The Ensemble Situational Awareness Table: Overview and Future Enhancements

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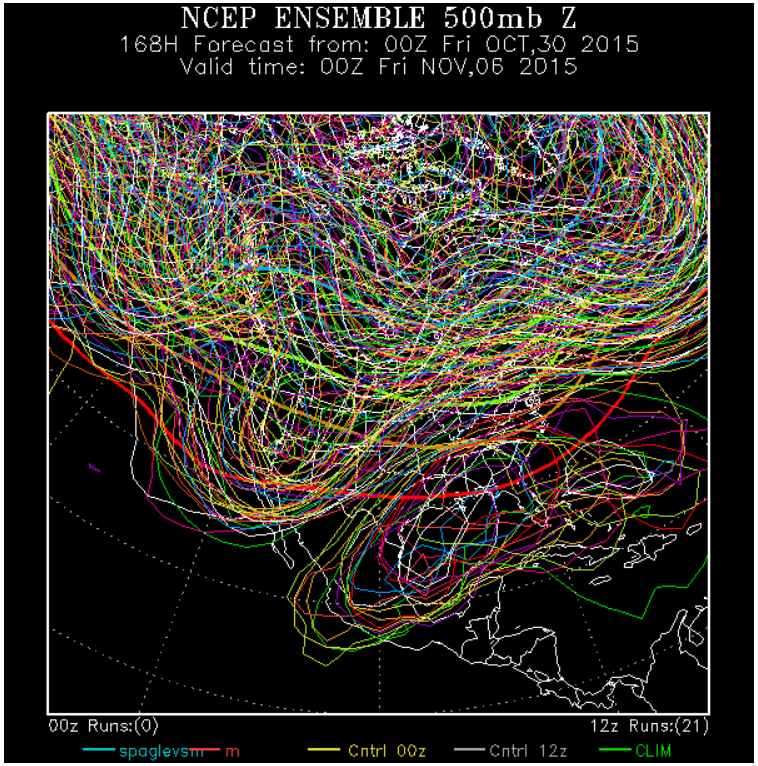
VLAB Forum – 18 Nov 2015

Outline

- Overview of what the Ensemble Situational Awareness Table (ESAT) is
- Case studies that highlight ESAT's usefulness
- Overview of ongoing efforts to transition ESAT to NWS Integrated Dissemination Program (IDP)
- Scheduled improvements to ESAT

What is ESAT?

- ESAT is a tool that adds context to NAEFS forecasts
- Helps a forecaster identify and determine the likelihood of a potentially high impact weather event
- Extremely useful, probabilistic information contained in an ensemble forecast, but forecasters often don't have time to mine through the onslaught of data in search of it.
- Need a tool that will effectively leverage the data to point out what is significant in the forecast and how likely this significant event is
- ESAT was developed to help fill this need



168-hour GEFS forecast of 500 mb heights

Adding Context to the Forecast

- Context added by comparing the **ensemble mean** forecast to reanalysis climatology (R-climate) and model climatology (M-climate)

- ESAT based on idea that ensemble mean can be leveraged as a confidence tool
  - When the ensemble mean departs significantly from climatology, usually indicates there is agreement in location and timing of large event among the members
  - A large event usually occurs

- A tool that displays how much the ensemble mean differs from climatology can improve forecasts by:
  - Alerting forecasters that a high impact event is possible
  - Clarifying the ensembles confidence in the event

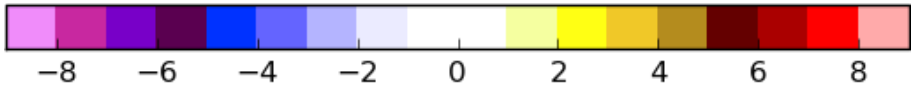
R-Climate and M-Climate

- R-Climate: how forecast compares to typical conditions at this time of year
  - A trough this deep in November is very rare

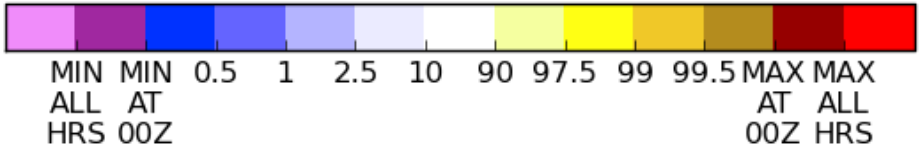
- M-Climate: how forecast compares to other forecasts made at this time of year
  - The model rarely predicts this much precipitation at 5-days out in October

R-Climate Output Types

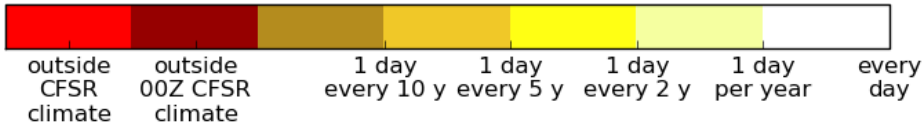
- Standardized Anomalies: How different the model forecast is from the climatological mean



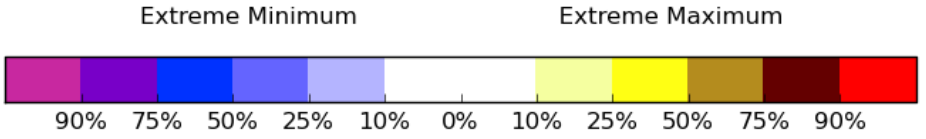
- Percentile: Where the model forecast falls with respect to climatology



- Return Intervals: How often a forecast value shows up in the climatology



- Probability (of extreme event): Percentage of the ensemble members that produce "extreme" values (i.e. outside climatology)



R-Climate Methodology

- NAEFS **ensemble mean** compared to 1979 – 2009 Climate Forecast System Reanalysis (CFSR)
  - NAEFS is compared to CFSR over a 21-day window that centers on the forecast's valid time
  - Forecasts valid at 00Z compared only to 00Z analyses, 06Z compared to 06Z, etc.

- 21-day window chosen because it's long enough to highlight events associated with impacts, but not so long that it only highlights massive events (don't need all-time records to have an impactful event)

R-Climate Variables

- ESAT primarily focuses on pressure-level variables: geopotential height, temperature, specific humidity, u-wind, v-wind, and wind speed

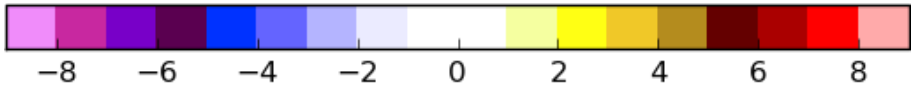
- Includes a few single-level variables: sea-level pressure, precipitable water, and integrated vapor transport

M-Climate Methodology

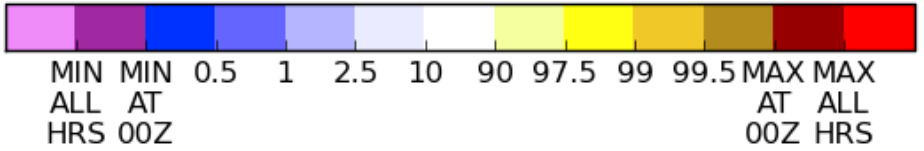
- GEFS **ensemble mean** compared to ensemble mean from the GEFS Reforecast dataset
  - GEFS is compared to GEFS Reforecast over a 21-day window that centers on the forecast's valid time
  - 6-hour forecasts compared only to 6-hour reforecasts, 12-hour forecasts compared to only 12-hour reforecasts, etc.
  - Forecasts valid at 00Z compared to only 00Z analyses, 06Z compared to 06Z, etc.

M-Climate Output Types and Variables

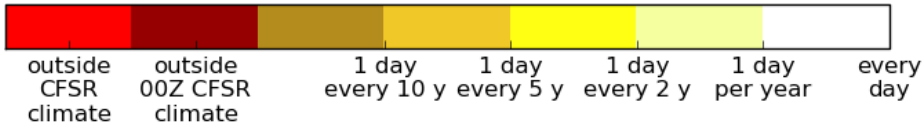
- Standardized Anomalies: How different the model forecast is from the climatological mean



- Percentile: Where the model forecast falls with respect to climatology



- Return Intervals: How often these forecast values show up in the climatology

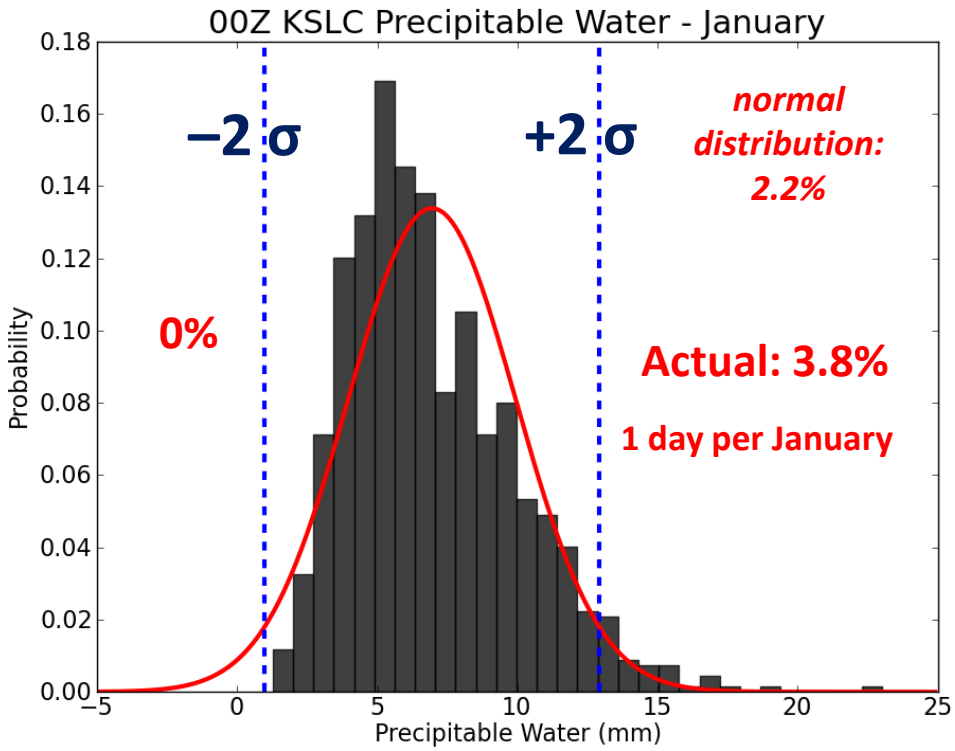


- Variables: geopotential height and temperature on a few pressure levels, sea-level pressure, precipitable water, and **QPF (percentile only)**.

Recommended Output: Percentiles

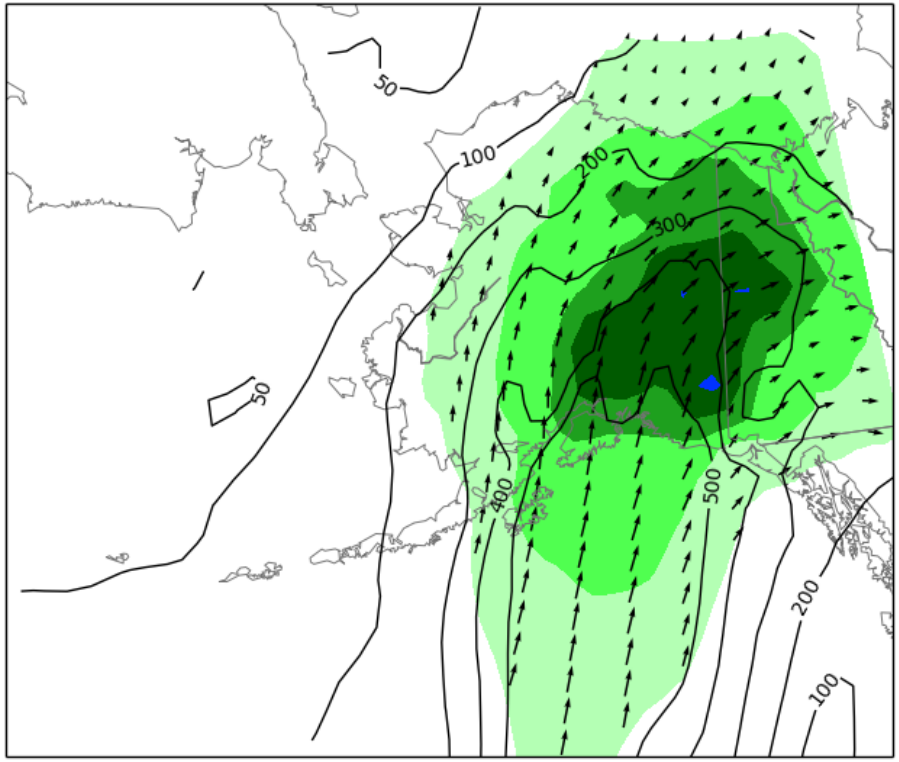
- Not all forecast variables are normally distributed

- Percentiles help translate standardized anomalies into "where exactly does this event fall relative to climatology?"

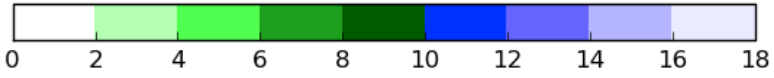


Anomaly vs Percentile

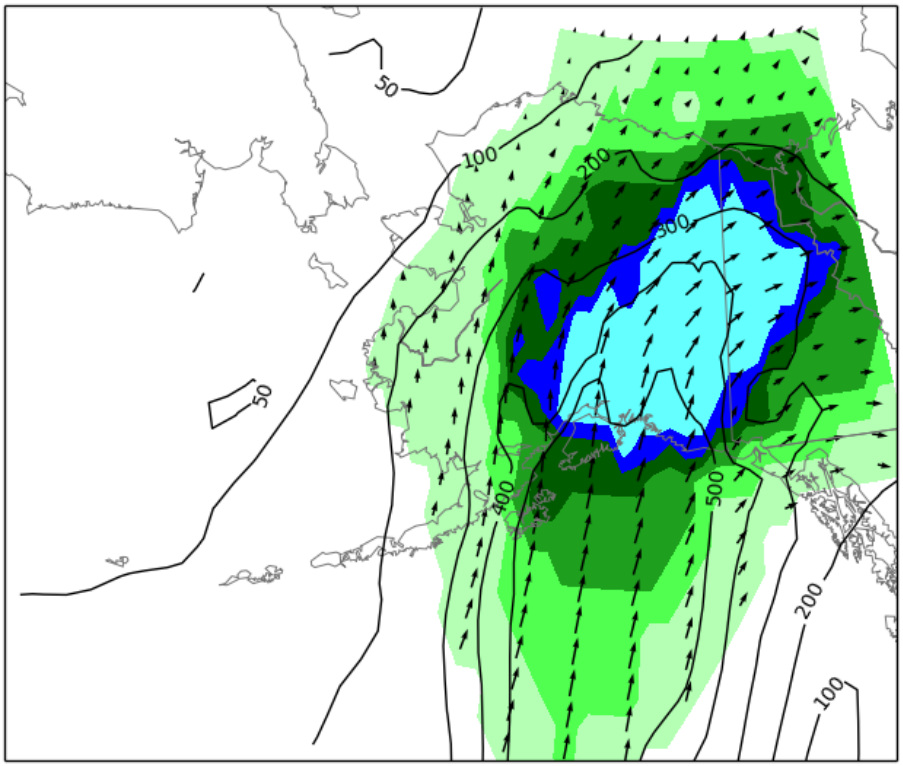
NAEFS Mean IVT and Standardized Anomaly
Hour 120 – Valid 12:00 UTC Mon Oct 28 2013



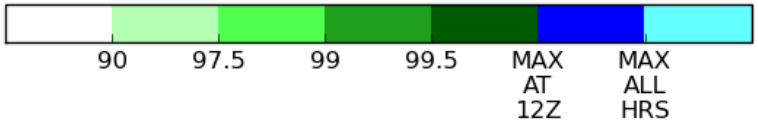
Relative to the 18-Oct to 08-Nov 1979-2009 CFSR climatology



NAEFS Mean IVT and Climatological Percentile
Hour 120 – Valid 12:00 UTC Mon Oct 28 2013



Relative to the 18-Oct to 08-Nov 1979-2009 CFSR climatology



Where is ESAT?

http://ssd.wrh.noaa.gov/satable

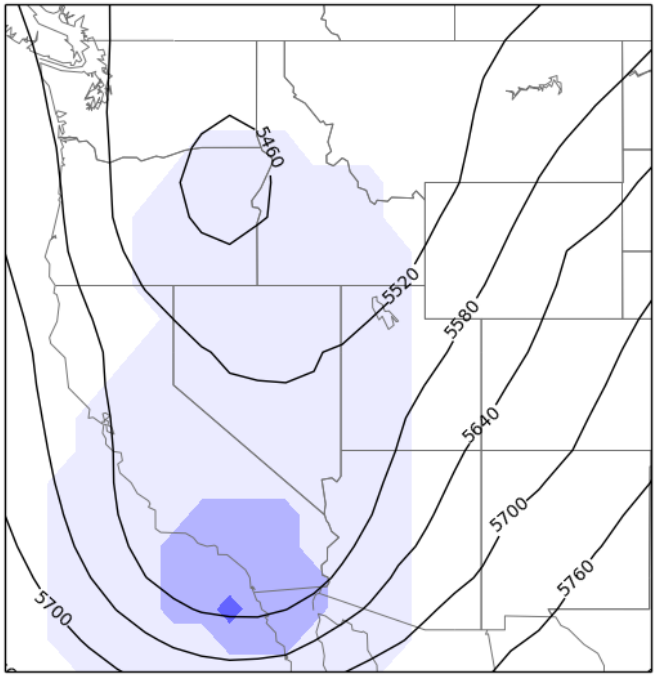
Model Run: Nov 4, 2015 00Z | **Table Region:** Western U.S. | **Plot Region:** Western U.S. | **Output:** NAEFS Percentile | View Table

Fcst Hr: 0 Valid: Tue Nov 3 7:00 PM EST

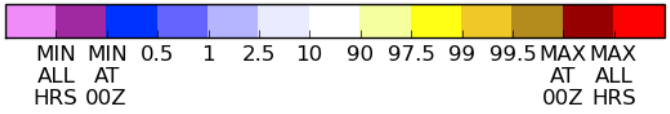
WFO Western U.S. Table Nov 4, 2015 00Z Run

			Z	T	U	V	WSP	SLP	Q	PW	IVT
0	Wed 4th	00Z	1	99.5	MIN	MAX	99.5	2.5	97.5	90	99
6		06Z	2.5	99	99	MAX	99	10	90	10	99
12		12Z	2.5	1	99	MAX	97.5	10	97.5	10	90
18		18Z	2.5	1	99	MAX	99	10	10	10	97.5
24	Thu 5th	00Z	2.5	97.5	99	MAX	99	2.5	97.5	10	99
30		06Z	10	1	97.5	99.5	99	10	10	10	90
36		12Z	10	1	97.5	99.5	99.5	90	10	10	AVG
42		18Z	90	2.5	99.5	99	99	90	10	AVG	AVG
48	Fri 6th	00Z	90	10	90	97.5	97.5	90	10	10	AVG
54		06Z	90	10	2.5	2.5	90	97.5	2.5	2.5	AVG
60		12Z	90	2.5	10	2.5	90	97.5	2.5	2.5	AVG
66		18Z	90	2.5	10	1	AVG	90	10	AVG	AVG
72	Sat 7th	00Z	90	10	10	2.5	AVG	90	2.5	90	AVG
78		06Z	90	10	AVG	2.5	AVG	90	10	10	AVG
84		12Z	90	90	AVG	10	AVG	90	10	2.5	AVG
90		18Z	90	90	2.5	90	90	97.5	2.5	2.5	AVG
96	Sun 8th	00Z	90	90	2.5	90	AVG	90	2.5	10	AVG
102		06Z	90	90	1	90	90	90	10	10	AVG
108		12Z	90	90	90	90	AVG	90	90	10	AVG
114		18Z	10	10	90	90	AVG	AVG	90	AVG	AVG
120	Mon 9th	00Z	10	10	90	90	90	AVG	90	AVG	AVG
126		06Z	90	10	90	90	90	AVG	AVG	AVG	AVG
132		12Z	90	10	90	90	90	AVG	90	AVG	AVG
138		18Z	90	10	97.5	90	90	AVG	90	AVG	AVG
144	Tue 10th	00Z	97.5	10	97.5	90	90	AVG	90	AVG	AVG
150		06Z	97.5	10	97.5	10	97.5	AVG	90	AVG	AVG
156		12Z	97.5	2.5	97.5	10	97.5	90	90	AVG	AVG
162		18Z	97.5	90	90	10	90	97.5	AVG	AVG	90
168	Wed 11th	00Z	97.5	10	90	10	90	97.5	AVG	AVG	90
174		06Z	97.5	2.5	90	10	90	99.5	AVG	AVG	AVG
180		12Z	99	2.5	90	10	90	99.5	10	10	AVG
186		18Z	97.5	10	90	2.5	90	99	10	10	AVG
192	Thu 12th	00Z	99	10	90	10	90	99	10	10	AVG
198		06Z	90	10	90	10	90	99	10	10	AVG
204		12Z	90	10	10	10	AVG	97.5	10	10	AVG
210		18Z	AVG	90	10	AVG	AVG	90	10	10	AVG

NAEFS Mean 500-hPa Geopotential Height (m) and Climatological Percentile
HOUR 000 - VALID 00:00 UTC Wed Nov 04 2015



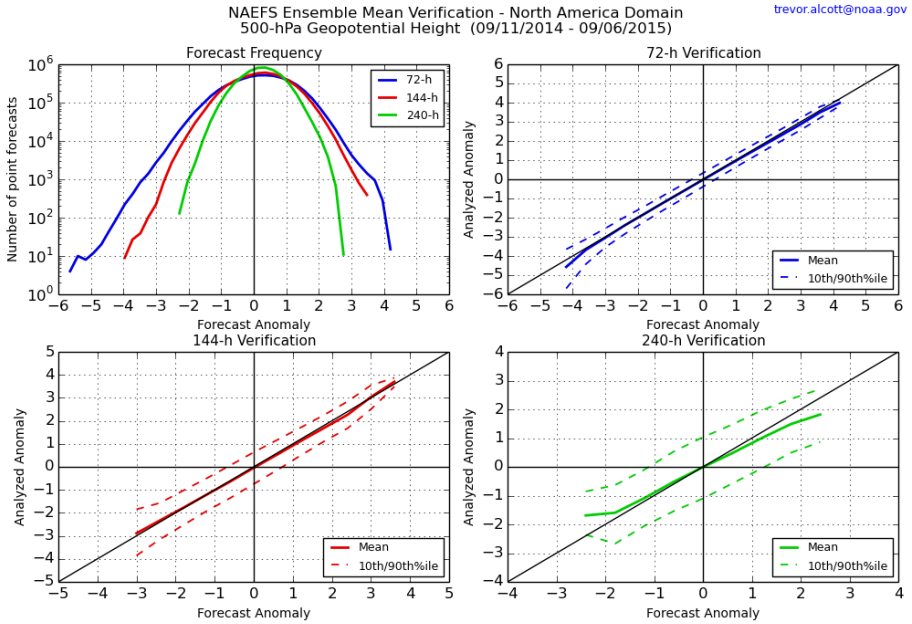
Relative to the 24-Oct to 14-Nov 1979-2009 CFSR climatology



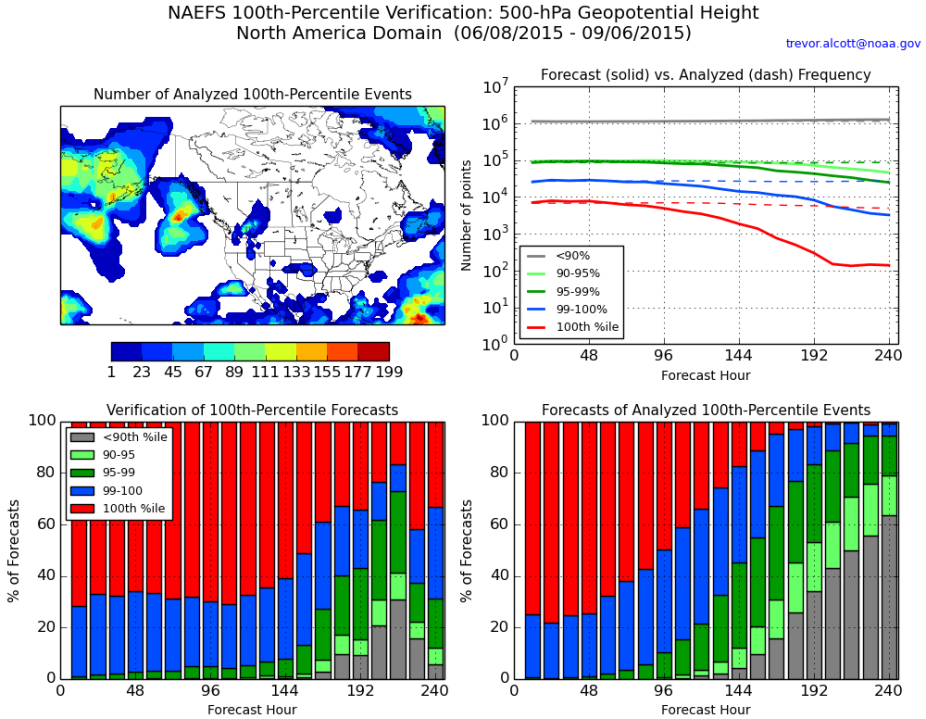
ESAT Verification: is it Useful?

- Vist http://ssd.wrh.noaa.gov/satable/verify for whole host of verification statistics, but short answer is: Yes!

Verification For Anomalies



Verification For Percentiles



Verification: Standardized Anomalies

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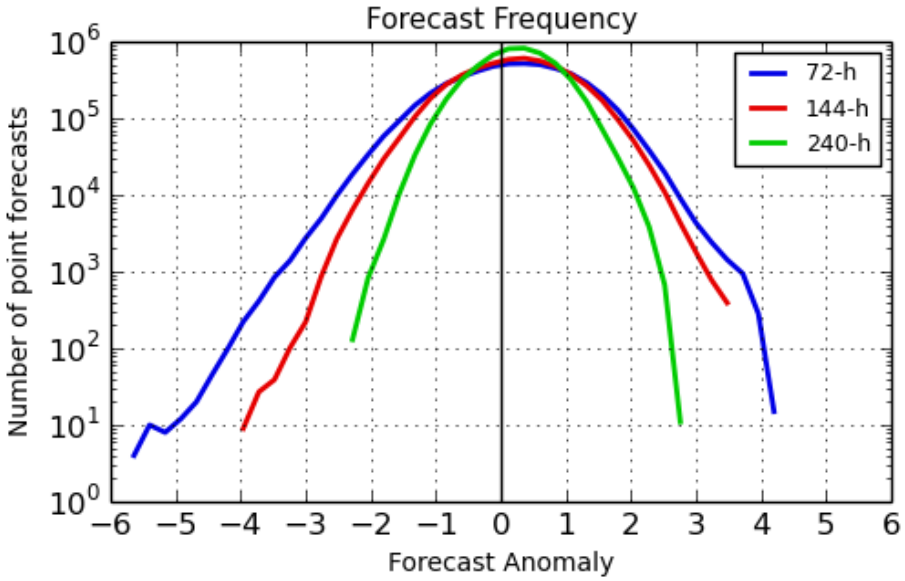
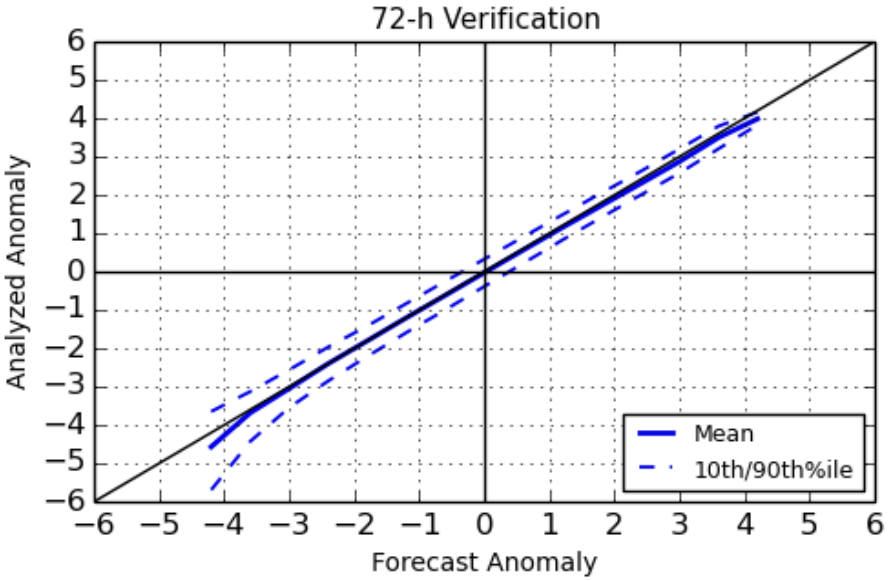
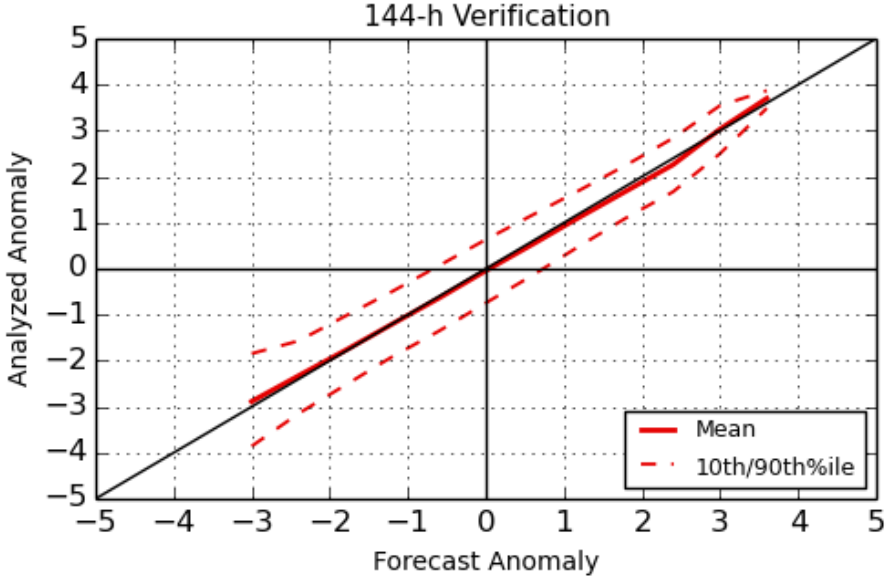
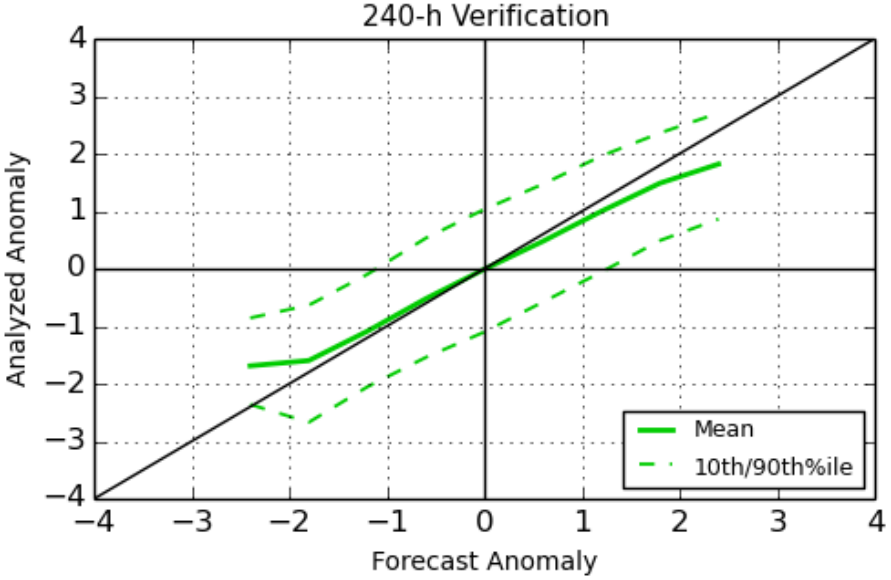
NAEFS Ensemble Mean Verification - North America Domain
500-hPa Geopotential Height (09/11/2014 - 09/06/2015)



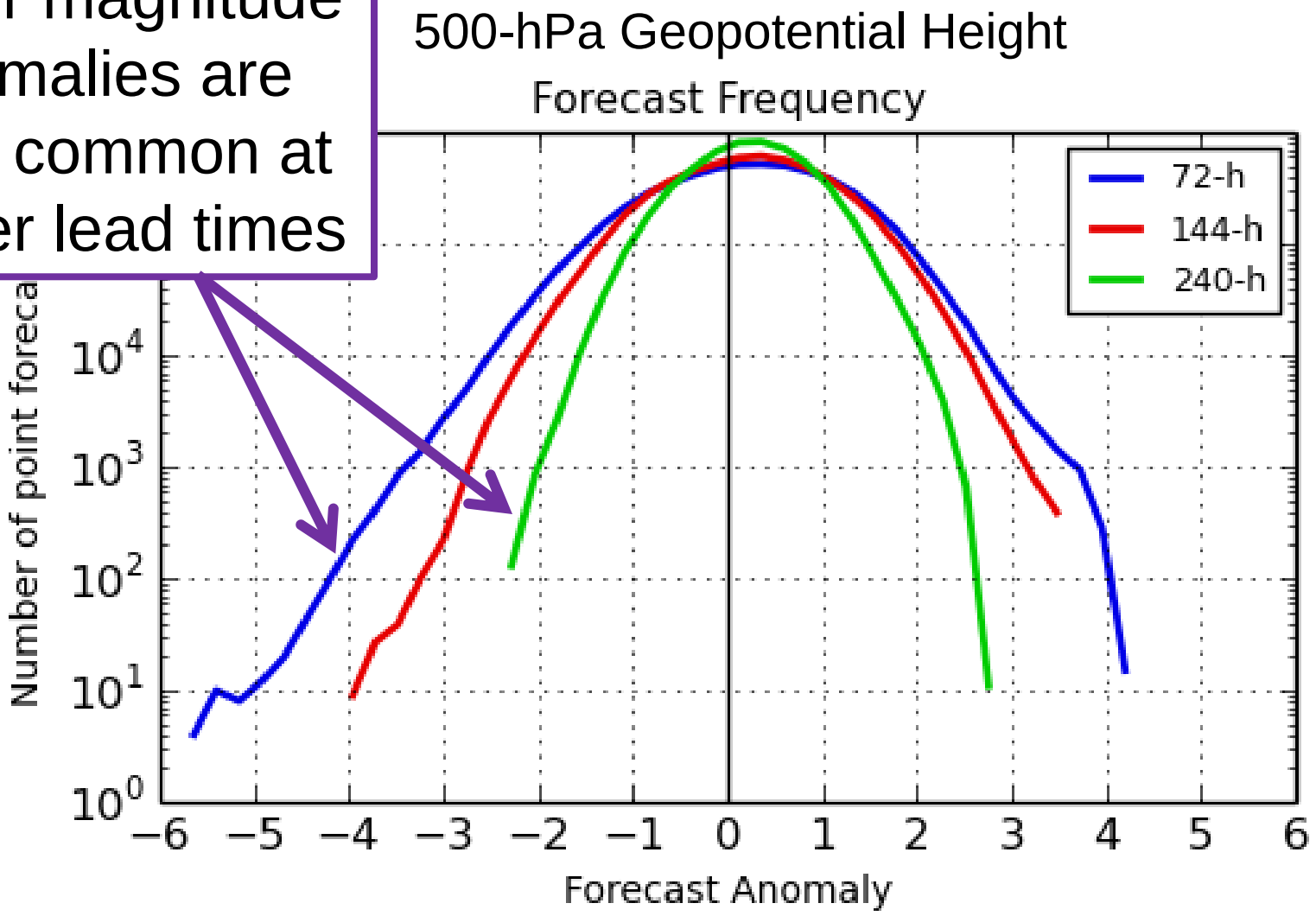






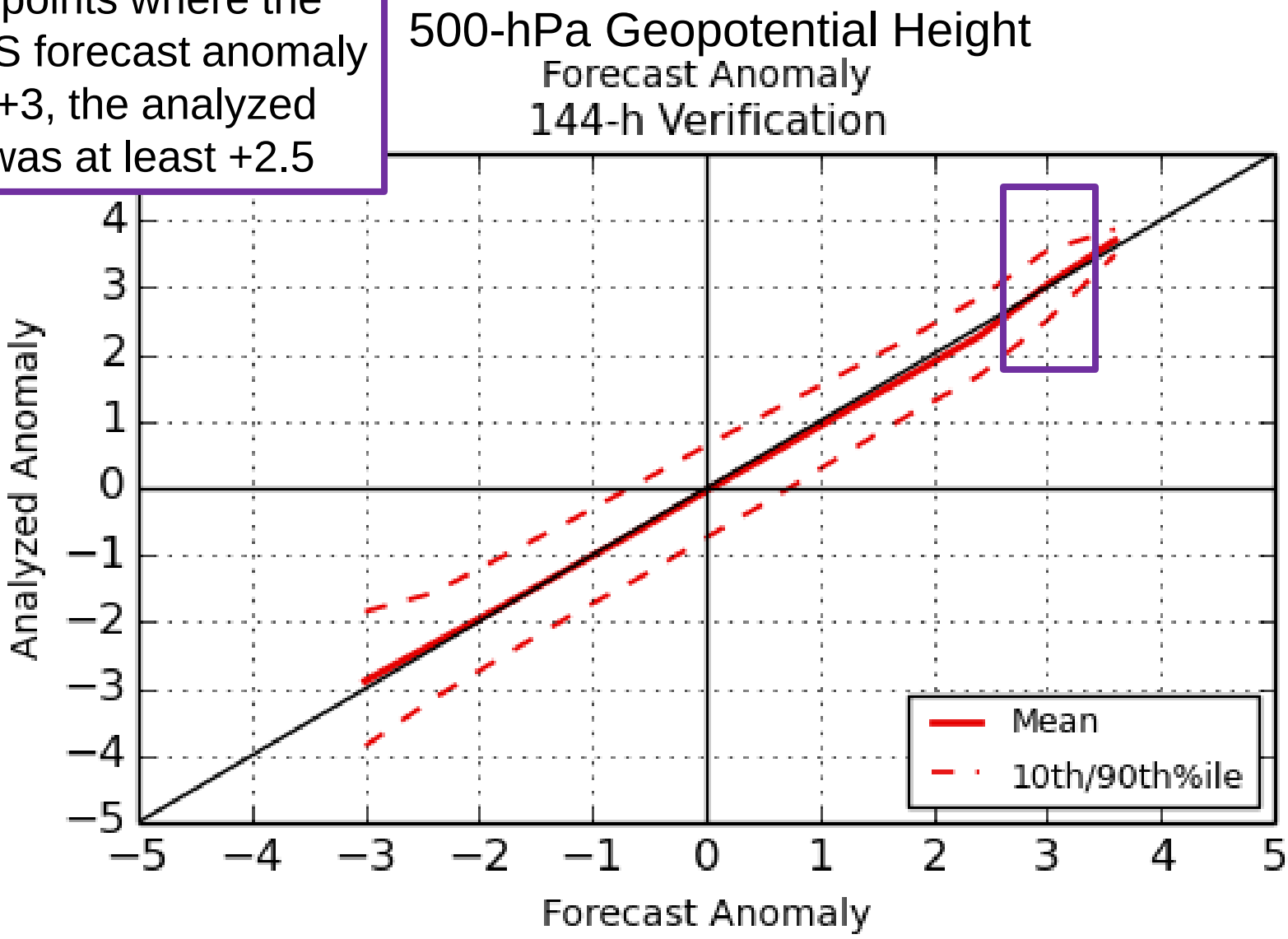
Verification: Standardized Anomalies

Larger magnitude anomalies are more common at shorter lead times

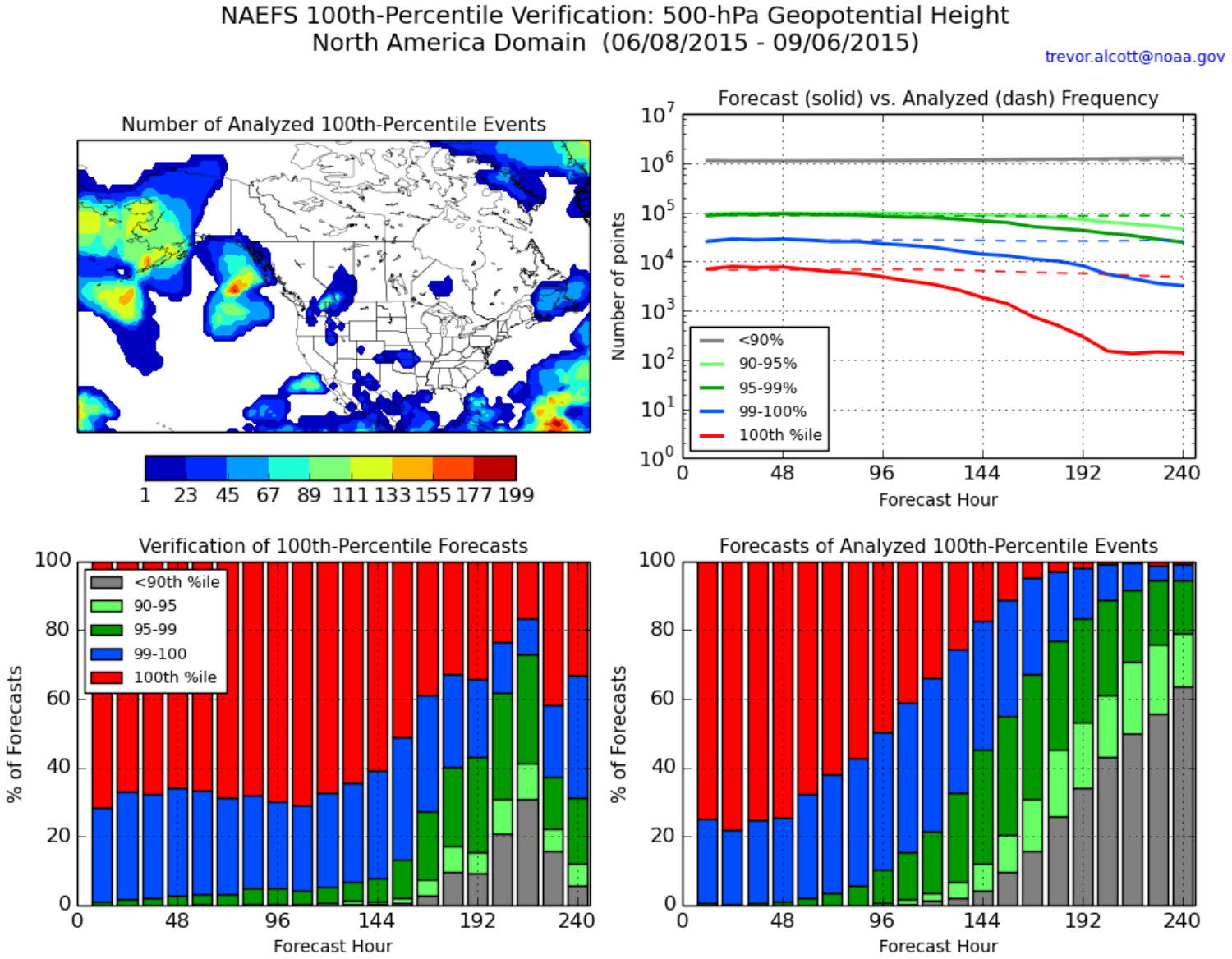


Verification: Standardized Anomalies

At 90% of points where the day-6 NAEFS forecast anomaly was near +3, the analyzed anomaly was at least +2.5



Verification: Percentiles



Verification: Percentiles

NAEFS 100th-Percentile Verification: 500-hPa Geopotential Height
North America Domain (06/08/2015 - 09/06/2015)

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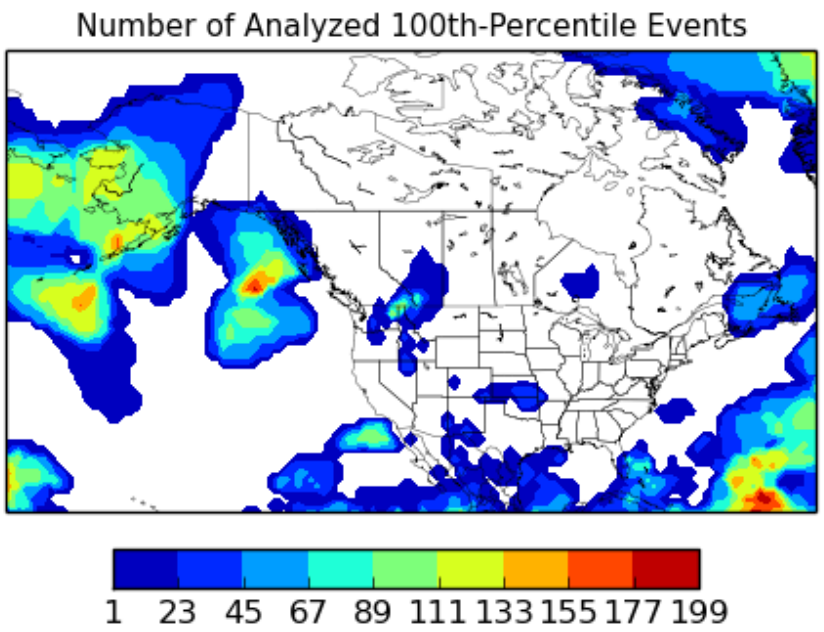
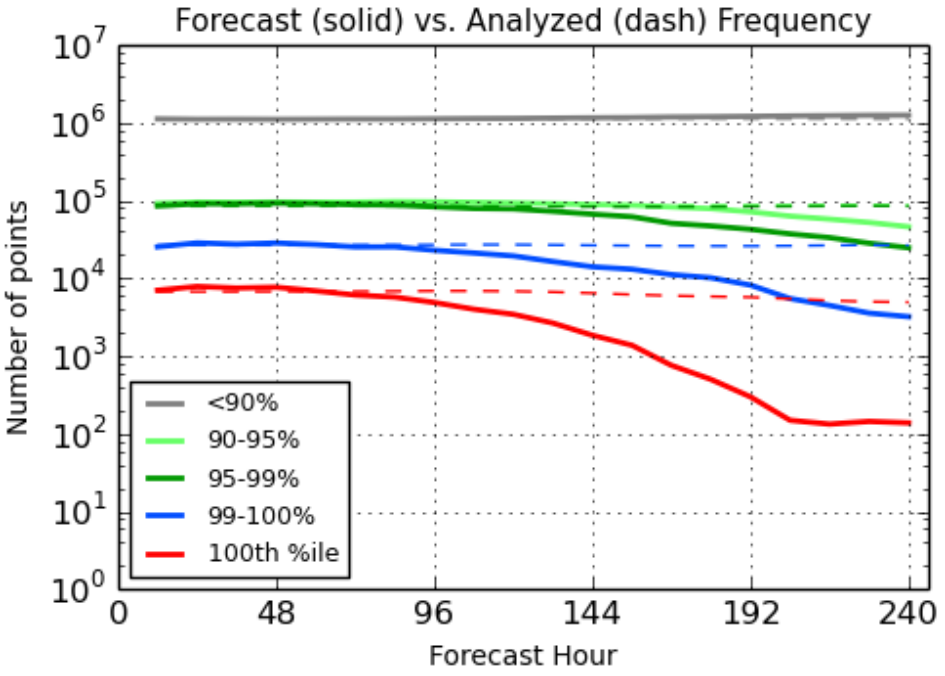
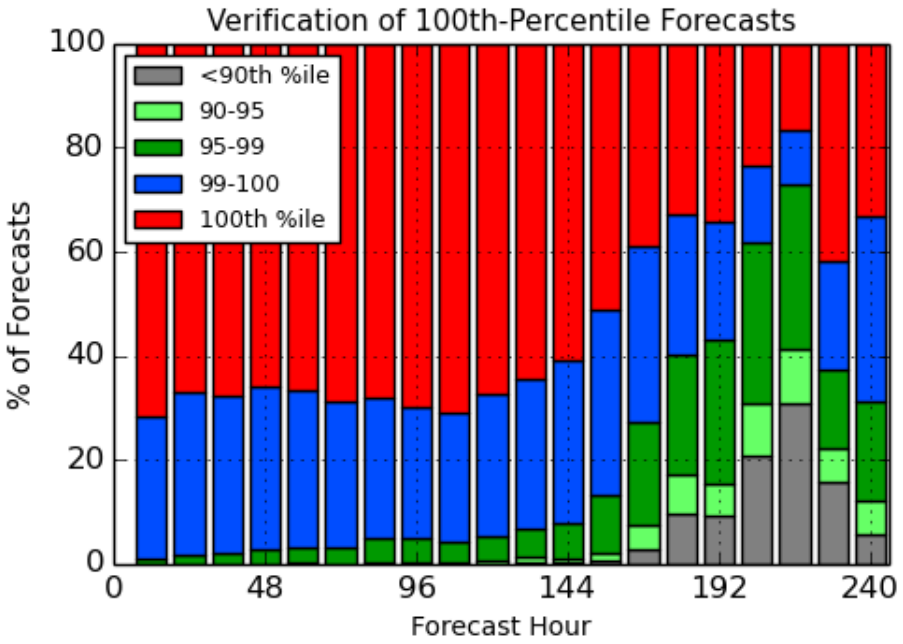


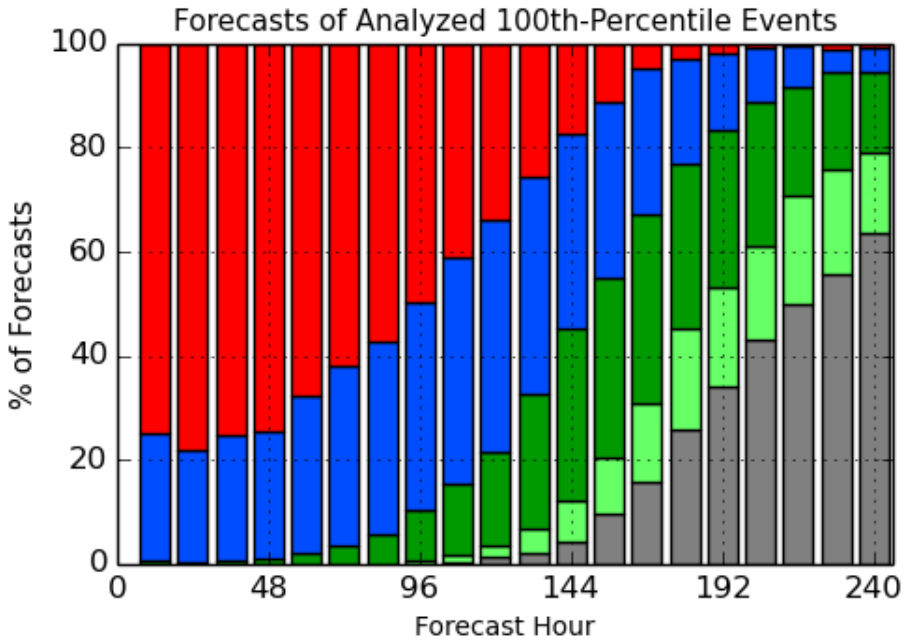


At longer lead times, NAEFS ensemble mean tends to underforecast extreme events

Verification: Percentiles

500-hPa Geopotential Height





"**False-Alarm Rate**"
When a 100th-percentile event was forecast, how did it verify?

"**Probability of Detection**"
When a 100th-percentile event occurred, what was the forecast?

Verification

- Smoothing effect of a multi-model mean can be used to our advantage:
  - Big signal means that most members agree on location, timing, and large amplitude
  - Very low false-alarm ratio

- Rough estimates of NAEFS predictability limits over North America
  - Major upper-level patterns (8 – 10 days)
  - Major surface highs and lows (6 – 8 days)
  - Significant warmth and cold (5 – 7 days)
  - Strong large-scale winds (5 – 7 days)
  - Significant rainfall events (3 – 5 days)

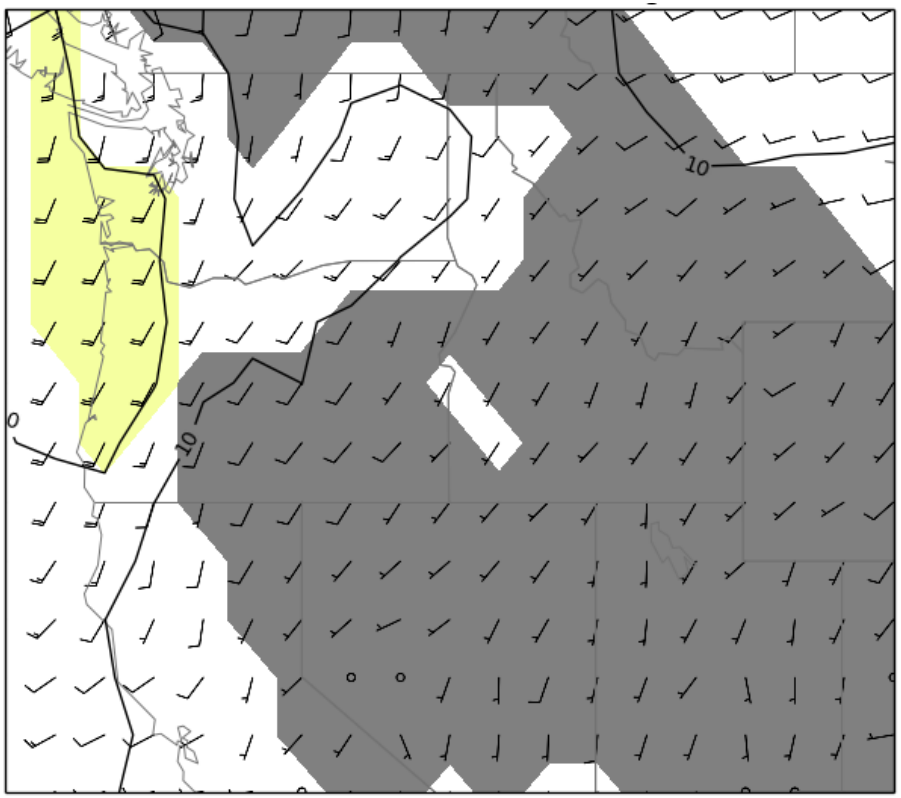
Case Study: Pacific NW Windstorm of 29 Aug 2015

- 2 Fatalities in Western Washington
- 300,000+ customers without power at storm's peak
- Widespread wind gusts of 50 mph – 70 mph
- Strongest summer windstorm to impact the Pacific Northwest in recorded history.

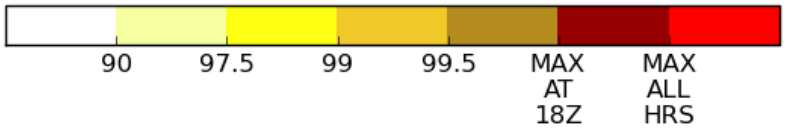
How Did ESAT Do?

Northwest U.S. Table Aug 24, 2015 12Z Run												
			Z	T	U	V	WSP	SLP	Q	PW	IVT
0	Mon 24th	12Z	90	90	AVG	90	90	AVG	99	10	90
6		18Z	90	97.5	90	97.5	90	AVG	99	10	90
12	Tue 25th	00Z	90	10	90	90	90	AVG	99	10	90
18		06Z	90	10	AVG	90	90	AVG	10	10	90
24		12Z	90	10	90	90	AVG	AVG	10	10	90
30		18Z	90	99	90	90	AVG	AVG	10	10	AVG
36	Wed 26th	00Z	90	97.5	AVG	90	AVG	AVG	97.5	90	90
42		06Z	90	97.5	AVG	90	AVG	AVG	97.5	97.5	97.5
48		12Z	90	97.5	90	90	90	AVG	97.5	99	99.5
54		18Z	90	2.5	AVG	90	AVG	AVG	99	99	99
60	Thu 27th	00Z	90	97.5	AVG	97.5	90	90	99.5	99	97.5
66		06Z	90	10	AVG	90	90	90	99	97.5	90
72		12Z	97.5	97.5	AVG	97.5	90	90	97.5	90	90
78		18Z	90	99	AVG	97.5	90	90	99	90	90
84	Fri 28th	00Z	90	99	90	90	90	90	97.5	97.5	97.5
90		06Z	90	99	90	90	90	90	99	97.5	97.5
96		12Z	90	99	90	90	90	AVG	99	97.5	97.5
102		18Z	90	99	90	90	90	AVG	99	97.5	97.5
108	Sat 29th	00Z	90	99	90	10	90	AVG	99	[illegible]	99
114		06Z	10	99	90	10	90	10	97.5	97.5	99
120		12Z	10	99	90	97.5	90	10	97.5	97.5	99
126		18Z	10	99	90	97.5	90	10	97.5	90	99
132	Sun 30th	00Z	10	99	90	97.5	97.5	10	99	[illegible]	97.5
138		06Z	10	99	90	99	90	10	97.5	90	97.5
144		12Z	10	99	90	97.5	90	10	97.5	90	97.5
150		18Z	10	99	90	97.5	90	10	97.5	90	90

NAEFS MEAN 850-hPa Wind Speed (kt) and Percentile
Hour 126 – Valid 18:00 UTC Sat Aug 29 2015



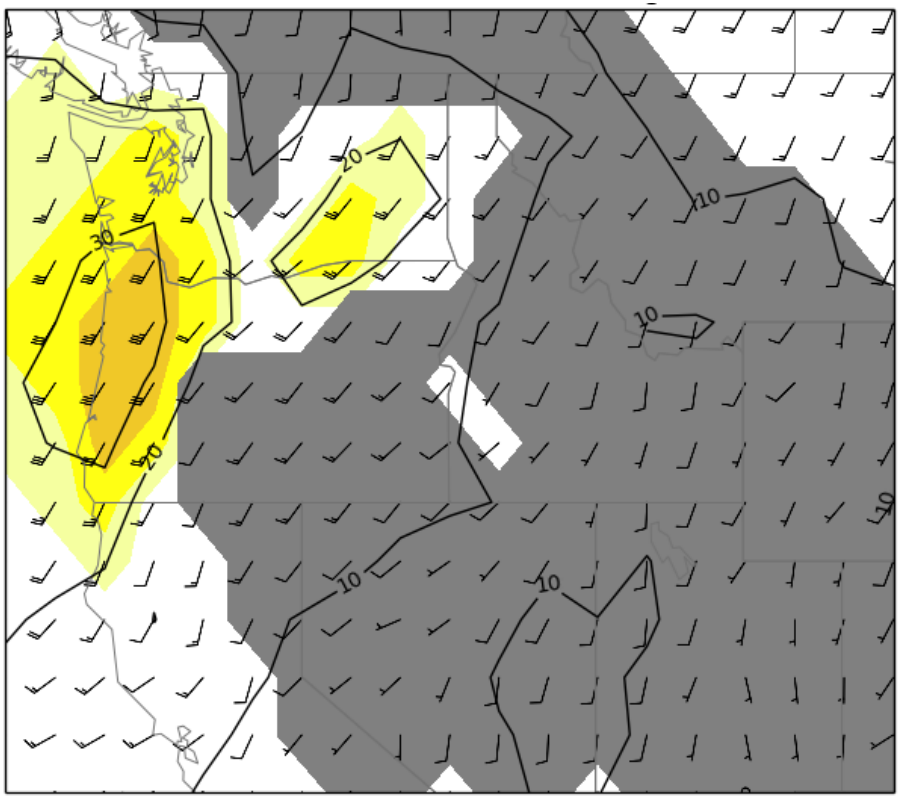
Relative to the 19-Aug to 09-Sep 1979-2009 CFSR climatology
(gray = near or below ground)



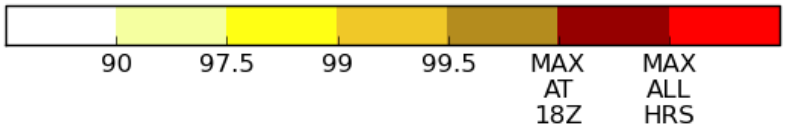
How Did ESAT Do?

Northwest U.S. Table Aug 25, 2015 12Z Run											
			Z	T	U	V	WSP	SLP	Q	PW	IVT
0	Tue 25th	12Z	97.5	99	90	90	90	AVG	2.5	2.5	90
6		18Z	99	99.5	90	90	90	AVG	2.5	10	90
12	Wed 26th	00Z	99	97.5	1	90	AVG	AVG	97.5	10	90
18		06Z	97.5	97.5	1	97.5	90	AVG	99	97.5	99
24		12Z	97.5	97.5	90	97.5	90	AVG	99	99.5	MAX
30		18Z	90	99	90	97.5	97.5	90	MAX	99	MAX
36	Thu 27th	00Z	90	97.5	90	90	90	90	99.5	99	99
42		06Z	90	97.5	90	90	90	90	99.5	97.5	90
48		12Z	90	99	AVG	90	AVG	90	97.5	90	90
54		18Z	90	99	AVG	0.5	90	90	99	90	90
60	Fri 28th	00Z	90	99.5	90	90	90	90	99	97.5	97.5
66		06Z	90	99.5	90	97.5	90	AVG	99.5	97.5	97.5
72		12Z	AVG	99	90	97.5	90	AVG	MAX	99	99
78		18Z	10	99	90	97.5	90	10	99.5	99	99
84	Sat 29th	00Z	10	99	90	99	99	2.5	99	[illegible]	MAX
90		06Z	1	99	97.5	99	99	1	99	99	MAX
96		12Z	MIN	99	99	99	99	0.5	97.5	97.5	MAX
102		18Z	0.5	99	99	99.5	MAX	0.5	99	97.5	MAX
108	Sun 30th	00Z	1	97.5	99	99	99	1	99	[illegible]	MAX
114		06Z	2.5	90	97.5	99.5	99	2.5	97.5	90	99.5
120		12Z	2.5	97.5	97.5	99	99	2.5	97.5	90	99
126		18Z	10	97.5	97.5	97.5	97.5	10	97.5	90	97.5
132	Mon 31st	00Z	10	10	90	97.5	90	10	97.5	90	99
138		06Z	10	10	90	97.5	90	10	90	90	90
144		12Z	10	10	90	90	90	10	90	AVG	90
150		18Z	2.5	10	90	97.5	90	2.5	90	AVG	90

NAEFS MEAN 850-hPa Wind Speed (kt) and Percentile
Hour 102 – Valid 18:00 UTC Sat Aug 29 2015



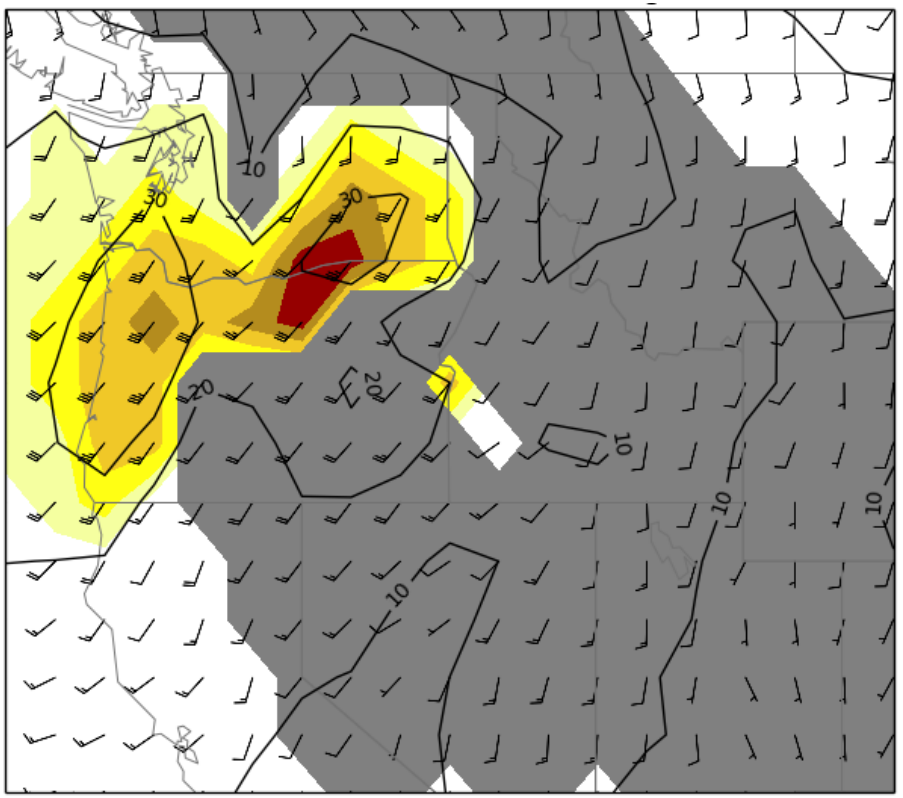
Relative to the 19-Aug to 09-Sep 1979-2009 CFSR climatology
(gray = near or below ground)



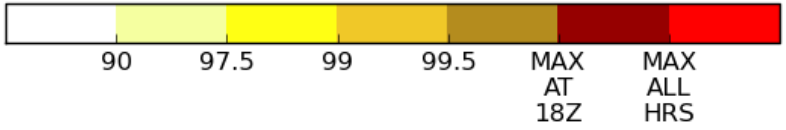
How Did ESAT Do?

Northwest U.S. Table Aug 27, 2015 12Z Run											
			Z	T	U	V	WSP	SLP	Q	PW	IVT
0	Thu 27th	12Z	99	99.5	90	10	90	90	99	90	97.5
6		18Z	90	99	90	97.5	90	90	99	97.5	97.5
12	Fri 28th	00Z	90	MAX	90	99	90	90	99.5	99	99
18		06Z	90	MAX	90	99.5	97.5	AVG	MAX	99	99
24		12Z	90	99	90	99	99	AVG	MAX	99	99
30		18Z	10	99	90	99.5	99	10	99.5	99	MAX
36	Sat 29th	00Z	2.5	99	90	MAX	MAX	2.5	99		MAX
42		06Z	MIN	99	MAX	MAX	MAX	MIN	99	99	MAX
48		12Z	MIN	99	MAX	MAX	MAX	MIN	99	99	MAX
54		18Z	MIN	99	99.5	MAX	MAX	MIN	99.5	99	MAX
60	Sun 30th	00Z	MIN	99	99.5	MAX	MAX	MIN	99.5		MAX
66		06Z	1	97.5	99.5	99.5	MAX	1	99	97.5	99.5
72		12Z	2.5	90	MAX	99	99.5	2.5	97.5	90	99.5
78		18Z	2.5	90	99	99	99	10	10	97.5	99
84	Mon 31st	00Z	2.5	90	99	97.5	99	2.5	99	90	99
90		06Z	2.5	10	99	99	99	2.5	90	90	97.5
96		12Z	10	90	99.5	97.5	99	2.5	90	90	97.5
102		18Z	10	10	97.5	97.5	97.5	10	90	AVG	90
108	Tue 1st	00Z	2.5	90	97.5	90	90	2.5	90	AVG	90
114		06Z	2.5	10	90	90	90	10	90	AVG	90
120		12Z	1	10	90	90	90	10	90	AVG	90
126		18Z	1	10	97.5	90	90	2.5	90	AVG	90
132	Wed 2nd	00Z	1	10	90	97.5	90	2.5	97.5	AVG	90
138		06Z	2.5	10	90	90	90	10	90	AVG	90
144		12Z	2.5	10	90	90	90	10	90	AVG	90
150		18Z	10	10	90	90	90	10	97.5	AVG	AVG

NAEFS MEAN 850-hPa Wind Speed (kt) and Percentile
Hour 054 – Valid 18:00 UTC Sat Aug 29 2015

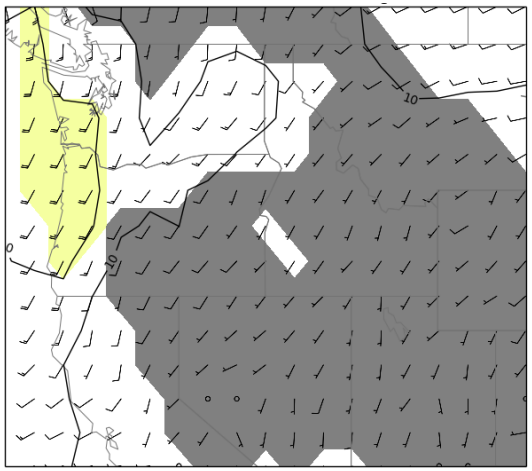


Relative to the 19-Aug to 09-Sep 1979-2009 CFSR climatology
(gray = near or below ground)

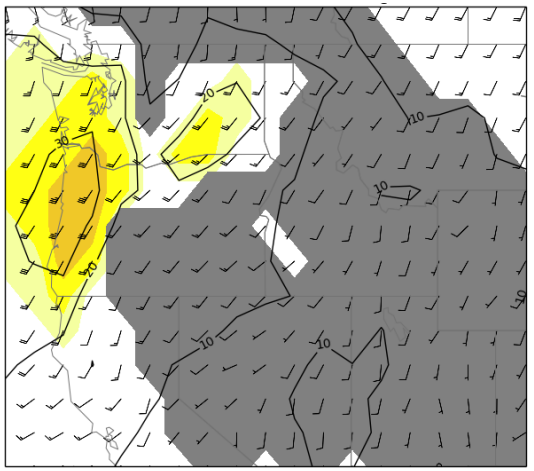


How Did ESAT Do?

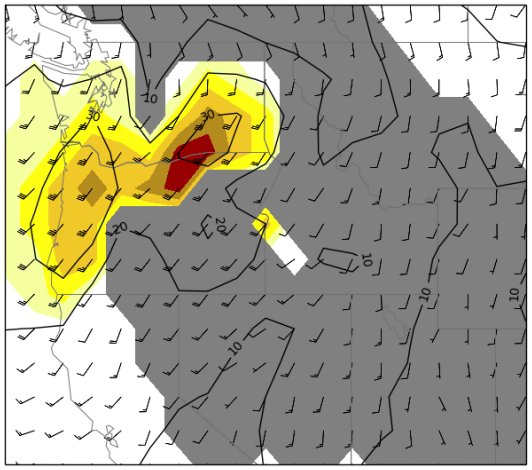
Hour 126 – Valid 18:00 UTC Sat Aug 29 2015



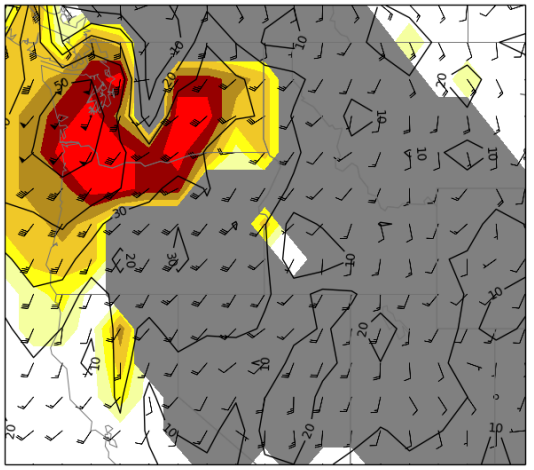
Hour 102 – Valid 18:00 UTC Sat Aug 29 2015

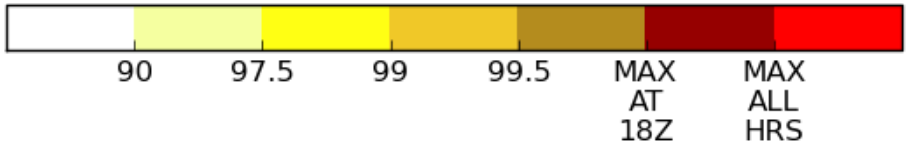


Hour 054 – Valid 18:00 UTC Sat Aug 29 2015



Analysis – Valid 18:00 UTC Sat Aug 29 2015

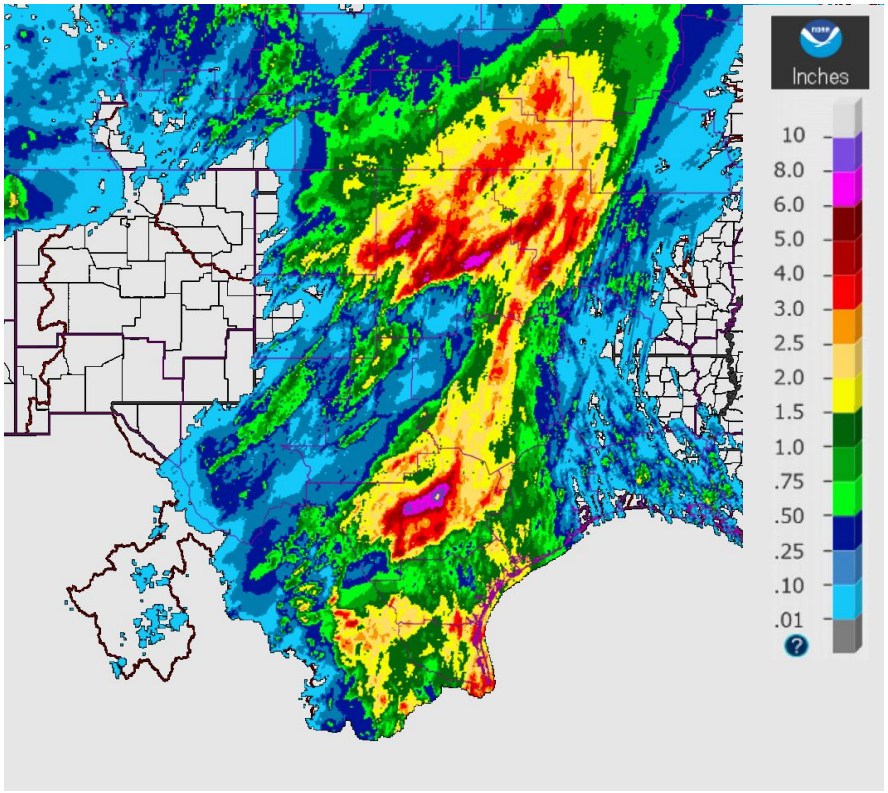




QPF Case Study: TX and OK Flood 24 May 2015

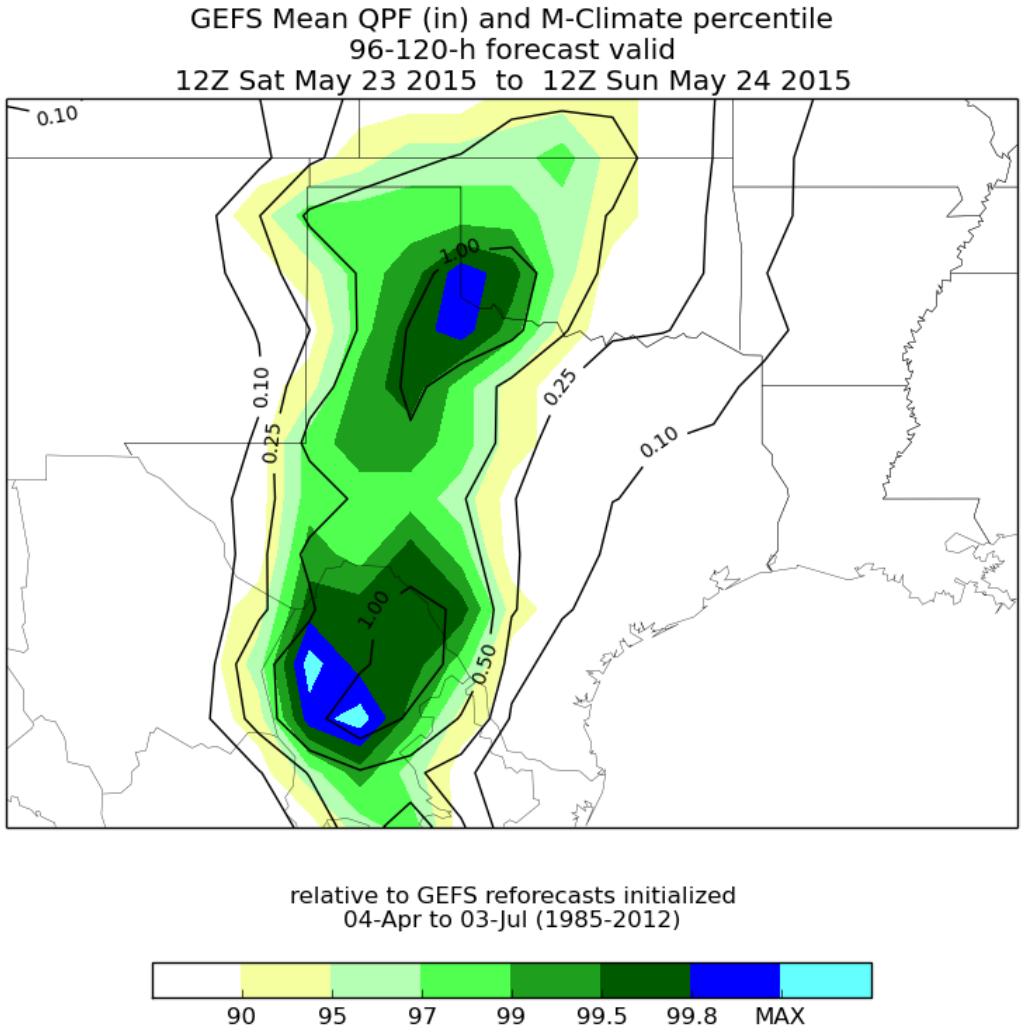
Damage in Wimberley, TX

24-hour precipitation ending 1200 UTC 24 May 2015



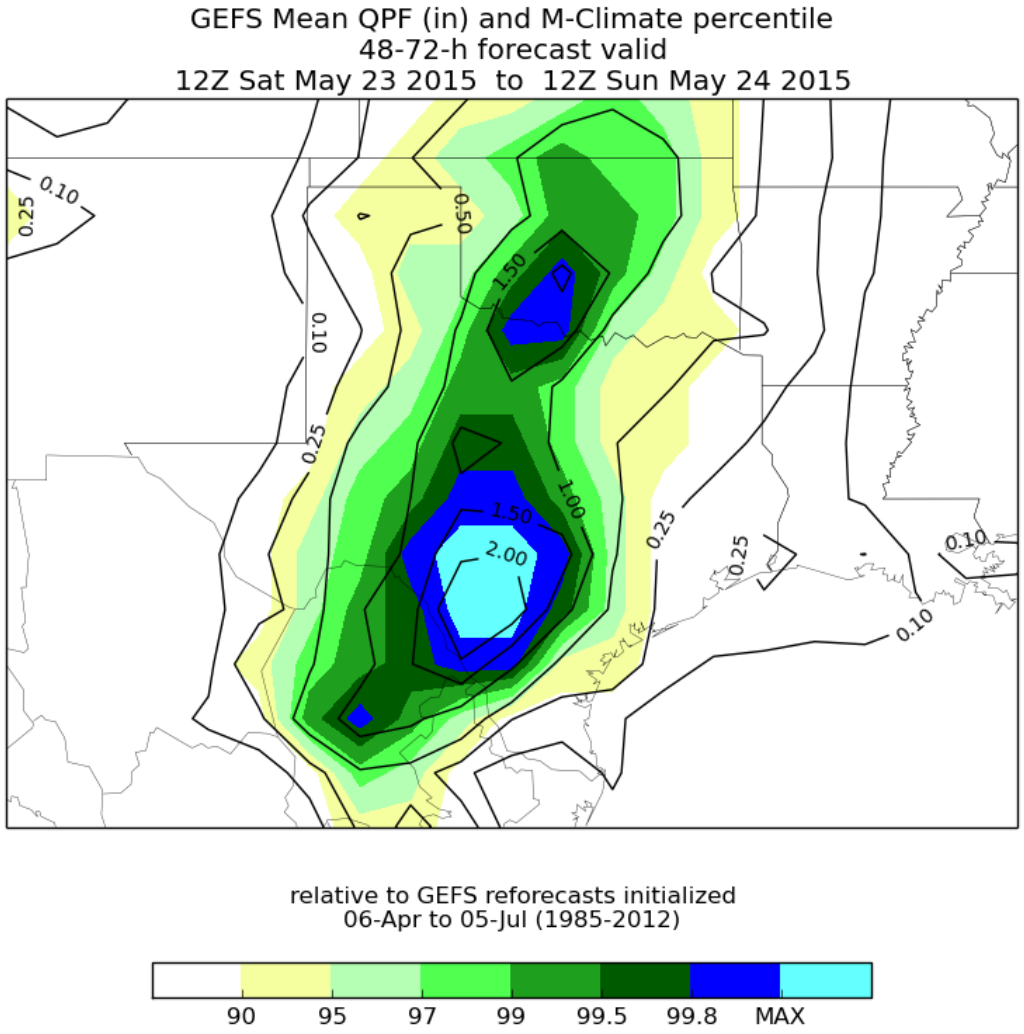
How Did ESAT Do?

Texas Table May 19, 2015 12Z Run			6-h	12-h	24-h	48-h	72-h
6	Tue 19th	18Z	MAX				
12	Wed 20th	00Z	99.1	MAX			
18		06Z	99.1	98.1			
24		12Z	99.0	98.9	99.4		
30		18Z	99.8	99.7	98.8		
36	Thu 21st	00Z	97.7	99.0	98.6		
42		06Z	95.2	98.5	99.2		
48		12Z	97.9	96.4	98.5	98.4	
54		18Z	99.3	98.8	98.3	98.7	
60	Fri 22nd	00Z	99.7	99.4	98.9	98.8	
66		06Z	99.9	99.8	99.8	99.9	
72		12Z	99.7	MAX	99.9	99.8	99.9
78		18Z	97.8	98.8	99.8	99.9	99.9
84	Sat 23rd	00Z	93.5	97.1	99.9	99.9	99.8
90		06Z	99.3	99.3	99.4	99.9	99.9
96		12Z	99.8	99.9	99.4	99.9	99.9
102		18Z	[illegible]	[illegible]	[illegible]	MAX	MAX
[illegible]	Sun 24th	00Z	99.8	99.7	99.9	MAX	[illegible]
114		06Z	MAX	MAX	MAX	MAX	MAX
120		12Z	99.8	MAX	MAX	MAX	MAX
126		18Z	MAX	99.9	MAX	MAX	MAX
132	[illegible]	00Z	99.9	99.9	MAX	[illegible]	[illegible]
138	25th	06Z	99.6	99.7	99.8	MAX	MAX



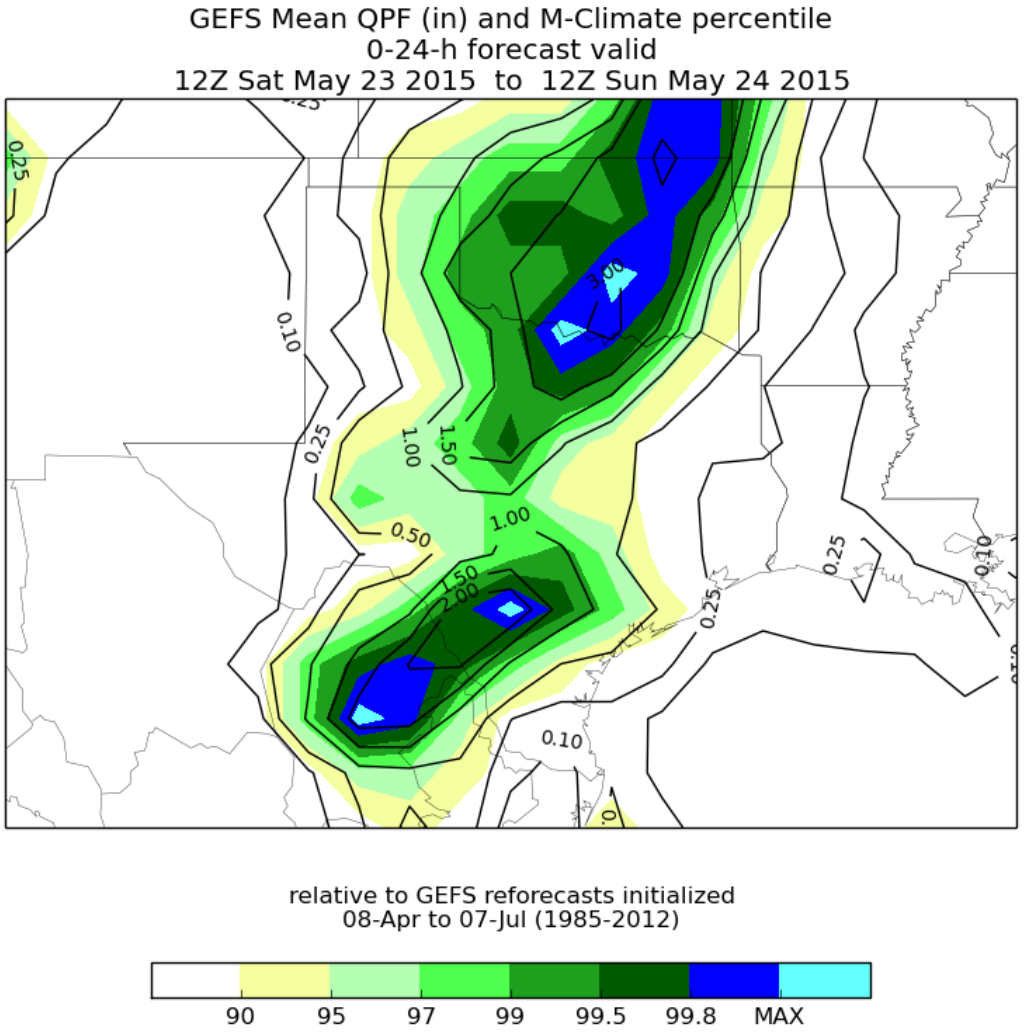
How Did ESAT Do?

Texas Table May 21, 2015 12Z Run			6-h	12-h	24-h	48-h	72-h
6	Thu 21st	18Z	99.5				
12	Fri 22nd	00Z	99.2	98.3			
18		06Z	MAX	MAX			
24		12Z	99.6	99.9	99.7		
30		18Z	95.6	99.2	99.7		
36	Sat 23rd	00Z	92.5	94.8	99.7		
42		06Z	MAX	MAX	MAX		
48		12Z	99.7	MAX	MAX	MAX	
54						MAX	
	Sun 24th	00Z	MAX	MAX	MAX	MAX	
66		06Z	MAX	MAX	MAX	MAX	
72		12Z	MAX	MAX	MAX	MAX	MAX
78		18Z	99.9	MAX	MAX	MAX	MAX
84	Mon 25th			MAX	MAX		MAX
90		06Z	99.8	99.9	MAX	MAX	MAX
96		12Z	MAX	99.9	99.9	MAX	MAX
102		18Z	99.9	MAX	99.9	MAX	MAX
108	Tue 26th	00Z	98.9	99.9	99.9	MAX	MAX
114		06Z	96.7	98.4	99.9	MAX	MAX
120		12Z	95.0	97.6	99.3	99.9	MAX
126		18Z	96.9	97.0	98.5	99.9	MAX
132	Wed 27th	00Z	98.5	97.6	98.2	MAX	MAX
138		06Z	90.8	96.7	97.1	99.7	99.9



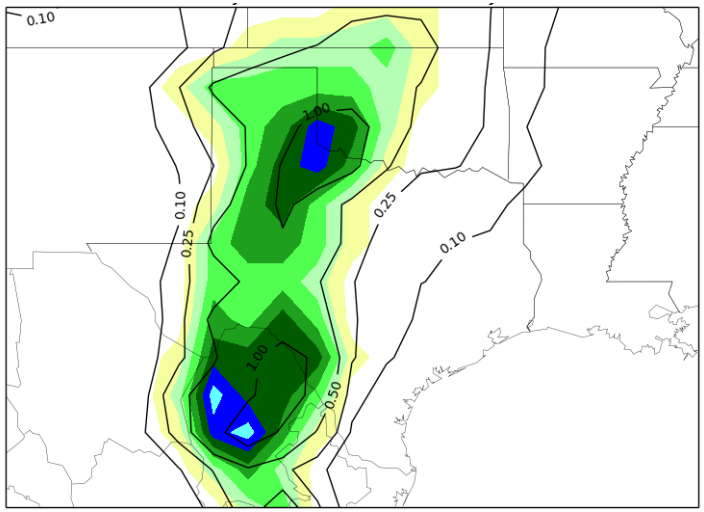
How Did ESAT Do?

Texas Table May 23, 2015 12Z Run			6-h	12-h	24-h	48-h	72-h
6	Sat 23rd	18Z	MAX				
	Sun 24th	00Z	MAX	MAX			
18		06Z	MAX	MAX			
24		12Z	MAX	MAX	MAX		
30		18Z	MAX	MAX	MAX		
	Mon 25th	00Z	MAX	MAX	MAX		
42		06Z	99.5	99.8	99.9		
48		12Z	99.9	99.8	99.9	MAX	
54		18Z	99.9	99.8	99.6	MAX	
60	Tue 26th	00Z	MAX	MAX	99.6	MAX	
66		06Z	MAX	MAX	MAX	99.9	
72		12Z	MAX	MAX	MAX	99.9	MAX
78		18Z	MAX	MAX	MAX	99.9	MAX
84	Wed 27th	00Z	99.3	99.7	99.9	99.9	MAX
90		06Z	97.8	99.0	99.9	99.9	MAX
96		12Z	93.7	97.3	99.7	MAX	MAX
102		18Z	97.0	96.0	99.1	MAX	MAX
108	Thu 28th	00Z	97.9	97.6	98.2	MAX	MAX
114		06Z	99.7	99.7	98.9	MAX	MAX
120		12Z	MAX	99.9	99.5	99.5	MAX
126		18Z	98.8	99.8	99.6	98.5	MAX
132	Fri 29th	00Z	99.9	99.9	99.9	98.6	MAX
138		06Z	98.3	99.2	99.7	99.5	99.8

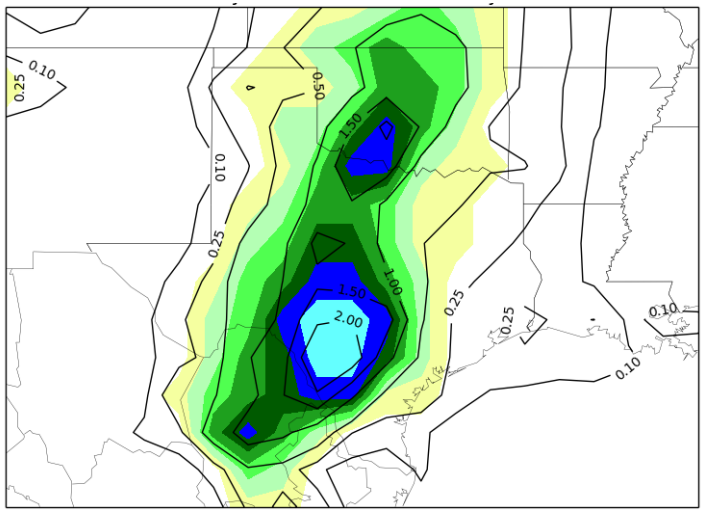


How Did ESAT Do?

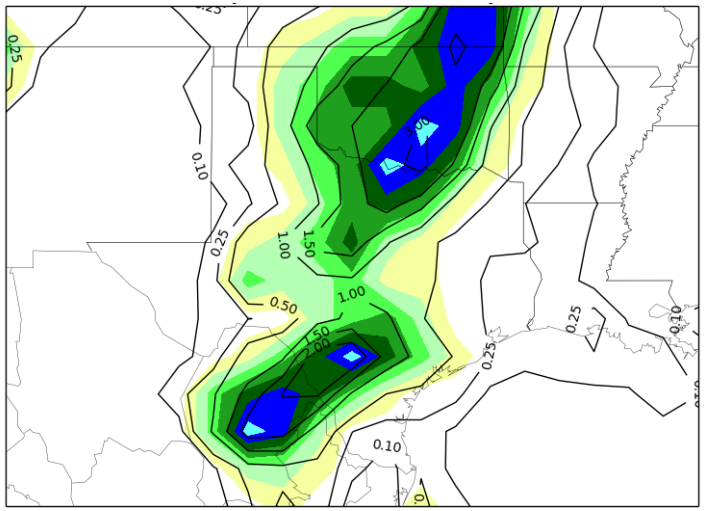
96 – 120-h forecast ending 12Z May 24 2015



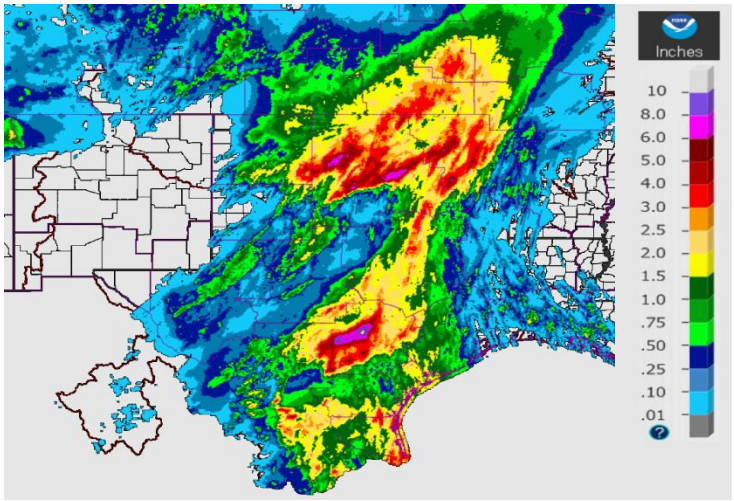
48 – 72-h forecast ending 12Z May 24 2015

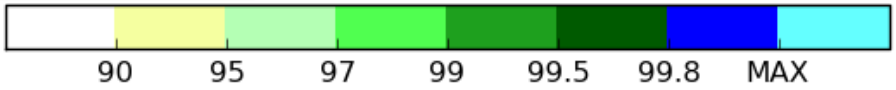


0 – 24-h forecast ending 12Z May 24 2015



24-hour precip ending 12Z 24 May 2015





Case Study Overview

- ESAT provided a ~5 day heads-up that an extreme, high-impact weather event was likely
- ESAT visually communicated this information efficiently.

ESAT Caveats

- ESAT uses a 21-day window so “Max” or “Min” forecasts are rarely all-time highs or lows
- Not every high-impact event is associated with anomalous upper-level forecast fields
- Anomalous upper-level fields are not always associated with high-impact weather
- Not every high-impact event is well predicted and the tool will struggle with these events
- The tool may not provide a heads-up for every high impact event, but when it is indicating a high impact event, pay attention!

Current Work on ESAT

- ESAT is transitioning to the Integrated Dissemination Program (IDP)
  - This will allow for enhanced stability and support for the tool

- The transition process is underway and Version 1 (V1.0) will hopefully be available by February 2015
  - V1.0 maintains ESAT's current functionality
  - Only improvement is the addition of table and plotting domains for all NWS CWAs

- Training material currently in development

Future Work: Improvements to ESAT

- V2.0 of ESAT will tentatively contain the following major enhancements:
  - More regional domains and domains that cover the Pacific and Atlantic Oceans
  - 91-day climatology functionality in addition to current 21-day
  - More variables, particularly surface variables such as 2m temp, 10 m wind, and CAPE
  - A version of ESAT for the ECMWF ensemble

- V2.0 has a tentative release date of summer 2016

- Enhancements for V2.0 are not set in stone, so if you have an idea or want to see something in ESAT please let me know.

Thanks!

Questions or Comments?

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