

The record warmth of 11 February 2009

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1. INTRODUCTION

A surge of warm air produced record high temperatures over much of Pennsylvania and the eastern United States on 11 February 2009 (Fig. 1). High temperatures range through the 50s and 60s over most of central Pennsylvania ([Table 1](#)) and most locations set new record highs for the day. It should be noted that NWS COOP sites record temperatures for the period of 7 AM to 7 AM and thus the high for 11 February is recorded on 12 February. The values for record highs are thus from 12 February data for all COOP sites.

The warm temperatures were the result of a cyclone which moved from Colorado into the Great Lakes from 10 to 12 February. This cyclone pushed unseasonably warm and moist air into the region on 10 and 11 February, producing the record highs at many locations during the afternoon of 11 February.

This note will document warm episode of 11 February 2009.

2. METHODS

Temperature data were retrieved from the NWS COOP data and airports around central Pennsylvania. Data for the State College Forecast area were recorded in [Table 1](#). The value and date

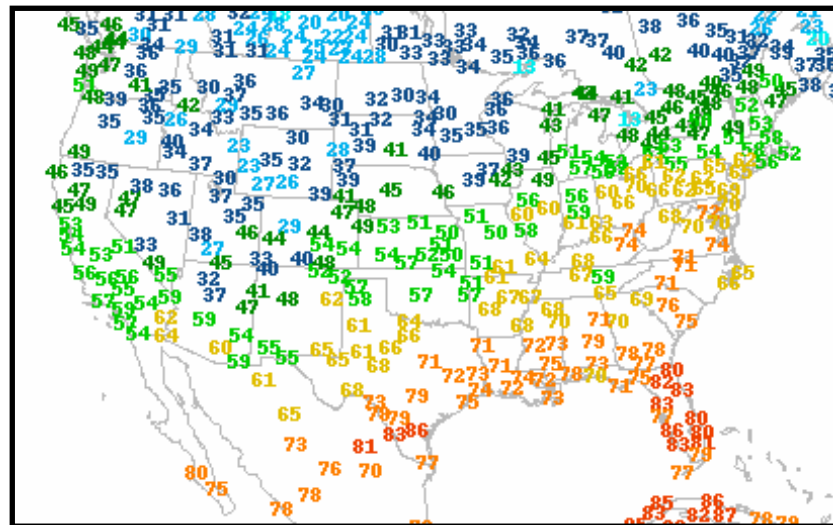


Figure 1. Maximum temperatures (F) for the continental United States valid for the 24 hour period ending at 0600 UTC 12 February 2009. Values are color coded in ten degree increments. Image courtesy of the Pennsylvania State University [e-wall website](#).

of the previous records were also recorded in [Table 1](#). Due to data collection methodologies, all COOP sites, the record highs were taken from 12 February. The high on 11 February is recorded at 7 AM on 12 February. The high at airports sites is taken from midnight to midnight.

Data used to show the patterns and anomalies were derived from NCEP models and the NCEP/NCAR global re-analysis data. All anomalies are shown in standardized anomalies.

Date and times are expressed at 11/1200 UTC for 11 February at 1200 UTC.

3. RESULTS

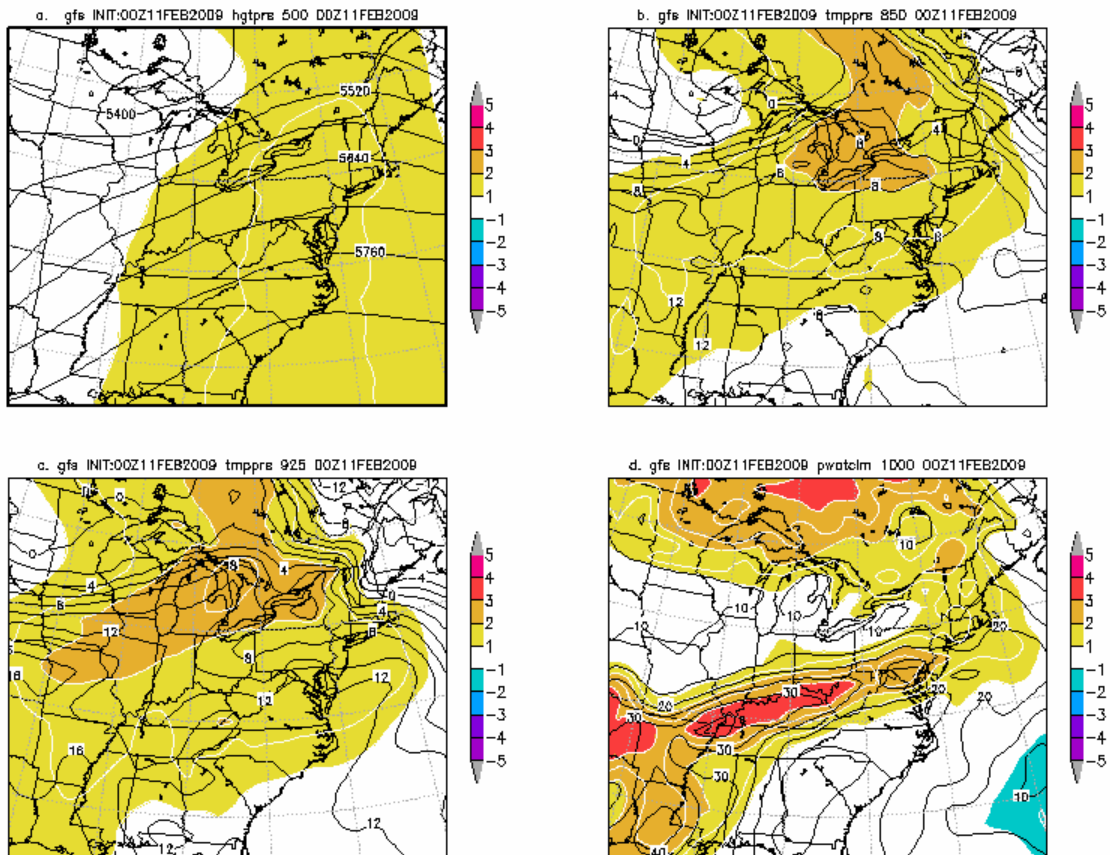


Figure 2. GFS 00-hour forecasts valid at 0000 UTC 11 February 2009 showing a) 500 hPa heights (m) and height anomalies, b) 850 hPa temperatures (C) and temperatures anomalies, c) 925 hPa temperatures (C) and temperatures anomalies, and d) precipitable water (mm) and precipitable water anomalies.

i. the pattern

Figures 2-4 show the large scale pattern over the eastern United States on 11 February at 11/0000, 11/1200 and 11/1800 UTC. Key features aloft include a 500 hPa ridge with 1 to 1.5 SD above normal 500 hPa heights which moved over the region (Figs 2a,3a, and 4a). A short-wave, associated with a surface cyclone moved over the domain from the west by 11/1200 UTC (Fig. 3a) and was over eastern Missouri by 11/1200 UTC (Fig. 4a).

The temperatures and temperature anomalies at 850 and 925 hPa depicted warm temperatures over nearly all of the eastern United States. The 850 hPa anomalies were 1 to 2 SDs above normal

with an area of 2-3SD above normal values head of the frontal boundary. Similar anomalies were present at 925 hPa and an area of +2.5 SD anomalies was present over Pennsylvania by 11/1800 UTC (Fig. 4c) when the actual values were around 12-14C.

Figure 5 shows the high temperatures on 10 February. The high warm temperatures from Texas into Illinois aligned well with both the surge of high PW air and the temperature anomalies over that region at 11/0000 UTC (Fig. 2).

In addition to the unseasonably high temperatures and heights, moisture values too were above normal. A surge of much above normal PW as indicated

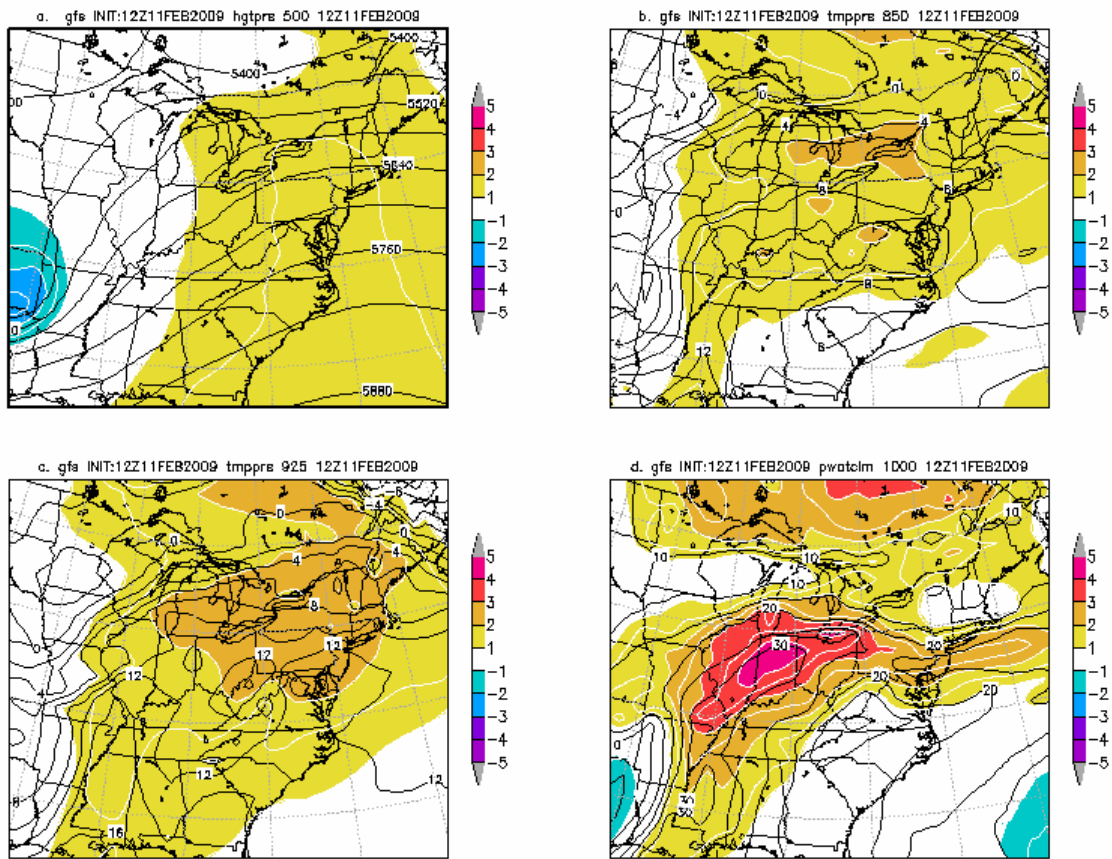


Figure 3. As in Figure 2 except valid at 1200 UTC 11 February 2009. by the PW anomalies is visible in these images. The high PW values at 11/0000 UTC likely contributed to warm overnight lows over Pennsylvania (not shown). The high PW air also played a role in the precipitation event which would end the short-lived warm episode.

ii. the forecasts

The pattern associated with this warm episode was well forecast by NCEP GFS and GEFS. For brevity only a few images are shown. The GFS forecasts initialized at 08/0000 and 09/0000 UTC valid at 11/1800 UTC are shown (Figs 6-7). The data shown are the same as those presented in Figures 2-4. Though not depicted, the thermal anomalies appeared to peak near 11/2100 UTC in several GFS forecasts.

These forecasts compare well with the observed pattern. A comparison of Figure 4c with Figure 6c is quite remarkable though the 48 hour GFS forecasts under estimated the extent of the 2SD anomalies over the Mid-Atlantic region. The frontal position over Illinois also reflected some uncertainty issues, common in all forecast. The pattern was well forecast but the details were not. The PW fields also show a good pattern in the forecasts but the details on the higher PW values is not correct.

Figure 8 shows the GEFS 850 hPa temperature forecasts initialized at 0000 UTC 7, 8, and 9 February 2009 valid at 11/1800 UTC. These forecasts show a similar pattern to those depicted by the GFS forecasts. Due to averaging of 21 members, the anomalies in the 850 hPa field are not quite as large as those

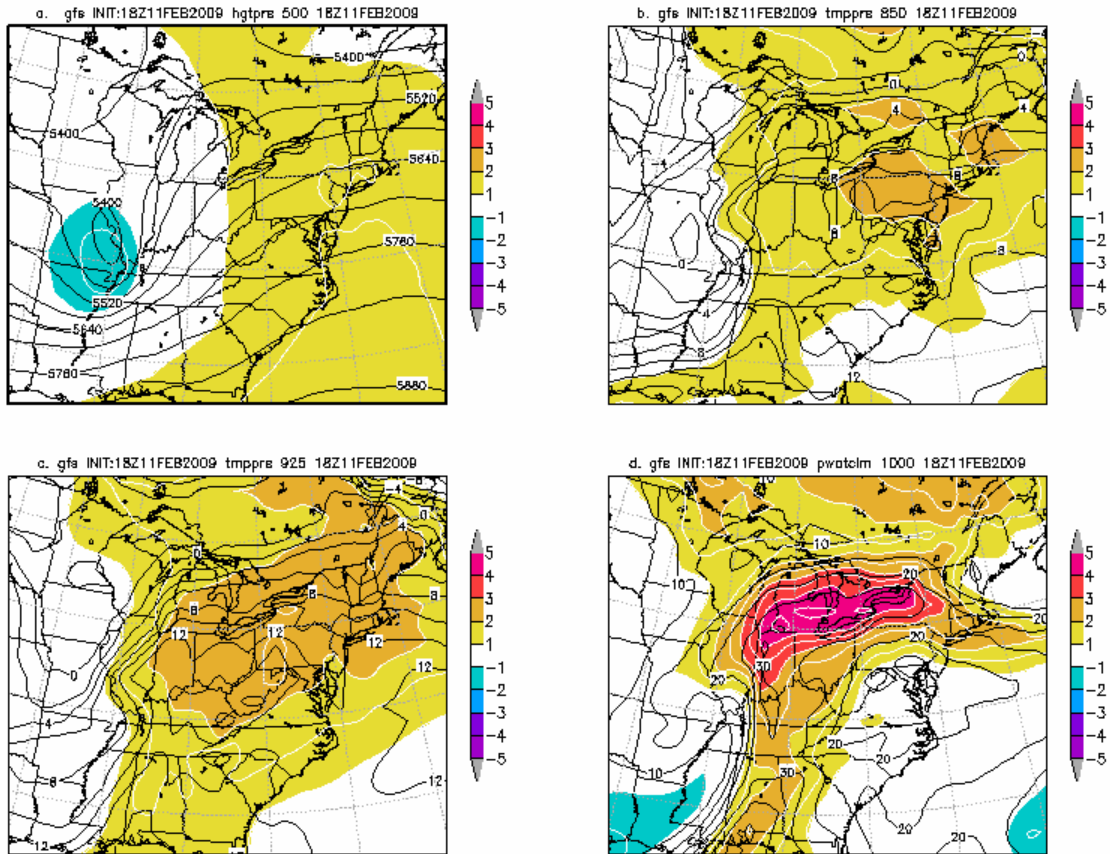


Figure 4. As in Figure 2 except valid at 1800 UTC 11 February 2009.

depicted by the single GFS. The ensemble data clearly is indicating some uncertainty though overall good agreement that it would be abnormally warm. The PW and 925 hPa temperatures showed similar patterns and are thus not shown.

4. CONCLUSIONS

An intrusion of unseasonably warm air into the eastern United States set many new high temperatures records on 11 February 2009. Due to recording methods, the COOP data show the values as of 7 AM 12 February.

The event was well predicted by the NCEP global models and ensembles (GEFS) several days in advance. Well away from fronts and cyclones, the

spread between members was relatively low and this event represented a high probability outcome event. None the less it represents a successful forecast. Due to the limits of predictability, all forecasts will show some degree of uncertainty and this event was no exception. The GFS and GEFS got the pattern correct with subtle difference verse the verifying analysis.

The pattern which produced the warm episode shared many of the characteristics of similar warm episodes and heat waves. Heat waves defined as warm episodes last 3 or more days in the summer when daily highs may exceed 95F.

The key features included a surge of above normally warm air at 850 and 925

hPa. Thermal anomalies were on the order of 2SDs above normal or higher on the day the records were set. Other features included above normal 500 hPa heights, in this case about 1.5SDs above normal and a surge of high PW air, north and west of the affected region.

A strong frontal system brought the episode to an abrupt end early on the 12th. Another common characteristic of cool season warm episodes in Pennsylvania is that the warmest air often arrives just ahead of the approaching cold front. This case followed that model to T.

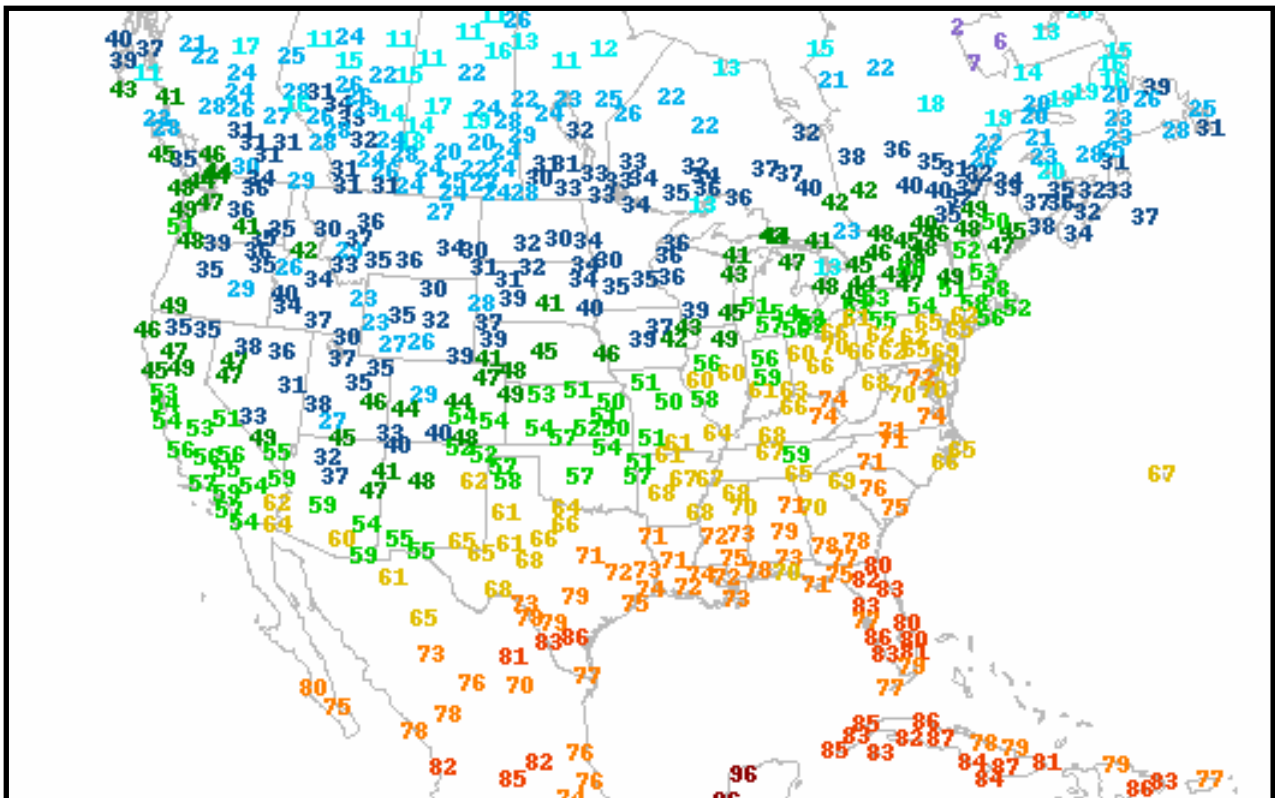


Figure 5. As in Figure 1 except valid at 0600 UTC 11 February 2009. [Return to text.](#)

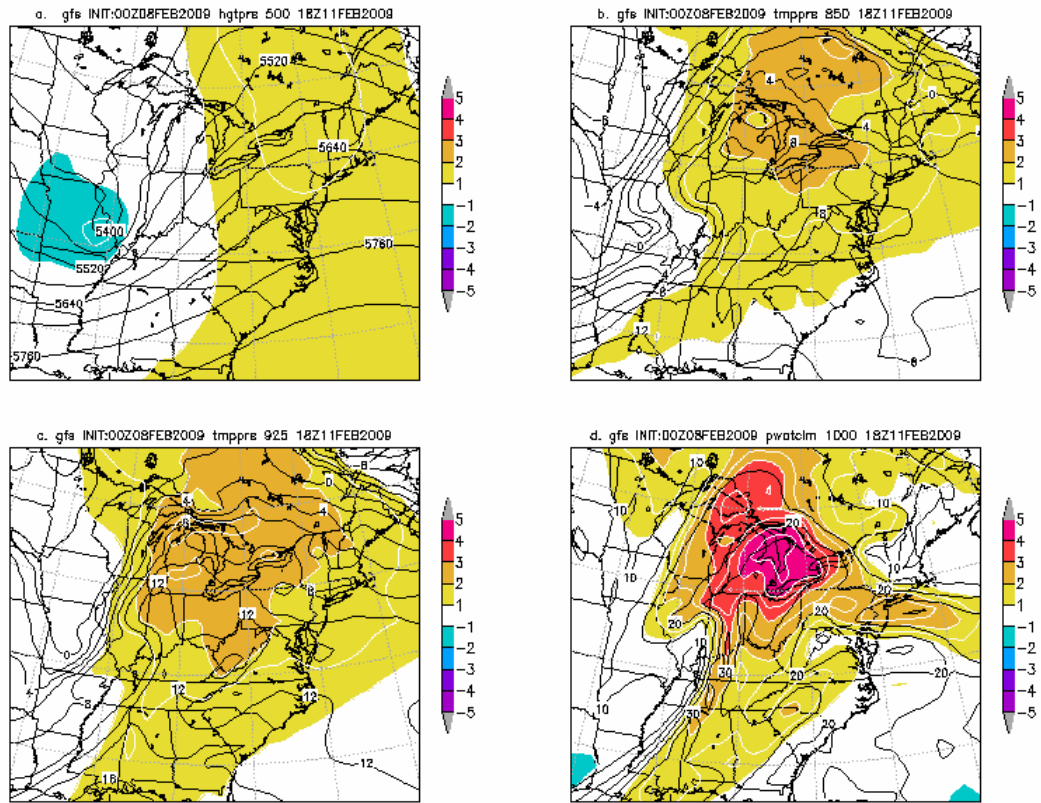


Figure 6. As in Figure 2 except GFS forecasts initialized at 0000 UTC 8 February valid at 1800 UTC 11 February 2009.

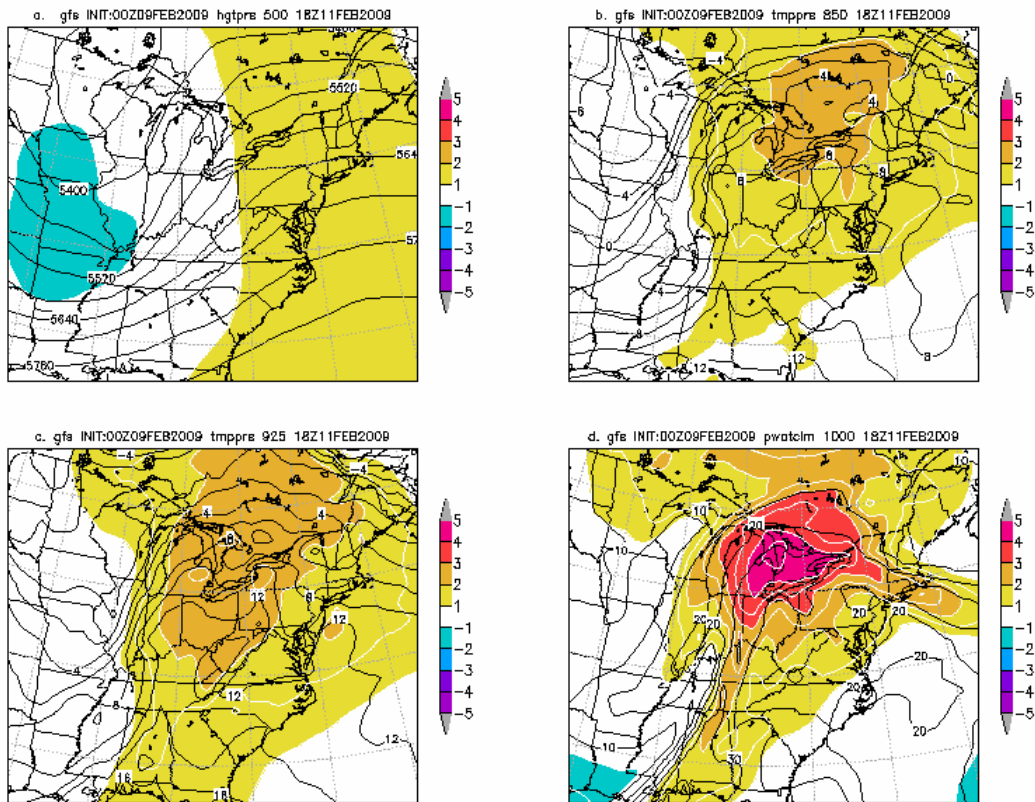


Figure 7. As in Figure 2 except GFS forecasts initialized at 0000 UTC 9 February valid at 1800 UTC 11 February 2009.

| LOCATION | RECORD | YEAR | 2009 | SITE |
|---------------------|--------|------|------|-------|
| STATE COLLEGE | 57 | 1940 | 62 | STCP1 |
| ALTOONA | 60 | 1999 | 62 | KAOO |
| HARRISBURG | 59 | 1999 | 63 | KMDT |
| WILLIAMSPORT | 55 | 1960 | 60 | KIPT |
| BRADFORD | 50 | 1960 | 55 | KBFD |
| EVERETT | 60 | 1918 | 65 | EVRP1 |
| LEWISTOWN | 61 | 1940 | 63 | LSTP1 |
| SUNBURY | 56 | 1960 | 61 | SUNP1 |
| SHIPPENSBURG | 71 | 1999 | 56 | SPBP1 |
| NEW HOLLAND | 68 | 1999 | 65 | NHDP1 |
| STEVENSON DAM | 55 | 1999 | 47 | STVP1 |
| BIGLERVILLE | 58 | 1999 | 63 | BGLP1 |
| LOCK HAVEN | 60 | 1981 | 54 | LOKP1 |
| WELLSBORO | 53 | 1940 | 54 | WLLP1 |
| SELINGSGROVE | 50 | 1951 | 55 | KSEG |
| YORK HAVEN | 50 | 1976 | 68 | YHNP1 |
| HUNTINGDON | 61 | 1940 | 65 | HUNP1 |
| KANE | 51 | 1999 | 49 | KANP1 |
| LANCASTER | 59 | 1999 | 67 | LCRP1 |
| LEBANON | 71 | 1999 | 56 | LEBP1 |
| LEWISBURG | 54 | 1999 | 61 | LBGP1 |
| PORT ALLEGHENY | 39 | 2000 | 57 | PALP1 |
| PRINCE GALLITZIN | 59 | 1999 | 66 | PGLP1 |

Table 1. A list by Station name of previous record high temperatures and the date of the record along with the temperature achieved on 11 February 2009. COOP sites record the highs for the 24 hour period of 7AM to 7AM thus the highs on Wednesday 11 February were recorded and compared to the values from 12 February. ASOS sites (site ID's begin with a K such as KAOO) record the true daily values. [Return to Text.](#)

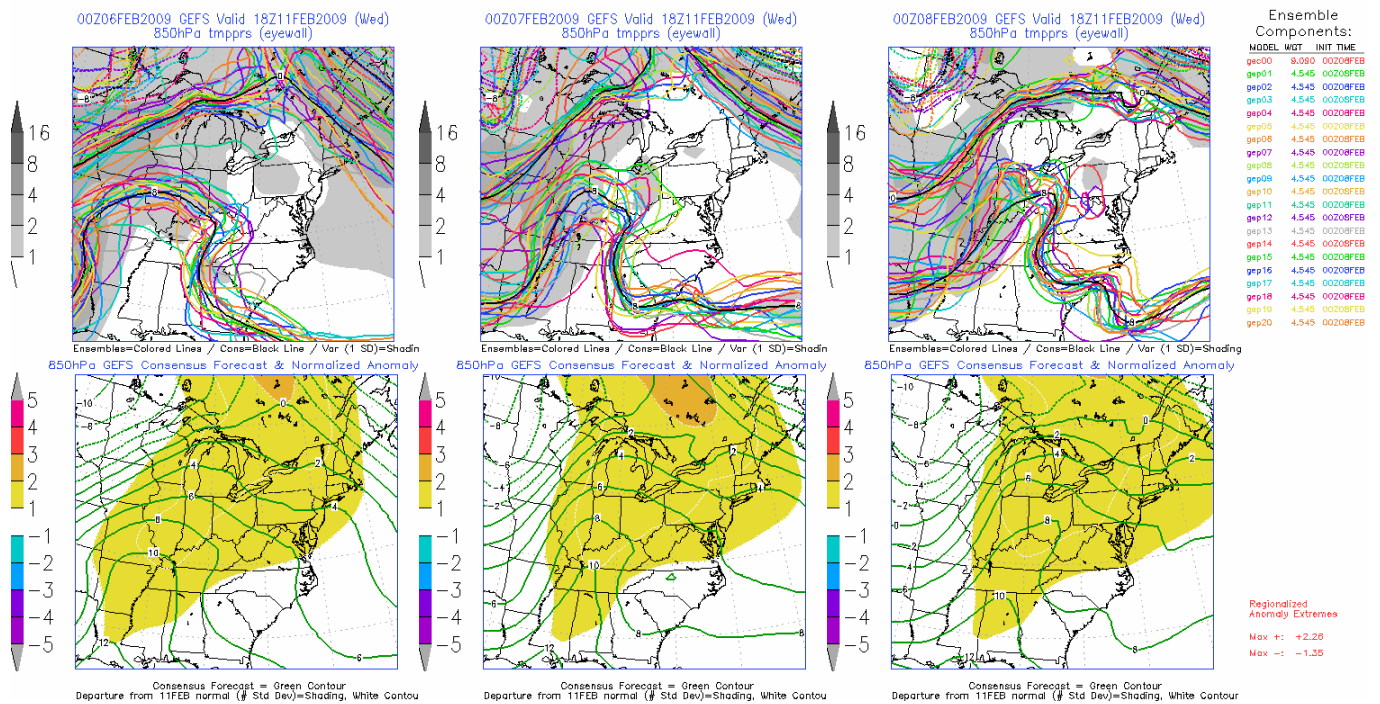


Figure 8. GEFS forecasts of 850 hPa temperature (C) valid at 1800 UTC 11 February 2009 from forecasts initialized at 0000 UTC (left) 7 February, (center) 8 February and (right) 9 February 2009. Upper panels show each member -8,0 and 8C contour with the spread about the mean. Lower panels show the ensemble mean and the spread about the mean. [Return to text.](#)