

When Models Go Wrong: The December 20-21, 2010 Cape Cod Snowstorm



Joe DelliCarpini

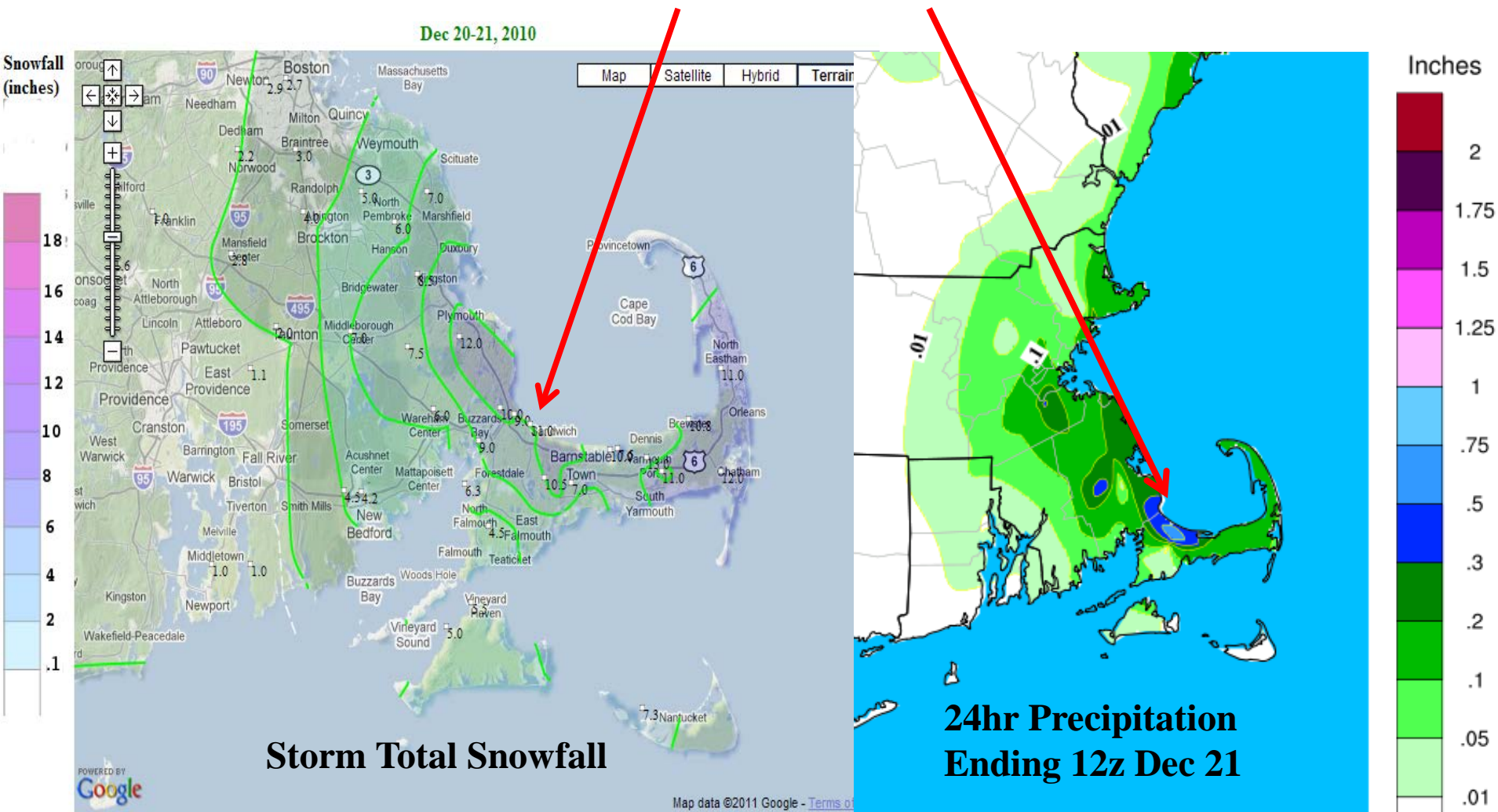
Frank Nocera

NOAA/NWS Taunton, MA

Cape Cod Times Photo

What Happened

10-13 inches of snow
Up to 0.75" liquid



3:27 am Forecast Discussion

NOT MUCH CHANGE FROM PREVIOUS FORECAST AS WE CONTINUE TO EXPECT MAINLY LIGHT SNOW TODAY ACROSS CAPE COD AND THE ISLANDS. POTENT S/WV EXITING MD/DE EARLY THIS MORNING WITH IMPRESSIVE COOLING CLOUD TOPS UPSTREAM JUST SOUTH OF NEW ENGLAND IN WARM CONVEYOR BELT. HOWEVER WITH THE MID LEVEL CIRCULATION CONTINUING TO DIG/TRACK NW TO SE AWAY FROM SOUTHERN NEW ENGLAND...HEAVY SNOW ASSOCIATED WITH WARM CONVEYOR BELT SHOULD REMAIN OFFSHORE. HOWEVER THE COMBINATION OF SOME BROAD SYNOPTIC SCALE LIFT AND DEEP LAYER MOISTURE CLIPPING SOUTHEAST MA ALONG WITH OCEAN EFFECT ENHANCEMENT WILL SUPPORT SNOW...MAINLY LIGHT FOR MUCH OF TODAY.

GOOD MODEL AGREEMENT ON QPF TODAY ACROSS THIS AREA WITH PRECIP AMOUNTS RANGING FROM A TENTH OR TWO OVER MUCH OF THIS REGION WITH TO 0.33 INCHES ACROSS THE OUTER CAPE AND NANTUCKET. HOWEVER WITH TEMPERATURES RUNNING AT OR SLIGHTLY ABOVE FREEZING ACROSS THIS AREA IT WILL BE DIFFICULT FOR SNOW TO ACCUMULATE ON ROADWAYS ESPECIALLY PRIMARY ROADS. CURRENT OBSERVATIONS AND WEB CAMS ABOVE FREEZING TEMPERATURES AND MAINLY WET ROADWAYS. NEVERTHELESS MOTORISTS SHOULD EXERCISE CAUTION THIS MORNING ESPECIALLY ON SECONDARY ROADS/EXIT AND ENTRANCE RAMPS.

IN ADDITION SNOW INTENSITY SHOULD MAINLY BE LIGHT AND NOT SUFFICIENT TO OVERCOME ABOVE FREEZING SFC TEMPS. AS A RESULT SNOW ACCUMULATIONS WILL BE CONFINED TO THE COLDER SURFACES WHERE 1-3 INCHES ARE POSSIBLE. THE HIGHEST AMOUNTS WILL LIKELY BE ACROSS THE UPPER CAPE INTO SOUTHERN PLYMOUTH WHERE TEMPS WILL BE SLIGHTLY COLDER. SECONDARY ROADS WILL LIKELY HAVE A MINOR SLUSHY ACCUMULATION. WE WILL CONTINUE THE SPECIAL WEATHER STATEMENT TO INCREASE PUBLIC AWARENESS FOR SLIPPERY TRAVEL THIS MORNING.

10:49 am Forecast Discussion

AREAS OF SNOW CONTINUE TO BACK IN ACROSS SE COASTAL NEW ENGLAND THIS MORNING AND RADAR SHOWS HEAVIER PRECIP LURKING JUST OFFSHORE WITH COOLING CLOUD TOPS. GFS QPF APPEARS A BIT TOO HEAVY OTHERWISE MODELS ARE IN PRETTY GOOD AGREEMENT WITH ADDITIONAL QPF THROUGH THIS EVENING OF 0.1 TO 0.3" ACROSS SE COASTAL NEW ENG...WITH HIGHER AMOUNTS OVER OUTER CAPE/ACK.

WHERE QPF IS HEAVIEST...BL TEMPS WILL BE AN ISSUE OVER THE OUTER CAPE AND ACK WHERE TEMPS SLIGHTLY ABOVE FREEZING WILL LIMIT ACCUMULATIONS. HOWEVER...TEMPS WILL REMAIN AT OR BELOW FREEZING NEAR THE CANAL AND POINTS WEST. SO FAR...ACCUM RANGE FROM 1-3" FROM S/E PYM COUNTY AND UPPER CAPE. ADDITIONAL ACCUM 1-3" POSSIBLE THROUGH THIS EVENING SO WE ISSUED A WINTER WX ADVSY FOR 2-5"...HIGHEST AMOUNTS NEAR THE CANAL. MOST OF THE ACCUMULATIONS WILL BE CONFINED TO THE COLDER SURFACES.

3:11 pm Forecast Discussion

MODERATE TO HEAVY SNOW OVER THE CAPE IS NOW EXPANDING WEST ACROSS EASTERN MA AS WAA IS PROVIDING THE NECESSARY LIFT WITH DEEP MOISTURE IN PLACE. 12Z GFS DOING A PRETTY GOOD JOB ON THE QPF AND A RECENT LOOK AT THE ECMWF SHOWS SIMILAR RESULTS. RADAR SHOWS HEAVIER BANDS OF PRECIP CONTINUING TO DEVELOP OFFSHORE AND BACKING IN ACROSS SE COASTAL NEW ENG SO WE LIKELY HAVE SEVERAL HOURS OF SNOW TO GO.

GFS SHOWING AN ADDITIONAL 0.10-0.25" QPF THROUGH 06Z FOR THE CAPE/ISLANDS WHILE ECMWF IS HEAVIER WITH 0.25-0.50". NOT COMPLETELY SOLD ON THE ECMWF QPF SO WE WILL USE A BLEND OF THE GFS/ECMWF WHICH STILL SUGGESTS AN ADDITIONAL 2-4" OVER CAPE/ISLANDS.

UPGRADED TO A WARNING FOR THE CAPE FOR TOTAL ACCUM 4-8". CURRENTLY HAVE REPORTS OF 3-4" IN THIS AREA. EXPANDED THE ADVISORY WEST TO S BRISTOL AND W PYM COUNTIES. GENERALLY LOOKING FOR 2-4" ON THE WESTERN PERIPHERY OF THE ADVISORY AREA WITH 4-6" FOR THE ISLANDS AND SE MA CLOSEST TO THE CAPE COD CANAL. COULD SEE HEAVIER AMOUNTS FOR MVY BASED ON RADAR TRENDS BUT NOT CONFIDENT ENOUGH FOR A WARNING AT THIS TIME.

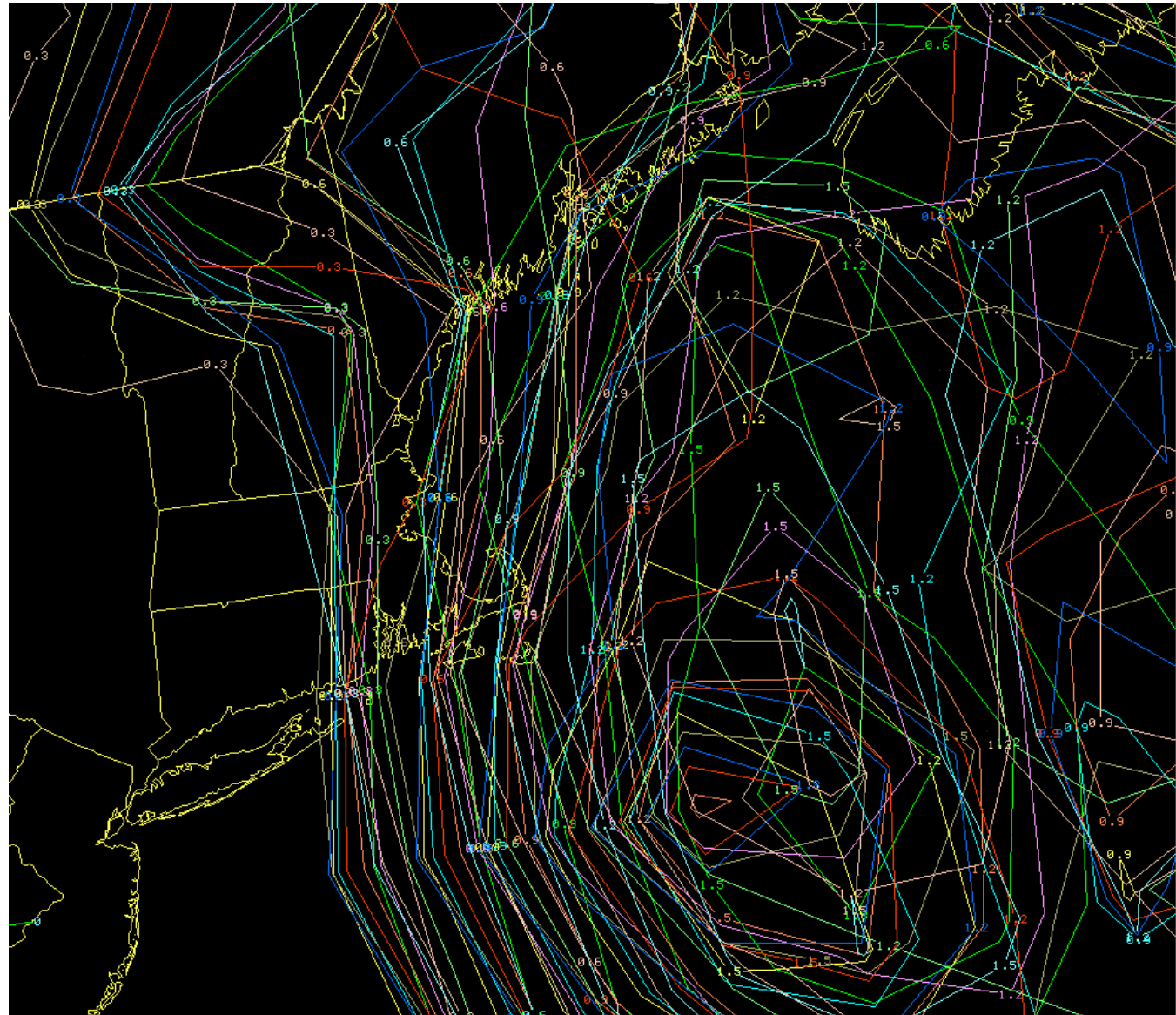
6:50 pm Forecast Discussion

BASED ON LATEST OBSERVATIONS...REPORTS AND RADAR TRENDS INCREASED SNOWFALL AMOUNTS ACROSS PORTIONS OF THE REGION. WE ARE NOW GOING FOR 5 TO 10 INCHES ON CAPE COD AS RADAR SHOWING 35 DBZ RETURNS WORKING INTO THE REGION. ITS NOT COMPLETELY OUT OF THE QUESTION THAT SOMEONE COMES IN WITH A FOOT OF SNOW...BUT DID NOT GO QUITE THAT HIGH AT THIS TIME. IN ADDITION...40 TO 45 MPH WIND GUSTS COMBINED WITH THE WET SNOW MAY RESULT IN A FEW DOWNED TREE LIMBS AND SCATTERED POWER OUTAGES. ACROSS NANTUCKET...WE UPGRADED TO A WINTER STORM WARNING FOR 4 TO 7 INCHES OF SNOW. EVEN IF THEY DO NOT GET THE EXACT WARNING SNOWFALL...WINDS ARE GUSTING CLOSE TO 50 MPH SO THIS IS A PRETTY SIGNIFICANT STORM. TRAVEL IS NOT RECOMMENDED ACROSS CAPE COD OR NANTUCKET TONIGHT WITH THE HEAVY SNOW AND STRONG WIND GUSTS.

GFS Ensemble 12 hr QPF: 12z Dec 20

Good agreement in keeping axis of heaviest precipitation offshore

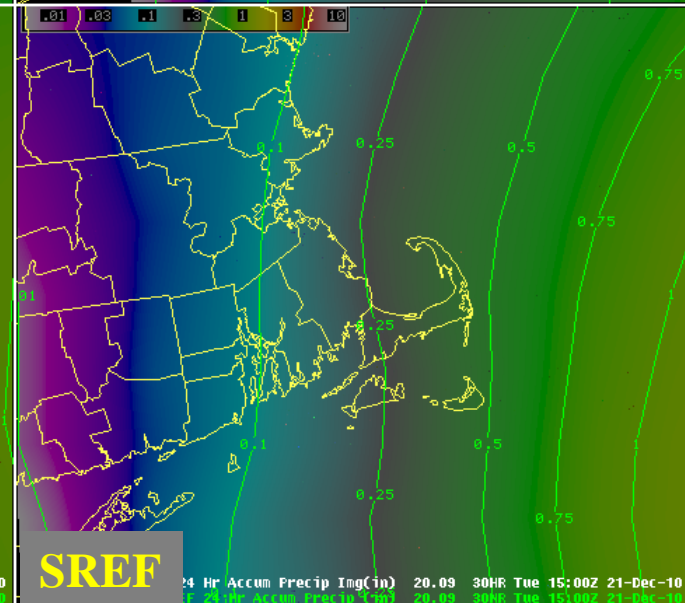
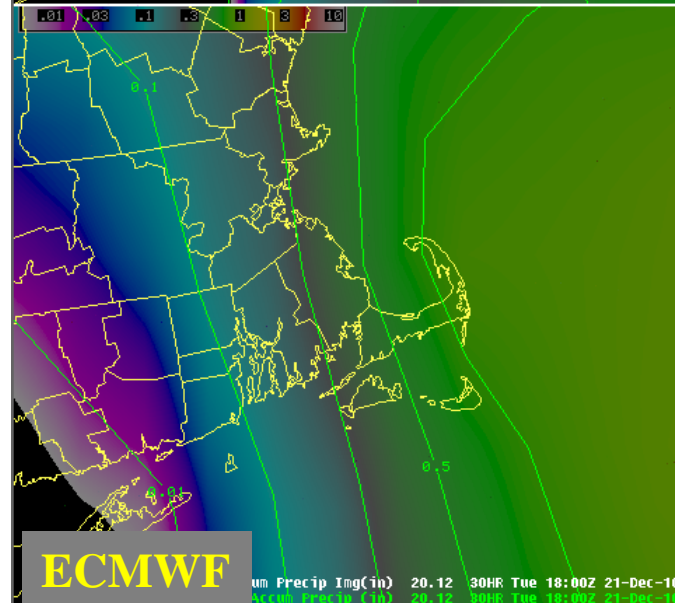
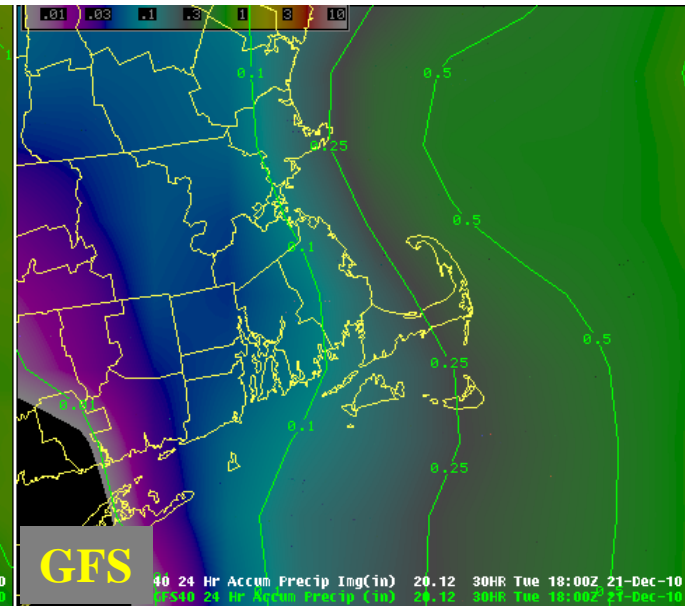
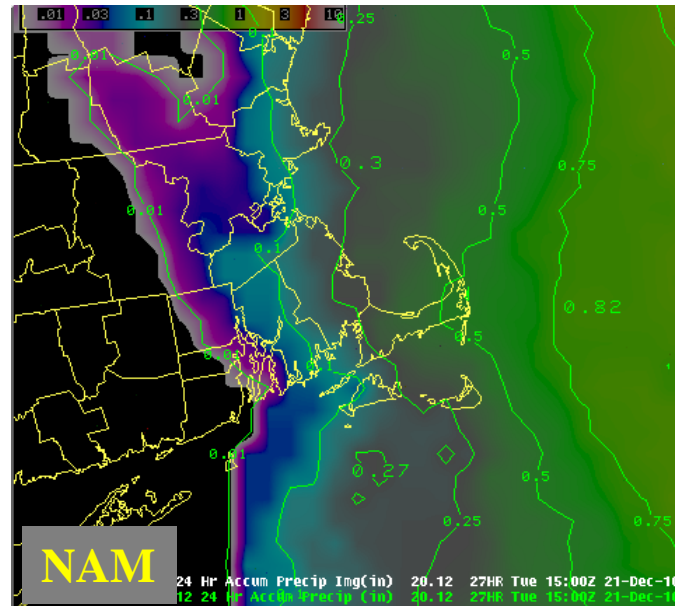
Most members show 0.60" to 0.90" on Cape Cod



Model 24 Hour QPF: Ending 18z Dec 21

Consensus is
0.25 to 0.50”
with higher
amounts
offshore

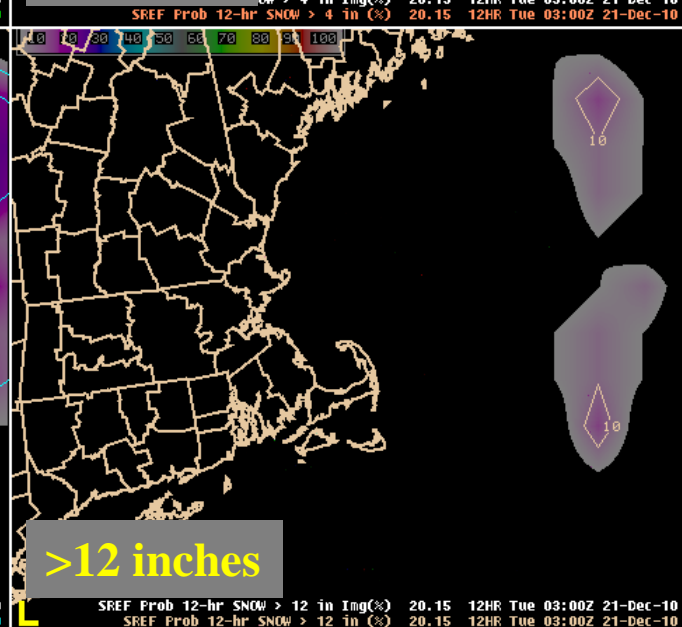
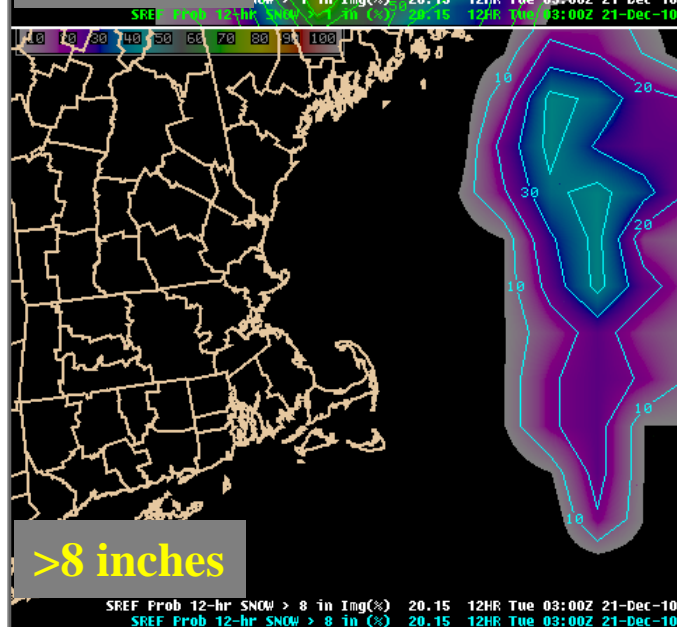
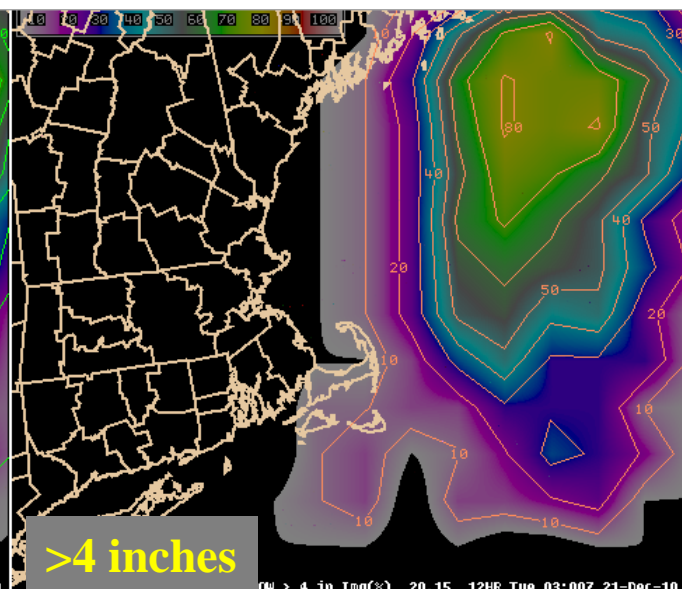
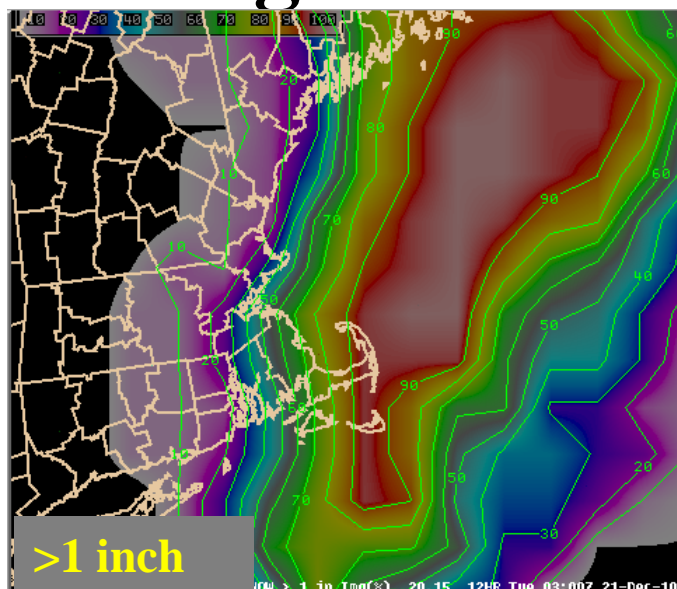
ECMWF
forecast as
much as 0.75”
on the outer
Cape



SREF Snowfall Probabilities: Ending 03z Dec 21

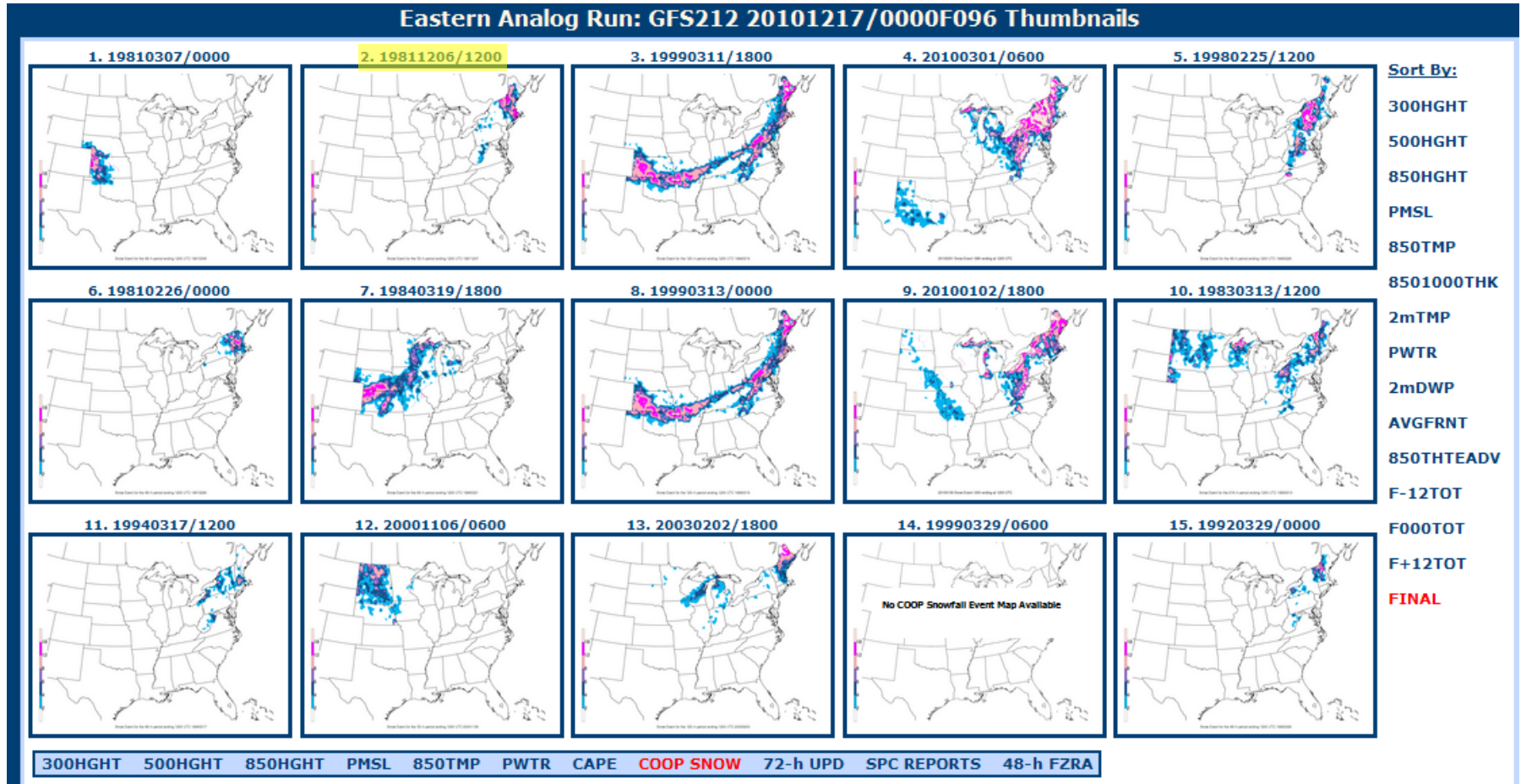
Highest 12hr
probabilities
for >1 and
>4 inches

Greatest
totals
focused
offshore



96hr CIPS Snowfall Analogs

<http://www.eas.slu.edu/CIPS/ANALOG/analog.php>

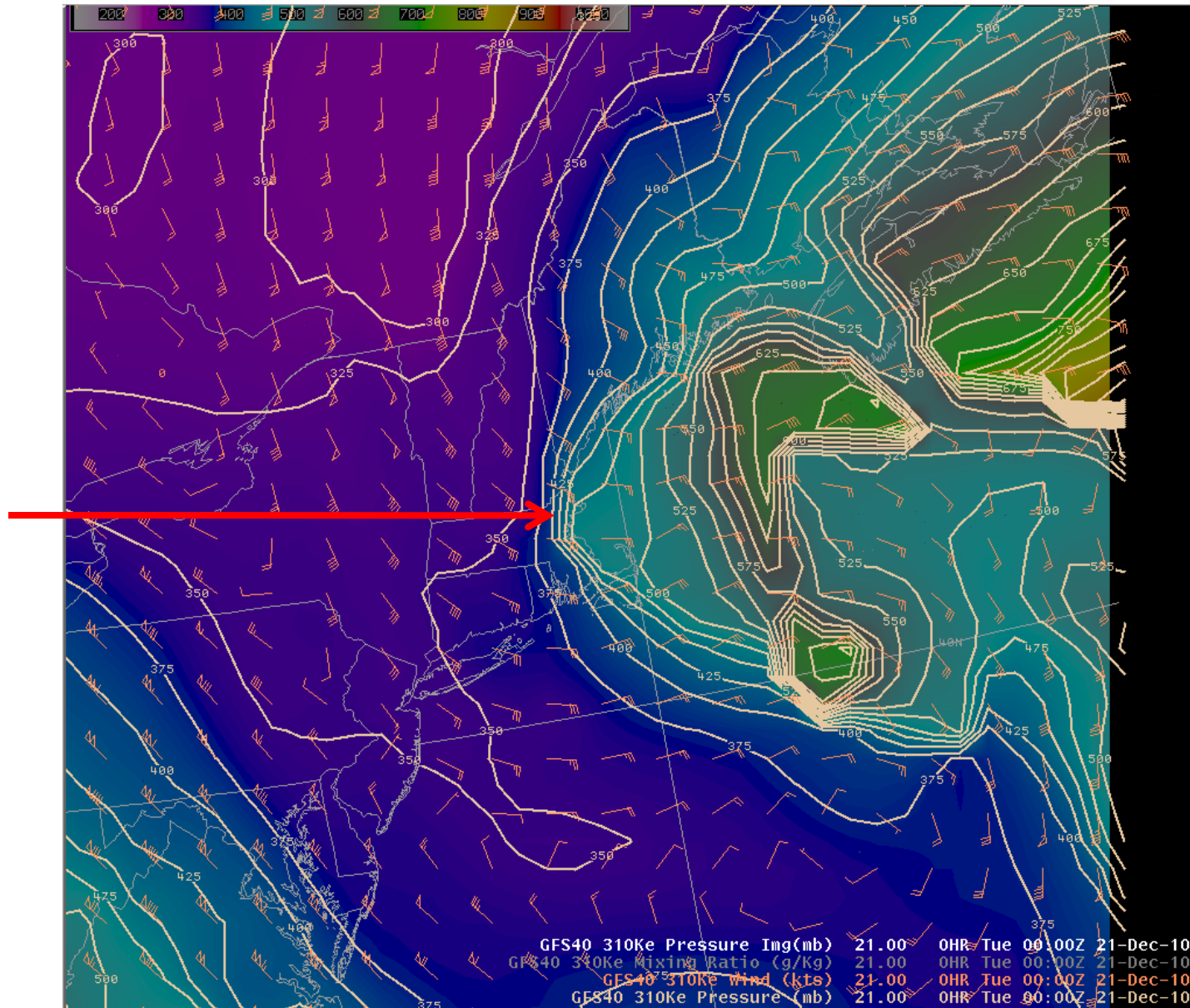


December 6, 1981 – Over a foot of snow in southeast Massachusetts

310Ke Isentropic Surface

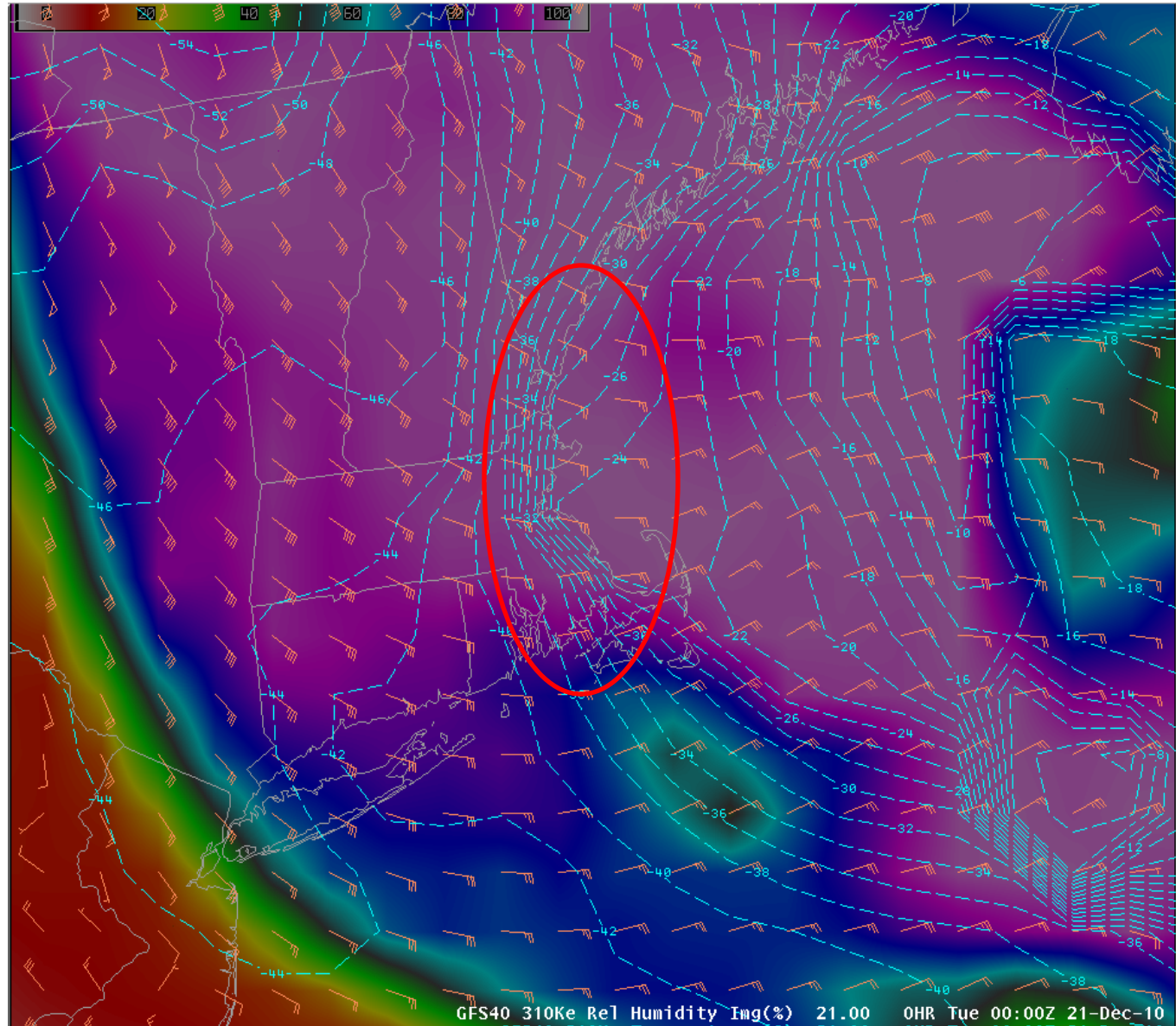
Strong lift east of
New England at
00z Dec 21

Tight gradient
along E MA coast
implies presence
of upper level
boundary



310Ke Isentropic Surface

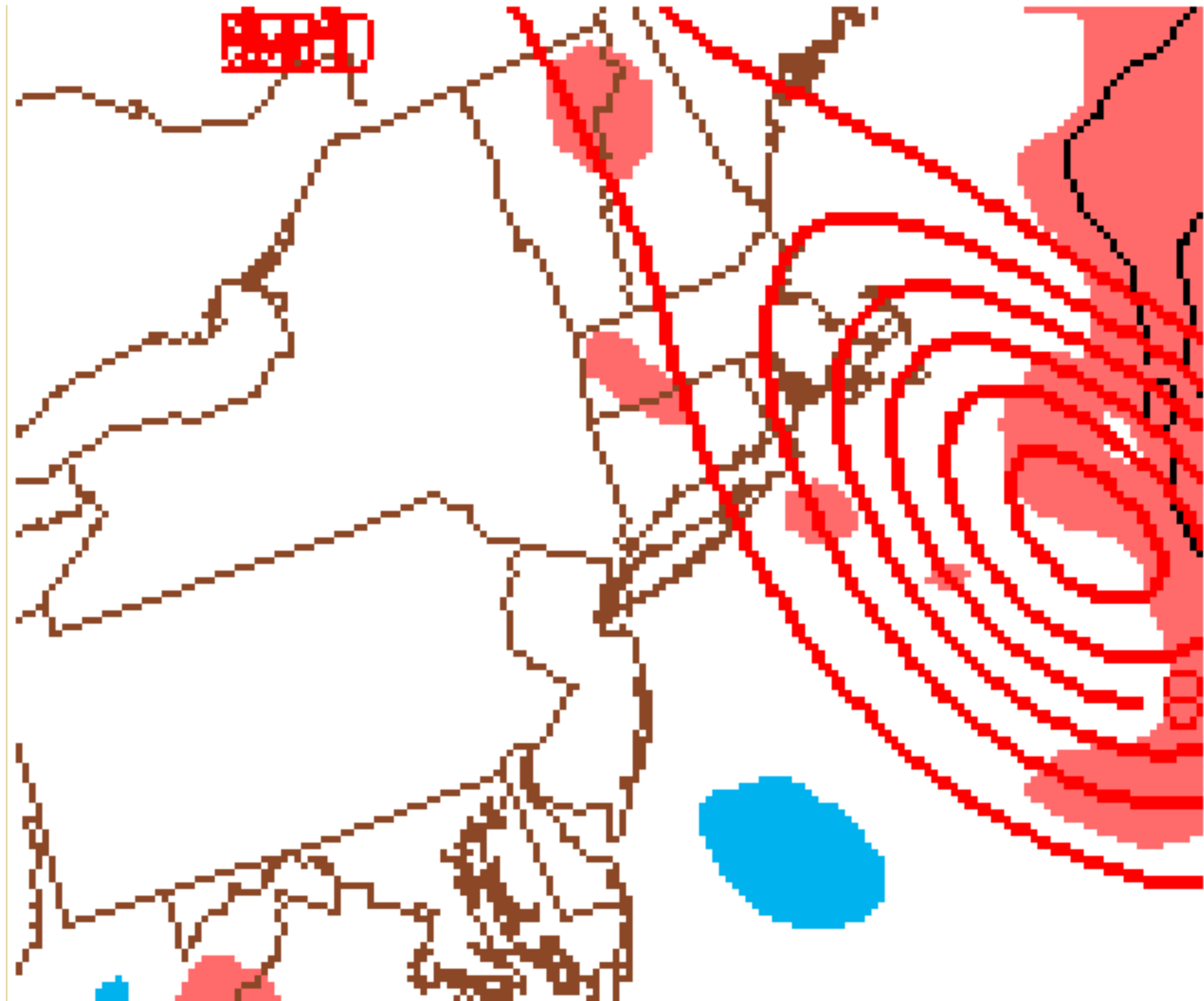
Strong thermal gradient shows location of mid level warm front (TROWAL)



700 mb Frontogenesis: 23z Dec 20

Axis of frontogenesis along coast – farther west than models indicated

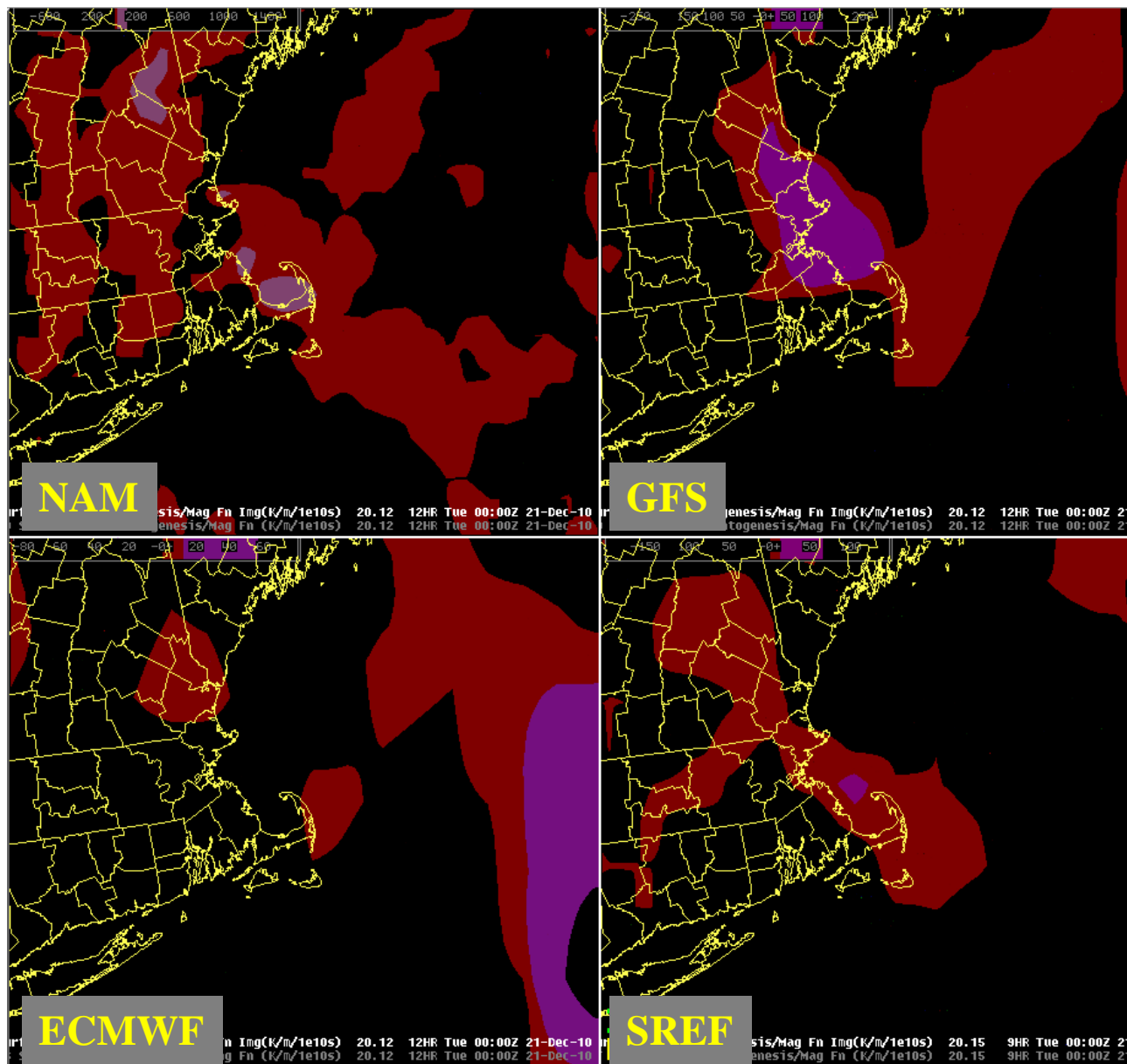
-EPV located offshore (shading)



Pettersen 2-D Frontogenesis

Weak surface
frontogenesis
over eastern MA
at 00z Dec 21

ECMWF is
focused offshore

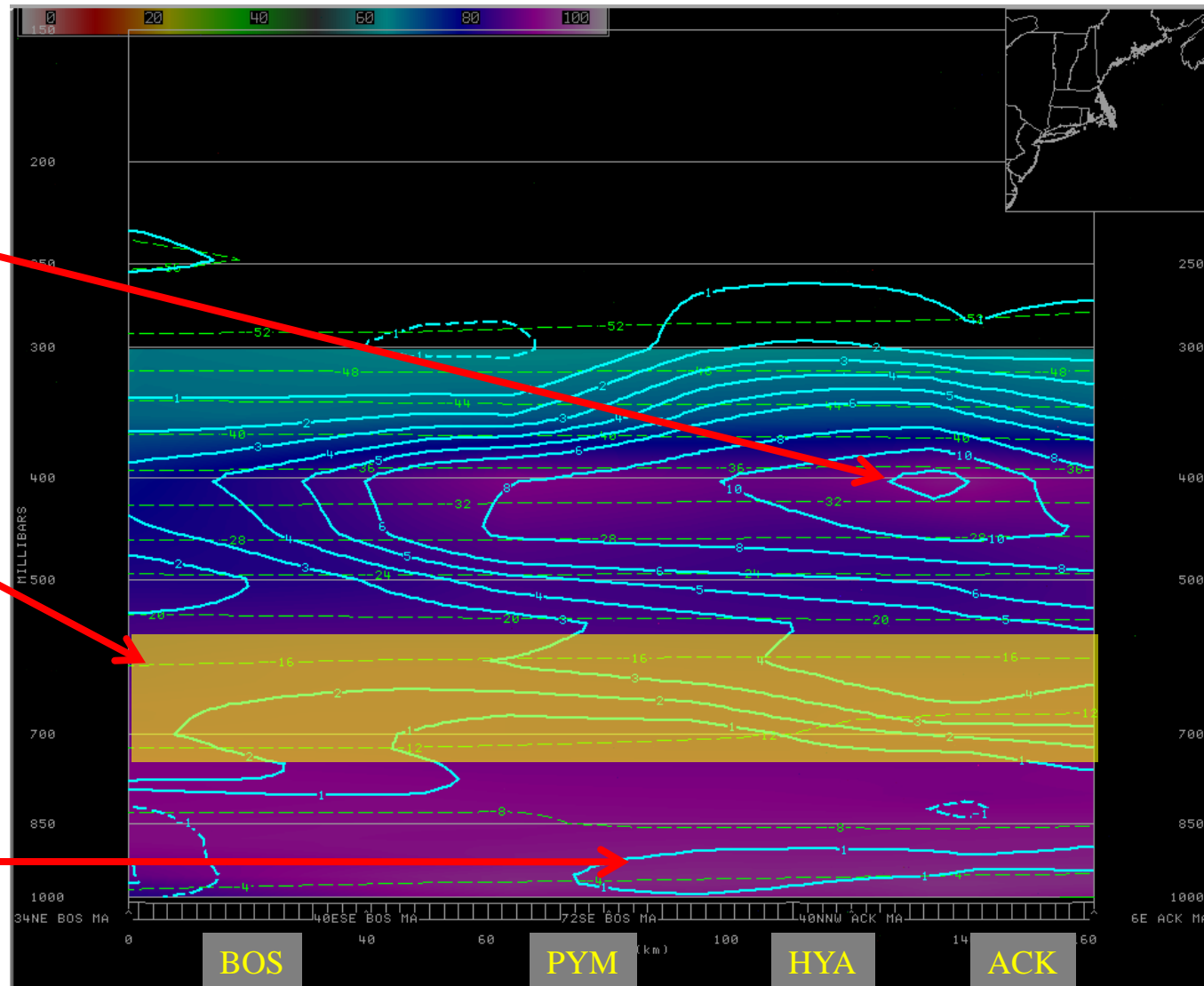


NAM Snow Growth Cross Section

Strongest lift
400-500 mb in
“cold” air on
Cape Cod

Weaker lift in
-12C to -18C
max snow
growth layer

Some low level
lift present



NAM lineF	Rel Humidity	Img(%)	20.18	6HR	Tue	00:00Z	21-Dec-10
NAM lineF	Omega (-ubar/s)		20.18	6HR	Tue	00:00Z	21-Dec-10
NAM lineF	Rel Humidity (%)		20.18	6HR	Tue	00:00Z	21-Dec-10
NAM lineF	Temperature (C)		20.18	6HR	Tue	00:00Z	21-Dec-10

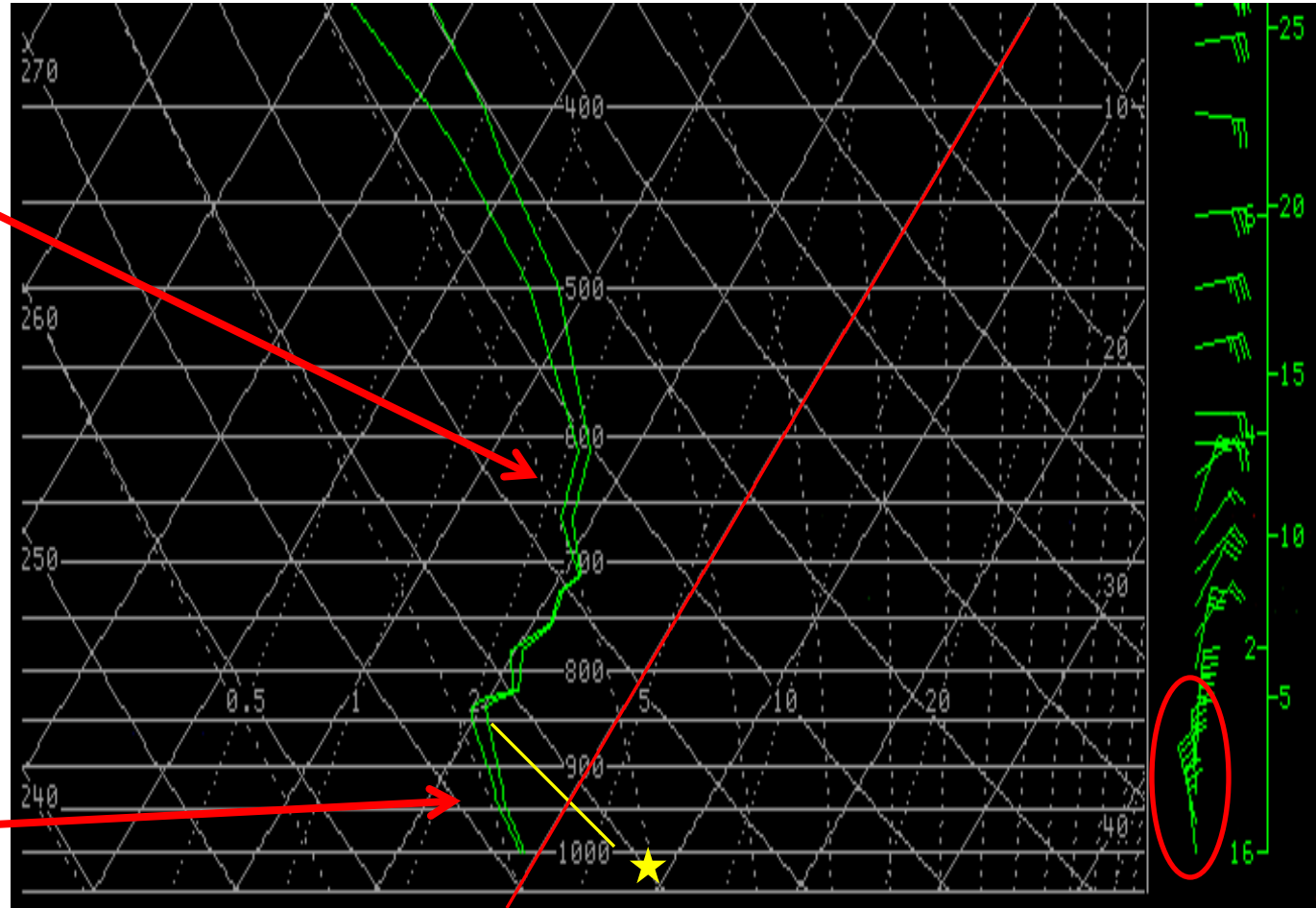
Chatham Sounding: 00z Dec 21

0 C

Deep and nearly saturated ice-producing layer and snow growth region

Well aligned northerly low level flow

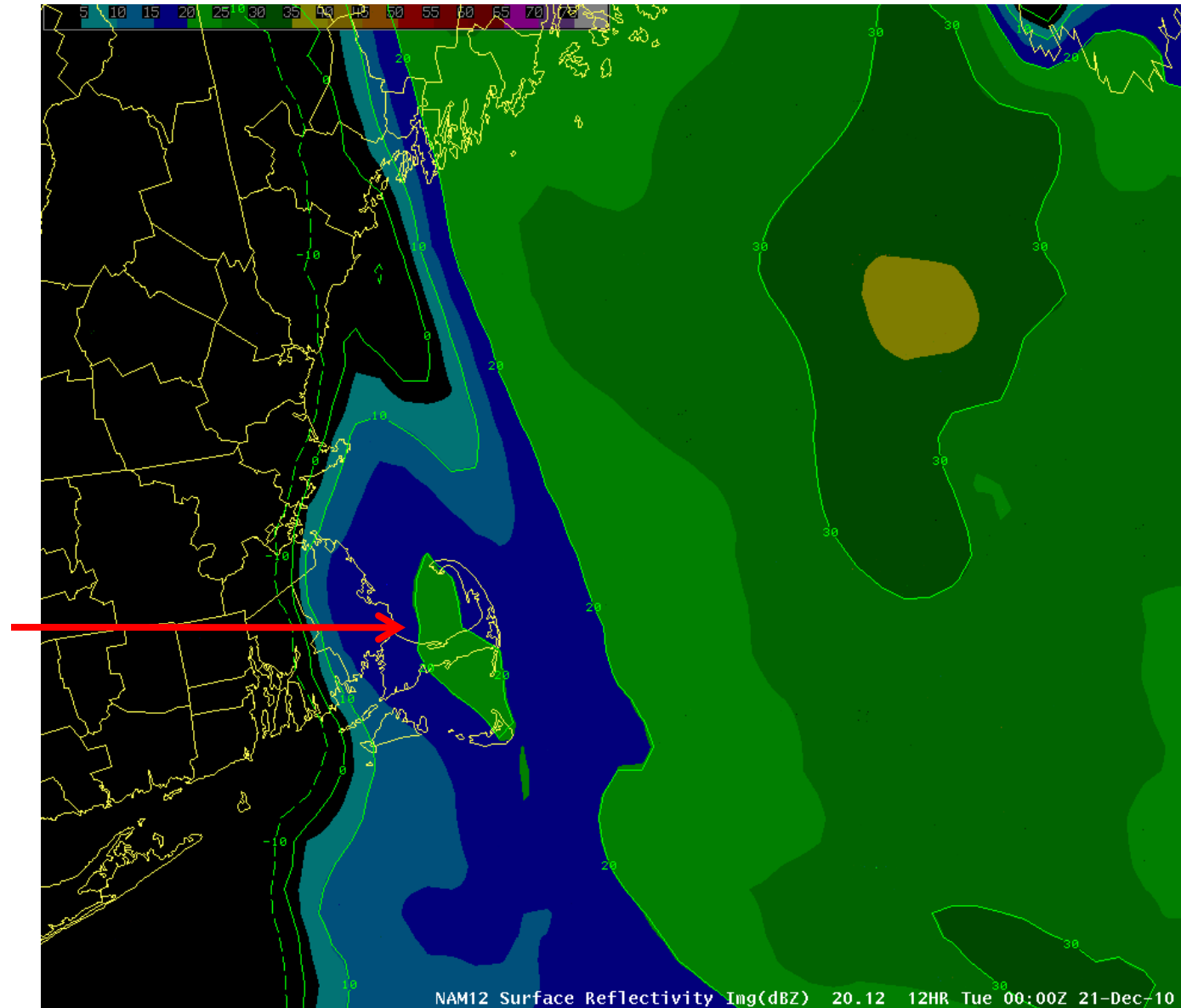
17 C delta T between surface and base of inversion



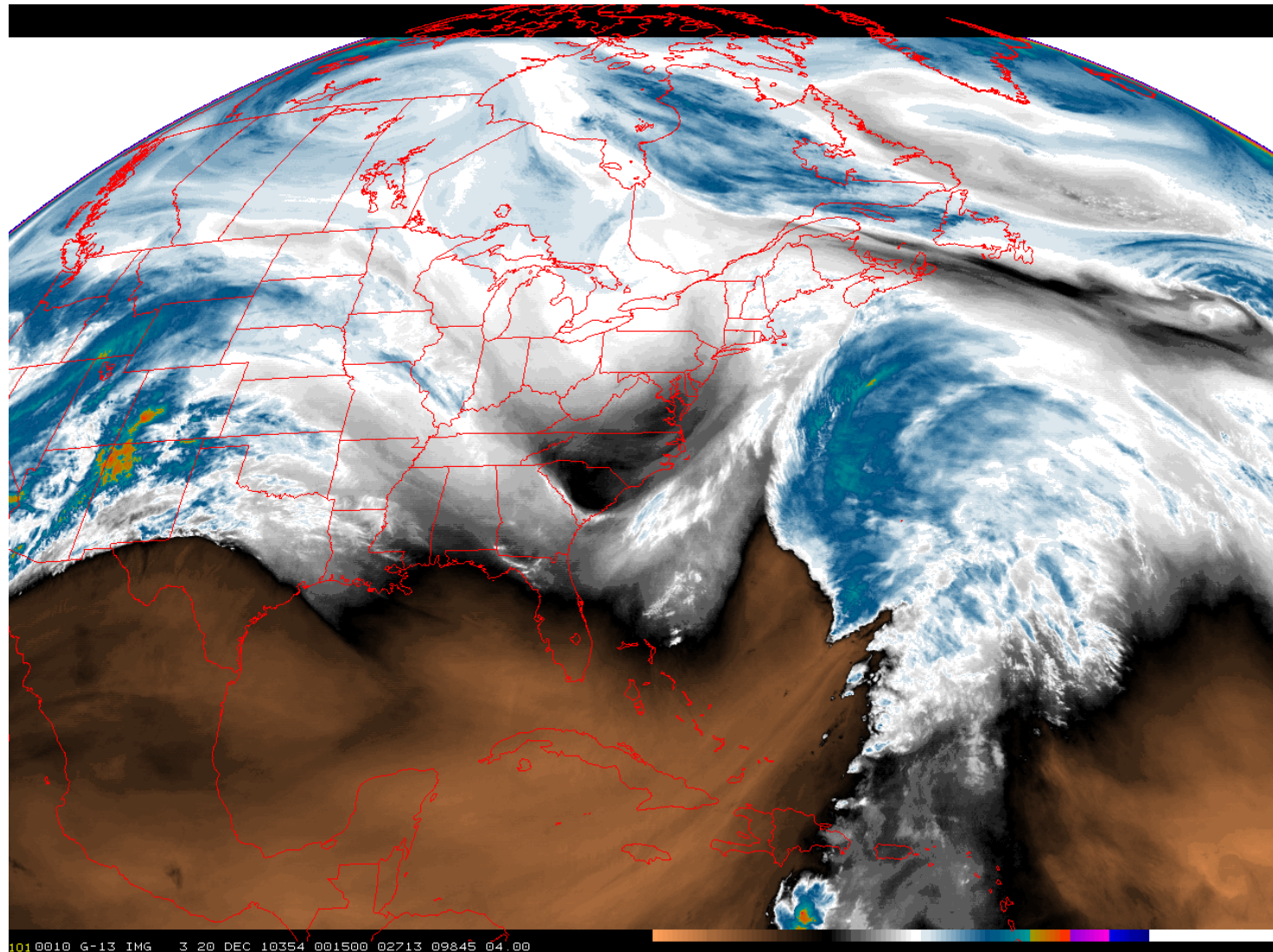
NAM Simulated Reflectivity

Highest
reflectivity
(35-40 dbz) well
offshore at 00z
Dec 21

Some ocean
enhancement is
evident on Cape
Cod

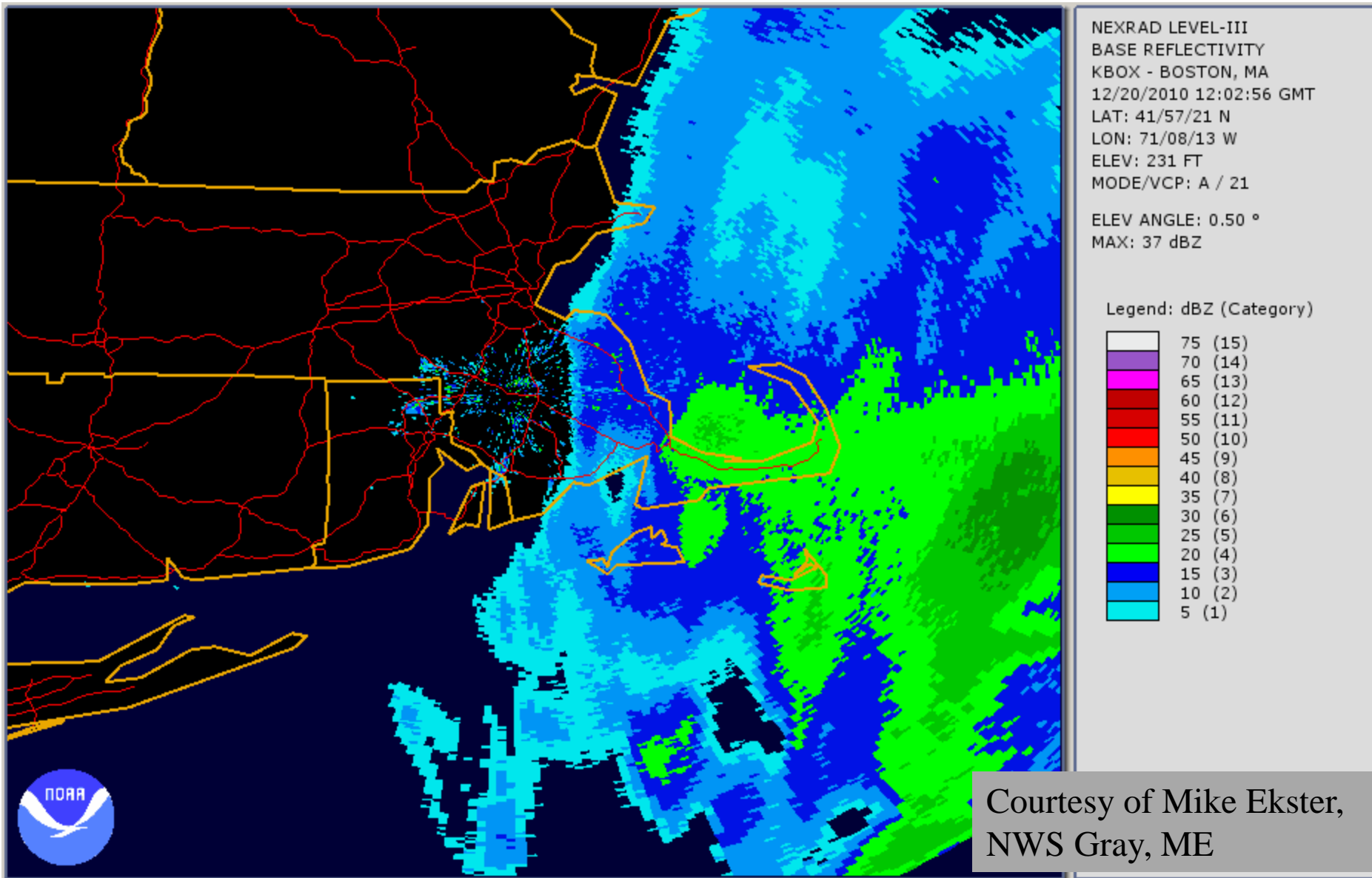


Water Vapor Satellite Loop



Courtesy of Sheldon Kusselson,
NESDIS

Taunton, MA Radar Loop



Summary

- Strong mid level lift (TROWAL) combined with low level instability to produce heavy snow on Cape Cod (modeled too far offshore)
- Cold air aloft helped to overcome “warm” surface temperatures
- Good case where forecasters need to examine satellite and radar trends to adjust model QPF
- Demonstrates importance of nowcast tools to maintain high situational awareness
 - Radar, satellite, observations, webcams

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Contact Information:

Joseph.Dellicarpini@noaa.gov

Frank.Nocera@noaa.gov