Western Water Assessment CIRES University of Colorado Boulder http://wwa.colorado.edu

September's Extreme Weather:

How the weather system that flooded Colorado's Front Range affected the Upper Colorado River Basin

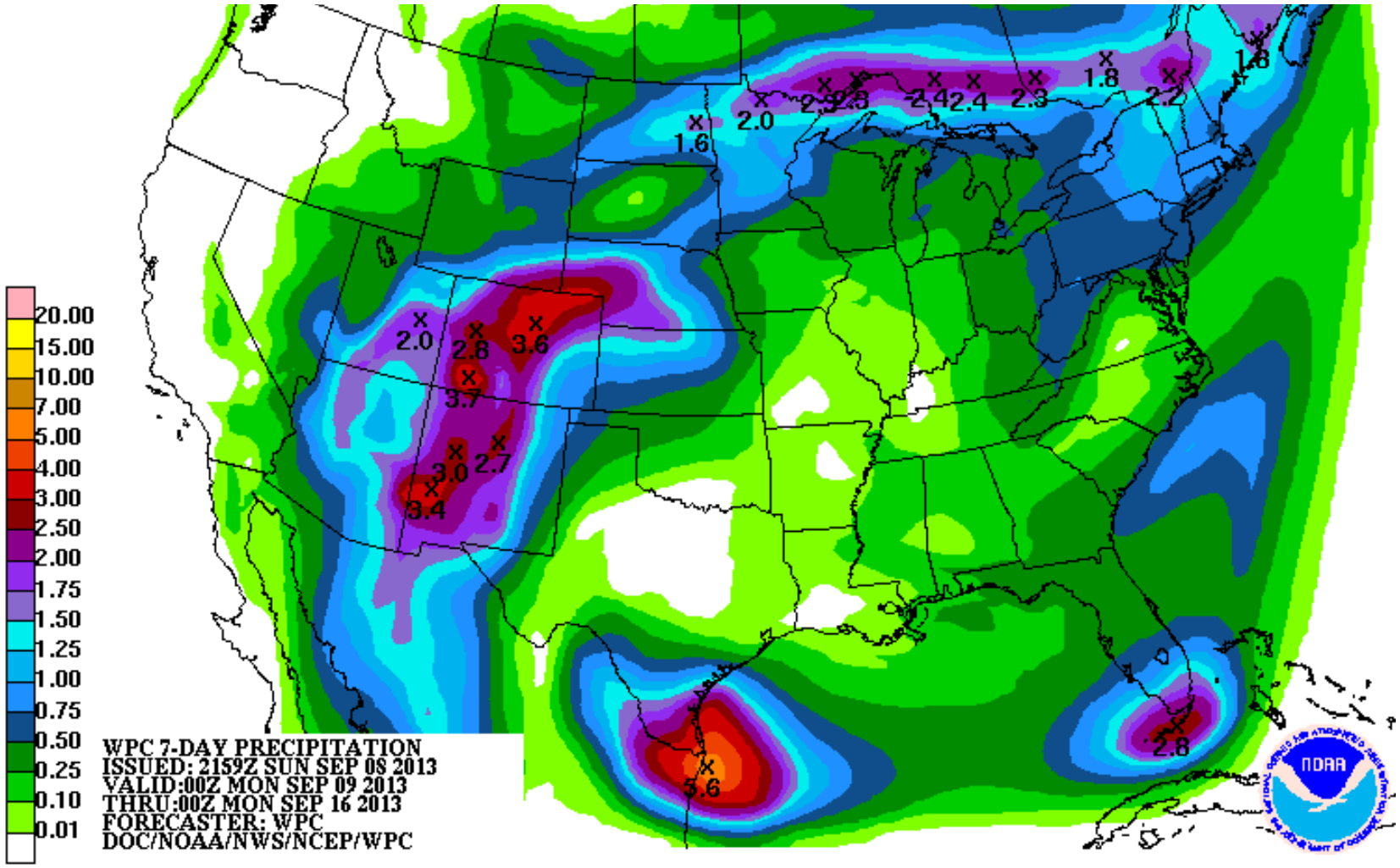
Upper Colorado River Basin Forum
Colorado Mesa University
November 7, 2013

Jeff Lukas, Senior Research Associate
CIRES Western Water Assessment

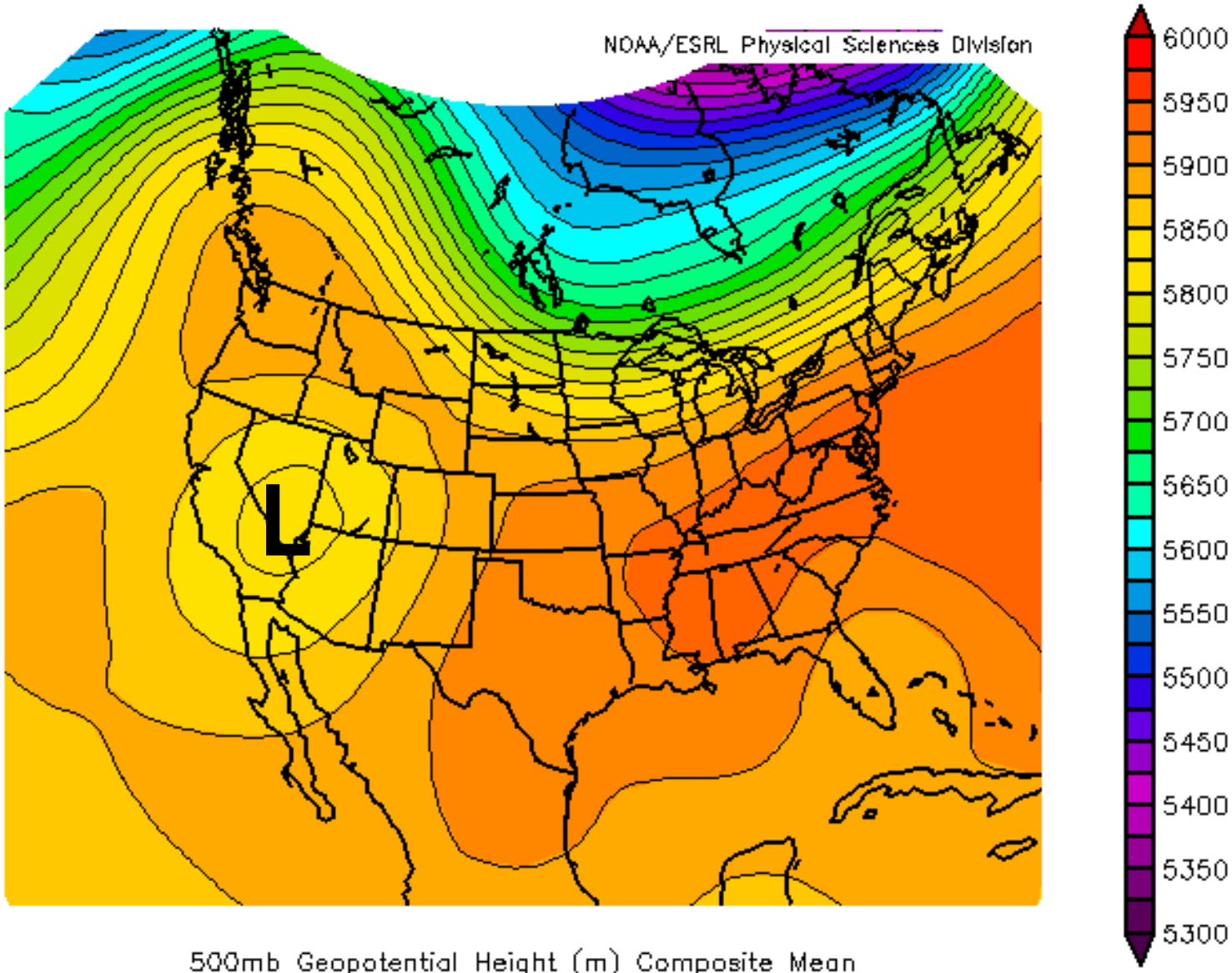
Acknowledgements

- Klaus Wolter, Kelly Mahoney, and Joe Barsugli (CIRES/NOAA PSD)
- Nolan Doesken and Wendy Ryan (Colorado Climate Center, CSU)
- Imtiaz Rangwala, Ben Livneh, and Eric Gordon (CIRES/WWA)
- Martin Hoerling and George Kiladis (NOAA PSD)

NOAA HPC 7-day Quantitative Precipitation Forecast (QPF) issued 6pm 9/8/2013 for 9/9 through 9/15

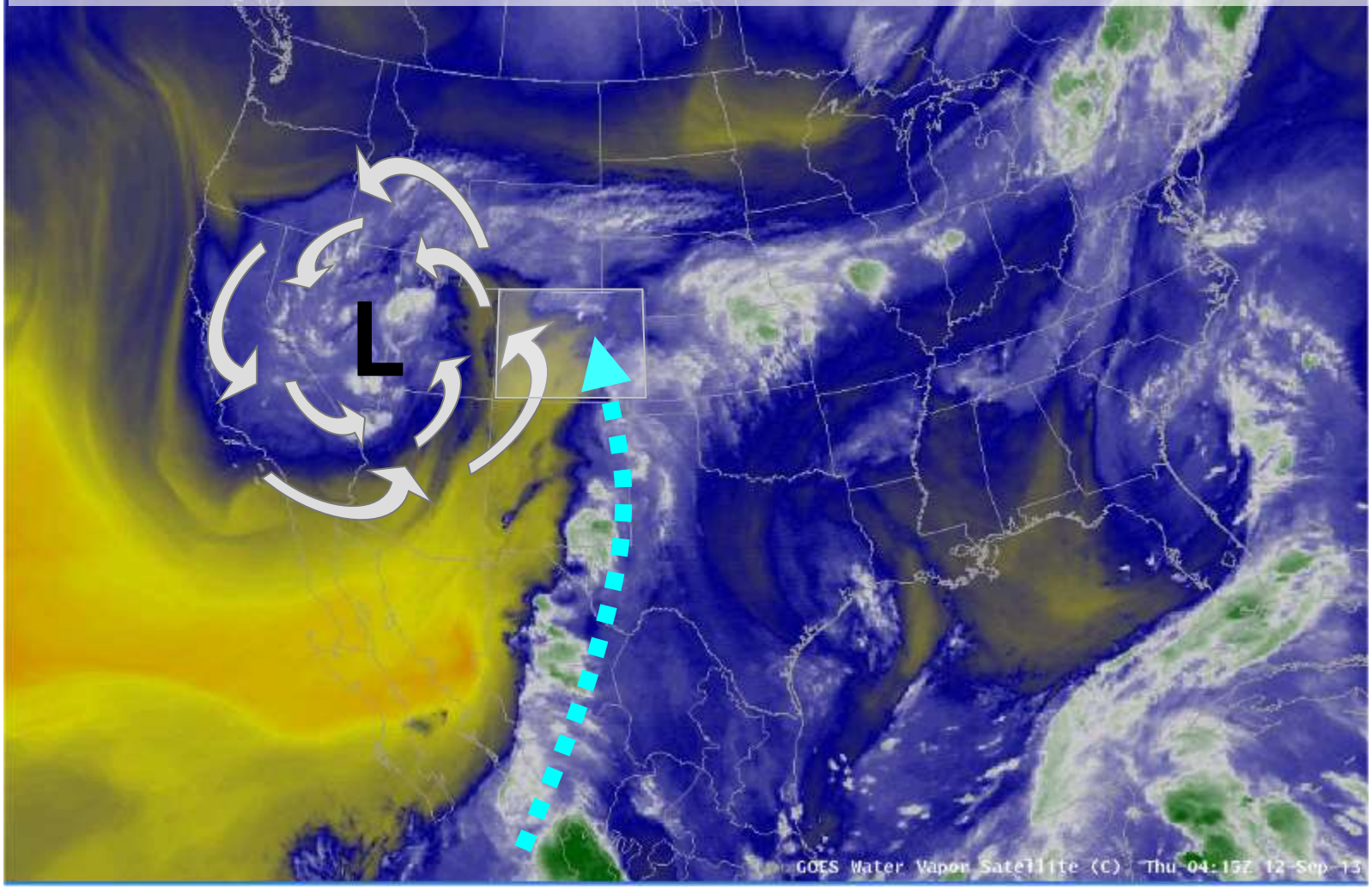


Upper-air (500mb) pattern – September 11, 2013

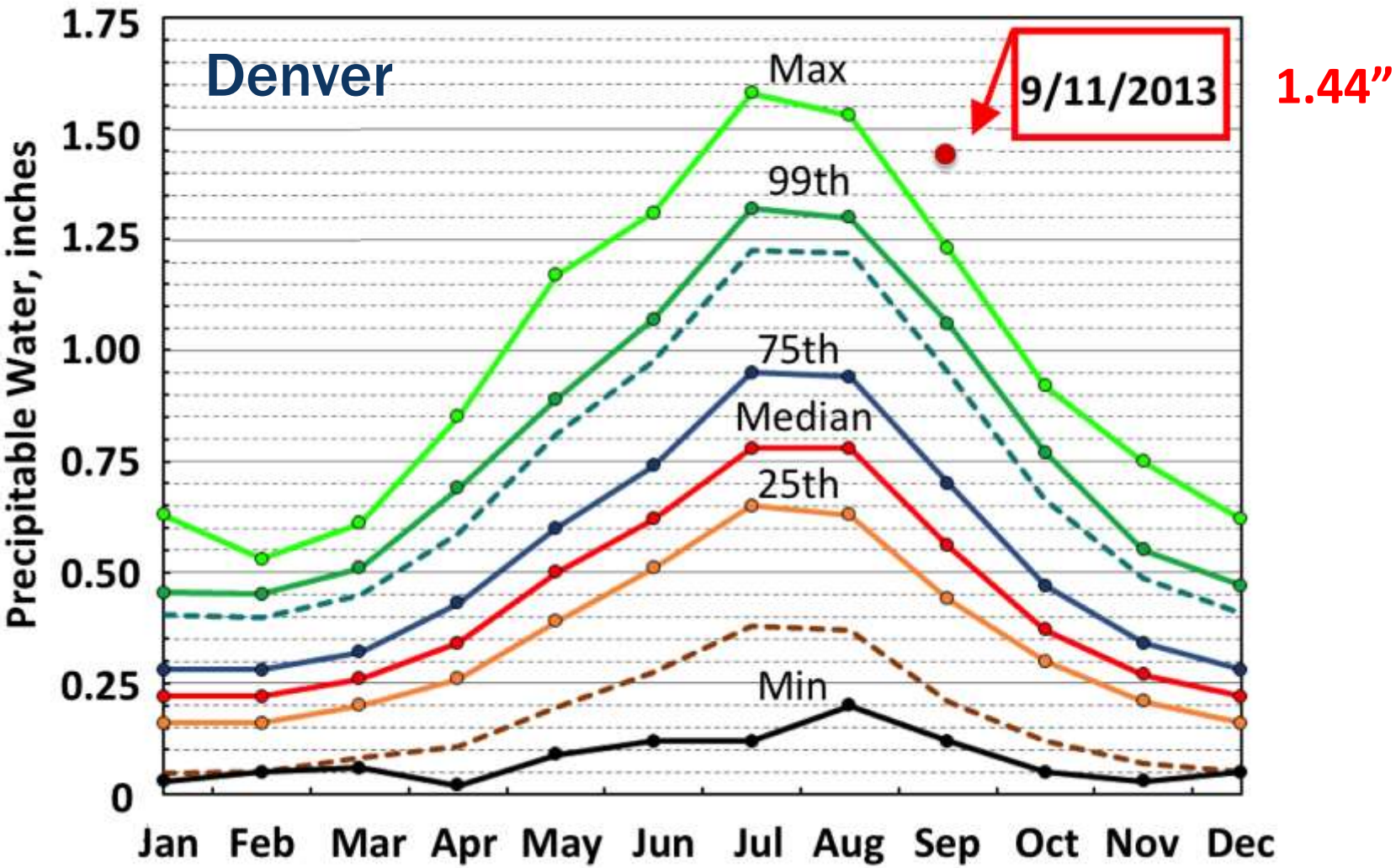


Water vapor and atmospheric circulation at 11:15 pm MDT, September 11, 2013.

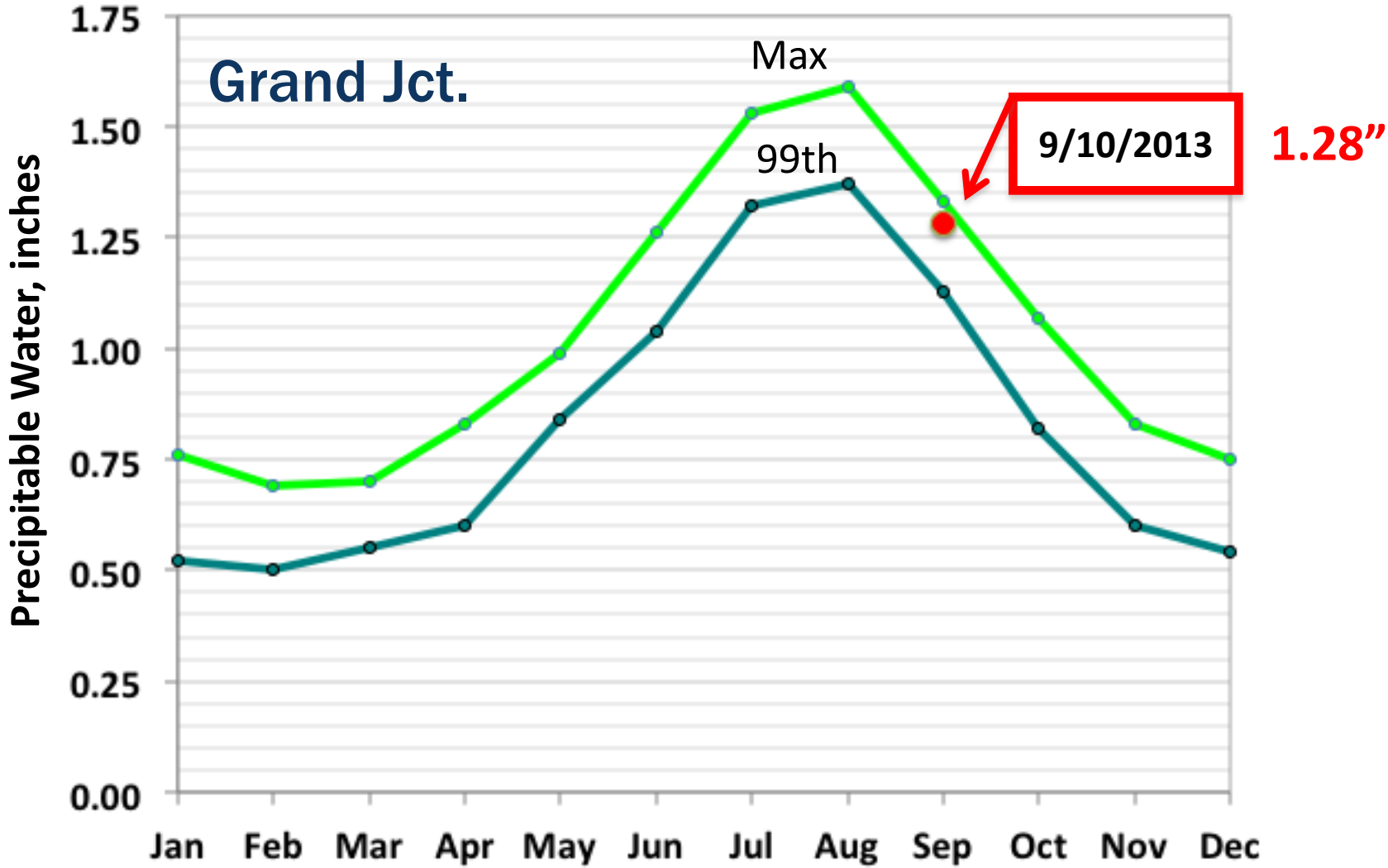
(Satellite image: CIMSS, University of Wisconsin)



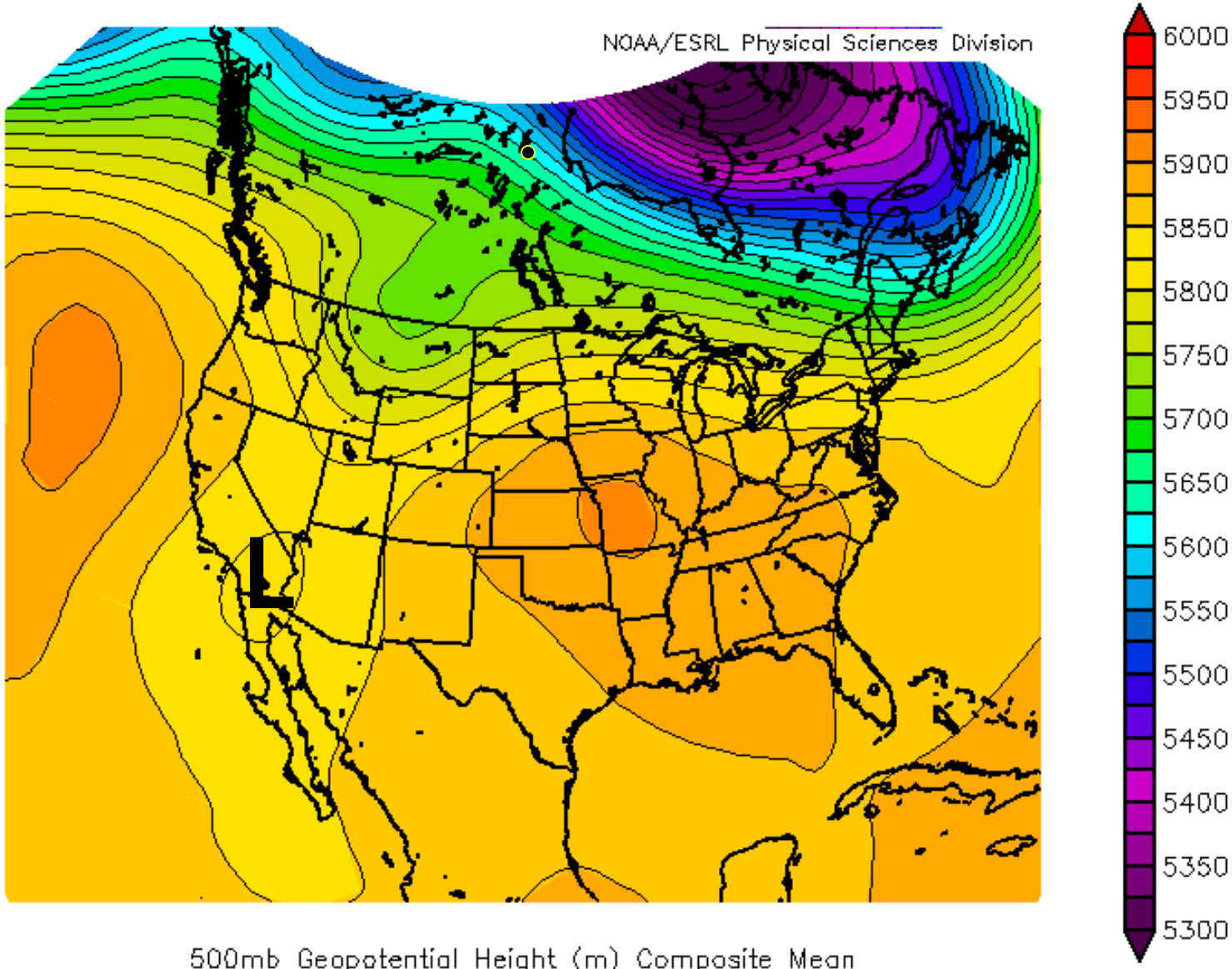
Total atmospheric precipitable water (PW) over Denver on Sept. 11, 2013, compared to all values from 1948-2012



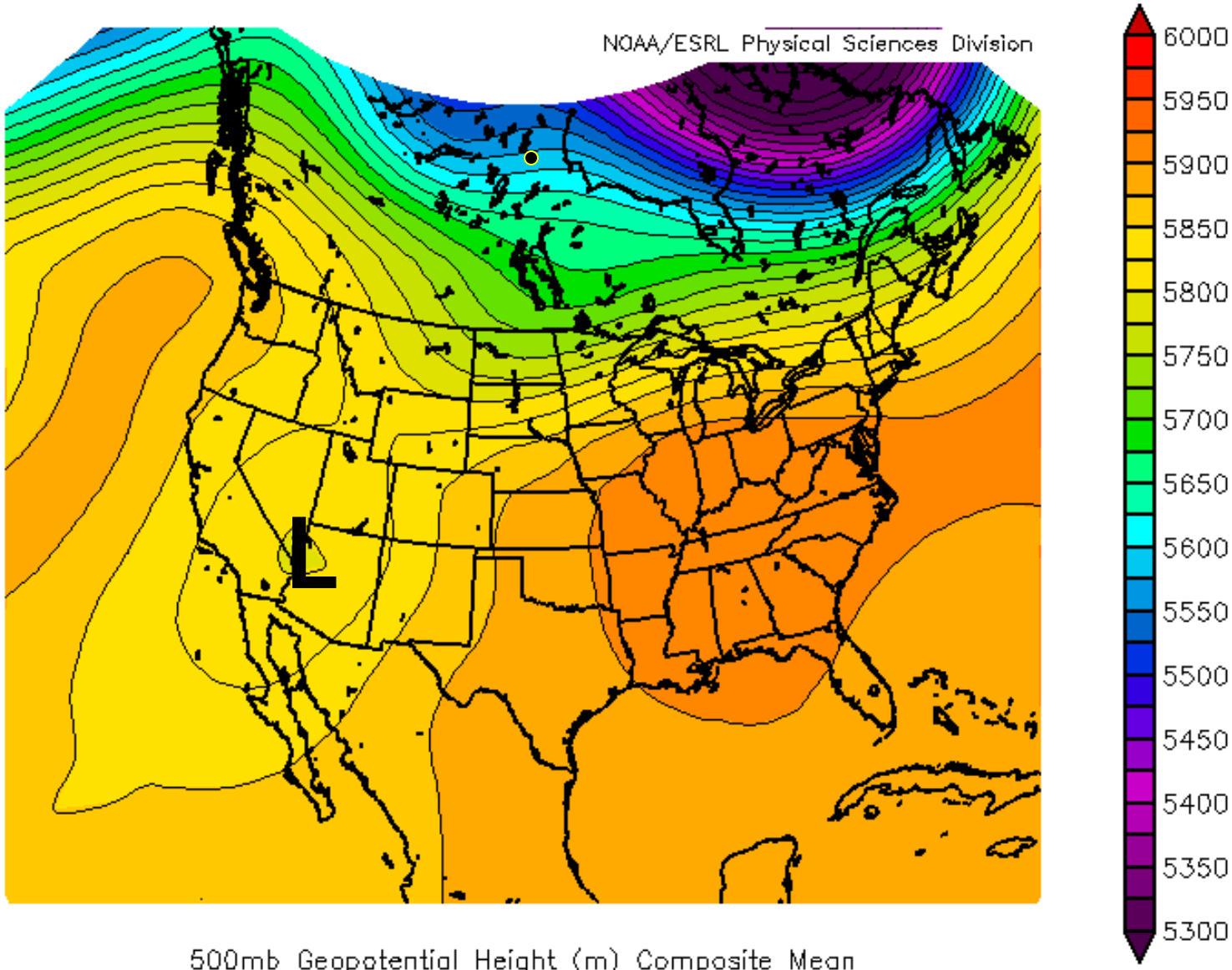
Total atmospheric precipitable water (PW) over Grand Jct. on Sept. 10, 2013, compared to all values from 1948-2012



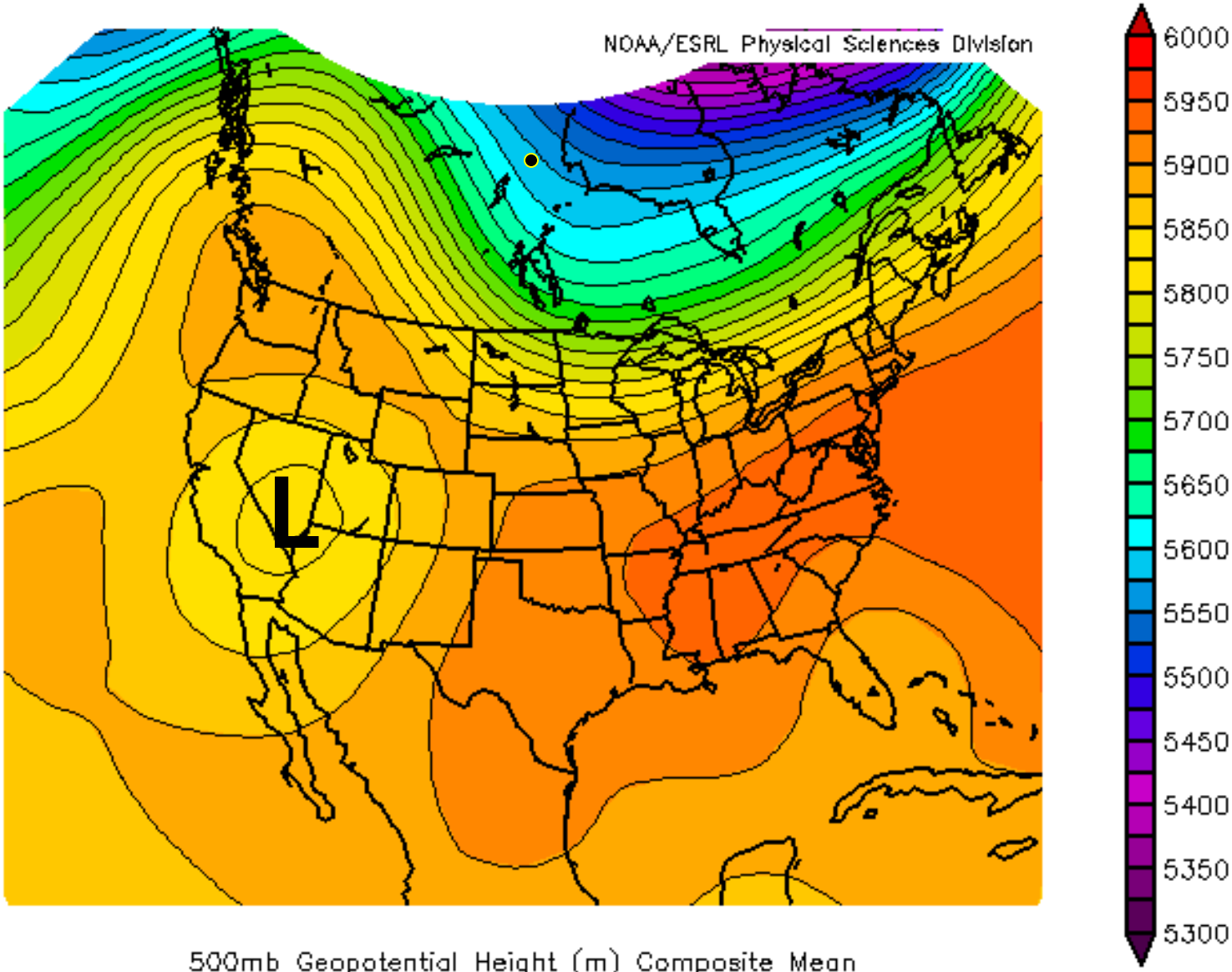
Upper-air (500mb) pattern – September 9, 2013



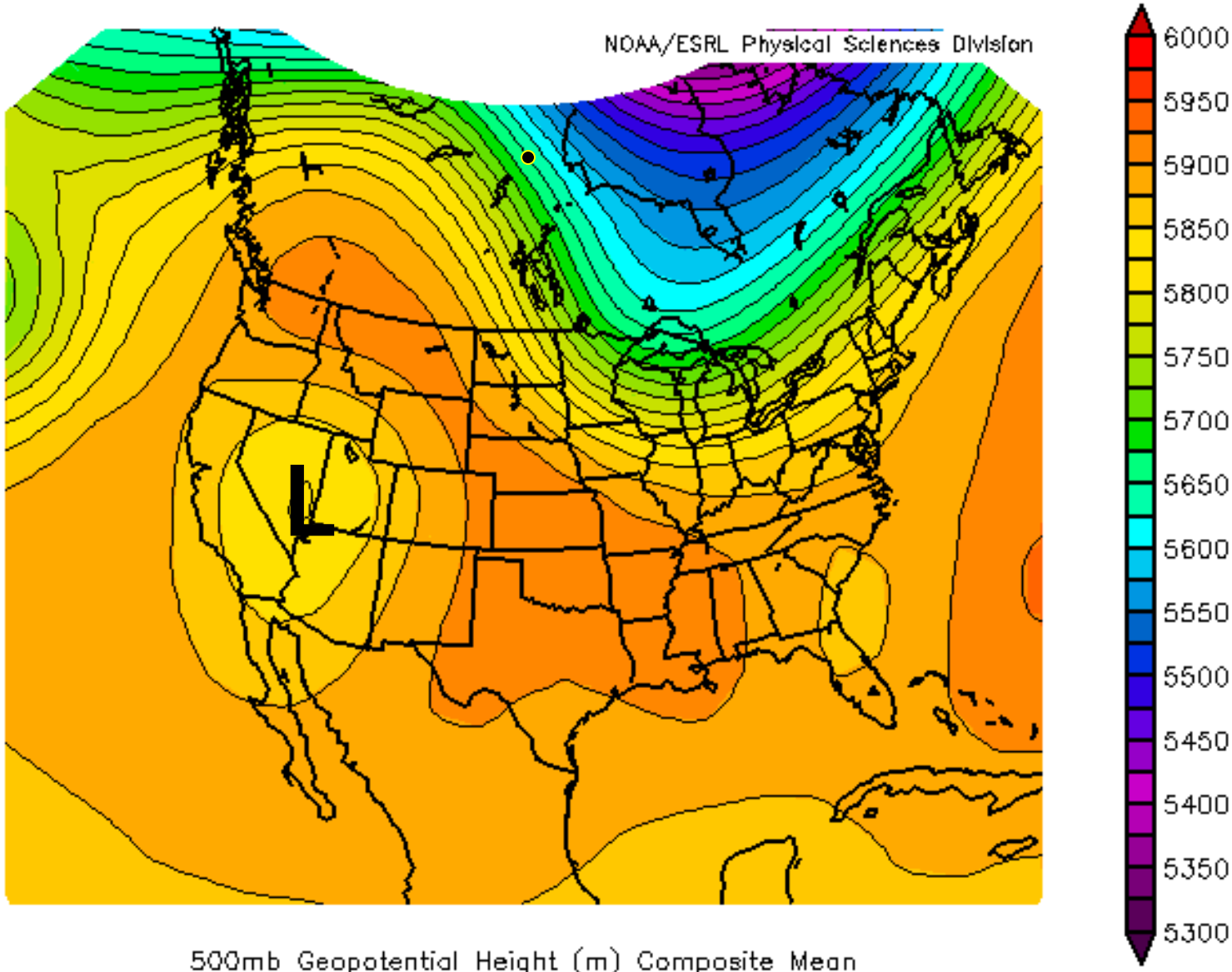
Upper-air (500mb) pattern – September 10, 2013



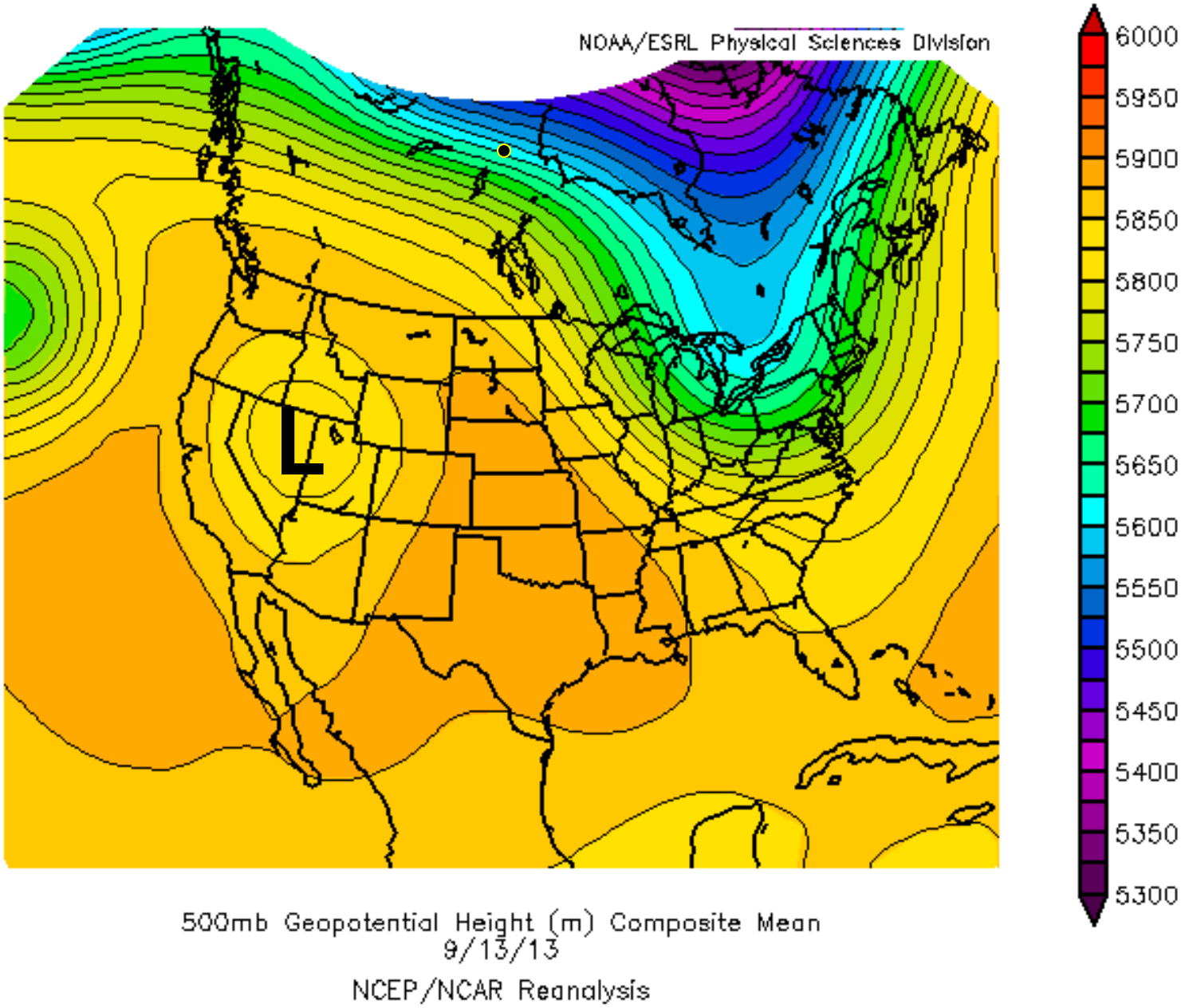
Upper-air (500mb) pattern – September 11, 2013



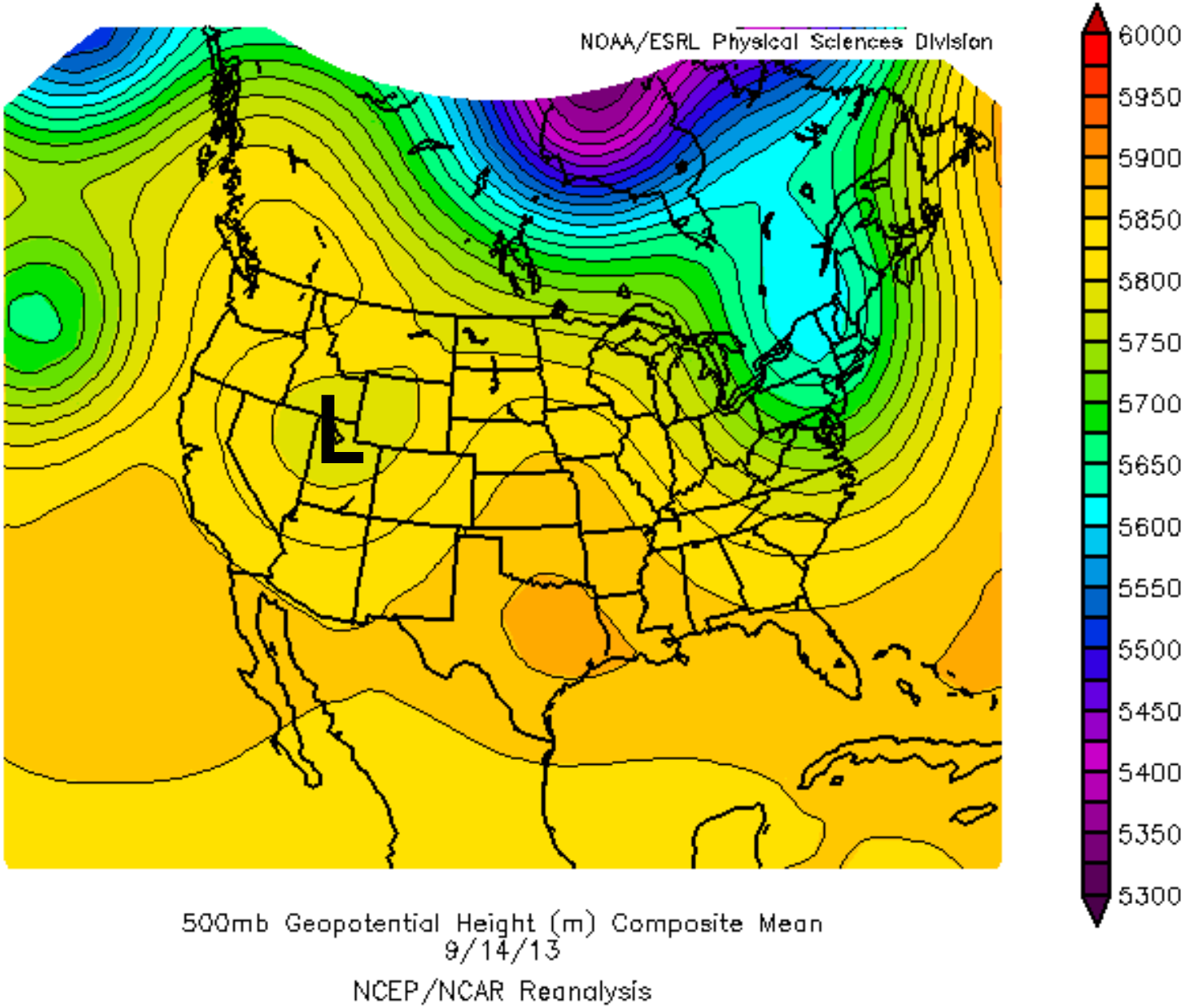
Upper-air (500mb) pattern – September 12, 2013



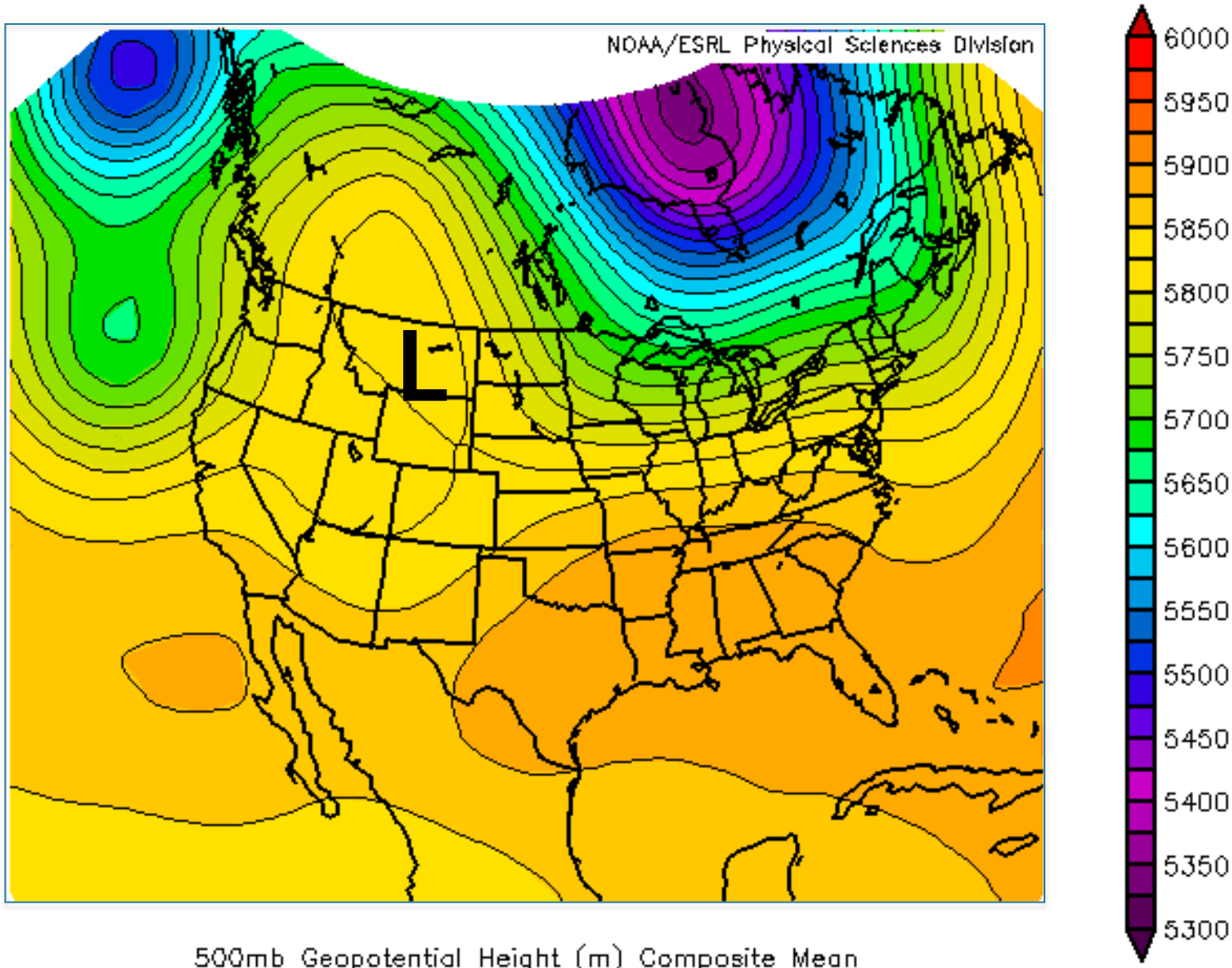
Upper-air (500mb) pattern – September 13, 2013



Upper-air (500mb) pattern – September 14, 2013

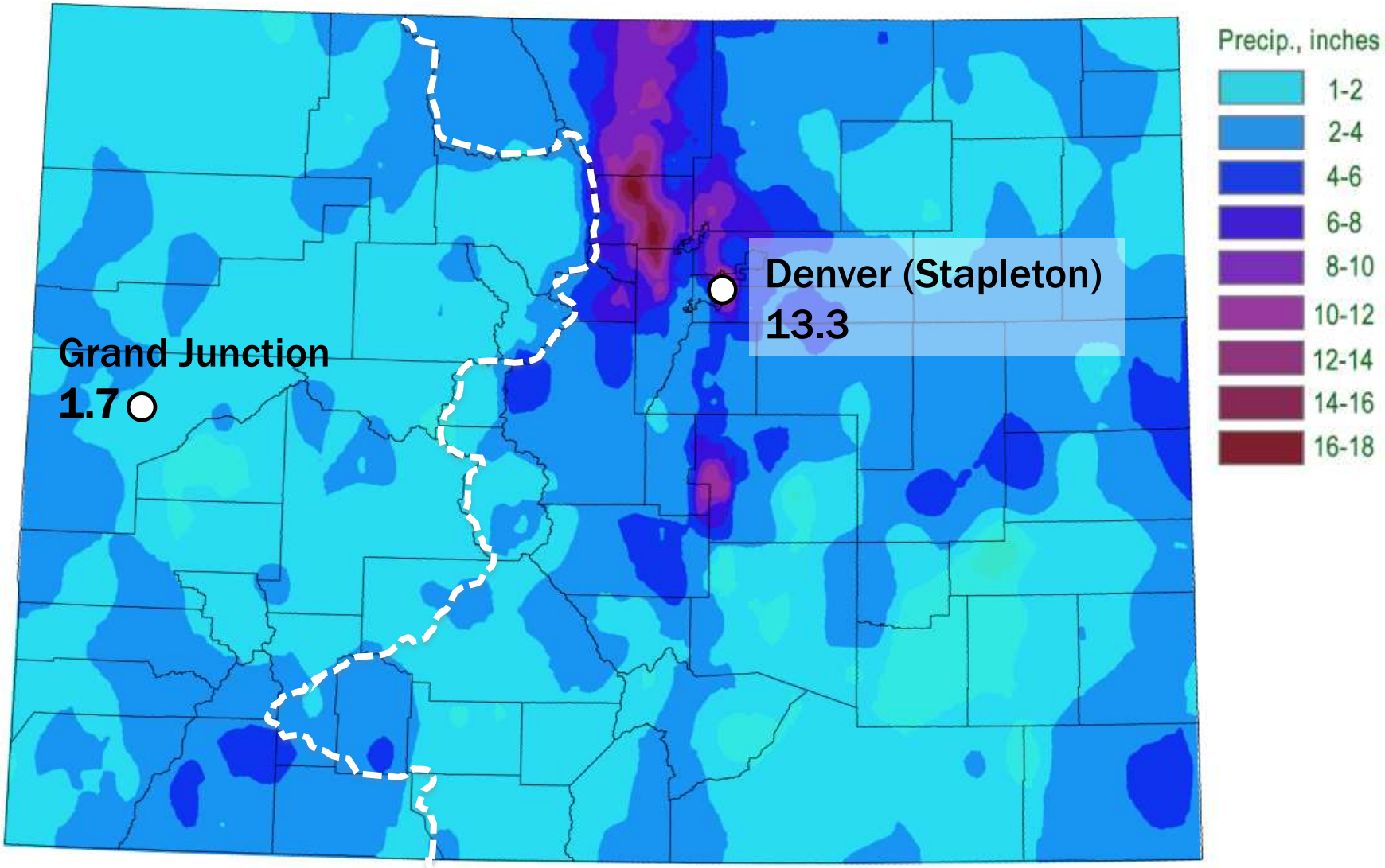


Upper-air (500mb) pattern – September 15, 2013



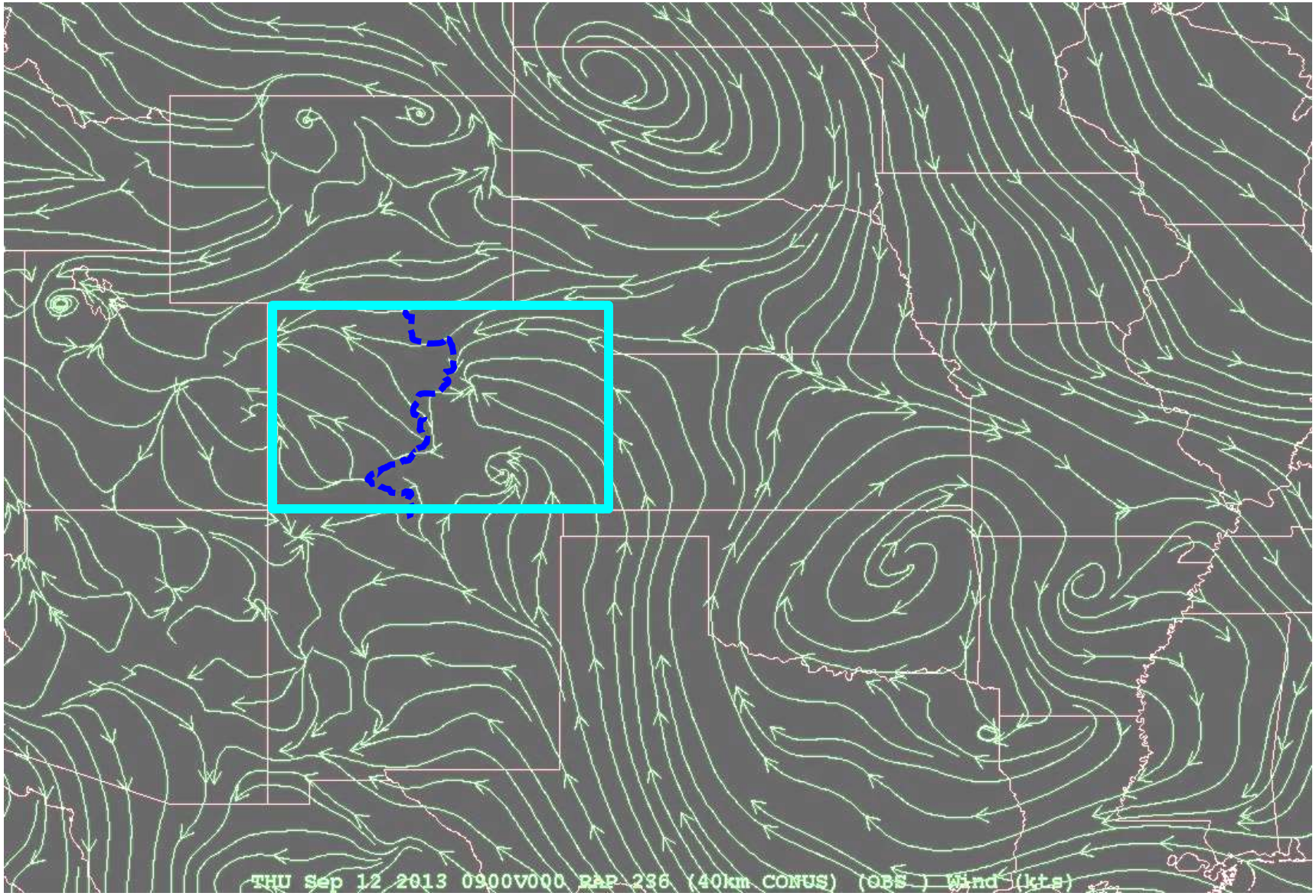
500mb Geopotential Height (m) Composite Mean
9/15/13
NCEP/NCAR Reanalysis

CoCoRAHS total precipitation from September 9–15, 2013



(Map: Colorado Climate Center, CSU)

Near-surface (850mb) winds, September 12, 2013



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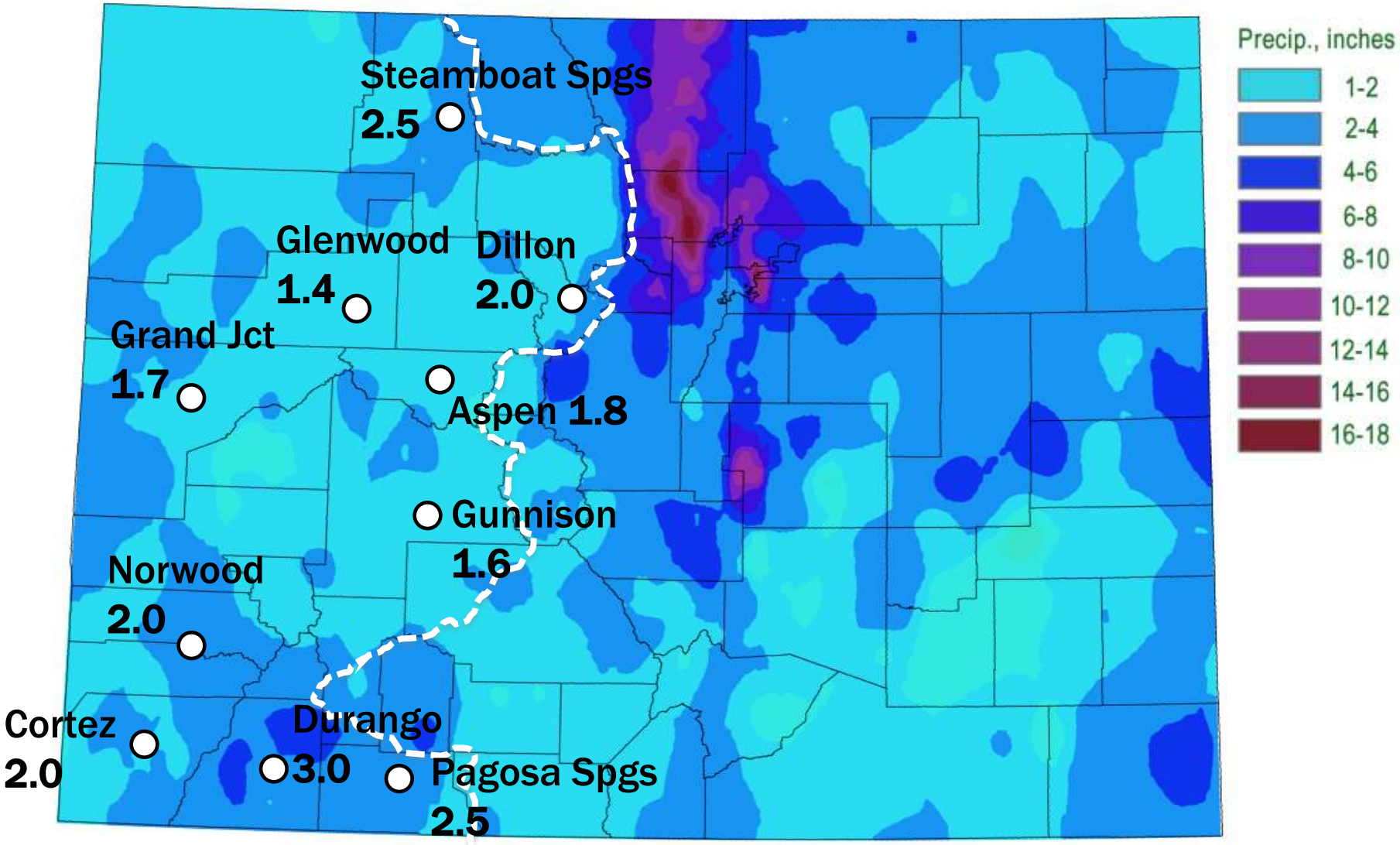

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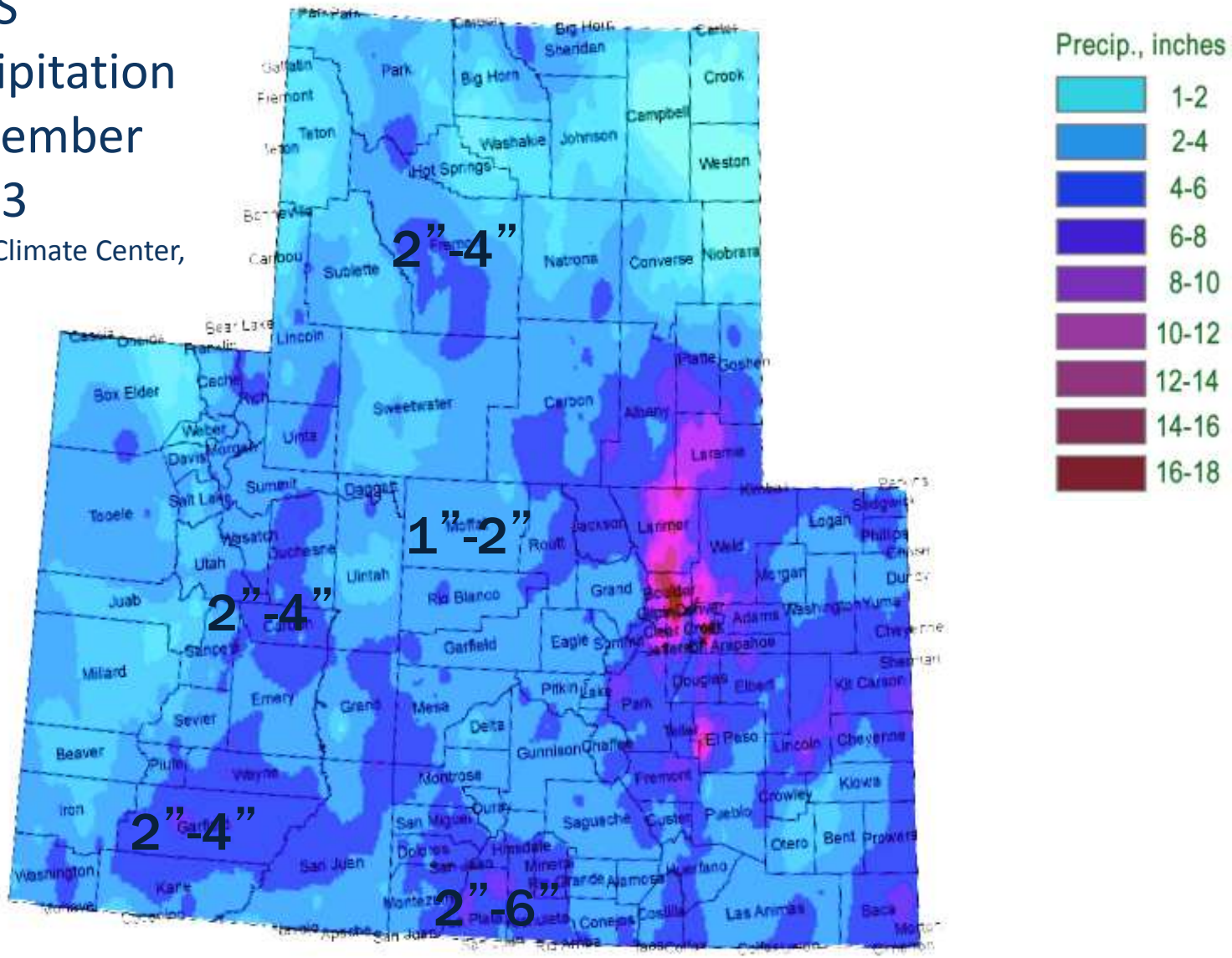
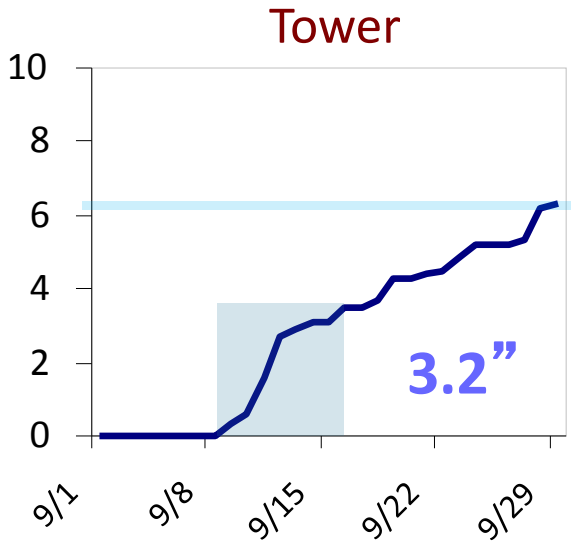
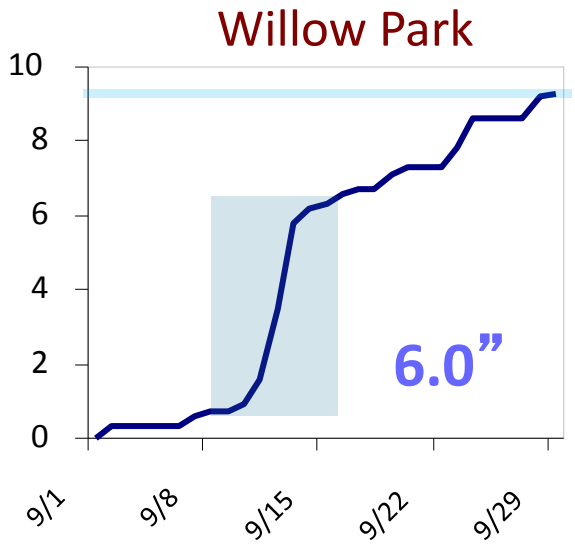
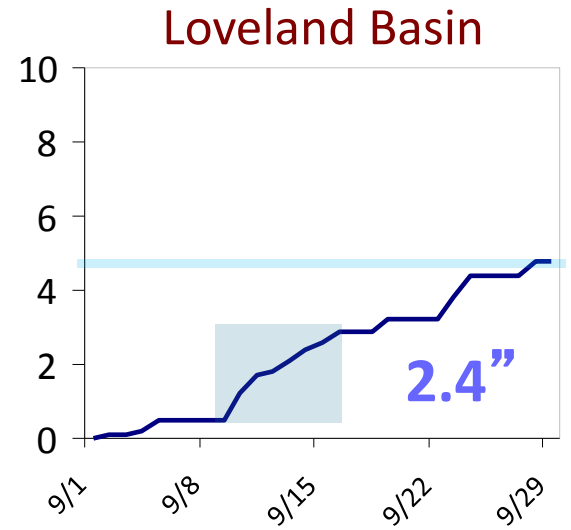
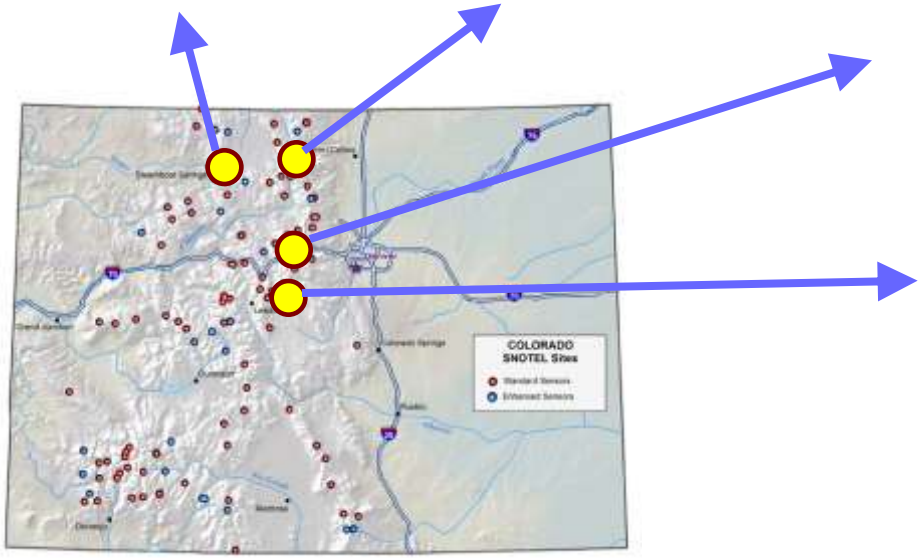


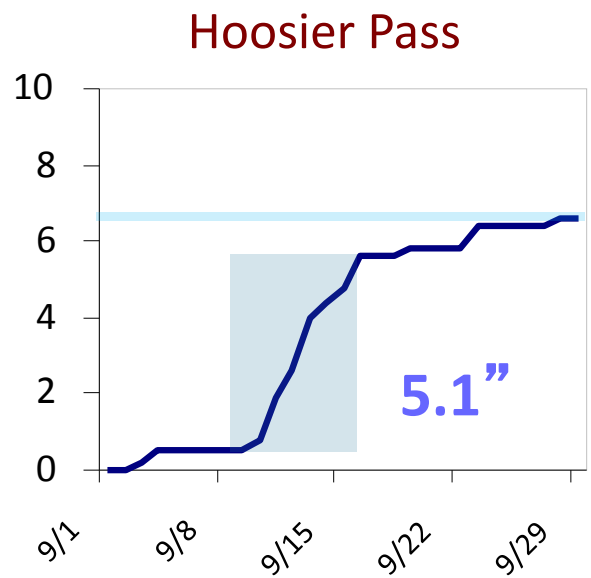
SNOTEL precipitation (in.), September 2013 with Sept. 9-16 shaded











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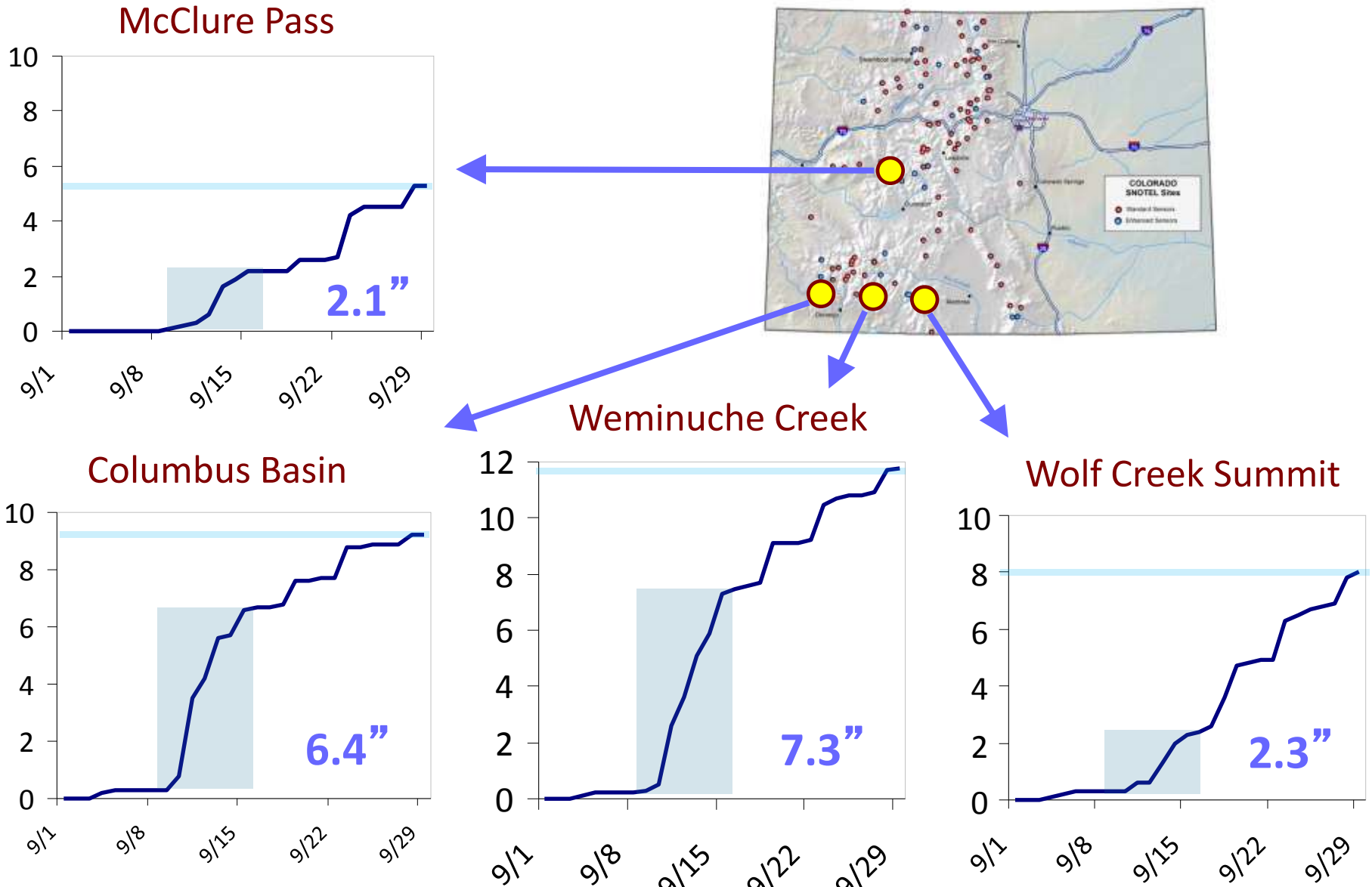
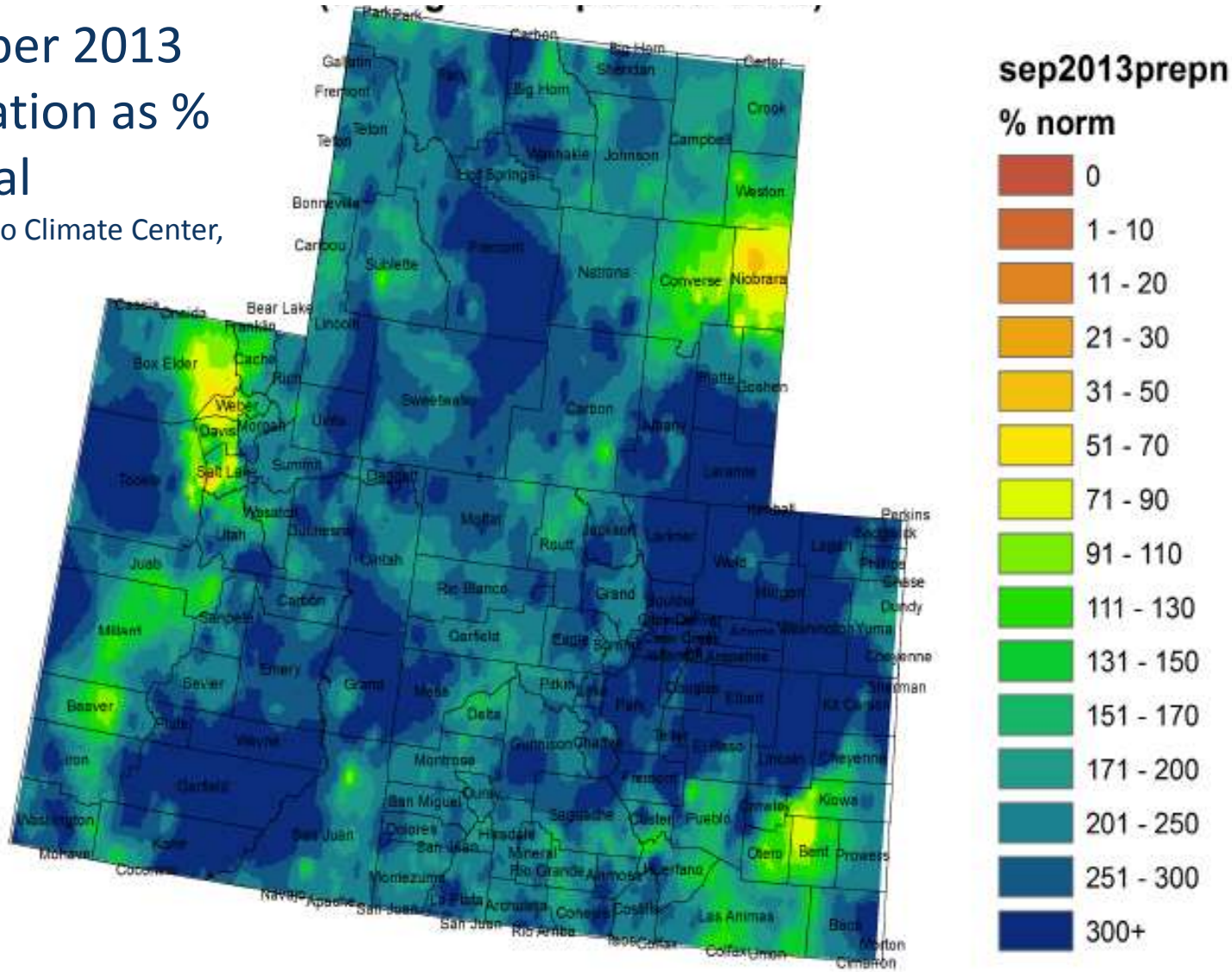
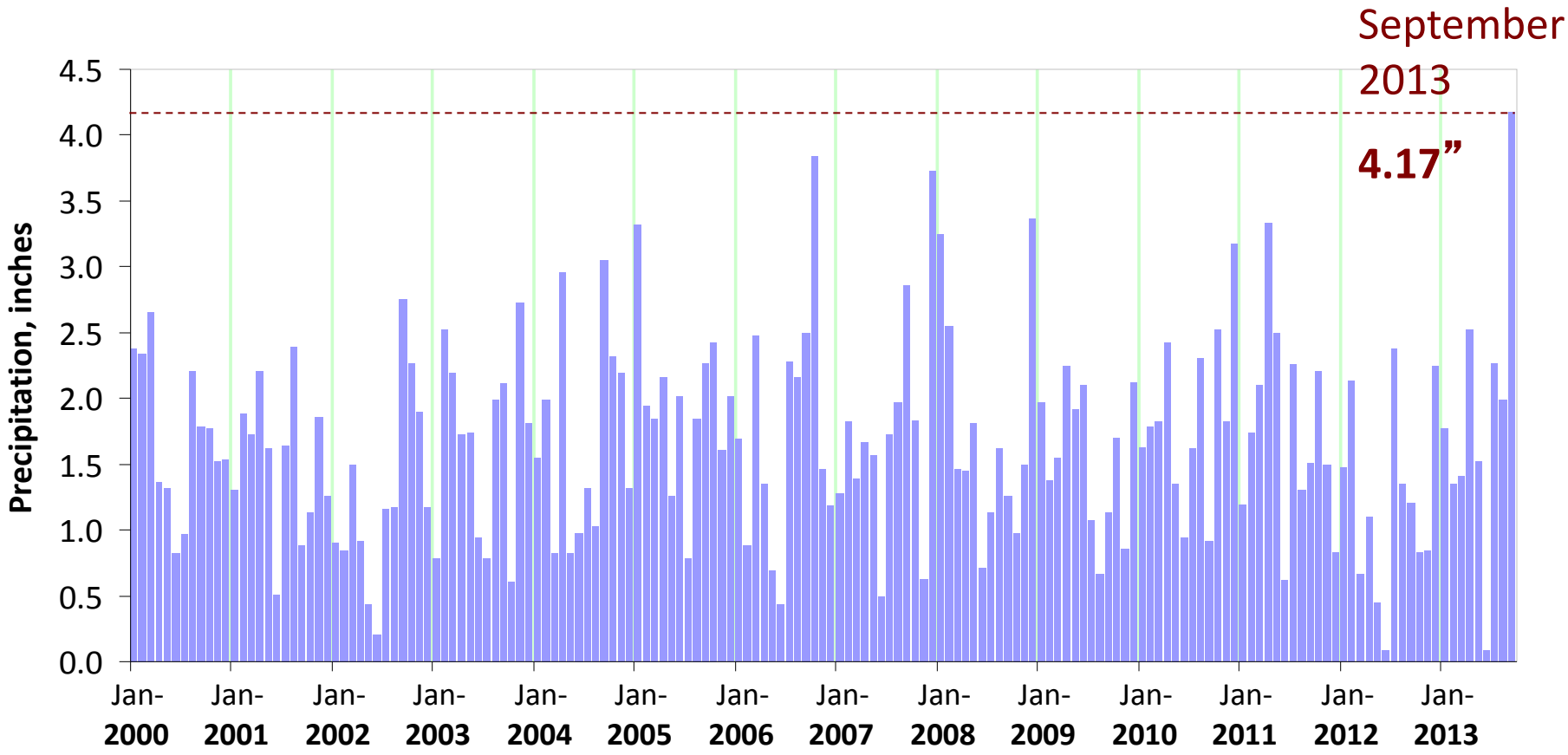


CoCoRAHS September 2013 precipitation as % of normal

(Map: Colorado Climate Center, CSU)



PRISM monthly Western CO (Div. 2) precipitation, 2000–2013

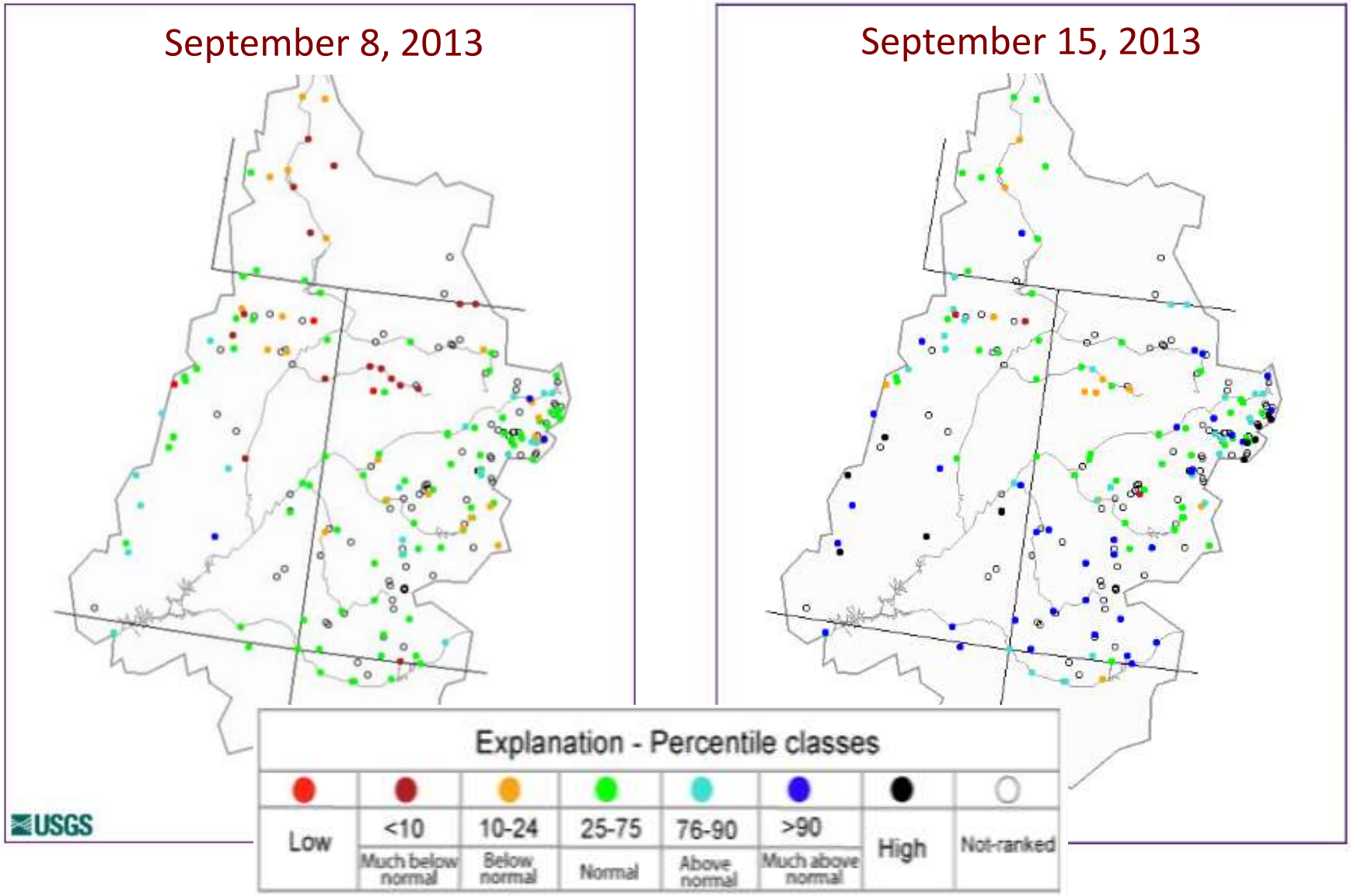


September 2013: wettest month since April 1999

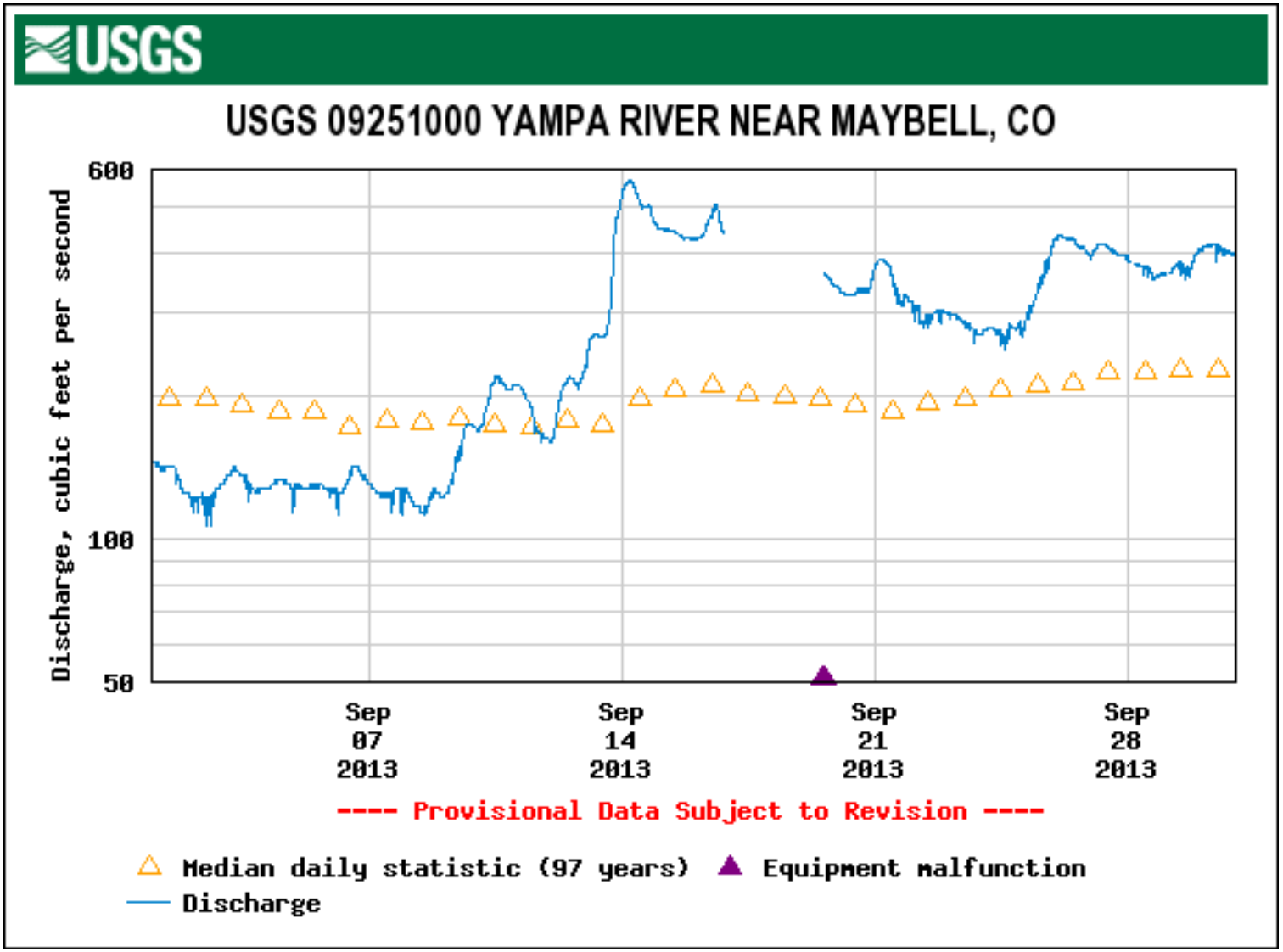
3rd wettest September on record

13th wettest month on record

Upper Colorado Basin streamflow percentiles



Upper Colorado Basin hydrographs for September 2013



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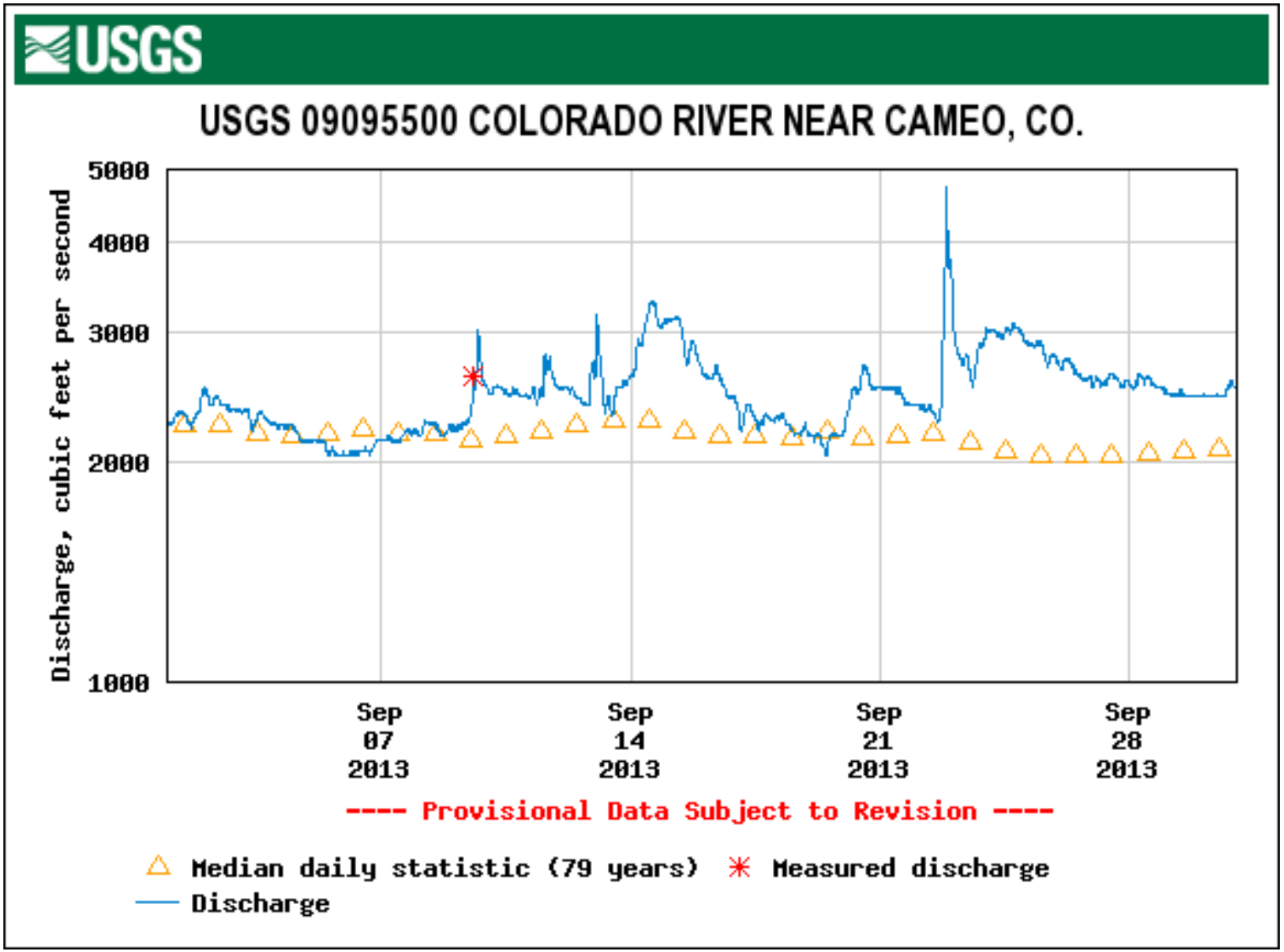

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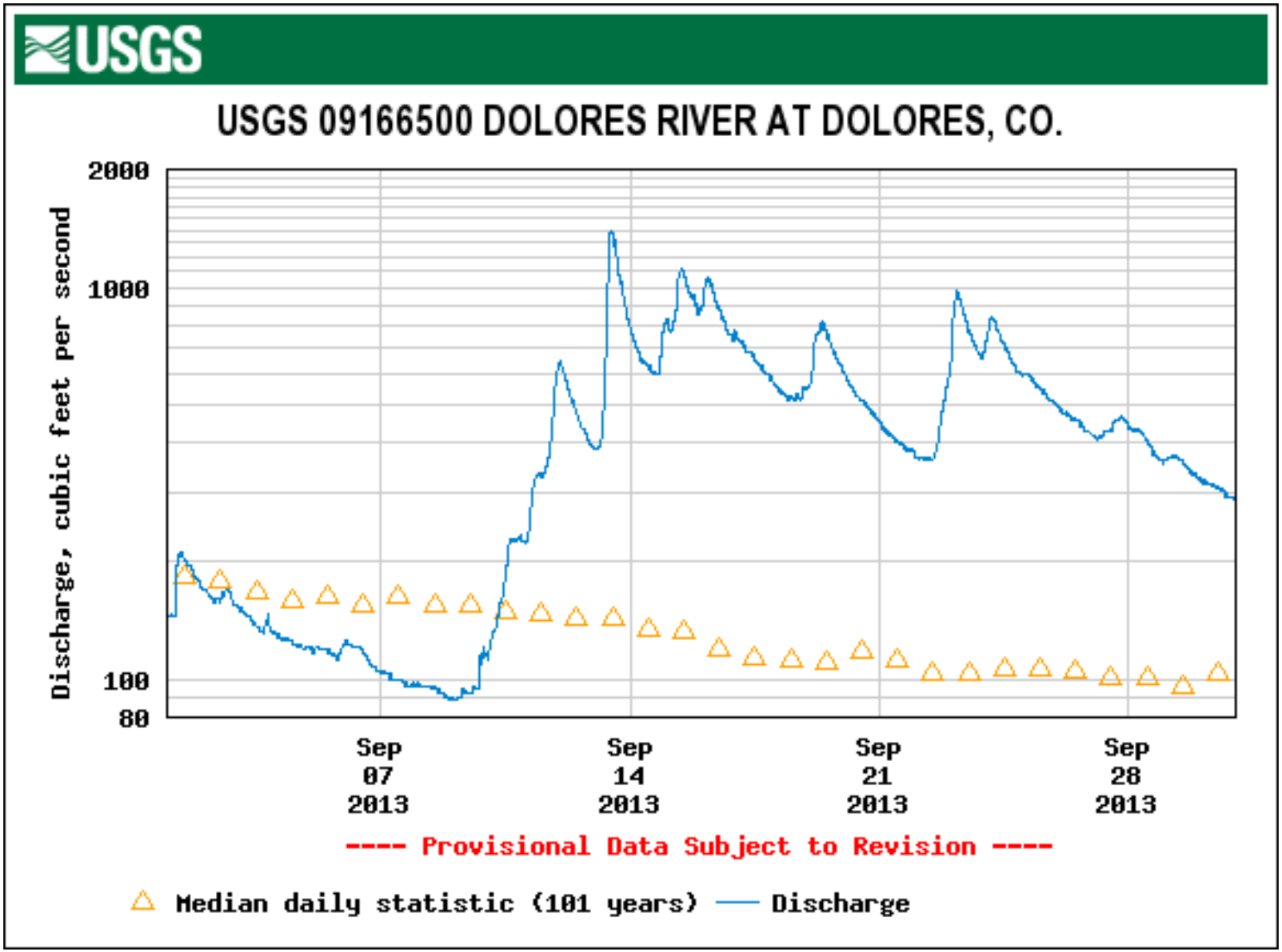

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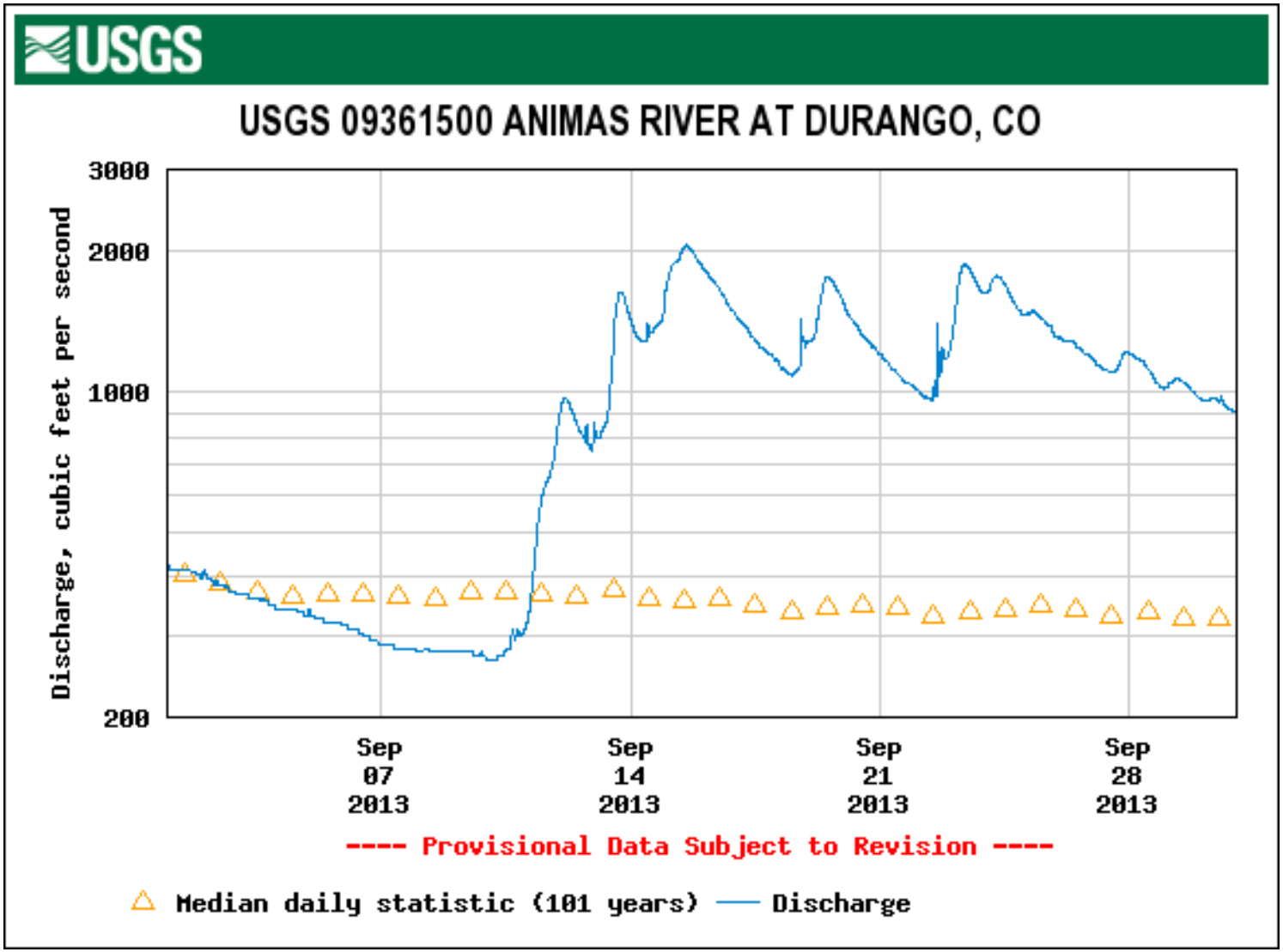

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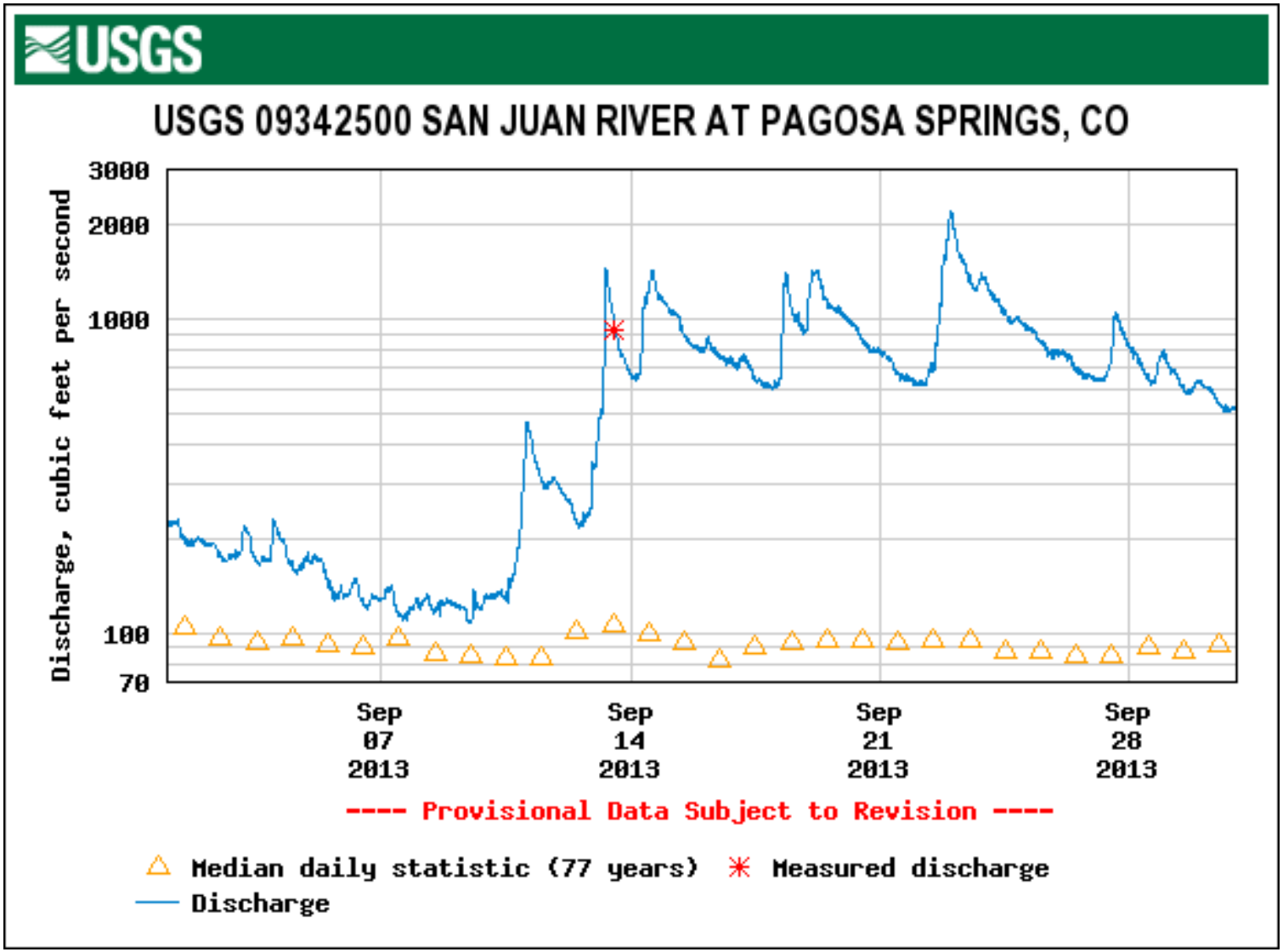
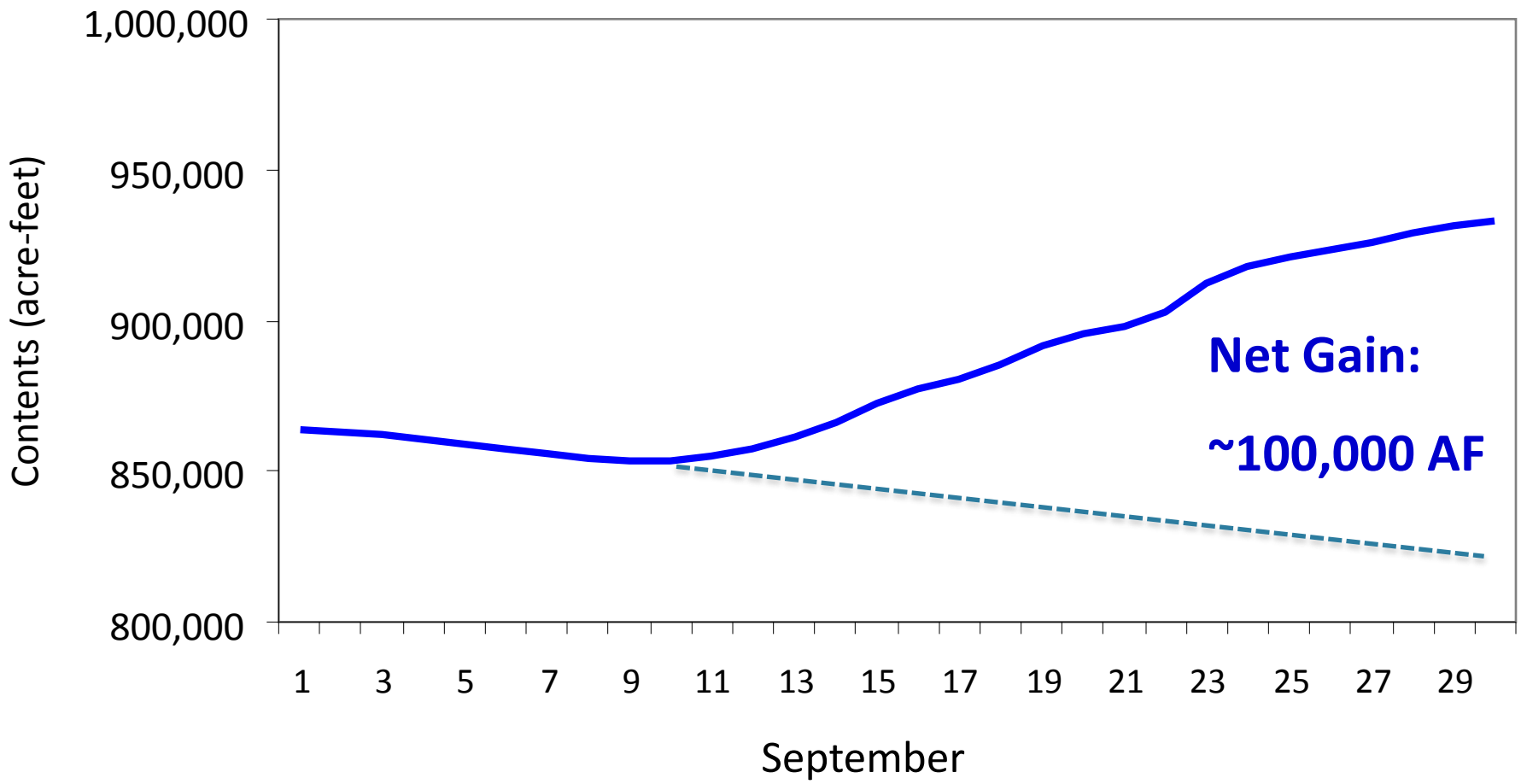
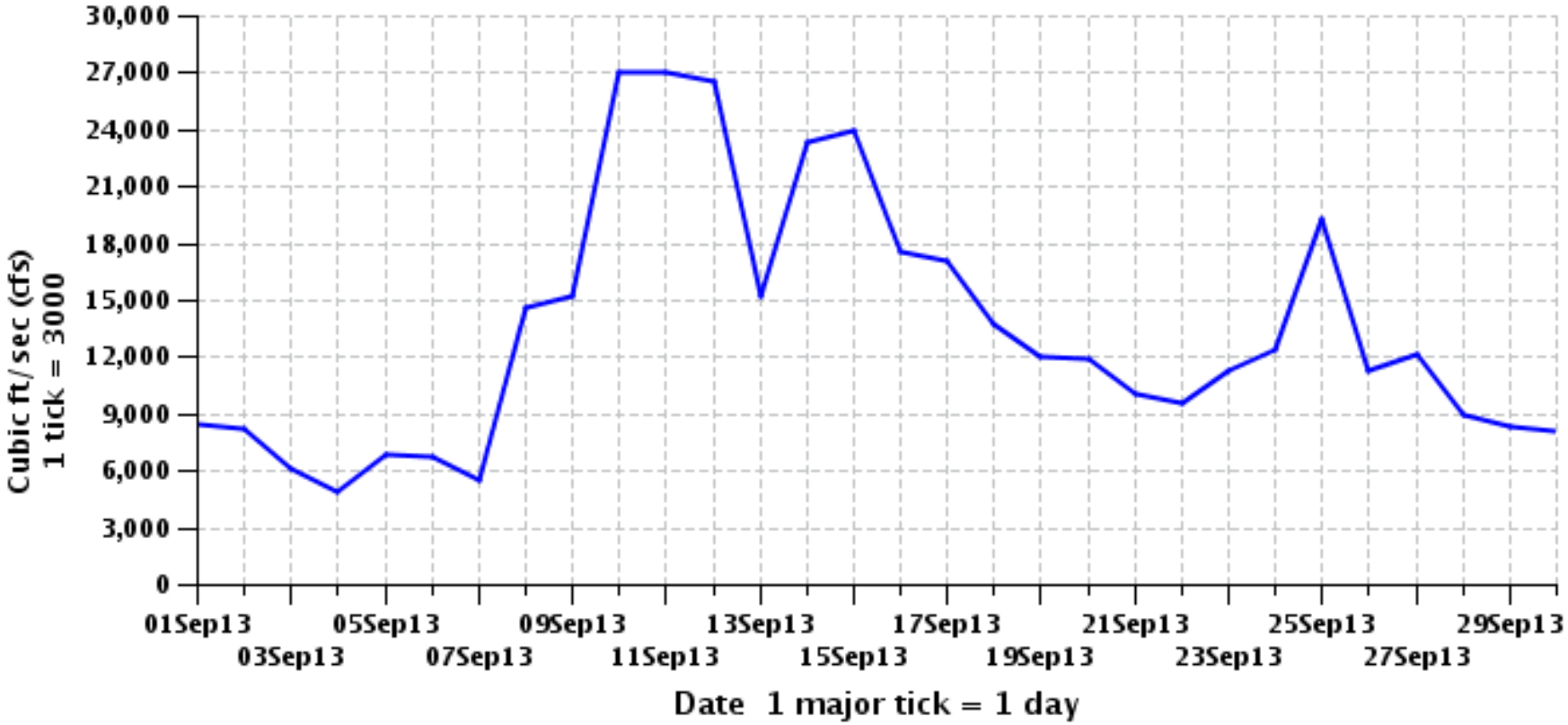


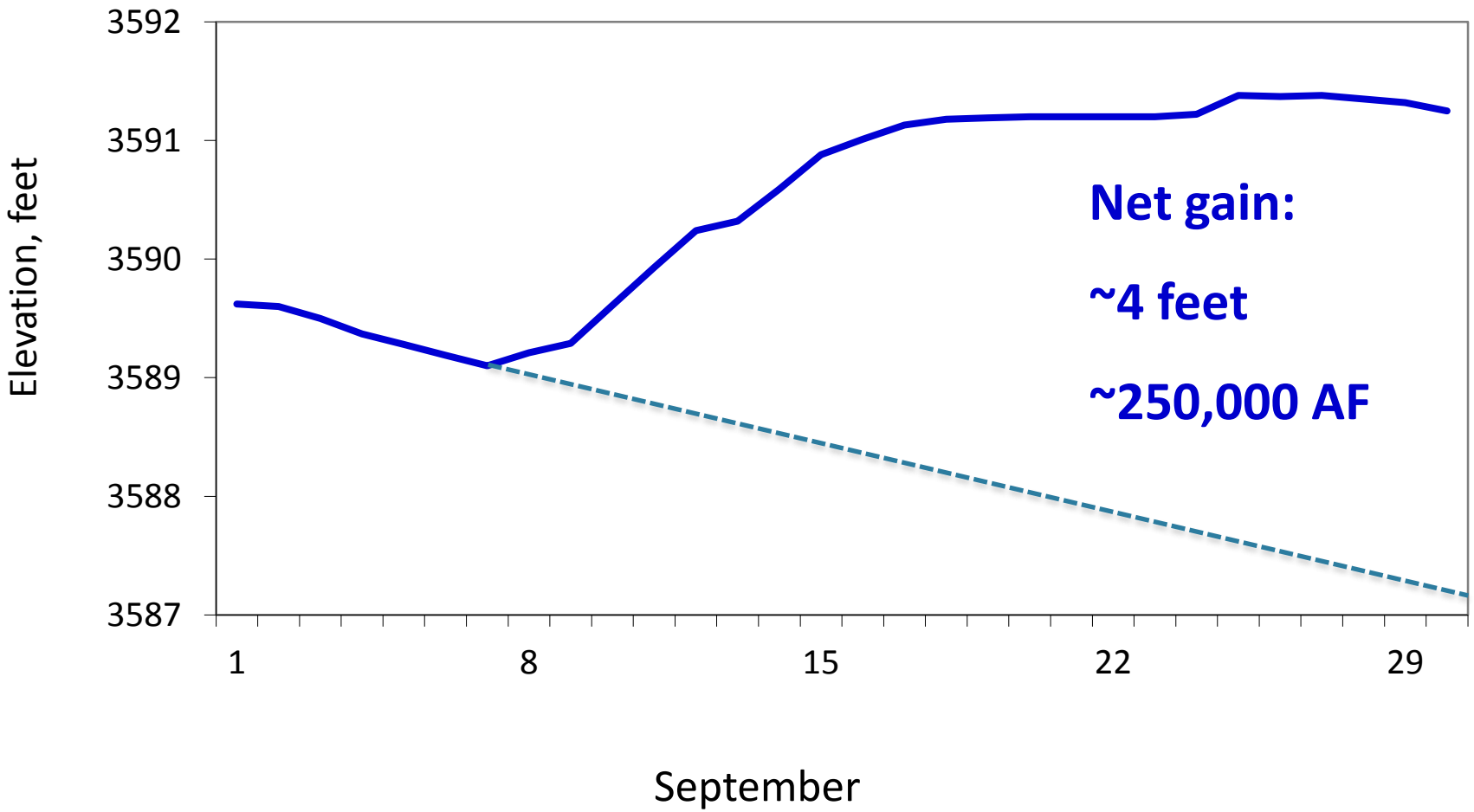
Navajo Reservoir contents - September 1st-30th, 2013



Lake Powell Daily Inflows - September 2013



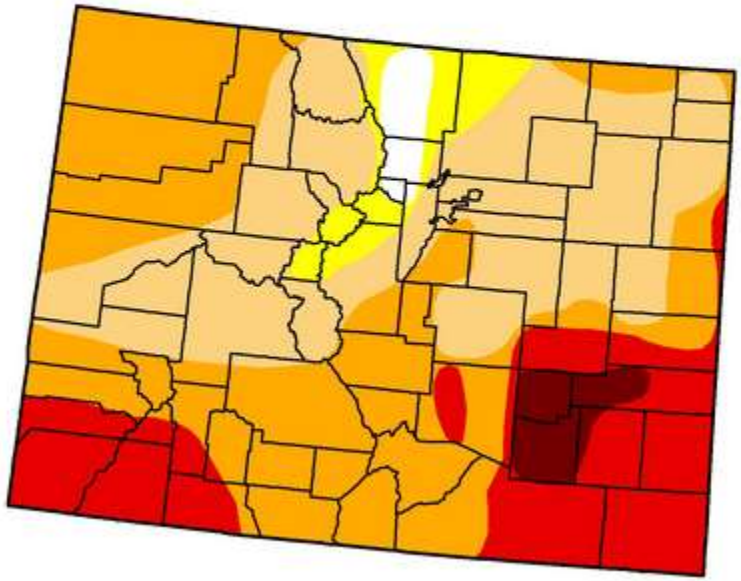
Lake Powell change in reservoir level - September 1st-30th



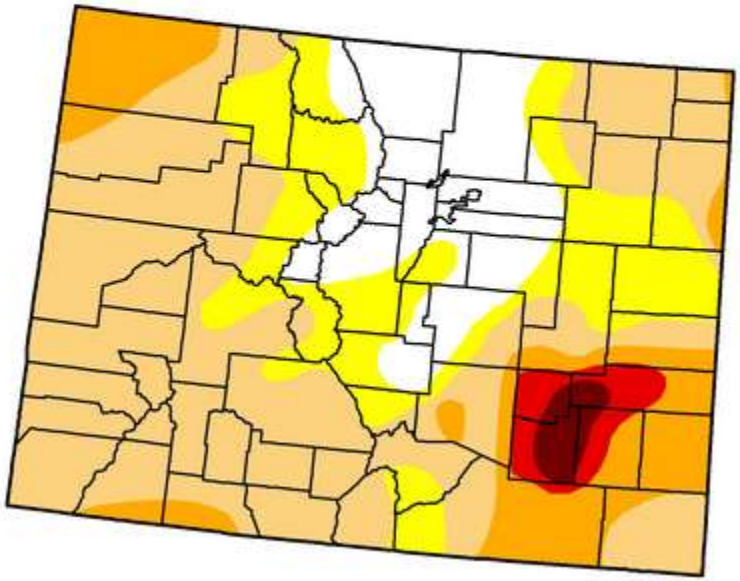
Colorado

Drought Severity

- D0 - Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

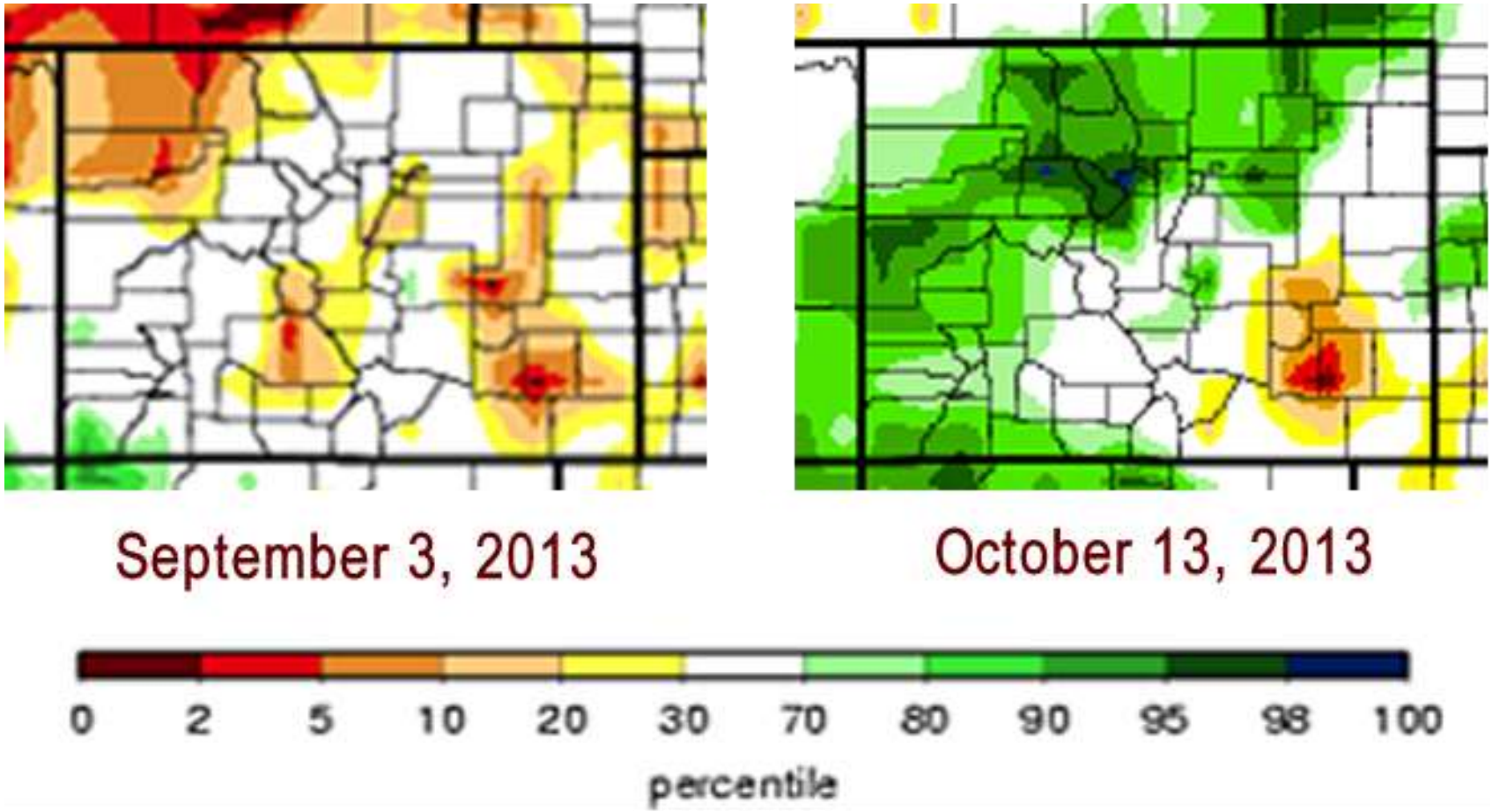


September 3, 2013



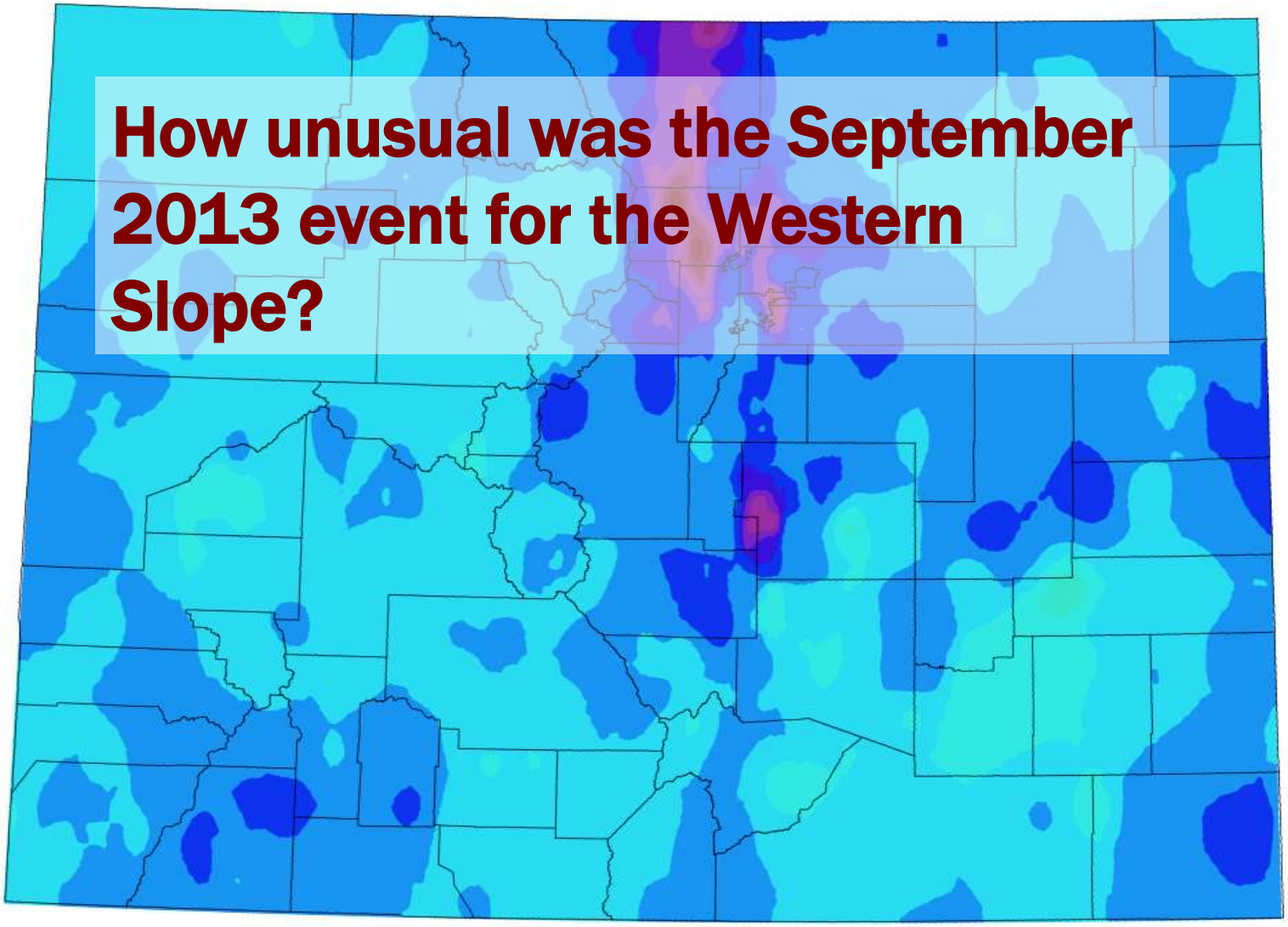
September 17, 2013

US Drought Monitor for Colorado – before and after the rain event



VIC simulated soil moisture percentiles – before and after

How unusual was the September 2013 event for the Western Slope?



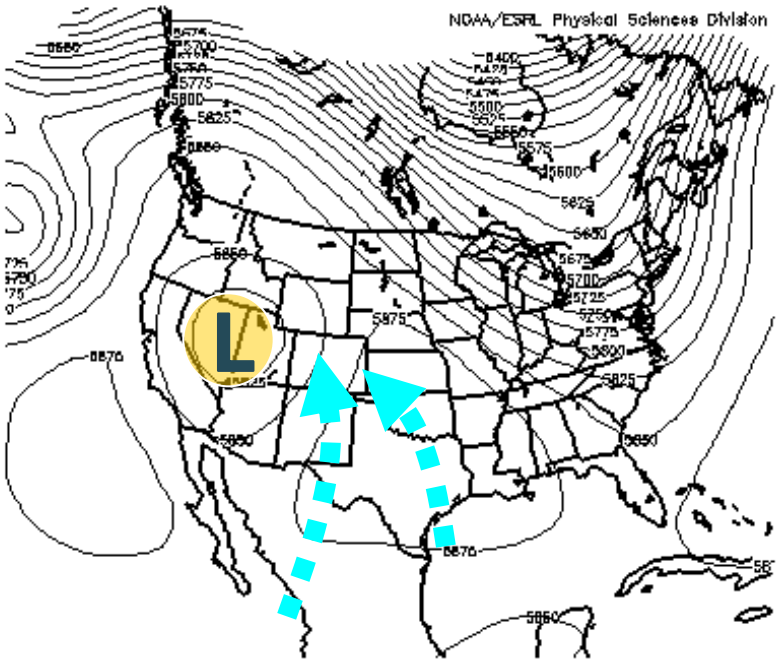
Previous September/October multiday Western Slope precipitation events

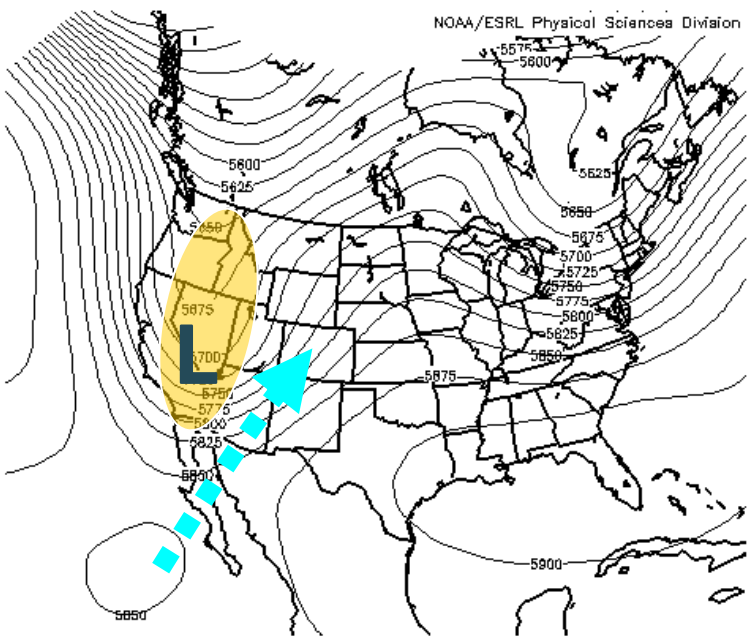
- Sept. 3-7, 1909
- **Sept. 3-4, 1927**
- Sept. 18-23, 1941
- Sept. 27-30, 1959
- Sept. 20-24, 1961
- **Sept. 4-6, 1970**
- Sept. 19-21, 1997
- Sept. 6-10, 2003

- Oct. 10-15, 1894
- **Oct. 4-6, 1911**
- Oct. 19-20, 1972
- Oct. 10-12, 1986

- Focus of these events is usually San Juans

Upper-level (500 Mb) pattern, averaged over ~3-day period of peak of rainfall in two West Slope heavy precip events

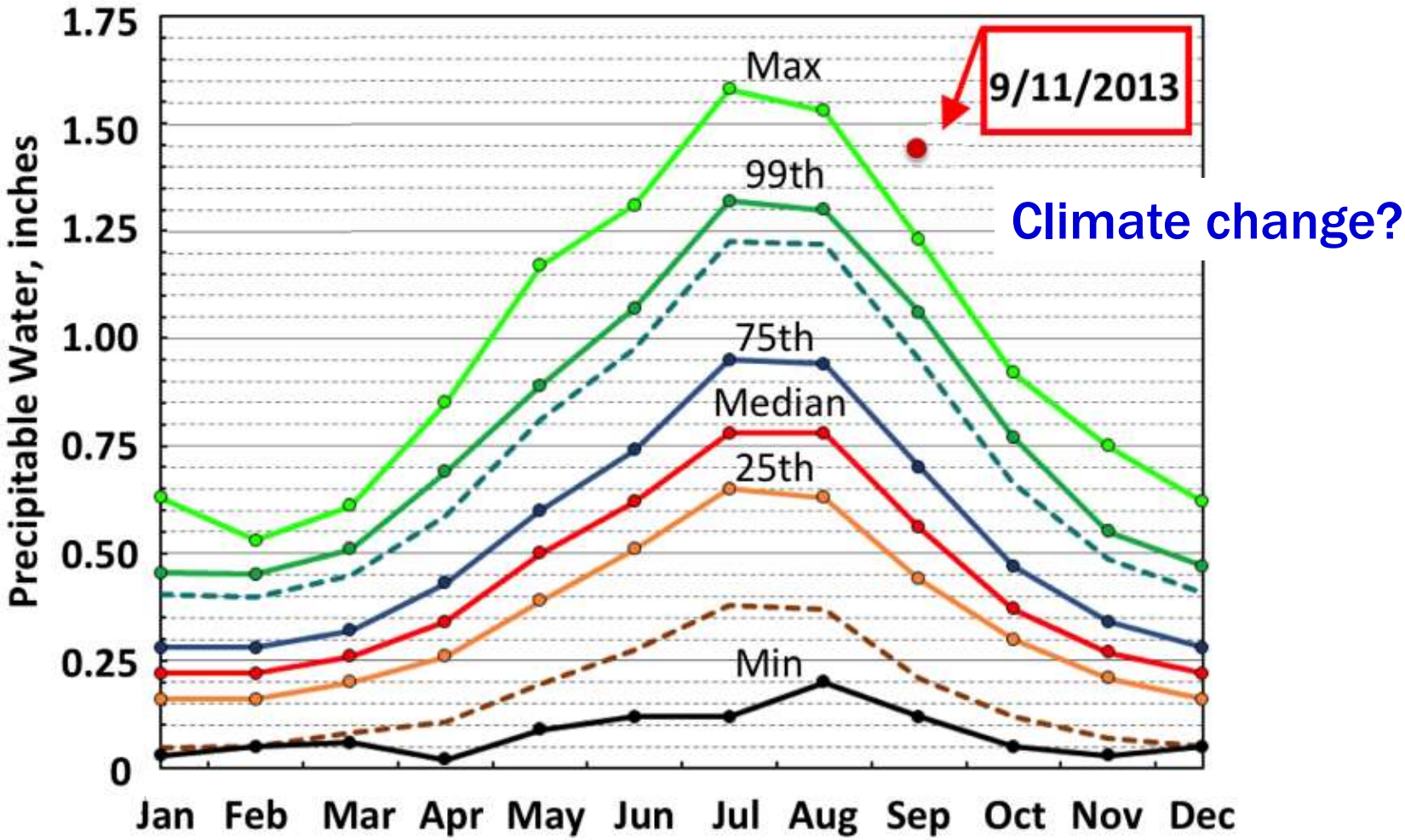




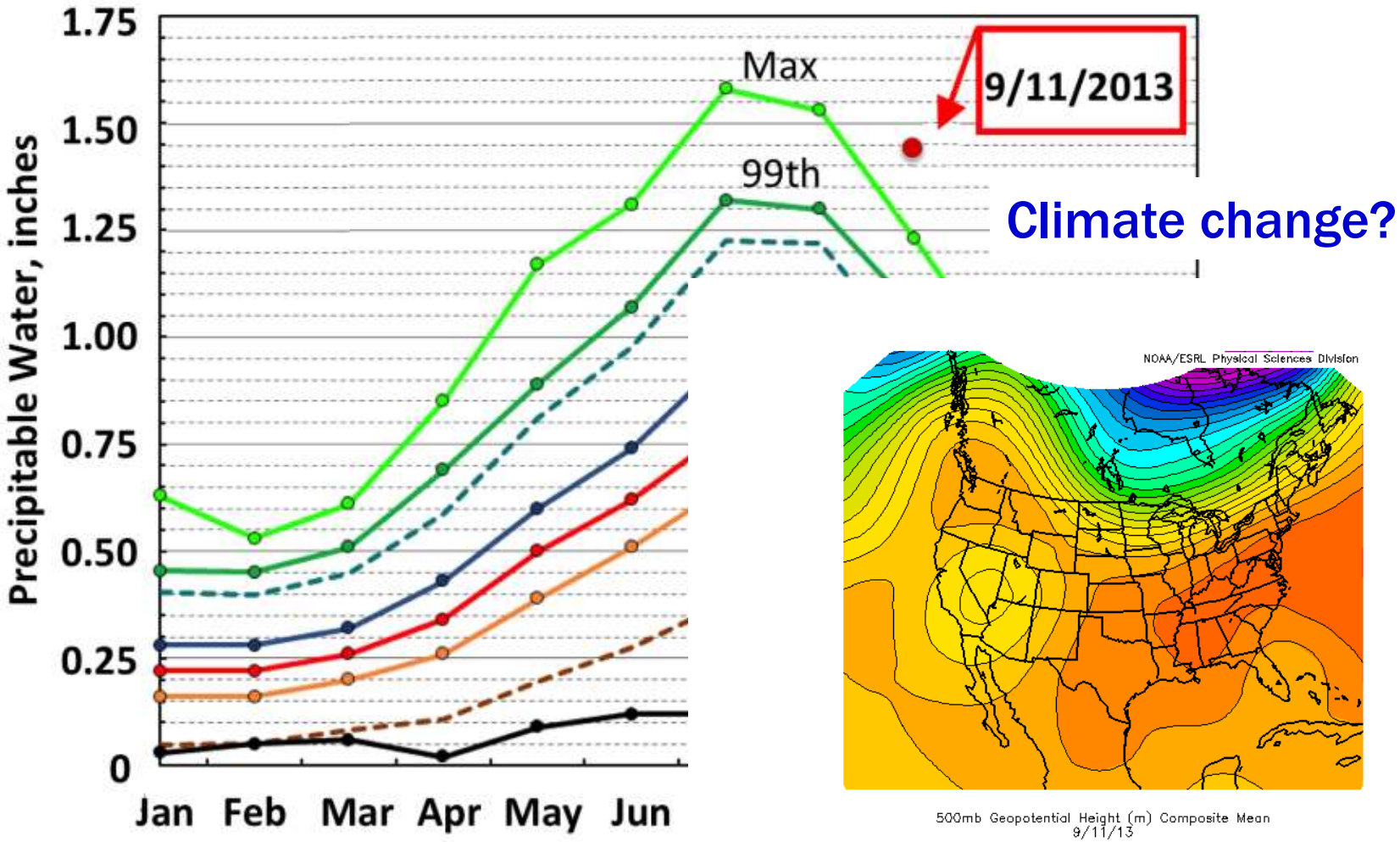
Sept. 12-14, 2013

Sep. 4-6, 1970

(Data: NCAR/NCEP and NOAA 20th Century Reanalyses)



Total atmospheric precipitable water (PW) over Denver from 1948-2012, compared to the measurement for 6pm MDT on September 11, 2013 (red dot) ***(Plot adapted from NOAA NWS.)***



Total atmospheric precipitable water (PW) over Denver from 1948-2012, compared to the measurement for 6pm MDT on September 11, 2013 (red dot) ***(Plot adapted from NOAA NWS.)***

Summary of the September 2013 event

- Surges of subtropical monsoon-like moisture persisted for ~1 week due to near-stationary upper-level pattern
- Western Slope and UCRB received widespread beneficial precipitation without the severe flooding (except NW NM)
- Event contributed to September 2013 being wettest month for Western Slope since 1999
- Precipitation fell as rain at all elevations: increase in runoff, reservoir levels, and soil moisture
- Similar widespread fall precipitation events on West Slope have occurred every ~10 years
- Not clear how climate change may alter frequency of these events – but each event will likely be wetter

Thank you!

Comments? Questions?
Please contact me at
Lukas@colorado.edu