Project Update:
An Assessment of Weather and Climate Monitoring Systems in Colorado – "Current Systems, Gaps, and Future Needs"

Assessment conducted by CSU's
Colorado Climate Center
in collaboration with NOAA's
National Weather Service

Presented to Water Availability Task Force
17 August 2016
Denver, CO

Background

- In 2013, the Colorado Department of Public Safety convened the Weather Technical Assistance Partnership (Weather TAP)
- Founder Kenneth Brink – CDPS – took new job outside Colorado in 2014 and the TAP folded, but not quite

Background (continued)

- Before Ken left, he encouraged a proposal to investigate weather and climate data needs specific to Colorado's public safety concerns
- The Colorado Climate Center submitted a draft "Integrated Monitoring" proposal to Ken in spring 2014
- Formal process "HMGP 4145 5% (Other Project Types) Application" became available in July 2014
- HMGP = "Hazard Mitigation Grant Program) FEMA funds distributed through Colorado Dept. of Public Safety

Background (continued)

- Notification of selection March 2015
- Contract completed May 2015
- Project initiated July 2015
- Technical Advisory Group convened Aug 2015
- Meetings with each NWS office Fall-Winter 2015-16
- Presentation to Colorado Emergency Managers Conference March 2016

Key elements:

• Convene a technical advisory group

• Inventory and describe all Colorado weather observing networks including: parameters collected (temperature, precipitation, wind, etc.), temporal frequency of observations (e.g. 5-minute, hourly, once –daily, etc , locations (latitude, longitude, elevation), heights and types of observing equipment, metadata and how data are communicated to outside agencies and the public. Provide maps (GIS layers) for each network and overlays of multiple networks.

• Identify the strengths and also the restrictions and limitations of each network. Identify the issues (like communications) that may be keeping some networks from public data sharing or access to historic data.

Share weather network inventory with federal, state and local jurisdictional stakeholders to broaden the community awareness of available weather data assets and access.

• Conduct surveys and interviews to assess weather and climate needs by stakeholder groups (from citizen to county or city public safety public safety officials to state and federal agencies including the National Weather Service forecast offices, county and state emergency managers, transportation officials, water infrastructure officials).

Continued

- Identify data and information gaps (weather elements, geographic locations, technology communications, etc.) Show these on GIS layers for communicating to partners, participants and potential sponsors.
- Using the combination of resource assessment and needs assessment, define what an effective integrated network would look like and how it could be managed to meet multiple needs.
- Describe how an integrated network can aid with risk assessment and disaster mitigation with essential early warning and potential improvements to weather forecasts (i.e. if data feeds into NWS, surface data can be integrated into short term models to improve local forecasts).

Continued

- Prepare written report addressing the following questions:

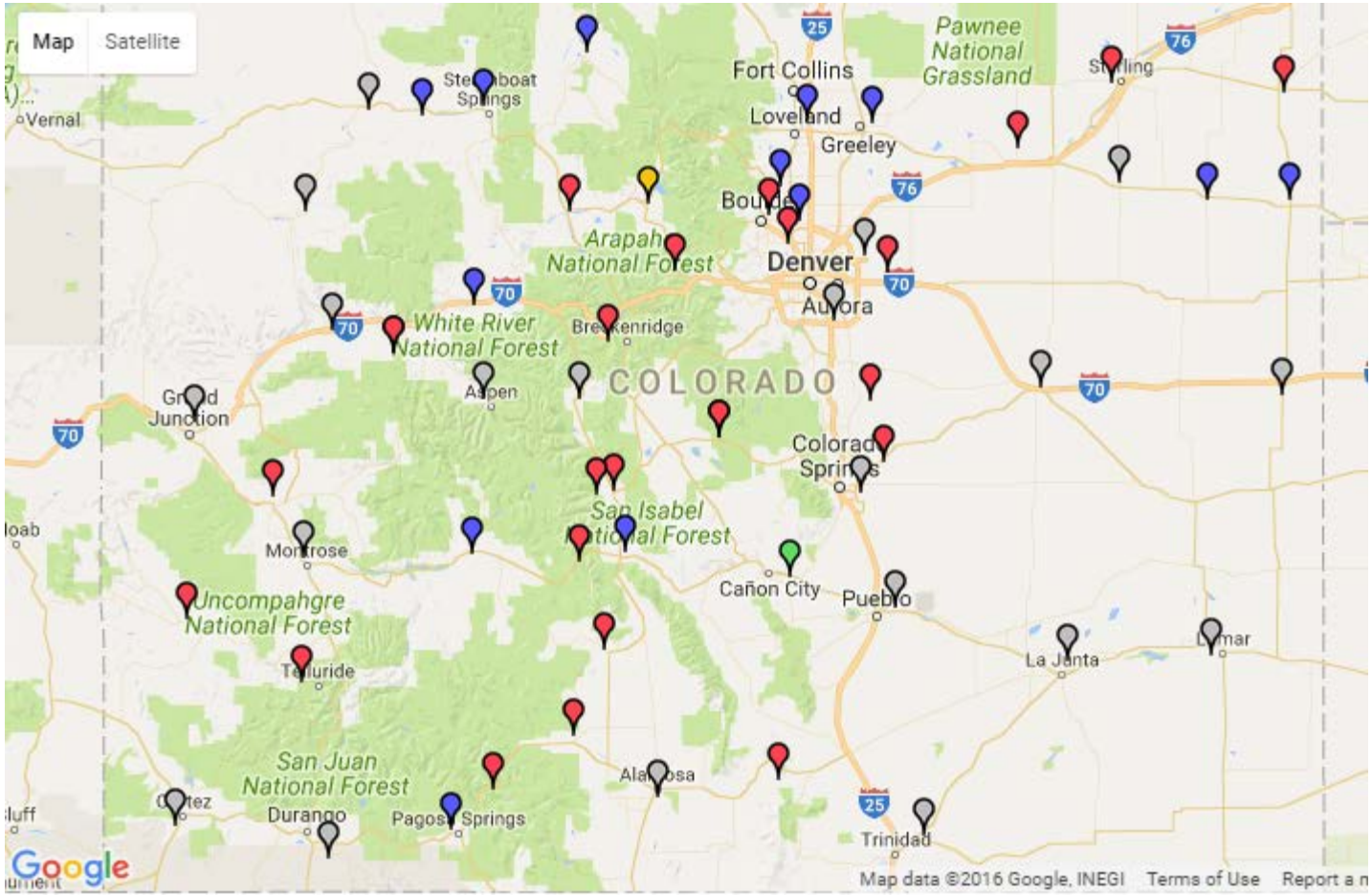
-- Could the myriad of existing networks be integrated to effectively support real time weather forecasting and warning as well as the longer term design, risk assessment, planning and climate adaptation needs?

-- What is the feasibility and cost to integrate the data resources from these many networks into a system that could better serve multiple federal, state, local, private and educational needs?

-- What improvements and enhancements could be done (provide priorities) to create a statewide weather and climate “mesonet” and what would the costs and benefits be for the State?

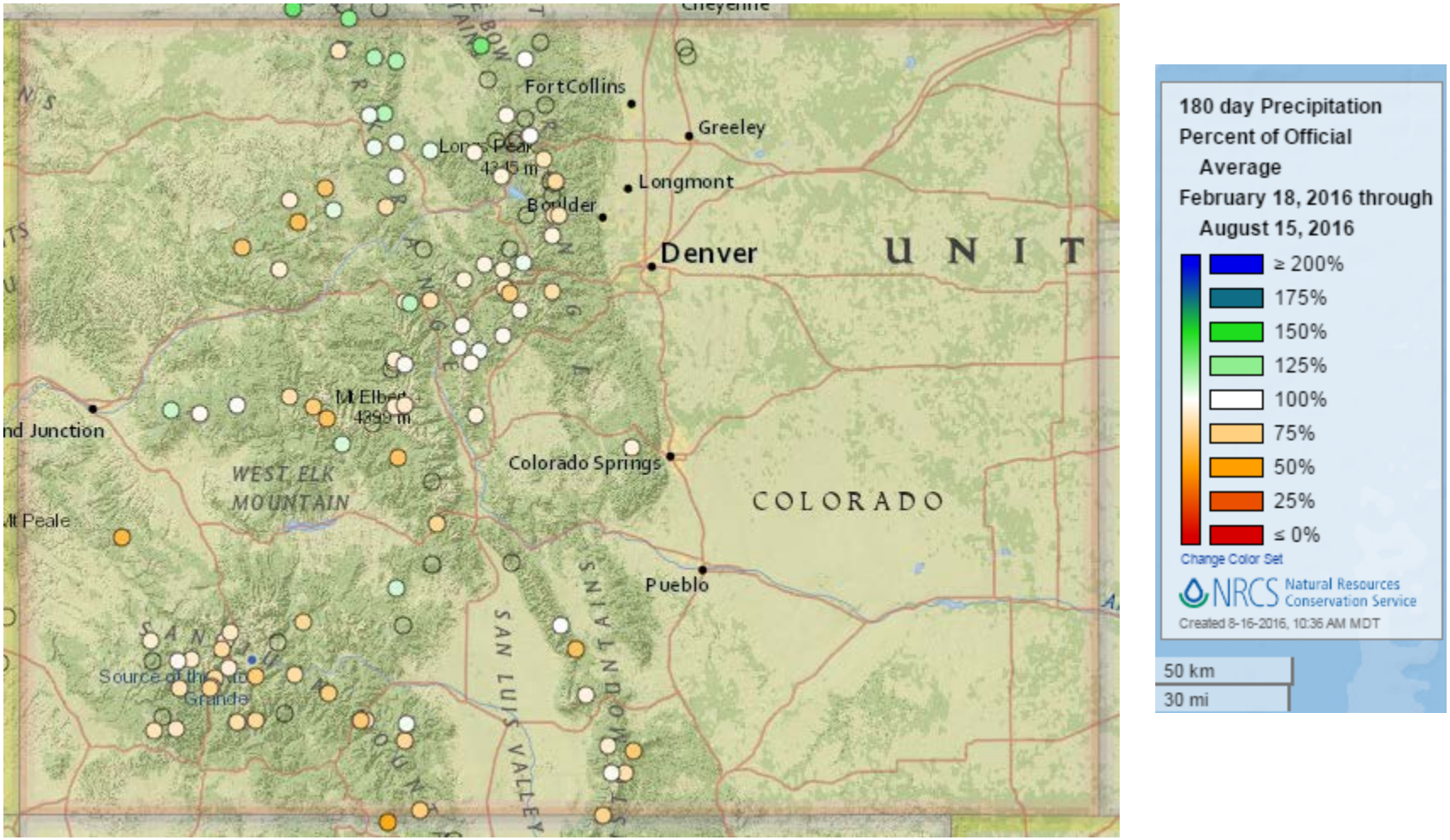
-- Identify activities that local jurisdictions could undertake to fill gaps and improve data resources for their area.

Automated Weather Observing Stations (NWS + FAA)

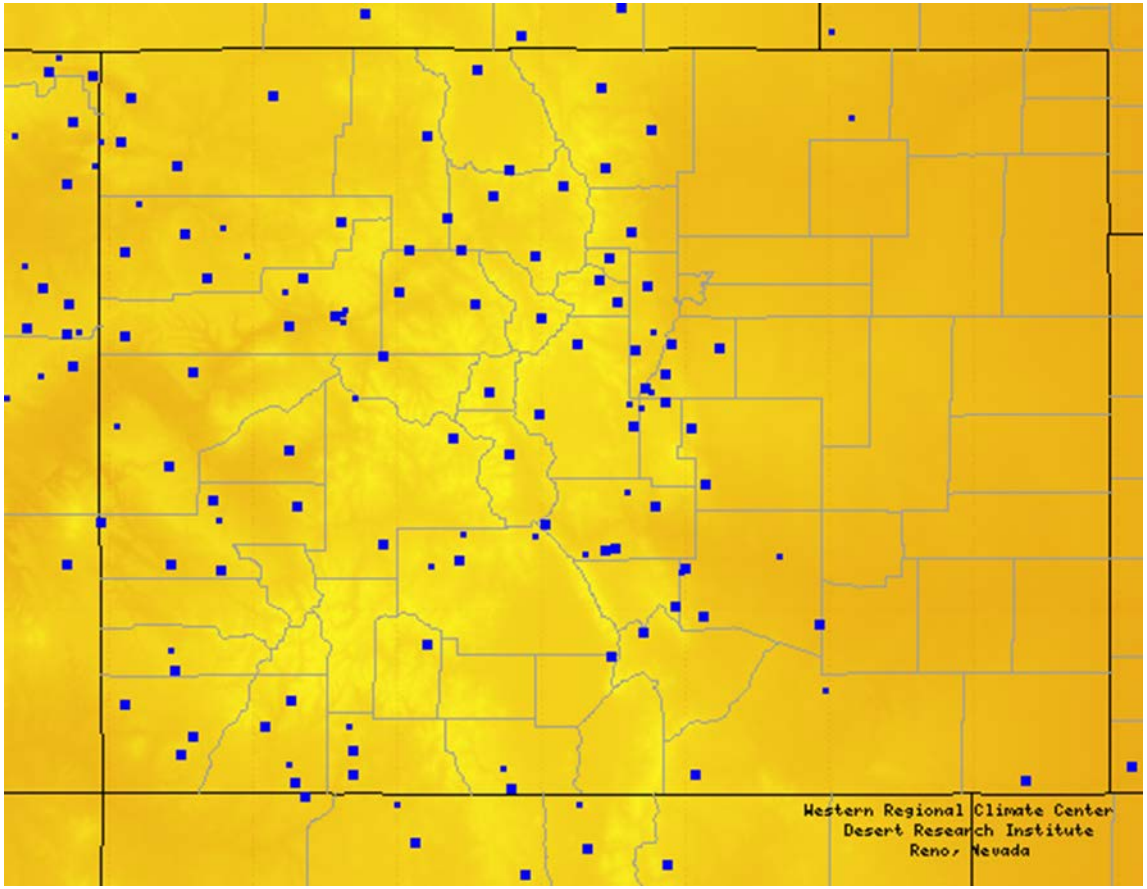


- AWOS A:
- AWOS A/V:
- AWOS I:
- AWOS II:
- AWOS III:
- AWOS IIIP:
- AWOS IIIT:
- AWOS IIIP/T:
- ASOS:
- AWSS:
- AWOS IV:

Snowpack Telemetry Network



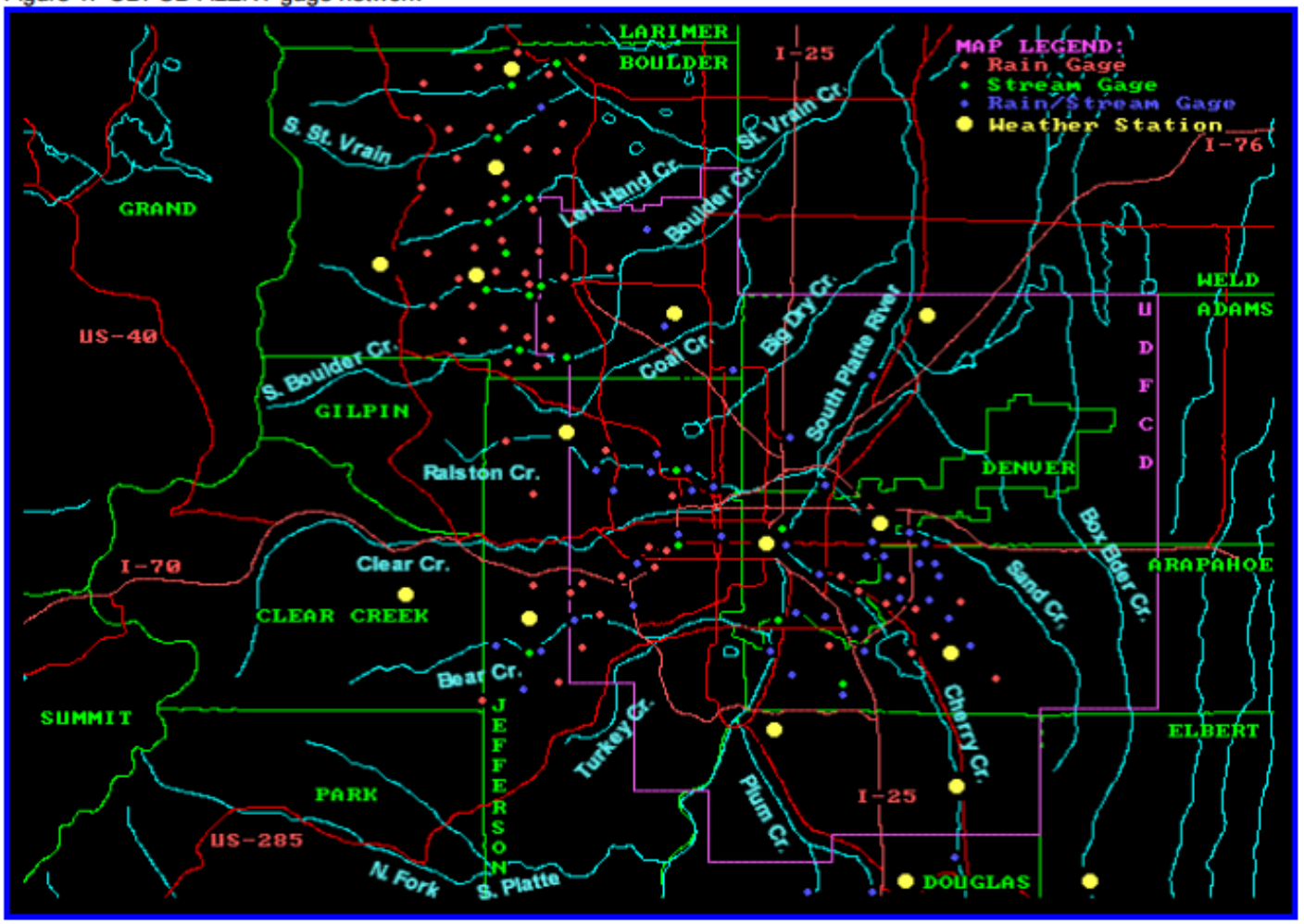
Remote Automatic Weather Stations



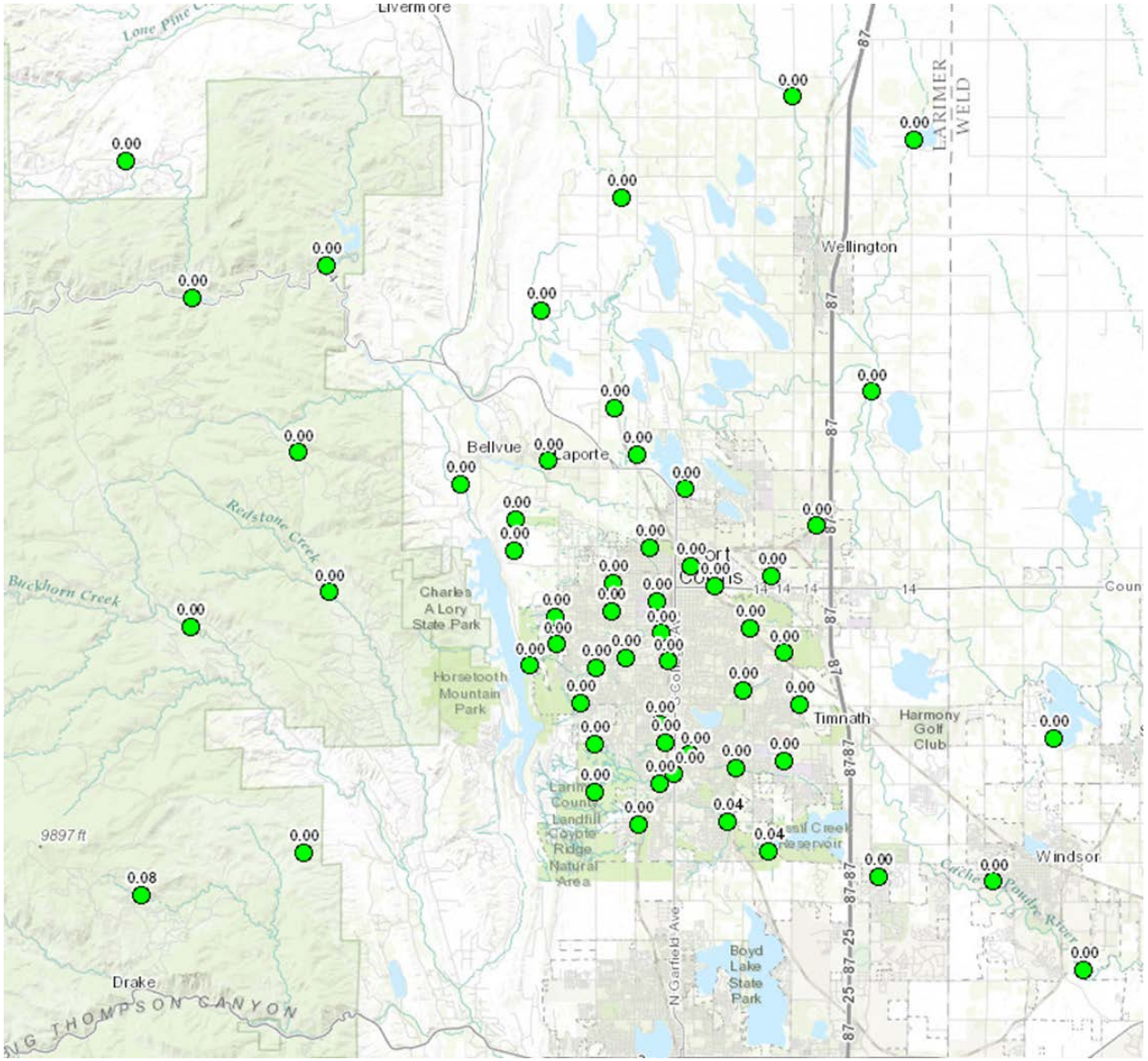
- Large blue squares = active station
- Small blue squares = inactive station

Alert System (Urban Drainage Flood Control District)

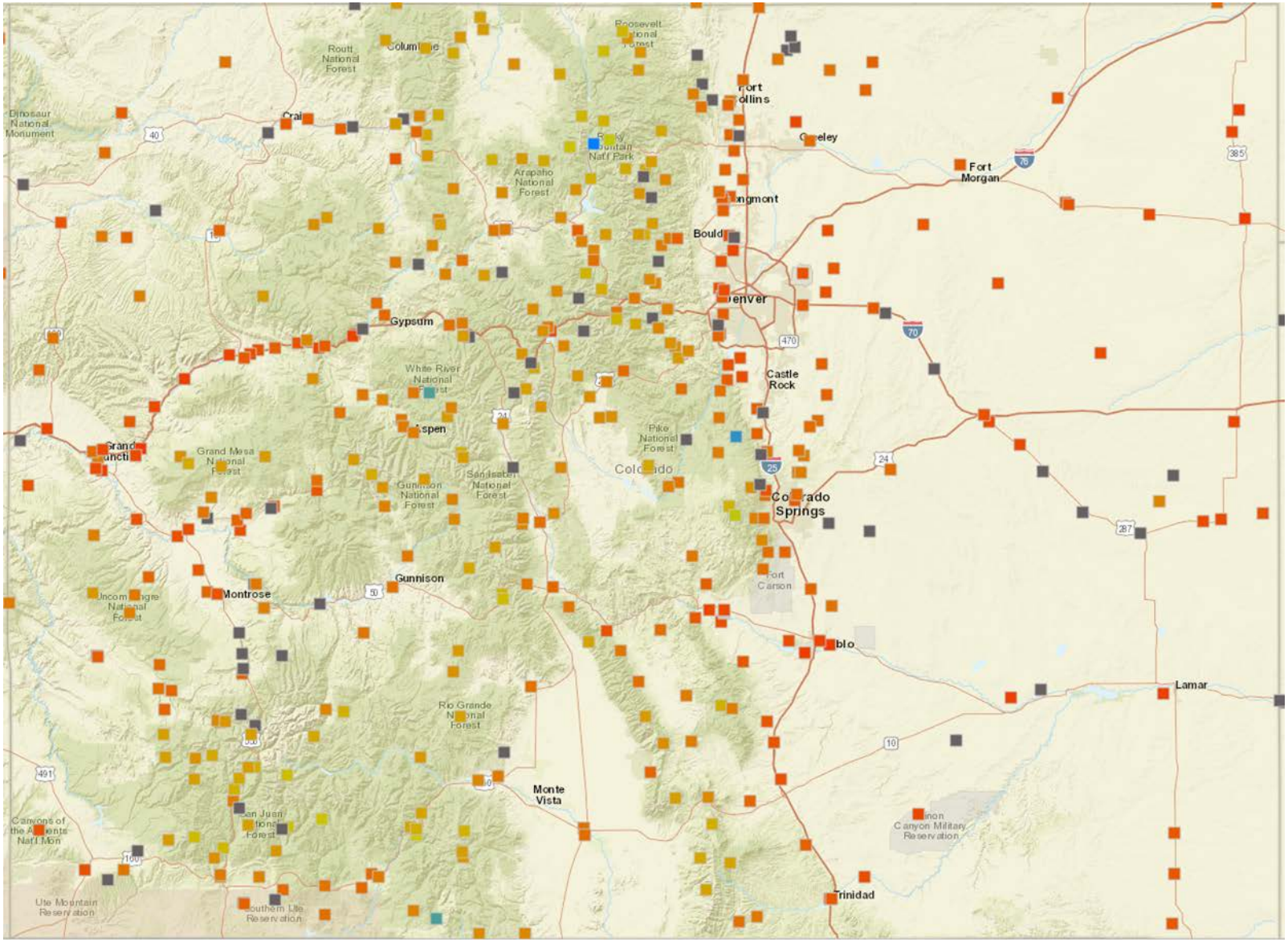
Figure 1. UDFCD ALERT gage network



Alert Systems (Fort Collins Flood Warning System)

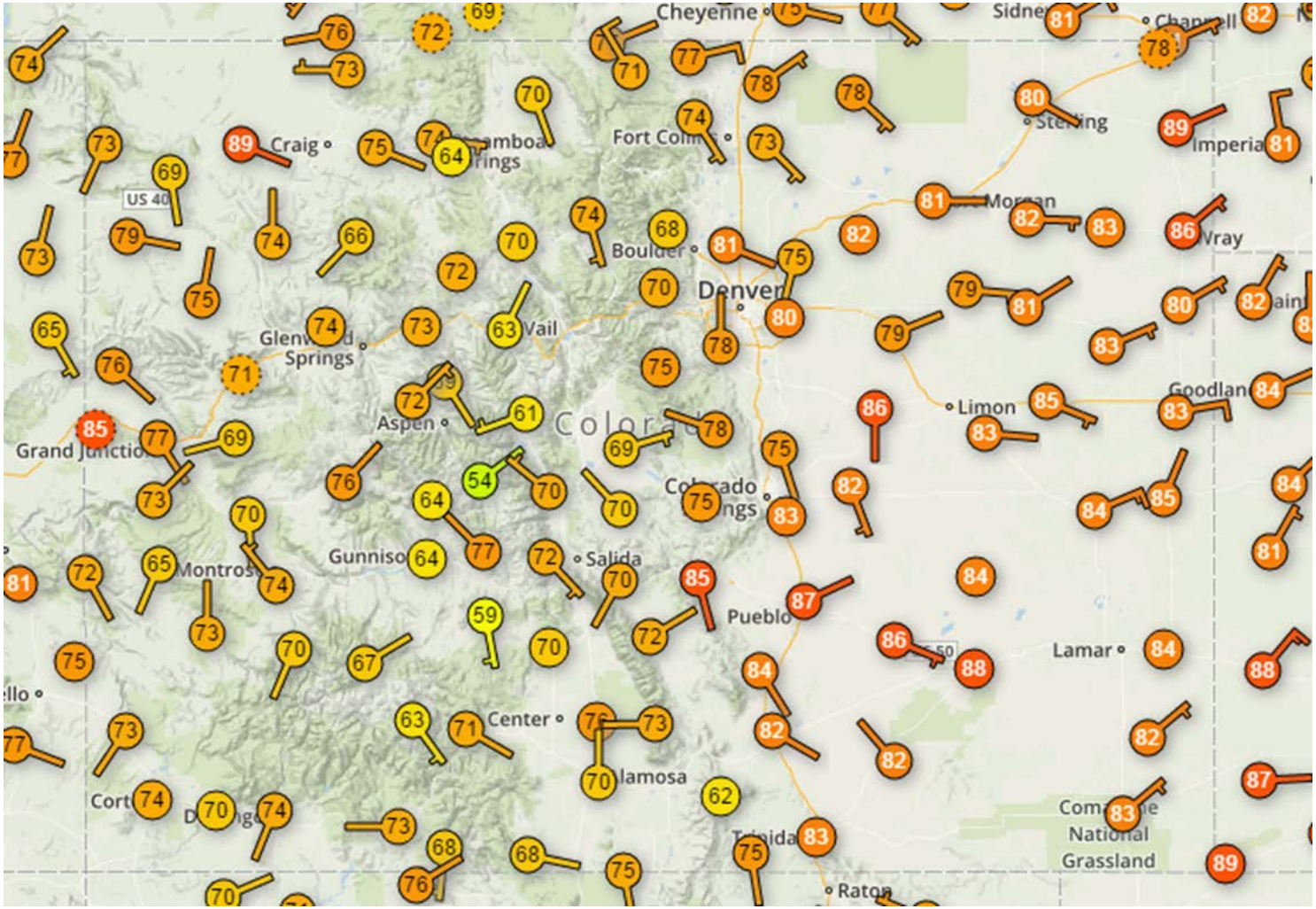


MADIS: 748 Colorado Stations Ingested



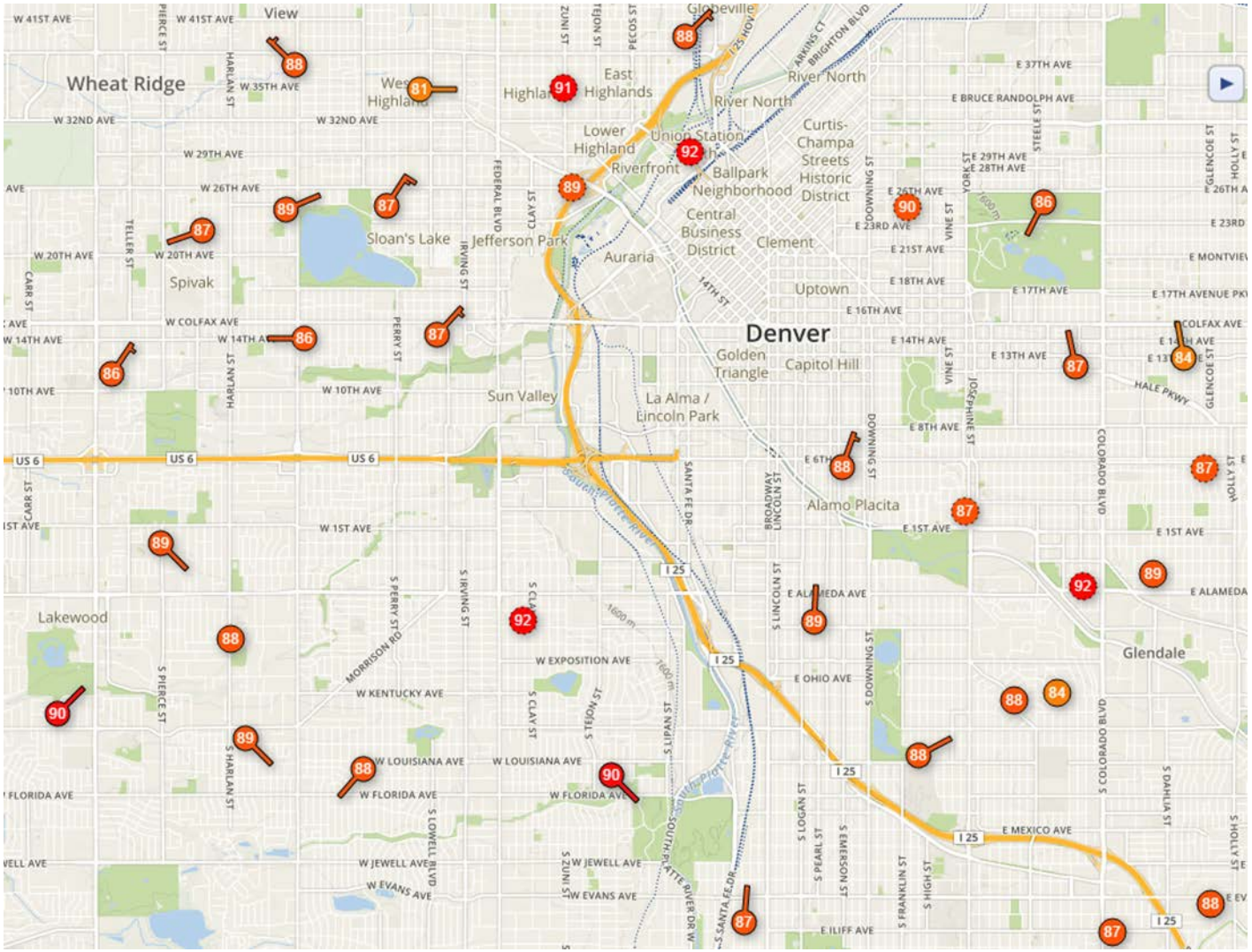
Weather Underground

- Over 3000 stations in Colorado

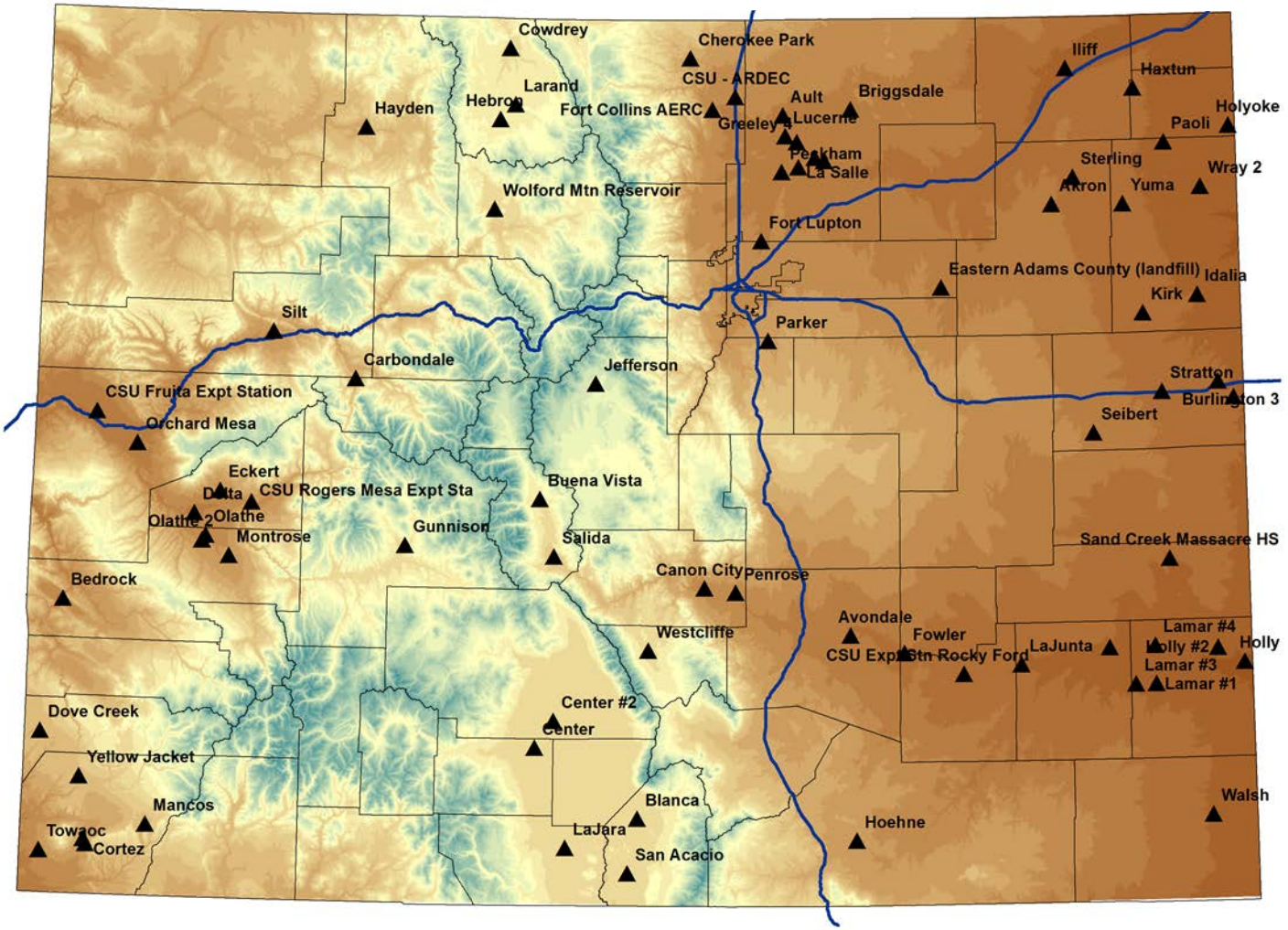


Weather Underground

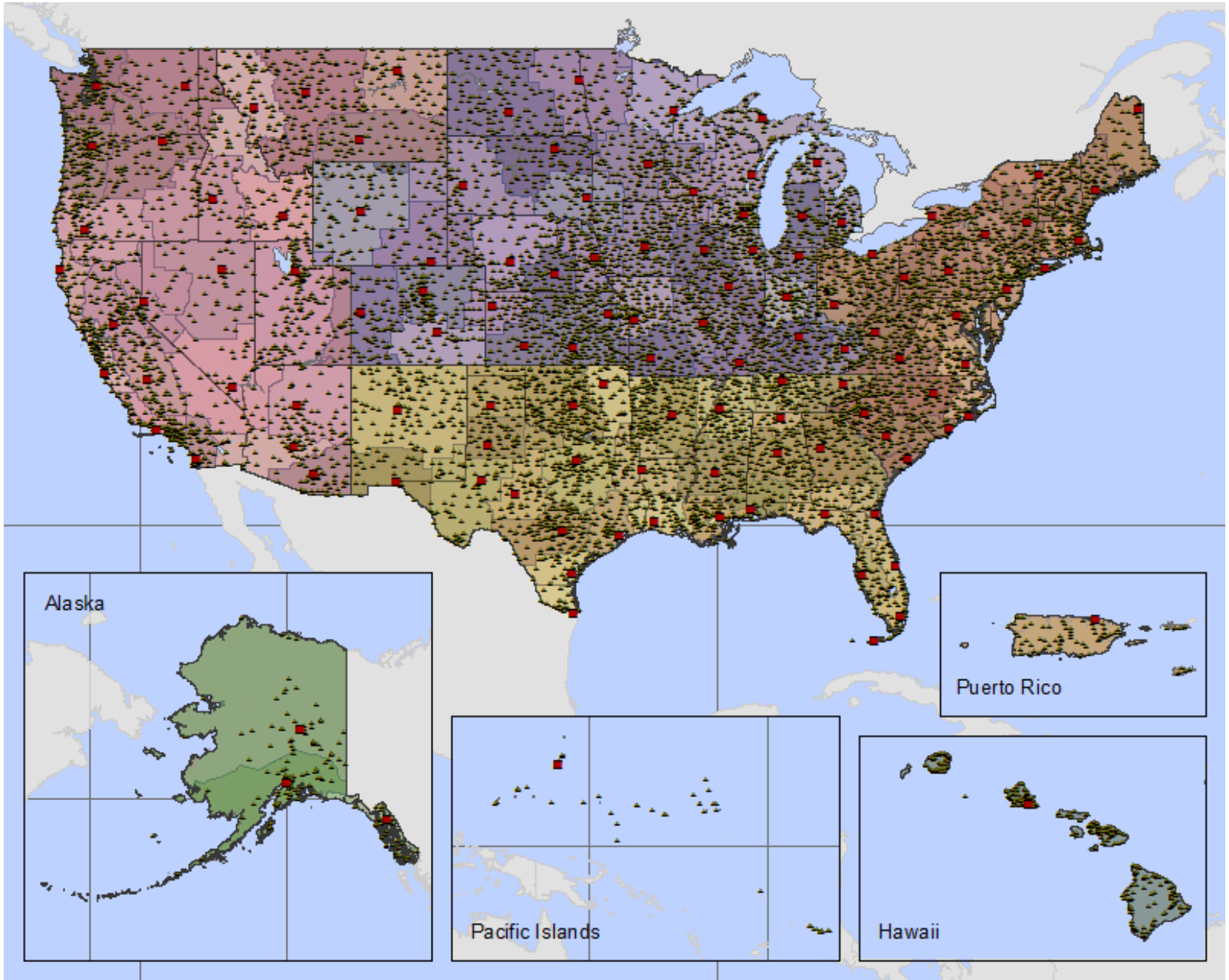
- High concentration in urban environments



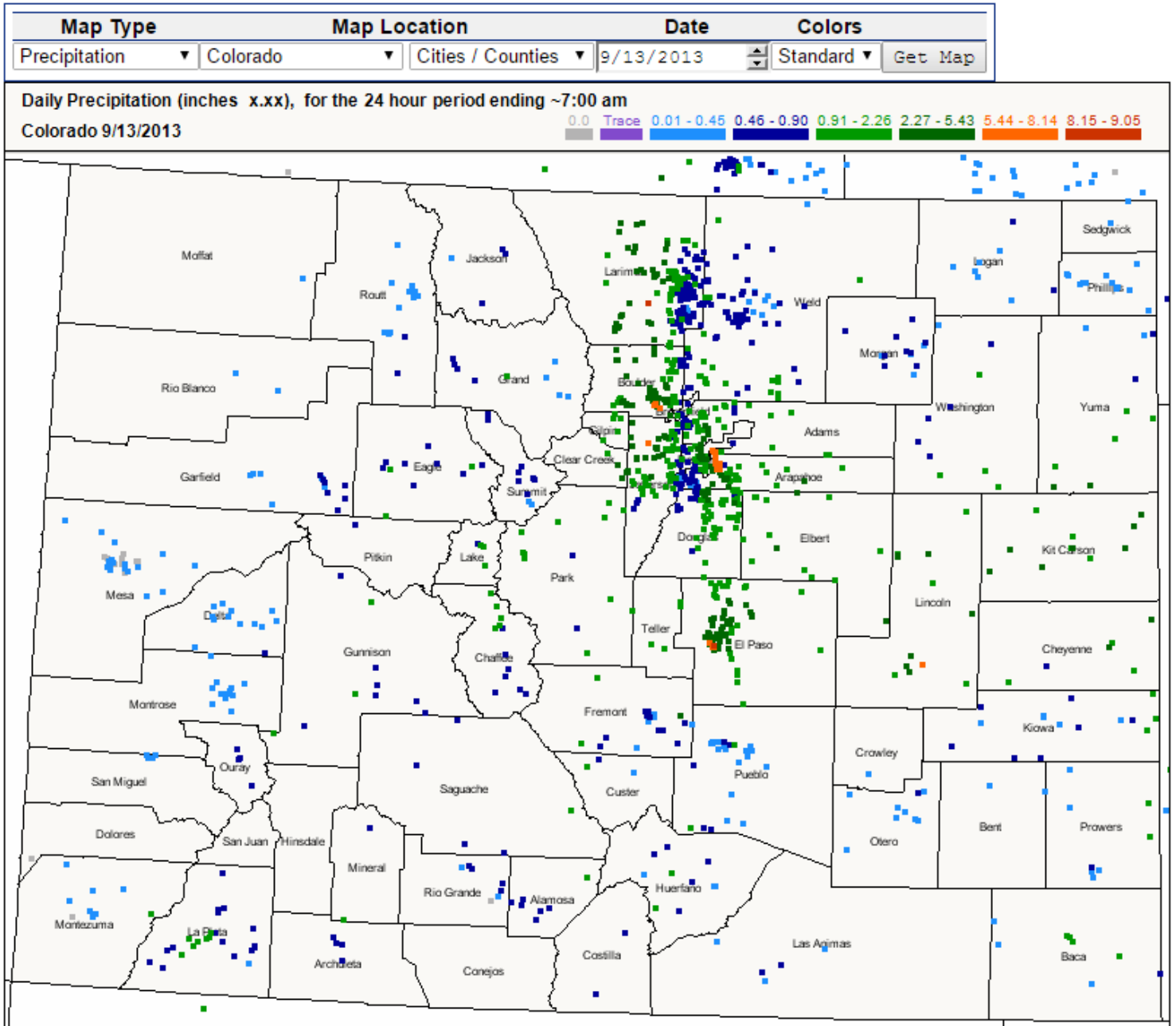
Colorado Agricultural Meteorological Network

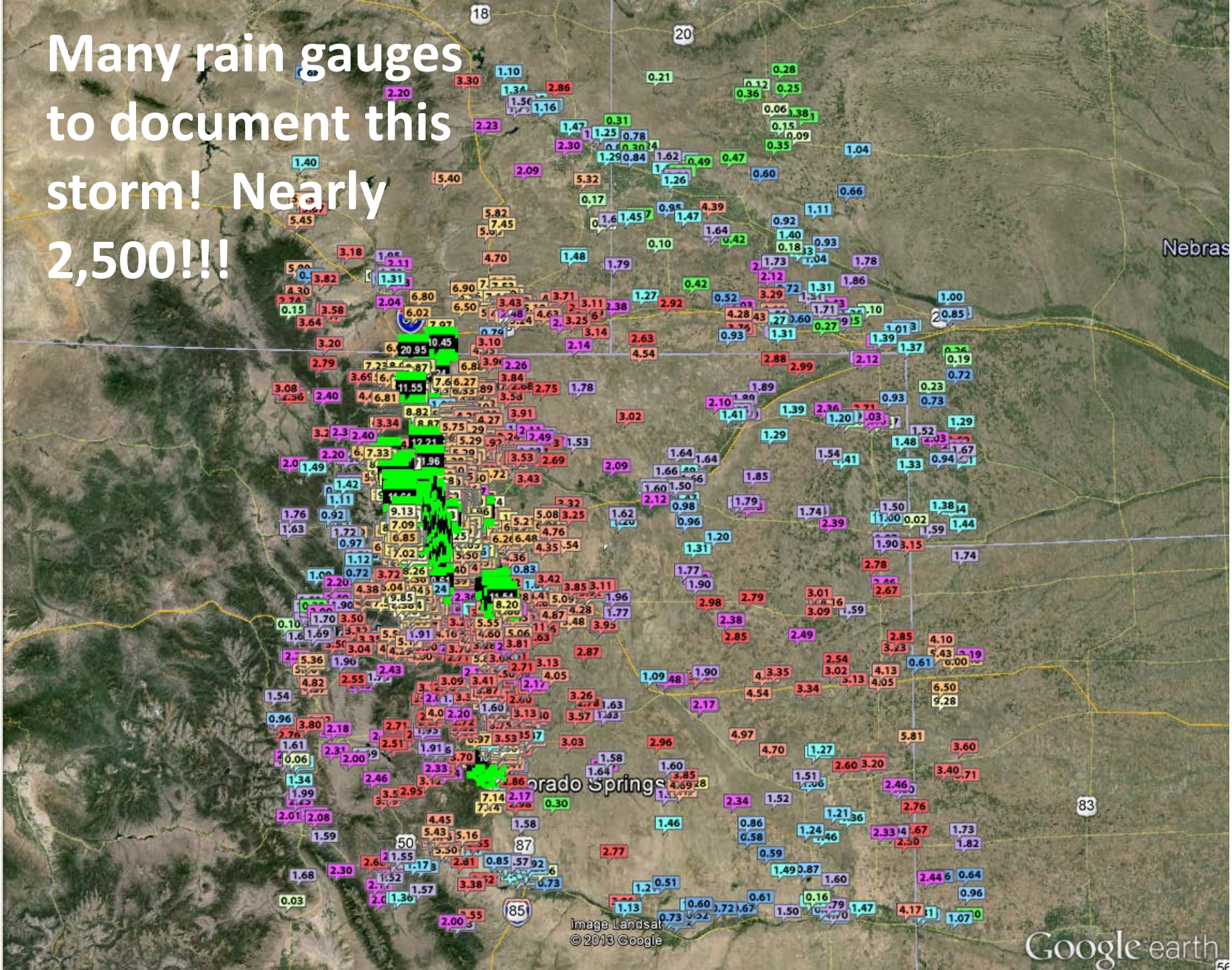


This is it -- Our COOPERATIVE Network ~2010

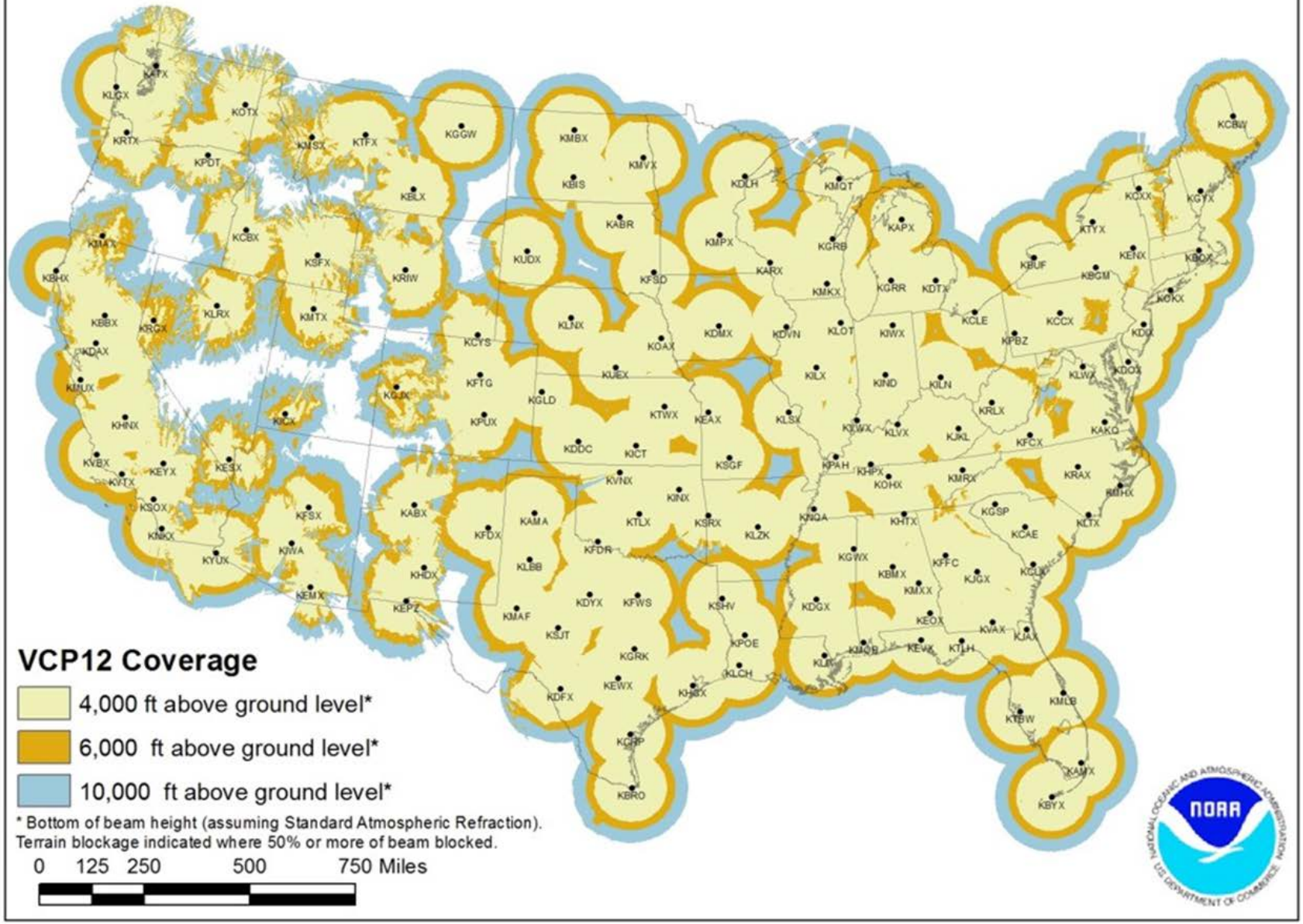


CoCoRaHS


Map Type
Map Location
Date
Colors
Precipitation
Colorado
Cities / Counties
9/13/2013
Standard
Get Map
Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Colorado 9/13/2013
0.0
Trace
0.01 - 0.45
0.46 - 0.90
0.91 - 2.26
2.27 - 5.43
5.44 - 8.14
8.15 - 9.05
Moffat
Routt
Jackson
Larimer
Weld
Logan
Sedgwick
Phillips
Rio Blanco
Grand
Boulder
Morgan
Washington
Yuma
Garfield
Eagle
Summit
Clear Creek
Adams
Arapahoe
Douglas
Elbert
Kit Carson
Pitkin
Lake
Park
Mesa
Delta
Gunnison
Chaffee
Teller
El Paso
Lincoln
Cheyenne
Montrose
Fremont
Kiowa
Ouray
San Miguel
Saguache
Custer
Pueblo
Crowley
Dolores
San Juan
Hinsdale
Mineral
Rio Grande
Alamosa
Huerfano
Otero
Bent
Prowers
Montezuma
La Plata
Archuleta
Conejos
Costilla
Las Animas
Baca

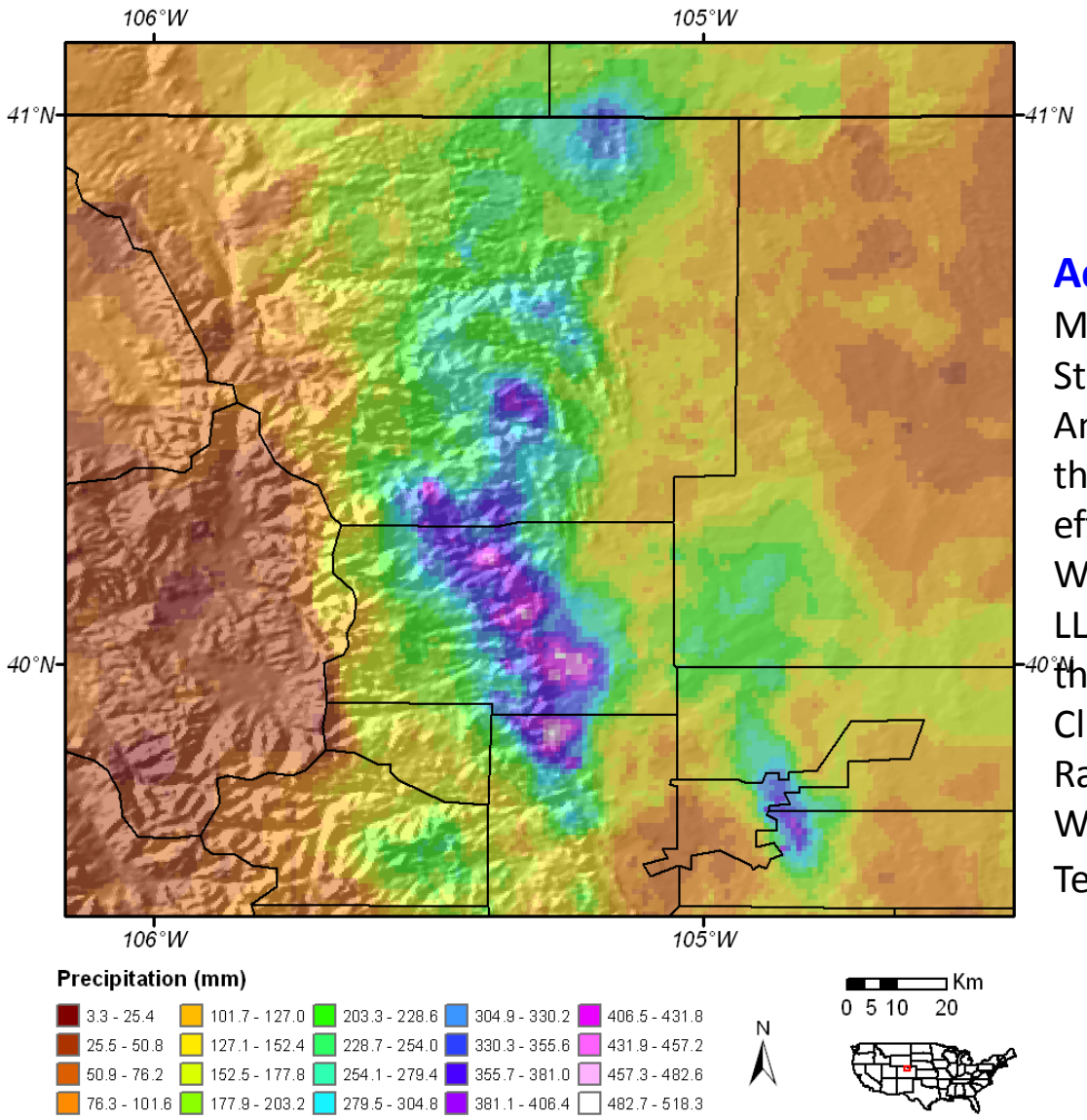

Many rain gauges to document this storm! Nearly 2,500!!!
Nebras
Image Landsat
© 2013 Google
Google earth

NEXRAD Coverage Below 10,000 Feet AGL



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.

Great progress has been made since 1976

(40th anniversary just remembered of the Big Thompson Flood 31 July 1976)

Most treasured data sets for public safety

-- Radar

-- Flood Warning Systems

-- real time precip and stream gauges

-- WebCams CDOT + Other

-- SNOTEL for snow

-- RAWS for fire weather

-- ASOS and AWOS for aviation

-- NWS COOP for drought/long-term climate

-- CoCoRaHS for rain and snow

"validation"

But any weather observation
in the right place
and at the right time
is the most important
– at that moment --

Gaps have shrunk but still remain

-- RADAR , all corners of state but especially SW

-- CoAgMet not yet available to NWS

-- still not nearly enough rain gauges

-- snowfall data shaky and many areas unmonitored

-- need higher time resolution (=< 5-min)

-- several holes in surface obs network

Different “Uses” have different “Gaps”

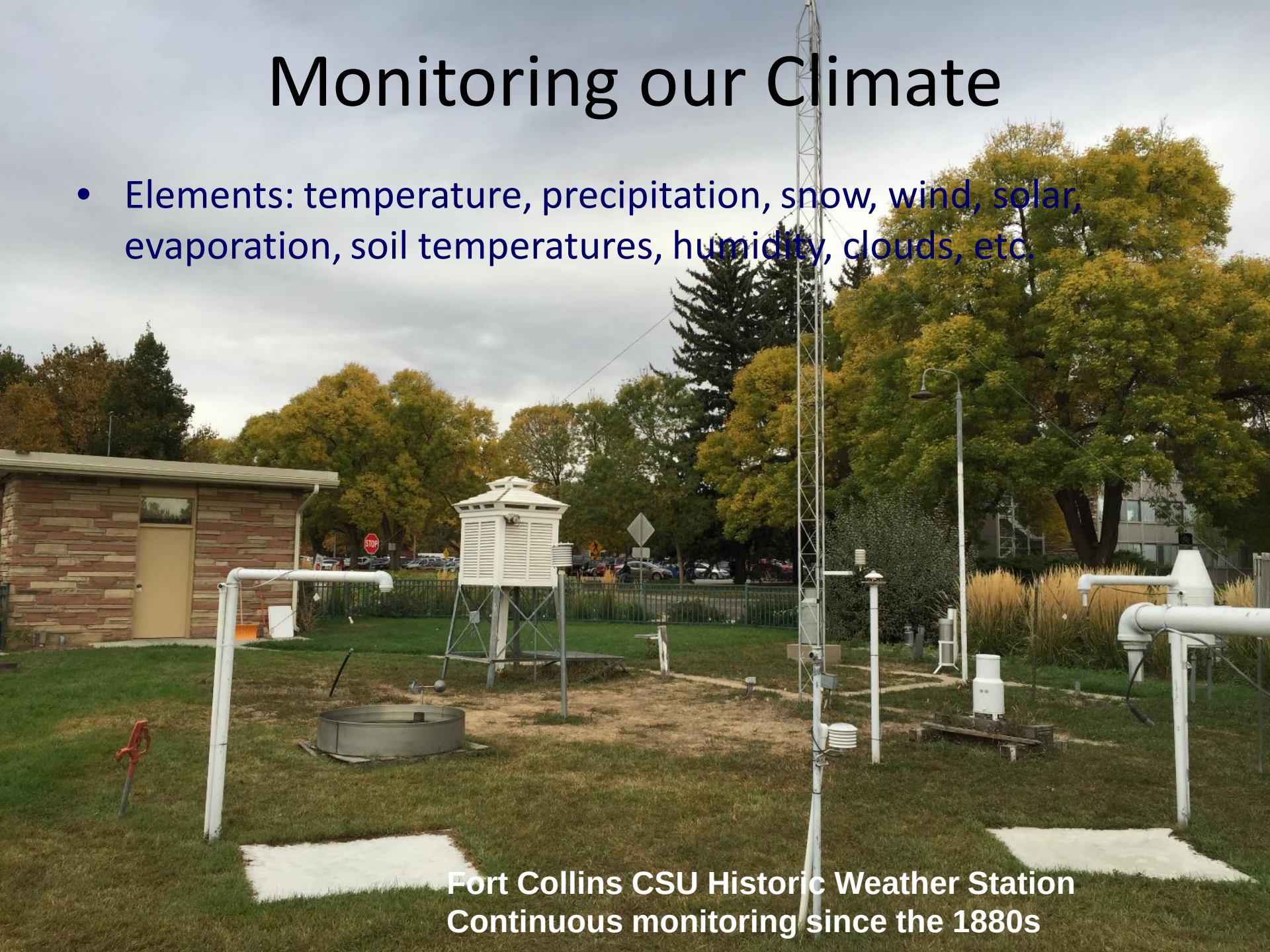
What are yours?

Please fill out the “Weather Data Needs Assessment” and return to Nolan Doesken
Colorado Climate Center

Deadline: 30 September 2016

Monitoring our Climate

- Elements: temperature, precipitation, snow, wind, solar, evaporation, soil temperatures, humidity, clouds, etc.



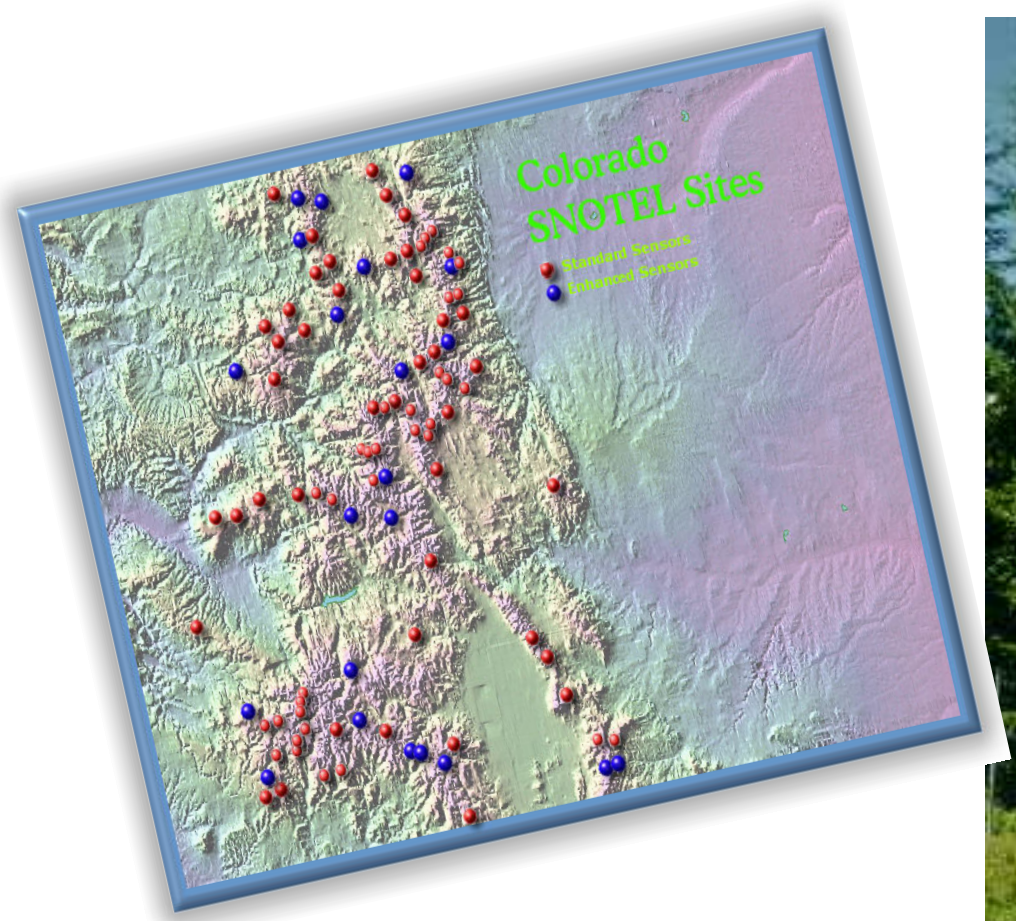
Fort Collins CSU Historic Weather Station
Continuous monitoring since the 1880s

The National Weather Service still faithfully maintains a "taken for granted" network of weather stations in Colorado and across the country – the Cooperative Observer Network

Photo by Christopher Davey


Credit: NOAA Photo Library

USDA, Natural Resources Conservation Service



And all the others collecting weather and climate data –MANY SOURCES


Thank you!