An Approach to Drought Monitoring in the Semi-Arid Four Corners

Daniel Ferguson
Intermountain West Drought Early Warning System Drought & Climate Outlook
Biosphere 2
September 20, 2016

The University of Arizona
CLIMAS
Climate Assessment for the Southwest

Tuba City
Moenkopi
Hotevilla
Oraibi
Kykotsmovi Village
Polacca
Keams Canyon
Shongopovi
Second Mesa
State Route 264
US Route 160
Apache County
US Route 180, State Route 64
US Route 89
US Route 180
State Route 64
Coconino County
Little Colorado River
Navajo County
State Route 77
State Route 87
Flagstaff
Winslow
Interstate Route 40
0 miles 50
0 kilometers 100

Three problems

Sparse instrumental weather/climate monitoring

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existing indicators in Hopi drought plan mismatched in scale and scope to actual experience of drought by Hopi people

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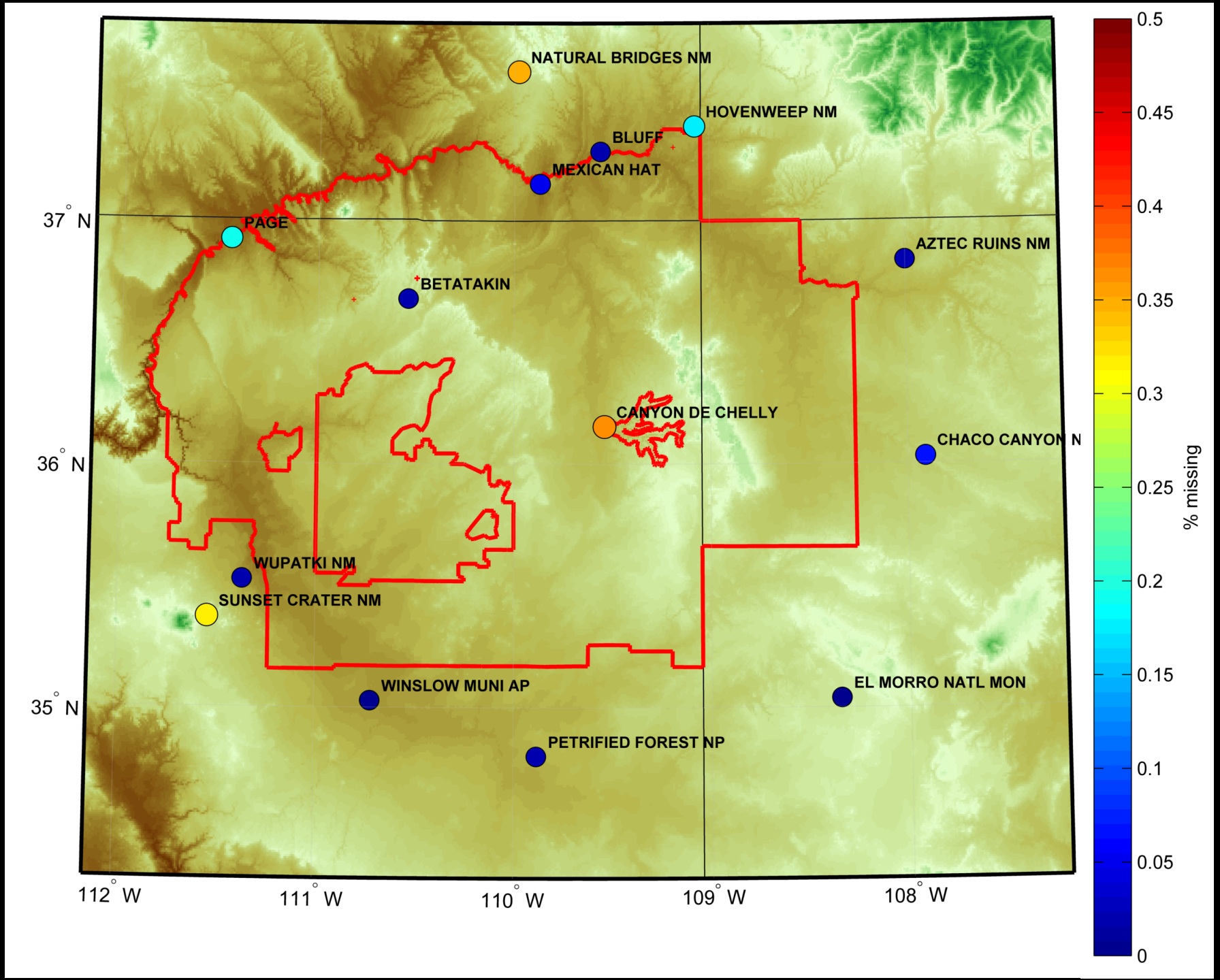
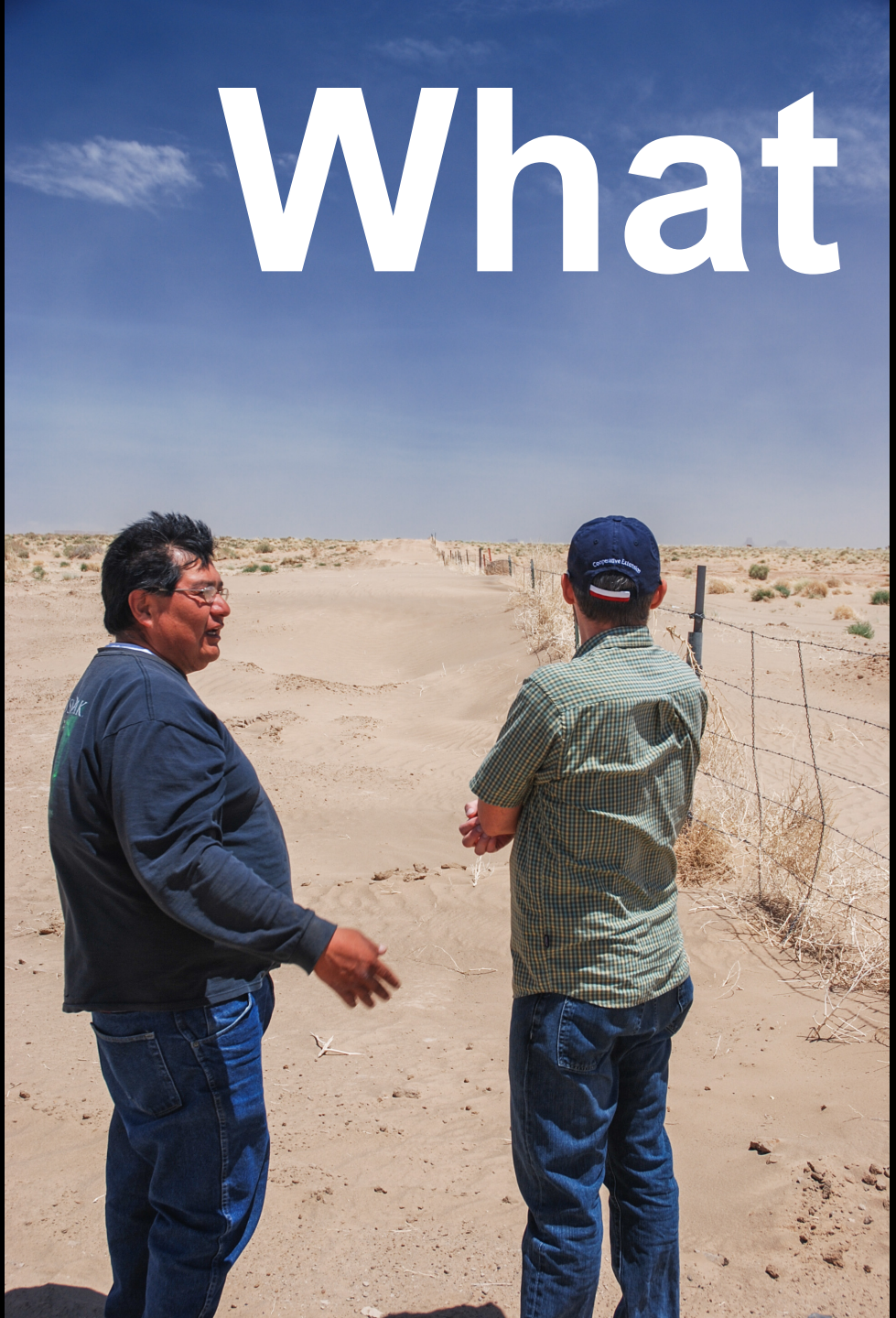
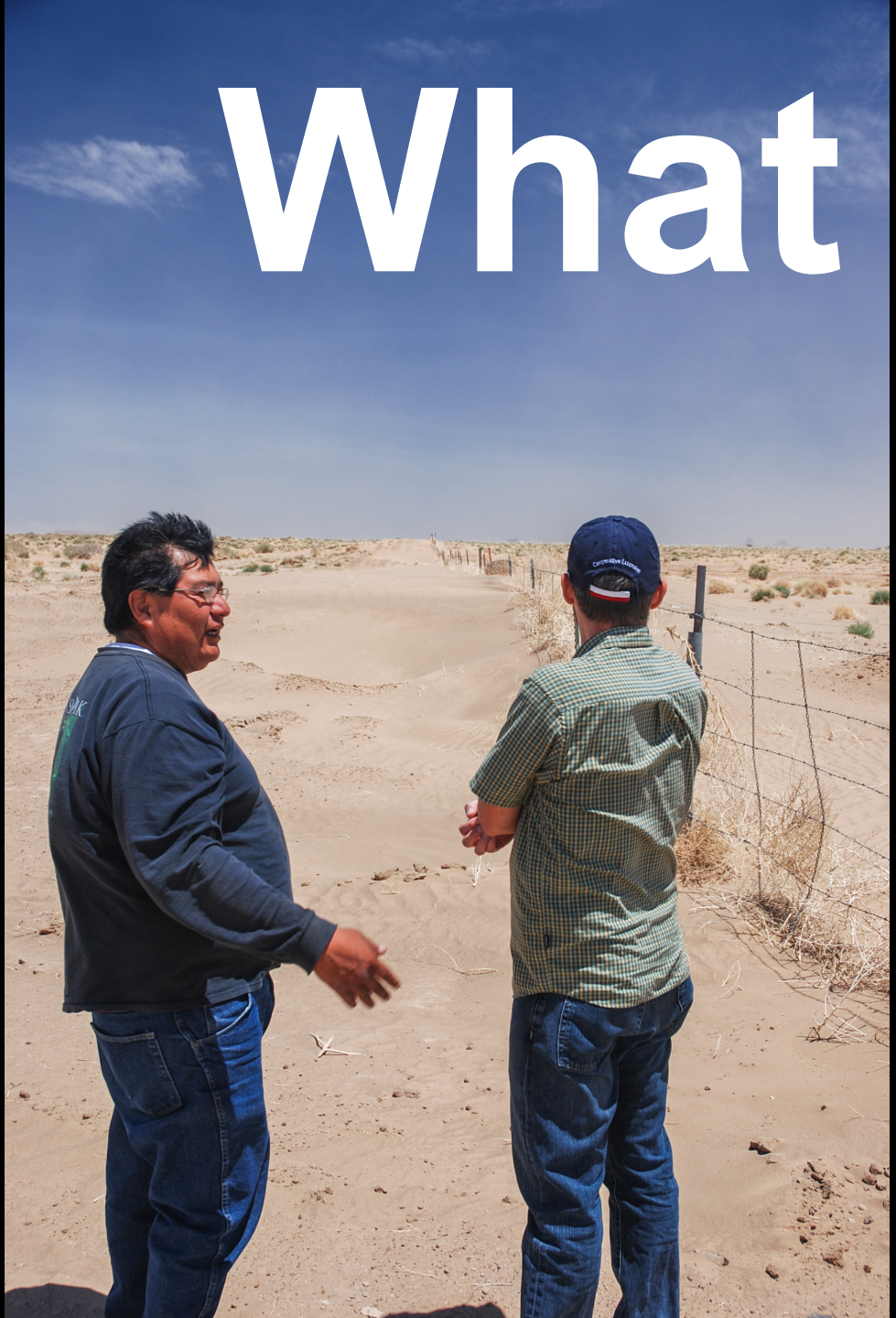
no reliable source for local information about drought conditions


NATURAL BRIDGES NM
HOVENWEEP NM
BLUFF
MEXICAN HAT
PAGE
AZTEC RUINS NM
BETATAKIN
CANYON DE CHELLY
CHACO CANYON N
WUPATKI NM
SUNSET CRATER NM
WINSLOW MUNI AP
EL MORRO NATL MON
PETRIFIED FOREST NP
37° N
36° N
35° N
112° W
111° W
110° W
109° W
108° W
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
% missing

What did we do?



What did we do?



THE HOPI TRIBE

Quarterly Hopi Drought Status Report
July-September 2014

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CURRENT RANGE CONDITIONS – HOPI RESERVATION

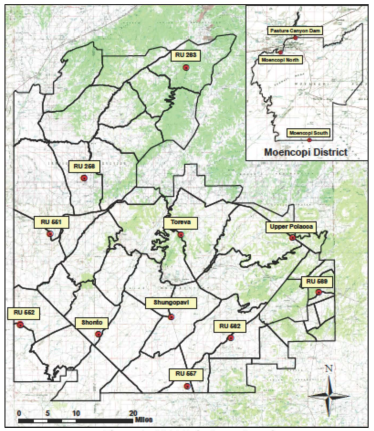

Figure 1. 2014 Rain Gauge Locations

Range Condition Notes:

The general condition of the range is poor to fair depending on the amount of precipitation received this monsoon season.

The monsoon rains arrived late (August) this summer and was very spotty throughout the reservation. The warm season annual grasses that are located in areas that received rain responded to the moisture and grew to maturity and are now in the seeding stage. The vegetation in areas that did not receive rain did not respond and only old growth vegetation (grey color) is present.

Table 1. July – September 2014 Precipitation (inches)

Rain Gauge Location	July	August	September	TOTAL
Range Unit 263	No Data	.83	.02	**.85**
Range Unit 256	No Data	.06	.20	**.26**
Range Unit 551	No Data	1.0	.08	**1.08**
Range Unit 552	.24	.26	.18	**.68**
Range Unit 557	.12	.36	.27	**.75**
Range Unit 562	.10	.45	.10	**.65**
Range Unit 569	0.0	.72	.18	**.90**
Upper Polacca	0.0	1.35	.63	**1.98**
Toreva	.03	1.0	.04	**1.07**
Shungopavi	.13	.60	.39	**1.12**
Shonto	.05	.40	.28	**.73**
Pasture Canyon Dam	.71	.61	.96	**2.28**
Moencopi North	1.0	0	.17	**1.17**
Moencopi South	.15	0	.26	**.41**

average with some isolated locations observing above-average amounts (Figure 3.). Most precipitation fell in a couple of storm events spread throughout the summer with locally heavy rains observed in mid-August and again in late September with the end of the monsoon season. Temperatures were largely kept in check due to cloud cover associated with afternoon thunderstorms with most of the region observing near-average temperature for the July-September season (Figure 4.). Given the spottiness of thunderstorm precipitation through the summer season, some isolated locations may have observed very little or even no precipitation, leading to no improvement or even worsening drought conditions. The recent update of the U.S. Drought monitor (Figure 2.) shows that the entire region remains in moderate to severe drought with little change in conditions over the past three months.

CONTRIBUTORS

Field Monitors, Office of Hopi Land Administration
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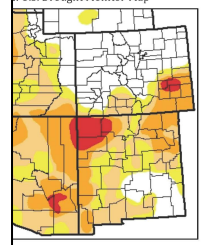
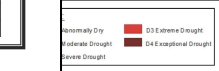


U.S. Drought Monitor Map



July-Sept 2014 % of normal precipitation.

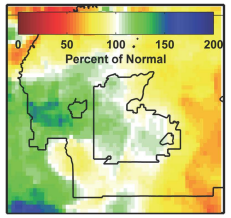
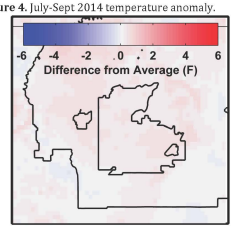
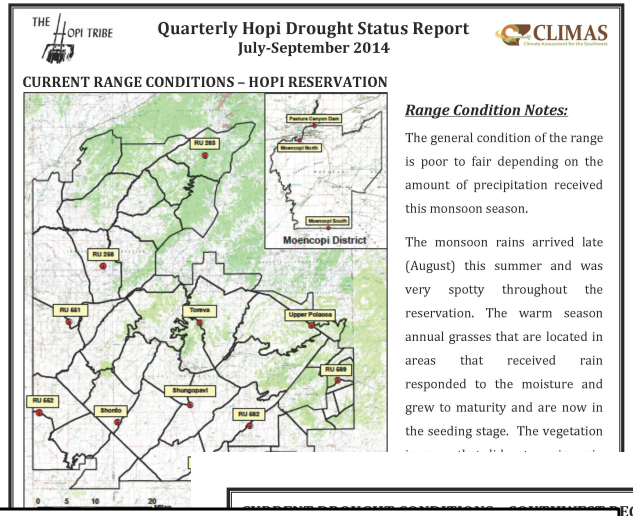


Figure 4. July-Sept 2014 temperature anomaly.



What



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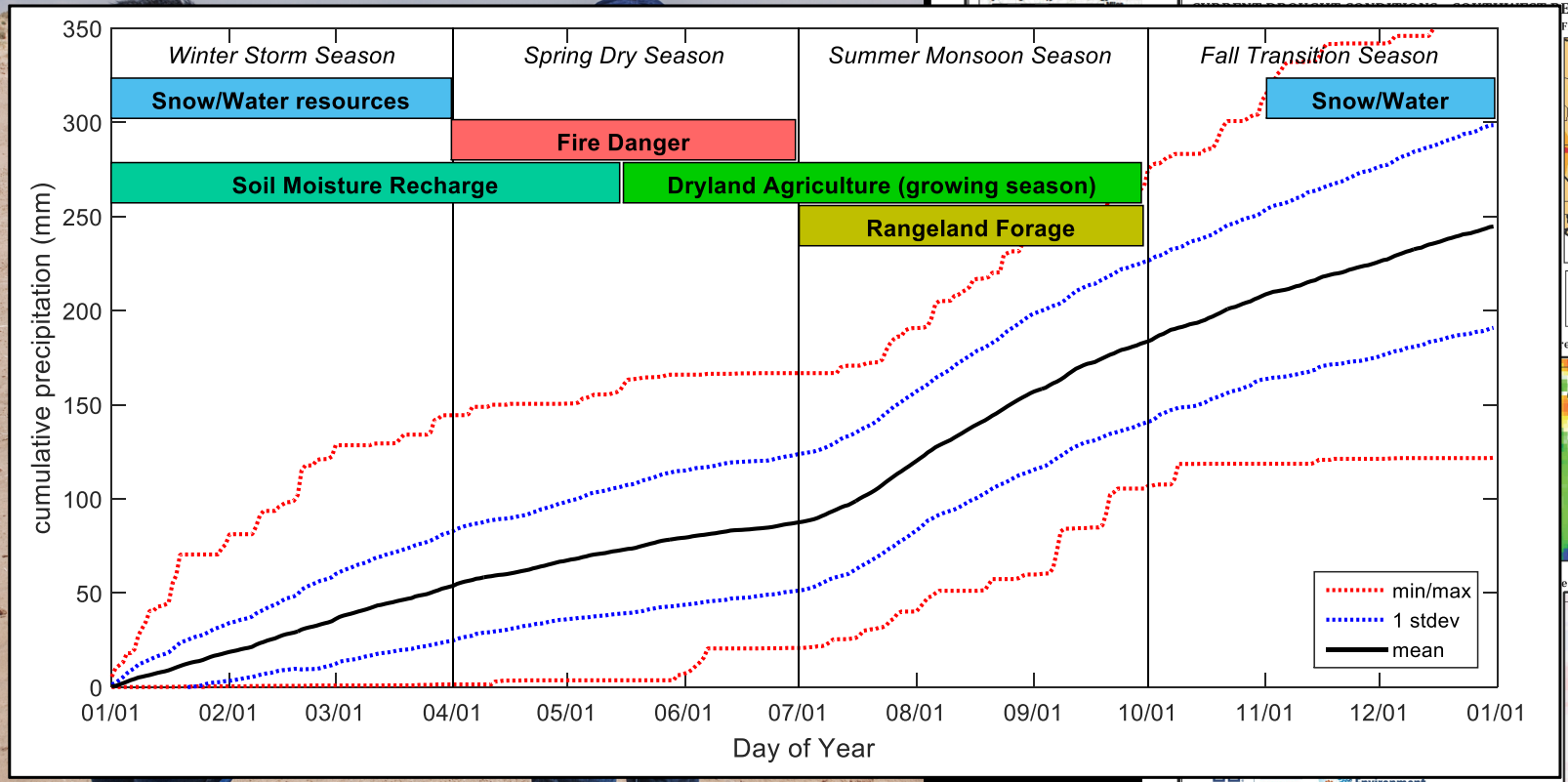

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Figure 2. U.S. Drought Monitor Map

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

e 3. July-Sept 2014 % of normal precipitation.

Percent of Normal

e 4. July-Sept 2014 temperature anomaly.

Difference from Average (F)

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What may be useful elsewhere?

does monitoring match drought concerns?

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what decisions can be or actually are being made that require drought data and info?

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does the presentation of monitoring data and information suit the context?

Scintillating further reading

Crimmins, M.A., D. B. Ferguson, A.M. Meadow, and J. Weiss. In review. Discerning 'flavors' of drought using climate extremes indices.

Ferguson, D. B., A. Masayesva, A. M. Meadow, and M. A. Crimmins. 2016. Rain Gauges to Range Conditions: Collaborative Development of a Drought Information System to Support Local Decision-Making. Weather, Climate, and Society 8 (4):345-359. doi:10.1175/WCAS-D-15-0060.1

Crimmins, M.A., D. B. Ferguson, J. L. Weiss, and H. L. Faulstich. 2015. Hopi Climate: An Overview to Support Drought Monitoring and Management. Tucson, AZ: Climate Assessment for the Southwest. http://www.climas.arizona.edu/publication/report/hopi-climate-overview-support-drought-monitoring-and-management

Meadow, A. M., M. A. Crimmins, and D. B. Ferguson. 2013. Field of Dreams or Dream Team? Assessing Two Models for Drought Impact Reporting in the Semiarid Southwest. Bulletin of the American Meteorological Society 94 (10):1507-1517. 10.1175/BAMS-D-11-00168.1

Meadow, A., D. B. Ferguson, and M. Crimmins. 2013. Helping a Community Develop a Drought Impacts Reporting System. Rural Connections, January 2013, 15-18.

Crimmins, M., N. Selover, K. Cozzetto, and K. Chief. 2013. Technical Review of the Navajo Nation Drought Contingency Plan – Drought Monitoring, ed. A. Meadow. Tucson, AZ: Climate Assessment for the Southwest. http://www.climas.arizona.edu/files/climas/project-documents/public/1062/navajo-nation-drought-plan-technical-review.pdf

Lackstrom, K., et al. 2013. The Missing Piece: Drought Impact Monitoring: Carolinas Integrated Sciences & Assessments and Climate Assessment for the Southwest. http://www.climas.arizona.edu/publications/2852

Ferguson, D. B., and M. Crimmins. 2009. Who's paying attention to the drought on the Colorado Plateau? Southwest Climate Outlook, July 2009. http://www.climas.arizona.edu/files/climas/pdfs/feature-articles/2009_jul_droughtcoplateau.pdf

thank you

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