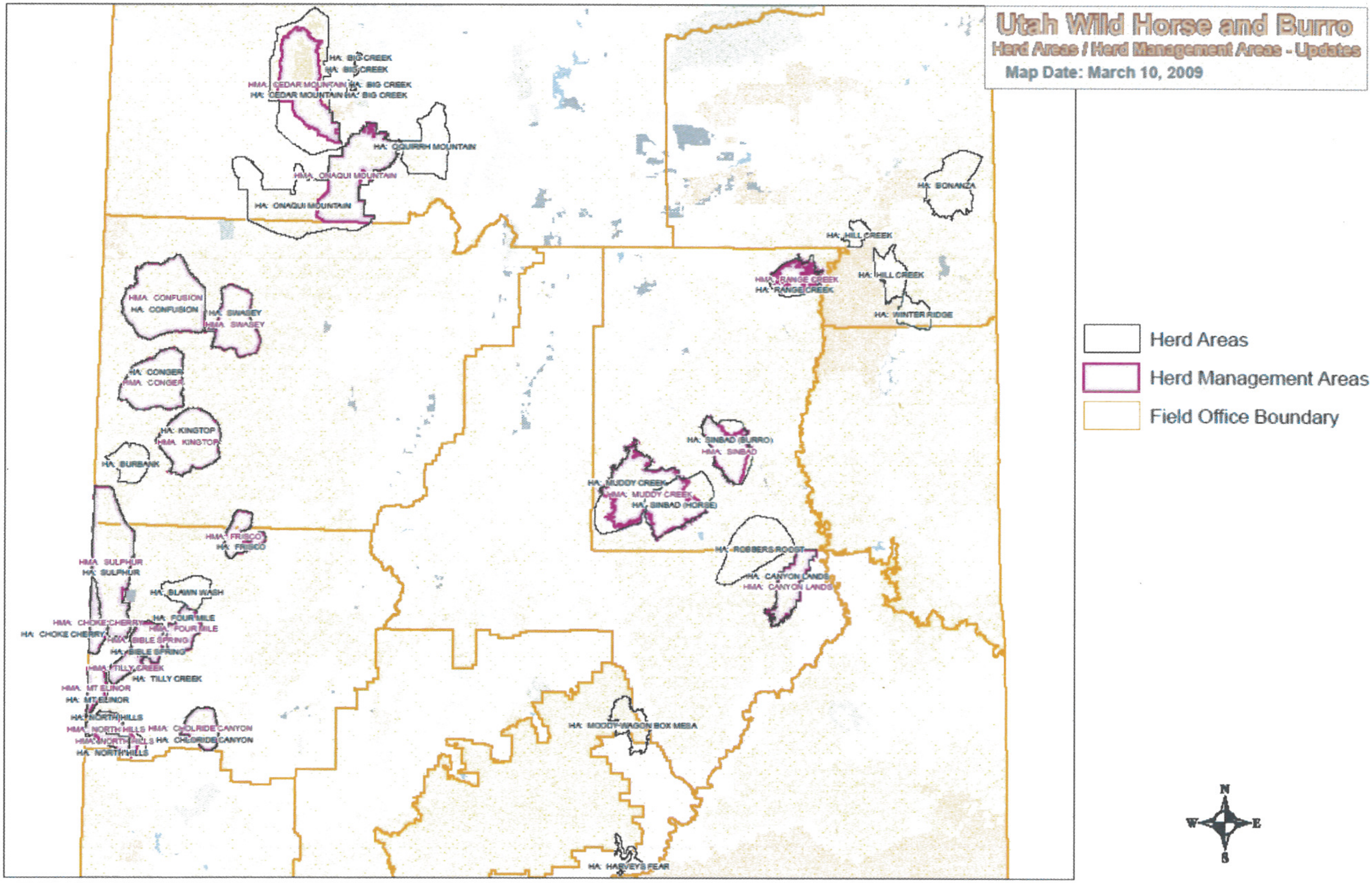
Utah Wild Horse and Burro
Herd Areas / Herd Management Areas - Updates
Map Date: March 10, 2009
HA: BIG CREEK
HA: BIG CREEK
HMA: CEDAR MOUNTAIN
HA: BIG CREEK
HA: CEDAR MOUNTAIN
HA: BIG CREEK
HA: OQUIRRH MOUNTAIN
HMA: ONAQUI MOUNTAIN
HA: ONAQUI MOUNTAIN
HA: BONANZA
HA: HILL CREEK
HMA: RANGE CREEK
HA: RANGE CREEK
HA: HILL CREEK
HA: WINTER RIDGE
HMA: CONFUSION
HA: CONFUSION
HA: SWASEY
HMA: SWASEY
HA: CONGER
HMA: CONGER
HA: KINGTOP
HMA: KINGTOP
HA: BURBANK
HA: SINBAD (BURRO)
HMA: SINBAD
HA: MUDDY CREEK
HMA: MUDDY CREEK
HA: SINBAD (HORSE)
HMA: FRISCO
HA: FRISCO
HA: ROBBERS ROOST
HMA: SULPHUR
HA: SULPHUR
HA: CANYON LANDS
HMA: CANYON LANDS
HA: BLAWN WASH
HA: FOUR MILE
HMA: CHOKE CHERRY
HMA: FOUR MILE
HA: CHOKE CHERRY
HMA: BIBLE SPRING
HA: BIBLE SPRING
HMA: TILLY CREEK
HA: TILLY CREEK
HMA: MT ELINOR
HA: MT ELINOR
HA: NORTH HILLS
HMA: NORTH HILLS
HMA: CHLORIDE CANYON
HMA: NORTH HILLS
HA: CHLORIDE CANYON
HA: NORTH HILLS
HA: MOODY-WAGON BOX MESA
HA: HARVEYS FEAR
Herd Areas
Herd Management Areas
Field Office Boundary
N
W
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The Nature and Impact of Drought

Climate and Climate Change Implications

By
Jan Curtis, Applied Climatologist
NRCS - National Water & Climate Center

BLM: Wild Horses and Burros Advisory meeting: SLC 29 Oct 2012

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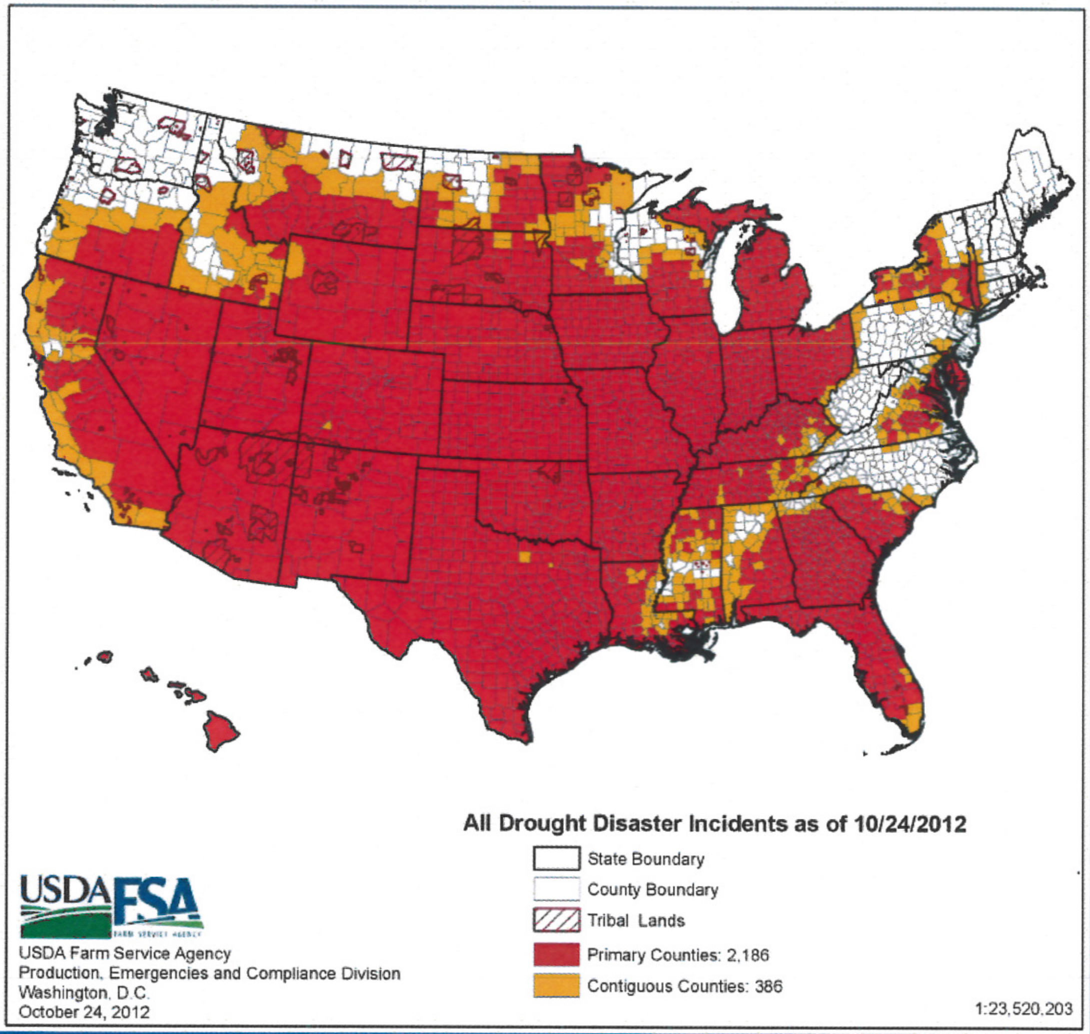
Currently

2012 Secretarial Drought Designations - All Drought



Food, Conservation and Energy Act of 2008 ("Farm Bill") authorizes the Livestock Forage Disaster Program (LFP) for a county experiencing:

- D2 intensity for at least 8 consecutive weeks during normal grazing
- D3 intensity for at least 4 weeks during normal grazing
- D4 intensity at any time

Source: http://www.usda.gov/wps/portal/usda/usdahome?navid=DISASTER_ASSISTANCE

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Drought Classification

Category	Description	Possible Impacts	Occurs on Average
Drought Severity Classification			
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	4 Years
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	7 Years
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	13 Years
D3	Extreme Drought	Major crop/pasture loses; widespread water shortages or restrictions	25 years
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	50 Years

Ref: http://droughtmonitor.unl.edu/classify.htm

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Drought Monitor Categories

Drought Severity Classification

Category	Description	Possible Impacts	Ranges					
			Palmer Drought Index	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Short and Long-term Drought Indicator Blends (Percentiles)	
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	21-30	4Y
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	11-20	7Y
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	6-10	13Y
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	3-5	25Y
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	0-2	50Y

Ref: http://droughtmonitor.unl.edu/classify.htm

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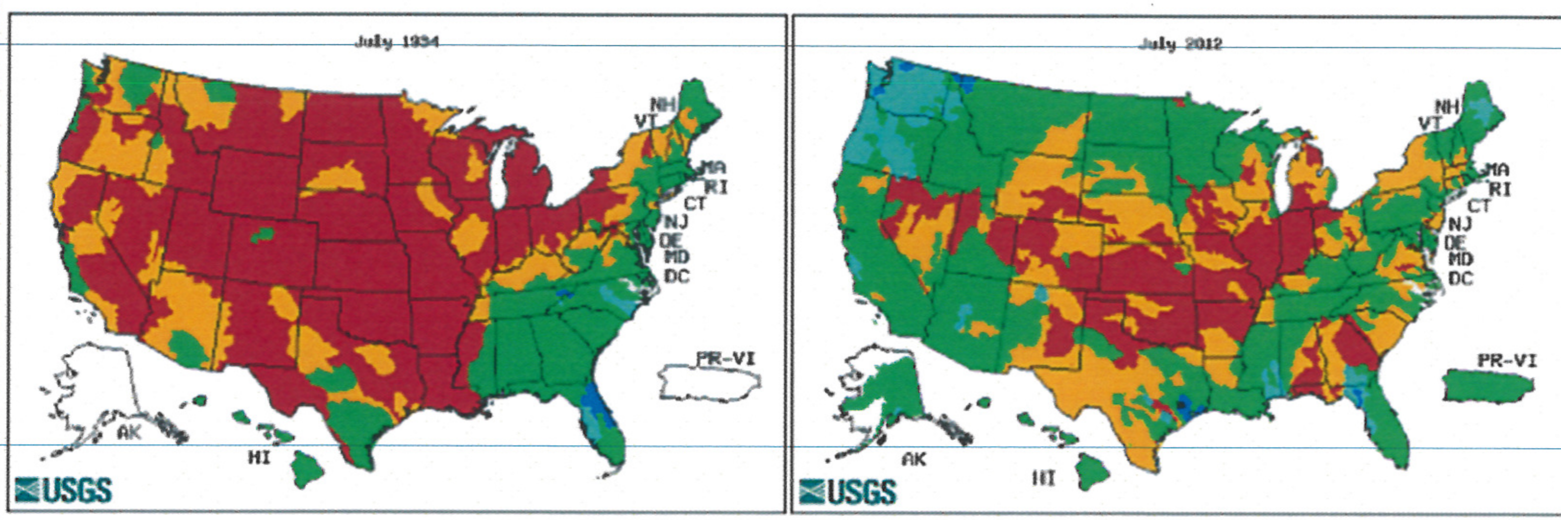
DROUGHT INDICATOR BLEND AND COMPONENT PERCENTILES -- *October 20, 2012*

(KEY: D4=0-2 [dark fill] D3=2-5 [red fill] D2=5-10 [brown fill] D1=10-20 [tan fill] D0=20-30 [yellow fill] WET=70-100 [green text]*)*

Climate Division						Drought Blends		Individual Blend Components										
								Precipitation						Palmer Z-Index	Palmer Drought Index (PDI)	Palmer Hydro. Drought Index (PHDI)	5-Year Average Z-Index	CPC Soil Moisture Model
ID #	U.S. CD #	State #	State CD #	State Name	CD Name	Short Term	Long Term	1-Month	3-Month	6-Month	1-Year	2-Year	5-Year					
4201	294	42	1	Utah	Western	38.7	17.3	48.5	22.4	1.1	0.0	38.3	16.9	58.8	32.3	26.2	23.6	8.6
4202	295	42	2	Utah	Dixie	65.4	25.8	75.0	85.2	72.2	35.8	60.6	49.9	50.8	28.0	8.6	28.3	39.5
4203	296	42	3	Utah	North-Central	27.4	29.8	31.6	24.1	5.4	9.8	84.6	63.3	40.5	8.0	8.7	46.3	16.1
4204	297	42	4	Utah	South-Central	64.2	38.4	64.8	81.3	64.5	40.7	82.0	61.2	59.1	10.7	8.5	56.3	53.1
4205	298	42	5	Utah	Northern Mountains	27.7	20.6	32.3	15.3	4.0	3.4	59.6	55.9	52.5	6.1	6.7	36.3	7.4
4206	299	42	6	Utah	Uinta Basin	57.0	16.3	55.0	42.7	7.0	3.0	49.1	43.5	86.2	10.9	2.0	30.5	18.5
4207	300	42	7	Utah	Southeast	44.1	5.7	50.3	48.5	22.3	14.3	27.0	33.2	56.0	1.5	0.0	14.6	14.8
2601	181	26	1	Nevada	Northwestern	8.0	0.2	12.8	6.2	0.0	0.0	7.1	1.7	27.8	2.7	2.7	2.5	1.2
2602	182	26	2	Nevada	Northeastern	42.3	16.5	45.8	72.8	19.8	4.7	48.2	28.2	37.0	6.0	6.0	33.6	16.1
2603	183	26	3	Nevada	South-Central	84.7	70.0	78.0	94.9	88.6	77.6	92.3	83.0	72.9	50.2	27.0	80.2	86.4
2604	184	26	4	Nevada	Extreme Southern	94.1	63.7	89.9	94.6	88.9	48.8	67.7	43.8	88.6	83.2	82.1	28.0	90.1
2501	173	25	1	Nebraska	Panhandle	7.9	21.5	27.8	0.7	0.0	0.0	12.6	69.7	25.0	0.0	0.0	71.6	1.2
2502	174	25	2	Nebraska	North-Central	1.4	9.1	5.0	0.0	0.0	0.0	26.9	89.7	10.0	0.0	0.0	90.8	1.2
2503	175	25	3	Nebraska	Northeast	5.1	4.9	18.4	0.0	0.0	0.0	7.6	67.7	19.0	1.1	1.1	78.8	1.2
2505	176	25	5	Nebraska	Central	2.4	9.5	10.1	0.0	0.0	0.4	11.1	93.4	10.3	6.8	6.8	93.5	1.2
2506	177	25	6	Nebraska	East-Central	10.3	10.4	29.0	0.0	3.6	4.1	19.3	65.8	26.2	9.0	8.9	76.6	1.2
2507	178	25	7	Nebraska	Southwest	4.9	34.1	17.2	0.0	0.0	0.0	14.7	93.8	18.9	1.7	2.2	95.8	1.2
2508	179	25	8	Nebraska	South-Central	13.5	13.7	28.5	4.0	0.9	5.4	24.9	92.2	29.9	11.2	11.8	97.0	7.4
2509	180	25	9	Nebraska	Southeast	15.8	8.6	41.5	7.0	4.7	14.9	15.7	37.1	29.0	11.0	10.6	60.5	2.5

For the 1st 6 months of 2012, precipitation has been the lowest since 2002. However, compared to the Depression Era (Dust Bowl) Drought, it pales in comparison. The depiction below shows the stream flows between July 1934 and July 2012. Clearly, much of the country back then was far worse off.



Explanation - Percentile classes						
Low	<10	10-24	25-75	76-90	>90	High
	Much below normal	Below normal	Normal	Above normal	Much above normal	

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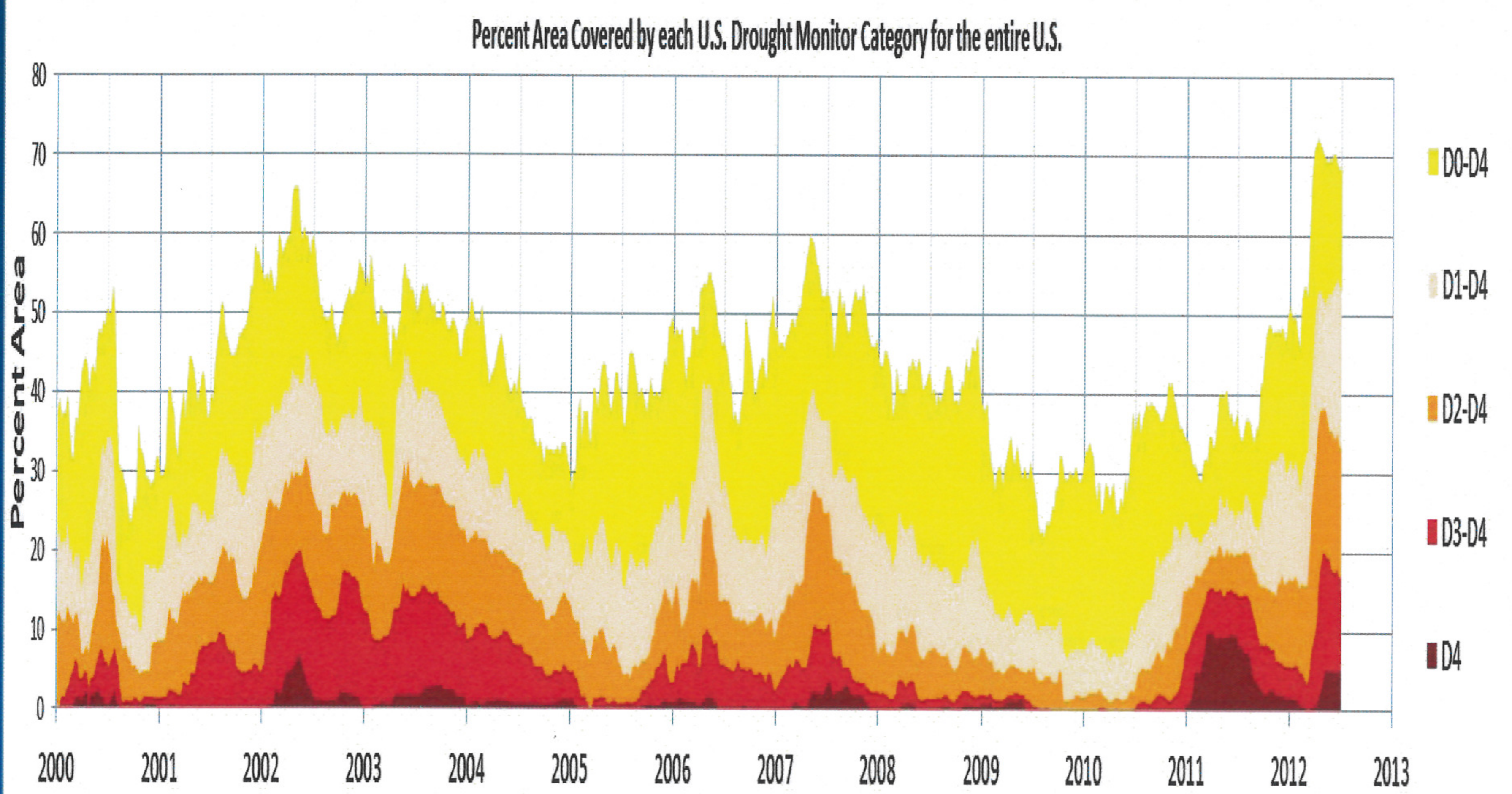

This time series shows the area of the United States in abnormally dry and drought conditions from 2000 through early October 2012. The area in moderate drought

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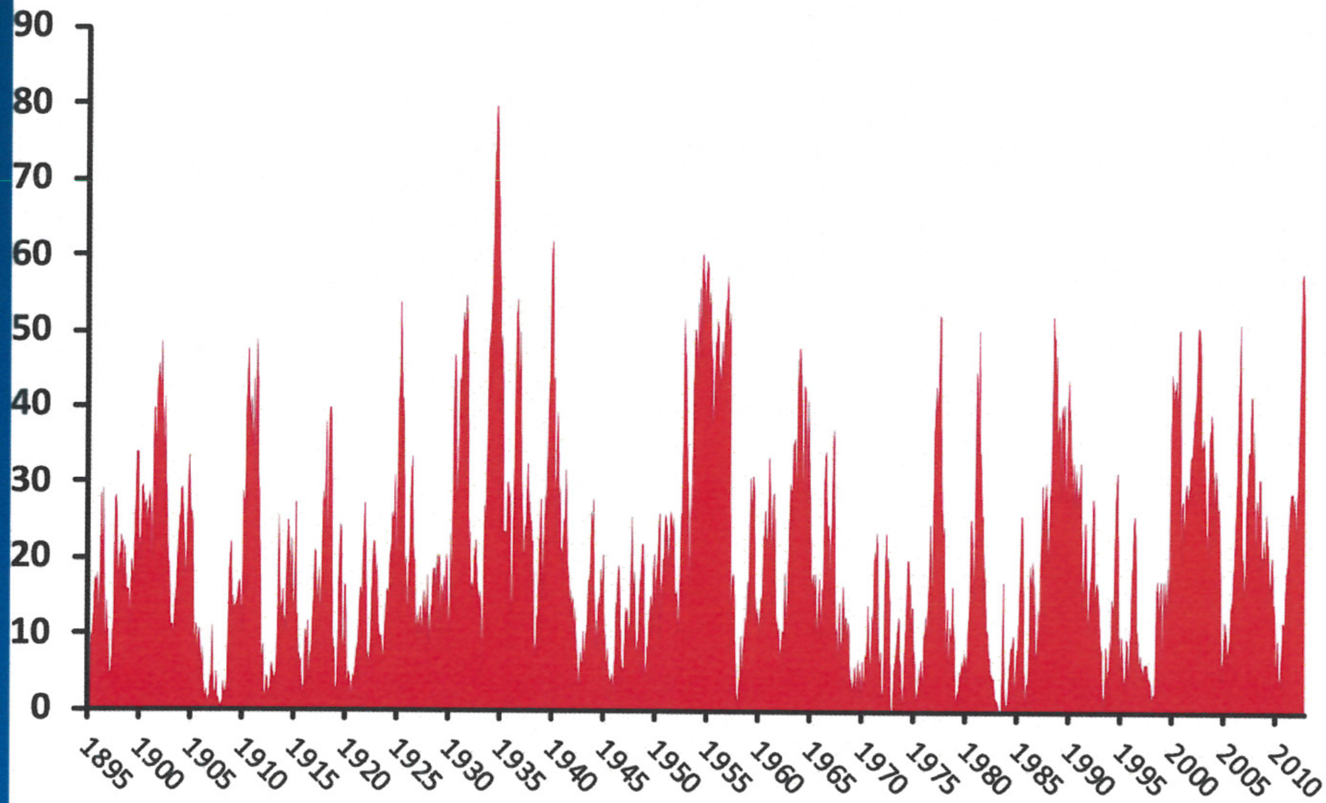
Percent Area of the United States in Moderate to Extreme Drought

January 1895–September 2012



Based on data from the National Climatic Data Center/NOAA

Source: http://drought.unl.edu/Portals/0/docs/DroughtScape/DSfall2012.pdf

This chart shows the portion of the United States in moderate to extreme drought from January 1895 through September 2012 according to the Palmer Drought Severity Index. Data is from the National Climatic Data Center.

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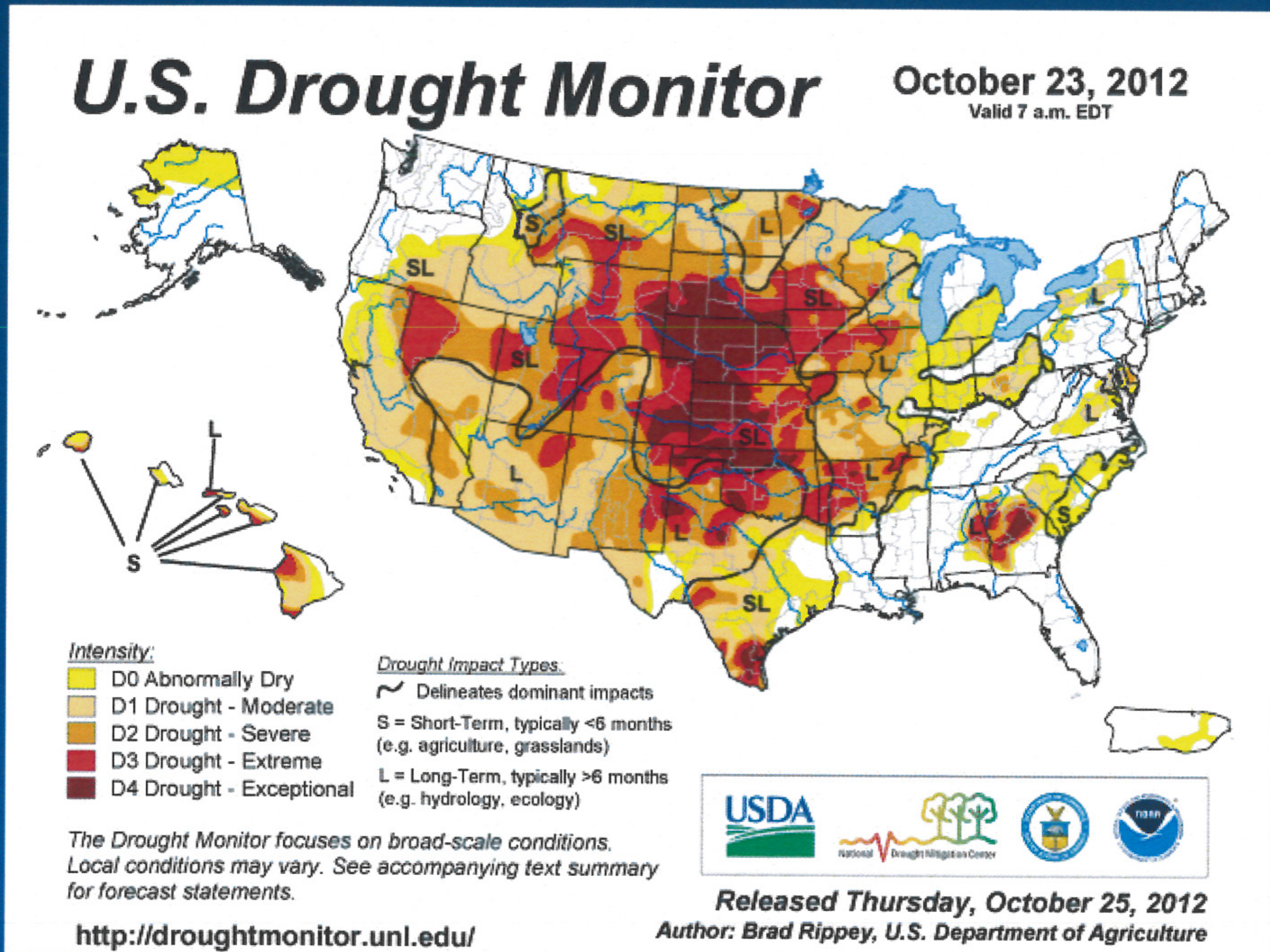
Currently



Source: http://www.droughtmonitor.unl.edu/

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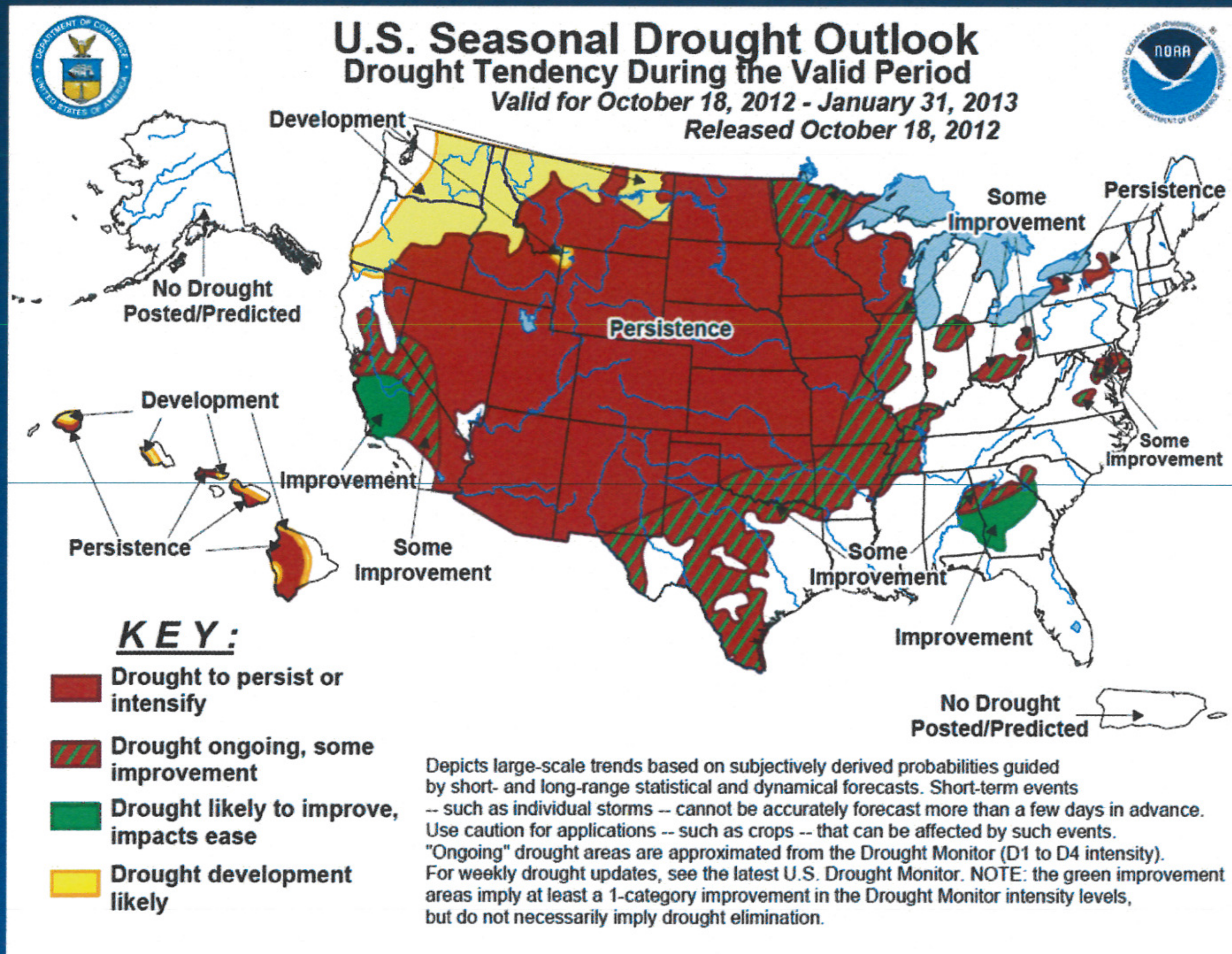
Forecast



Source: http://www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.gif/

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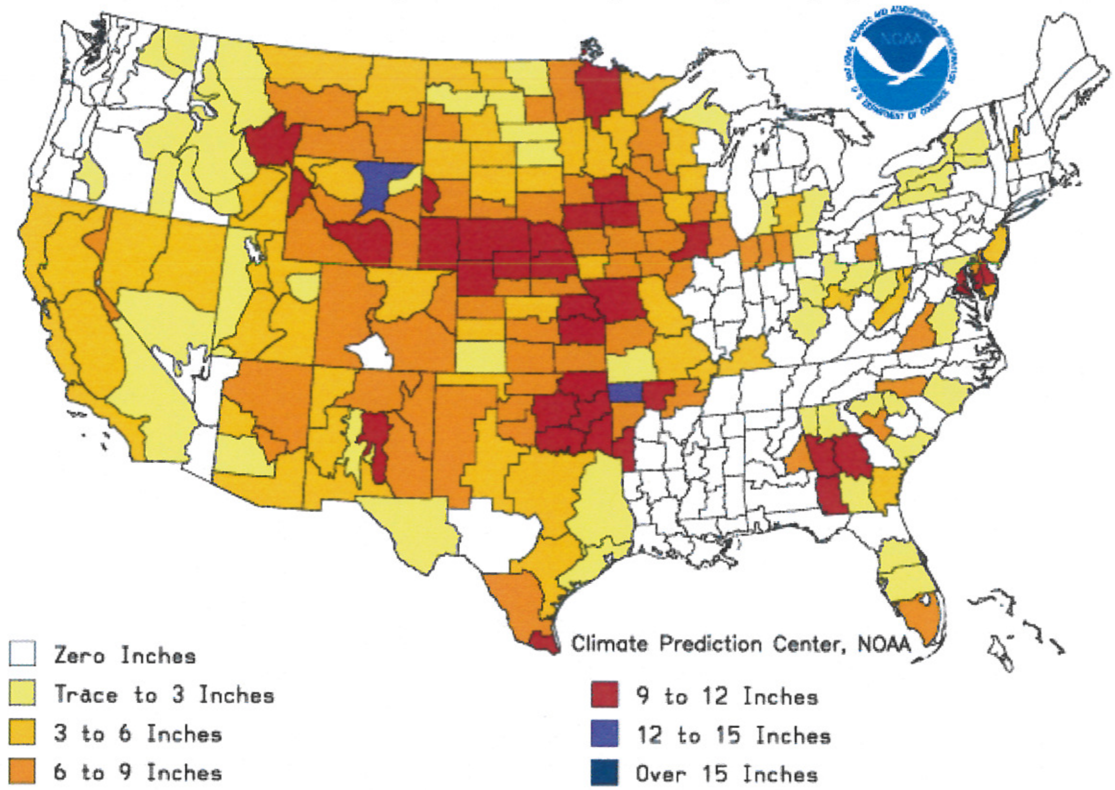
Additional Precip. Needed (In.) to Bring PDI to −0.5

Weekly Value for Period Ending OCT 20, 2012

Long Term Palmer Drought Severity Index (PDI)



Ref: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/addpcp.gif

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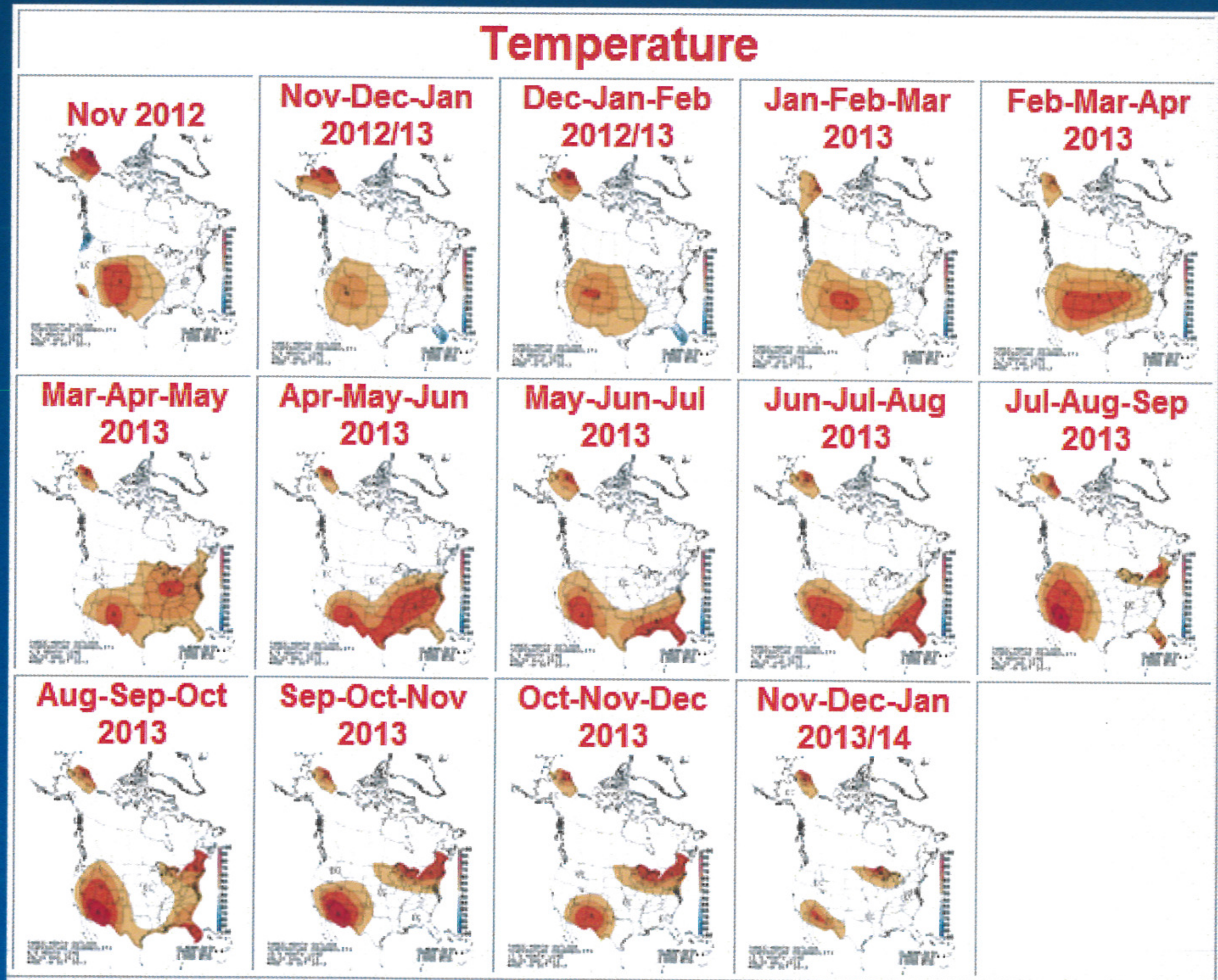

Source: http://www.cpc.ncep.noaa.gov/products/predictions/long_range/two_class.php

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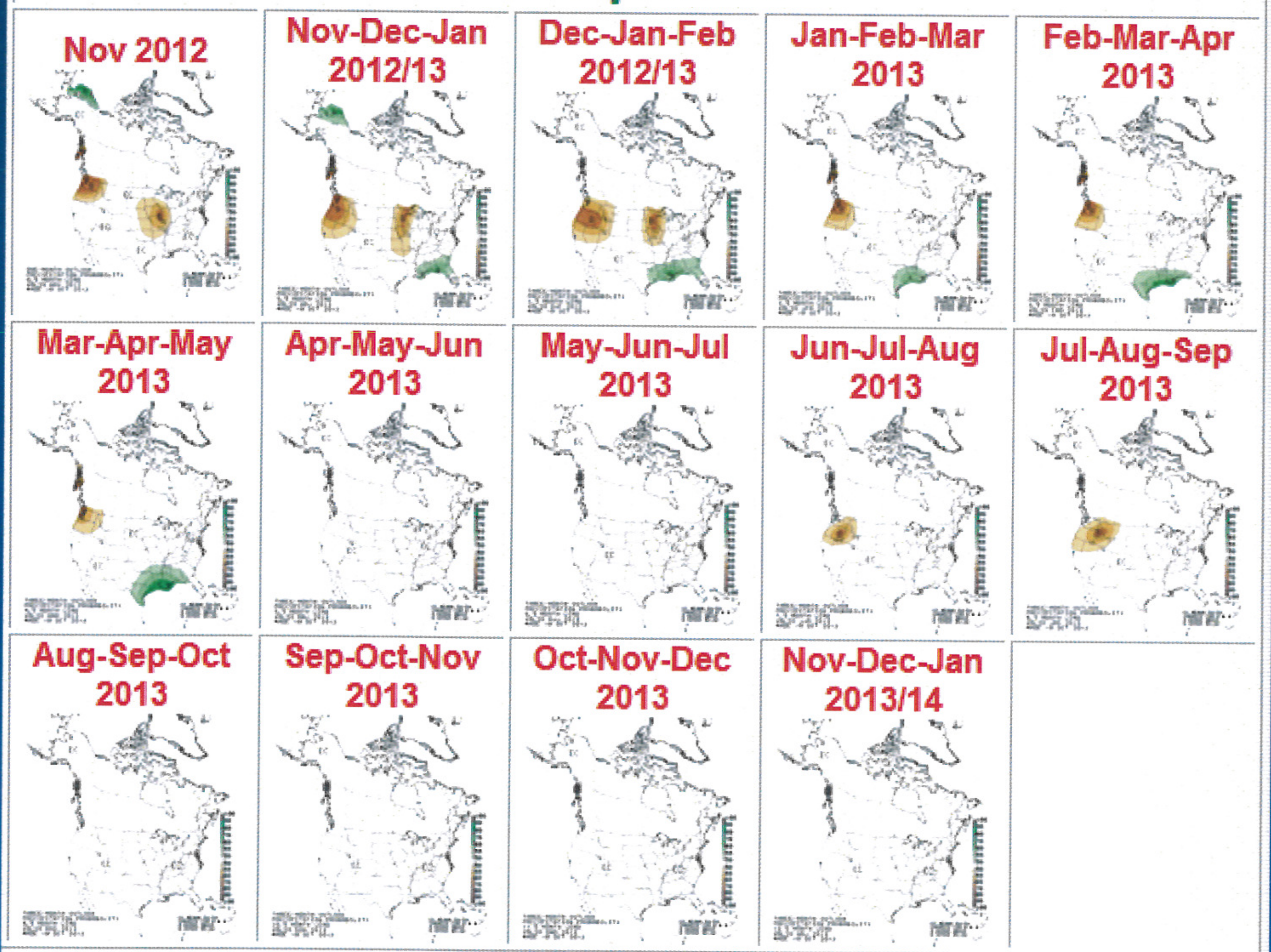
Precipitation



Source: http://www.cpc.ncep.noaa.gov/products/predictions/long_range/two_class.php

Definition

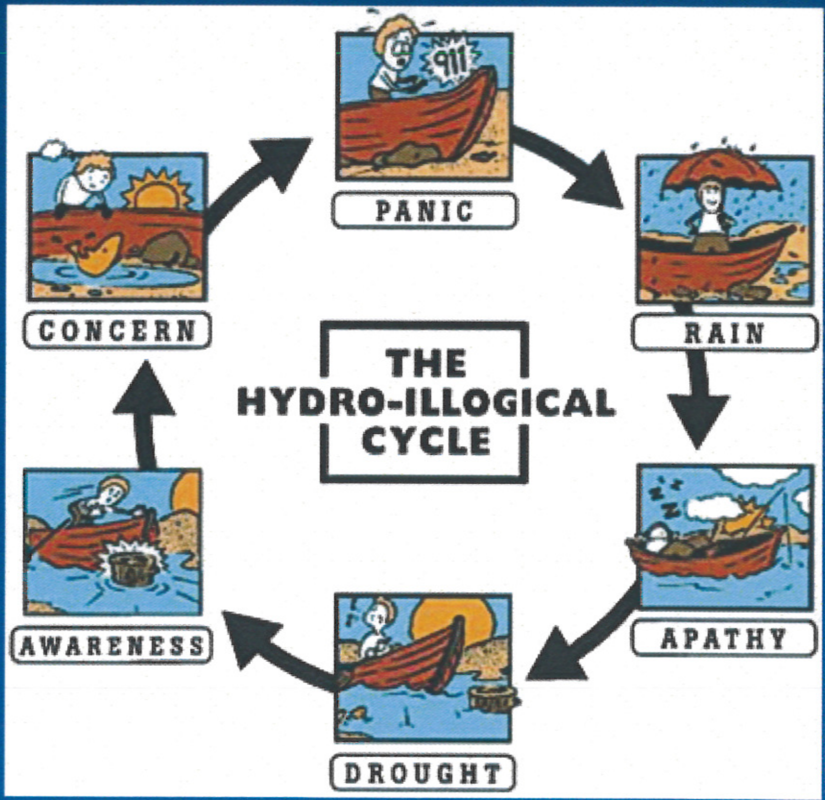
drought

noun

1. a period of dry weather, especially a long one that is injurious to crops.

2. an extended shortage: a drought of good writing.

3. Archaic. thirst.



Source: http://drought.unl.edu/Planning/HydroillogicalCycle.aspx

More Definitions

Severity, the most commonly used term for measuring drought, is a combination of **magnitude (aerial extent)** and **duration**

Occurs in 4 stages

- **Stage 1: Meteorological drought.**
  - Any precipitation shortfall of 75% of normal for three months or longer
- **Stage 2: Agricultural drought.**
  - Soil moisture is deficient - plants are stressed and biomass reduced
- **Stage 3: Hydrological drought**
  - Reduced streamflow (inflow) to reservoirs and lakes
- **Stage 4: Socioeconomic drought.**
  - Physical water shortage begins to affect people's health

Drought is Complex

Conveyance of water from snow packed mountains via streams or local ground water can often support arid regions with adequate supplies of water

In summary: Drought = Precipitation - Evaporation = Negative Accumulation
(Definition of a Desert)

But must be measured in terms of

Impacts

(e.g. When is there a drought in a desert)?

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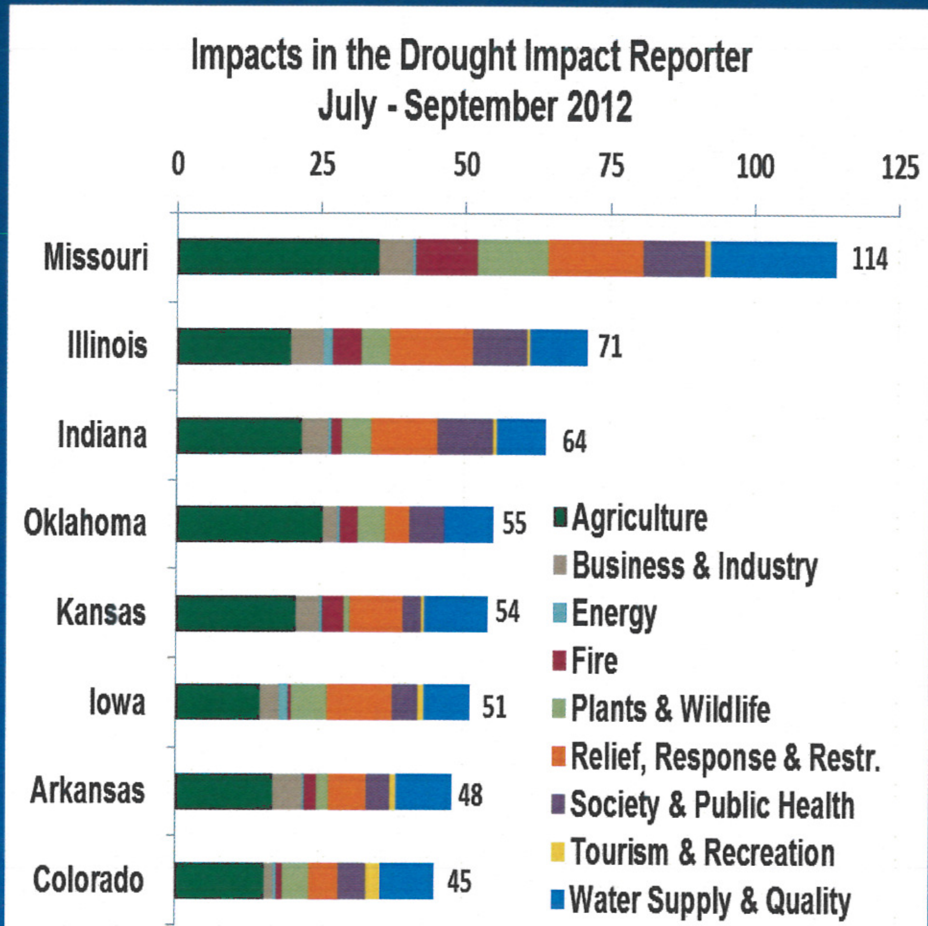
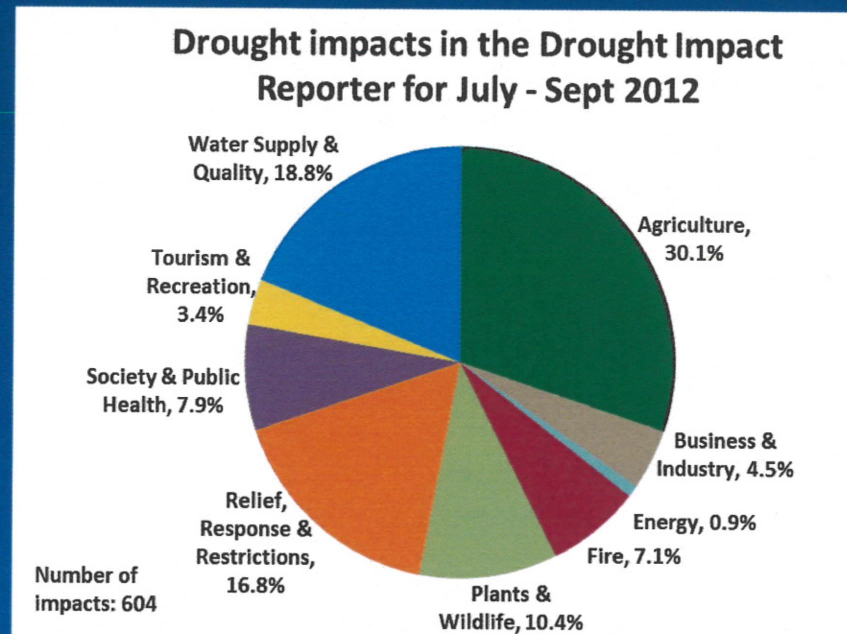
Example of Impacts



http://droughtreporter.unl.edu/



Ref: http://moderator.droughtreporter.unl.edu/rssfeed/

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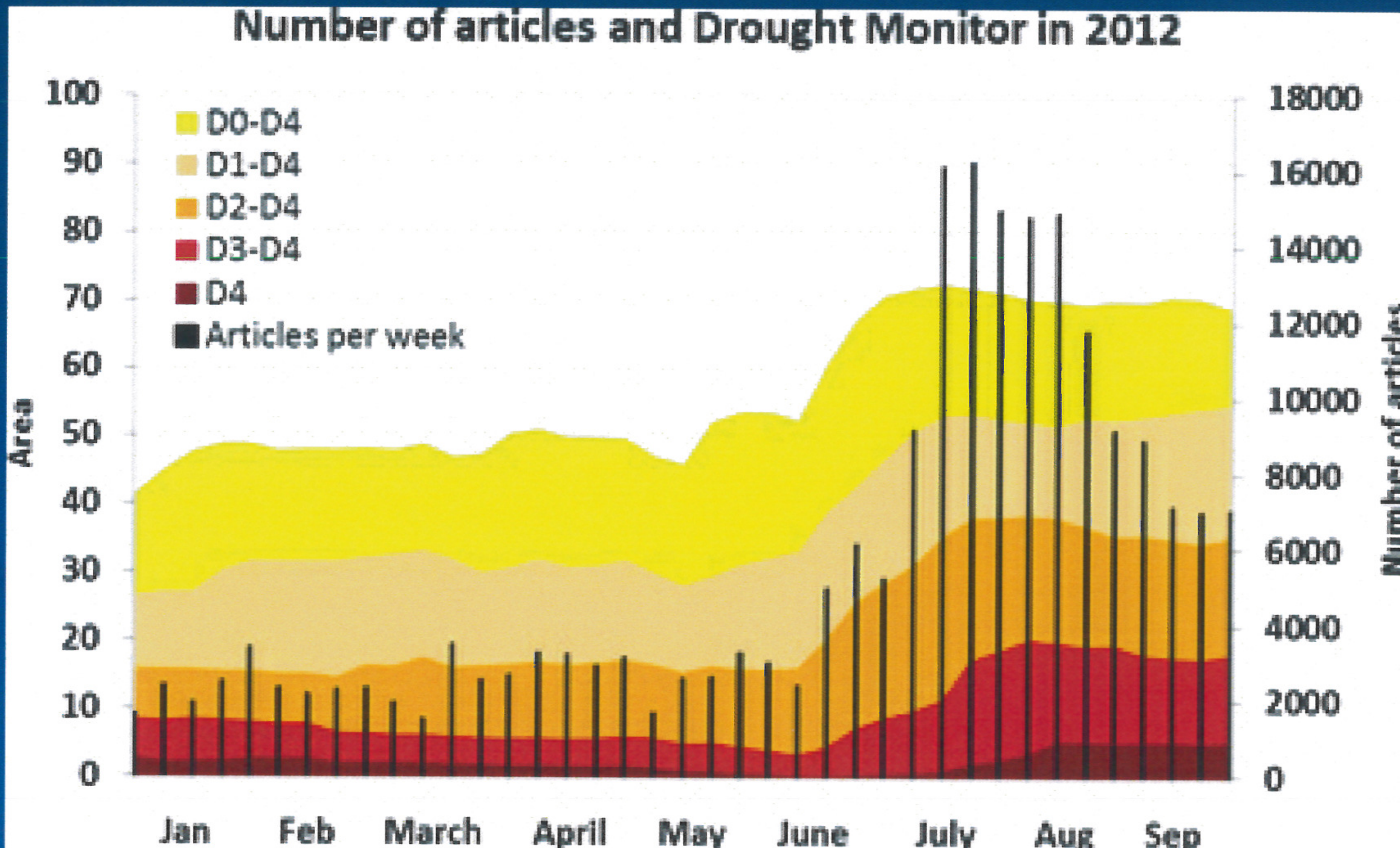
Drought Impact



Source: http://drought.unl.edu/Portals/0/docs/DroughtScape/DSfall2012.pdf

Common consequences of drought

- Diminished crop growth or yield productions and carrying capacity for livestock
- Dust bowls, themselves a sign of erosion, which further erode the landscape
- Dust storms, when drought hits an area suffering from desertification and erosion
- Famine due to lack of water for irrigation
- Habitat damage, affecting both terrestrial and aquatic wildlife
- Malnutrition, dehydration and related diseases
- Mass migration, resulting in internal displacement and international refugees
- Reduced electricity production due to reduced water flow through hydroelectric dams
- Shortages of water for industrial users
- Snake migration and increases in snakebites
- Social unrest
- War over natural resources, including water and food
- Wildfires, such as forest and prairie fires, are more common during times of drought

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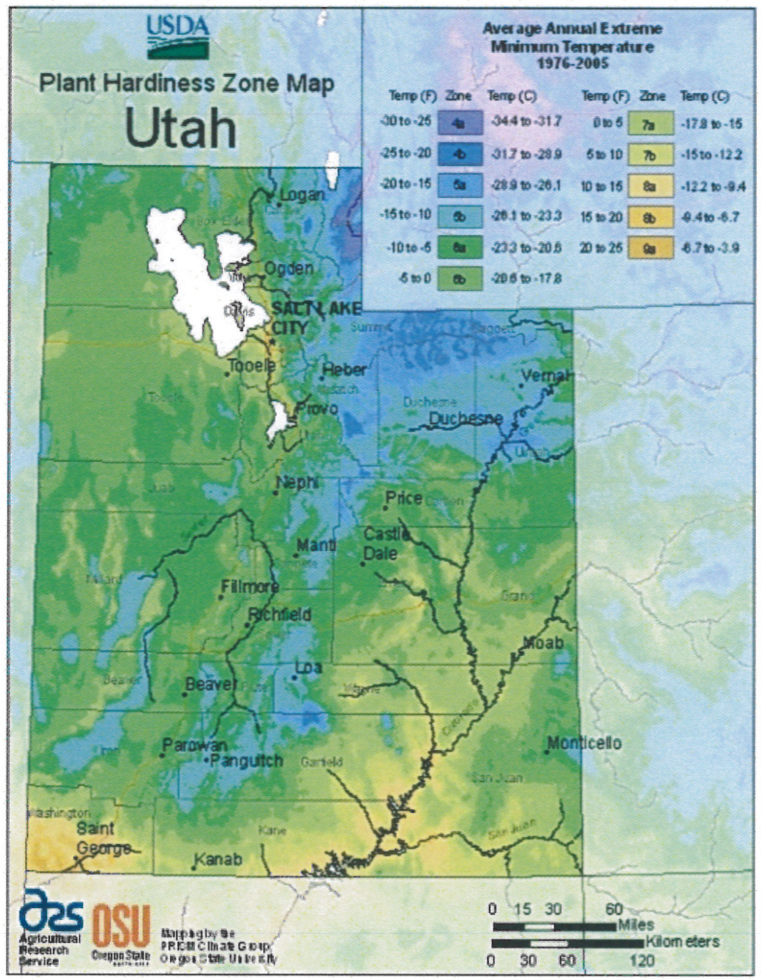
Climate Proxy



Adaptively

Plants usually have a range of several Hardiness Zones however this is based on winter minimum temperatures and not precipitation

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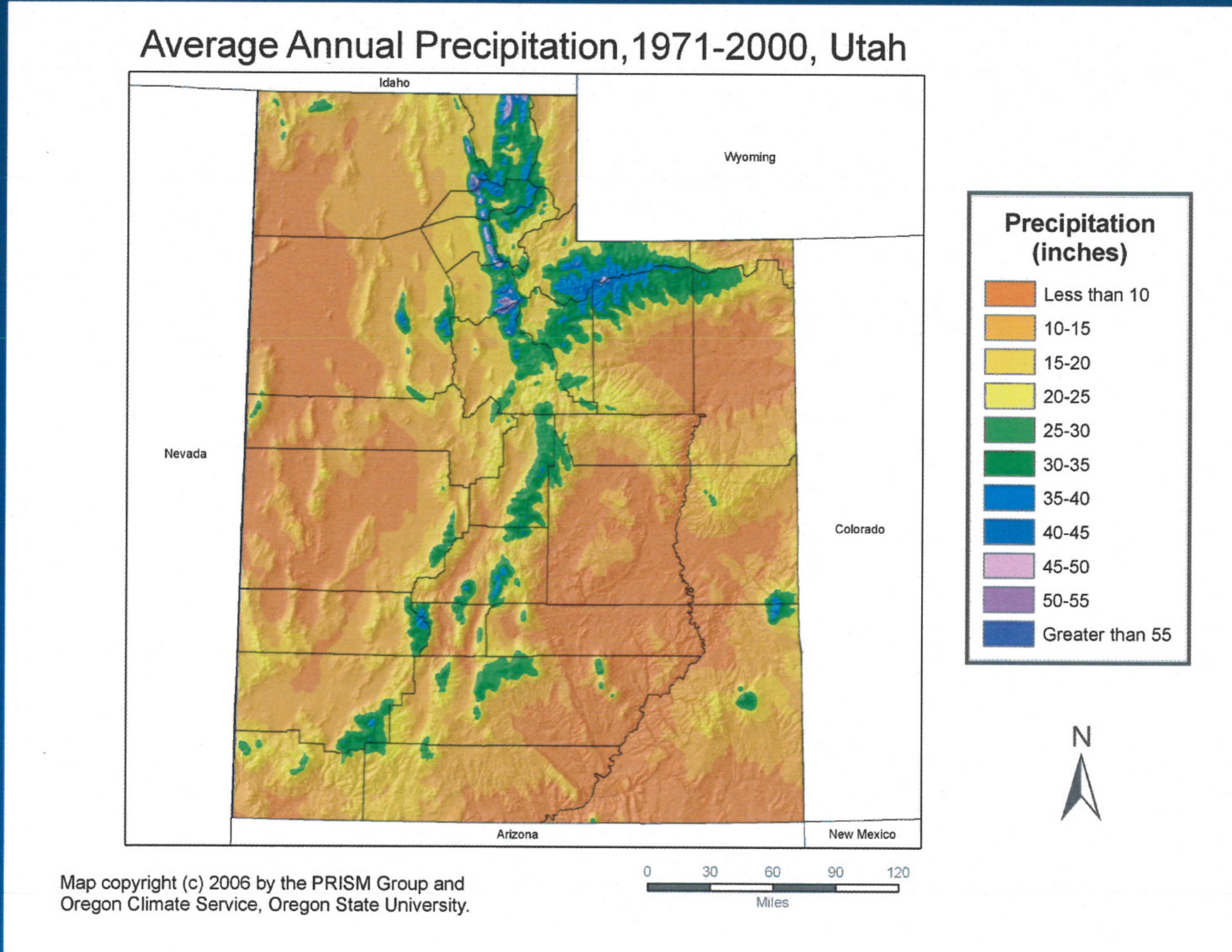
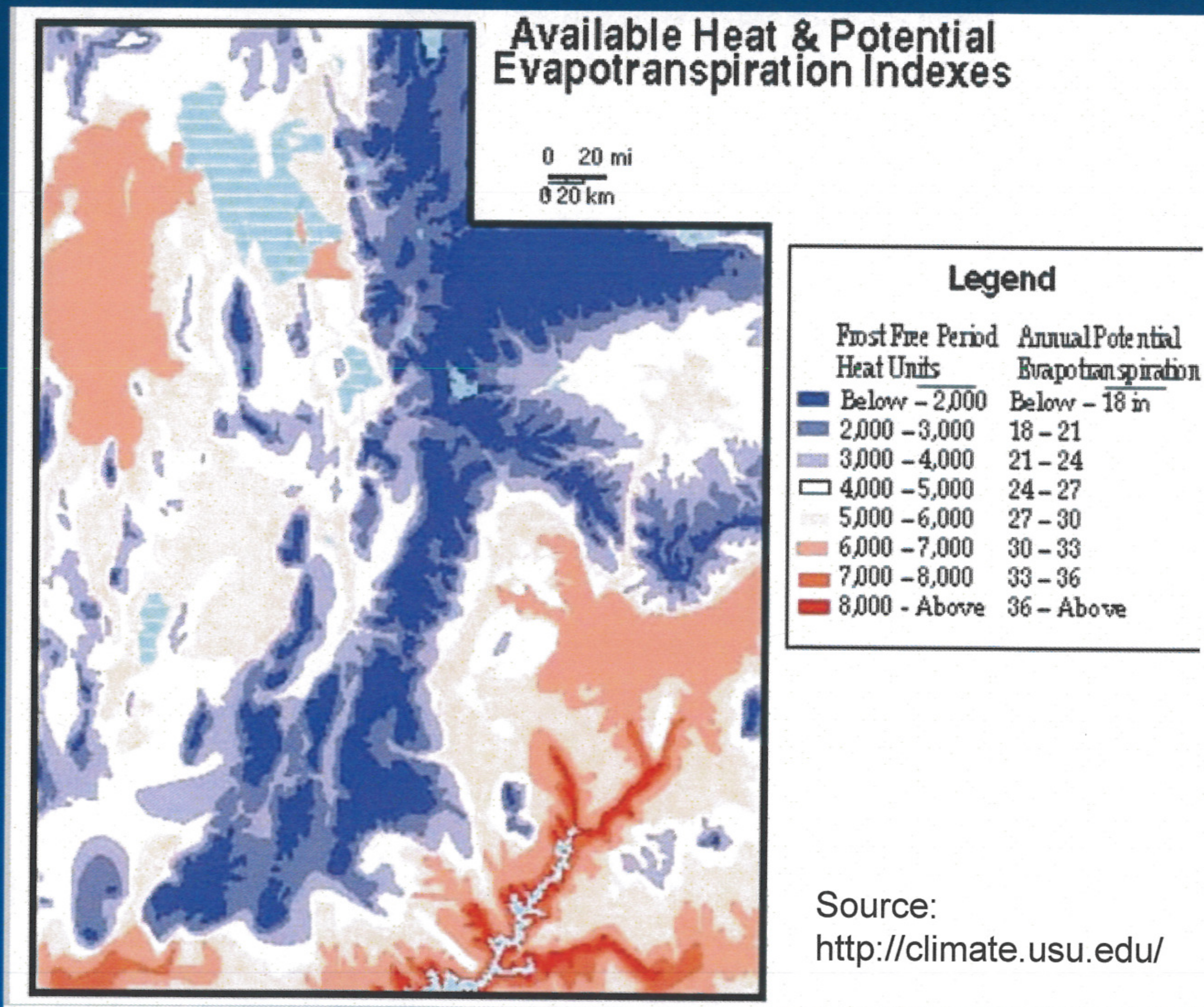
PRISM (Spatial Climate Data)



Source: http://prism.oregonstate.edu/pub/prism/state_ppt/utah300.png

Definition of a Desert



Source: http://climate.usurf.usu.edu/

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Desert Biome

The hot desert biome is found only in Utah's extreme southwestern corner. Geographers define deserts as places where evaporation exceeds precipitation. The "hot desert" probably approaches what most people think of when they picture a desert. It is usually very dry and quite hot. Precipitation in the hot desert averages 5 to 10 inches per year. Temperatures soar above 100 degrees Fahrenheit in the summer and drop below freezing in the winter.

Utah's cold deserts generally range from 4,000 to 6,000 feet in elevation and can be characterized as broad valley and broke, rolling hills. Annual rainfall is usually less than 11 inches. Utah's cold deserts provide a favorable temperate climate for both wildlife and humans. Most of Utah's human population lives in cold desert areas. These areas provide a large portion of the range for Utah's livestock industry.

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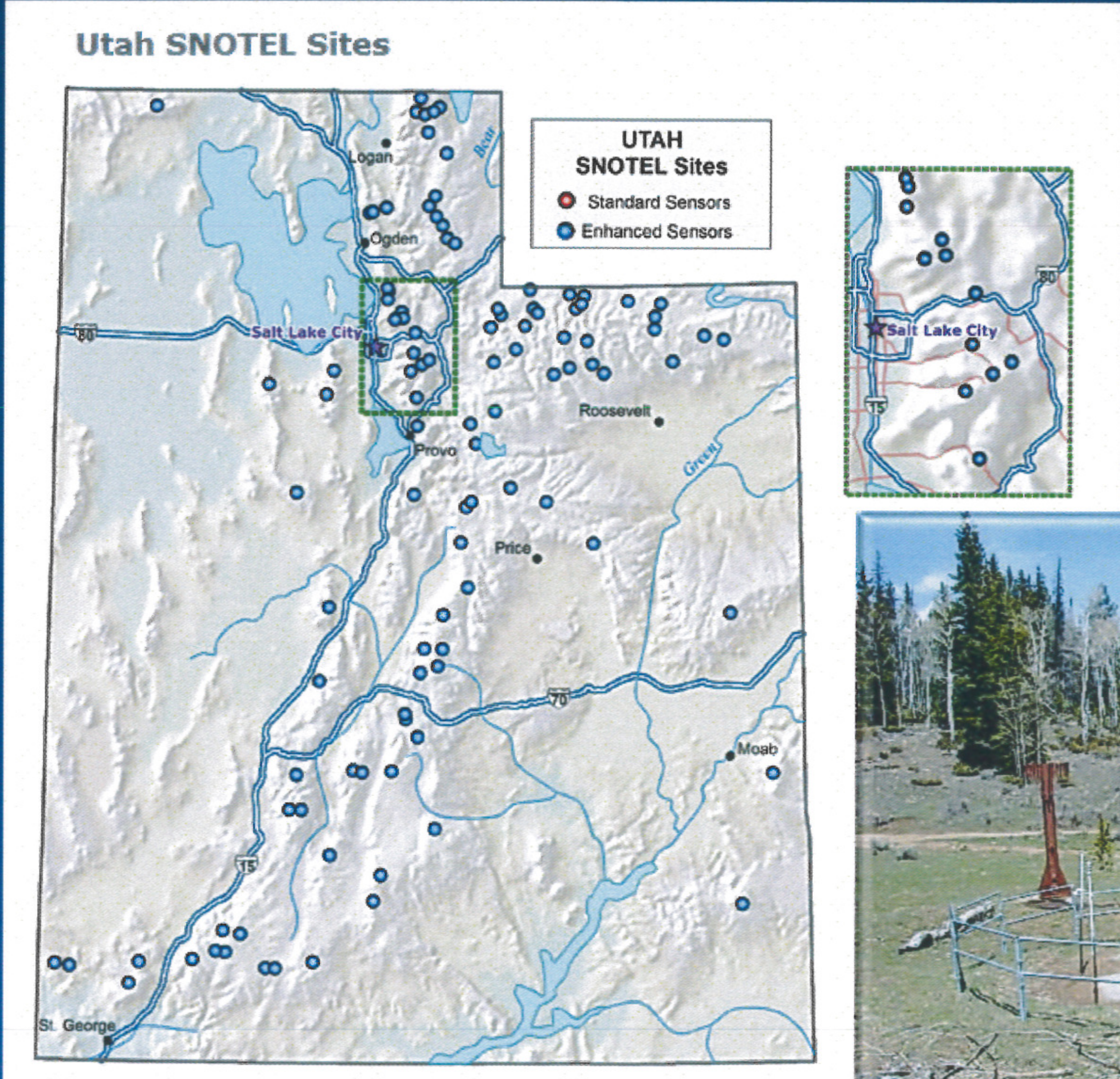

http://www.wcc.nrcs.usda.gov/snotel/Utah/utah.html

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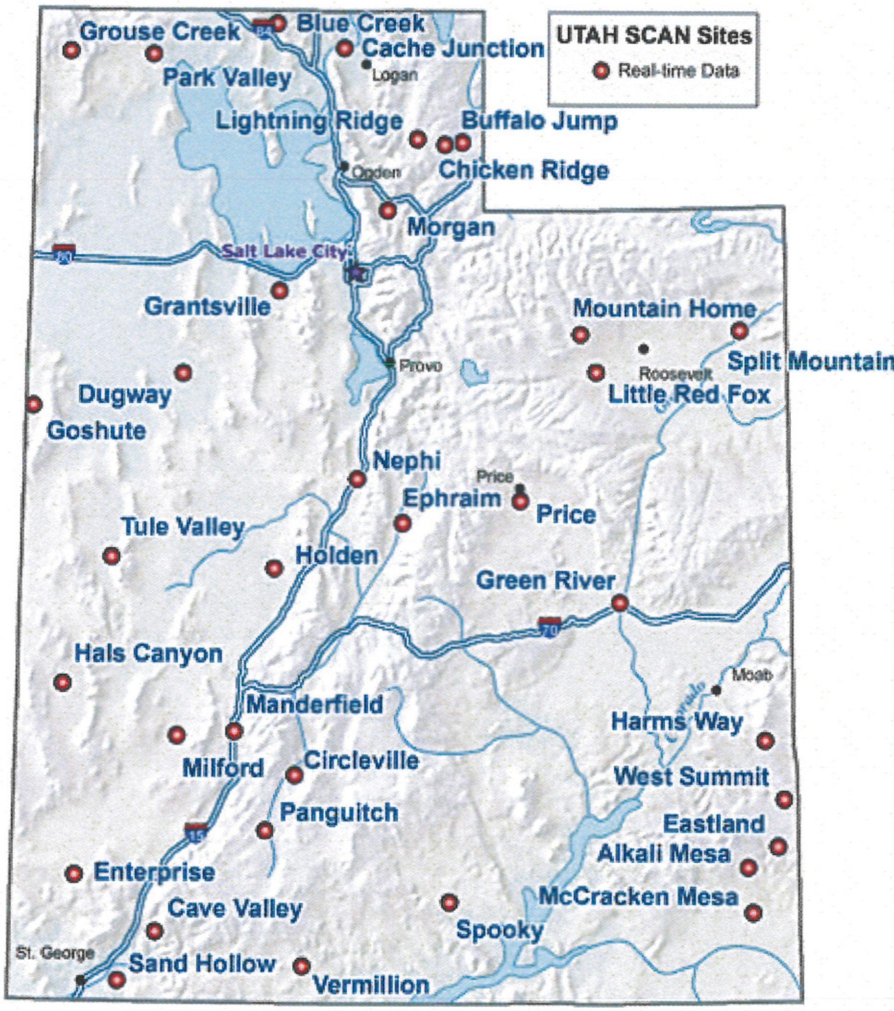

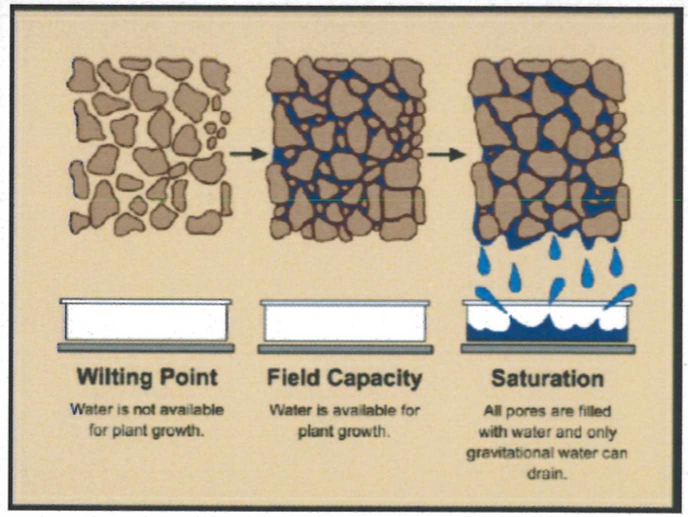

Visual explanation of soil water capacity definitions.

Reference: http://www.wcc.nrcs.usda.gov/scan/Utah/utah.html

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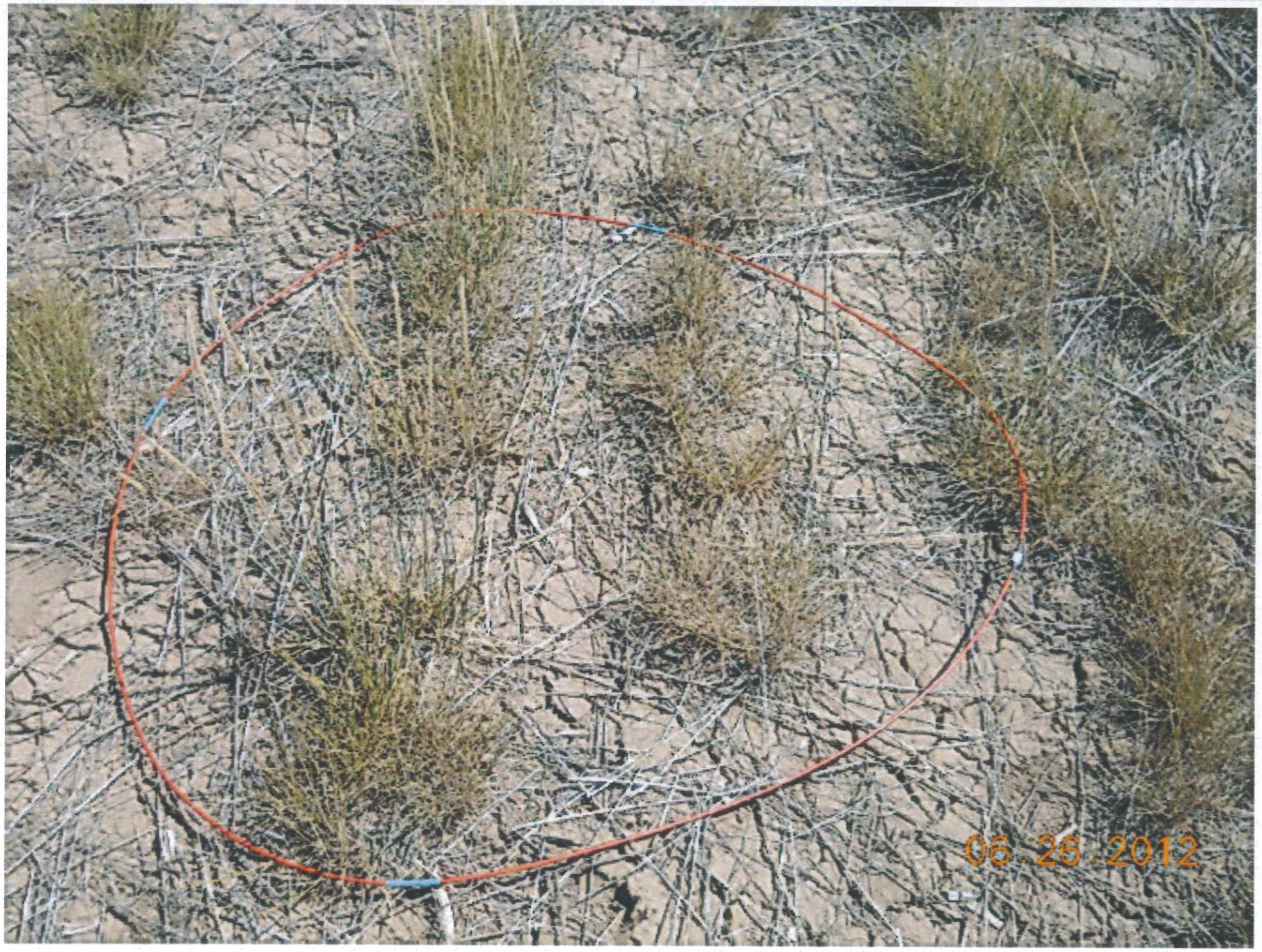
Impacts



Current year's forage with some of last year's production on the ground in southern Utah – note the difference in length. Photo by Jeremiah Armstrong.

Source: http://www.ut.nrcs.usda.gov/snow/watersupply/wsor.html

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Utah

May 1, 2012

Surface Water Supply Index

Basin or Region	April EOM* Reservoirs	May-July Stream Forecast	Reservoir + Streamflow	SWSI#	Percentile	Years with similar SWSI
	KAF^	KAF	KAF		%	
Bear River	1068	35	1103	1.08	63	58,19,11,70
Ogden River	117	25	142	-1.39	33	02,94,96,89
Weber River	406	70	476	-0.76	41	79,76,81,70
Provo River	429	17	446	-0.25	47	81,87,91,05
West Uintah Basin	165	91	256	-2.23	23	07, 79, 04, 90
East Uintah Basin	59.0	28.0	87	-2.21	24	03, 81, 92, 87
Price River	54.2	10.0	64.2	-1.39	33	07, 01, 08, 93
Joe's Valley	51.4	16.0	67.4	-1.50	32	92, 94, 04, 07
Ferron Creek	12.7	14.0	26.7	-3.15	12	89, 76, 90, 81
Moab	1.5	1.5	3.0	-2.88	15	90, 89, 09, 04
Upper Sevier River	116	19	135	-1.75	29	92, 91, 03, 68
Lower Sevier River	229	25	254	1.39	67	93, 79, 87, 06
Beaver River	24.1	8.5	32.6	-0.80	40	90, 89, 74, 00
Virgin River	40.4	15	56	-2.31	22	02,04,07,91

**EOM, end of month; # SWSI, surface water supply index; ^KAF, thousand acre-feet.*

What is a Surface Water Supply Index?

The Surface Water Supply Index (SWSI) is a predictive indicator of total surface water availability within a watershed for the spring and summer water use seasons. The index is calculated by combining pre-runoff reservoir storage (carryover) with forecasts of spring and summer streamflow which are based on current snowpack and other hydrologic variables. SWSI values are scaled from +4.1 (abundant supply) to -4.1 (extremely dry) with a value of zero (0) indicating median water supply as compared to historical analysis. SWSI's are calculated in this fashion to be consistent with other hydroclimatic indicators such as the Palmer Drought Index and the Precipitation index.

Source: http://www.ut.nrcs.usda.gov/snow/watersupply/wsor.html

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Range of Wild Horses

Source: http://animaltourism.com/animals/horse.php

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North American Desert (over 2 million Acres)

Source: http://www.bing.com/images/search?q=map+north+american+desert&view=detail&id=D6DB486A23924F0F9364DC52EE9696D2BC17E38A&first=36

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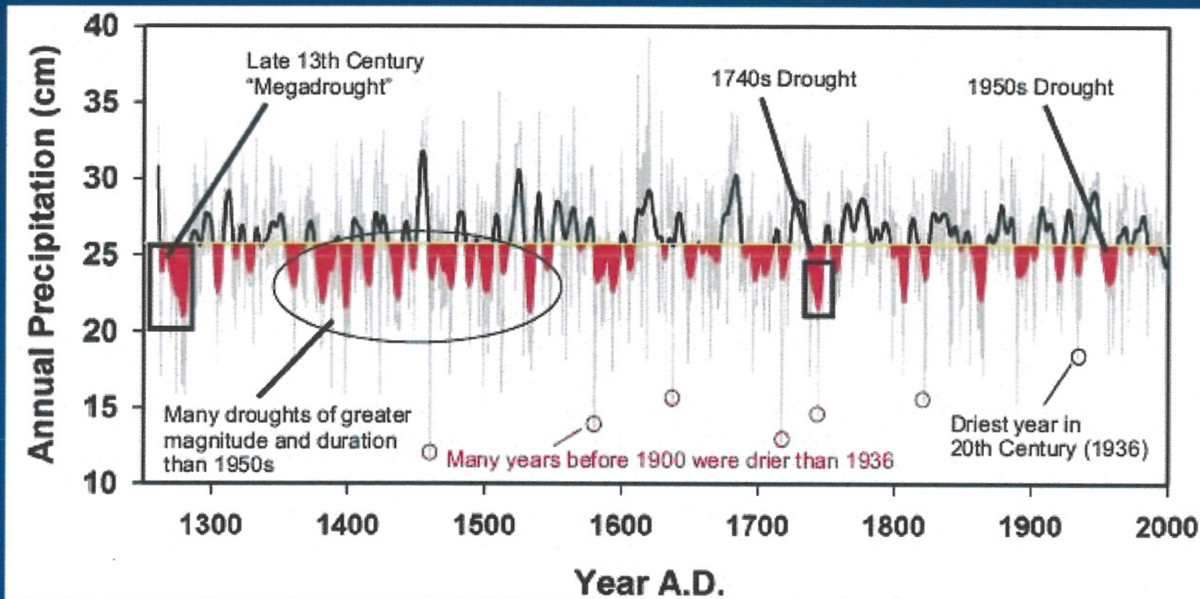
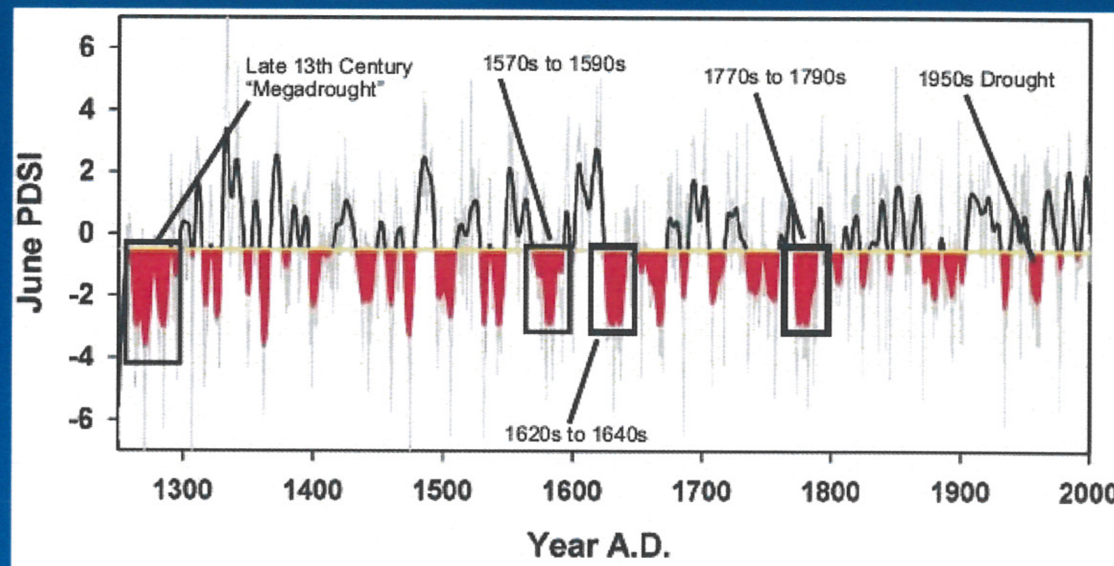


← Bighorn Basin, WY

Green River Basin, WY→



Source:
http://www.wrds.uwyo.edu/sco/climateatlas/drought.html

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New – Old 30-Year Normals

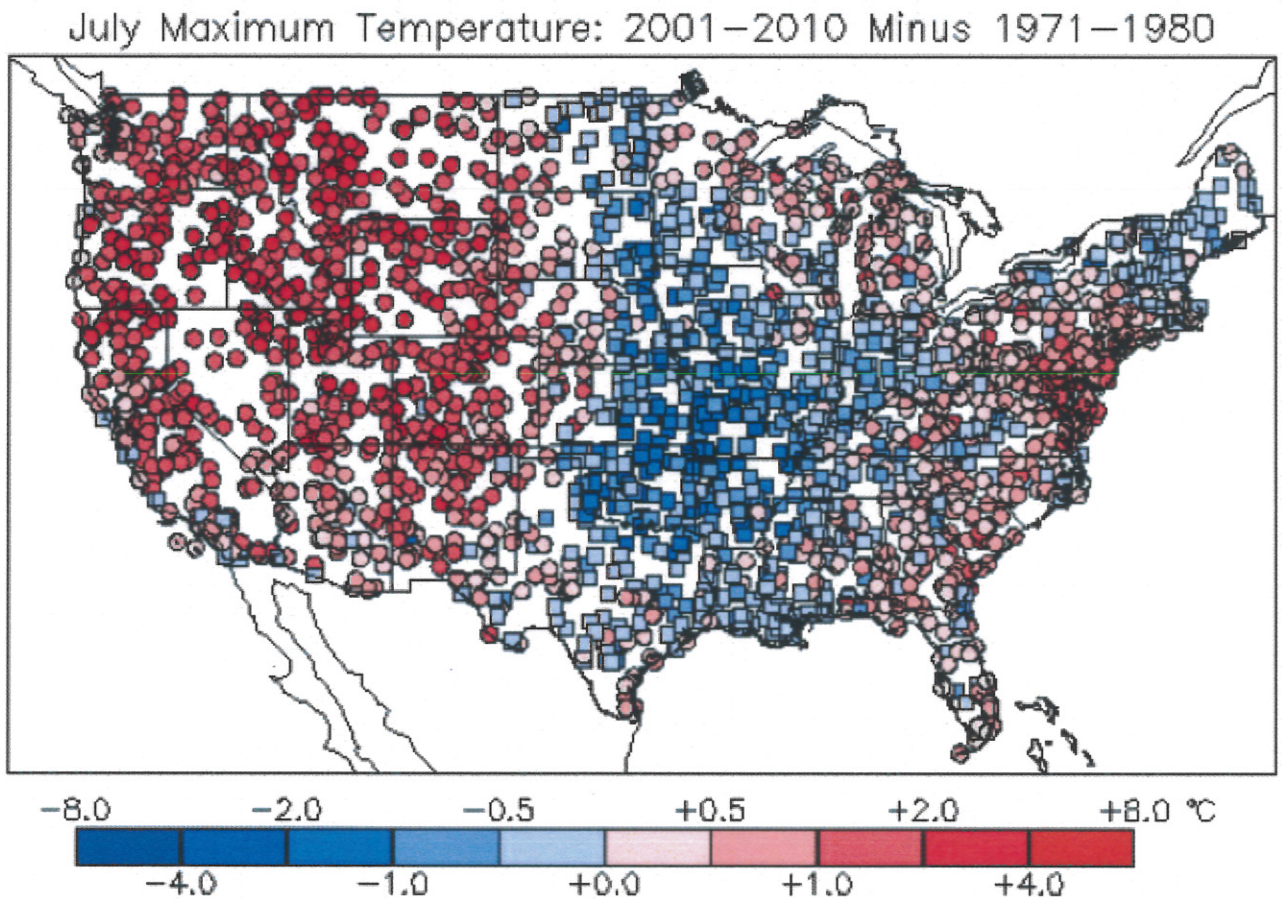

Figure 1. The difference between the decade-averaged maximum temperatures in July for the 2001-2010 period and the 1971-1980 period. Red circles (blue squares) indicate positive (negative) anomalies, i.e., warmer (cooler) conditions in the most recent decade versus the decade cycling off of the normals computation.

Reference: http://lwf.ncdc.noaa.gov/oa/climate/normals/usnormals.html#NORMALSCHANGES

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Natural Resources Conservation Service

USDA NRCS

New – Old 30-Year Normals

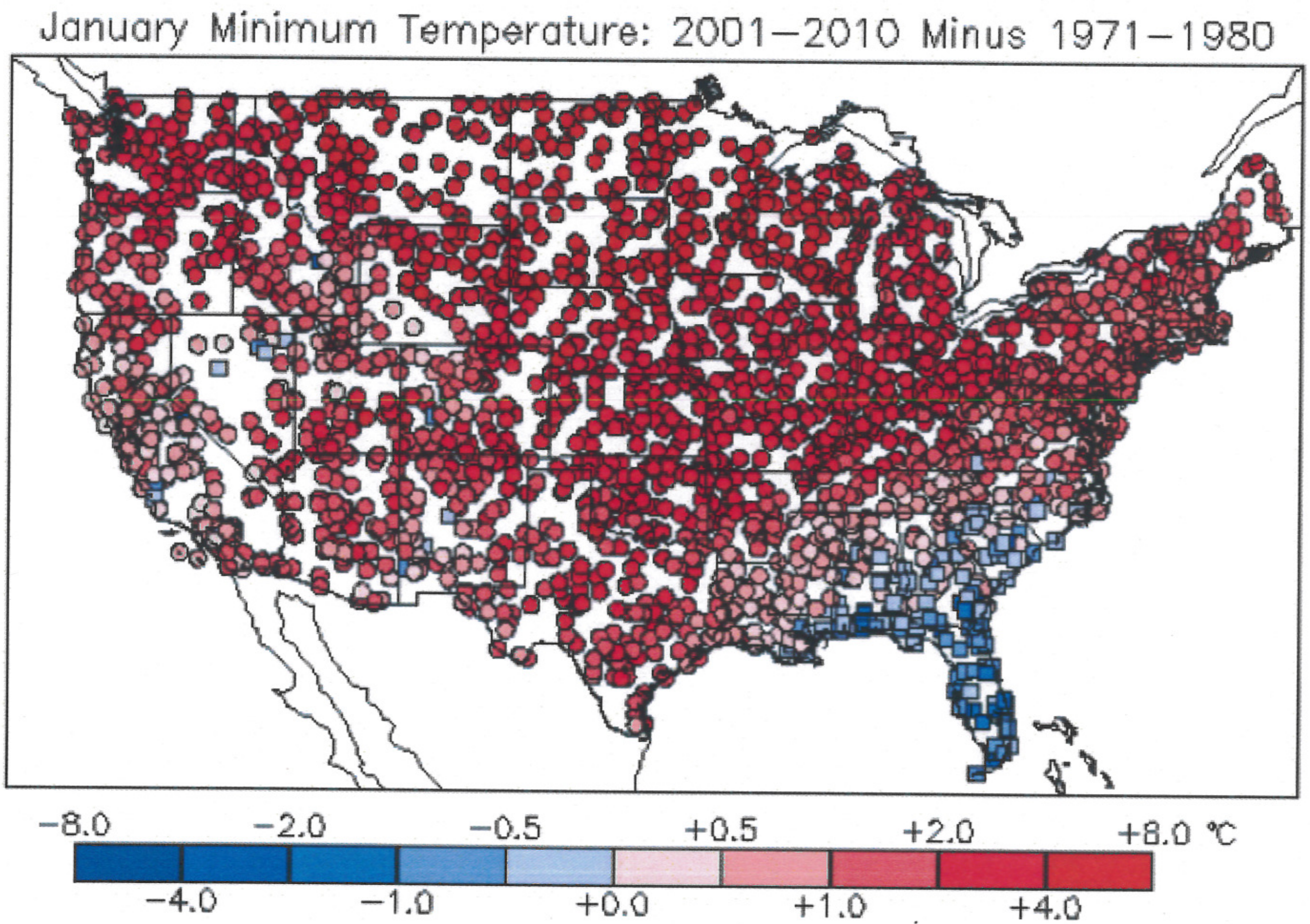
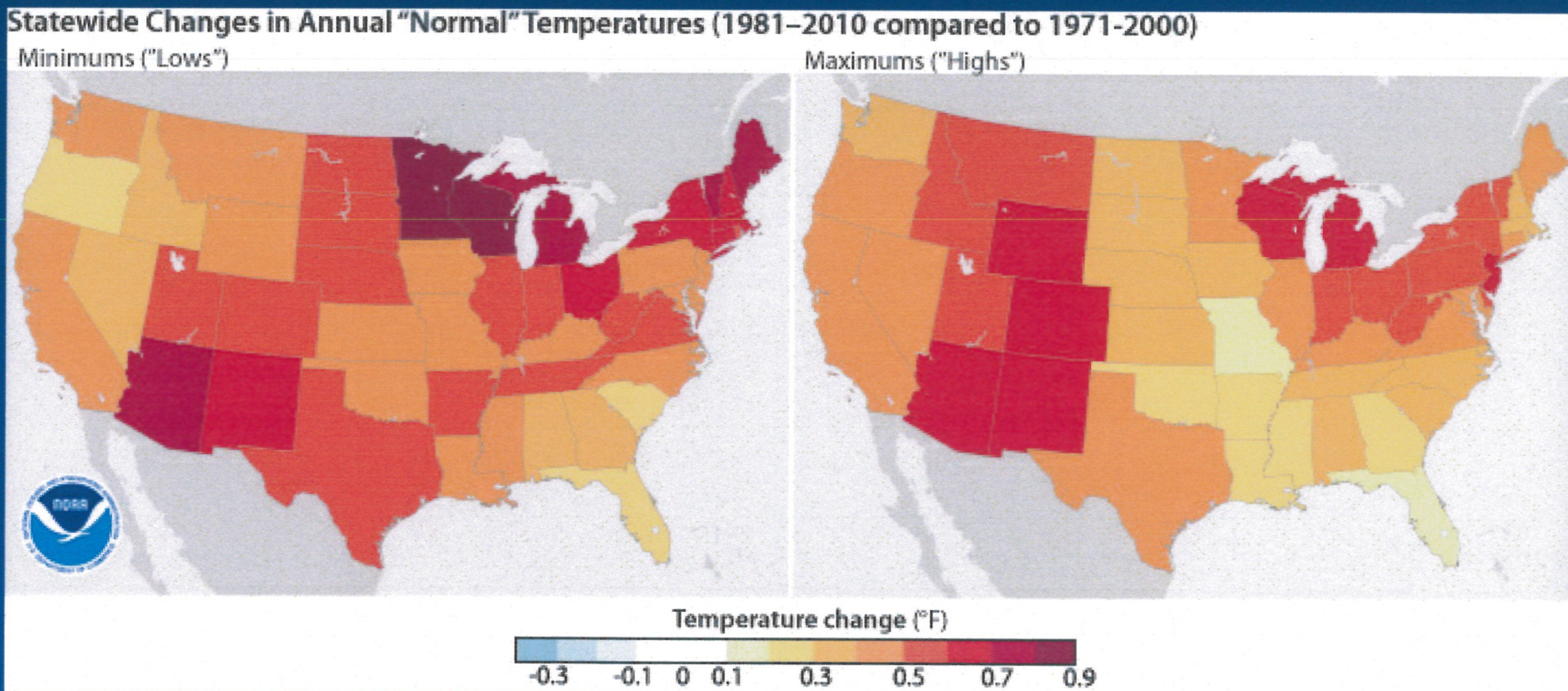


Figure 2. Same as Figure 1, but for January minimum temperatures.

Reference: http://lwf.ncdc.noaa.gov/oa/climate/normals/usnormals.html#NORMALSCHANGES

Average U.S. temperature increases by 0.5 degrees F



Reference: http://www.noaanews.noaa.gov/stories2011/20110629_newnormals.html

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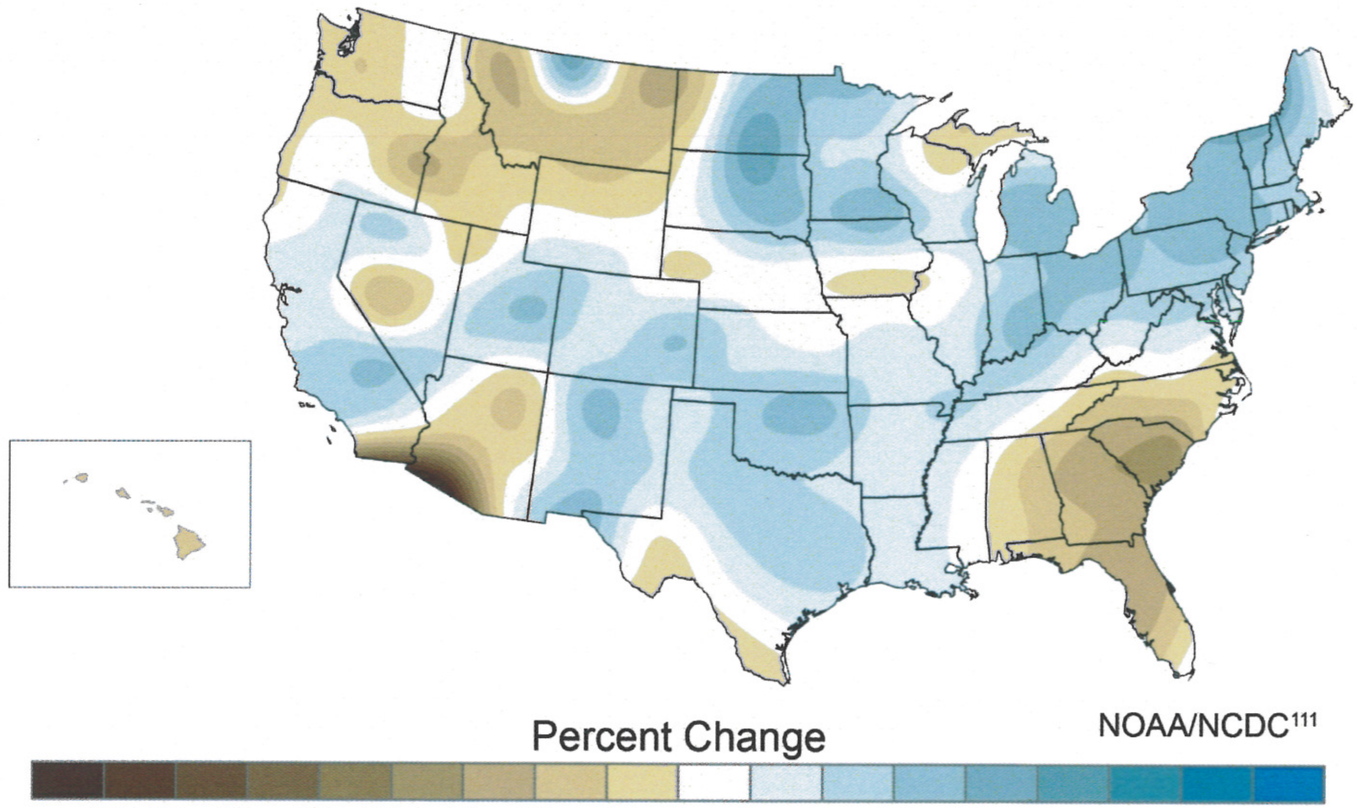
Precipitation changes over the past 50 years



While U.S. annual average precipitation has increased about 5 percent over the past 50 years, there have been important regional differences as shown above.

Source: http://www.globalchange.gov/HighResImages/2-National-pg-30.jpg

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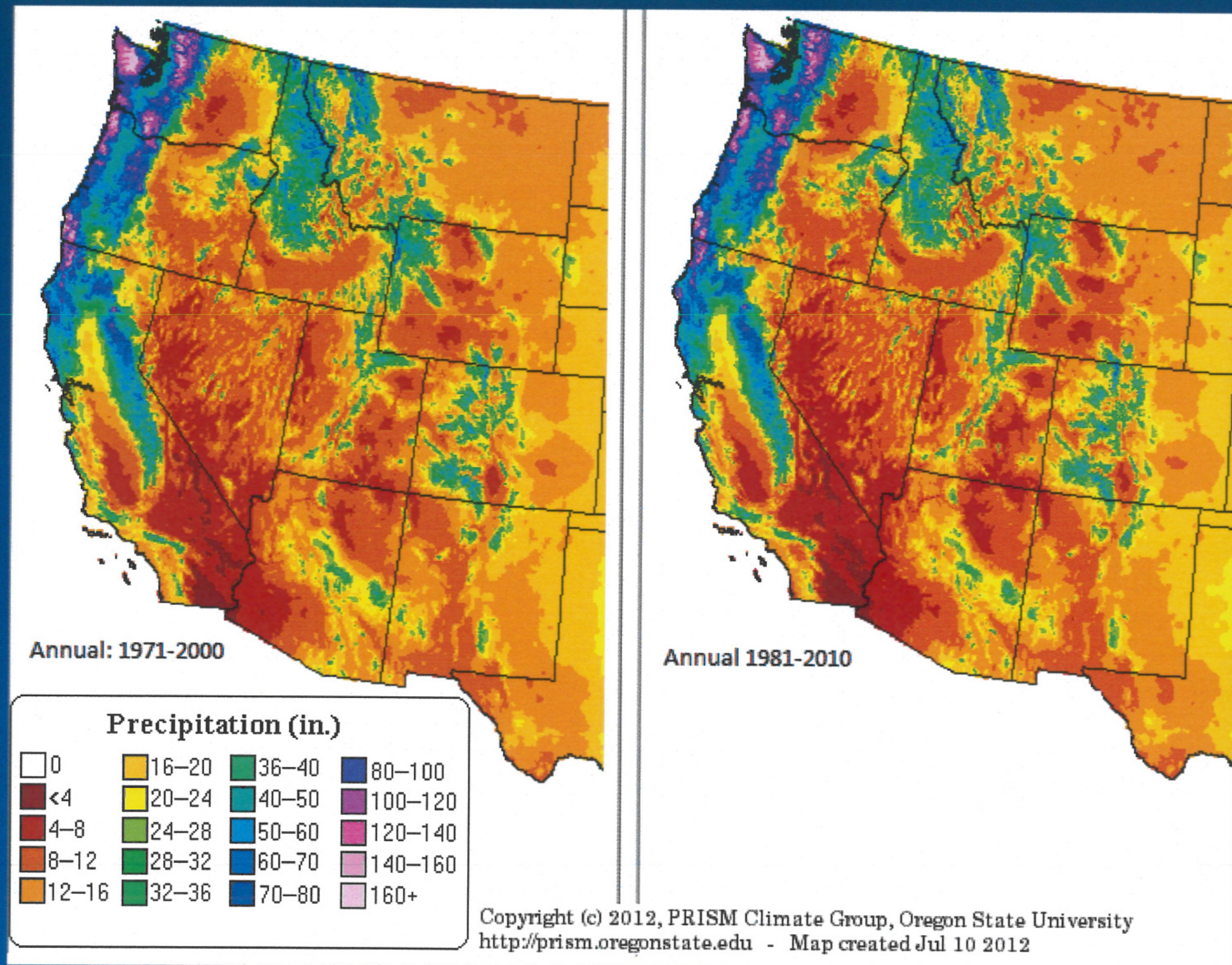
PRISM (Spatial Climate Data)

Climate Trends



United States Department of Agriculture
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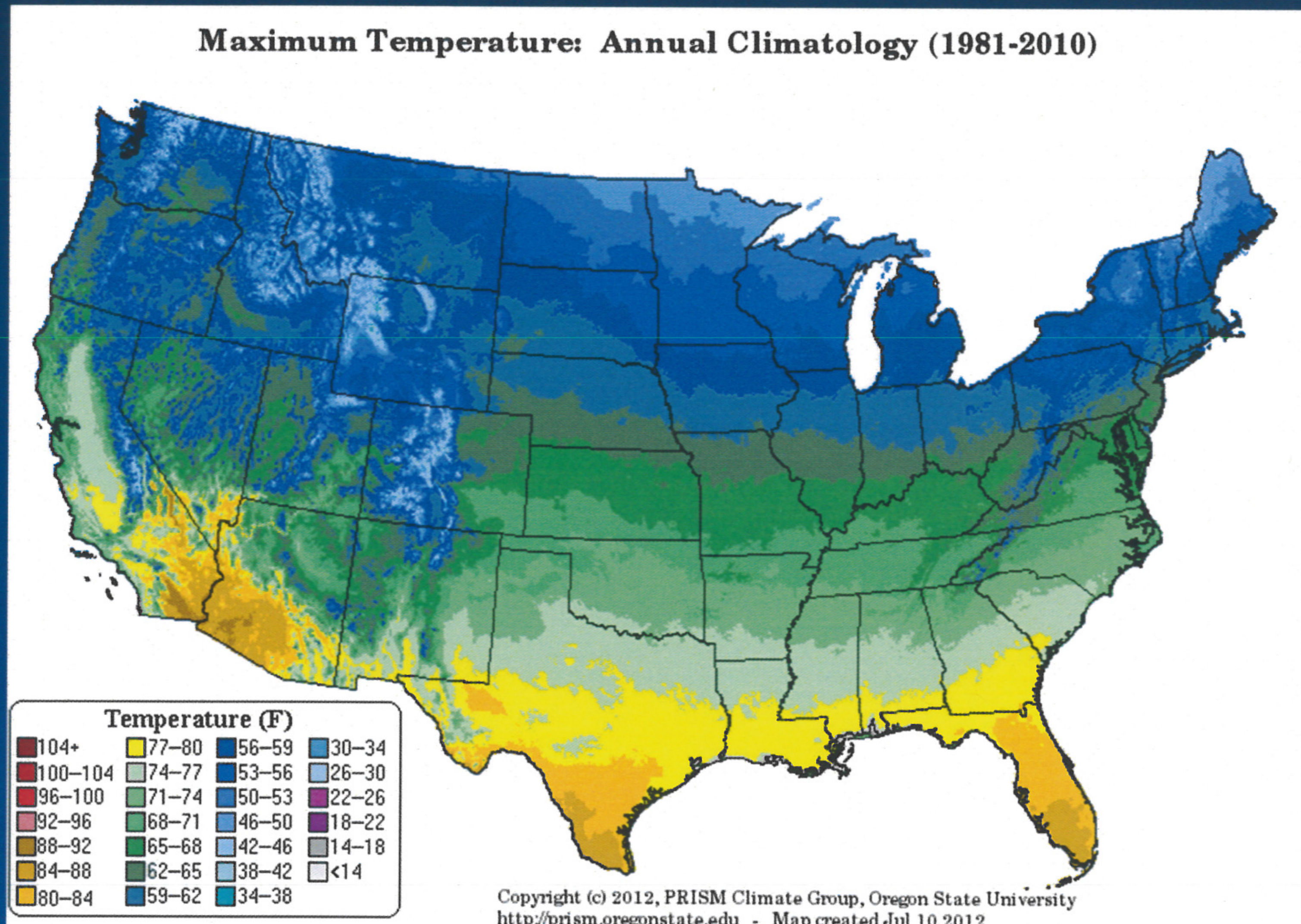
USDA NRCS



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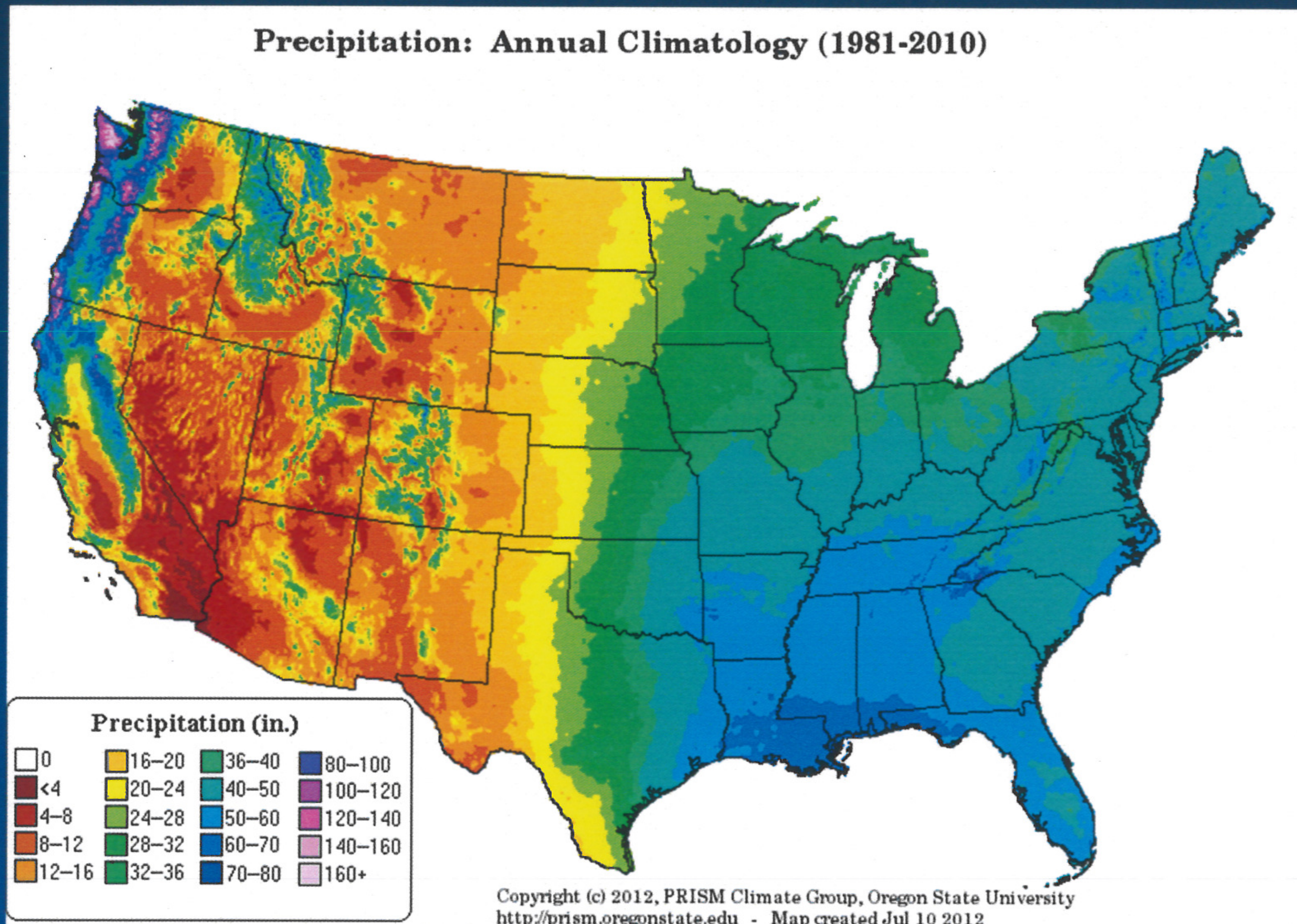

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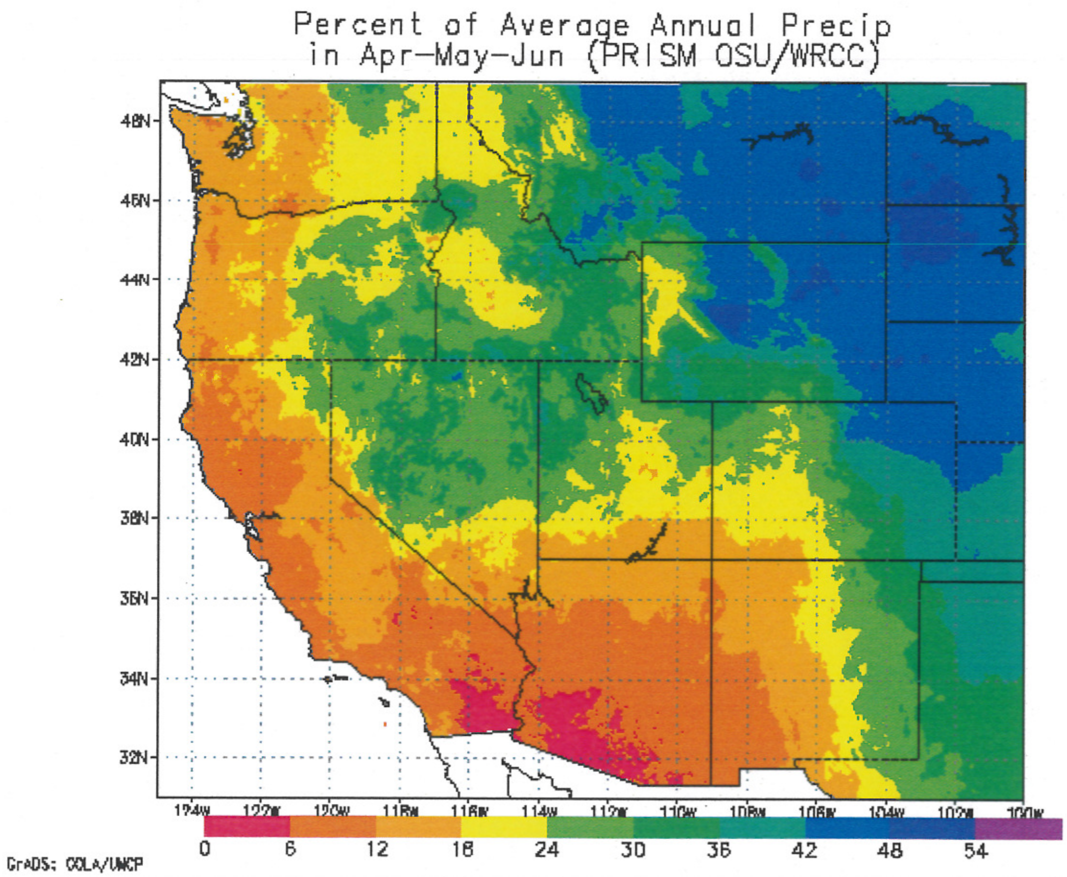
Critical Grassland Growth Period – 3 Months



Source: http://www.wrcc.dri.edu/pcpn/west.frac.aprmayjun.gif

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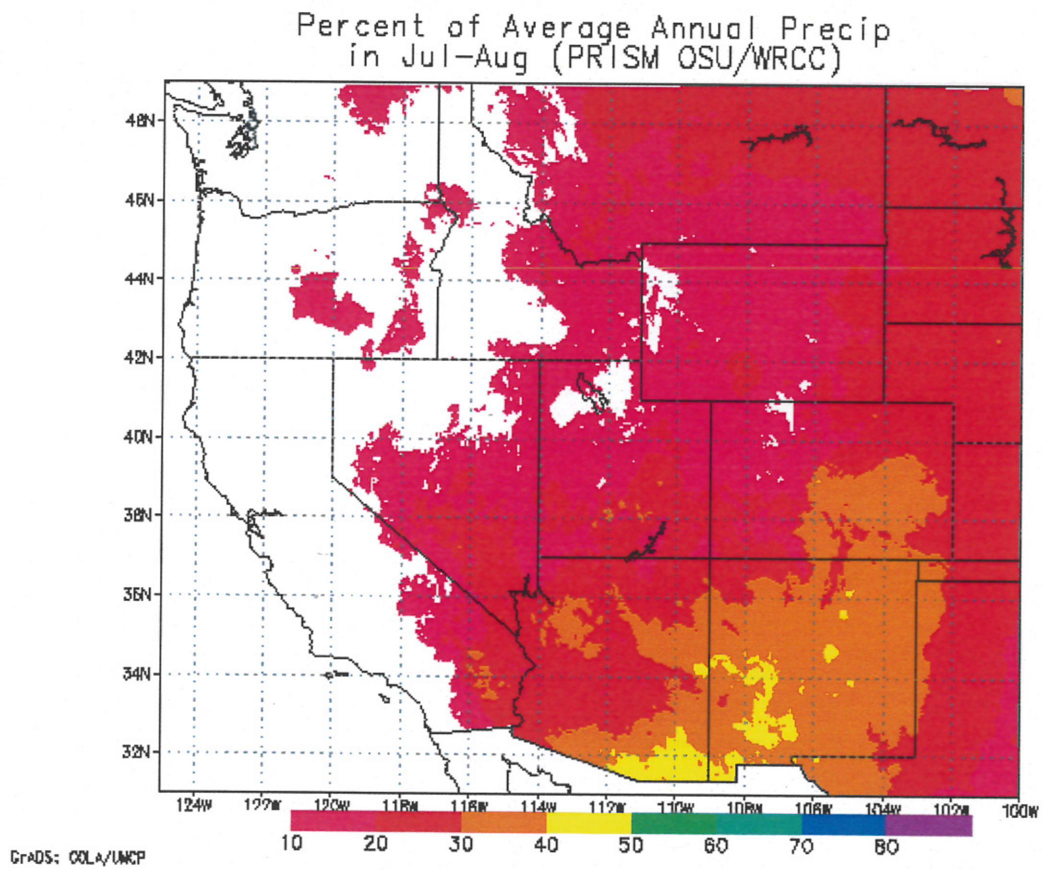
Contribution from the Southwest Monsoon – 2 Months



Source: http://www.wrcc.dri.edu/pcpn/west.frac.julaug.gif

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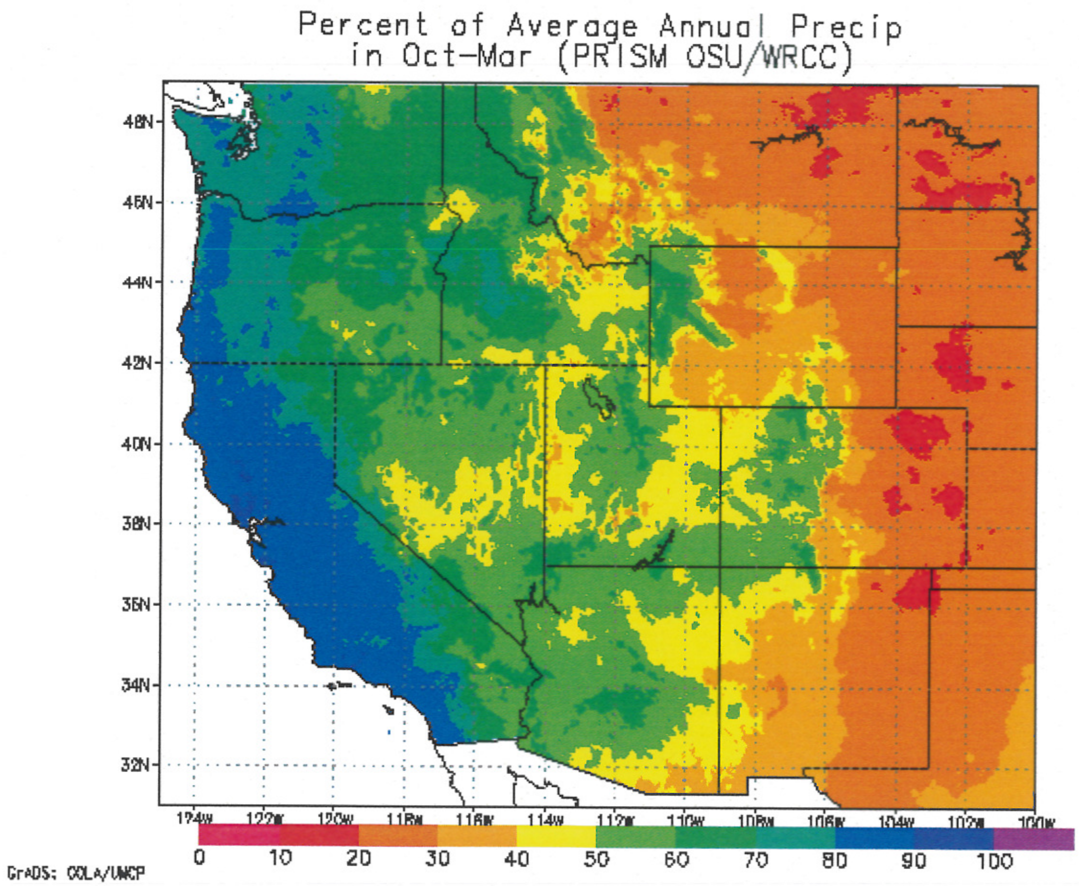
Winter Precipitation Supports West Coast States – 6 months



Source: http://www.wrcc.dri.edu/pcpn/west.frac.octmar.gif

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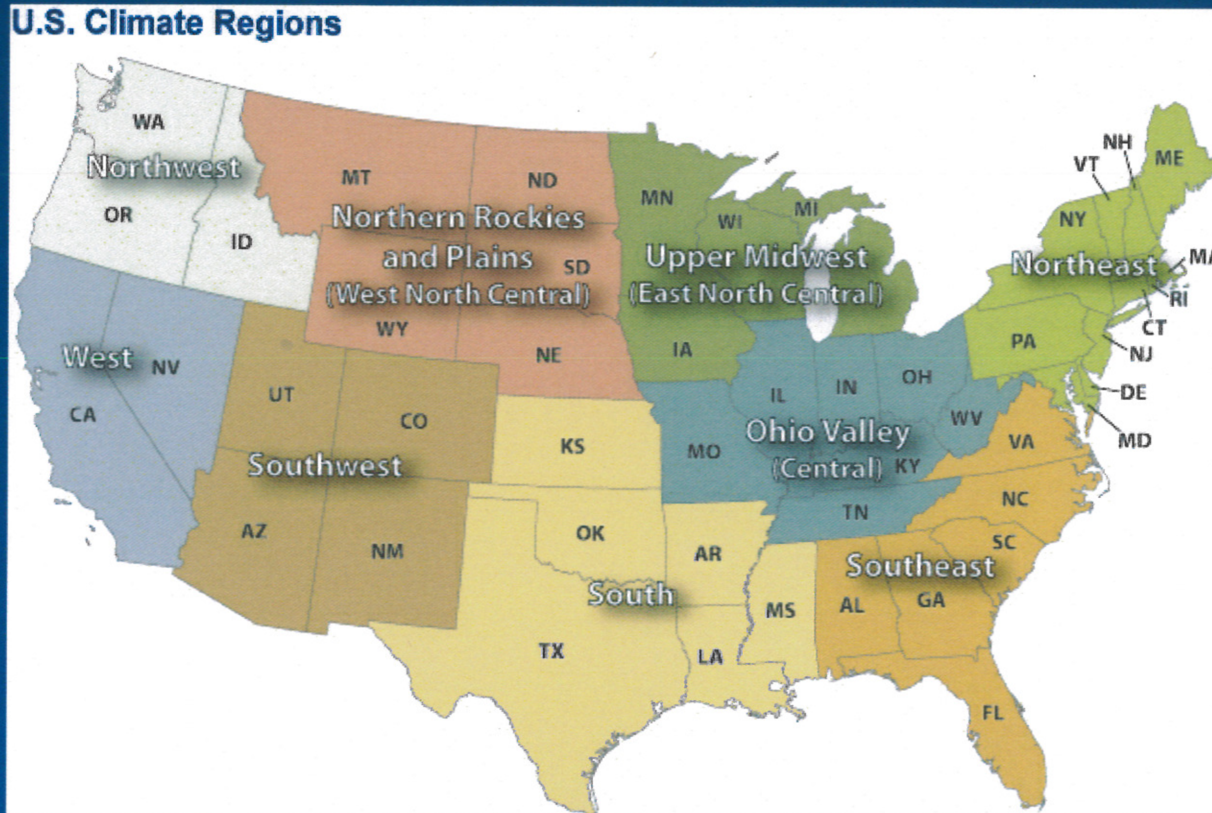
100 Year Trends



	NE	SE	ENC	C	WNC	S	NW	W	SW	US
TEMP (F)	0.9	-0.1	0.9	0.2	1.6	0.1	0.9	1.4	1.5	1.24
PRECIP (in)	4.8	2.8	3.1	2.9	0.5	2.3	1.4	-0.9	0.5	1.7

http://www.ncdc.noaa.gov/temp-and-precip/us-climate-regions.php

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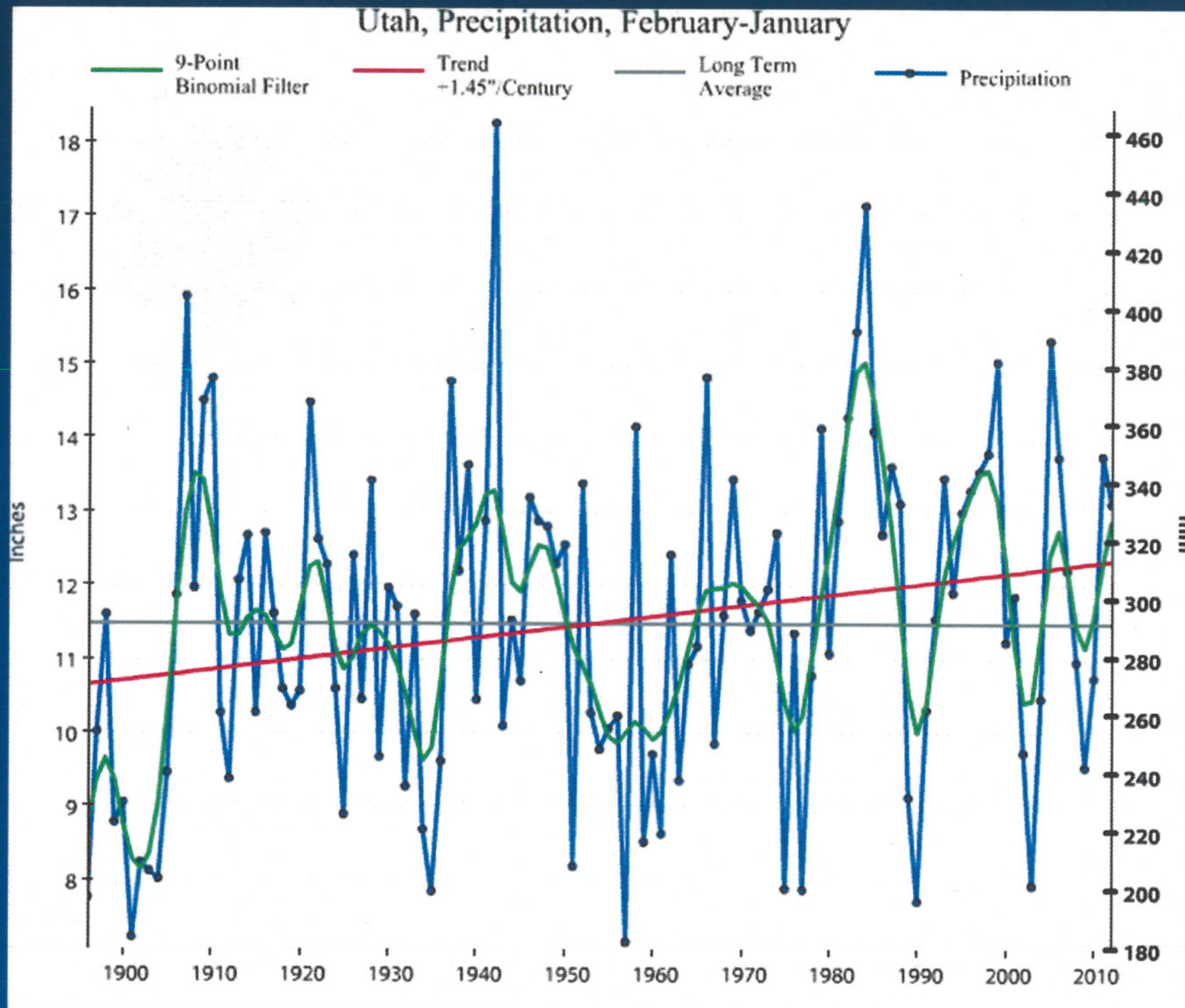
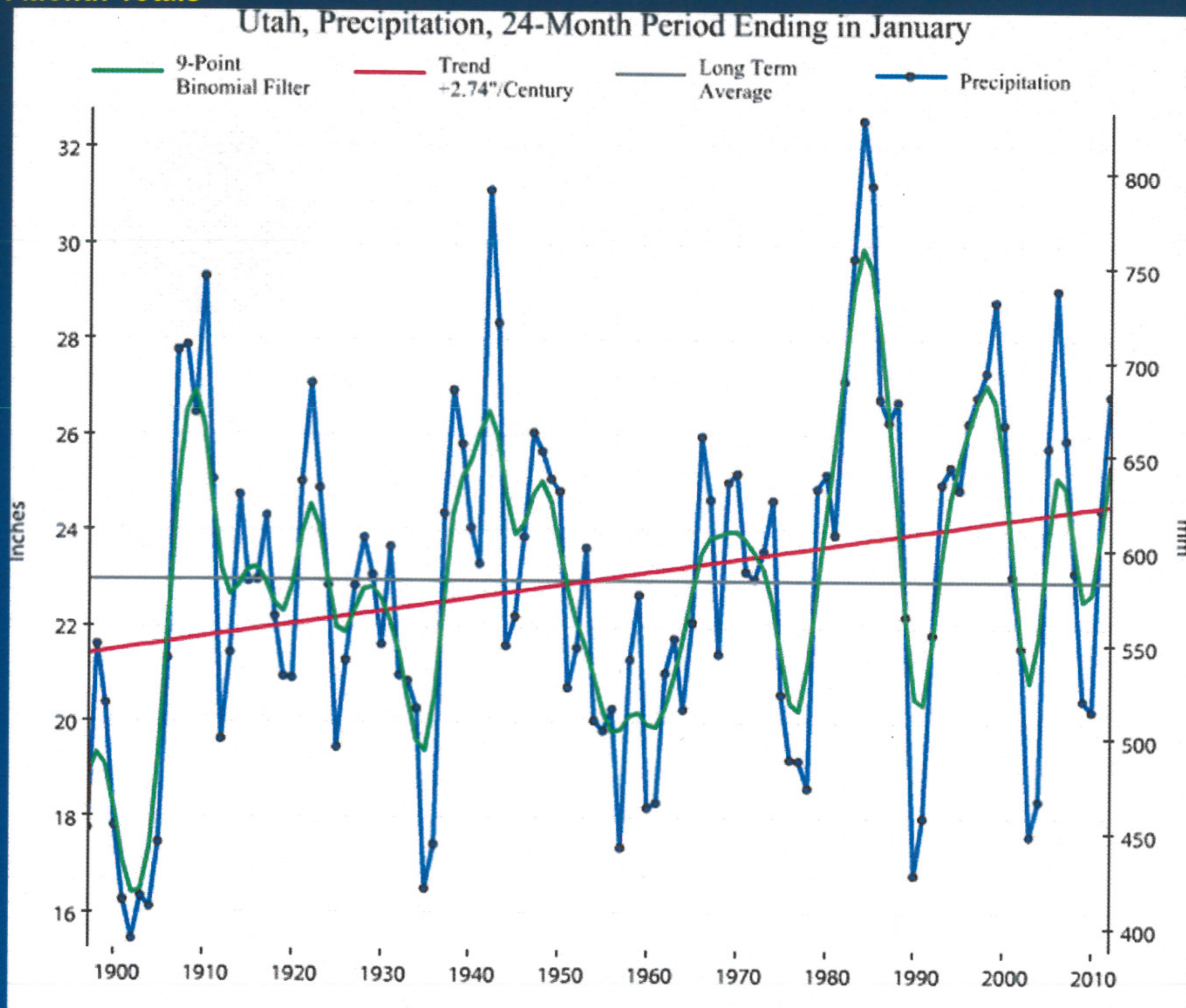
12 Month Totals



Source: http://www.ncdc.noaa.gov/temp-and-precip/time-series/

United States Department of Agriculture
Natural Resources Conservation Service

24 Month Totals



Source: http://www.ncdc.noaa.gov/temp-and-precip/time-series/

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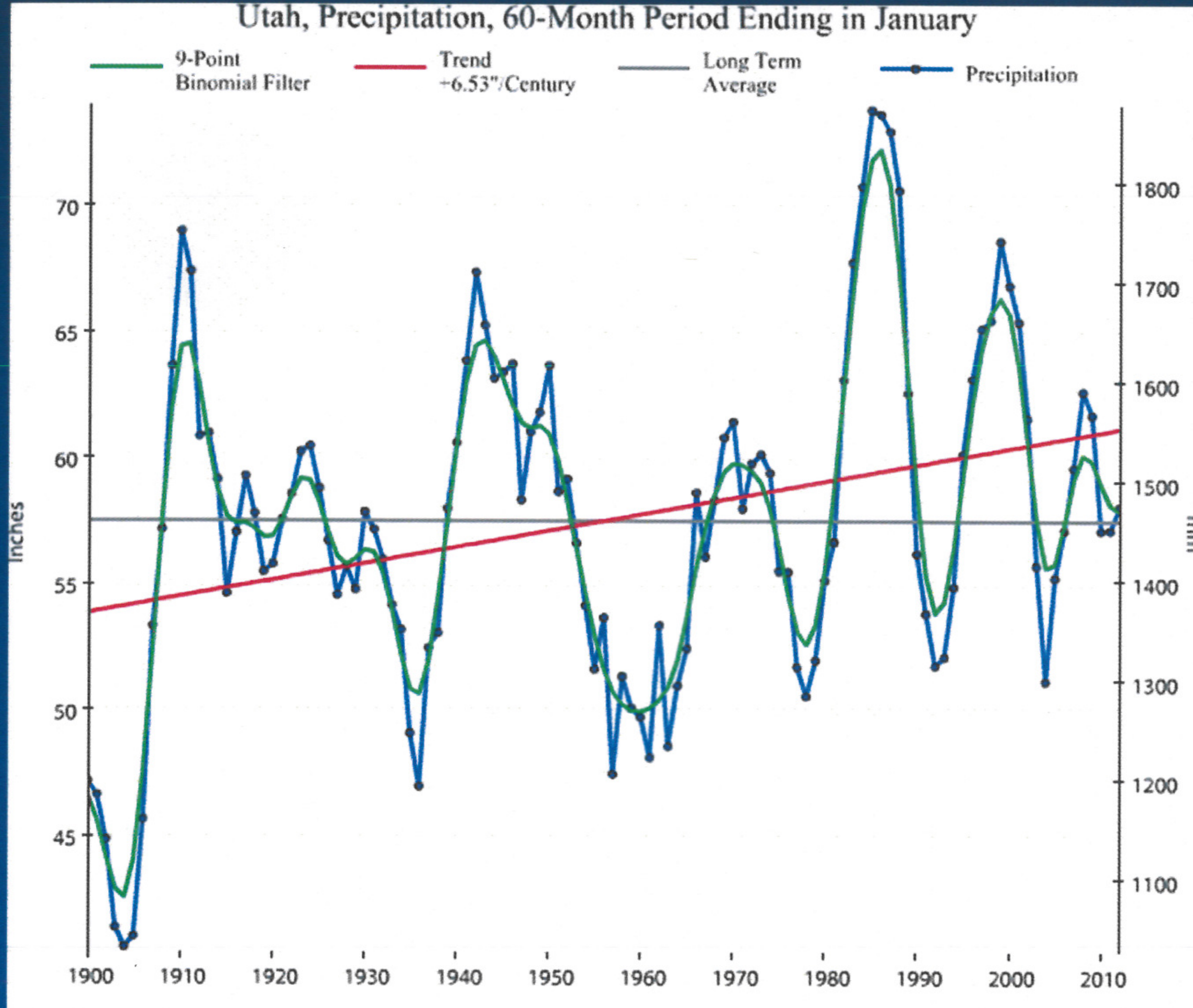
60 Month Totals



Source: http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=pcp&month=3&year=2011&filter=60&state=42&div=0

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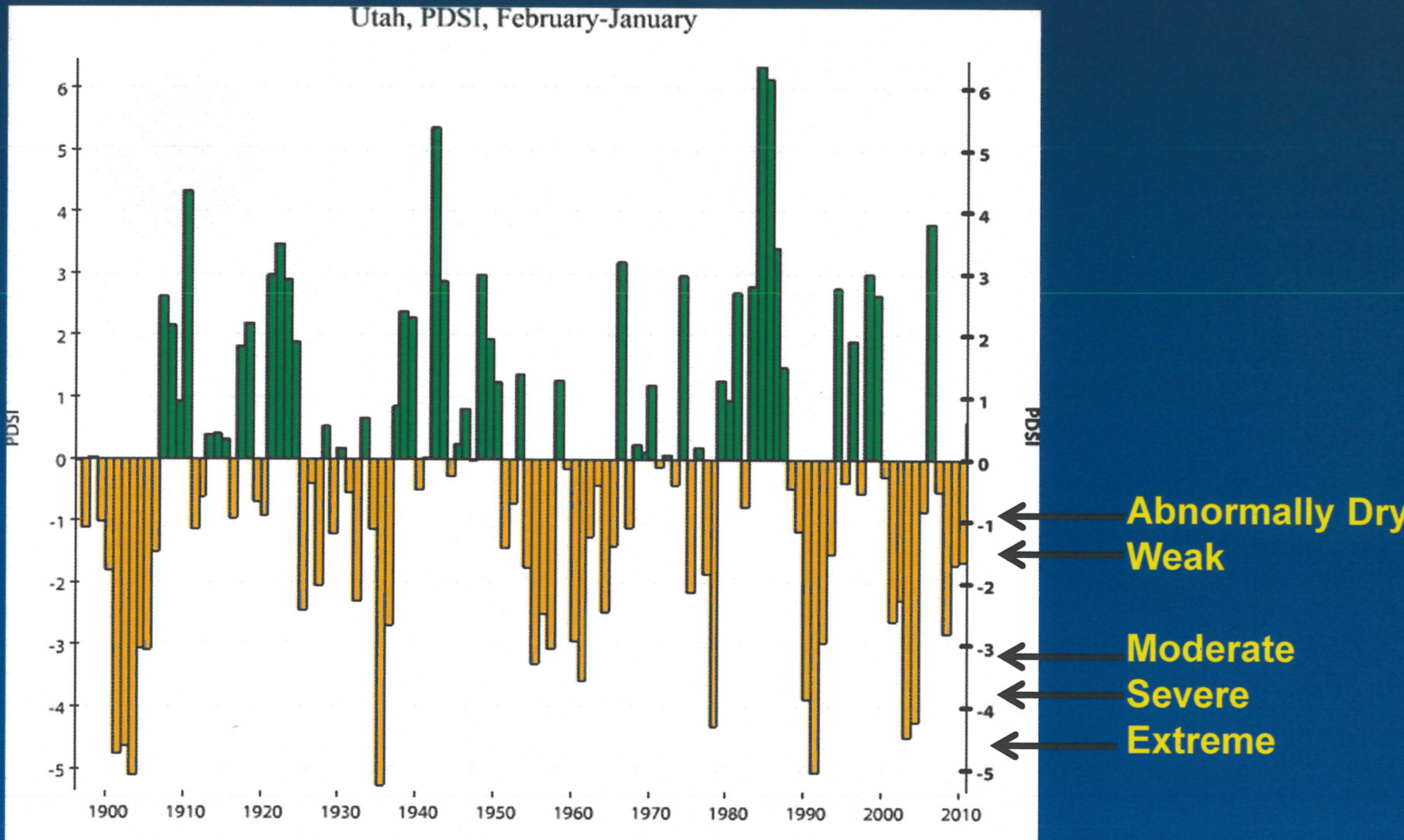
Palmer Drought Severity Index



Source: http://www.ncdc.noaa.gov/temp-and-precip/time-series/

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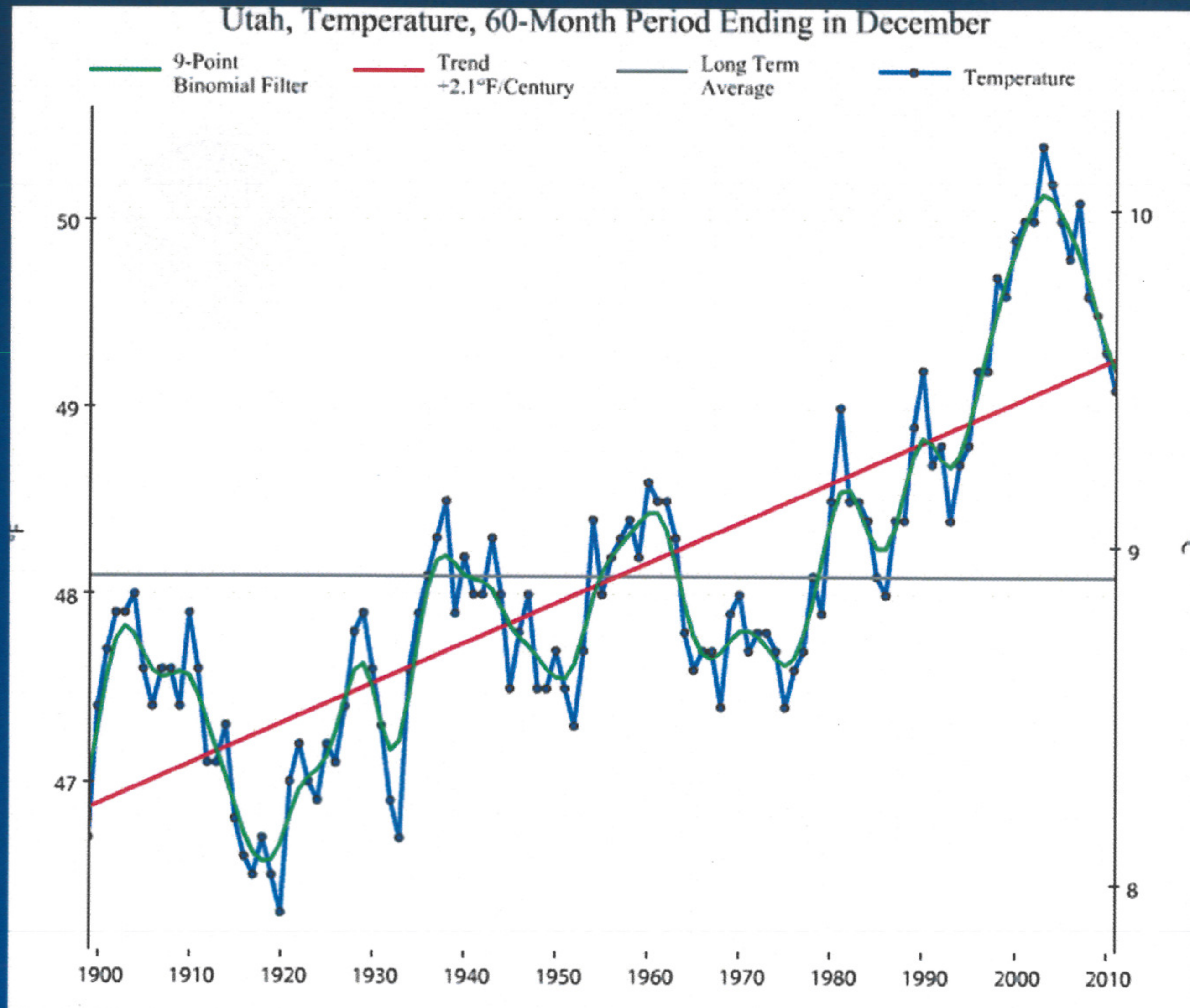
60 Month Average



Source: http://www.ncdc.noaa.gov/temp-and-precip/time-series/

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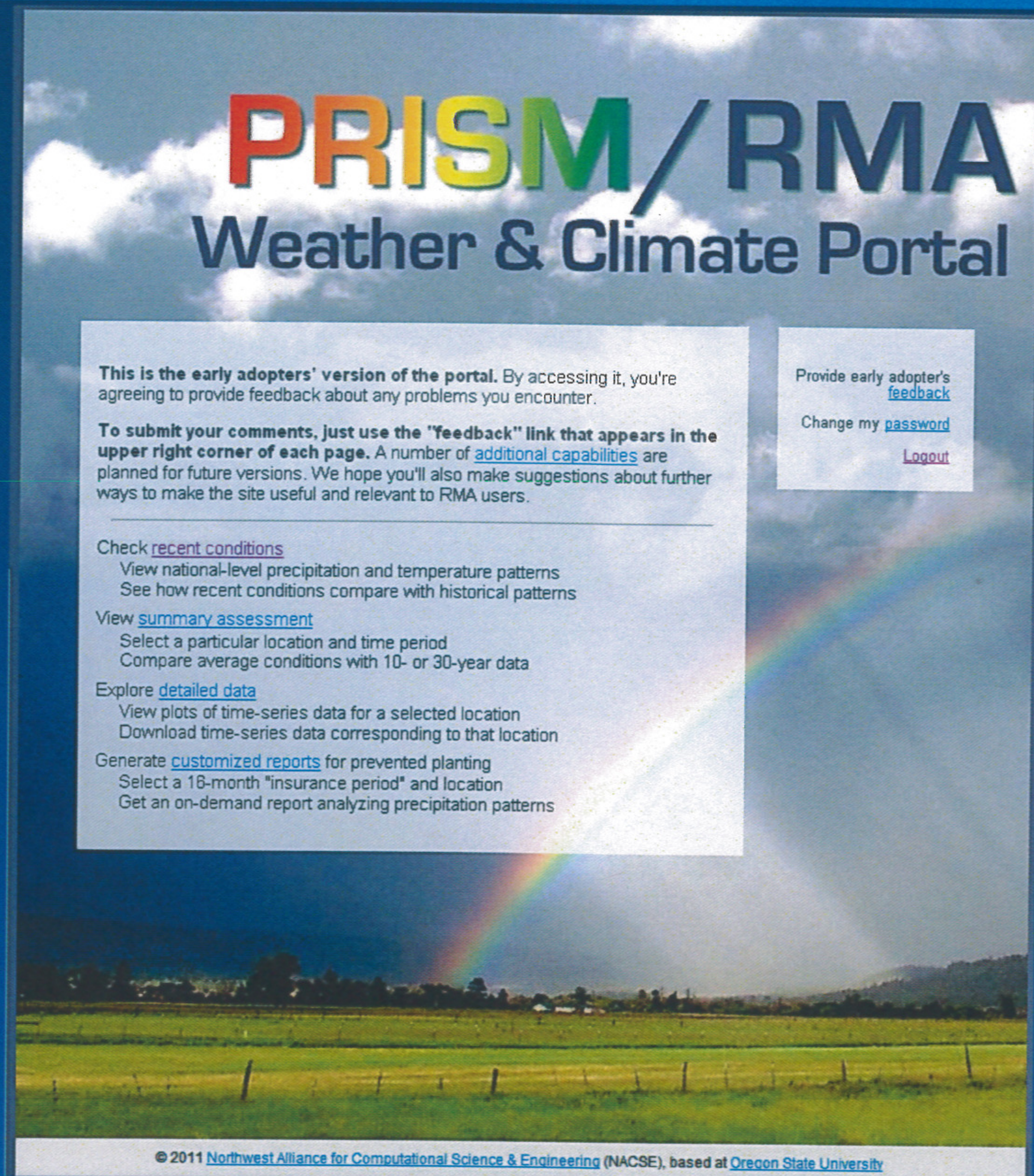

Future Support is just around the corner

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Near Real-Time and Customized Climate Comparisons

(Prototype Version)
Summary Assessment: Choose Settings

Title Summary Assessment 18/48 [Will appear as part of page title]

Time period [How data stability is calculated]

- Daily time period (current limit is 16 months)
  - Starts: 2012 September 27 Data for this date is ...
  - Runs through: 2012 September 27 Data for this date is ...
- Monthly time period (current limit is 16 months)
  - Starts: 2012 July Data for this date is **preliminary**
  - Runs through: 2012 July Data for this date is **preliminary**

Compare to Prior 10 years 30-year normals (1981-2010: applies to monthly periods only) [How normals are calculated]

Location

- Name a specific CLU
  - -- State -- ------------ Farm: Tract: Field: [Specifying CLUs]
- Select a geographic location
  - State & County -- State -- ------------
  - PLSS -- State -- ------------ ------------ ------------ ------------
  - Coordinates Latitude: Longitude:
  - Click-to-choose

View Assessment

Click to select. Click & drag to pan. Use mouse wheel to zoom. Latitude: Longitude:

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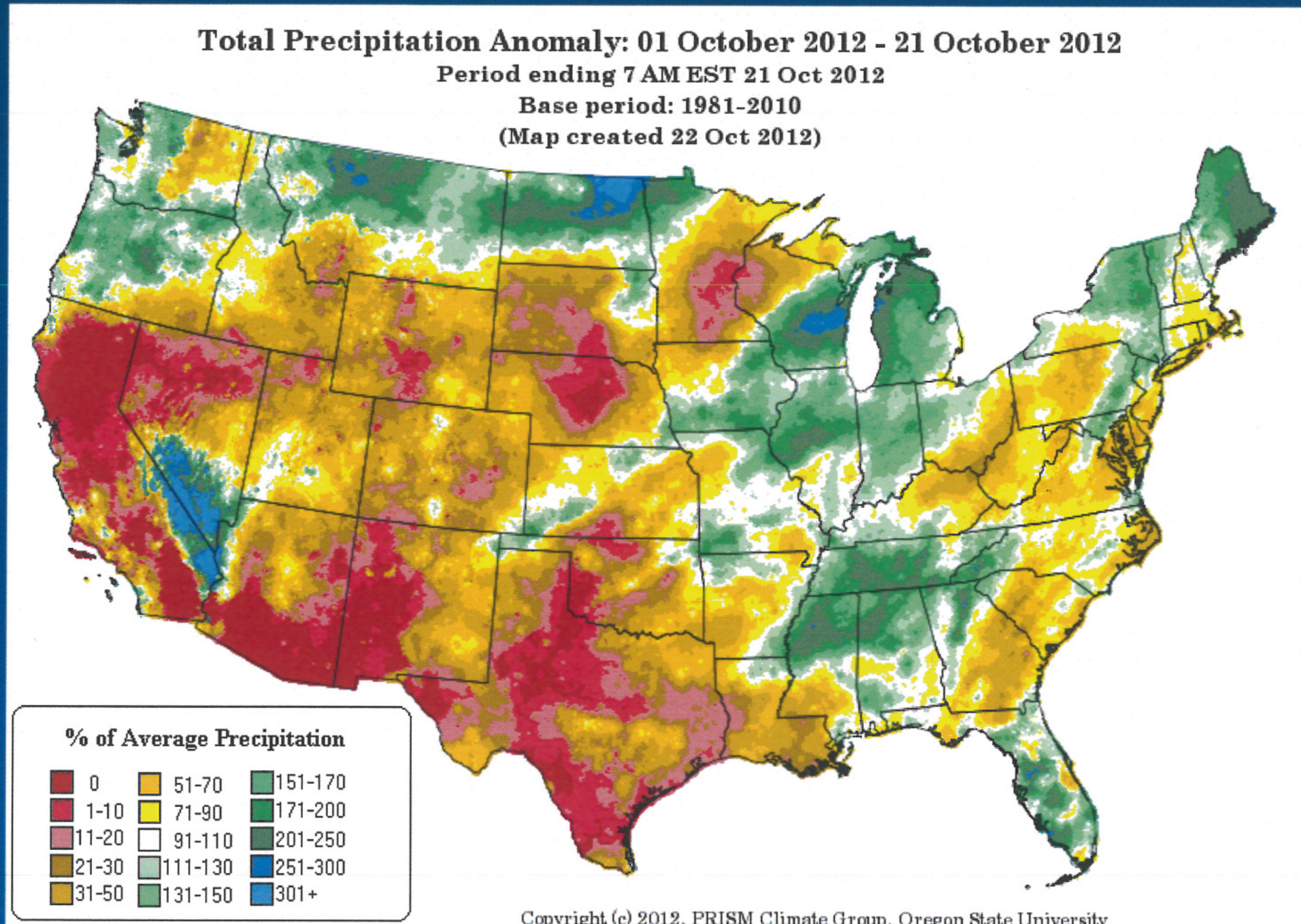
Types of Spatial Climate Products



800 meter resolution updated 7days & Monthly

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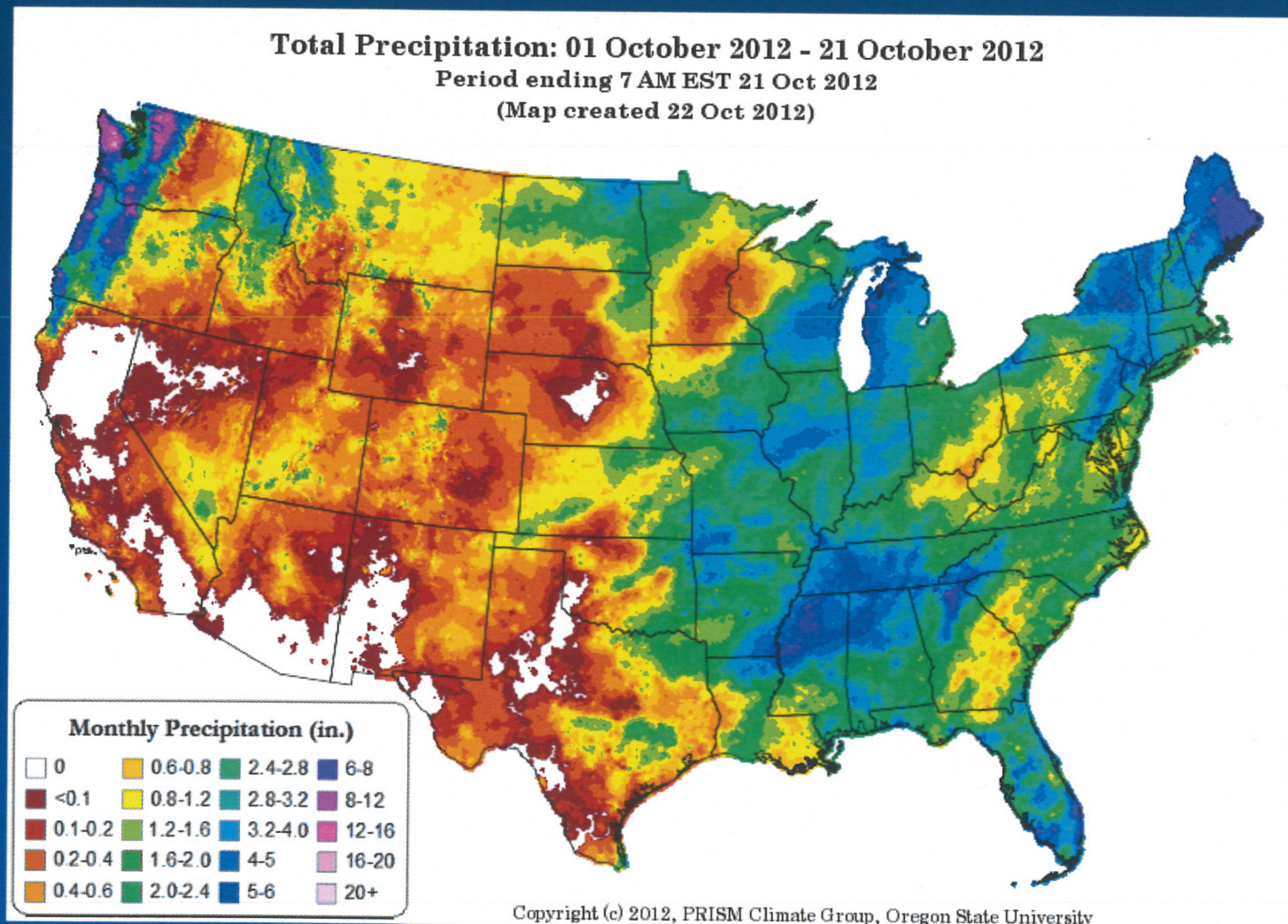
Types of Spatial Climate Products



Actual amount of precipitation

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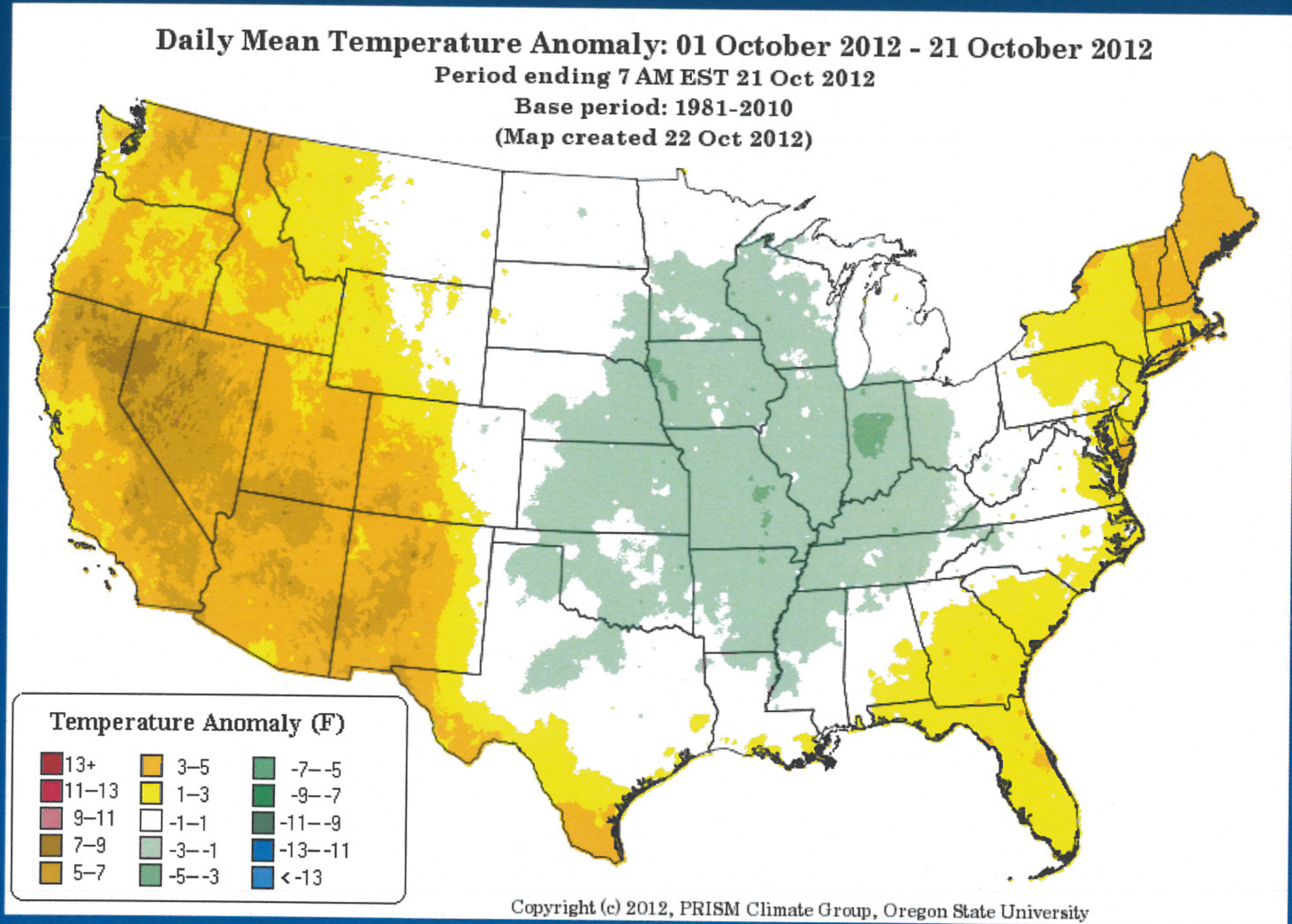
Types of Spatial Climate Products



Temperature departures from Normal

Diversity keeps grasslands resilient to drought, climate change

The benefits of a diverse grassland are evident when the U.S. faced a drought in the 1980s, said Towne, who also collects plant community data.

"After that drought we saw a **booming explosion of tall grasses** the following year," Towne said. "So it really backs up what the study found: that drought forces the grasslands to adapt to the weather conditions so they can get through that rough period."

The study, "Global diversity of drought tolerance and grassland climate-change resilience," was recently published online at Nature Climate Change:

Source: www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate1634.html

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nature climate change

LETTERS

PUBLISHED ONLINE: 5 AUGUST 2012 | DOI: 10.1038/NCLIMATE1634

Global diversity of drought tolerance and grassland climate-change resilience

Joseph M. Craine[1]*, Troy W. Ocheltree[1], Jesse B. Nippert[1], E. Gene Towne[1], Adam M. Skibbe[1], Steven W. Kembel[2] and Joseph E. Fargione[3]

- "If we still have grasslands that are diverse, the grasslands are going to continue to function relatively well and not change too much," Craine said. "But when we replace our prairies with ones that just have a few species in it, then it's less likely that grasslands will be able to function normally in the future. That affects the animals and other things that depend on grasslands, making it more likely that the whole ecosystem collapses."

- "After that drought we saw a booming explosion of tall grasses the following year," Towne said. "So it really backs up what the study found: that drought forces the grasslands to adapt to the weather conditions so they can get through that rough period."

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Biogeosciences, 8, 3053–3068, 2011
www.biogeosciences.net/8/3053/2011/
doi:10.5194/bg-8-3053-2011

Biogeosciences

Relative effects of precipitation variability and warming on tallgrass prairie ecosystem function

P. A. Fay[1], J. M. Blair[2], M. D. Smith[3], J. B. Nippert[2], J. D. Carlisle[4], and A. K. Knapp[5]

[1]USDA ARS Grassland Soil and Water Research Laboratory, 808 E Blackland Rd., Temple, Texas 76502, USA
[2]Division of Biology, Kansas State University, Manhattan, Kansas 66506, USA
[3]Department of Ecology and Evolutionary Biology, Yale University, New Haven, Connecticut 06520, USA
[4]Utah Climate Center, Utah State University, Logan, Utah 84322, USA
[5]Department of Biology and Graduate Degree Program in Ecology, Colorado State University, Fort Collins, Colorado 80523, USA

Received: 1 June 2011 – Published in Biogeosciences Discuss.: 13 July 2011
Revised: 10 October 2011 – Accepted: 11 October 2011 – Published: 31 October 2011

Rangeland Ecol Manage 64:352–357 | July 2011 | DOI: 10.2111/REM-D-10-00121.1

Decreasing Precipitation Variability Does Not Elicit Major Aboveground Biomass or Plant Diversity Responses in a Mesic Rangeland

Justin D. Derner,[1] Karen R. Hickman,[2] and H. Wayne Polley[3]

Authors are [1]Research Rangeland Management Specialist and Research Leader, US Department of Agriculture, Agricultural Research Service, Rangeland Resources Research Unit, Cheyenne, WY 82009, USA; [2]Professor, Natural Resource Ecology and Management, Oklahoma State University, Stillwater, OK 74078, USA; and [3]Ecologist, US Department of Agriculture, Agricultural Research Service, Grassland, Soil & Water Research Laboratory, Temple, TX 76502, USA.

Study Findings

- The 1st study suggests Grassland may be substantially altered by interannual climate variability
- Interannual variability > intra-annual rainfall and temperature variability
- Increasing growth with > season rainfall variability and warming were small
- Soil moisture @ 15cm depth only varied 40% despite 2-fold growing season rainfall variability
- Biomass decreased 8-40% during these seasonal rainfall variability periods
- The 2nd study suggest only a 20% difference in biomass with twofold difference in annual precipitation (bio-diversity helps maintain balance)

Additional reference: http://www.pnas.org/content/103/34/12793.full

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Self-organization and complex dynamics of regenerating vegetation in an arid ecosystem: 82 years of recovery after grazing

Original Research Article
Journal of Arid Environments, Volume 88, January 2013, Pages 156-164
V. Lawley, L. Parrott, M. Lewis, R. Sinclair, B. Ostendorf

The authors compare four sites, which have been subjected to the same climate and grazing.

- **They assess long-term changes in vegetation community organization.**
- **Sites show remarkably different developmental pathways over 82 years.**
- **Internal factors play a key role in community organization and not external factors.**
- **Regeneration is not a linear, predictable trajectory.**

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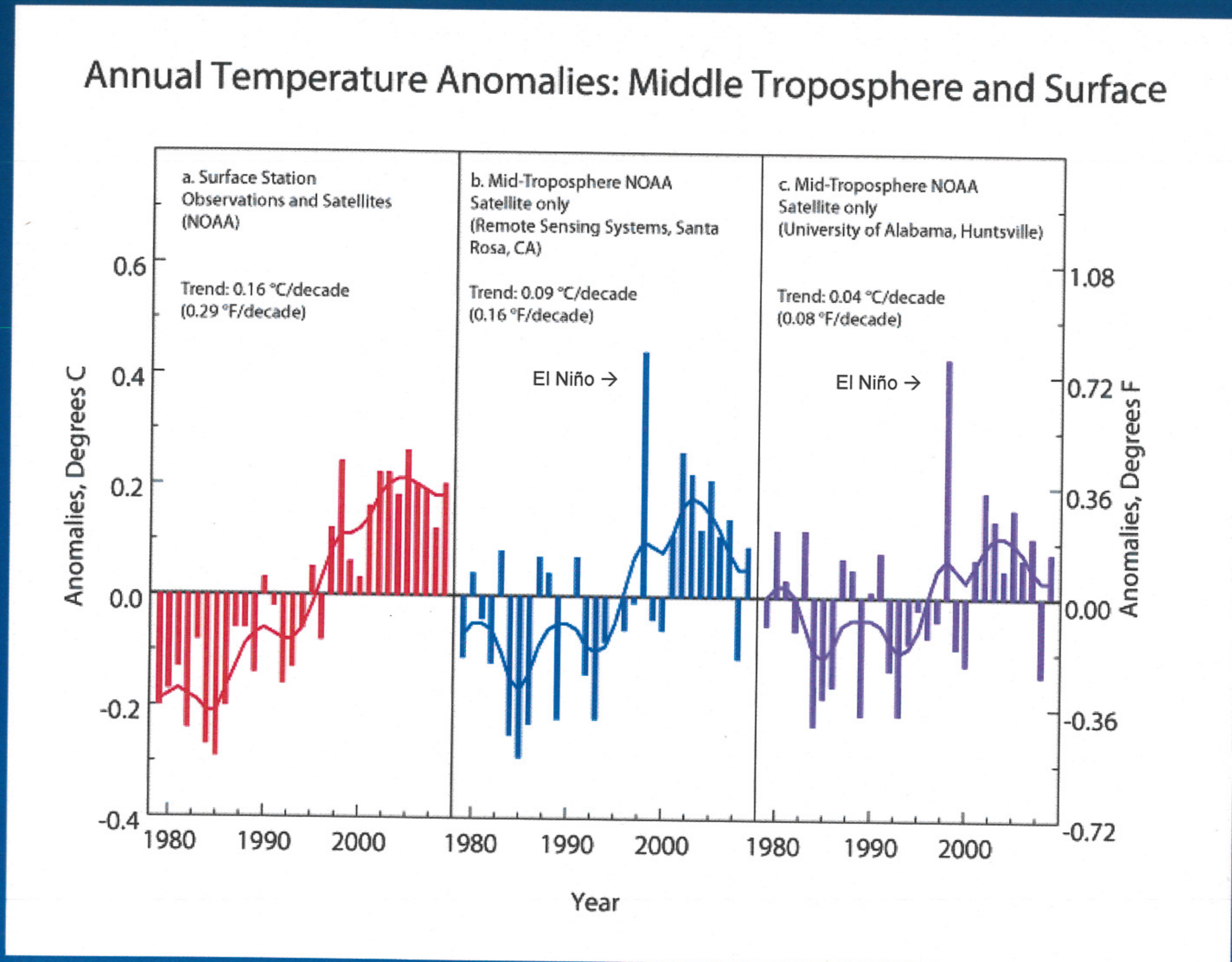
Recent Temperature Trends



Ref: http://www.ncdc.noaa.gov/sotc/?report=global&year=2009&month=13&submitted=Get+Report

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ENSO

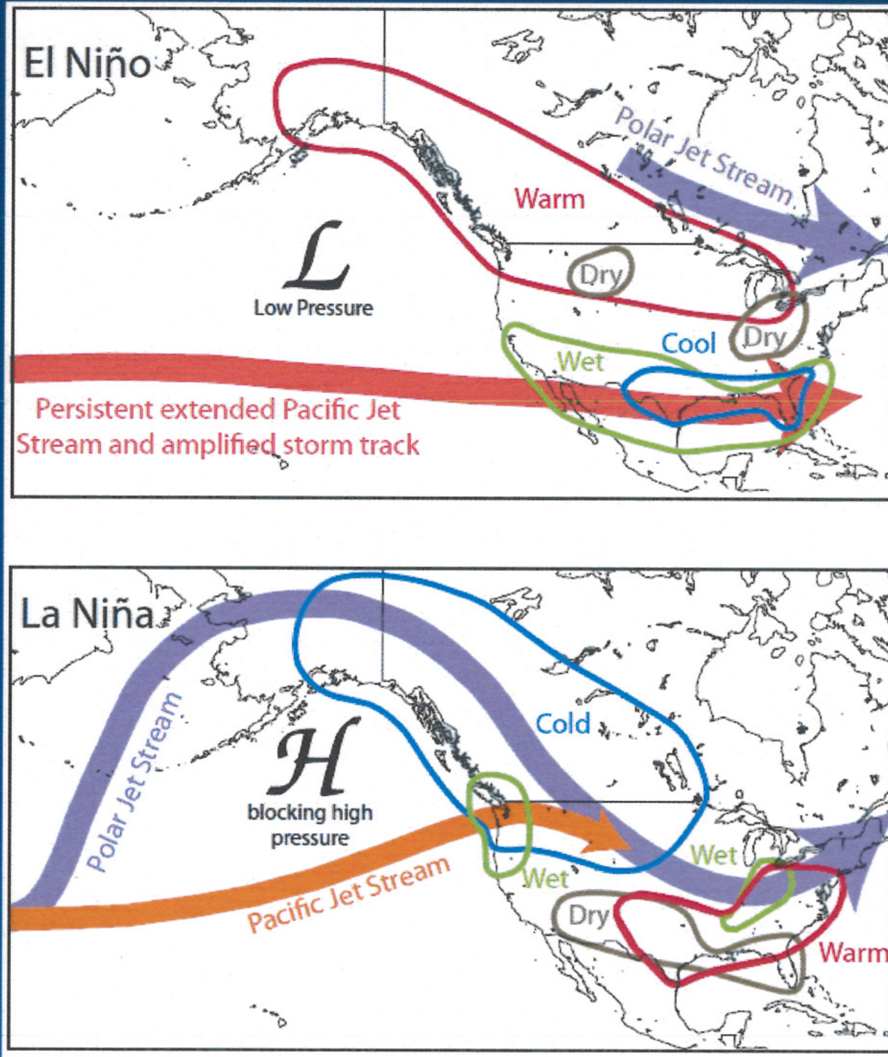

Figure 2. El Niño and La Niña events cause the path of the jet streams to move over the US in different locations, often causing wet winters during El Niño episodes and dry winters during La Niña events in the Southwest.

Ref: http://www.climas.arizona.edu/forecasts/articles/2010_jan_ensoscillation.pdf

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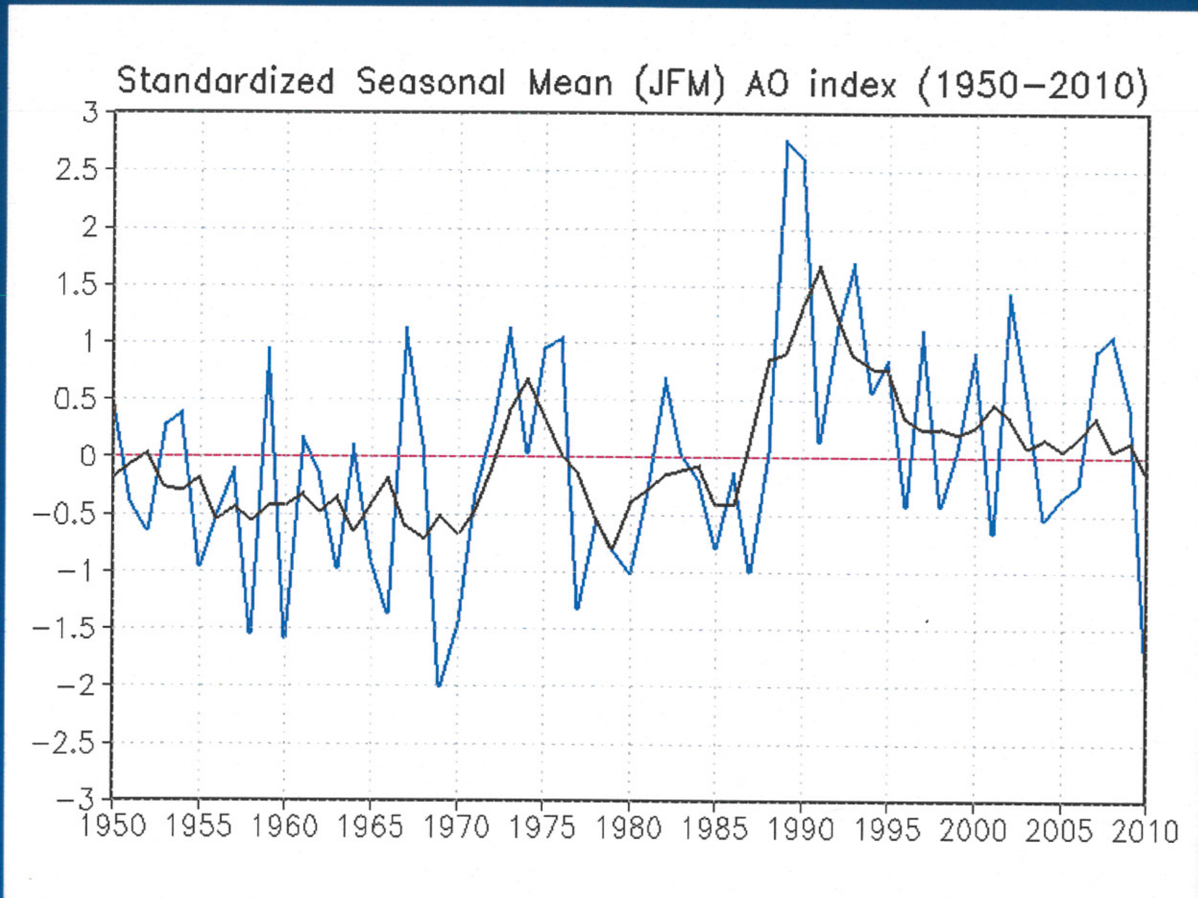
Arctic Oscillation



The standardized seasonal mean AO index during cold season (blue line) is constructed by averaging the daily AO index for January, February and March for each year. The black line denotes the standardized five-year running mean of the index. Both curves are standardized using 1950-2000 base period statistics.

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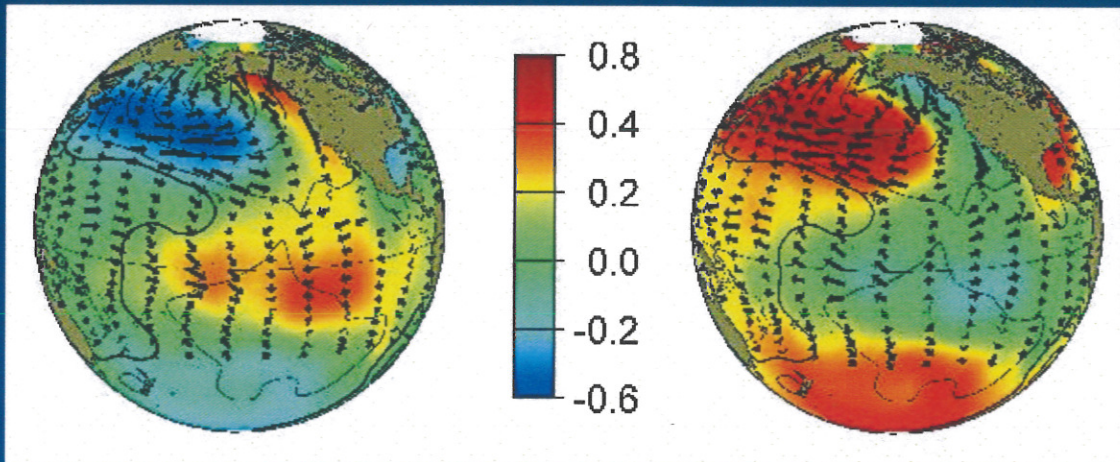
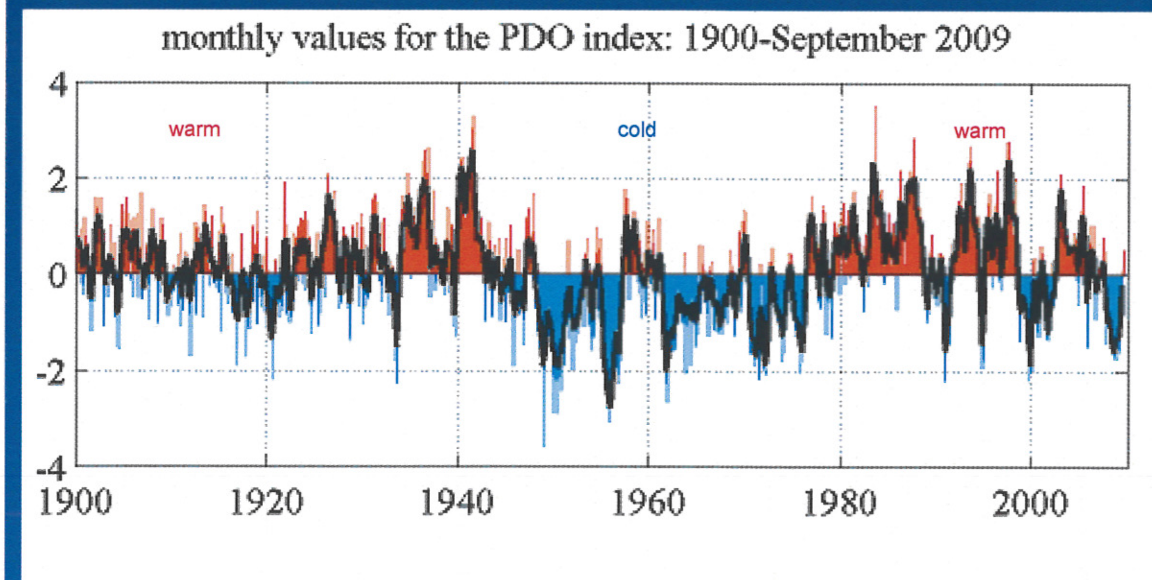
The Pacific Decadal Oscillation (PDO)





A Pacific interdecadal climate oscillation with impacts on salmon production by Nathan J. Mantua, et al., 1997

Salmon Stock	1947 step	1977 step
Western Alaska Sockeye	-37.2%	+242.2%
Central Alaska Sockeye	-33.3%	+220.4%
Central Alaska Pink	-38.3%	+251.9%
Southeast Alaska Pink	-64.4%	+208.7%

Ref: http://en.wikipedia.org/wiki/Pacific_decadal_oscillation

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Earth's Balancing Act

Emissions of greenhouse gases and other factors such as land-use changes, modify the energy budget. The Intergovernmental Panel on Climate Change (IPCC) provides an estimate of this forcing.

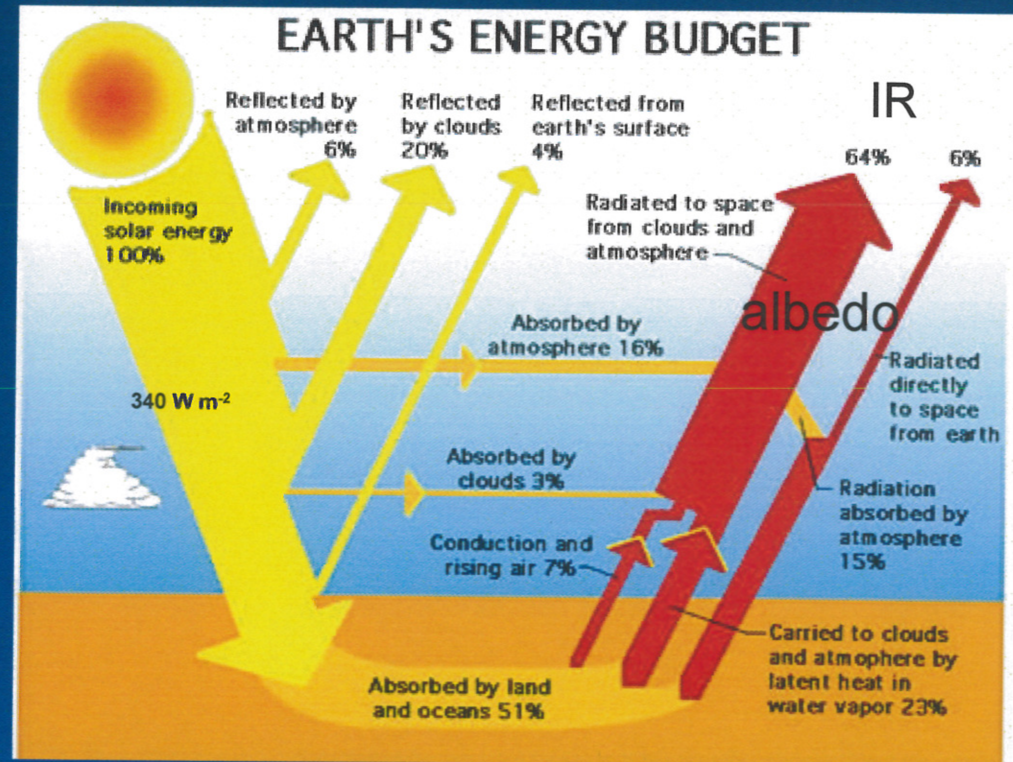
The largest and best known are from the well-mixed greenhouse gases (H_2O, CO_2, CH_4, halocarbons), totaling an increase in forcing of 2.4 W m^{-2} relative to 1750. Total forcing effects are:

H_2O	75 W m^{-2}	(60%)
CO_2	32 W m^{-2}	(26%)
O_3	10 W m^{-2}	(8%)
CH_4+N_2O	8 W m^{-2}	(6%)

This is less than 1% of the solar input, but contributes to the observed increase in atmospheric and oceanic temperature.

Temperature changes are inferred from radiative forcing using climate sensitivity in computer models. Fossil fuel consumption produces ~3% of the total atmospheric CO_2. This equates to 0.28% of the greenhouse effect.*

*Ref: http://www.geocraft.com/WVFossils/greenhouse_data.html



Ref: http://en.wikipedia.org/wiki/Earth%27s_energy_budget

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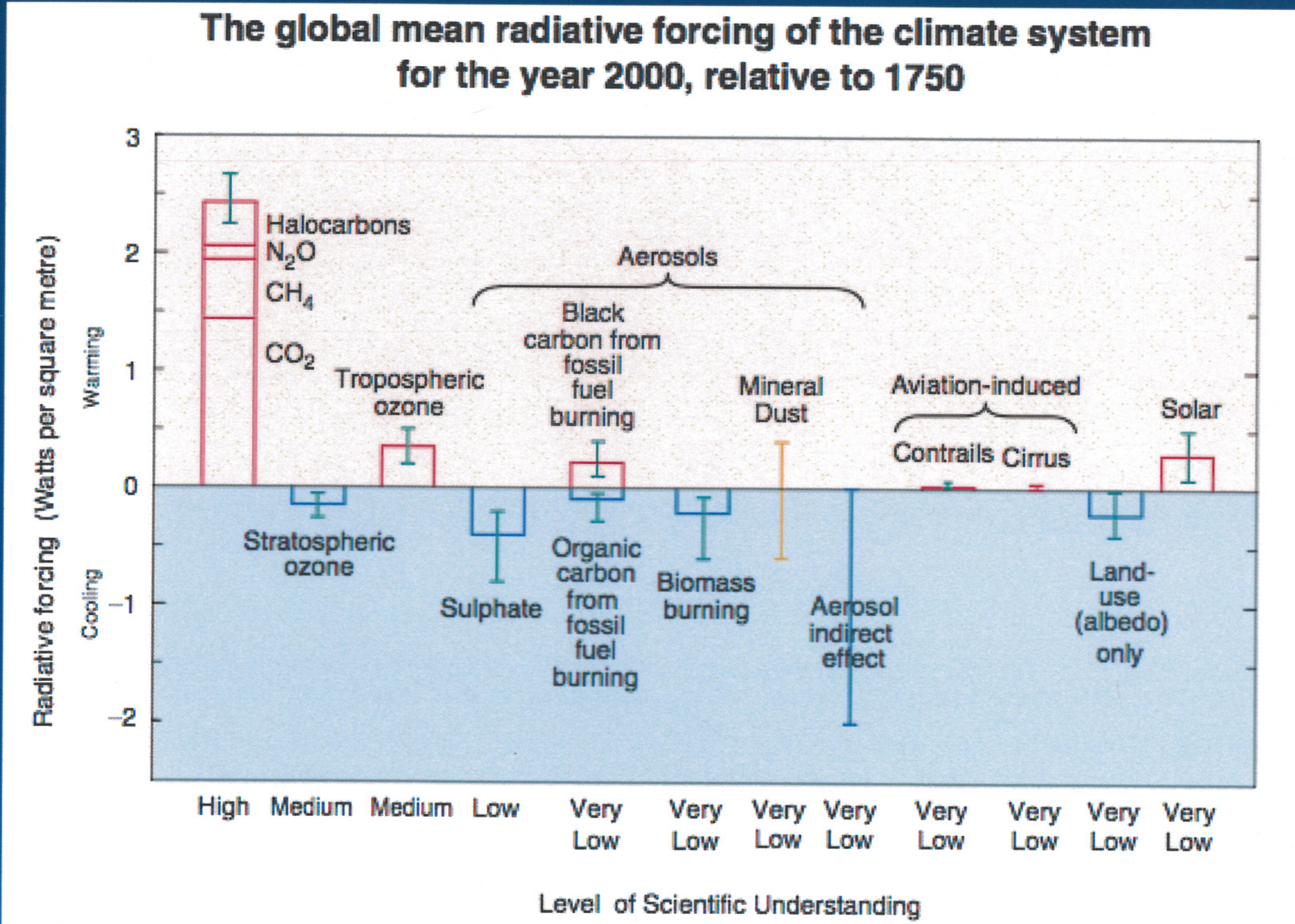
What we think we know



Ref: http://www.ipcc.ch/

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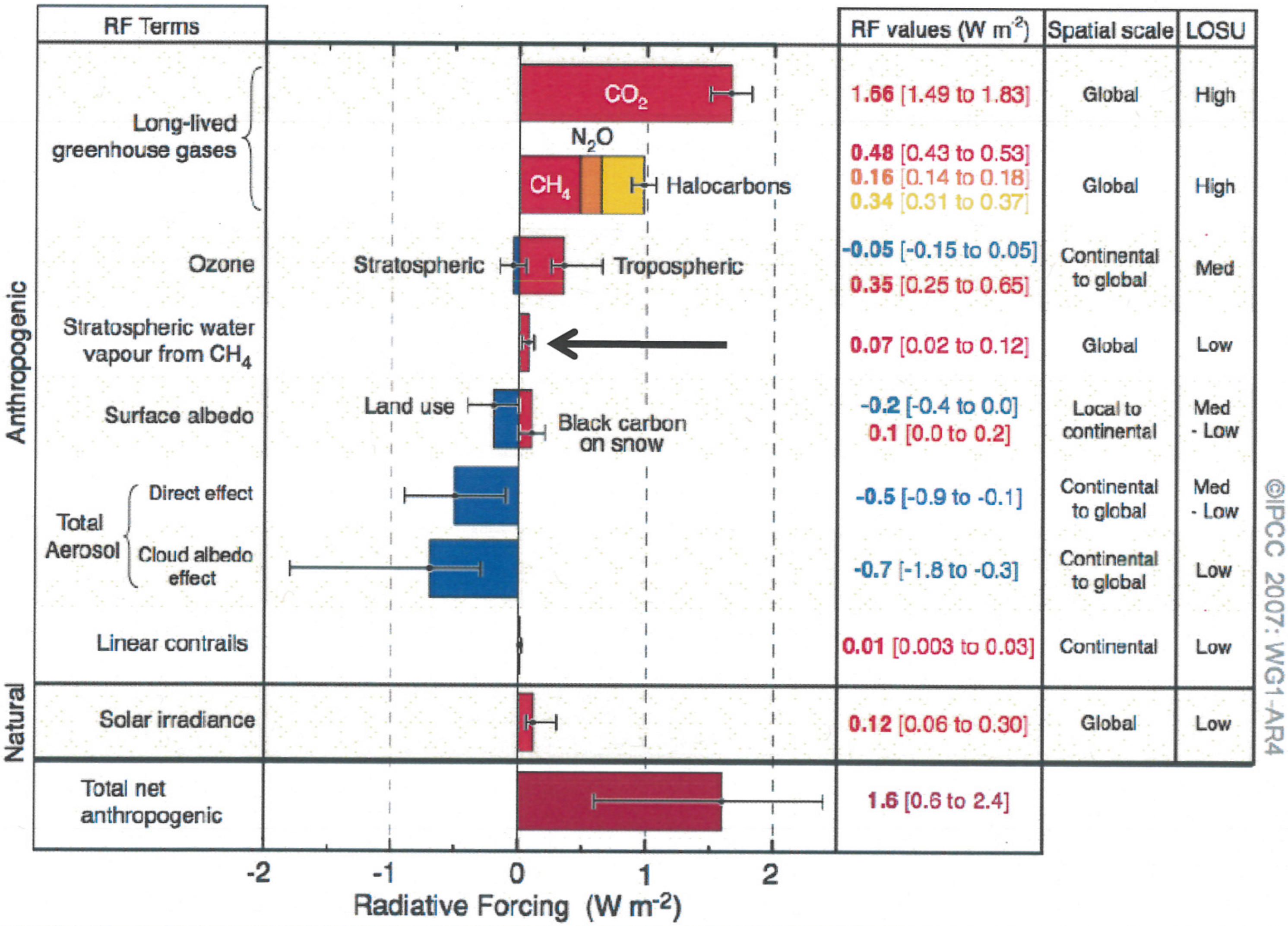
Radiative Forcing Components



Ref: http://www.ipcc.ch/

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New discoveries are being made!

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

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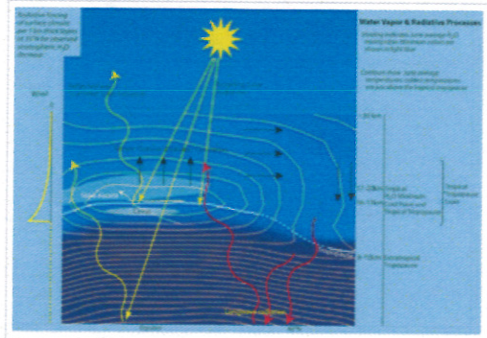
Related Links
» NOAA Research
» Greenhouse Gas FAQ

Media Contact
» Jana Goldman
301-734-1123

Stratospheric Water Vapor is a Global Warming Wild Card

January 28, 2010

A 10 percent drop in water vapor ten miles above Earth's surface has had a big impact on global warming, say researchers in a study published online January 28 in the journal *Science*. The findings might help explain why global surface temperatures have not risen as fast in the last ten years as they did in the 1980s and 1990s.



High resolution (Credit: NOAA)

Observations from satellites and balloons show that stratospheric water vapor has had its ups and downs lately, increasing in the 1980s and 1990s, and then dropping after 2000. The authors show that these changes occurred precisely in a narrow altitude region of the stratosphere where they would have the biggest effects on climate.

Water vapor is a highly variable gas and has long been recognized as an important player in the cocktail of greenhouse gases—carbon dioxide, methane, halocarbons, nitrous oxide, and others—that affect climate.

"Current climate models do a remarkable job on water vapor near the surface. But this is different — it's a thin wedge of the upper atmosphere that packs a wallop from one decade to the next in a way we didn't expect," says Susan Solomon, NOAA senior scientist and first author of the study.

Ref: http://www.noaanews.noaa.gov/stories2010/20100128_watervapor.html

Recent Journal Paper

Climate Was Warmer 1000 and 2000 Years Ago

Ref: http://www.clim-past.net/8/765/2012/cp-8-765-2012.html

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Natural Resources Conservation Service

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Thank You

Questions?

http://images.fanpop.com/images/image_uploads/wild-horses-the-animal-kingdom-250738_1024_768.jpg

Jan Curtis
Natural Resources Conservation Service
National Water & Climate Center
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Portland, OR 97232
(503) 414-3017
Jan.curtis@por.usda.gov


Advisory Board Meeting
Program Budget Overview
Wild Horse and Burro Program
TM
U.S. Department of the Interior
Bureau of Land Management

FY 2013 Performance Measures

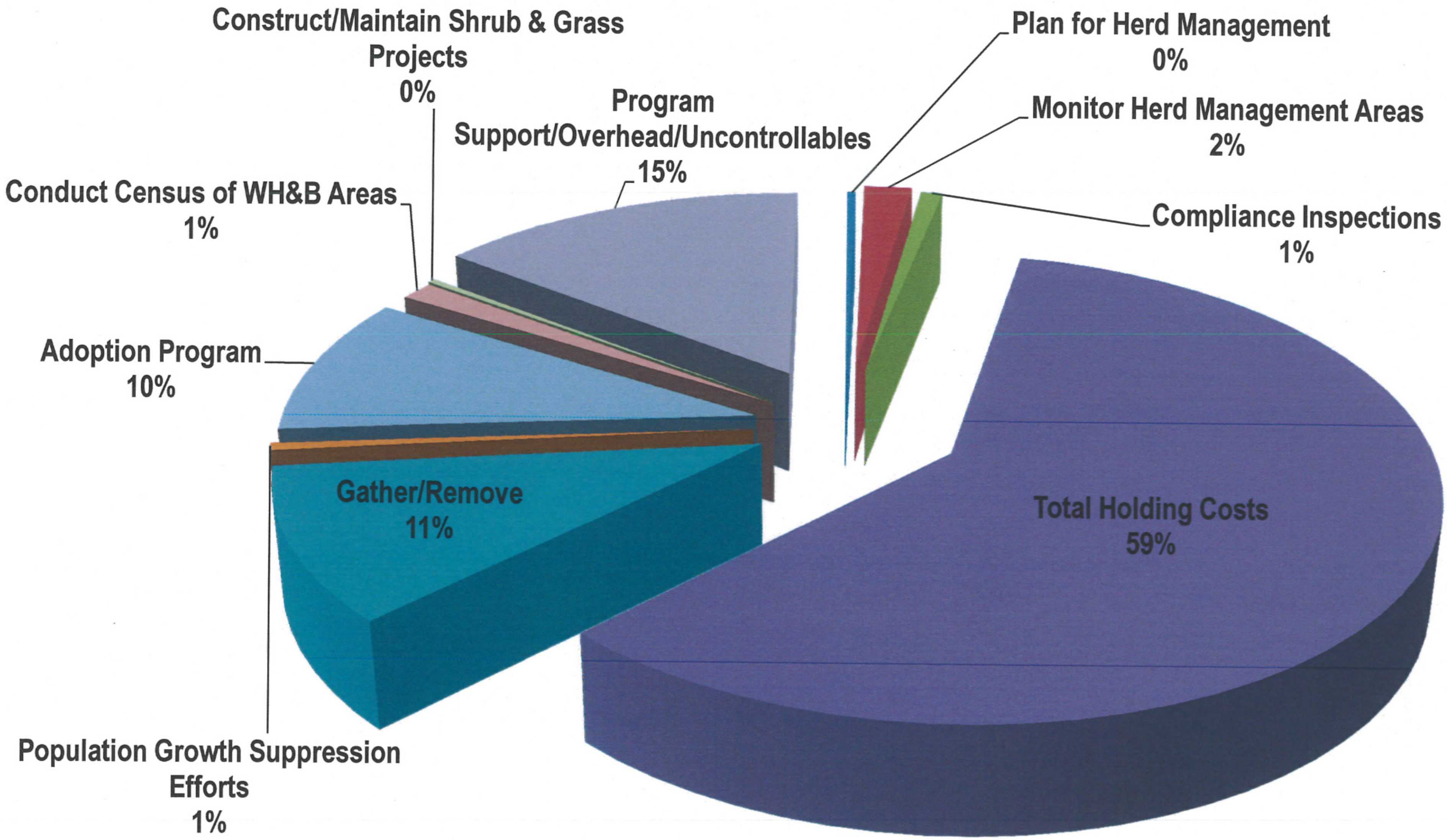
Percentage of Herd Management Areas (HMAs) at appropriate management levels (AML).(Bureau Measure)

Percentage of Herd Management Areas (HMAs) gathered where population growth suppression techniques were applied. (Bureau Measure)

FY 2012 Actual Expenditures

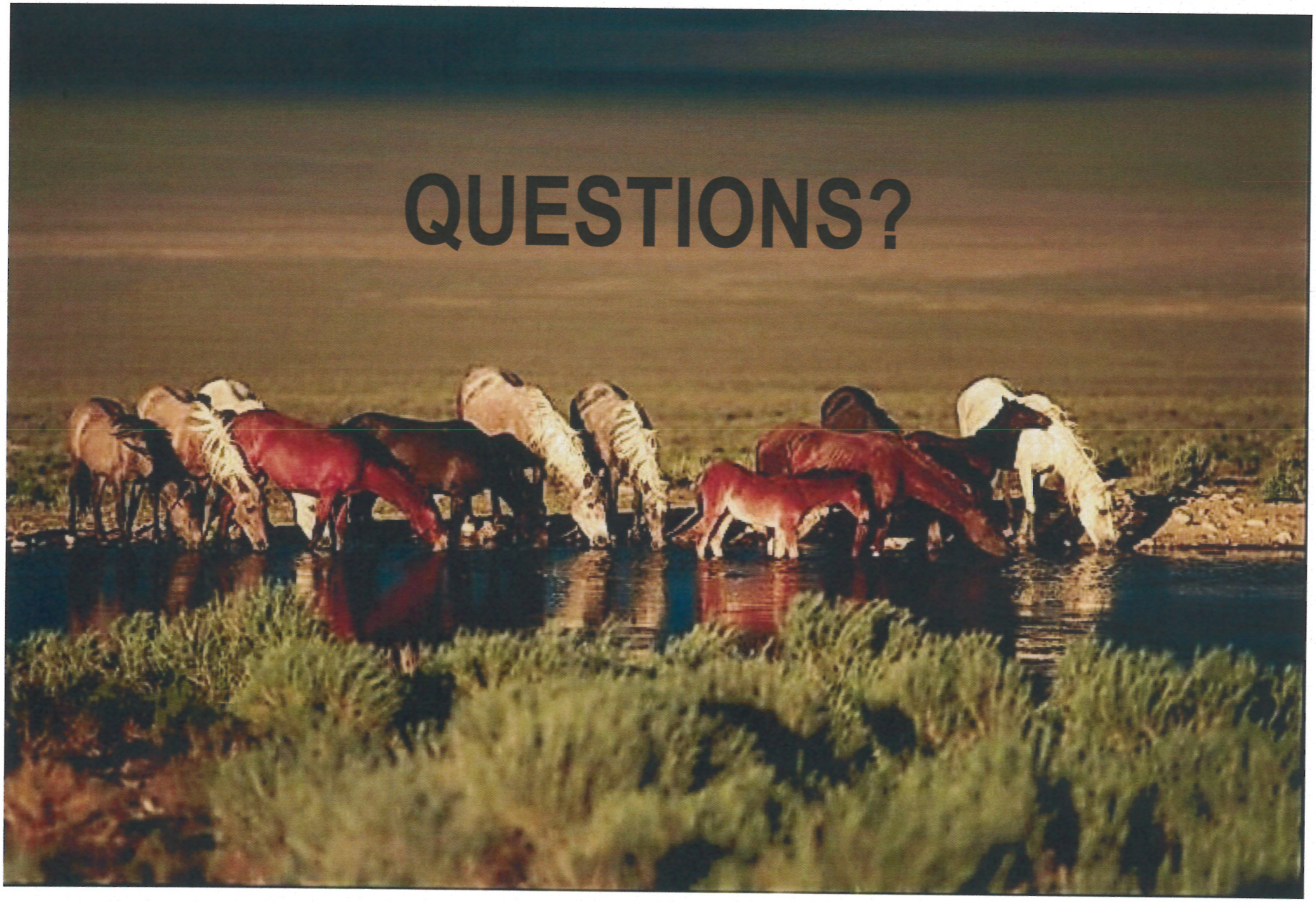
(DI) Plan for Herd Management	$235,536
(HG) Adoptions	$7,132,033
(HH) Long-term Holding	$17,451,196
(HI) Short-term Holding	$25,503,871
(JB) Construct Shrub/Grass Projects/Water Developments	$117,651
(JC) Maintain Shrub/Grass Projects/Water Developments	$112,933
(JJ) Gather/Remove	$7,807,517
(KF) Animals Gathered for Fertility Control	$333,835
(KG) Animals Treated to Reduce the Population	$52,229
(MC) Conduct Census of WH&B Areas	$966,008
(MP) Monitor Herd Management Areas	$1,389,092
(NK) Compliance Inspections	$624,933
(Law Enforcement & Admin/IT Support)	$5,271,029
(PC) Program Support / Overhead	$5,442,051
WHB Program Costs:	**$72,439,914**

% of FY 2012 Expenditures



FY 2013 Budget Projections

(DI) Plan for Herd Management	$241,250	0.3%
(HG) Adoptions	$7,701,650	9.8%
(HH) Long-term Holding	$16,534,438	21.1%
(HI) Short-term Holding	$28,036,179	35.8%
(JJ) Gather and Remove	$6,932,330	8.8%
(KF) Gather for Population Growth Suppression	$660,380	0.8%
(KG) Population Growth Suppression Applications	$585,500	0.7%
(MC) Conduct Population Survey of WH&B Areas	$772,200	1.0%
(MP) Monitor Herd Management Areas	$1,138,065	1.5%
(NK) Conduct WH&B Compliance Inspections	$699,875	0.9%
(Law Enforcement, Admin/IT & other Support)	$3,764,000	4.8%
(PC) Program Support / Overhead*	$11,293,000	14.4%
WHB Program Costs:	**$78,358,867**	


QUESTIONS?

Wild Horse and Burro Program TM

U.S. Department of the Interior
Bureau of Land Management

National WHB Advisory Board
Salt Lake City: October 29-30, 2012

FY2013 Gather/Treat/Release Plans
Escalating Issues/Emergencies

FY 2013 Gather/Treat/Release Plans

- Implementation Team's Tentative Plan (Aug, 2012)
  - Fall/Winter
    - 3,500 Removals
    - 900 PZP Treatments
  - Summer Not Planned
    - Evaluate priorities as winter progresses

Escalating Issues/Emergencies

(Monitoring Since May, 2012)

- Concerns Identified in 65 Areas (61 HMAs & 4 Outside HMA Areas)
  - Wildfire
  - Limited Forage
    - Minimal herbaceous growth during last 2-3 yrs.
    - Horses locating on wintering areas prematurely
    - Heavy forage utilization in many areas
  - Diminishing Water
    - Dry springs & reservoirs
    - Water hauling 15 HMAs
  - Declining Horse Condition in some areas
    - Concerns about survival this winter
  - Animals moving outside of HMAs in search of forage/water - in some cases onto private land

Wildfire

- Since July, 2012
  - Fires in 10 HMAs – About 650,000 acres
    - Oregon (4)
      - Jackies Butte HMA
    - Utah (2)
      - Cedar Mtn & Onaqui HMAs
    - California (4)
      - Twin Peaks HMA

Wildfire Twin Peaks HMA

(Oct 2012)

Water Availability Issues

- Many areas report decreasing water supplies
- Most serious situations
  - Paisley HMA
    - Emergency Gather (August, 2012)
  - Jackson Mountain
    - Emergency Gather
  - Owyhee & Little Owyhee HMAs
    - Few water sources for 1,300 horses

1 of 3 Water Haul Stations - Little Owyhee HMA (Oct. 2012)

Water/Forage Issues - Little Owyhee HMA (October, 2012)

Water Issues - Little Owyhee HMA

(October, 2012)

FY 2013 Gather Schedule May be Changed

- Requests to remove 2,000 more animals in last 30 days
  - Water issues
  - Wildfire
- Team visited field conditions in N Nevada and California
- Fall/winter removals – limited to 3,500 (available space)
- New requests/changes to Gather/Treat/Release schedule under consideration.

QUESTIONS???

Wild Horse and Burro Program
U.S. Department of the Interior
Bureau of Land Management

National Wild Horse and Burro Research Advisory Team Update

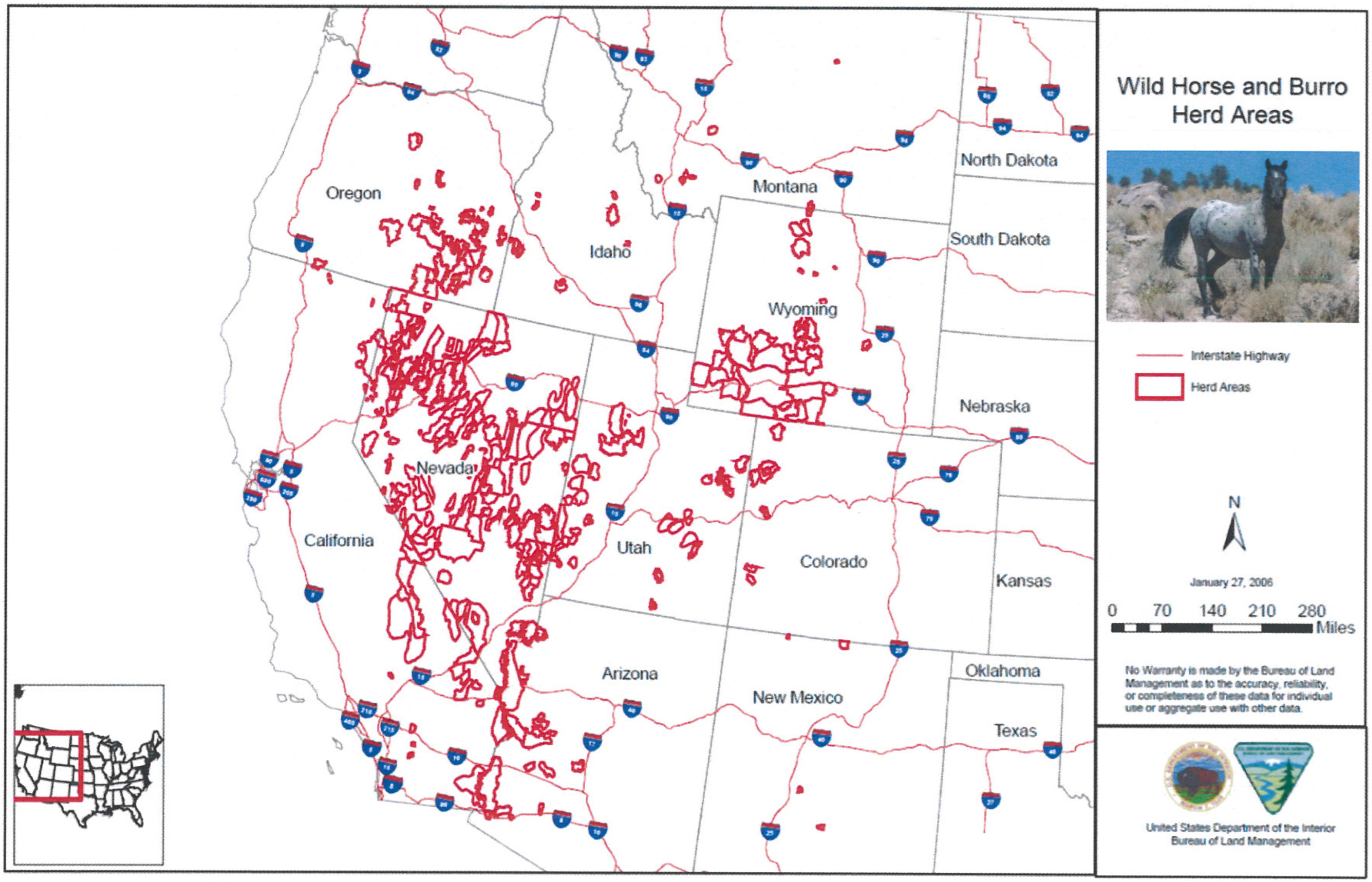
Briefing to:
The Wild Horse and Burro Advisory Board
Salt Lake City, Utah

Presented by:
Dr. Jeff Manning
Research Advisory Team Leader

October 29, 2012

U.S. Department of the Interior
Bureau of Land Management
Wild Horse and Burro Program

A Diversity of Wild Horse Herds



Current Research Issues

Strategic Research Plan
Wild Horse and Burro Management

The Bureau of Land Management,
Wild Horse and Burro Program
U.S. Department of Interior

Prepared in collaboration with
U.S. Geological Survey, Biological Resources Division
and
Animal and Plant Health Inspection Service,
Fort Collins, Colorado

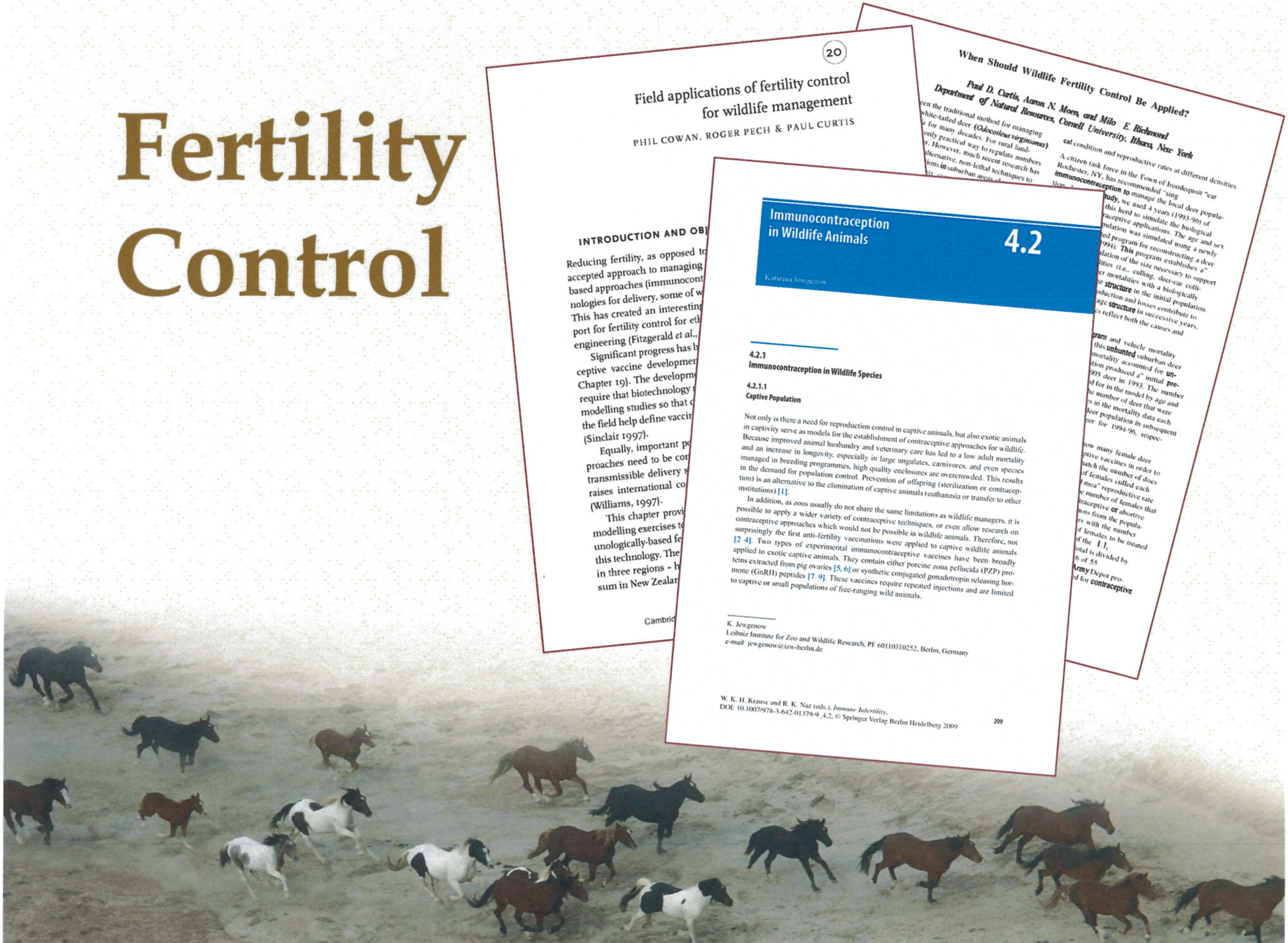
October 2003
(revised March 2005)

1. Fertility control
2. Population estimation
3. Genetics
4. Health and handling
5. Habitat assessment

Presentation Outline

1. Fertility control
2. Population estimation
3. Genetics
4. Future

Fertility Control



SpayVac® Field Study (USGS)

- North Lander Complex, Wyoming
- 2012-2018

1. SpayVac®
   a) A PZP immunocontraceptive
   b) 90 mares (60:30)

2. Response
   a) Annual foaling rate
   b) Behaviors (if mares become approachable)

Sex Ratio Adjustment (USGS & BLM)

- Currently not being implemented

1. Change herd composition
   a) Reduce number of mares
   b) Introduce geldings and stallions with epididymectomies

2. Approach may be revisited

SpayVac® Pasture Trial (USGS)

- BLM Pauls Valley Adoption Facility, OK
- 2nd breeding season

1. Design
   a) 90 mares (60:30)
   b) Three 30-acre pastures
   c) Treatments March 2011
   d) Stallions introduced May through Oct

SpayVac® Pasture Trial (USGS)

2. Response
   a) Annual pregnancy and foaling rates
   b) PZP titers
   c) Body condition

SpayVac® Pasture Trial (USGS)

3. Status
   a) Study proceeding as planned
   b) Blood samples will be drawn in December 2012 to test 2nd-year effect of vaccine on pregnancy

3 to 4-year PZP Pen Trial (UT)

- Northern NV Corrections Facility, Carson City
- 2nd breeding season

1. Design
   a) 104 mares
   b) 2 control groups and 3 PZP treatment groups
      a) Controls: untreated and positive (Zonastat-H)
      b) Treatments: vary by time-release, & pellet form
   c) Treatments March 2011
   d) Stallions introduced each spring

3 to 4-year PZP Pen Trial (UT)

2. Response
   a) PZP antibody levels and pregnancy rates
   b) Hormone tests for pregnancy were inconsistent in 2011
   c) Palpation and ultrasound used thereafter

3 to 4-year PZP Pen Trial (UT)

3. Status
   a) 1st-year fertility rate of controlled-release PZP=0-19%
   b) A progress report for the second year received last week and is being reviewed

PZP Field Study (HSUS)

- Sand Wash Basin and Cedar Mountain HMAs
- 2008-2012

1. Design

HMA	Date - Season	# of Mares	Treatment	Method
Cedar Mt	2008 –Dec	70	PZP-22 pellets	Hand inject
	2012 – Feb	143	PZP-22 pellets	Hand inject
Sand Wash	2008 – Oct	62	PZP-22 pellets	Hand inject
	2010 Summer / fall	51	Zonastat-H with or without PZP pellets	Remote dart

PZP Field Study (HSUS)

2. Response
   a) Annual foaling rate
   b) Population size and growth
   c) Body condition
   d) General health
   e) Group affiliation

PZP Field Study (HSUS)

2. Status
    a) Annenberg Foundation continues to fund through 2012
    b) HSUS continues to monitor mares & foals through 2012
    c) Results presented at Annenberg Foundation's Wild Horse Symposium, Jackson Hole, WY in August 2012
    d) Results indicate PZP-22 is less effective than reported for the Clan Alpine, NV
        1. HSUS postulates that "this failure was due both to the low proportion of Cedar Mt mares gathered and treated in 2008 and the relatively low vaccine efficacy…"
    e) Population-level responses difficult to ascertain due to:
        1. Different proportions of mares treated in each HMA
        2. Cedar Mt HMA is connected to adjacent military lands

Population Estimation

$$\widehat{N} = \sum_{i=1}^{M_{t+1}} \frac{1}{1-[1-\hat{p}_1(x_i)][1-\hat{p}_2(x_i)]...[1-\hat{p}_t(x_i)]}$$

$$\widehat{\text{var}\left(\hat{\bar{\theta}}\right)} = \sum_{i=1}^{R} w_i \left(\widehat{\text{var}(\hat{\theta}_i|M_i)} + (\hat{\theta}_i - \hat{\bar{\theta}})^2\right) \quad \text{where } \hat{\bar{\theta}} = \sum_{i=1}^{R} w_i\hat{\theta}_i$$

Training and Implementation

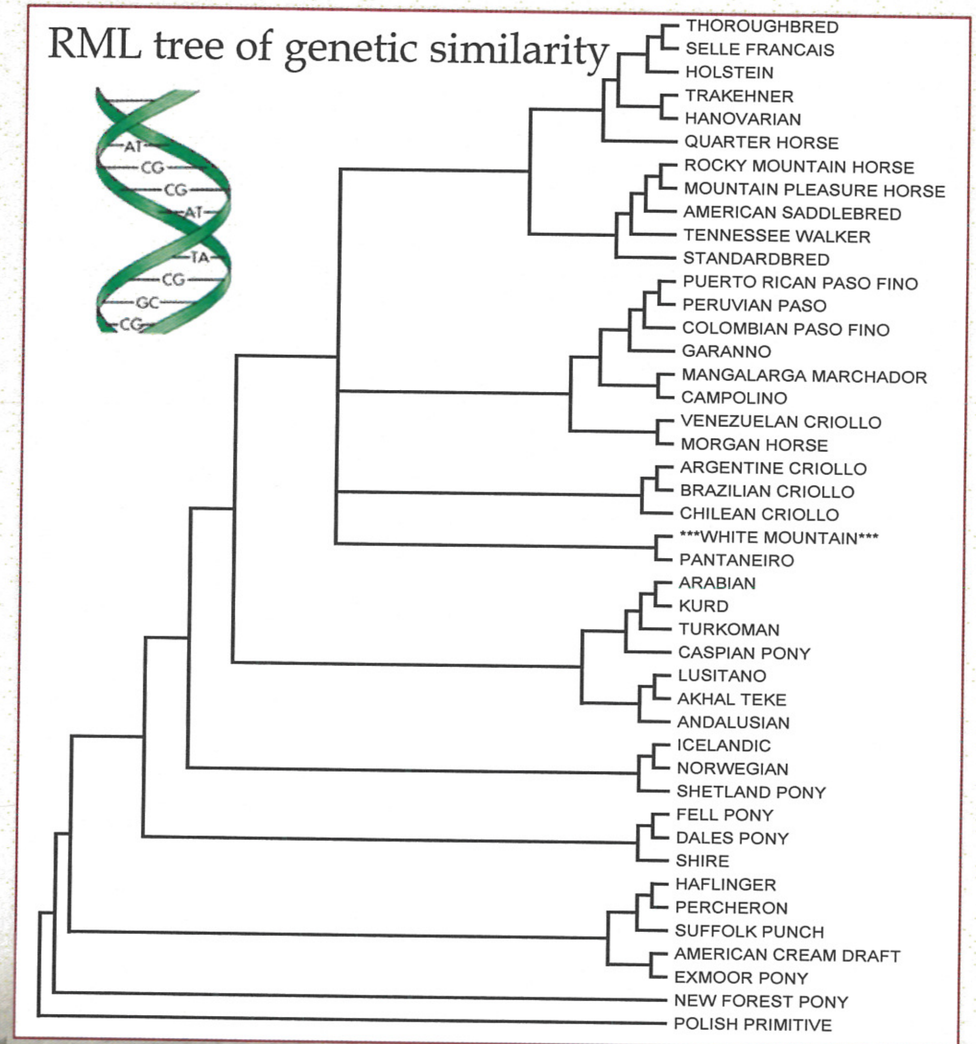
- 2 techniques developed by USGS
  1. Photographic mark-resight
  2. Simultaneous double-count

- Based on sampling and statistical theory
- Utilized on numerous species worldwide
  1. Terrestrial mammals
  2. Marine mammals
  3. Birds
  4. Insects
  5. Plants

Training and Implementation

- August 2012 -- BLM hired a Population Survey Lead
- September 2012 -- USGS conducted training
    - 8 BLM employees attended
- To date, BLM employees trained in 8 states
- Implemented in selected HMAs in UT, NV, & OR

Genetics


RML tree of genetic similarity
AT
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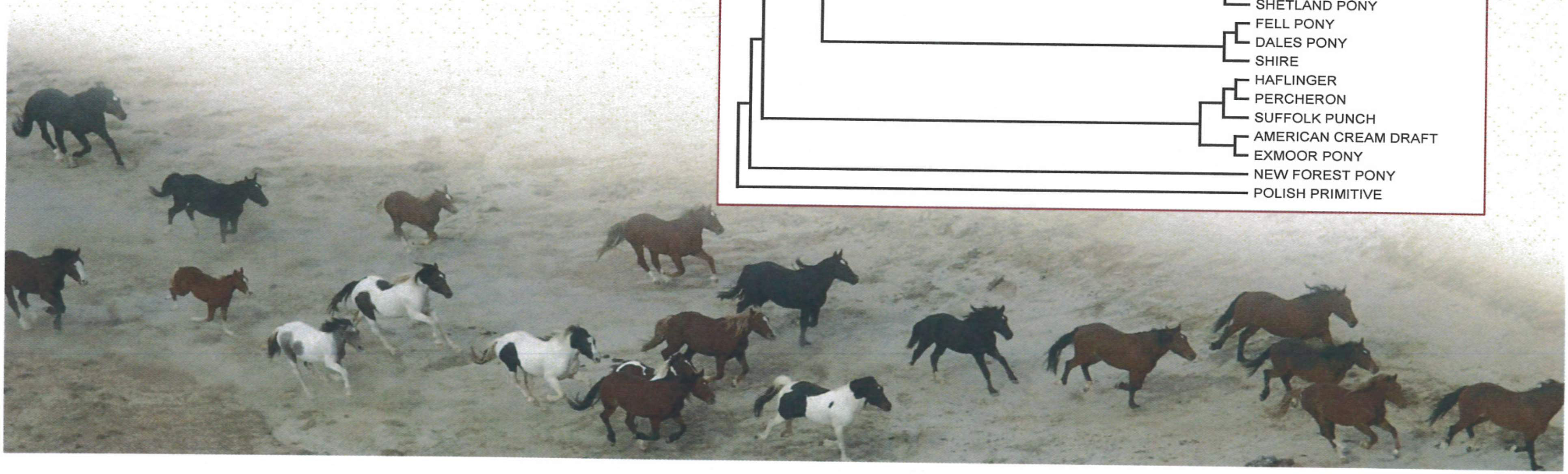
THOROUGHBRED
SELLE FRANCAIS
HOLSTEIN
TRAKEHNER
HANOVARIAN
QUARTER HORSE
ROCKY MOUNTAIN HORSE
MOUNTAIN PLEASURE HORSE
AMERICAN SADDLEBRED
TENNESSEE WALKER
STANDARDBRED
PUERTO RICAN PASO FINO
PERUVIAN PASO
COLOMBIAN PASO FINO
GARANNO
MANGALARGA MARCHADOR
CAMPOLINO
VENEZUELAN CRIOLLO
MORGAN HORSE
ARGENTINE CRIOLLO
BRAZILIAN CRIOLLO
CHILEAN CRIOLLO
WHITE MOUNTAIN
PANTANEIRO
ARABIAN
KURD
TURKOMAN
CASPIAN PONY
LUSITANO
AKHAL TEKE
ANDALUSIAN
ICELANDIC
NORWEGIAN
SHETLAND PONY
FELL PONY
DALES PONY
SHIRE
HAFLINGER
PERCHERON
SUFFOLK PUNCH
AMERICAN CREAM DRAFT
EXMOOR PONY
NEW FOREST PONY
POLISH PRIMITIVE



Genetics (Texas A&M)

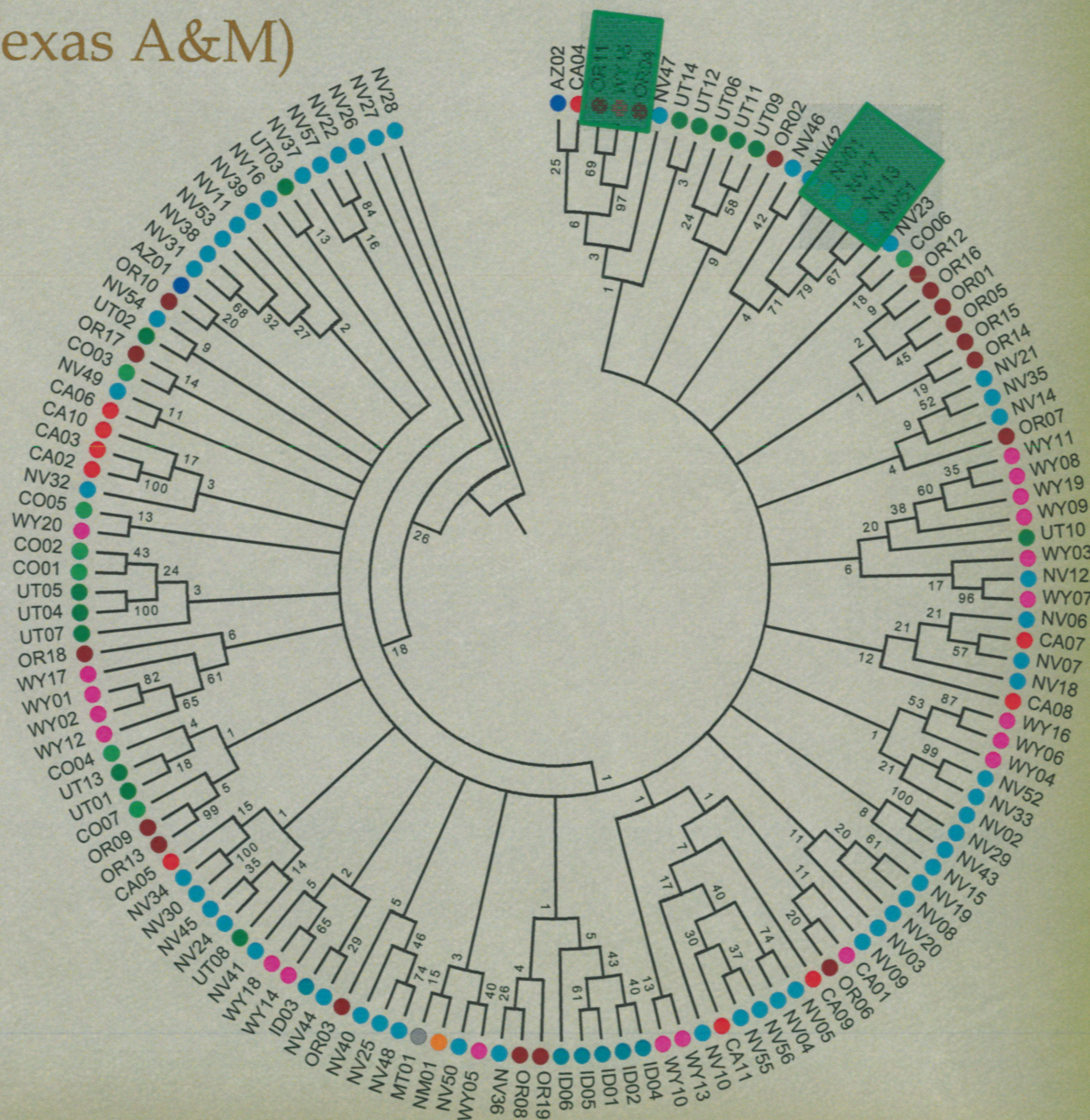
- Evaluation of genetic diversity of wild horse herds is on-going

- September 2012 -- Dr. Cothrun presented results on genetic diversity among all sampled BLM horses at the International Conference on Wild Equids in Austria
  1. No apparent pattern of change in genetic variation
  2. Level of variability sometimes increases

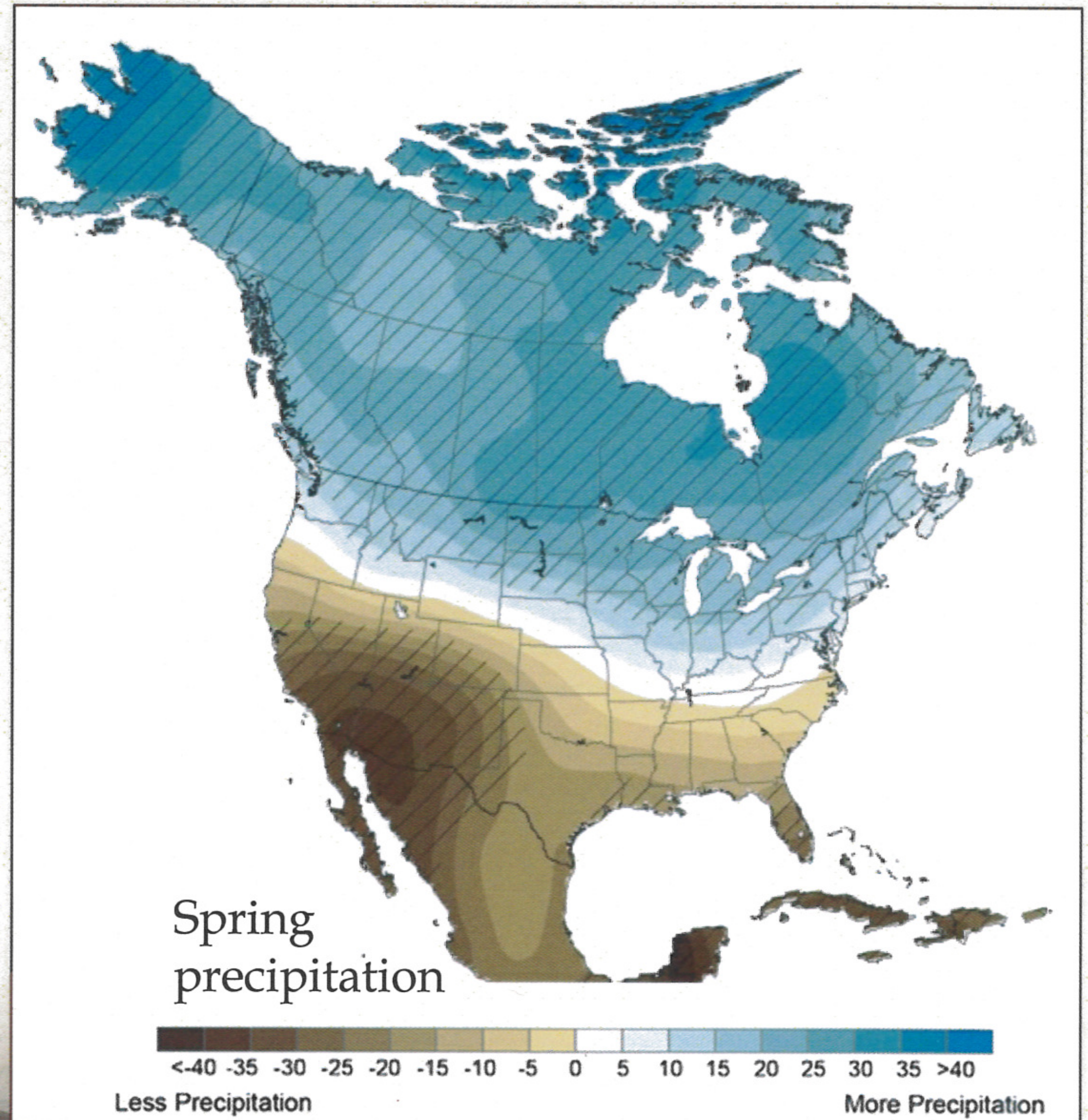
Genetics (Texas A&M)

Phylogenetic Tree

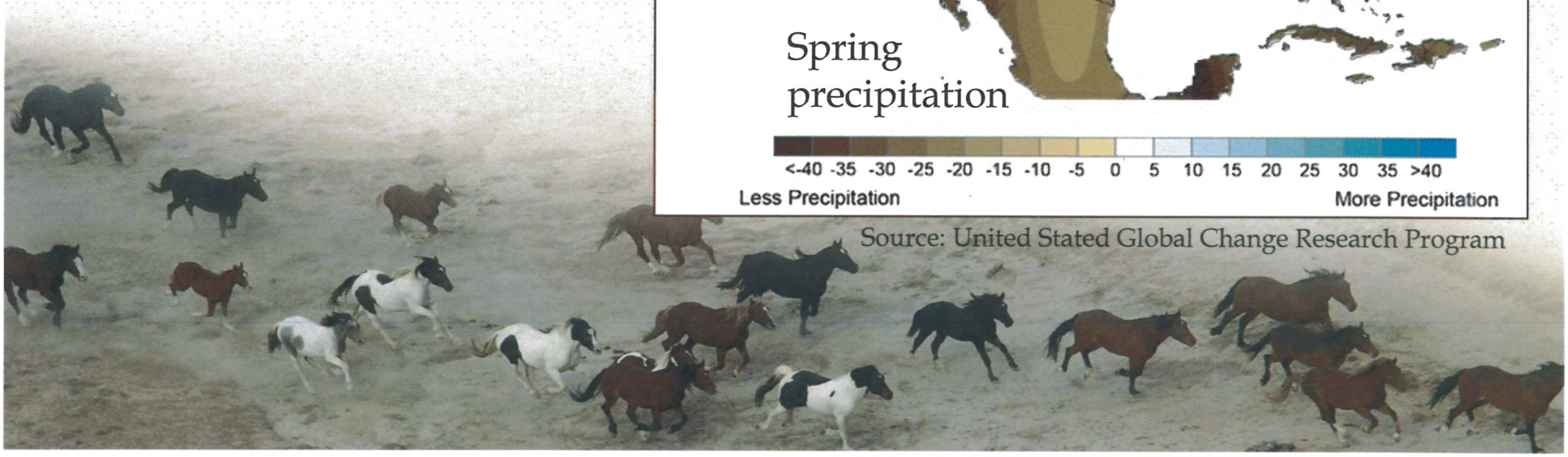
(Genetic relatedness)



Future



Source: United Stated Global Change Research Program



Future

- Field experiments and observational studies
- Adaptive management
- New technologies and approaches
  - Landscape genetics
  - Systems modeling
  - Space use and resource selection estimation
  - Remote sensing technology
  - GPS collar technology