@ICBOconf
#ICBO2016

Welcome to
ICBO & BioCreative 2016

ICBO 2016
BioCreative

August 1-4, 2016, Oregon State University, Corvallis, Oregon USA

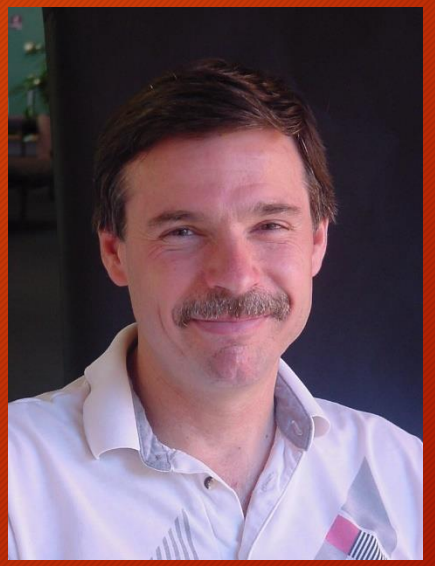
www.icbo-conference.org

ICBO 2016
BioCreative

Keynote Address

Challenges In Mapping the Nation's Climate and Weather: Every day, Everywhere

Chris Daly's professional background spans a unique combination of disciplines, including meteorology and climatology, geography, ecology, and process and statistical modeling. Drawing from this background, he has pioneered and advanced an emerging discipline he termed "geospatial climatology," the study of the spatial and temporal patterns of climate and their relationships with features on the earth's surface. Daly is the Founder and Director of Oregon State University's PRISM Climate Group, a recognized world leader in spatial climate analysis.



Prof. Christopher Daly
Professor and Director
PRISM Climate Group
School of Chemical, Biological, and Environmental Engineering
Oregon State University
Corvallis, Oregon, USA

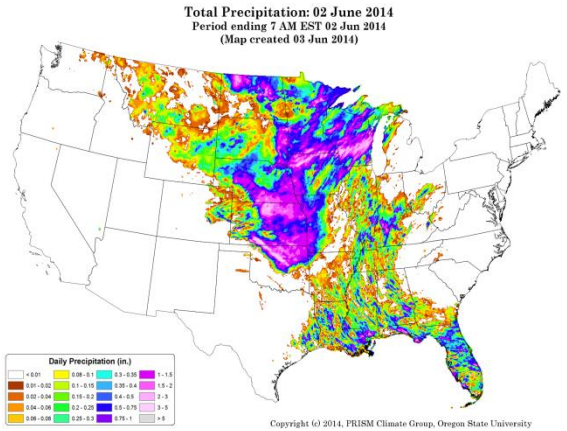
Challenges In Mapping the Nation's Climate and Weather: Every day, Everywhere

Christopher Daly, Ph.D.

Director, PRISM Climate Group

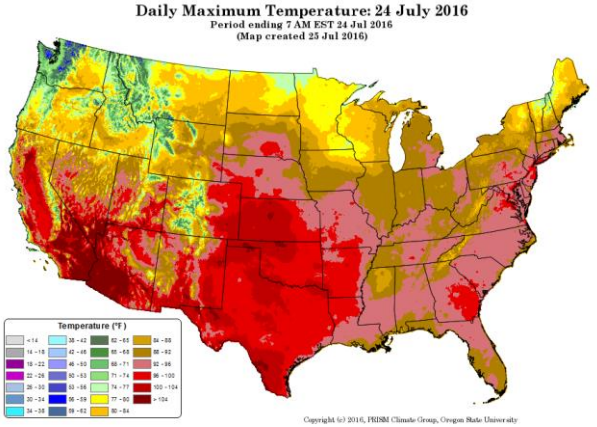
Northwest Alliance for Computational Science and Engineering

Oregon State University



OSU Oregon State University — PRISM Climate Group

ICBO and BioCreative
August 2, 2016



ICBO 2016 BioCreative

Topics

- Who is the PRISM Climate Group?
- Who do we serve?
- What do we do and how do we do it?
- Examples of challenges we face
  - Metadata
  - Data
  - Natural language

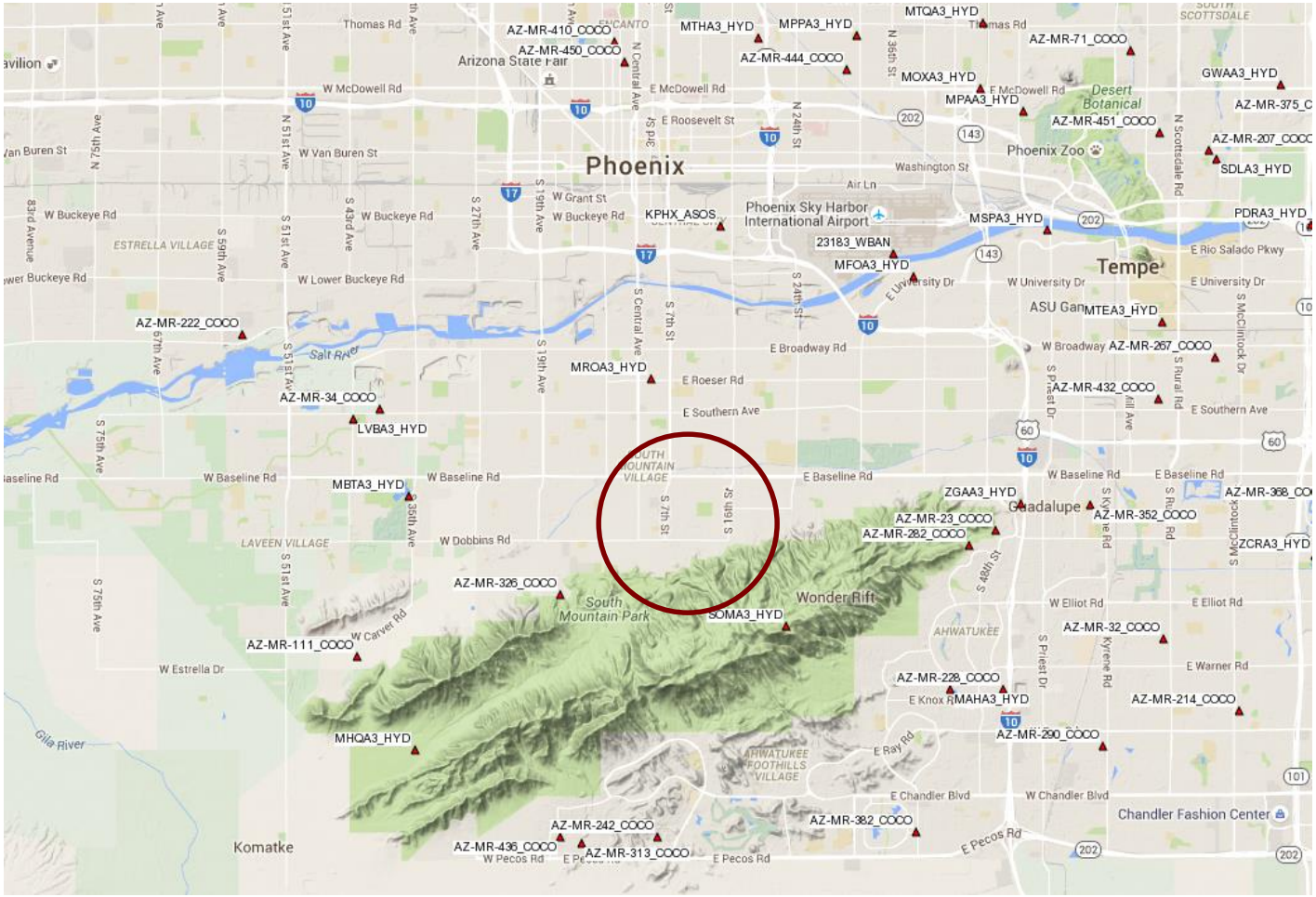
What is this? An A-Bomb?

Close – A “Microburst”

Phoenix, AZ, 19 July 2016

So How Much Rain Fell? Must Have Been HUGE!

Uh, dunno, there were no rain gauges there…

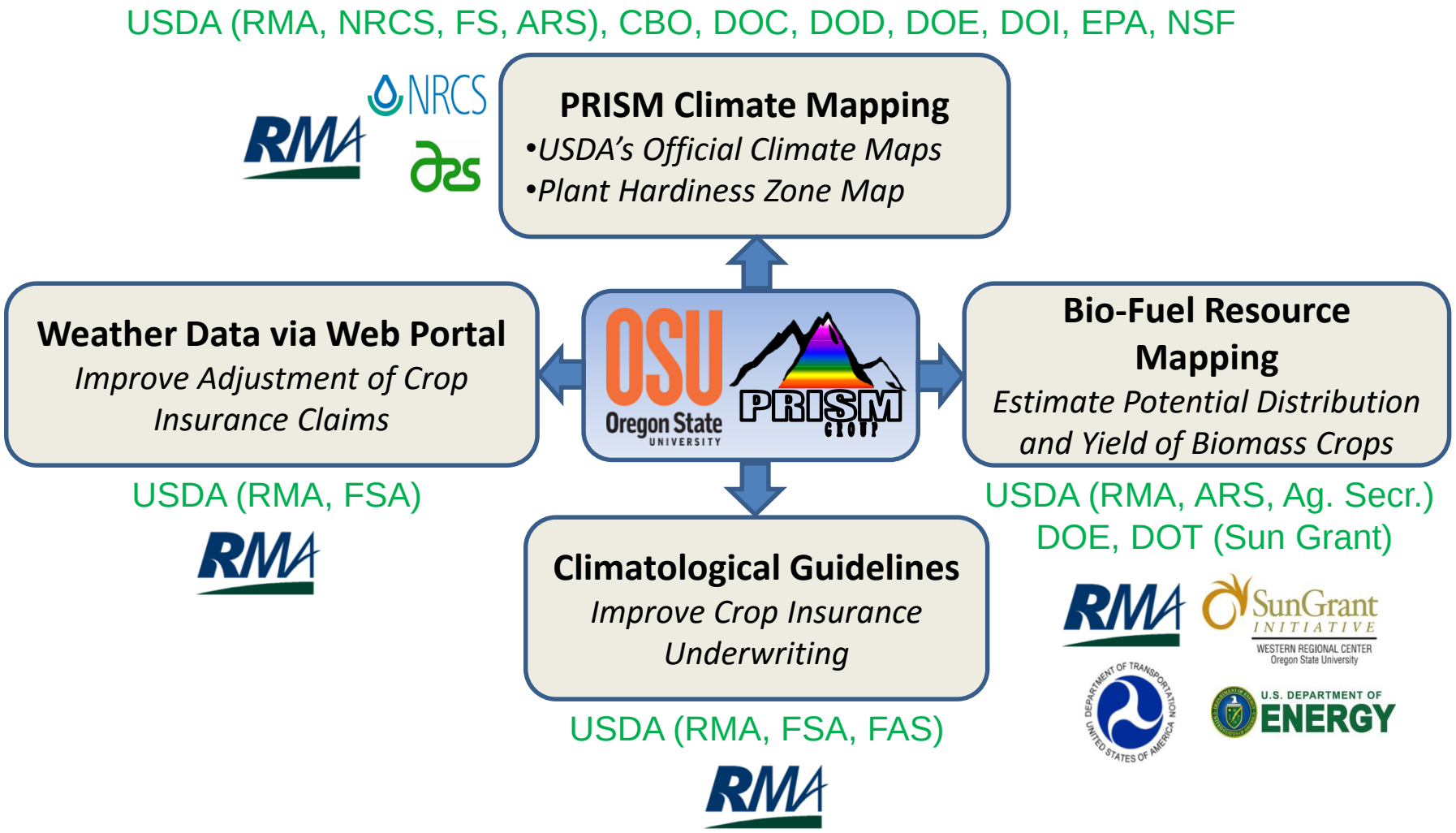


PRISM Climate Group Overview

- Applied research team (5-10 FTE) since 1991, founded and directed by Dr. Christopher Daly
- Housed within the Northwest Alliance for Computational Science and Engineering (NACSE), College of Engineering, Oregon State University
- Climate mapping center for the USDA; *de facto* climate mapping center for the US
- Federal sponsors cut across many departments and disciplines

OSU
Oregon State
UNIVERSITY

Many Agencies Benefit from Collaboration with the OSU PRISM Climate Group / NACSE



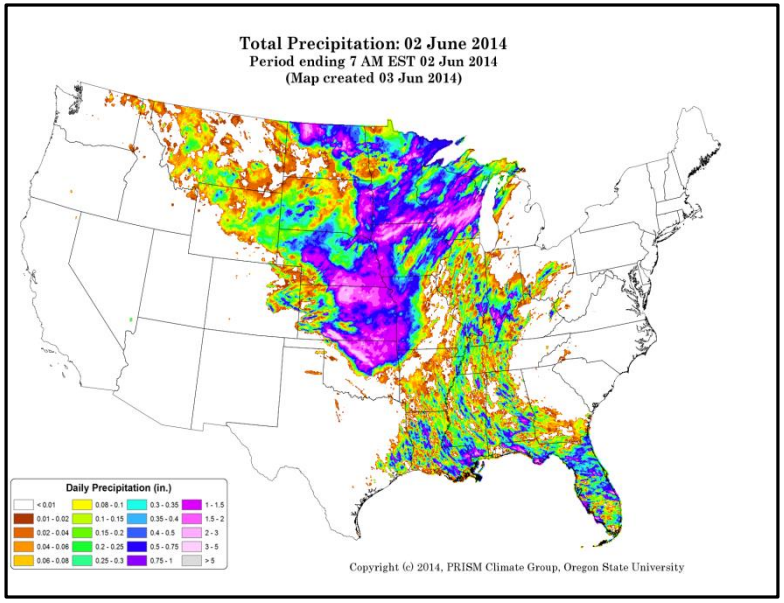
PRISM Public Data Portal

http://prism.oregonstate.edu

- More and more climate-driven modeling and analysis activities are performed within spatially-explicit computing environments

- Since 2014: 70 million gridded dataset downloads

PRISM data are used in a broad range of applications in agriculture, hydrology, engineering, ecology, economics, retail, and many others.



What is PRISM?

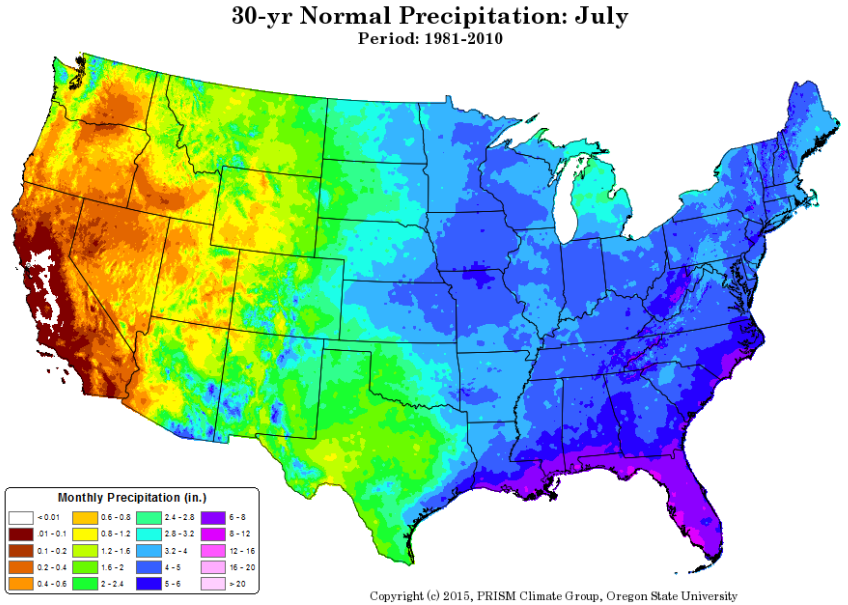
- There are many locations in the US for which no weather observations exist. To create a continuous weather or climate map across the country, station observations are fed into a computer model called PRISM (**Parameter-elevation Regressions on Independent Slopes Model**).

- PRISM estimates weather and climate variables, such as temperature and precipitation, on a grid of millions of pixels, each measuring about 0.5 mile across the entire conterminous US, every day.

Weather maps show what occurs from day to day.

Climate maps show long-term averages of weather over a period of 10-30 years

PRISM is used to produce both kinds of maps.

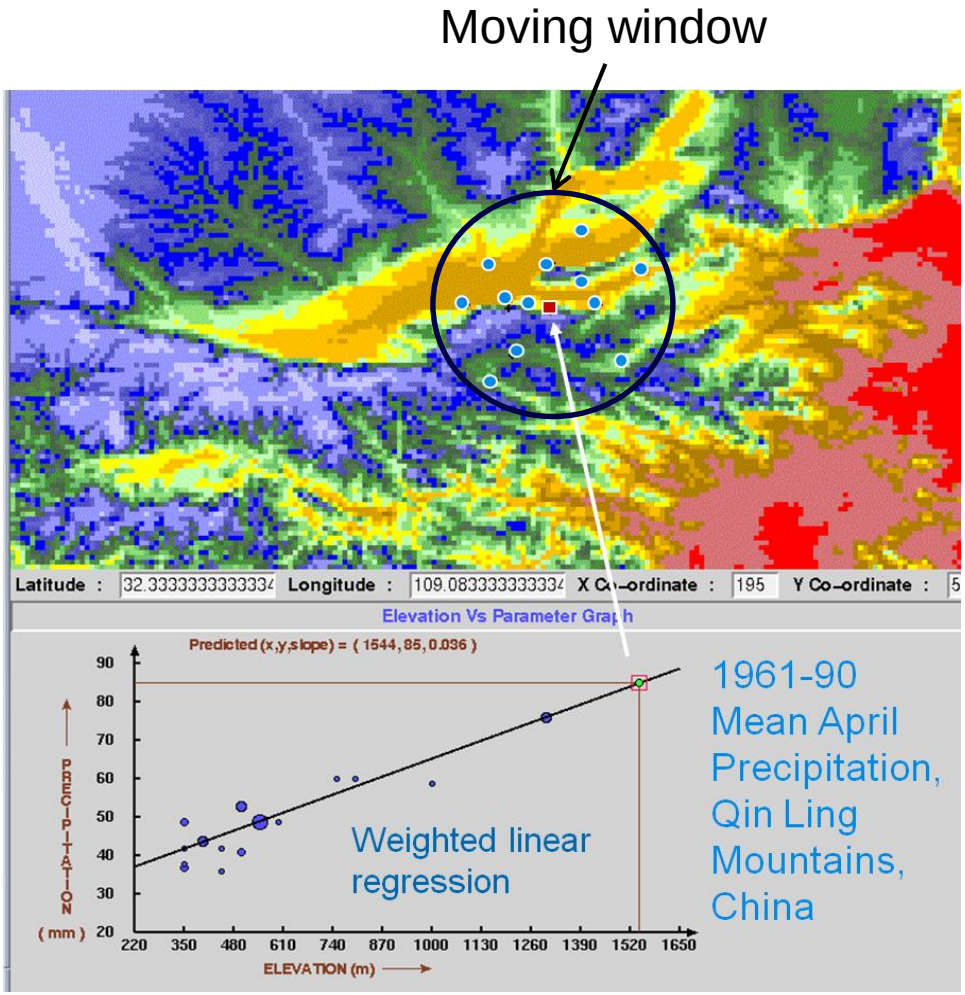


PRISM Operation

- Attempts to simulate the thought process of an expert climatologist, only faster and more objective

- Pixel by pixel moving-window regression of observations vs. elevation or observations vs. climatology/radar for each grid cell
  - Uses nearby station observations

- Spatial climate knowledge base weights stations in the regression function by their physiographic similarity to the target grid cell



Physiographic Station Weighting

Combined weight of a station in the regression function is:

$$W = f\{W_d\, W_z\, W_f\, W_p\, W_c\, W_l\, W_t\}$$

W_d = Distance

W_z = Elevation – lapse rates

W_f = Terrain orientation – rain shadows

W_p = Terrain profile – terrain enhancement of precipitation

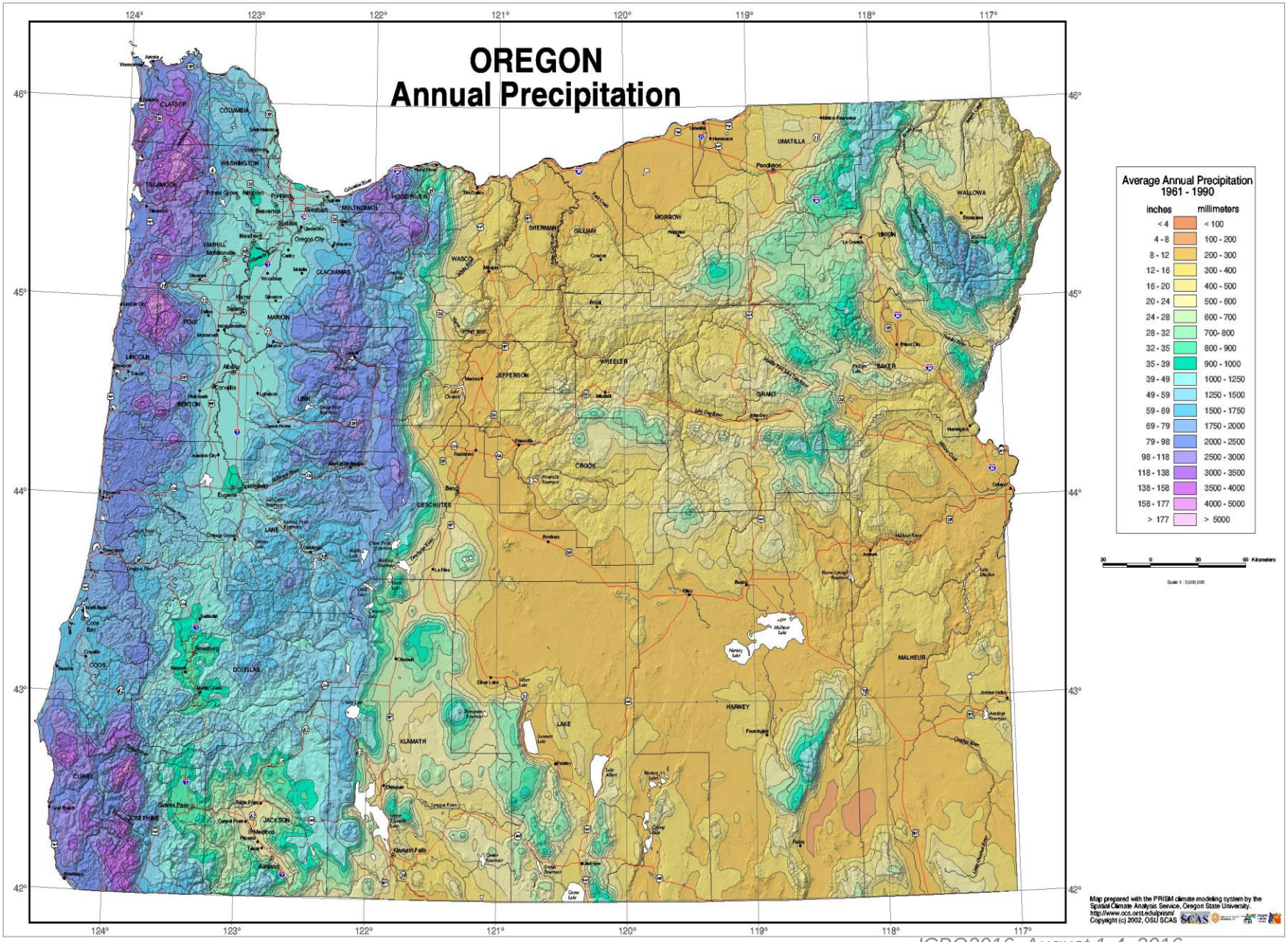
W_c = Moisture regime/coastal proximity – exposure to moisture sources and marine air intrusion

W_l = Two-layer atmosphere – inversion layer, free atmosphere

W_t = Topographic position – susceptibility to cold air pooling

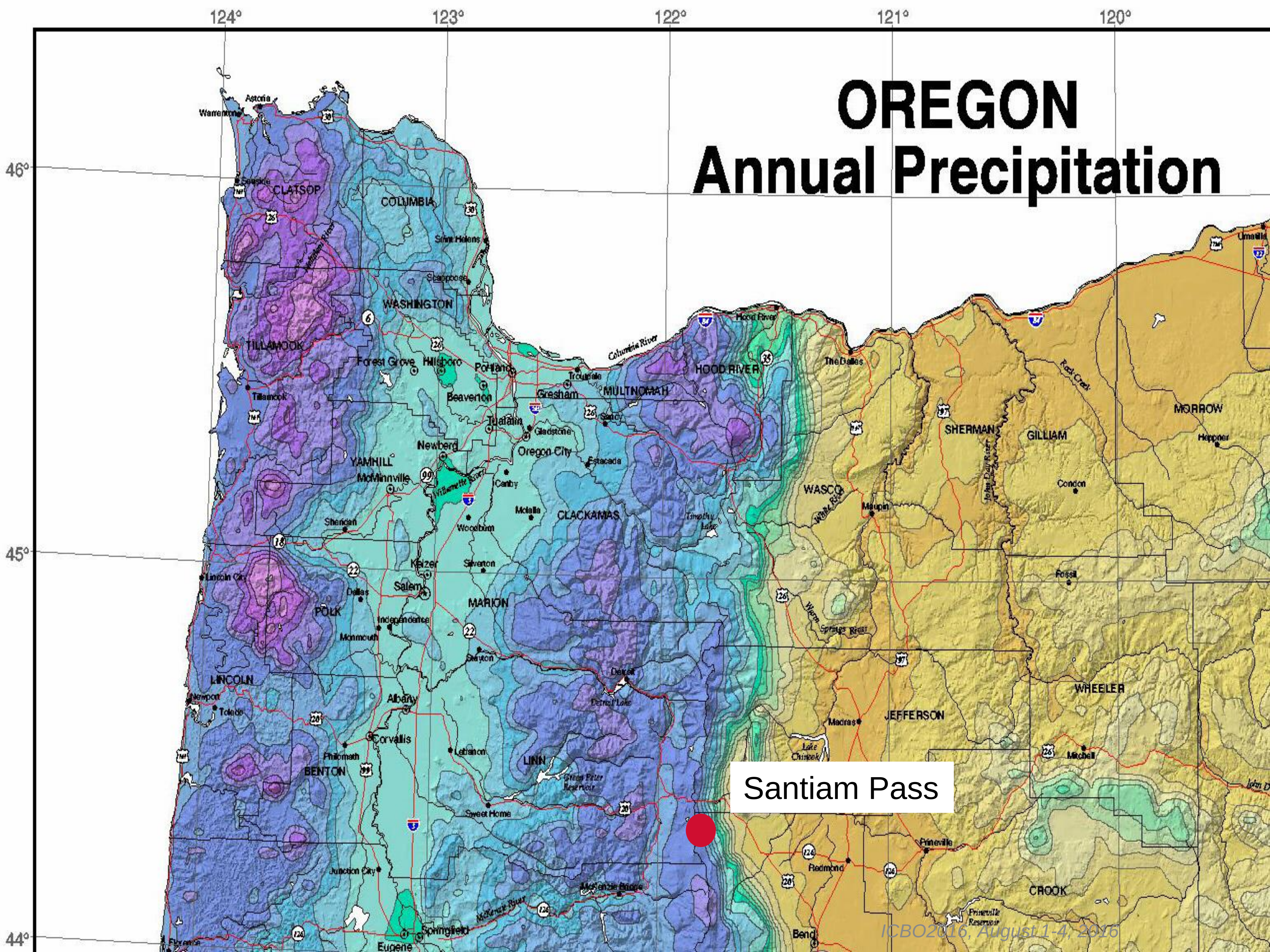
"Geospatial Climatology"

Example: Rain Shadows

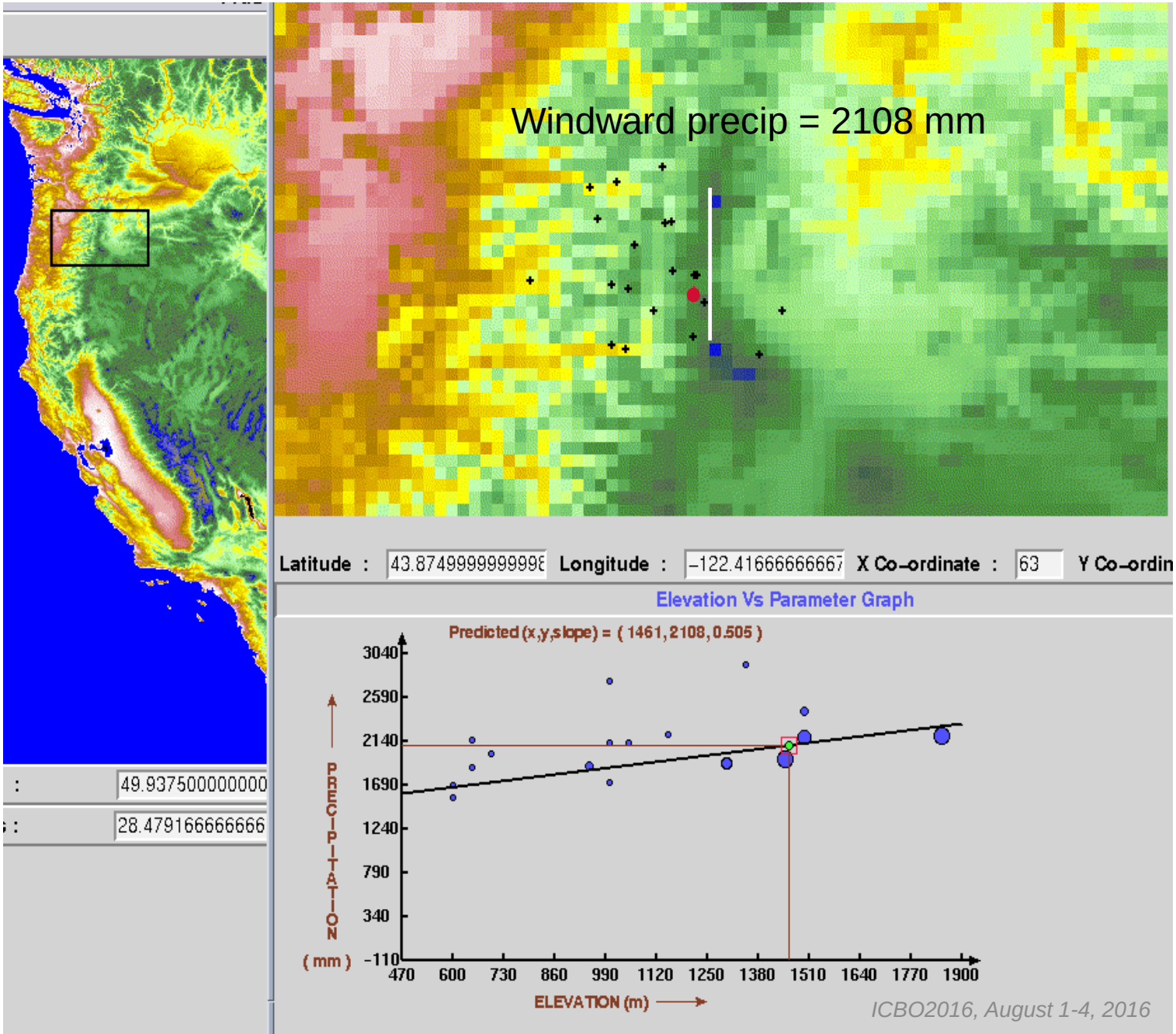


Western Oregon

Eastern Oregon


OREGON
Annual Precipitation
Santiam Pass
124°
123°
122°
121°
120°
46°
45°
44°
Astoria
Warrenton
Seaside
CLATSOP
COLUMBIA
Saint Helens
Scappoose
WASHINGTON
TILLAMOOK
Tillamook
Forest Grove
Hillsboro
Portland
Beaverton
Tualatin
Gresham
Troutdale
Sandy
MULTNOMAH
HOOD RIVER
Hood River
Columbia River
The Dalles
SHERMAN
GILLIAM
MORROW
Heppner
Umatilla
Gladstone
Oregon City
Estacada
Newberg
YAMHILL
McMinnville
Canby
Molalla
Woodburn
CLACKAMAS
Timothy Lake
WASCO
Maupin
Condon
Sheridan
Lincoln City
Keizer
Silverton
Salem
Dallas
POLK
MARION
Fossil
Independence
Monmouth
Stayton
Detroit
Detroit Lake
LINCOLN
Newport
Toledo
Albany
Corvallis
Philomath
BENTON
Lebanon
LINN
Green Peter Reservoir
Sweet Home
WHEELER
JEFFERSON
Madras
Lake Chinook
Mitchell
Prineville
Redmond
CROOK
Prineville Reservoir
Junction City
McKenzie Bridge
McKenzie River
Springfield
Eugene
Florence
Bend

1961-90 Mean Annual Precipitation, Cascade Mtns, OR, USA



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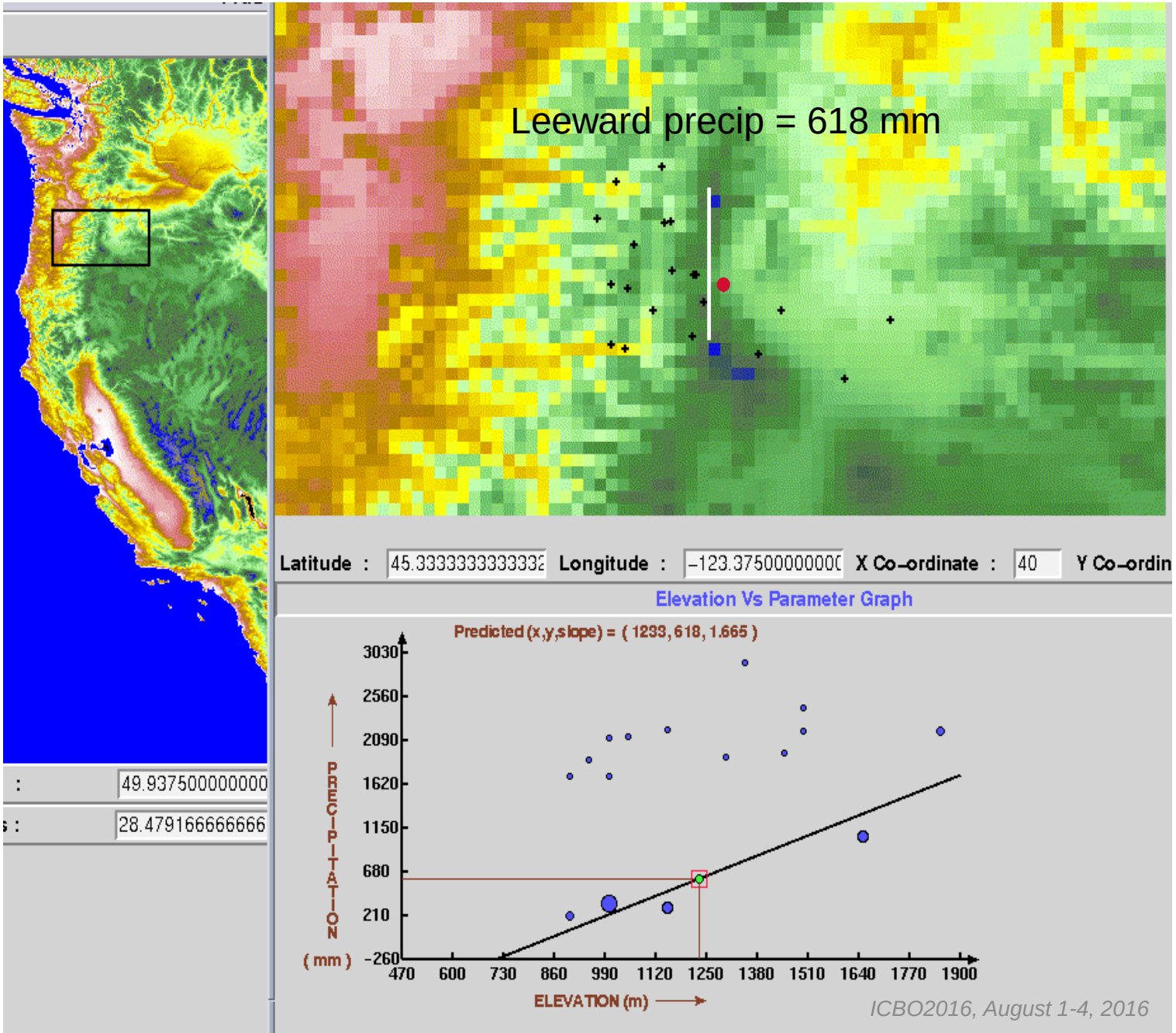
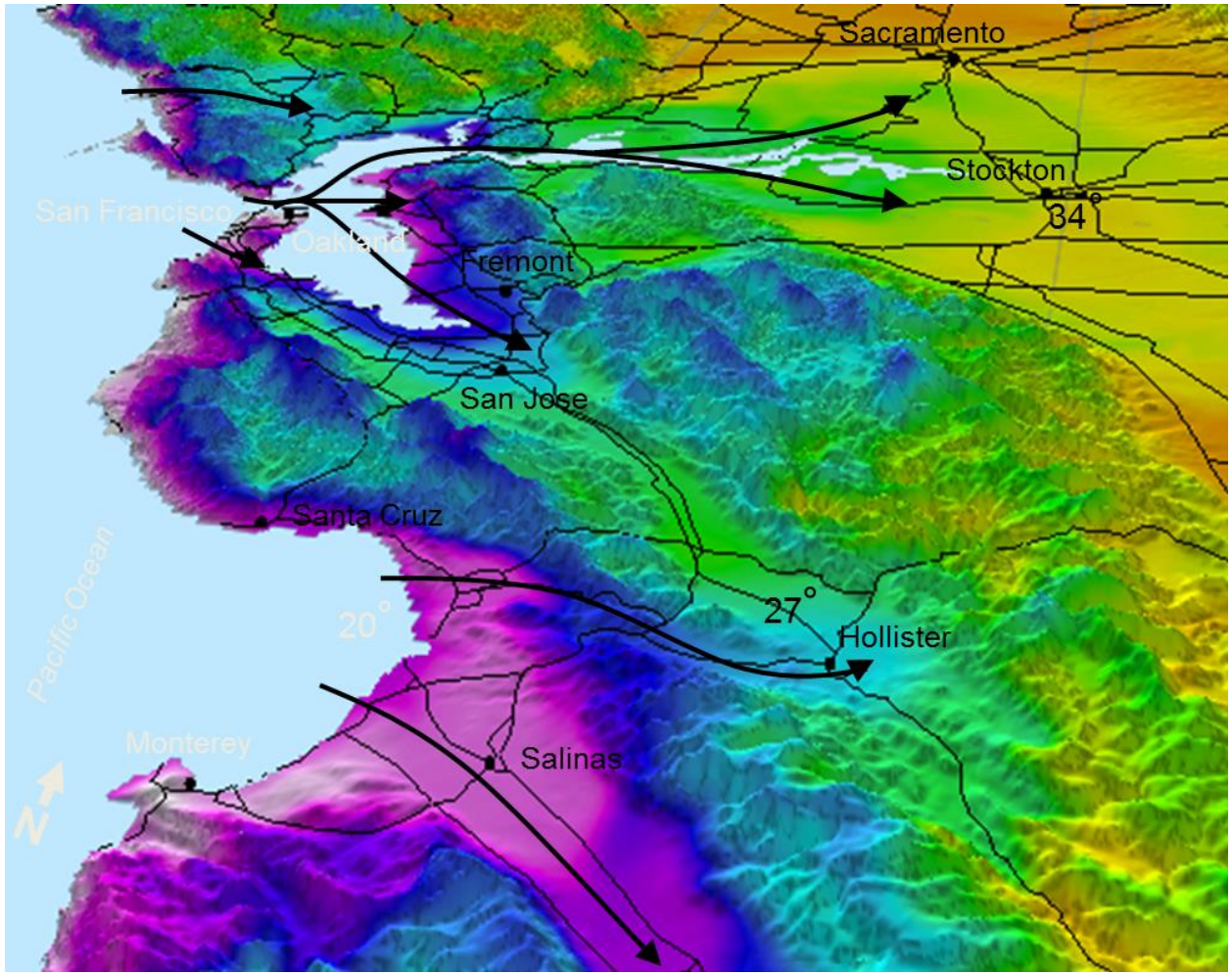


Example: Coastal Effects

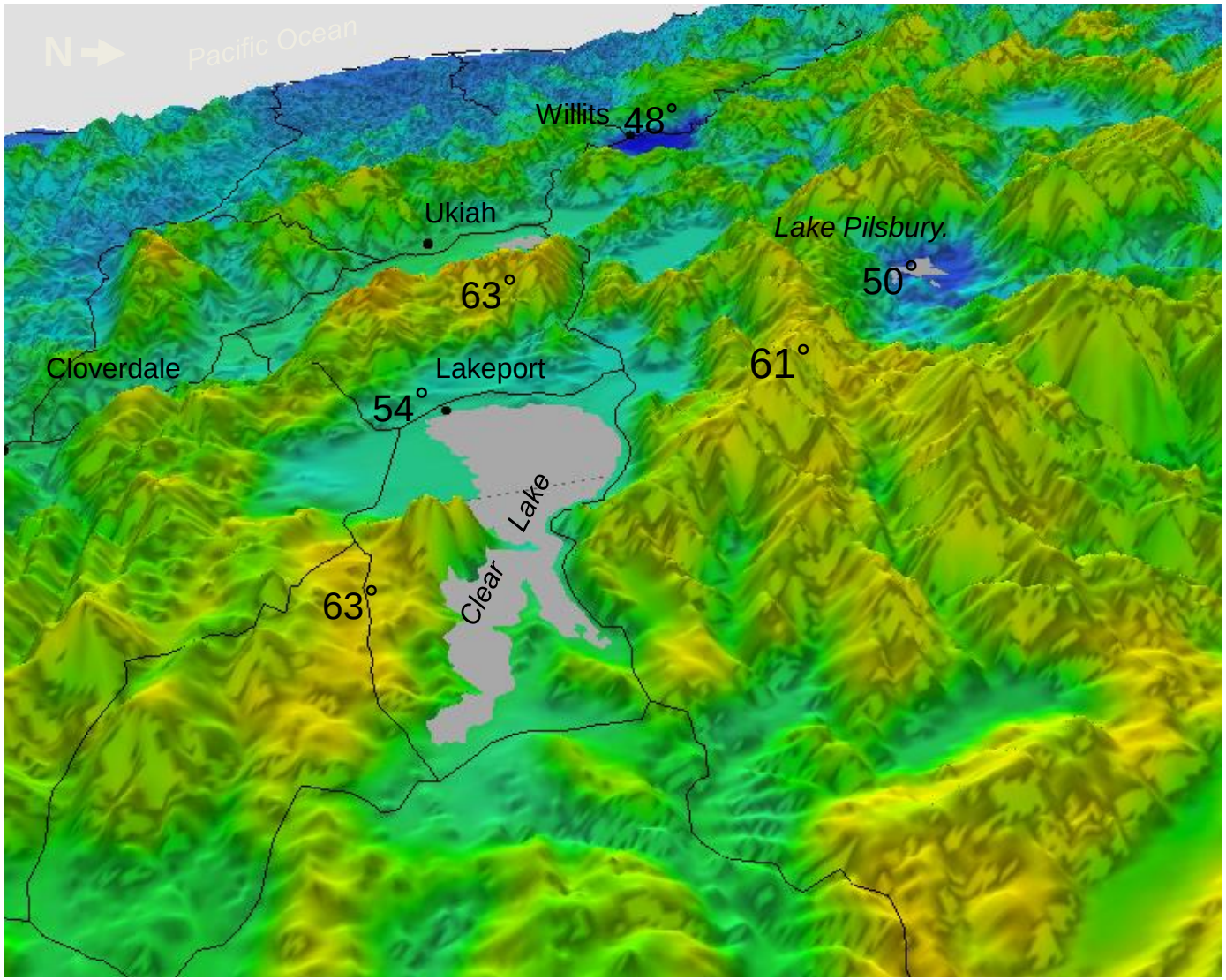
1971-00 July Maximum Temperature
Central California Coast

Preferred Airflow Trajectories →



Example: Temperature Inversions

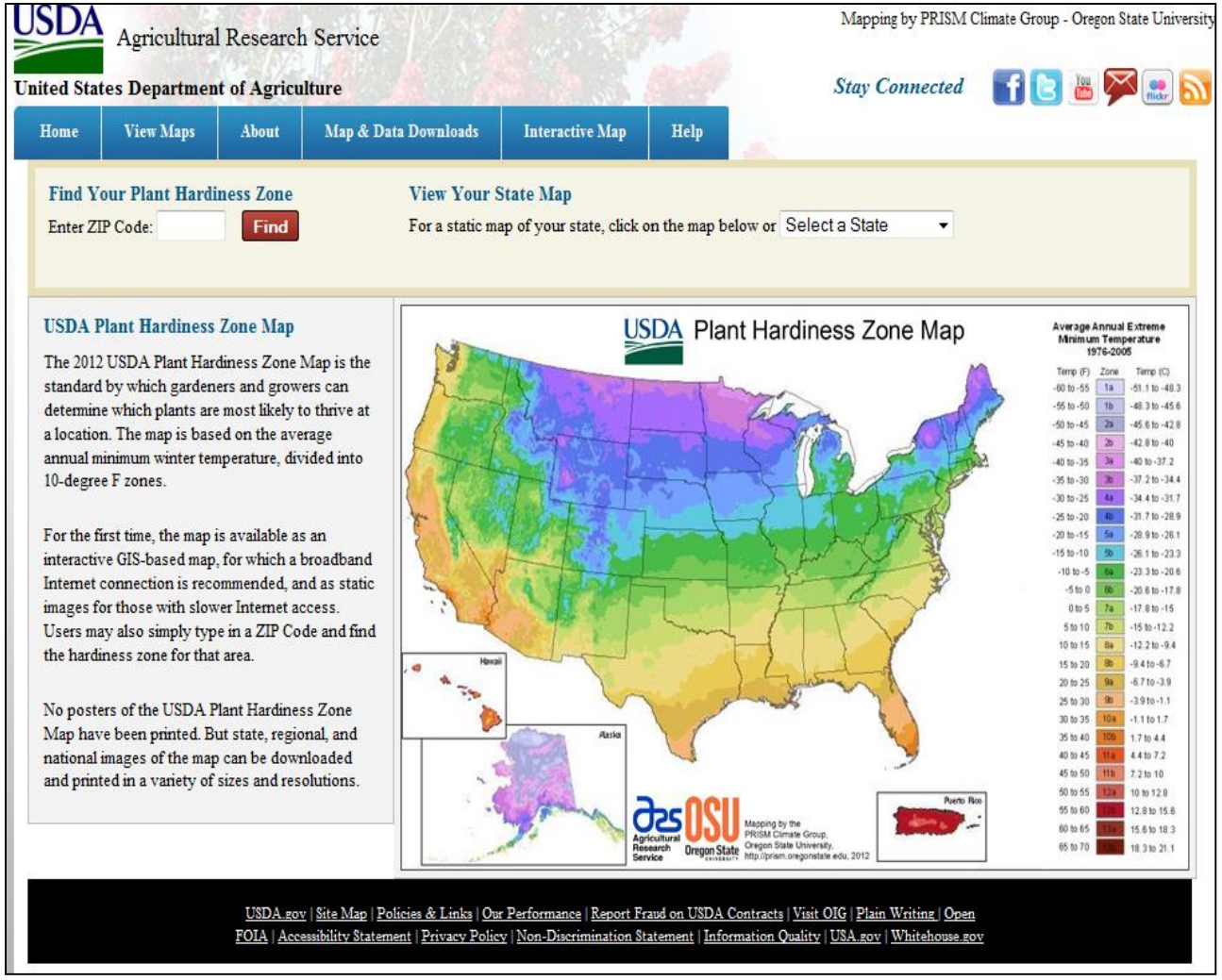
1971-00 July Minimum Temperature
Northwestern California



2012 USDA Plant Hardiness Zone Map

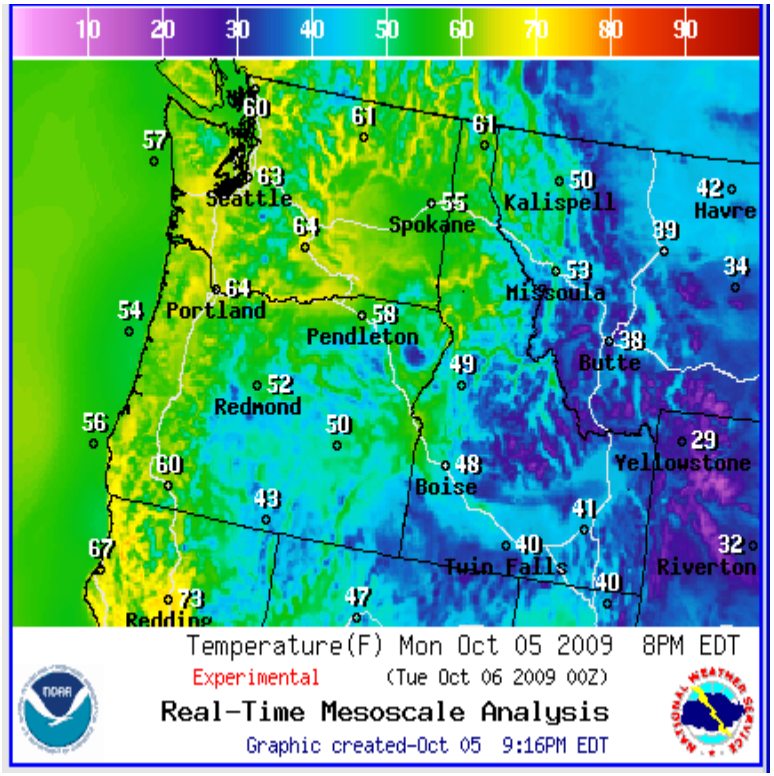
The PRISM Climate Group was chosen to author the 2012 USDA Plant Hardiness Zone map, which receives about ½ million visits per month.

It is likely the most heavily used climate map in the world.



Spatial Weather Forecasts Guided by PRISM

PRISM datasets are used by the National Weather Service and the Weather Channel, the two largest weather forecast providers, to guide the spatial patterns of their forecasts.



The Weather Channel

Weather @ 30,000 ft. | The Glacier Highway | Pollen Levels | Travel Forecasts

10-Day Forecast for Corvallis, OR (97330)

Weather for your life

[English | Metric] Printable Forecast

Weather Related to...

Forecast Conditions		High °F / Low °F	Precip. Chance	High Temperatures
Tonight Oct 5	Mostly Clear	N/A 39°	0%	High not valid after 2pm
Tue Oct 6	Sunny	69° 44°	0%	69°F
Wed Oct 7	Partly Cloudy	68° 44°	10%	68°F
Thu Oct 8	Sunny	71° 41°	0%	71°F

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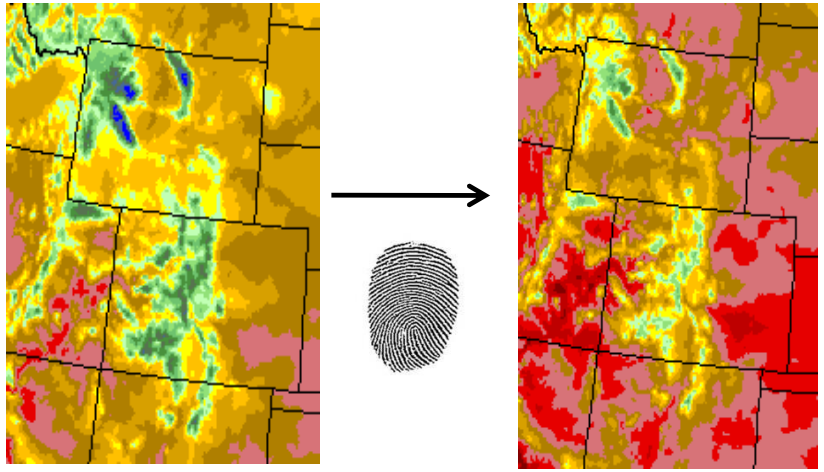
Climatologically-Aided Interpolation

- Climate provides a long-term context for weather events
- Weather is a variation on typical climate conditions
- The spatial patterns of long-term climate inform the spatial patterns of weather ("Climate Fingerprint")

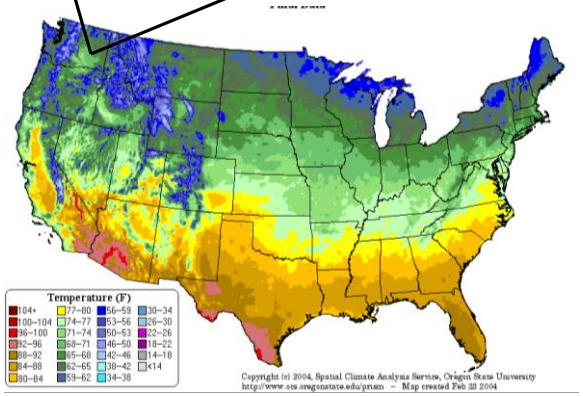
1971-2000
July Tmax



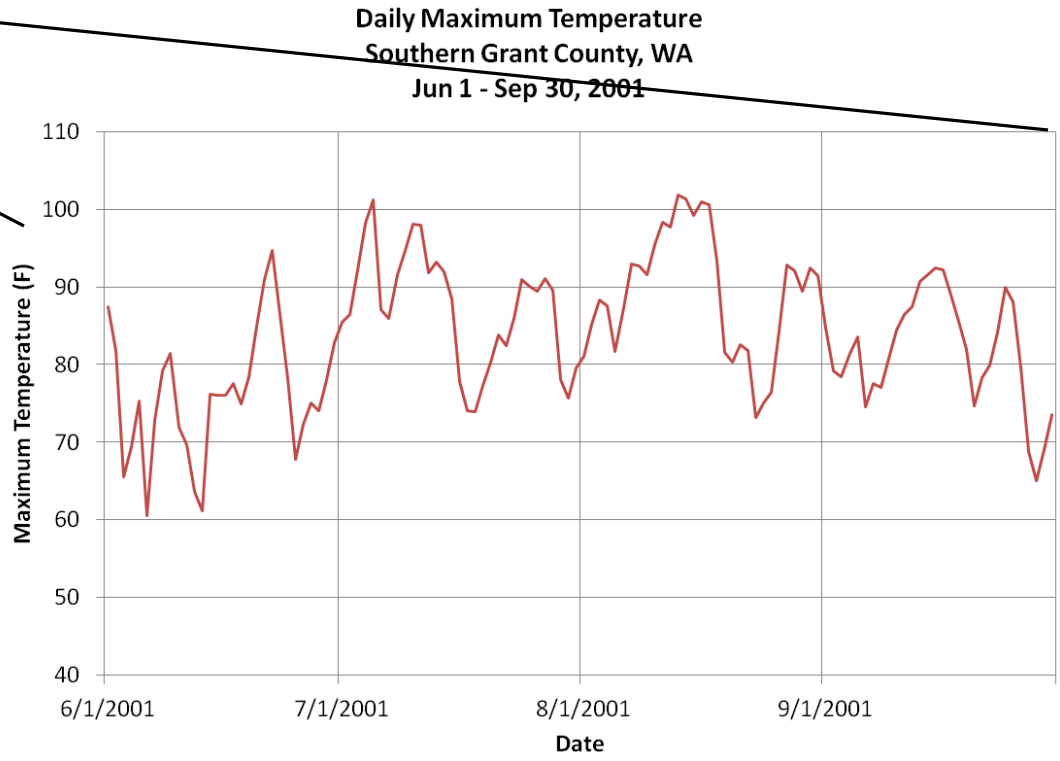
2003
July Tmax
(One of Hottest
on Record)

Different values, but similar spatial pattern

Conterminous US 1981-present
Daily Weather Time Series



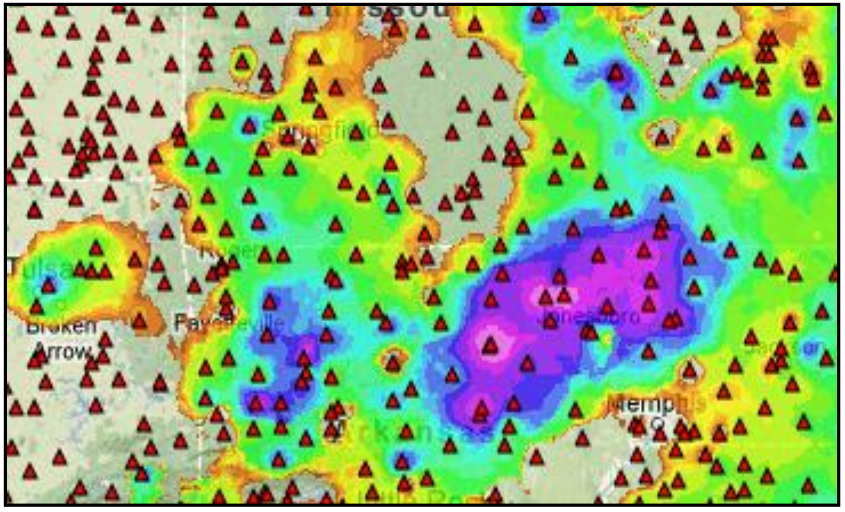
Daily precipitation, and
min and max temperature



PRISM-Radar Mapping

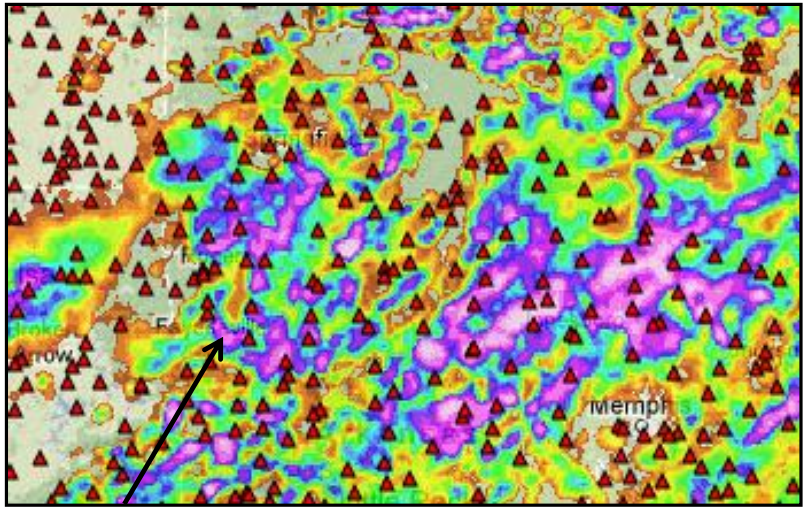
East of the Rockies, PRISM uses NOAA weather radar to provide detailed rainfall information between stations, resulting in a more precise and accurate picture of rainfall patterns than would be possible with station data alone.

PRISM daily rainfall map for the SE US on July 1, 2003



▲ = Station

Stations Only



Heavy rain cell

Stations + Radar

PRISM Crop Insurance Support

Purpose: Provide high-quality weather and climate data to expedite claims

- Did the claimed damaging event occur?
  - Short time scale: Daily and monthly weather maps over the lower 48 states in near real time
- Was the event unusual enough to support a loss claim?
  - Long time scale: Climate maps to provide context for the event
- Can the assessment process be made quick and easy?
  - Web-based tools

Summary Assessment: Raleigh, NC 2010 Tobacco Season

Location: **Lat: 35.8485 Lon: -78.4770 (North Carolina - Wake County)**
Elevation: **299 ft**
Start Date: **April 2010** Data for this date is **unlikely to change**
End Date: **November 2010** Data for this date is **unlikely to change**
Assessment Basis: **30-year normals (1981-2010)**
Plant Hardiness Zone: **7b: 5 to 10 °F**

[How data stability is calculated]
[About PRISM estimates]
[How comparison periods are calculated]
[What are the plant hardiness zones]

Precipitation (total inches)	Mean Temperature (overall average °F)	Maximum Temperature (daytime highs °F)	Minimum Temperature (nighttime lows °F)
Typical	**Unusually Warm**	**Unusually Warm**	**Unusually Warm**
19.76 41.48 29.97	65.5 70.2 70.2	76.9 81.8 81.8	53.8 58.6 58.6

Deviation from normal

Ranking and plain-English interpretation

View Details

	Selected Period	1981-2010 Normal	Percent of 1981-2010 Normal	Rank in Normal Period & Assessment	[How rank
Precipitation (total)	29.97"	31.13"	96.3%	**16/30 = Typical**	

	Selected Period	1981-2010 Normal	Deviation from 1981-2010 Normal	Rank in Normal Period & Assessment	[How rank is used]
Mean Temperature (overall average)	70.2°F	67.6°F	+2.6°F	**1/30 = Unusually Warm**	
Maximum Temperature (daytime highs)	81.8°F	79.0°F	+2.8°F	**1/30 = Unusually Warm**	
Minimum Temperature (nighttime lows)	58.6°F	56.2°F	+2.4°F	**1/30 = Unusually Warm**	

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Typical	**Unusually Warm**	**Unusually Warm**	**Unusually Warm**

	30-year Normal Rank	10-year Average Rank	Percentile
Unusually Wet / Warm	1-3	1	91-100
Wet / Warm	4-9	2-3	71-90
Typical	10-21	4-7	31-70
Dry / Cool	22-27	8-9	11-30
Unusually Dry / Cool	28-30	10	1-10

	Selected Period	1981-2010 Normal	Deviation from 1981-2010 Normal	Rank in Normal Period & Assessment	[How rank is used]
Mean Temperature (overall average)	70.2°F	67.6°F	+2.6°F	**1/30 = Unusually Warm**	
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View Details

Station Data

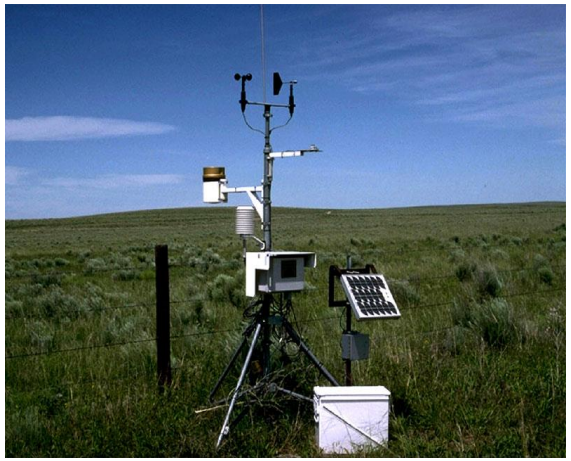
Each day, over 20,000 precipitation and 6,000 temperature stations collected

- NOAA's major networks
- US Forest Service / Bureau of Reclamation
- USDA
- CoCoRaHS precipitation network
- State and regional networks

Manned CoCoRaHS rainfall station

The quality of the station observations is a key factor in the accuracy of PRISM datasets.

Measurement protocols must be known

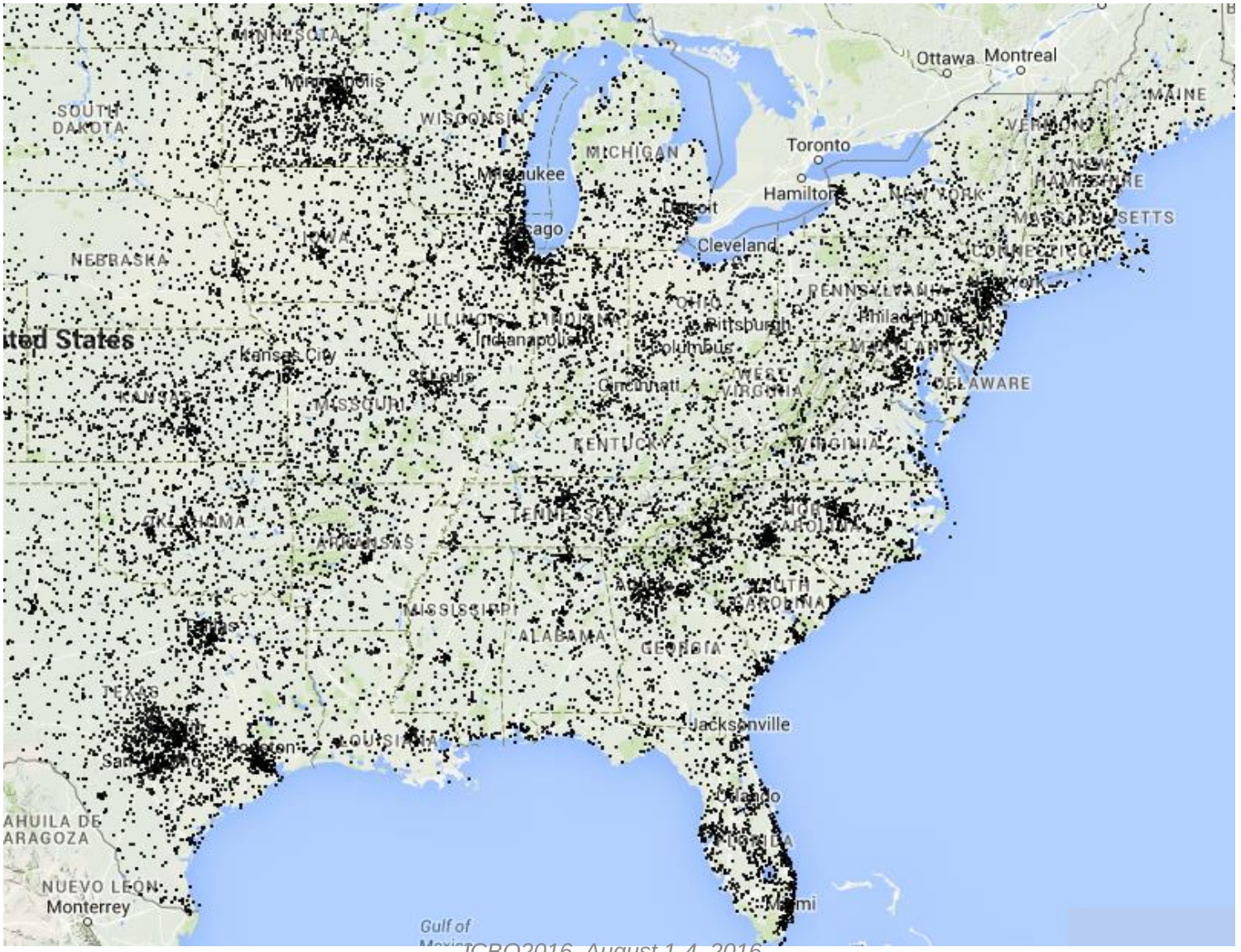


Automated Colorado Ag Weather Network Station

Photos: Colorado State University

PRISM Stations

Reporting Precipitation on 1 July 2014



PRISM Stations

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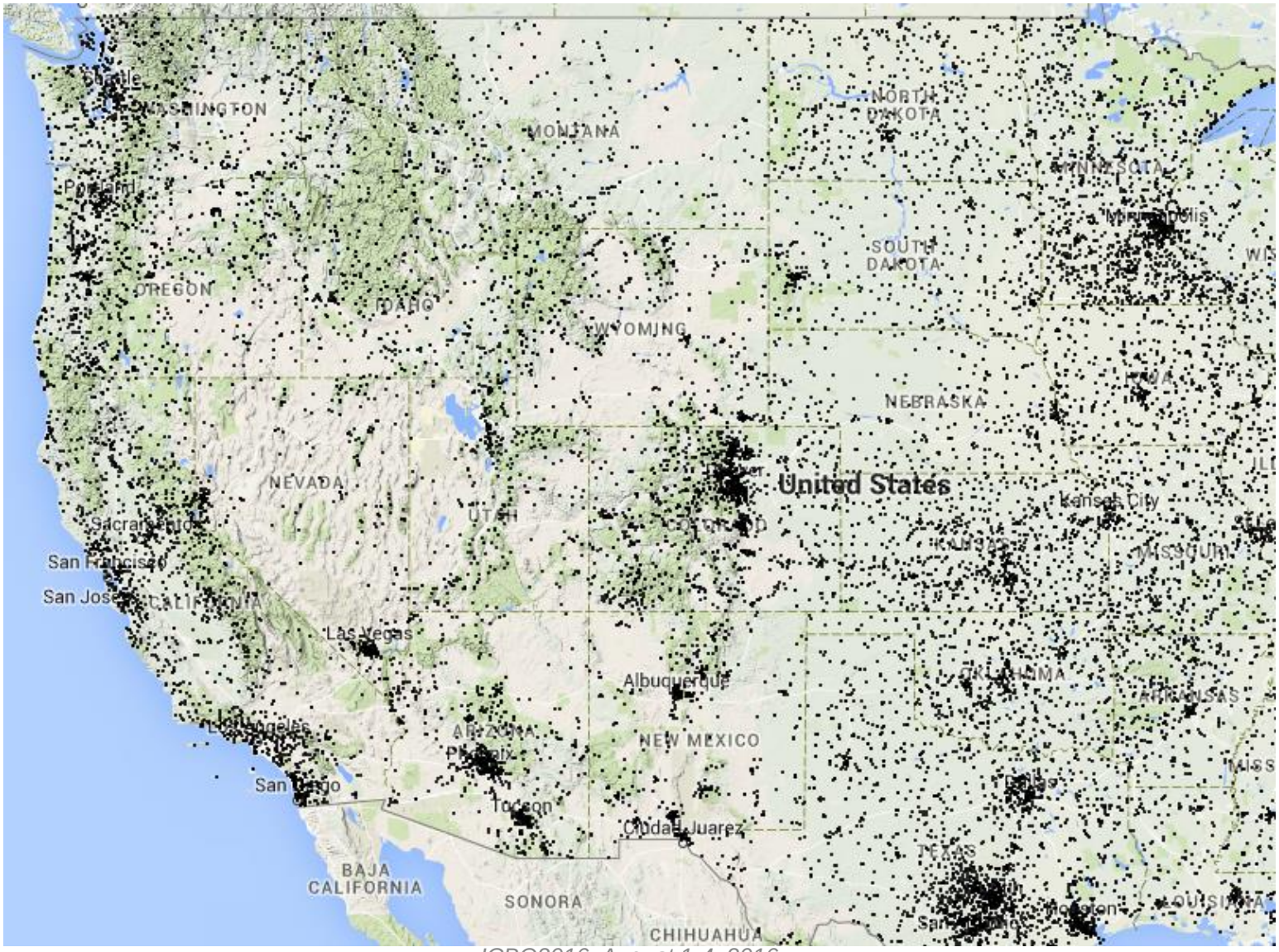
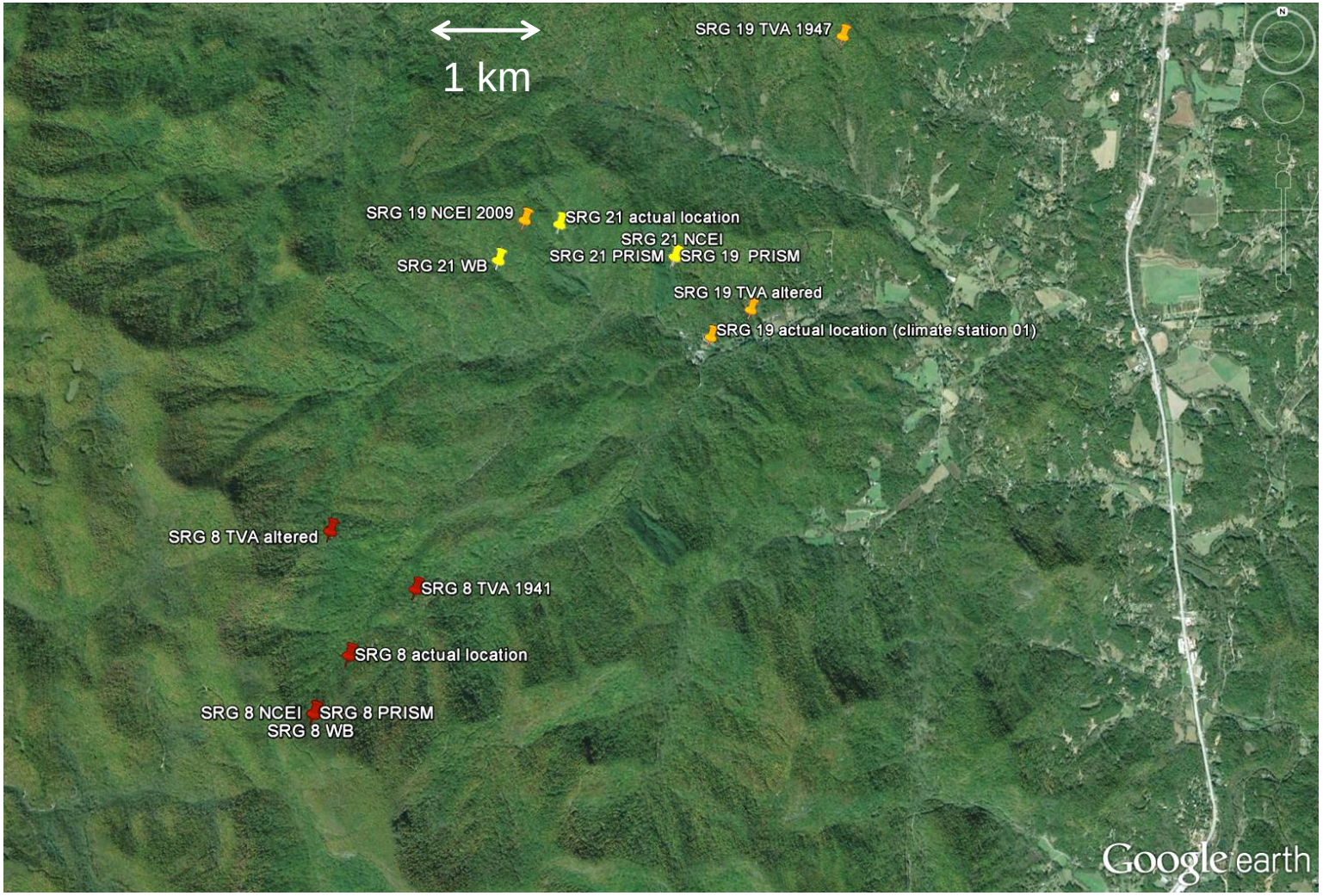


National Weather Service Cooperative Observer Program (COOP)

- Backbone of the US historical climate record
- Began in late 1800's, continues today
- Instrumentation has not changed much
- Once per day observations
  - Total Precipitation and max/min temperature over previous 24 hours
- Time of observation varies, not always obvious
  - Mostly early morning or late afternoon
- Measurements recorded by volunteers
  - This is good and bad

Rain Gauge Mis-locations

Coweeta Watershed, NC

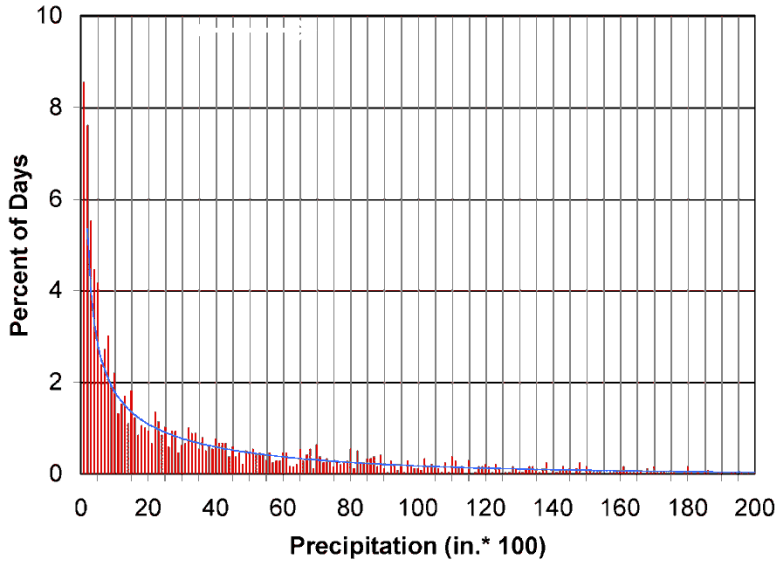


Human Observer Bias

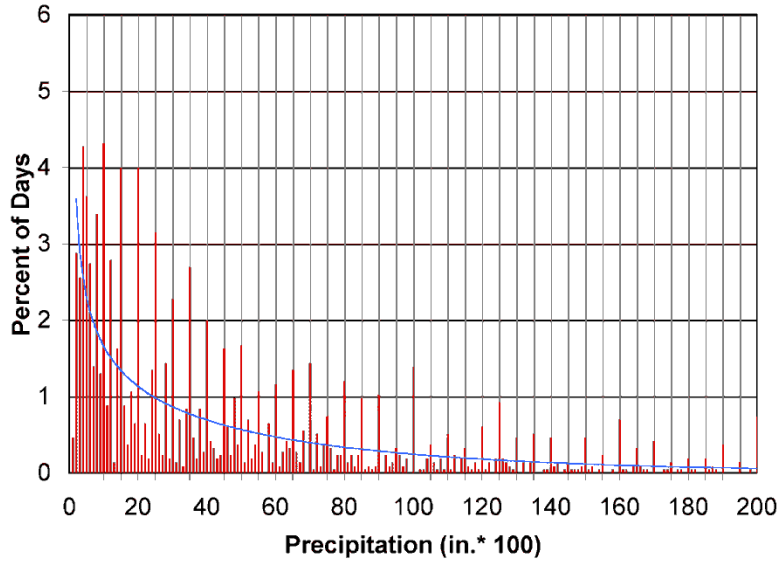
Human Observer Bias

Frequency Distribution of Daily Precipitation

Watonga, OK



Purcell, OK



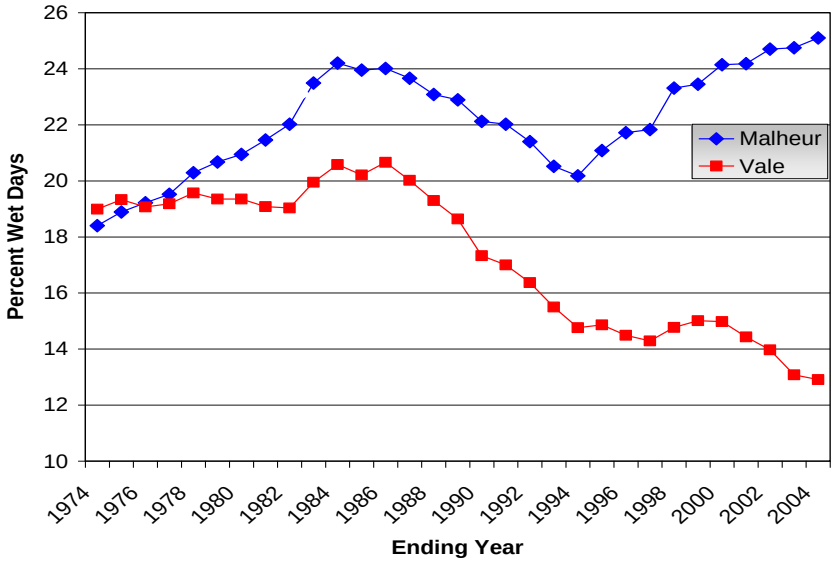
Under-reporting Bias

"5/10" Bias

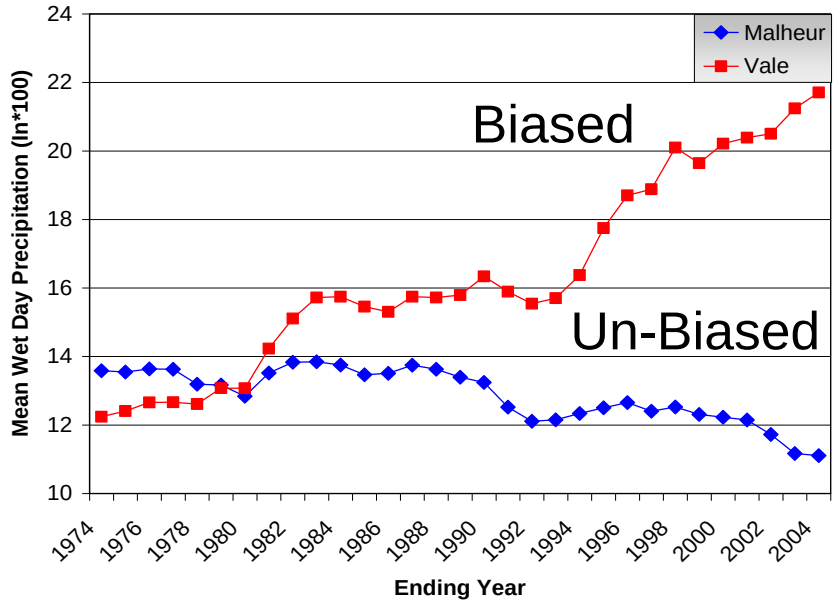
Human Observer Bias

Conflicting Precipitation Trends

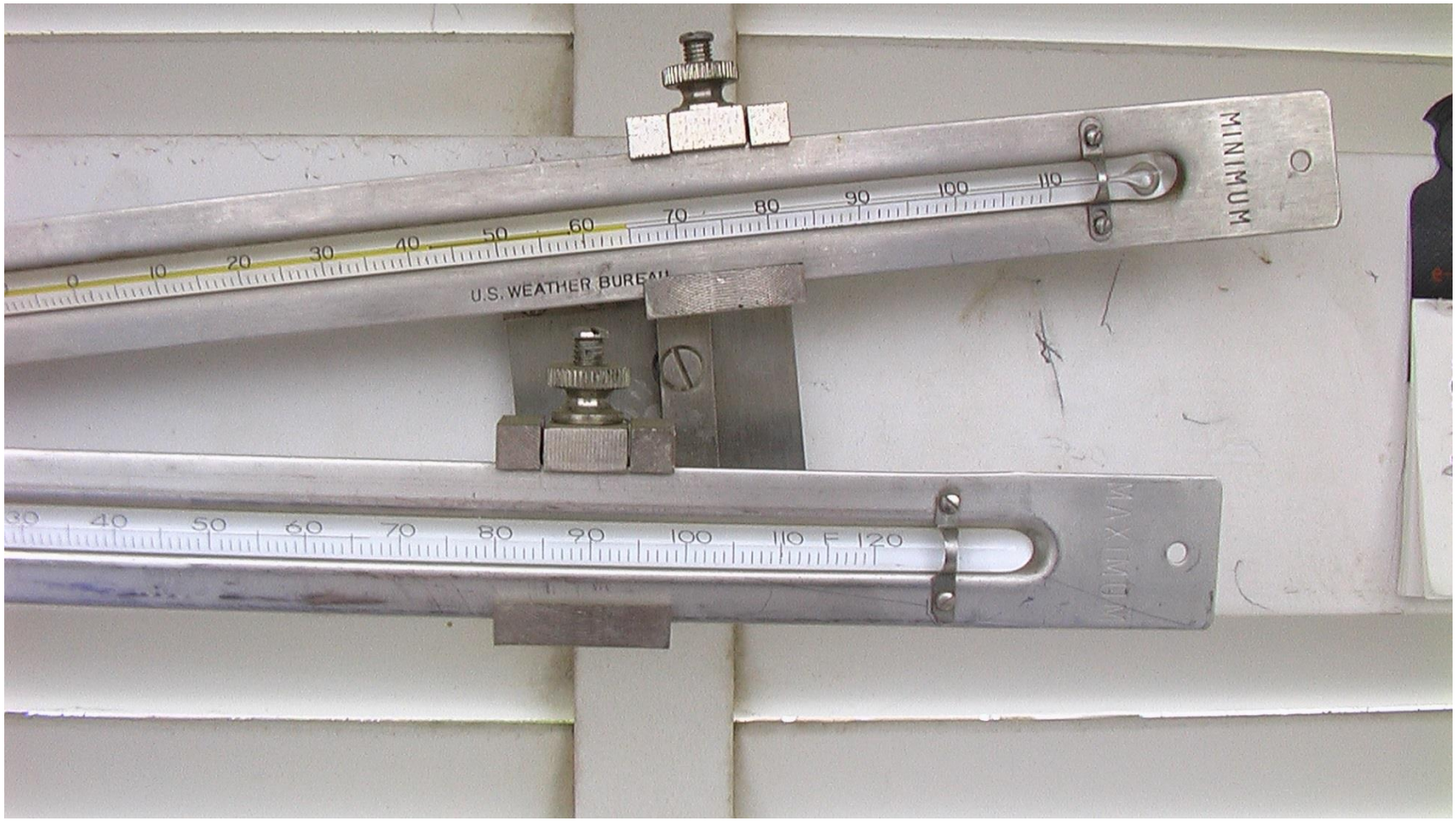
Percent of Days that are Wet



Average Precip on a Wet Day



COOP Max/Min Temperature Observations



Time of Observation

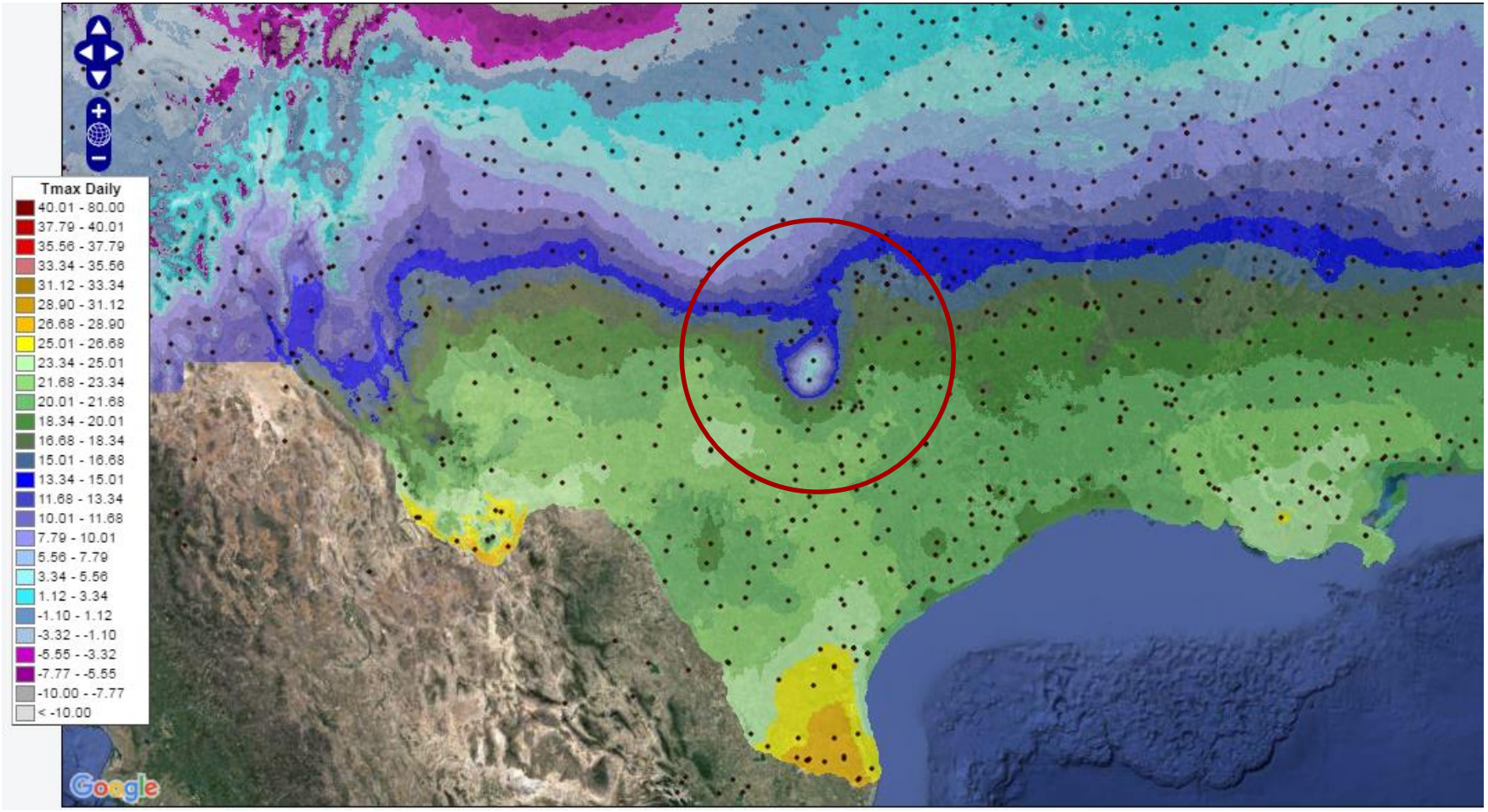
A Little Thing Can Kill You

- Obs time is poorly documented
- Sometimes people don't tell the truth about their obs time
- Spatial-temporal errors result
- Both data and metadata analyses are needed

Richard Hendrickson, 101 years old
84-year COOP observer in 2014
Bridgehampton, NY

Spatial Discontinuity in Daily Tmax

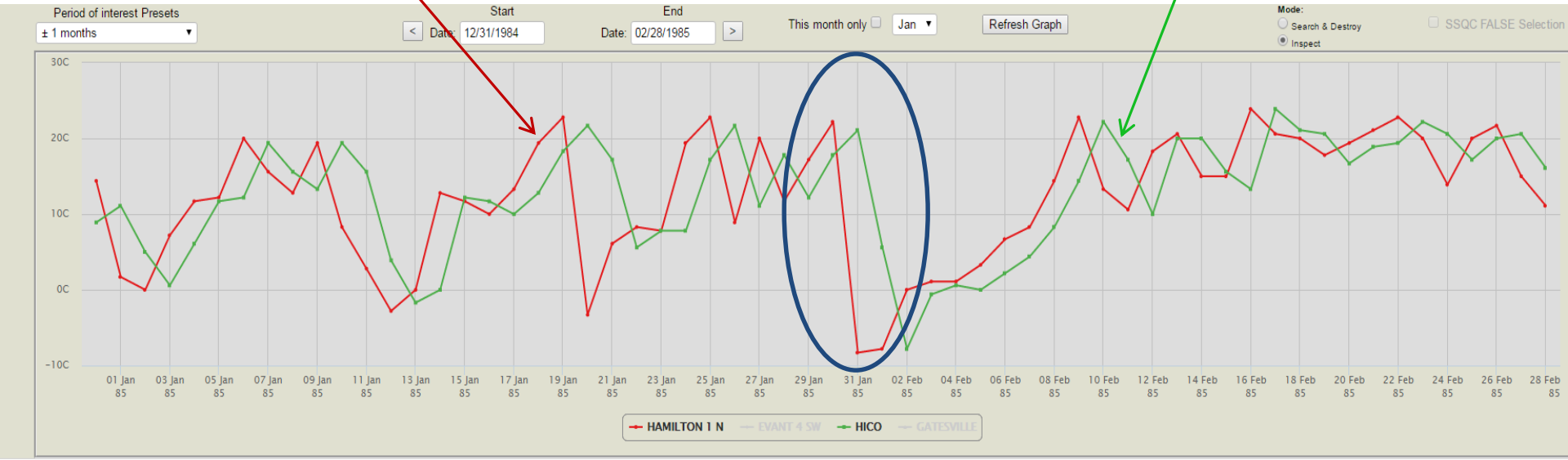
31 January 1985



Cause: Time Shifting

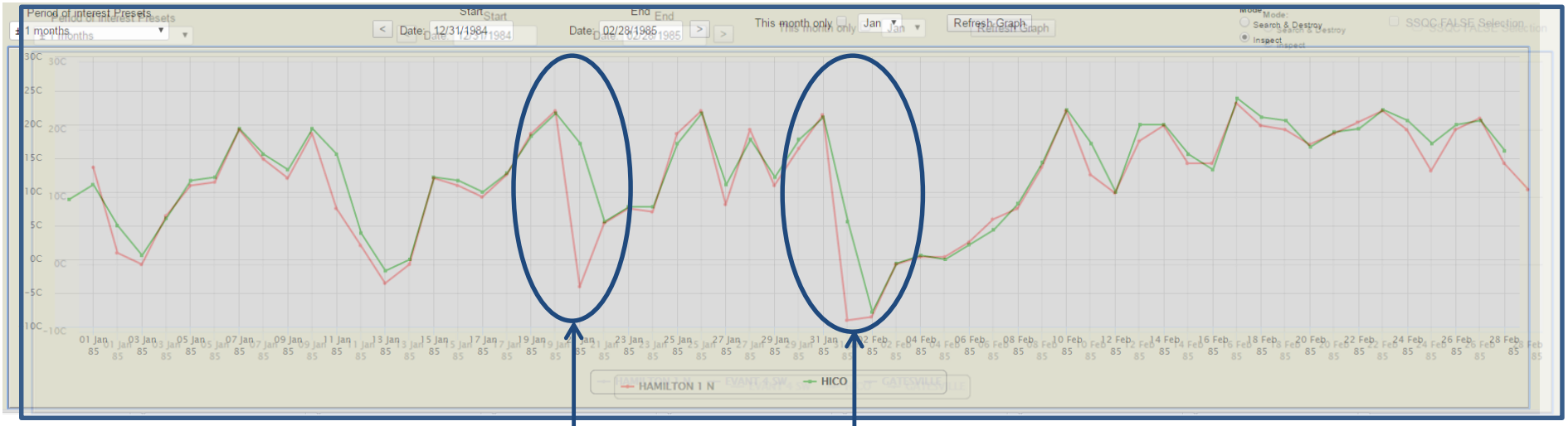
Hamilton, TX
7 AM observer
Recorded Tmax on Previous Day?

Hico, TX
6 PM Observer



Warm Tmax Bias By Afternoon Observers

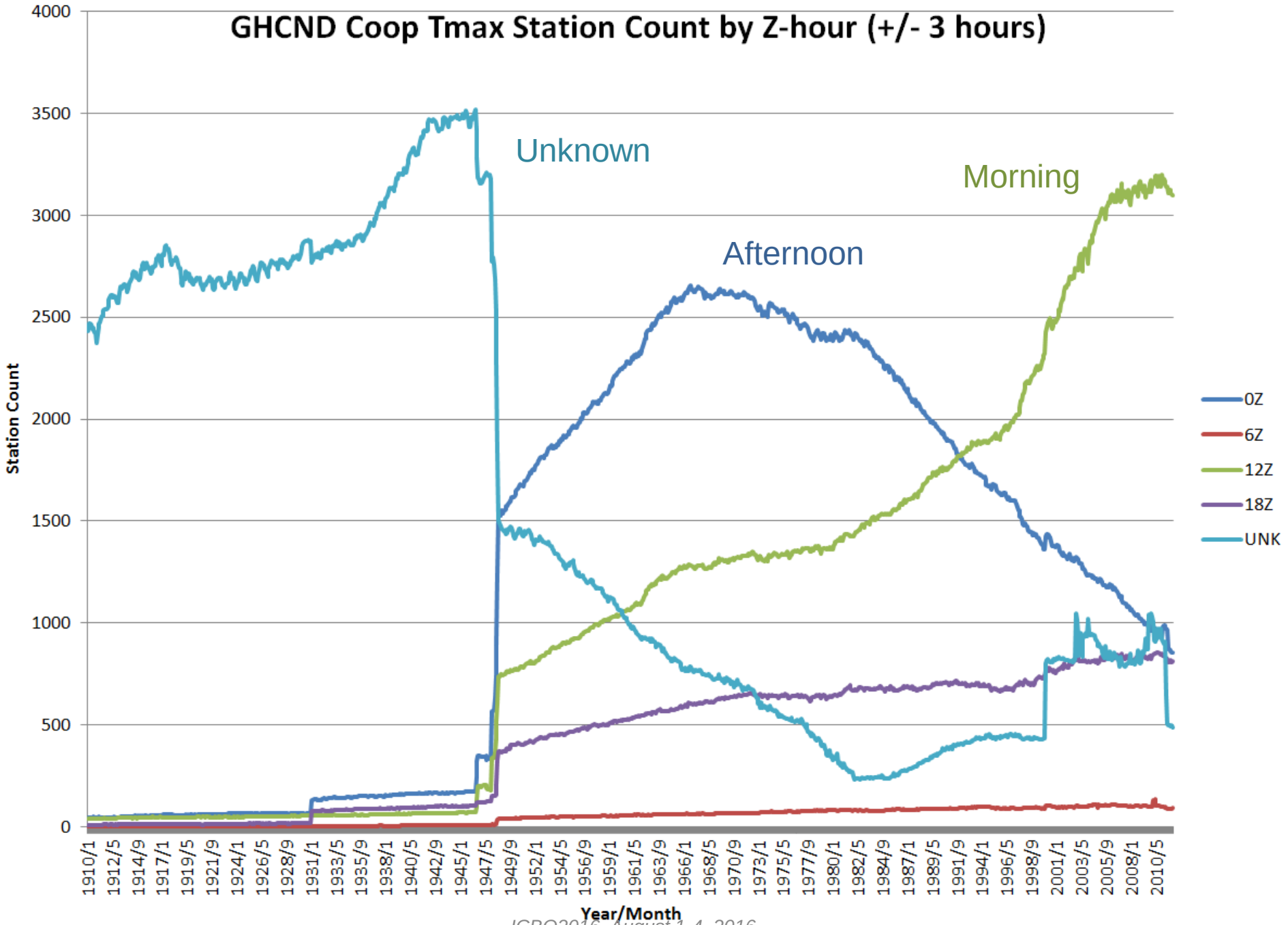
"Bridging" or delay of cold events



17.2°C difference

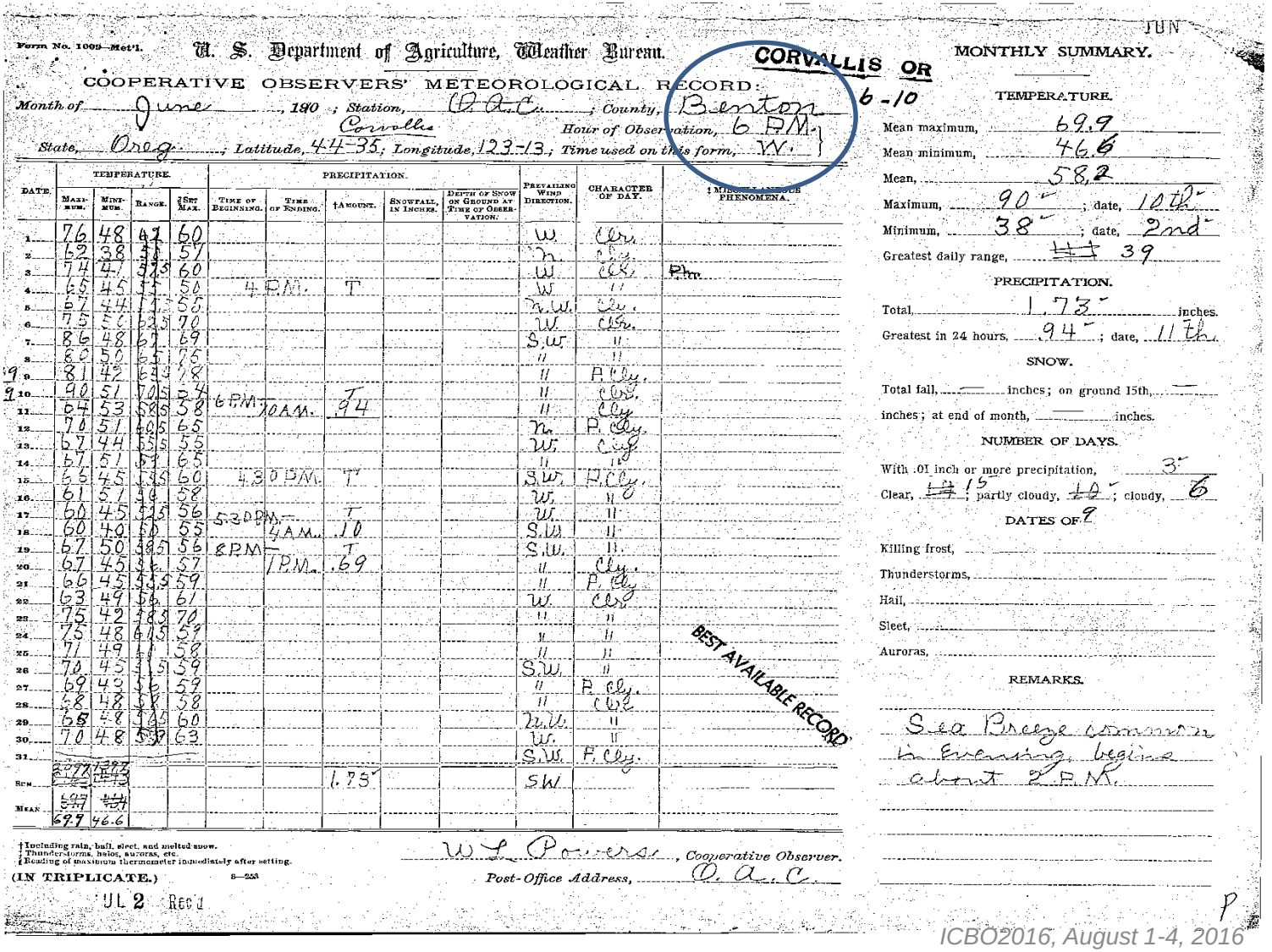
13.9°C difference

Monthly bias = 1°C



Corvallis, OR Observer Form

June 1910



Form No. 1009—Met'l. U. S. Department of Agriculture, Weather Bureau. CORVALLIS OR

COOPERATIVE OBSERVERS' METEOROLOGICAL RECORD: 6-10

Month of June, 190 ; Station, O. A. C. (Corvallis); County, Benton; Hour of Observation, 6 P.M.; State, Oreg.; Latitude, 44-35; Longitude, 123-13; Time used on this form, W.

DATE	TEMPERATURE. Maximum	Minimum	Range	†Set Max.	PRECIPITATION. Time of Beginning	Time of Ending	†Amount	Snowfall, in Inches	Depth of Snow on Ground at Time of Observation	Prevailing Wind Direction	Character of Day	‡Miscellaneous Phenomena
1	76	48	47	60						W	Clr.	
2	62	38	24	57						N.	Clr.	
3	74	47	33	60						W	Clr.	Fog.
4	65	45	20	50	4 P.M.		T			W	"	
5	67	44	23	56						N.W.	Cy.	
6	75	50	25	70						W	Clr.	
7	86	48	38	69						S.W.	"	
8	80	50	30	75						"	"	
9	81	42	39	78						"	P. Cly.	
10	90	51	39	84						"	Clr.	
11	64	53	11	58	6 P.M.	10 A.M.	.94			"	Cdy.	
12	70	51	19	65						N.	P. Cly.	
13	67	44	23	55						W.	Cdy.	
14	67	51	16	65						"	"	
15	65	45	20	60	4:30 P.M.		T			S.W.	P. Cly.	
16	61	51	10	58						W.	"	
17	60	45	15	56	5:30 P.M.		T			W.	"	
18	60	40	20	55		4 A.M.	.10			S.W.	"	
19	67	50	17	56	8 P.M.		T			S.W.	"	
20	67	45	22	57		1 P.M.	.69			"	Cly.	
21	66	45	21	59						"	P. Cly.	
22	63	49	14	61						W.	Clr.	
23	75	42	33	70						"	"	
24	75	48	27	59						"	"	
25	71	49	22	58						"	"	
26	70	45	25	59						S.W.	"	
27	69	43	26	59						"	P. Cly.	
28	68	48	20	58						"	Clr.	
29	68	48	20	60						N.W.	"	
30	70	48	22	63						W.	"	
31										S.W.	P. Cly.	
Sum.	2077	1383	694				1.75			SW		
Mean	69.7	46.6	23.1									

†Including rain, hail, sleet, and melted snow.
‡Thunder-storms, halos, auroras, etc.
§Reading of maximum thermometer immediately after setting.

(IN TRIPLICATE.) 8—253

W. L. Powers, Cooperative Observer.

Post-Office Address, O. A. C.

JUL 2 Rec'd

JUN

MONTHLY SUMMARY.

TEMPERATURE.

Mean maximum, 69.9

Mean minimum, 46.6

Mean, 58.2

Maximum, 90°; date, 10th

Minimum, 38°; date, 2nd

Greatest daily range, ~~44~~ 39

PRECIPITATION.

Total, 1.73" inches.

Greatest in 24 hours, .94"; date, 11th

SNOW.

Total fall, — inches; on ground 15th, —

inches; at end of month, — inches.

NUMBER OF DAYS.

With .01 inch or more precipitation, 3

Clear, ~~13~~ 15; partly cloudy, ~~10~~ 9; cloudy, 6

DATES OF

Killing frost,

Thunderstorms,

Hail,

Sleet,

Auroras,

REMARKS.

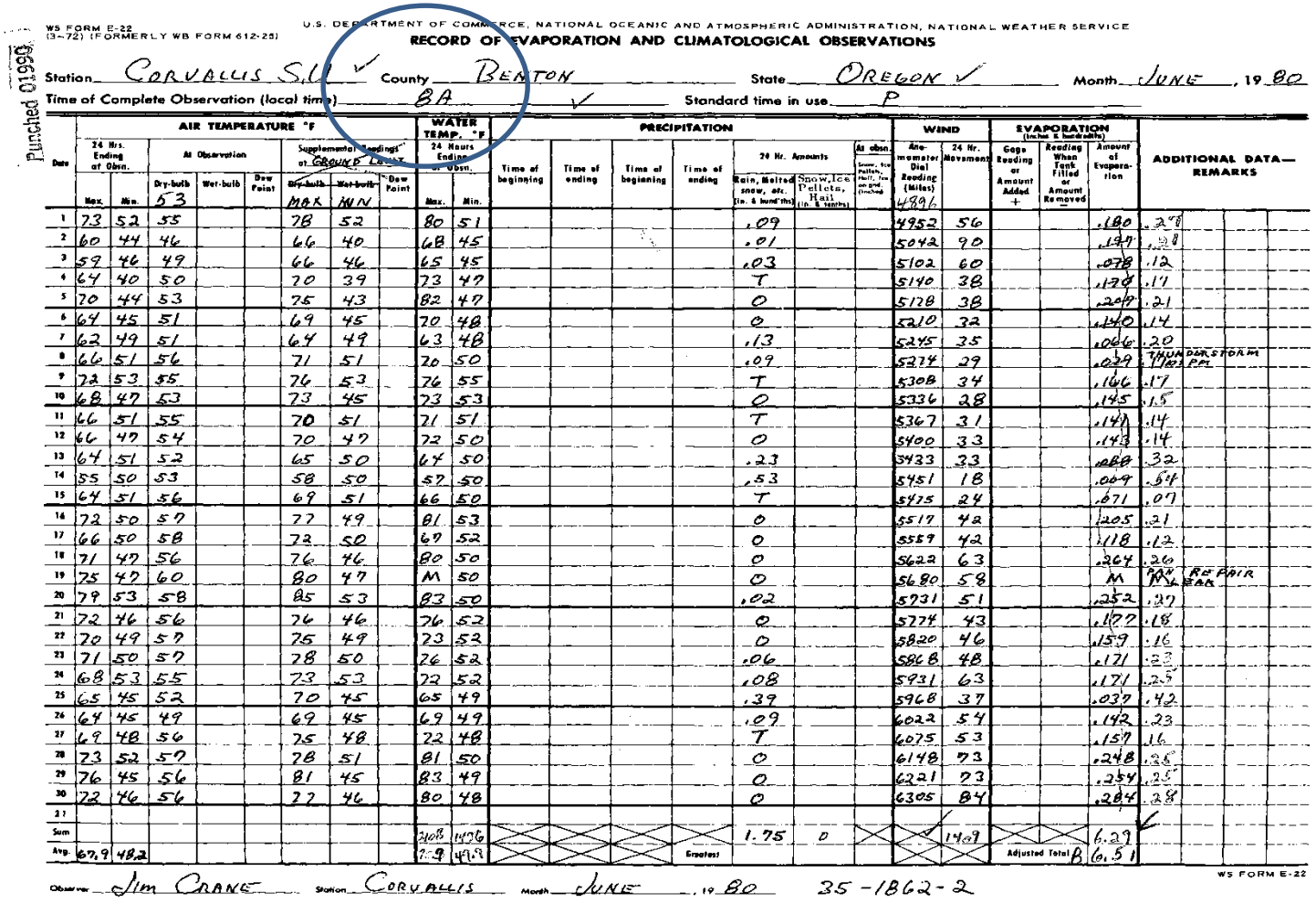
Sea Breeze commences in Evening, begins about 2 P.M.

BEST AVAILABLE RECORD

P

Corvallis, OR Observer Form

June 1980



WS FORM E-22 (3-72) (FORMERLY WB FORM 612-25)

U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL WEATHER SERVICE

RECORD OF EVAPORATION AND CLIMATOLOGICAL OBSERVATIONS

Punched 01990

Station CORVALLIS S.U. ✓ County BENTON State OREGON ✓ Month JUNE, 19 80

Time of Complete Observation (local time) 8A ✓ Standard time in use P

Date	AIR TEMPERATURE °F: 24 Hrs. Ending at Obsn. Max.	Min.	At Observation: Dry-bulb	Wet-bulb	Dew Point	Supplemental Readings at GROUND LEVEL: Dry-bulb MAX	Wet-bulb MIN	Dew Point	WATER TEMP. °F: 24 Hours Ending at Obsn. Max.	Min.	PRECIPITATION: Time of beginning	Time of ending	Time of beginning	Time of ending	24 Hr. Amounts: Rain, Melted snow, etc. (in. & hundredths)	At obsn. Snow, Ice Pellets, Hail, Ice on pond (inches) Snow, Ice Pellets, Hail (in. & tenths)	WIND: Anemometer Dial Reading (Miles)	24 Hr. Movement	EVAPORATION (inches & hundredths): Gage Reading or Amount Added +	Reading When Tank Filled or Amount Removed −	Amount of Evaporation	ADDITIONAL DATA—REMARKS
1	73	52	55			78	52		80	51					.09		4896				.180	.28
2	60	44	46			66	40		68	45					.01		4952	56			.199	.28
3	59	46	49			66	46		65	45					.03		5042	90			.078	.12
4	64	40	50			70	39		73	47					T		5102	60			.178	.17
5	70	44	53			75	43		82	47					0		5140	38			.209	.21
6	64	45	51			69	45		70	48					0		5178	38			.140	.14
7	62	49	51			64	49		63	48					.13		5210	32			.066	.20
8	66	51	56			71	51		70	50					.09		5245	35			.029	.06 THUNDERSTORM 1:05 PM
9	72	53	55			76	53		76	55					T		5274	29			.166	.17
10	68	47	53			73	45		73	53					0		5308	34			.145	.15
11	66	51	55			70	51		71	51					T		5336	28			.141	.14
12	66	47	54			70	47		72	50					0		5367	31			.143	.14
13	64	51	52			65	50		67	50					.23		5400	33			.088	.32
14	55	50	53			58	50		57	50					.53		5433	33			.009	.54
15	64	51	56			69	51		66	50					T		5451	18			.071	.07
16	72	50	57			77	49		81	53					0		5475	24			.205	.21
17	66	50	58			72	50		69	52					0		5517	42			.118	.12
18	71	47	56			76	46		80	50					0		5559	42			.264	.26
19	75	49	60			80	47		M	50					0		5622	63			M	RAIN REPAIR WORK
20	79	53	58			85	53		83	50					.02		5680	58			.252	.27
21	72	46	56			76	46		76	52					0		5731	51			.177	.18
22	70	49	57			75	49		73	52					0		5774	43			.159	.16
23	71	50	57			78	50		76	52					.06		5820	46			.171	.23
24	68	53	55			73	53		72	52					.08		5868	48			.171	.25
25	65	45	52			70	45		65	49					.39		5931	63			.039	.42
26	64	45	49			69	45		69	49					.09		5968	37			.142	.23
27	69	48	56			75	48		72	48					T		6022	54			.159	.16
28	73	52	57			78	51		81	50					0		6075	53			.248	.26
29	76	45	56			81	45		83	49					0		6148	73			.254	.25
30	72	46	56			77	46		80	48					0		6221	73			.284	.28
31																	6305	84				
Sum									2408	1496					1.75	0		1489			6.29	
Avg.	67.9	48.2							77.9	49.9			Greatest						Adjusted Total	B	6.51	

Observer Jim CRANE Station CORVALLIS Month JUNE, 19 80 35-1862-2

WS FORM E-22

Corvallis, OR Observer Form

June 2012

STATION (Climatological): Corvallis State Univ (River Station, if different)
MONTH: Jun 2012
STATE: OR
COUNTY: BENTON
RIVER:
TIME (local) OF OBSERVATION RIVER:
TEMPERATURE: 08:00
PRECIPITATION: 08:00
STANDARD TIME IN USE: P
TYPE OF RIVER GAGE:
ELEVATION OF RIVER GAGE ZERO:
FLOOD STAGE:
NORMAL POOL STAGE:

WS FORM B-91 (03-09)
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

RECORD OF RIVER AND CLIMATOLOGICAL OBSERVATIONS

This form was dynamically generated from WeatherCoder 3 data on 2013-03-13 at 11:38 AM EDT.

DATE	TEMPERATURE: 24 HRS ENDING AT OBSERVATION MAX	TEMPERATURE: 24 HRS ENDING AT OBSERVATION MIN	TEMPERATURE: AT OBSN	PRECIPITATION: 24 HR AMOUNTS AT OR Rain, melted snow, etc. (in and hundredths)	PRECIPITATION: Snow, ice pellets, hail (ins.and tenths)	PRECIPITATION: Snow, ice pellets, hail ice on ground (in)
1	78	53	63	0.00	0.0	0
2	79	51		0.16	0.0	0
3	68	46	51	0.01	0.0	0
4	64	47	51	0.17	0.0	0
5	63	44	51	0.27	0.0	0
6	62	37	48	0.02	0.0	0
7	69	48	51	0.32	0.0	0
8	63	47	51	0.07	0.0	0
9	58	43	47	0.23	0.0	0
10	64	37	46	T	0.0	0
11	71	44	57	0.00	0.0	0
12	78	55	57	0.07	0.0	0
13	70	53	55	T	0.0	0
14	69	45	52	0.00	0.0	0
15	71	45	57	0.00	0.0	0
16	79	53	59	0.00	0.0	0
17	86	57	61	0.00	0.0	0
18	72	51	54	0.00	0.0	0
19	65	49	52	0.00	0.0	0
20	63	45	53	0.05	0.0	0
21	79	45	58	0.00	0.0	0
22	82	53	54	0.03	0.0	0
23	65	49	51	0.47	0.0	0
24	65	50	53	0.04	0.0	0
25	70	51	54	0.01	0.0	0
26	65	51	54	0.28	0.0	0
27	66	45	53	0.06	0.0	0
28	76	47	57	0.00	0.0	0
29	74	57	62	0.01	0.0	0
30	75	60	63	0.00	0.0	0
31						
	70.3	48.6	SUM	2.27	0.0	

PRECIPITATION: Over a straight line (--------) through hours precipitation was observed, and a wavy line (~~~~~) through hours precipitation probably occurred unobserved
A.M. 1 2 3 4 5 6 7 8 9 10 11 NOON P.M. 1 2 3 4 5 6 7 8 9 10 11

WEATHER (Observation Day) Mark 'X' for all types occurring each day: Fog, Ice pellets, Glaze, Thunder, Hail, Damaging winds; Time of occurrence if different from above

RIVER STAGE: Condition; Gage reading at ___ AM; Tendency

REMARKS (SPECIAL OBSERVATIONS, ETC.)

CHECK BAR (for wire weight) NORMAL CHECK BAR
READING | DATE

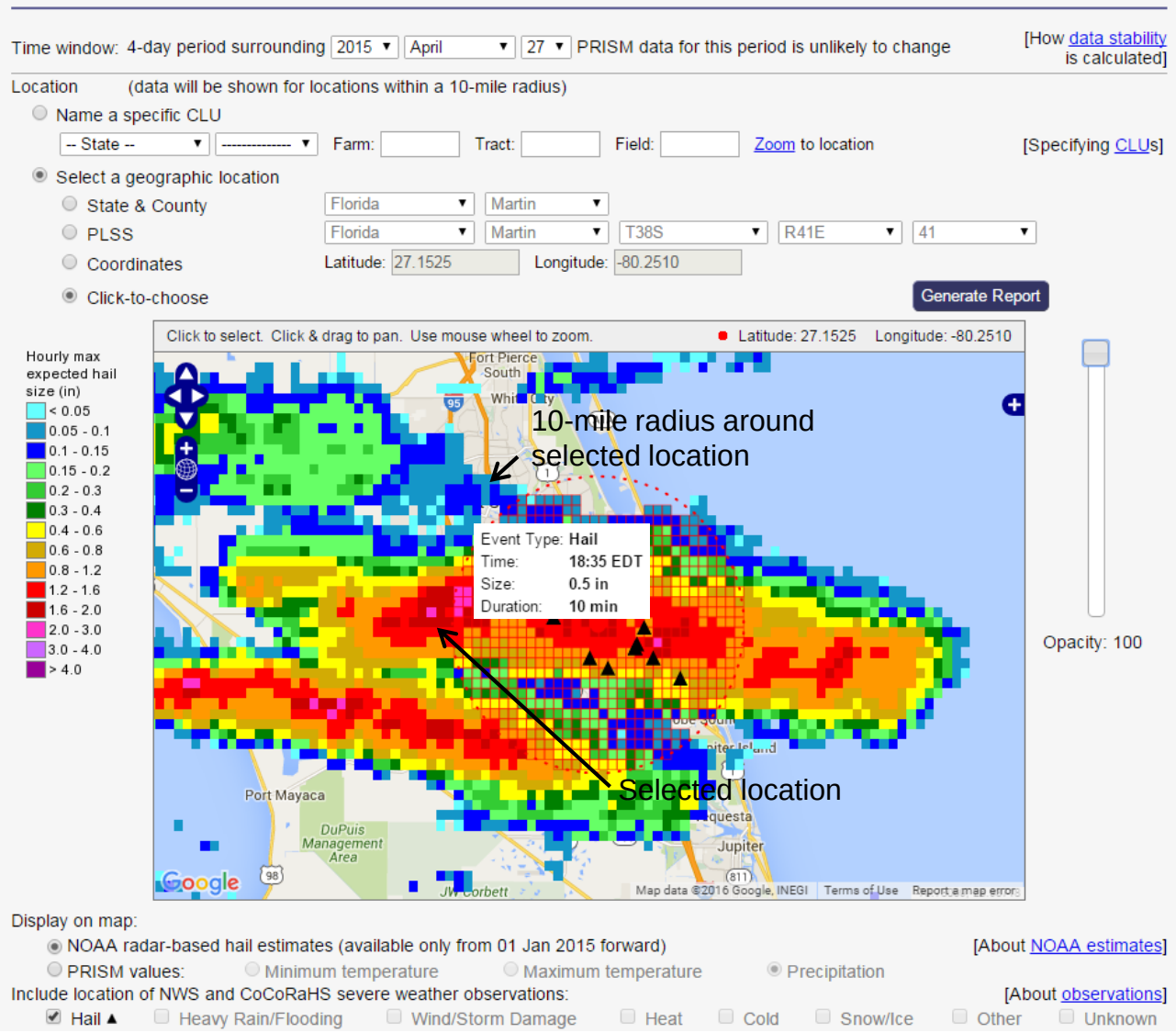
CONDITION OF RIVER AT GAGE
A. Obstructed by rough ice
B. Frozen, but open at gage
C. Upper surface smooth ice
D. Ice gorge above gage
E. Ice gorge below gage
F. Shore ice
G. Floating ice
H. Pool stage

Fog | Ice pel | Glaze | Thund | Hail | Dam winds

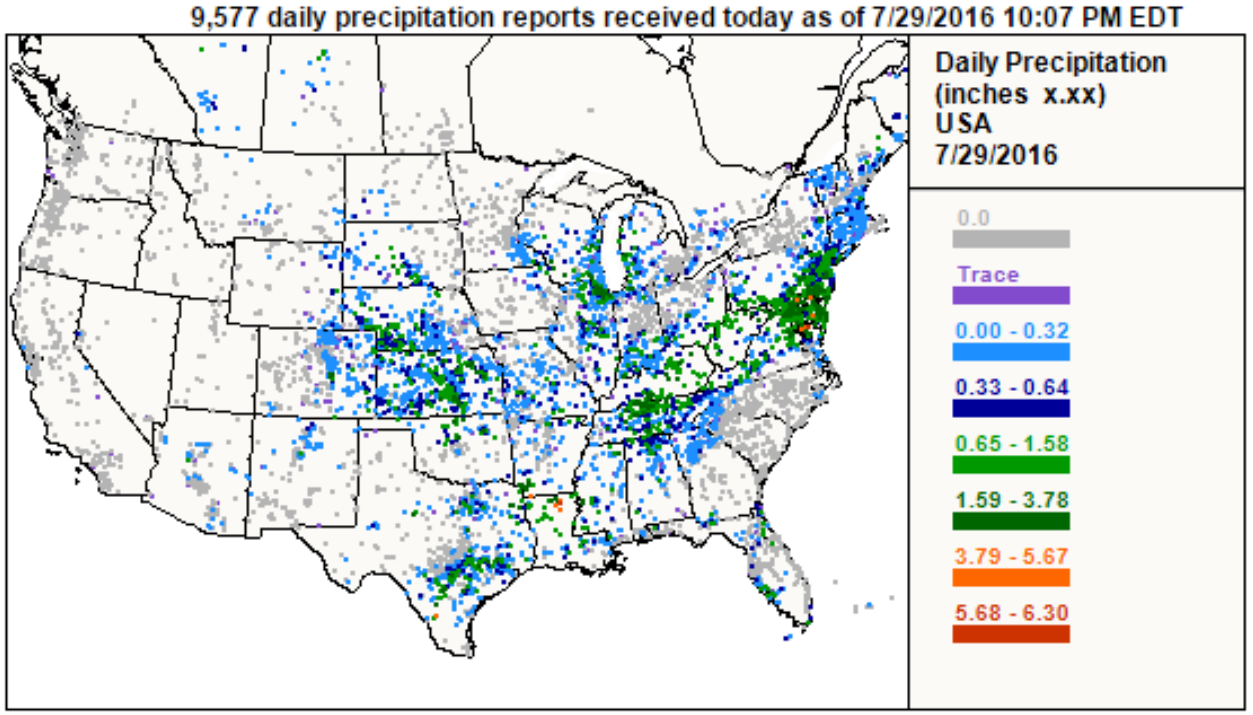
OBSERVER: OREGON STATE UNIVERSITY
SUPERVISING OFFICE: PQR PORTLAND
STATION INDEX NO.: 35-1862-02

RMA Severe Weather Interface

Martin Co, FL, 27 Apr 15, 18:00 EDT



CoCoRaHS Observations



Anyone can join: http://cocorahs.org

CoCoRaHS Comments with "Hail" in the Text

Positive (January 2016)

"Some corn pellet sized **hail** and windy yesterday morning."

"Some mung bean size **hail**"

1045AM: Dippin' Dots-sized **hail**"

"Severe baseball sized **hail** damage. Many windows blown out, severe structural damage and vehicles severely damaged. Rain gauge and weather station destroyed. **Hail** storm began at 6:00PM and lasted approx. 45 minutes."

"Hail up to 2.33 in. Most just under an inch. I was unable to find the ones with my blood on them. Had to put on a MC helmet after I was attacked. As of 0702 I'm still bleeding"

CoCoRaHS Comments with "Hail" in the Text

Negative (January 2016)

"We did not have any rain, sleet, **hail** or snow at our house this day."

"Neither rain or **hail**, sleet nor snow. Just plain COLD."

"Trace of frost in the rain gauge and on the **hail** pad."

"Lightly misting now. Yesterday we had a brief bit of something mid morning- little white balls but not **hail**, they were light weight almost like Styrofoam…"

CoCoRaHS Comments with "Hail" in the Text

Mis-direction (April 2016)

I got a lot of pea size **hail**, but some areas in San Antonio got golf ball and soft ball size **hail**.




??

"On the afternoon of 4/1/16, I ran into pea-sized **hail** several times on a trip from Princeton MO back to Gallatin, most noticeably in Trenton, MO. I also saw small **hail** in north Gallatin, around 3:30 that afternoon. My wife noticed a trace of rain at home, but didn't see any **hail**. There was nothing in the gauge at observation time on 4/2/16."

Ø

"Looks like "here we go again" as the N.W.S. issued a Severe Thunderstorm Watch until midnight - includes **Hail** over golf ball size. We'll see, so far they've been batting zero & hopefully we'll get the water w/o the **Hail**."

Ø

Wrap Up Thoughts

- Wall-to-wall weather and climate surfaces are accessed by thousands of users each day
  - Many important decisions and lots of taxpayer money depend on them
  - They are used to assess how the country's climate is changing
- Creating these maps takes domain knowledge about how climatologists do their work, and the ability to simulate it
- Data from many sources are combined to produce the most intelligent product
  - The earth's physiography
  - "Climate fingerprint"
  - Radar assimilation (precipitation)

Wrap Up Thoughts

- Data are imperfect and lacking
  - People have biases and don't follow directions
  - Volunteers are just that
  - Automated stations have their own issues
- Metadata are imperfect and lacking
  - Station locations
  - Observation times
- But the data can tell you wonderful things if you can separate the wheat from the chaff

To succeed in this work, you have to LOVE DATA