

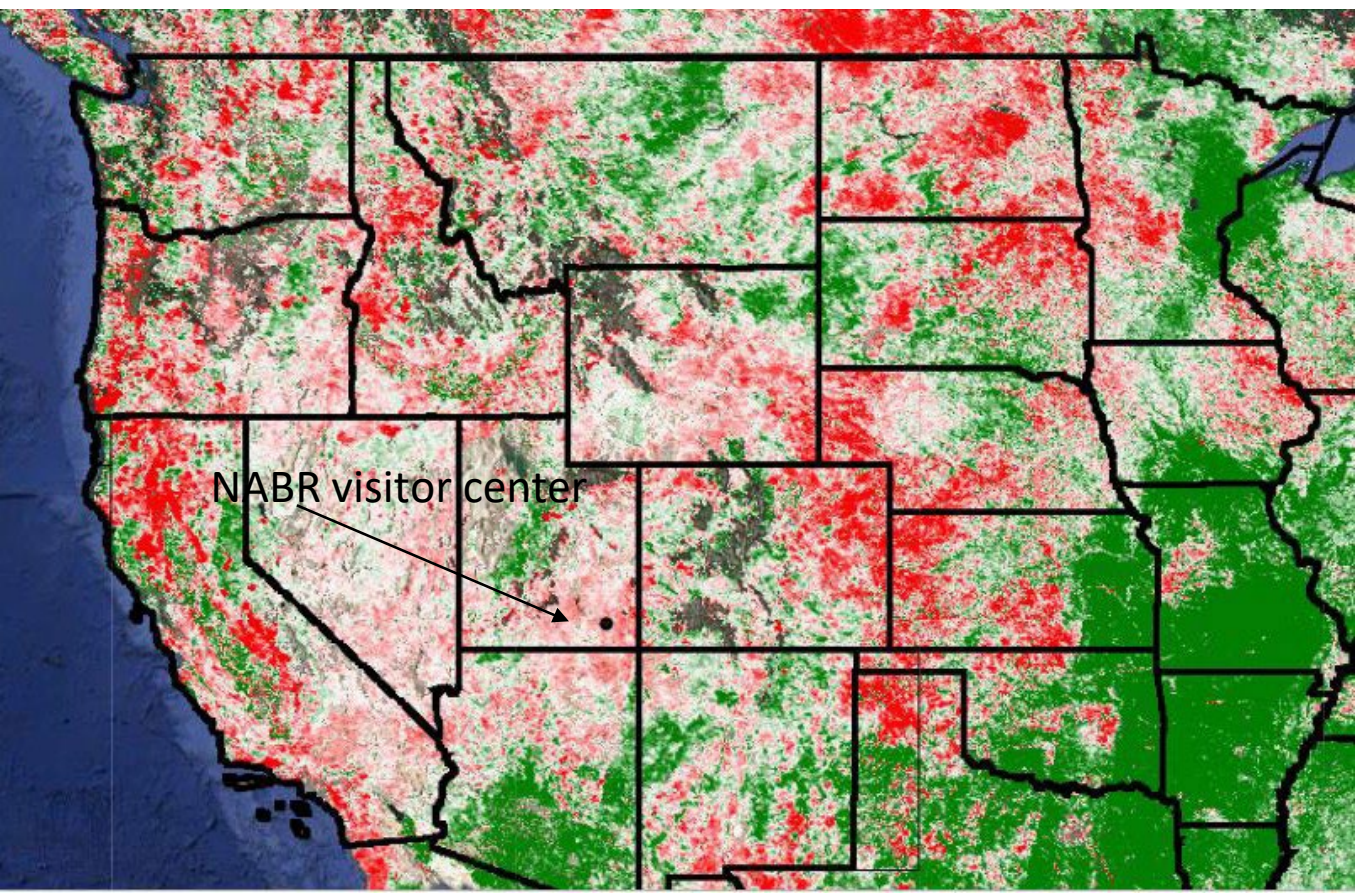
Juniper Mortality in Southeast Utah: A consequence of drought?

David Thoma

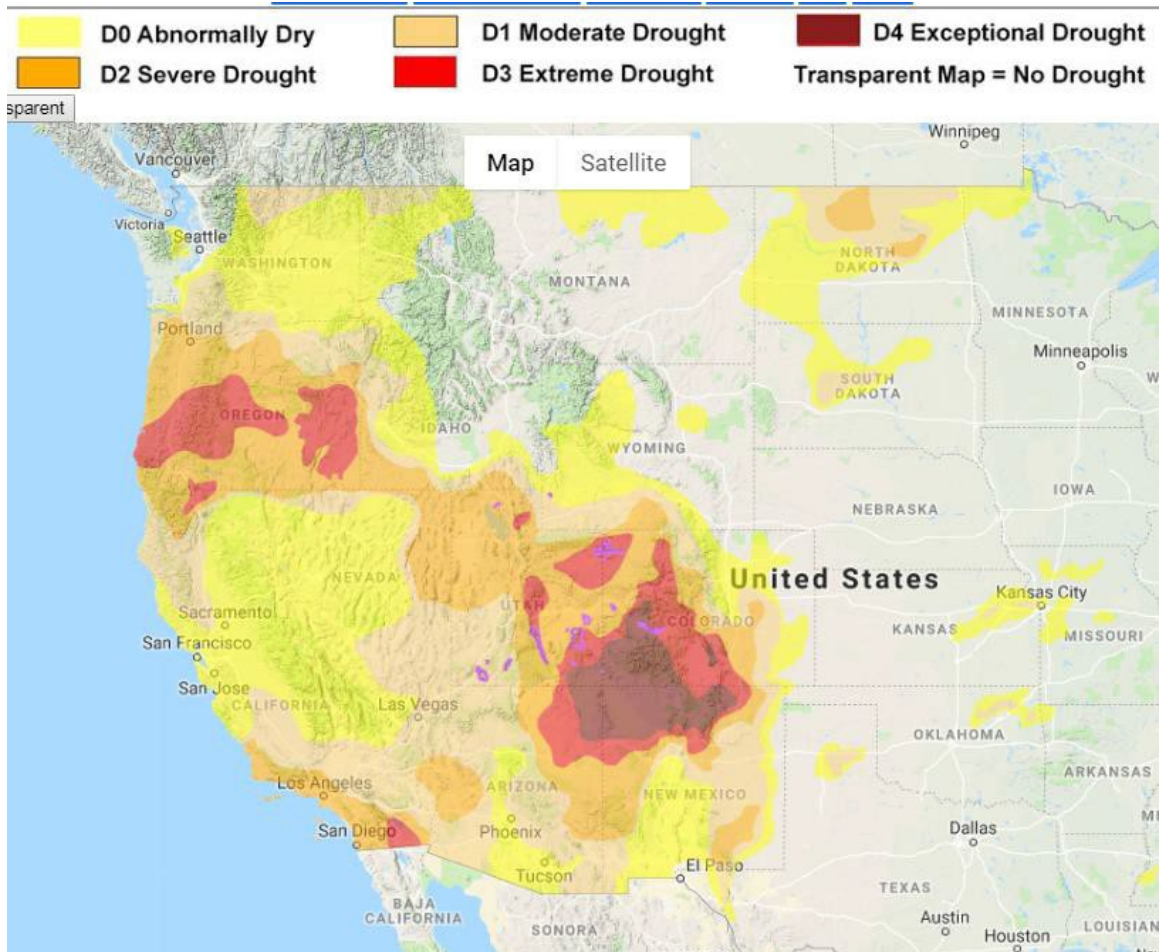
NPS Inventory & Monitoring Program

October EVI minus the mean of all October values between 2000-2017.
EVI is the enhanced vegetation index, similar to NDVI
Red= below average
Green = above average for this time of year, October

October 2018 enhanced vegetation index (EVI) anomaly.



For comparison October 2018 U.S. Drought Monitor

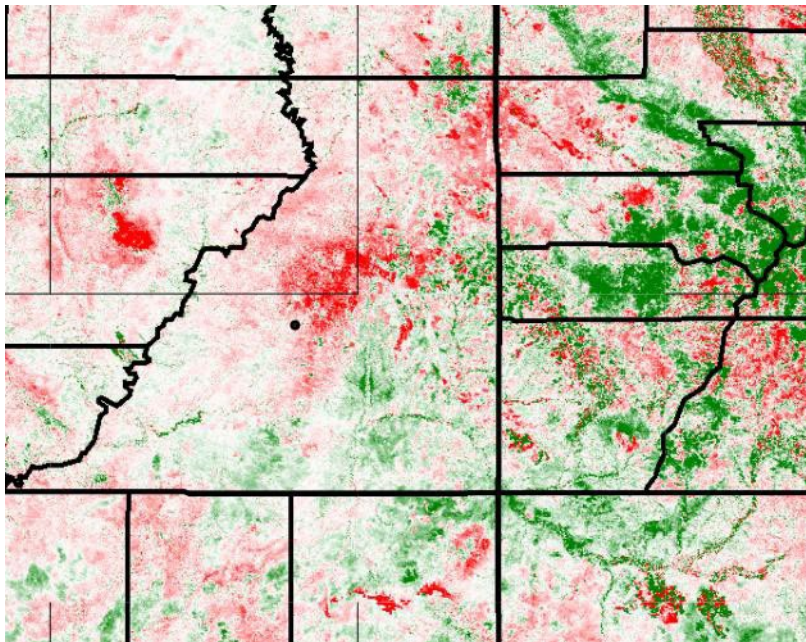


For context, anomalies for known dry and wet years for comparison against 2018 using the same base period (2000-2008) for computing the long-term average in each figure.

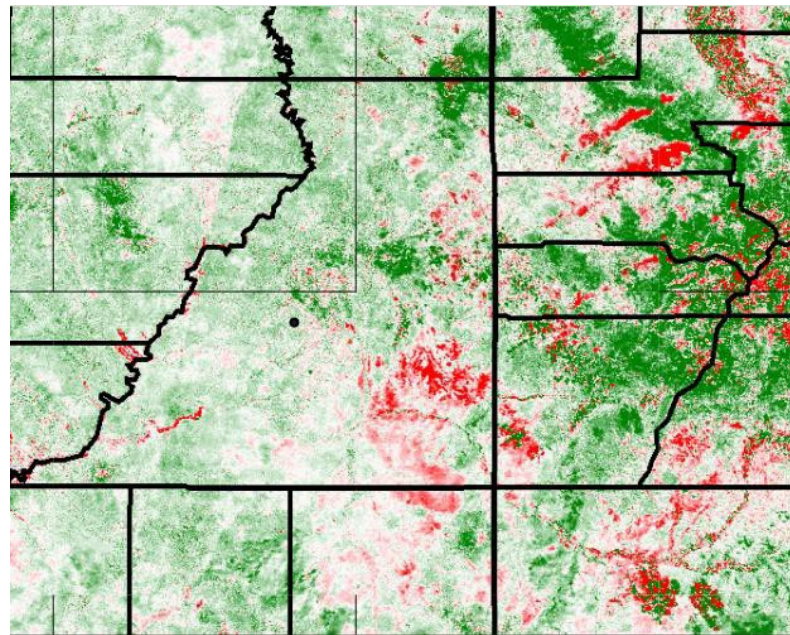
2003 was a year of juniper mortality on the Colorado Plateau. In 2018 the declines in vegetation index were much greater.

Black point marks NABR visitor center

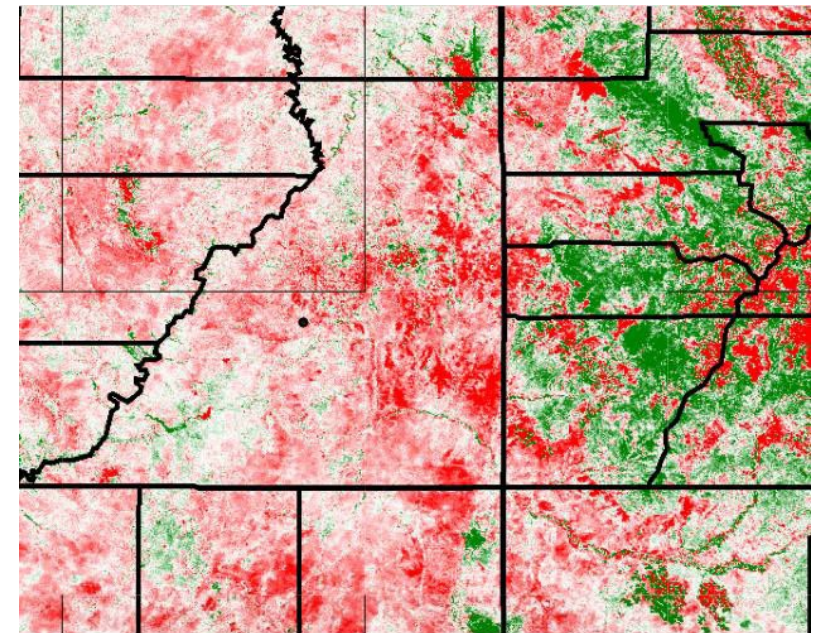
2003 Anomaly – a dry year



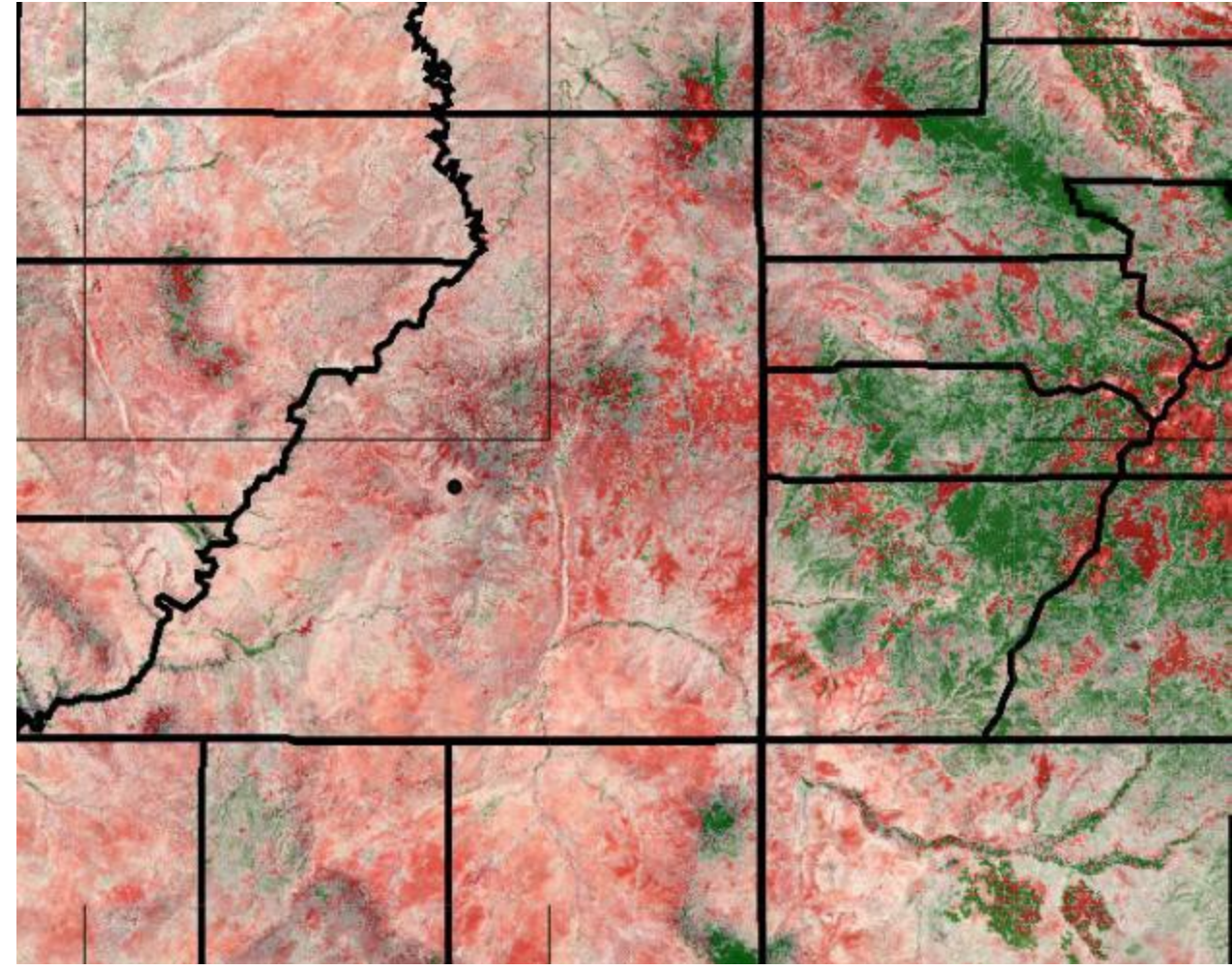
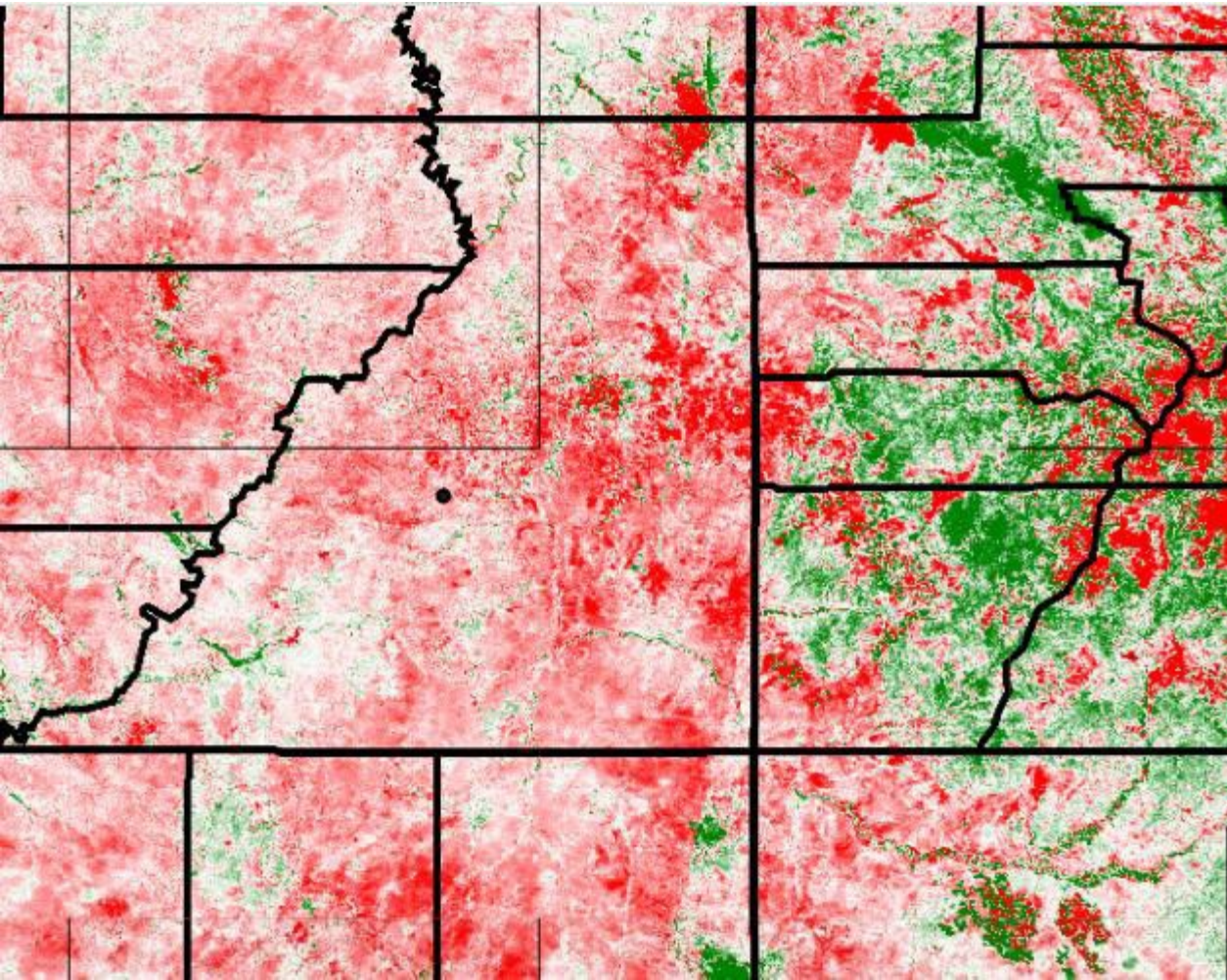
2011 Anomaly – a wet year



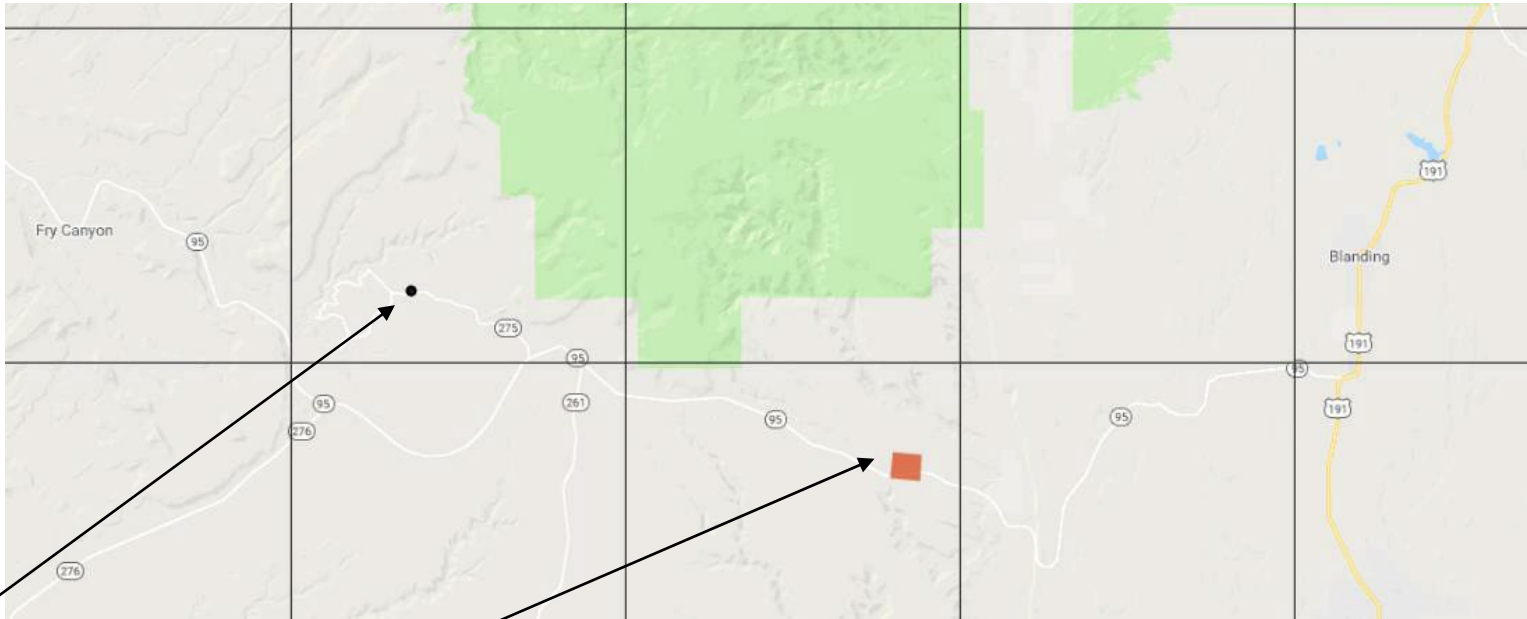
2018 Anomaly – extreme dry year



2018 Anomaly calculated as difference between 2018 and 2000-2017 average
Same data in each panel, but with a bit of topography showing through figure on right.

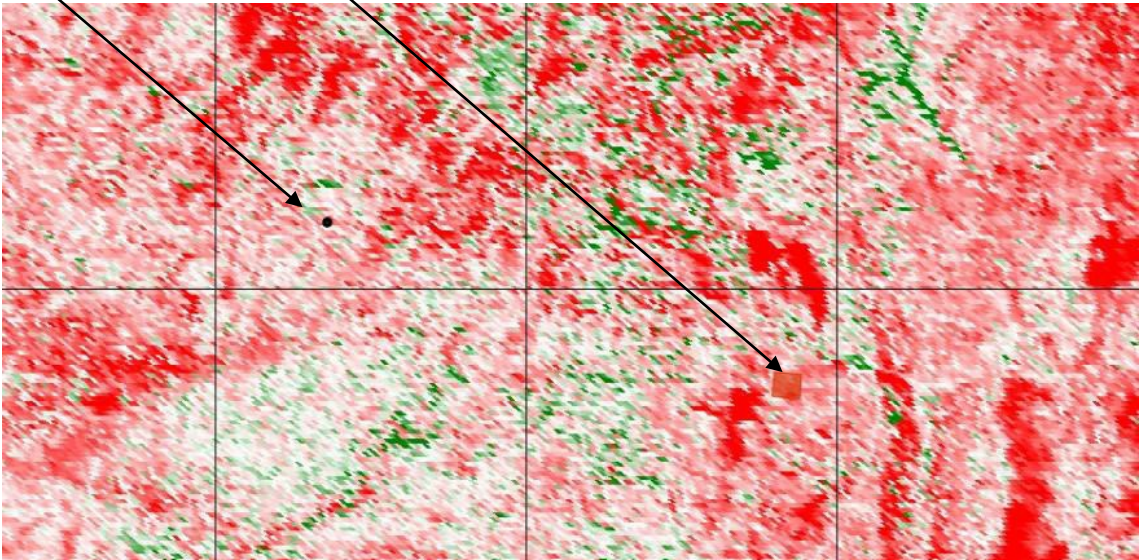


Zoomed in views
show point and
area charted in
the next slide.

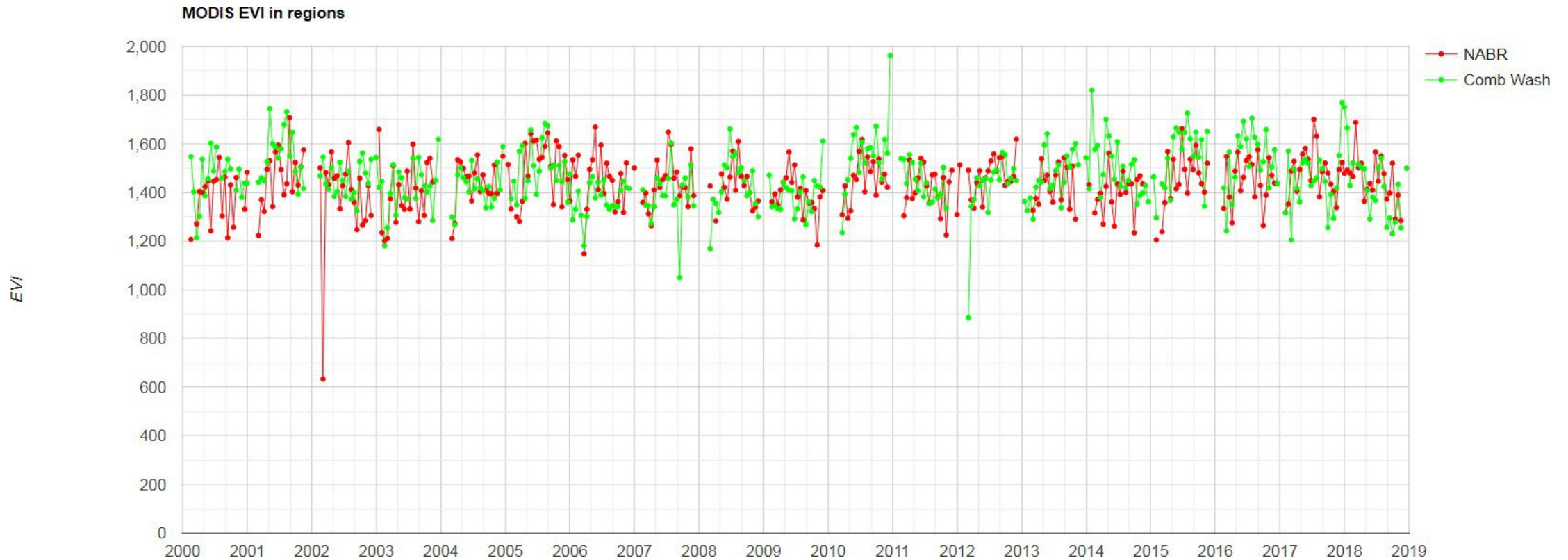


Point extraction of EVI time series at NABR visitor center

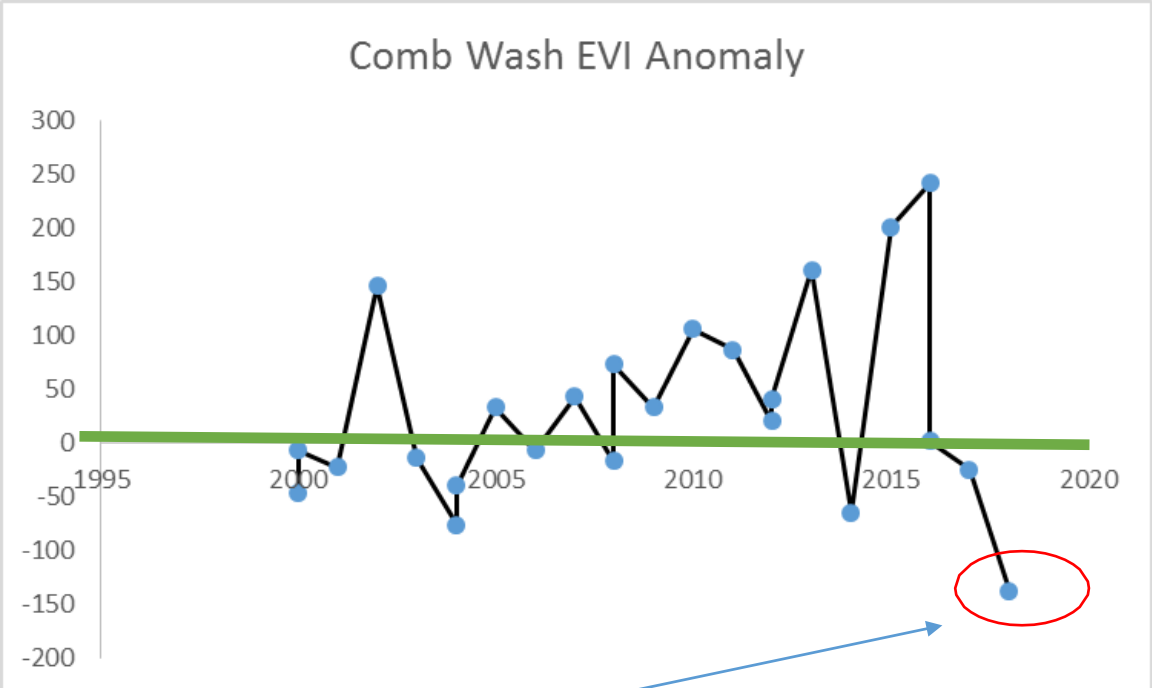
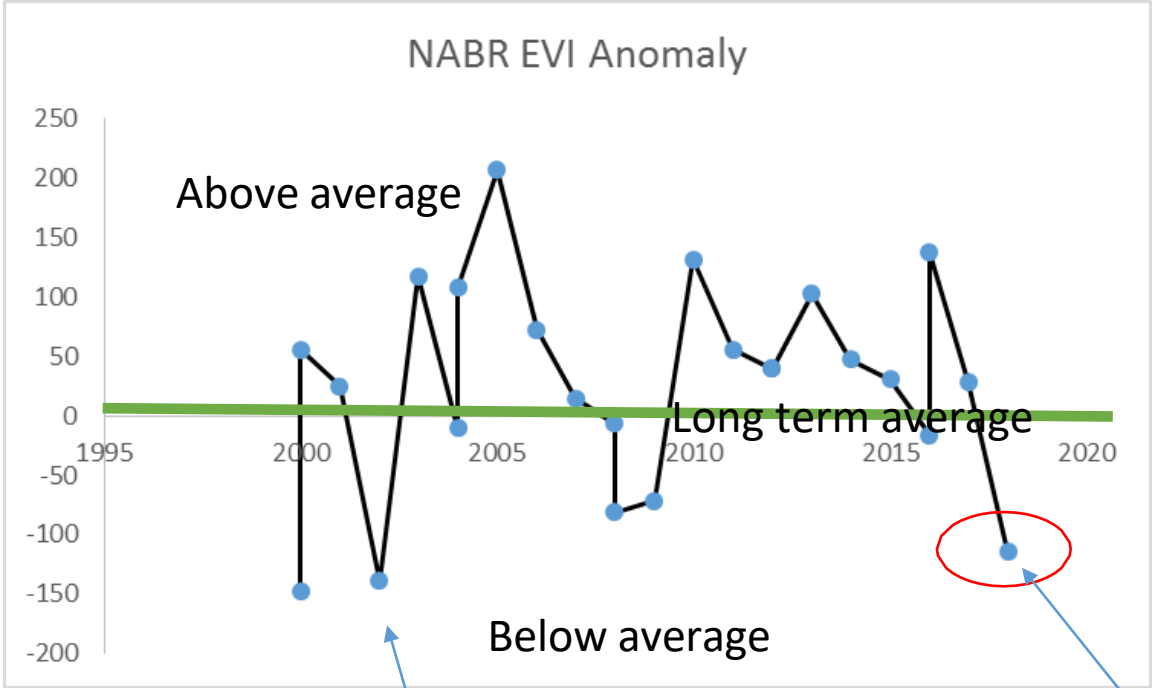
Area average extraction of EVI time series for area near Comb Wash



These are “raw” pixel time series values that have been screened for quality but not smoothed.
I still need to figure out how to do that in Earth Engine



October differences from long-term average

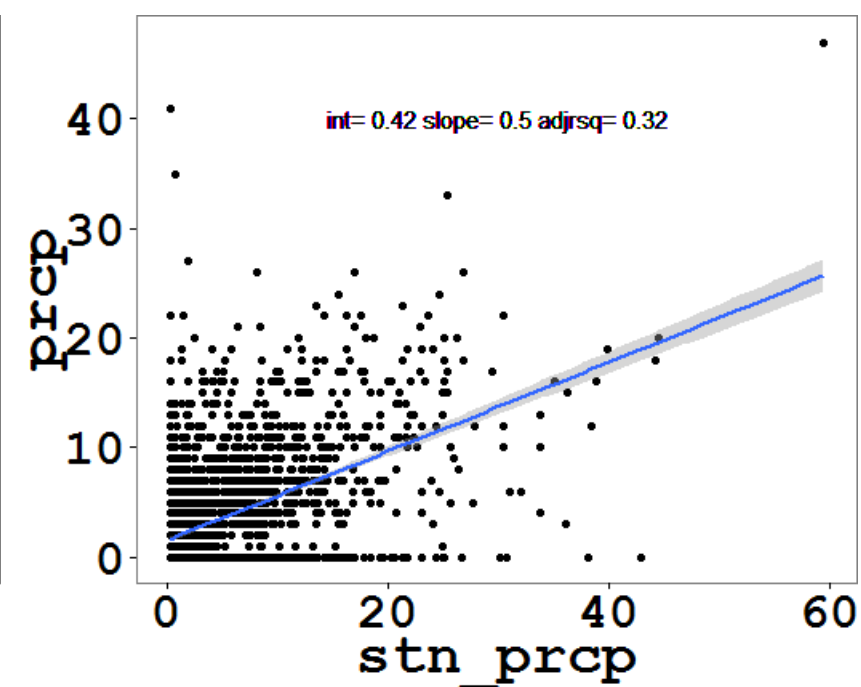
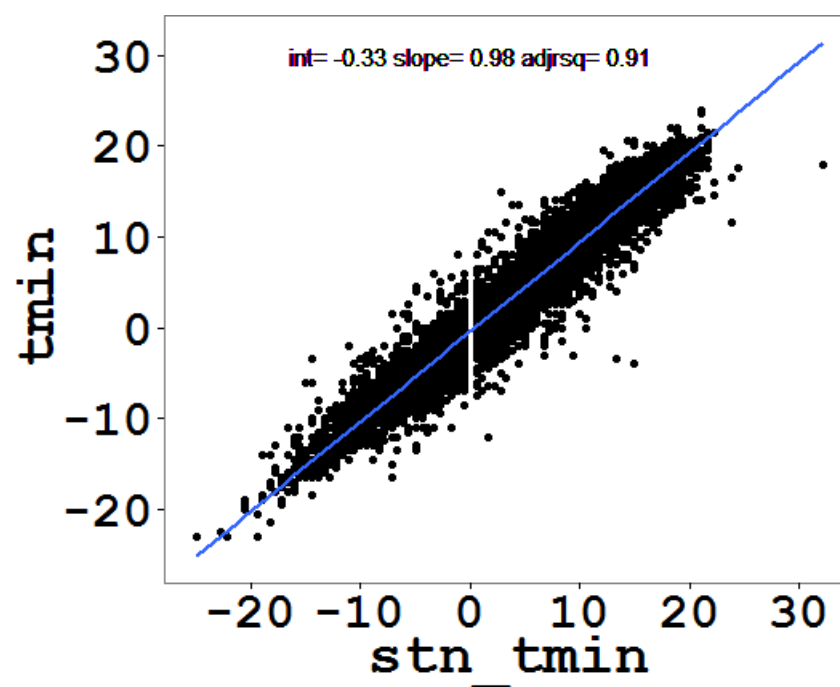
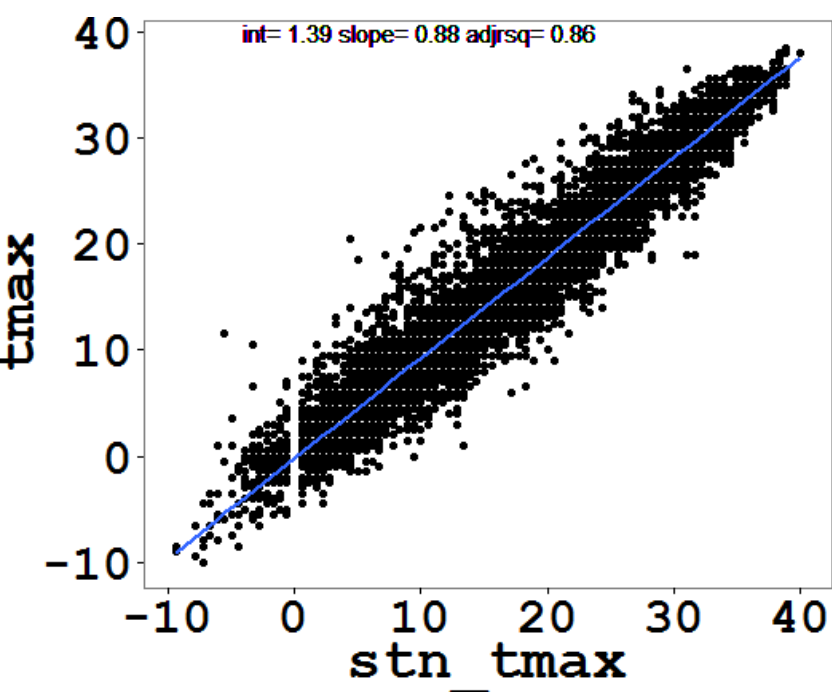


October 2018 vegetation condition at location of known Juniper mortality

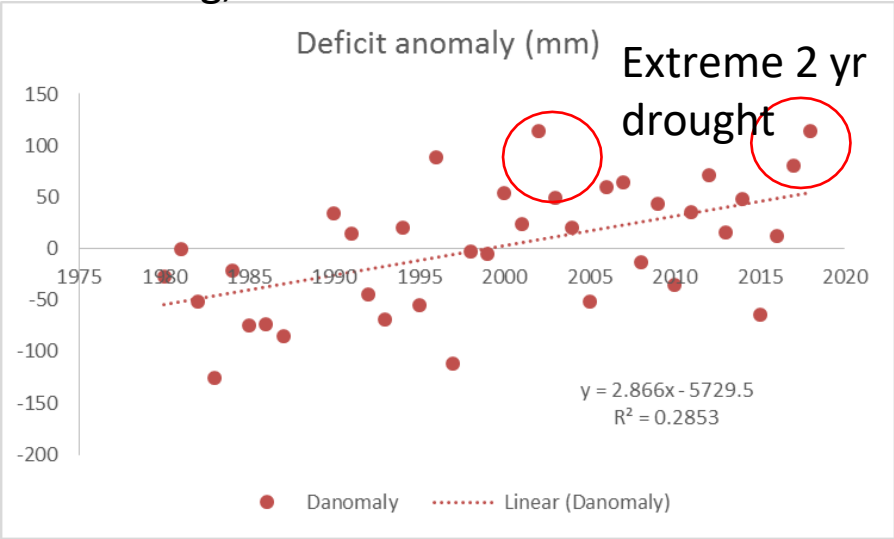
2003, another notably dry year
Refer to maps on slide 3 for comparison of extent and severity of regional drought

Lapse Rates: Blanding to NABR

Enables use of Blanding station data to run water balance model at NABR. This is necessary b/c daymet ends at 2017 and this analysis is for October 2018. (now dated we have 2018 Daymet, but for real-time monitoring we need to use station data)

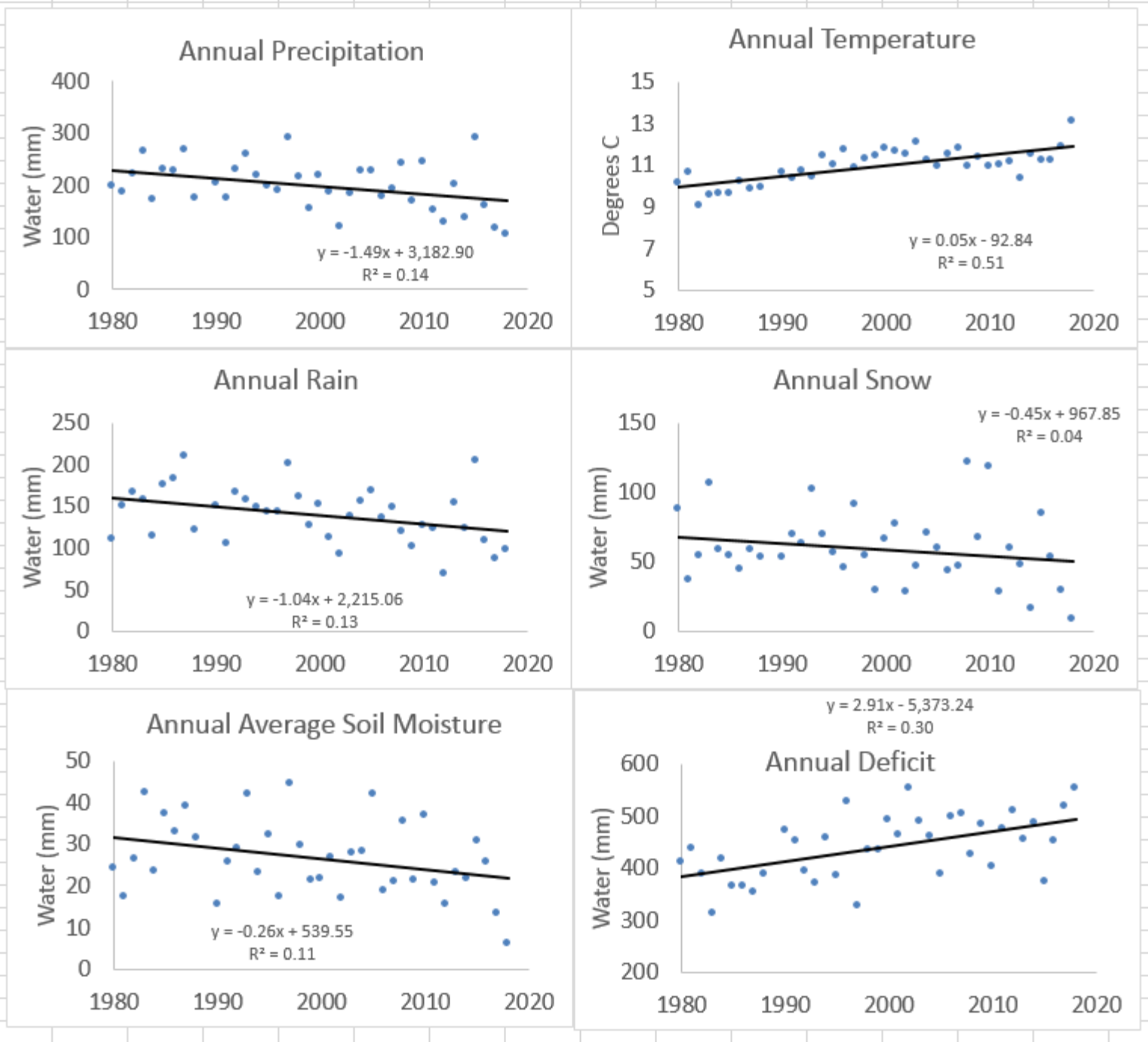


Modeled water balance at
NABR using temperature and
 precipitation lapse rate
 corrected station data from
 Blanding, UT



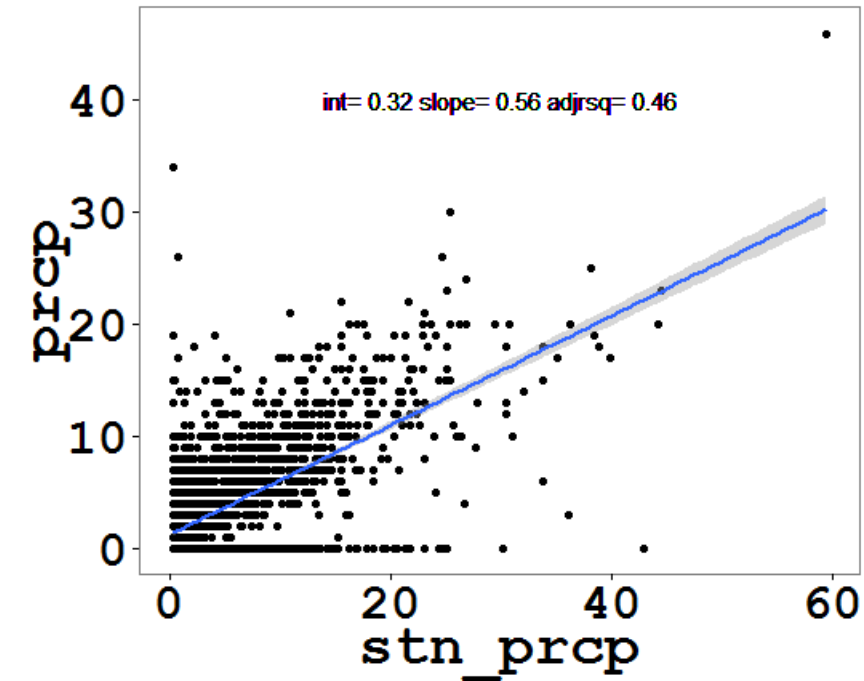
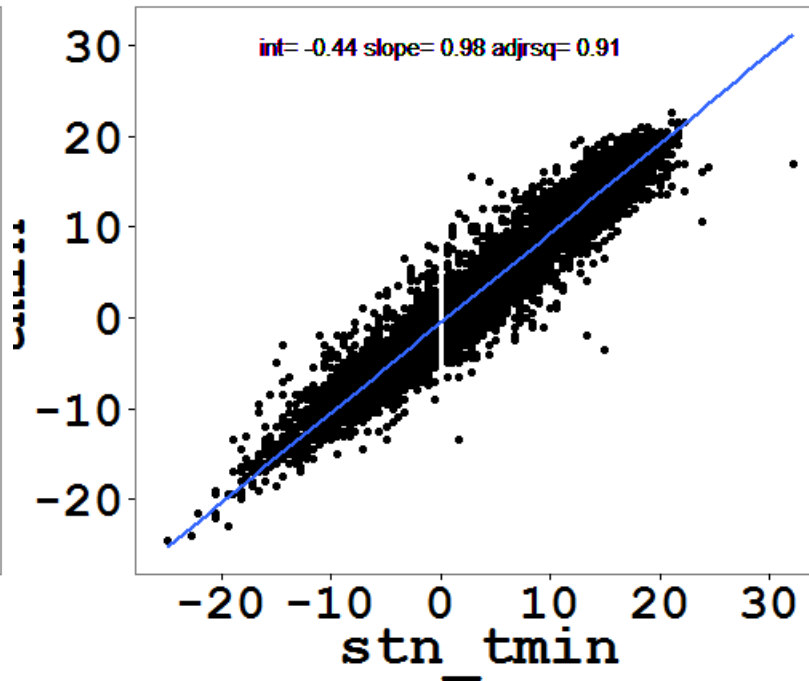
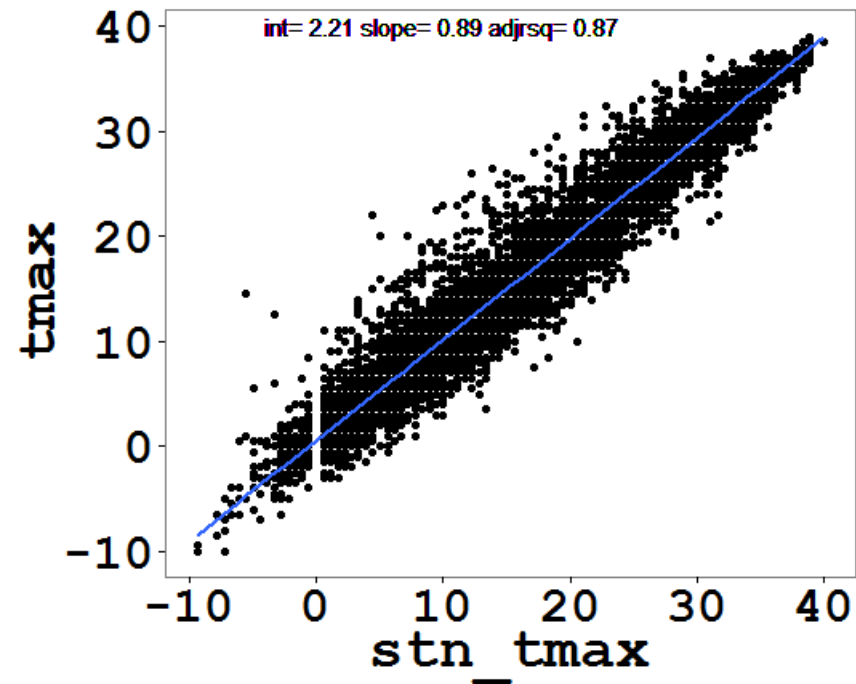
2.9 mm deficit increase / year
 on average is equivalent to 4.3
 inches more deficit in 2018 than
 1980. That means 4.3 more
 inches precip needed in 2018 to
 bring deficit back to 1980 level

Avg annual Precip 1980-2018
 was 7.8 inches.

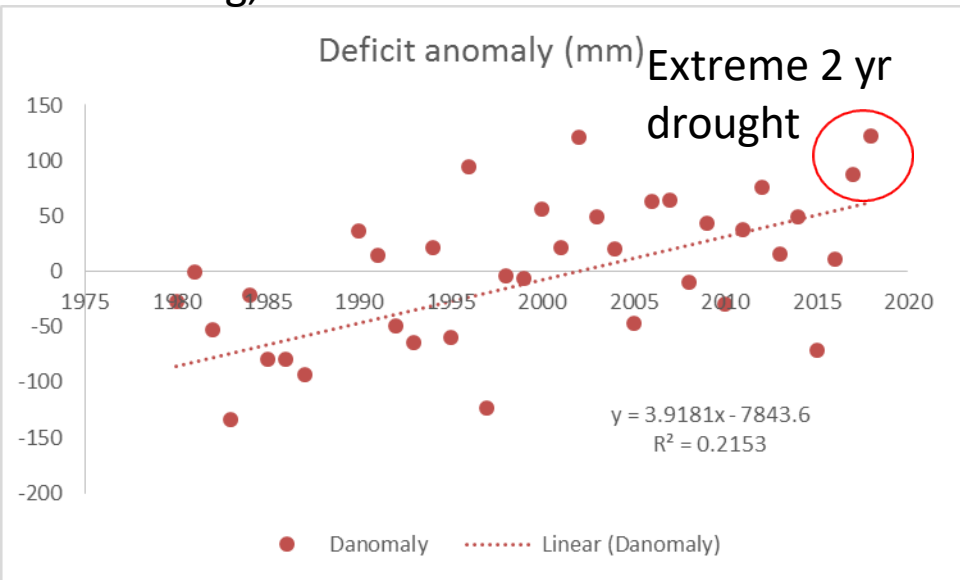


Lapse rates: Blanding to Comb wash

Lapse rates for Blanding to Comb Wash. Enables use of Blanding station data to run water balance model at Comb Wash. This is necessary b/c daymet ends at 2017.

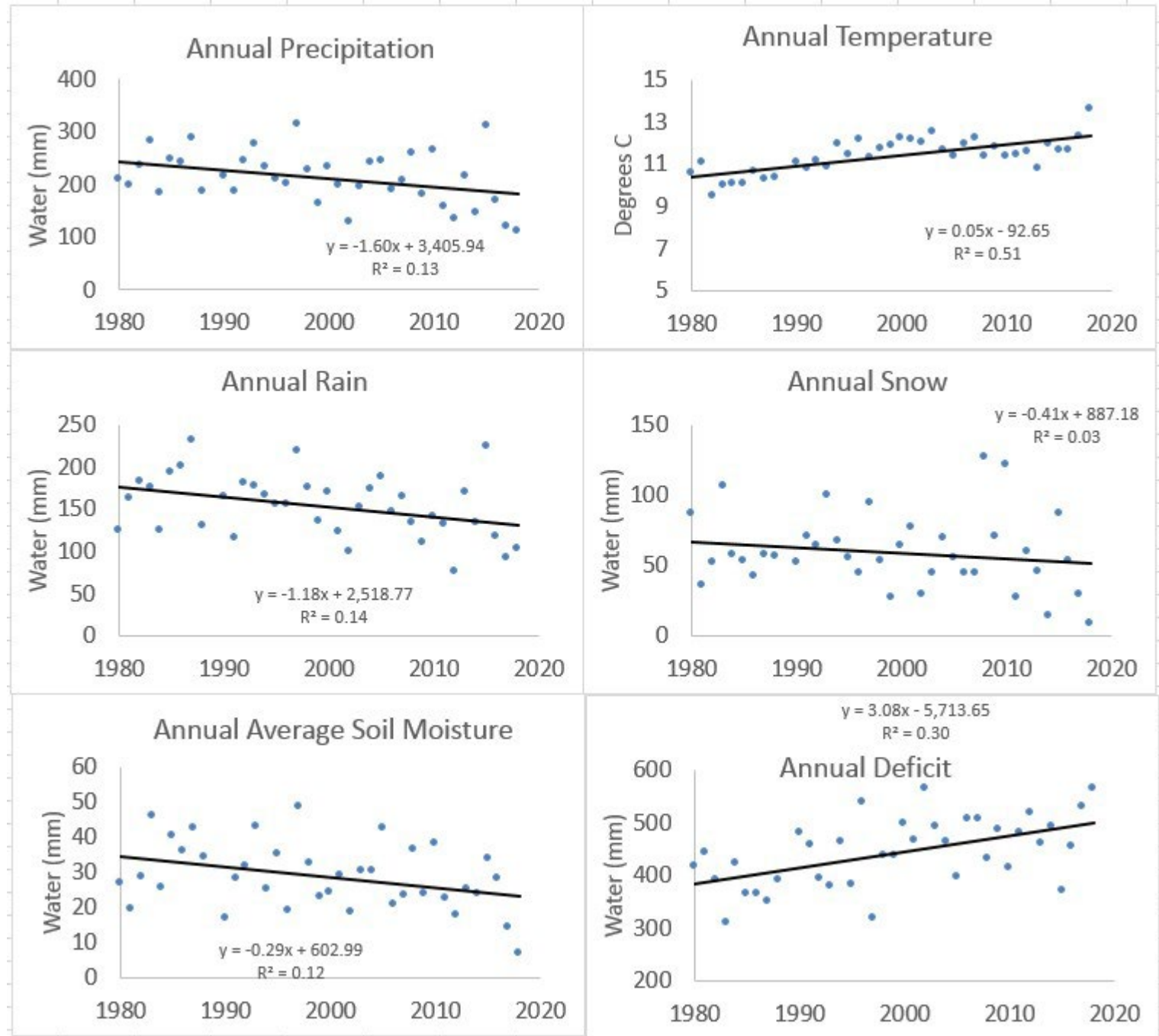


Modeled water balance at
Comb Wash using temperature
and precipitation lapse rate
corrected station data from
Blanding, UT



3.1 mm deficit increase / year
on average is equivalent to 4.6
inches more deficit in 2018 than
1980. That means 4.6 more
inches precip needed in 2018 to
bring deficit back to 1980 level

Avg annual Precip 1980-2018
was 8.3 inches.



Previously the worst drought since 1980 was in 2003 which was not an exception drought but it was preceded by an exceptional drought in 2002. So, it appears that two consecutive dry years can cause mortality. The cumulative two-year deficit in 2002 and 2003 was 164 mm while the cumulative two year deficit in 2017 and 2018 was 195 mm. This suggests the two-year cumulative deficit between 164 and 195 mm can kill juniper trees. Additionally, we found a 2.9 mm deficit increase per year since 1980 which is equivalent to 110 mm (4.3 inches) more deficit in 2018 than 1980. That means 4.3 more inches of precipitation would be needed in 2018 to bring deficit or drought stress back to the level experienced by juniper trees in 1980. Compare that “need” for water to the average annual precipitation from 1980 to 2018 which was 7.8 inches. The upshot: we would need an increase in precipitation of about 50% of the long term average to bring drought stress back to what trees “felt” in 1980.