MANAGING FOR CLIMATE VARIABILITY IN MONTANA

Water Policy Interim Committee
January 7, 2014

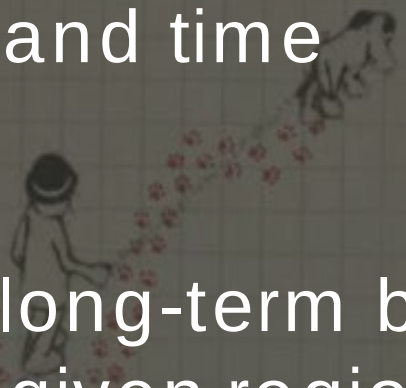
Montana Climate Office
Montana University System
University of Montana

OBJECTIVES:

1. Montana's climate and its variability
2. Priorities to enhance agricultural productivity in response to climate

WEATHER VS. CLIMATE

Weather: the condition of the atmosphere at any particular place and time



Climate: represents the long-term behavior of the atmosphere at a given region. A description of aggregate weather conditions; the sum of all statistical weather information that helps describe a place or region

CLIMATE OF MONTANA

East of the continental divide:

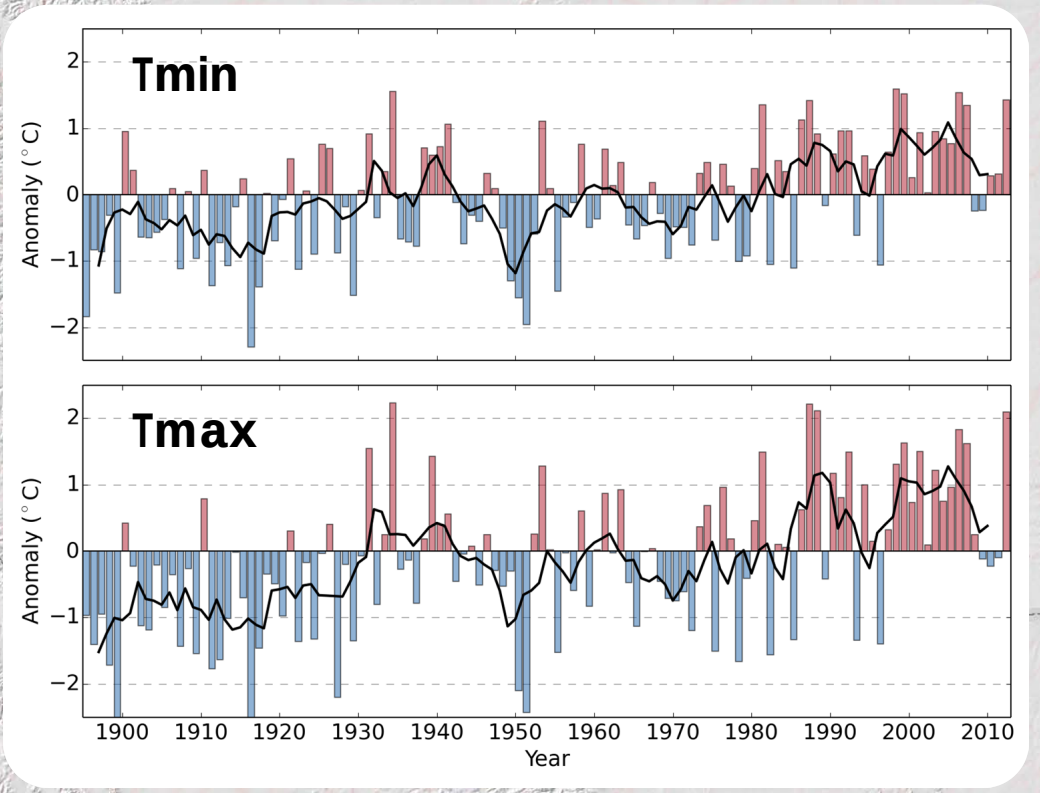
- **continental climate**
- Large annual temperature range
- Cold winters and hot, dry summers, convective summer precipitation

The continental divide forms a transition zone between maritime and continental climates:

- **Maritime** air masses bring storms during the winter with increased precipitation at higher elevations
- More moderate winter temperatures in the valleys
- More stability in July-August with clear and dry conditions

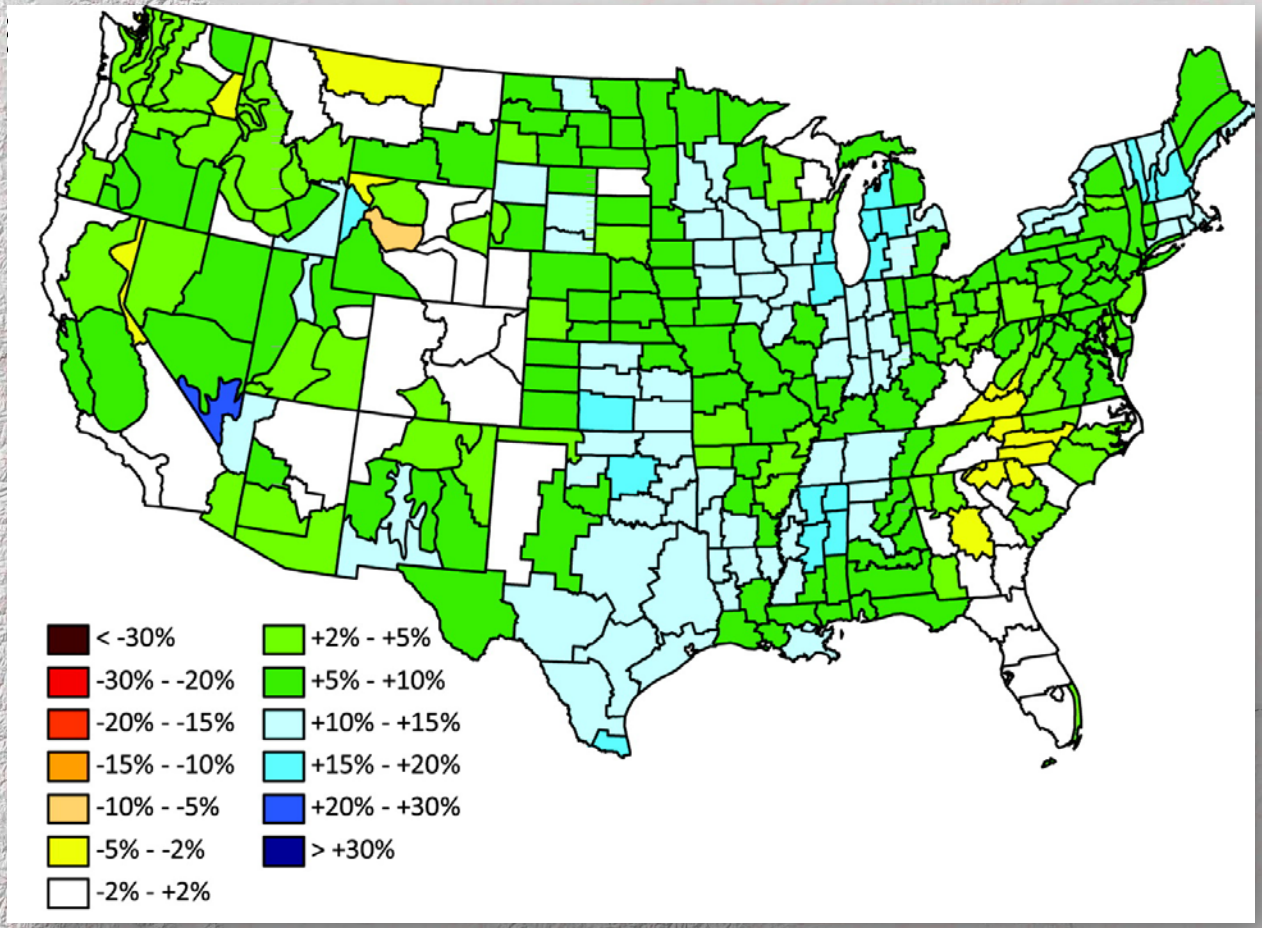
MONTANA TEMPERATURE TRENDS

Montana Annual Temperature Anomalies – U.S. HCN (1961-1990 baseline)



MONTANA PRECIPITATION TRENDS

Linear trends of annual precipitation from the 1895–2009 (% per century)



McRoberts, D. B., & Nielsen-Gammon, J. W. (2011). A New Homogenized Climate Division Precipitation Dataset for Analysis of Climate Variability and Climate Change. Journal of Applied Meteorology and Climatology, 50(6), 1187–1199. doi:10.1175/2010JAMC2626.1

PRIORITIES TO ENHANCE AGRICULTURAL PRODUCTIVITY IN RESPONSE TO CLIMATE

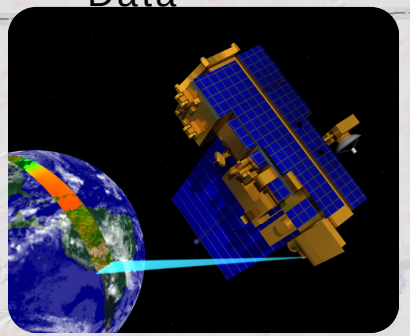
- Quantification of the spatial and temporal climate trends across Montana
- A dialogue between climate product developers and the user community to create new climate tools
- Distribute climate information and forecasts to growers in a timely and easy to access manner

How to manage agriculture for climate variability?

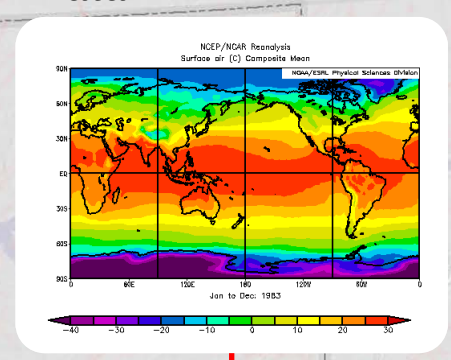
Weather Station Data

Topographic and LULC data

Satellite Data

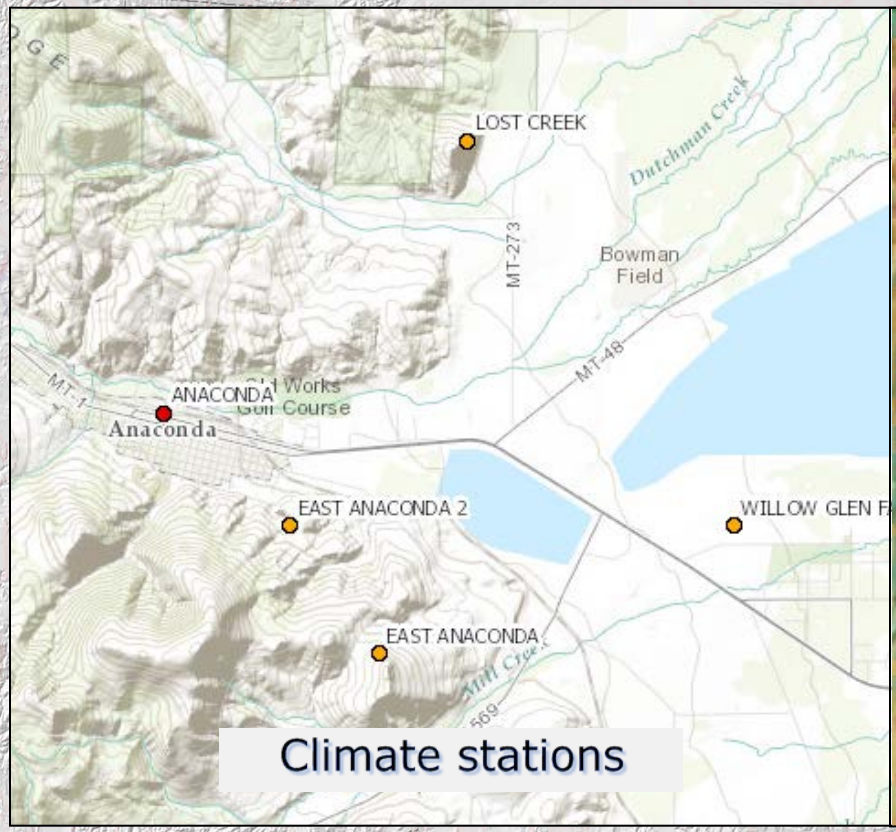


Large-scale Atmospheric Data

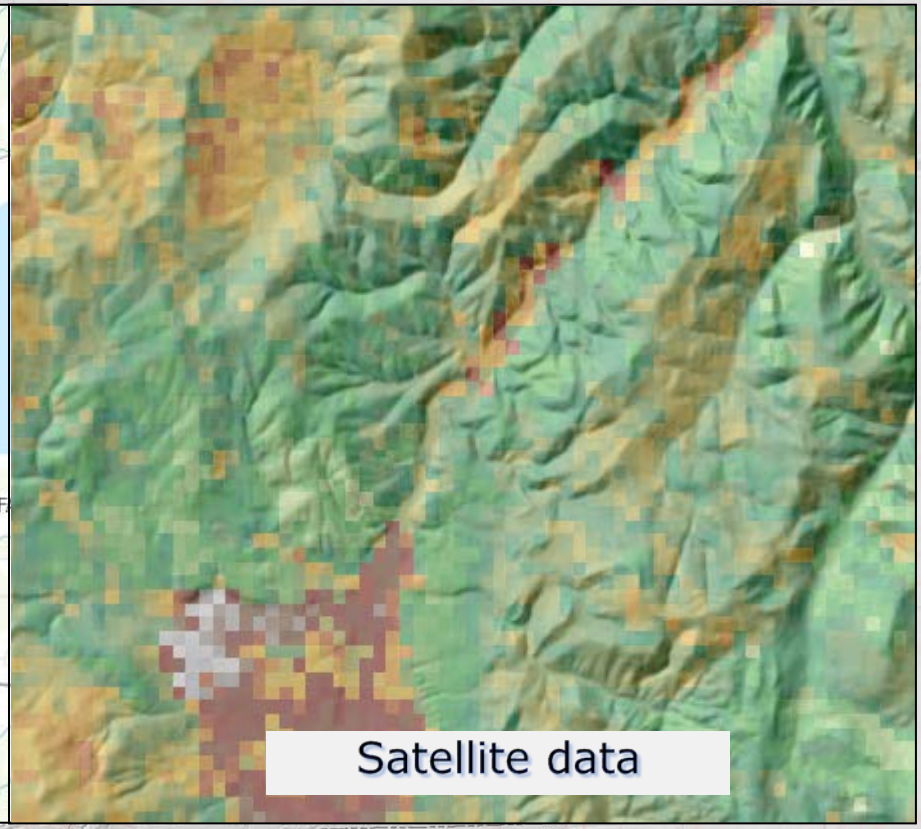


First we must know where and when to manage!

Climate data consists of statewide science-based climate information with two primary data types – point and raster (gridded) data



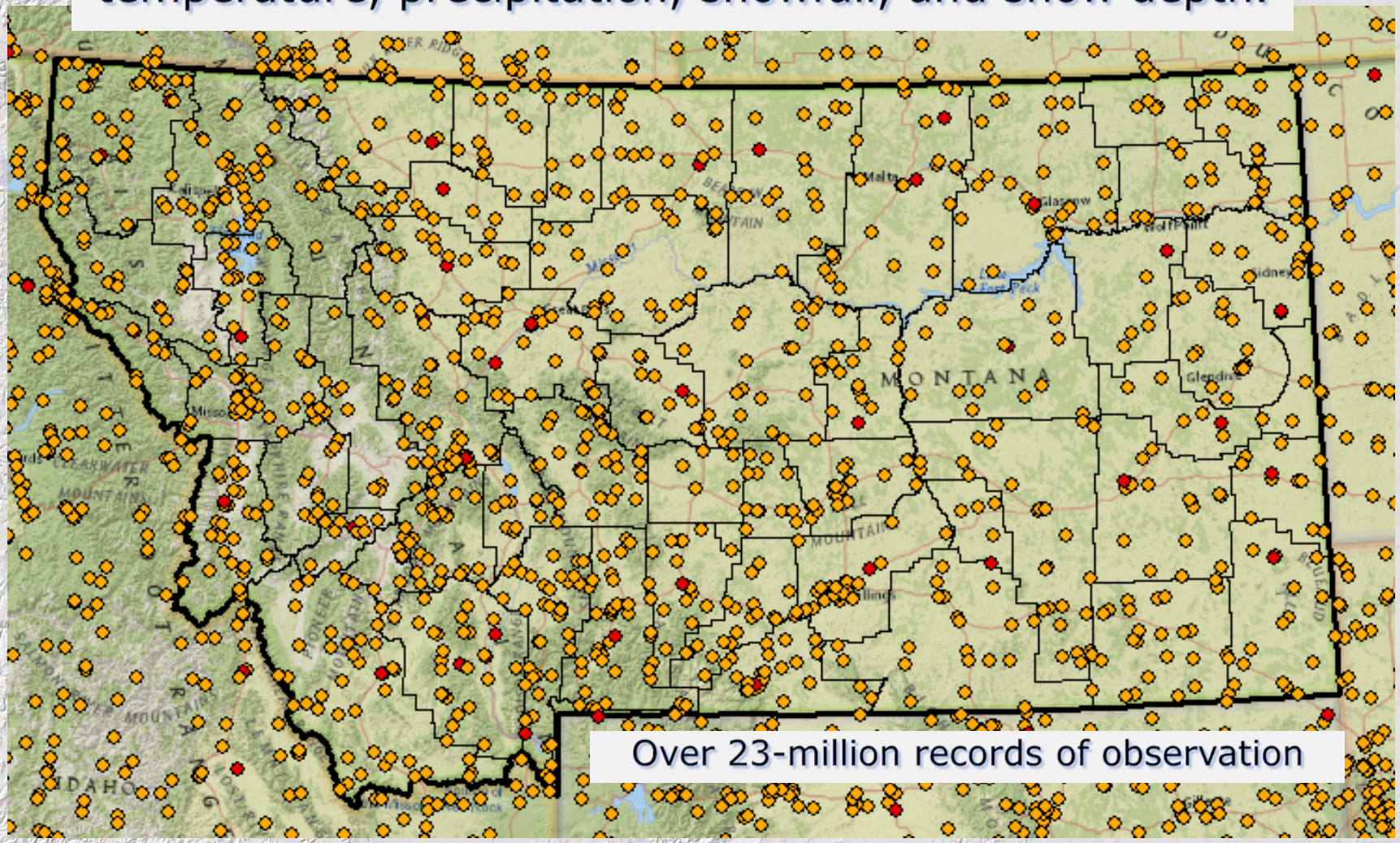
Climate stations



Satellite data

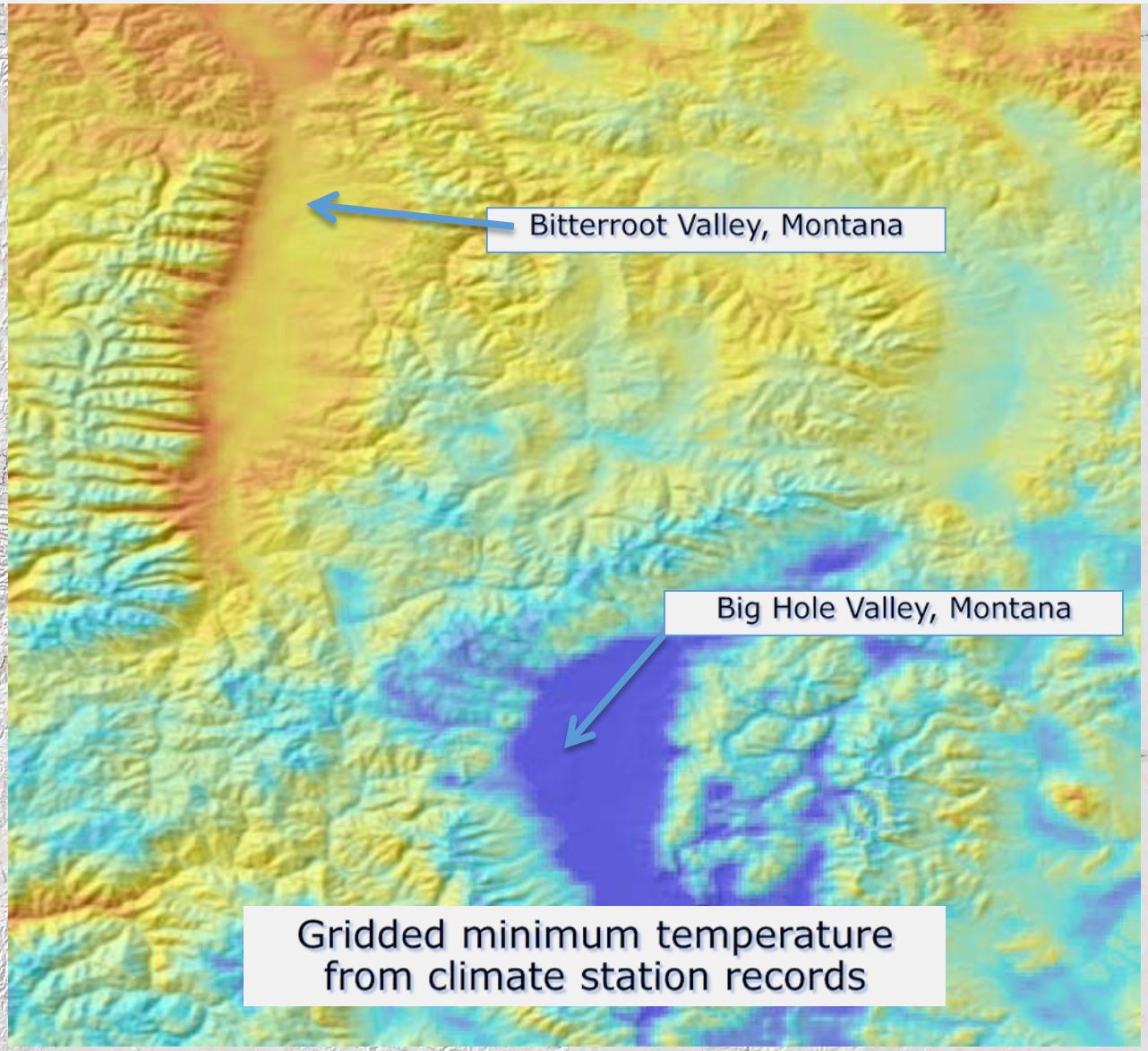
"Developed, Integrated, and Maintained"

The most common measured elements for climate stations include minimum temperature, maximum temperature, precipitation, snowfall, and snow depth.



"Developed, Integrated, and Maintained"

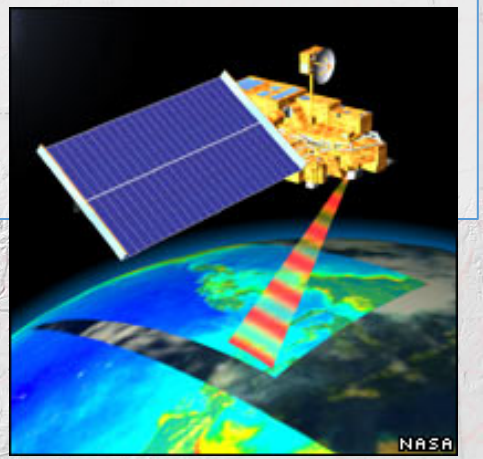
Daily statewide product for temperature and precipitation with measures of quality and uncertainty (1948-2012 results in over 25,000 rasters)



GRIDDED (RASTER) DATA

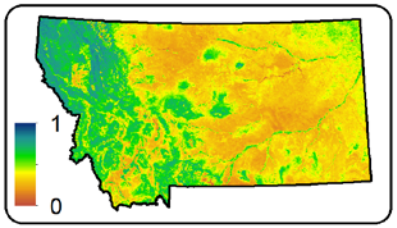
Satellite-based products:

- Normalized Difference Vegetation Index (**NDVI**) as a proxy of vegetation health and productivity.
- Evapotranspiration (**ET**) as a measure of evaporation from the ground or vegetated surfaces combined with plant transpiration.
- A new drought severity index (**DSI**) to accurately quantify the spatial and temporal persistence of drought.

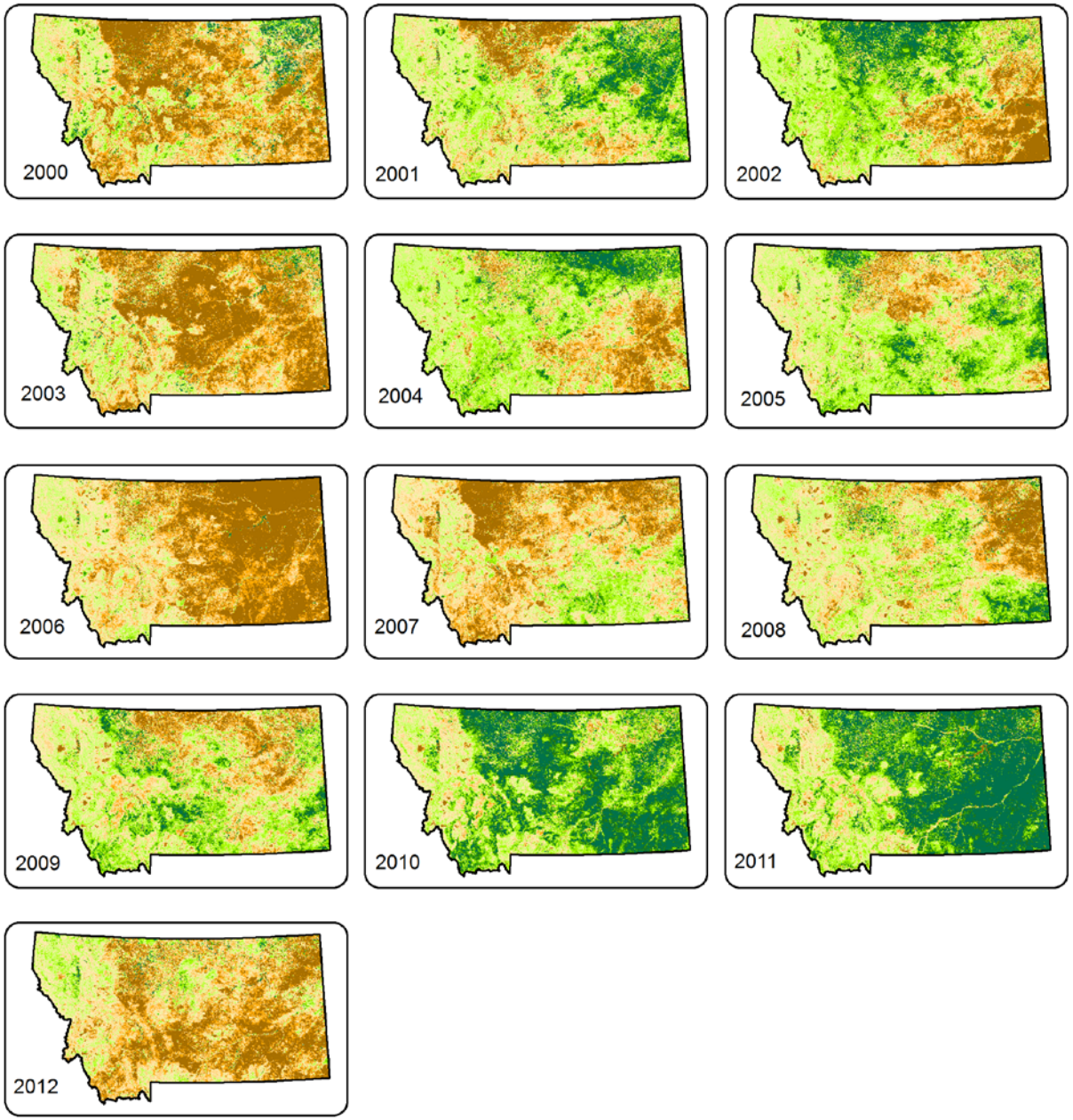


Departure from average "greenness"

2000 - 2012
Avg. August NDVI



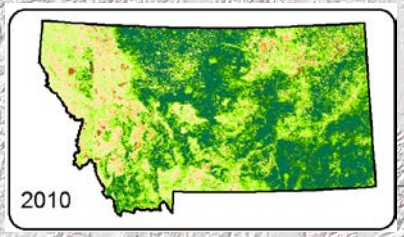
2000 - 2012
Annual August NDVI Anomalies

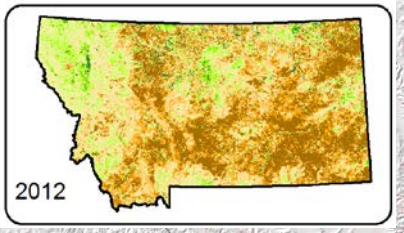


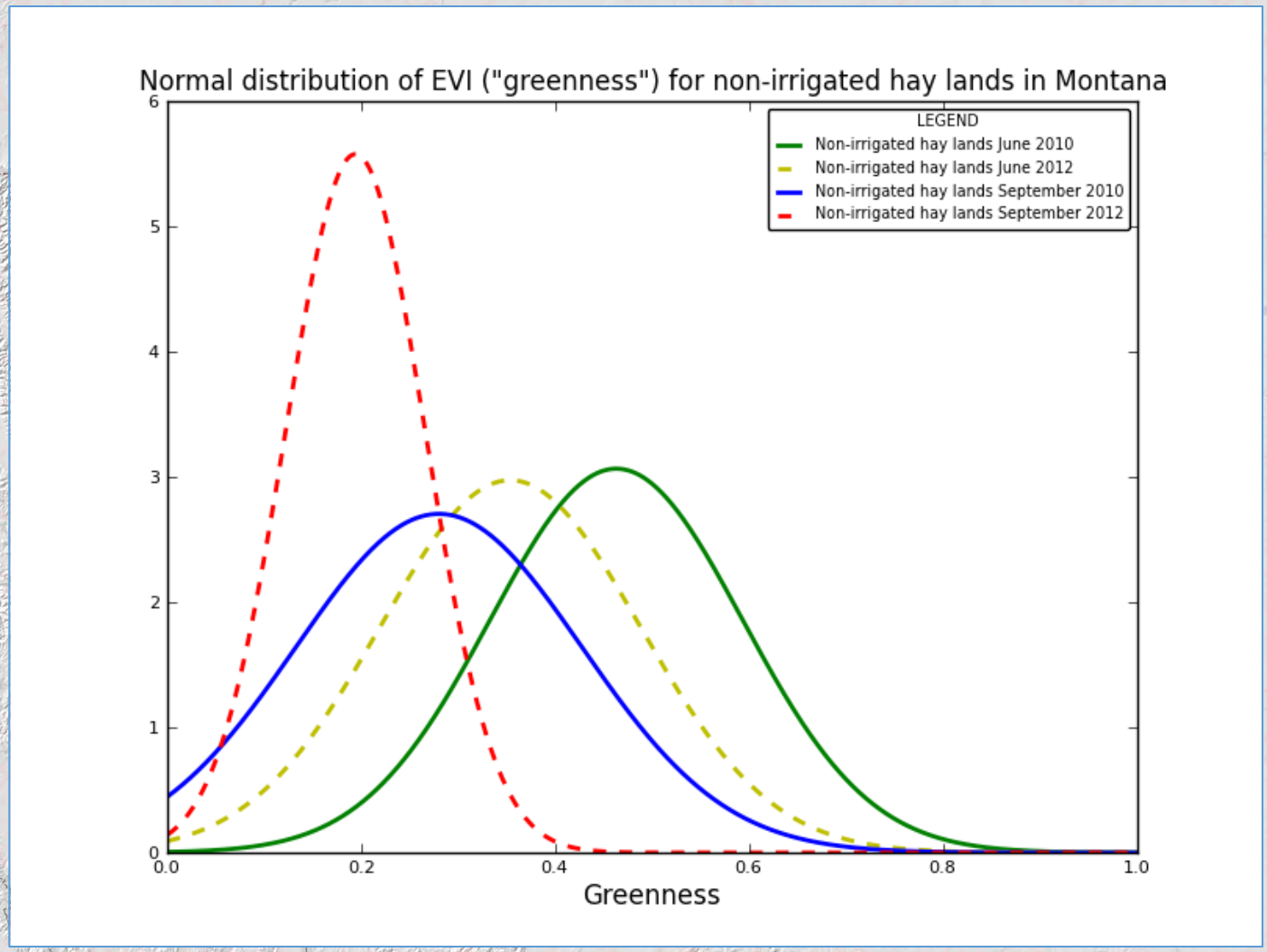
NDVI Aug. Anomaly

% Above/Below Normal

- < -15%
- -15% - -10%
- -10% - -5%
- -5% - 0%
- 0% - 5%
- 5% - 10%
- 10% - 15%
- 15% - 20%
- 20% - 25%
- > 25%

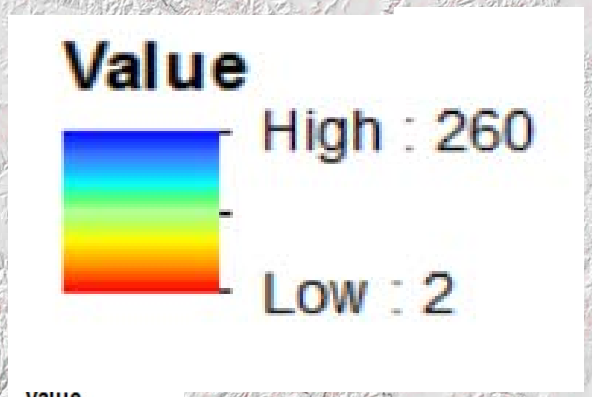


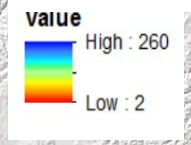


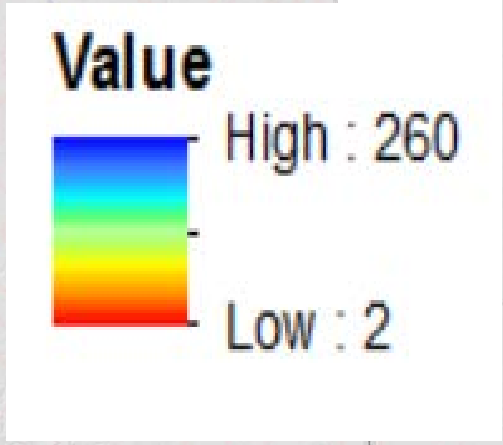


Characterization of croplands between different time periods.

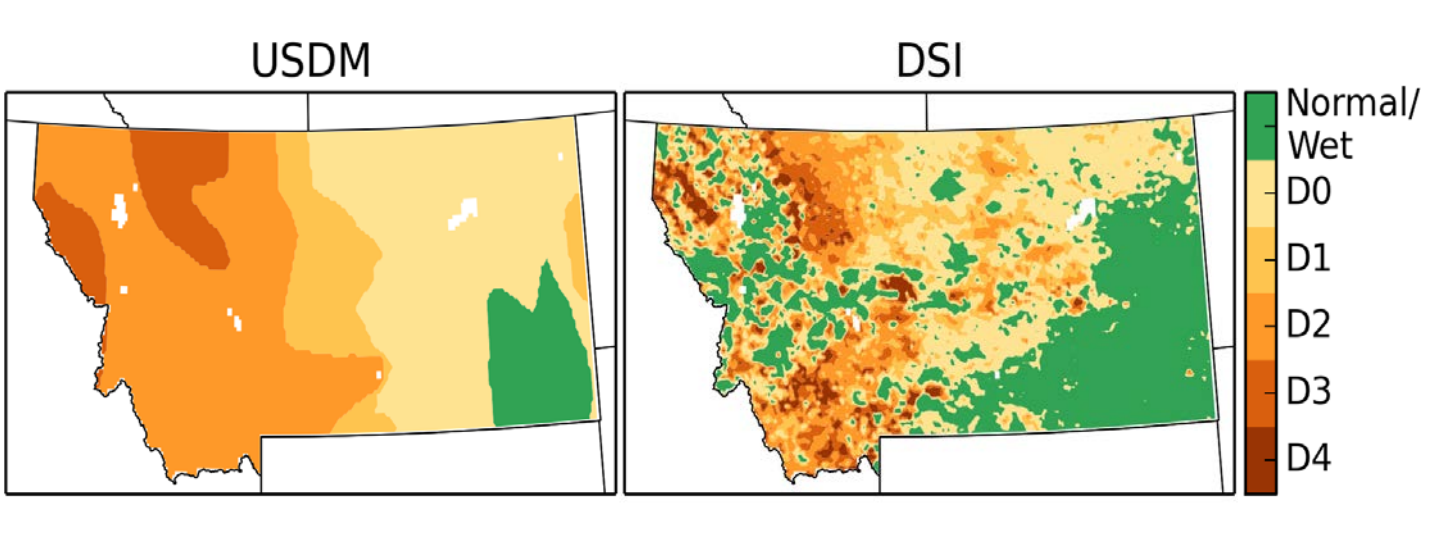
SATELLITE MEASURES OF EVAPOTRANSPIRATION



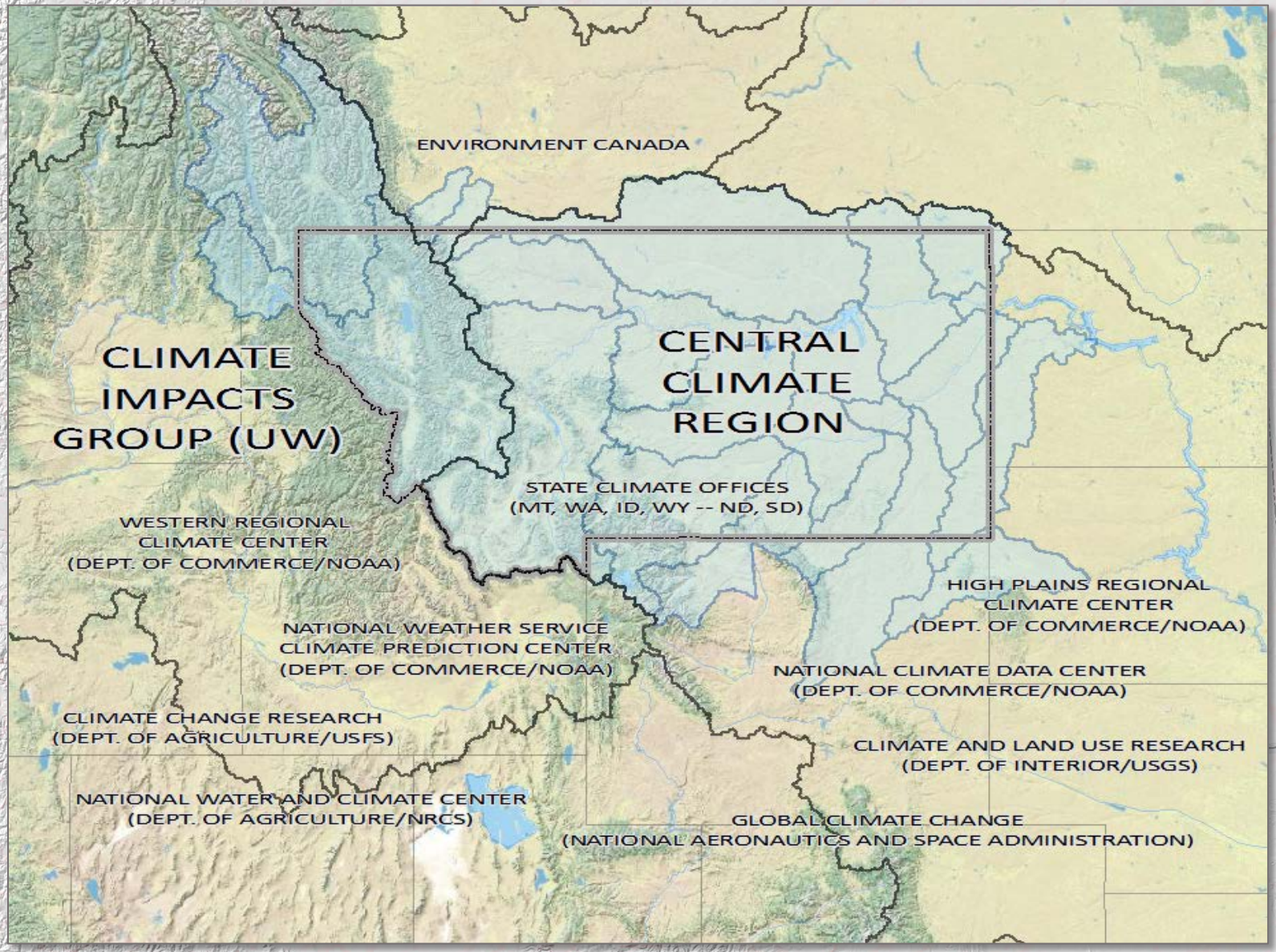




SATELLITE MEASURES OF DROUGHT SEVERITY

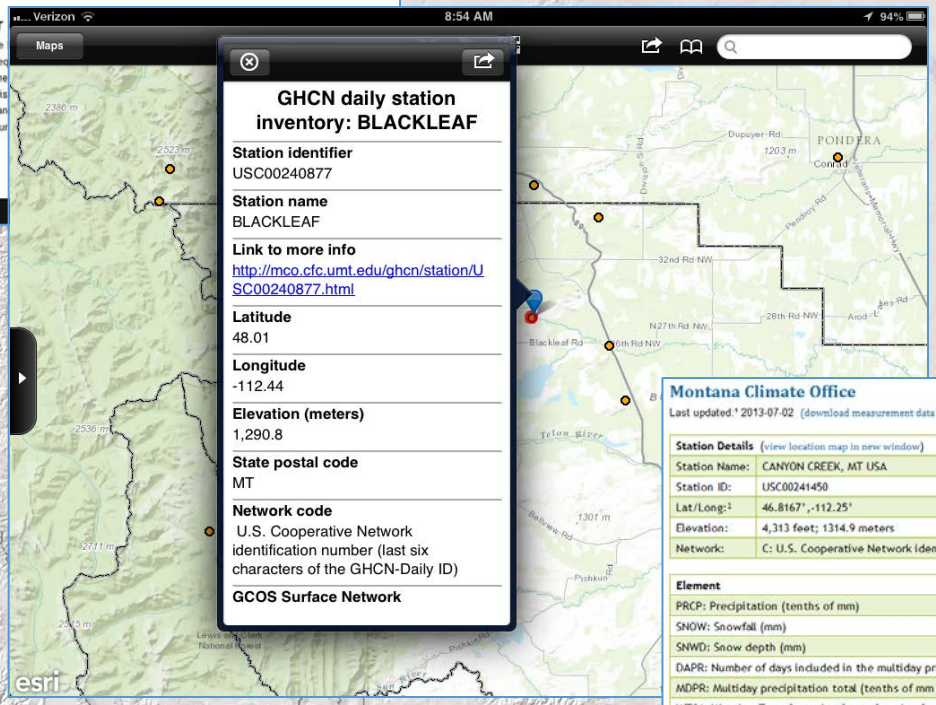


MONTANA AT THE HEADWATERS

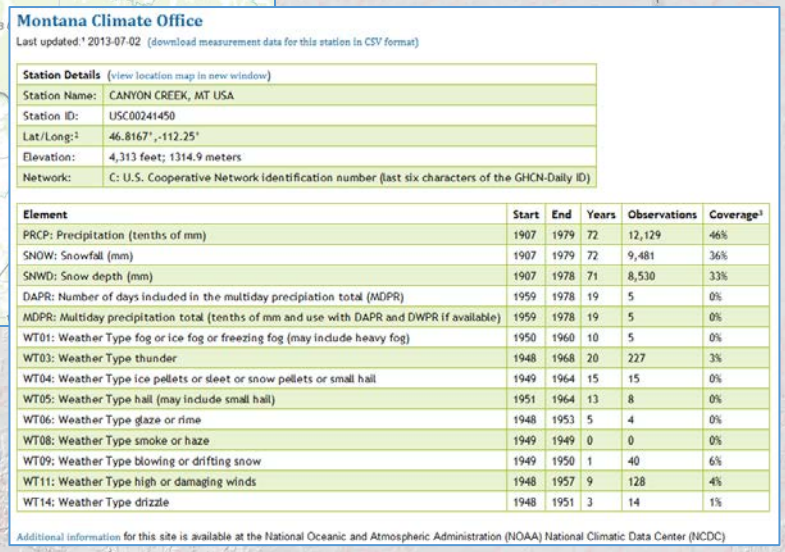


"Coordinated"

Access through MCO website, and published through the Montana State Library portal



Access via mobile devices



Montana Climate Office

Last updated: 2013-07-02 (download measurement data for this station in CSV format)

Station Details (view location map in new window)	
Station Name:	CANYON CREEK, MT USA
Station ID:	USC00241450
Lat/Long:	46.8167°,-112.25°
Elevation:	4,313 feet; 1314.9 meters
Network:	C: U.S. Cooperative Network identification number (last six characters of the GHCN-Daily ID)

Element	Start	End	Years	Observations	Coverage
PRCP: Precipitation (tenths of mm)	1907	1979	72	12,129	46%
SNOW: Snowfall (mm)	1907	1979	72	9,481	36%
SNWD: Snow depth (mm)	1907	1978	71	8,530	33%
DAPR: Number of days included in the multiday precipitation total (MDPR)	1959	1978	19	5	0%
MDPR: Multiday precipitation total (tenths of mm and use with DAPR and DWPR if available)	1959	1978	19	5	0%
WT01: Weather Type fog or ice fog or freezing fog (may include heavy fog)	1950	1960	10	5	0%
WT03: Weather Type thunder	1948	1968	20	227	3%
WT04: Weather Type ice pellets or sleet or snow pellets or small hail	1949	1964	15	15	0%
WT05: Weather Type hail (may include small hail)	1951	1964	13	8	0%
WT06: Weather Type glaze or rime	1948	1953	5	4	0%
WT08: Weather Type smoke or haze	1949	1949	0	0	0%
WT09: Weather Type blowing or drifting snow	1949	1950	1	40	6%
WT11: Weather Type high or damaging winds	1948	1957	9	128	4%
WT14: Weather Type drizzle	1948	1951	3	14	1%

Additional information for this site is available at the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC)

Access via direct download or through web services

"Distributed"

MONTANA CLIMATE OFFICE

www.climate.umt.edu

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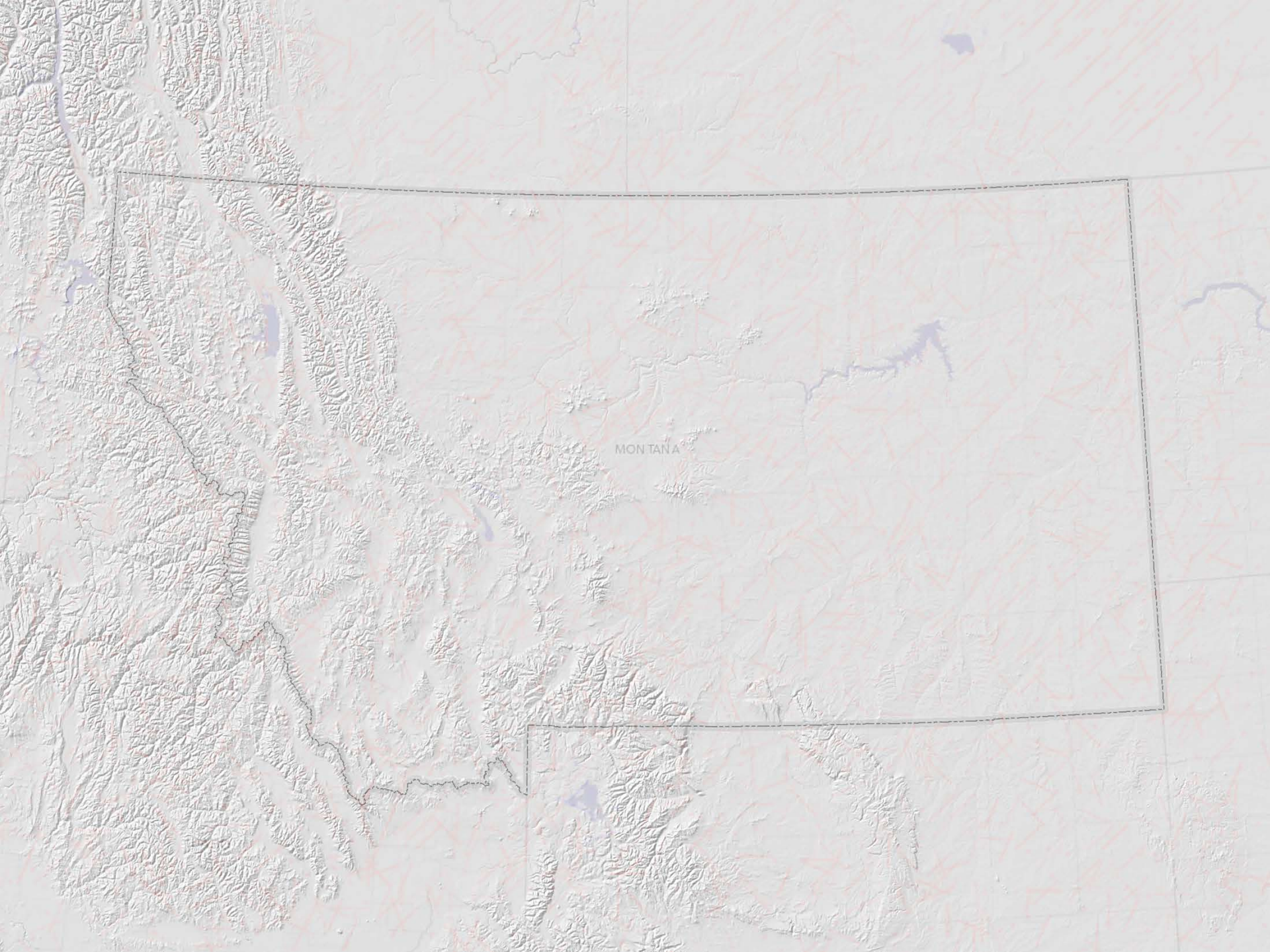
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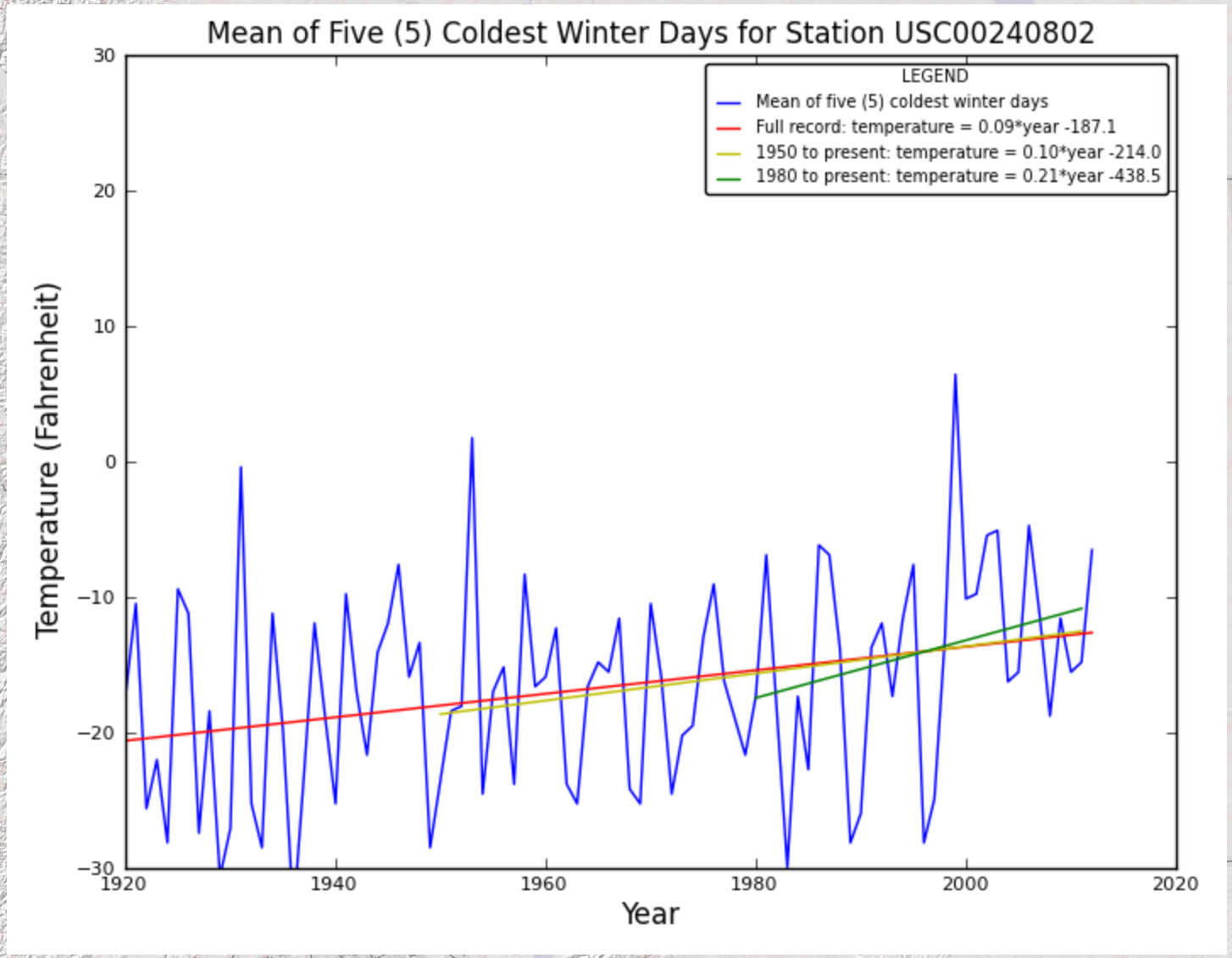
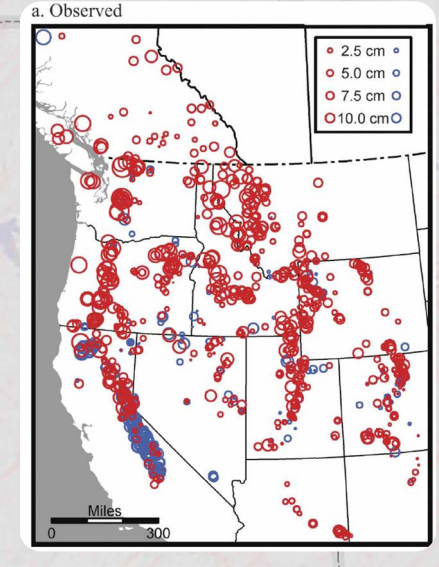


Billings, Montana

TRENDS IN SNOWPACK

The bad news:

- Overall decreases in regional snowpack
- Earlier snowmelt



Mote, P. (2006) Journal of Climate.

The good news:

- Increase in later spring precipitation has likely helped buffer some of the decreases in snowpack
- A decadal shift in large-scale Pacific climate variability around 1976-1984 may account for 30%-50% of:
  - Western North America springtime warming
  - Decreasing winter precipitation in the N.Rockies