



Cold Season Heavy Precipitation across WFO Wakefield's County Warning Area

**Winter Weather Workshop
December 5 2007**

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Senior Meteorologist/Winter Weather Focal Point**

Methodology

1. Study incorporates daily heavy precipitation events of 2" or more at RIC and/or ORF/SBY/FVX/ECG during the months from November through March (POR 1948-2006)
2. Precipitation events broken into two types:
 - a. **Surface Cold Front (10 events)**
 - b. **Surface Low Pressure (10 events)**
3. Plots 6 hour mean composite anomalies (as standard deviations from normal - stdv) for atmospheric variables (height, surface pressure, temperature, u/v wind component, precipitable water) using the **NCEP/NCAR Reanalysis**; *based on 1970-2000*

Heavy Precipitation Pattern - Surface Cold Front

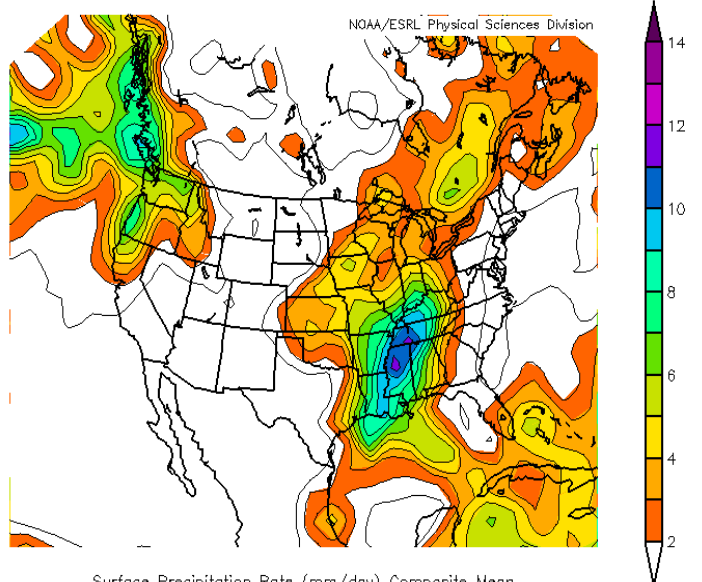
Date	RIC	ORF	SBY	FVX	ECG
Jan 28 1952 (total)	2.07" 2.51"	0.82" 0.82"	1.47" 1.90"	1.42" 2.35"	0.47" 0.47"
Dec 20 1957 (total)	2.10" 2.10"	0.12" 0.12"	0.52" 0.53"	0.53" 0.94"	0.79" 0.81"
Nov 6 1959 (total)	2.71" 4.05"	0.92" 0.92"	0.57" 0.70"	0.69" 0.70"	0.61" 0.64"
Nov 24 1959 (total)	3.00" 3.02"	0.21" 0.22"	2.06" 2.42"	1.76" 1.84"	0.48" 0.52"
Jan 6 1962 (total)	3.31" 3.31"	1.24" 1.24"	3.09" 3.15"	1.50" 1.70"	1.35" 1.38"
Feb 24 1979 (total)	2.64" 4.48"	1.71" 2.94"	1.80" 4.14"	2.50" 4.06"	1.75" 2.41"
Mar 21 1983 (total)	2.40" 2.40"	0.89" 0.89"	0.72" 0.72"	0.49" 0.49"	1.16" 1.18"
Mar 25 1984 (total)	2.20" 2.60"	0.38" 0.39"	2.52" 2.91"	1.84" 2.36"	0.25" 0.25"
Nov 21 1994 (total)	2.31" 2.31"	1.37" 1.37"	1.31" 1.31"	2.15" 2.15"	0.02" 0.04"
Nov 12 2006 (total)	2.18" 2.18"	2.75" 2.75"	2.77" 2.86"	0.87" 1.45"	1.33" 2.12"

Heavy Precipitation Pattern - Surface Low Pressure

Date	RIC	ORF	SBY	FVX	ECG
Nov 21 1952 (total)	2.62" 4.41"	3.31" 4.07"	2.16" 3.08"	3.28" 4.06"	2.54" 2.70"
Nov 1 1956 (total)	2.44" 4.24"	0.07" 0.08"	1.02" 1.18"	0.72" 0.78"	0.17" 0.17"
Dec 29 1958 (total)	2.46" 3.28"	0.69" 1.55"	2.54" 2.64"	3.41" 4.01"	1.69" 1.84"
Nov 9 1962 (total)	2.22" 2.35"	1.09" 1.09"	0.77" 1.29"	1.55" 2.43"	1.07" 1.07"
Nov 6 1963 (total)	2.53" 3.10"	1.48" 2.29"	2.15" 2.51"	2.51" 3.40"	1.22" 1.60"
Nov 29 1963 (total)	2.07" 2.15"	2.00" 2.04"	1.69" 1.79"	1.17" 1.77"	2.92" 2.95"
Dec 24 1986 (total)	2.35" 2.65"	1.57" 1.63"	3.21" 3.21"	1.31" 1.96"	1.50" 1.55"
Mar 29 1991 (total)	2.82" 2.94"	1.93" 2.01"	1.83" 1.96"	2.02" 2.50"	0.15" 1.60"
Mar 2 1994 (total)	2.42" 2.87"	3.78" 4.38"	2.53" 3.31"	2.07" 3.37"	3.70" 3.76"
Feb 4 1998 (total)	2.26" 2.83"	4.75" 5.18"	2.23" 3.64"	1.23" 2.74"	2.26" 2.56"

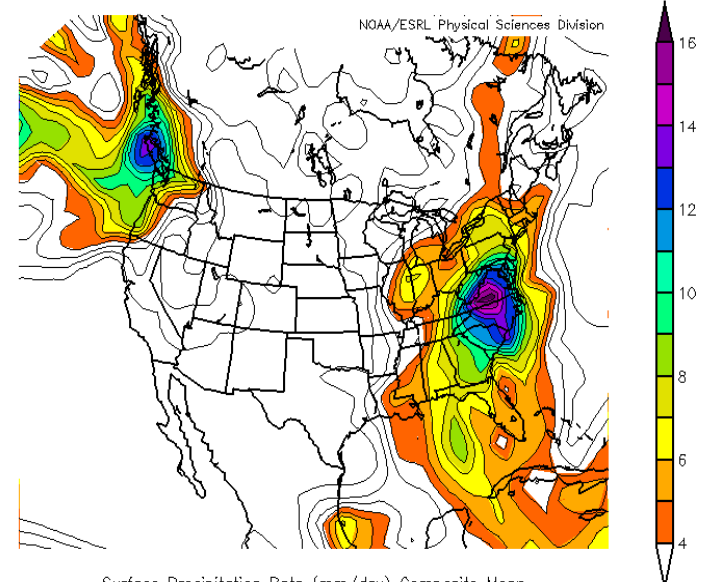
Heavy Precipitation Pattern - Surface Cold Front

Day -1



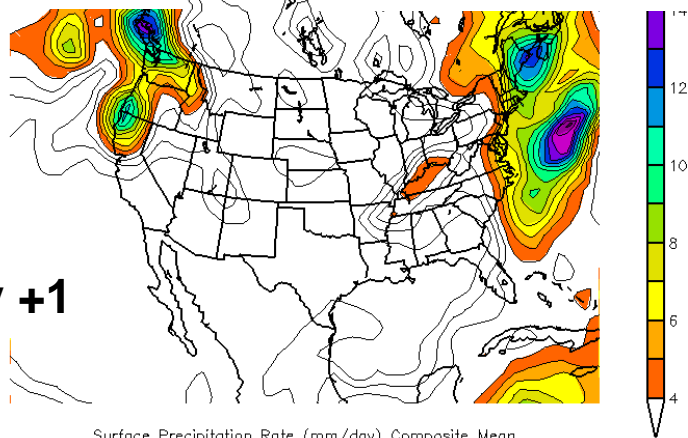
Surface Precipitation Rate (mm/day) Composite Mean
1/27/52 12/19/57 11/5/59 11/23/59 1/5/62 2/23/79 3/20/83 3/24/84 11/20/94 11/11/06
NCEP/NCAR Reanalysis

Day



Surface Precipitation Rate (mm/day) Composite Mean
1/28/52 12/20/57 11/6/59 11/24/59 1/6/62 2/24/79 3/21/83 3/25/84 11/21/94 11/12/06
NCEP/NCAR Reanalysis

Day +1

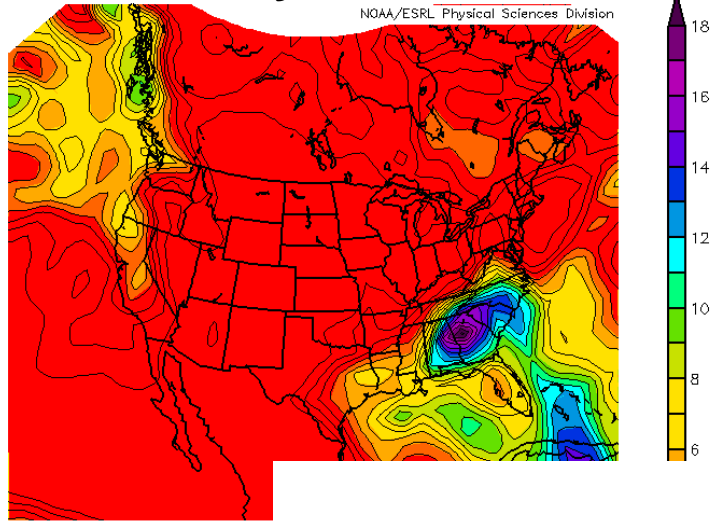


Surface Precipitation Rate (mm/day) Composite Mean
1/29/52 12/21/57 11/7/59 11/25/59 1/7/62 2/25/79 3/22/83 3/26/84 11/22/94 11/13/06
NCEP/NCAR Reanalysis

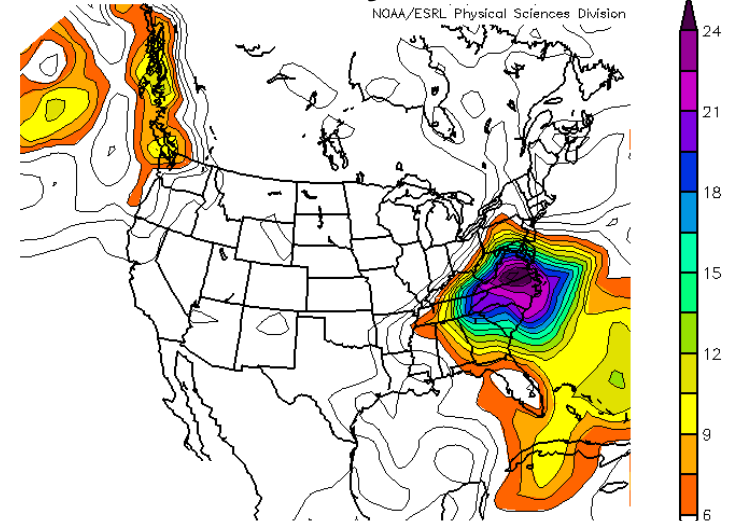


Heavy Precipitation Pattern - Surface Low Pressure

Day -1



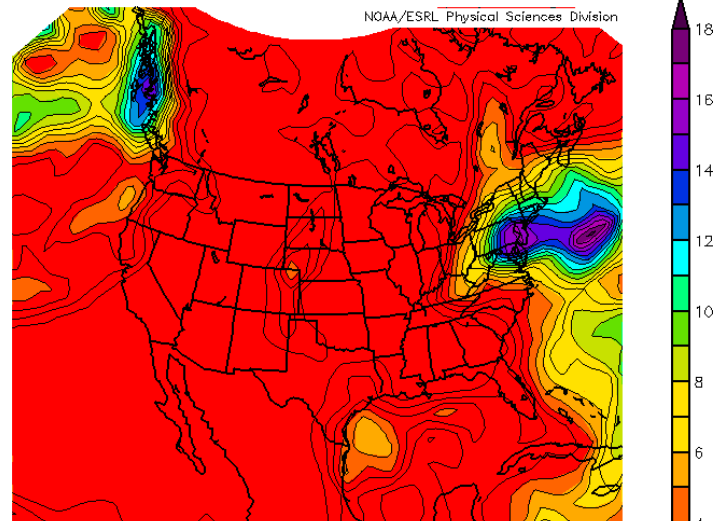
Day



Surface Precipitation F
11/20/52 10/31/56 12/28/58 11/8/62 11/
NCEP/

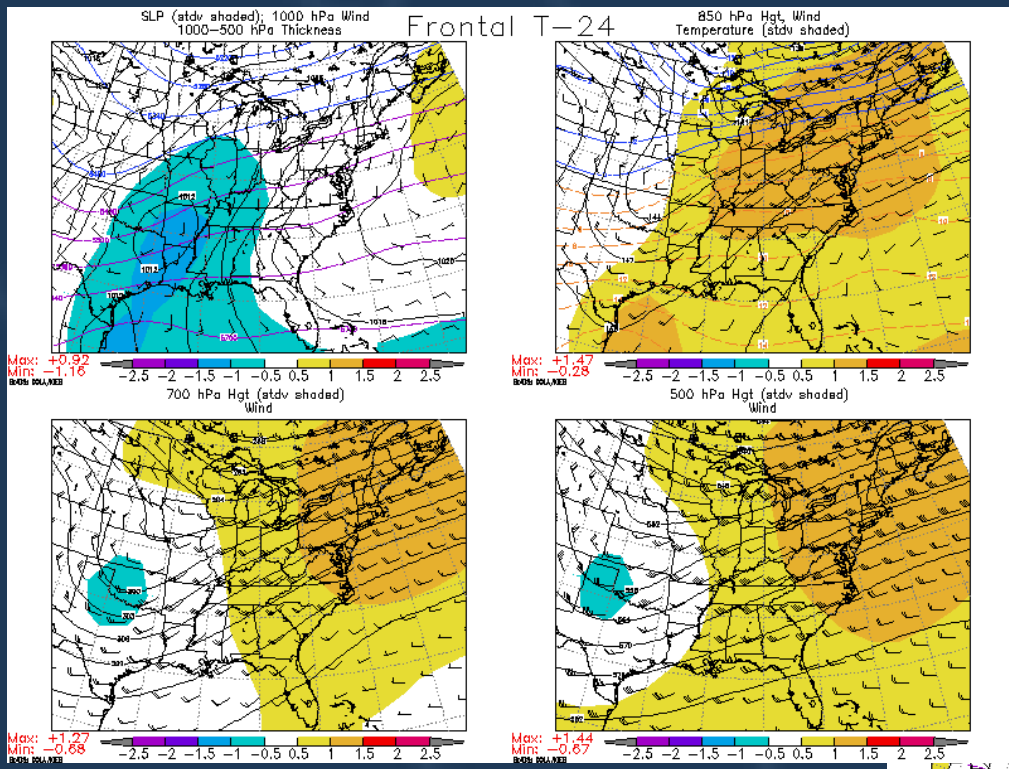
Surface Precipitation Rate (mm/day) Composite Mean
62 11/9/63 11/29/63 12/24/66 3/29/91 3/2/94 2/4/98
NCEP/NCAR Reanalysis

Day +1



Surface Precipitation Rate (mm/day) Composite Mean
11/22/52 11/2/56 12/30/58 11/10/62 11/10/63 11/30/63 12/25/86 3/30/91 3/3/94 2/5/98
NCEP/NCAR Reanalysis



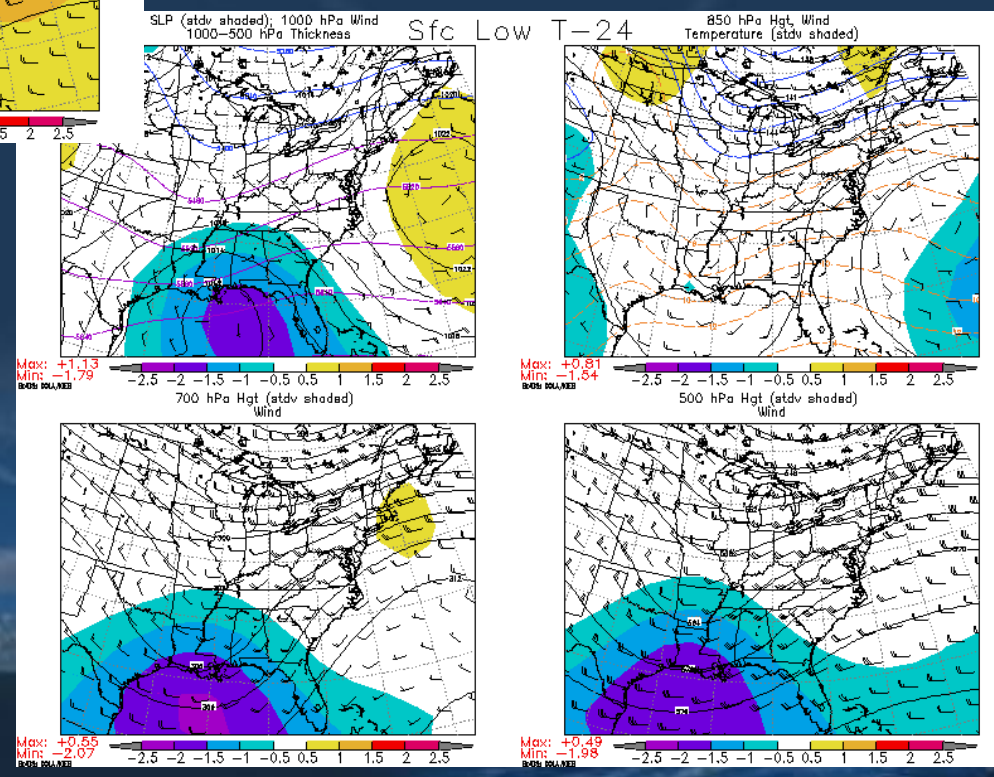


Frontal t-24

- large area of +1 to 1.5 stdv of 850 hPa temperature, and 700/500 hPa height over the northeast quarter of the us.
- area of near -1 stdv of SLP just west of the lower Mississippi River Valley.
- small area of slightly negative stdv of 700/500 hPa across the southern Plains.

Sfc Low t-24

- area of slightly positive stdv of 850 hPa temperature and 700 hPa height near New England.
- large area of -1 to -2.5 stdv of SLP near the central Gulf Coast.
- large area near -2 stdv of 700/500 hPa over the western half of the Gulf of Mexico.

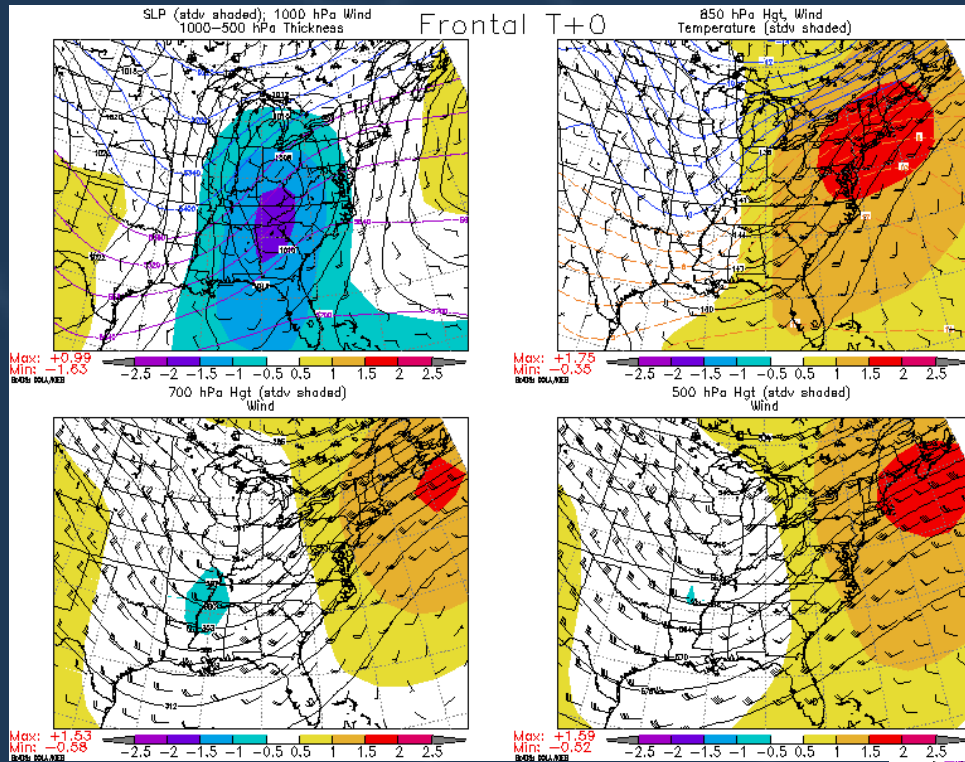


Frontal t+0

- large area of +1.5 to 2 stdv of 850 hPa temperature, and +1 to +2 stdv of 700/500 hPa height over the northeast quarter of the us.

-area of near -1.5 to -2 stdv of SLP over the southern Appalachians.

- very small area of slightly negative stdv of 700/500 hPa across the lower Mississippi River Valley.

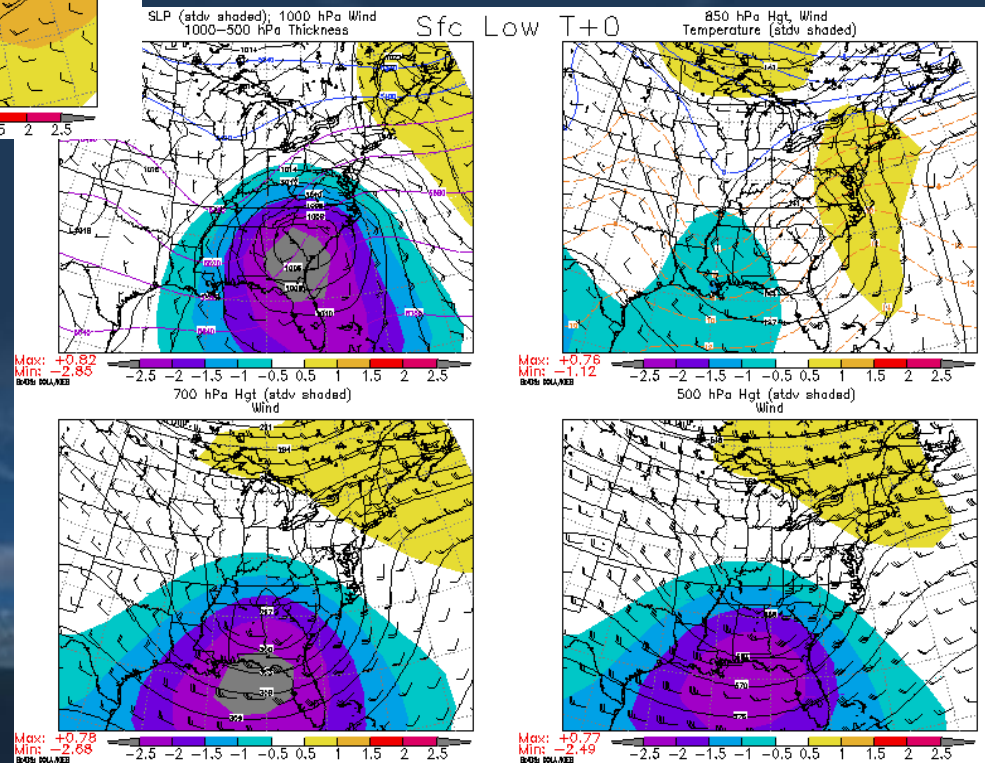


Sfc Low t+0

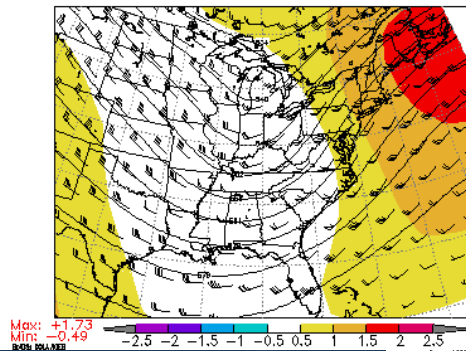
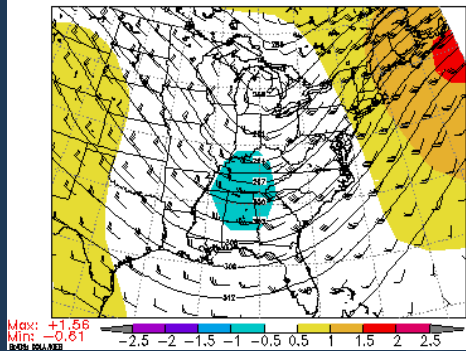
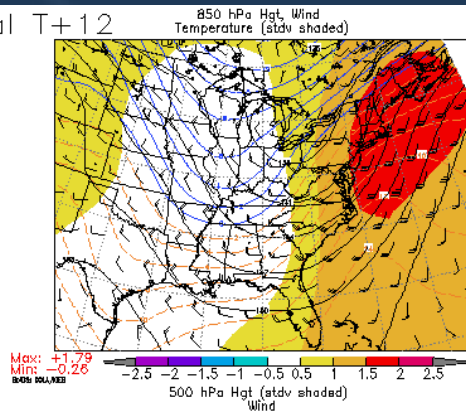
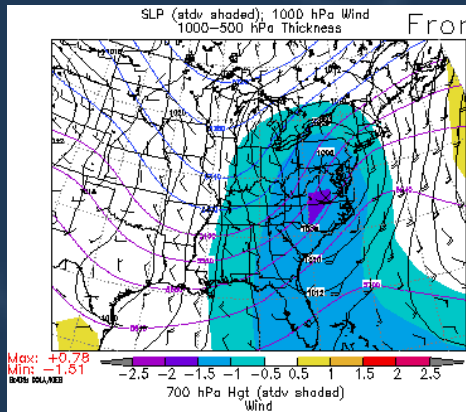
- area of slightly positive stdv of 850 hPa temperature from the mid-Atlantic to New England; as well as slightly positive stdv of 700/500 hPa height near New England.

-large area of -2 to -3 stdv of SLP across the Southeast states.

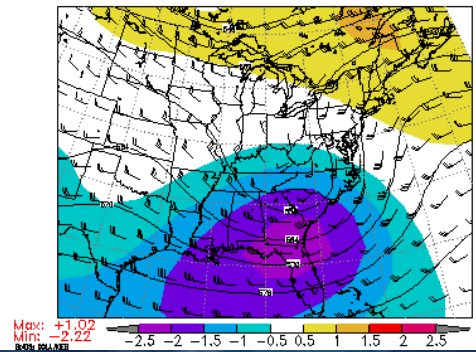
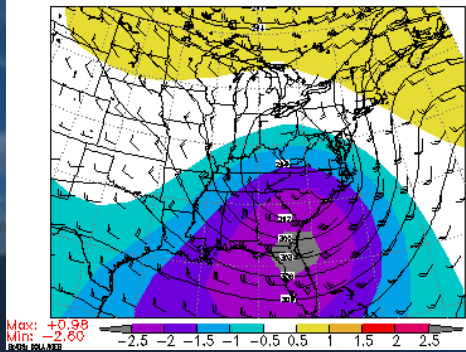
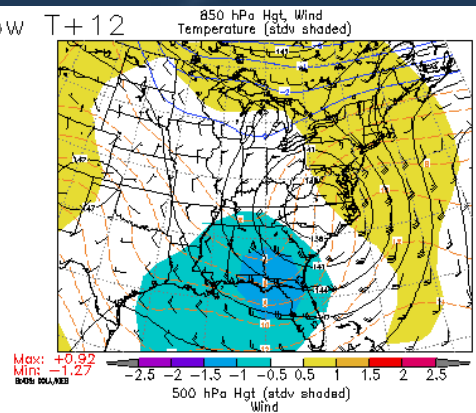
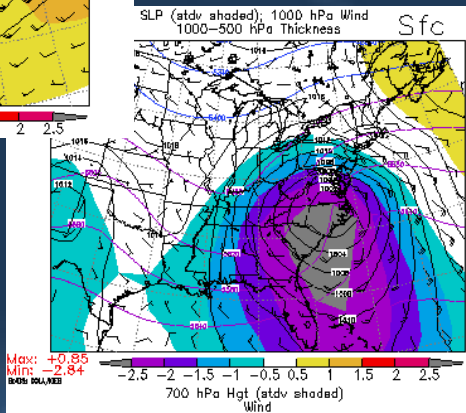
- large area near -2.5 stdv of 700/500 hPa over the northeast portion of the Gulf of Mexico.



Frontal T+12



Sfc Low T+12

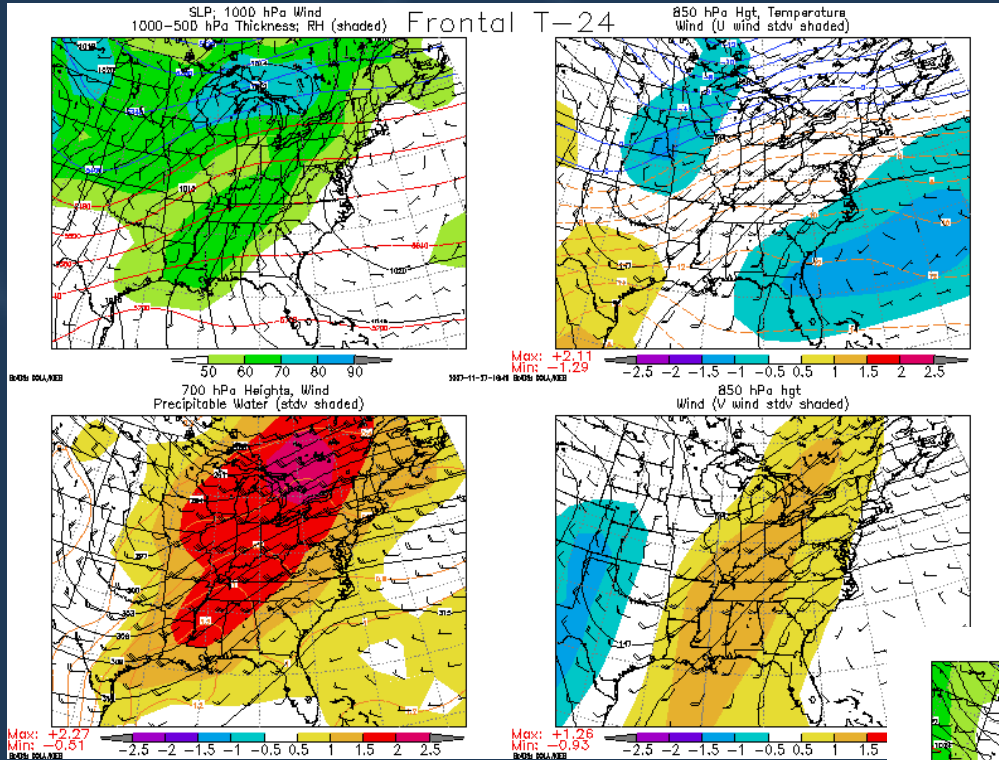


Frontal t-24

- large area of +1.5 to 2.5 stdv of precipitable water from the great lakes region to the western Gulf Coast states.

- axis of +1 to 1.5 stdv of 850 hPa v-wind component from the central Gulf Coast states to the eastern Great Lakes states.

- two areas of -1 to -1.5 stdv of 850 hPa u-wind component...off the Southeast coast...and over the Midwest.

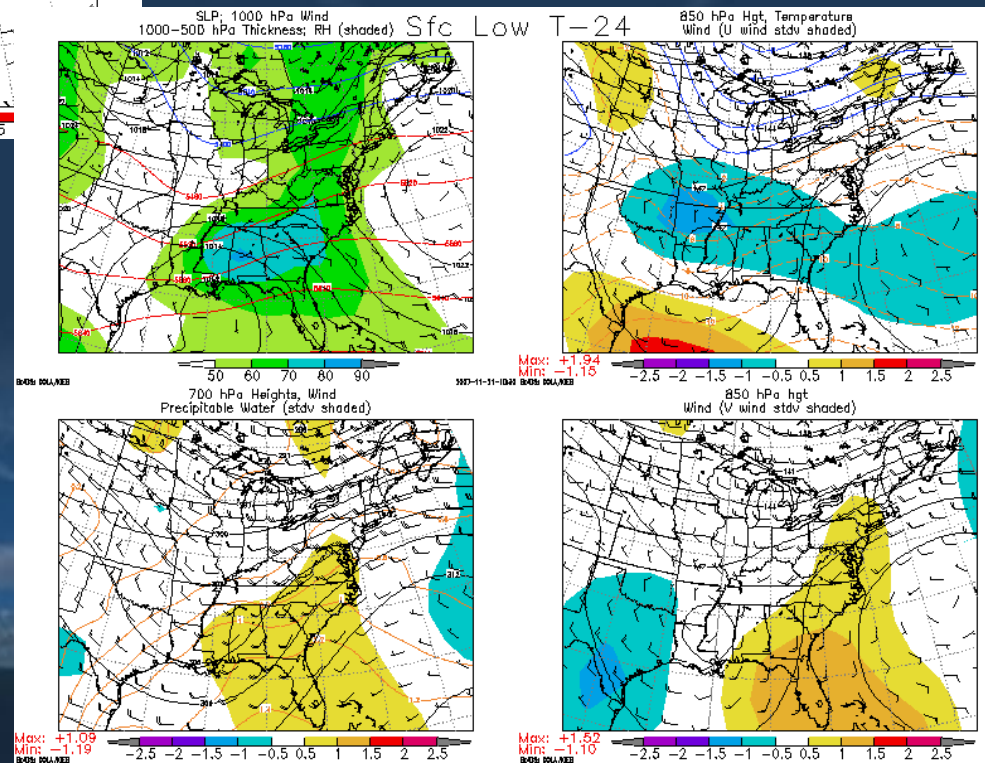


Sfc Low t-24

- area of slightly positive stdv of precipitable water over the Southeast states.

- axis of near +1.5 stdv of 850 hPa v-wind component over Florida.

- Small area of near -2 stdv of 850 hPa u-wind component centered over Arkansas.

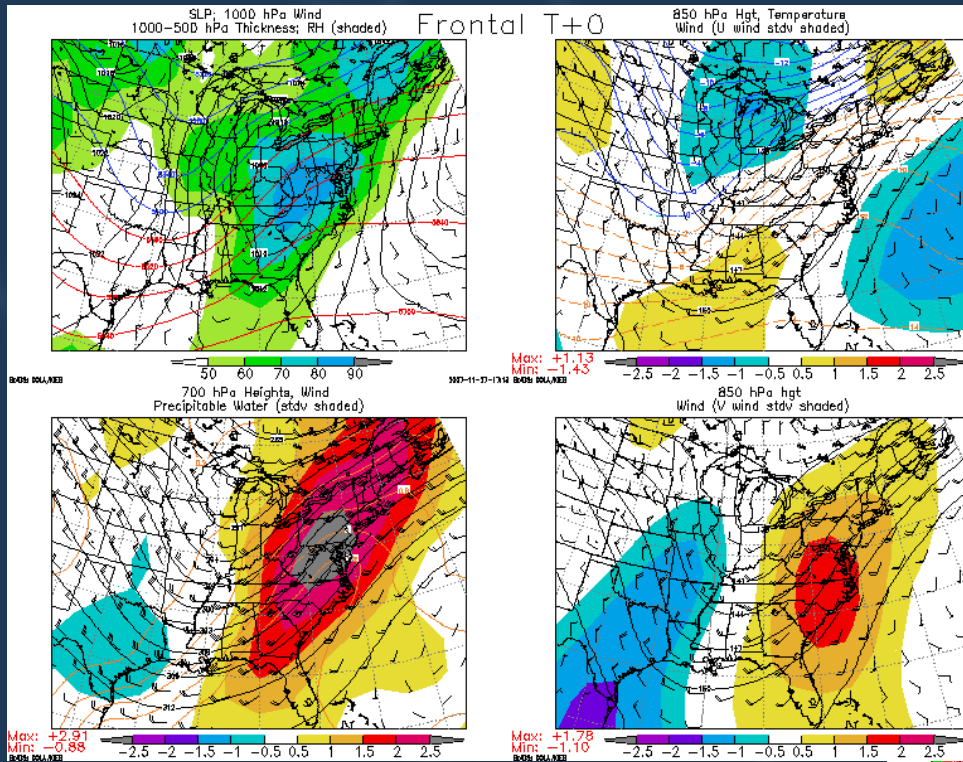


Frontal t+0

- large area of +2 to +2.5 stdv of precipitable water from South Carolina to New England...with near +3 stdv over Virginia, Maryland and Pennsylvania.

- axis of +1.5 to +2 stdv of 850 hPa v-wind component from the coastal Carolinas north through the mid-Atlantic states.

- two areas of -1 to -1.5 stdv of 850 hPa u-wind component...off the East Coast...and over the Great Lakes states.

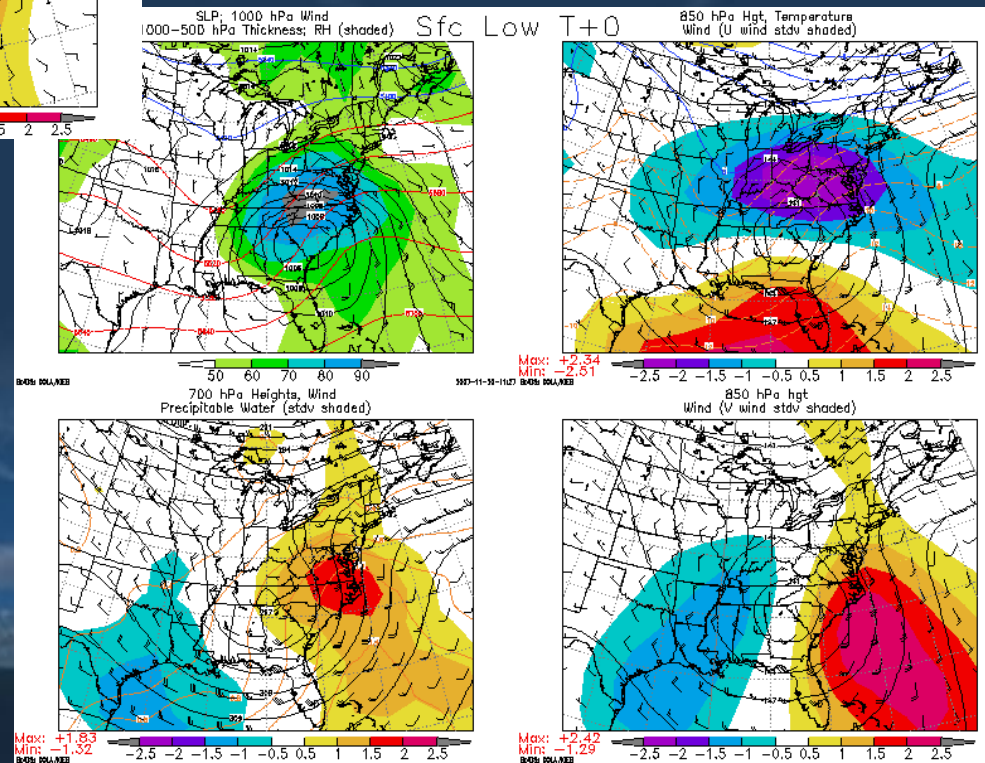


Sfc Low t+0

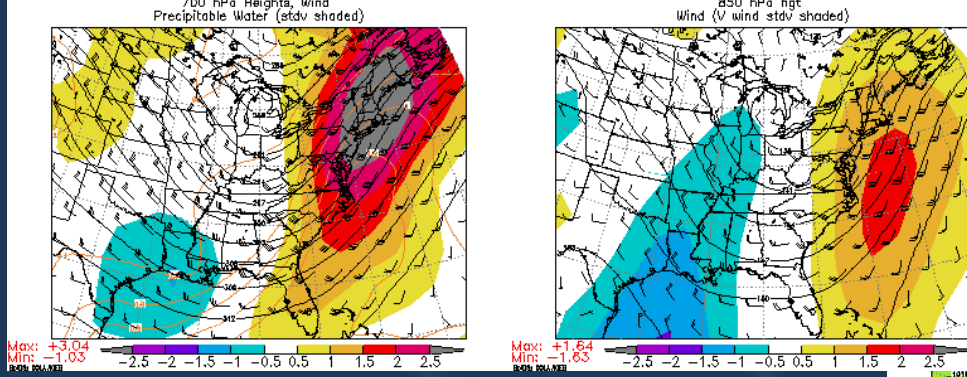
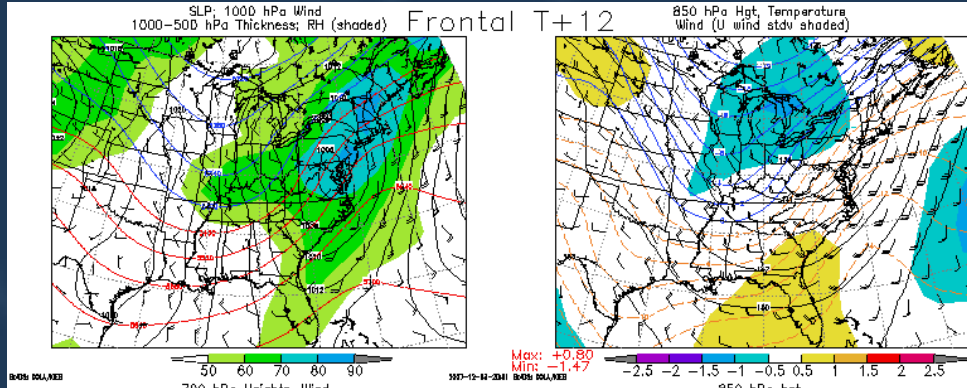
- area of +1.5 to +2 stdv of precipitable water centered over eastern Virginia and eastern North Carolina.

- axis of near +2.5 stdv of 850 hPa v-wind component just off the Southeast coast.

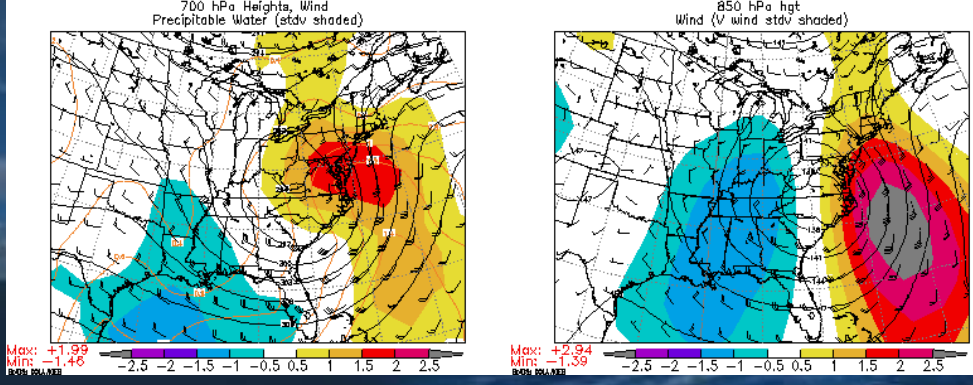
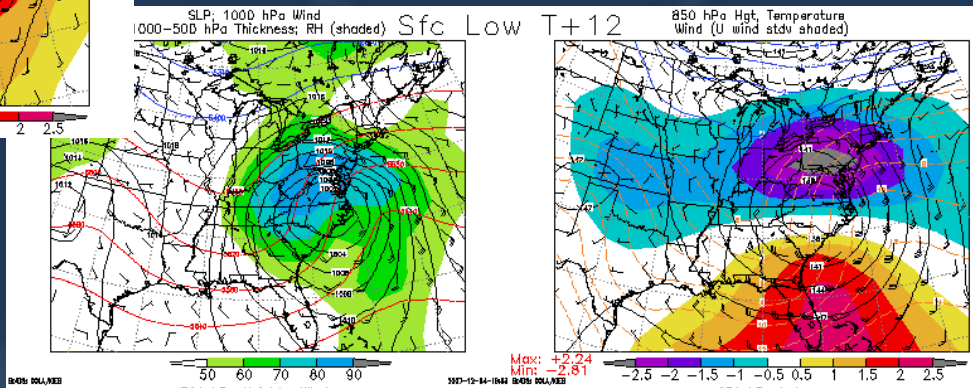
- large area of -2.5 stdv of 850 hPa u-wind component centered over West Virginia.



Frontal T+12



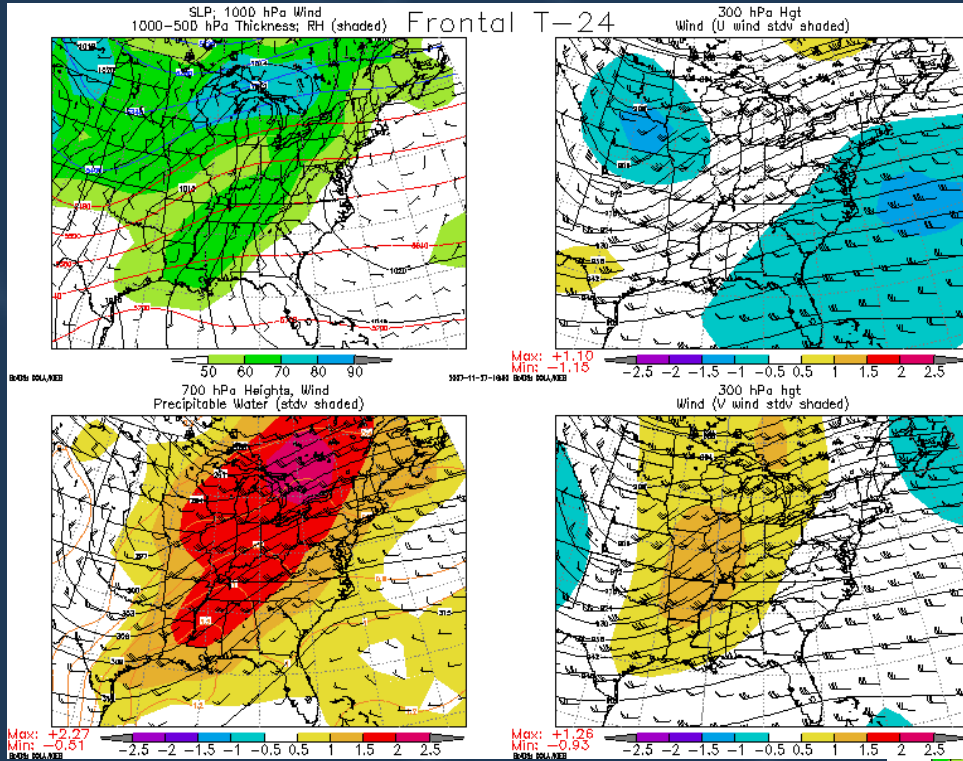
Sfc Low T+12



Frontal t-24

- axis of +1 to +1.5 stdv of 300 hPa v-wind component over the central Mississippi River Valley.

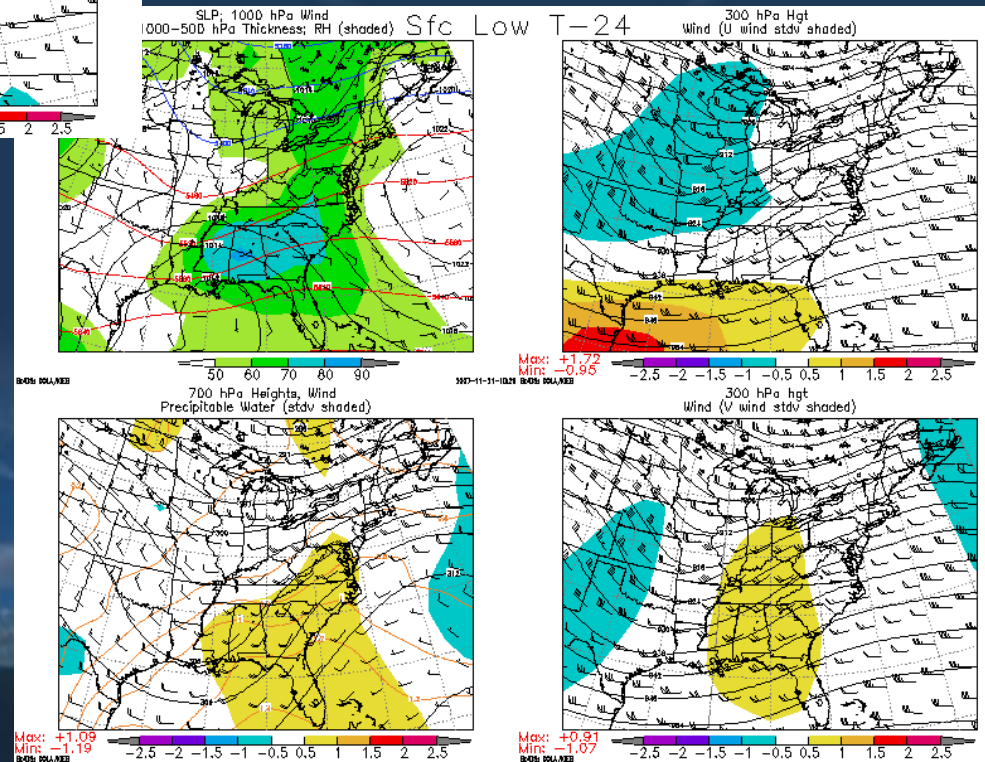
- two areas of -1.5 to -2 stdv of 300 hPa u-wind component...off the East Coast...and centered over Nebraska.



Sfc Low t-24

- area of slightly positive stdv of 300 hPa v-wind component from the Ohio Valley to northwest Florida.

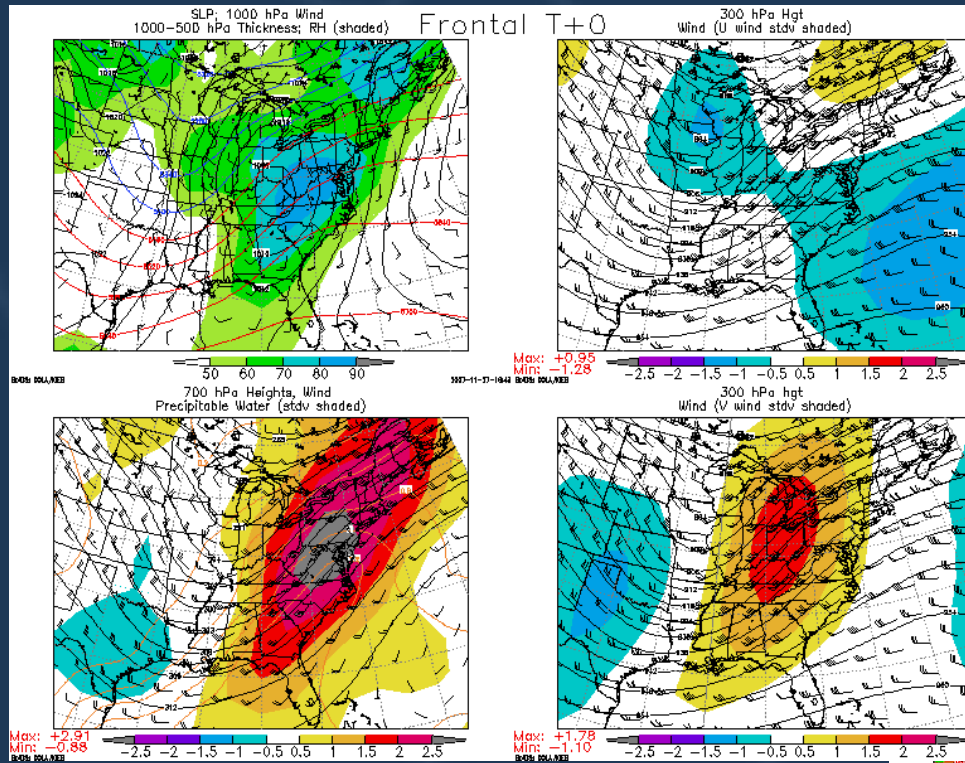
- area of slightly negative stdv of 300 hPa u-wind component from the central Plains to the western Great Lakes states.



Frontal t+0

- axis of +1.5 to +2 stdv of 300 hPa v-wind component from eastern Tennessee to the eastern Great Lakes states.

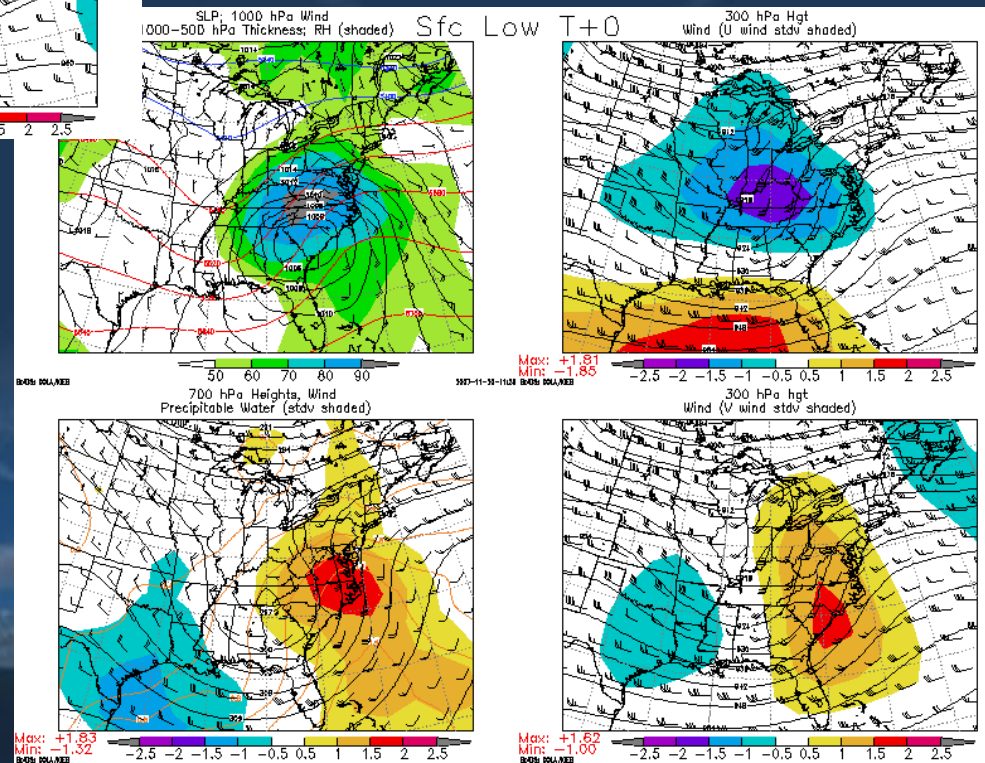
- two areas of -1.5 to -2 stdv of 300 hPa u-wind component...off the East Coast...and over the Midwest.

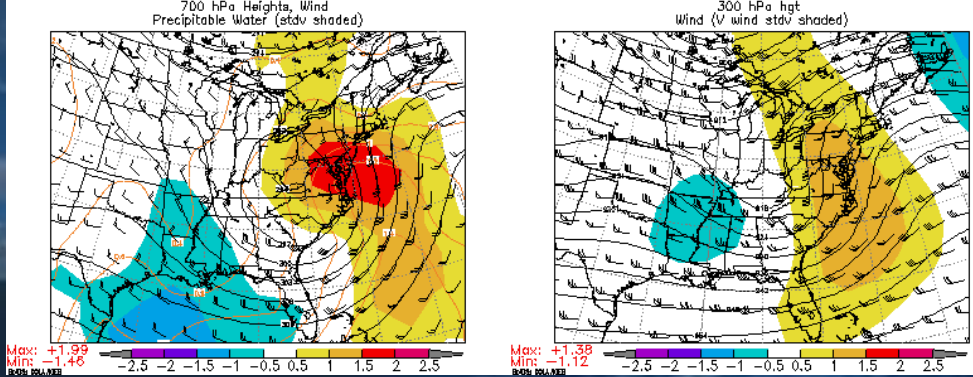
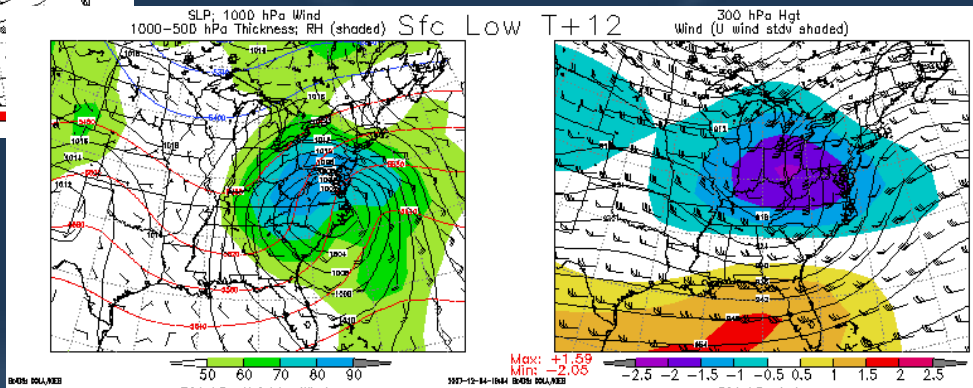
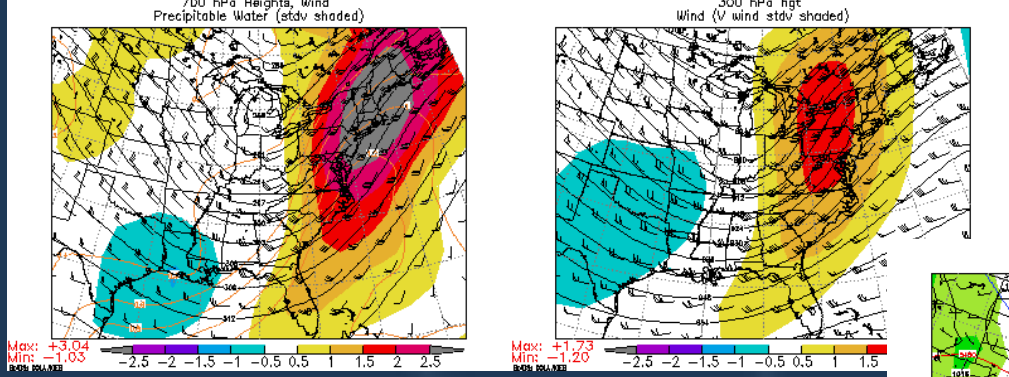
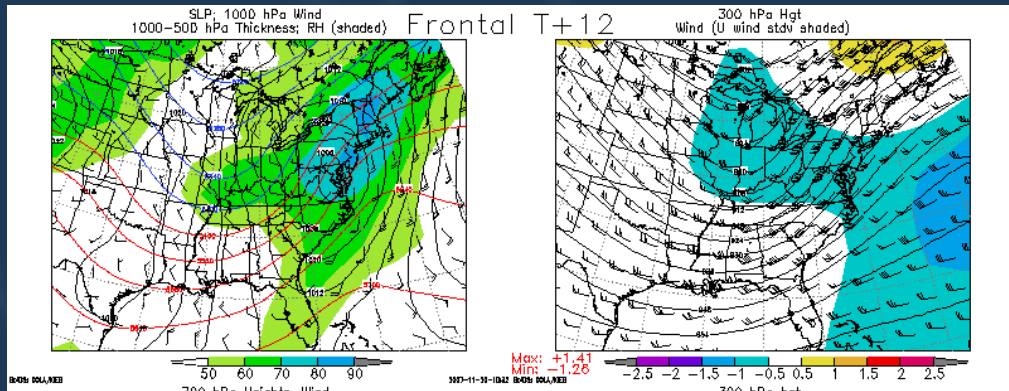


Sfc Low t+0

- axis of +1.5 to +2 stdv of 300 hPa v-wind component from the coastal Carolinas.

- area of -1.5 to -2 stdv of 300 hPa u-wind component centered over Kentucky.





Cold Season Heavy Precipitation

Key Ingredients

Surface Front

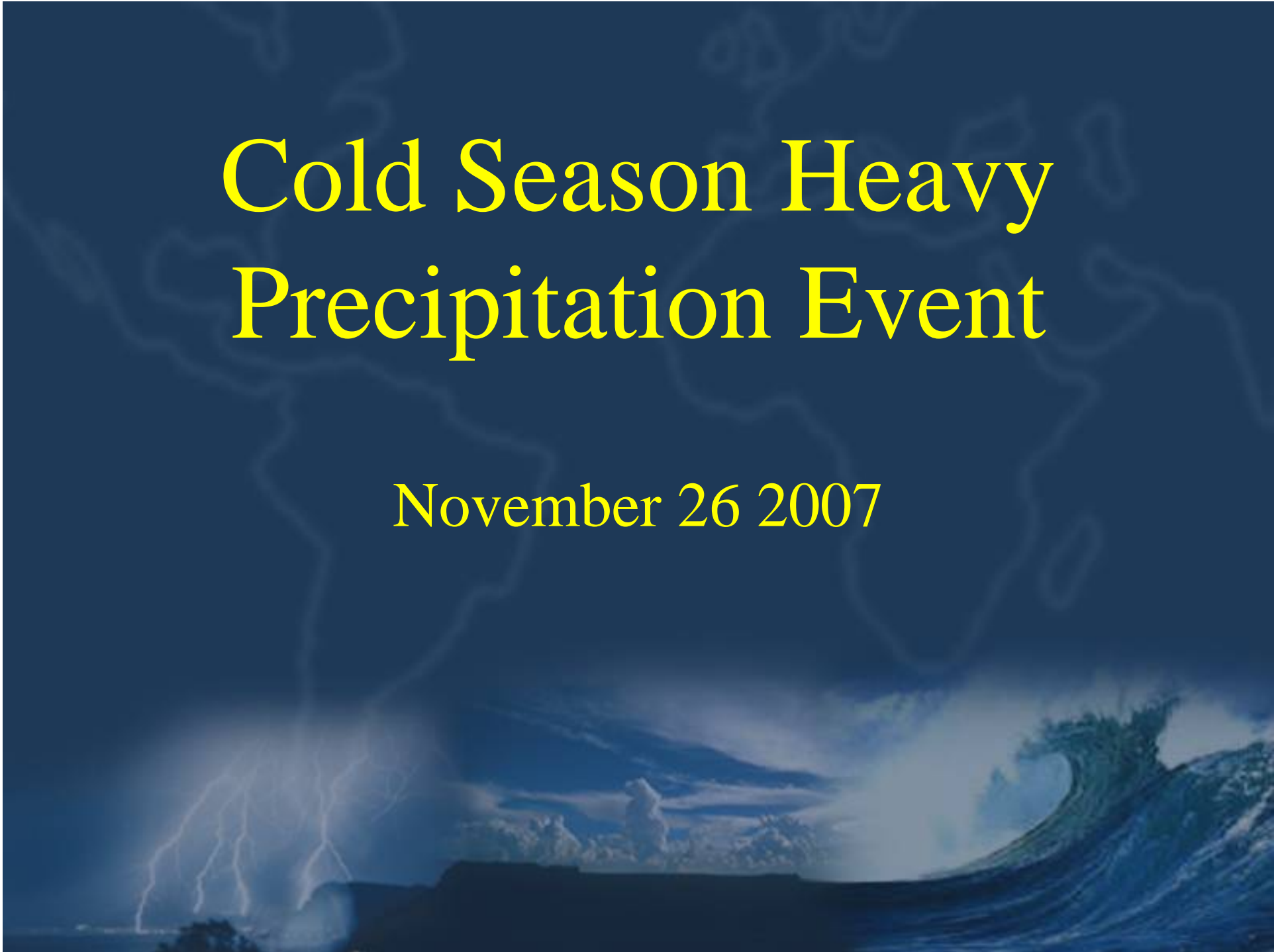
- POSITIVE anomalies of 850 hPa temperatures; and 700/500 hPa heights near New England
- POSITIVE anomalies of 850 hPa v-wind component from the coastal Carolinas north through the mid-Atlantic states (stronger than normal low level south winds)
- LARGE POSITIVE anomalies of precipitable water centered over Virginia, Maryland and Pennsylvania

Surface Low

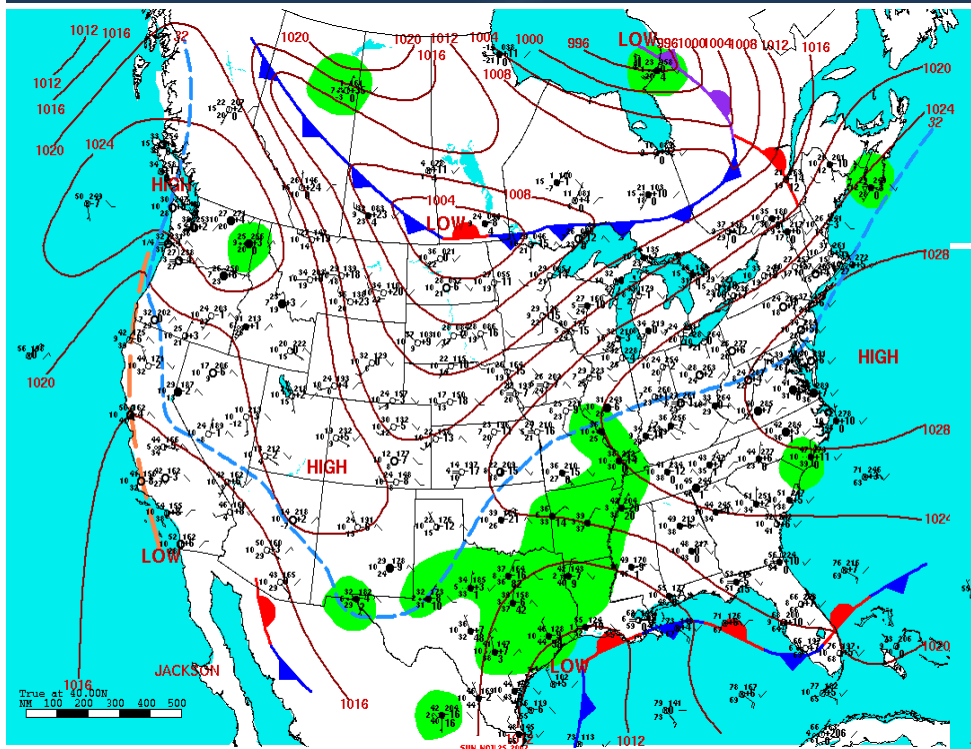
- LARGE NEGATIVE anomalies of SLP; and 700/500 hPa heights in the vicinity of the Southeast states and the northeast Gulf of Mexico
- LARGE NEGATIVE anomalies of 850 hPa u-wind component centered over West Virginia (indicative of stronger than normal low level east winds)
- LARGE POSITIVE anomalies of 850 hPa v-wind component Just off the Southeast coast (indicative of stronger than normal southeast winds)
- POS. anomalies of precipitable water over eastern Virginia and eastern North Carolina
- NEG. anomalies 300 hPa u-wind component from eastern Tennessee to the eastern Great Lakes states (indicative of a “slowing down” or intensifying upper level system)

Cold Season Heavy Precipitation Event

November 26 2007

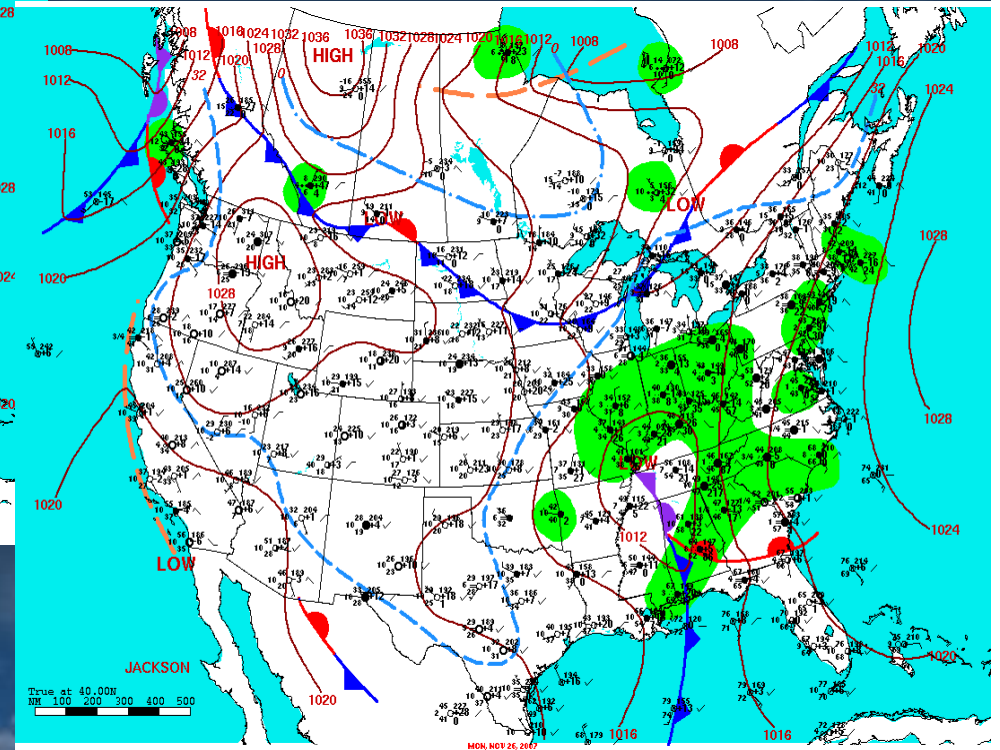


Cold Season Heavy Precipitation Event



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

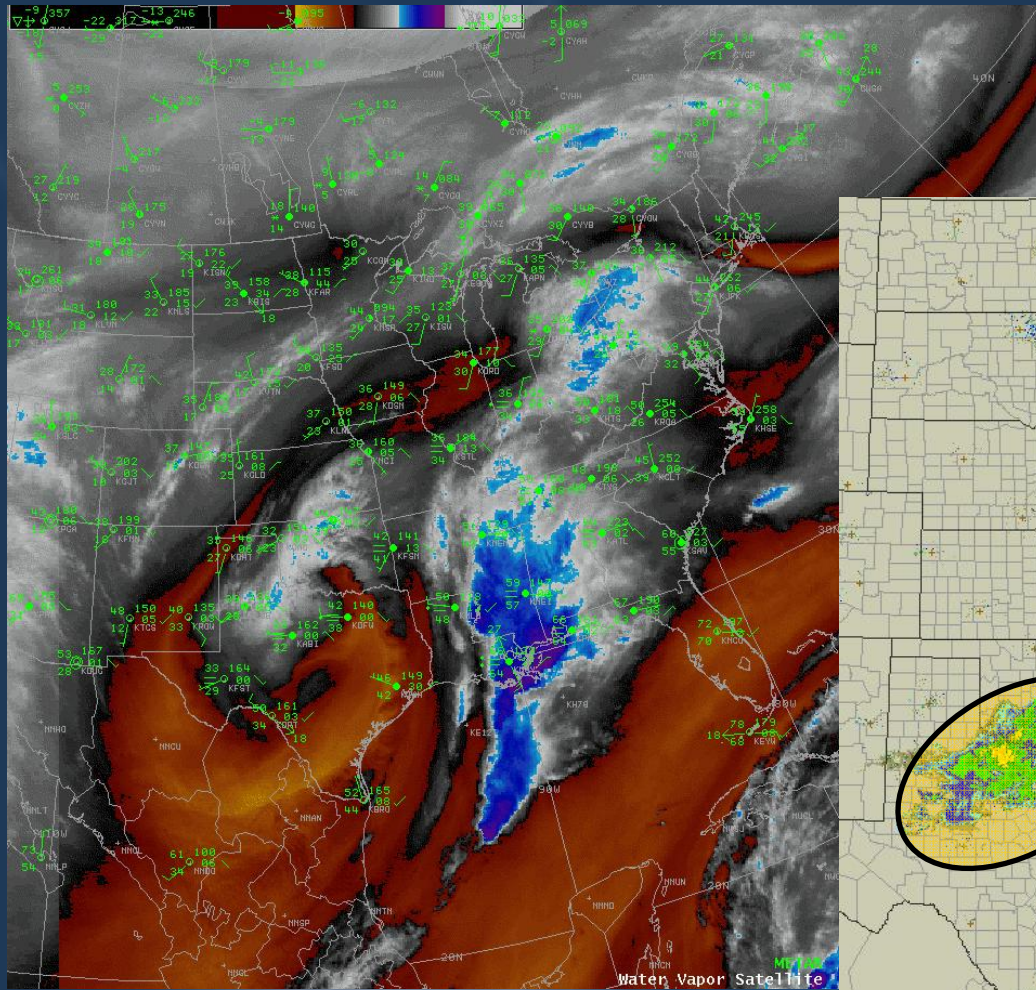
12z Nov 25 2007



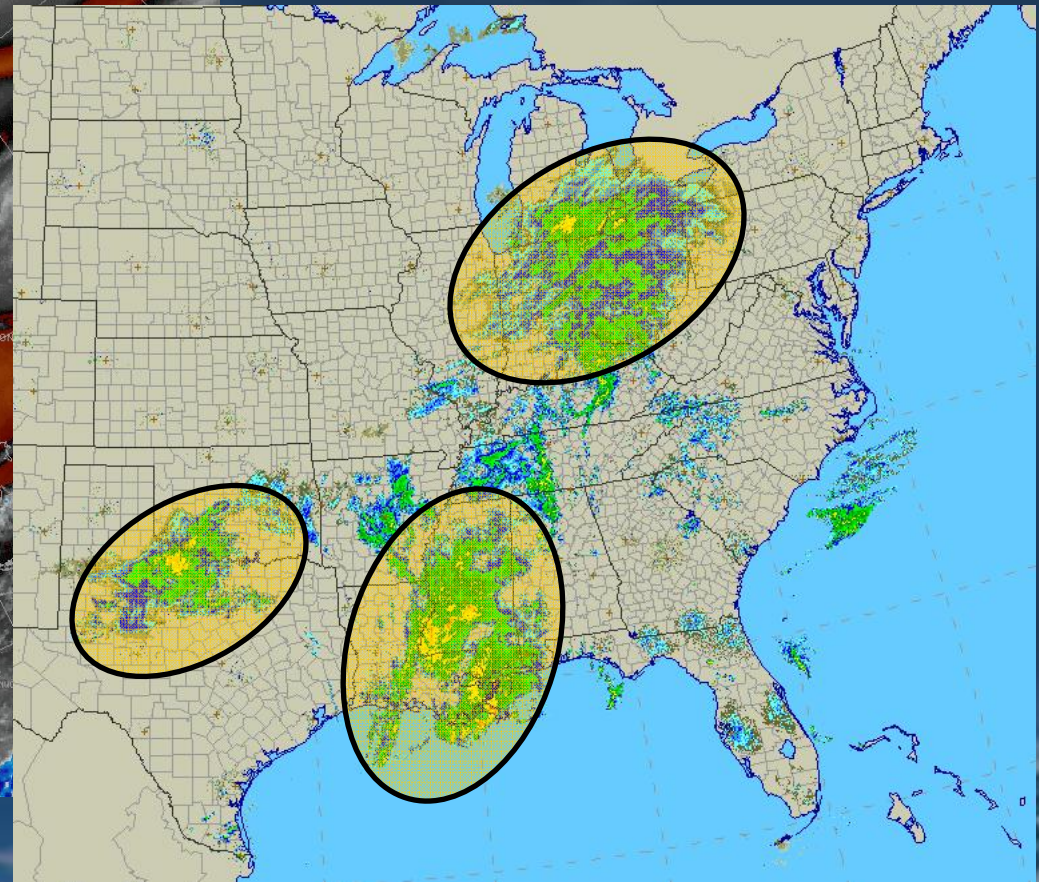
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

12z Nov 26 2007

Cold Season Heavy Precipitation Event



00Z Nov 26 2007
IR imagery

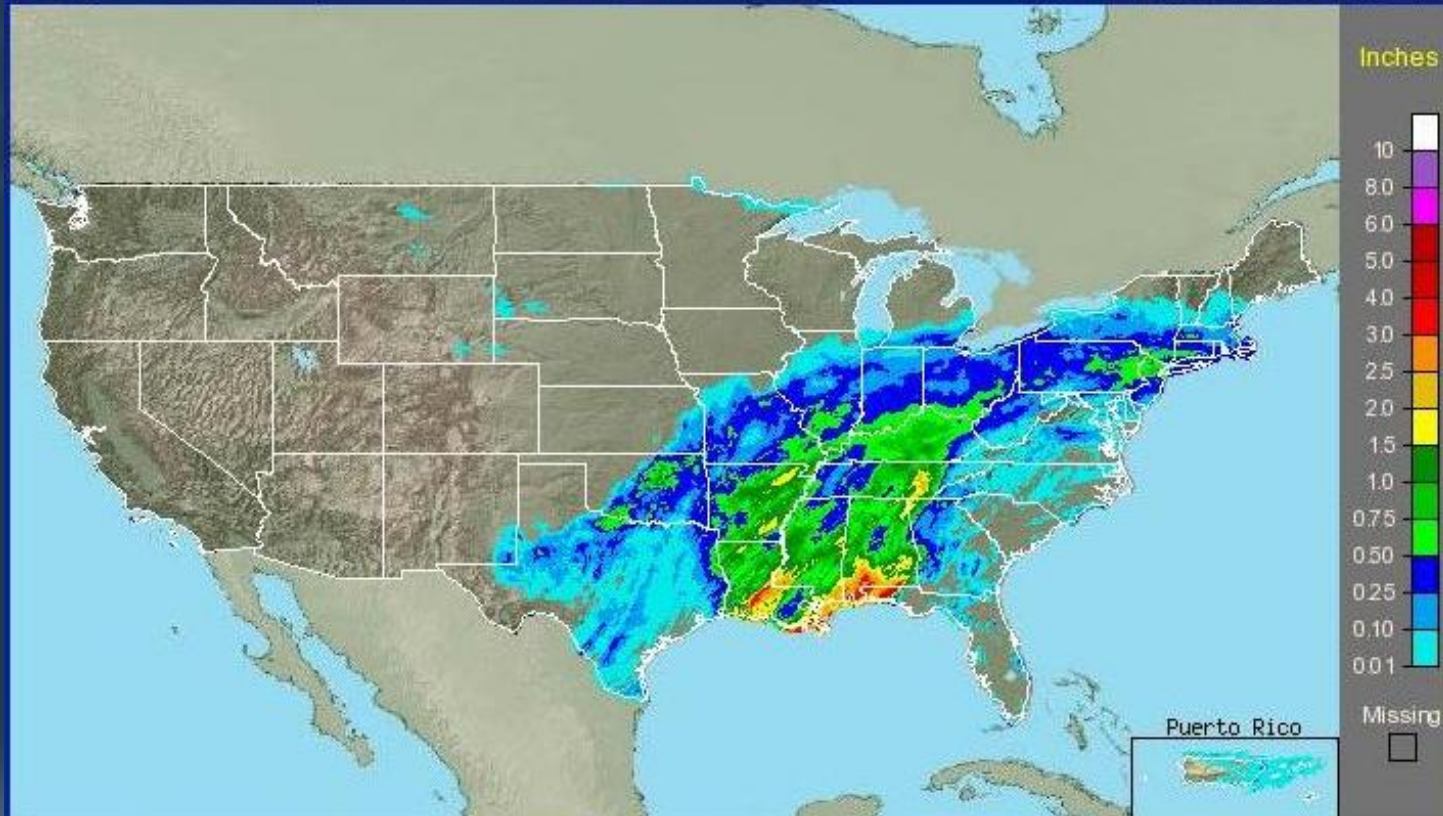


00Z Nov 26 2007
radar

Cold Season Heavy Precipitation Event

Continental United States
1-Day Observed Precipitation - Valid 11/26/2007 1200 UTC

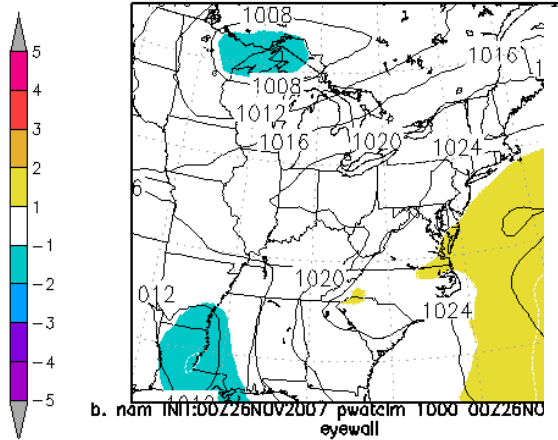
Click on the image to zoom in
Click on "States" to zoom out



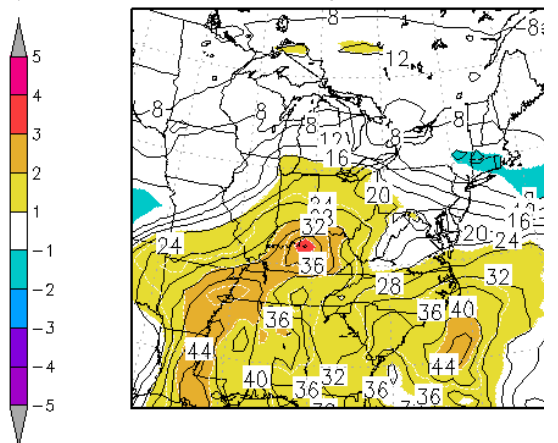
24 hr total precipitation
12z 11/25-12z 11/26

Cold Season Heavy Precipitation Event Surface Cold Front

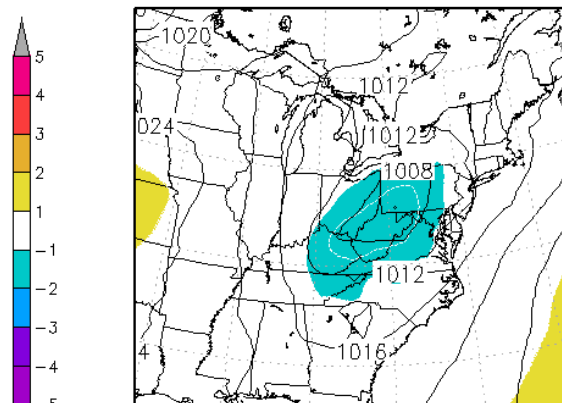
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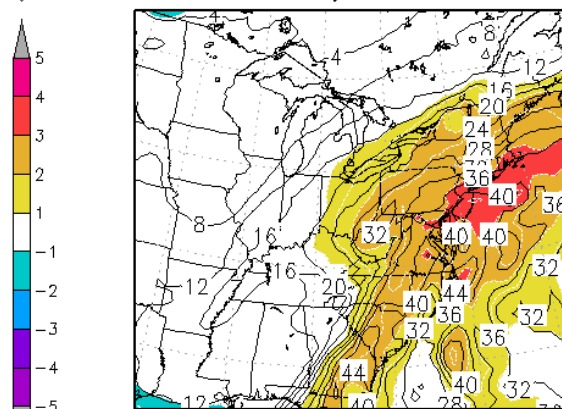
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eyewall



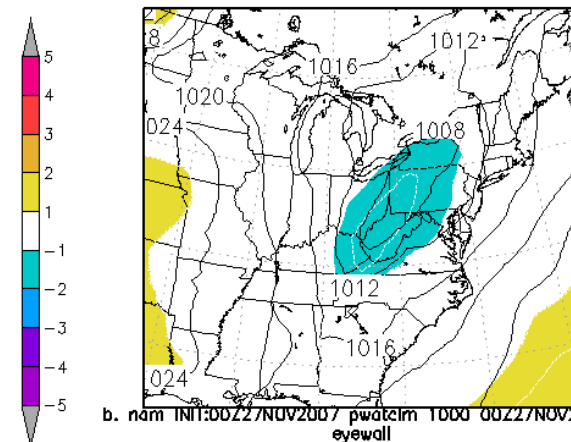
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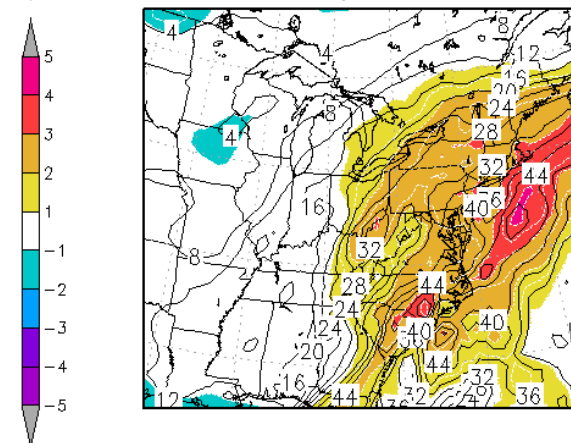
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eyewall



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b. nam INIT:00Z27/NOV2007 pwatcirm 1000 00Z27/NOV2007
eyewall



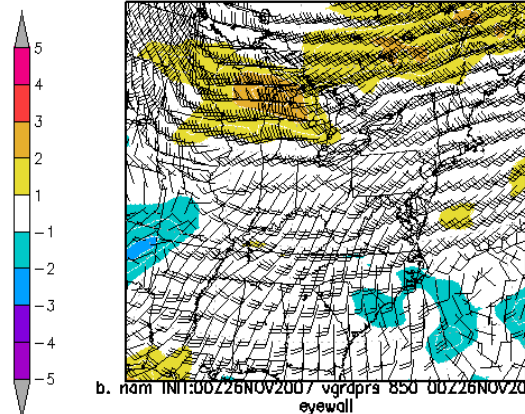
00z 11/26
Initial

00z 11/26 24 hr fcst
(valid for 00z 11/27)

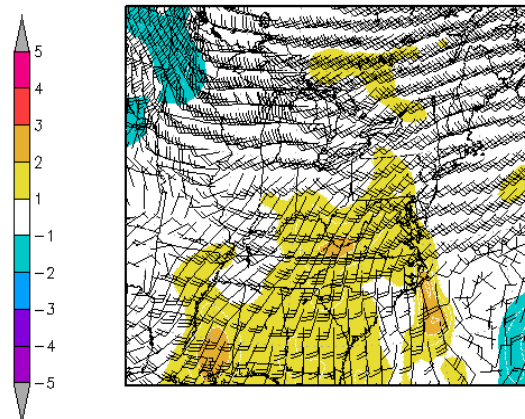
00z 11/27
Initial

Cold Season Heavy Precipitation Event Surface Cold Front

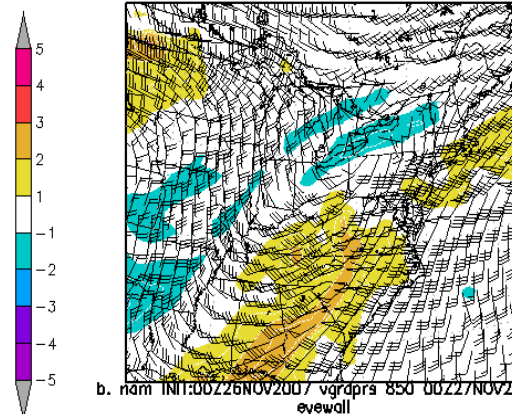
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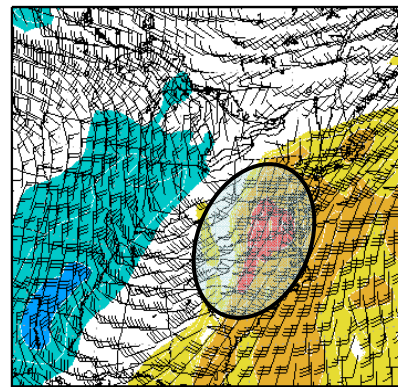
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eyewall



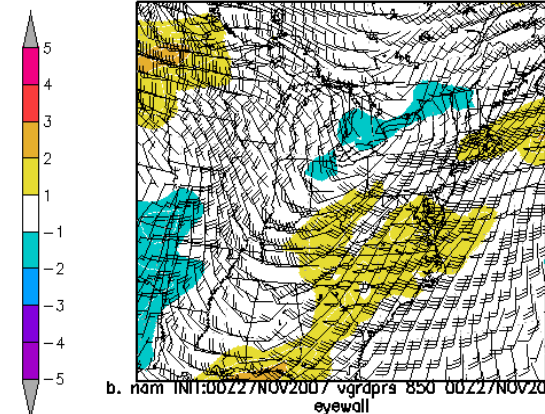
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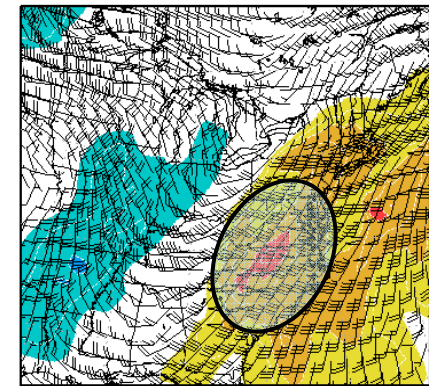
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eyewall



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eyewall



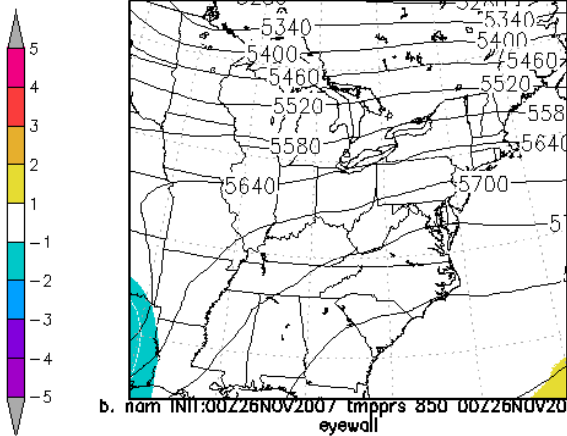
00z 11/26
Initial

00z 11/26 24 hr fcst
(valid for 00z 11/27)

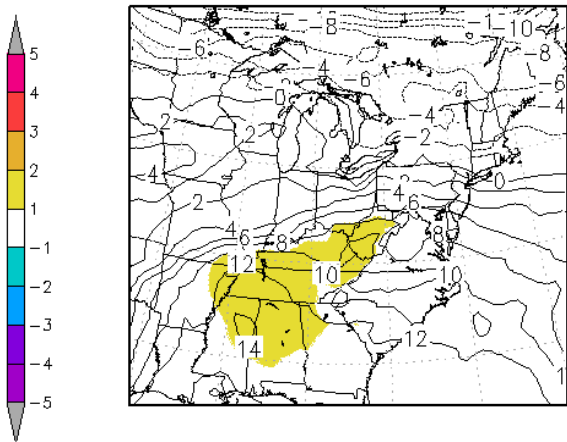
00z 11/27
Initial

Cold Season Heavy Precipitation Event Surface Cold Front

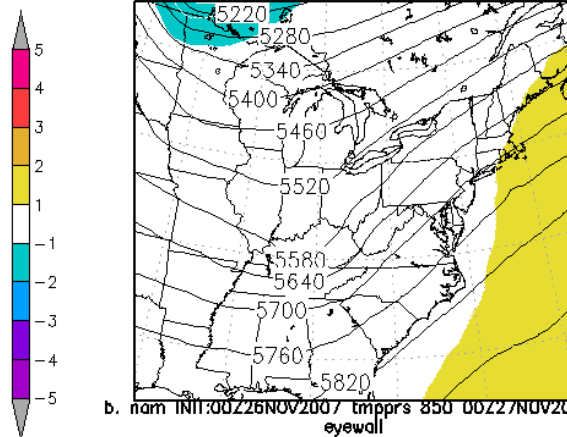
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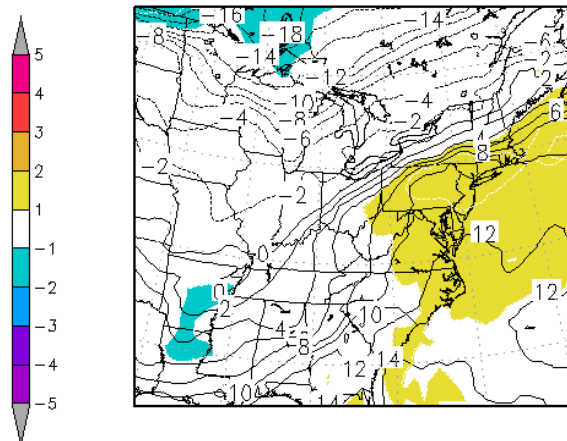
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eyewall



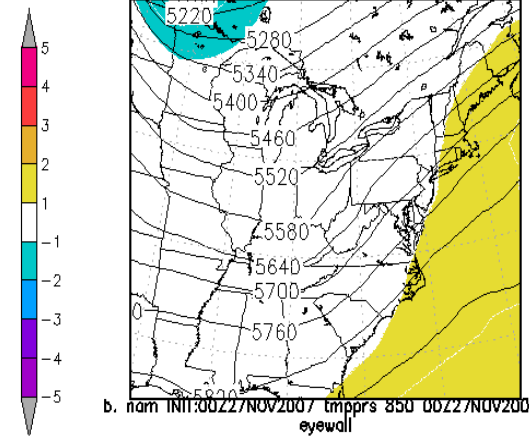
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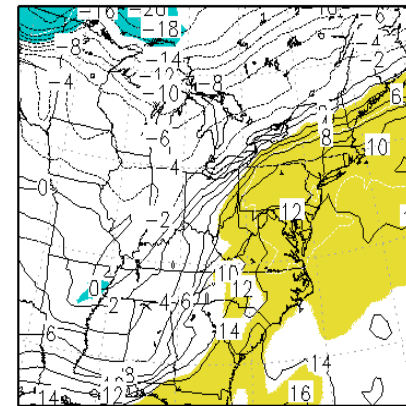
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b. nam INIT:00Z27NOV2007 tmpprrs 850 00Z27NOV2007
eyewall



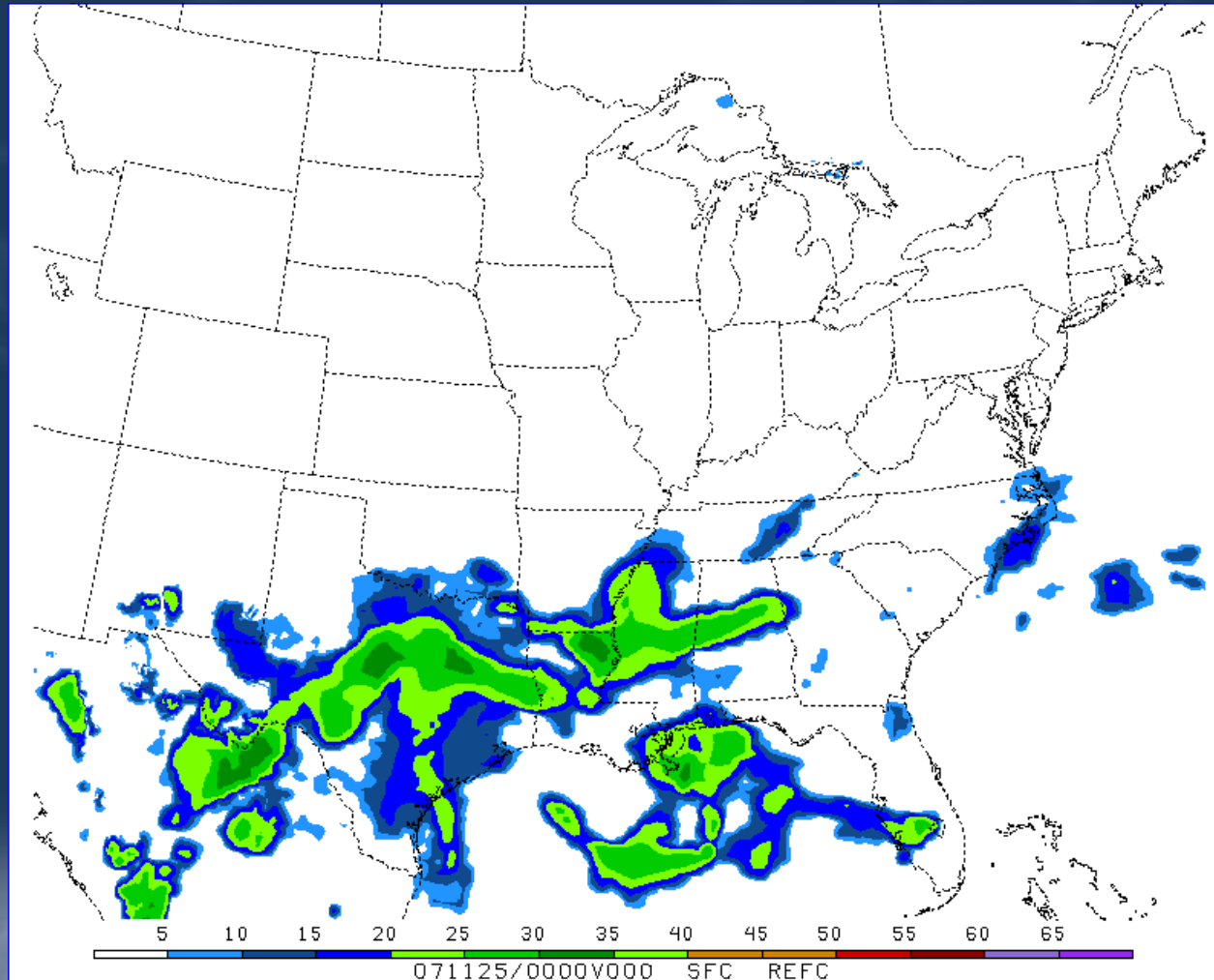
00z 11/26
Initial

00z 11/26 24 hr fcst
(valid for 00z 11/27)

00z 11/27
Initial

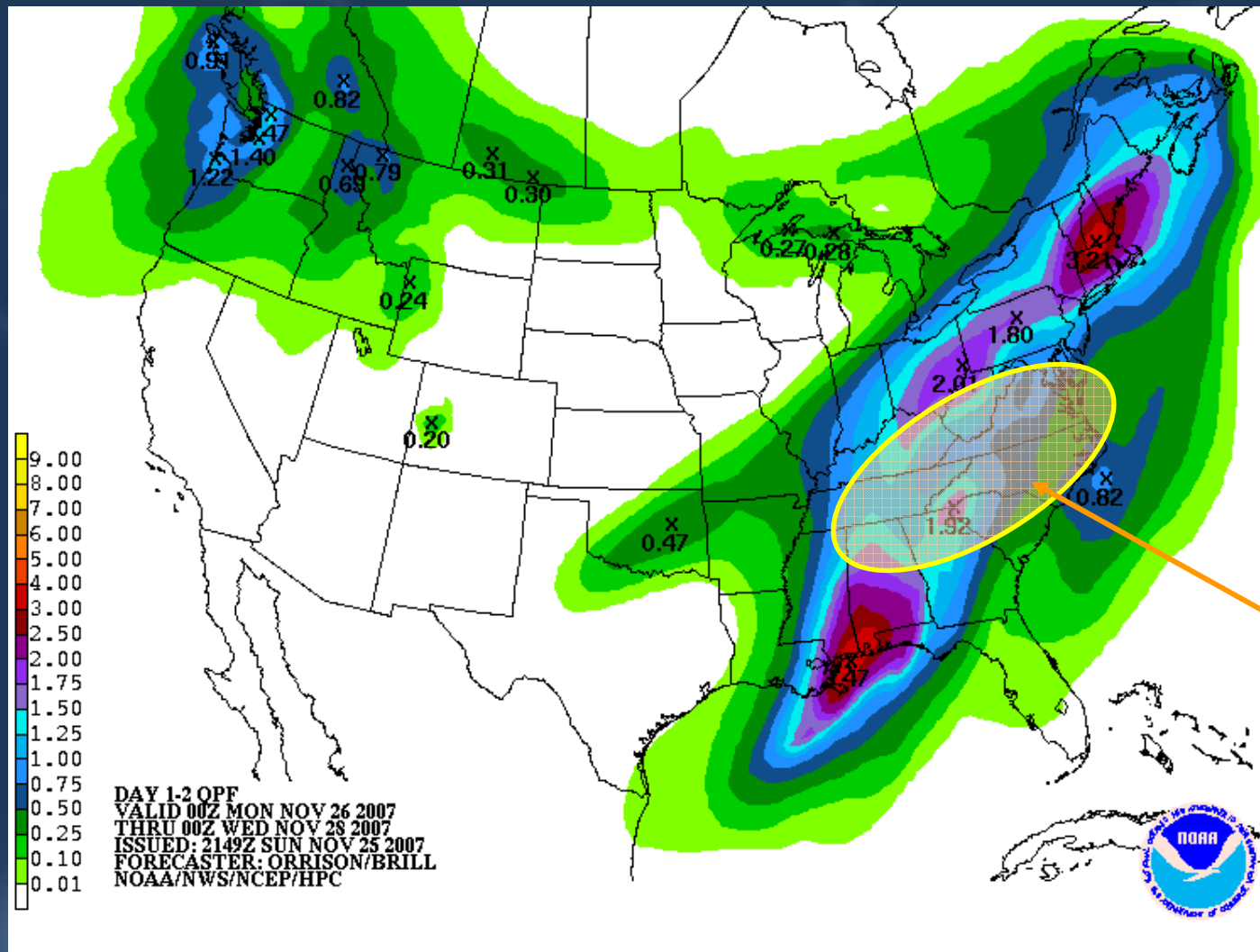
Cold Season Heavy Precipitation Event

Simulated WRF Radar



36 hr fcst
00z 11/25 – 12z 11/26

Cold Season Heavy Precipitation Event

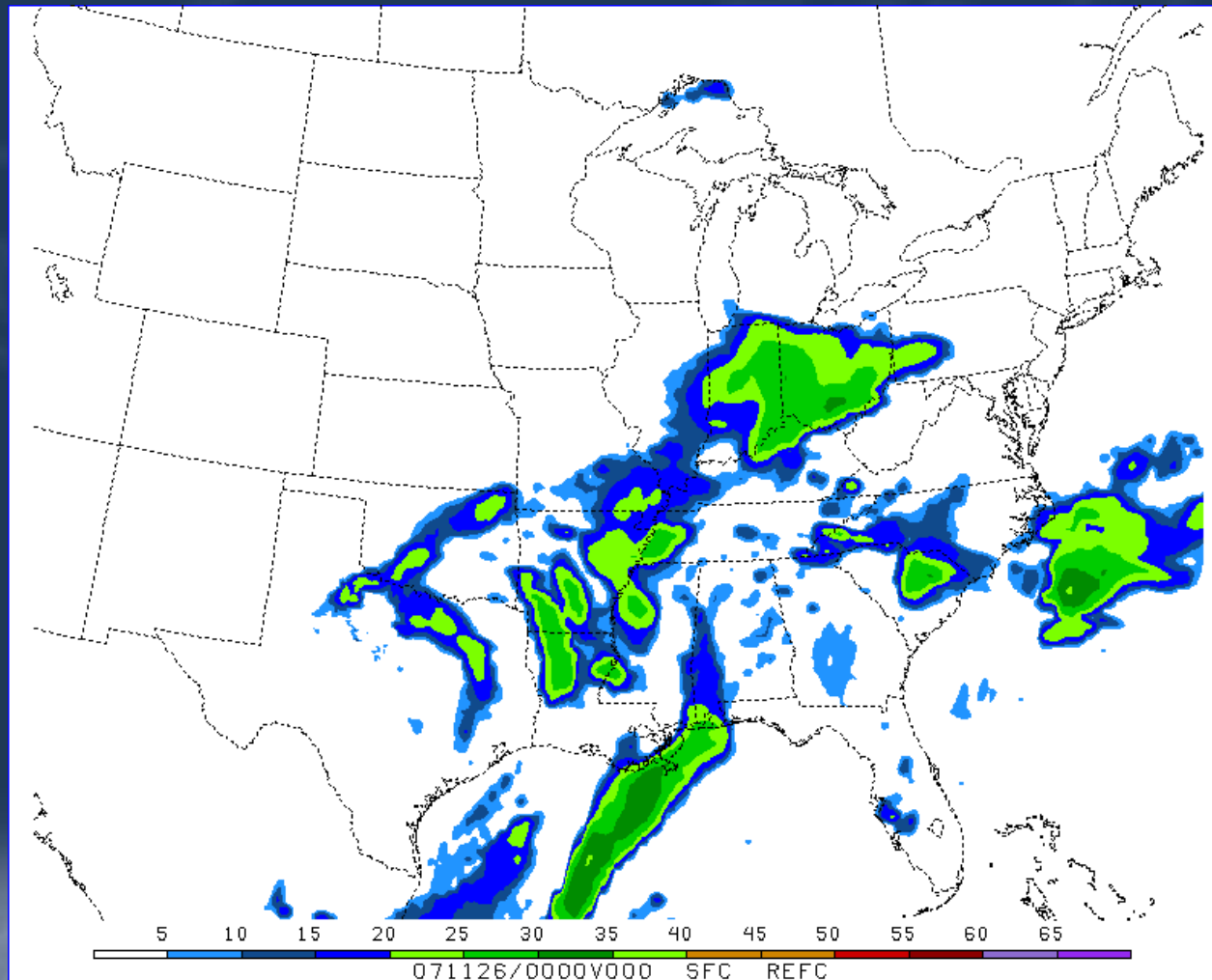


Split in
highest
QPF

HPC Day 1-2 QPF fcst
00z 11/26 – 00z 11/28
(issued 2149z 11/25)

Cold Season Heavy Precipitation Event

Simulated WRF Radar

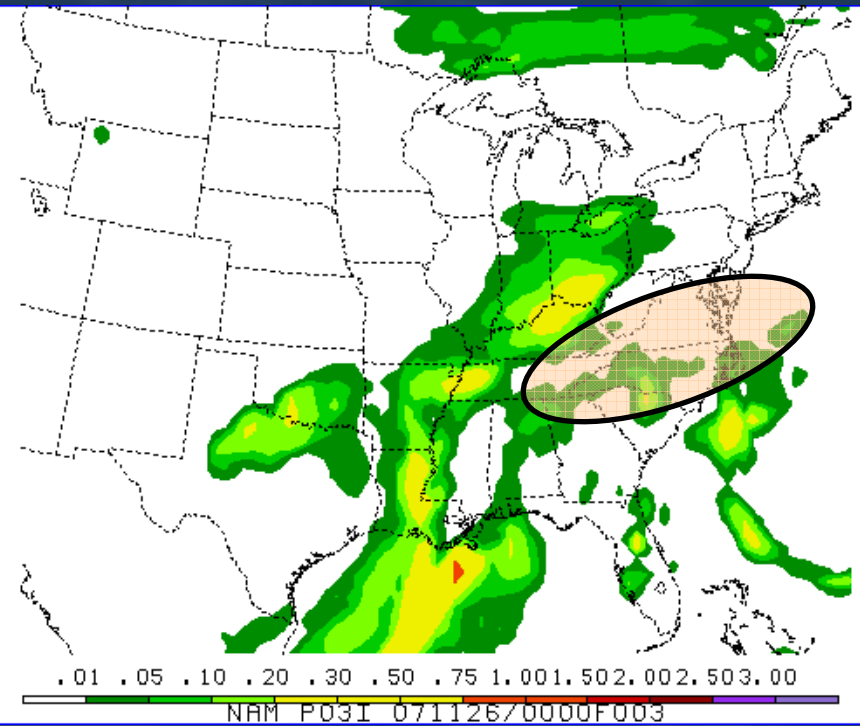
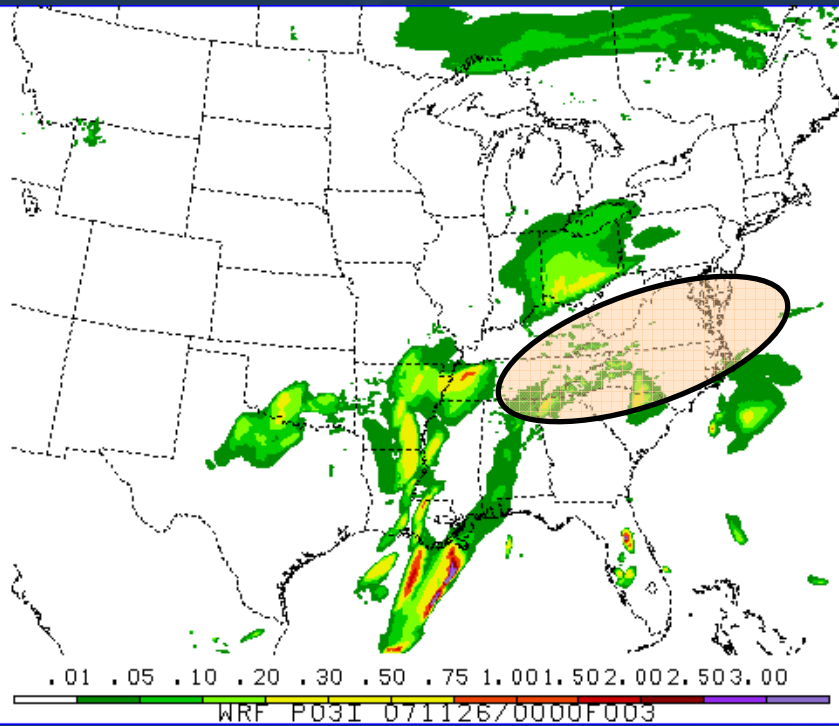


36 hr fcst
00z 11/26 – 12z 11/27

Cold Season Heavy Precipitation Event

Simulated QPF forecasts

WRF vs NAM



WRF

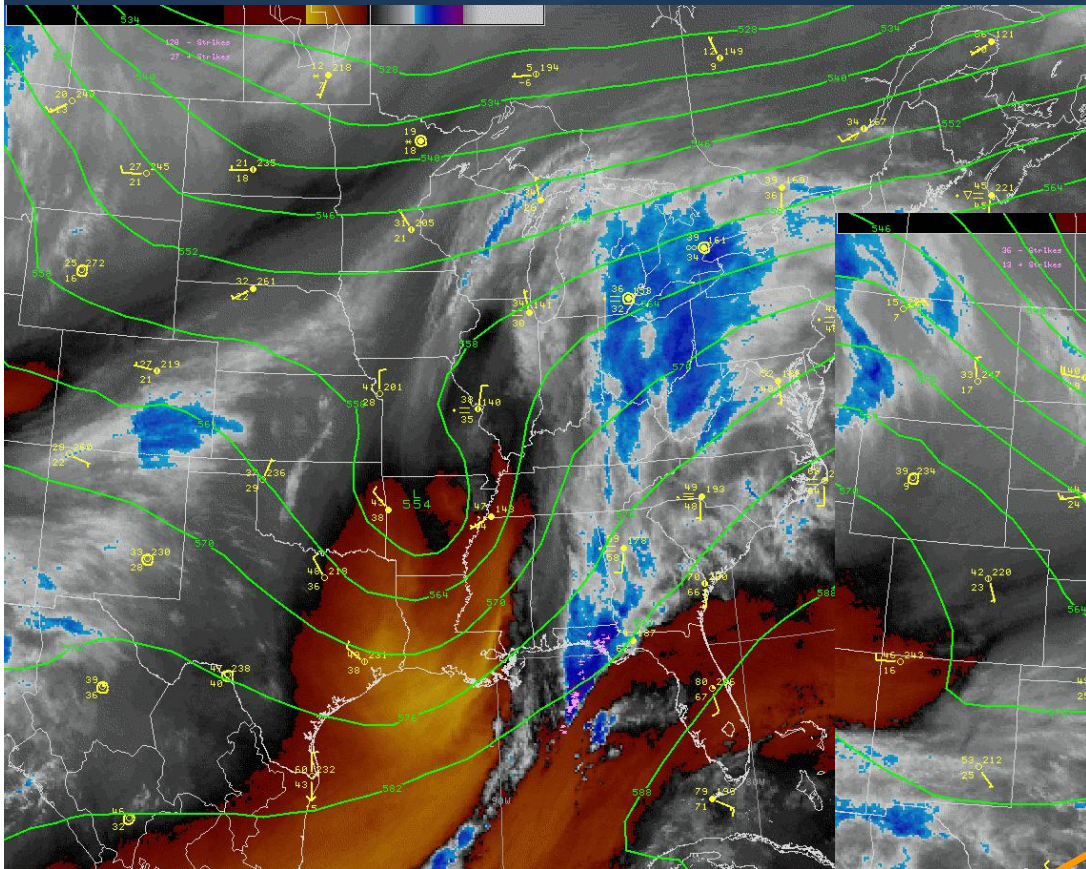
NAM

36 hr fcst

00z 11/26 – 12z 11/27

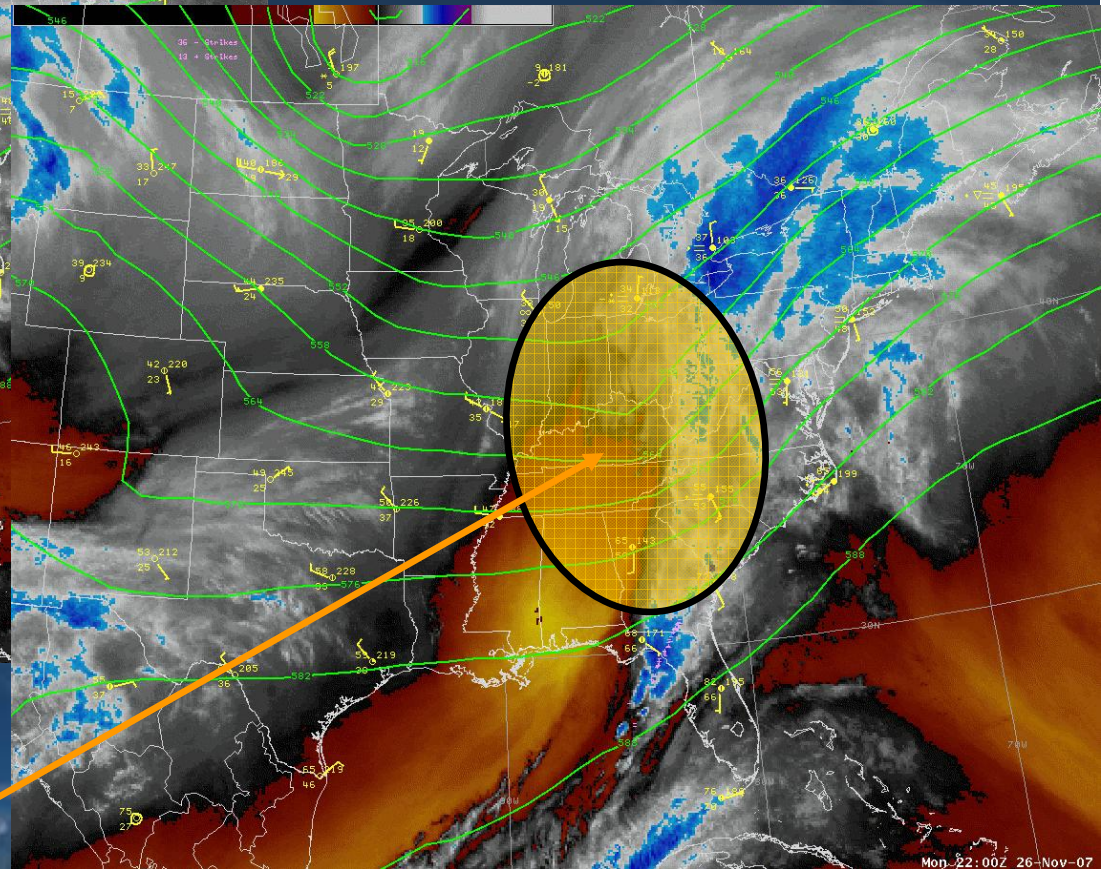
** note that both the WRF and NAM decrease convection near the eastern Gulf States, followed by a period of increasing QPF moving across VA and NC

Cold Season Heavy Precipitation Event IR Satellite



16Z Nov 26 2007
IR imagery

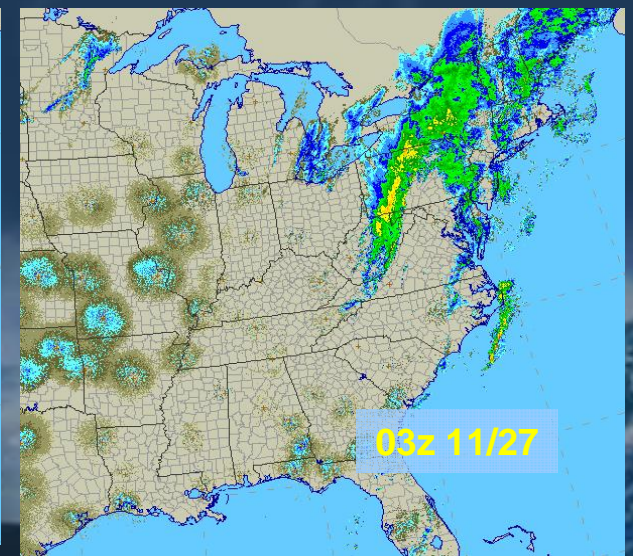
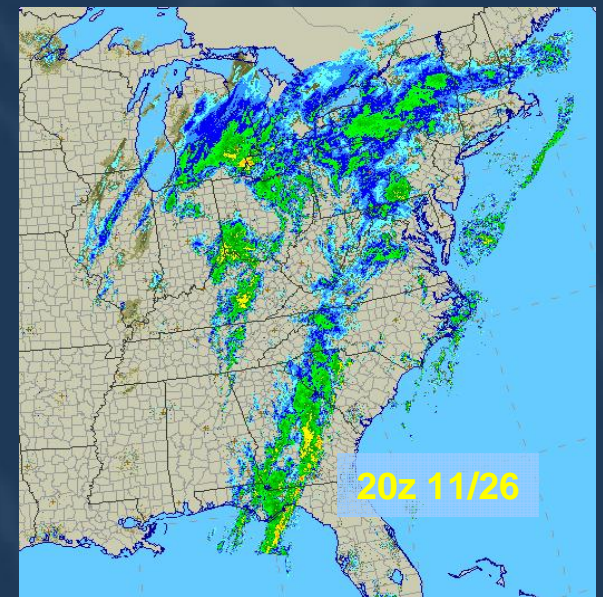
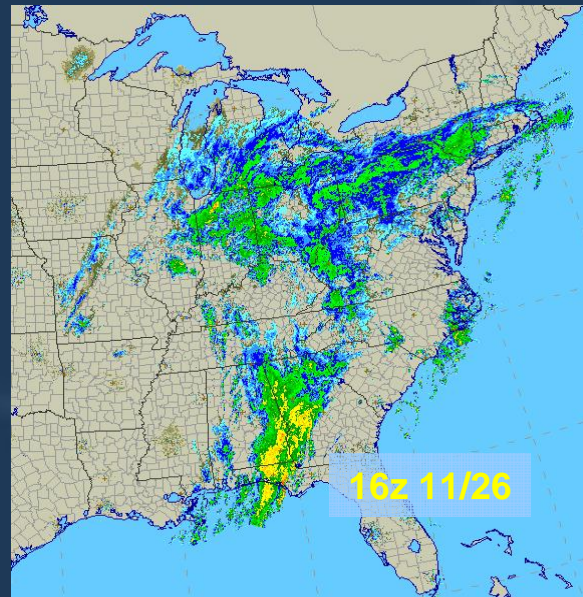
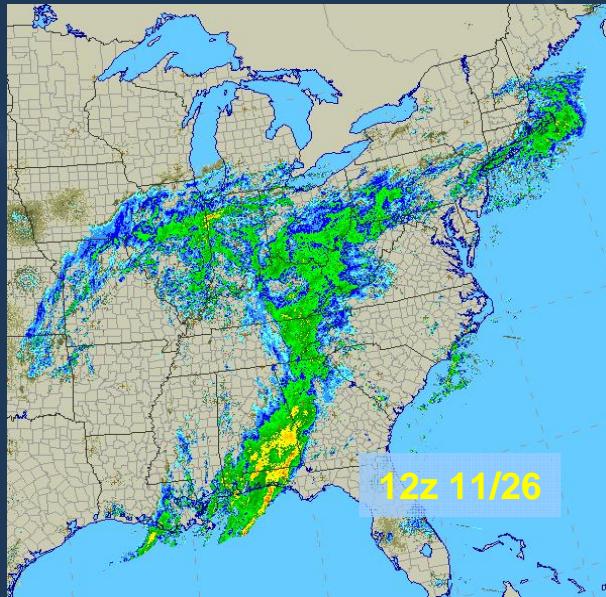
**** note shortwave "lifting"
northeast into central Appalachians**



22Z Nov 26 2007
IR imagery

Mon_22:00Z_26-Nov-07

Cold Season Heavy Precipitation Event Radar

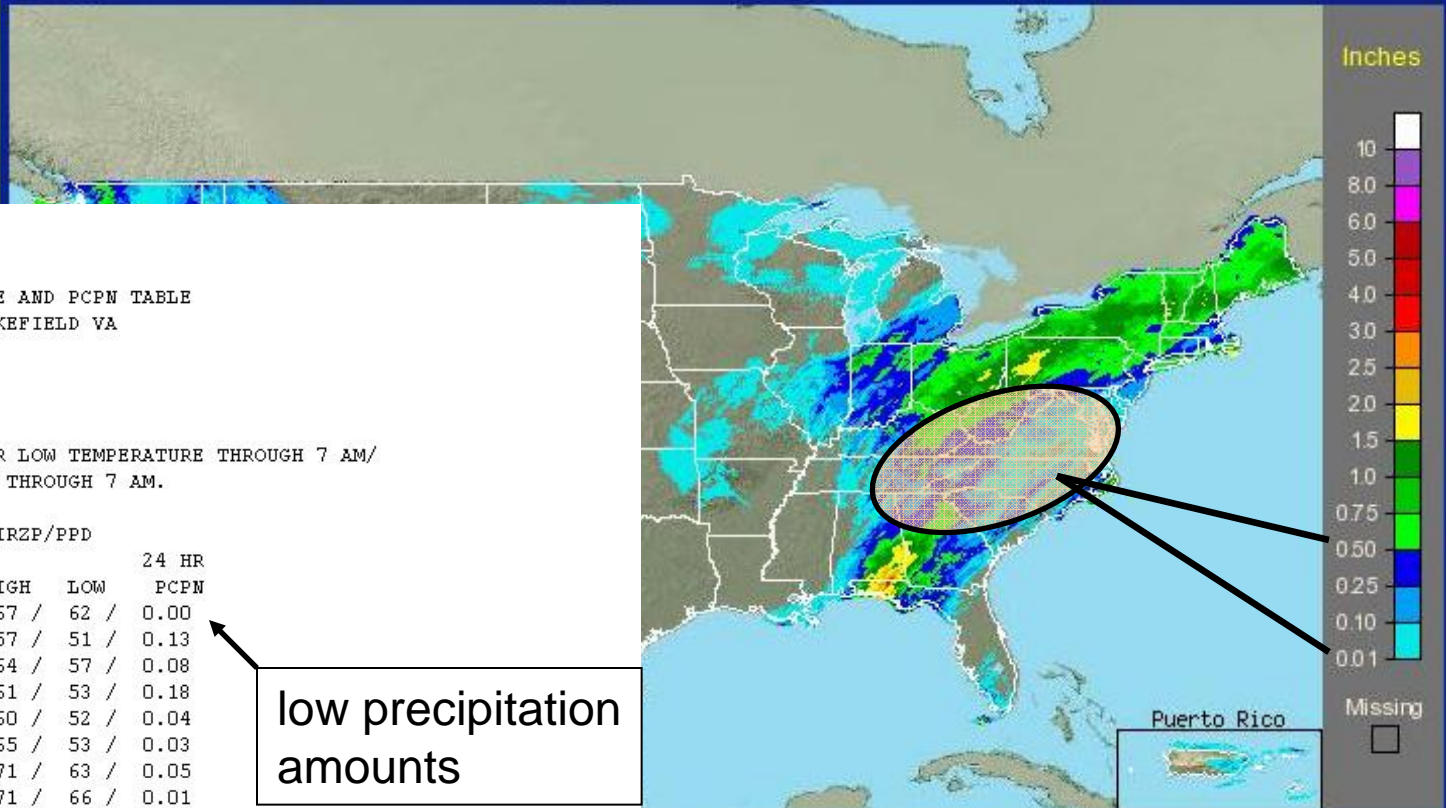


Cold Season Heavy Precipitation Event

What Happened...

Continental United States
1-Day Observed Precipitation - Valid 11/27/2007 1200 UTC

Click on the image to zoom in.
Click on "States" to zoom out



```
000
ASUS61 KAKQ 271224
RTPAKQ
REGIONAL MAX/MIN TEMPERATURE AND PCPN TABLE
NATIONAL WEATHER SERVICE WAKEFIELD VA
724 AM EST TUE NOV 27 2007

...FULL TIME STATIONS...

HIGH TEMP YESTERDAY/ 12 HOUR LOW TEMPERATURE THROUGH 7 AM/
PRECIPITATION PAST 24 HOURS THROUGH 7 AM.
```

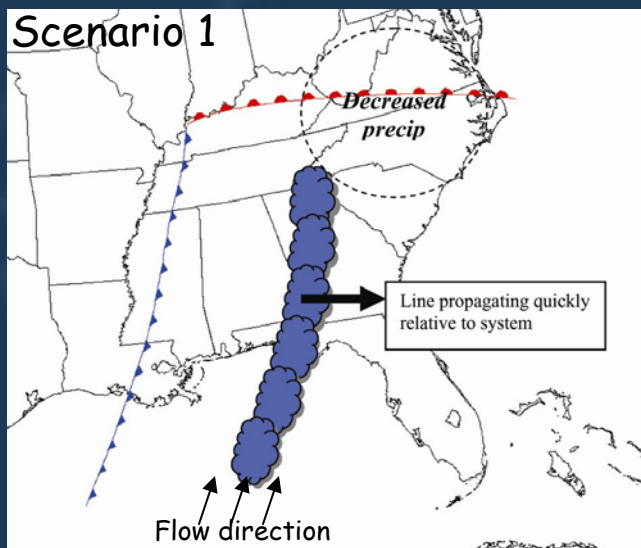
```
.B AKQ 1127 DH07/TX/DH12/TAIRZP/PPD
:
:ID   STATION      HIGH  LOW   24 HR
:    :              :      :      : PCPN
RIC  : RICHMOND     67 / 62 / 0.00
LYH  : LYNCHBURG   57 / 51 / 0.13
DCA  : WASHINGTON DC 64 / 57 / 0.08
IAD  : DULLES AIRPORT 61 / 53 / 0.18
ROA  : ROANOKE     60 / 52 / 0.04
DAN  : DANVILLE   65 / 53 / 0.03
PHF  : NEWPORT NEWS 71 / 63 / 0.05
ORF  : NORFOLK     71 / 66 / 0.01
WAL  : WALLEPS ISLAND 62 / 60 / 0.01
SBY  : SALISBURY   68 / 59 / 0.00
AKQ  : WAKEFIELD   67 / 62 / 0.04
.END
```

low precipitation amounts

24 hr total precipitation
12z 11/26-12z 11/27

to our precipitation????

Upstream Convection Scenarios

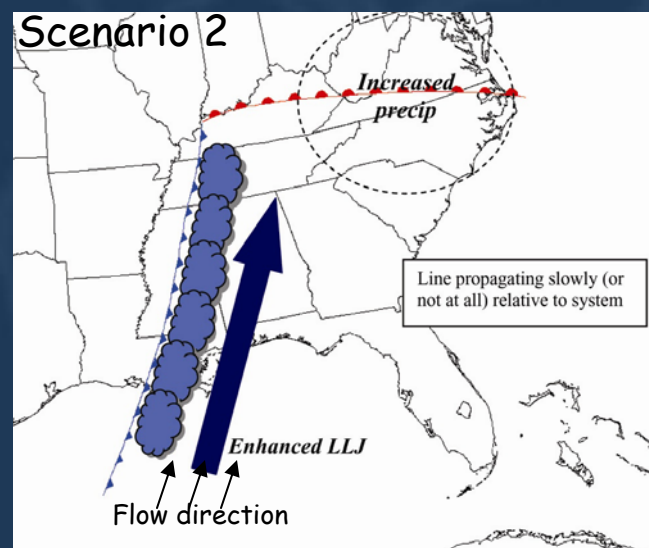


Scenario 1 (S1)

UC oriented parallel to flow.
Propagates quickly relative to main synoptic system, perpendicular to flow.

QPF bias:

S1: Decreased downstream precipitation



Scenario 2 (S2)

UC oriented parallel to flow.
Propagating slowly, or not at all, relative to main synoptic system

QPF bias:

S2: Increased downstream precipitation

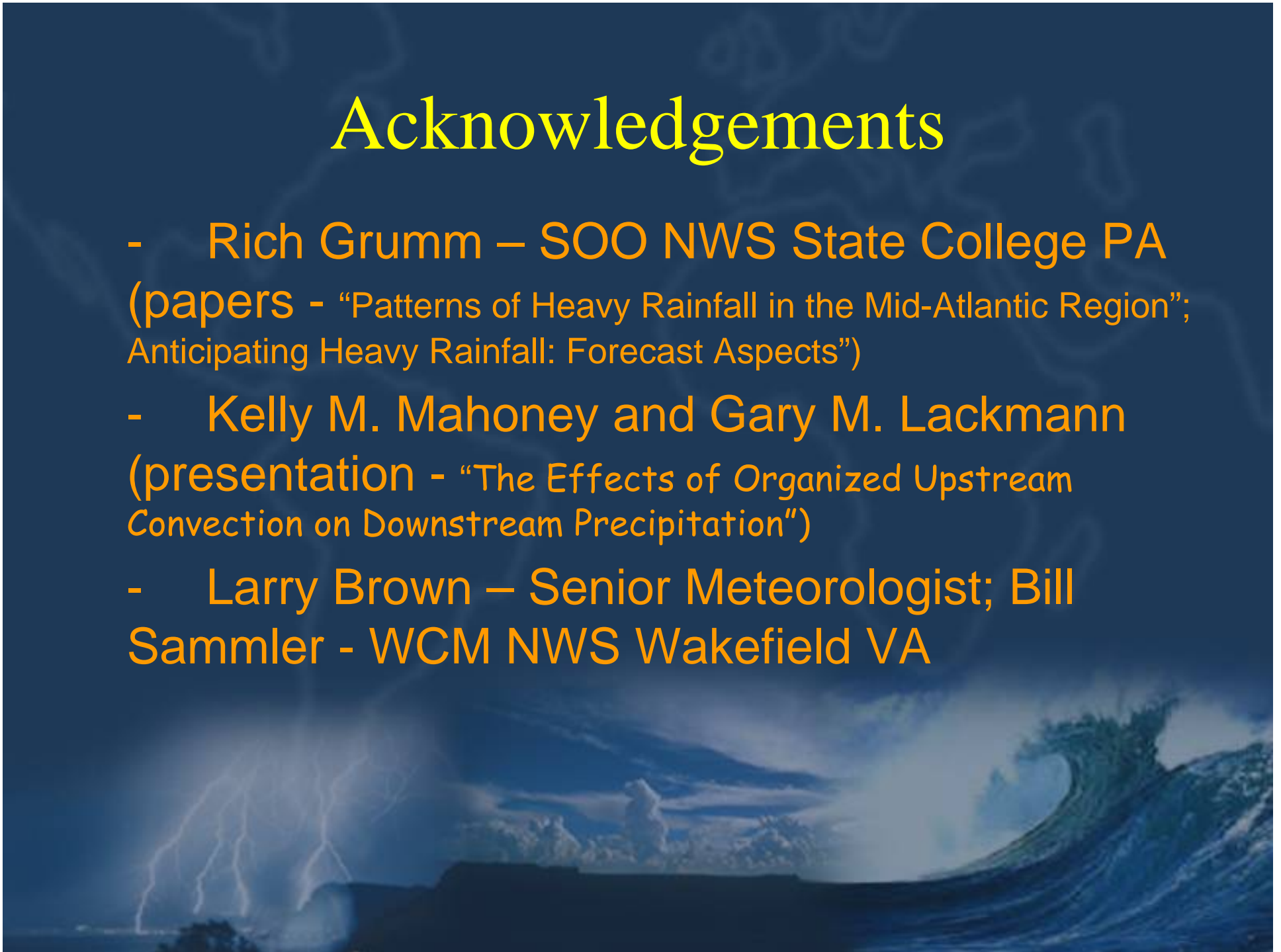
Web Sites

- WRF simulated radar
<http://www.emc.ncep.noaa.gov/mmb/mmbpll/cent4km/v2/menu.html>
- PSU Collaborative Research and Weather Data - ensembles
<http://nws.met.psu.edu/models/index.htm>
- Historical daily weather maps
http://docs.lib.noaa.gov/rescue/dwm/data_rescue_daily_weather_maps.html
- GrADS (Grid Analysis and Display System)
<http://grads.iges.org/grads/>
- NOAA Earth System Research Laboratory – Climate Analysis Branch
<http://www.cdc.noaa.gov/>



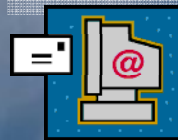
Acknowledgements

- Rich Grumm – SOO NWS State College PA
(papers - “Patterns of Heavy Rainfall in the Mid-Atlantic Region”;
Anticipating Heavy Rainfall: Forecast Aspects”)
- Kelly M. Mahoney and Gary M. Lackmann
(presentation - “The Effects of Organized Upstream
Convection on Downstream Precipitation”)
- Larry Brown – Senior Meteorologist; Bill
Sammler - WCM NWS Wakefield VA



The End!!

Are There Any
Additional
Questions?



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