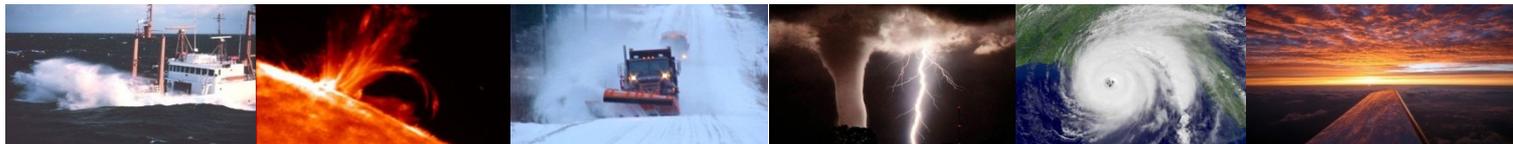




Emerging Trends in the Role of the American Forecaster



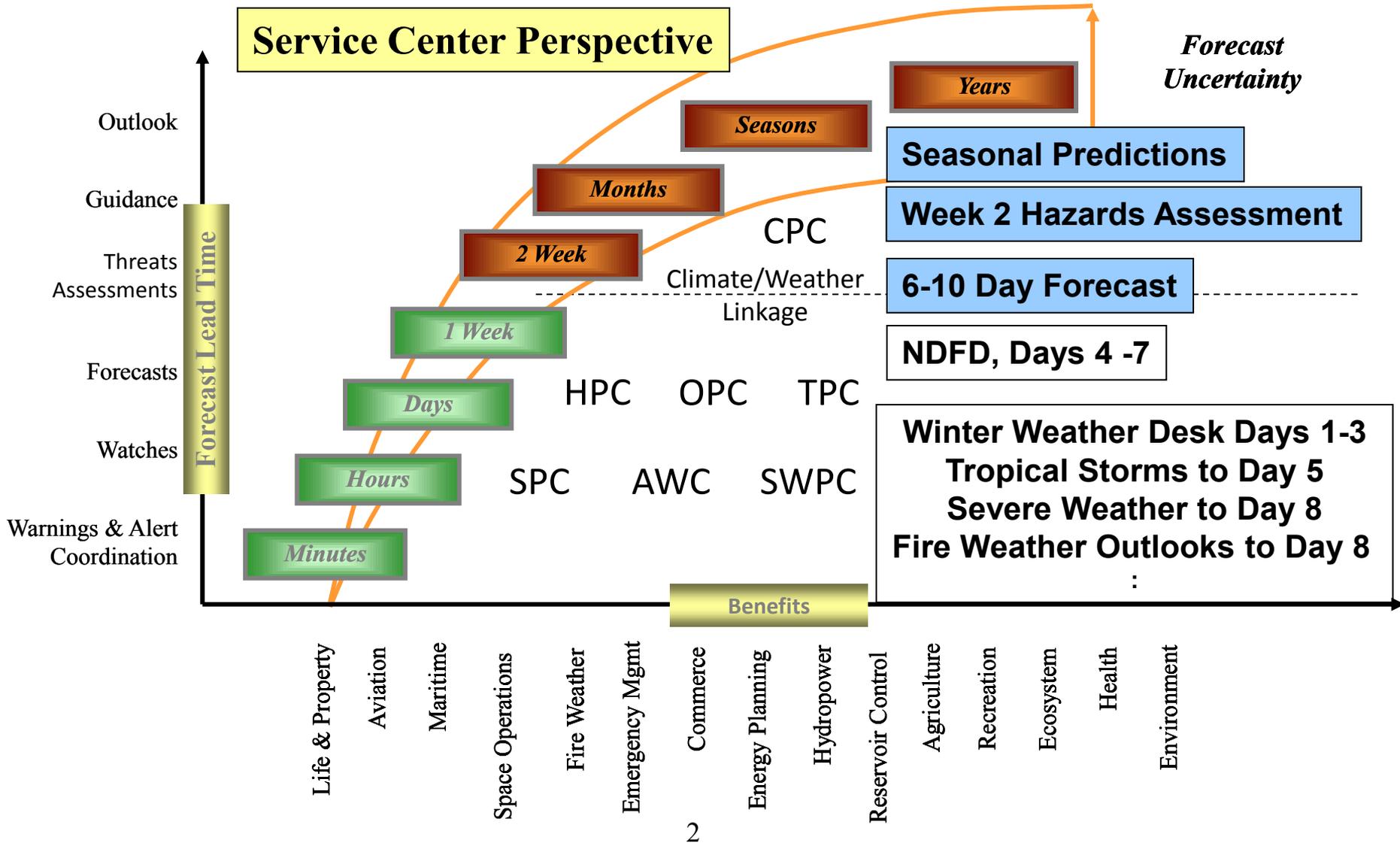
David Novak, Chris Bailey, Keith Brill, Michael Schichtel
NOAA/NCEP/ Hydrometeorological Prediction Center



“Where America’s Climate, Weather, Ocean and Space Weather Services Begin”

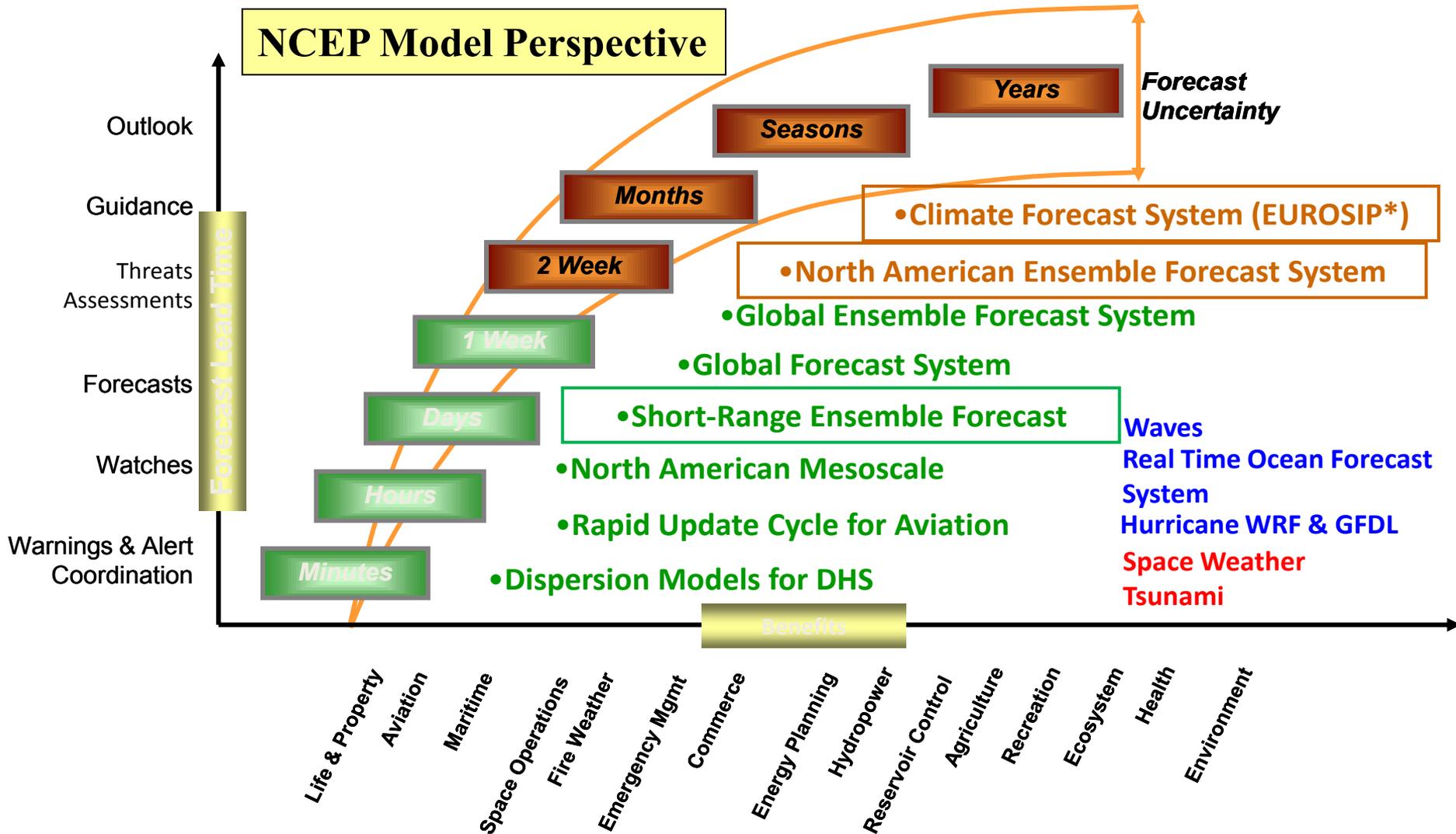


NOAA Seamless Suite of Forecast Products Spanning Climate and Weather





NWS Seamless Suite of Forecast Products Spanning Weather and Climate



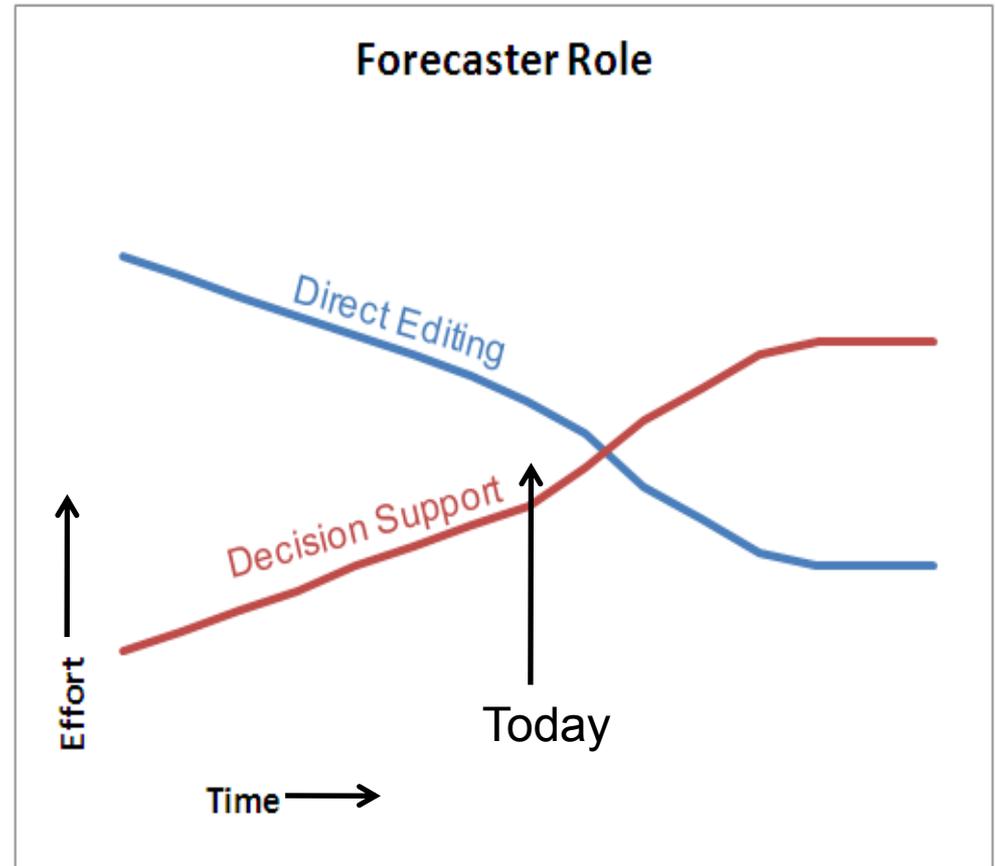
*To become available for NCEP operational seasonal prediction in Dec 2011



Forecaster Trends



- 1st Transition: Editing NWP → Managing NWP
- 2nd Transition: Advising decision makers (Decision Support)
- Testbeds support the transitions

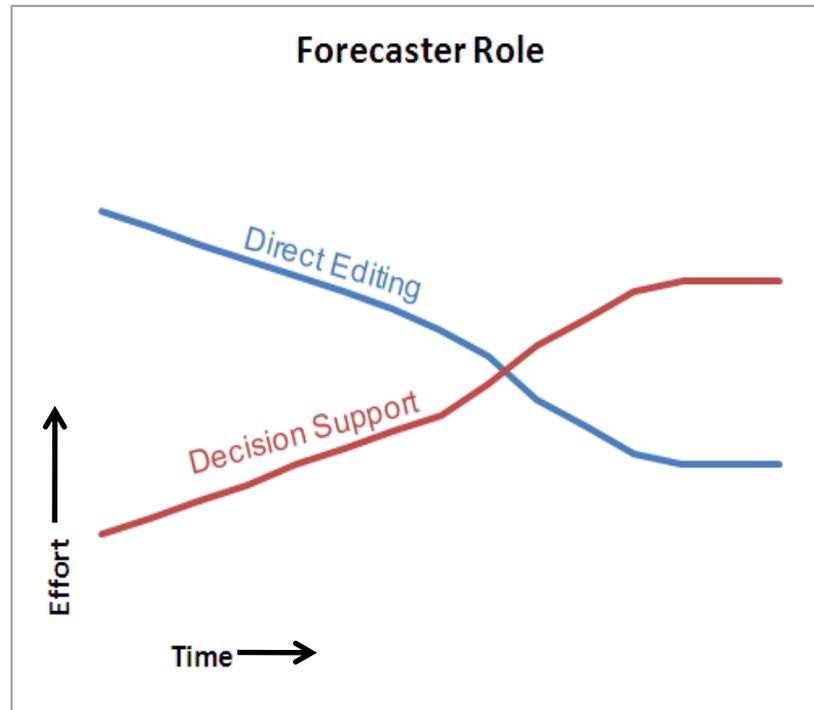




1st Transition



Forecaster Editing → Managing





HPC Medium Range Desk



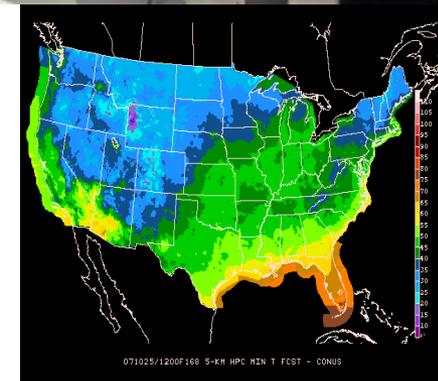
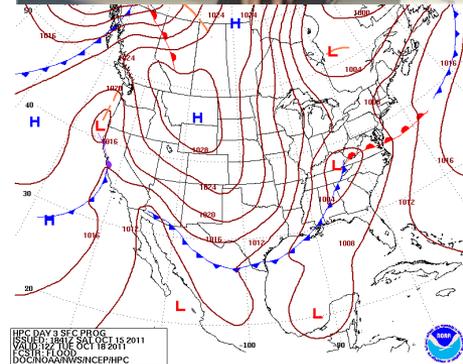
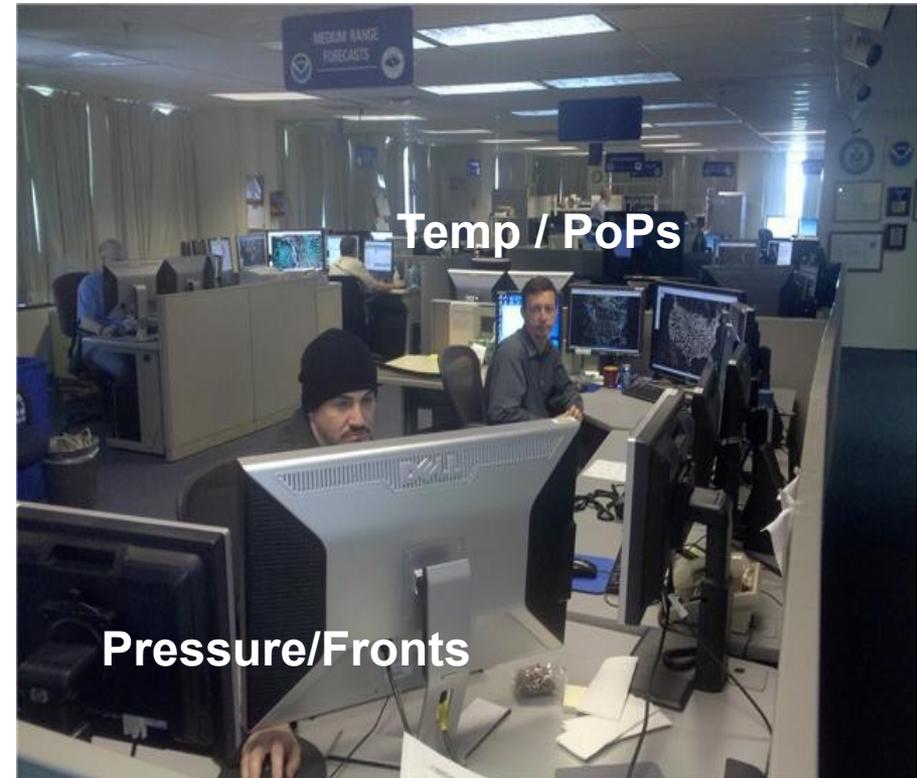
**Staffed daily 1030-1930 UTC
by two forecasters**

Temperatures / PoPs Desk

- Max/Min temps, PoPs, sky,
- Dewpoint, and weather grids
- QPF's
- Hawaiian desk

Pressure / Fronts Desk

- Wind grids
- Tropical coordination
- Targeted obs program
- Written discussions



HPC DAY 3 SEC PROG
VALID 12Z 01 DEC 2011
GSI 11Z 01 DEC 2011
GSI 11Z 01 DEC 2011
DOCNOAAVWSNCEPHPC

071025/1200P160 5-KM HPC MIN T FCST - CONUS



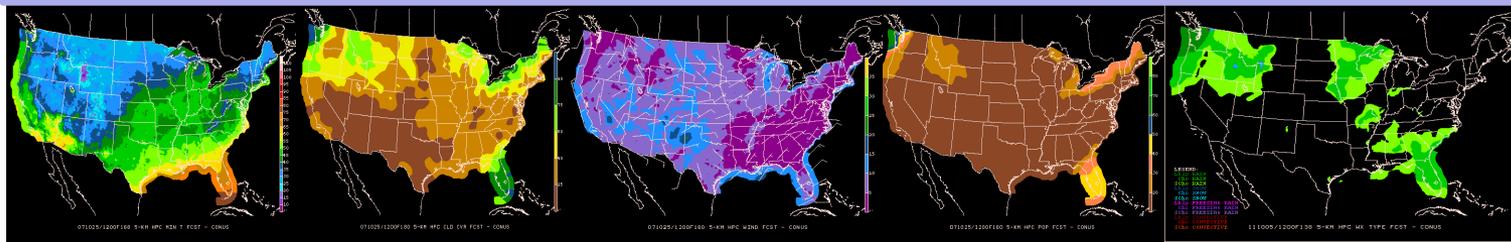
Forecast Process Overview



Evaluation of model guidance

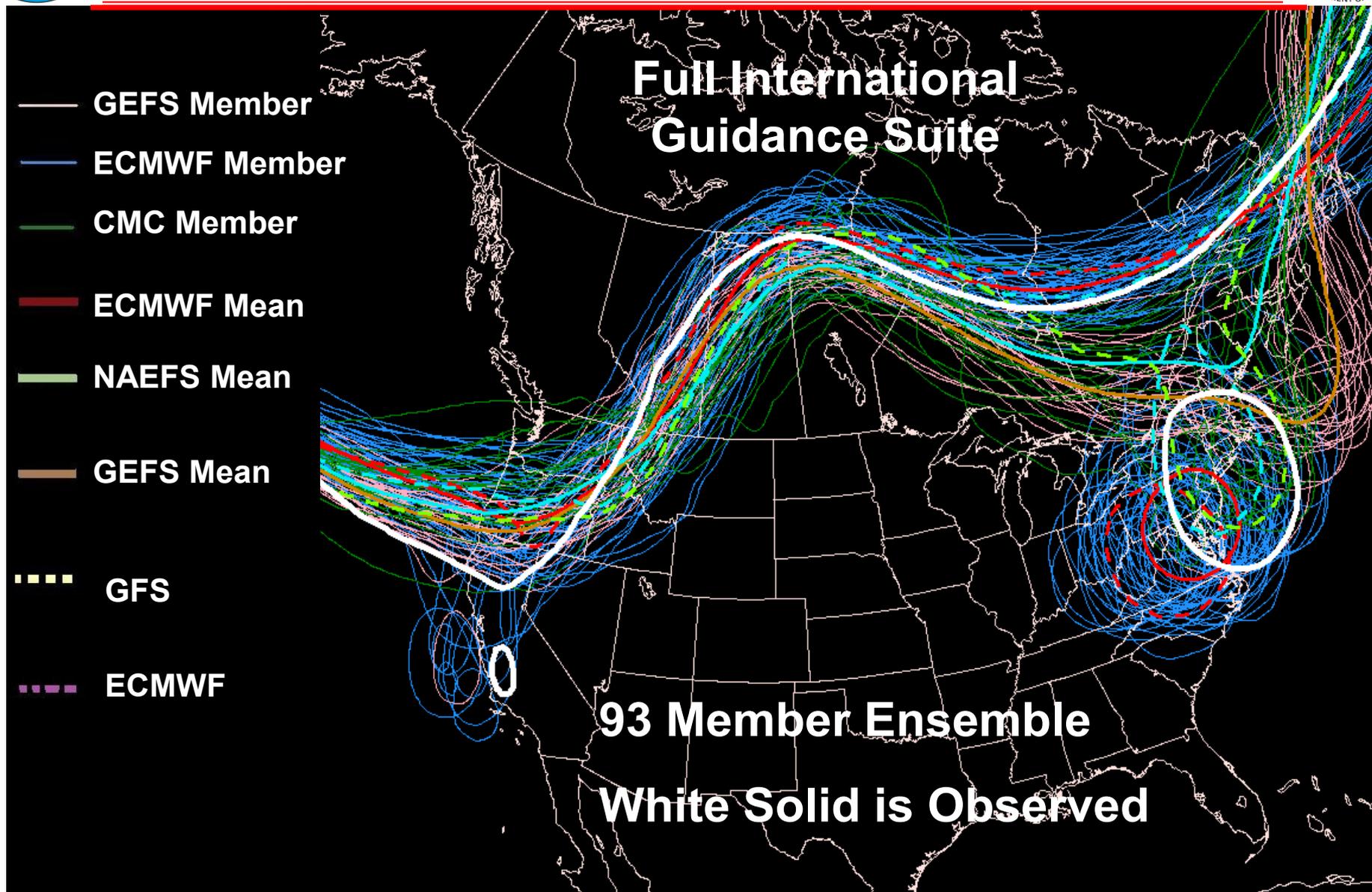
Weighting of solutions

Post-processing





Step 1: Evaluation of Guidance





Step 2: Weighting of Solutions



Identify preferred solutions

Used as inputs to model blends (weights) selected by forecasters for first-guess forecast

HPC MASTERBLENDER

File Help Check

Templates	d1qDayPre d1qEveFin d1qMidPre d1qMidFin	MDD Day MDD Nite	BawrxDay Day P1 Day P2 Day P3 Day P4 BawrxNite Nite P1 Nite P2 Nite P3 Nite P4	fmin: 84	forecast hour: 84
MedrPass500	d23DayPre d23DayFin d23MidPre d23MidFin	Alaska AkTemps		fmax: 192	clear F0
Medr T d45 qpf am d45 qpf pm d67 qpf am d67 qpf pm		Misc		incr: 12	84 108 132 156 180
					clear all copy all copy intermediates
					PREVIEW CREATE

Total Blend at f84: 100%

HPC AK-coming 0	Cyc	GFSP 0	Cyc
CMC 0	Cyc	HPC 0	Cyc
DGEX 0	Cyc	NAEFS_bc Mea 0	Cyc
ECMWF(hr) 20	Cyc	NAM 0	Cyc
ECMWF #2 (hr) 0	Cyc	NOGAPS 0	Cyc
ECMWF ens 30	Cyc	SREF Mean 0	Cyc
GEFS Mean 30	Cyc	UKMET HiRes 0	Cyc
GFS 20	Cyc	ENS QPF BC 0	Cyc
GFS #2 0	Cyc	Climo temp 0	Cyc
NDFD-T/P only 0	Cyc	GMOS-T/P only 0	Cyc

Make Tmps Make AK P

FcstrID&Confidence	Lo	Avg	Hi
HPC			
SEND500			
Opt Text: _____			
Copy Text	Clear All Text		

To rename files:	Days	Fronts
1. Select days	<input type="checkbox"/> d3 <input type="checkbox"/> d3.5 <input type="checkbox"/> d3f	
2. Select fronts	<input type="checkbox"/> d4 <input type="checkbox"/> d4.5 <input type="checkbox"/> d4f	
3. press RENAME	<input type="checkbox"/> d5 <input type="checkbox"/> d5.5 <input type="checkbox"/> d5f	
	<input type="checkbox"/> d6 <input type="checkbox"/> d6.5 <input type="checkbox"/> d6f	
	<input type="checkbox"/> d7 <input type="checkbox"/> d7.5 <input type="checkbox"/> d7f	
	<input type="checkbox"/> d8 <input type="checkbox"/> d8.5 <input type="checkbox"/> d8f	
Rename	sel all	
Undo rename	clear all	sel all
Show blend files	intrmeds	clr all

<input type="checkbox"/> Min T	Domain	<input type="checkbox"/> PMSL	Ref Cycle
<input type="checkbox"/> Max T	US	<input type="checkbox"/> 500 mb	00Z 12Z
	W US	<input type="checkbox"/> Thck	06Z 18Z
	Medr	<input type="checkbox"/> QPF	24Z
<input type="checkbox"/> VGF	AK	<input type="checkbox"/> D45QPF	
<input type="checkbox"/> Grid	MDD	<input type="checkbox"/> D67QPF	
	NWRFC	<input type="checkbox"/> 700 mb	
<input type="checkbox"/> debug			<input type="checkbox"/> test mode

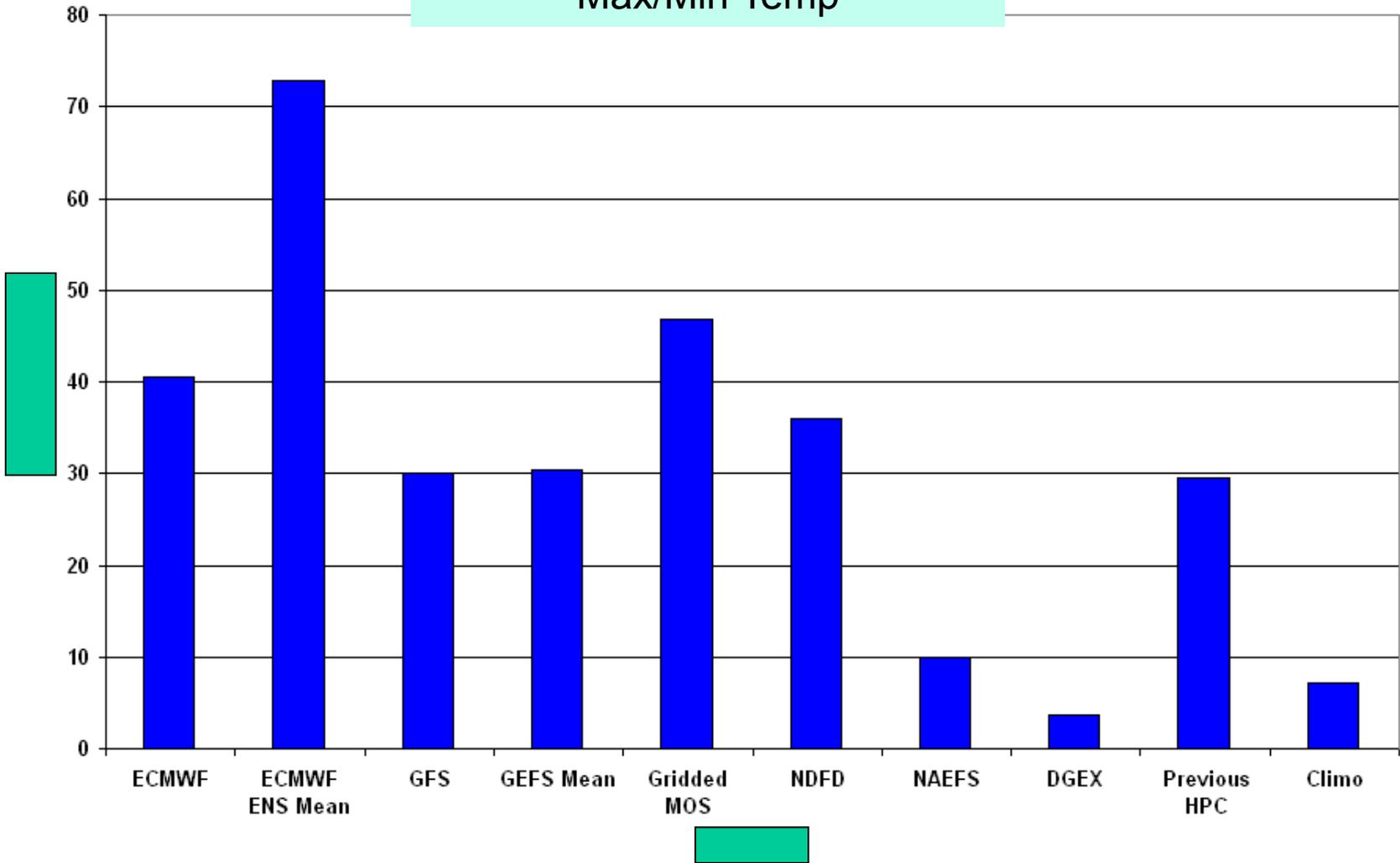
EXIT



Step 2: Weighting of Solutions

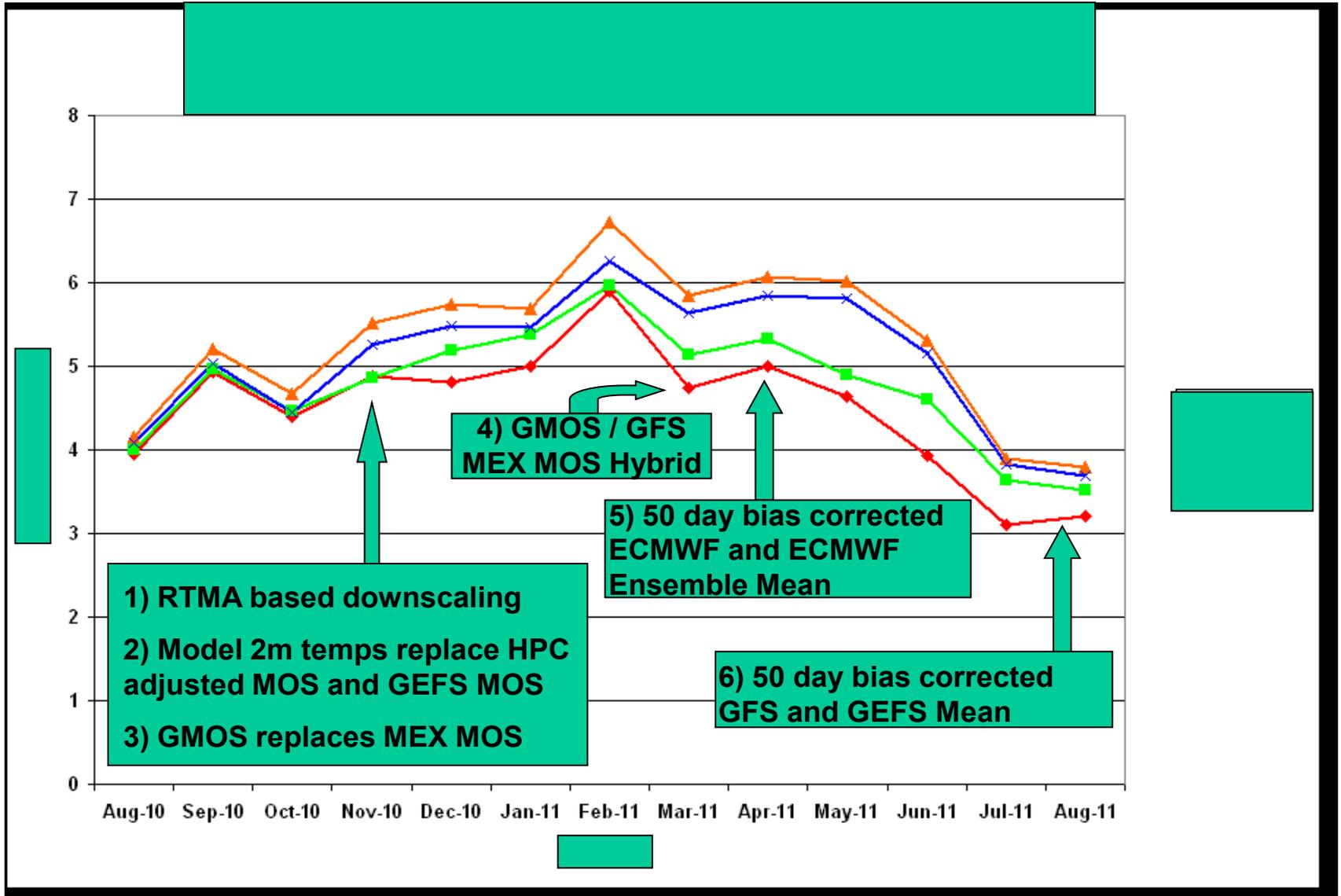


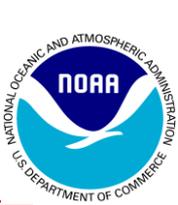
Frequency of Use
Max/Min Temp





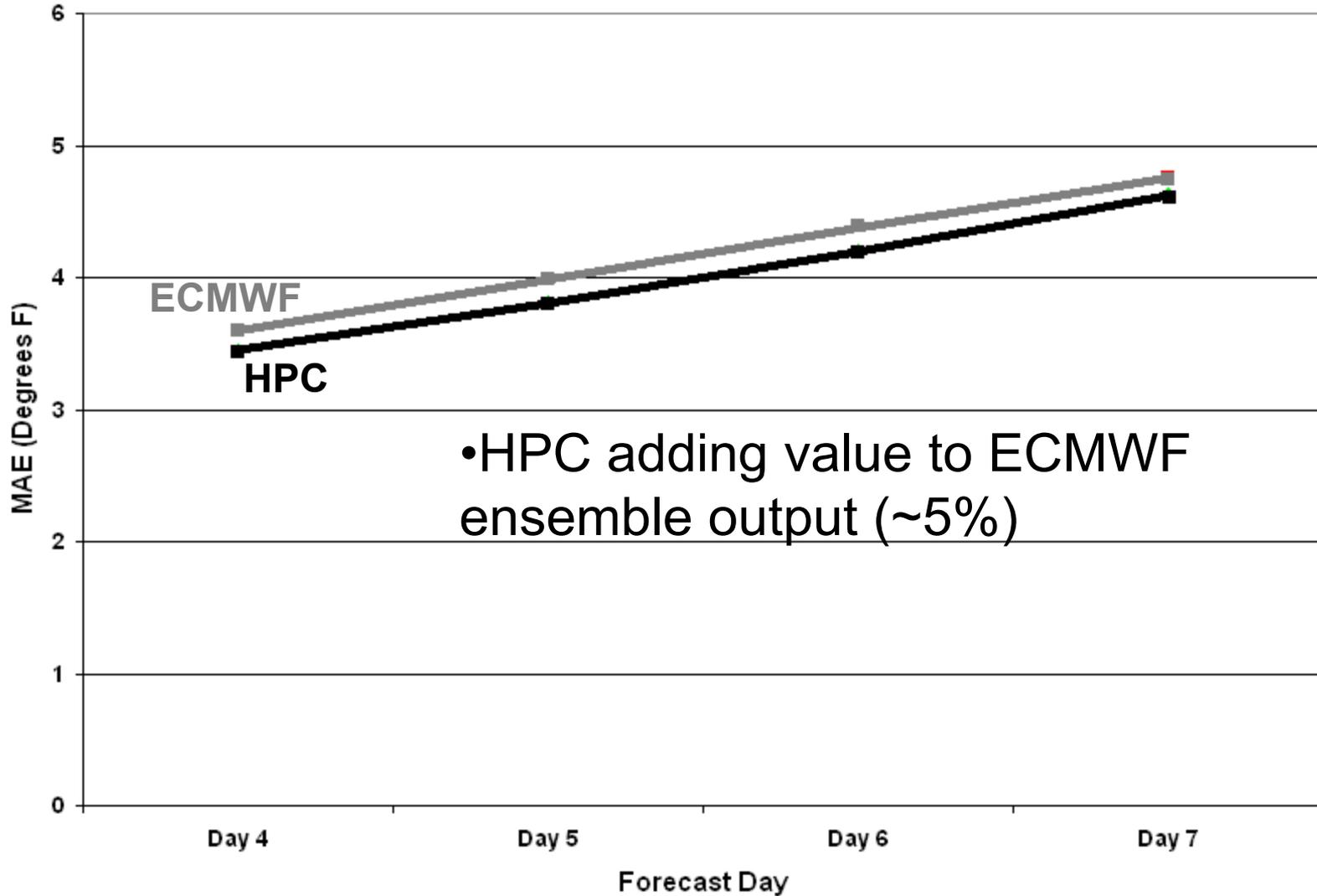
Step 3: Post Processing





Performance

Maximum Temperature MAE
April 2011 - September 2011





Probabilistic Forecasts



Q: Can a forecaster add value to probabilistic forecasts?

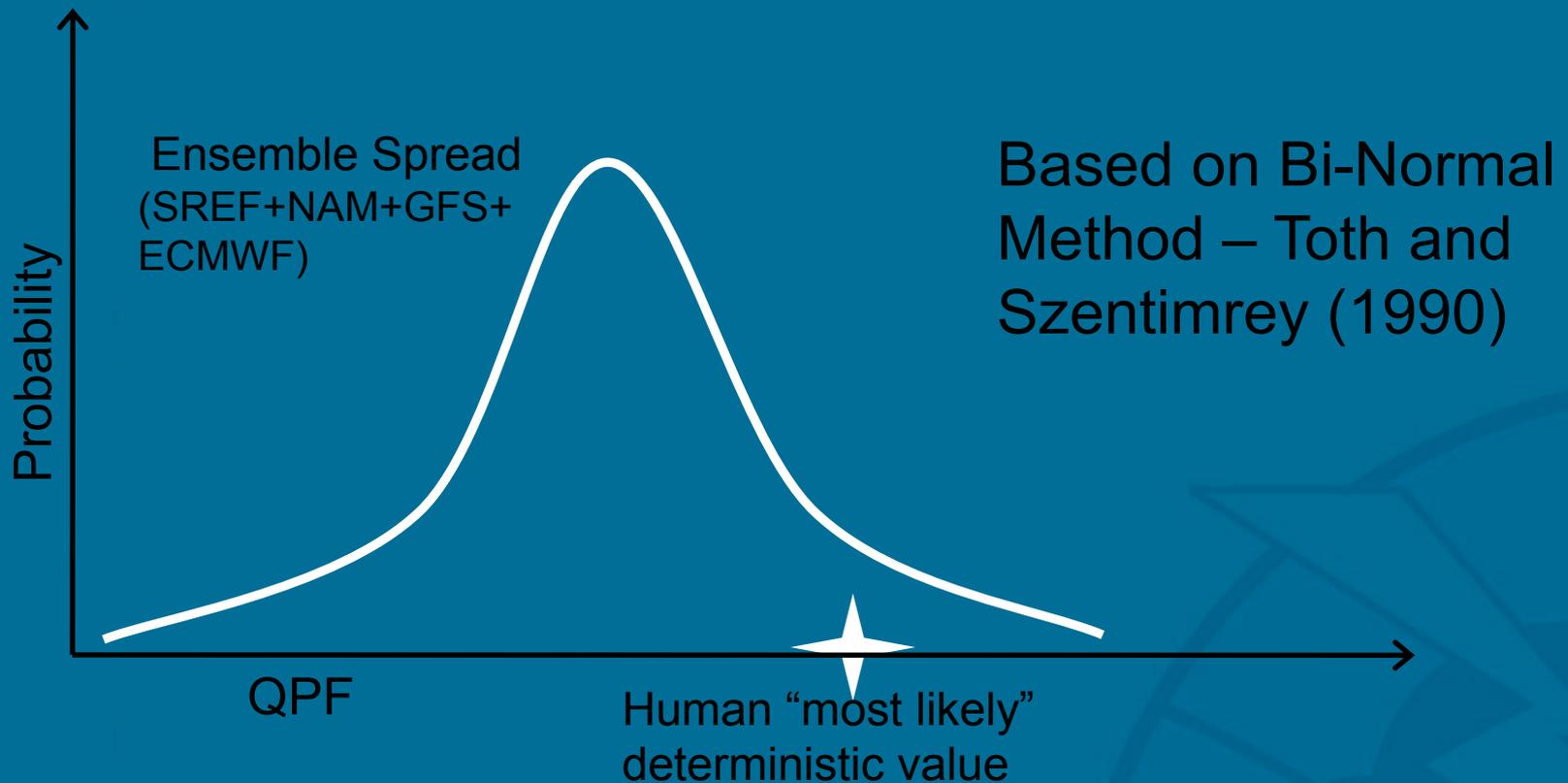
A: Maybe.

Workload makes this difficult for multiple thresholds.

Testing approaches combining human forecasts with objective ensemble information

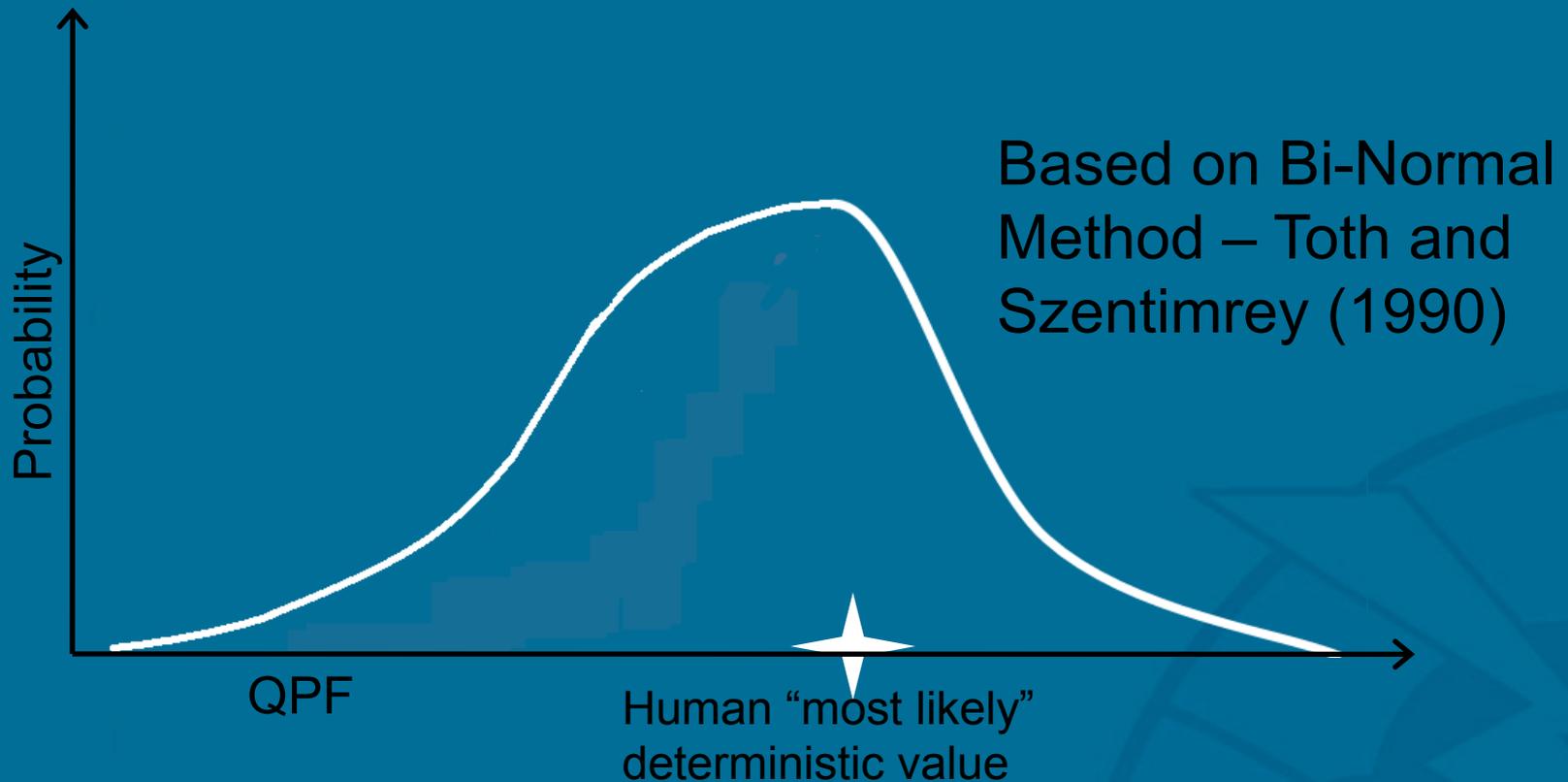
HPC PQPF Method

Modifies ensemble distribution such that human deterministic QPF is the mode, while allowing skew



HPC PQPF Method

Modifies ensemble distribution such that human deterministic QPF is the mode, while allowing skew





Probabilistic Rainfall Skill

Oct 2011 – April 2012



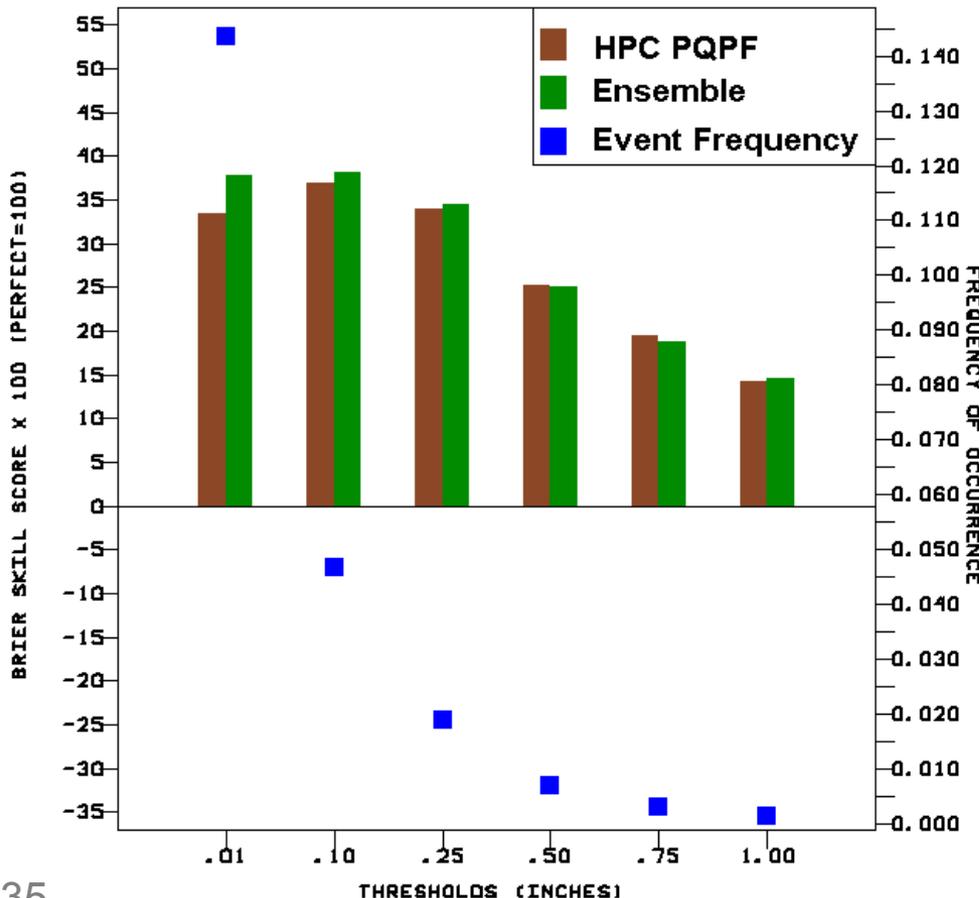
Day 1 CONUS Cool Season Brier Skill Score

- Using Stage IV
- Relative to sample climatology

•HPC PQPF comparable to ensemble during cool season

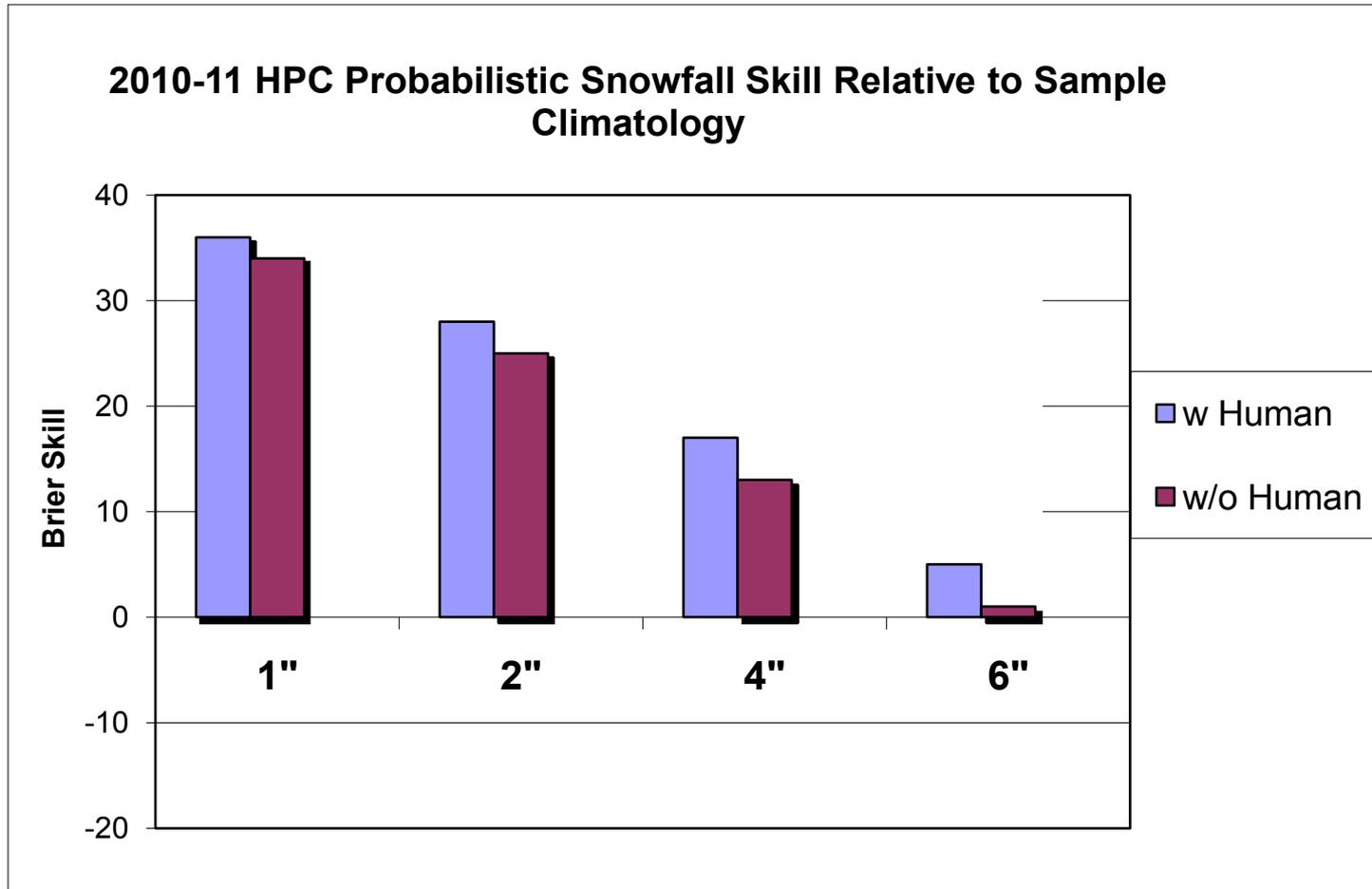
•HPC PQPF does not add value to ensemble during warm season (not shown)

•Continuing to modify approach





Probabilistic Snowfall Skill



- Including human forecast in calculation adds value



2nd Transition



Decision Support





Decision Support Services



Accurate and trusted weather information is just an *initial* requirement for saving lives and livelihoods

“The fact is, NWS services –principally direct interaction with decision makers—are in greater demand than at any time in our nearly 140-year history.”

Jack Hayes, NWS Director 2008





Decision Support Services



- Understand impact of forecasts on society
- Focus resources to provide decision assistance to core federal, state, and emergency partners

What Forecast Success Looks Like

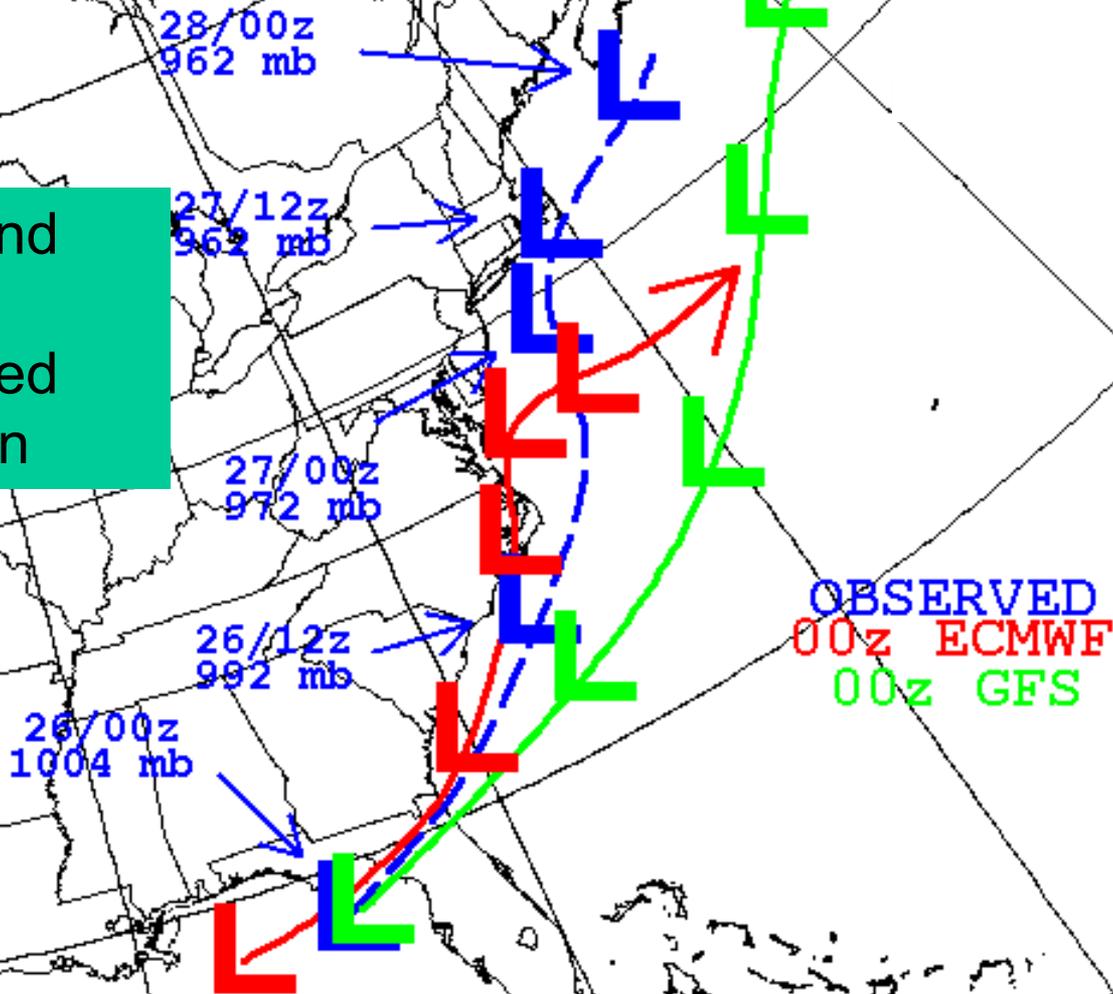




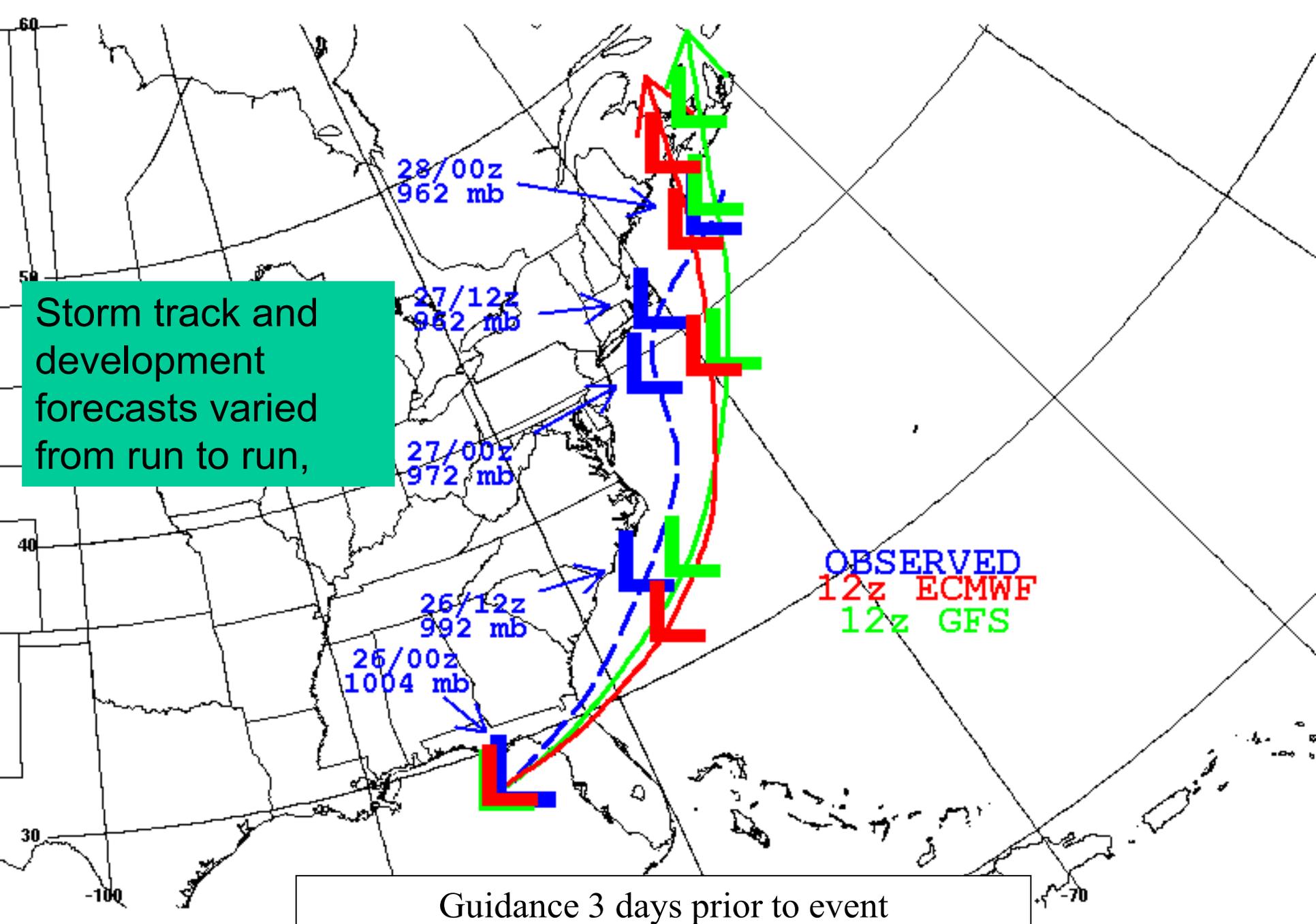
Post Christmas Storm



Storm track and development forecasts varied from run to run



Guidance 4 days prior to event



NM 50 100 150 200

Ensemble Storm Centers for Sunday Evening

~5% Chance of
Blizzard in NYC



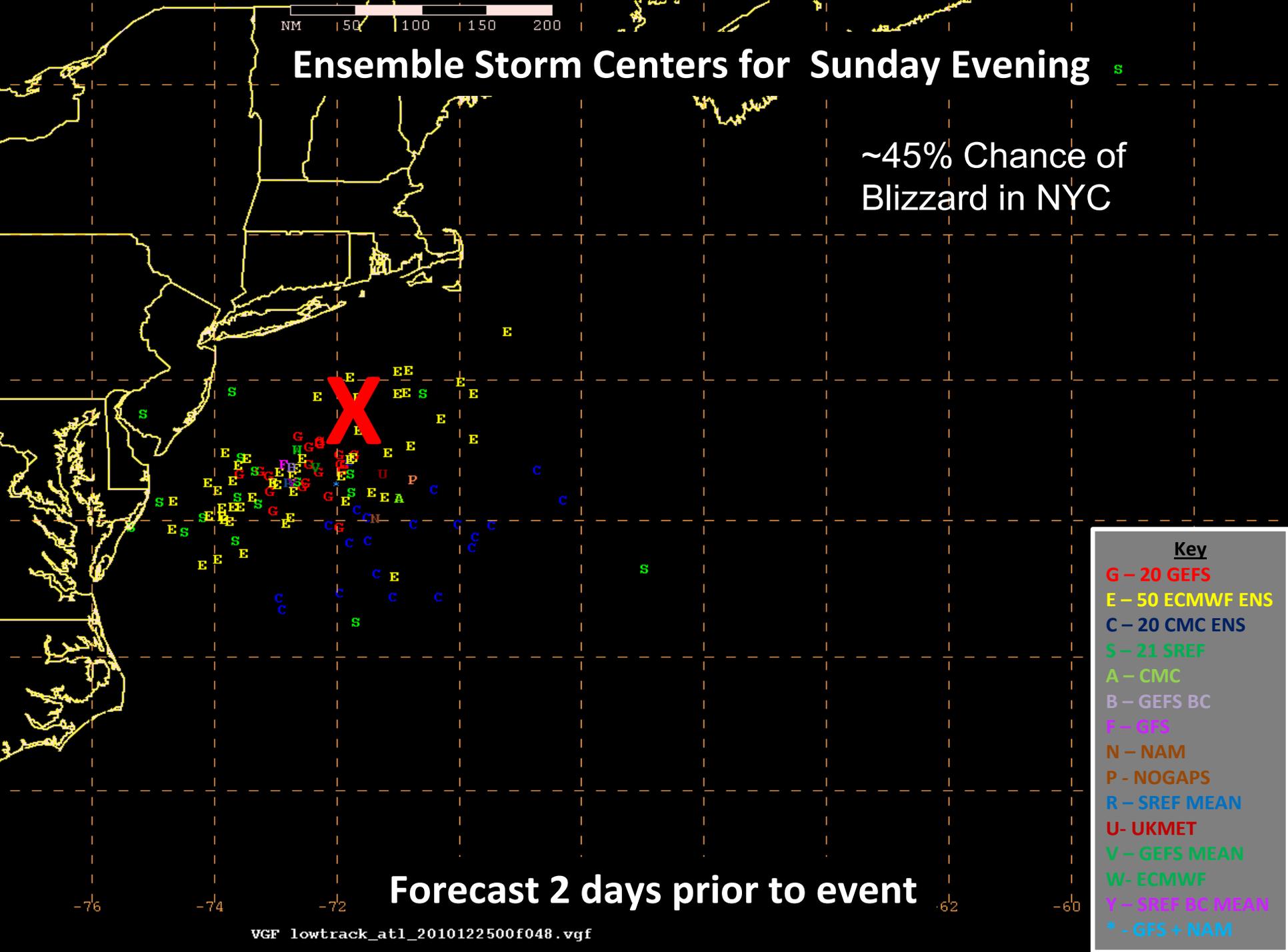
Key

- G – 20 GEFS
- E – 50 ECMWF ENS
- C – 20 CMC ENS
- S – 21 SREF
- A – CMC
- B – GEFS BC
- F – GFS
- N – NAM
- P – NOGAPS
- R – SREF MEAN
- U – UKMET
- V – GEFS MEAN
- W – ECMWF
- Y – SREF BC MEAN
- * – GFS + NAM

Forecasts 3 days prior to event

Ensemble Storm Centers for Sunday Evening

~45% Chance of
Blizzard in NYC

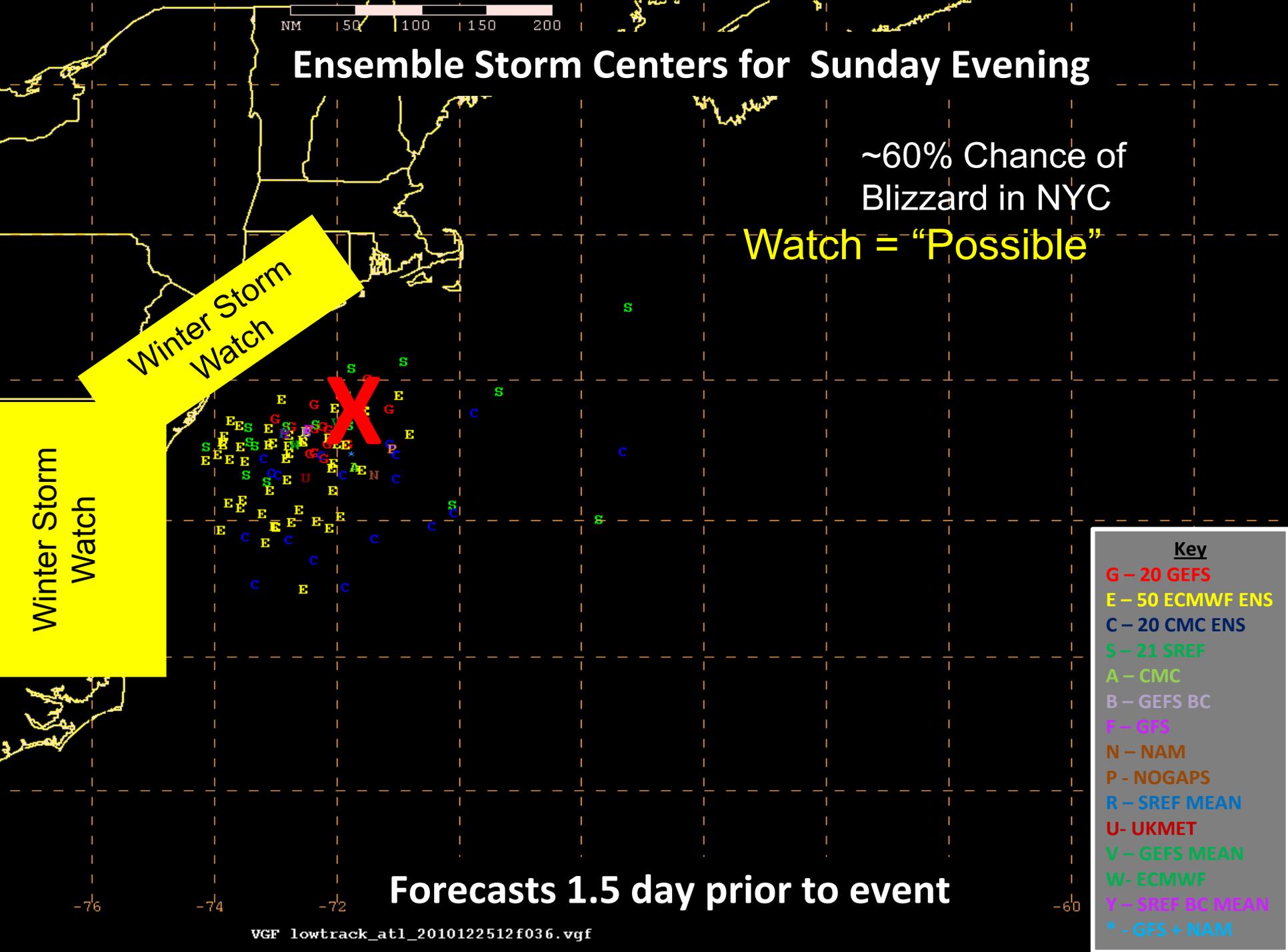


Key	
G	20 GEFS
E	50 ECMWF ENS
C	20 CMC ENS
S	21 SREF
A	CMC
B	GEFS BC
F	GFS
N	NAM
P	NOGAPS
R	SREF MEAN
U	UKMET
V	GEFS MEAN
W	ECMWF
Y	SREF BC MEAN
*	GFS + NAM

Ensemble Storm Centers for Sunday Evening

~60% Chance of
Blizzard in NYC

Watch = "Possible"



Forecasts 1.5 day prior to event

Ensemble Storm Centers for Sunday Evening

~85% Chance of
Blizzard in NYC

Warning = "Imminent"

Blizzard warning

Winter Storm
Warning

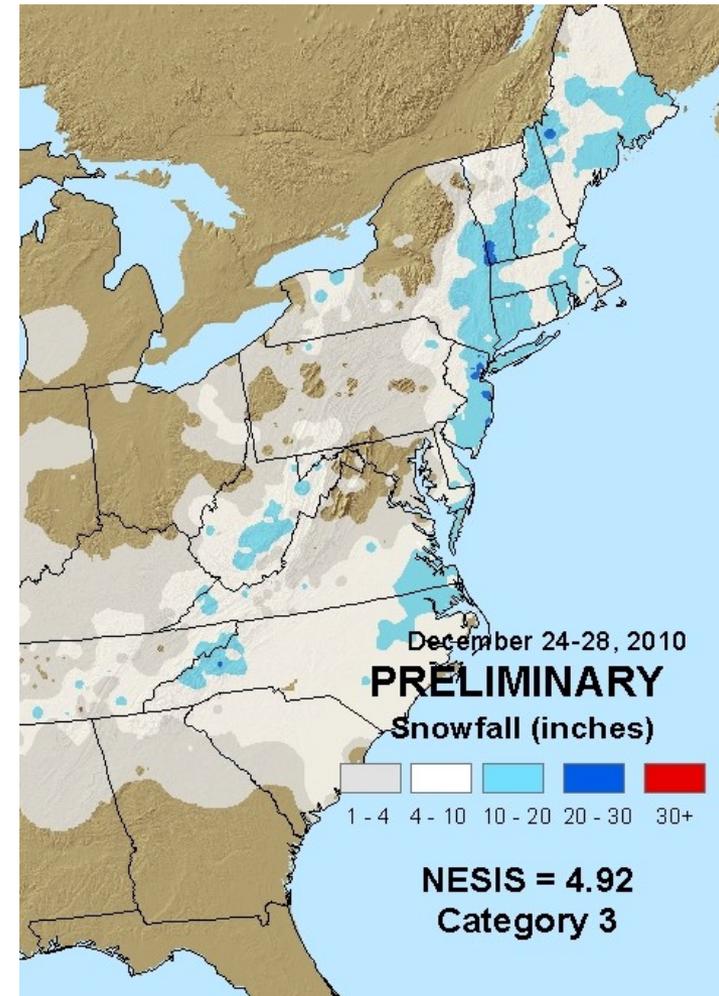


Key	
G	20 GEFS
E	50 ECMWF ENS
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A	CMC
B	GEFS BC
F	GEFS
N	NAM
P	NOGAPS
R	SREF MEAN
U	UKMET
V	GEFS MEAN
W	ECMWF
Y	SREF BC MEAN
*	GEFS + NAM

Forecast 1 day prior to event

From a Forecast Perspective

- Potential for East Coast cyclone recognized days-week in advance
- Special efforts made to convey uncertainty related to track forecast
- Key transition December 24 – storm forecast along the coast with more certainty
 - NJ, NYC and New England would be main focus of blizzard conditions
- Warning lead times of 12-24 h



From a City Manger Perspective

Did not have necessary level of certainty before Christmas Day

- NYC does not declare snow emergency
- Results in major gridlock within city
- City response under scrutiny



From a Aviation User Perspective

Conditioned to react on short lead time

- Airlines/airports are prepared for crippling event
 - Cancel thousands of flights to mitigate impact on national and international flight operations
 - Fully recover in 3-4 days



Connecting Forecast Uncertainty to Decision Support

- Do forecasters know thresholds for critical decisions?
- Do forecasters know *when* critical decisions are made
- Can forecasters convey information needed for users to make appropriate decisions given imperfect forecasts?
 - “Just give me your best guess”
 - “How confident are you?”
- How can we conveying forecast uncertainty for different user-groups?



Role of Testbeds



Bridging Weather Research to Operations



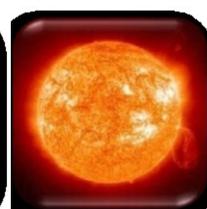
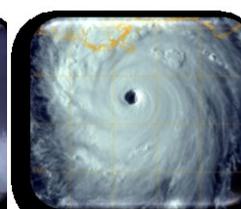


NCEP Test Beds



“Does the new technique/model work?”

- EMC – Developmental Test Bed
- HPC – Hydrometeorological Test Bed
- AWC – Aviation Weather Test Bed
- SPC – Hazardous Weather Test Bed
- NHC – Joint Hurricane Test Bed
- CPC – Climate Test Bed
- OPC – Ocean Test Bed
- SPWC – Space Weather Test Bed





Success Criteria

- **Benefit:** expected improvement in operational forecast and/or analysis accuracy
- **Efficiency:** adherence to forecaster time constraints and ease of use needs
- **Compatibility:** IT compatibility with operational hardware, software, data, communications, etc.
- **Sustainability:** availability of resources to operate, upgrade, and/or provide support



Spring and Winter Experiments



Forum for testing the evolving role of the human forecaster

- Mix of operational forecasters and researchers
- Challenged to make real-time forecasts with experimental data/techniques
- Multiple week participation





Recent Focuses

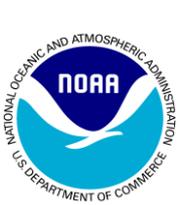


How can the forecaster add value to probabilistic forecasts?

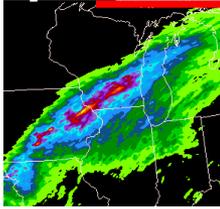
How can convection-allowing model guidance be used with traditional guidance?

How can ensemble guidance be more effectively visualized?

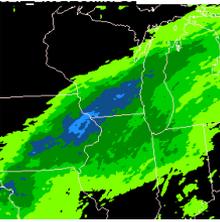
What are effective means to communicate uncertainty?



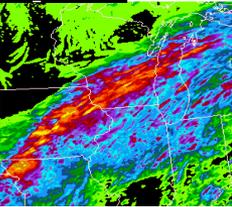
Testbed Postprocessing Examples



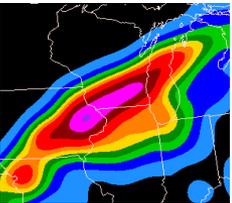
Probability matched mean—combines the spatial pattern of the ensemble mean QPF with the frequency distribution of the rainfall rates (Ebert 2001)



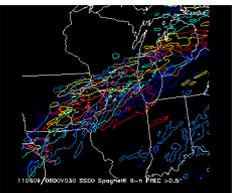
Bias corrected mean—running 14 day bias correction applied to 6hr QPF



Maximum—Maximum from any member



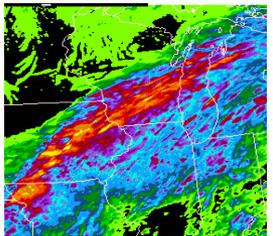
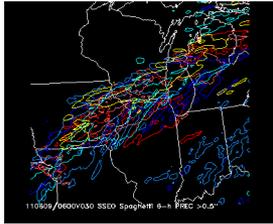
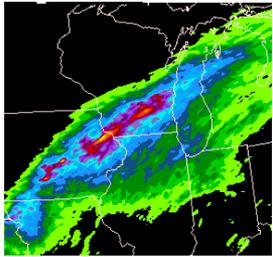
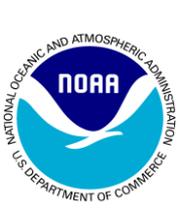
Neighborhood probabilities—probability of an event occurring in the vicinity of a point



Spaghetti plots—contours outlining selected precipitation amounts

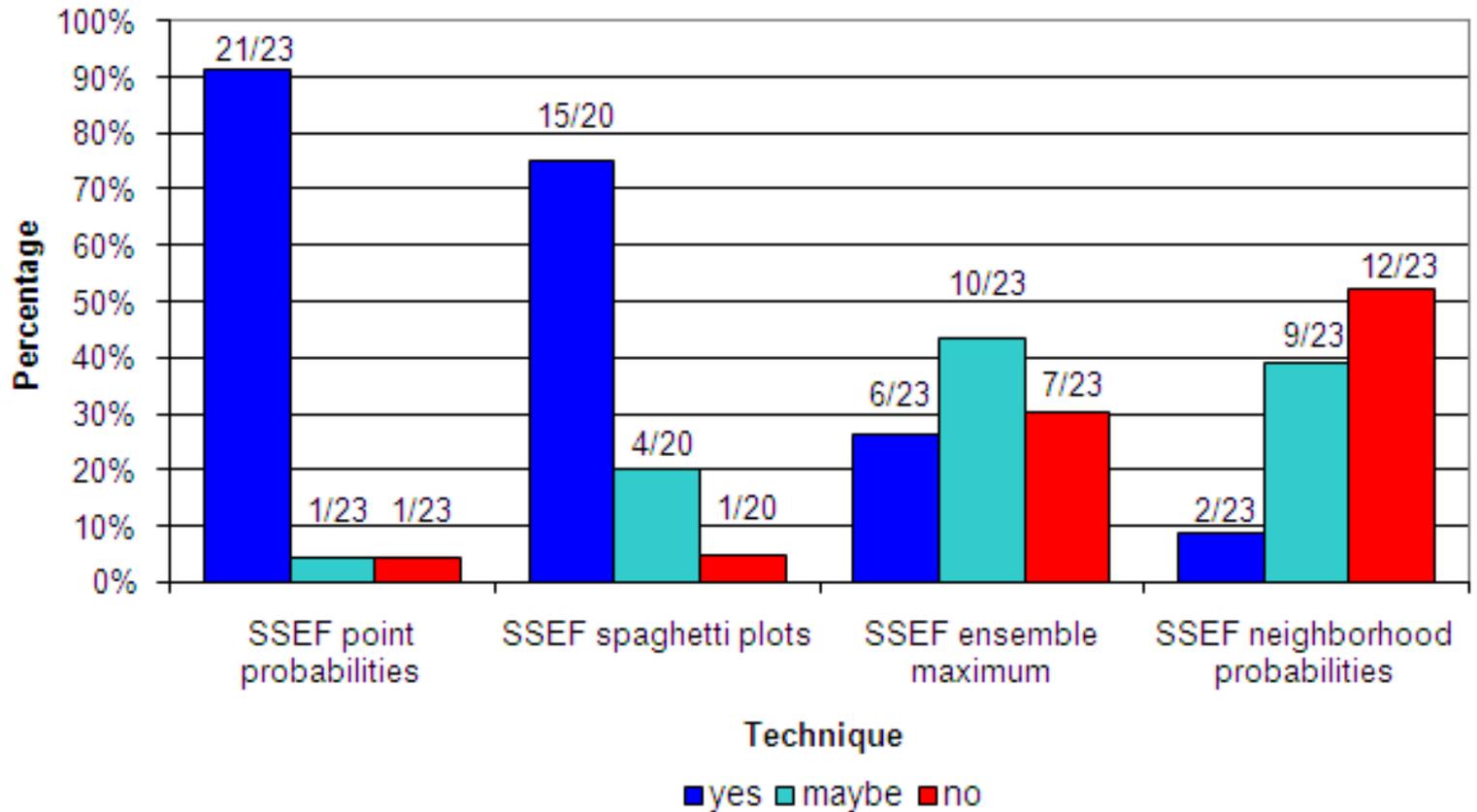


Testbed Postprocessing Results



2011 HWT Spring Experiment

Are Post-Processing Techniques Ready for Operational Implementation?

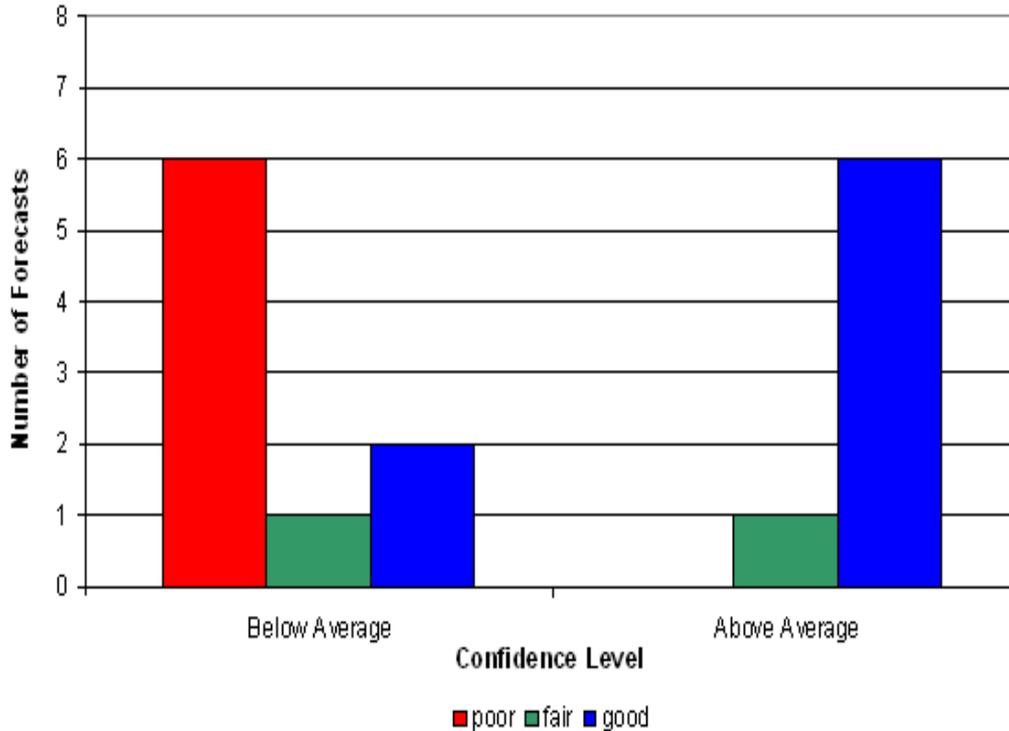




Testbed Example Results



2011 HMT-HPC Winter Weather Experiment
Experimental Snowfall Forecast Performance by Confidence Level



Forecast team's confidence was qualitatively correlated to snowfall errors

Transferring into operations

MODEL DIAGNOSTIC DISCUSSION
225 AM EDT FRI OCT 28 2011

...PREFERENCE: 00Z ECMWF/00Z GFS/00Z NAM/21Z SREF MEAN
COMPROMISE WITH ABOVE AVERAGE CONFIDENCE



Summary



Optimization of forecast resources via

- Transition to managing NWP
- Transition to focused decision support

Allows:

- Extension of forecast through time
- Expansion of decision support services

While maintaining accuracy

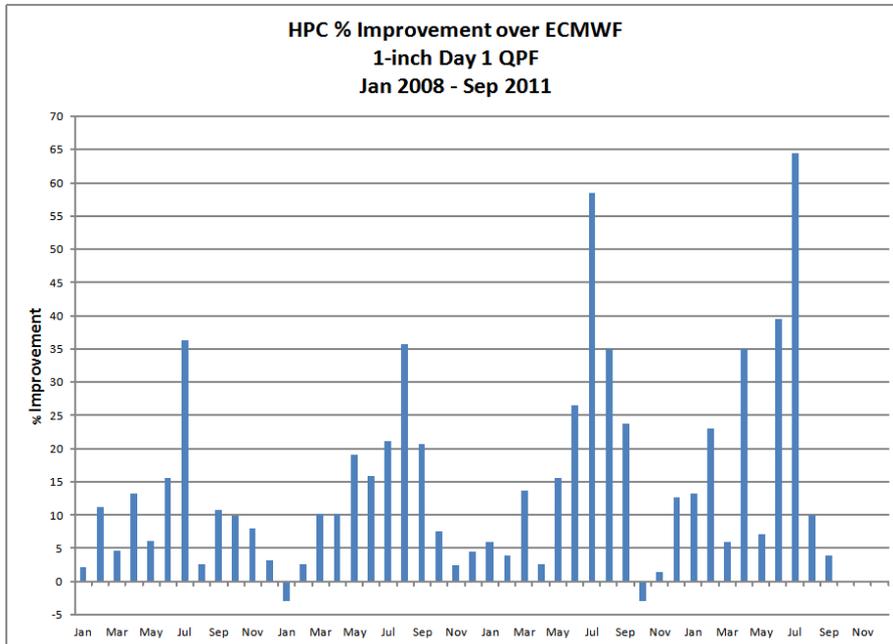
Ensemble guidance key part of transition

Testbeds supporting the transition

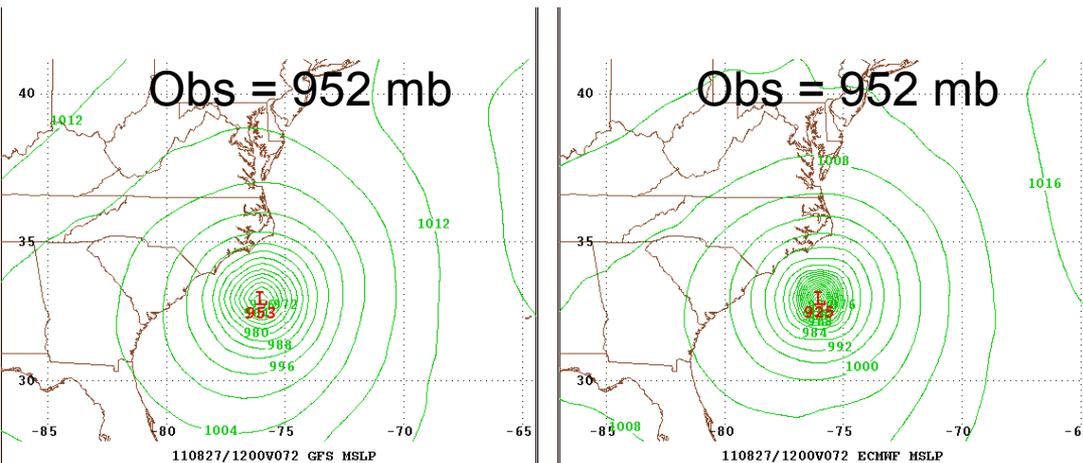


Backup





QPF forecasters make most improvement over short range ECMWF forecasts during the warm season



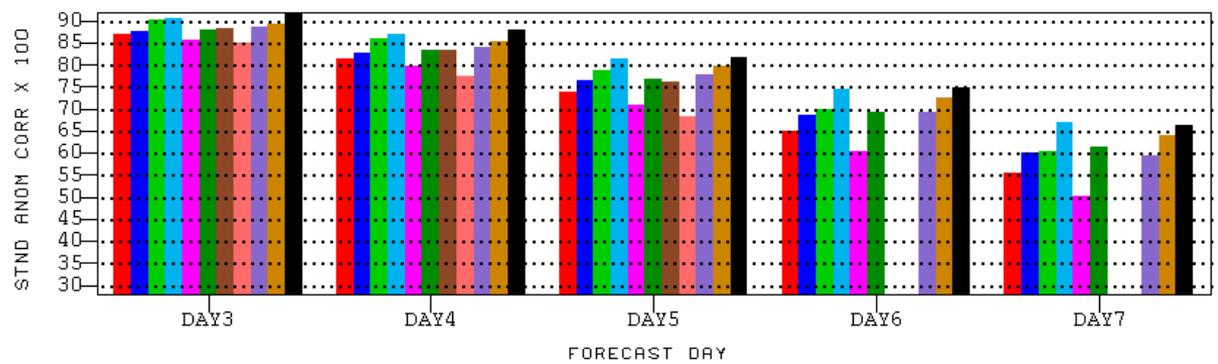
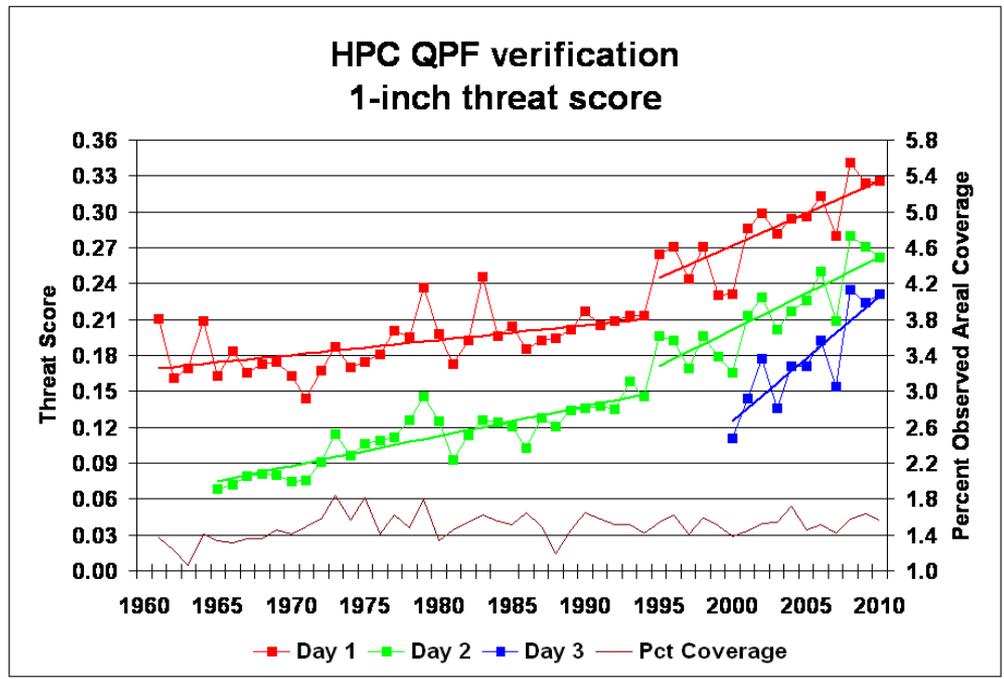
Perception that ECMWF storms are too deep



QPF →

Medium Range ↓

- 00Z NCEP GFS
- 00Z NCEP GFS ENSEMBLE MEAN
- 00Z EUROPEAN CENTER MDL
- 00Z EUROPEAN CNTR ENS MEAN
- 00Z CANADIAN MDL
- 00Z BIAS CRRCTED NAEFS MEAN
- 00Z UK MET MDL
- 00Z NOGAPS (US NAVY)
- 12Z NCEP GFS
- 12Z NCEP GFS ENSEMBLE MEAN
- HPC MEDIUM RANGE DESK



CONUS REGION 12 UTC PMSL FRCST VERIFICATION FOR 20101027 THRU 20111027

