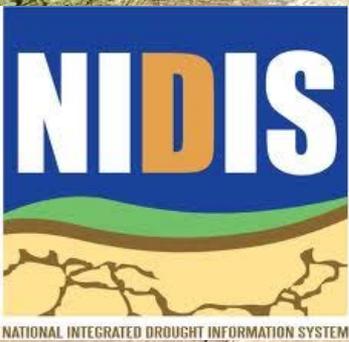


EXPERIENCES FROM THE NIDIS UPPER COLORADO RIVER BASIN DROUGHT EARLY WARNING SYSTEM

Colorado Climate Center
Dept of Atmospheric Science
Colorado State University



Our UCRB DEWS team

- ▣ Becky Bolinger (Smith) PhD student – weekly monitoring, reservoirs, water balance, supply/demand, seasonal prediction
- ▣ Morgan Phillips (MS Student) – snow sublimation
- ▣ Peter Goble (MS Student – Soil moisture monitoring) Wendy Ryan – data collection and integration, weekly monitoring (precip. ET) state coordination
- ▣ Zach Schwalbe – weekly monitoring (snowpack)
- ▣ Noah Newman – Webinar logistics
- ▣ Henry Reges – Drought impact reporting, weekly communications
- ▣ Nolan Doesken – Stakeholder engagement, interstate coordination, management, outreach, and evaluation

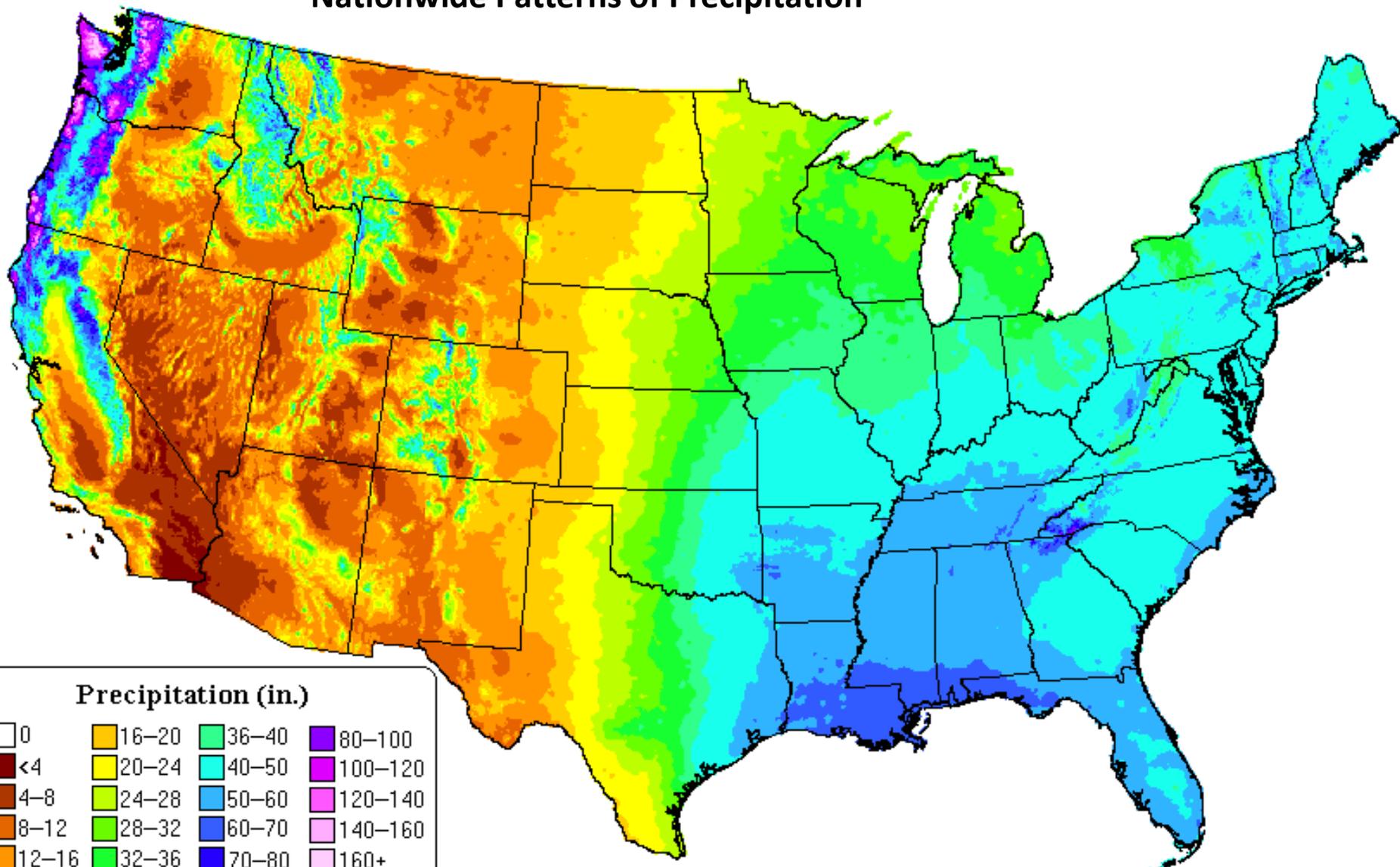
The Colorado River Basin

- Majority of the land in the UCRB is federally owned and managed:
- USDA/FS
- USDI/BLM
- USDI/NPS



Precipitation: Annual Climatology (1981-2010)

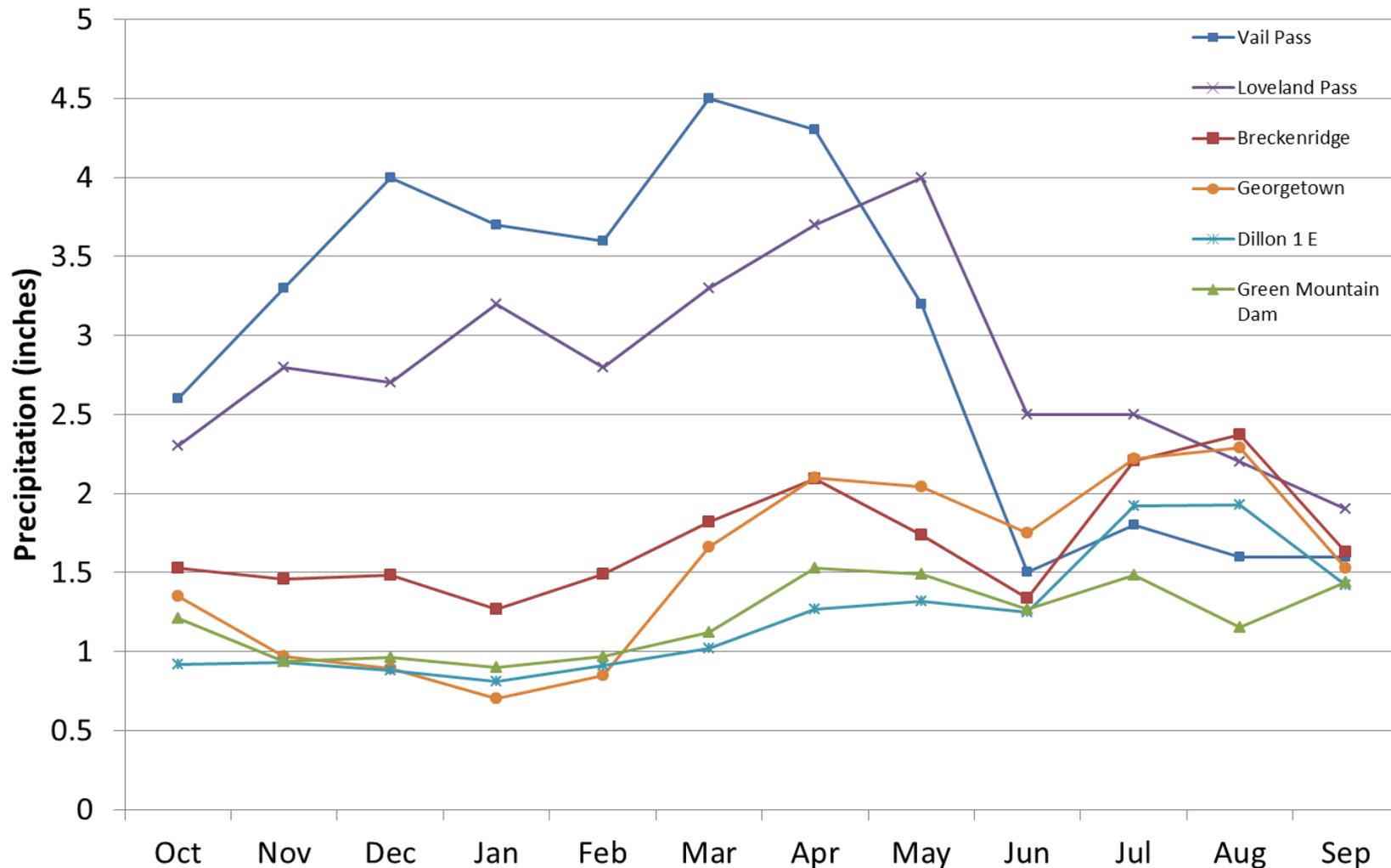
Nationwide Patterns of Precipitation



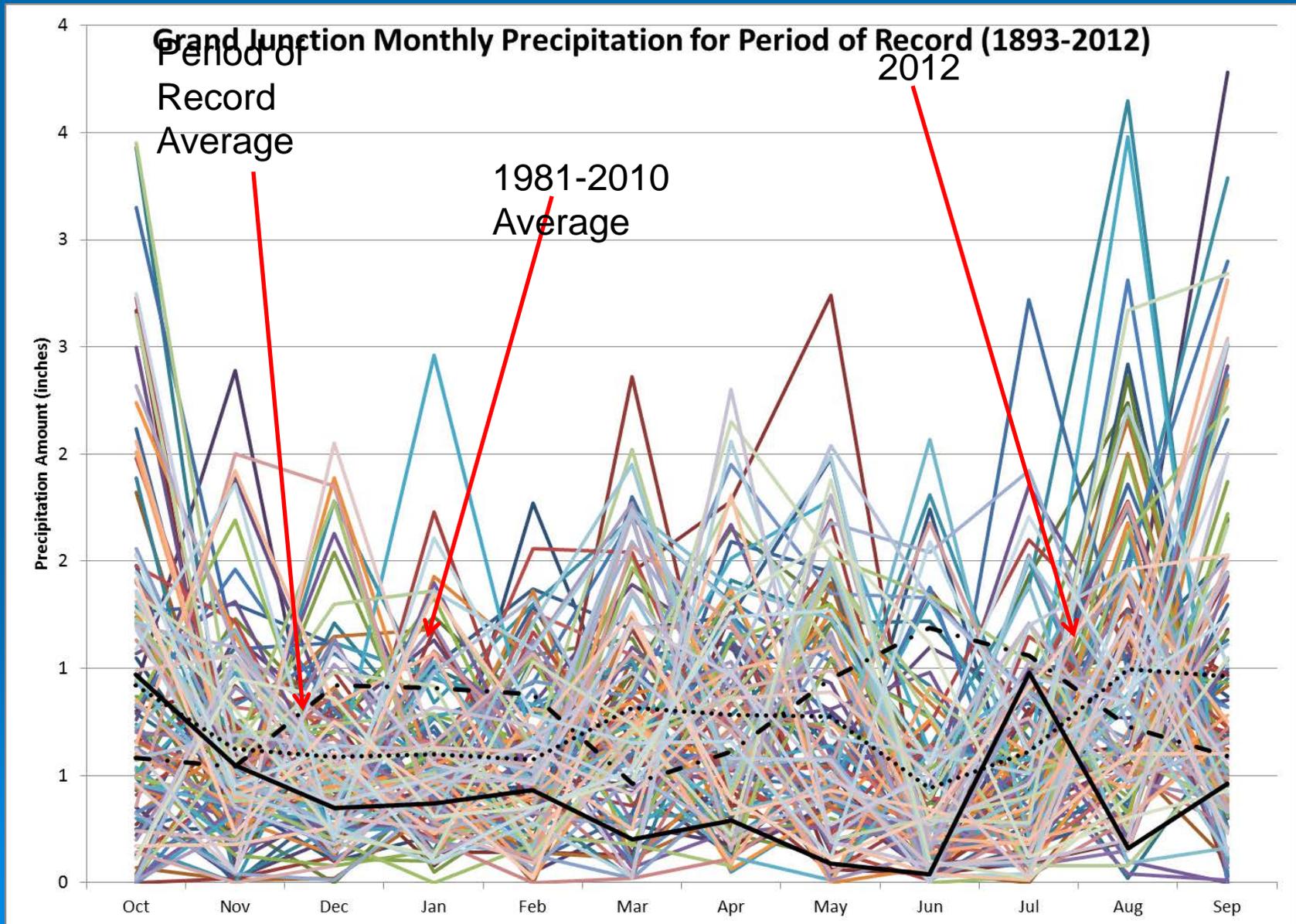
Copyright (c) 2012, PRISM Climate Group, Oregon State University
<http://prism.oregonstate.edu> - Map created Jul 10 2012

Complex “Seasonality” varying with lat/long and elevation

Average Monthly Precipitation



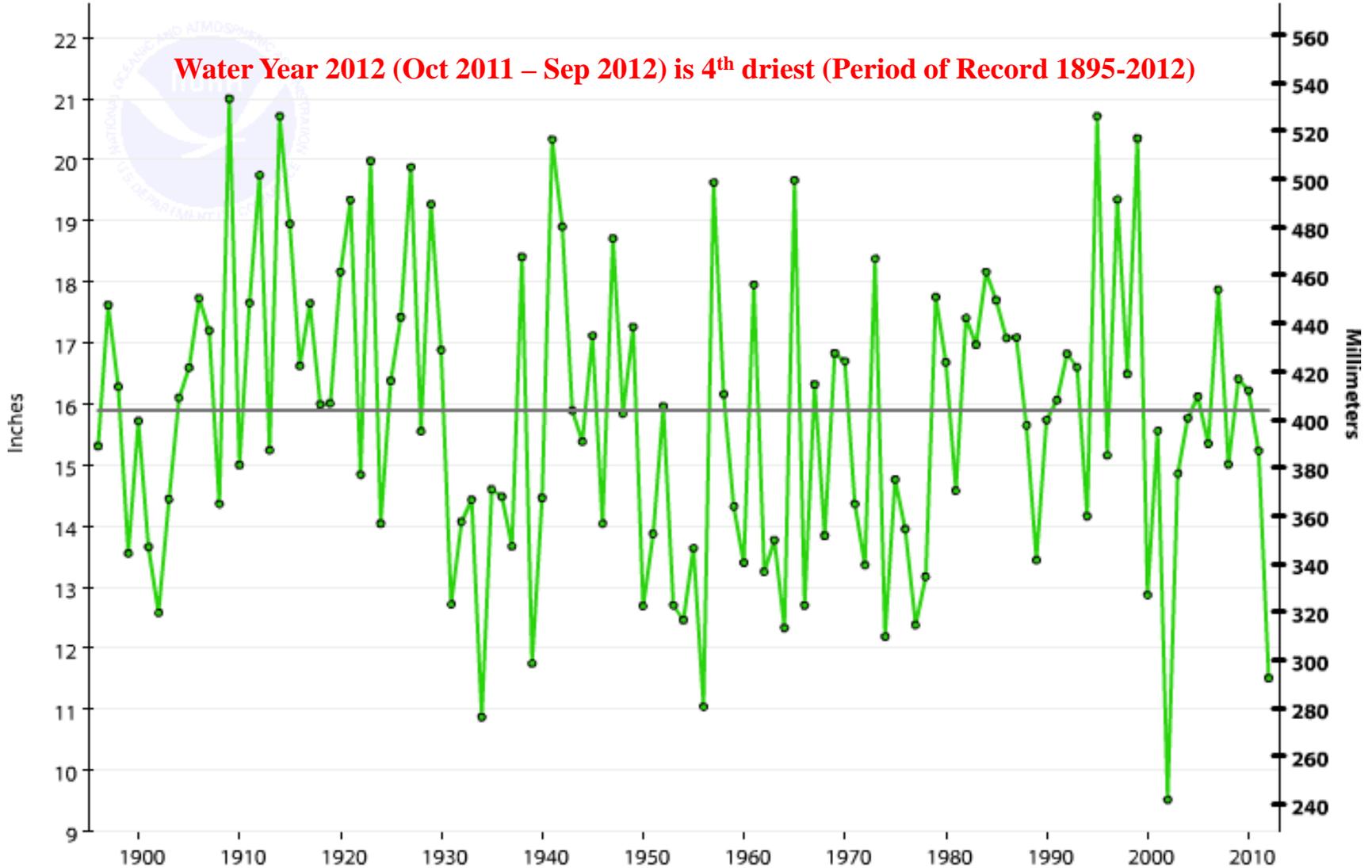
Average is nice: but variability is reality



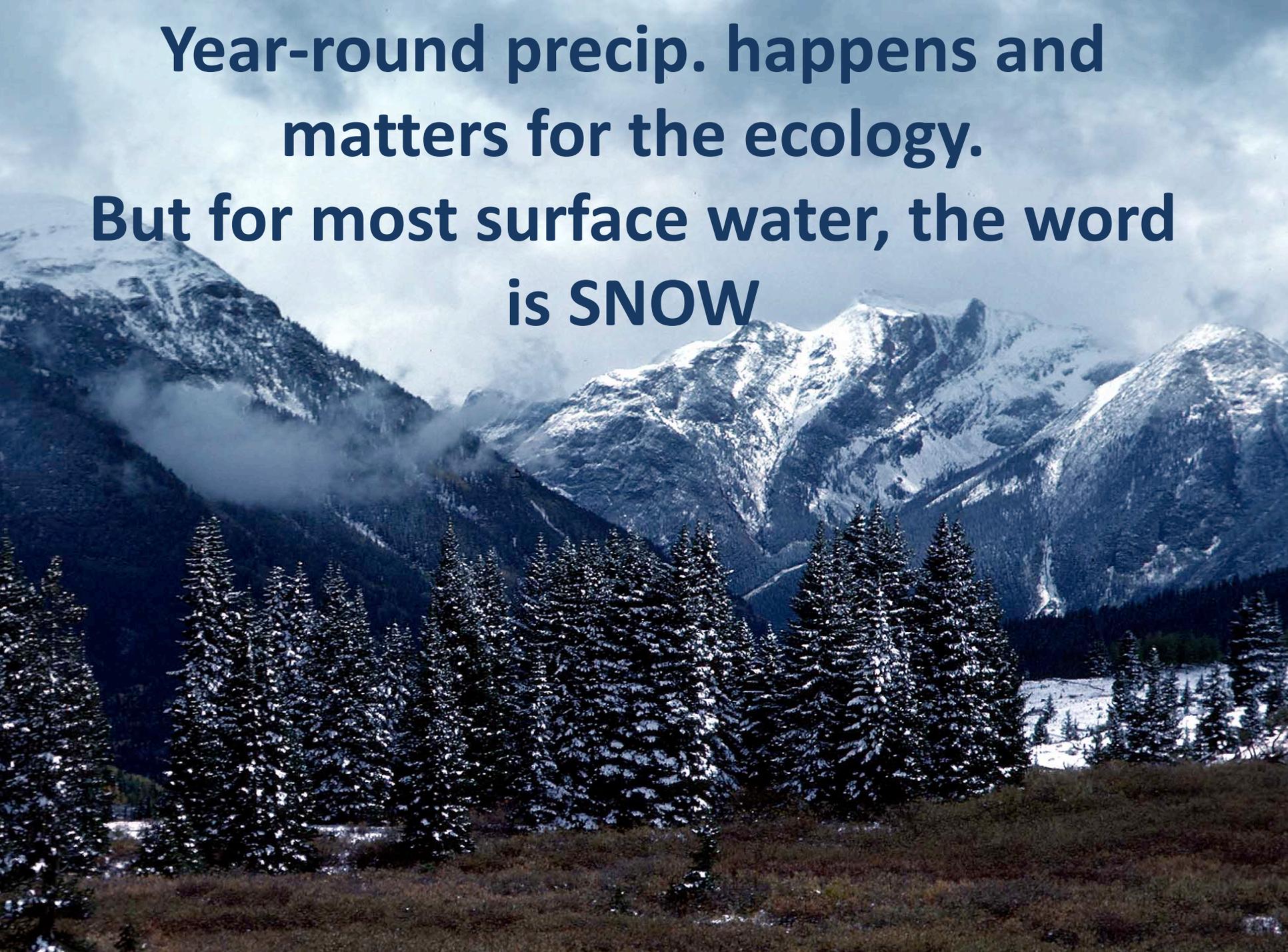
Colorado Precipitation in Historic Perspective

Colorado, Precipitation, October-September

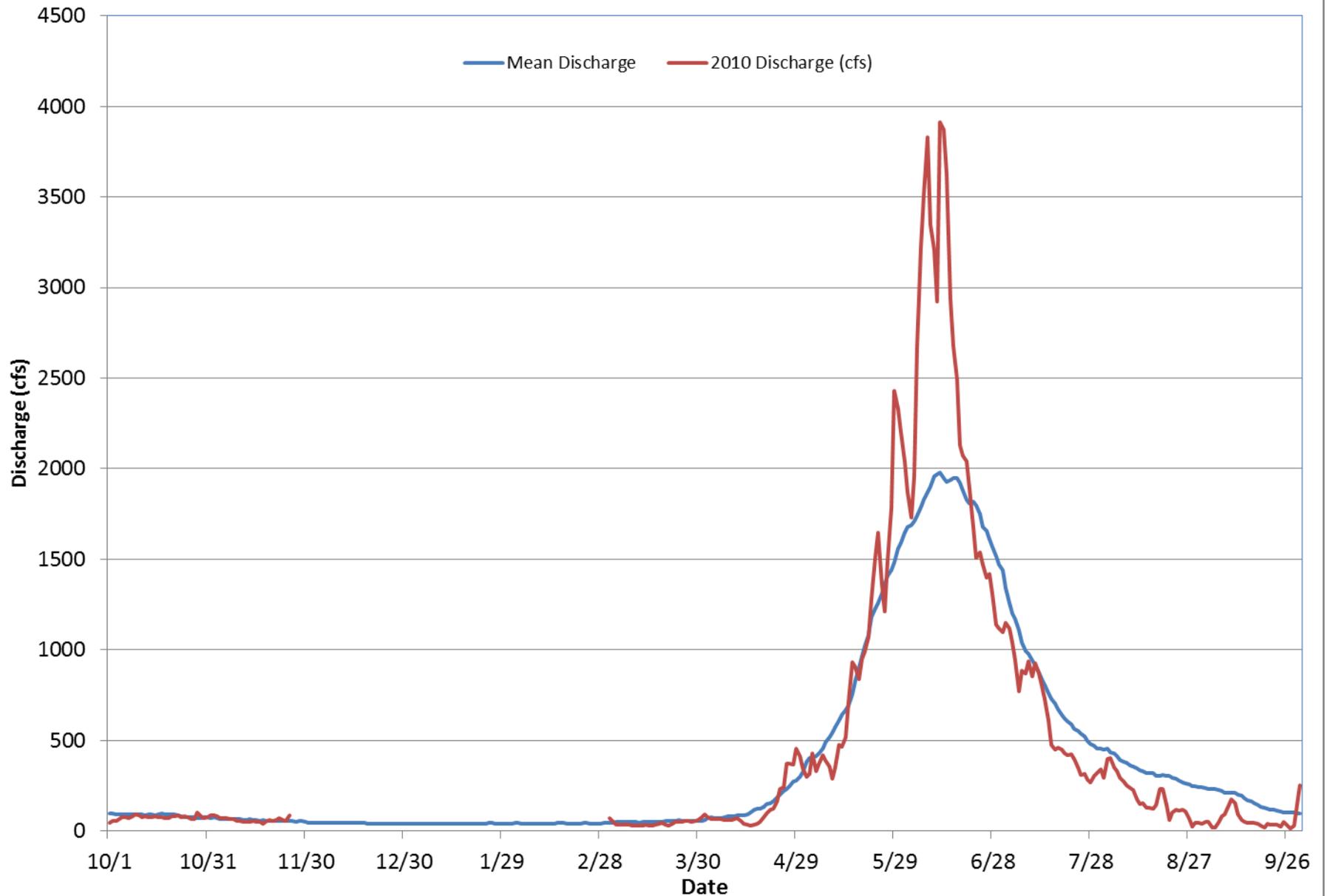
— 1901-2000 Avg: 15.90" —●— Precip



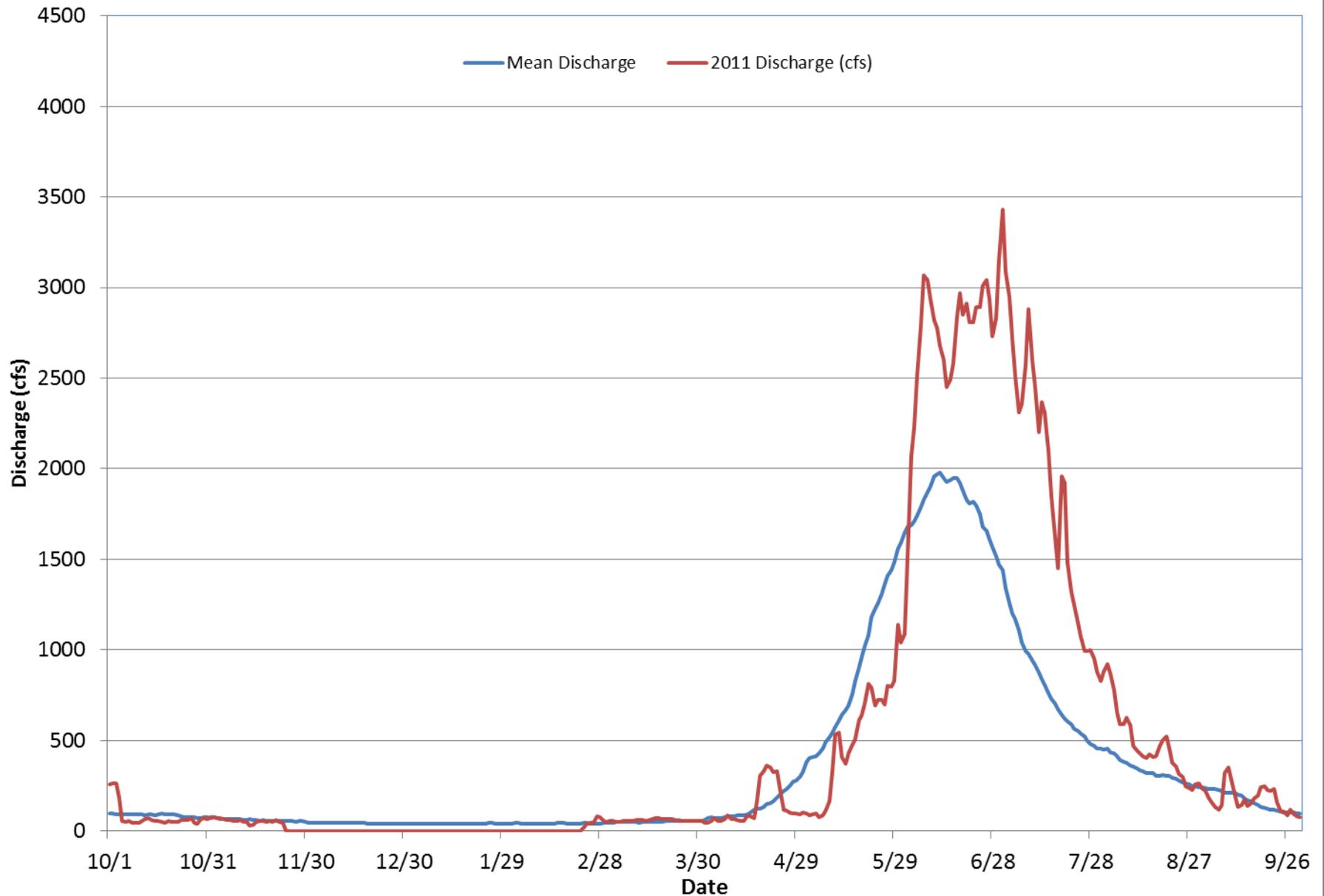
**Year-round precip. happens and
matters for the ecology.
But for most surface water, the word
is SNOW**



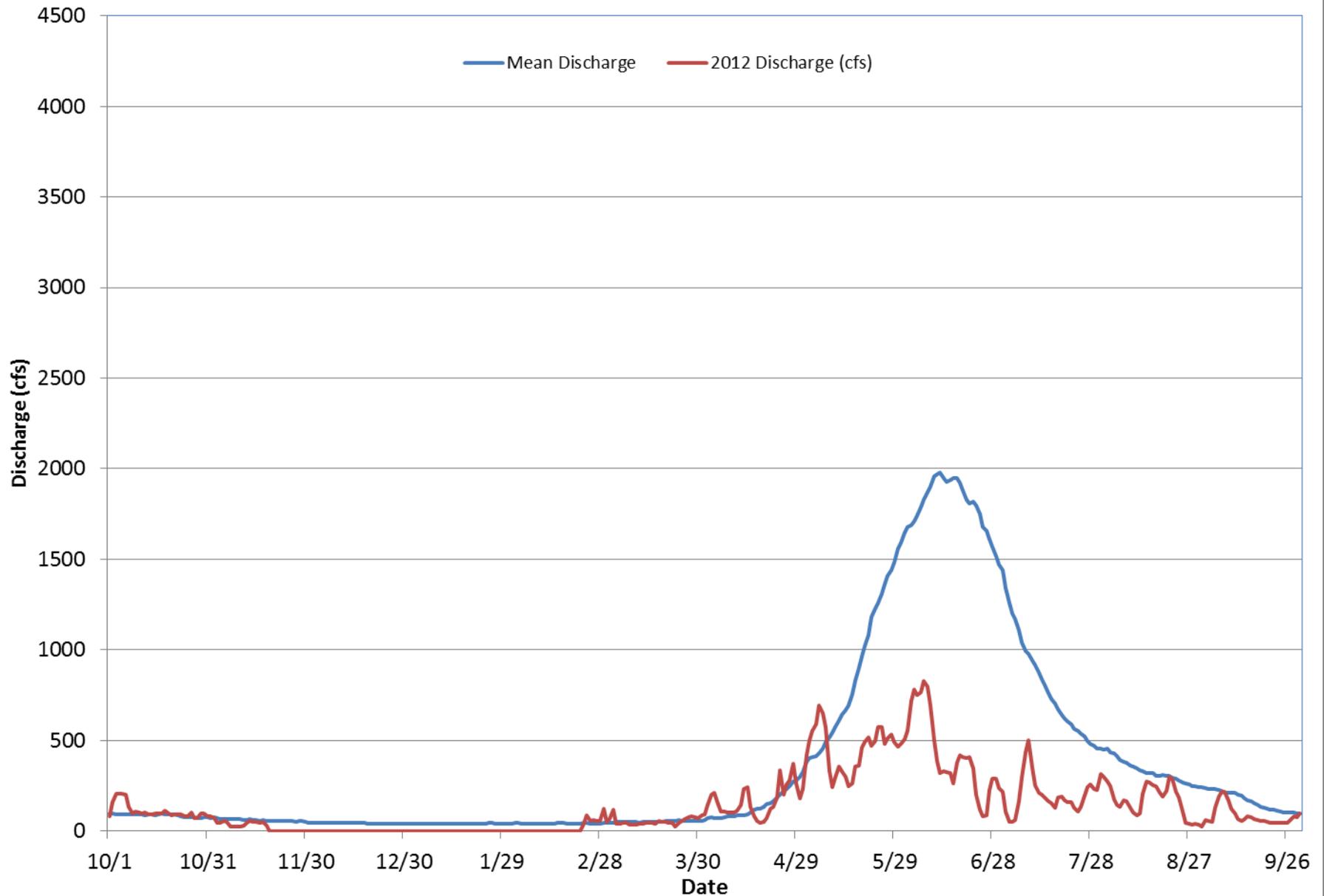
Poudre River at the Canyon Mouth Mean and WY 2010 Discharge (cfs)



Poudre River at the Canyon Mouth Mean and WY 2011 Discharge (cfs)



Poudre River at the Canyon Mouth Mean and WY 2012 Discharge (cfs)



Blue Mesa Reservoir



Land of limited and highly managed water

Storage prevails,
Flood control
usually minimal
Concern most
years

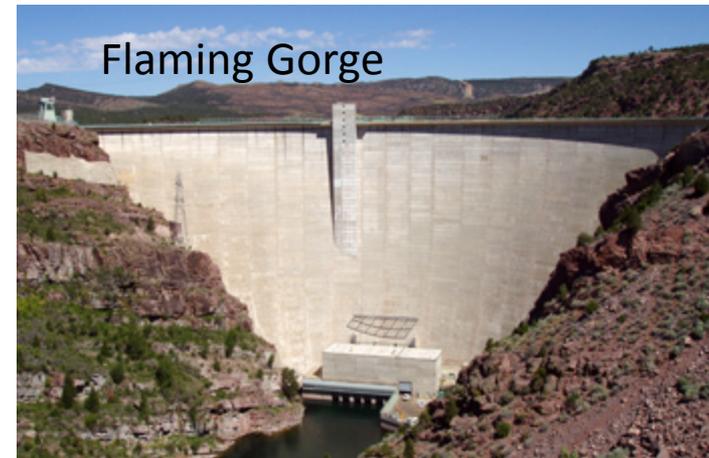


Green Mountain Dam

Navajo Reservoir



Flaming Gorge



Lake Granby

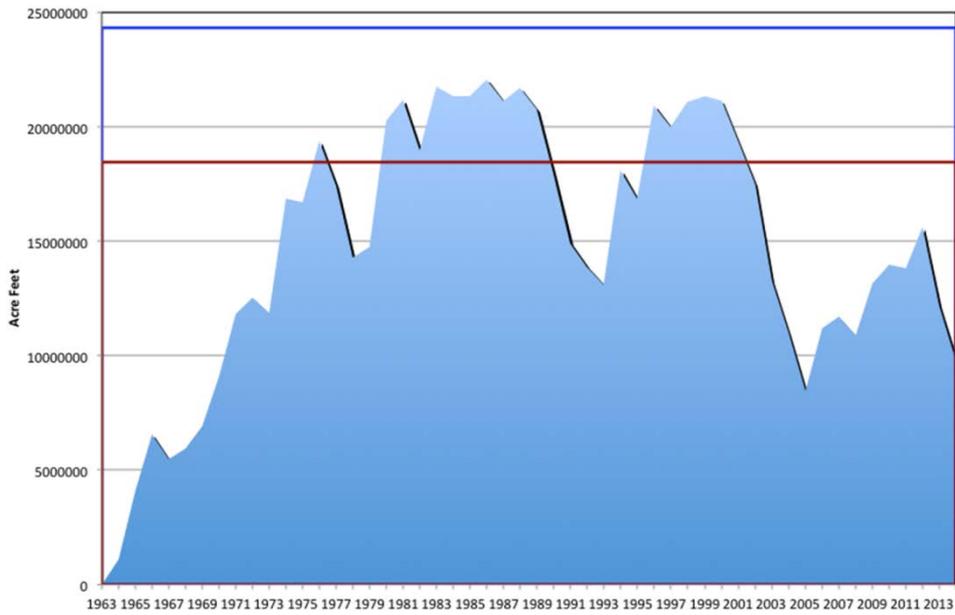


Lake Granby Spillway



Northern Colorado Water Conservancy District

Lake Powell January Reservoir Storage



The giant bathtub and its rings— Lake Powell

Land of
recreation
(much based
on water)



Copper Mountain Feb 23, 2014



**Great snow this year –
but avalanche challenges**

Looking NE from Copper Mountain
March 24, 2012 -- drought onset!

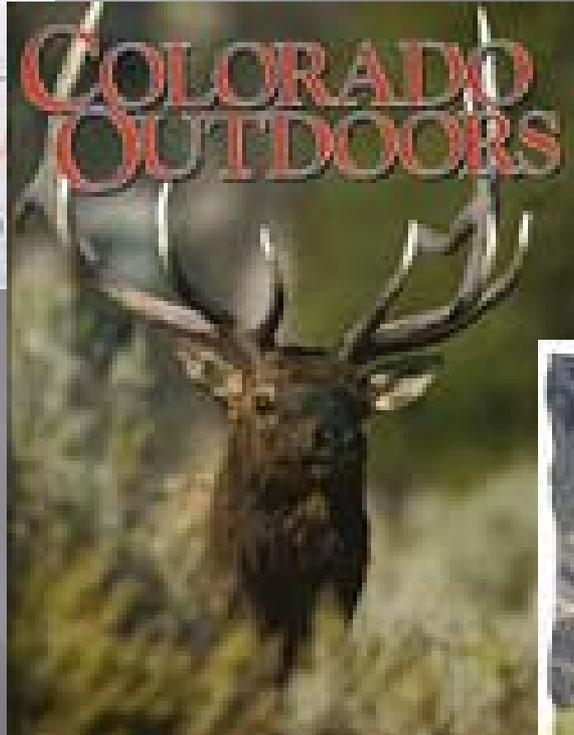






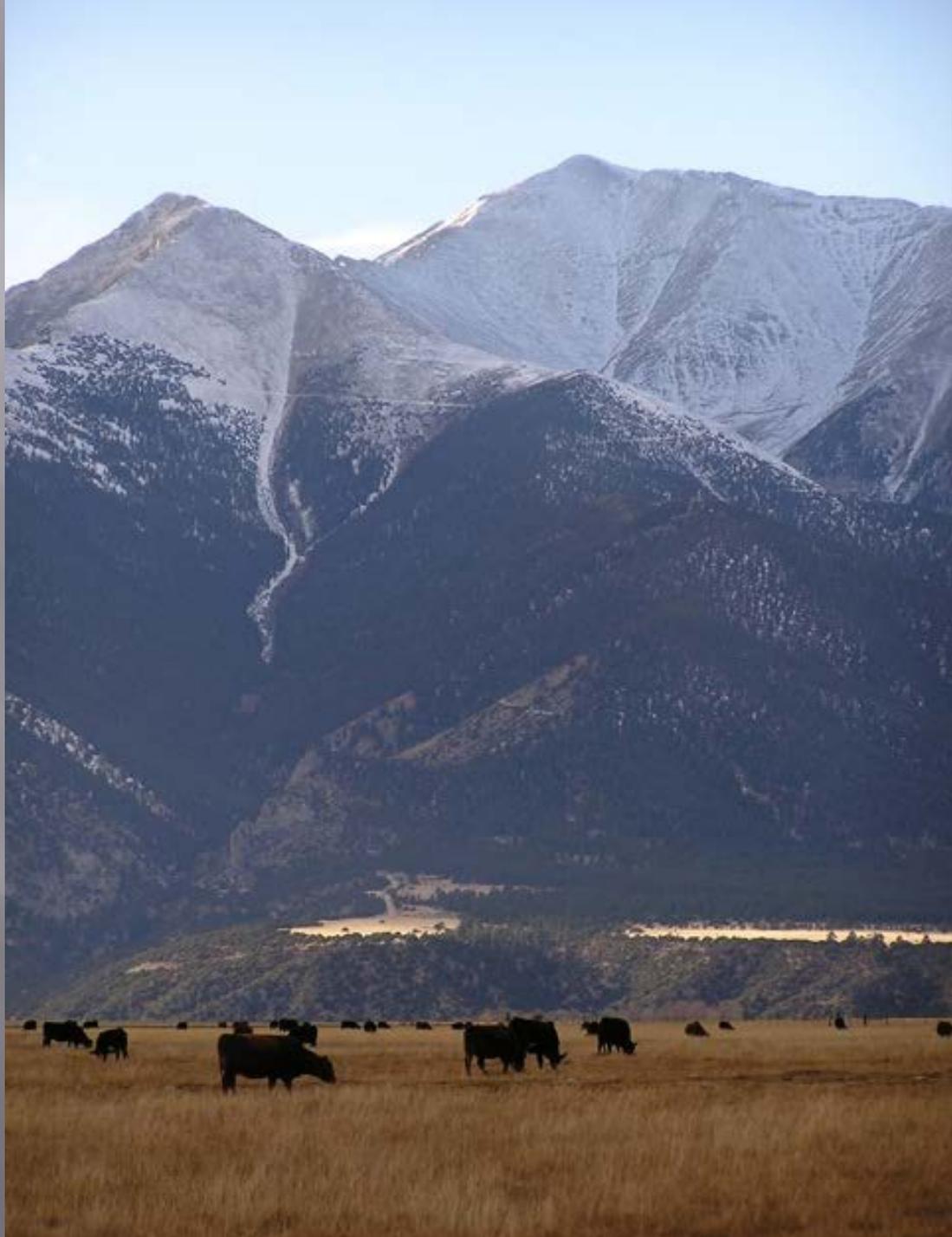


Wildlife management and hunting economics



Majority of consumptive use of water in UCRB is for agriculture – primarily hay – but Ag is much smaller player in economy than it was decades ago



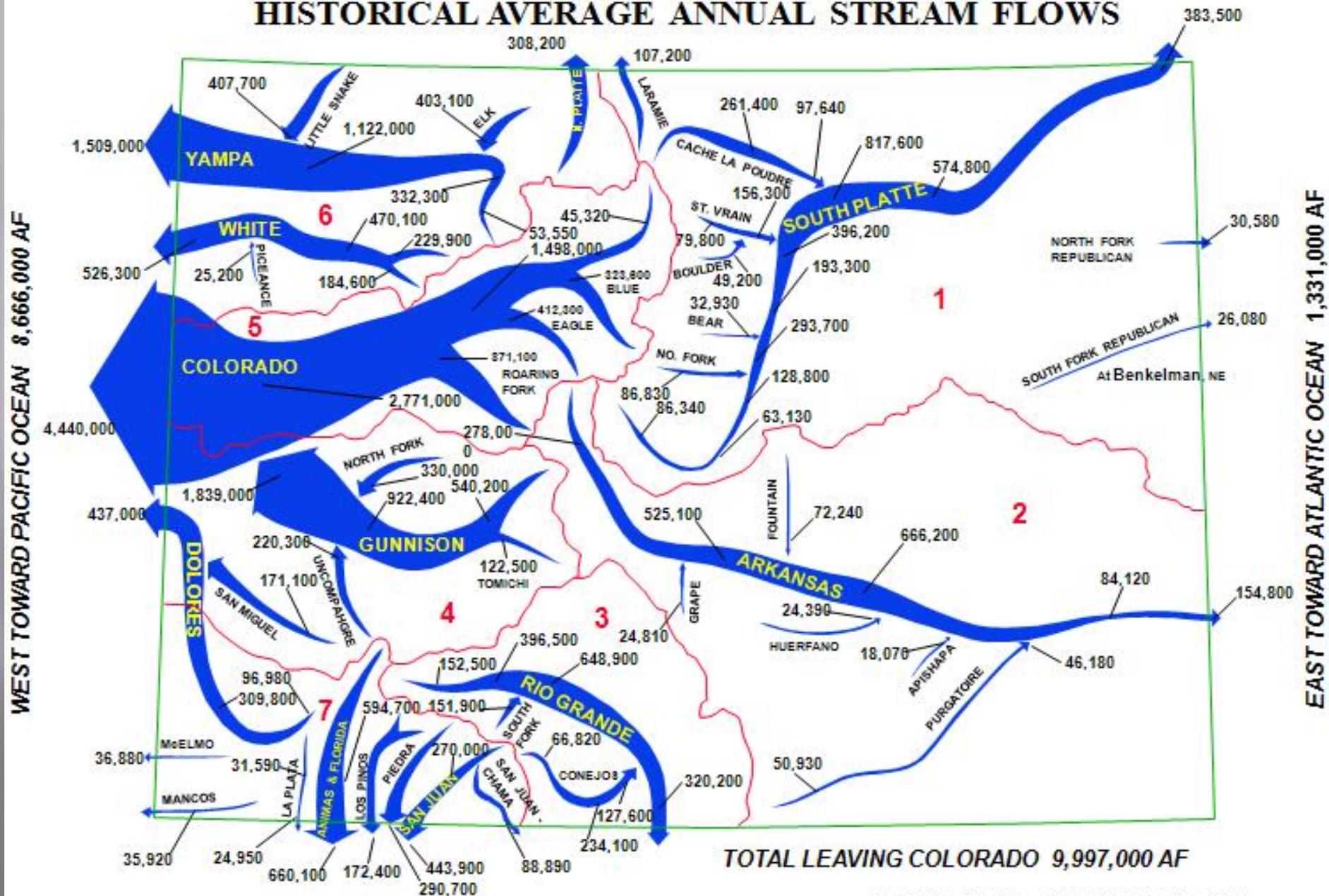


Growth of high-value crops and agro-tourism



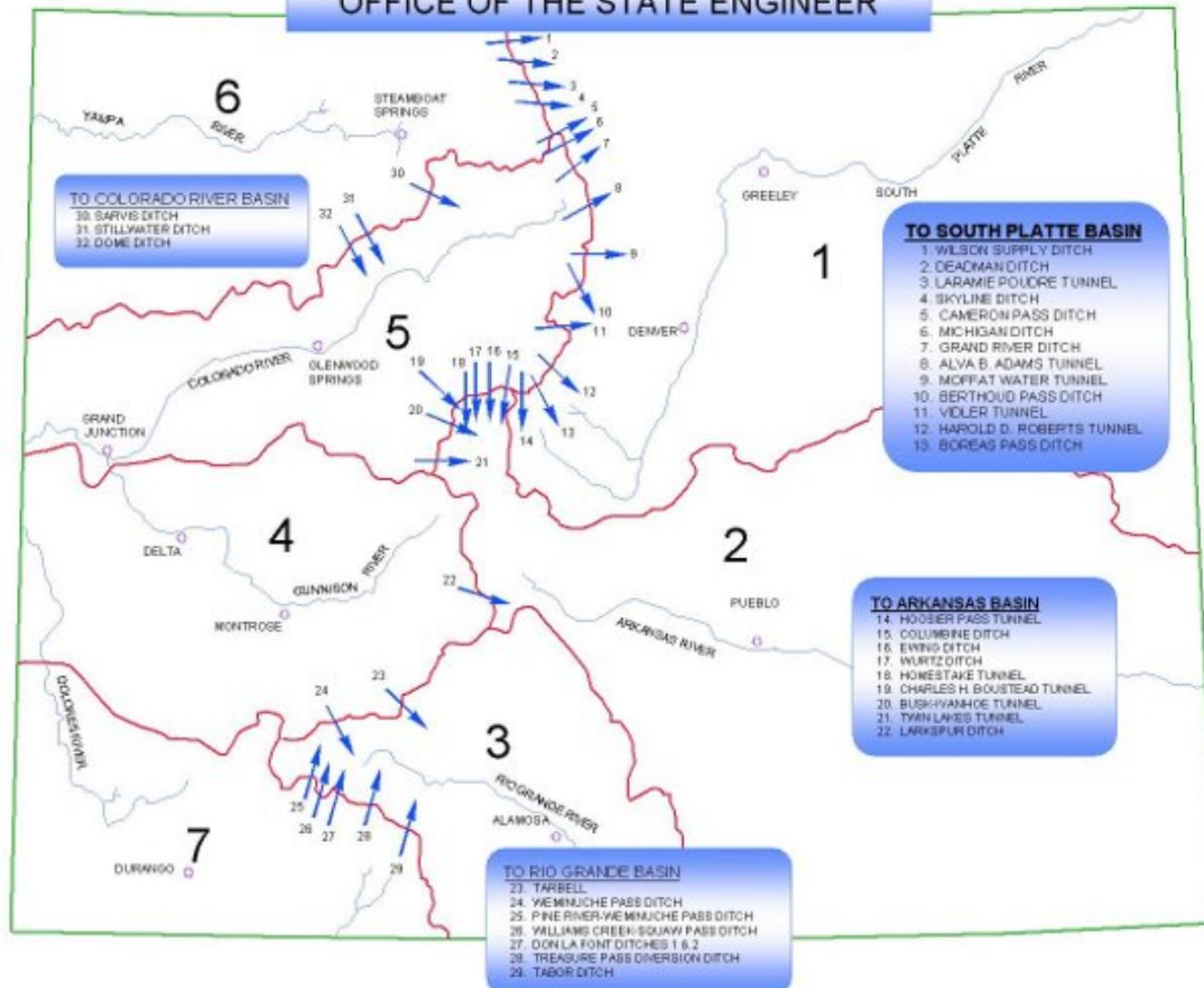
COLORADO

HISTORICAL AVERAGE ANNUAL STREAM FLOWS



Out-of-basin water export is big

TRANSMOUNTAIN DIVERSIONS OFFICE OF THE STATE ENGINEER



Why water is exported -- Western population growth



Colorado River Basin





Endangered Species - a fair claim to water



Humpback Chub
Gila cypha



Bonytail
Gila elegans

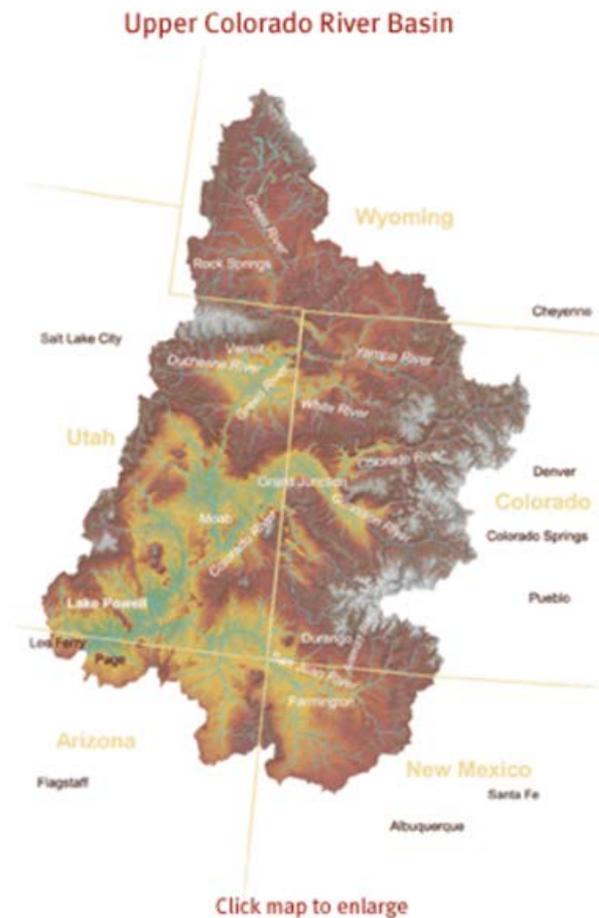


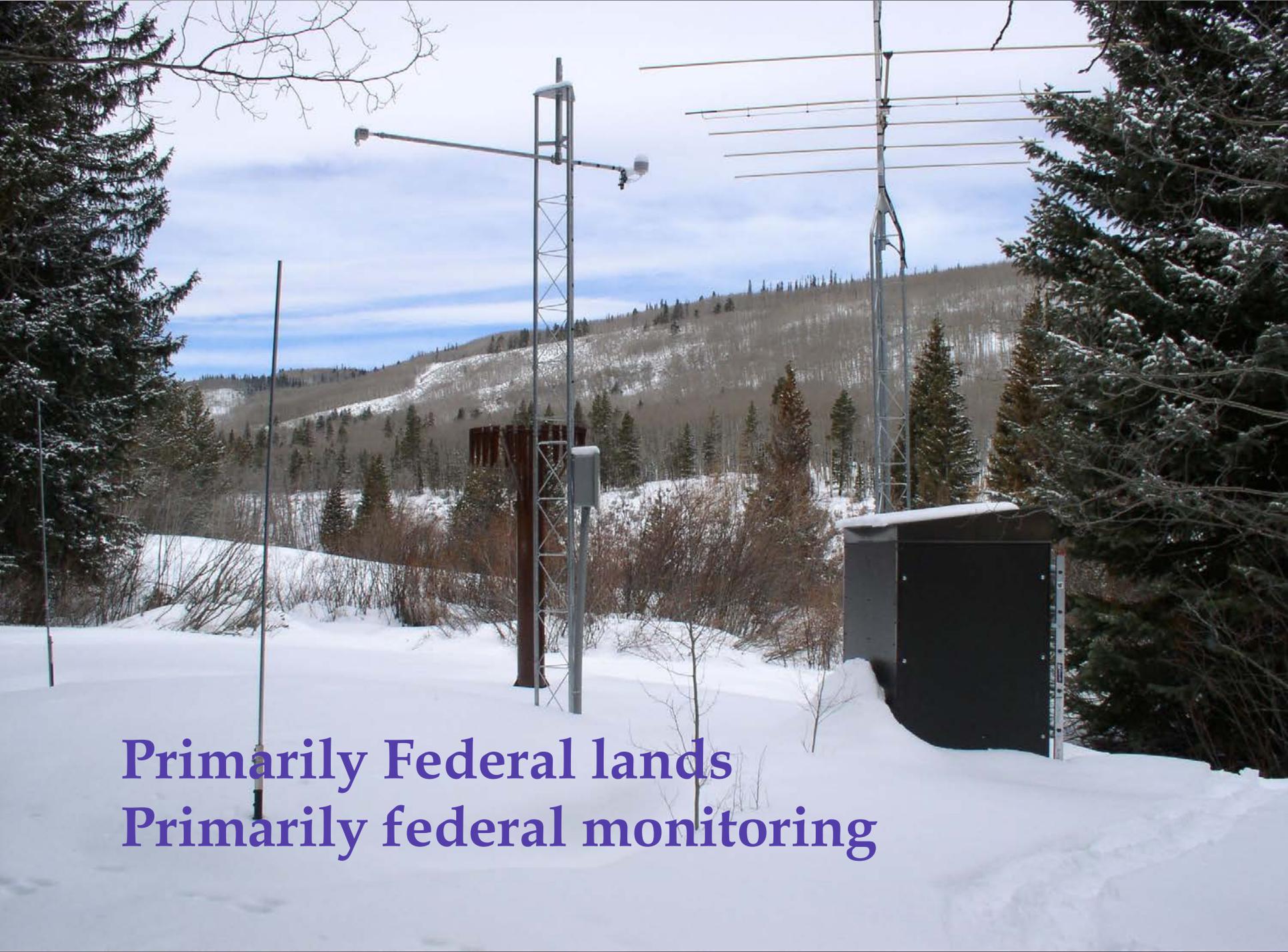
Colorado Pikeminnow
Ptychocheilus lucius



Razorback Sucker
Xyrauchen texanus

© Joseph R. Tomelleri

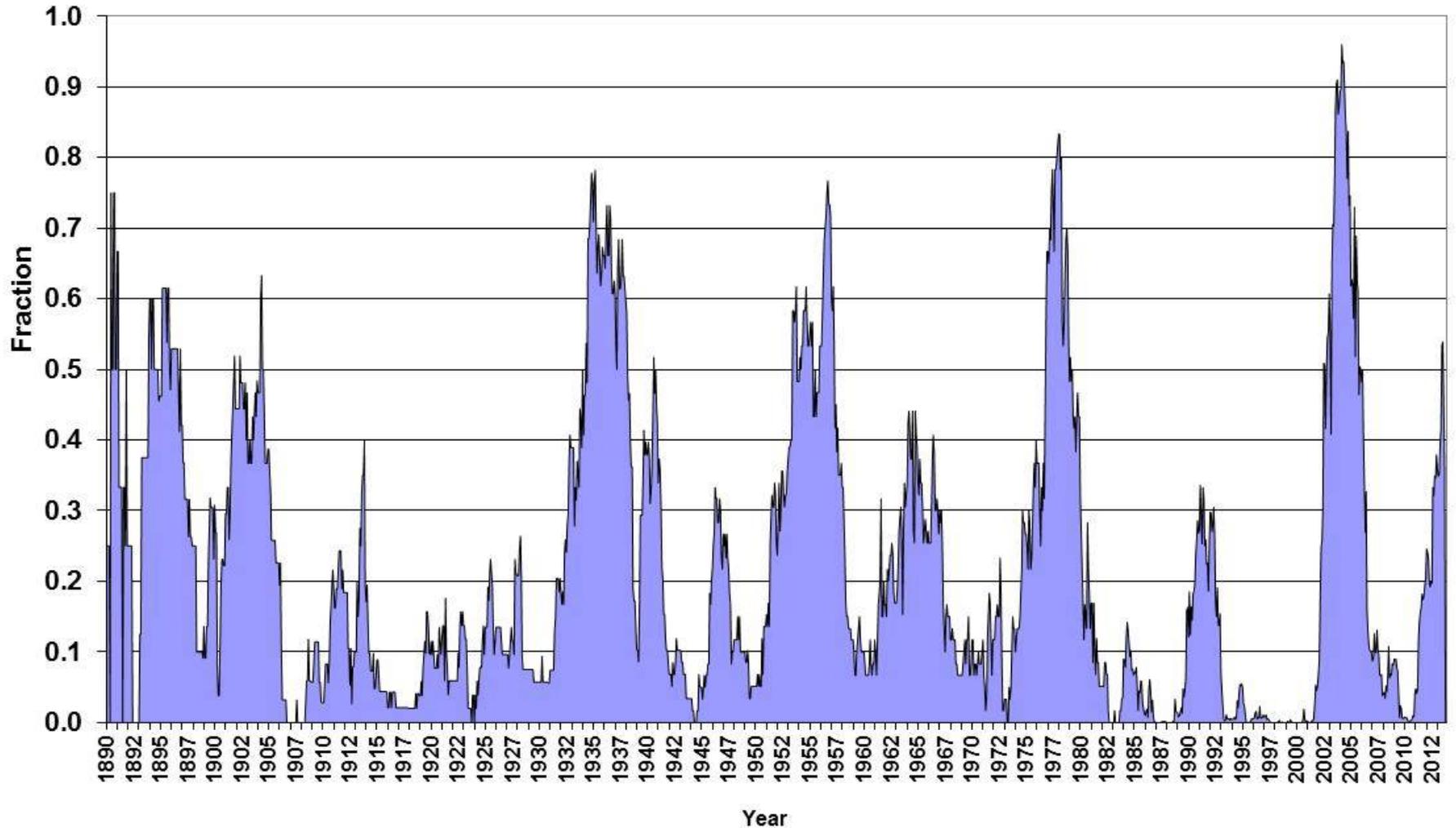




Primarily Federal lands
Primarily federal monitoring

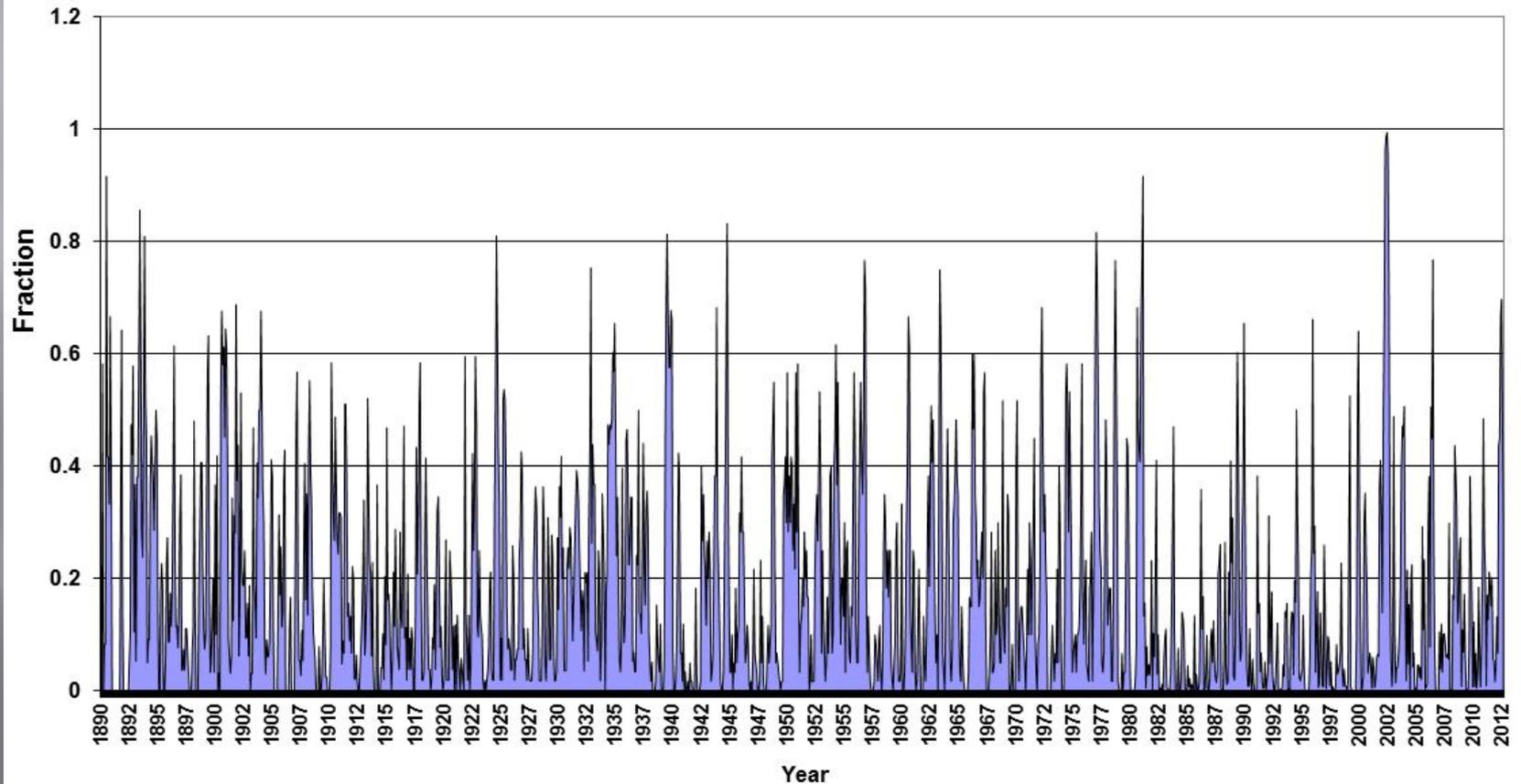
Realistic Perspective - Drought Happens

Fraction of Colorado in Drought
Based on 48 month SPI (SPI <-1)
(1890 - September 2013)



Drought “almost happens” often

Fraction of Colorado in Drought
Based on 3 month SPI
(1890 - August 2012)



We thought this was history





But alas

Photo by Lyric Lucero
2013 Manzanola, CO

Pilot Focus

- ▣ Assess and address stakeholder needs
- ▣ Understand impacts, identify triggers
- ▣ Develop an effective drought early warning system.
- ▣ Enhance local, state, and regional expertise and capabilities.
- ▣ Inform Drought Portal development -- drought.gov
- ▣ Local “expertise” for USDAM.
- ▣ Test concept of sustainability

Stakeholders and what we've learned from them

- Water users and providers, resource managers and watershed protectors in the UCRB.
 - Drought Triggers and Indices
 - Monitoring Gaps
 - Favorite data, products, etc. Find out what they use.



Interviews and Focus Groups

conducted by the Colorado Climate Center between May and December 2009 exploring drought indicators, triggers and data needs by sector

- USBR (Grand Junction and Loveland offices)
- Colorado Division of Wildlife
- Colorado DNR (state and local)
- Denver Water and other smaller water providers
- Northwest Council of Governments (water quality)
- Watershed protection groups
- USDI (BLM, NPS) and other resource managers
- Colorado River Water Conservation District
- Northern Colorado Water Conservancy District
- EXCEL Energy
- Grand County interest group
- Summit County interest group
- Fraser Experimental Forest
- Water Availability Task Force
- Winter Park Resorts and other ski area representatives
- Other (discussed with WY and UT State Climatologists but did not conduct interviews with users outside of Colorado)

Interview Findings

- ▣ Responses vary by sector and individual user based on “exposure to drought risk”.
- ▣ Most already tracked widely available data sources at critical times of year.
- ▣ Remote sensing products not trusted for LOCAL drought monitoring and water management.
- ▣ Water law, water rights and the prior appropriation doctrine dictates “exposure and potential risk and impacts” for pretty much all surface water users. River “calls” are the ultimate drought triggers.

Interview Findings

- ▣ Reservoir operators: “Our jobs are easiest during drought, but our critical decisions and errors are made during high flows, affecting our capability to deal with future drought”
- ▣ Surface Water Interests: “Not worried about a drought until it is a 3-year drought” (change now to 2-year)
- ▣ USDM is popular, but used to assess drought in OTHER areas (*wasn't trusted locally then*).
- ▣ Users want more data all in one place “one stop shopping”
 - More SNOTEL
 - Better gages on unmanaged, representative streams.

Interview Findings

- ▣ Winter recreation is huge – NOVEMBER conditions are critical to the industry
- ▣ *Users want better long range forecasts (2 years) with skill*
- ▣ *Users have more confidence than we do in our ability to deliver.*

- ▣ Few groups had identified “drought triggers”
 - Lake Dillon reservoir levels (Denver Water)
 - Colorado River summer water temperatures

More findings

- ▣ Governors don't want surprises, but they don't want too much info– be brief and be right
- ▣ History matters – users want current drought and projections with respect to known extreme drought (ideally recent -- the 2002 drought)
- ▣ Times change, stakeholders change

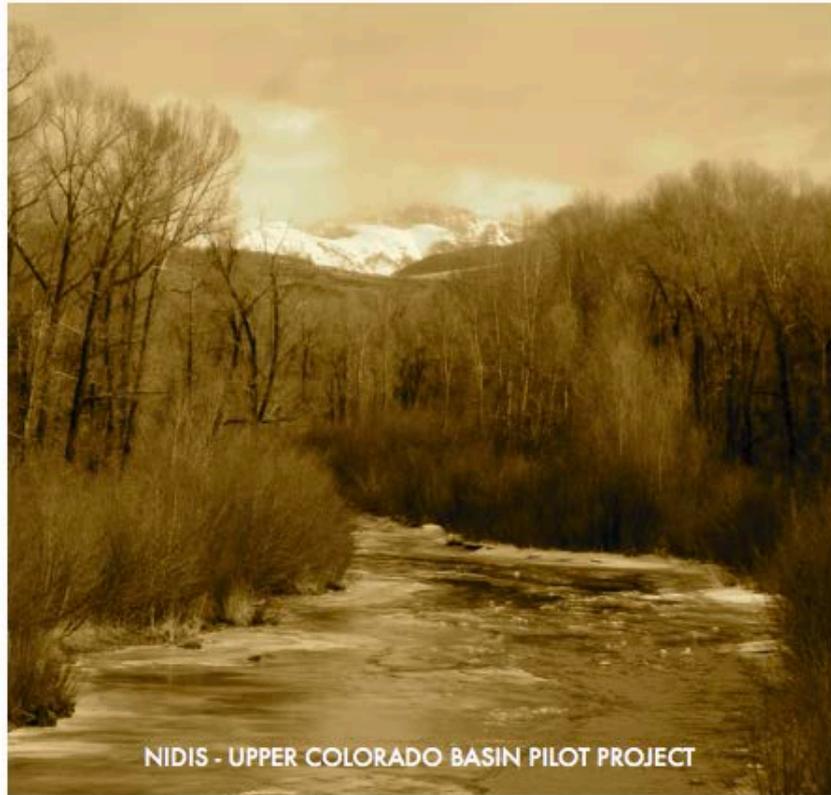
- ▣ “Face-to-face” greatly appreciated -- key for building relationships and trust

Most Requested Information from Users

- ▣ More detailed local monitoring.
- ▣ More frequent updates (at critical times of year)
- ▣ Forecasts delivered by experts
- ▣ Interpretation of complex drought information (i.e. not everyone understands SPI)
- ▣ Better elevational depiction of precipitation.
- ▣ Historical perspective on streamflow and reservoir data.
- ▣ Information on water demand – in and outside of basin .
- ▣ One-stop shopping for all information
- ▣ Sublimation/Soil Moisture/Dust on Snow

Weekly Drought and Water Assessments

Winter
2010

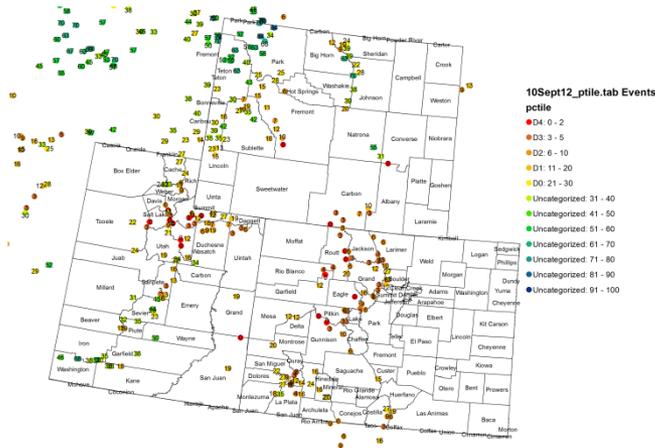


NIDIS - UPPER COLORADO BASIN PILOT PROJECT

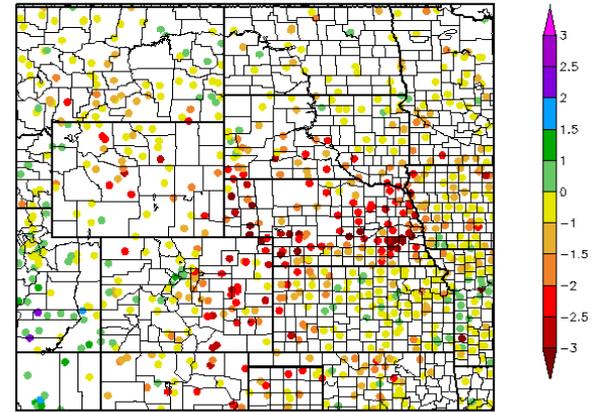
Weekly Climate, Water & Drought Assessment

We put current conditions into historical perspective for diverse users

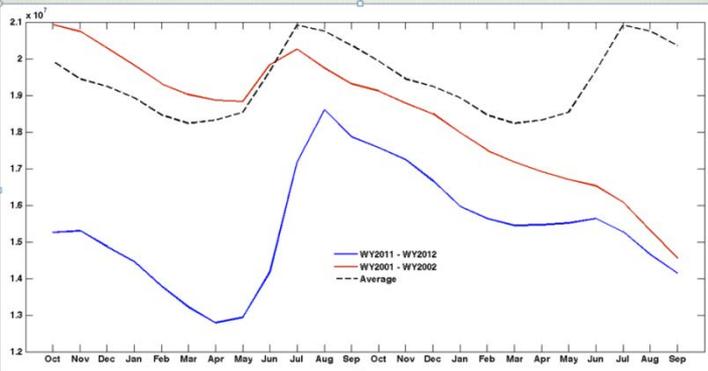
Snotel Water Year Precipitation Percentile Ranking for 10 September 2012 (Stations with 15+ years of data only)



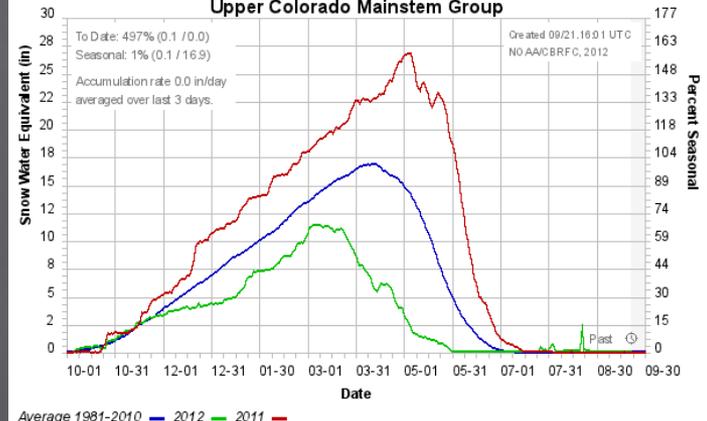
60 Day SPI
7/13/2012 - 9/10/2012



Lake Powell – Monthly Storage



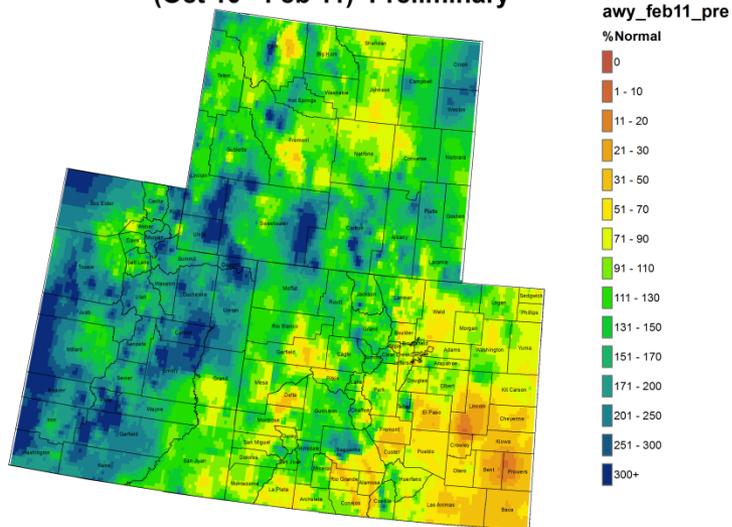
Colorado Basin River Forecast Center
Upper Colorado Mainstem Group



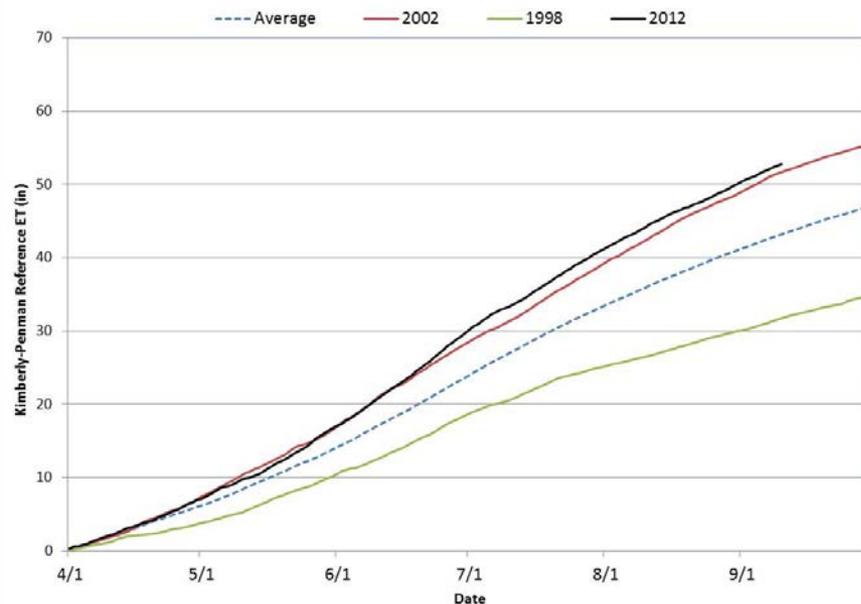
Local Expertise

- CCC and other local agencies provide updates on current conditions.
 - USGS puts streamflow data into context.
 - NWS provides weather forecasts

Colorado, Utah and Wyoming Water Year to Date
Precipitation as Percentage of Average
(Oct 10 - Feb 11) Preliminary

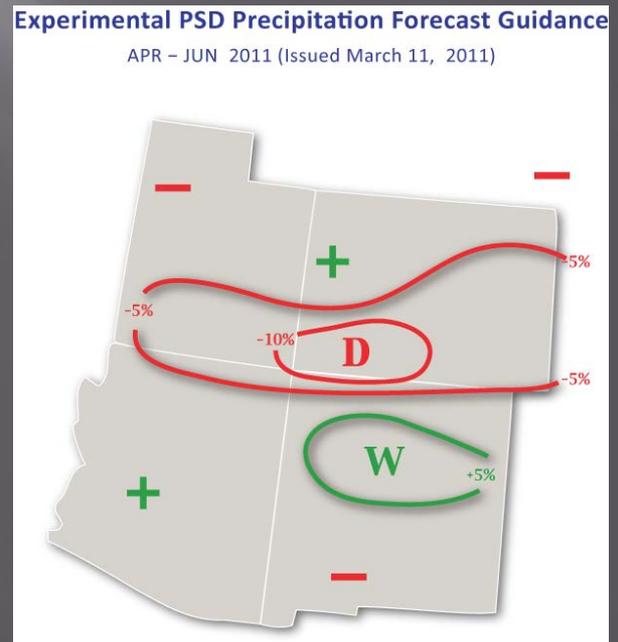
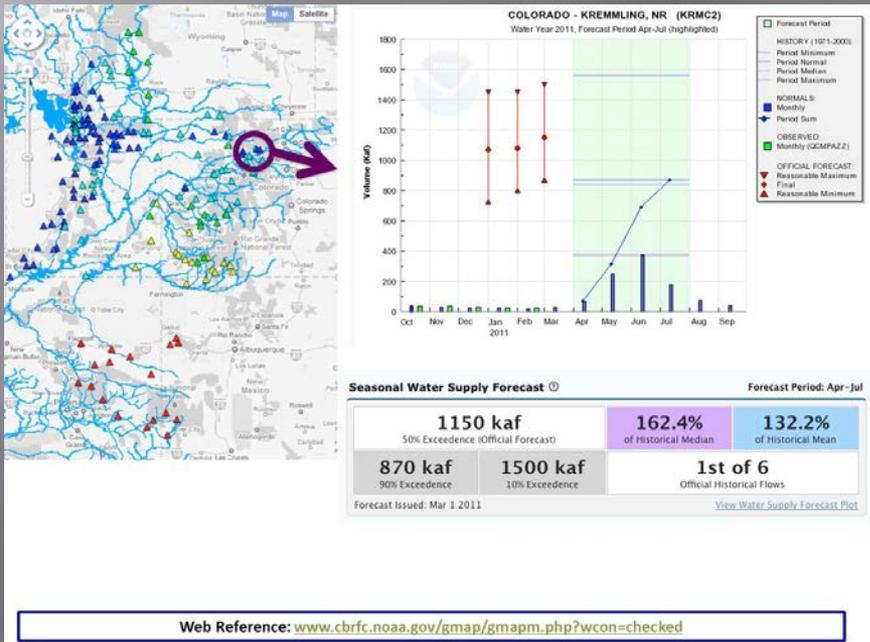


Avondale Kimberly-Penman Reference ET (1993 - 2012)



Regional Expertise

- ▣ Regional experts provide less frequent, but desirable updates.
 - CBRFC provides water supply and peak flow forecasts.
 - Klaus Wolter provides long range climate outlooks.



Weekly Drought and Water Assessments

- ▣ During critical times of year (Feb – June or times of drought), weekly webinars are held at 10AM on Tuesday.
- ▣ Normally 15-20 participate on the call and the USDM author is invited to attend.
 - Greater attendance with long range climate outlooks/streamflow forecasts.
- ▣ Approximately 15 minutes in length, covering precipitation, streamflow, reservoir levels, snowpack conditions, water demand and NWS forecast.
- ▣ Ends with discussions, sometimes contentious, of the USDM and any needed changes.

Weekly Drought and Water Assessments

- ▣ Content is dynamic, it changes based on user input and current conditions.
- ▣ Farm Service Agency contacts have been very useful for on the ground reports and indirectly provide evaluation of satellite/model derived products.
 - i.e. Does VegDRI depiction represent what is being observed on the ground?
- ▣ After the call, summaries are sent out to larger group for input, then to the USDM author, and then to a list of hundreds).
- ▣ Suggestions and feedback are encouraged!

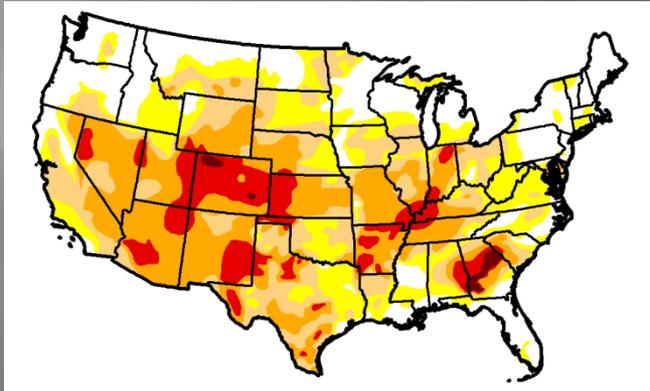
Challenges

- ▣ Competing needs, changing priorities.
- ▣ Difficult to maintain interest in certain sectors unless disaster is looming.
- ▣ *Fundamental conflict between Rec/Tourism and Ag/Municipal*
 - To the tourism sector, drought is a 4-letter word.
- ▣ Boundaries!
 - Tough for us to cross state lines
 - Tough for us to EXCLUDE half of Colorado, so we include it anyway!
- ▣ Water Law controls the distribution of surface water, but many scientists don't fully understand it.

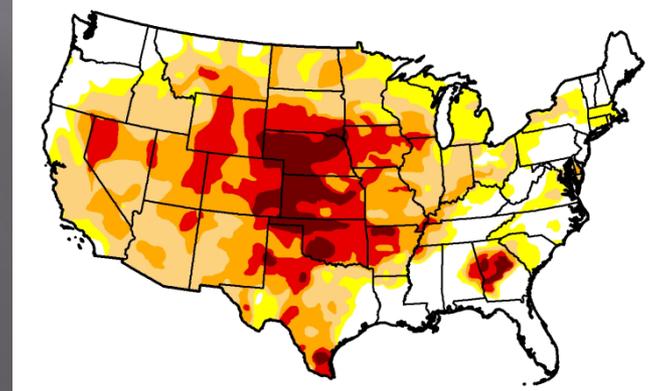
Put to the test!!

Experiences from 2012

July 3, 2012



September 18, 2012



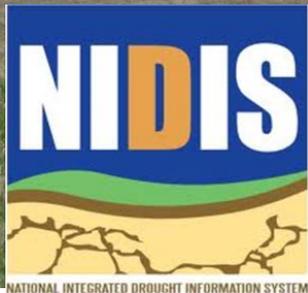
▣ Wild fire makes drought “real” for Everyone



Experiences from 2012

- ▣ FSA input was invaluable for assessing ground conditions.
 - Dedicated to the calls as the growing season got worse.
 - Pasture and range updates, status of crops and winter wheat planting (or not planting), updates on prevented and failed acres.
- ▣ NWS offices are also dedicated to our calls and even took it upon themselves to develop a “Forecast rotation” as the weekly updates went on.
- ▣ The calls bring the right people together to discuss current conditions and tie all that information into the USDM.
 - Since the USDM is now used for disaster declarations, everyone has a vested interest in getting it right.

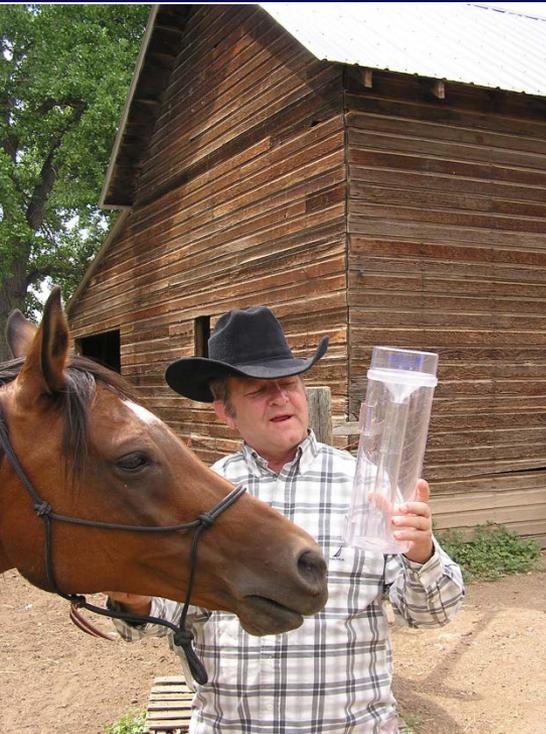
In the end, we're only as good as the climate data we collect and the skill with which we analyze, present and explain it



Colorado
State
University

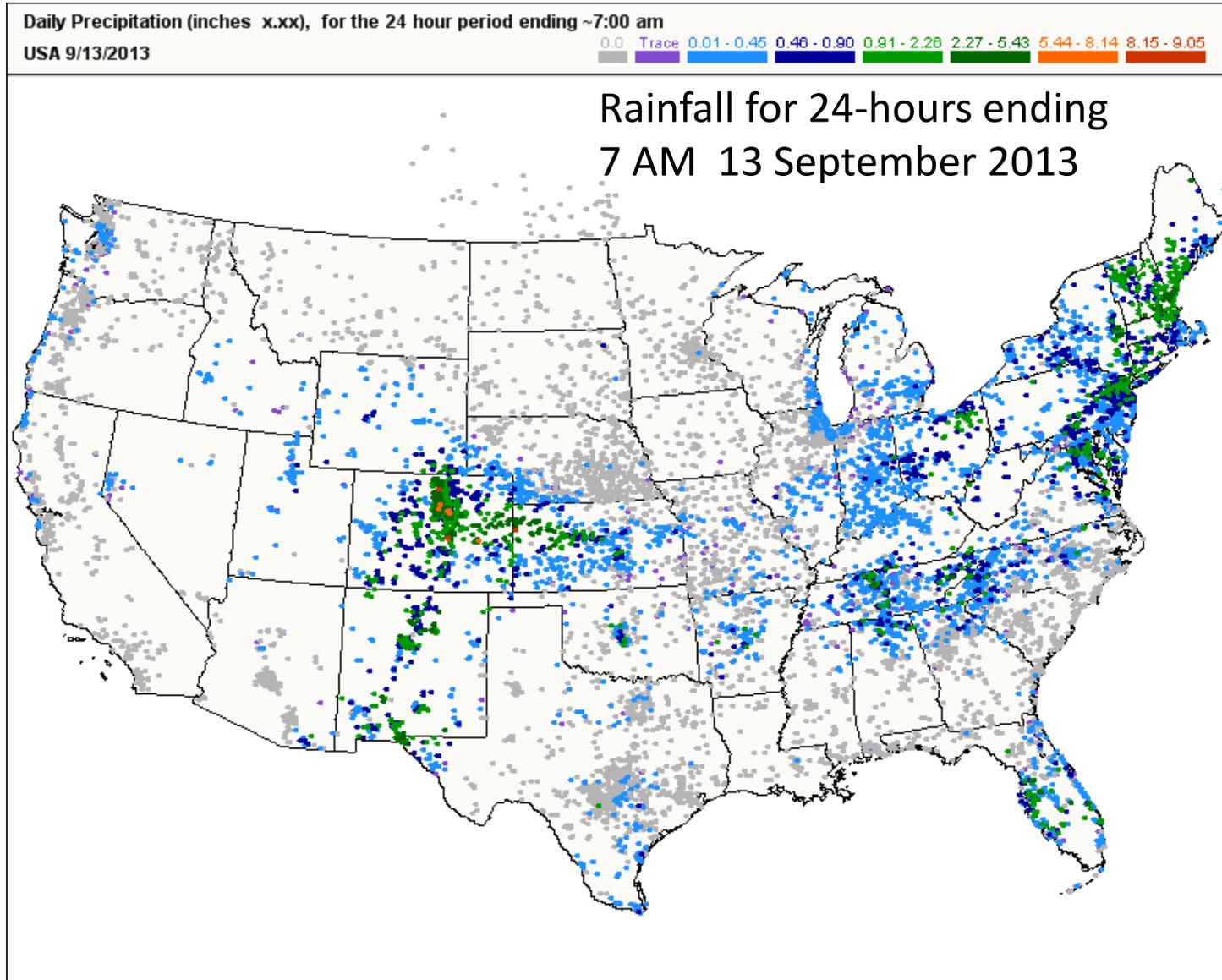
Placeholder for the stuff I forget

When in doubt, measure!!

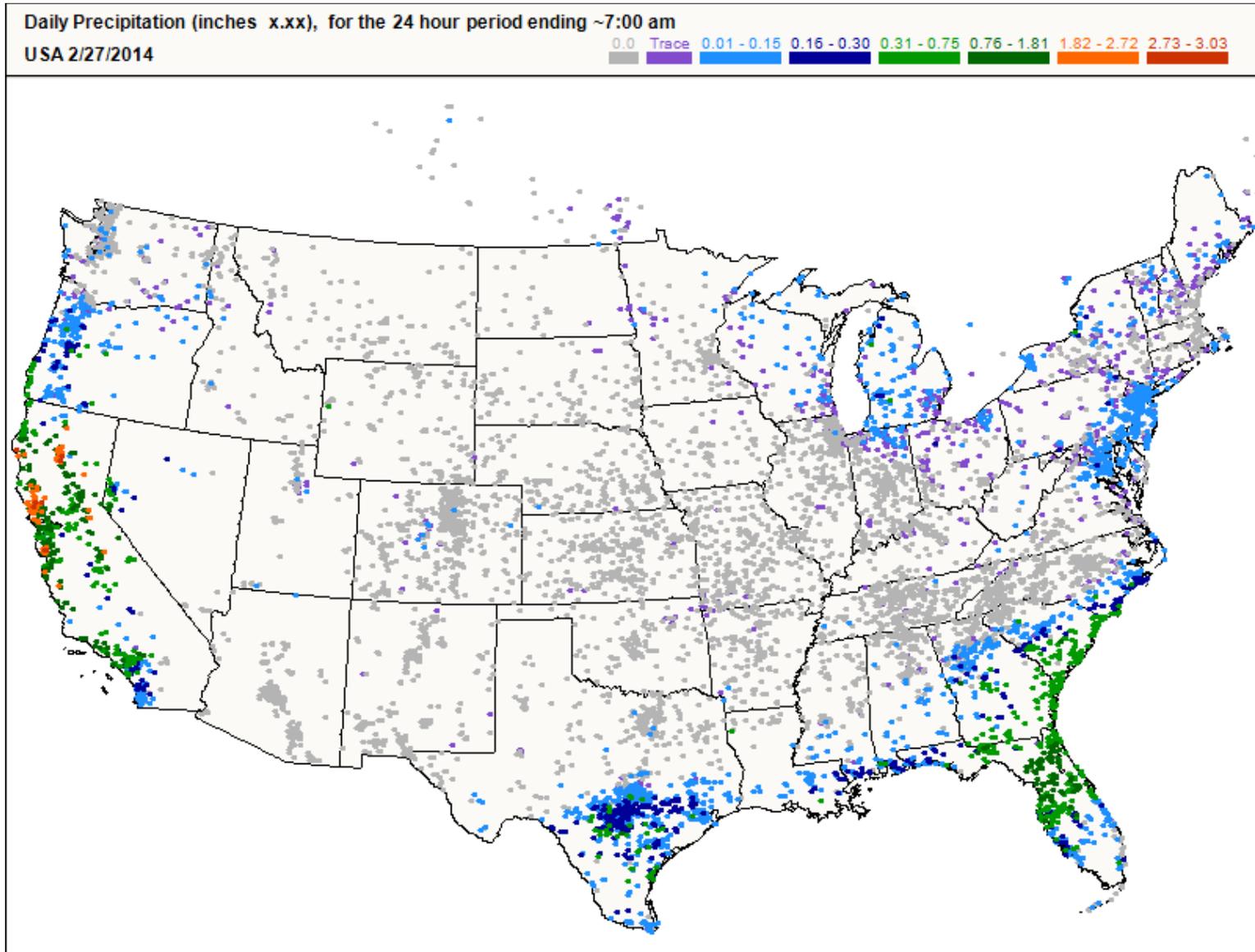


Photos by H. Reges

--The Value of Volunteers --



Finally – Rain (Feb 27, 2014)

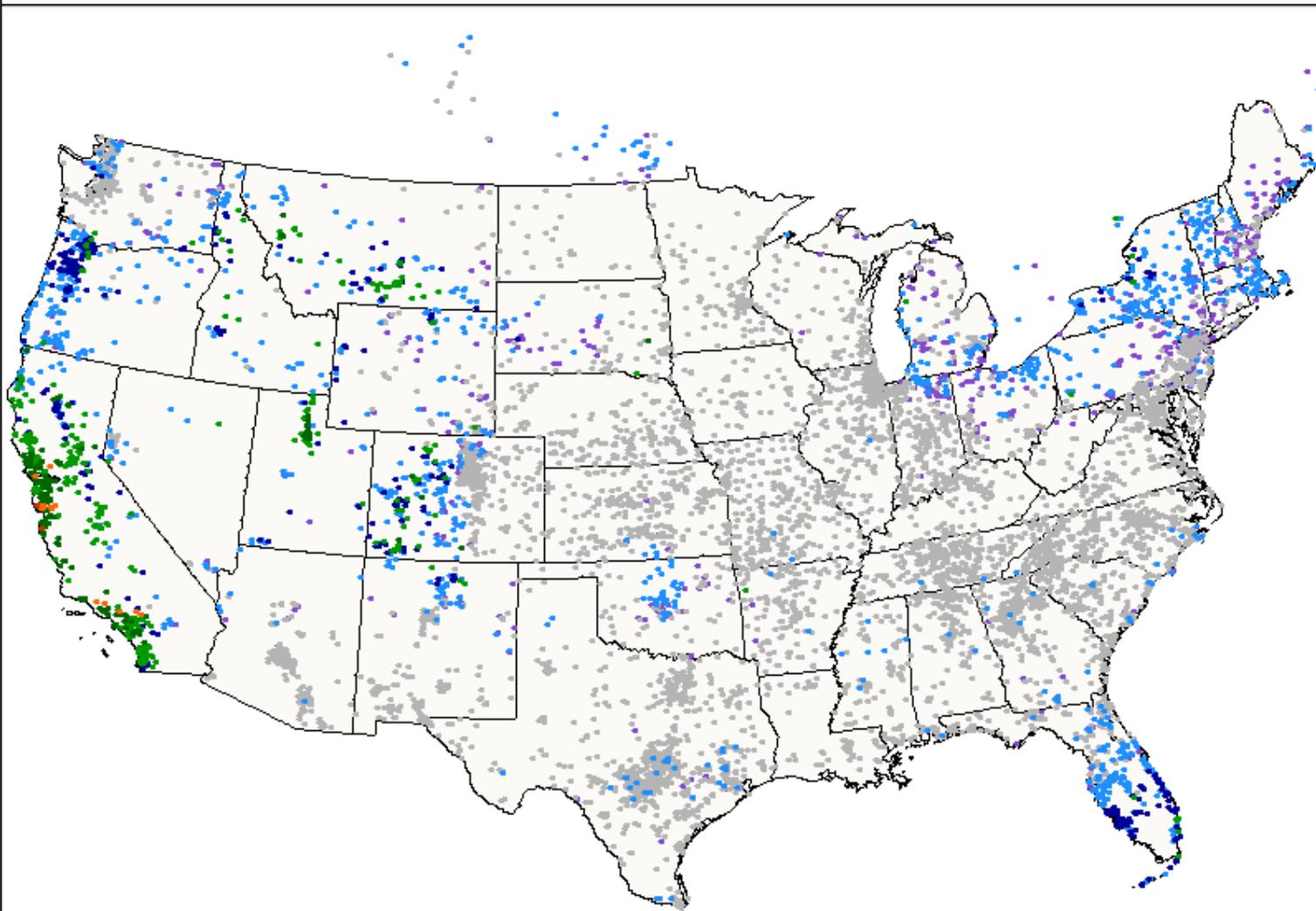


Feb 28, 2014

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am

USA 2/28/2014

0.0 Trace 0.01 - 0.15 0.16 - 0.30 0.31 - 0.75 0.76 - 1.79 1.80 - 2.68 2.69 - 2.98



Thanks!

- ▣ For more information contact:
Nolan.Doesken@Colostate.edu

- ▣ Webinar Registration:
 - http://ccc.atmos.colostate.edu/drought_webinar_registration.php

- ▣ Archive of Weekly Assessments:
 - http://ccc.atmos.colostate.edu/drought_webinar.php

