Using Hourly-Observed Data Web Services: A Climatology of Wind Chill and Heat Index for the Eastern Continental United States

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NATIONAL WEATHER SERVICE

NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

NIDIS Drought.gov U.S. Drought Portal

Hourly Data Climatology Challenges

- Access & breadth of data a barrier to entry
- Methodologies on handling long term hourly data sparse
- How to Deal with Missing Data
  - Missing data not always in databases (“M”)

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Motivations

Hourly Web Services through Cli-DAP

- Saw a collective need for easier access to hourly data
- Partnered with Western Regional Climate Center who had infrastructure in place
- ASOS/AWOS data from Surface Data Hourly Global (DS3505)
- Hired an intern to create the web services for the database

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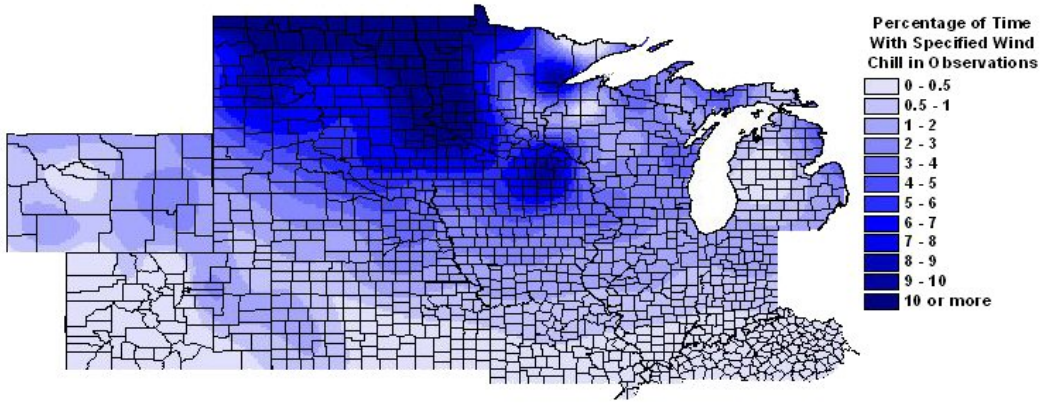
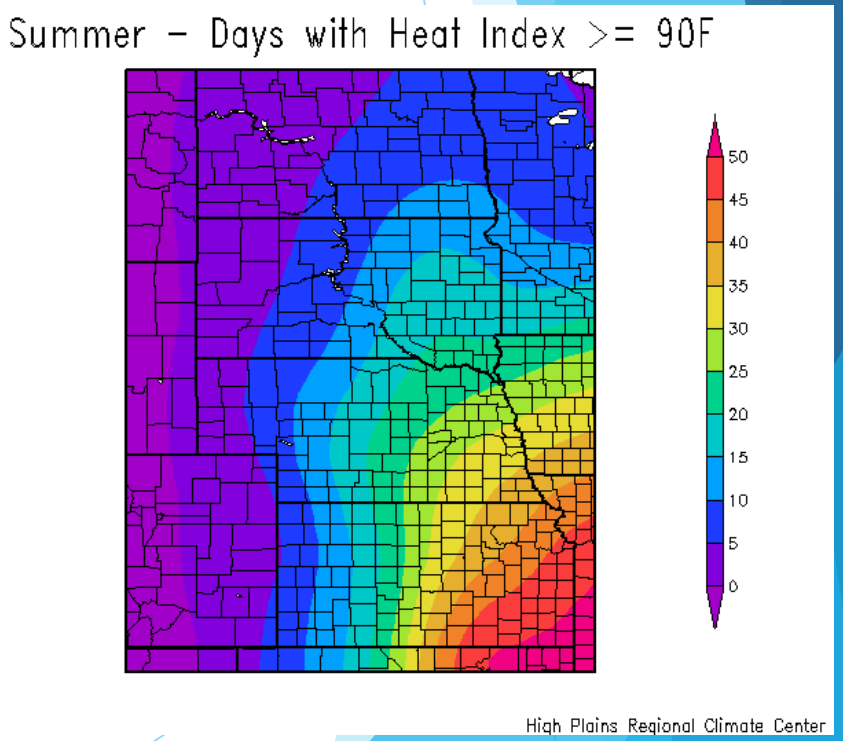
Motivations

Past Climatologies of Heat Index/ Wind Chill

- NWS Technical Report by Todd Rieck (1973-2000)
- High Plains RCC Climatology for Plains States (1973-2010)





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Process

Methods and Processes

- Start Date 1973
  - Most US Hourly Stations upgraded in early 70s, with many coming online in 1973
- Temperature Data availability of 90% or higher for 30+ years (non-consecutive)
  - Allows stations that shut down during ASOS transition to be included
- Days values must have at least 22 of 24 hours available
- More than 300 stations met data criteria across domain

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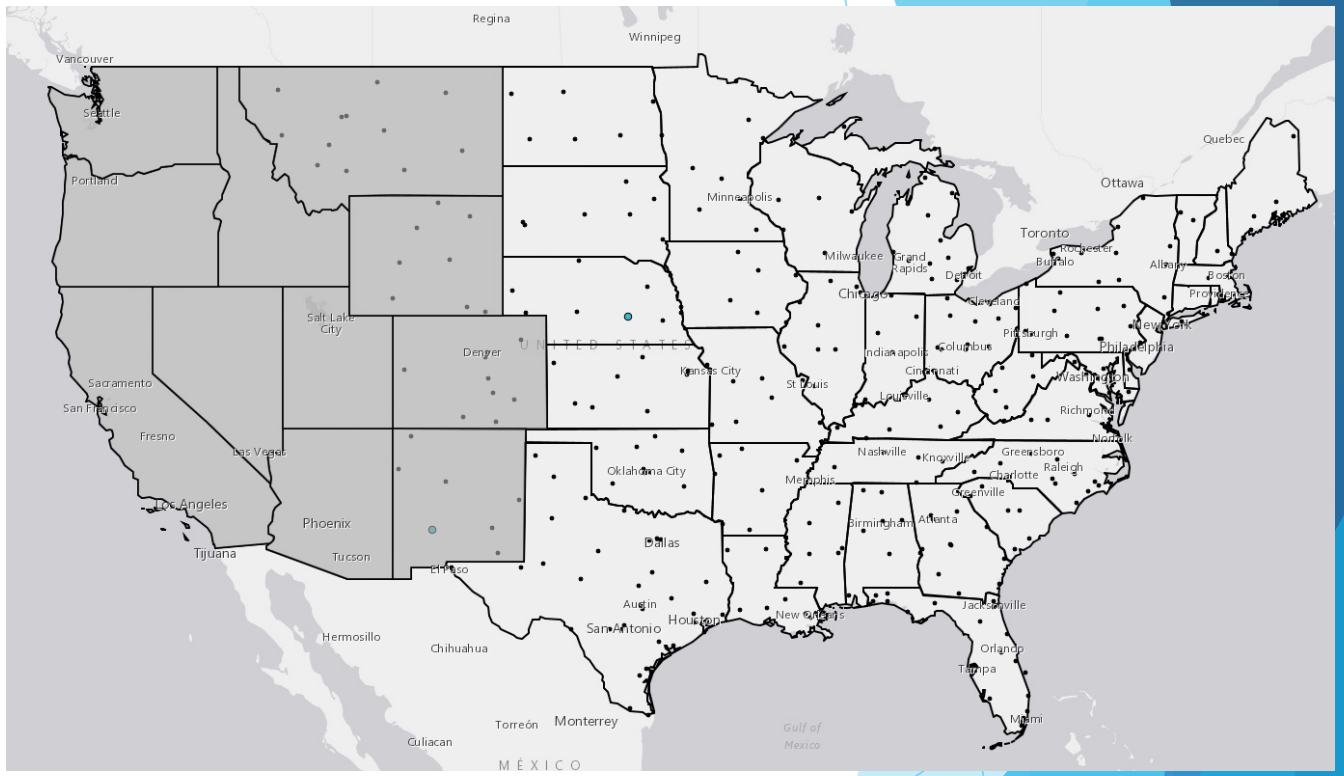
Process

Methods and Processes

- Spatial Domain
  - Continental U.S.
  - Stations over the western U.S. recently added through NCEI AWR



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Process

Methods and Processes

- Equations
  - Rothfusz (1990) for Heat Index
  - Osczevski and Bluestein (2005) for Wind Chill

Wind Chill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

NWS Heat Index

Relative Humidity (%) \ Temperature (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

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Process

Products

- Wind Chill
  - https://mrcc.illinois.edu/clim/windChill/index.jsp
- Heat Index
  - https://mrcc.illinois.edu/clim/heatIndex/index.jsp

Usefulness for Schools

- Hypothetical Example: School closings in La Crosse, WI
  - School's close for minimum wind chill of -30°F
  - Average 3.0 days per year with -30°F wind chill
  - Added with the 1.1 days of 6" snowfall per snow year, can expect 4 closings during winter on average

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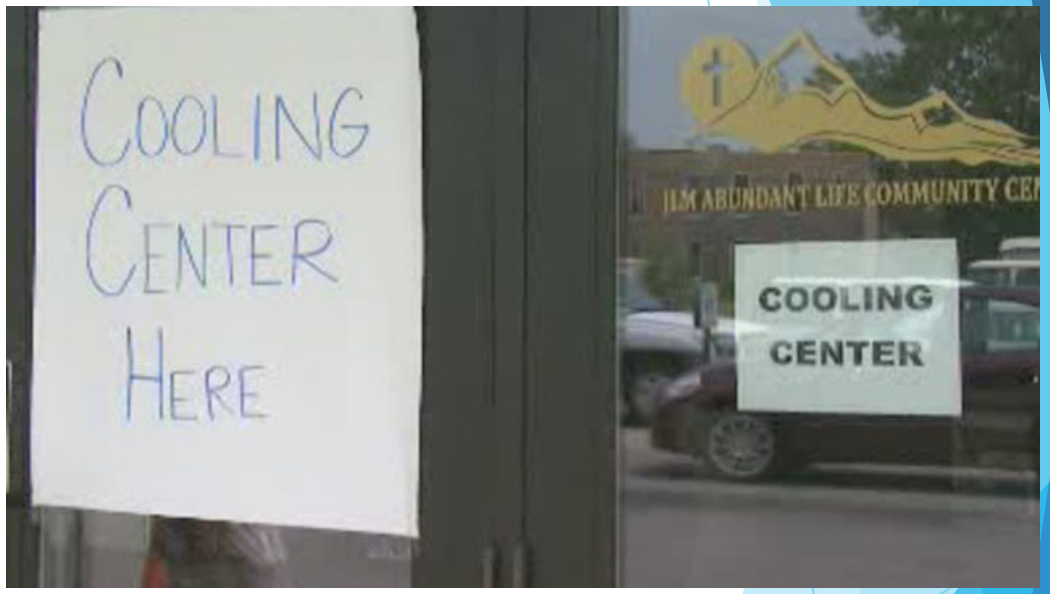
Decision-Making

Usefulness for Municipalities

- Hypothetical Example: Cooling Shelters in Chicago
  - Opened for Heat Index over 100°F for 3 hours
  - Average 3.5 days per year with 100°F heat index for 3 hours



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Decision-Making

Future Changes/Additions

- Wind chill switched from calendar year to snow year
- Product enhancements
  - Wind Chill GIS Map
  - Hour of the day averages through GIS map
  - Percent of hours values through GIS map
- Addition of percentile values
  - Use instead of discrete records due to data quality

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Future Considerations

For Station Data & Output, Contact Me:

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