

Frequency of Winter Weather Regimes in the US Northeast as an Indicator for National Climate Assessment

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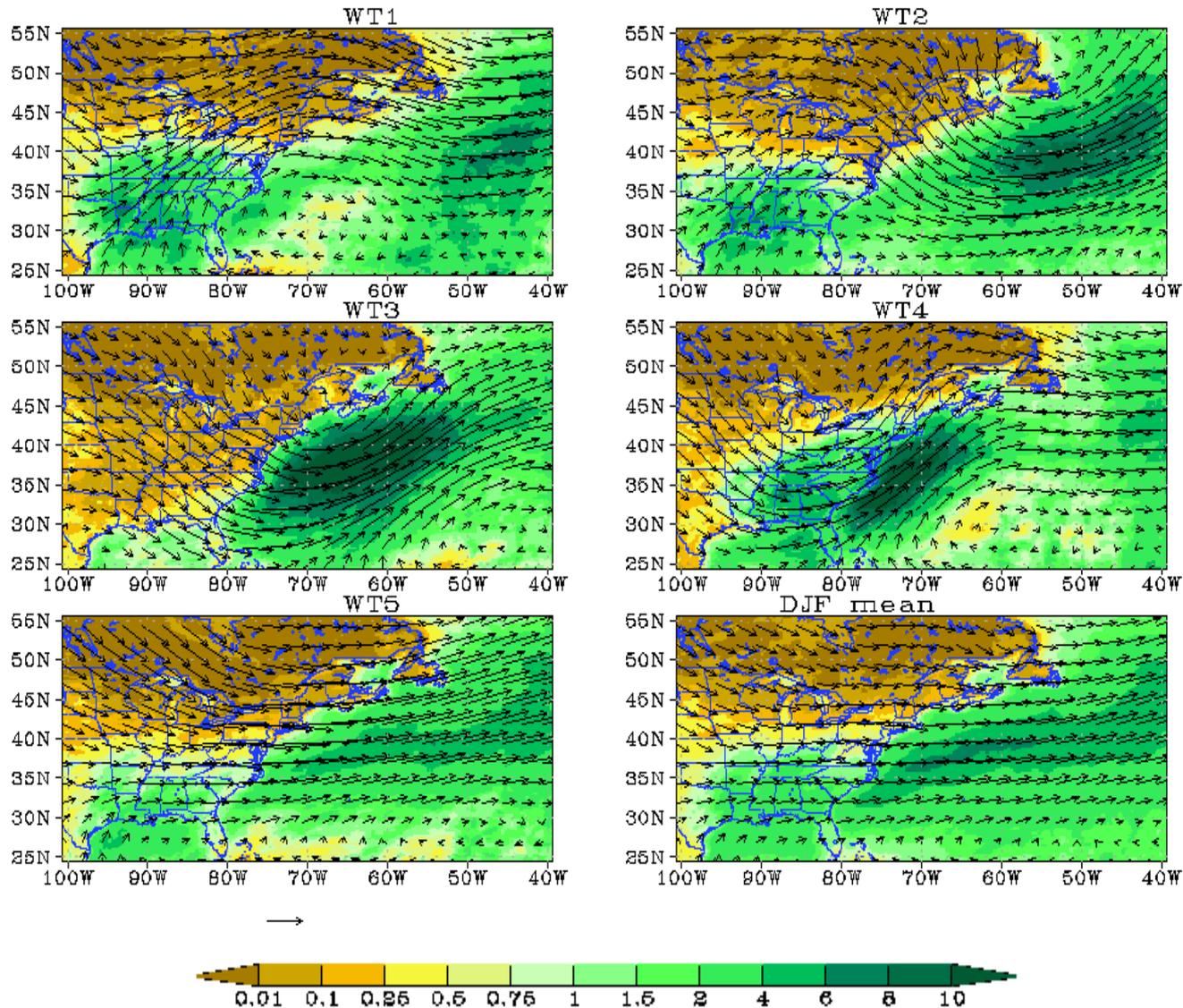
NASA Headquarter, Washington, DC



Outline

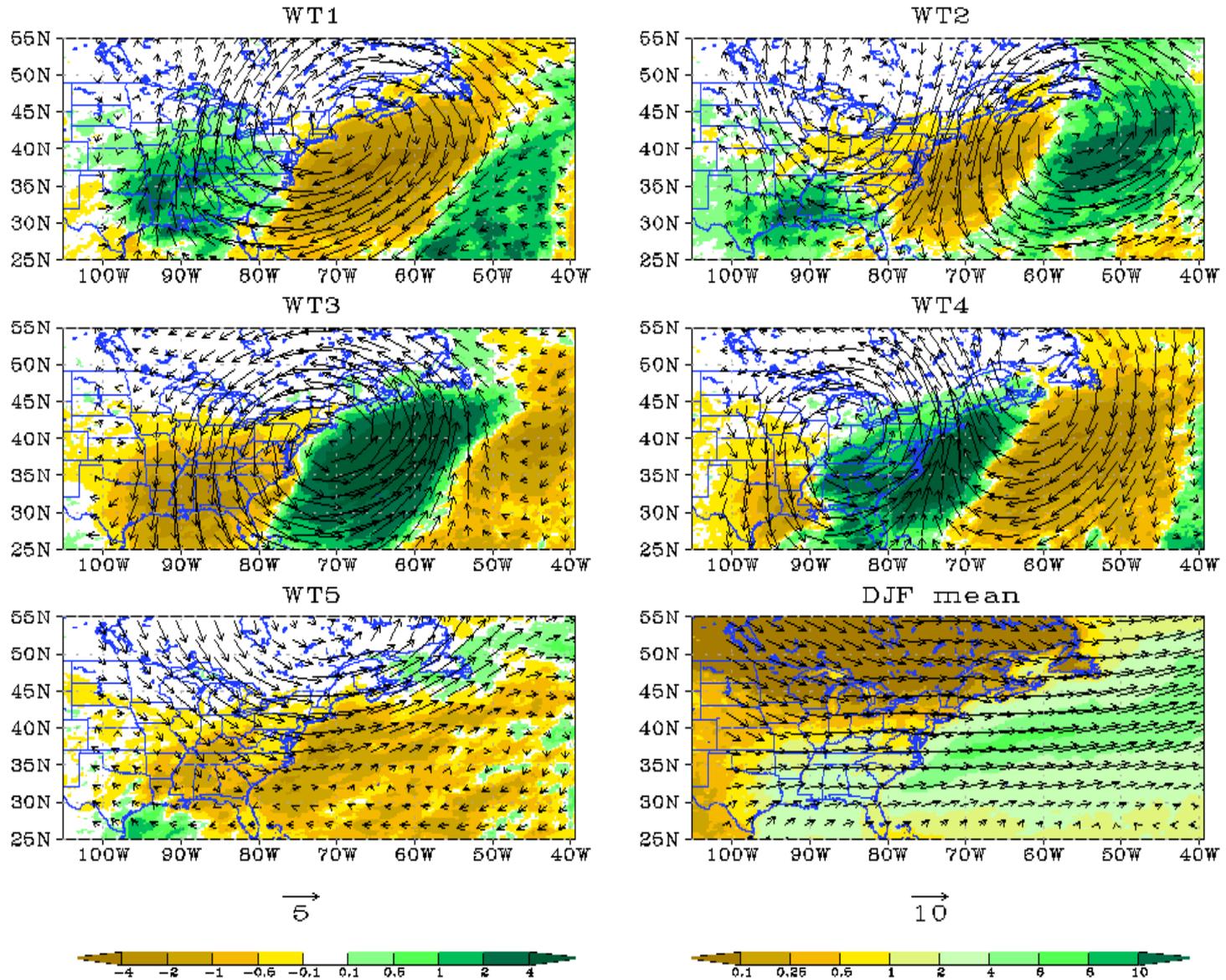
- **Winter Weather Types (WTs) in Northeast US**
- **WTs & Extreme Precipitation**
- **Future plan: Frequency of the WTs corresponding to extreme precipitation as an NCA indicator & energy usage**

Mean precipitation & 850 hPa winds for the 5 WTs



Climatology of CMORPH (2003–2010) precipitation WT1–5 (mm/day; shaded) and MERRA reanalysis winds at 850 hpa (m/s).

Anomalous precipitation & 850 hPa wind for the 5 winter WTs



Anomalous CMORPH (2003-2010) precipitation WT1-5 (mm/day; shaded) and MERRA reanalysis winds at 850 hPa (m/s).

Persistence and change of daily Weather Types

Persistence Plot

↓first/second →	1	2	3	4	5	Totals
1	187	25	55	168	158	593
2	191	167	48	95	63	564
3	25	196	130	22	95	468
4	17	44	156	60	114	391
5	173	132	80	46	252	683
	593	564	469	391	682	2699

Across	143.5275	19.18817	42.21397	128.9445	121.2692
Normalized %	162.0608	141.6972	40.72733	80.60617	53.45462
	30.80713	241.5279	160.1971	27.11027	117.0671
	30.01223	77.67872	275.4064	105.9255	201.2585
	100.0939	76.37222	46.28619	26.61456	145.8015
Down	143.5275	21.21215	67.48696	296.5915	91.68351
Normalized %	146.5976	141.6972	58.89771	167.7154	36.55735
	19.18817	166.3033	159.5146	38.83936	55.12616
	13.04795	37.33338	191.4176	105.9255	66.15139

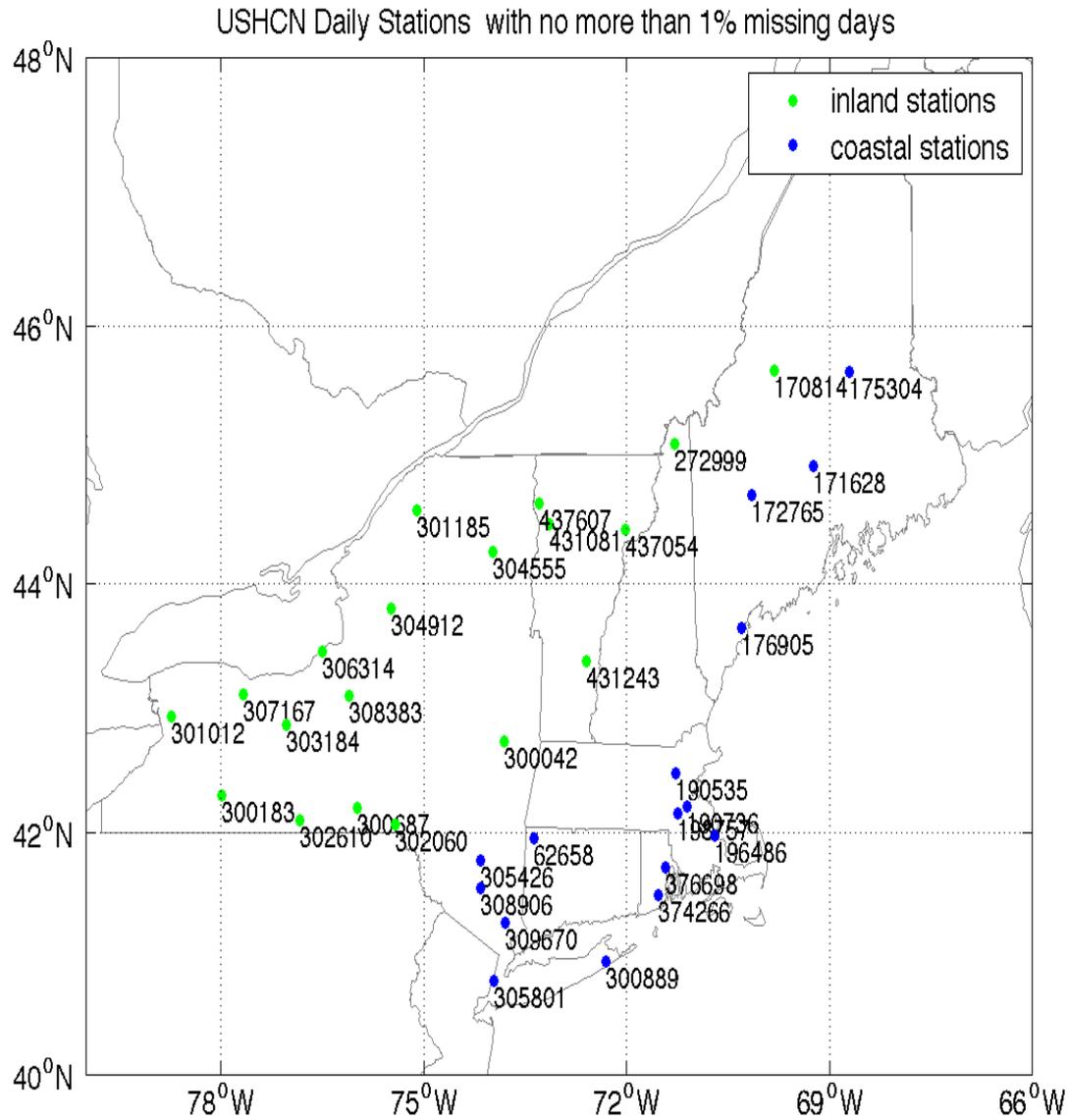
WTs & Teleconnection

Dates of Each WT Corresponding to a Phase of the NAO

							Totals
NAO>1		141	59	56	45	114	41
		33.9759	14.21687	13.49398	10.84337	27.46988	
NAO<-1		27	69	49	28	52	22
		12	30.66667	21.77778	12.44444	23.11111	
1>NAO>-1		424	435	363	318	517	205
		20.61254	21.1473	17.64706	15.45941	25.13369	
Totals		592	563	468	391	683	269
% Tot WT to Tot		21.95032	20.87505	17.35261	14.49759	25.32443	
NAO>1	Normalized %	154.7855	68.1046	77.76336	74.79432	108.4718	
NAO<-1	Normalized %	54.66892	146.9059	125.5014	85.83802	91.26013	
1>NAO>-1	Normalized %	93.90545	101.3042	101.6968	106.6343	99.2468	

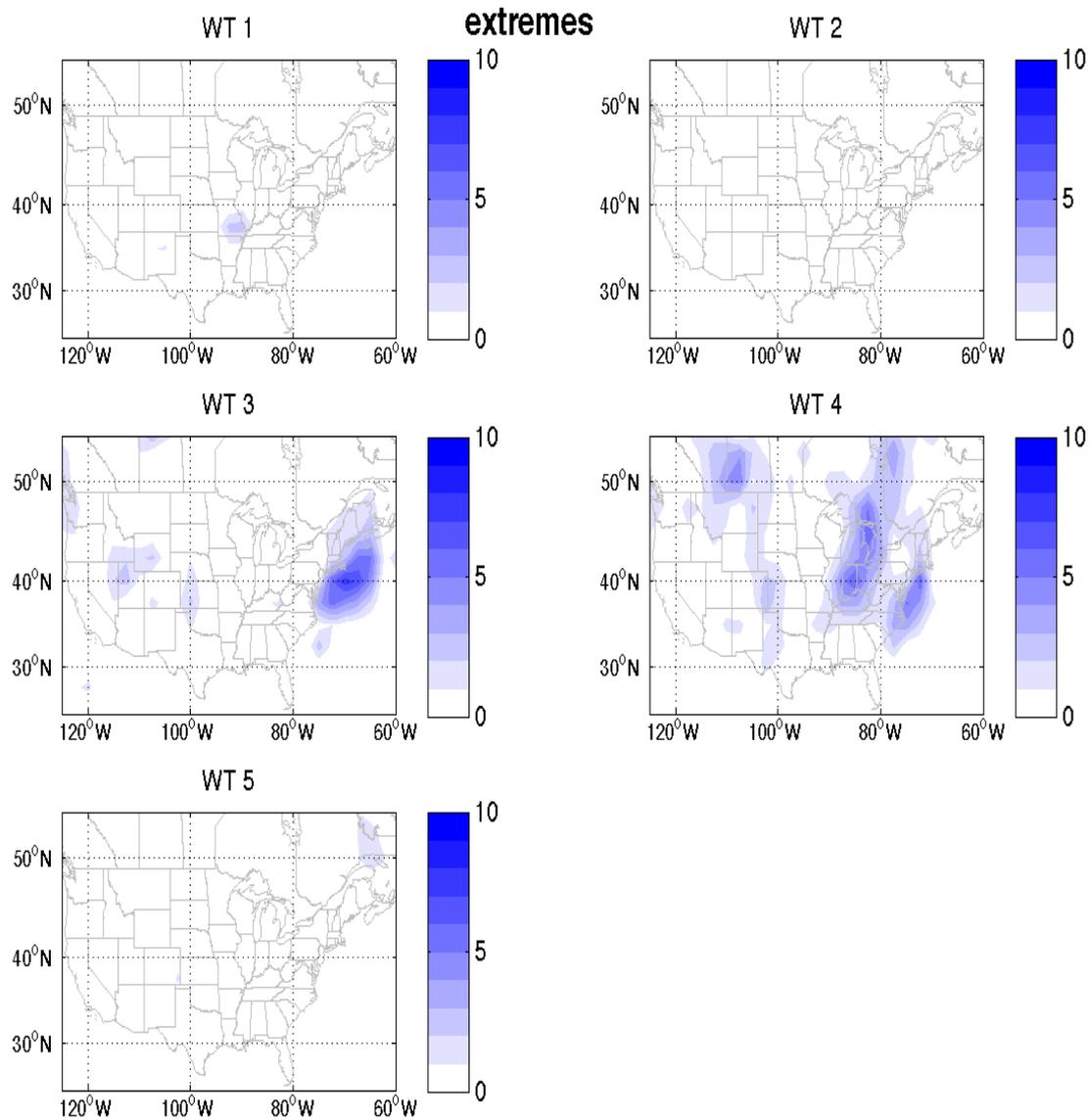
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- Winter Weather Types (WTs) in Northeast US
- **WTs & Extreme Precipitation**
- Frequency of the WTs corresponding to extreme precipitation as an NCA indicator & energy usage

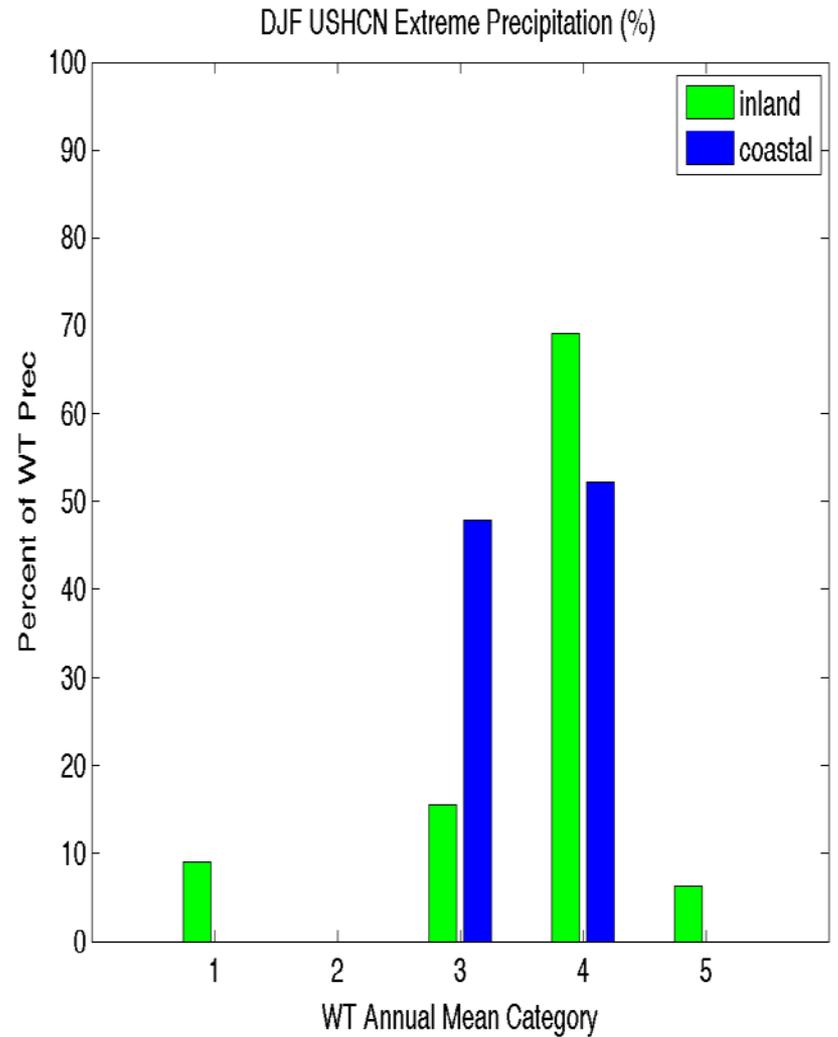
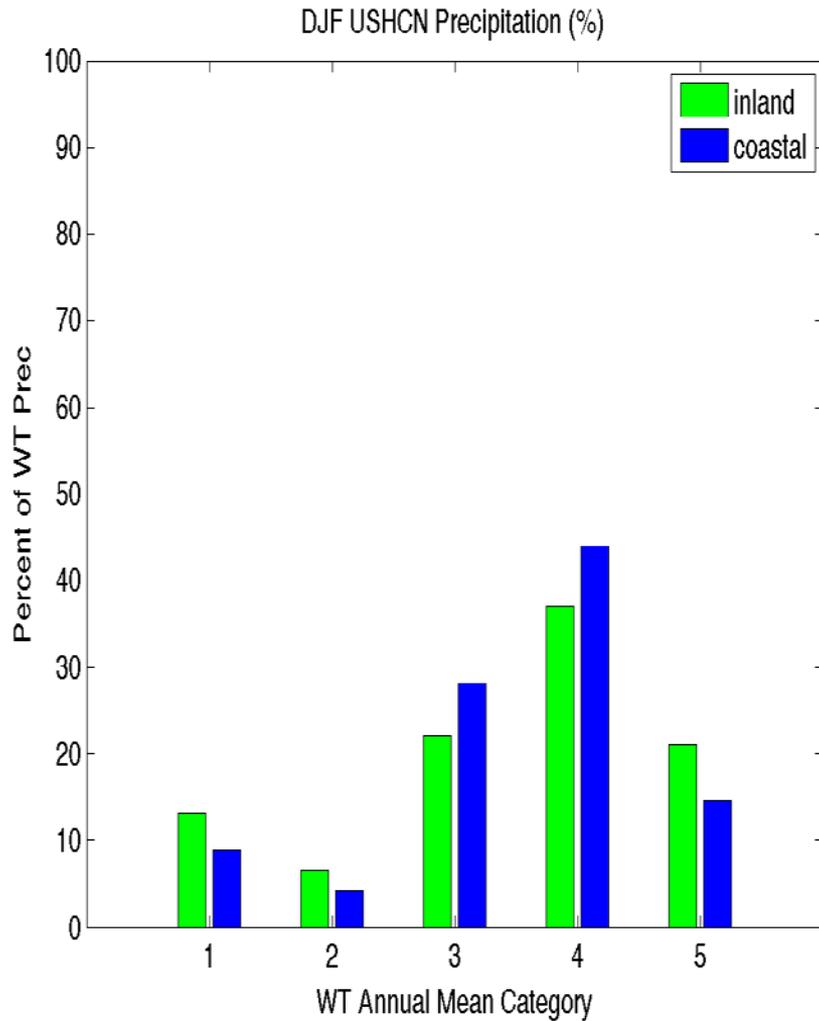


Weather Stations used for Extreme Precipitation Analysis

Storm density (for extreme winter precipitation) for the 5 WTs



Percentage of precipitation for the 5 winter WTs

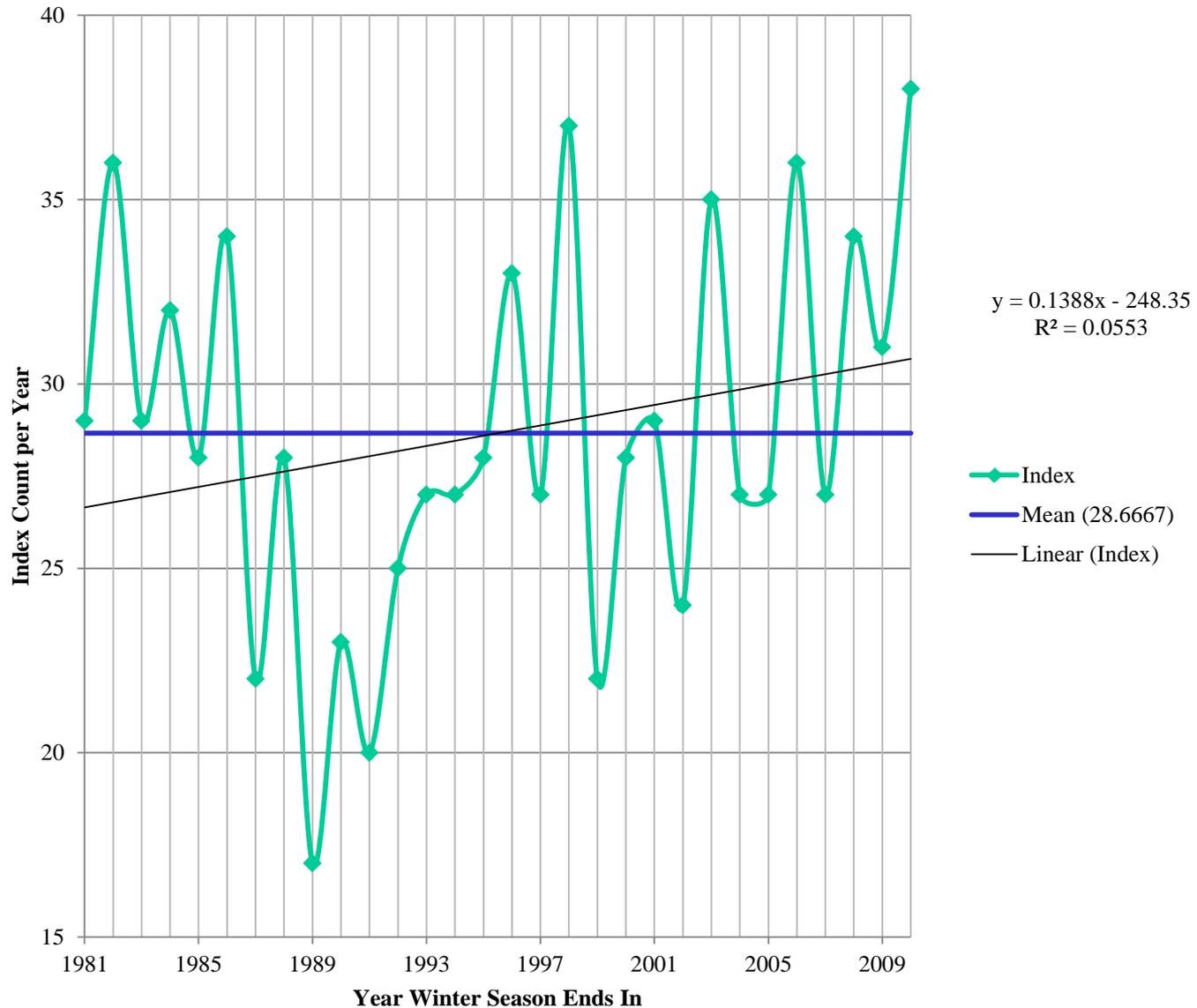


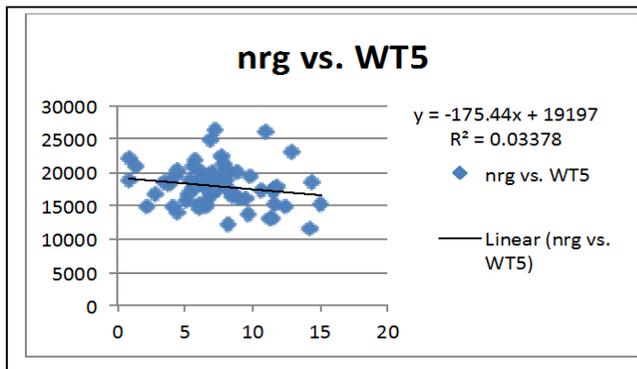
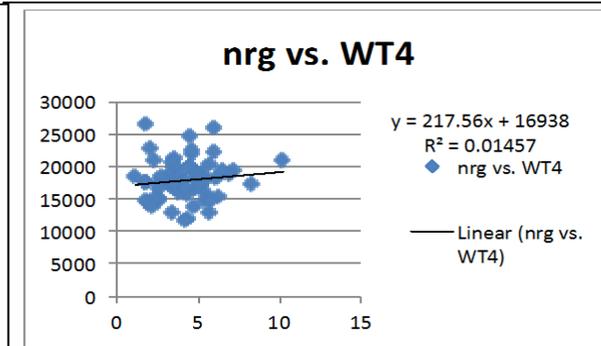
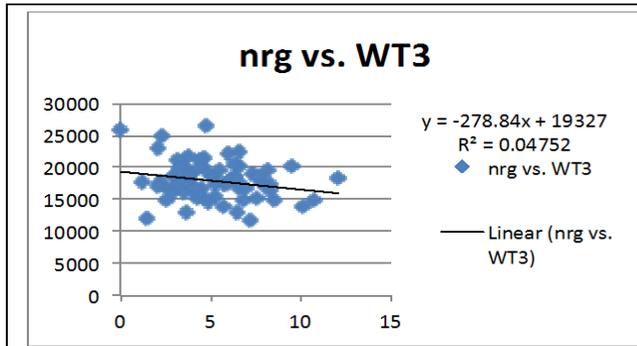
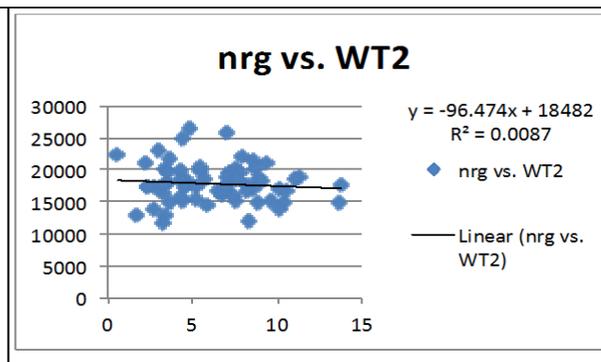
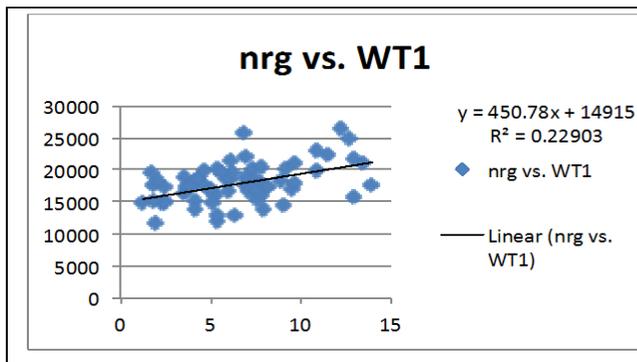
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- **Future plan: Frequency of the WTs corresponding to extreme precipitation as a possible NCA indicator (sum of the frequencies of WT3 and WT4) & energy usage**

Total Frequency of Extreme Weather Types (WT3 & WT4)

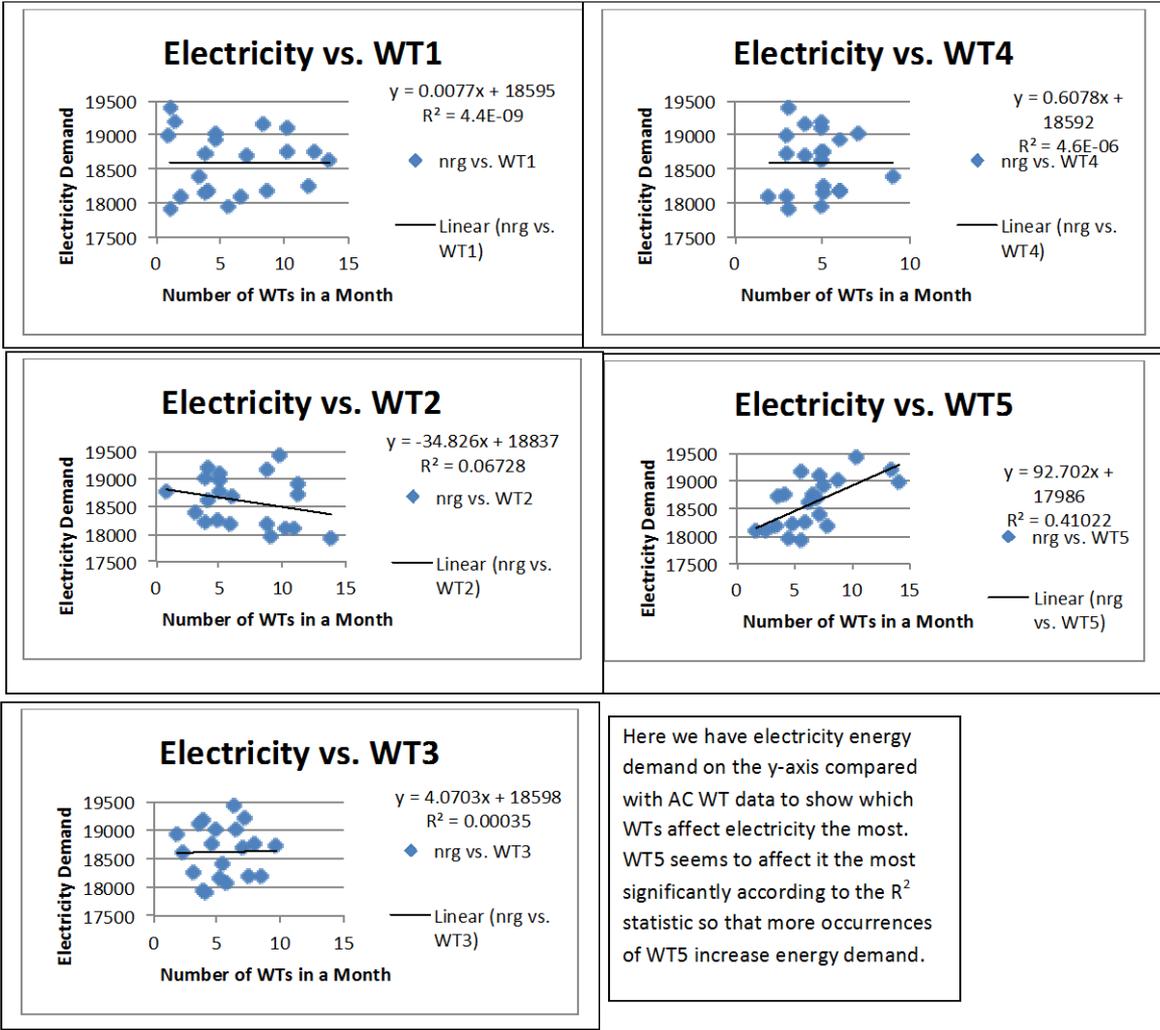
Index over Winter Season





Here we have natural gas energy demand on the y-axis compared with AC WT data to show which WTs affect natural gas usage the most. WT1 seems to affect it the most significantly according to the R^2 statistic so that more occurrences of WT1 increase energy demand.

Natural Gas usage and Weather Types (WTs)



Electricity usage and Weather Types (WTs)

Summary

- **Weather Typing Analysis in NE U.S.:** Five Weather Types (WTs) are found in the winter season (DJF) based on the 30-year (1980-2010) NASA MERRA reanalysis data. The WTs are used for climate teleconnection studies (e.g., WT3 corresponding to $-$ ENSO, $+$ PNA, $-$ AO and $-$ NAO)
- **WT3 and WT4** corresponding to **extreme** precipitation events in the US Northeast
- **Future Plan: The total frequency of WT3 and WT4 – a possible indicator** of winter extreme weather in the US Northeast (Normalized extreme WT frequency?).
- Natural gas and electricity usages will be further examined for the 5 WTs
- This Weather-Typing method could also be expanded from winter to other seasons and from Northeast to other regions