

# The 2013 Colorado Flood

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**Colorado State University**

**<http://ccc.atmos.colostate.edu>**



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Colorado Flood Forum

Broomfield, Colorado

Prepared with assistance from

Zach Schwalbe and Wendy Ryan

**Since the late 1990s  
Colorado had not  
experienced any  
widespread severe flooding**

**Remember,  
it was only a few months ago when drought  
still held a dusty grip on much of Colorado**

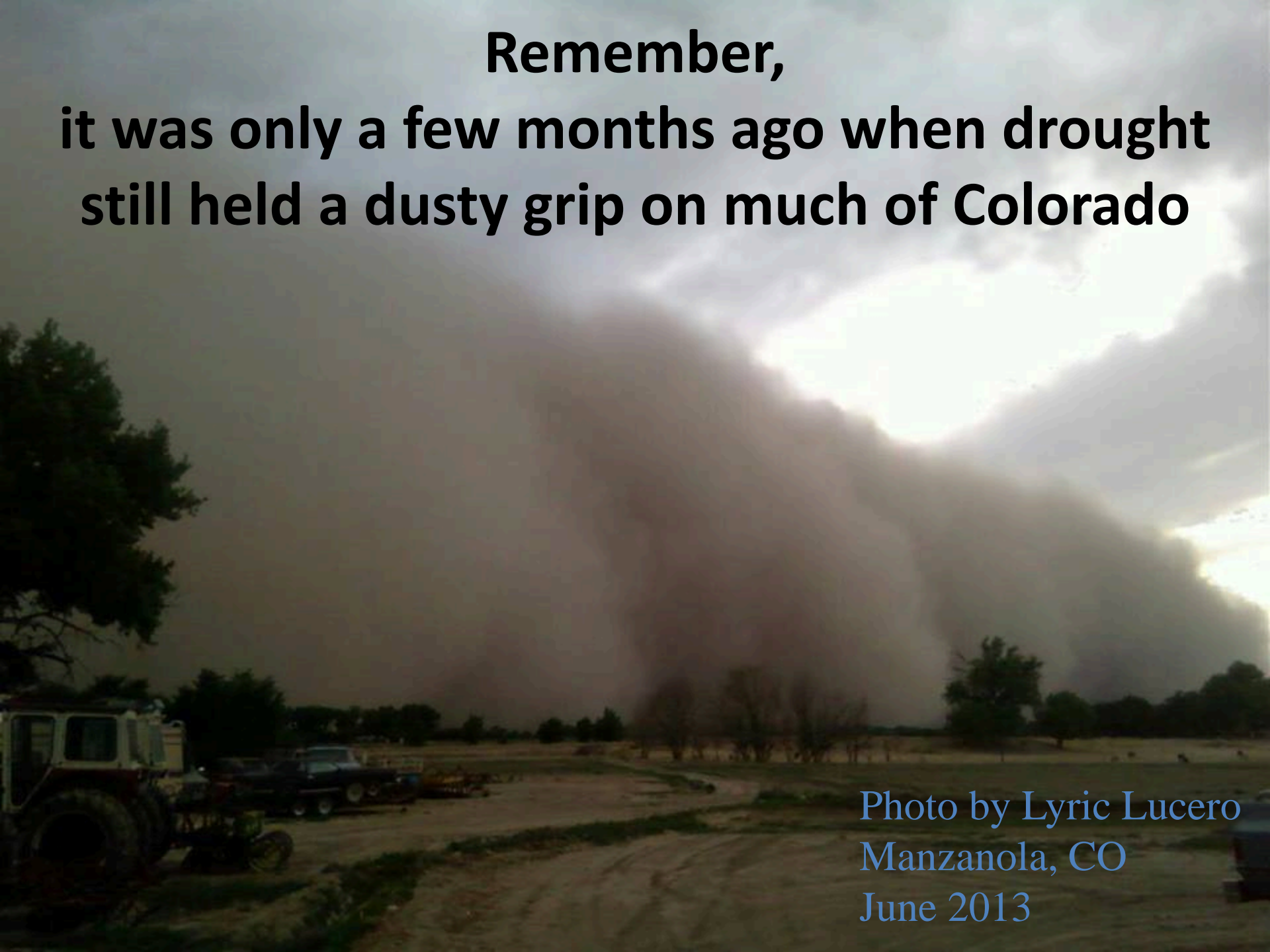


Photo by Lyric Lucero  
Manzanola, CO  
June 2013

**And wildfire and water shortages were  
our main concern**

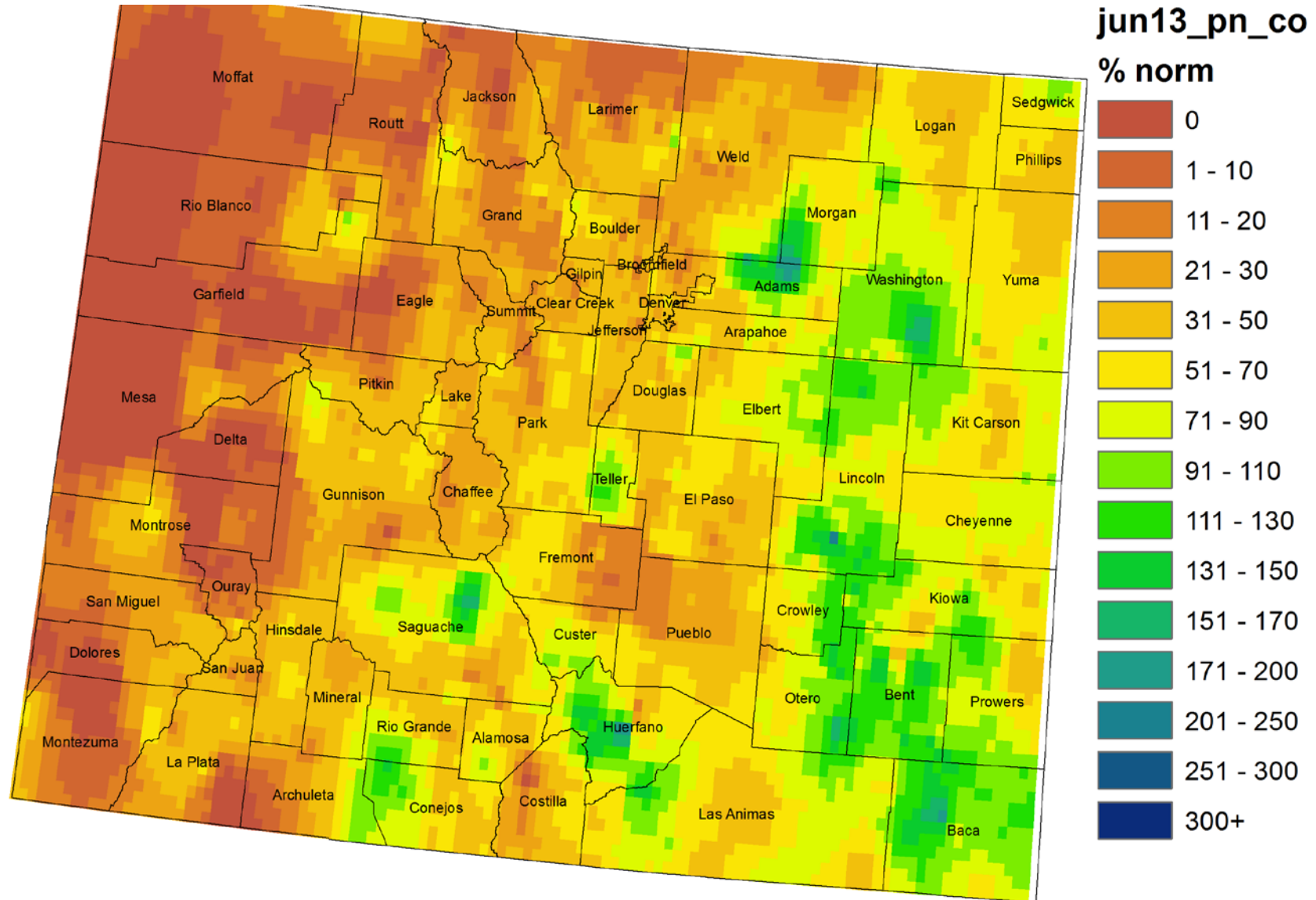


# Let's think back to summer 2013



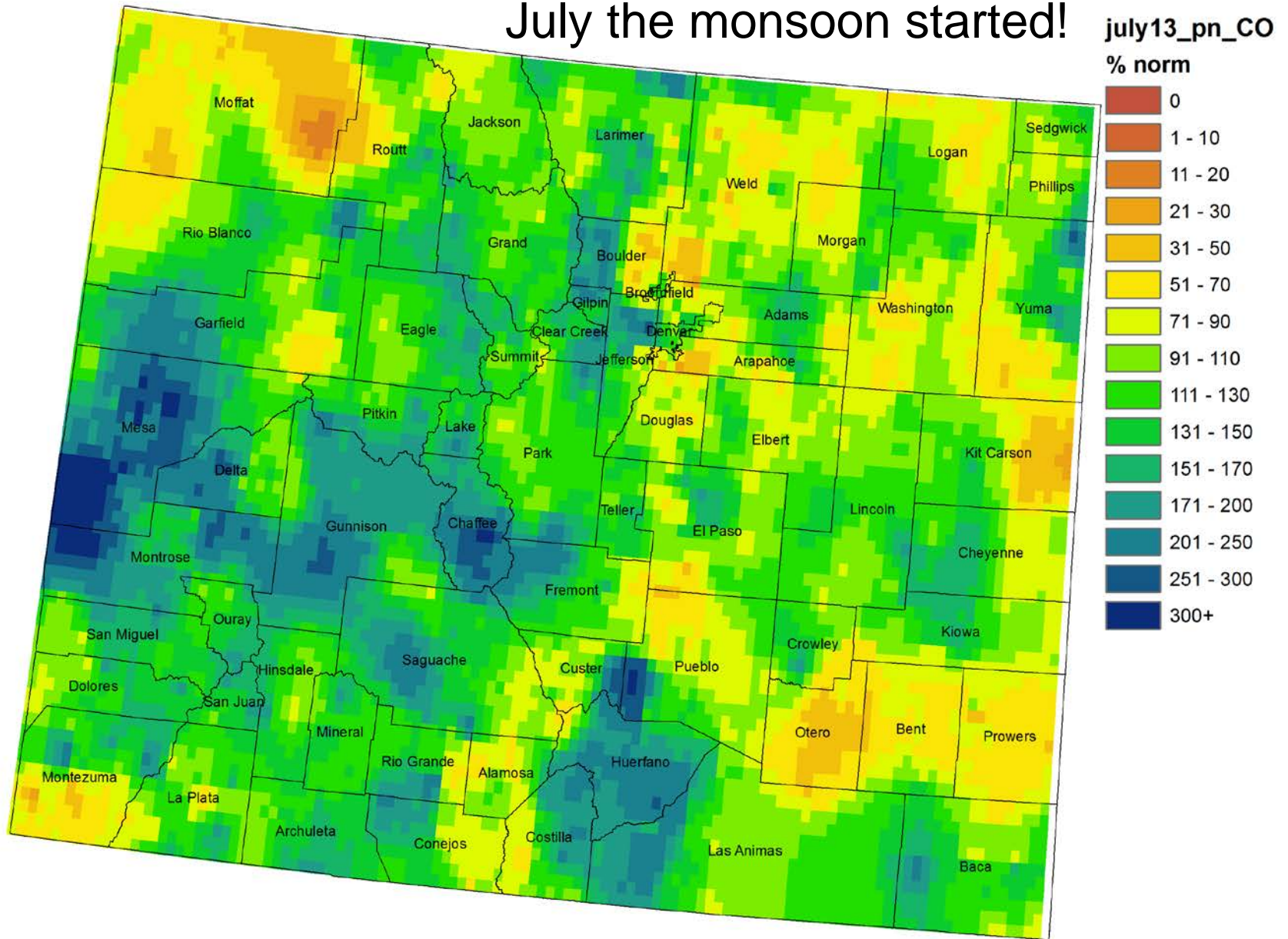
Credit: Henry Reges

June brought another round of hot and dry weather for much of the state, while SE Colorado finally received some beneficial rains.



# Colorado July 2013 Precipitation as a Percentage of Normal

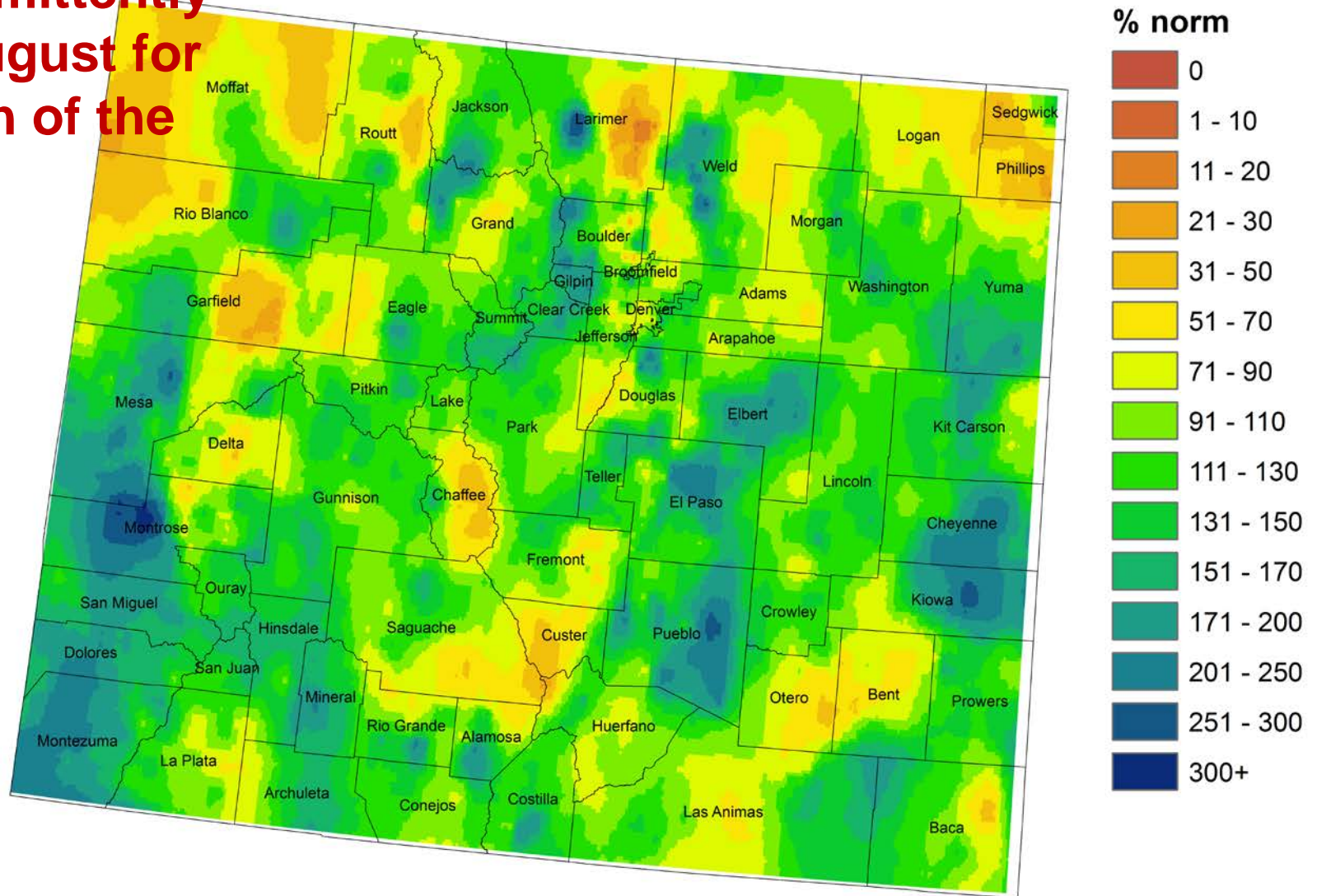
July the monsoon started!





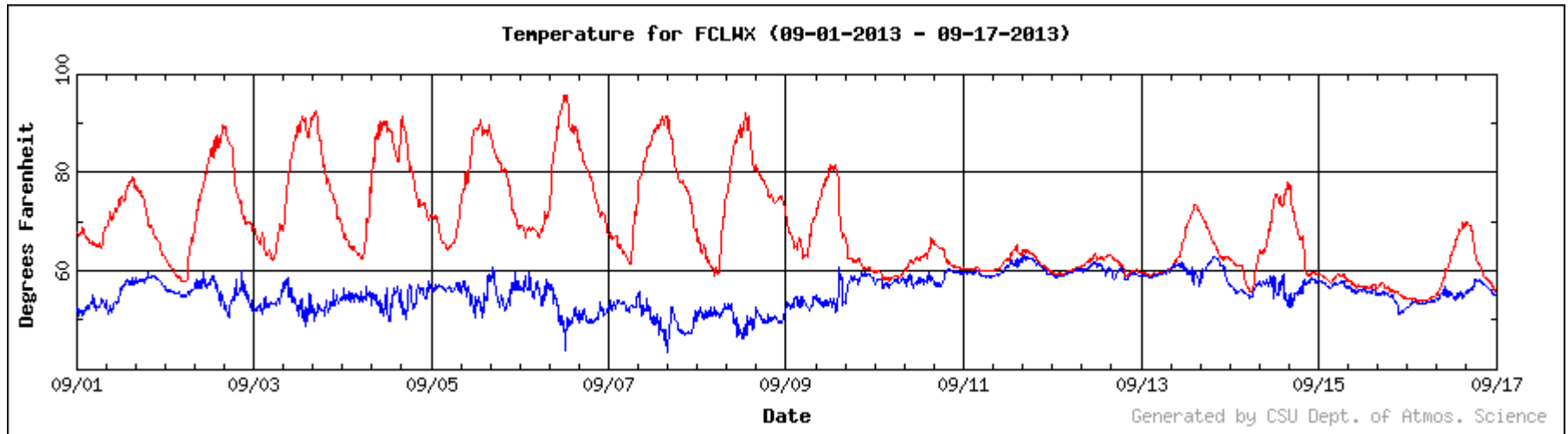
**And continued intermittently in August for much of the state**

## Colorado August 2013 Precipitation as Percentage of Normal



# Then came September 2013

Weather Conditions at the Colorado State University Main Campus Weather Station  
September 1 through 16, 2013



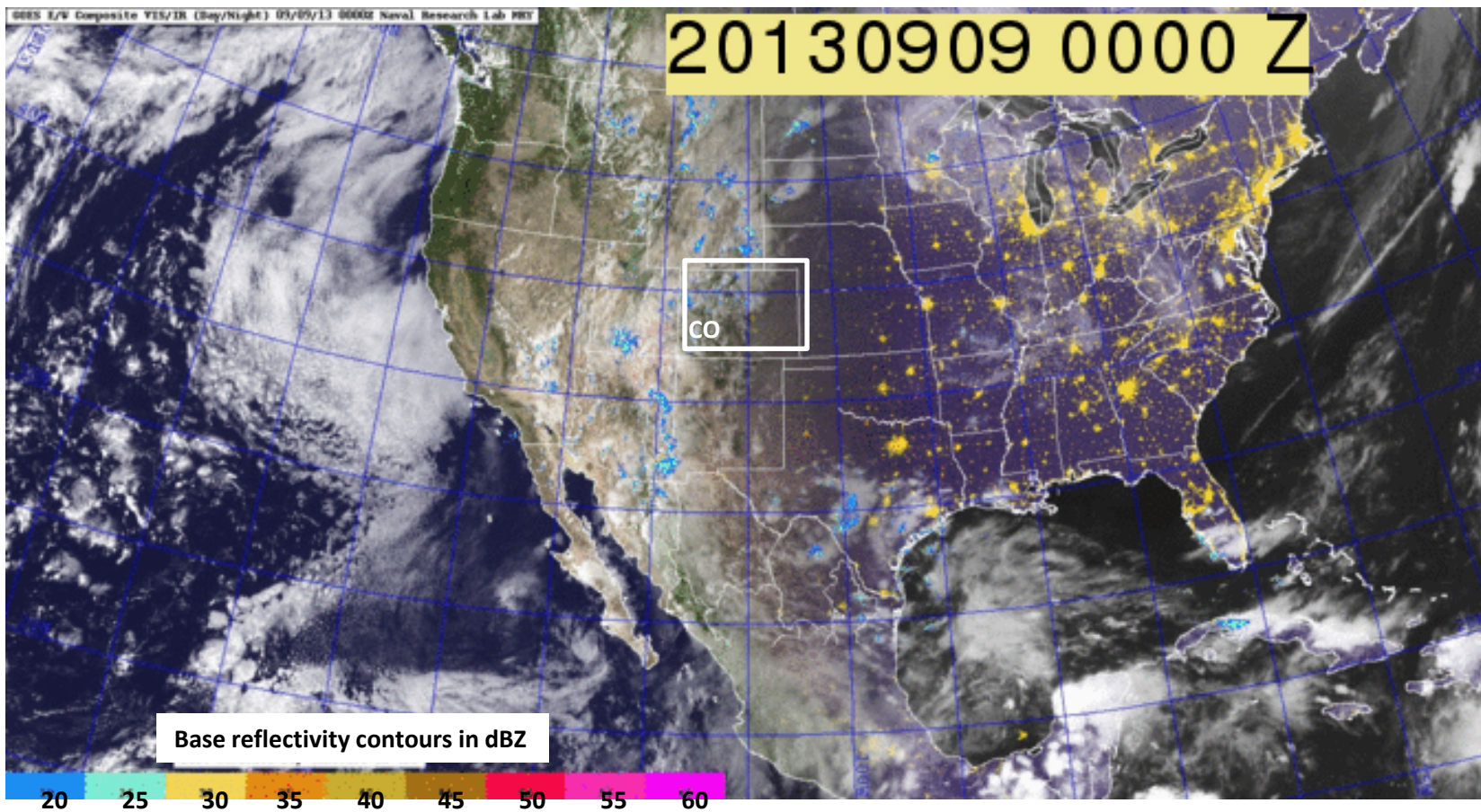
. . **HEAT!!** . . . . Humidity ..



# Case Study of Colorado Flood Event

## GOES Imagery with NEXRAD Radar Overlays

Hourly animation: 9 – 15 Sept 2013



Rains came first to the W Slope Sept. 7-8 and spilled over to the Front Range later on the 9th



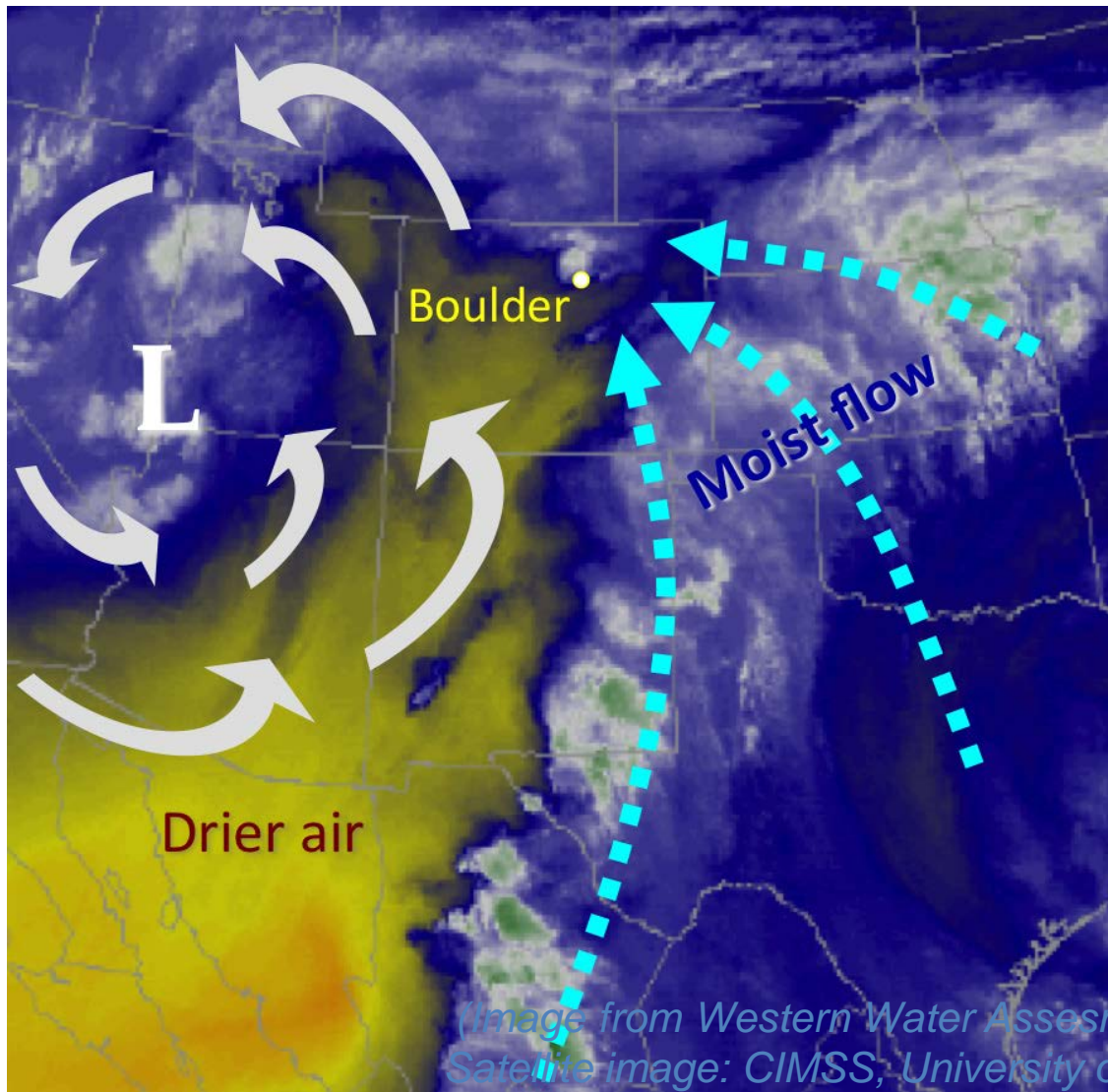
Credit: [thedenverchannel.com](http://thedenverchannel.com)

# Low stratus upslope developed along the Front Range

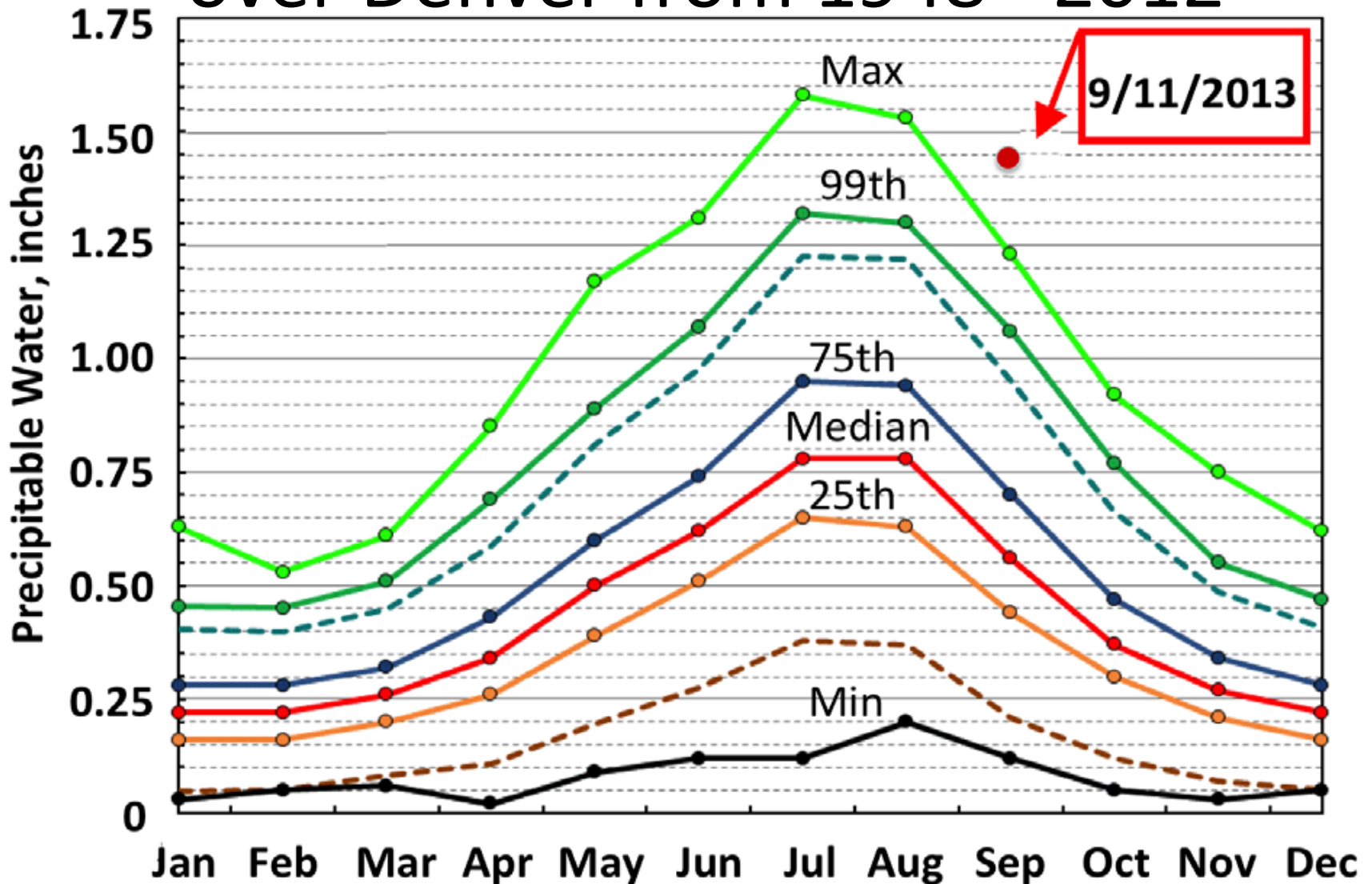


Credit: Henry Reges

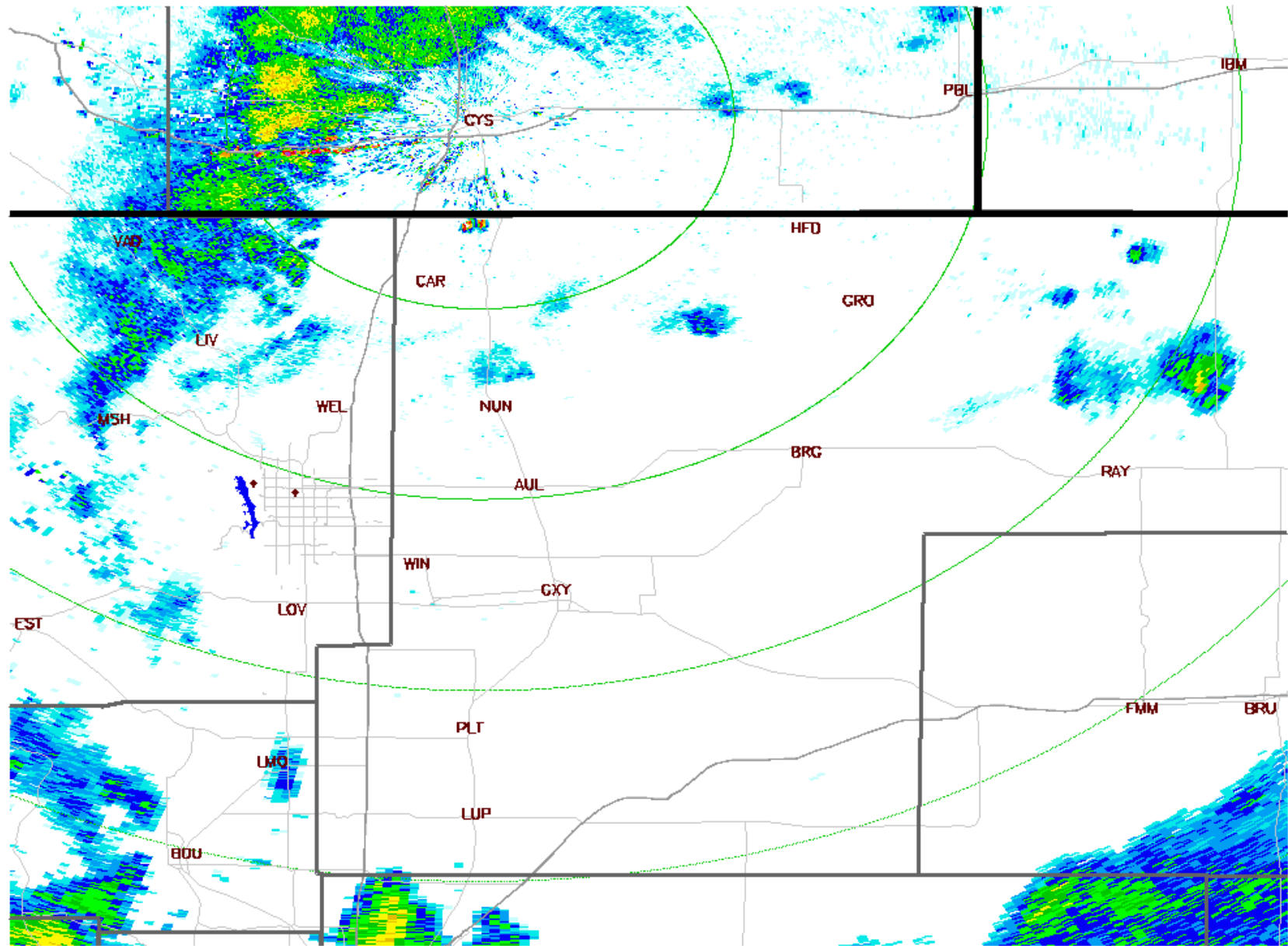
By Sept 11, 2013 ingredients for very heavy rains were in place



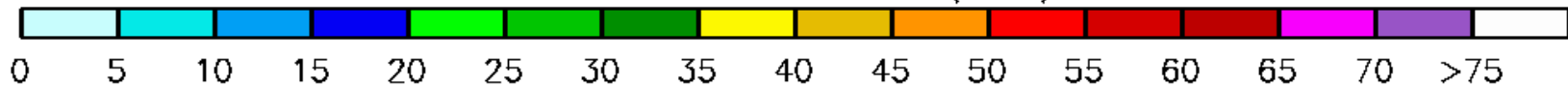
# Total Atmospheric Precipitable water over Denver from 1948 - 2012



11 SEP 2013 18:01 UTC -- ELEV: 0.5° -- VCP: 21 (PCP)

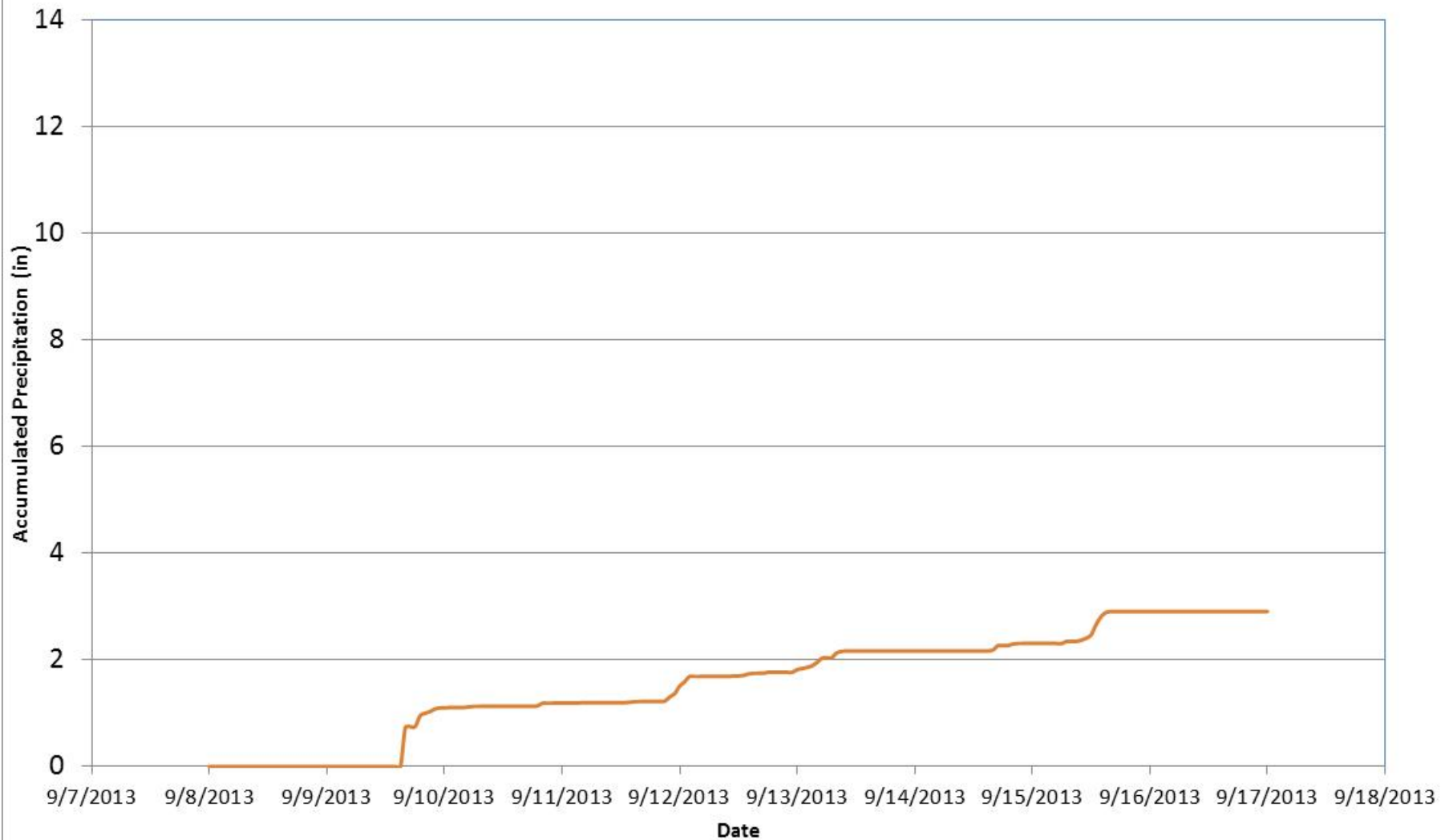


BASE REFLECTIVITY (dBZ)



# Hourly Accumulated Precipitation 9/8/13-9/17/13

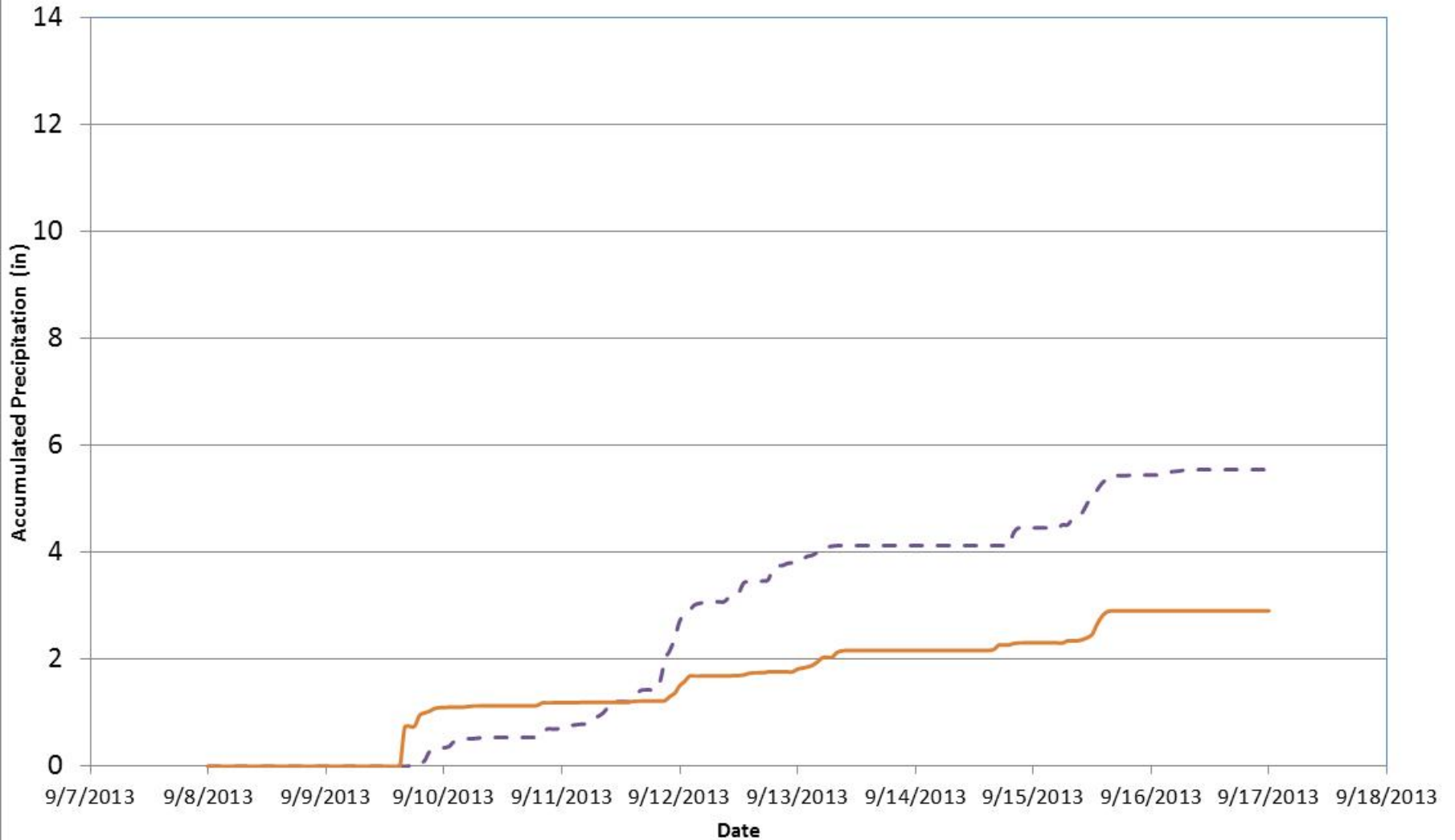
Greeley04 CoAgMet 4,683'



# Hourly Accumulated Precipitation 9/8/13-9/17/13

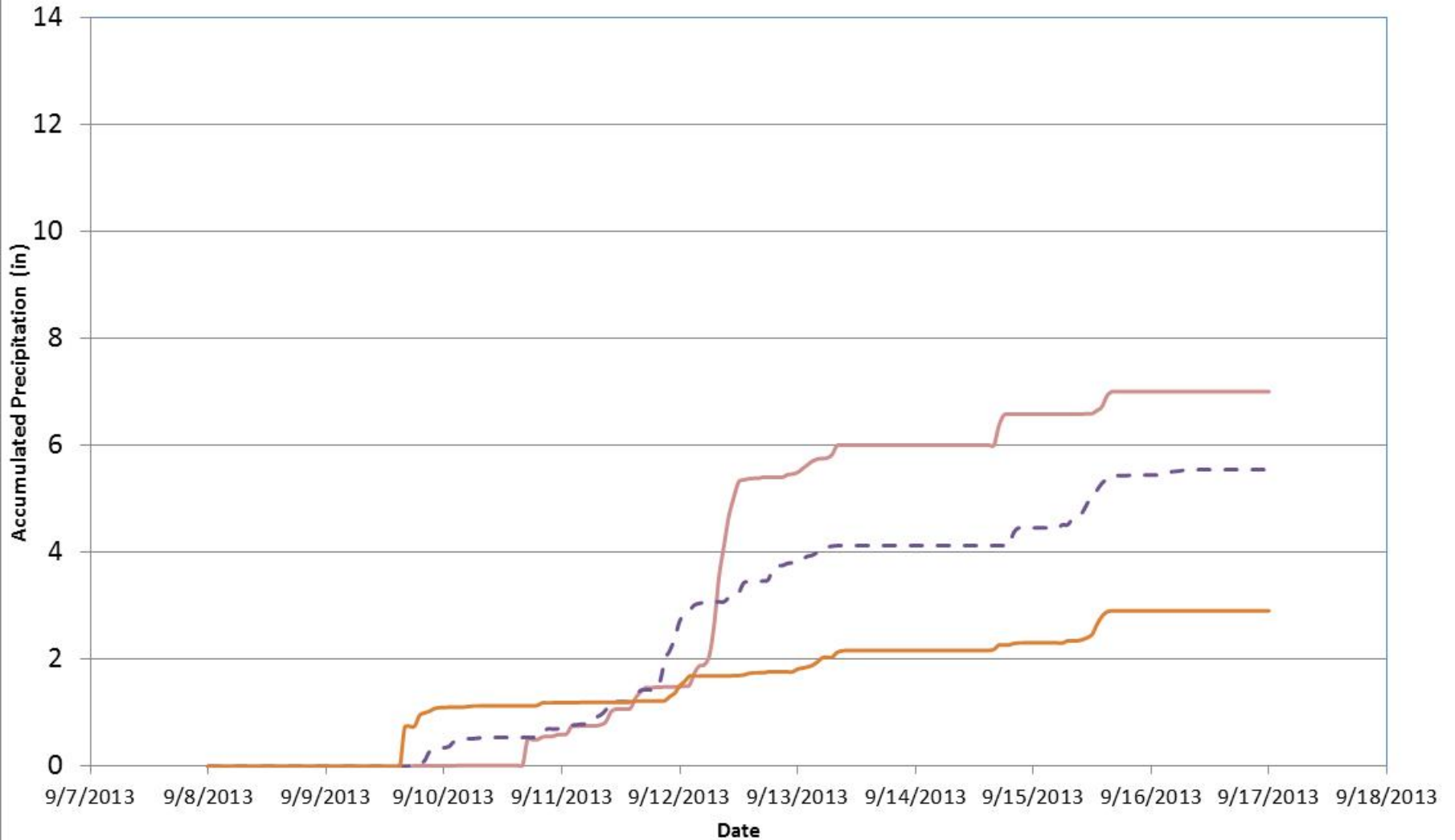
- - Fort Collins West CoAgMet (in) 5,120'

— Greeley04 CoAgMet 4,683'



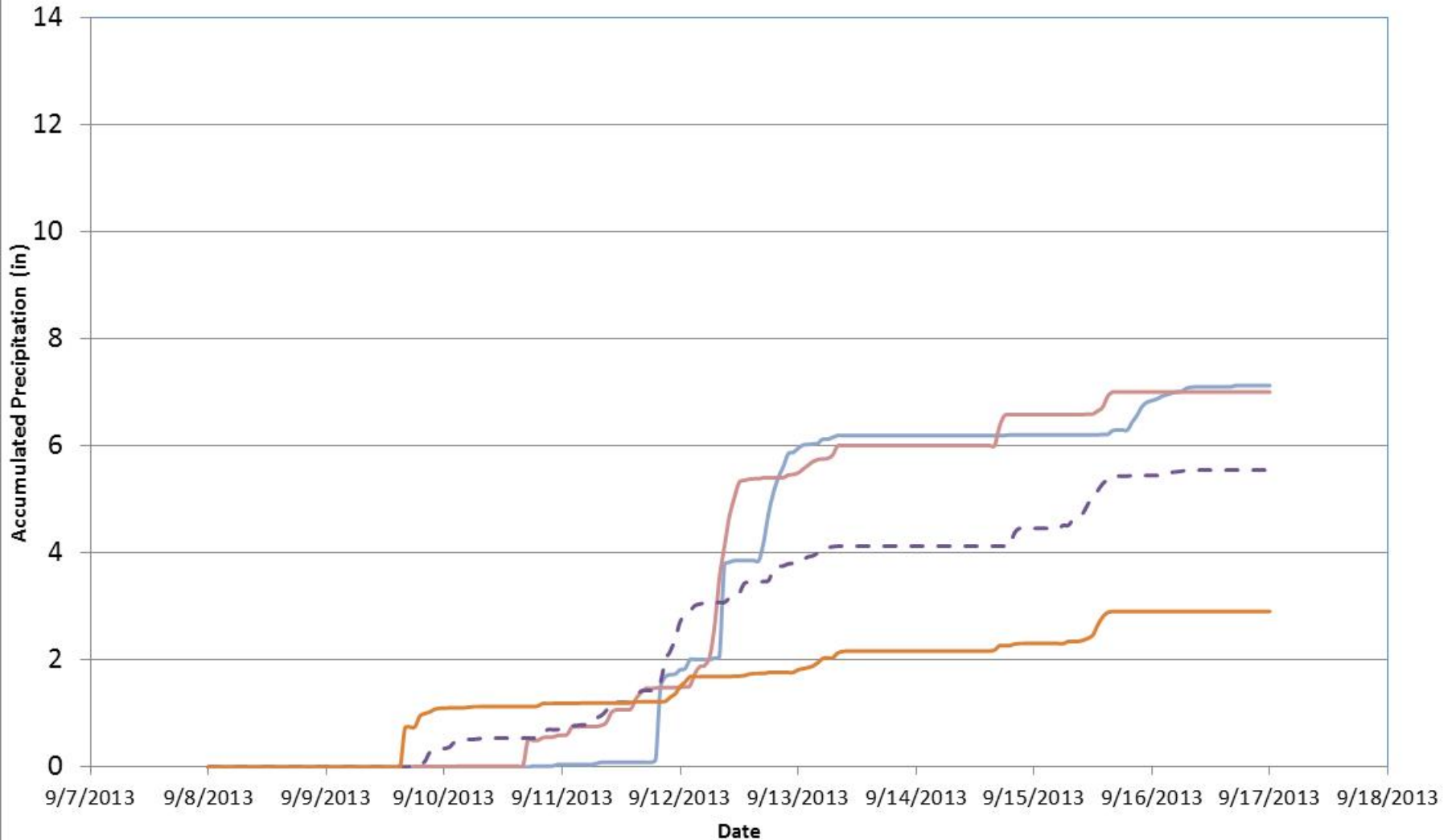
# Hourly Accumulated Precipitation 9/8/13-9/17/13

— Denver City Park 5307'    - - Fort Collins West CoAgMet (in) 5,120'    — Greeley04 CoAgMet 4,683'



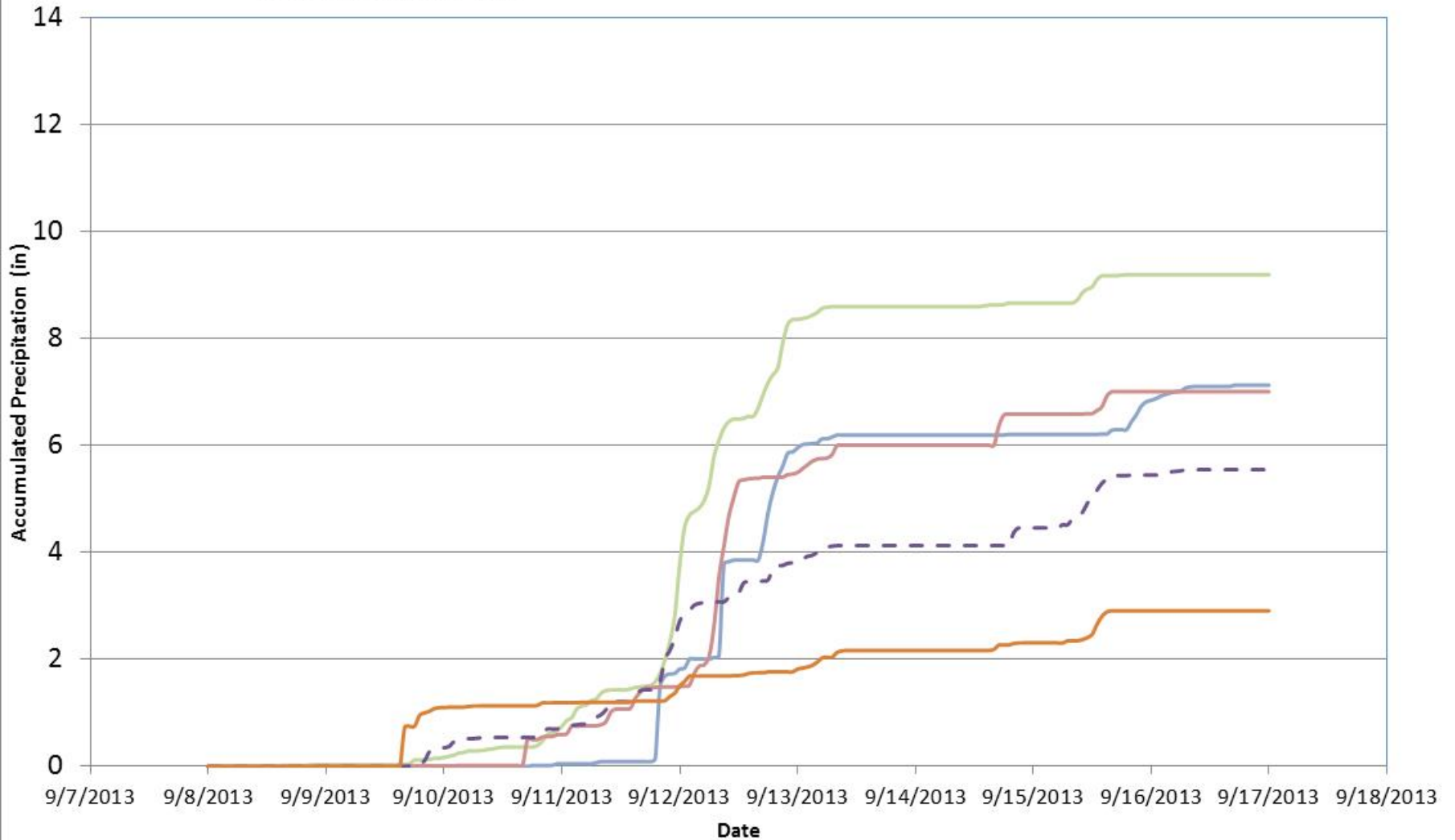
# Hourly Accumulated Precipitation 9/8/13-9/17/13

- Fort Carson RAWS 6,700'
- Denver City Park 5307'
- Fort Collins West CoAgMet (in) 5,120'
- Greeley04 CoAgMet 4,683'



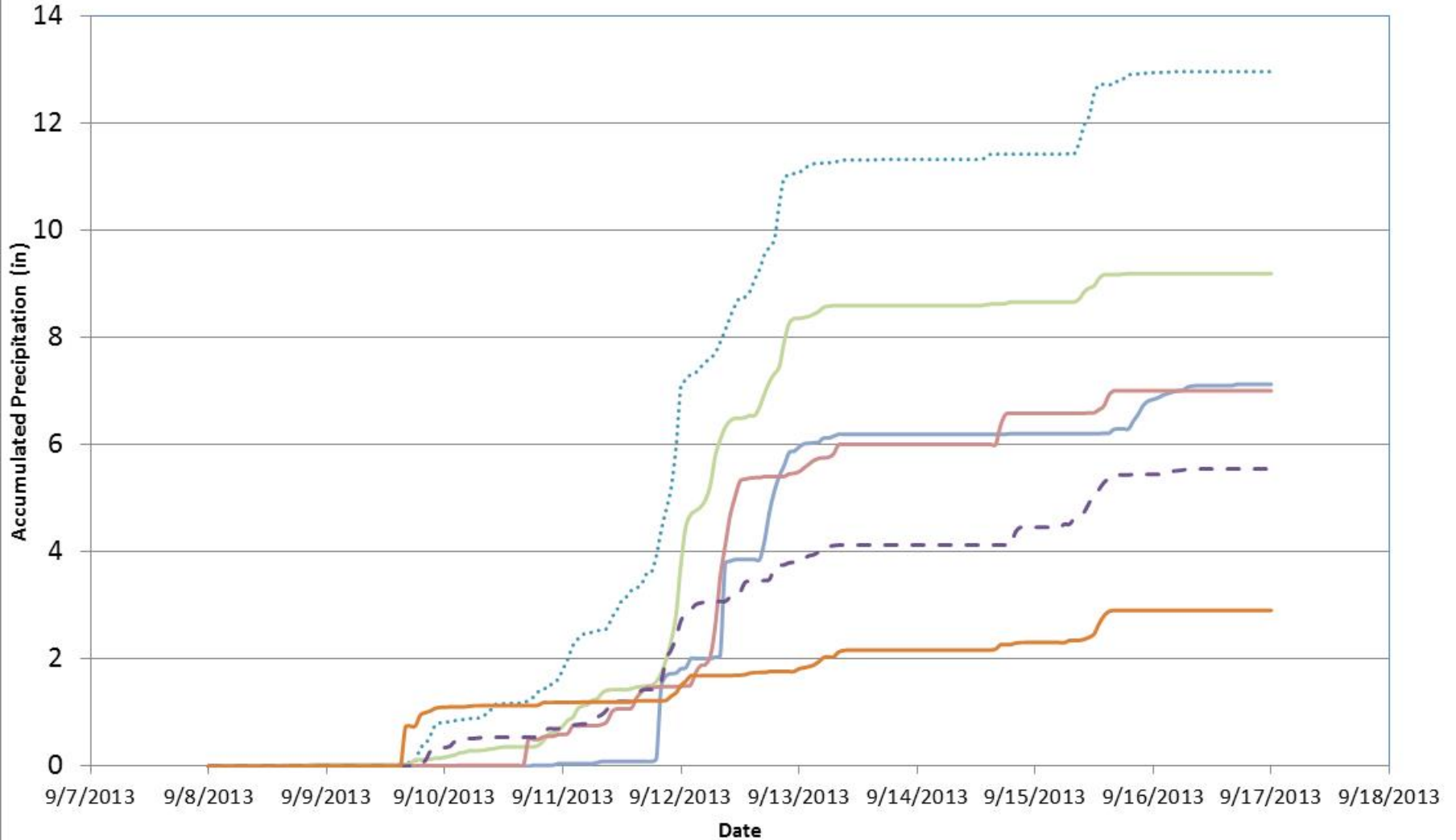
# Hourly Accumulated Precipitation 9/8/13-9/17/13

- Estes Park RAWS 7,820'
- Fort Carson RAWS 6,700'
- Denver City Park 5307'
- Fort Collins West CoAgMet (in) 5,120'
- Greeley04 CoAgMet 4,683'



# Hourly Accumulated Precipitation 9/8/13-9/17/13

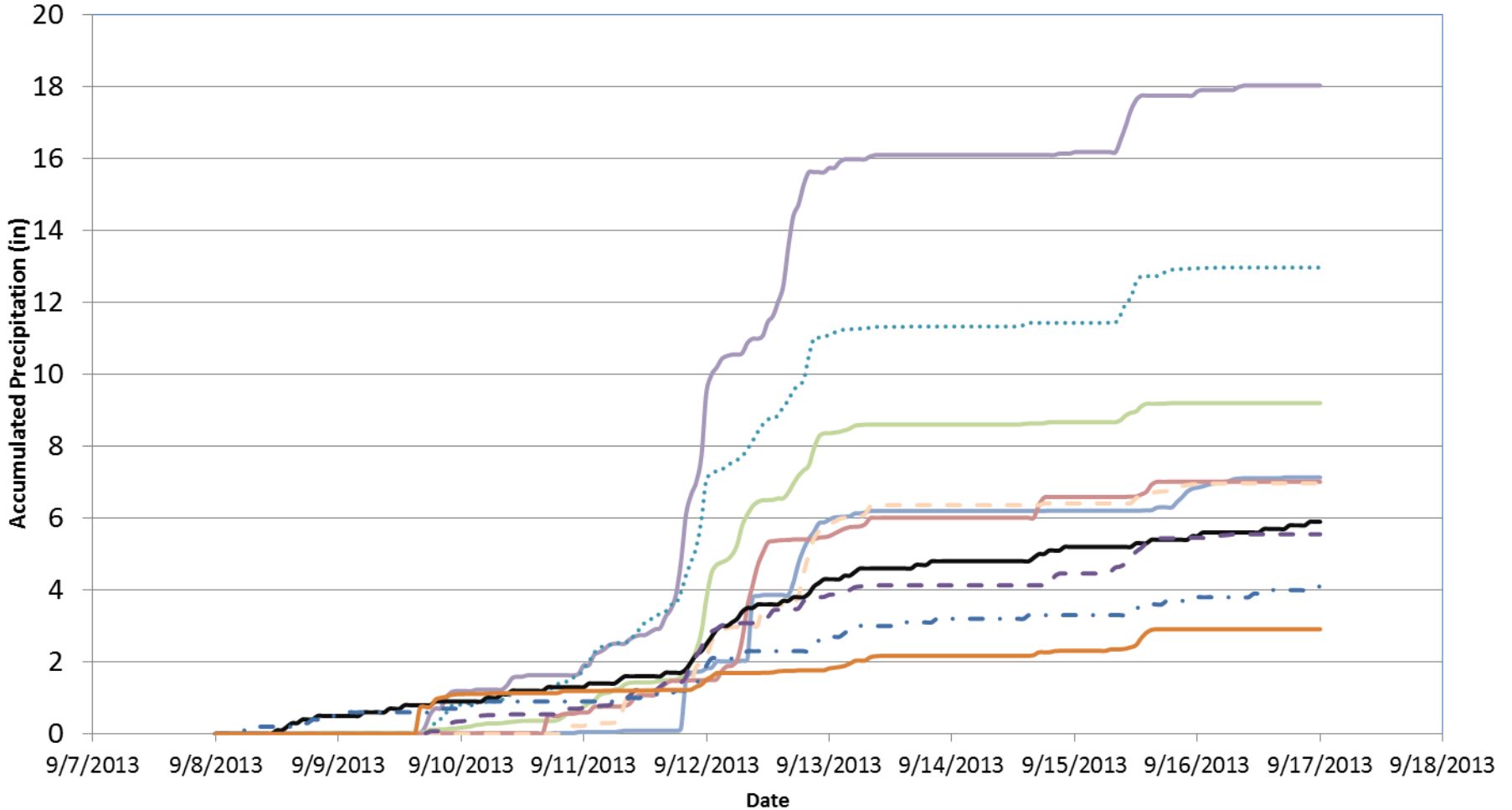
- ..... Sugarloaf (Boulder) RAWS 6,733'
- Fort Carson RAWS 6,700'
- - Fort Collins West CoAgMet (in) 5,120'
- Estes Park RAWS 7,820'
- Denver City Park 5307'
- Greeley04 CoAgMet 4,683'



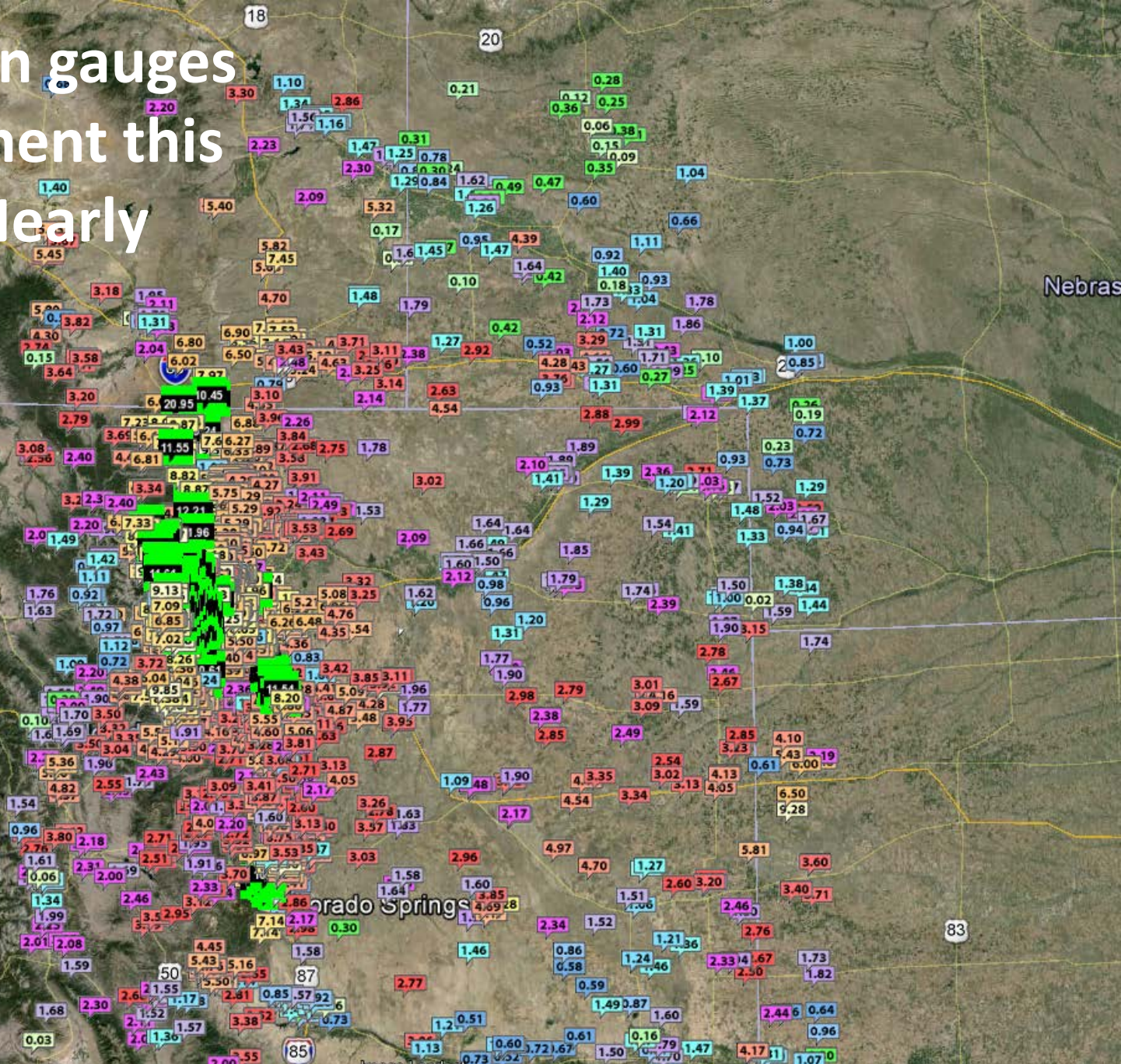


# Hourly Accumulated Precipitation 9/8/13-9/17/13

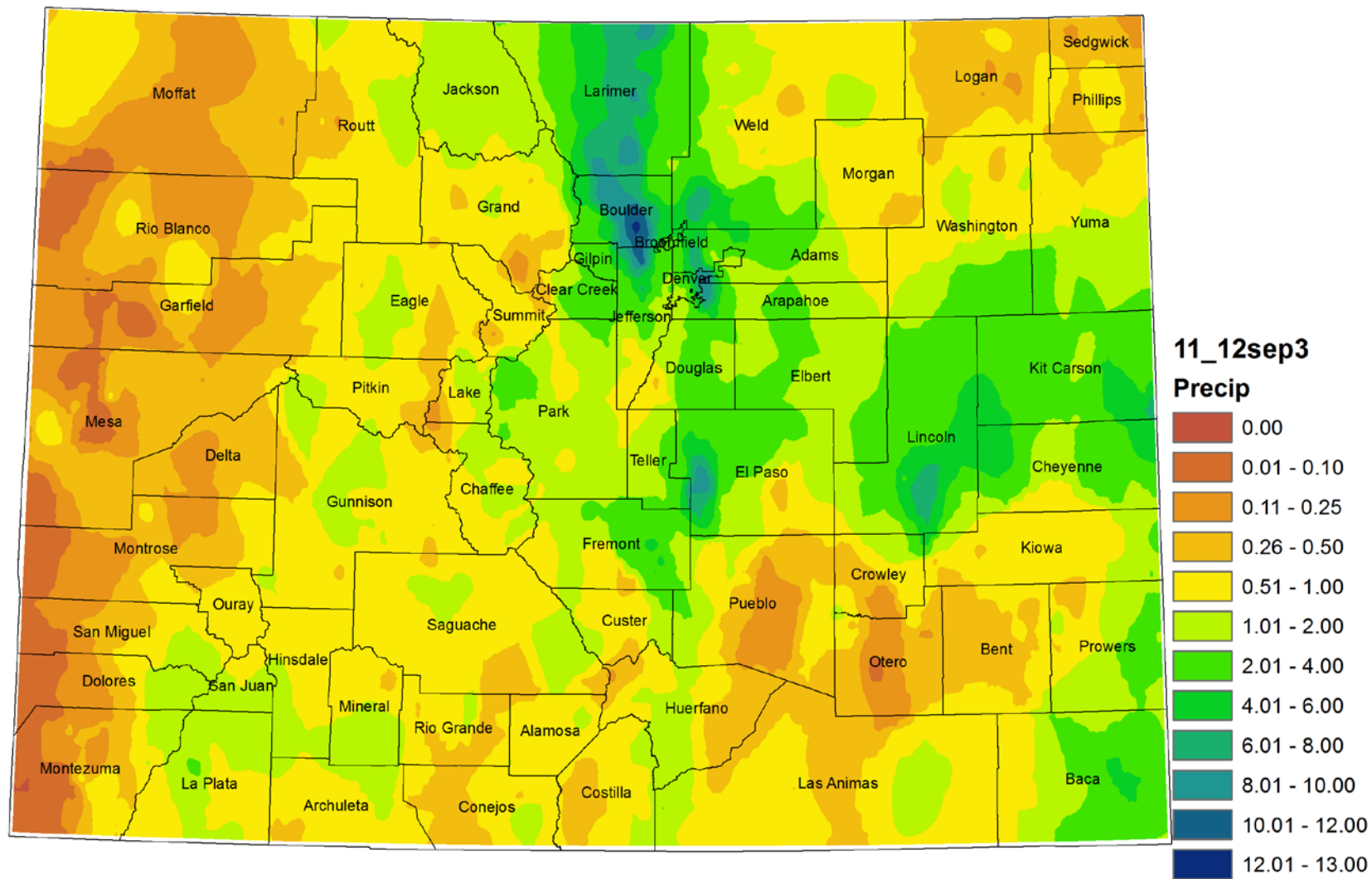
- SBC @ South Boulder Road 5350'
- Estes Park RAWS 7,820'
- Denver City Park 5307'
- Deadman Hill 10,220'
- Joe Wright Snotel 10,120'
- Sugarloaf (Boulder) RAWS 6,733'
- Fort Carson RAWS 6,700'
- Rampart Range (W. El Paso) RAWS 9,207'
- Fort Collins West CoAgMet (in) 5,120'
- Greeley04 CoAgMet 4,683'



Many rain gauges  
to document this  
storm! Nearly  
2,500!!!

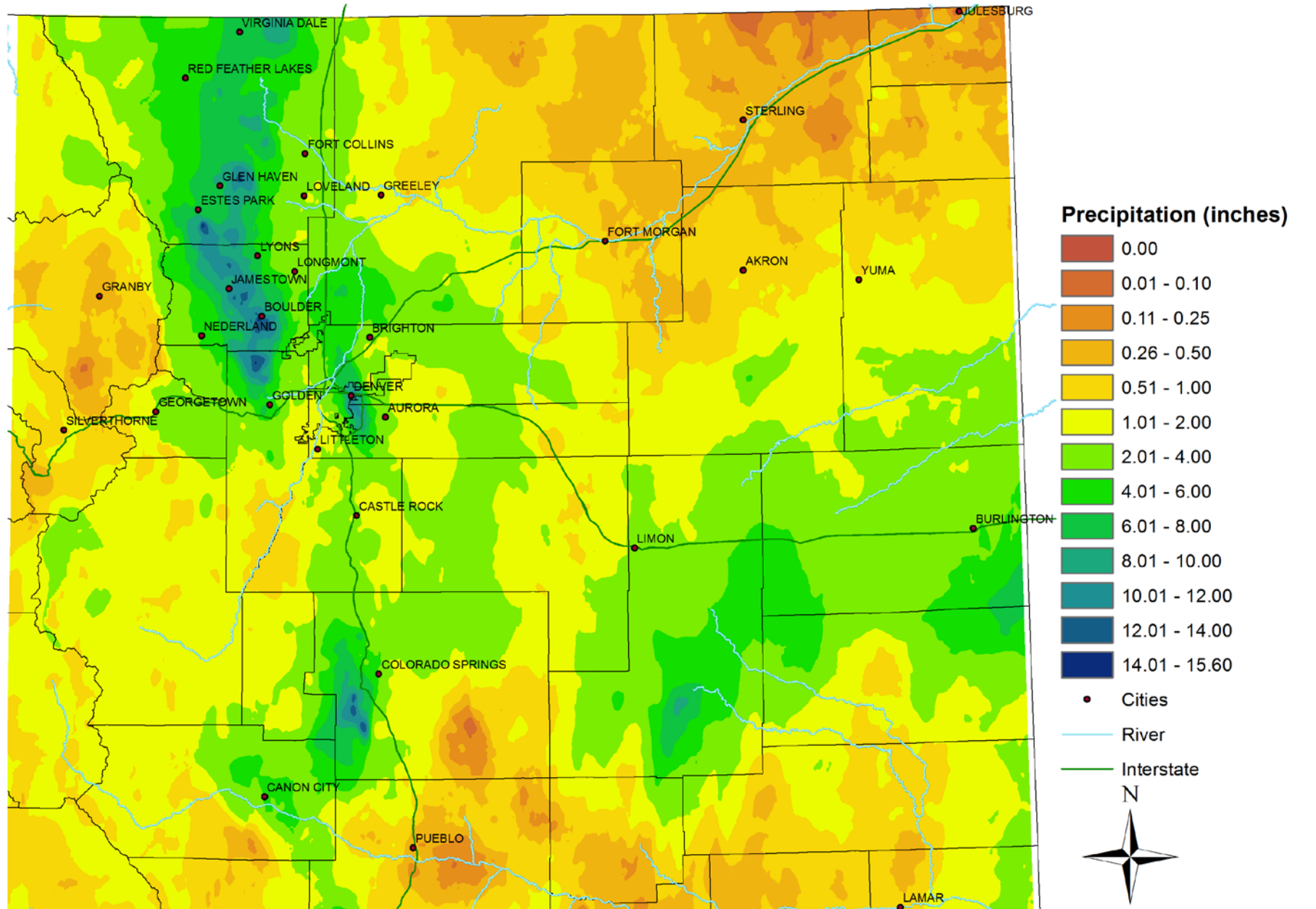


# September 11 – 12 Precipitation (inches)



This analysis based on rain gauge data only

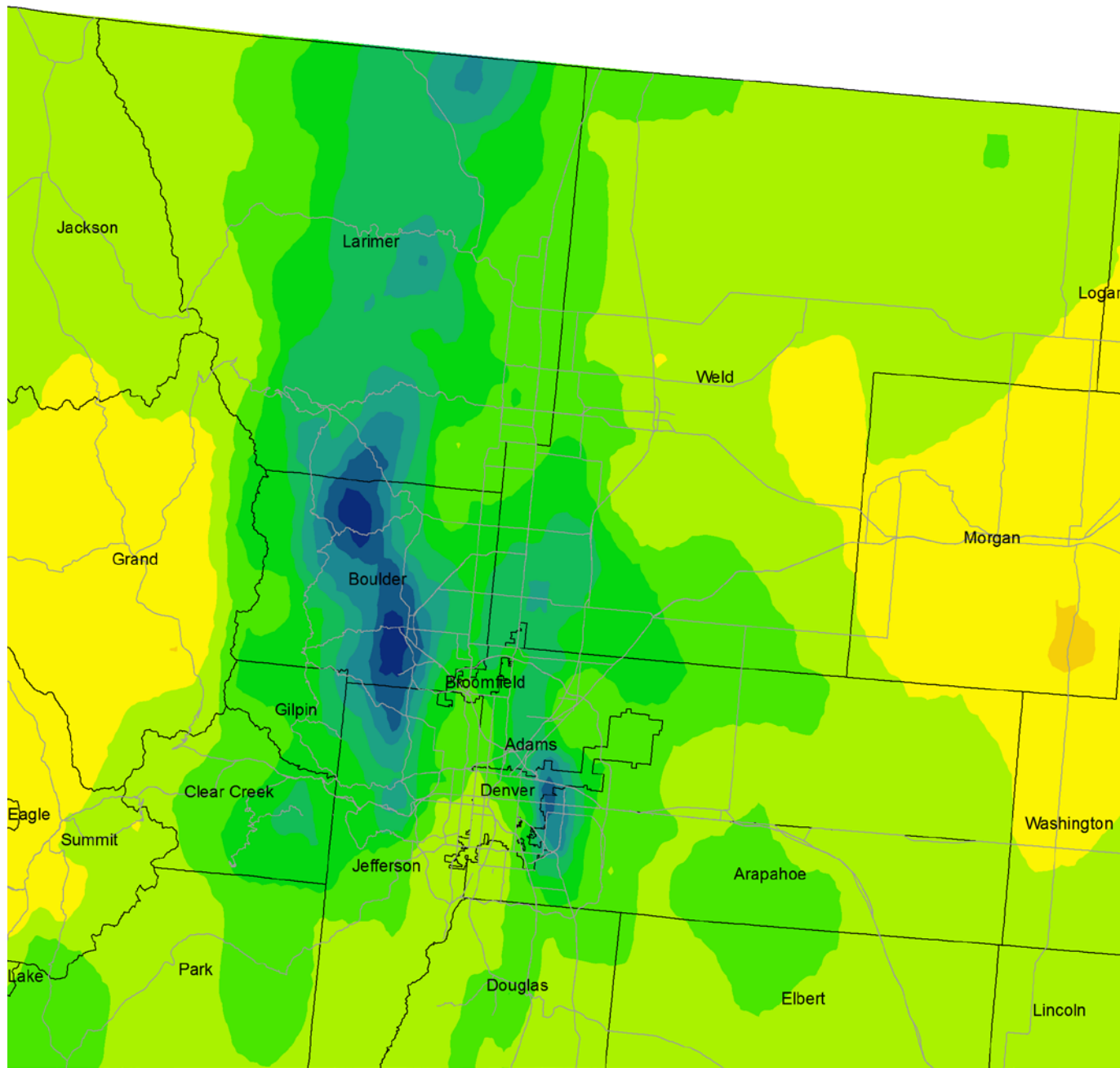
# Precipitation Beginning September 11, 2013 ending 7:00 AM MST September 13, 2013



Map created with the Storm Precipitation Analysis System (SPAS) through a collaborative effort by Applied Weather Associates, LLC, MetStat, Inc. and the Colorado Climate Center. Radar data supplied by Weather Decision Technologies, Inc.

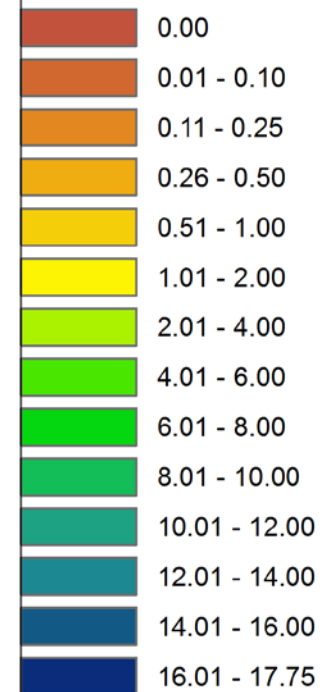
# Preliminary Precipitation Accumulation for Colorado

## 8 - 15 September 2013

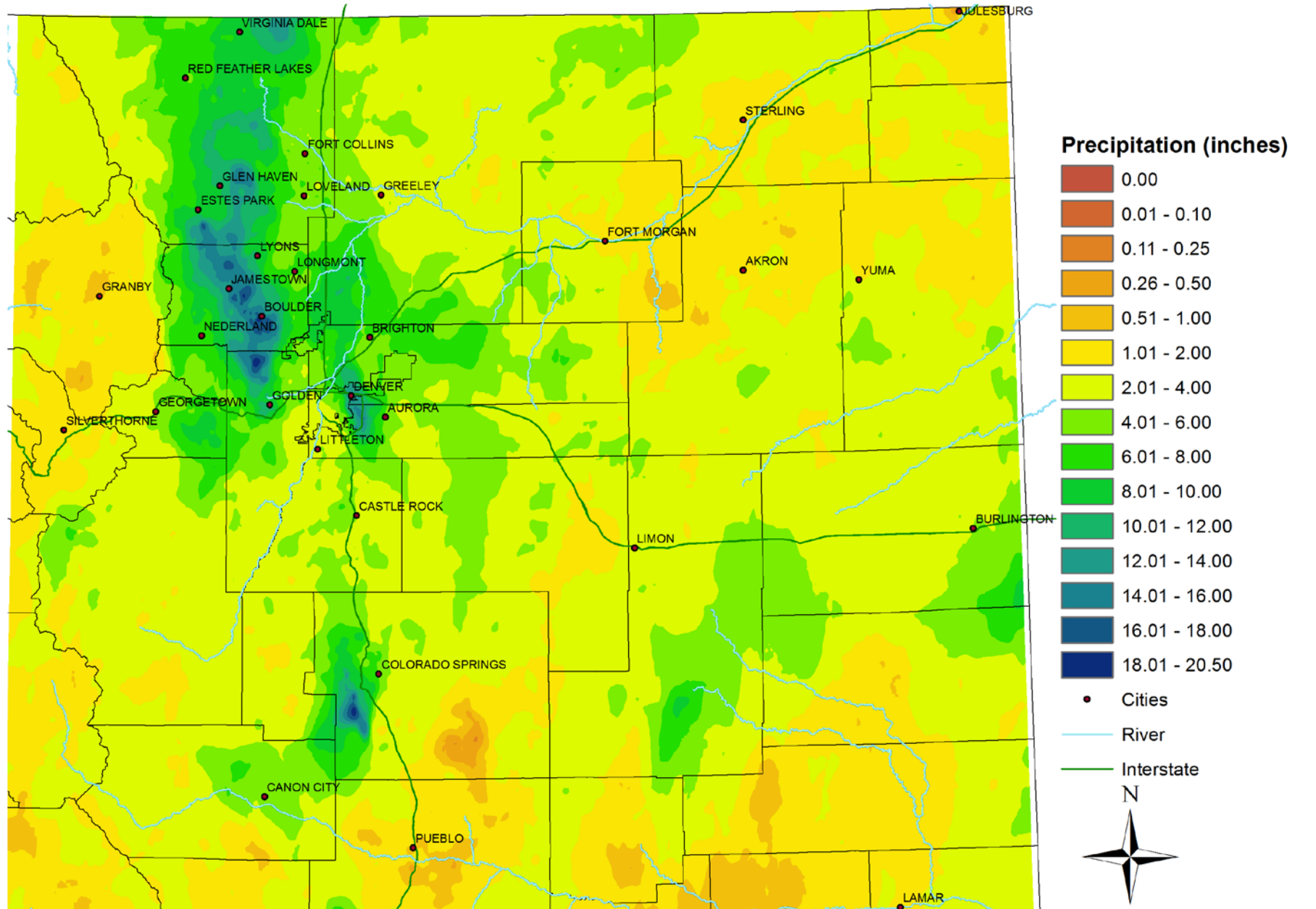


This analysis  
also based  
on rain  
gauges only

### Precipitation (inches)



# Precipitation Beginning September 8, 2013 ending 7:00 AM MST September 17, 2013



Map created with the Storm Precipitation Analysis System (SPAS) through a collaborative effort by Applied Weather Associates, LLC, MetStat, Inc. and the Colorado Climate Center. Radar data supplied by Weather Decision Technologies, Inc.

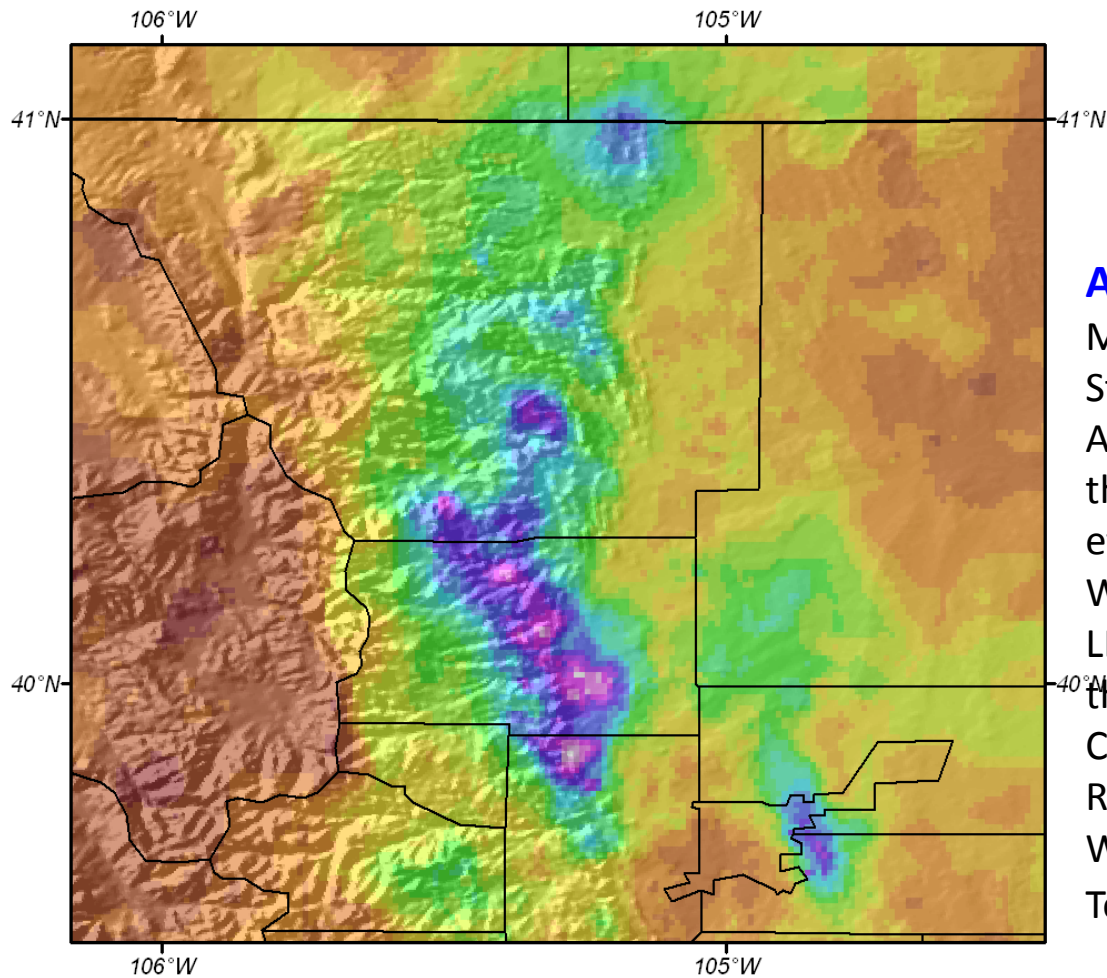
# Gauge+calibrated radar Storm-total Rainfall, north central Colorado, Sep 8-17, 2013

## Note:

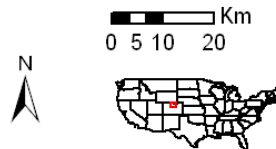
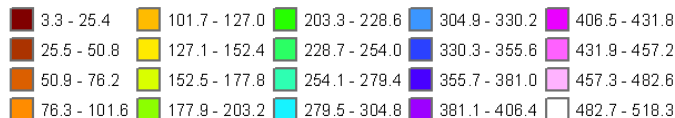
Heaviest Rainfall in the St. Vrain and Big Thompson watersheds fell at higher elevations than other watersheds contributing to the observed extreme hydrologic response.

## Acknowledgement:

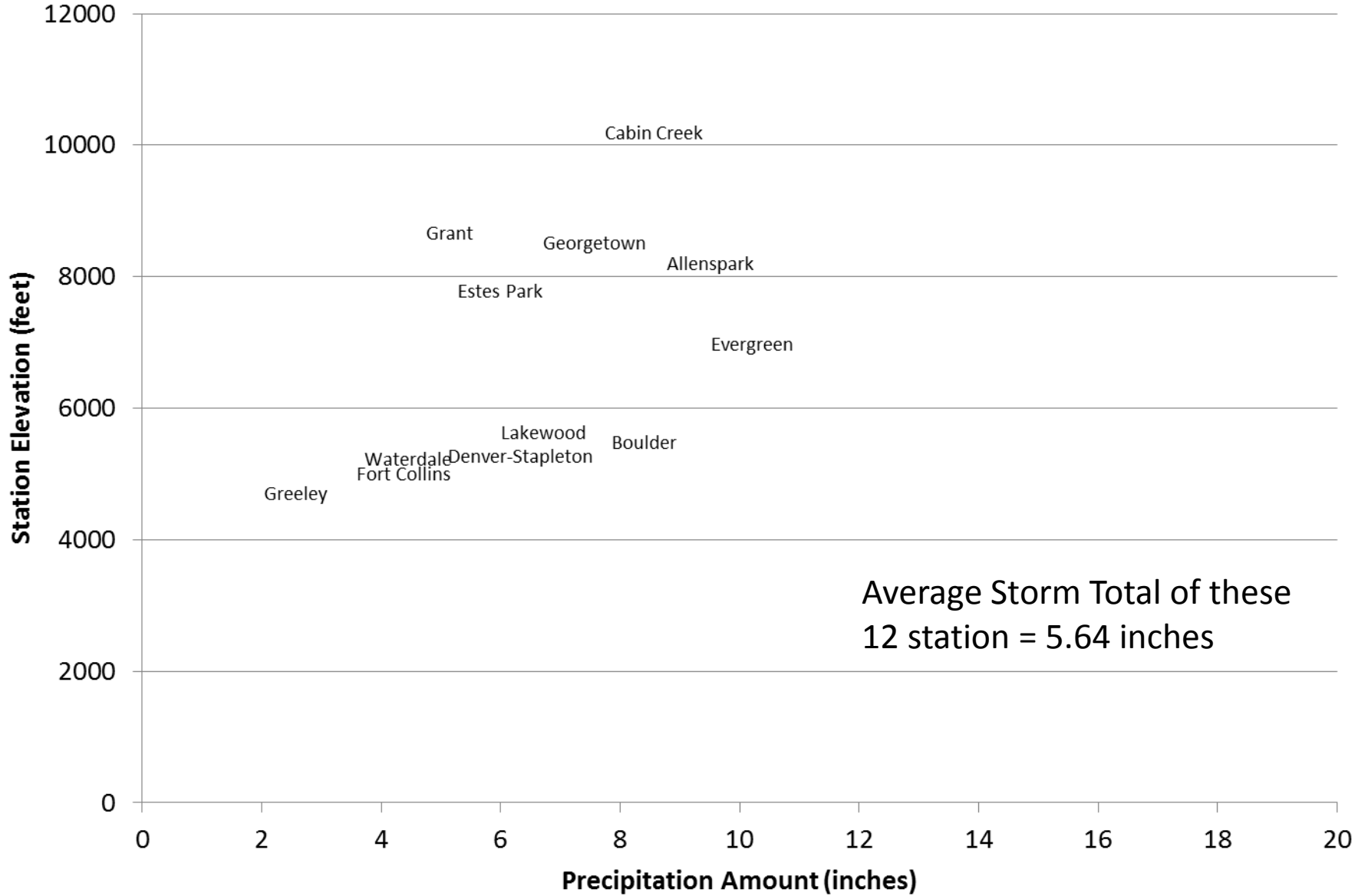
Map created with the Storm Precipitation Analysis System (SPAS) through a collaborative effort by Applied Weather Associates, LLC, MetStat, Inc. and the CSU Colorado Climate Center. Radar data supplied by Weather Decision Technologies, Inc.



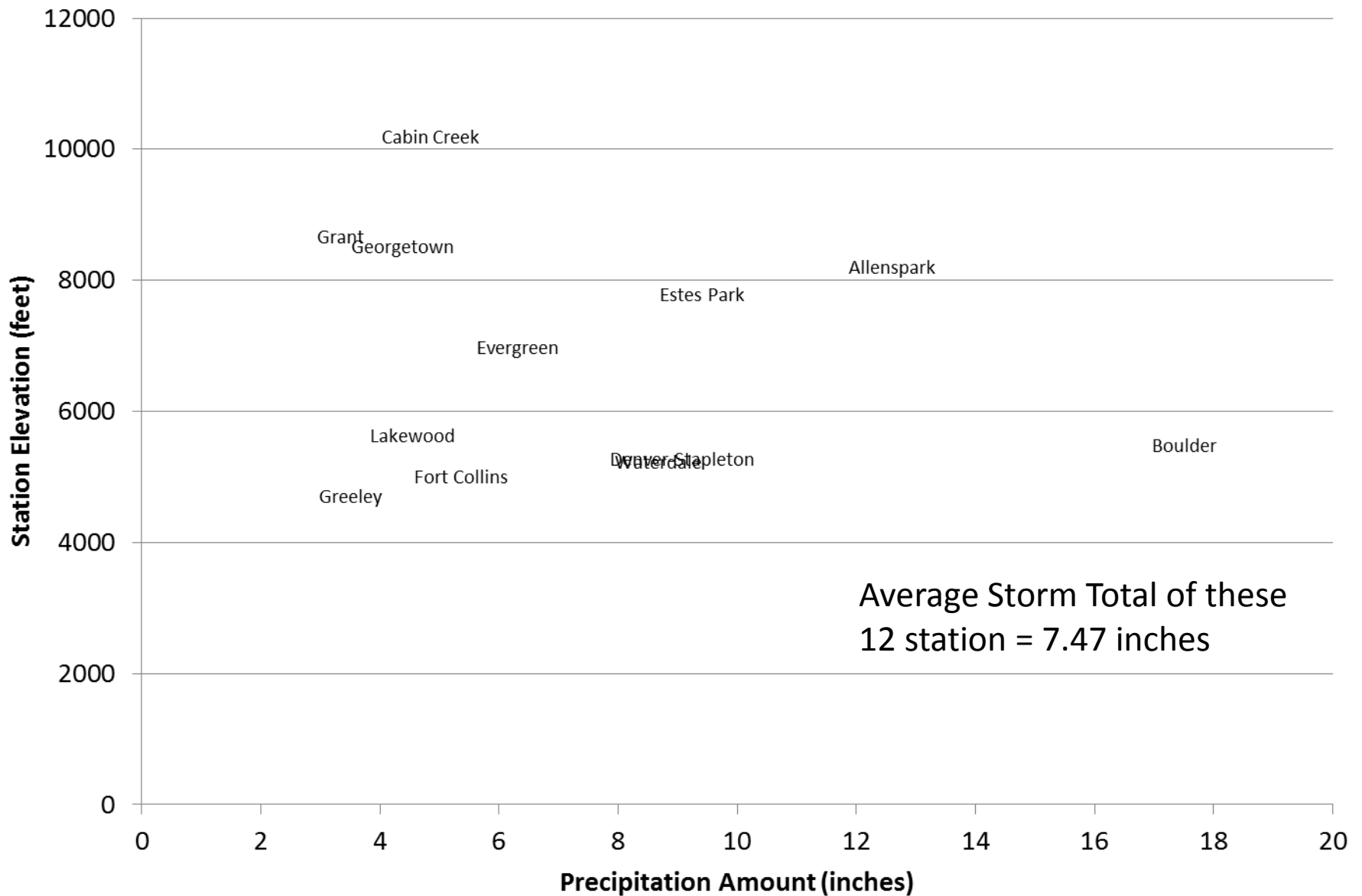
### Precipitation (mm)



# May 4th-8th, 1969, Precipitation versus Elevation



# September 9-16, 2013, Precipitation versus Elevation



<b>Top Total By County</b>		
<b>Stations Exceeding 10" of Rain</b>		
<b>Sep-13</b>		
CO-BO-30	Boulder 1.9 SE	19.18
CO-LR-225	Drake 3.0 NNE	16.65
CO-AD-127	Aurora 4.2 NNW	16.63
CO-AR-270	Aurora 0.7 WSW	16.39
CO-DN-183	Denver 5.1 ENE	13.49
CO-EP-175	Manitou Springs 1.2 ESE	12.84
CO-JF-365	Golden 2.1 SW	12.64
CO-WE-203	Longmont 8.2 ESE	11.57
CO-CC-7	Idaho Springs 4.7 SSE	10.34

**Records back to 1893 at Boulder NWS Wx Stn.  
were shattered Also at other locations E.P. etc**

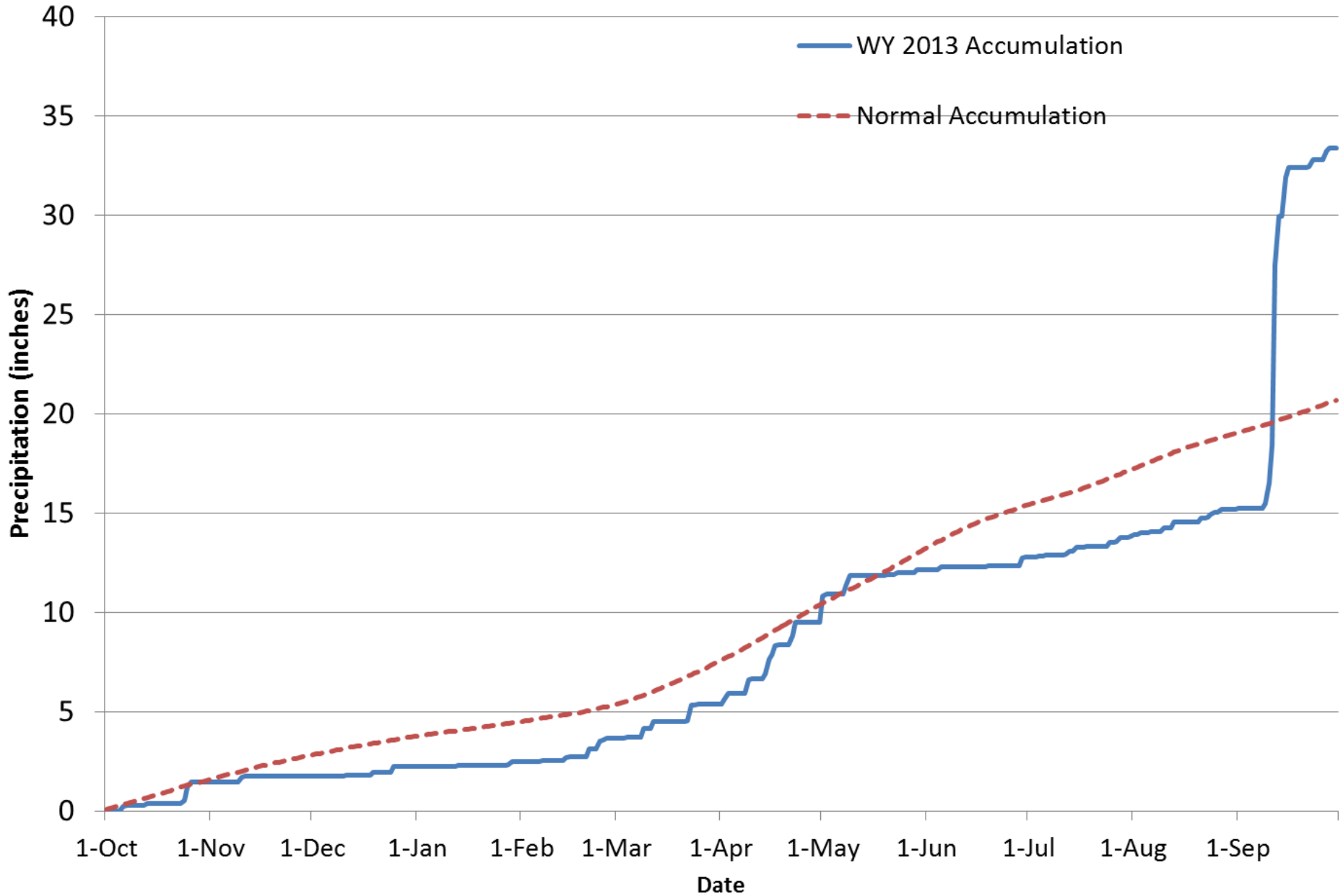
- All time 1-day rainfall, 9.08" (previous record was 4.80")
- 2-day rainfall, 11.52"
- 7-day 16.9"
- Monthly precip total, 18.16" (nearly double the previous record)
- Total Water Year precip, 33.35"



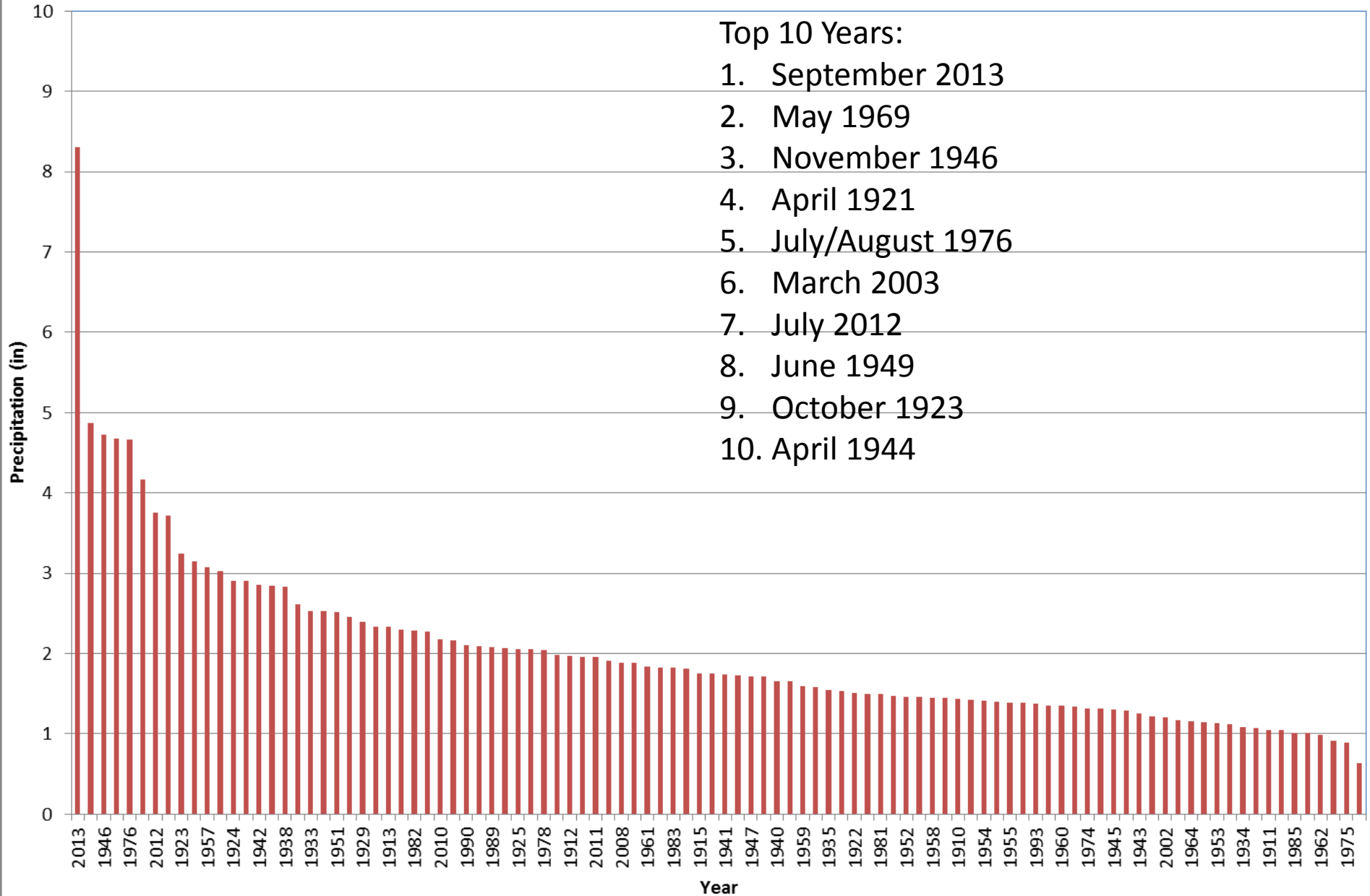
# New Colorado one-day rainfall record set 12 Sep 2013

- Fort Carson Rod and Gun observing station
  - 11.85" calendar day total
  - 12.46" for 24-hour period ending 9 AM Sep 13, 2013

# Boulder Water Year 2013 Daily Precipitation Accumulation



# Estes Park 3 day precipitation maximum



# **It has rained hard in September before**

## **September 1938 Flood in Eldorado Springs, CO**

### **Some Similarity to September 2013**



Photo copyright by the Denver Public Library.

## Flooding on Colorado State University Campus, September 1938



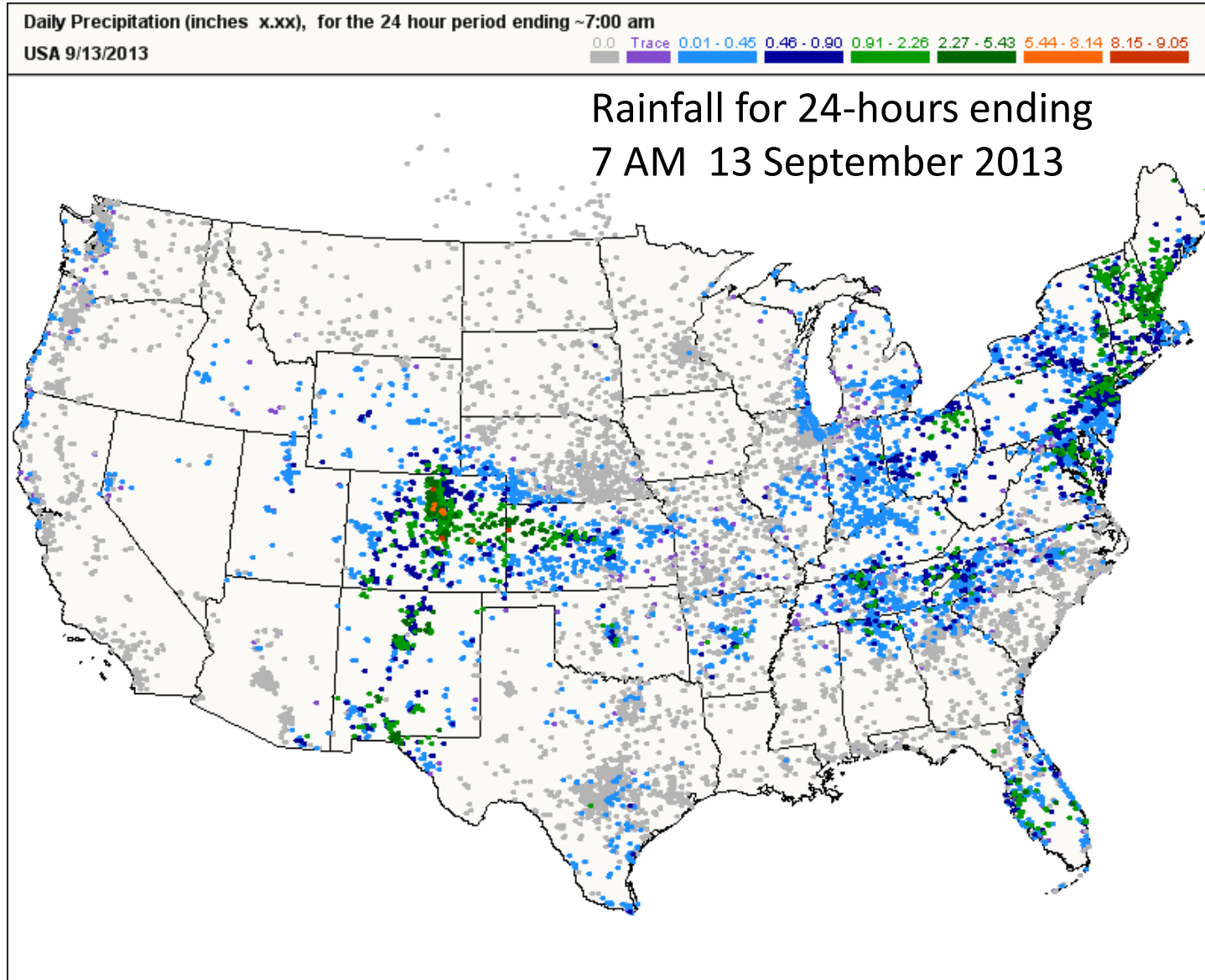
Credit: Colorado State University Library

# Floods happen, drought happens – And Data Collection should happen!

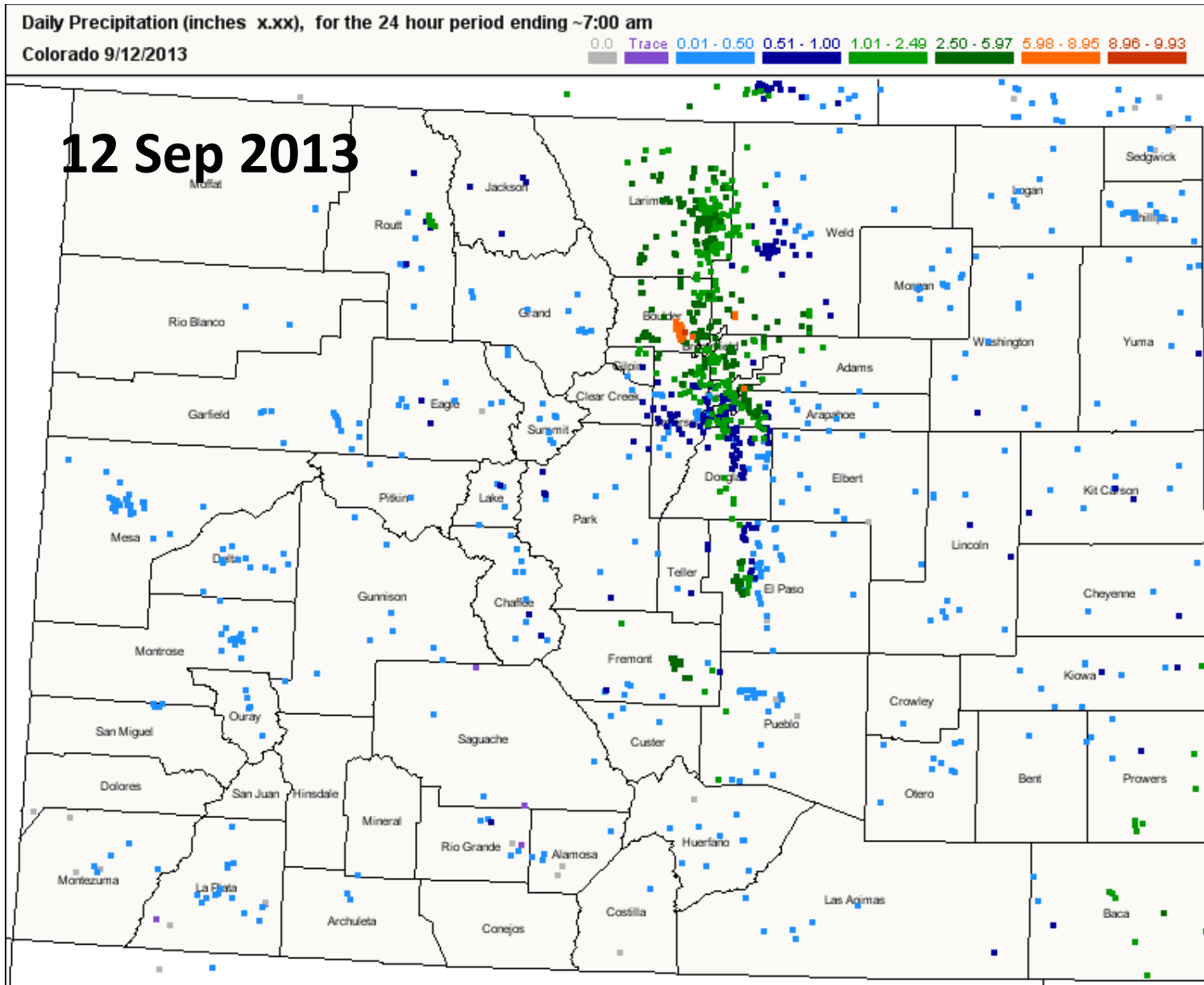


# Mapping Precipitation

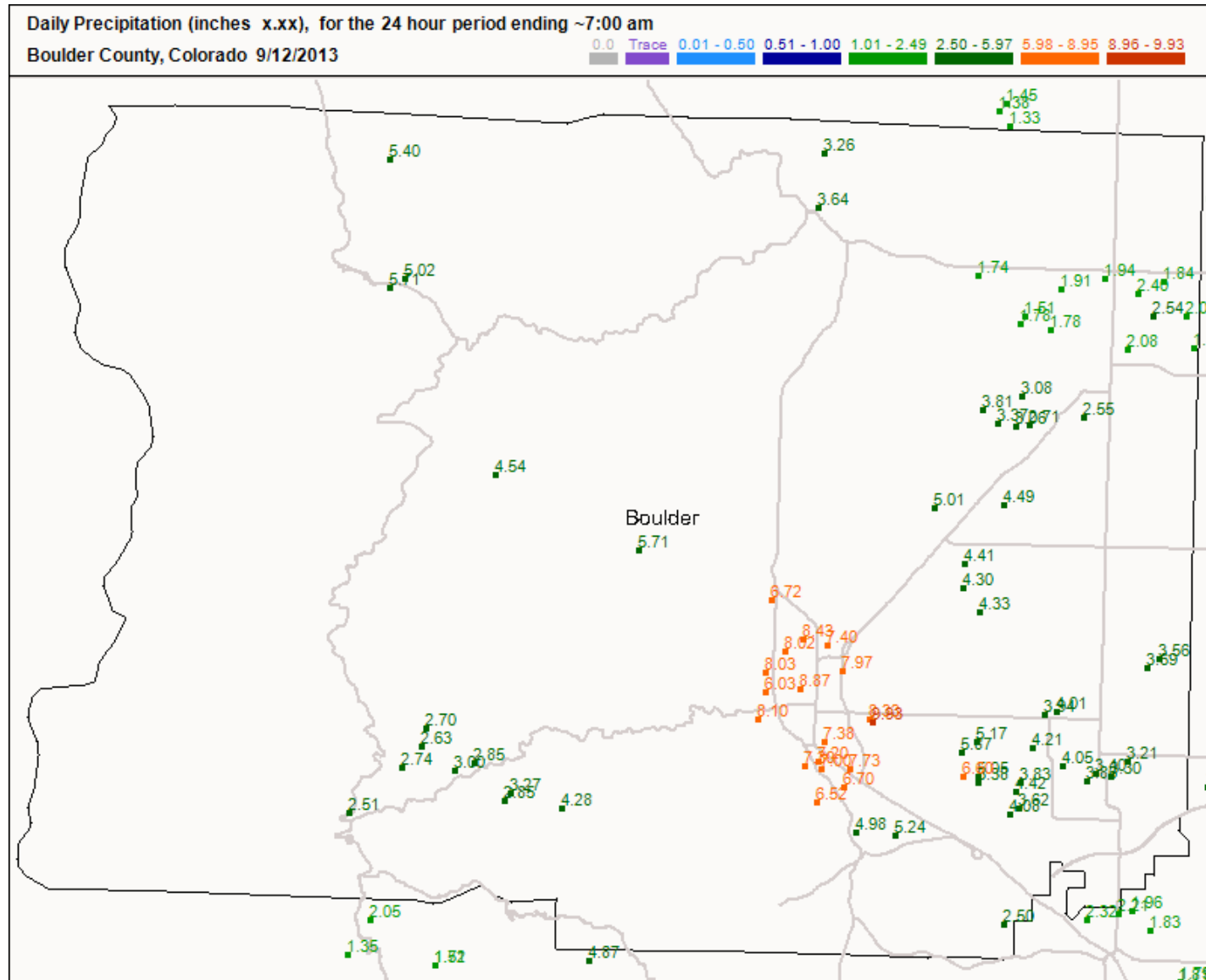
## --The Value of Volunteers --



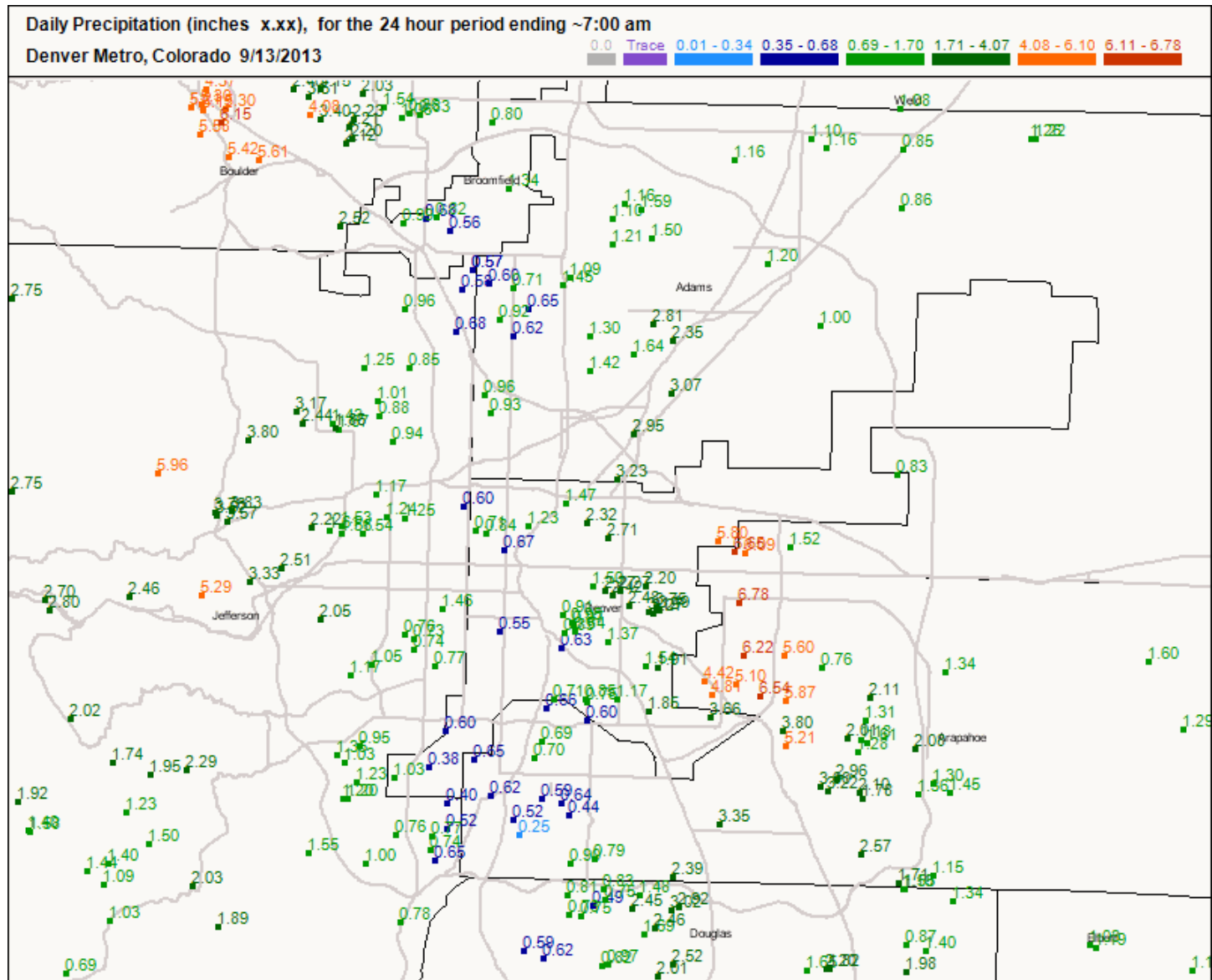
# Thanks for Measuring!!



# 9/12/2013 in Boulder County



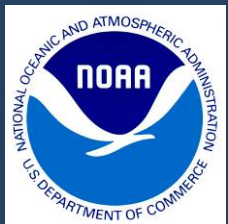
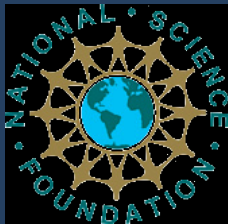
# 9/13/2013 Denver Metro



For information and to volunteer, visit the  
CoCoRaHS Web Site



<http://www.cocorahs.org>



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