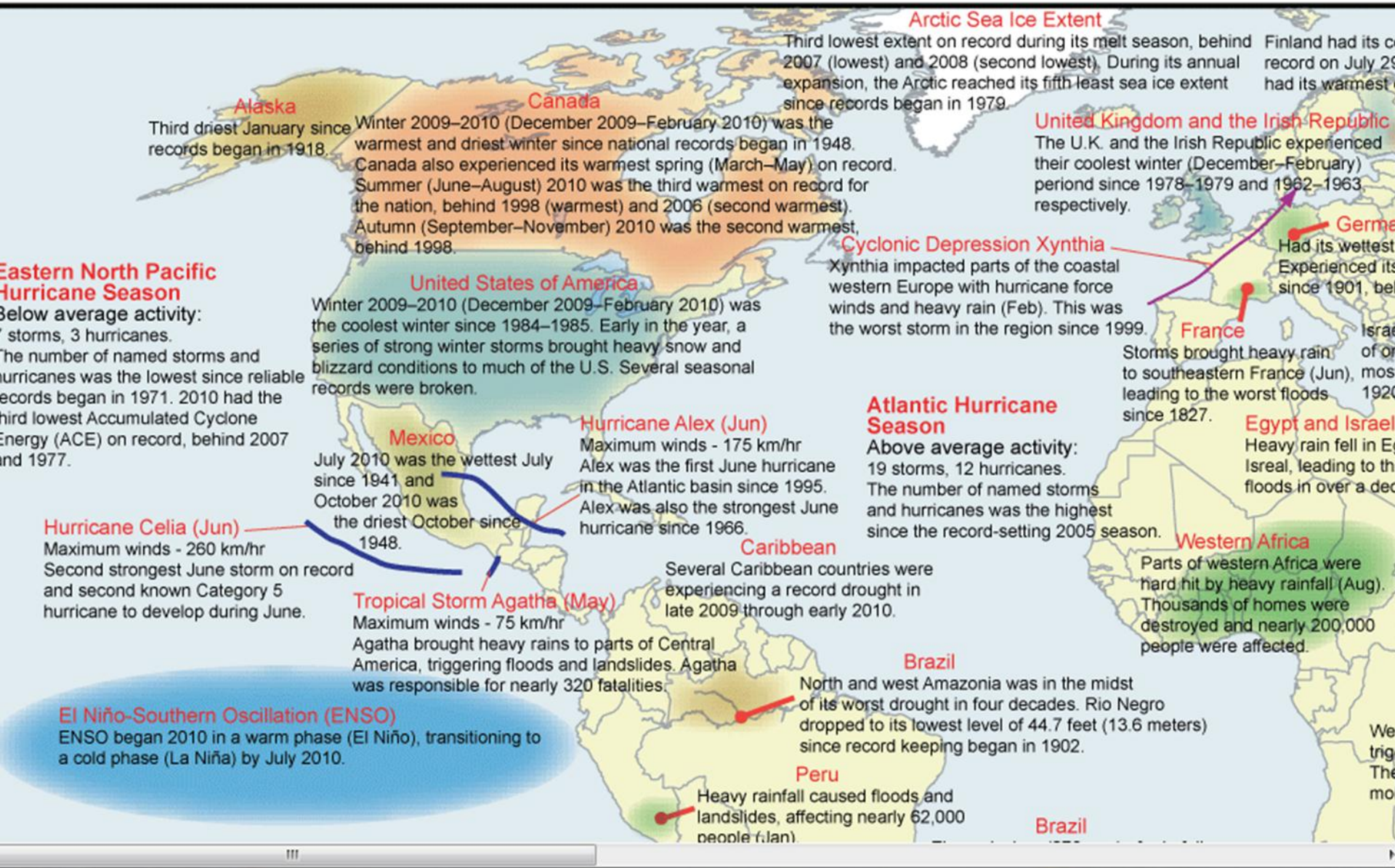
Assignments

- Class Notes 2 review questions due today
- Additional assignment: due Feb. 8
  - Read AMS draft policy statement on communicating science
  - http://www.ametsoc.org/policy/draftstatements/communicating_science_draftstatement.pdf
  - Summarize and critique the draft statement in a couple paragraphs
  - Comment in a couple paragraphs on the role of appropriate use of statistics for communicating science

2010 Climate

- http://www.ncdc.noaa.gov/sotc



changing climate, continual information about climate o helps assess the incidence, hort-term and weather-scale tornado activity and tropical is to give the recent climate ctive based on 131 years of ts as well as paleoclimate tanding of the Earth's climate A discussion of century-scale mperature and precipitation is f 2010 extreme events.

ort can be found online at: otc

E ANOMALIES IN 2010

e

for this manuscript is NOAA's rface Temperature (Smith et 880, making for a 131-year 2010 global (land and ocean e temperature anomaly was as the warmest calendar year global land temperature tied nest year on record, and the

May were the warmest on record for the respective month. This tied 2010 with 1998 as the calendar years with the most such "warmest months" on record, with three each. December 2010 was the coolest December since 2000.

2010 Annual Temperature	Anomaly vs. 1901-2000 avg	1880-2010 Rank (131 years)	
Global			
Land	+0.96°C	2nd warmest	tied 2005
Ocean	+0.49°C	2nd warmest	tied 2005
Land & Ocean	+0.62°C	Warmest	tied 2005
Northern Hemisphere			
Land	+1.08°C	2nd warmest	
Ocean	+0.51°C	3rd warmest	tied 2003
Land & Ocean	+0.73°C	Warmest	
Southern Hemisphere			
Land	+0.65°C	5th warmest	tied 2003
Ocean	+0.49°C	5th warmest	
Land & Ocean	+0.51 °C	6th warmest	

Table 1. 2010 surface temperature anomaly (°C) and rank. Source: NOAA/NCDC.

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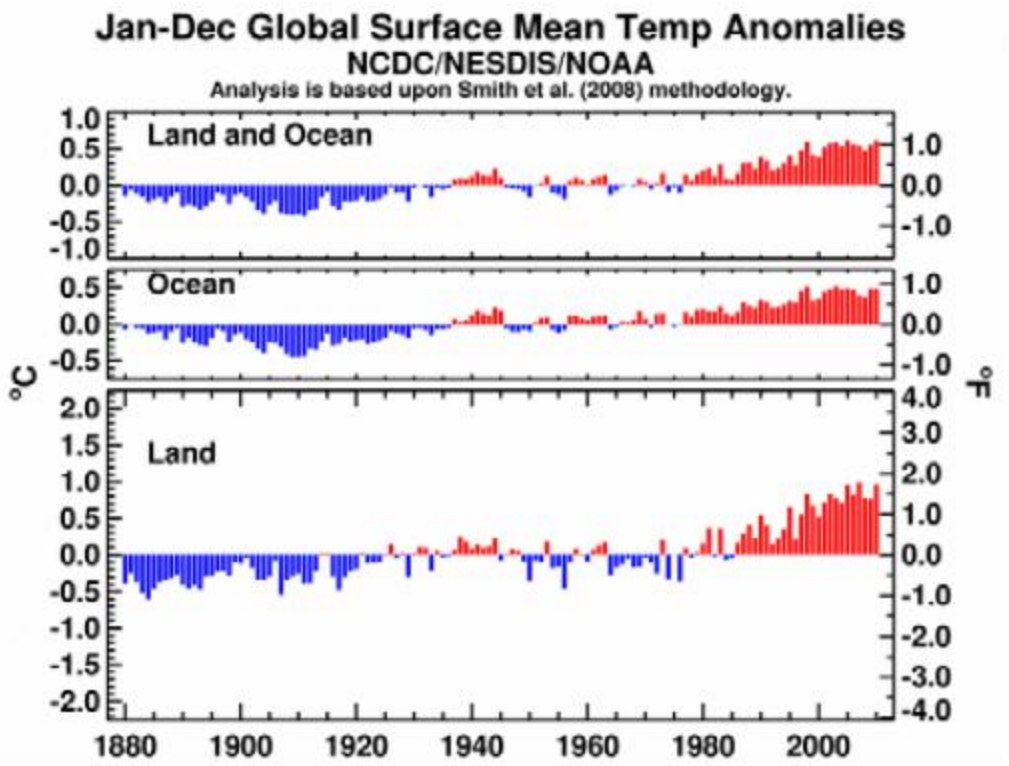

Fig.1. Global surface temperature anomalies for 1880-2010. Source: NOAA/NCDC.

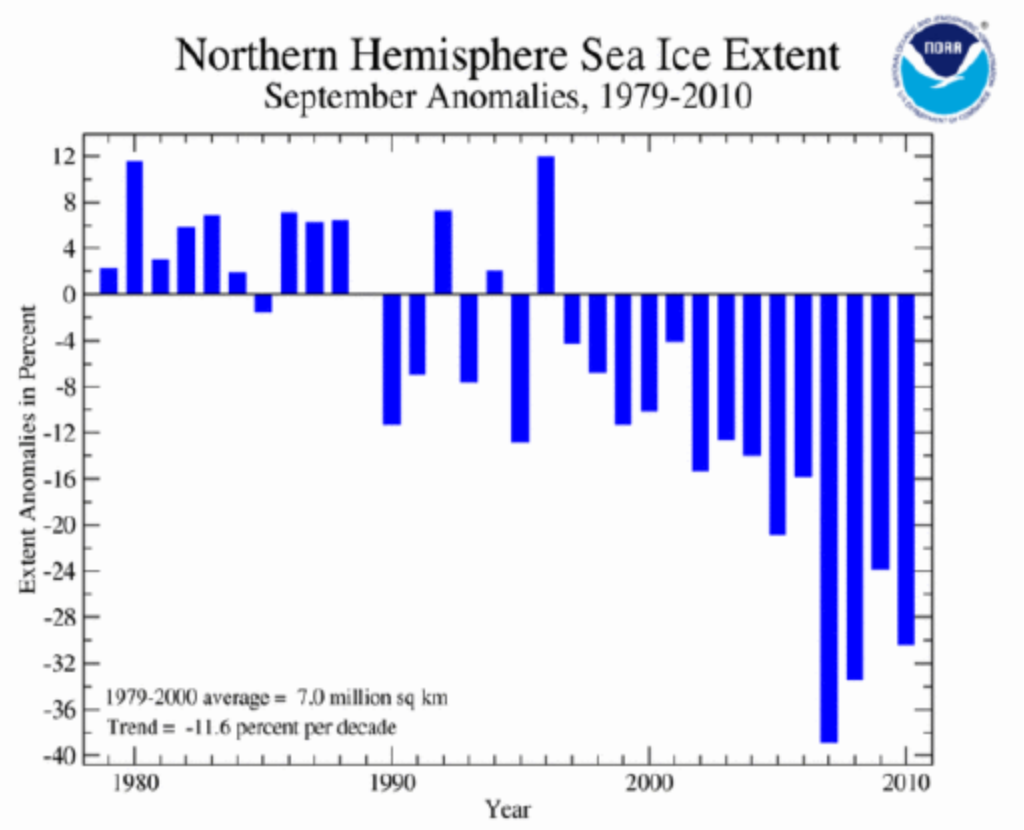

Fig. 6 Northern Hemisphere sea ice anomalies, September 1979-2010. Source: National Snow & Ice Data Center.

counts ended 30 Ju
65 tropical storms, w
average of 85.6. O
alternatively, typhoo
the long-term averag
total of 35. Tropical
summarized in Table
are preliminary.

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during La Niña, whic
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season, and tied wit
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the modern era, b
extremely active Atla
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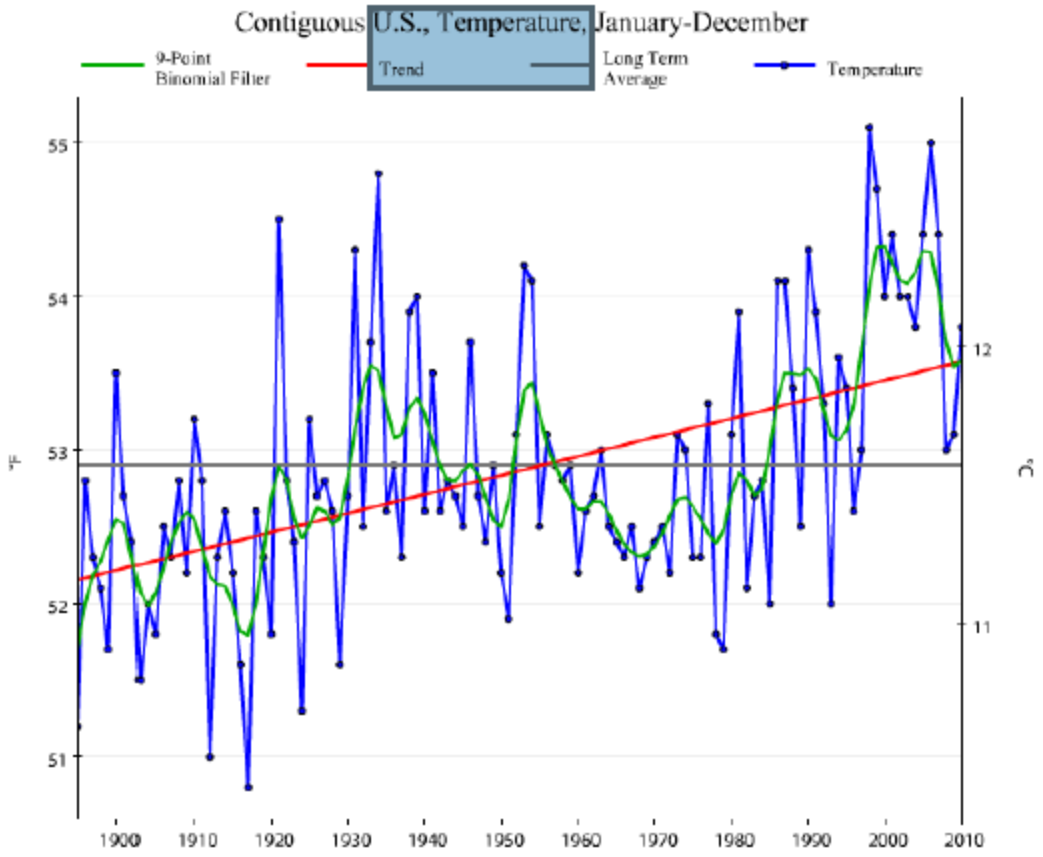

Fig. 7. Contiguous U.S. average annual temperatures, 1895-2010. Source: NOAA/NCDC.

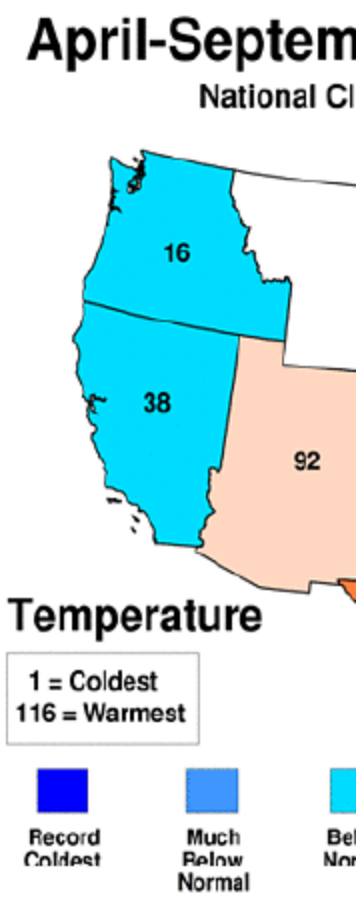

Fig. 9. Warm-sea

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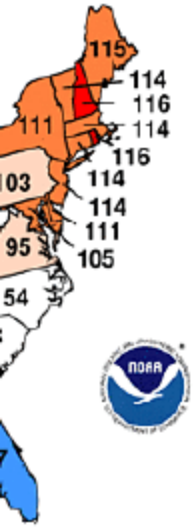

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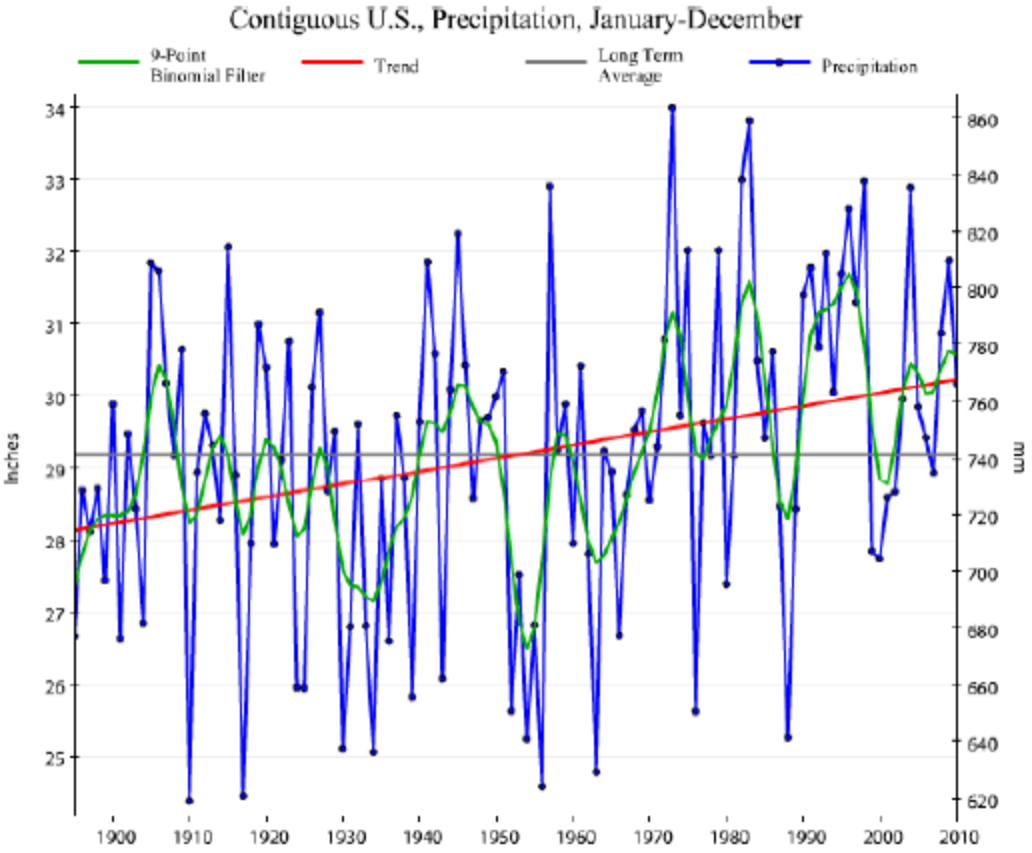

Fig. 10. Contiguous U.S. annual average precipitation, 1895-2010. Source: NOAA/NCDC.

Changes in Climate Normals

Arguez-Extended-Normals-AMS2011.pdf - Adobe Acrobat

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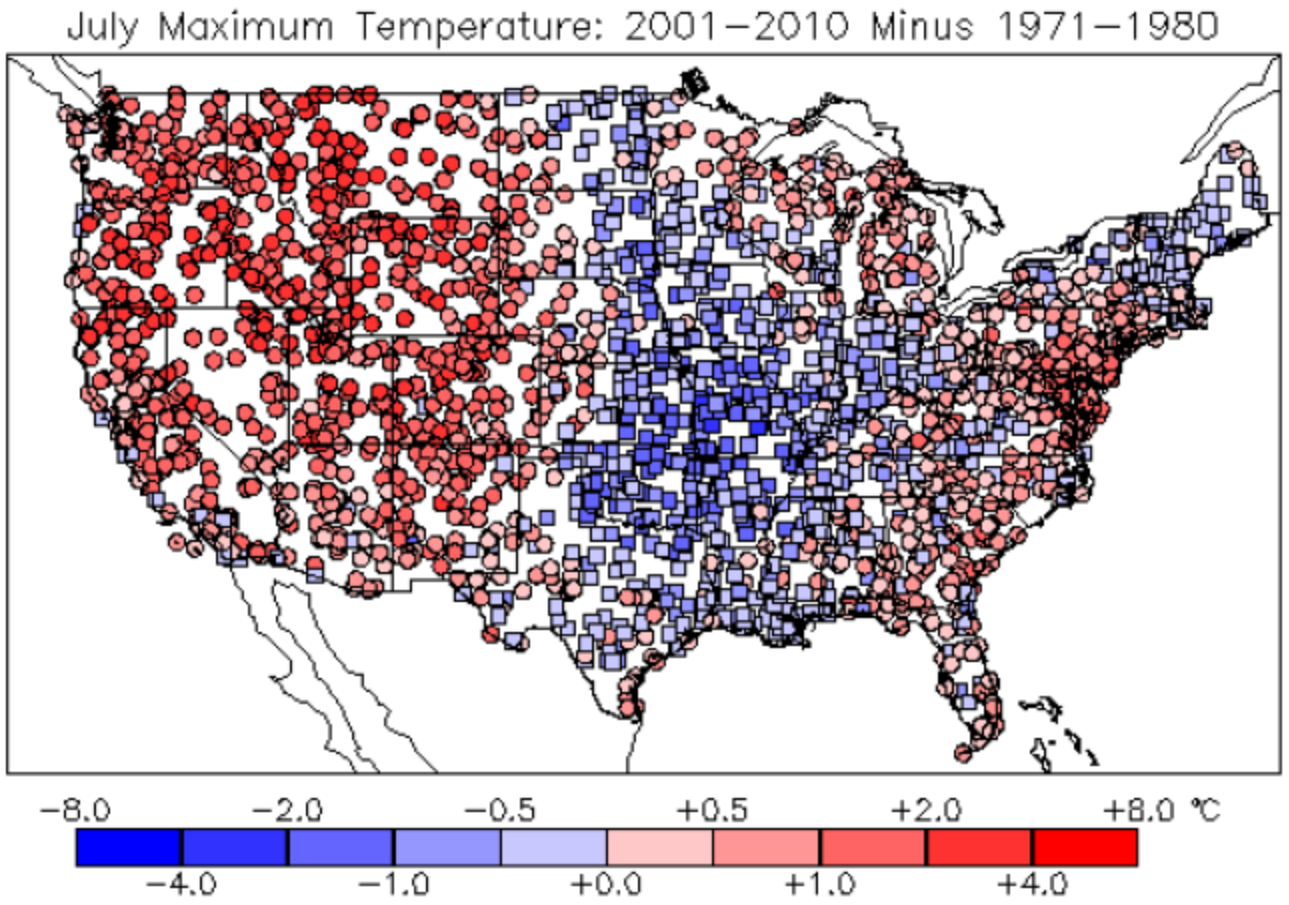

Figure 1. The difference between the decade-averaged maximum temperatures in July

Changes in Climate Normals

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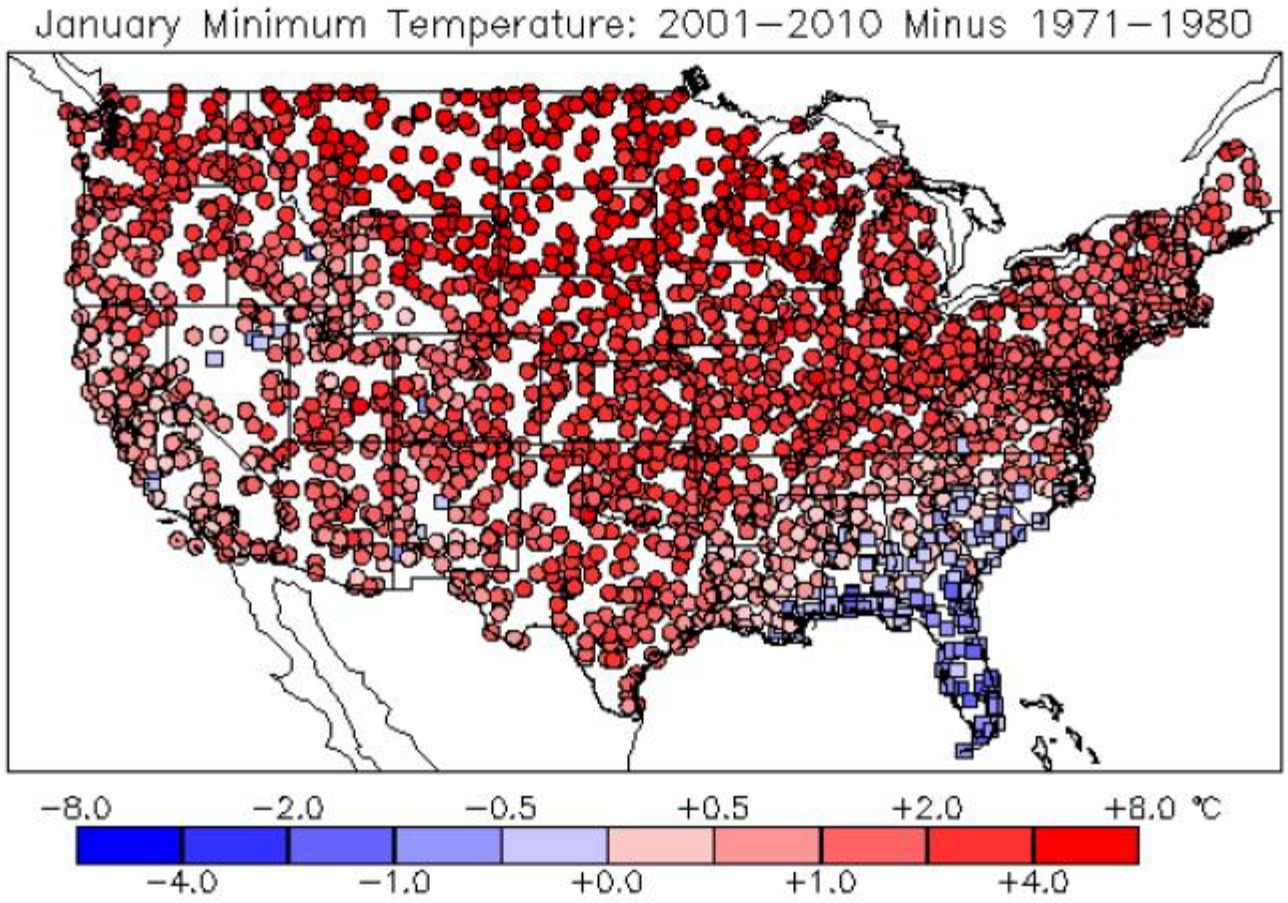
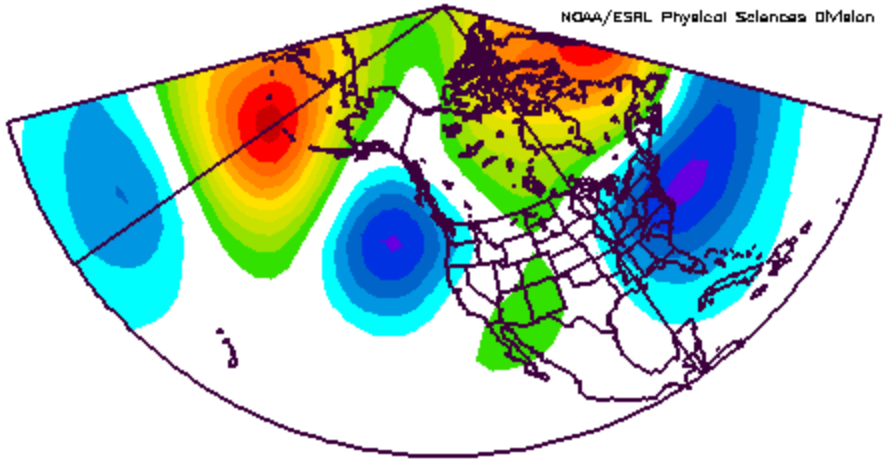
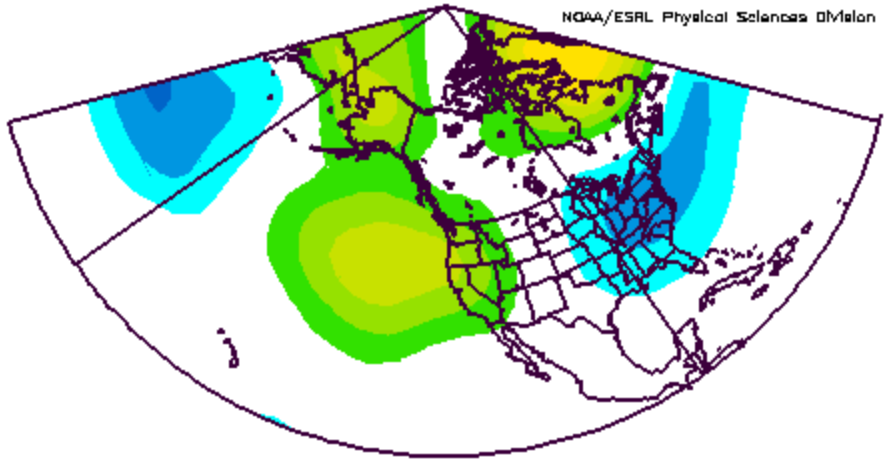


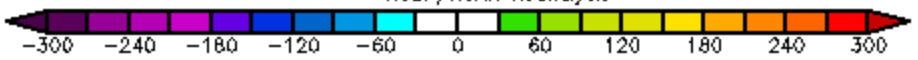
Figure 2. Same as Figure 1, but for January minimum temperatures.



500mb Geopotential Height (m) Composite Anomaly (1968-1996 Cl
12/1/10 to 12/31/10
NCEP/NCAR Reanalysis



500mb Geopotential Height (m) Composite Anomaly (1968-1996 Climatology)
1/1/11 to 1/29/11
NCEP/NCAR Reanalysis



Active Watch/Warnings - NOAA's National Weather Service - Mozilla Firefox

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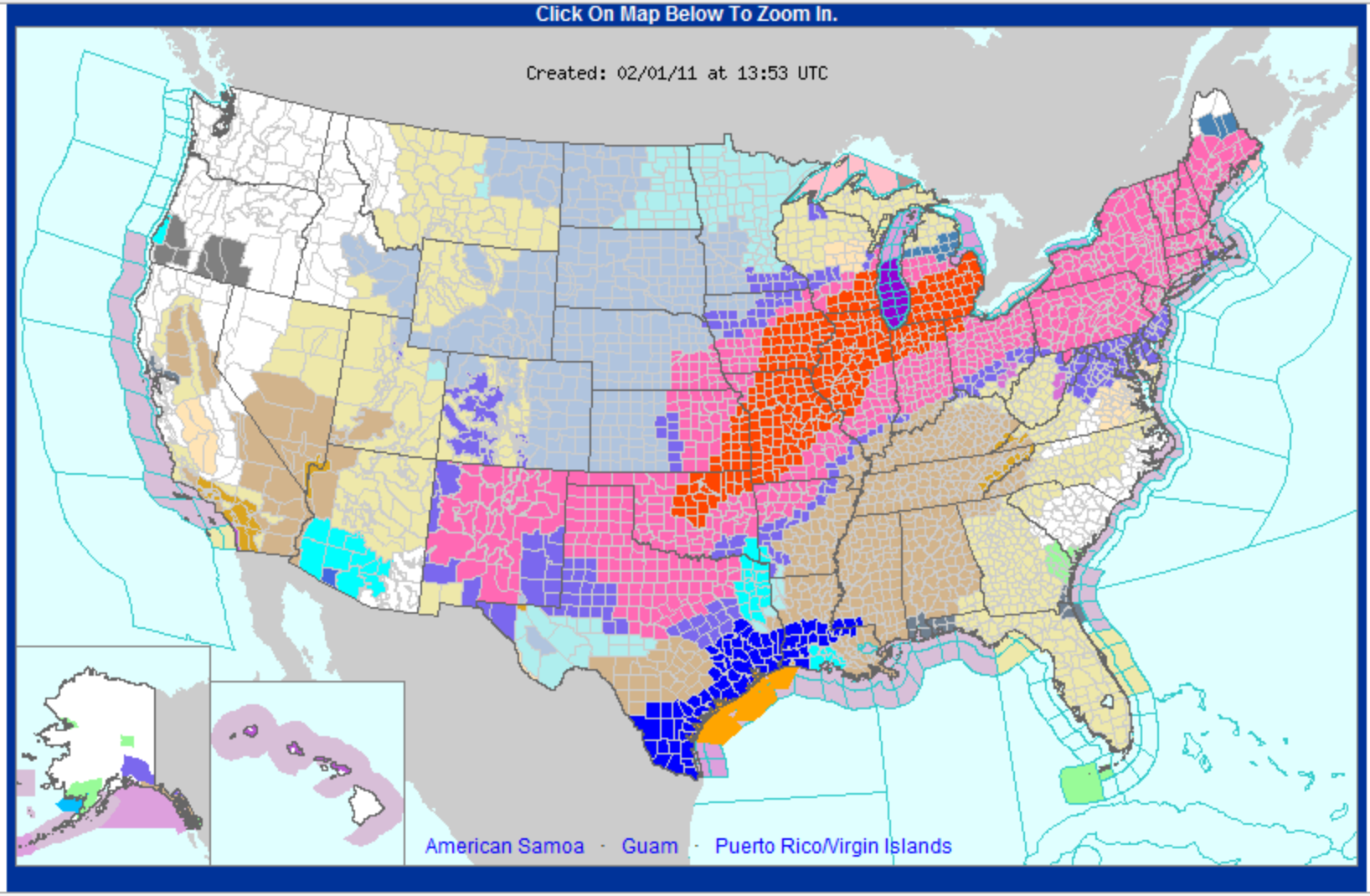
http://www.weather.gov/largemap.php

jon

iGoogle | Gmail - [atmos-pcaps-uu] Downs... | Facebook | Active Watch/Warnings - NOA...



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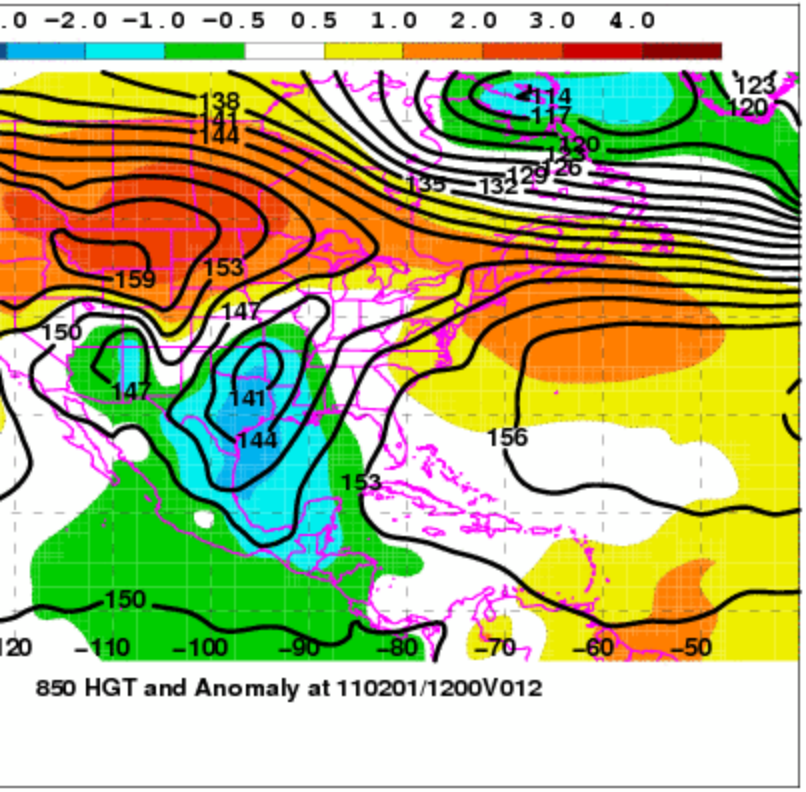
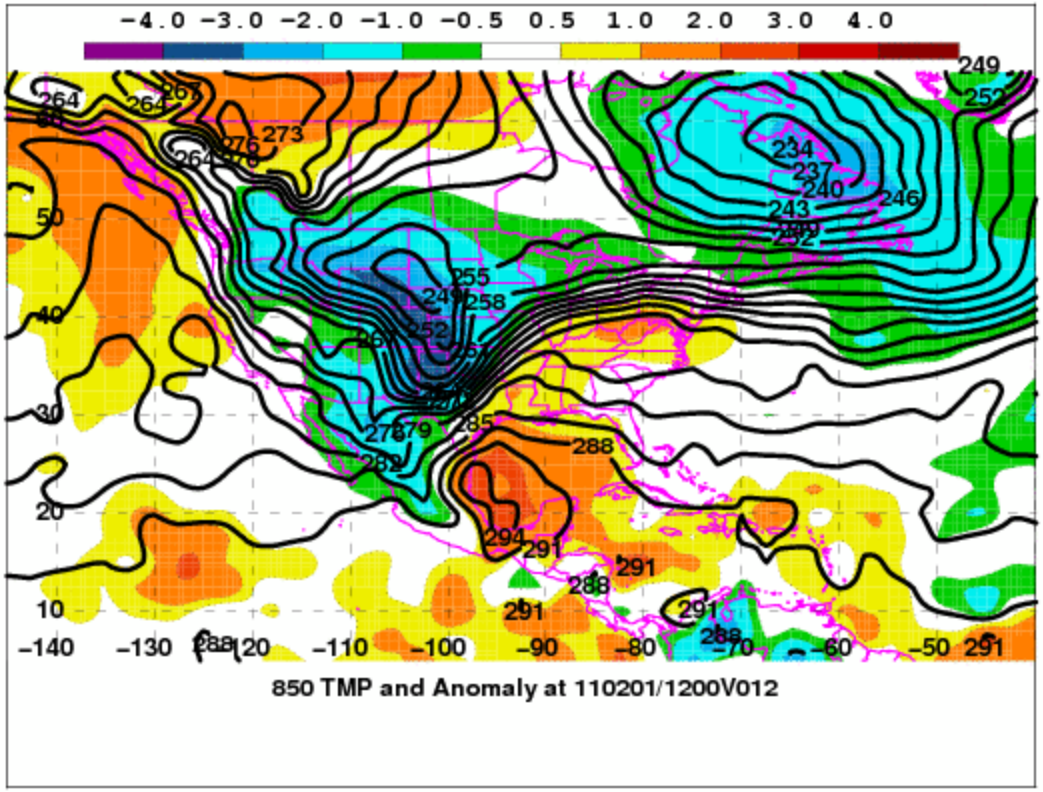
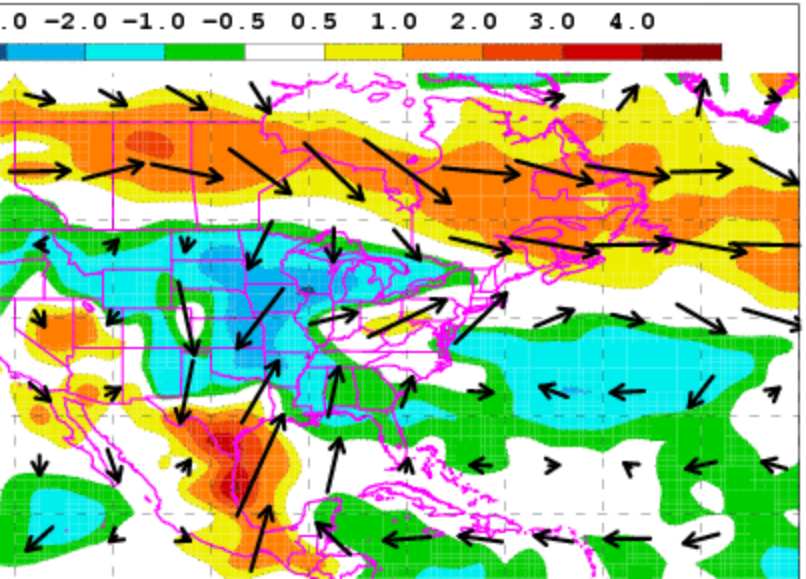
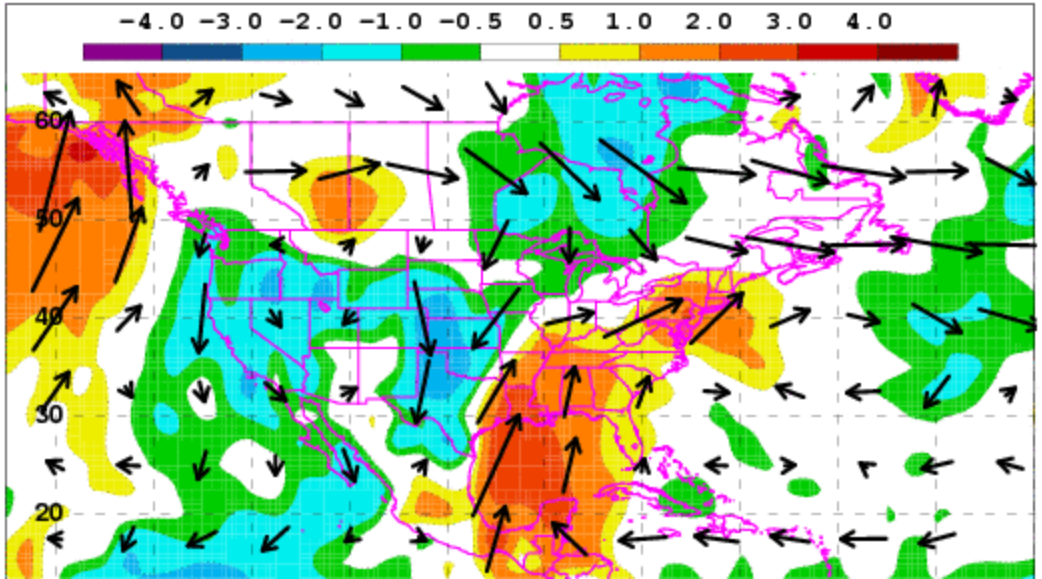


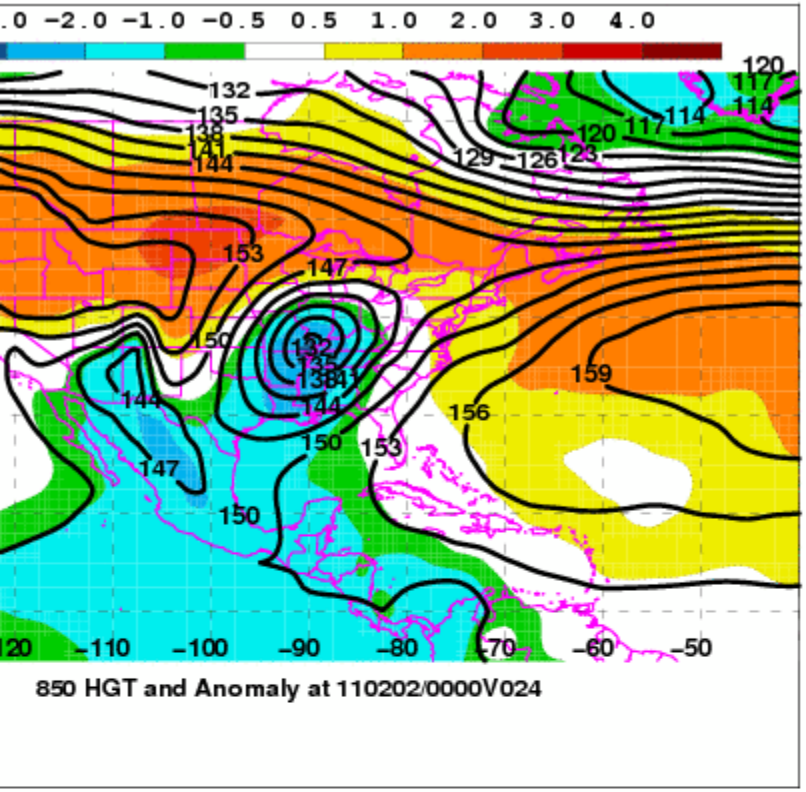
850 HGT and Anomaly at 110201/1200V012



850 TMP and Anomaly at 110201/1200V012



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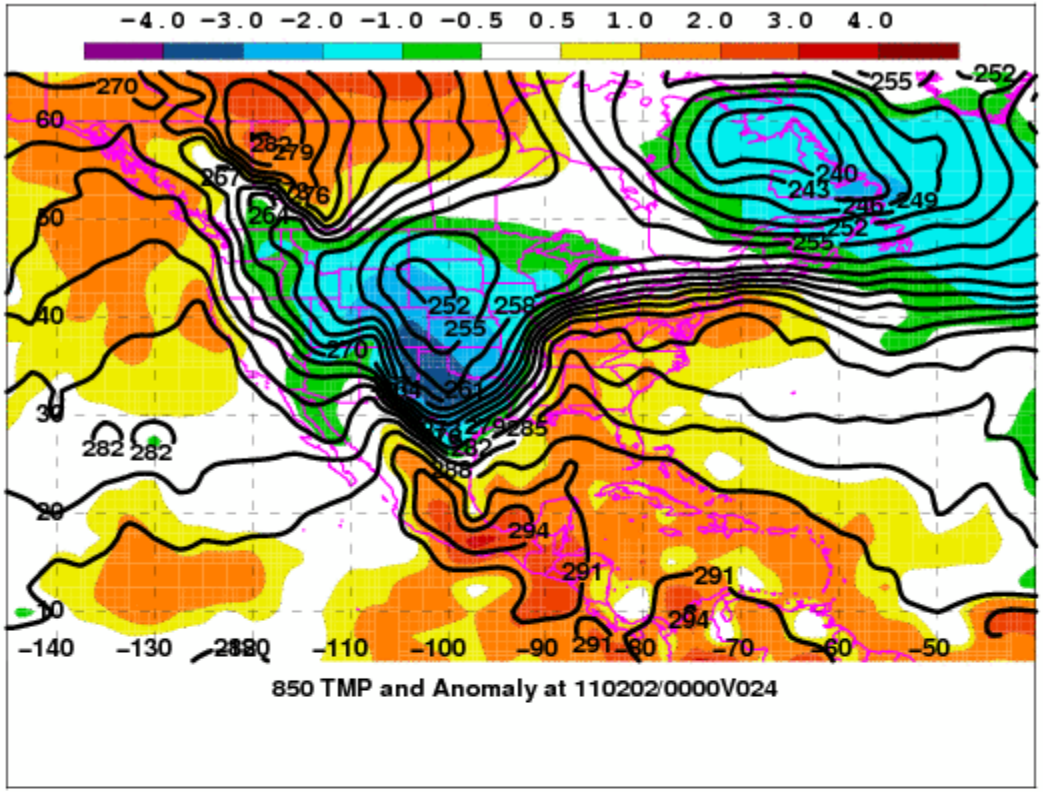
850 HGT and Anomaly at 110202/0000V024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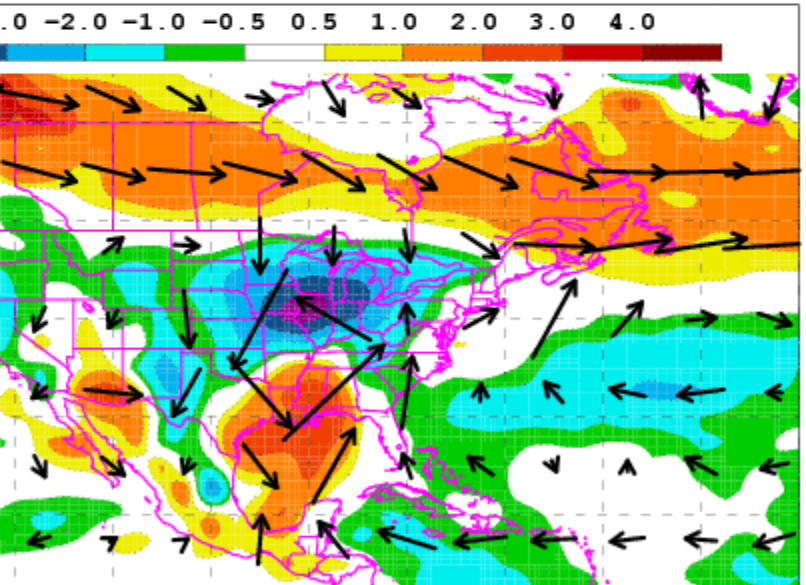
850 TMP and Anomaly at 110202/0000V024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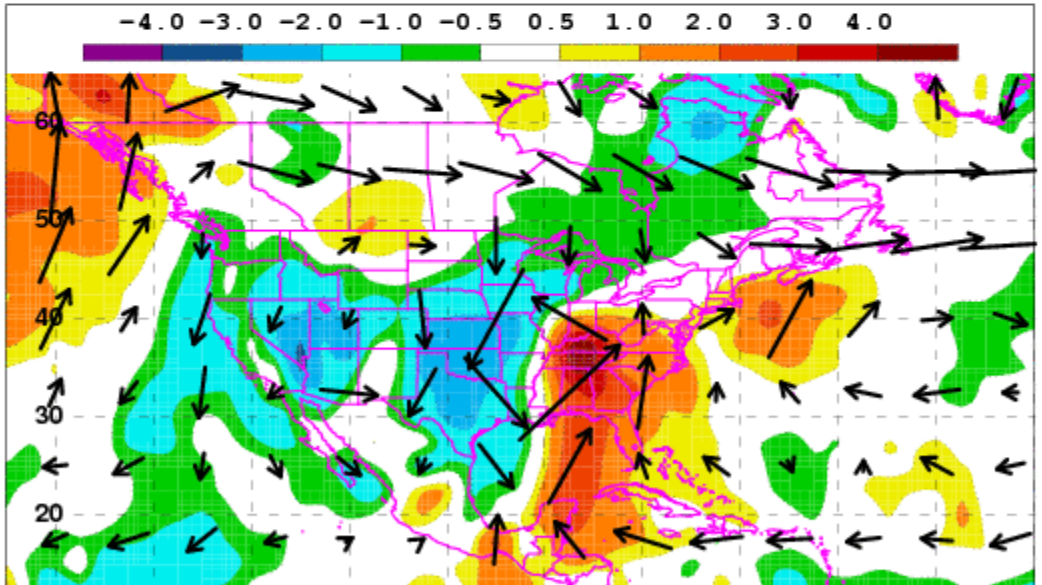
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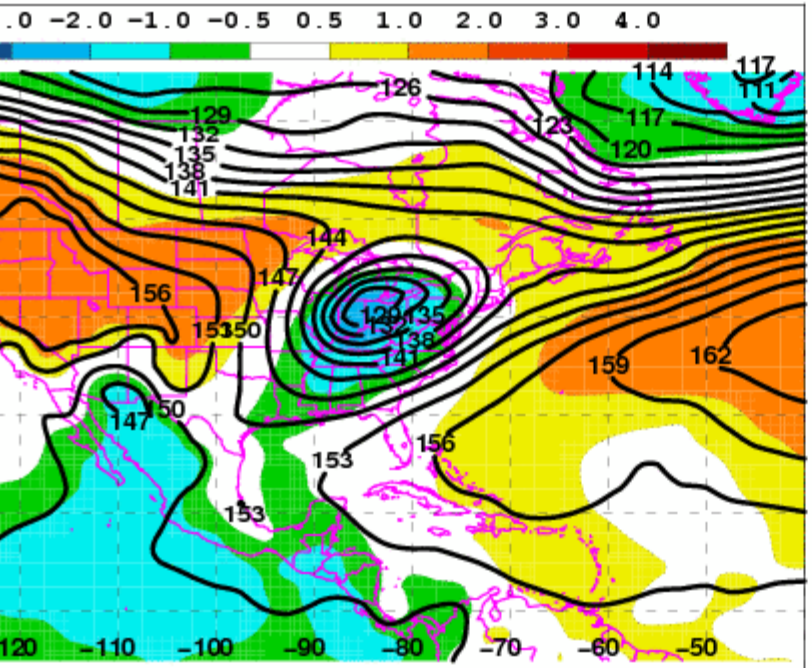
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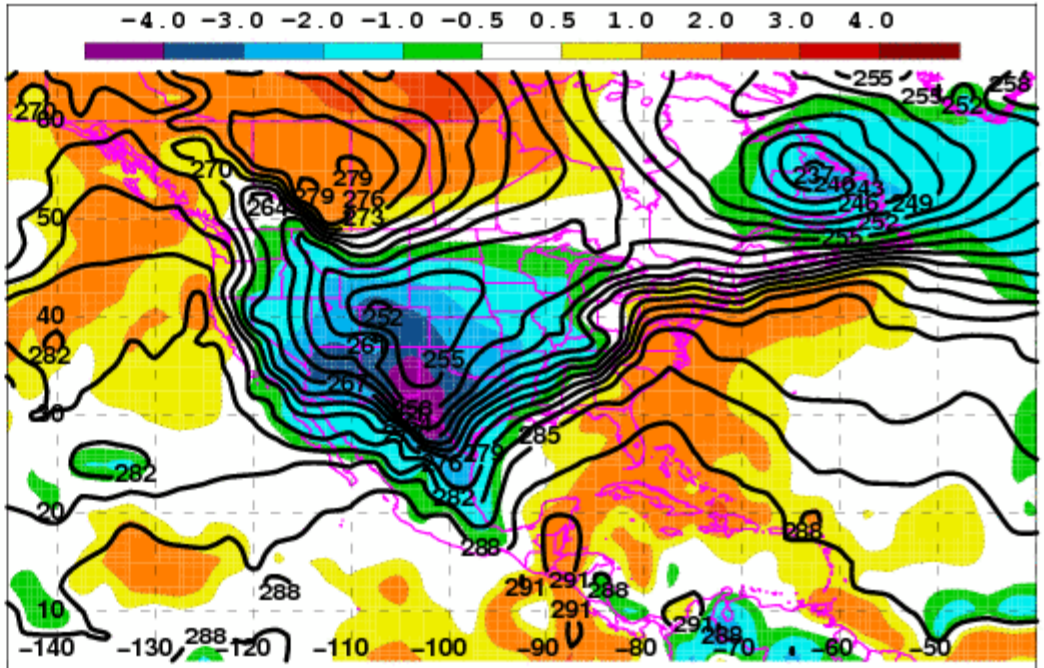
850 HGT and Anomaly at 110202/1200V036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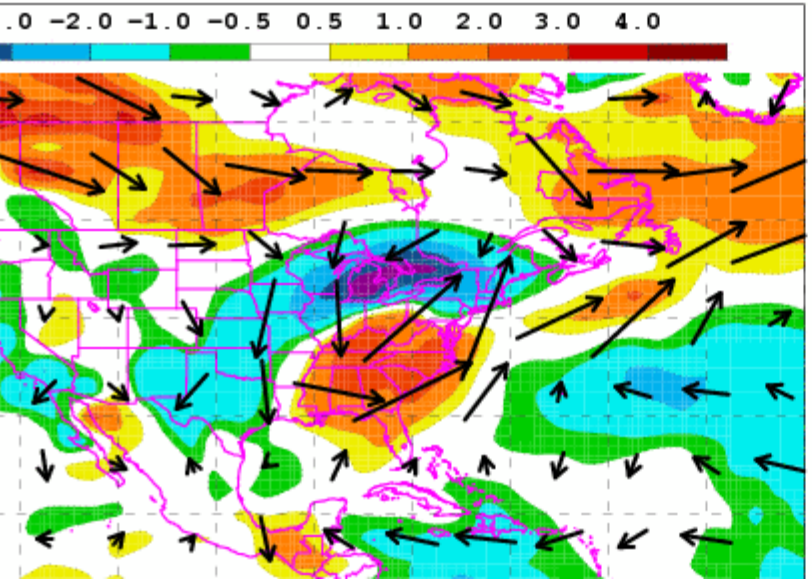
850 TMP and Anomaly at 110202/1200V036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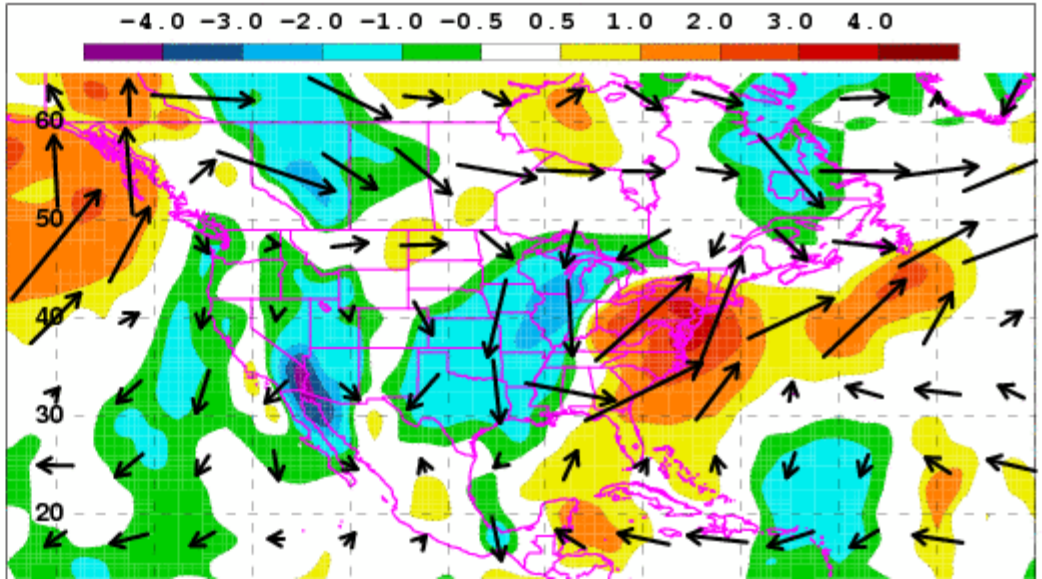
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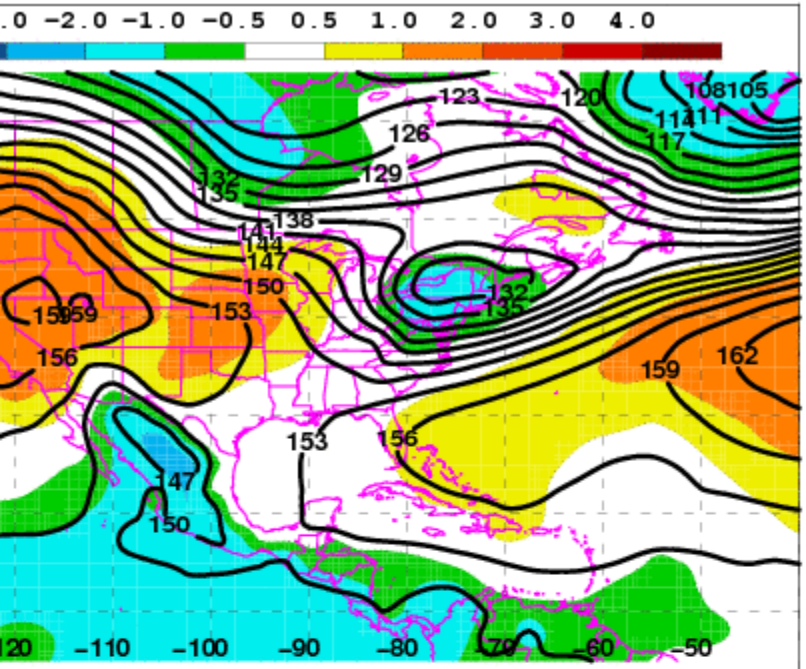
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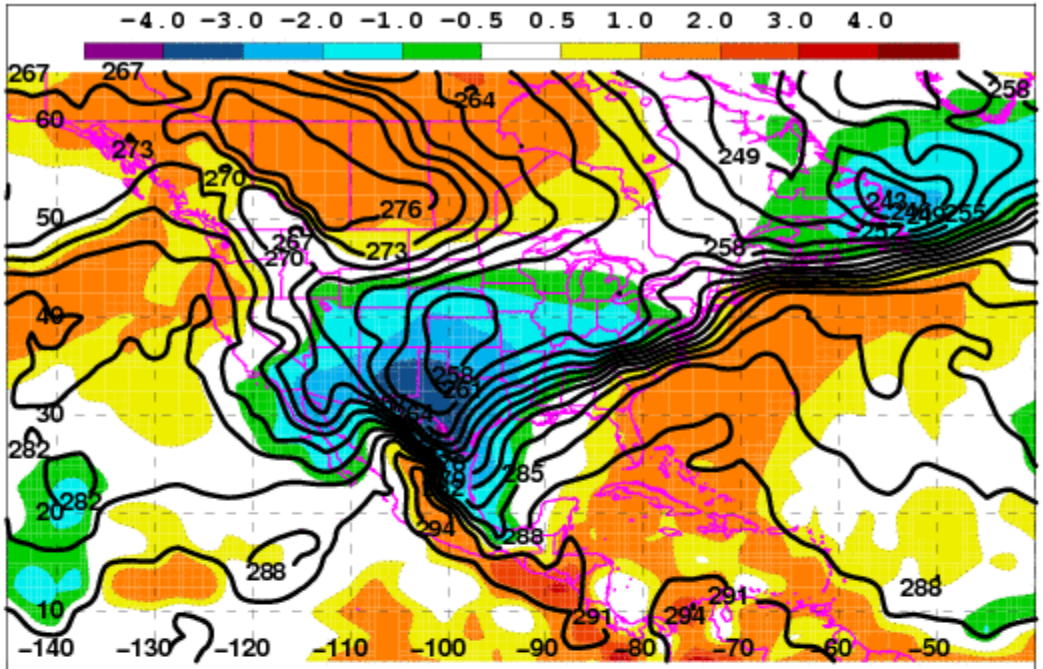
850 HGT and Anomaly at 110203/0000V048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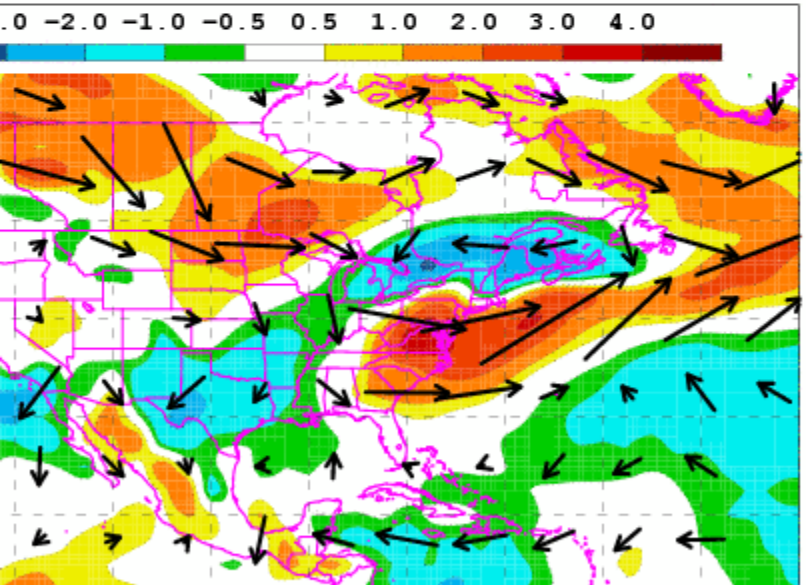
850 TMP and Anomaly at 110203/0000V048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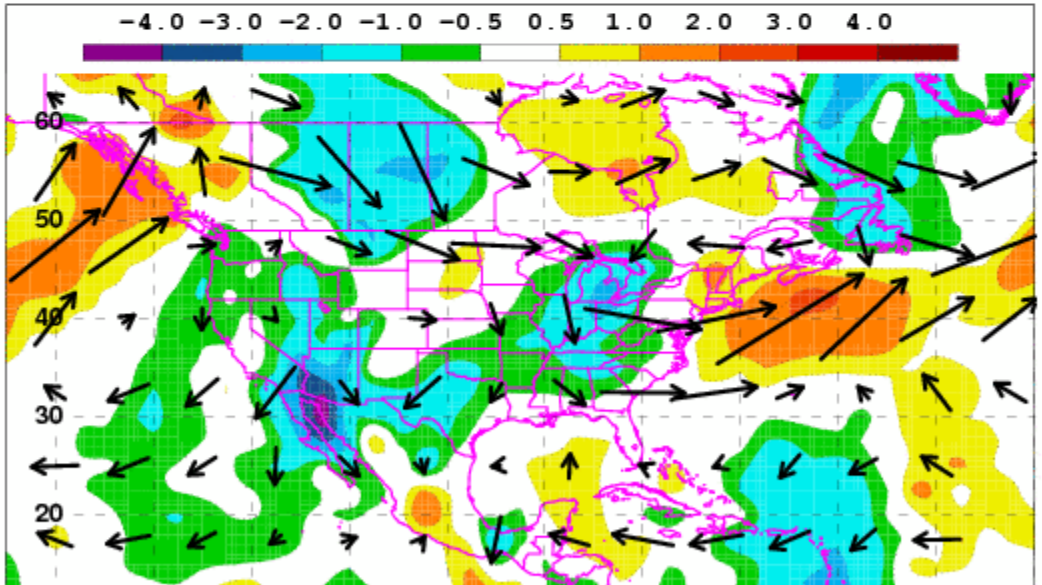
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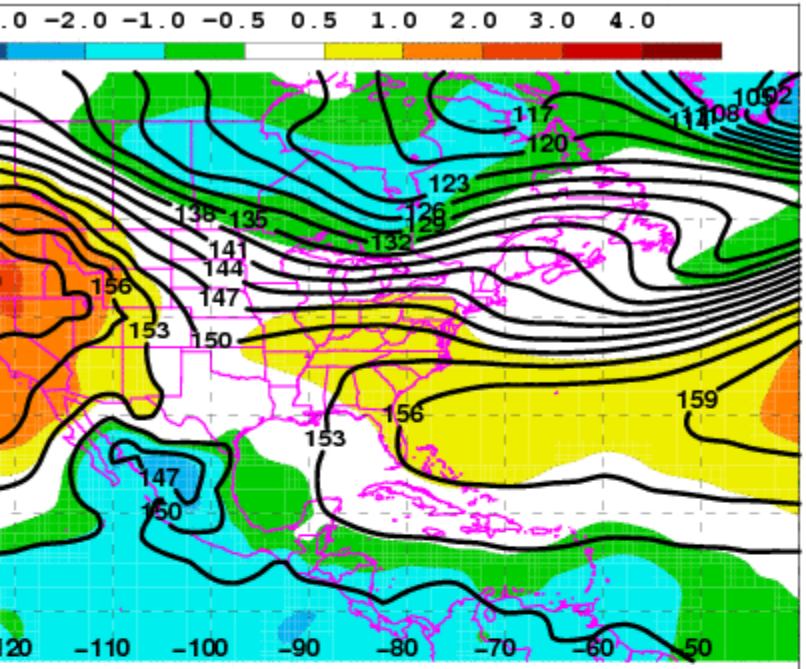
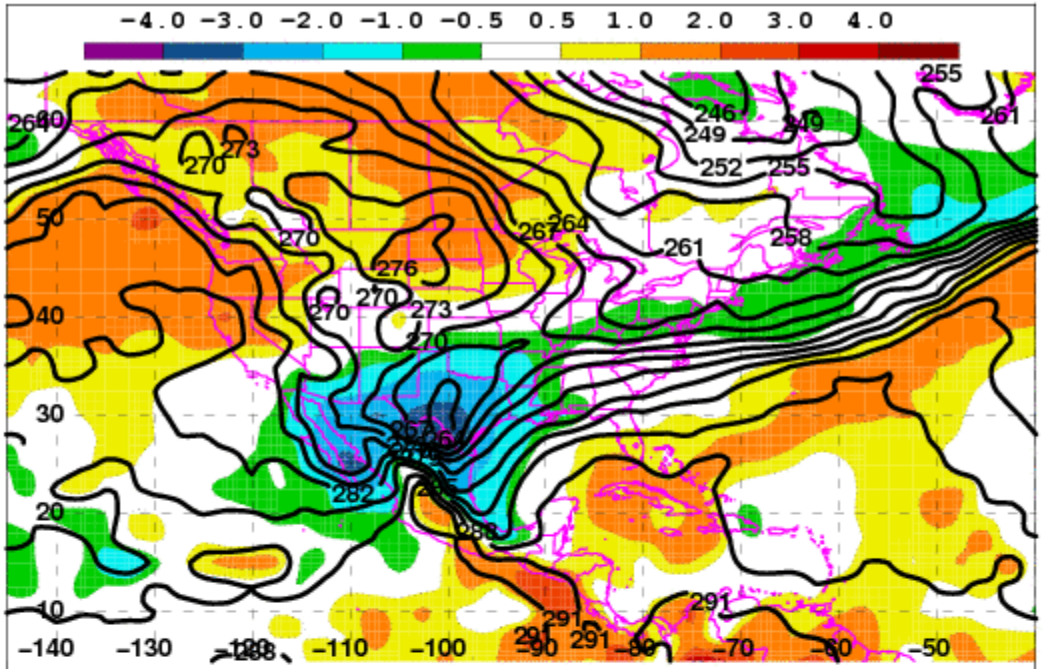
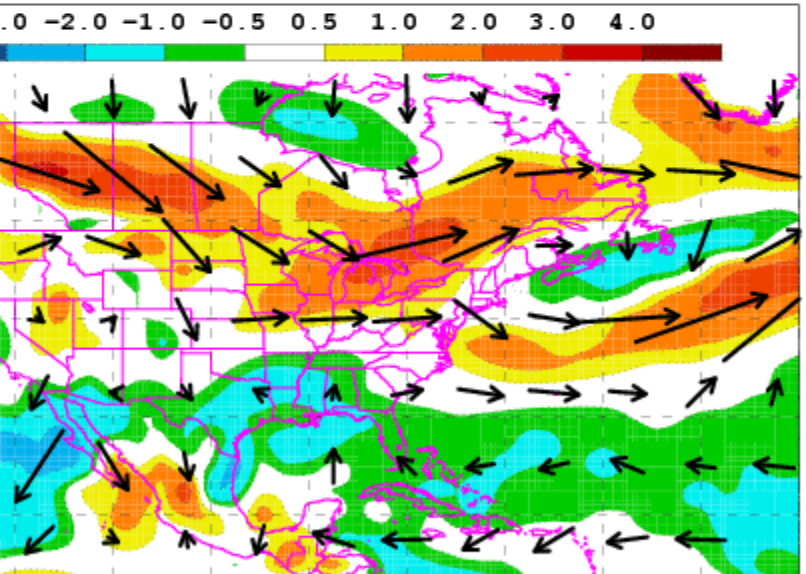
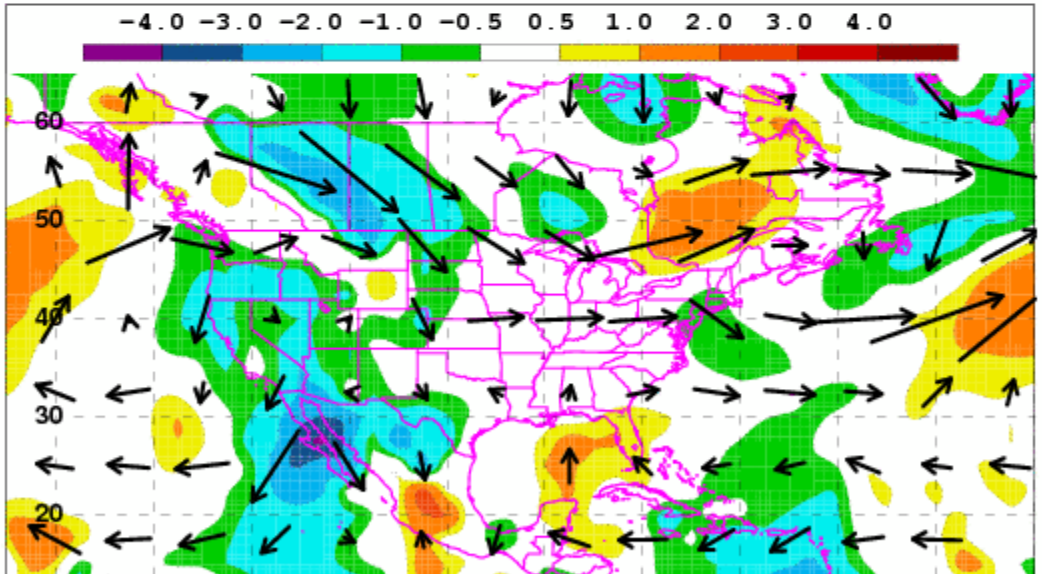


850 HGT and Anomaly at 110204/0000V072



850 TMP and Anomaly at 110204/0000V072





Probability Definitions

- Event- possible uncertain outcomes
- Null event- can’t happen
- Elementary event- can’t be decomposed into other events
- Compound event- decomposable into 2 or more elementary events
- S- sample or event space- all possible elementary events
- Mutually exclusive- two events that can’t occur at same time
- MECE- Mutually exclusive and collectively exhaustive- no more than 1 event can occur and at least one event will occur

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ility of each event
uation and location.

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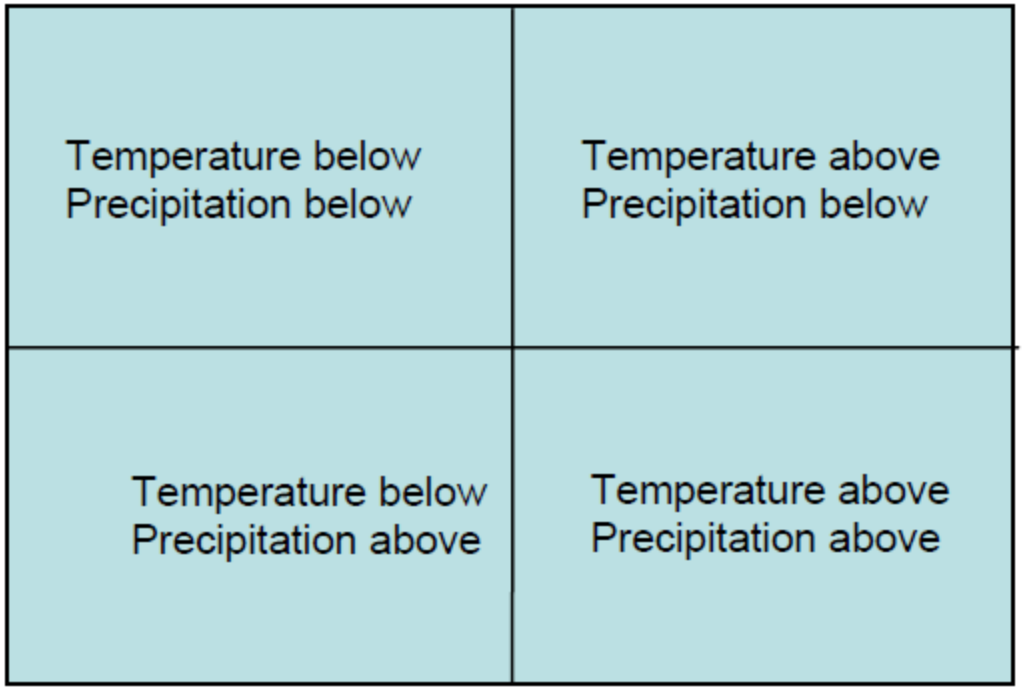
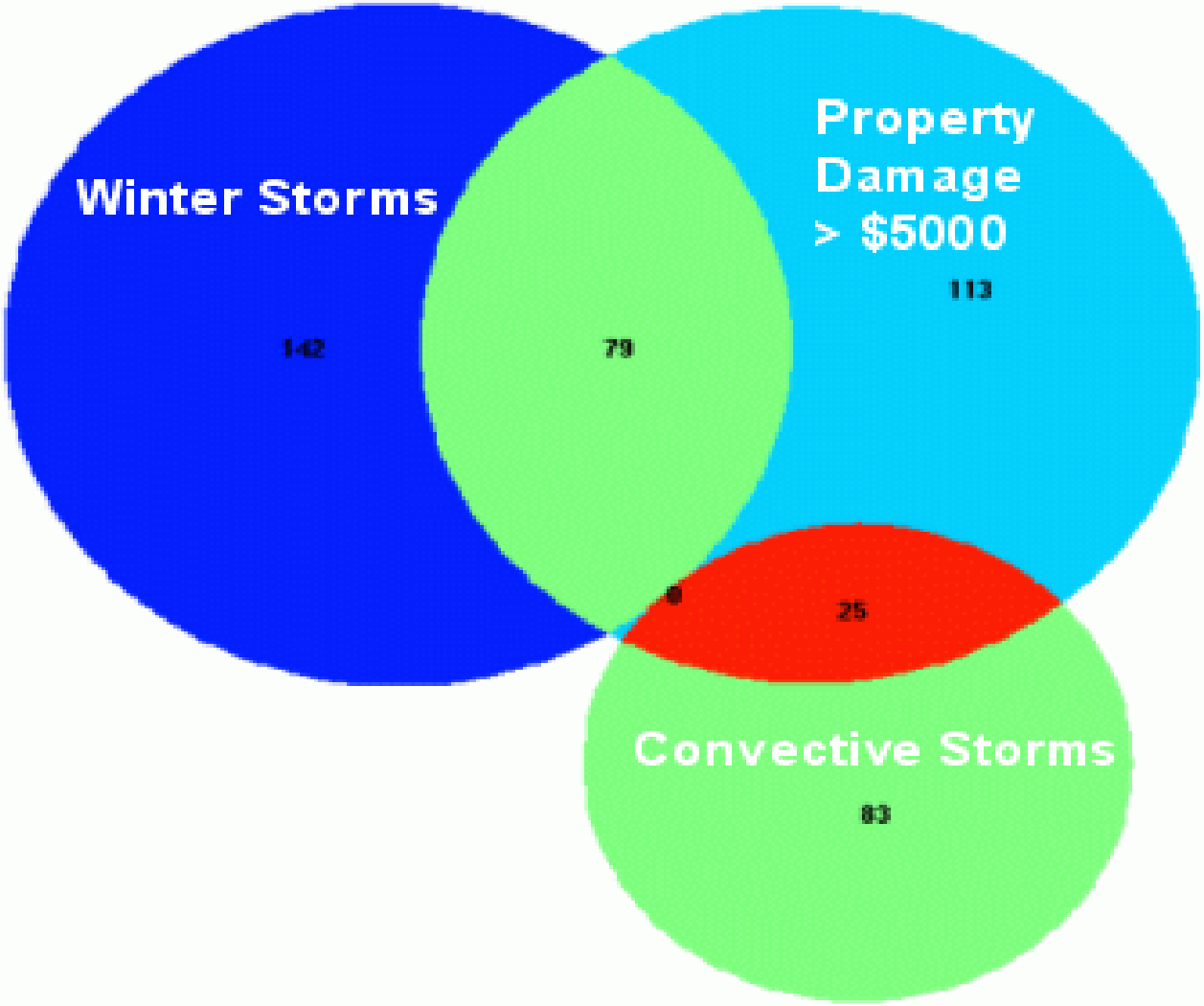


Figure 4.2. MECE possibilities for seasonal forecasts temperature and precpitation anomalies for a specific location.

More Definitions

- E- Event
- Pr{E}- probability of Event E; $0 \leq Pr\{E\} \leq 1$
- Pr{E} = 0, event does not occur
- Pr{E} = 1 event occurs

Storm Reports: Salt Lake County 1993-2005



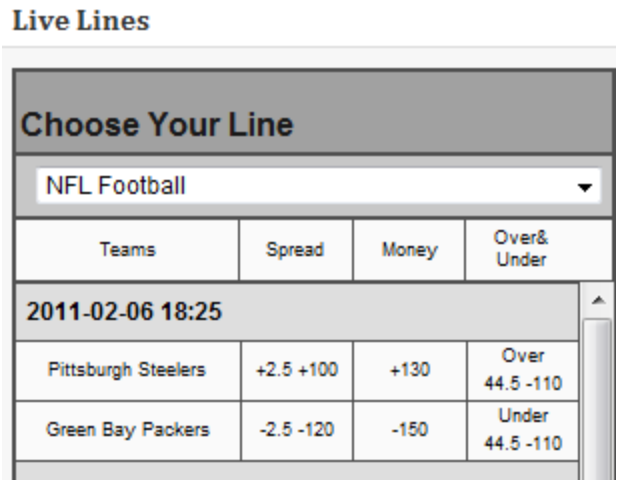
Number of Opportunities: 2340 (180 days * 13 years)

Two Statistical Frameworks: Frequency vs. Bayesian

- Frequency- probability of an event is its relative frequency after many trials
- a- number of occurrences of E
- n- number of opportunities for E to take place
- a/n- relative frequency of E occurring
- $\Pr\{E\} \rightarrow a/n$ as $n \rightarrow \infty$

Two Statistical Frameworks: Frequency vs. Bayesian

- Bayesian- probability represents the degree of belief of an individual about an outcome of an uncertain event
- Some events occur so rarely that there is no long-term relevant probability
- Two individuals can have different probabilities for same outcome
- Bookies are Bayesian



Live Lines

Choose Your Line

NFL Football

Teams	Spread	Money	Over& Under
2011-02-06 18:25			
Pittsburgh Steelers	+2.5 +100	+130	Over 44.5 -110
Green Bay Packers	-2.5 -120	-150	Under 44.5 -110

More concepts

- $\{E\}^c$- complement of {E}, event does not occur
- $Pr\{E\}^c = 1-\{E\}$
- $Pr\{E_1 \cap E_2\}$- joint probability that E_1 & E_2 occur
- $Pr\{E_1 \cap E_2\} = 0$ if E_1 & E_2 are mutually exclusive
- $Pr\{E_1 \cup E_2\}$- probability that E_1 OR E_2 occur
- $Pr\{E_1 \cup E_2\} = Pr\{E_1\} + Pr\{E_2\} - Pr\{E_1 \cap E_2\}$

Conditional Probability

- Conditional probability: probability of $\{E_2\}$ given that $\{E_1\}$ has occurred
- $Pr\{E_2 \mid E_1\} = Pr\{E_1 \cap E_2\} / Pr\{E_1\}$
- E_1 is the conditioning event
- If E_1 and E_2 are independent of each other, then
  $Pr\{E_2 \mid E_1\} = Pr\{E_2\}$ and $Pr\{E_1 \mid E_2\} = Pr\{E_1\}$
- Fair coin- Pr{heads} = 0.5
  - chance of getting heads on second toss is independent of the first

    Pr{heads | heads} = 0.5

    Pr{heads} twice = 0.5 * 0.5 = 025

Bayes Theorem

- $Pr\{E_2 \mid E_1\} = Pr\{E_1 \cap E_2\} / Pr\{E_1\}$ or
- $Pr\{E_1 \cap E_2\} = Pr\{E_2 \mid E_1\} * Pr\{E_1\}$
- $Pr\{E_1 \cap E_2\} = Pr\{E_1 \mid E_2\} * Pr\{E_2\}$ then
- $Pr\{E_1 \mid E_2\} = Pr\{E_2 \mid E_1\} * Pr\{E_1\} / Pr\{E_2\}$
- What is the advantage? Probability of conditioning event E_2 only computed once

Bayesian Application: how a rational person responds to evidence

	Pos Test	Neg Test	TOTAL
DRUG USER	0.495%	0.005%	0.5%
NOT DRUG USER	.995%	98.505%	99.5%
TOTAL	1.49%	98.51%	1

What are odds of falsely accusing non drug user?

E_1 – not drug user

E_2 - positive test

$Pr\{E_1\}$ – 99.5%

$Pr\{E_2\}$ – 1.49%

$Pr\{E_2 \mid E_1\}$ – .995%

$$Pr\{E_1 \mid E_2\} = Pr\{E_2 \mid E_1\} * Pr\{E_1\} / Pr\{E_2\} =$$
$$= 0.995 * 99.5 / 1.49 = 68\%$$

Conclusion: always ask for second opinion if clean and test positive

Bayesian Application:

	COLD	WARM	TOTAL
DRY	20	60	80
WET	20	0	20
TOTAL	40	60	100

E_1 – cold
E_2 - dry
$Pr\{E_1\}$ – 0.4
$Pr\{E_2\}$ – 0.8
$Pr\{E_2 \mid E_1\}$ – 0.5

We can't tell if it is cold or warm
But we know it is dry

$$Pr\{E_1 \mid E_2\} = Pr\{E_2 \mid E_1\} * Pr\{E_1\} / Pr\{E_2\} =$$
$$= 0.5 * 0.4 / 0.8 = 0.25$$

NAME_____

ATMOS 5040/6040 In Class Assignment

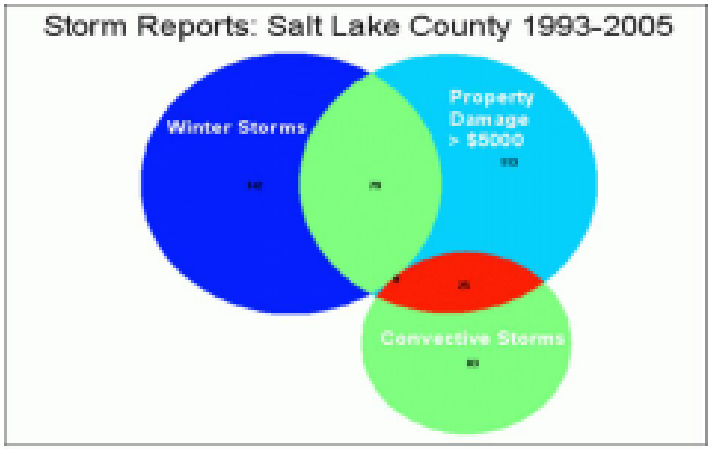
Number of opportunities: 2340

$\{E_1\}$ = occurrence of winter storms
(142+79=221)

$\{E_2\}$ = occurrence of convective storms
(25+83=108)

$\{E_3\}$ = occurrence of property damage

(79+113+25= 217)



$Pr\{E_1\}$ = $Pr\{E_2\}$ = $Pr\{E_3\}$ = $Pr\{E_1 \cap E_2\}$ = $Pr\{E_2 \cap E_3\}$ = $Pr\{E_1 \cap E_3\}$=

$Pr\{E_1 \cup E_2\}$ = $Pr\{E_2 \cup E_3\}$ = $Pr\{E_1 \cup E_3\}$= $Pr\{E_3 \mid E_1\}$ = $Pr\{E_3 \mid E_2\}$ =

For a standard deck of 52 cards, deal out all cards in pairs. Pr{ace} = Pr{10-K} = Pr{2-9} =

What is the probability of getting a blackjack for any pair of cards: Pr{ace ∩ 10-K} =

What is the probability of getting blackjack twice: Pr{ace ∩ 10-K} * Pr{ace ∩ 10-K} =

Now, play at least 20 hands of blackjack with 3 other people Summarize in a table below your own relative frequencies (s/n) of getting an ace, 10-K, 2-9, blackjack, and two blackjacks. Who in your group was really lucky?

	n	s	s/n
ace			
10-K			
2-9			
blackjack			
Two blackjacks			