Development of Prototype National Water Model Soil Moisture Products for Drought Monitoring

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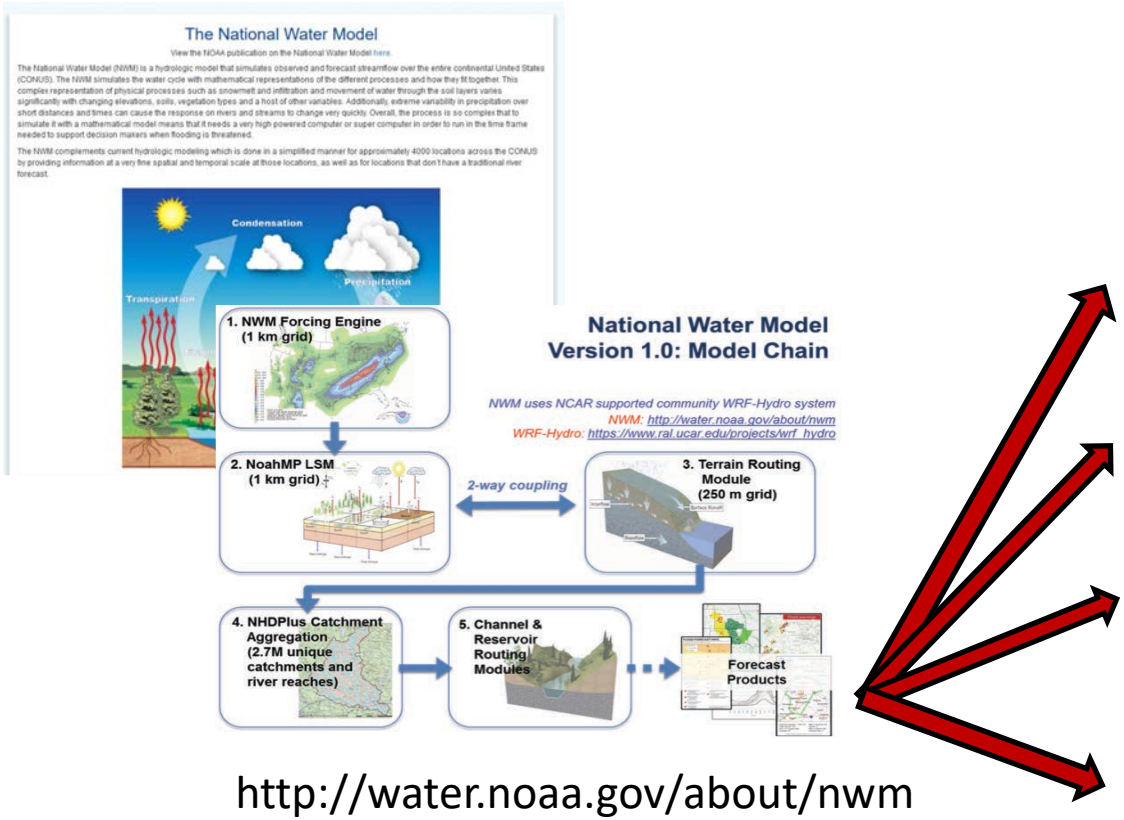
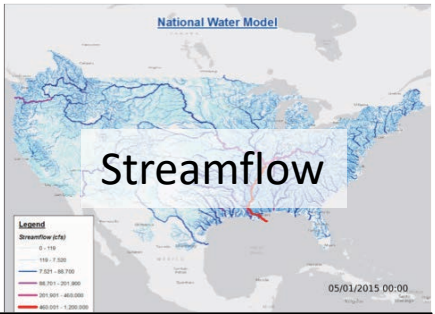
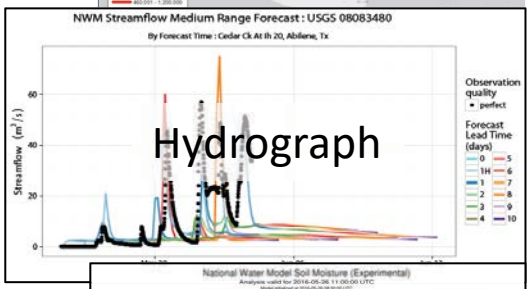
Funding from NOAA CPO and NIDIS

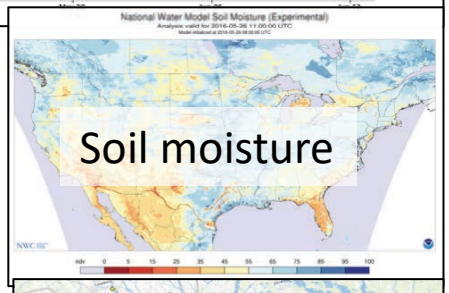
The National Water Model

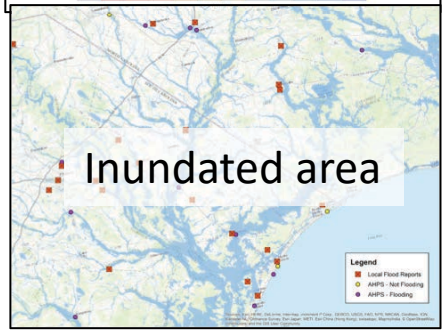
Development Team: NCAR/RAL, NOAA/NWS/OWP , USGS, CUAHSI, Universities
Sponsor: NOAA Office of Water Prediction











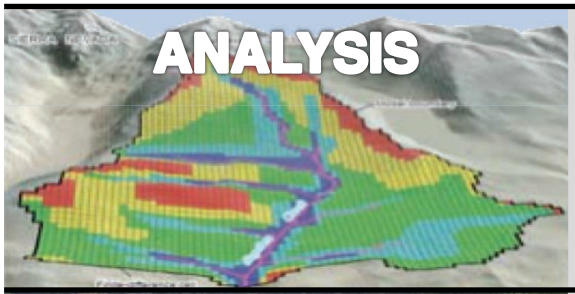
http://water.noaa.gov/about/nwm

System became fully operational beginning Aug. 16, 2016

- Real-time verification since June 2016 (Rwrfhydro)
- Multiple operational products created by NOAA, academia, private sector

Slide courtesy David Gochis (NCAR)

NWM Operational Cycles:

	Cycling	Forecast	Met Forcing	Outputs
	Hourly	-3 - 0 hrs	MRMS QPE and HRRR/RAP blend	1-km spatial fluxes (water & energy); 250-m routed fluxes (water); NHDPlus channel routing
	Hourly	1 – 18 hrs	Downscaled HRRR/RAP Blend	1-km spatial fluxes (water & energy); 250-m routed fluxes (water); NHDPlus channel routing
	4x Daily	to 10 days	Downscaled GFS	1-km spatial fluxes (water & energy); 250-m routed fluxes (water); NHDPlus channel routing
	Daily x 16 ensembles	to 30 days	Downscaled & NLDAS2 Bias-Corrected CFS	1-km spatial fluxes (water & energy); NHDPlus channel routing

Slide courtesy David Gochis (NCAR)

NWM Operational Cycles:

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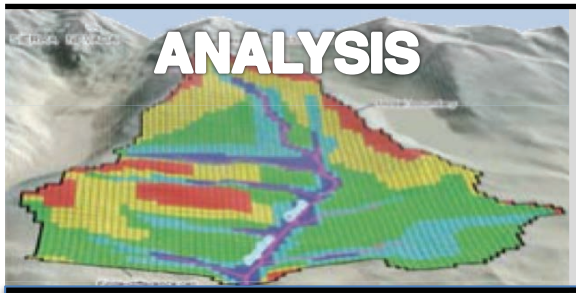
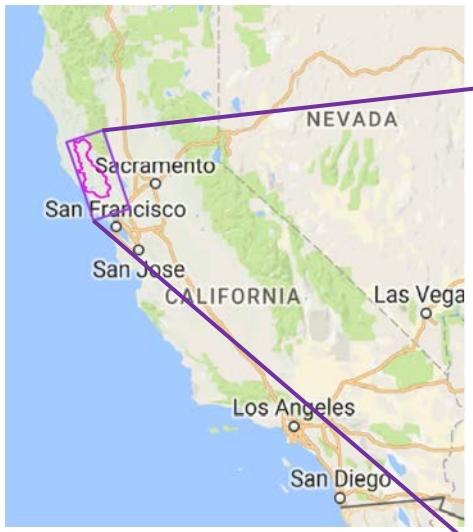
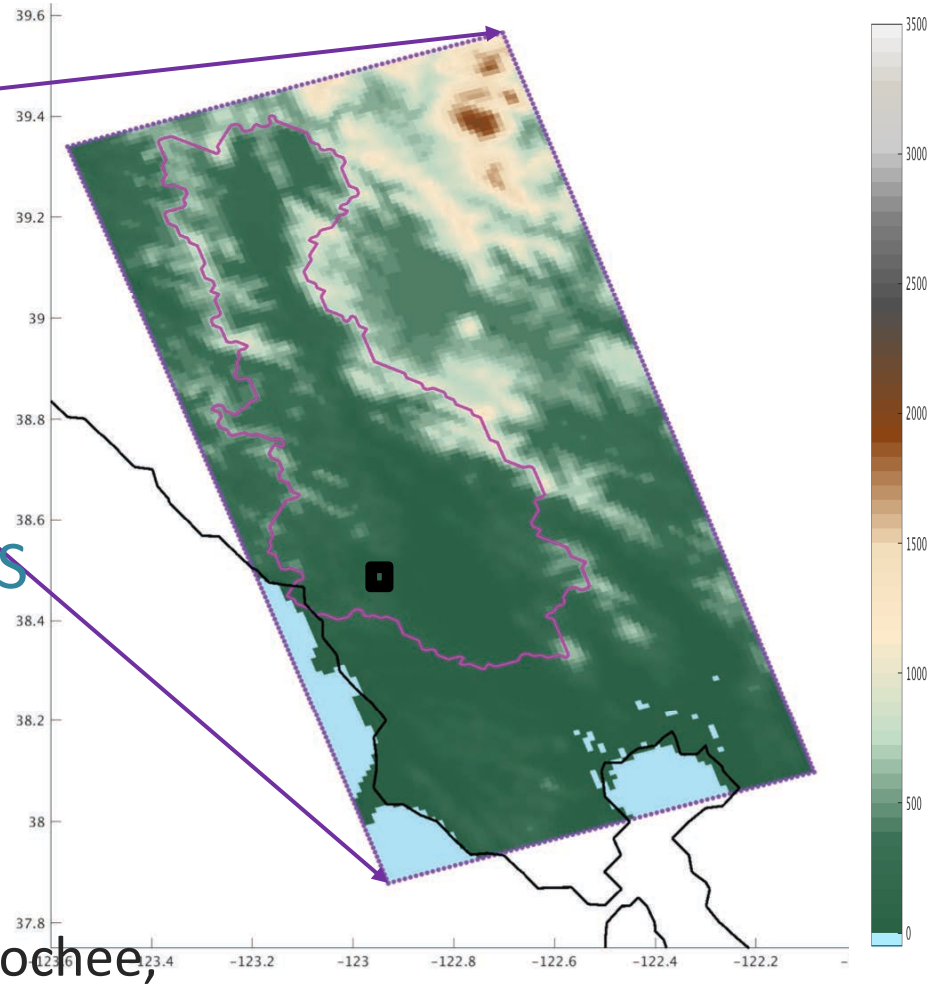
	Hourly	-3 - 0 hrs	MRMS QPE and HRRR/RAP blend	1-km spatial fluxes (water & energy); 250-m routed fluxes (water); NHDPlus channel routing
	Hourly	1 – 18 hrs	Downscaled HRRR/RAP Blend	1-km spatial fluxes (water & energy); 250-m routed fluxes (water); NHDPlus channel routing
	4x Daily	to 10 days	Downscaled GFS	1-km spatial fluxes (water & energy); 250-m routed fluxes (water); NHDPlus channel routing
	Daily x 16 ensembles	to 30 days	Downscaled & NLDAS2 Bias-Corrected CFS	1-km spatial fluxes (water & energy); NHDPlus channel routing

Project goal: Create products from the NWM analysis outputs for drought monitoring purposes.

Slide courtesy David Gochis (NCAR)

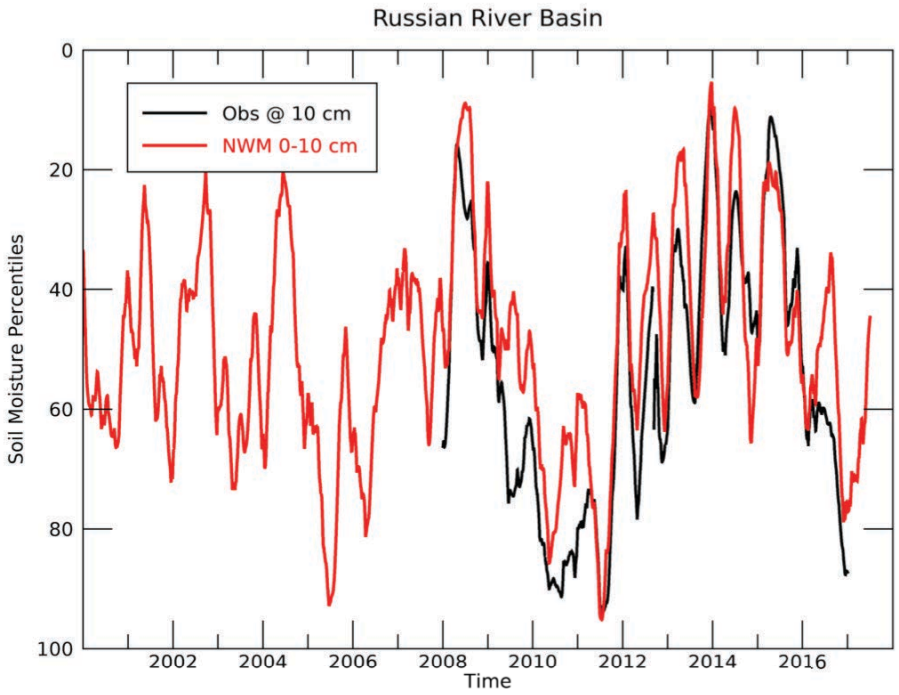
Demonstration regions

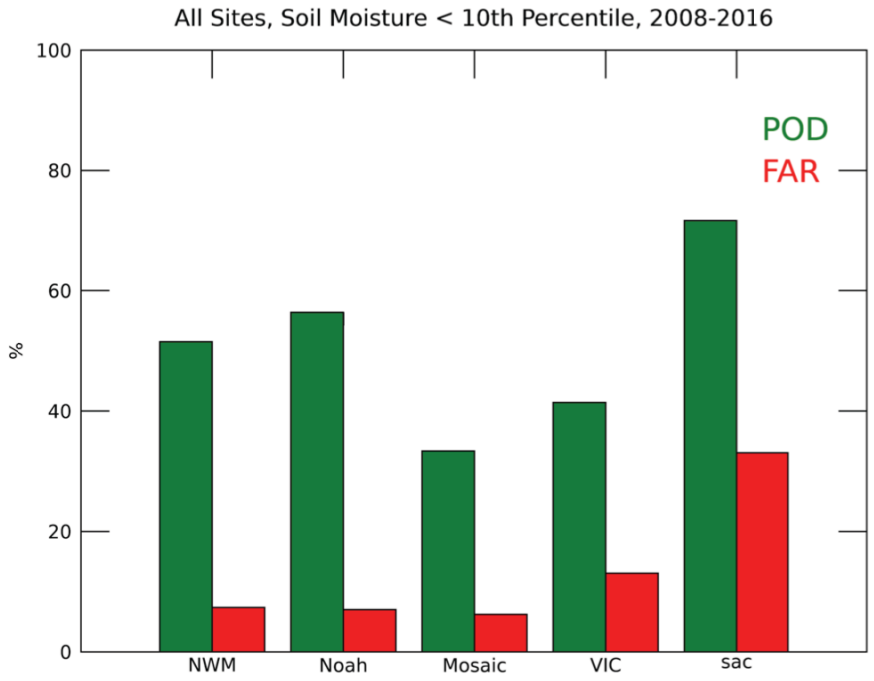




- Initial focus will be on NIDIS priority watersheds:
  - **Russian River Basin**
  - Lower Colorado River Basin
  - Missouri River Basin
  - ACF (Apalachicola, Chattahoochee, and Flint) River Basin

Comparison against in situ observations





2x2 Contingency Table		Event Observed	
		Yes	No
Event Forecast	Yes	a (hits)	b (false alarms)
	No	c (misses)	d (correct negatives)

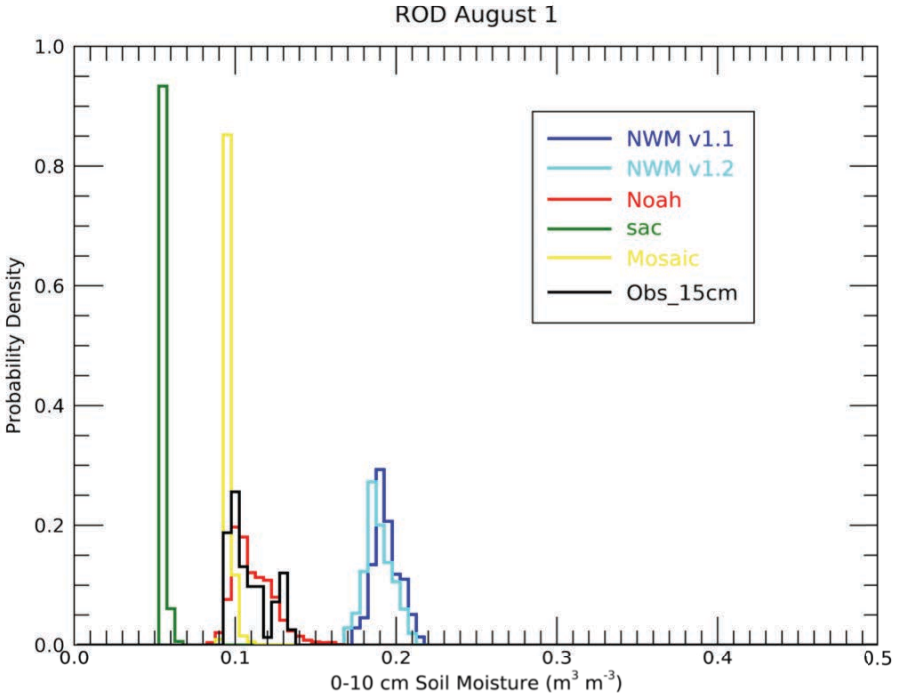
POD = a/(a+c)

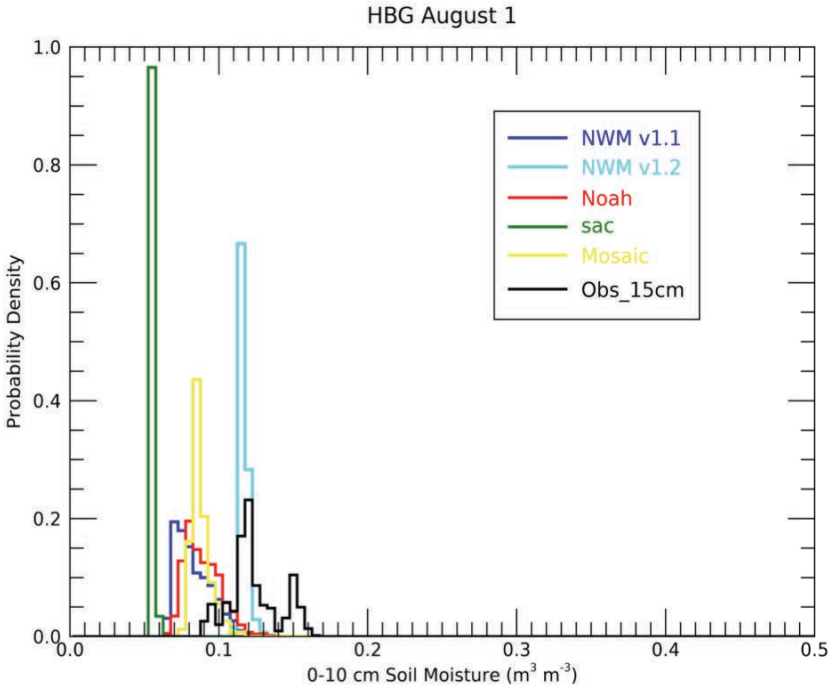
FAR = b/(a+b)

Confronting challenges: Version changes

Probability Density comparison at 0-10 cm layer in dry season

- v1.1 and v1.2 agree very well at Rio Nido (ROD) but biased wet from observations
- V1.1 and v1.2 disagree at Healdsburg (HBG) with v1.2 in better agreement

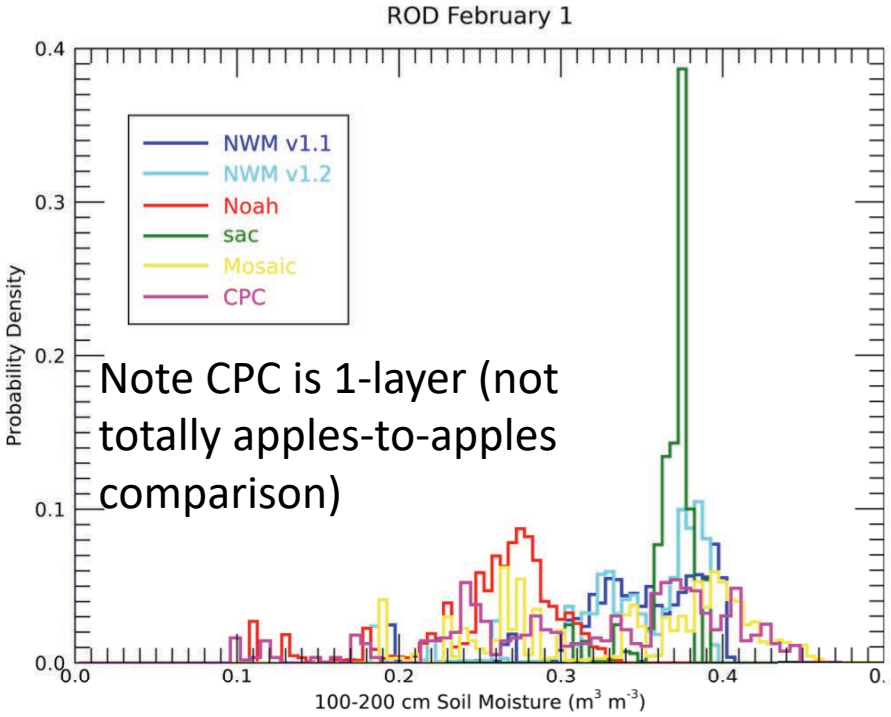


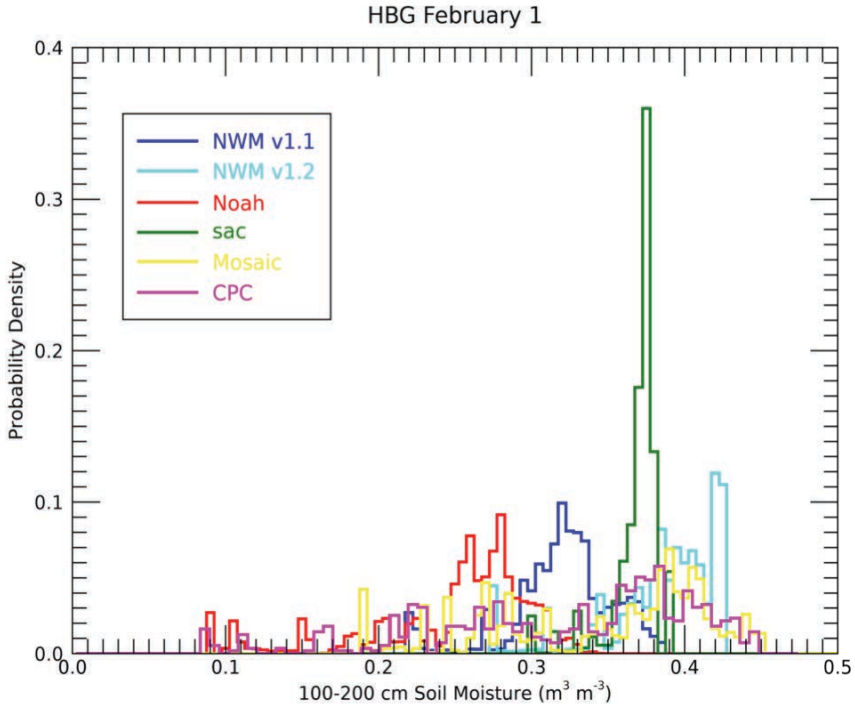


Confronting challenges: Version changes

Probability Density comparison at 100-200 cm in wet season

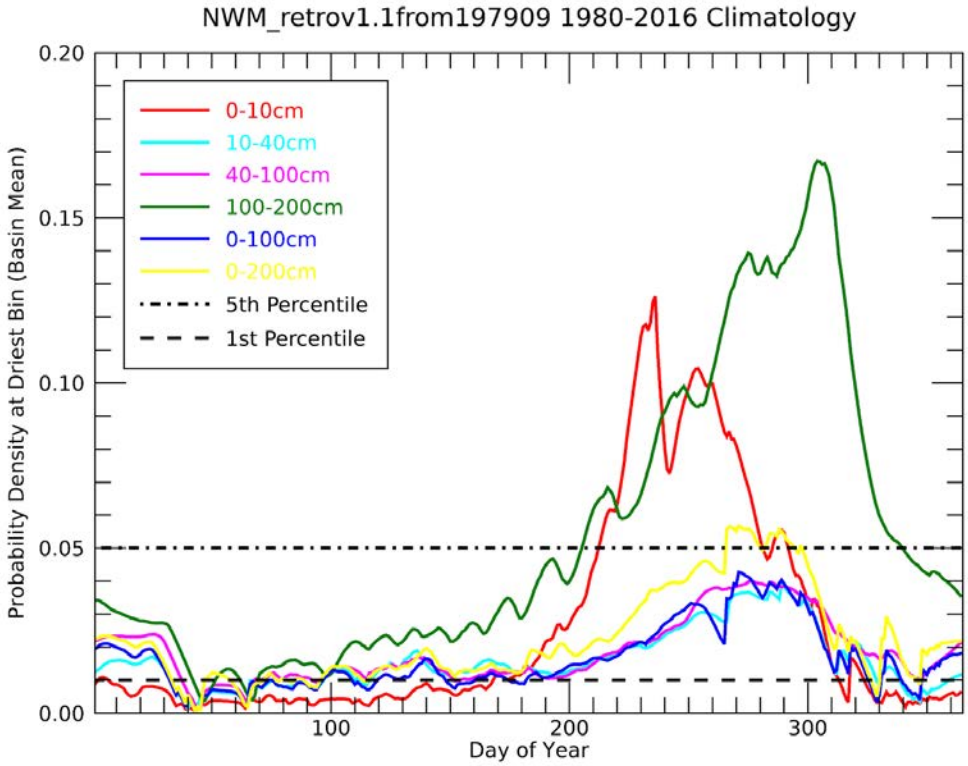
- Broader distributions during the wet season.
- Similar result for v1.1 to v1.2 comparison with similar structure at ROD but biased results at HBG.





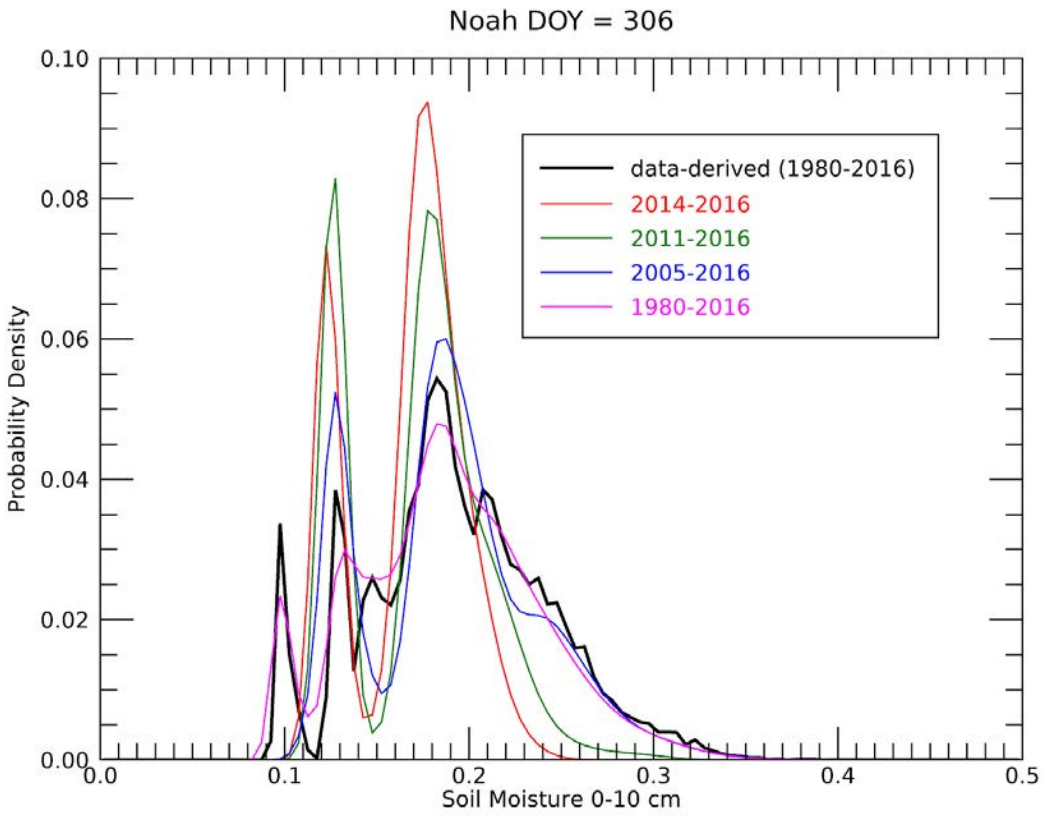
Thanks to Yun Fan from CPC for the NLDAS-forced leaky bucket output

Confronting challenges: narrow PDFs



- In some locations and depths, the climatological PDF is too narrow to be able to distinguish precipitation extremes

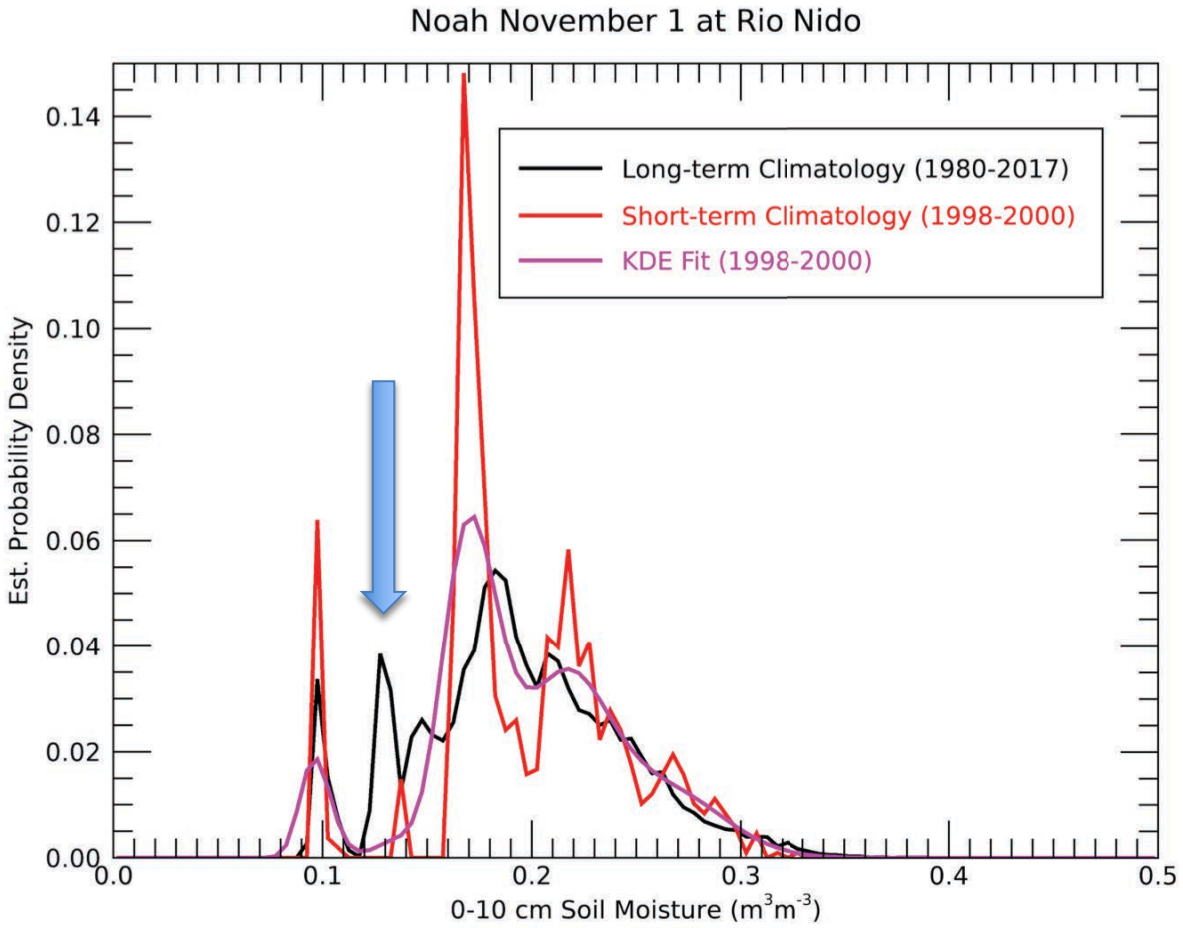
Confronting challenges: short historical period data



The NWM analysis cycle is forced with a blend of operational forcings (HRRR model and MRMS). These forcings are only available post ~2014.

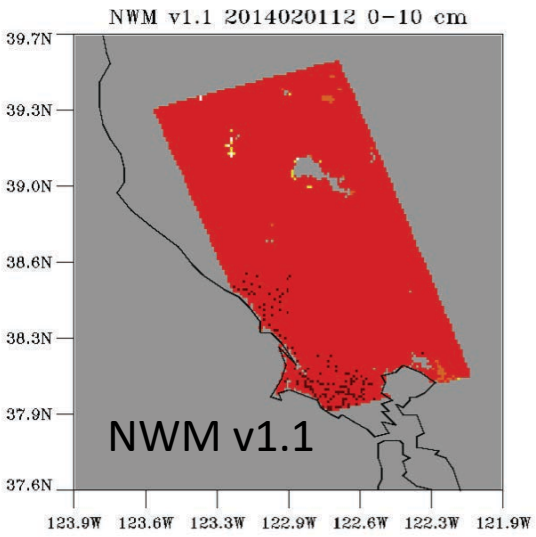
Estimation of reference climatology with KDE

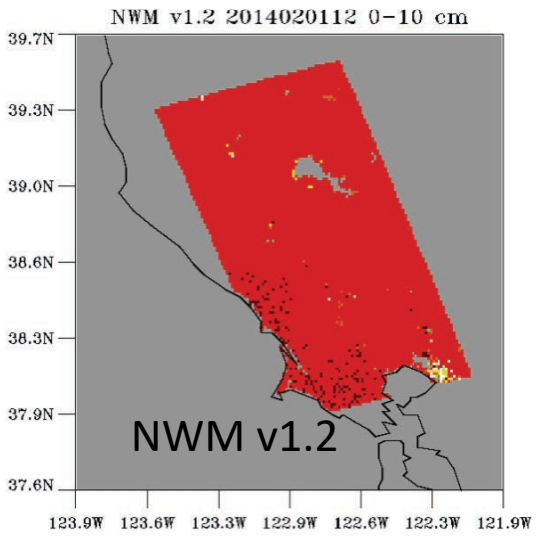
Kernel Density Estimation (KDE) method used to fit short-term climatology.

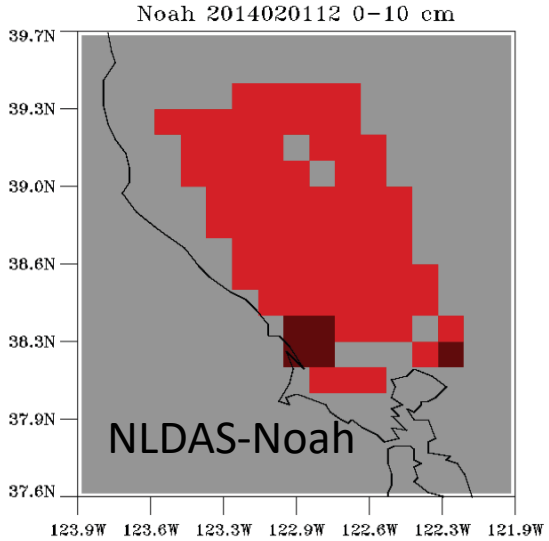


0-10 cm layer soil moisture PDFs for both long and short term for one grid cell at Rio Nido in the Russian River Basin.

Example products: 0-10 cm soil moisture percentiles

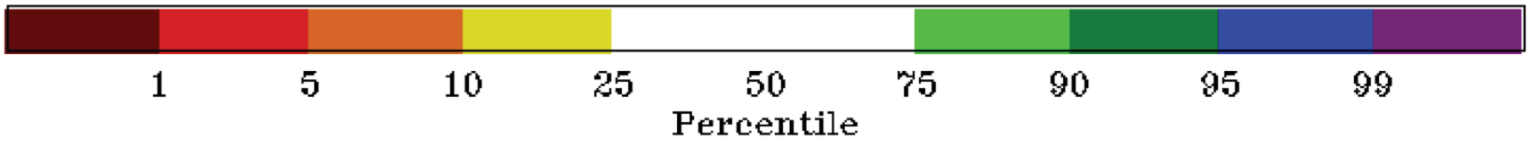




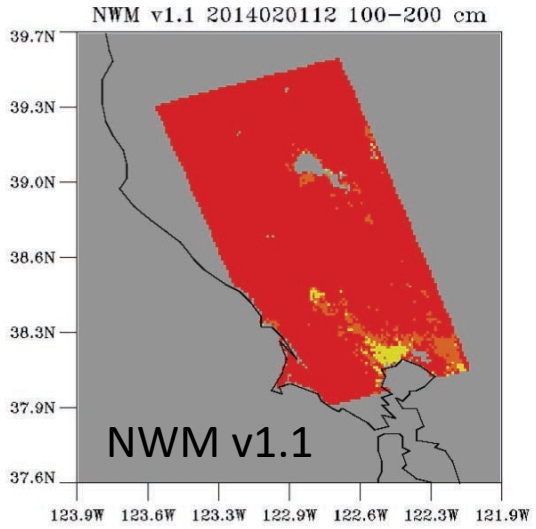


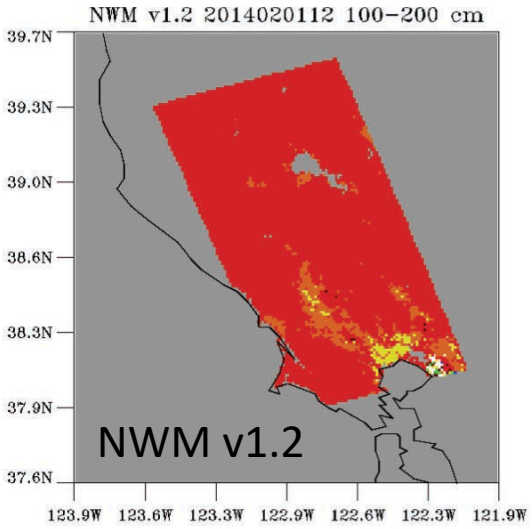
February 1, 2014

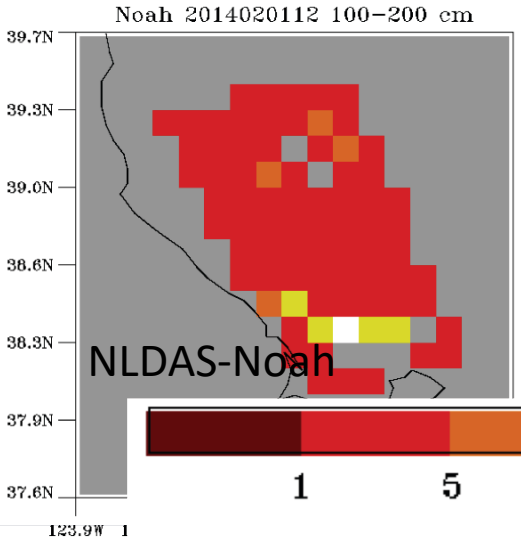
- Nearing peak of exceptional drought later in 2014

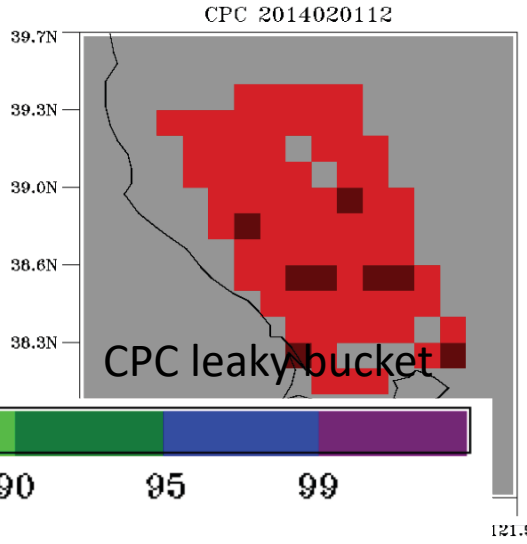


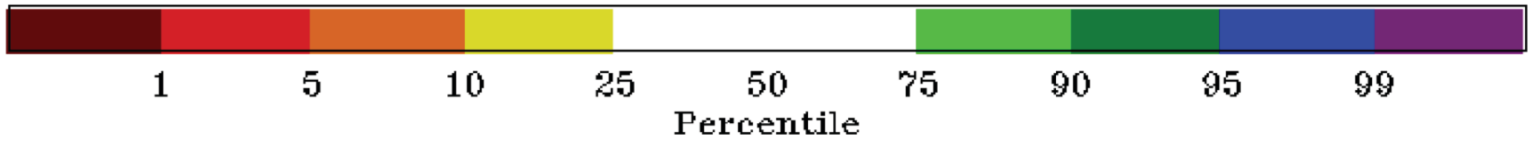
Example products: 100-200 cm SM percentiles







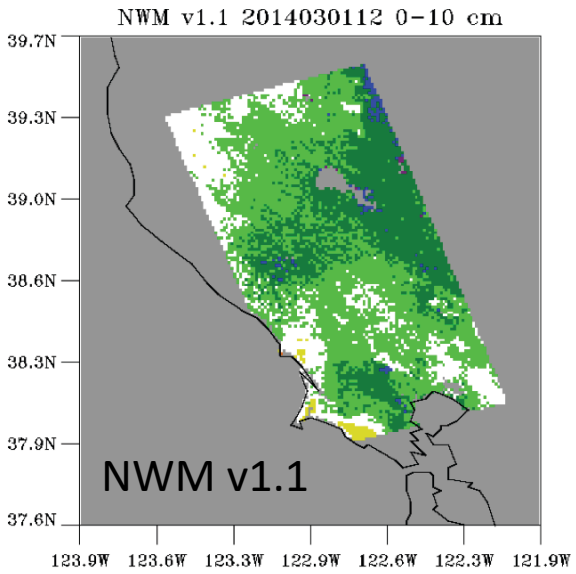


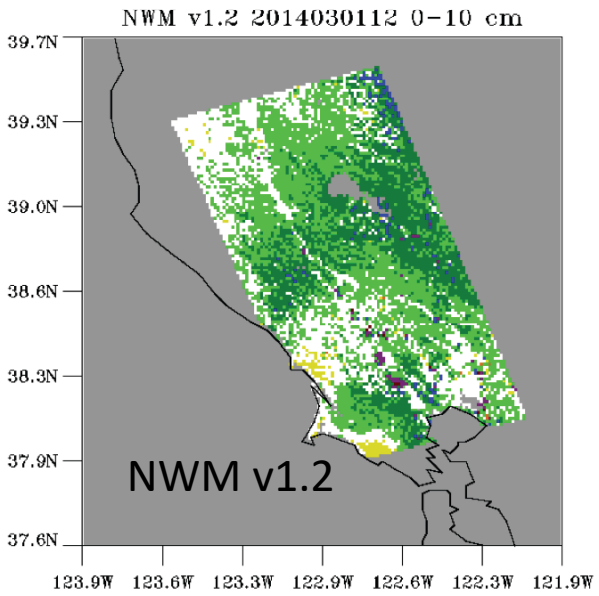


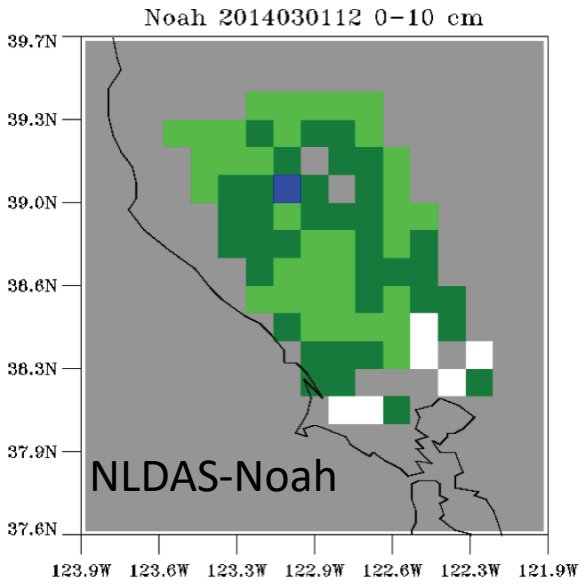
February 1, 2014

- 100-200 cm lower soil layer

Example products: 0-10 cm SM percentiles

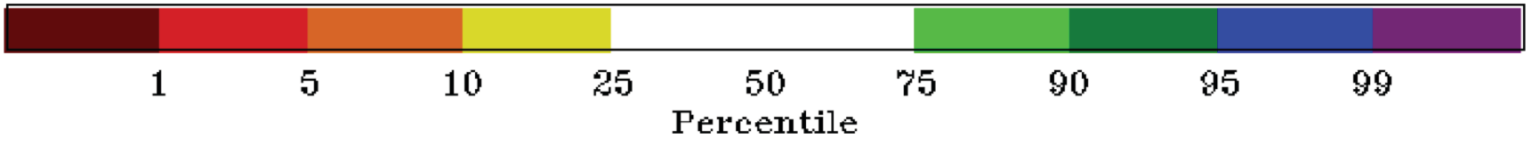




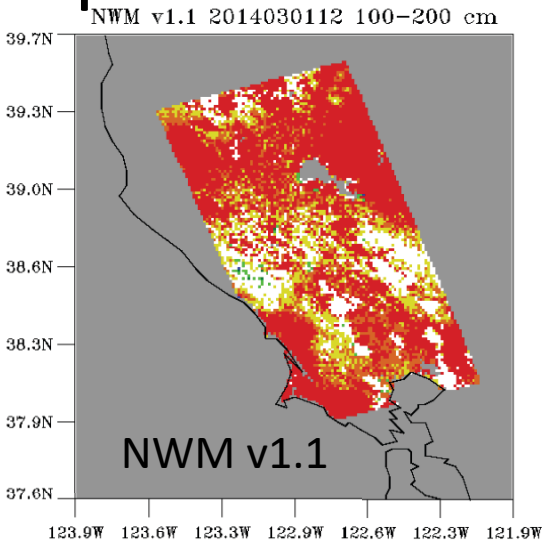


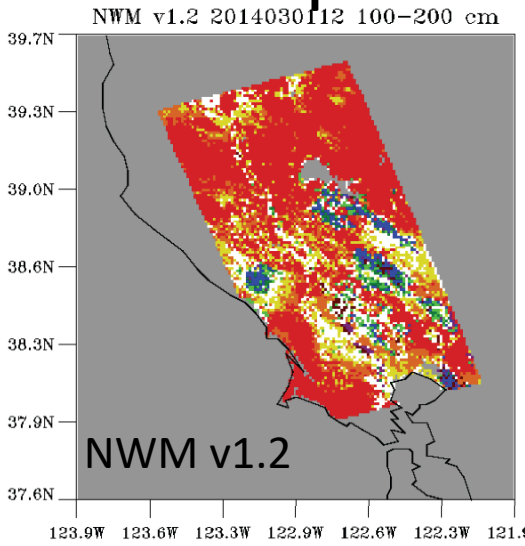
March 1, 2014

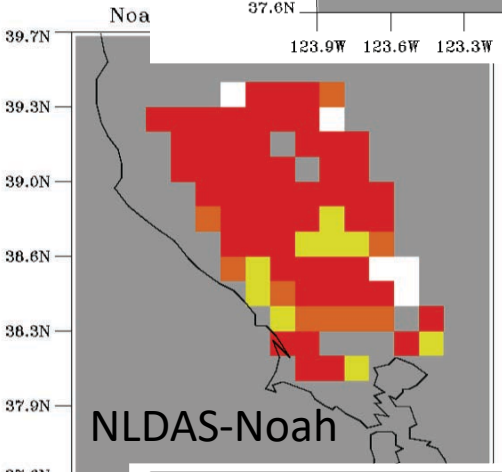
- 0-10 cm upper soil layer following rainfall on February 27th.
- Note Russian river signature in v1.2 and extreme wet regions

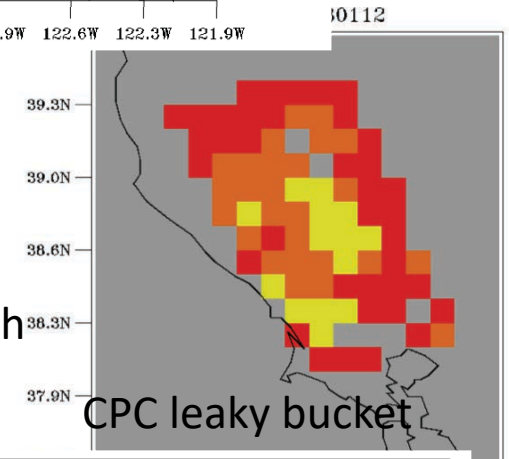


Example products: 100-200 cm SM percentiles



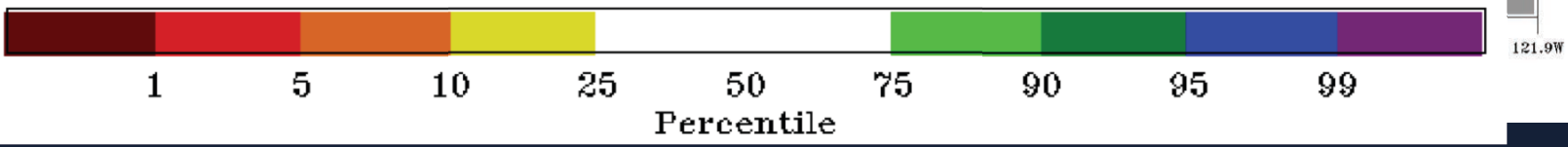






March 1, 2014

- 100-200 cm lower soil layer following rainfall on February 27th
- V1.2 has intense wet areas



Thanks!

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NWM: http://water.noaa.gov/about/nwm

Funding from NOAA CPO and NIDIS