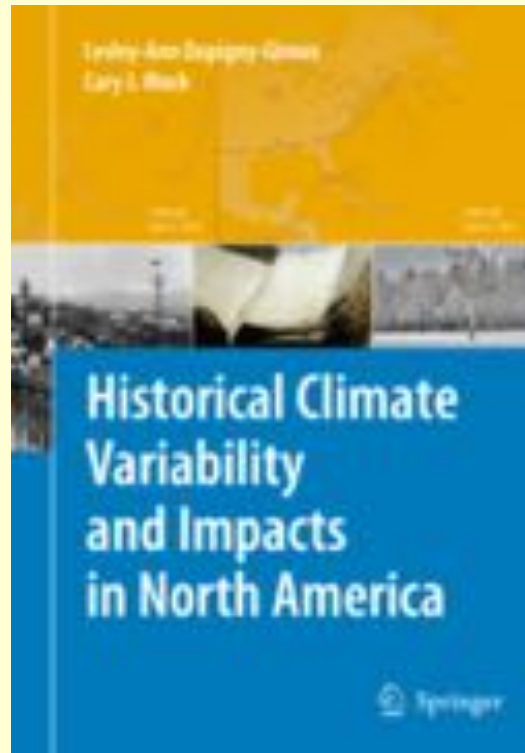


North American Historical Climate, Current Status and Comments



Go Gamecocks!



Go Ducks!

<http://www.springer.com/environment/global+change+-+climate+change/book/978-90-481-2827-3>

Cary J. Mock , Department of Geography, U. of S. Carolina

Victoria C. Slonosky, Independent Researcher

Michael Chenoweth, Independent Researcher

PURPOSE OF THE PRESENTATION:

To provide a brief overview of N American historical climatology (mostly pre-1880), with some Data Recovery thoughts from the perspectives of Mock, Slonosky, and Chenoweth.

THEMES AND EXAMPLES:

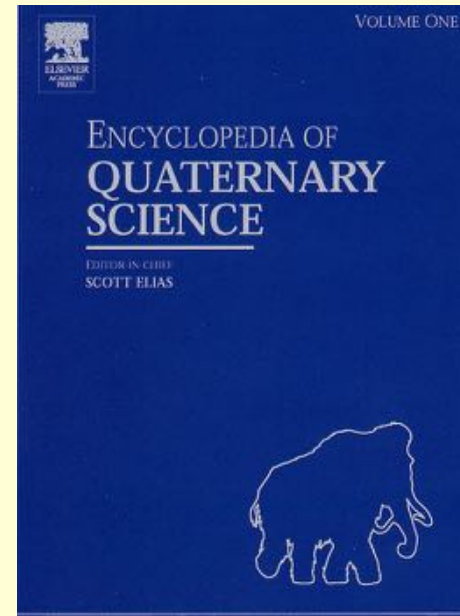
- **The Finding and Nature of “High Priority” Historical Climate Materials**
- **Instrumental Data (pressure, temperature are of particular interest)**
- **Logbook, and Documentary Data (particularly for precip. Cloudiness, Wind, Extremes)**
- **Some Data Quality and Methodological Aspects**
- **Some Historical Climate Reconstructions**
- **Relationships with Paleoclimatology**

Historical Climatology

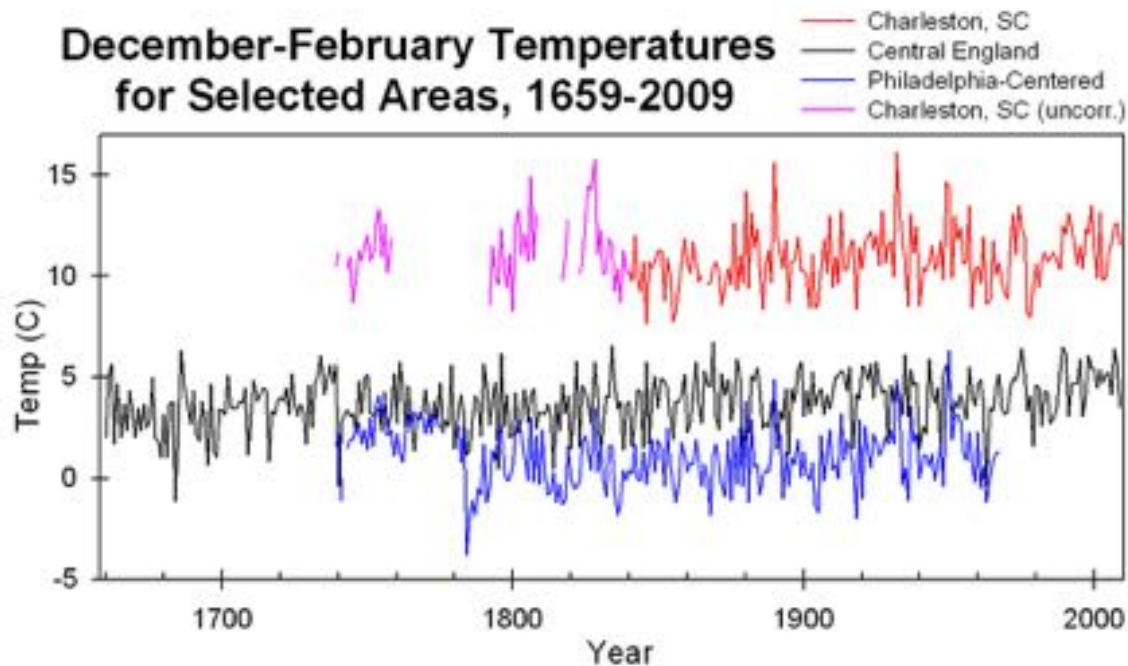
M Chenoweth, Elkridge, MD, USA

© 2007 Elsevier B.V. All rights reserved.

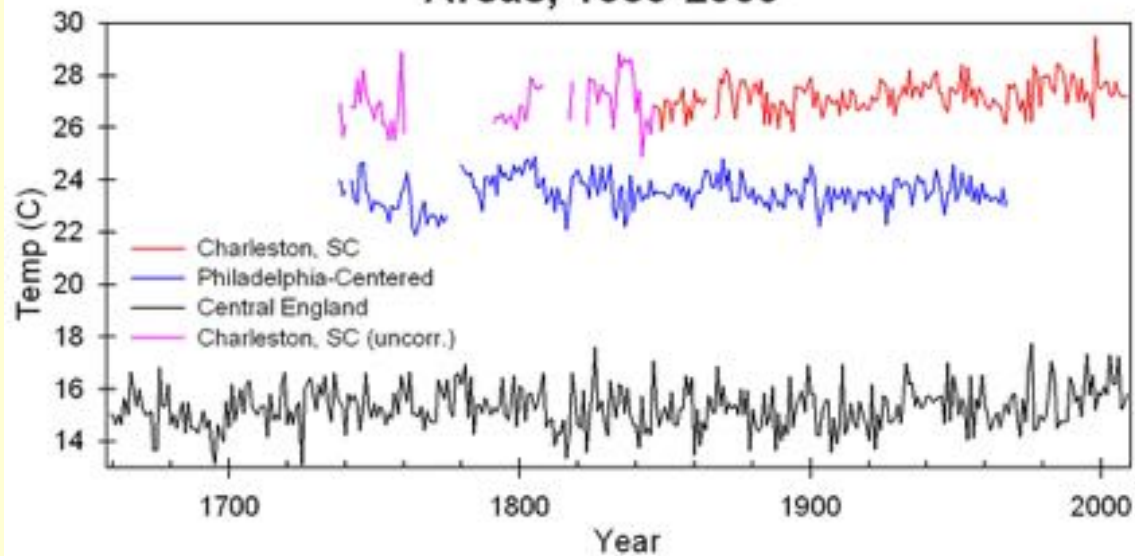
“There are no shortcuts to the production of high quality historical climate records”

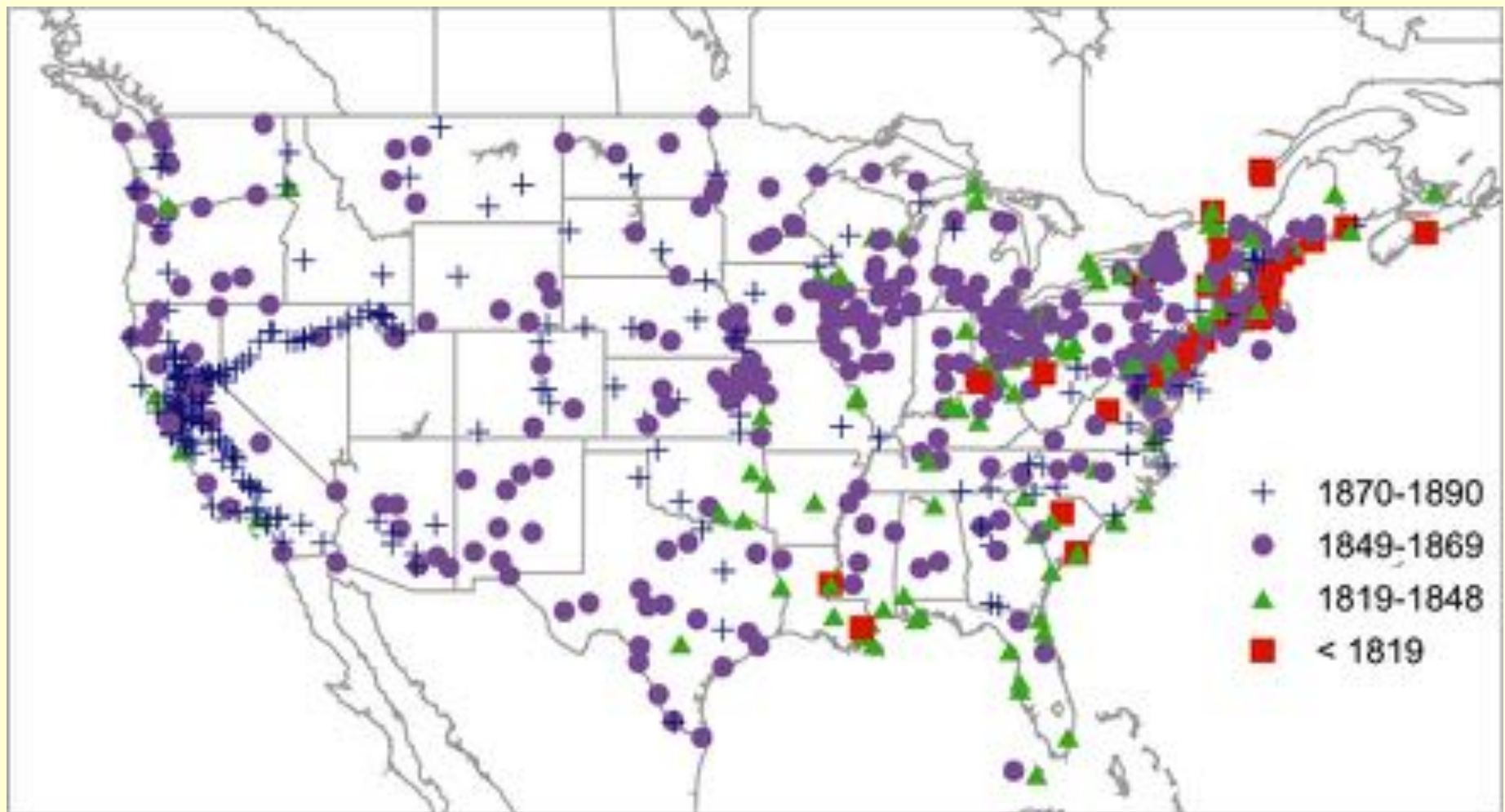


December-February Temperatures for Selected Areas, 1659-2009



June-August Temperatures for Selected Areas, 1659-2009





Distribution of Stations with Records $>$ 10 Years

Geographical Distribution of Archives and Repositories Visited and Queried



- ★ Research done by Mock
- Research done by one of Mock's Colleagues
- Research by Correspondence
- Queried but No Archival Records Extracted



UK National Archives,
Kew, London



US National Archives,
Washington, D.C.



Kendall Institute,
New Bedford
Whaling Museum,
New Bedford, MA



South Caroliniana
Library, Columbia , SC

Day	Therm.			Remarks
	Morn.	Noon	Even.	
1	30	32	32	Clear / Breeze
2	31	36	37	Clear & Fine
3	34	35	35	Clear & Fine
4	33	32	37	Cloudy
5	35	34	38	do & Star
6	32	30	39	do & do
7	30	29	36	Clear & Fine
8	30	32	36	Clear & Fine
9	31	35	38	Cloudy & Breeze
10	32	38	37	do & do
11	34	39	34	Clear & Fine
12	33	35	35	Clear & Fine
13	33	37	38	Clear & Fine
14	37	36	39	do & do
15	37	34	35	do / Cloudy
16	32	30	30	Clear & Fine
17	30	34	35	do & do
18	31	34	35	do & do
19	32	35	38	do & do
20	35	39	39	do / Breeze
21	33	30	34	do / Breeze
22	34	33	34	Clear & Fine
23	32	30	34	do / Breeze
24	32	30	34	do / Breeze
25	34	38	39	Clear & Fine
26	35	38	39	Clear & Fine
27	38	34	34	Clear & Fine
28	34	37	35	Clear & Fine
29	32	35	38	do / Breeze
30	35	33	34	Clear & Fine
31	37	35	36	Clear & Fine

Day	Therm.			Remarks
	Morn.	Noon	Even.	
1	37	5	29	Cloudy - SW. Moon in sight. P.M. XIV
2	32	5	29	fair - W. P.M. cloudy - clearing
3	35	5	29	cloudy - N. rain P.M.
4	30	5	29	rain - X p.m. - wind S. clearing
5	35	5	29	rain - SW - p.m. - wind W. clearing
6	30	5	29	fair - W. p.m. - SW. clearing
7	30	5	29	cloudy - X
8	36	5	29	rain - rain - X. cloudy p.m. - rain all night
9	32	5	29	rain - rain - W. - fair - SW. clearing hard - moon in sight
10	30	5	29	fair - IV - p.m. - cloudy - SW
11	35	5	29	clear - V - moon in sight - p.m. - cloudy
12	30	5	29	fair - IV - mid night - cloudy
13	32	5	29	fair - X - p.m. - S
14	36	5	29	rain - SW
15	36	5	29	fair - fair - W
16	34	5	29	cloudy - X - rain from 2 p.m.
17	31	5	29	clear - rain - S
18	32	5	29	fair - S - clear up P.M.
19	39	5	29	rain - IV - fair - SW
20	35	5	29	rain - SW - clearing - p.m.
21	32	5	29	clearing - W
22	36	5	29	fair - X
23	36	5	29	fair - S - fair - cloudy - S

Examples from Halifax, NS, April 1828 (left), and from McCord for Montreal in April 1831 (above)

METEOROLOGICAL JOURNAL.
NANTUCKET, JUNE 4 TO JUNE 10, 1825.
 (50 feet above the level of the ocean.)

Days of Observation.	Hours of Observation.	Barometer.	Thermometer.	Course of the Winds.	Weather.
4	6 A. M.	29.82	56	E	Rain
	2	29.48	55	NE	do.
	10 P. M.	29.65	55	NE	do.
5	6 A. M.	29.57	61	S E	Rain.
	12	29.63	62	S S E	Fair.
6	10 P. M.	29.70	58	N W	do.
	6 A. M.	29.65	59	S S W	Fair.
	12	29.68	61	S W	do.
7	10 P. M.	29.74	58	W S W	do.
	6 A. M.	29.82	63	W	Fair.
	12	29.90	74	W	do.
8	10 P. M.	28.84	64	S W	do.
	6 A. M.	29.82	69	Y W	Fair.
	12	29.87	81	W N W	do.
9	10 P. M.	29.81	65	W N W	do.
	8 A. M.	29.90	67	E	Fair.
	12	29.97	78	S S W	do.
10	10 P. M.	29.94	60	S S W	do.
	6 A. M.	29.93	64	W S W	Fair.
	12	29.93	75	W S W	do.
	10 P. M.	29.86	65	S W	do.

WEEKLY REPORT OF THE WEATHER, from the Centre Signal Station, at Bermuda—Between the 6th and 12th October, 1839; height above the Sea being 134 feet.

Date	Hours.	Direction of Wind.	Winds force	Weather.	Barometer.	Thermometer	Genl. Remarks
Oct. 1839							
6th	noon	NE	6	go.	30.04	75	weather threatening
7th	noon	NE	8	g	30.04	74	Wind veered to N at 8.15 pm.
	pm.	N by E	9	ur	29.92	71	Bar. falling, wr. threatening.
	midnight	N	9	ur	29.9	70	
8th	am 2-25	N	9	o	29.8	67	Th. storm at 2.15 am.
	noon.	NE by S	9	m o	29.7	70	Moderate breeze at 10pm
9th	noon.	NW	4	m	29.71	73	frequent showers & dist. th.
10th	noon.	NNE	2	by	30.0	74	High sea at N. Reef.
11th	noon.	NNE	2	by	30.02	75	
12th	noon.	E by N	2	by	30.04	78	Calm at 5.15 p. m, wind rising at 6.45 pm; lt. in the s. at 9.20 pm.: lt. continued at intervals with hvy. rain during the night.
	midnight	NE	3	c	30.04	77	

JOHN MAHON, Sergt., 30th Regt.,
Signal Director.

The Numbers used to denote the Wind's Force, and Symbols to express the State of the Weather are those now in use in the Royal Navy.

Bermuda Royal Gazette.

Hamilton, October 15, 1839.

Newspaper clippings from the *Nantucket Inquirer* for June 1825, and the *Bermuda Royal Gazette*, early October 1839

Meteorological Observations for past Week.

BY G. B. PELIER, M. D., CITY REGISTRAR.

Days.....	Barometer.			Thermometer attached.			Thermometer detached in the shade & open air.		
	T. A. M.	2 P. M.	9 P. M.	T. A. M.	2 P. M.	9 P. M.	T. A. M.	2 P. M.	9 P. M.
	25	30.380	30.334	30.286	34	48	45	35	50
26	30.246	30.174	30.208	45	62	58	46	63	56
27	30.276	30.260	30.284	54	61	59	55	61	60
28	30.204	30.186	30.262	57	62	61	57	63	61
29	30.182	30.102	30.028	54	59	60	55	60	60
30	30.006	30.000	30.114	59	62	62	60	62	63
31	30.104	30.080	30.150	66	53	45	56	63	46

Days.....	Register Thermometer.		Dew Point.	Wind-its course and force from		Remarks.
	Min.	Maxi.	Sun Rise.	Sun rise	4 P. M.	Weather.
25	29	62	32.7	S. W.....2	S. W.....2	Fair.
26	39	63	42.3	S. W.....3	S. W.....2	Fair.
27	49	61	50.3	S. W.....1	S. W.....1	Cloudy.
28	52	63	52.3	S. W.....2	S. W.....1	Cloudy.
29	50	63	52.7	S. E.....2	S. E.....1	Rain 0.01
30	53	63	57.7	S. W.....2	S. W.....2	Rain. 0.70
31	50	56	63.2	S. E.....2	E. N. E. 4	Rain. 0.91

Charleston
Board of Health
Dec. 1859.
From the
*Charleston
Courier*

Meteorological Table.

Observations by THOMAS TENNENT, Mathematical Instrument Maker, sign of the "Wooden Sailor," Battery street, opposite the Custom House:

Date.	Gr't cold	9 A. M.		Meridian.		3 P. M.		6 P. M.	
		Bar.	Th.	Bar.	Th.	Bar.	Th.	Bar.	Th.
Jan. 2	40°	29 80	50°	29 81	52°	29 83	53°	29 86	50°
3	32	29 96	47	29 96	49	29 91	48	29 91	46
4	26	30 13	42	30 14	45	30 12	46	30 10	43
5	34	29 86	45	29 86	47	29 87	47	29 89	46
6	33	29 69	45	29 69	47	29 70	48	29 72	47
7	36	30 00	47	30 00	52	30 00	54	30 02	52
8	37	30 01	49	29 92	50	29 87	50	29 84	48

REMARKS.—Jan. 2d, cloudy, variable; 3d, clear, clouds; 4th, Ice formed, light clouds; 5th, rain; 6th, rain and gale, cloudy; 7th, clear, variable; 8th, rain.

RAIN GAUGE — Jan. 5th, 2:67; 6th, 1:49; 8th, 1:35—Total, 5:51 inches.

WINDS — Jan. 2d, North, West; 3d, North; 4th, East, S by E., South; 5th, South, S. by E; 6th, North, N by E; 7th, South, South east; 8th, South-east, South.

San Francisco,
Jan. 1862.
From the
Daily Alta
California

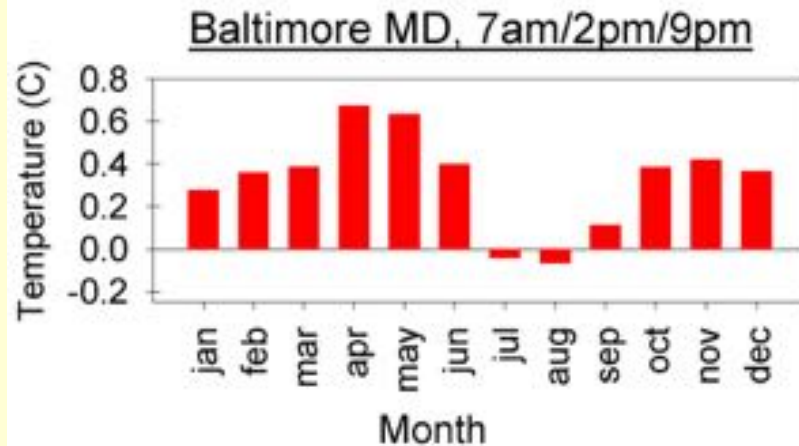
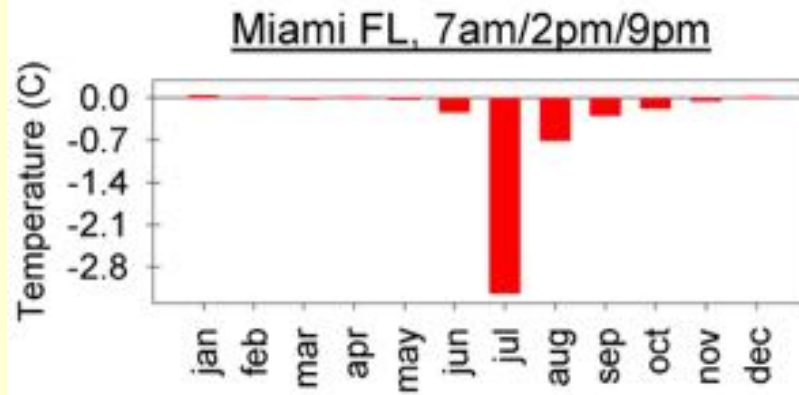
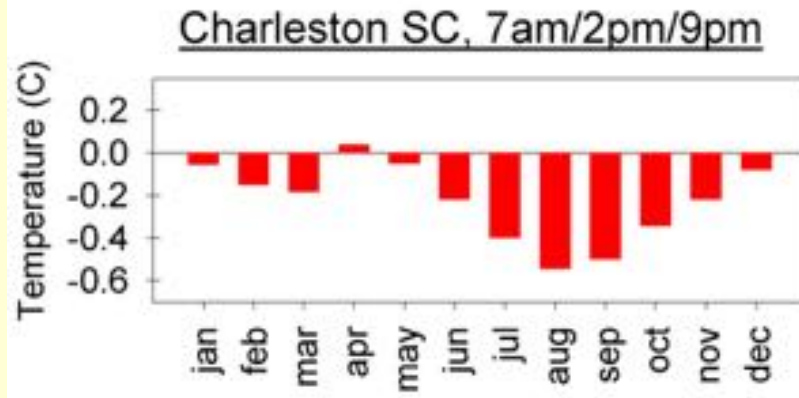
St. Paul Island March 1886

Lat 57° 49' Lon 156° 29' 45" 7 411

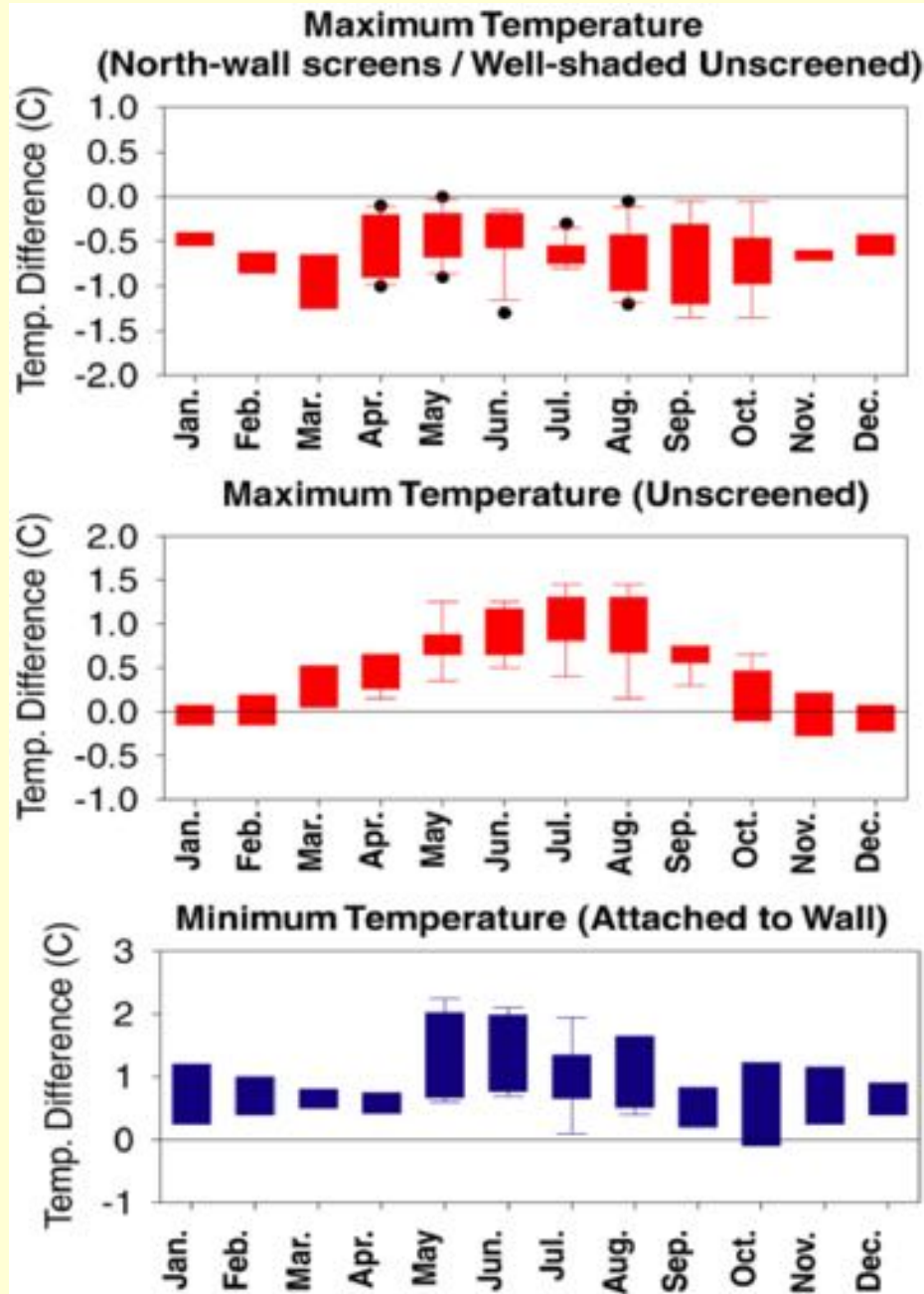
Date	Wind	Weather	Clouds	Barometer	Thermometer	Fahrenheit	Celsius	Remarks	
									Barometer
1 S	3	Clear	1	0	35	29.320	30	25 57 Light snow	
2 SW	11	Cloudy	11	NE	Light	31	29.780	34	25 . .
3 S.E.	11	Clear	1	NE	Light	31	29.380	32	25 Snowing fast
4 SW	5	Cloudy	10	NE	.	30	29.60	32	20 Snowing fast
5 .	3	Snow	5	.	.	32	29.60	34	30 "
6 Clear	.	.	1	4	Light	26	29.60	32	20 "
7 N	2	Cloudy	10	0	0	21	29.70	33	20 "
8 .	4	Snow	5	0	Light	14	29.30	21	14 23 Snowing fast
9 NE	5	Blowing	10	0	0	10	29.60	18	11 "
10 N	7	Snow	10	0	0	0	29.70	12	2 "
11 SE	2	Clear	10	0	0	10	30.10	10	0 "
12 SW	3	Cloudy	10	0	Light	30	29.820	30	10 20 Snowing fast
13 NW	2	.	10	0	.	25	29.720	32	27 . .
14 SW	11	.	10	.	.	20	30.20	30	23 15 . .
15 S.	6	.	10	.	.	30	30.10	33	25 "
16 .	4	.	10	.	.	28	29.60	32	25 30 Rain
17 NW	6	.	10	SE	.	20	30.10	33	18 20 Snowing fast
18 N	4	.	10	E	.	30	30.10	30	20 "
19 NW	5	Cloudy	10	SE	.	16	30.10	30	14 "
20 N	11	Clear	10	0	.	12	30.50	15	0 "
21 NW	3	Cloudy	10	SE	.	25	30.20	25	12 15 Snowing fast
22 NE	3	Clear	0	0	0	8	30.00	30	8 10 . .
23 N	11	.	0	0	0	2	29.920	8	0 "
24 NE	11	.	0	0	0	1	29.60	11	0 "
25 .	8	Cloudy	10	0	0	13	29.60	13	1 "
26 NW	6	Clear	0	0	0	12	29.60	16	10 "
27 N	11	Snow	11	0	0	12	29.50	16	7 "
28 N	0	Clear	0	0	0	15	29.90	16	10 "
29 S.	3	Snow	5	0	0	25	29.00	25	10 20 Snowing fast
30 N	3	Cloudy	10	NE	Light	30	29.30	25	25 15 . .
31 E.	3	.	10	0	0	26	29.60	20	20 "

St. Paul Island,
AK

Temperature Differences between Fixed Observations and Max/Min Observations

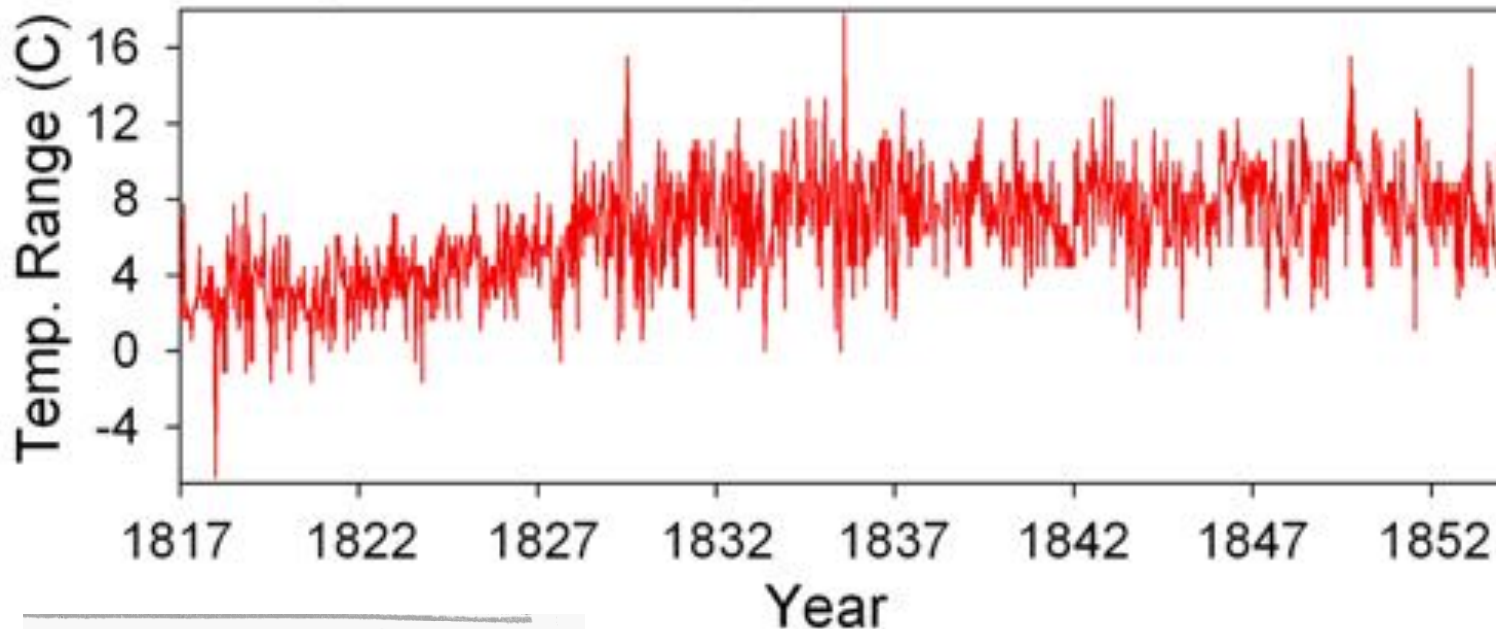


Issues of Different
Fixed Observation
Times



**“Unstandard
Thermometer
Exposure
Error” (modified from
Chenoweth 1993)**

Early PM minus Early AM Daily July Temp. Ranges for Newport, RI, 1817-1855



Metecorological Diary for September, 1821.

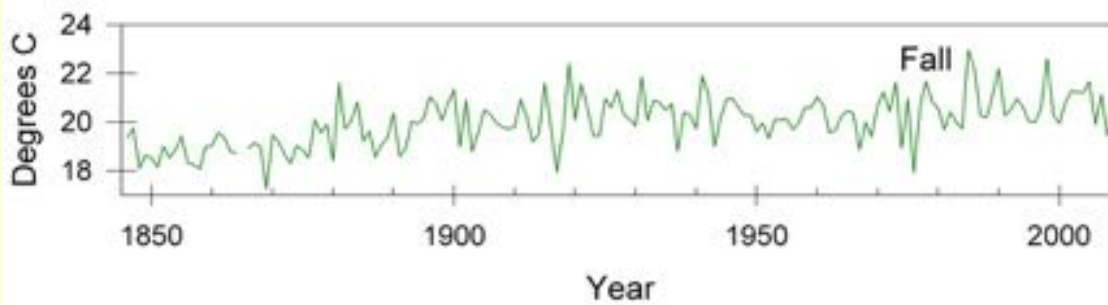
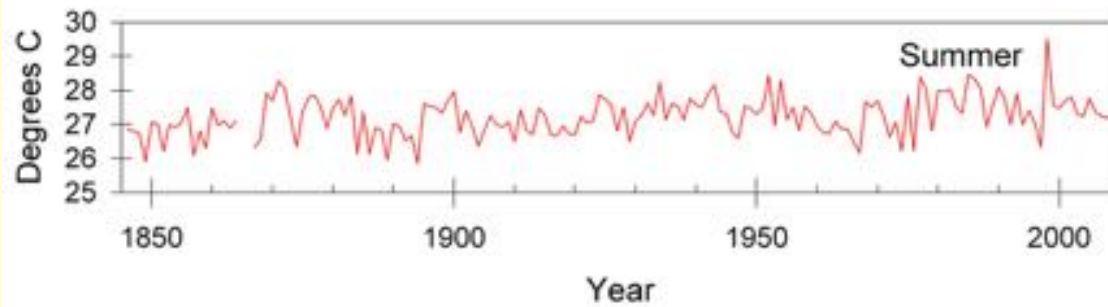
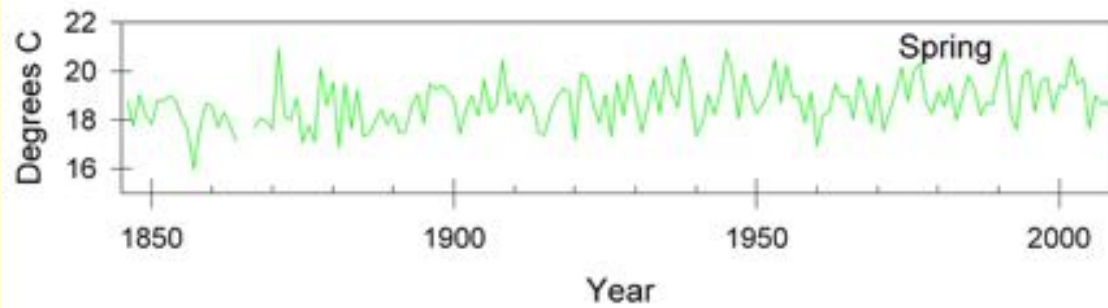
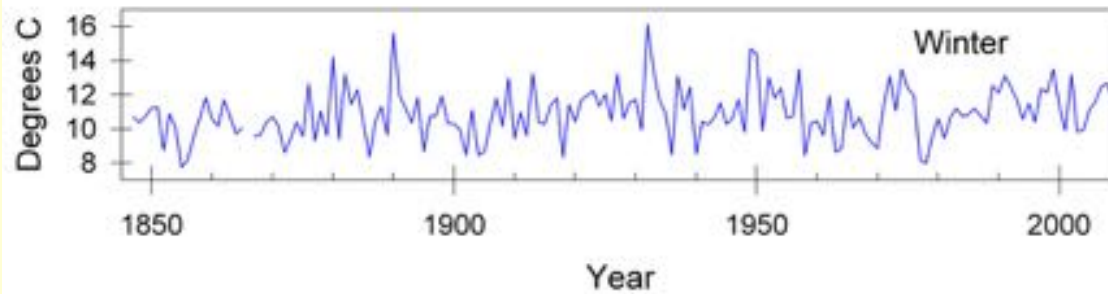
SEPT.	8 a.	m 2 p.	m 10 p.	m.	WINDS	WEATHER.
1	73	78	73		S SbyE SSE	Cloudy hazy hazy brisk winds
2	73	77	73		SSW	Rain 0.17 clear cloudy brisk wd
3	76	78	73		S SE SSE	Foggy cloudy violent winds
4	72	73	70		SW	Cloudy clear brisk winds
5	68	74	66		SW	Clear clear clear brisk winds
6	65	80	63		WbyN NW ENE	Clear clear clear brisk winds
7	65	72	68		N SbyE SW	Clear clear clear light winds
8	71	77	69		SW	Clear clear clear brisk winds
9	71	75	70		SW	Light & r. cloudy th & r. 1.01
10	72	76	63		WbyN NW E	Clear clear mod. wd [bk. winds
11	68	72	67		SW S SSE	Clear clear clear brisk winds.
12	65	72	63		SE SW NW	Rain clear rain 0.53 brisk winds
13	63	72	60		NNW	Clear clear clear moderate wind
14	64	74	55		NhW SW N	Clear clear clear mod. wd
15	63	69	60		NyE S SW	Clear clear clear mod. winds
16	65	69	65		SSW SSE SE	Clear flying clouds brisk winds
17	62	66	64		SSE E SSE	Rain 0.29 flying clouds md. wind
18	64	74	62		NW N N	Cloudy clear cloudy light winds
19	62	71	60		NNW	Clear clear clear brisk winds
20	58	67	62		NNE SE SSE	Clear clear clear mod. winds
21	68	75	65		SW	Cloudy clear clear brisk winds
22	66	70	58		NW	Clear clear clear brisk winds
23	57	68	60		WNW	Clear clear clear mod. winds
24	69	62	67		ENE SE SE	Flying clouds rain 0.88 brisk wind
25	68	75	60		WNW SW NW	Clear clear clear moderate winds
26	54	61	36		NbyE SW N	Clear moderate rain 0.11 bk. wd.
27	52	63	53		WNW	Clear clear clear light winds
28	60	68	58		W SW WNW	Clear clear clear mod. winds
29	61	67	60		N SSW SE	Clear clear clear light winds
30	64	67	60		SE	Clear clear cloudy light winds

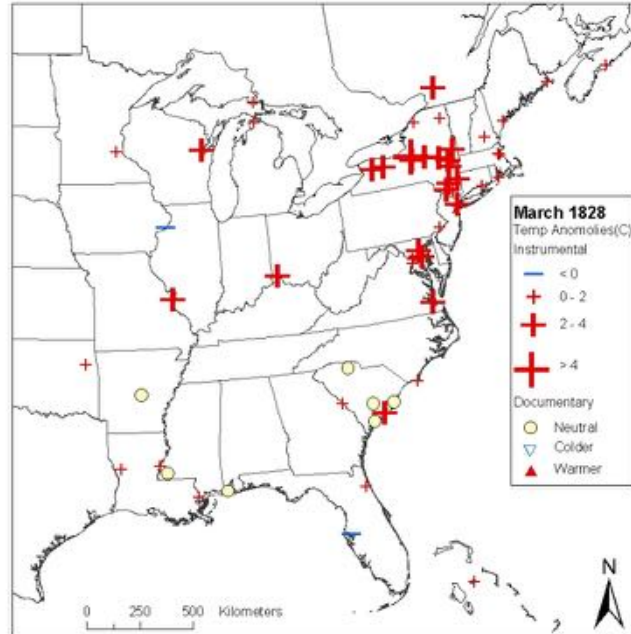
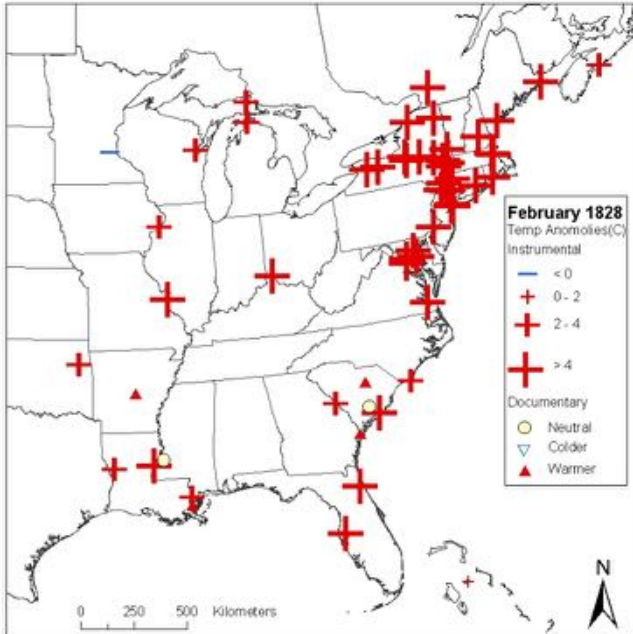
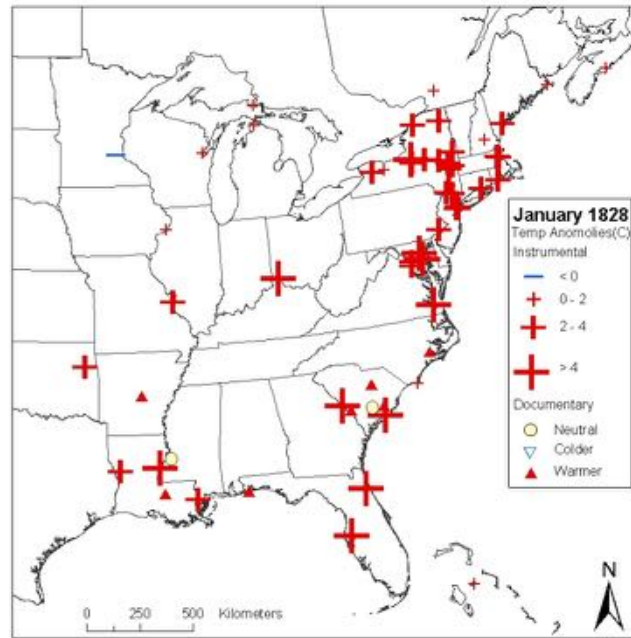
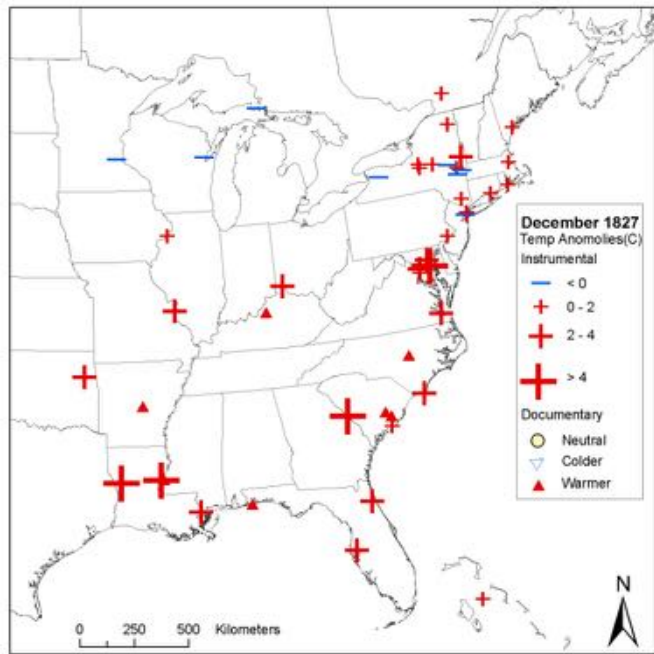
Mean temperature of the month 66°. 61 | Greatest variation in one day, 19°.
 Mean temperature of the coolest day 50° | Least, 3°.
 Mean heat of the warmest day 75° 2-3 | Rain, in the month 3.02 inches.

Searching for Discontinuities

Record from the *Newport Mercury*

Charleston, SC Temperatures, 1846-2009





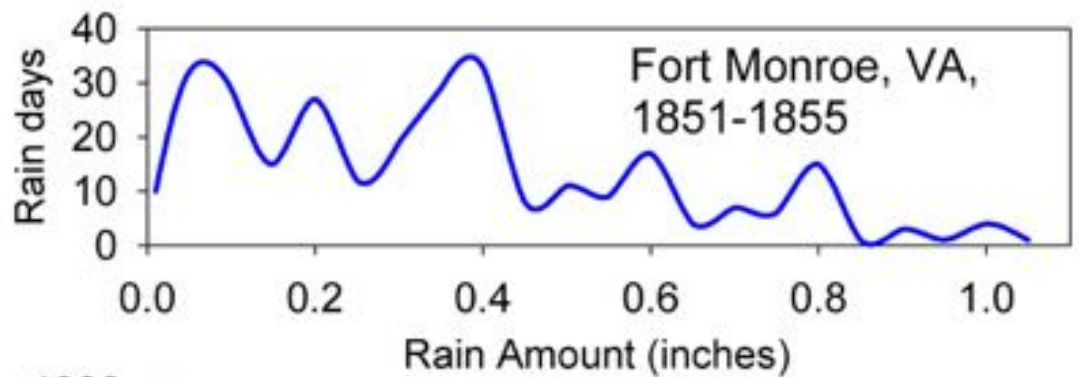
**Temperature
Anomalies
1827-28, based
on data within
the 1820-1840
timeframe**

Analyses of Historical Precipitation:

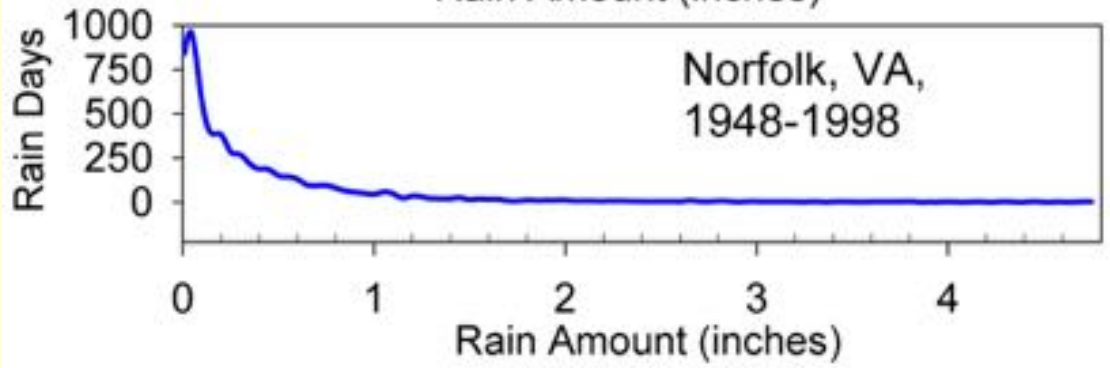
Missing Days?

Time Ob Bias?

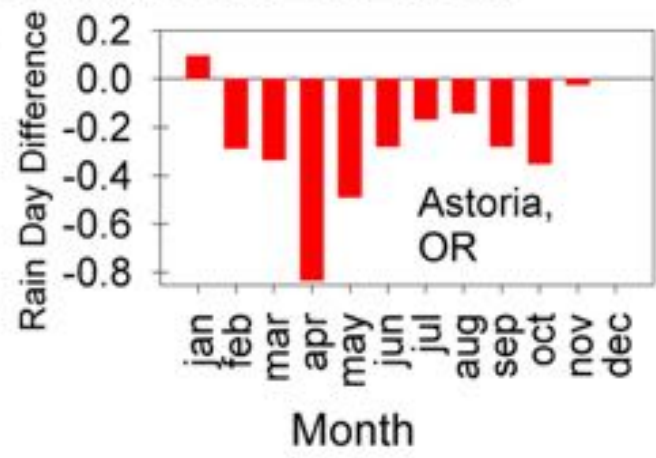
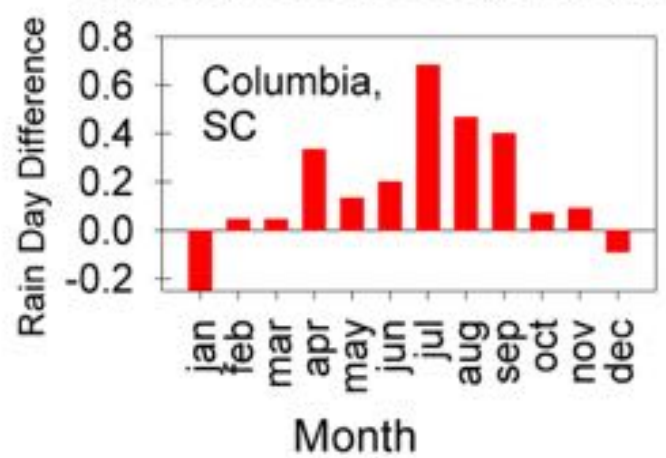
“YOU NEED EVERYTHING”



Rain Day Frequency Curves



Rain Day Differences, 5 PM-based Minus 24 Hr-Day-based



Log of United States Steam Ship *Rhode Island*, Commanded by *Lieut. J. R. Swinburn*.

Subsidiary
 SERVICES OF THIS 21 DAY IN September 1861

No.	Date	Time	Wind		Direction	Thermom.		Remarks
			Force	Dir.		Surf	Air	
1	12	12.00	W	7	bc			Underway to S. Am.
2	11			7		47.70		Underway to S. Am.
3	12		S.W.	7				Underway to S. Am.
4	12			7		66.47	27.77	Underway to S. Am.
5	11.5		S.W. by W	6				at 12.00 washed down deck saw look in
6	12			6		63.67		for hospital at 5. but reported from ship
7	11		S.W. by W	6				on deck at 7. but for hospital at 8.00
8	11.5			6		62.67		found a few soft specimens found it.
9	12.5			7				J. R. Swinburn
10	12	12.00		7		63.67		
11	6	12.00	S.W.	6				S to Providence
12	10	12.00		6		62.67		at 12.00 saw sail of ship on N. side. also

Distance per Log 276 miles
 Latitude, D. R. 39.06 N.
 Longitude, D. R. 74.16 W.
 Latitude observed 39.02 N.
 Longitude 74.19 W.
 Current
 Variation 2 East.

1	12	12.00	S.W.	6	bc			Underway to S. Am.
2	12			6		62.67		
3	12	12.00		7				
4	12			7		67.67	28.00	
5	12			8				S to S. Am.

Logbook of the USS *Rhode Island*, September 1861

HMS Wellesley. 1849

Located 44 04 N, 62 15 W Chebucto [near Halifax, anchored]

<u>Date</u>	<u>Time</u>	<u>Wind</u> <u>Dir.</u>	<u>Wind</u> <u>Spd.</u>	<u>Weather</u>	<u>Barometer</u>	<u>Temp.</u>
Sept. 22	6:00 AM	ESE	3	Bl	30.14	64
	12 noon	ESE	5	cg	"	"
	1:00 PM	ESE	5	cg		
	5:00 PM	SE	4	Dql	30.00	63
	9:00 PM	"	"	"		
	10:00 PM			5		
	12:00 PM	"	"	"	"	"
Sept. 23	4:00 AM	SE	5	orq		
	6:00 AM	"	"	"	29.83	63
	10:00 AM	"	6	"	"	"
	12 noon	"	"	"	"	"
	1:00 PM	SE	6	oqp	29.76	64
	7:00 PM	"	7	cqg	29.72	64
Sept. 24	1:00 AM	"	3	org		
	7:00 AM	SW	3	cg	29.52	64
	1:00 PM	SW	3	Bl	29.50	64
	8:00 PM	SSW	1	cg	29.46	64
Sept. 25	1:00 AM	SSW	3	cg		
	6:00 AM	"	"	"	29.50	64
	8:00 AM	WSW	4	"	"	"
	10:00 AM	NW	6	Bg	"	"
	12 noon	NW	6	Bl	29.60	64
	1:00 PM	NW	6	Bl		
	6:00 PM	NW	2	"	"	

**Typed
extract from
the log of the
HMS
Wellesley**

Monday August 6th 1849. Latitude 7. E. Longitude 160. 25 North. Long 160. 15 East. These 24 hours commenced with pleasant weather the wind N.E. blowing at 2 M at 3 P.M. we saw whales leaved ahead with the land 10 miles distant and along side at 8 P.M. we kept off N.W. wind strong. At dusk we arrived. Whales were light wind leaved out from the S.W. at 6 A.M. saw a plenty of whales leaved out and killed him took him along with us and began to cut a little. Having strong from the N.E. finished cutting and had whales.

Tuesday August 7th 1849. Latitude 7. E. Longitude 160. 32 North. Long 160. 54 East. These 24 hours commenced with strong winds from the Northward made sail and kept off S.W. we saw whales leaved ahead and killed him took him along with us. Having strong from the N.E. finished cutting and had whales.

Wednesday August 8th 1849. Latitude 7. E. Longitude 160. 33 North. Long 160. 53 East. These 24 hours commenced with light winds from the S.W. variable began to sail started 5 baskets of Bread into the sail wind and started 8 baskets of Flour into bags saw no ships in sight seeing nothing to do with the land 15 miles distant and pleasant and smooth. Whales were light wind at 4 P.M. spoke the gross ship, Orghall, Huntress, Therman and the Redford and November Hunt of Mystic 1000 lbs. taken to the S.E. Latter hours just about employed in

Extract from a whaling logbook in the western Arctic, August 1849



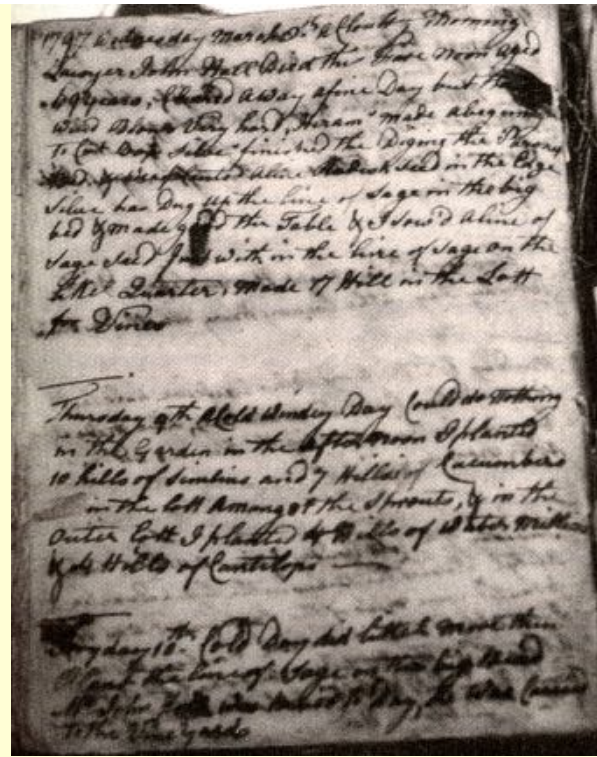
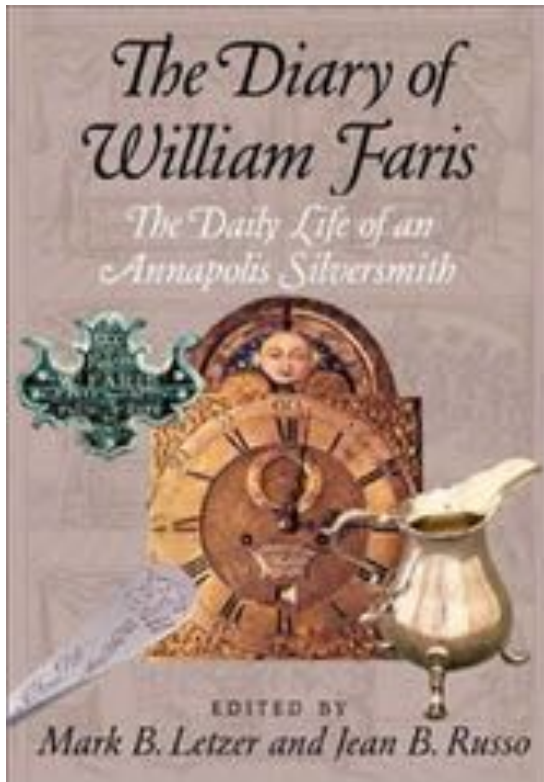
WRAGG-BOROUGH

Charleston Neck. 1835.

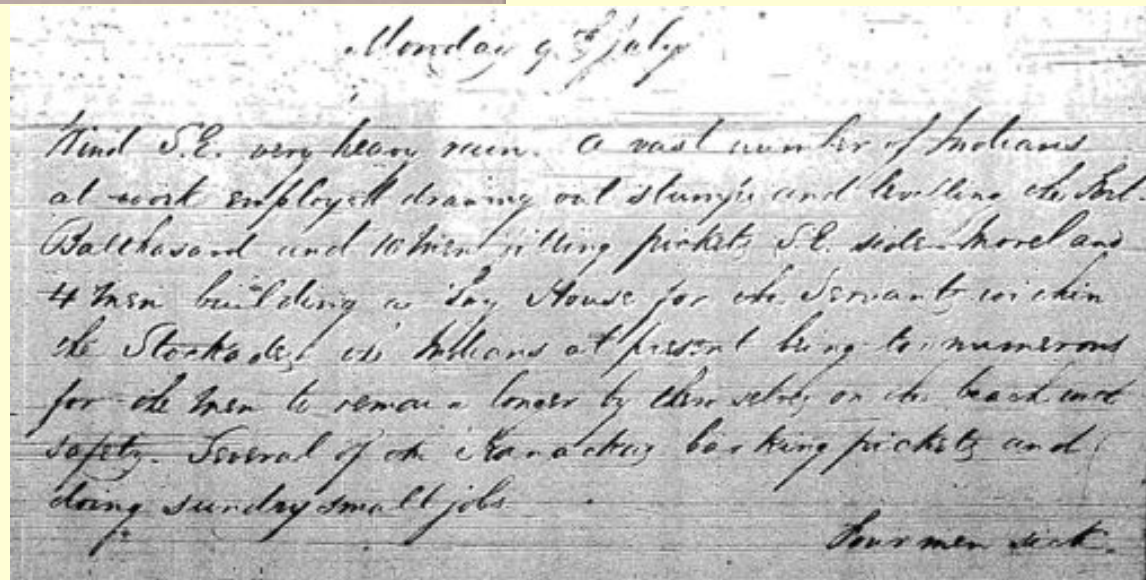
- August 1st 1835 A bright hot day.
Thermometer 90°. Wind west.
- 2^d Sunday Overcast and pleasant Th. 82
wind easterly.
- 3^d Clear. wind easterly. Th 81.
- 7th Cloudy, close and damp.
- 8th Rainy day with an easterly wind.
- 9th Much rain last night, and to day with
an high easterly wind Th. 76.
- 10 Cloudy in the morning but as the
day advanced it cleared off. wind
northerly Th 78.
- 11th Bright pleasant day, wind northerly
in the morning, but by sun down it got

Diary of Charles
Heyward, Charleston
Neck, SC August 1835

From the S. Caroliniana Library,
Univ. of SC

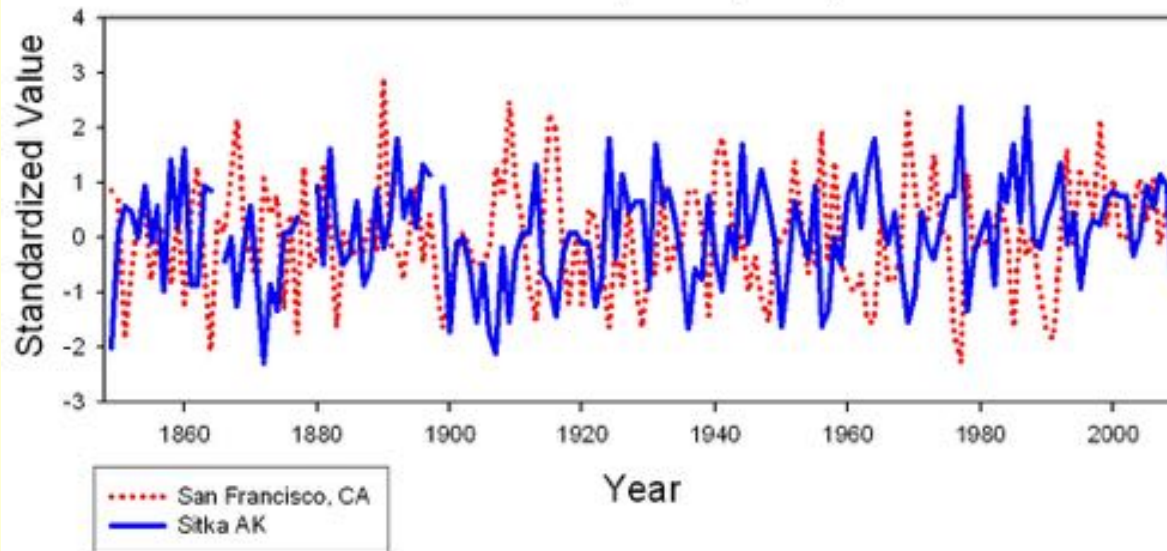


Entries from the Diary of William Faris, March 1797, MD Historical Soc.

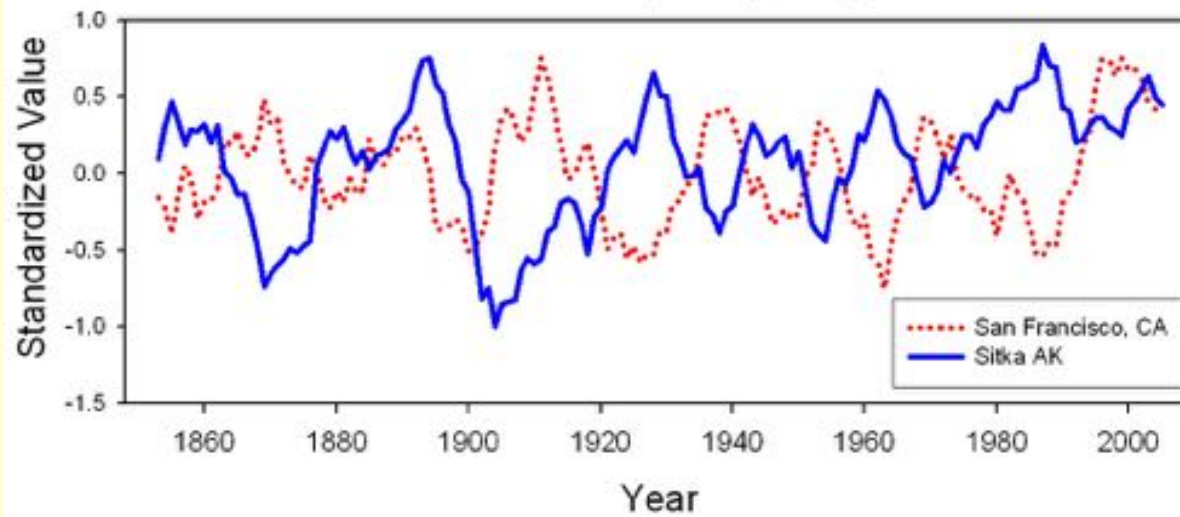


Example from Ft. Rupert, BC from the Hudson's Bay Company, July 1849.

Comparisons of Standardized Sitka AK
and San Francisco CA Pcp Frequency Data for DJF



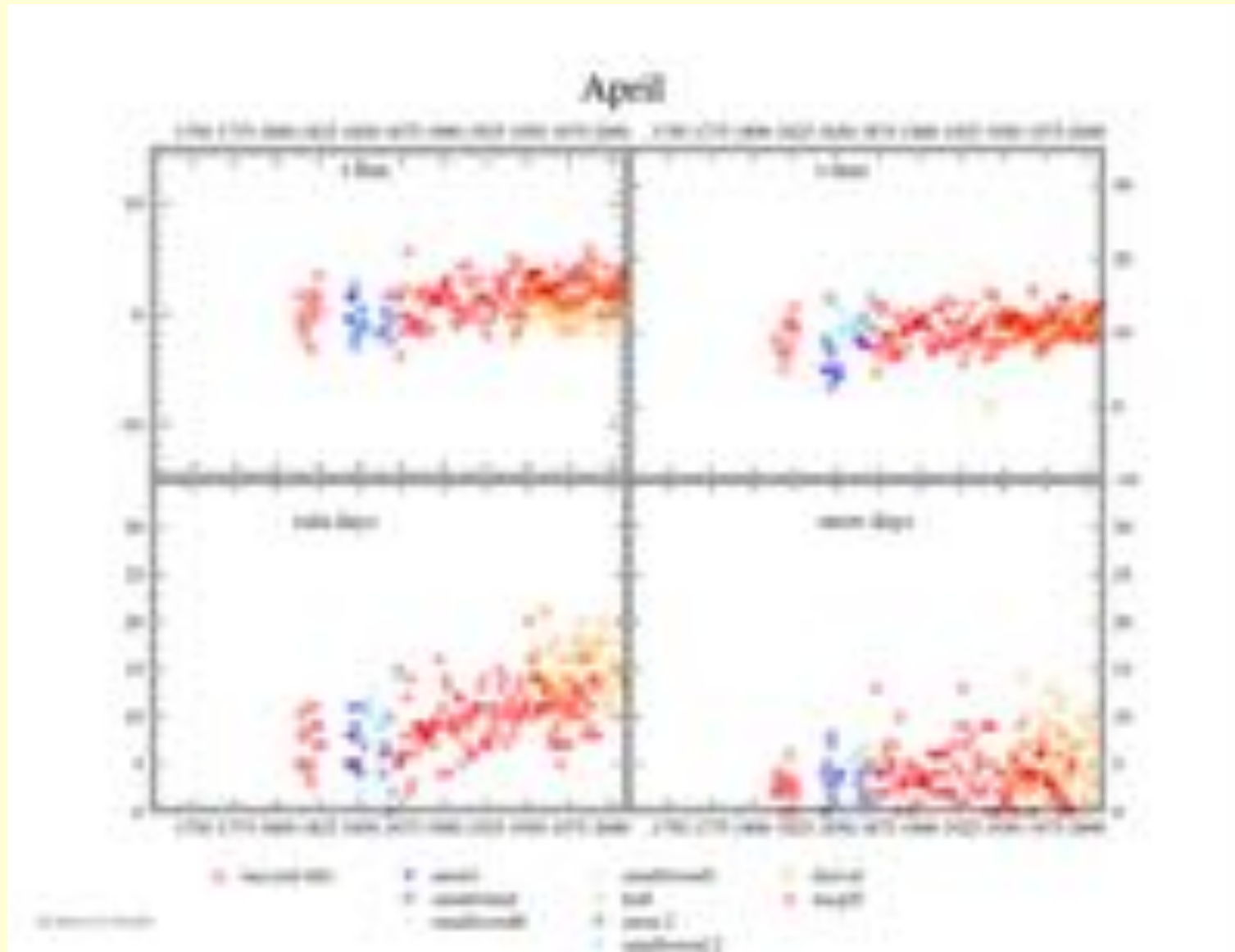
Comparisons of 10-Yr running means of Standardized Sitka AK
and San Francisco CA Pcp Frequency Data for DJF



Plan: Diaries and Volunteers (V. Slonosky)

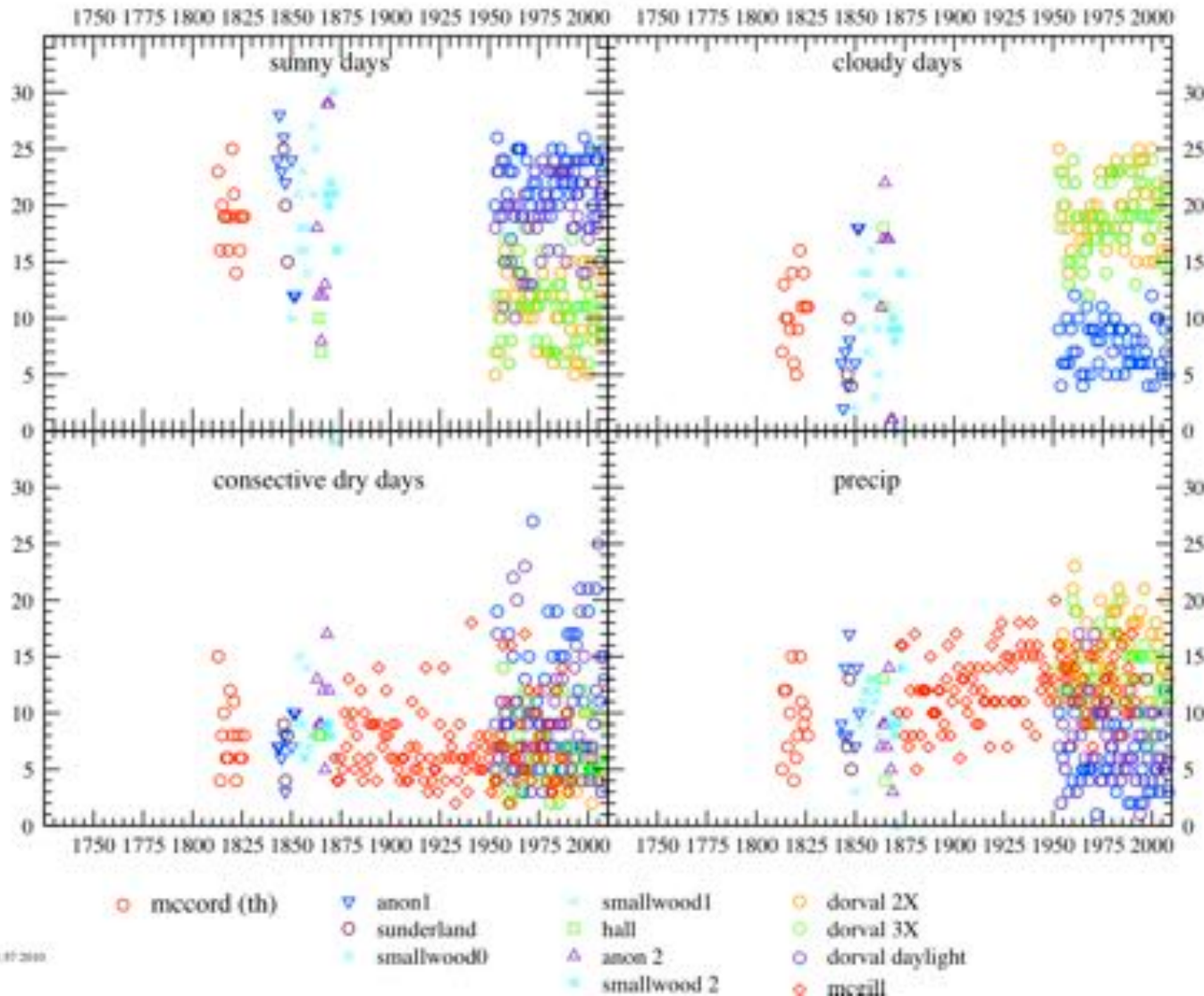
Atlantic Canada:

Dates	Halifax/ Nova Scotia	St. John's/ Newfoundland	volunteer
1786-1794	Acorn		Ray finished
1828-1860	<u>Alex. Munro on</u>		* will be split into 5-year segments.
1832-1837		<u>St. John's Times (Templeman?)</u>	
1863-1882	<u>Halifax Citadel Royal Engineers</u>		
1859-1874		<u>Twillingate</u>	
1859-1868		<u>Dolaney</u>	



“Preliminary Results” Montreal

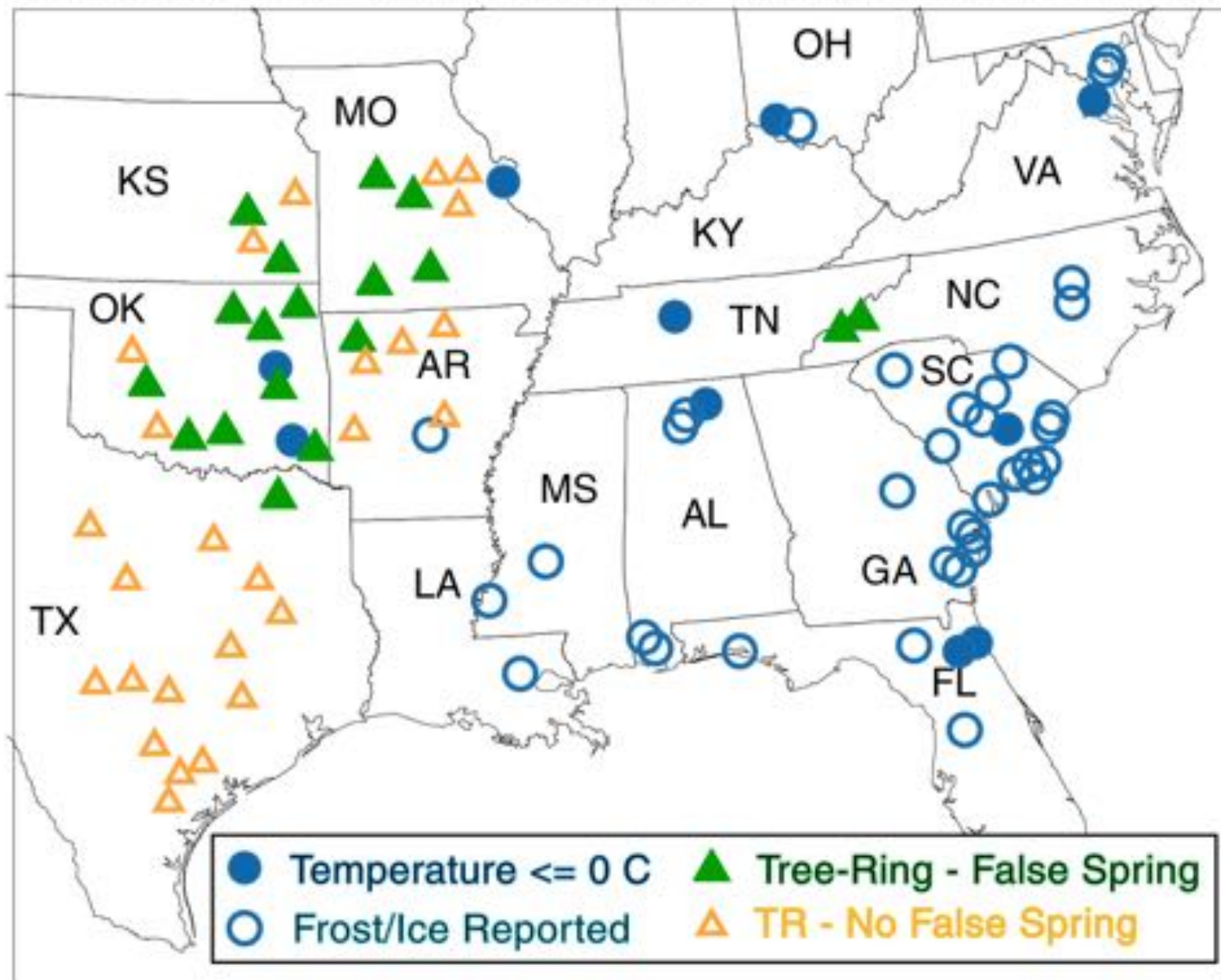
April



Tue Mar 16 13:11:07 2010

More “Preliminary Results” Montreal

Distribution of the Killing Frost/False Spring Event of April 1828



SOME CLOSING THOUGHTS:

1 – N American historical climate still lags much behind Europe and other areas around the world.

2 – Continue to do data recovery/digitization on land records based on various data quality, variables, record length, geography, weather extremes, copyright, etc.

3 – Similar focus on maritime archives. On the U.S. side, perhaps time now to get more into the original logbooks.

4 – Digitization of weather records should include “Everything” and not just 1 variable.

5 – Integration of other types of historical datasets – e.g., tropical cyclones, high resolution paleoclimate reconstructions.

6 – Connections and collaborations with historians and non-scientists are vital.

Questions? Email: mockcj@sc.edu

