# Gulf Coast Severe Event of 9-10 February 2013

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## 1. Overview

A fast moving frontal system produced severe weather over Texas on 9 February and across the Gulf States on 10 February 2013. There were 32 and 64 reports over each 24 hour period (Fig. 1). A line of storms developed in the panhandle of Texas, producing some hail reports (Fig.1) then became strong and more organized as it moved across central Texas on 10 February (Fig. 2) the line weakened as it moved into Louisiana before strengthening again. The line broke into more discrete storms after 1800 UTC on 10 February over southern Mississippi and Alabama, where the tornadoes (Fig. 1) were reported.

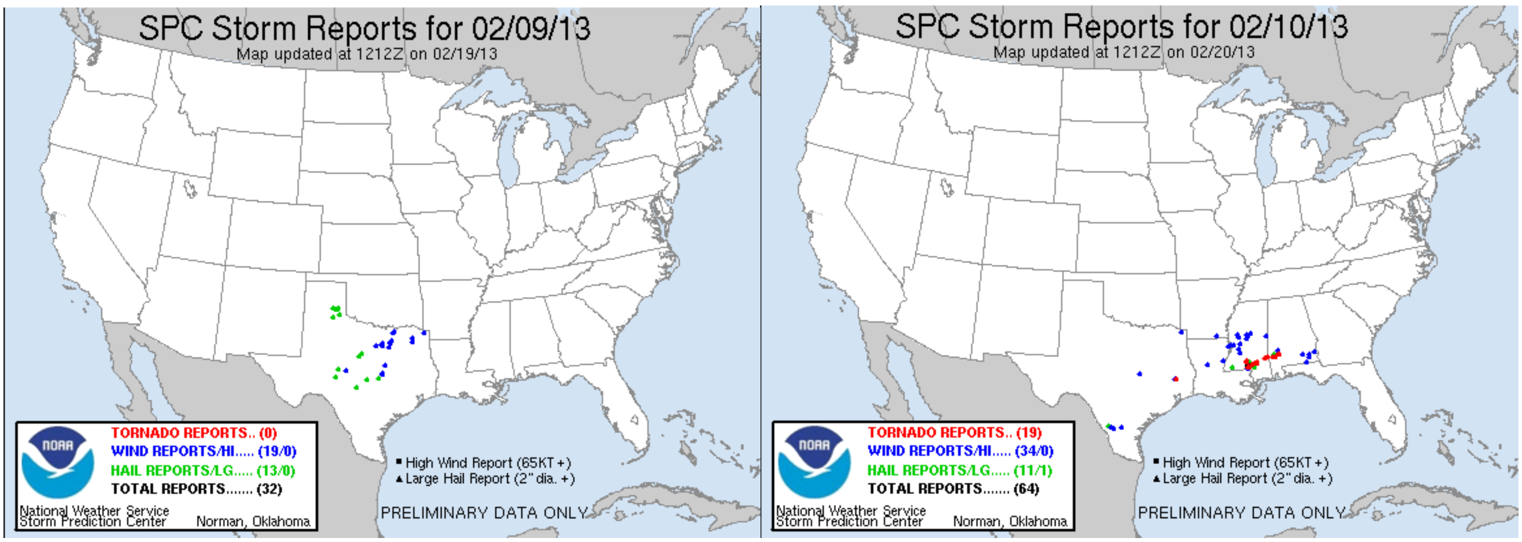


**Figure 1. Storm Prediction Centers reports of severe weather, color coded by type for the 24 hours ending at 1200 UTC 10 and 11 February 2013. Return to text.**

An EF4 tornado with winds estimated around 170 mph destroyed or damaged more than 800 homes in the Mississippi including the hard hit region around Hattiesburg. The damage to the University of Mississippi in Hattiesburg alone was estimated to be in excess of 10 million dollars (Huffington Post 2013; WIKI 2013).

The frontal system which triggered the convection was associated with a deep 500 hPa trough (Fig. 4) which came across the southwestern United States (Figs. 4a-d) and swept across the southern Plains and Gulf States on 10-11 February 2013 (Fig. 4e-f). As the trough raced eastward, it pulled a plume of Gulf moisture, as shown in the precipitable water data (PW: Fig. 5) into west Texas which then moved rapidly eastward (Figs. 5b-f). The deep moisture combined with southerly flow at 850 hPa (Fig. 6) produced high values of 850 hPa moisture flux (Fig. 7). In the warm moist air ahead of the advancing front implied cold front (Fig. 4) the high PW produced relatively high Convective available potential energy (CAPE) and strong moisture flux. The convection (Figs. 3-4) and severe weather (Fig. 1) occurred in this plume of warm moist air and strong shear. Most of the severe reports were relatively well aligned with the high PW air and +4 to +5s 850 hPa moisture flux (Figs. 1,6 &7).

## 2. Forecasts

The models did relatively well in predicting the pattern and no forecasts are shown here related to the pattern. In this section the simulated radar from the 13km RAP is presented. Figure 8 shows the RAP "*radar*" analysis, which relative to Figure 2 shows that the RAP 00-hour analysis was able to simulate the general pattern of the echoes but failed to identify the cores and key features with the intensity in the observations. The HRRR with 3km resolution may have produced better simulations. The times shown here are focused on the convective evolution over Mississippi where the strongest tornado of the event occurred. Simulations from other cycles showed the evolution of the strong line from Texas to Alabama (not shown).

The simulated radar from the 1600 UTC RAP on 10 February (Fig. 9) shows the 00-hour forecast and through 2100 UTC. The radar simulations did reasonable with the evolution and eastward progression of the convective rainfall. There were implications that the lines was breaking up into more discrete cells. But overall the echoes in the simulated radar were too weak relative to the observations, running 15-20 dBZ too low in the more intense echoes which were in the 60dBZ range verse forecasts of 45dBZ.

Only the 1600 UTC and 1800 UTC (Fig. 10) RAP are shown here. Forecasts from 10/0000 through 10/2100 UTC were examined. All of these data show that the model was able to show the evolution of a convective line, and its rapid progression eastward. These 13km RAP forecasts also showed an evolution from linear to implied more discrete cells. Clearly, higher resolution models are needed to predict stronger elements. In this case these data added value as the potential mode of convection and within a few hours, when the implied convection would arrive and move east of an affected region.

## 3. Precipitation

The observed precipitation for the event (Fig. 11) and 6-hour rainfall (Fig. 12) are presented. These data show how rapidly the precipitation shield move across Texas (Figs. 12a-b) and that a line of strong storms produced a southwest to northeast line of 16 to 32 mm of rainfall across east Texas (Fig. 12b). A broader region of 12 to 48 mm of rainfall fell for the period ending at 1800 UTC 10 and 0000 UTC 11 February (Figs. 12c-d).

Both the 6-hourly rainfall estimates and the storm total values (Figs. 11 & 12) show that cores of stronger storms produced locally enhanced precipitation. Clearly a strong core affected the region near Hattiesburg (Black do Figs 11 & 12) producing heavy rainfall near Hattiesburg and off the north and east (Fig. 12d). The 6-hour data show a considerable amount of discrete propagation.

The NCEP models had predicted the pattern relatively well and the 1500 UTC 9 February SREF QPFs (Fig. 13) show the forecasts of a QPF in the 6.25 to 12.5 mm range for the 3-hour period ending at 0000 UTC 11 February (Fig. 13a) and a 30-50% chance of in excess of 25mm in the 24 hours ending at 0000 UTC 11 February (Fig. 13d). The QPFs in this cycle and others suggest the SREF predicted a line of intense showers to move rapidly across the lower Mississippi Valley and the Gulf States.

## 4. Summary

A fast moving short-wave raced across the southwestern United States and into the Mid-Mississippi Valley from 8-10 February 2013 (Fig. 4). This wave pulled a plume of deep moisture with PW anomalies of 2-4σ (Fig. 5) above normal with strong low-level (Fig.6). The convection and severe weather developed in this plume of deep moisture and strong shear.

Radar imagery (Figs. 3 &4) and RAP simulated radar (Figs. 8-10) showed a strong line of convection moved across Texas then into the Gulf States. After 1800 UTC 10 February the line broke into more discrete storms and these discrete storms produced tornadoes and at least one EF4 tornado near Hattiesburg, MS. The storm damaged in excess of 800 homes and caused 10s of millions of dollars of damage to the University of Mississippi (Huffington Post 2013).

The strong frontal system and convection produced 25 to 50 mm of rainfall across western Texas and across the lower Mississippi Valley. Due to the strong forcing the NCEP SREF was able to predicted a line of enhanced rainfall moving across the region at about the correct time. The SREF also predicted over 25 mm of rainfall over the correct region. The NCEP 13km RAP did reasonably well showing the convective evolution of the system over the Gulf States. It lacked resolution and had both intensity and timing issues. However, these data show the emergent power of high resolution and rapidly updated forecasts to aid in anticipating the timing and mode of convection for strongly forced high-impact weather events.

## 5. Acknowledgements

## 6. References

Doty, B.E. and J.L. Kinter III, 1995: Geophysical Data Analysis and Visualization using GrADS. *Visualization Techniques in Space and Atmospheric Sciences,* eds. E.P. Szuszczewicz and J.H. Bredekamp, NASA, Washington, D.C., 209-219.

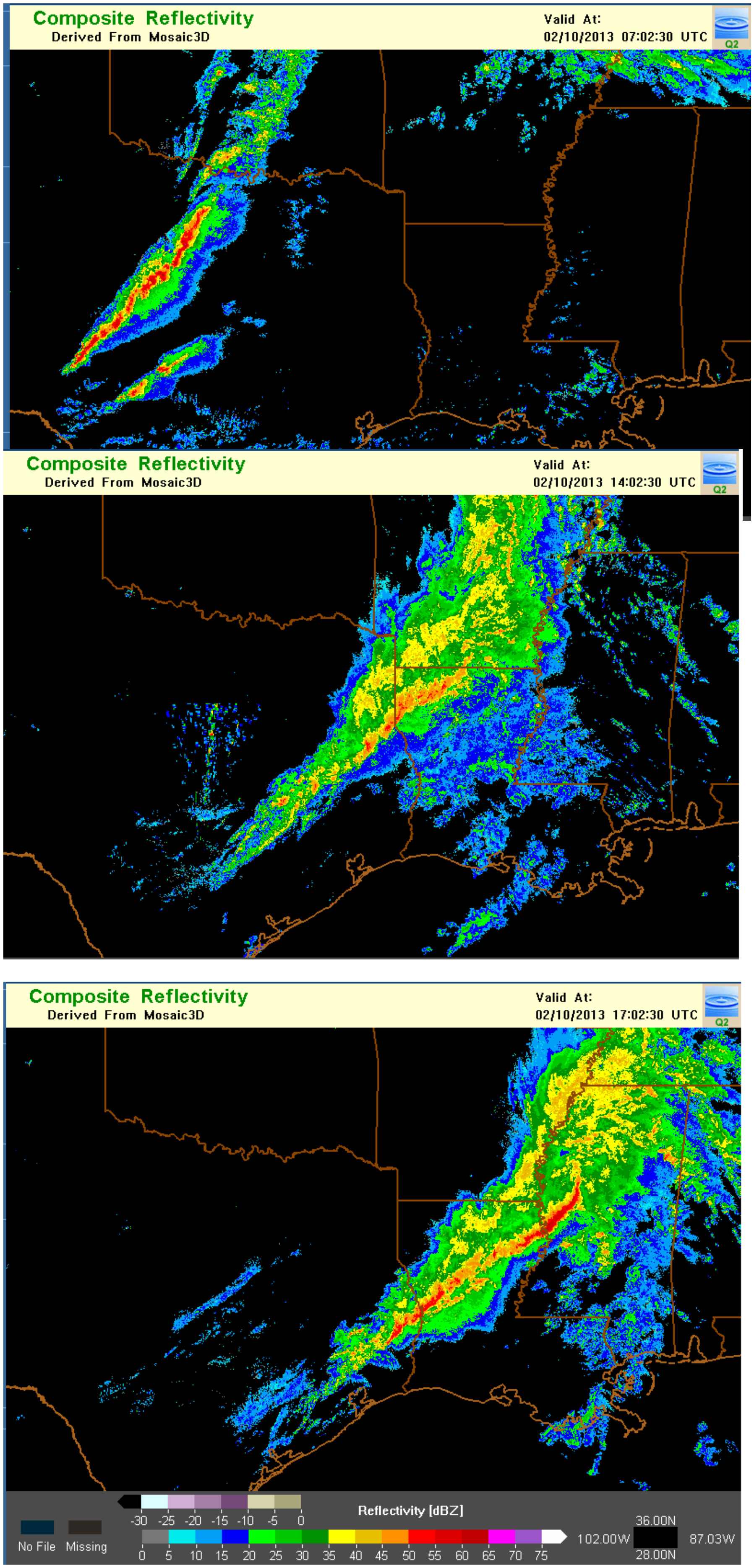


**Figure 2. NMQ Q2 composite reflectivity at 0702, 1402 and 1702 UTC 10 February 2013. Color scale shows the dBZ values.** **Return to text.**

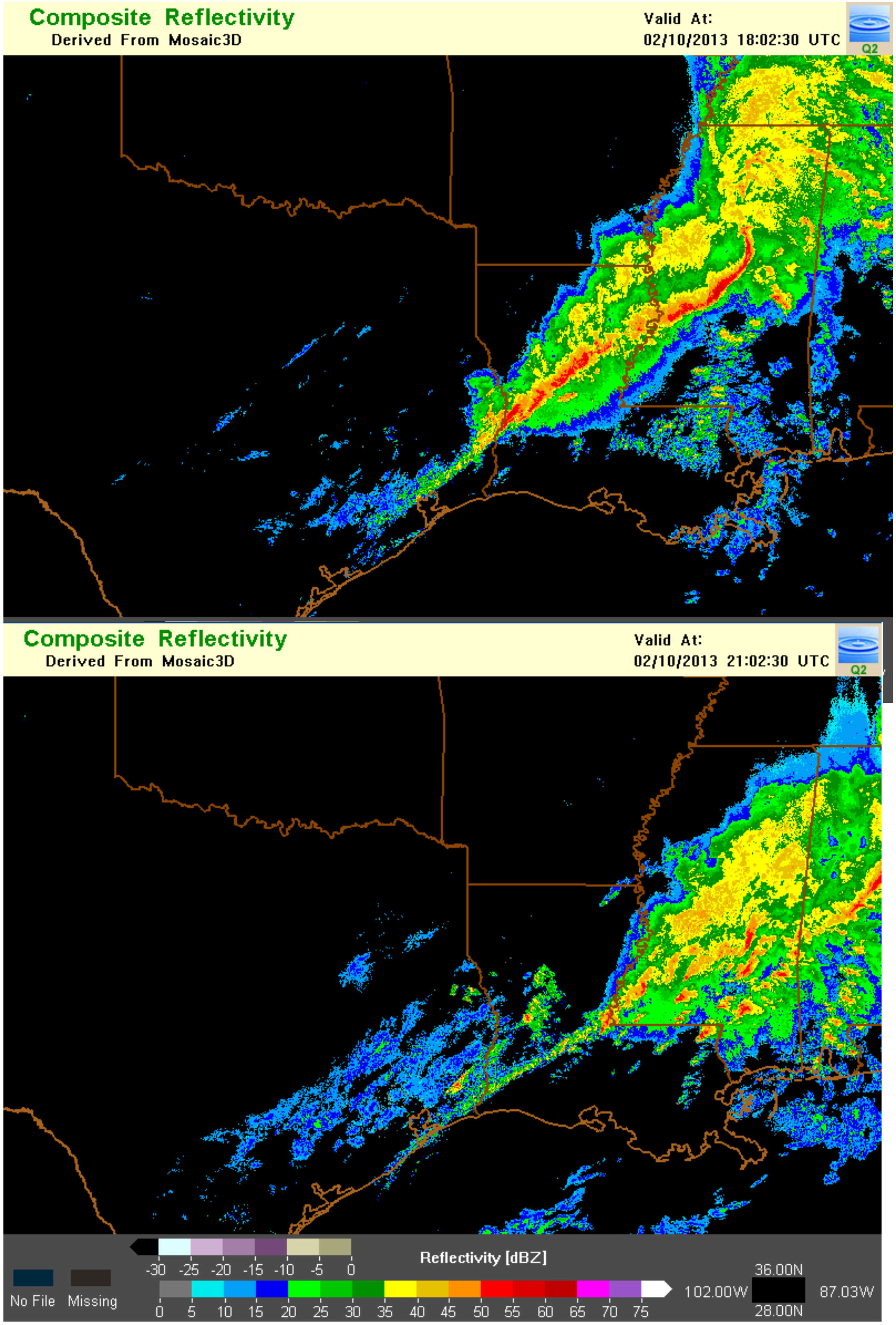


**Figure 3. As in Figure 2 except for 1802 and 2102 UTC. Return to text.**

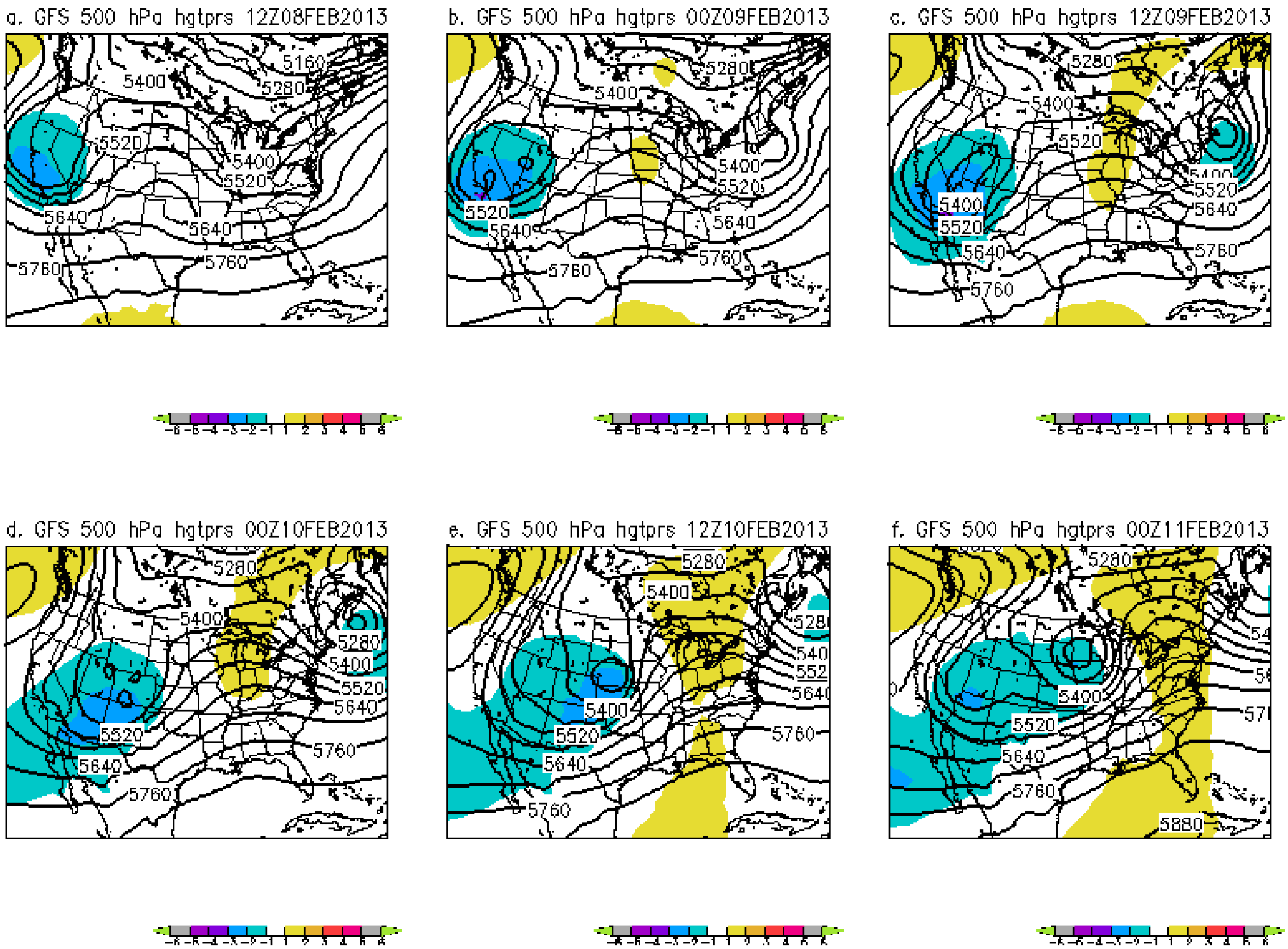


**Figure 4. GFS 00-hour forecasts of 500 hPa heights and 500 hPa height anomalies in 12 hour increments from a) 1200 UTC 8 through f) 0000 UTC 11 February 2013. Heights every 60 m and standardized anomalies as in the color bar below each image.** **Return to text.**

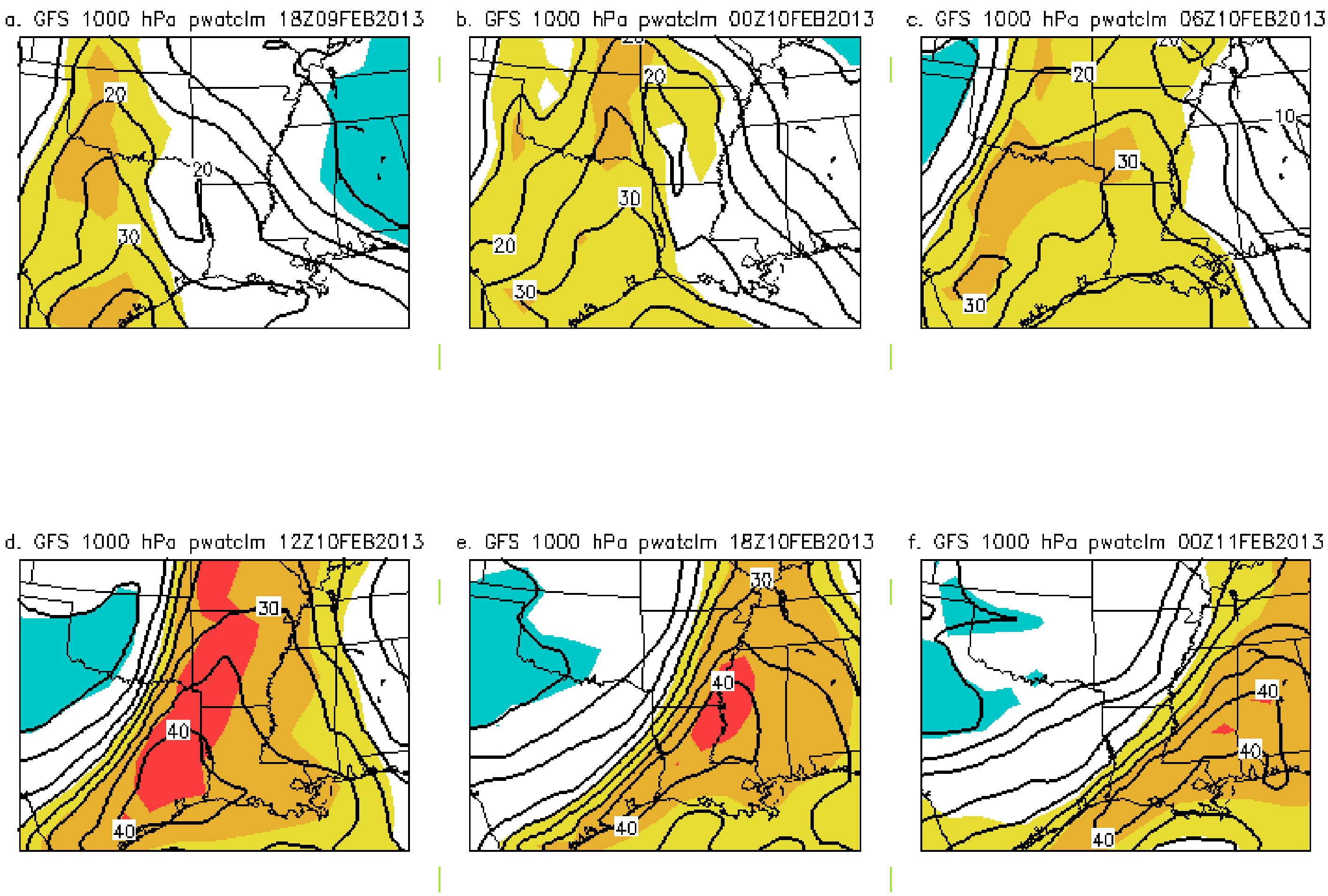


**Figure 5. As in Figure 4 except for precipitable water (mm) and precipitable water anomalies in 6-hour increments from a) 1800 UTC 09 February 2013 through 0000 UTC 11 February 2013. Contours every 5mm.** **Return to text.**

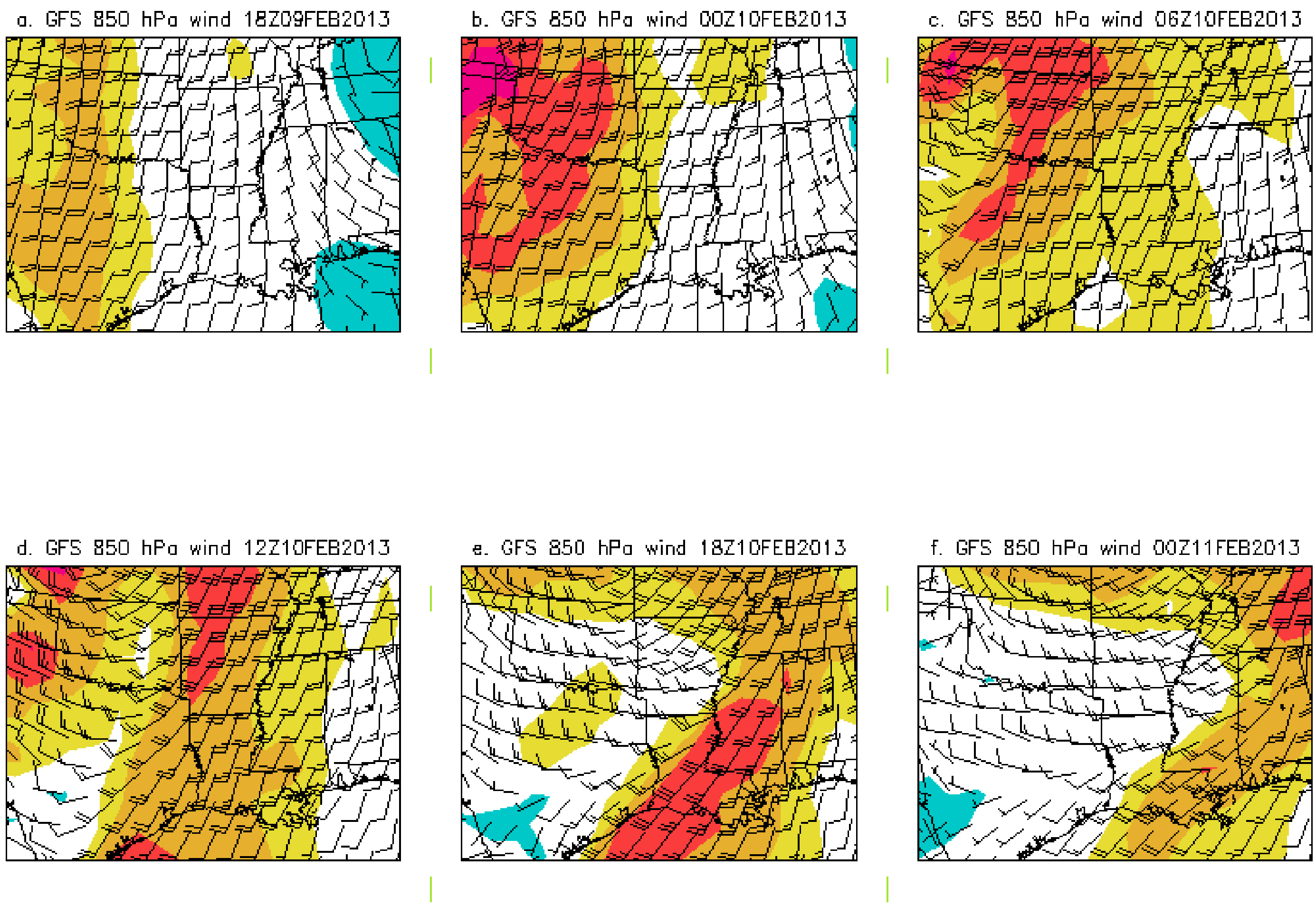


**Figure 6, As in Figure 7 except for 850 hPa winds(ms-1) and wind anomalies.** **Return to text.**

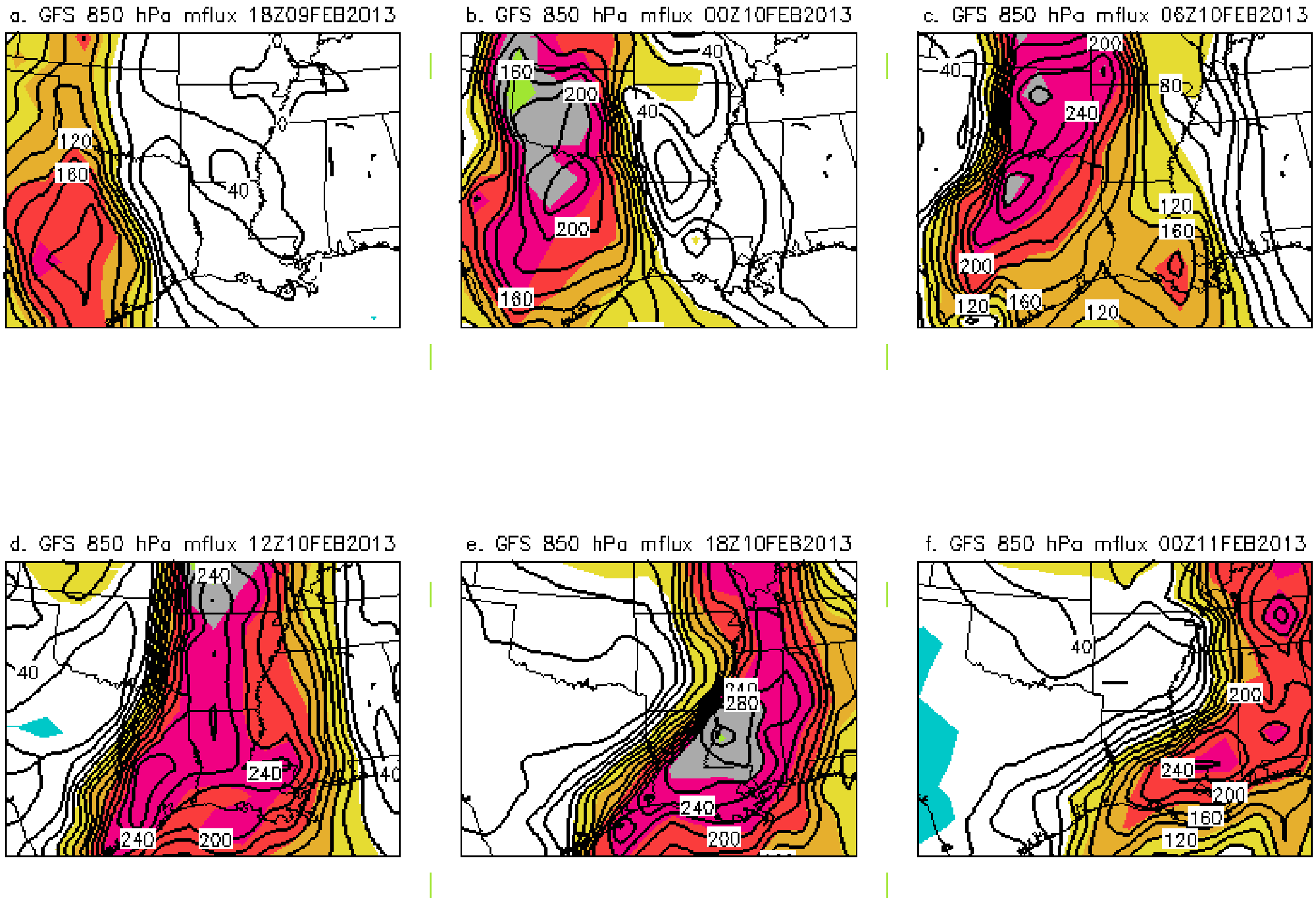


**Figure 7. As in Figure 6 except for 850 hPa moisture flux and moisture flux anomalies.** **[Return to text.](#)**.

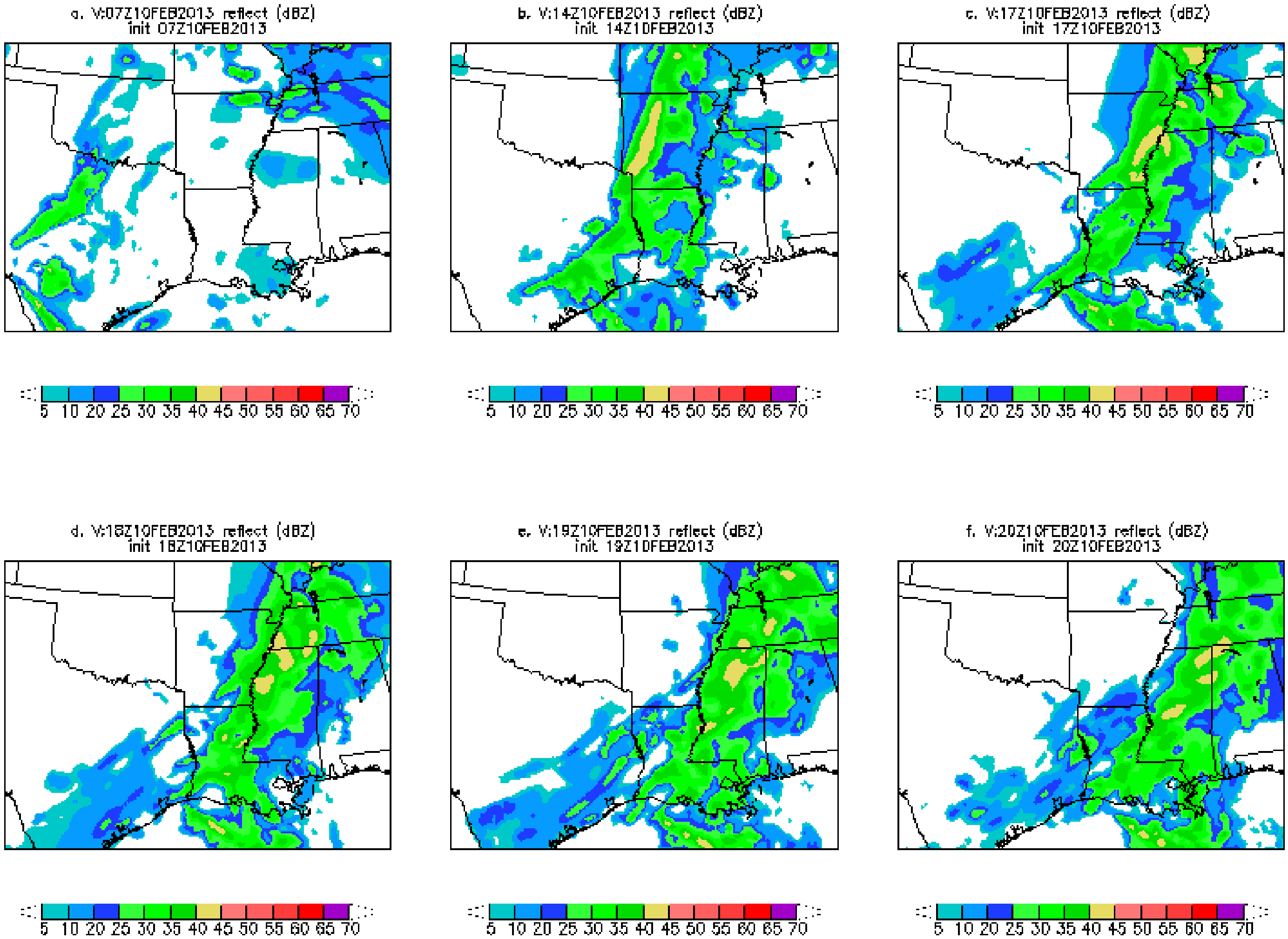


**Figure 8. RAP 13km showing synthetic reflectivity (dBZ) from 6 RAP 00-hour initialization times including a) 0700 UTC 10 February, b) 1400 UTC 10 February, c0 1700 UTC 10 February, d) 1800 UTC 10 February, e) 1900 UTC 10 February, and f) 2000 UTC 10 February 2013.** **Return to text**.

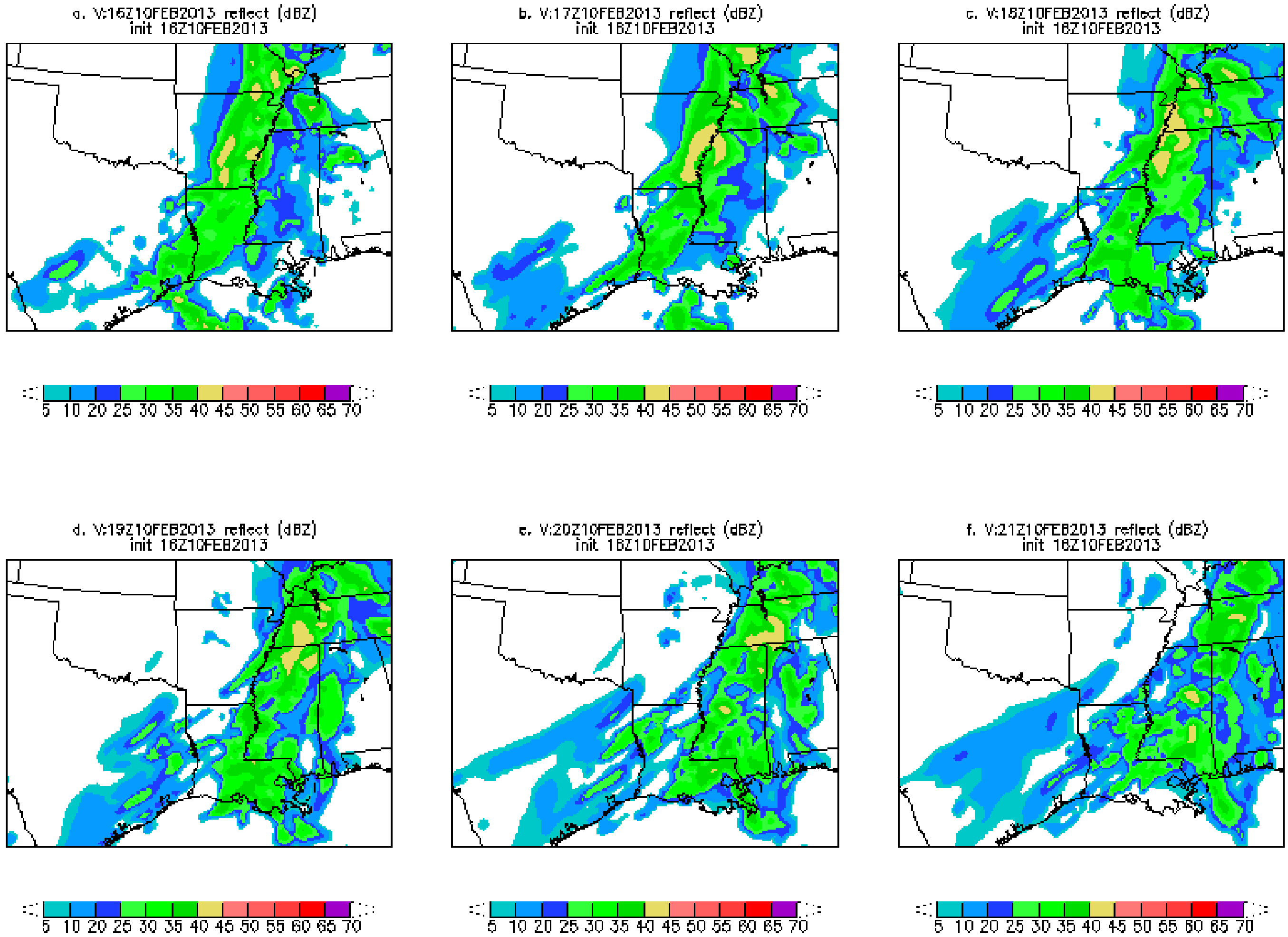


**Figure 9. As in Figure 8 except for NCEP 13km RAP initialized at 1600 UTC showing model simulated reflectivity (dBZ) in hourly increments from a) 1600 UTC through f) 2100 UTC 10 February 2013.** **[Return to text](#)**.

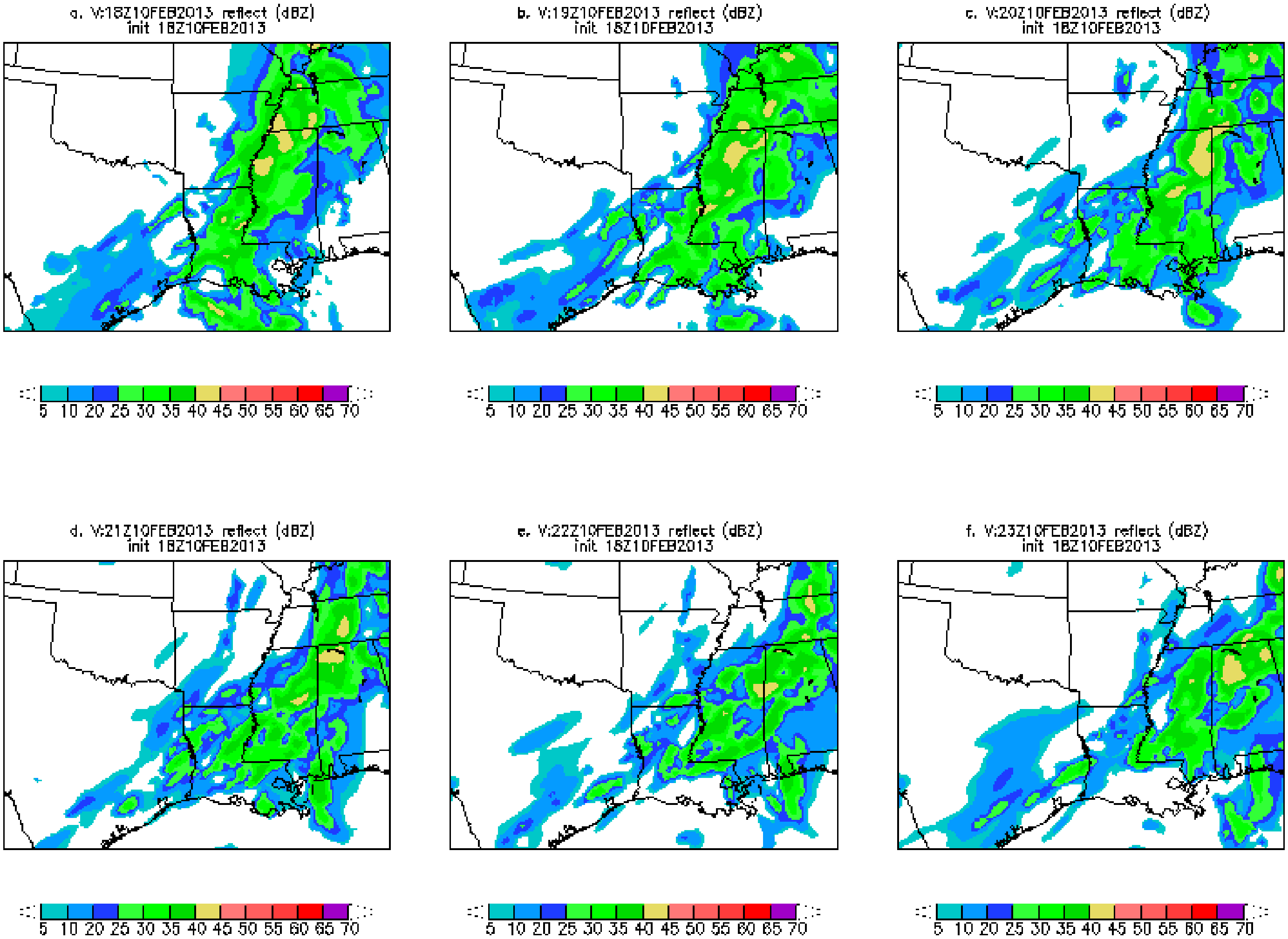


**Figure 10. As in but initialized at 1800 UTC showing forecasts in 1 hour increments through 2300 UTC 10 February 2013.** **Return to text.**

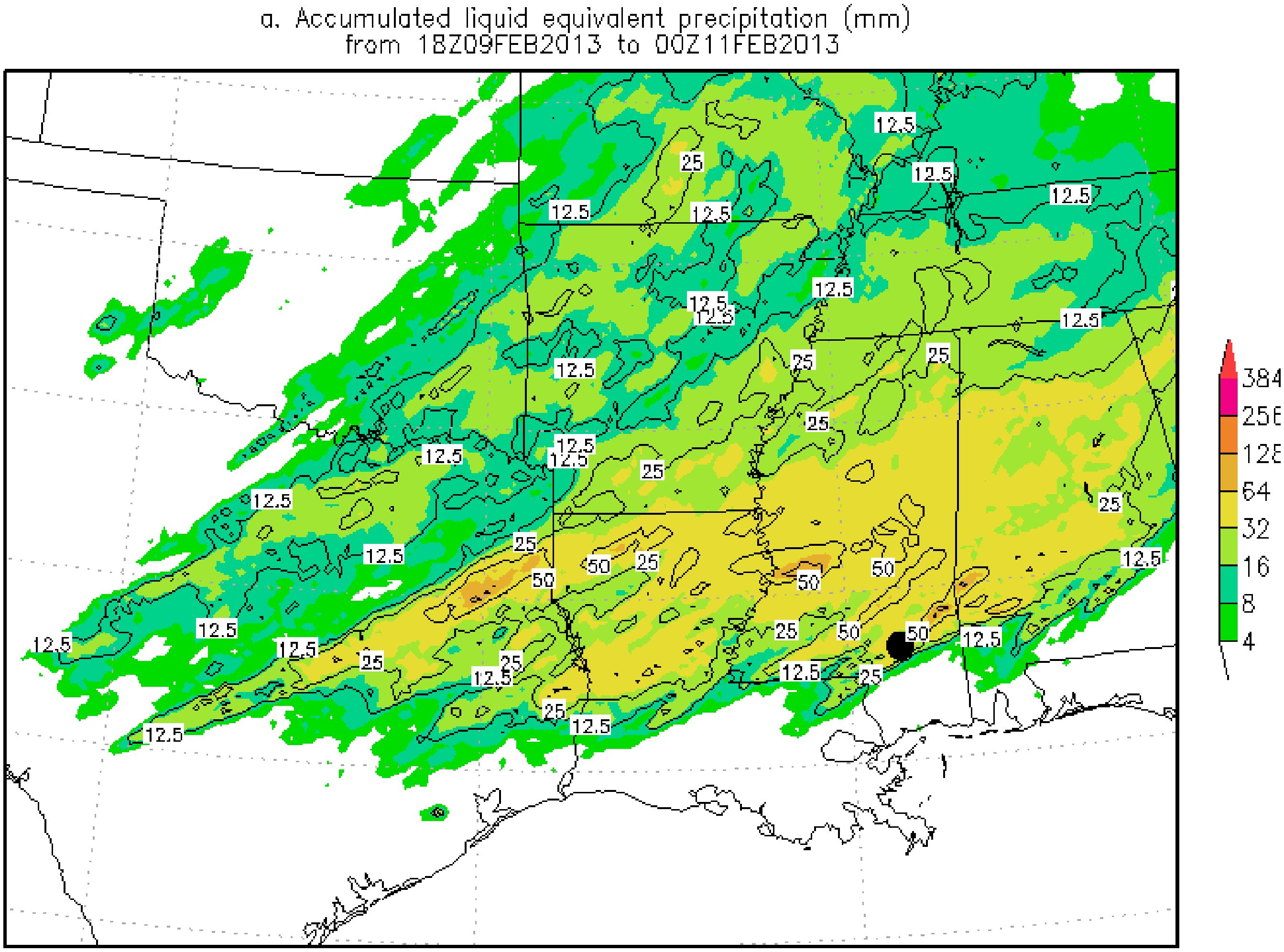


**Figure 10. Stage-IV estimated QPE (mm) for the period of 1800 UTC 9 February through 0000 UTC 11 February 2013. Contours 12.5, 25, and 50 mm and shading as per the color bar to the right of the image. The black dot is the relative position of Hattiesburg, MS.** **[Return to text.]**

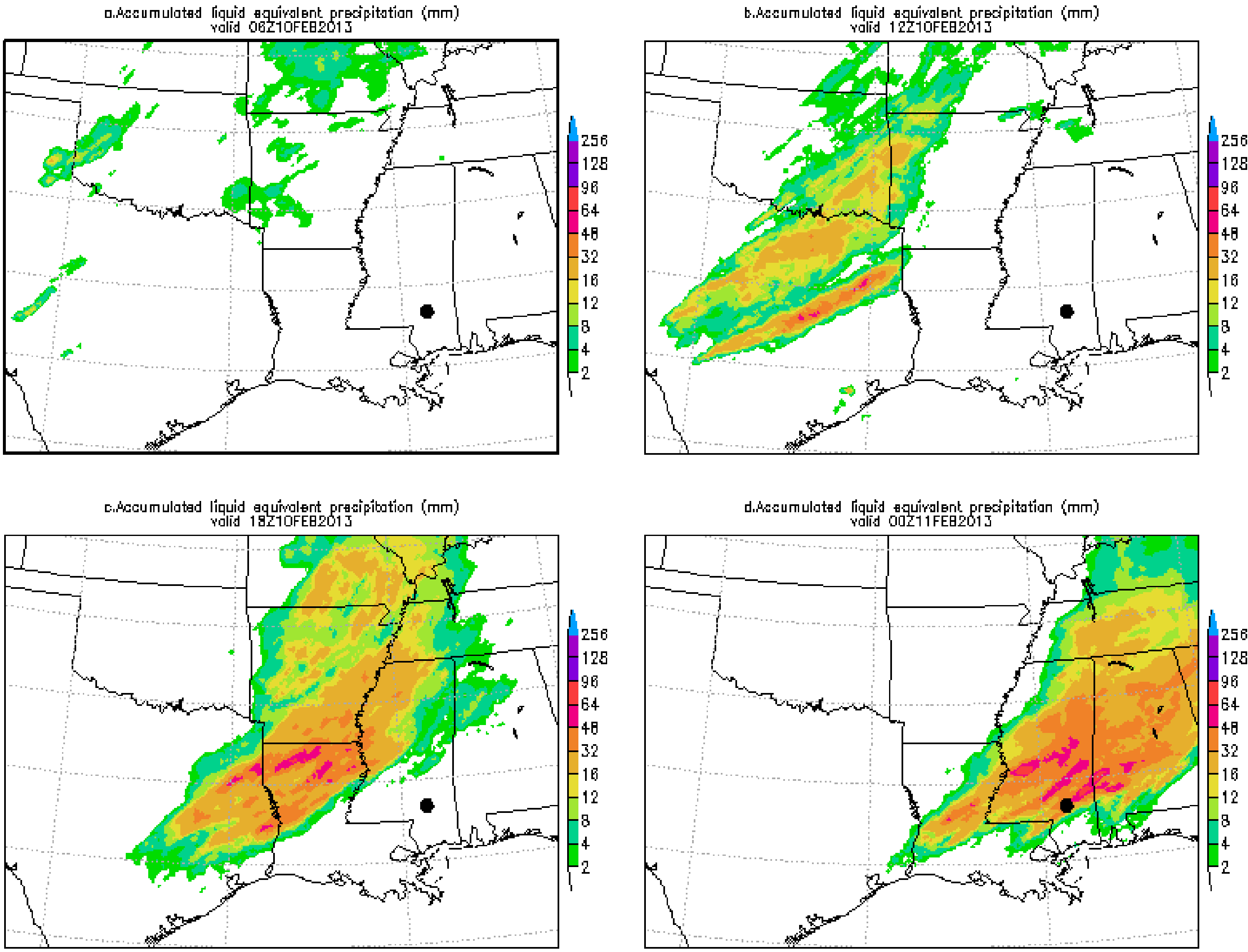


**Figure 11. As in Figure 11 except for QPE ending for the 6-hour perids from a) 0600 UTC 10 February through d) 0000 UTC 11 February 2013.** **[Return to text.]**

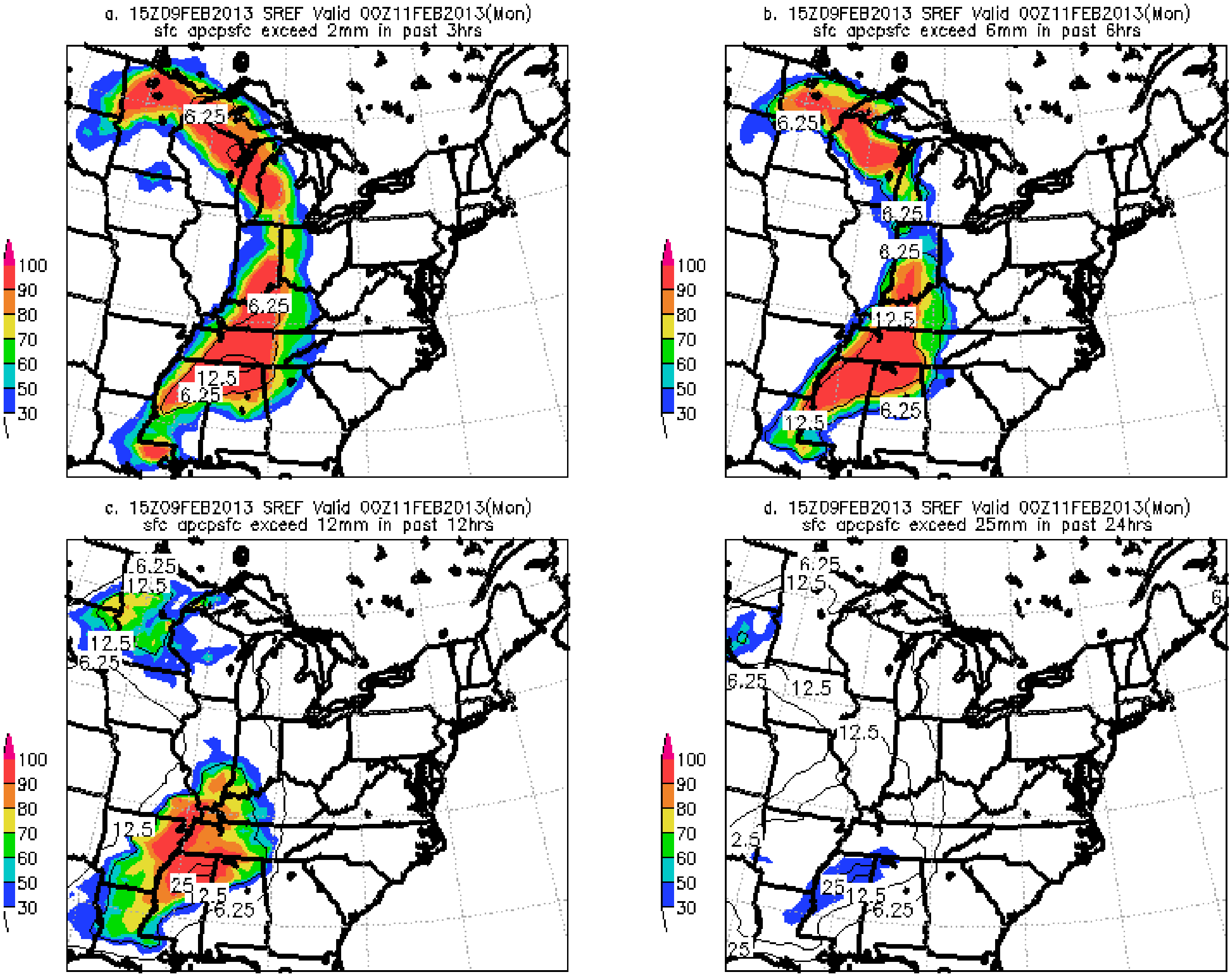


**Figure 12. NCEP SREF initialized at 1500 UTC 9 February 2013 showing QPF valid at 0000 UTC 11 February 2013 including a) the probability of 2mm or more QPF in the last 3 hours, b) the probability of 6mm or more QPF in the last 6 hours, c) the probability of 12 mm of QPF in the last 12 hours and d) the probability of 25 mm or more QPF in the last 24 hours. Probabilities are shaded and contours are every 6.25, 12.5 25 and 50 mm****. Return to text.**