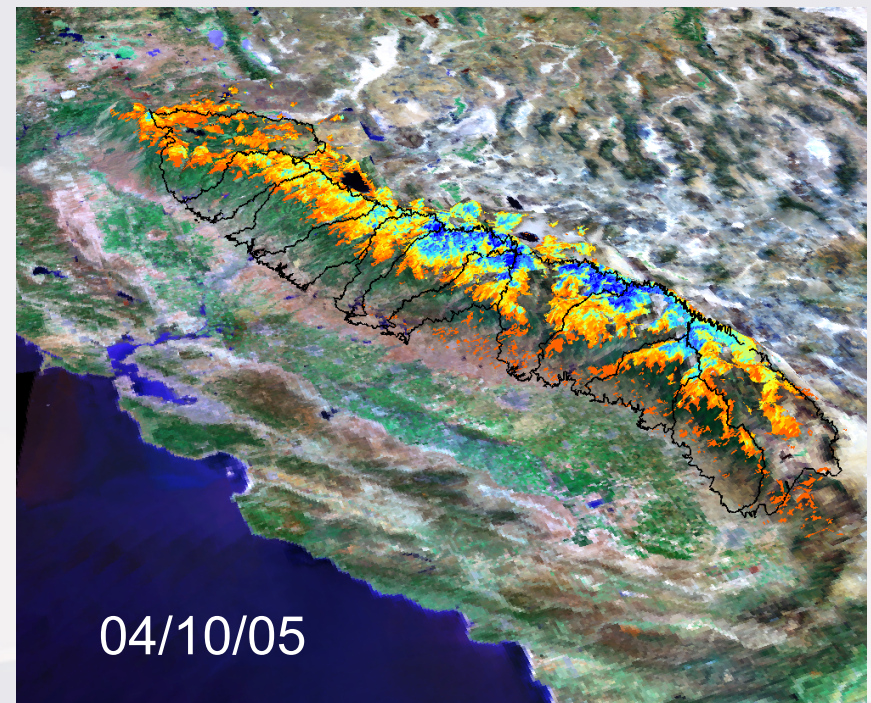
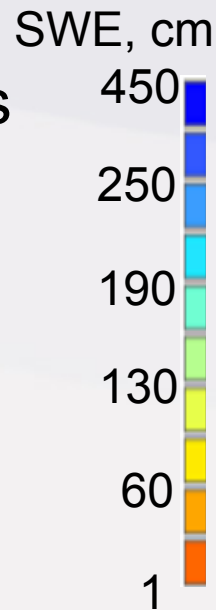
# Range-Scale Snow Cover: MODIS



MODSCAG – Dozier et al., 2010

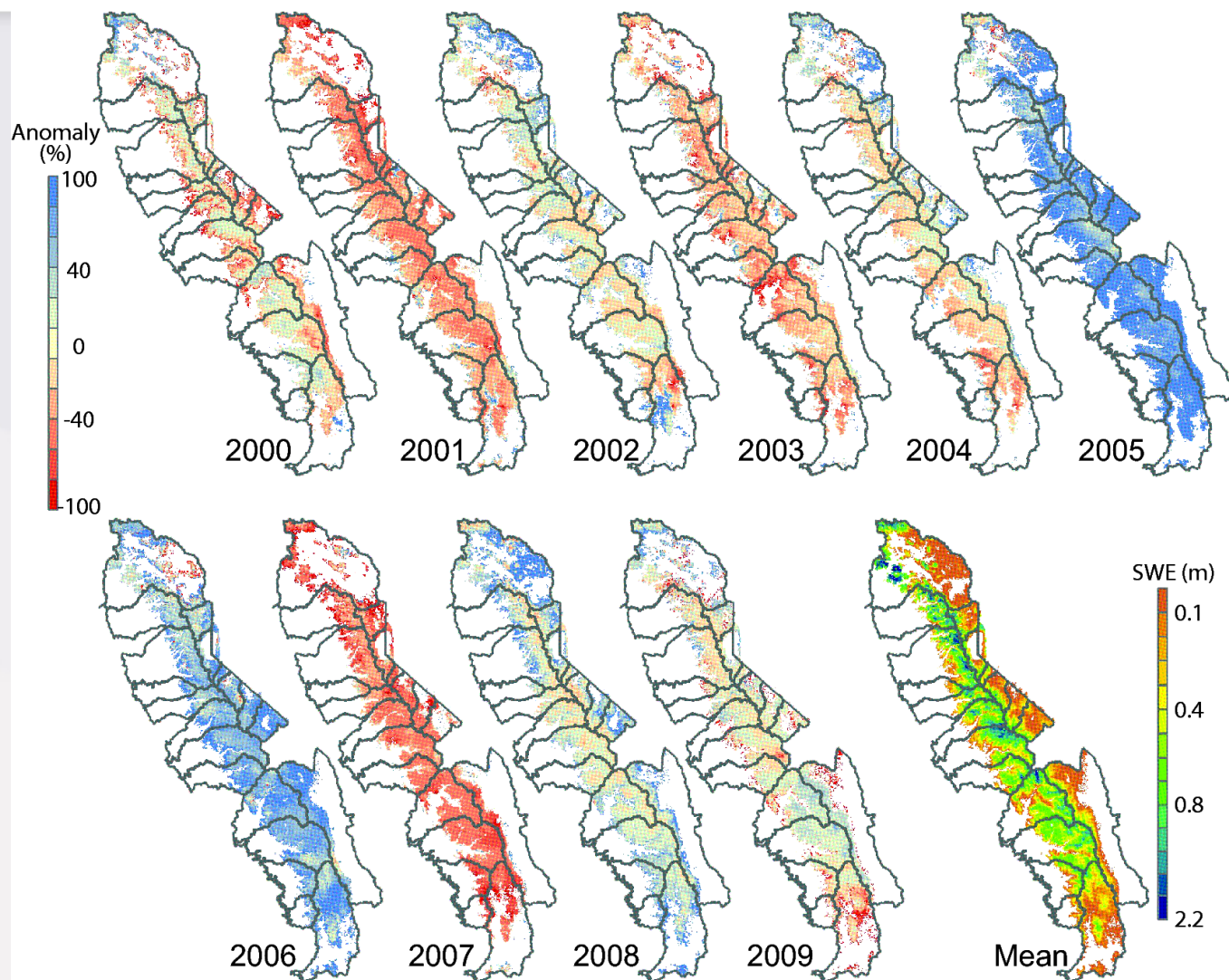
Due to lower initial mass  
snow disappeared  
rapidly in N. Sierra.

Areas with persistent  
snow cover had  
greatest mass.





# Snow Water Equivalent Anomalies



*Guan et al., in review*

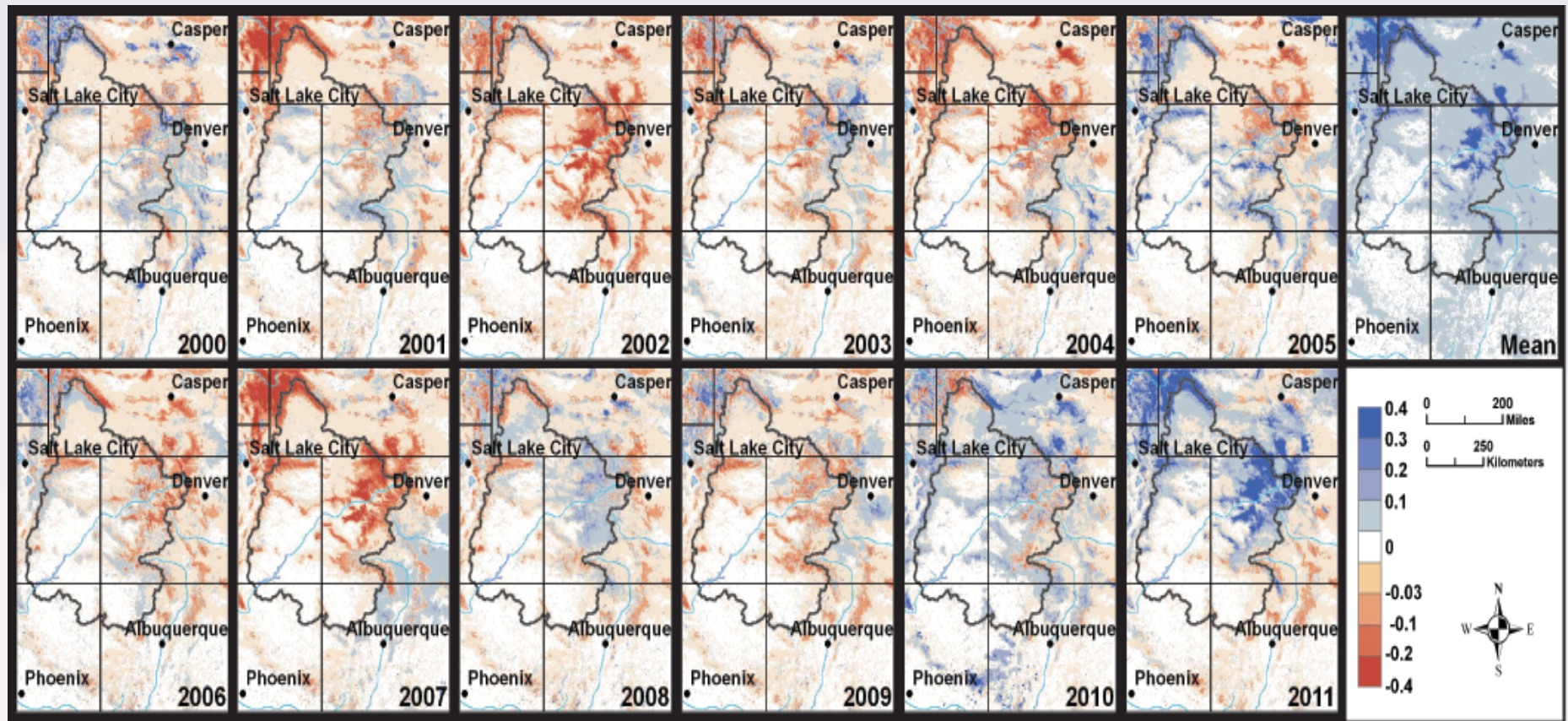
Max Accumulation = April 1



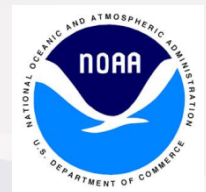




# Snow Water Equivalent Anomalies

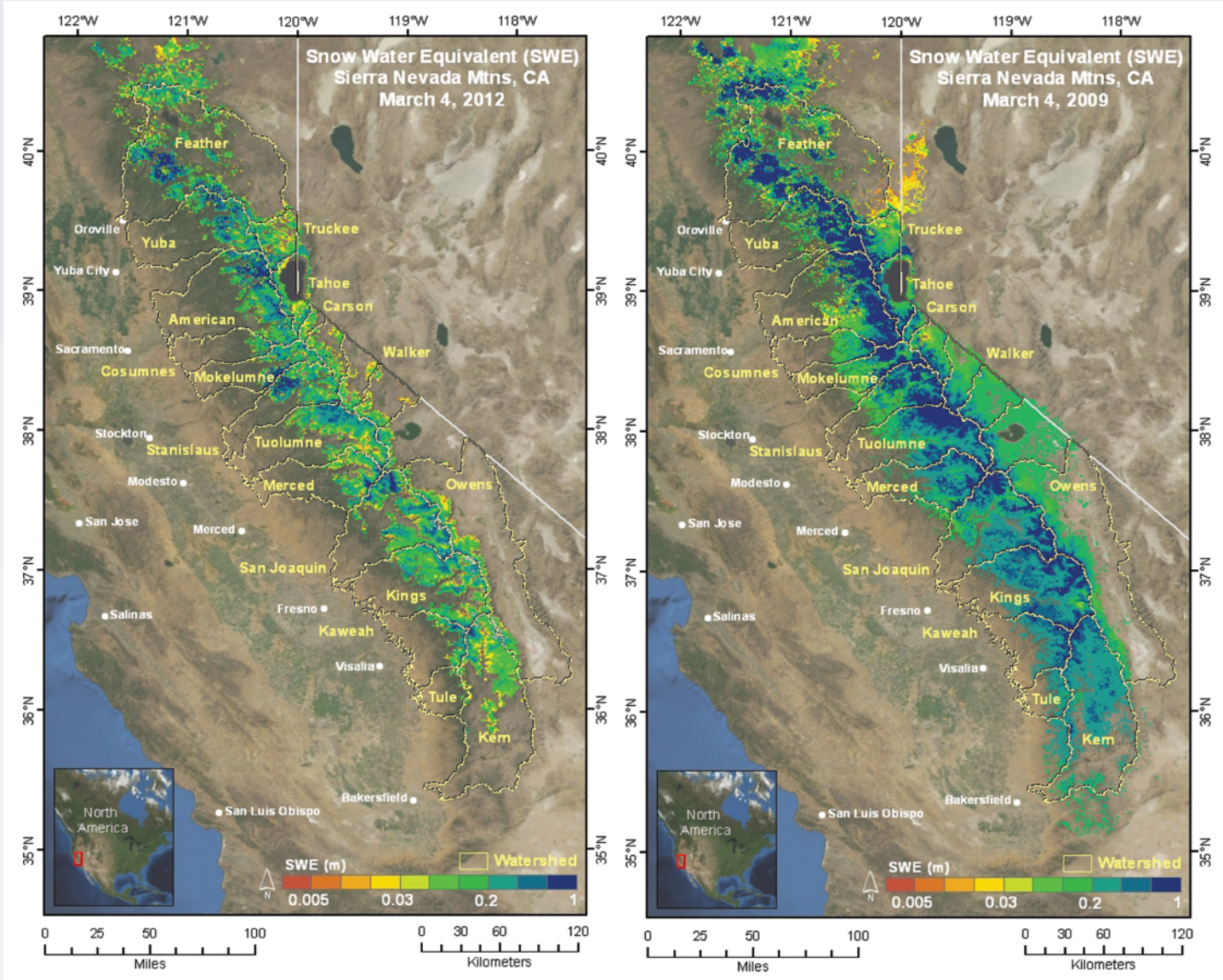


*Schneider et al., in preparation*





# Real Time SWE Product

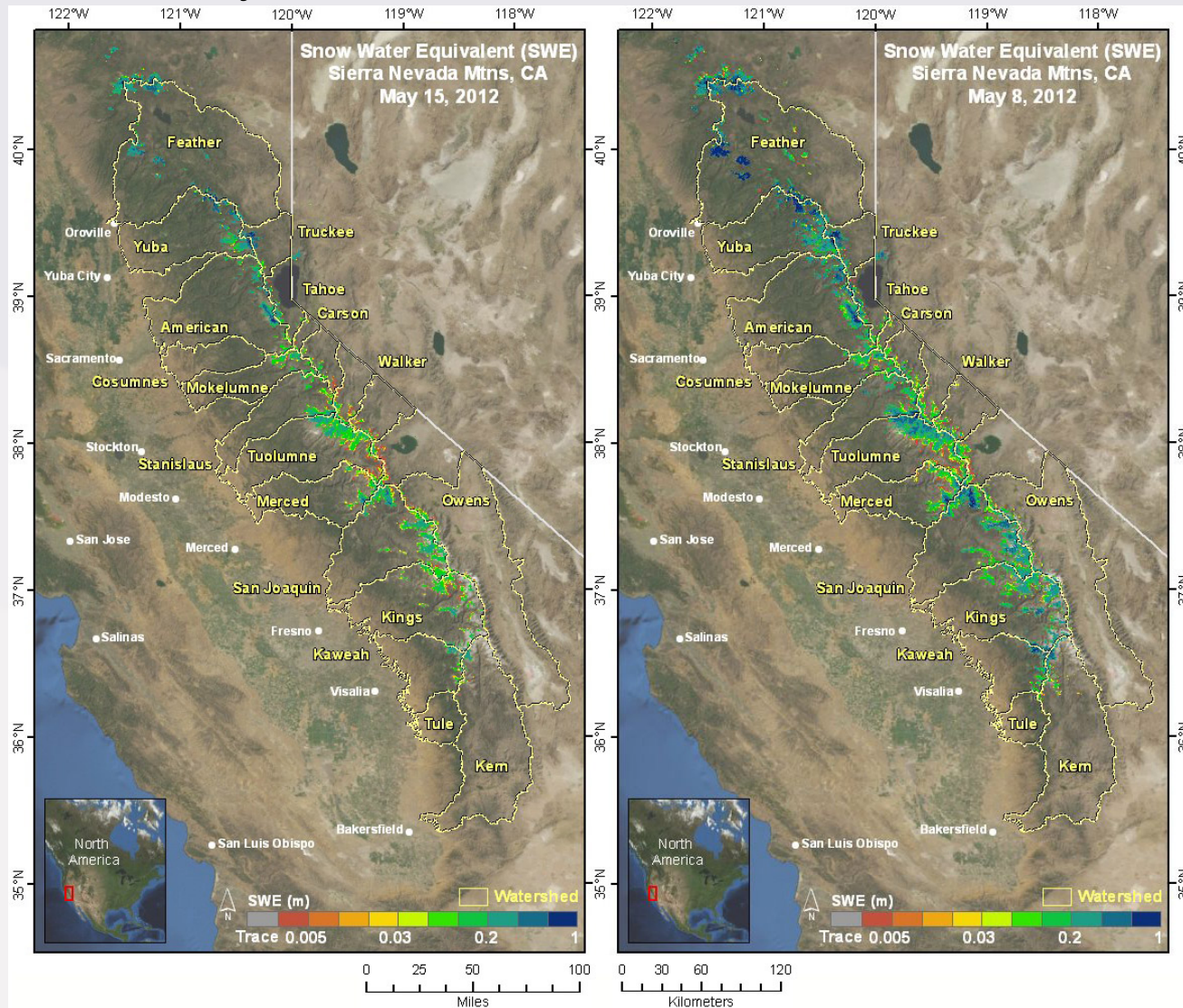




# Real-Time SWE Product Beta Version

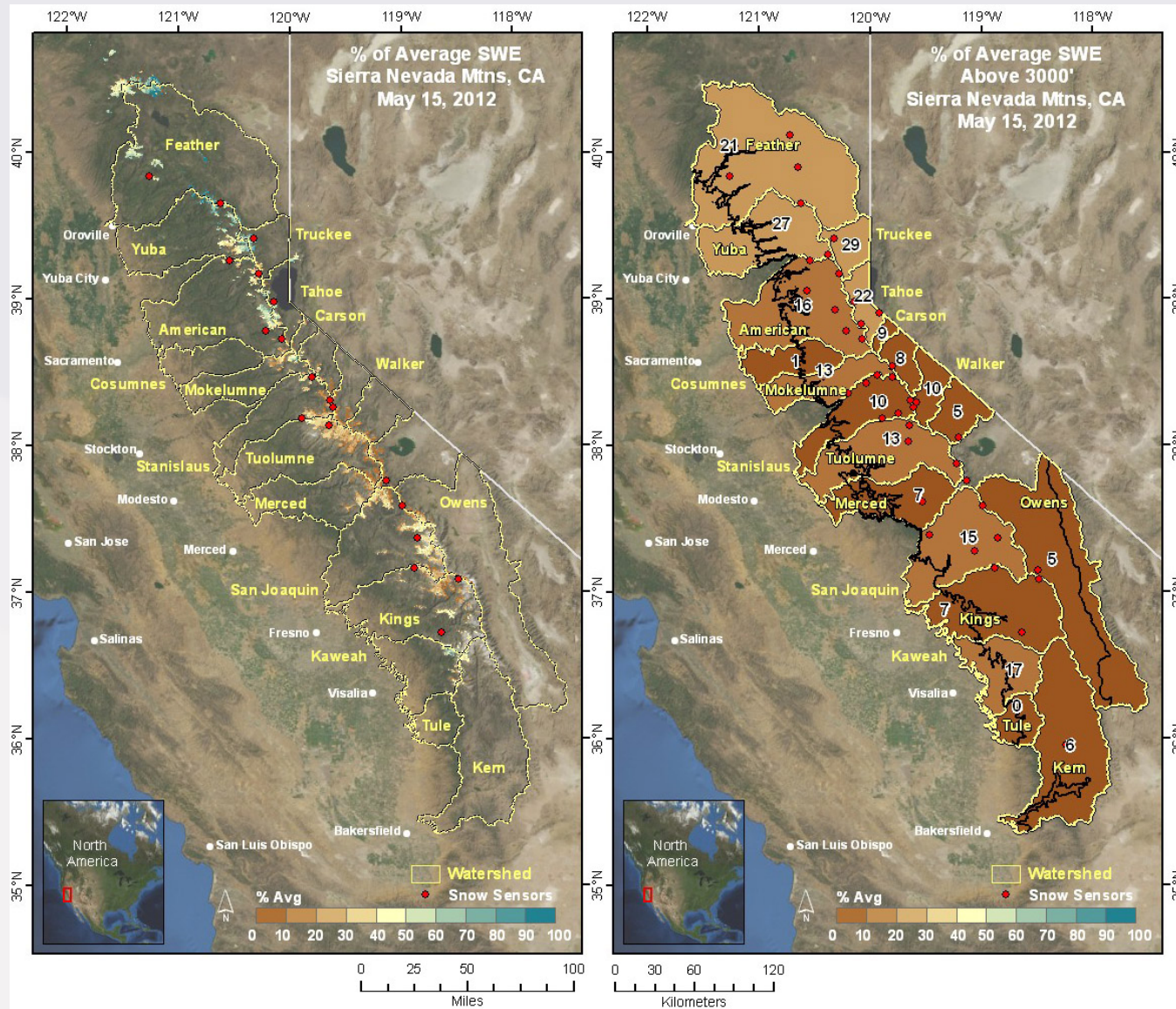
May 15, 2012

May 8, 2012





# Real-Time SWE Product Beta Version





# Real Time SWE Reports by Watershed

Watershed	5/15/12 SWE (in)	5/15/12 % Avg to Date	5/8/12 SWE (in)	5/8 thru 5/15 Change in SWE (in)
AMERICAN	1.17	16.28	2.75	-1.58
FEATHER	0.86	21.05	2.02	-1.17
KAWEAH	0.82	16.87	2.20	-1.38
KERN	0.13	5.63	0.44	-0.30
KINGS	0.75	7.46	2.64	-1.89
TAHOE	2.09	21.78	4.15	-2.06
MERCED	0.57	7.29	1.67	-1.10
OWENS	0.15	5.42	0.46	-0.31
SAN JOAQUIN	1.66	14.85	4.02	-2.36
STANISLAUS	1.01	9.58	2.42	-1.41
TRUCKEE	1.84	28.80	3.28	-1.44
TUOLUMNE	1.46	13.36	3.29	-1.83
YUBA	2.30	27.39	4.80	-2.50
COSUMNES	0.01	0.50	0.17	-0.16
MOKELUMNE	1.11	12.73	2.29	-1.18
TULE	0.00	0.29	0.07	-0.07
WEST WALKER RIVER	0.75	9.73	1.65	-0.90
EAST WALKER RIVER	0.30	5.46	0.73	-0.43
WEST FORK CARSON RIVER	0.57	8.68	1.26	-0.69
EAST FORK CARSON RIVER	0.48	7.59	1.23	-0.75





# Real Time SWE Report by Elevation Band

Watershed	Elevation	5/15/12 SWE (in)	5/15/12 % Avg to Date	5/8/12 SWE (in)	5/8 thru 5/15 Change SWE (in)	Area Sq Mi
AMERICAN	3000-4000'	0.00	0.00	0.00	0.00	191.9
	4000-5000'	0.00	0.00	0.01	-0.01	249.3
	5000-6000'	0.00	0.19	0.09	-0.09	294.8
	6000-7000'	0.49	5.26	2.45	-1.96	296.4
	7000-8000'	3.58	18.63	8.97	-5.39	175.7
	8000-9000'	8.65	31.35	14.84	-6.19	74.2
	9000-10,000'	13.15	37.87	19.80	-6.65	8.9
COSUMNES	3000-4000'	0.00	0.00	0.00	0.00	77.8
	4000-5000'	0.00	0.00	0.00	0.00	84.7
	5000-6000'	0.00	0.00	0.00	0.00	63.6
	6000-7000'	0.00	0.00	0.20	-0.20	28.1
	7000-8000'	0.32	1.93	4.71	-4.39	8.6
E CARSON	5000-6000'	0.00	0.00	0.00	0.00	32.7
	6000-7000'	0.00	0.01	0.00	0.00	77.7
	7000-8000'	0.02	0.67	0.16	-0.14	102.6
	8000-9000'	1.01	9.58	2.54	-1.53	96.5
	9000-10,000'	1.87	10.66	4.17	-2.30	29.7
	10,000-11,000'	1.02	5.12	3.56	-2.53	13.5
	> 11,000'	1.60	5.86	9.16	-7.56	0.3
E WALKER	6000-7000'	0.00	0.00	0.00	0.00	73.6
	7000-8000'	0.00	0.00	0.00	0.00	157.4
	8000-9000'	0.00	0.10	0.05	-0.04	154.9
	9000-10,000'	0.55	4.78	1.55	-0.99	63.1
	10,000-11,000'	2.11	10.75	4.71	-2.59	48.8
	> 11,000'	1.74	8.54	4.63	-2.88	7.8
FEATHER	3000-4000'	0.00	0.00	0.02	-0.02	286.2
	4000-5000'	0.00	0.08	0.03	-0.03	735.8
	5000-6000'	0.12	3.93	0.82	-0.70	1305.1
	6000-7000'	2.19	33.32	5.09	-2.90	871.3
	7000-8000'	5.84	43.15	9.20	-3.36	124.6
	8000-9000'	8.53	40.48	11.73	-3.21	5.2





- Identify other users / interested parties:
- Water Resources
- Forest Management
- Weather Research
- Regional Climate Modelers
- Hydrologic Modelers (CADWR-PRMS)
- [instaar.colorado.edu/research/labs-groups/mountain-hydrology-group/](http://instaar.colorado.edu/research/labs-groups/mountain-hydrology-group/)
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NASA: Terrestrial Hydrology & Applied Sciences



NSF: Hydrological Sciences



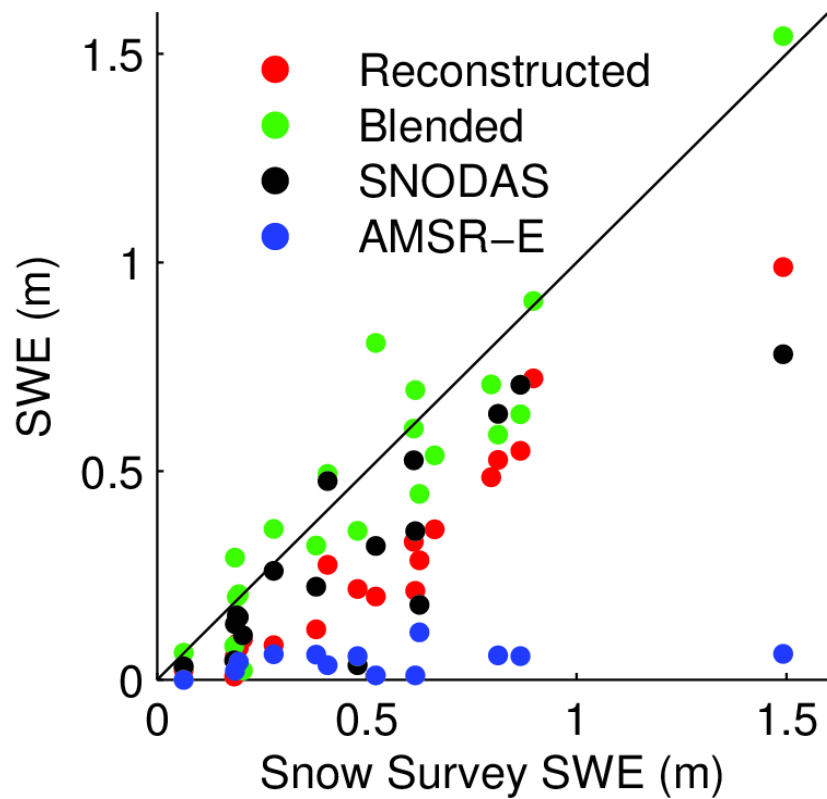
NOAA: Western Water Assessment



J. Dozier, T. Painter, D. Rizzardo, S. Nemeth, F. Gherke, M. Anderson, J. Jones

# Model Performance

## Sierra Nevada



## Upper Colorado River Basin

