Mid-Atlantic and southern New England Snow 10 March 2017

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1. Overview

A fast moving wave along a frontal boundary produced a snow event across Pennsylvania and southern New England on 10 March 2017 (Fig. 1). The heaviest snowfall was observed in west-central Pennsylvania where a few locations saw around 8 inches of snowfall. Areas to the east began as rain and changed to snow which may have limited snowfall totals. The total estimated QPE (Fig. 2) showed maximum QPE was around 12-14 mm (0.50 inches) with most of the snow areas receiving 8 to 12 mm of QPE. There was a sharp northern edge to the QPF shield.

Other factors which may have limited to the snowfall accumulations likely included warm antecedent conditions. On 9 March temperatures peaked from the low 70s in the DC area to the mid-50s in central Pennsylvania (not shown).

The snow event was associated with a fast moving trough as displayed in the 500 hPa height field (Fig. 3). The strong trough was associated with 500 hPa heights which were -2s below normal. This deep trough ushered in unseasonably cold air and an arctic airmass moved across the region on 11-12 March 2017. The 850 hPa temperatures on 9-10 March (Fig. 4) show the relatively warm 850 hPa temperatures on 9 March and the surge of cold air after 0000 UTC 10 March 2017. Based on radar data (not shown and observations) most of the snow in central Pennsylvania fell between 0600 and 1200 UTC. Farther east the snow fall was observed between approximately 1000 and 1800 UTC. Thus areas with accumulating snowfall were on the edge of the frontal boundary and had 850 hPa temperatures in the -2 to 10C range. It should be noted near the end of the event snow was observed as far south as Baltimore, MD[1].

At the surface, weak surface wave developed on the warm side of the frontal boundary. It moved across Virginia and Maryland then rapidly out to sea (Fig. 5c-f). This was not a significant snow event though it and the following cold surge occurred after a record warm February.

This short note will serve to document the event and GEFS and HRRR forecasts for the event.

2. Methods and Data

The 00-hour GFS forecasts and the climate forecast system reanalysis data version II were used to reconstruct the pattern. These data were displayed using GrADS. The NCEP GEFS and HRRR were used to examine QPF forecasts. Most of the guidance showed snow as the primary precipitation type or a quick change over from rain to snow along the southern edges and thus are not examined.

[1] No snow accumulated in the Baltimore-Washington area.

The QPF data were derived from the Stage-IV data and displayed in GrADS. The snow data was in GRIB format showing gridded 24 hour amounts. These data too were plotted in GrADS.

3. GEFS forecasts

The mean QPF from 6 GEFS cycles is shown in Figure 6 and the probability of 12.5 mm or more of QPF is shown in Figure 7. These data show that the GEFS forecasts from 8-9 March had the frontal QPF band. The axis of the maximum QPF lined up quite well, especially from forecasts issued on and after 0000 UTC 9 March with the observed QPE (Fig. 1). The [r

These were relatively good forecasts and triggered the issuance of winter weather advisories in areas where the probability of 12.5 or more QPF was forecast. Warnings were limited to the higher terrain of west-central Pennsylvania. The probability of 15 and 25mm or more QPF was very low and few runs had any member with much over 15 mm of QPF.

4. HRRR

The HRRR QPFs were quite useful during this event for both timing and total amounts. The 0000 UTC 10 March cycle is shown for brevity (Fig 8). The total QPF showed the maximum QPF from eastern Ohio across central Pennsylvania. Some amounts as high as 12-16 mm were forecasts over central Pennsylvania and northern Long Island. There were locally high amounts of 16-24 mm in the mountains of west-central Pennsylvania. These areas lined up well with the 8 inch snowfall maximum (Fig. 2) and the higher QPE (Fig. 1).

Six HRRR forecasts of the 12 hour QPF form 0600 to 1800 UTC 10 March are shown in Figure 9. These data show consistent forecasts with 12 mm or more QPF confined mainly to central Pennsylvania and Long Island. These data also showed the very sharp northern edge to the QPF shield.

5. Summary

A well forecast short wave and frontal system ahead of a surge of arctic air produced 2-10 inches of snow across central Pennsylvania eastward across southern New England. The heaviest snow fall was in the mountains of west-central Pennsylvania where 3 to 10 inches of snow was observed. Higher snow amounts were confined to the higher elevations of central Pennsylvania.

As shown both the NCEP GEFS and 3km HRRR did relatively well forecasting the snow, the timing of the snow and general snow amounts. The HRRR QPF was well aligned with the observed QPE. However, the HRRR produced too much QPF in the Poconos of northeastern Pennsylvania.

6. Acknowledgements

The Pennsylvania State University for data access.

7. References

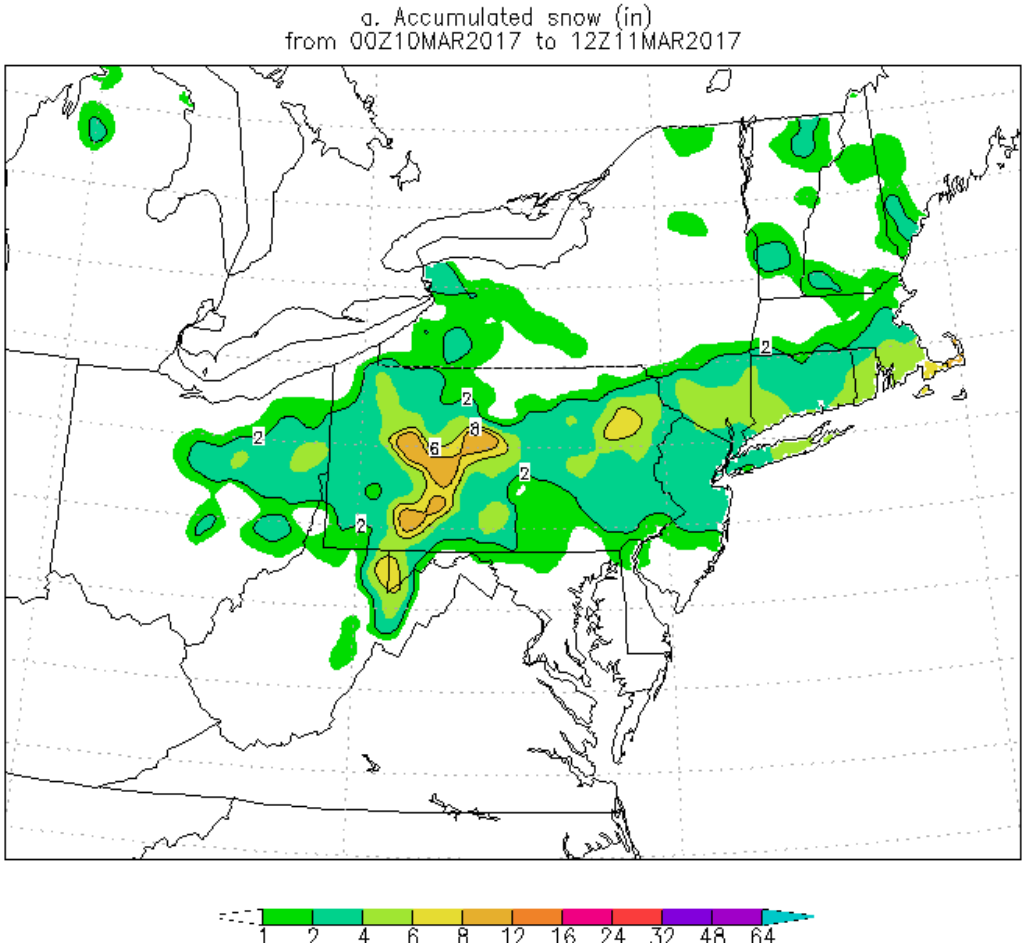

Figure 1. Total estimated snowfall in inches for the period 10-11 March 2017. Shading is in inches, contours are 2, 6, 8, and 16. **Return to text.**

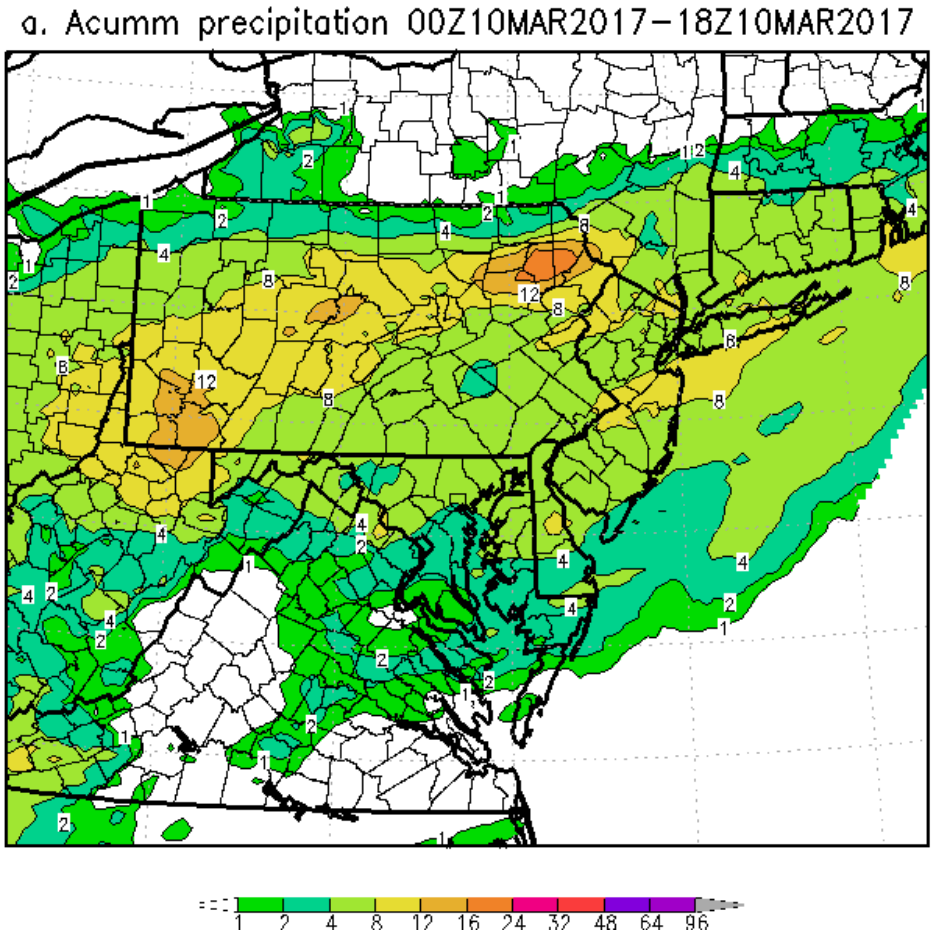

Figure 2. Total estimated liquid equivalent water milli-meters for the period 0000 UTC 10 March to 1800 UTC 10 March 2017. Shading as in color bar. Contours every 2, 4, 8, 12, 16 and 24 mm. **Return to text.**

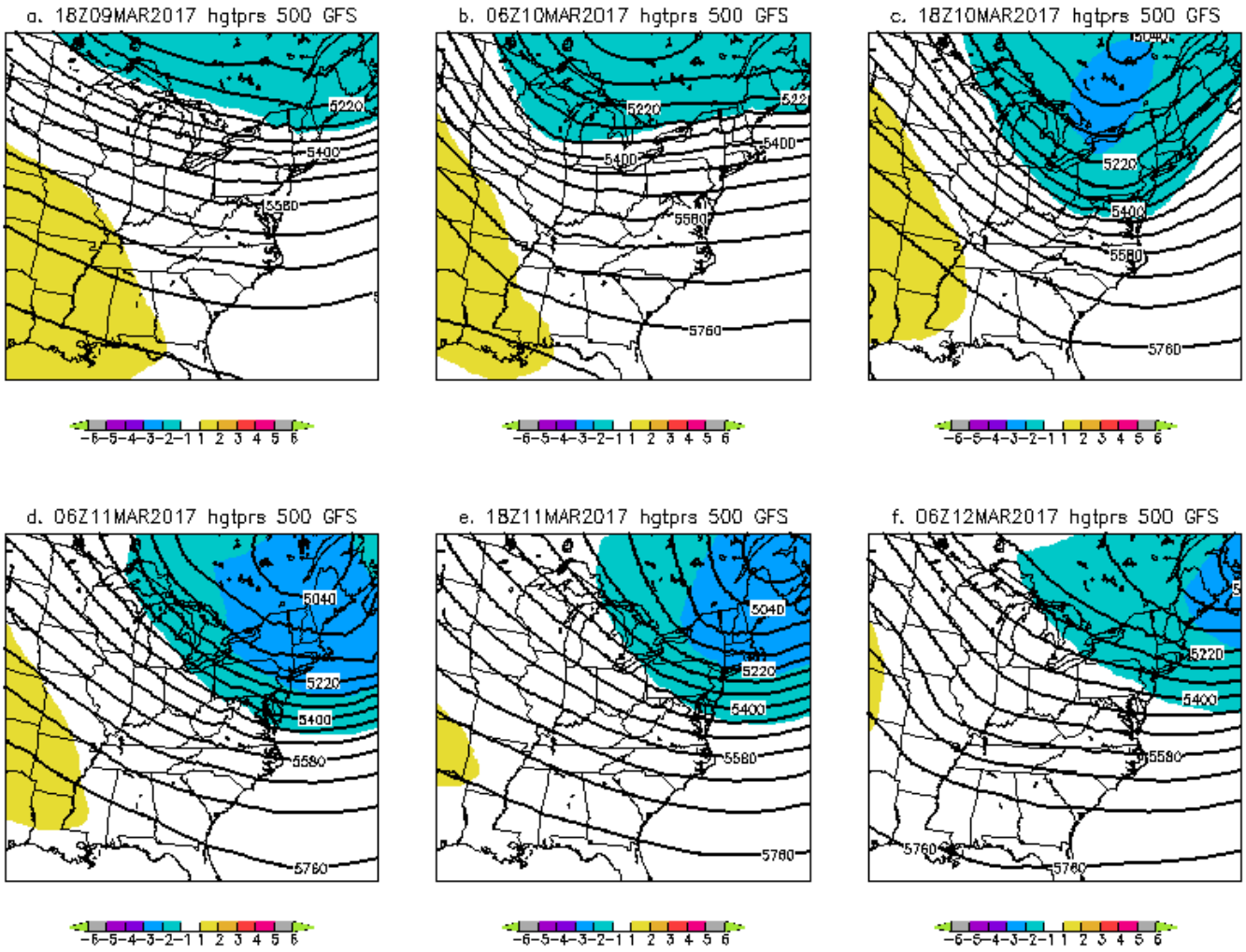

Figure 3. Analysis of 500 hPa heights (m) in 12 hour increments from a) 1800 UTC 9 through f) 0600 UTC 12 March 2017. Shading denotes anomalies from normal as in the color bar. **Return to text.**

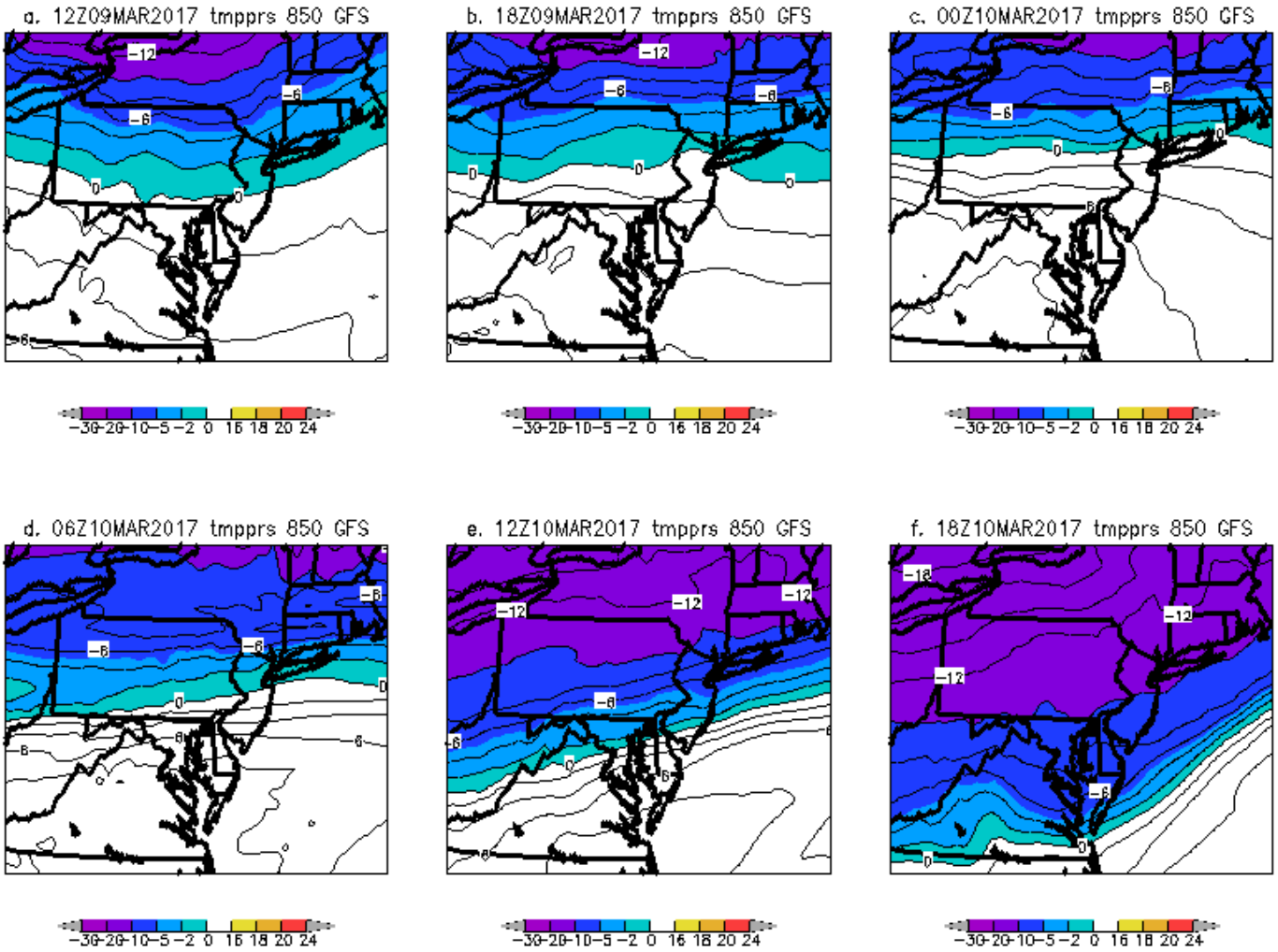

Figure 4. As in Figure 3 except for 850 hPa temperatures every 6 hours from a) 1200 UTC 9 March 2017 through f) 1800 UTC 10 March 2017.
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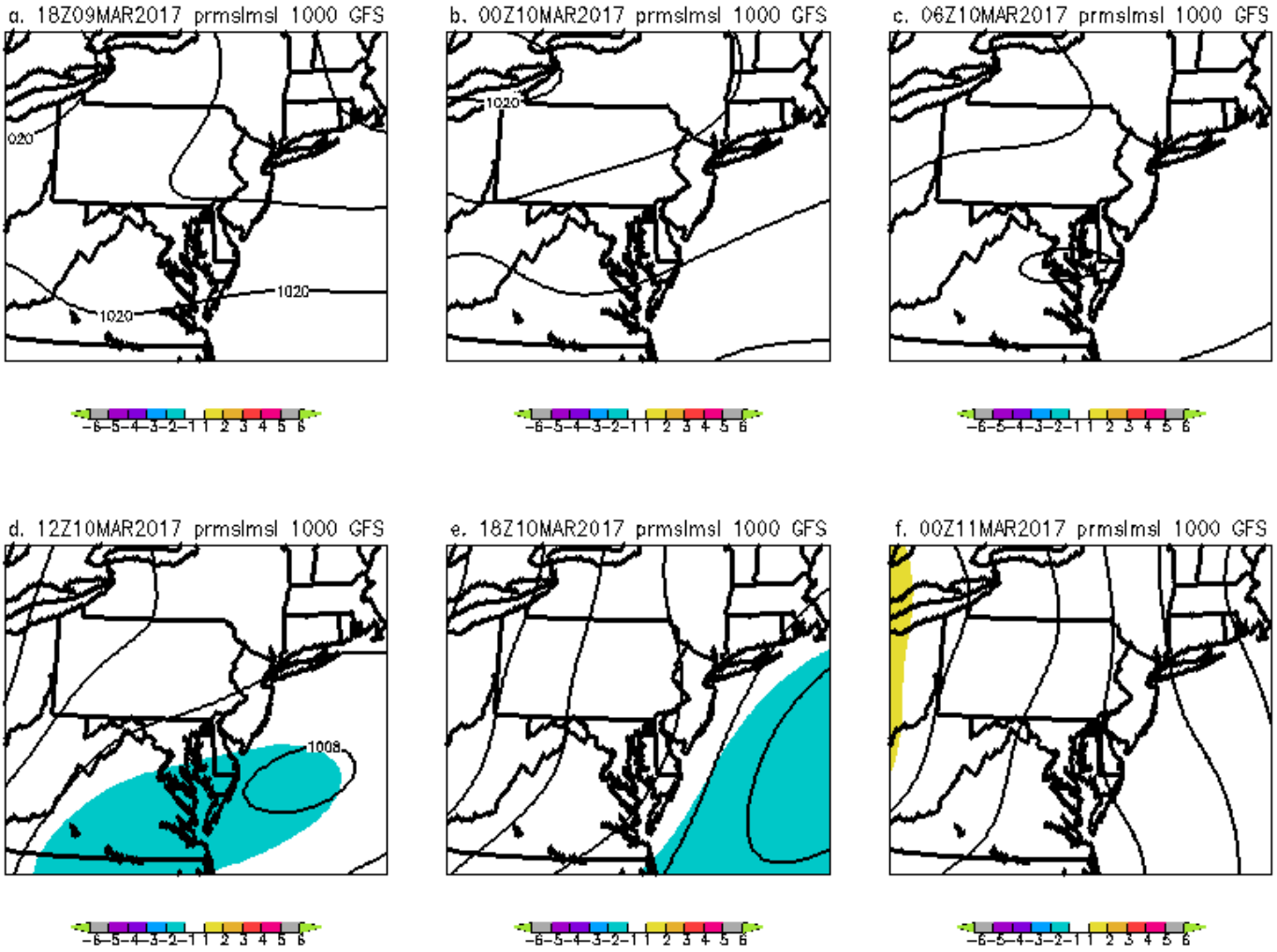

Figure 5. As in Figure 4 except for mean sea level pressure (hPa) every 6 hours from a) 1800 UTC 9 March through f) 0000 UTC 11 March 2017.
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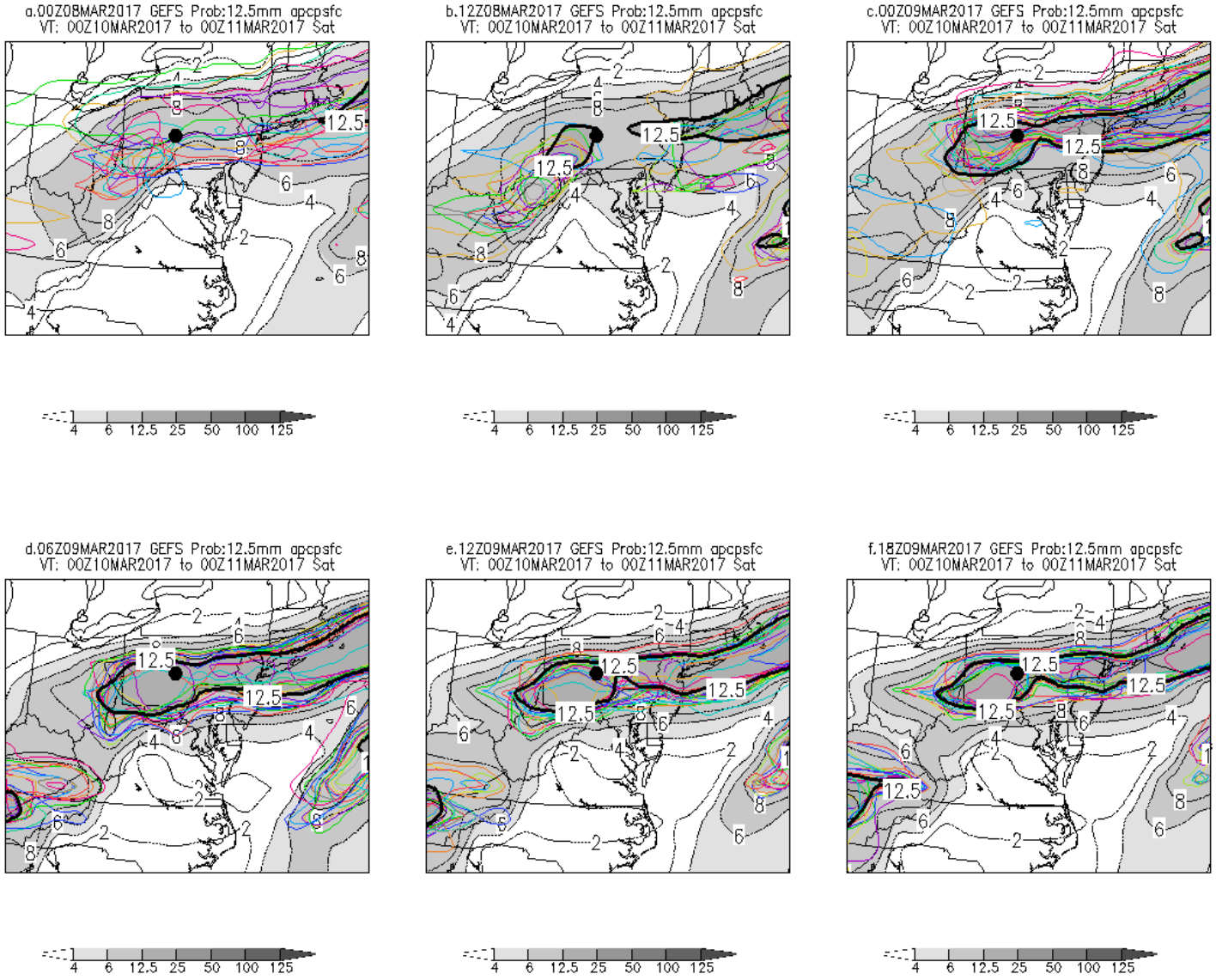

Figure 6. GEFS forecasts of total QPF and each member 12.5mm contour and the thick black line shows the ensemble mean 12.5 mm contour. GEFS forecasts valid 0000 UTC 10-11 March 2017. Forecasts initialized at a) 0000 UTC 8 March, b) 1200 UTC 8 March, c) 0000 UTC 9 March, d) 0600 UTC 9 March, e) 1200 UTC 9 March, and f) 1800 UTC 9 March 2017. **Return to text.**

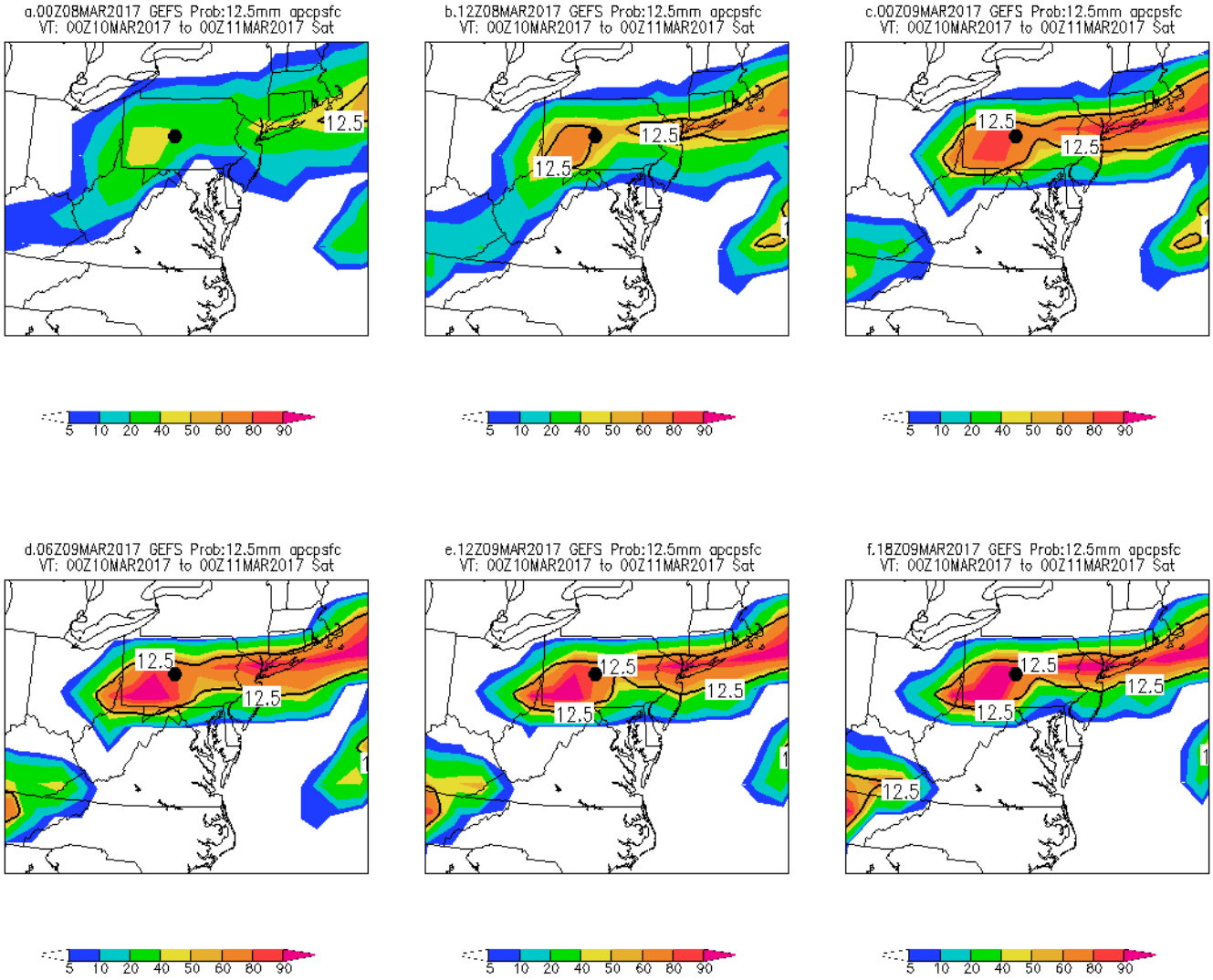

Figure 7. As in Figure 6 except for the probability of 12.5 mm or more QPF. Shading shows probabilities and contours is the 12.5 mm contour of the ensemble mean. **Return to text.**

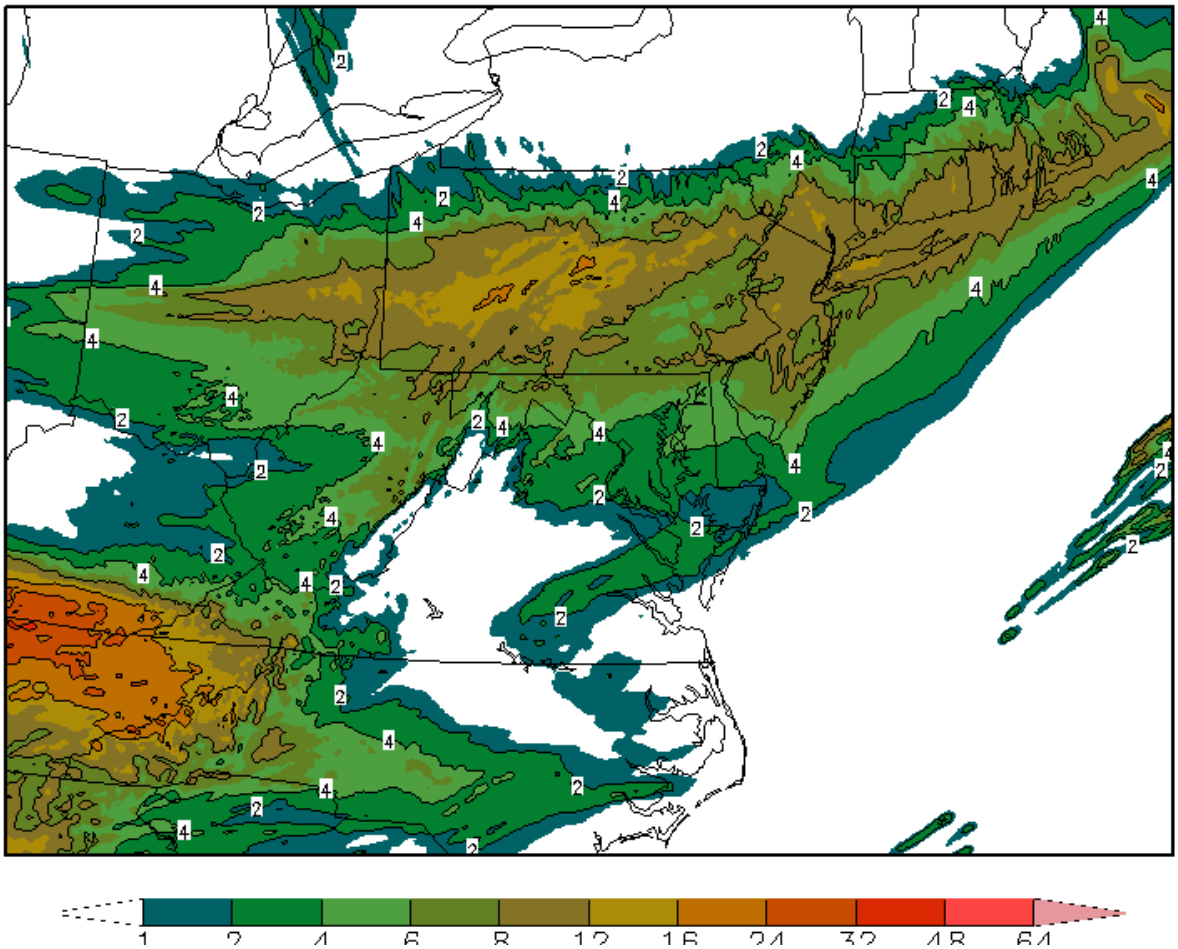

Figure 8. The 3km 0000 UTC 10 March HRRR total QPF (mm) for the period ending at 1800 UTC 10 March 2017. **Return to text.**

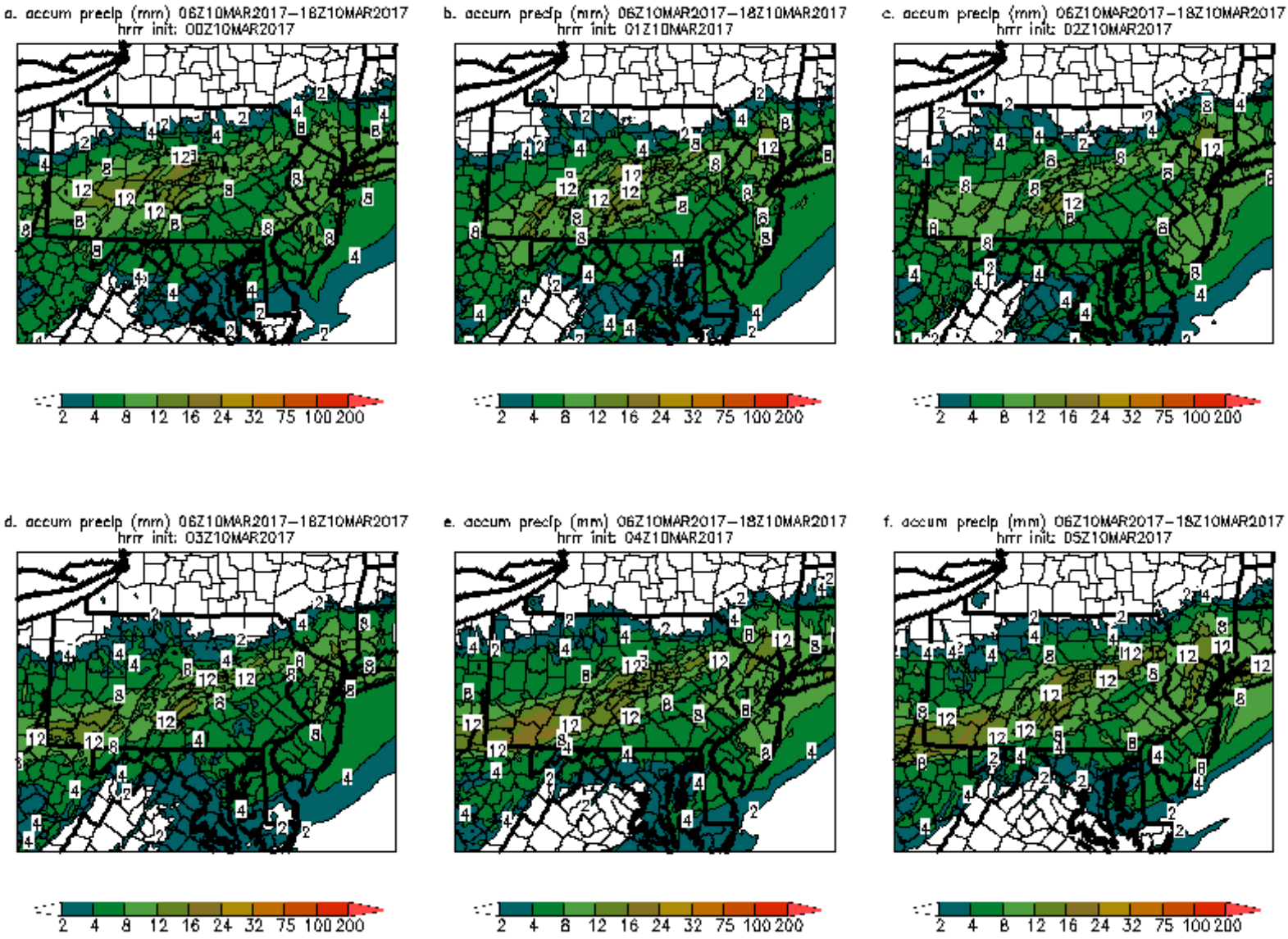

Figure 9. As in Figure 8 except for 8 successive HRRR forecasts showing the total QPF in the period from 0600 to 1800 UTC 10 March 2017. Forecasts initialized every hour from a) 0000 UTC through f) 0500 UTC 10 March 2017. **Return to text.**