

GFS-BASED MOS GUIDANCE - THE EXTENDED-RANGE ALPHANUMERIC
MESSAGES FROM THE 0000/1200 UTC FORECAST CYCLES

by

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1. INTRODUCTION

This Technical Procedures Bulletin (TPB) describes the format and contents of the Model Output Statistics (MOS) extended-range alphanumeric messages generated during the 0000 and 1200 UTC forecast cycles of the Global Forecast System (GFS). These messages contain forecasts of the daytime maximum/nighttime minimum temperature (max/min); time-specific 2-m temperature and dewpoint; mean total sky cover; maximum sustained surface wind speed; probability of precipitation (PoP) for 12- and 24-h periods; probability of thunderstorms for 12- and 24-h periods; conditional probabilities of freezing precipitation, snow, and rain mixed with snow; categorical precipitation type; quantitative precipitation for 12- and 24-h periods; and snowfall amount for a 24-h period. All elements except the temperature and dewpoint are valid over at least a 12-h period. Guidance is provided for projections of 24 to 192 hours for most weather elements.

The extended-range GFS-based MOS messages first became operational during the 0000 UTC forecast cycle on May 31, 2000. Named after the Medium Range Forecast (MRF) model, a particular run of the Global Spectral Model, this guidance was originally known as the MRF MOS; since September 2002, this model has been referred to as the Global Forecast System model. This TPB has been revised to reflect updates to the GFS-based MOS messages implemented on March 3, 2010, and replaces MDL TPB 05-07. These updates include the completion of the precipitation type guidance and the 24-h snowfall amount guidance for the 1200 UTC message, and a change in the definition of the daytime and nighttime periods used in the maximum and minimum temperature guidance for stations in Alaska. This TPB describes both the 0000 and 1200 UTC messages. With this March 2010 update, the 0000 UTC messages are complete, the 1200 UTC messages will contain all of the forecast elements described below, except for mean total sky cover. This element will be added when it becomes available. Technical Procedures Bulletin No. 460 which described the original MRF-based MOS message is obsolete.

The NWS also produces short-range MOS text products based on the GFS model for projections of 6 to 84 hours after the 0000, 0600, 1200, and 1800 UTC forecast cycles. These messages are described in MDL TPBs 05-03 and 05-04, which are available at <http://www.nws.noaa.gov/mdl/synop/smbpublications.php>.

2. MESSAGE HEADING

| | | | | | | | | | | | | | | | |
|------|-------------------|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----------|-----|----------|----------|
| KALB | GFSX MOS GUIDANCE | | | | | | | | | | | 1/01/2005 | | 0000 UTC | |
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |

The first line of the message heading shown above (see Figs. 1 and 2 also) identifies the station for which the guidance is valid, the contents of the message, and the date and forecast cycle during which the guidance was issued. In this example, the message is valid for Albany, NY (KALB). All stations are identified by a four-character identifier. The contents of the message are identified as "GFSX MOS GUIDANCE." The forecast date is given in the form mm/dd/yyyy where mm is the month (1 through 12), dd is the day (1 through 31), and yyyy is the four-digit year. The forecast cycle is identified in Universal Coordinated Time by the standard 0000 and 1200 UTC. In this example, the MOS guidance for KALB was issued from the 0000 UTC GFS run on January 1, 2005.

The second line of the message denotes the forecast hour or projection. For the temperature and dewpoint forecasts, this projection is the specific time the forecasts are valid. For the max/min temperature, the projection gives only the approximate ending time of the periods for which the max and min temperature guidance are valid. For all other elements, the time indicates the end of the 12- or 24-h period over which the forecasts are valid.

The third line of the message denotes the day and date on which the forecast projections end. Note that the days of the week are indicated by using standard three-letter abbreviations. The heading CLIMO is for the columns containing climatic normals for the 96-120 h period in the 0000 UTC issuance, or for the 84-108 h period in the 1200 UTC issuance. Currently, climatic normals are only available for the max/min and PoP elements. Note that no date separator (/) is placed between the last forecast date and the "CLIMO" heading.

3. X/N - MAXIMUM/MINIMUM TEMPERATURE

| | | | | | | | | | | | | | | | |
|------|-------------------|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----------|-----|----------|----------|
| KALB | GFSX MOS GUIDANCE | | | | | | | | | | | 1/01/2005 | | 0000 UTC | |
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| X/N | 47 | 20 | 41 | 35 | 45 | 25 | 32 | 23 | 30 | 25 | 33 | 24 | 36 | 21 | 37 12 31 |

The max/min surface temperature forecasts are displayed for projections of 24 to 192 hours every 12 hours after 0000 or 1200 UTC. Although the forecasts are presented at consecutive 12-h intervals, each forecast is actually valid for a daytime or nighttime period. Daytime is defined as 7 a.m. to 7 p.m. Local Standard Time (LST) and nighttime is defined as 7 p.m. to 8 a.m. LST. For stations in Alaska only, daytime is defined as 5 a.m. to 8 p.m. LST and nighttime is defined as 5 p.m. to 11 a.m. LST. Thus, the valid date in the appropriate column of the DT and HR lines must be converted by the forecaster to his/her local date. This local date then denotes the appropriate daytime or nighttime for the max or min temperature forecast. For the 0000 UTC forecast cycle, the

March 3, 2010

temperatures are shown in max/min (X/N) order and are valid for today's max, tonight's min, tomorrow's max, and so on. For the 1200 UTC cycle, the temperatures are shown in min/max (N/X) order and are valid for tonight's min, tomorrow's max, tomorrow night's min, and so on. The normal min and max (for January 5th in this example) are given in the column labeled "CLIMO". Note that these normals are based on the 1961-1990 normals provided by the National Climatic Data Center, and are not available for all stations in the message. Also, since the message does not include a leading space before the normals, min normals of -10F or less, or max normals of 100F or more will appear with no spaces between them and the preceding max or min value. Each temperature forecast is presented to the nearest whole degree Fahrenheit and three characters are allowed. A missing forecast is indicated by a 999.

4. TMP - 2-M TEMPERATURE

| KALB | GFSX MOS GUIDANCE | | | 1/01/2005 0000 UTC | | | | | | | | | | | |
|------|-------------------|-----|----|--------------------|----|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| TMP | 33 | 22 | 38 | 37 | 36 | 27 | 28 | 25 | 27 | 27 | 29 | 27 | 30 | 24 | 32 |

Time-specific 2-m temperature forecasts are valid every 12 hours from 24 to 192 hours after 0000 and 1200 UTC. These forecasts are valid specifically at either 0000 or 1200 UTC in contrast to the max/min forecasts which are valid for a period. Each temperature forecast is presented to the nearest whole degree Fahrenheit; a missing forecast is indicated by a 999.

5. DPT - 2-M DEWPOINT

| KALB | GFSX MOS GUIDANCE | | | 1/01/2005 0000 UTC | | | | | | | | | | | |
|------|-------------------|-----|----|--------------------|----|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| DPT | 18 | 12 | 25 | 32 | 26 | 24 | 25 | 22 | 23 | 24 | 24 | 21 | 21 | 19 | 25 |

Time-specific 2-m dewpoint forecasts are valid every 12 hours from 24 to 192 hours after 0000 and 1200 UTC. These forecasts are valid specifically at either 0000 or 1200 UTC in contrast to the max/min forecasts which are valid for a period. Each dewpoint forecast is presented to the nearest whole degree Fahrenheit; a missing forecast is indicated by a 999.

6. CLD - MEAN TOTAL SKY COVER CATEGORIES

| KALB | GFSX MOS GUIDANCE | | | 1/01/2005 0000 UTC | | | | | | | | | | | |
|------|-------------------|-----|----|--------------------|----|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| CLD | CL | CL | OV | OV | PC | OV | OV | OV | OV | OV | OV | PC | PC | OV | OV |

Categorical predictions of the mean total sky cover are available in plain language for 12-h periods ending 24 to 192 hours after 0000 and 1200 UTC. The forecasts are valid for the 1200-0000 and 0000-1200 UTC periods. The categorical forecasts are displayed as CL (mostly clear), PC (partly cloudy), or OV (mostly overcast); a missing forecast is denoted by XX. The categorical forecast is determined from the 3-category probability distribution of the mean total sky cover. The categories are defined by applying the breakpoints listed below to the mean cloudiness in each 12-h period.

Total Sky Cover Categories

- CL - mostly clear (mean cloudiness < 31%);
- PC - mixed clouds and clear skies, (31% ≤ mean cloudiness < 68%);
- OV - mostly overcast, (mean cloudiness ≥ 68%).

Future changes will convert this to a 5 category system. More details will be forthcoming at that time.

7. WND - MAXIMUM SUSTAINED SURFACE WIND SPEED

| KALB | GFSX MOS GUIDANCE 1/01/2005 0000 UTC | | | | | | | | | | | | | | |
|------|--------------------------------------|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | | ... | | | | | | |
| WND | 19 | 8 | 14 | 15 | 12 | 7 | 6 | 7 | 11 | 9 | 12 | 13 | 13 | 10 | 13 |

Maximum sustained surface wind speed forecasts (WND) are given for 12-h periods ending 24 to 192 hours after 0000 and 1200 UTC. The forecasts are valid for intervals ending at 0000 or 1200 UTC. Each forecast indicates the highest 10-m wind speed (2-minute average) expected to occur during the 12-h interval. Wind speed forecasts valid at specific hours (not shown in this message) are generated for projections of 6, 9, 12, 15, ..., 189, and 192 hours after the initial model time of 0000 or 1200 UTC. The WND guidance value is obtained by taking the greatest of the five speed forecasts valid during the appropriate 12-h interval. Each wind speed is reported to the nearest knot; a missing forecast will be denoted by 999.

8. P12 - PROBABILITY OF PRECIPITATION IN A 12-H PERIOD

| KALB | GFSX MOS GUIDANCE 1/01/2005 0000 UTC | | | | | | | | | | | | | | |
|------|--------------------------------------|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | | ... | | | | | | |
| P12 | 2 | 0 | 79 | 62 | 7 | 56 | 52 | 48 | 63 | 50 | 48 | 31 | 16 | 23 | 25 26 27 |

The P12 forecasts are the probability of 0.01 inches or more of liquid-equivalent precipitation (PoP) occurring during a 12-h period. The 12-h PoPs are valid for intervals from 0000-1200 or 1200-0000 UTC ending 24 to 192 hours after 0000 and 1200 UTC. In the message, the forecast values are displayed under the ending time of the period. The probability is given to the nearest percent. Values range from 0 to 100%. A missing

forecast value is indicated by 999. The normal observed relative frequencies of 0.01 inches or more of precipitation for the 96-108 and 108-120 h periods for the 0000 UTC issuance (January 5th in this example), and 84-96 and 96-108 h periods for the 1200 UTC issuance are shown in the column labeled "CLIMO".

9. P24 - PROBABILITY OF PRECIPITATION IN A 24-H PERIOD

| KALB | GFSX MOS GUIDANCE 1/01/2005 0000 UTC | | | | | | | | | | | | | | | |
|------|--------------------------------------|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 | |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 | CLIMO |
| P24 | | | 79 | | 72 | | 74 | | 67 | | 62 | | 48 | | 38 | 39 |

The P24 forecasts are the probability of 0.01 inches or more of liquid-equivalent precipitation (PoP) occurring during a 24-h period. The 24-h PoPs are valid for intervals from 0000-0000 UTC ending 48 to 192 hours after 0000 UTC and 36 to 180 hours after 1200 UTC. In the message, the forecast values are displayed under the ending time of the period. The probability is given to the nearest percent. Values range from 0 to 100%. A missing forecast value is indicated by 999. Note that the normal observed relative frequency of 0.01 or more inches of precipitation for the 96-120 h period for the 0000 UTC issuance (January 5th in this example), and the 84-108 h period for the 1200 UTC issuance is given under the "CLIMO" column.

10. Q12 - QUANTITATIVE PRECIPITATION AMOUNT IN A 12-H PERIOD

| KALB | GFSX MOS GUIDANCE 1/01/2005 0000 UTC | | | | | | | | | | | | | | | |
|------|--------------------------------------|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 | |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 | CLIMO |
| Q12 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | 4 | 2 | 2 | 1 | | | | |

Guidance for liquid-equivalent precipitation amount (QPF) accumulated during a 12-h period is presented in categorical form. These forecasts are available for intervals from 0000-1200 and 1200-0000 UTC ending 24 to 156 hours after 0000 and 1200 UTC. In the message, the forecasts are displayed beneath the ending projection of the period. The QPF guidance is a categorical forecast of liquid-equivalent precipitation equaling or exceeding certain specified amounts in the 12-h periods. The categories are as follows:

QPF Categories

- 0 = no precipitation expected;
- 1 = 0.01 - 0.09 inches;
- 2 = 0.10 - 0.24 inches;
- 3 = 0.25 - 0.49 inches;
- 4 = 0.50 - 0.99 inches;
- 5 = 1.00 - 1.99 inches;
- 6 = ≥ 2.00 inches.

Missing forecasts are denoted by 9. The categorical guidance is prepared by using probability forecasts of the same categories.

11. Q24 - QUANTITATIVE PRECIPITATION AMOUNT IN A 24-H PERIOD

| KALB | GFSX MOS GUIDANCE | | | | | | | | 1/01/2005 0000 UTC | | | | | | | |
|------|-------------------|--------|----|--------|----|--------|----|--------|--------------------|--------|-----|--------|-----|--------------|-----|--|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 | |
| SAT | 01 | SUN 02 | | MON 03 | | TUE 04 | | WED 05 | | THU 06 | | FRI 07 | | SAT 08 CLIMO | | |
| Q24 | | 2 | | 1 | | 2 | | 4 | | 3 | | | | | | |

Guidance for liquid-equivalent precipitation amount (QPF) accumulated during a 24-h period is presented in categorical form. These forecasts are available for intervals from 0000-0000 UTC ending 48 to 144 hours after 0000 UTC and 36 to 156 hours after 1200 UTC. In the message, the forecasts are displayed beneath the ending projection of the period. The QPF guidance is a categorical forecast of liquid-equivalent precipitation equaling or exceeding certain specified amounts in the 24-h periods. The categories are as follows:

QPF Categories

- 0 = no precipitation expected;
- 1 = 0.01 - 0.09 inches;
- 2 = 0.10 - 0.24 inches;
- 3 = 0.25 - 0.49 inches;
- 4 = 0.50 - 0.99 inches;
- 5 = 1.00 - 1.99 inches;
- 6 = ≥ 2.00 inches.

Missing forecasts are denoted by 9. The categorical guidance is prepared by using probability forecasts of the same categories.

12. T12 - PROBABILITY OF THUNDERSTORMS IN A 12-H PERIOD

| KALB | GFSX MOS GUIDANCE | | | | | | | | 1/01/2005 0000 UTC | | | | | | | |
|------|-------------------|--------|----|--------|----|--------|----|--------|--------------------|--------|-----|--------|-----|--------------|-----|--|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 | |
| SAT | 01 | SUN 02 | | MON 03 | | TUE 04 | | WED 05 | | THU 06 | | FRI 07 | | SAT 08 CLIMO | | |
| T12 | 1 | 2 | 0 | 1 | 0 | 2 | 2 | 3 | 3 | 5 | 5 | 3 | 0 | 0 | 1 | |

The T12 forecasts are the probability of thunderstorms occurring during a 12-h period. The 12-h probability forecasts are valid for intervals from 0000-1200 or 1200-0000 UTC ending 24 to 192 hours after 0000 or 1200 UTC. The forecasts are displayed in the message beneath the ending projection of the period. The thunderstorm probability is given to the nearest whole percent. Values range from 0 to 100%. A missing forecast value is indicated by 999. Probabilities are available year-round for stations in the contiguous U.S. and from May 1 – September 30 in Alaska. Note that these probabilities represent the likelihood of the event within a box approximately 40 km on a side and

containing the station specified. Forecasts are unavailable for stations in Hawaii and Puerto Rico because reports from the National Lightning Detection Network (NLDN) used to define the MOS thunderstorm predictand were unavailable in those areas.

13. T24 - PROBABILITY OF THUNDERSTORMS IN A 24-H PERIOD

| KALB | GFSX MOS GUIDANCE | | | | 1/01/2005 0000 UTC | | | | | | | | | | |
|------|-------------------|-----|----|-----|--------------------|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | ... | | | | | | | |
| T24 | | 2 | | 1 | | 5 | | 3 | | 5 | | 5 | | 2 | |

The T24 forecasts are the probability of thunderstorms occurring during a 24-h period. The 24-h probability forecasts are valid for intervals from 1200-1200 UTC ending 36 to 180 hours after 0000 UTC and 48 to 192 hours after 1200 UTC. The forecast values are displayed under the ending projection of the period. The thunderstorm probability is given to the nearest whole percent. Values range from 0 to 100%. A missing forecast value is indicated by 999. Probabilities are available year-round for stations in the contiguous U.S. and from May 1 – September 30 in Alaska. Note that these probabilities represent the likelihood of the event within a box approximately 40 km on a side and containing the station specified. Forecasts are unavailable for stations in Hawaii and Puerto Rico because reports from the NLDN used to define the MOS thunderstorm predictand were unavailable in those areas.

14. PZP - PROBABILITY OF FREEZING PRECIPITATION IN A 12-H PERIOD (CONDITIONAL)

| KALB | GFSX MOS GUIDANCE | | | | 1/01/2005 0000 UTC | | | | | | | | | | |
|------|-------------------|-----|----|-----|--------------------|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | ... | | | | | | | |
| PZP | 17 | 38 | 42 | 28 | 13 | 30 | 34 | 43 | 37 | 38 | 27 | 30 | 21 | 24 | 26 |

Conditional probability of freezing precipitation (given that precipitation is occurring) forecasts are available for 12-h intervals ending 24 to 192 hours after 0000 and 1200 UTC. The 12-h forecast periods are from either 1200-0000 UTC or 0000-1200 UTC. Freezing precipitation is defined as the occurrence of freezing rain or drizzle, ice pellets (sleet), or any mixture of freezing rain, drizzle, or ice pellets with other precipitation types during the 12-h period. The probabilities are given to the nearest whole percent, and values range from 0 to 100%. Missing values are indicated by 999. These probabilities are used in producing the categorical TYP forecast described in Section 17. The PZP guidance is transmitted only during the period of September 1 – May 31. Forecasts are not available for stations in Hawaii and the Caribbean Islands, where freezing rain and snow rarely occur. In these cases, the PZP line will not appear in the message at any time of the year.

15. PSN - PROBABILITY OF SNOW IN A 12-H PERIOD (CONDITIONAL)

| KALB | GFSX MOS GUIDANCE | | | | 1/01/2005 0000 UTC | | | | | | | | | | |
|------|-------------------|-----|----|-----|--------------------|-----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 CLIMO |
| | | | | | | | | ... | | | | | | | |
| PSN | 34 | 52 | 19 | 0 | 10 | 25 | 28 | 28 | 35 | 30 | 33 | 27 | 55 | 49 | 40 |

Conditional probability of snow (given that precipitation is occurring) forecasts are available for 12-h intervals ending 24 to 192 hours after 0000 and 1200 UTC. The 12-h forecast intervals are from either 1200-0000 UTC or 0000-1200 UTC. Snow is defined as the occurrence of a pure snow event, that is, snow, snow showers, snow grains, or snow pellets or any combination of those elements. The probabilities are given to the nearest whole percent, and values range from 0 to 100%. Missing values are indicated by 999. These probabilities are used in producing the categorical TYP forecast described in Section 17. The PSN guidance is transmitted only during the period of September 1 - May 31. Forecasts are not available for stations in Hawaii and the Caribbean Islands, where freezing rain and snow rarely occur. In these cases, the PSN line will not appear in the message at any time of the year.

16. PRS - PROBABILITY OF RAIN MIXED WITH SNOW IN A 12-H PERIOD (CONDITIONAL)

| KALB | GFSX MOS GUIDANCE 1/01/2005 0000 UTC | | | | | | | | | | | | | | |
|------|--------------------------------------|--------|--------|--------|--------|--------|--------|--------|-------|-----|-----|-----|-----|-----|-----|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN 02 | MON 03 | TUE 04 | WED 05 | THU 06 | FRI 07 | SAT 08 | CLIMO | | | | | | |
| | ... | | | | | | | | | | | | | | |
| PRS | 20 | 9 | 5 | 10 | 17 | 12 | 11 | 8 | 6 | 3 | 8 | 18 | 7 | 11 | 12 |

Conditional probability of rain mixed with snow (given that precipitation is occurring) forecasts are available for 12-h intervals ending 24 to 192 hours after 0000 and 1200 UTC. The 12-h forecast intervals are from either 1200-0000 UTC or 0000-1200 UTC. Rain mixed with snow is defined as the occurrence of both rain (or drizzle) and snow (see definition in Section 15) in the 12-h period. The probabilities are given to the nearest whole percent, and values range from 0 to 100%. Missing values are indicated by 999. Although the conditional probability of rain is not included in the message, it can be inferred since the sum of the probabilities of freezing precipitation (Section 14), snow (Section 15), rain and snow mixed, and rain is 100%. These probabilities are used in producing the categorical TYP forecast described in Section 17. The PRS guidance is transmitted only during the period of September 1 - May 31. Forecasts are not available for stations in Hawaii and the Caribbean Islands, where freezing rain and snow rarely occur. In these cases, the PRS line will not appear in the message at any time of the year.

17. TYP - PRECIPITATION TYPE FORECASTS (CONDITIONAL)

| KALB | GFSX MOS GUIDANCE 1/01/2005 0000 UTC | | | | | | | | | | | | | | |
|------|--------------------------------------|--------|--------|--------|--------|--------|--------|--------|-------|-----|-----|-----|-----|-----|-----|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| SAT | 01 | SUN 02 | MON 03 | TUE 04 | WED 05 | THU 06 | FRI 07 | SAT 08 | CLIMO | | | | | | |
| | ... | | | | | | | | | | | | | | |
| TYP | S | Z | Z | Z | R | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z |

The TYP guidance in the message gives the conditional forecast precipitation type (if precipitation occurs) for 12-h periods ending 24 to 192 hours after the initial hour of 0000

and 1200 UTC. The 12-h forecast intervals are from either 1200-0000 UTC or 0000-1200 UTC. These categorical forecasts are obtained from the probability forecasts described in sections 14 – 16. The forecast is indicated by one or two characters where "Z" represents freezing precipitation (freezing rain, freezing drizzle, ice pellets (sleet), or any report of these elements mixed with other precipitation types), "S" represents snow (snow, snow grains, snow pellets, or snow showers), "RS" represents rain and snow mixed, and "R" represents liquid precipitation (rain or drizzle). A missing forecast is denoted by "X". The precipitation type guidance is transmitted only during the period of September 1 - May 31. Forecasts are not available for stations in Hawaii and the Caribbean Islands, where freezing rain and snow rarely occur. In these cases, the TYP line will not appear in the message at any time of the year.

18. SNW - SNOWFALL AMOUNT CATEGORICAL FORECAST

| KALB | GFSX MOS GUIDANCE | | | | | | | | | | | | 1/01/2005 | | 0000 UTC | | | |
|------|-------------------|-----|----|-----|----|-----|----|-----|-----|-----|-----|-----|-----------|-----|----------|-------|--|--|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 | | | |
| SAT | 01 | SUN | 02 | MON | 03 | TUE | 04 | WED | 05 | THU | 06 | FRI | 07 | SAT | 08 | CLIMO | | |
| | | | | | | | | | ... | | | | | | | | | |
| SNW | | | 0 | | 0 | | 1 | | | 1 | | 1 | | | | | | |

Guidance for snowfall amount accumulated during a 24-h period is presented in categorical form. These forecasts are available for intervals from 0000-0000 UTC ending 48 to 144 hours after 0000 UTC and 36 to 156 hours after 1200 UTC. Since observations from the cooperative observer network are used to define the event, the valid times are only approximations. The categories are denoted as follows:

Snow Amount Categories

- 0 = no snow or a trace expected;
- 1 = > a trace to < 2 inches expected;
- 2 = 2 to < 4 inches;
- 4 = 4 to < 6 inches;
- 6 = 6 to < 8 inches;
- 8 = ≥ 8 inches.

A missing forecast is denoted by 9; forecasts are disseminated only for the period of September 1 - May 31. Forecasts are not available for stations in southern Florida, Hawaii, the Caribbean Islands, and parts of California, where snow rarely occurs. In these cases, the SNW line will not appear in the message at any time of the year.

19. AVAILABILITY

The extended-range GFS-based alphanumeric message is produced twice each day (at approximately 0500 and 1700 UTC) and is distributed in 10 alphanumeric messages transmitted to NWS NOAAPORT and Family of Services (FOS) circuits. Six messages contain guidance for stations in the contiguous U.S., Puerto Rico, and the Caribbean

Islands, three contain guidance for Alaskan sites, and one contains guidance for stations in Hawaii. The following WMO Headers and AWIPS ids are used:

| <u>REGION</u> | <u>WMO HEADING</u> | <u>AWIPS ID</u> |
|------------------|--------------------|-----------------|
| Pacific | FEPA20 KWNO | MEXPA0 |
| Northeast | FEUS21 KWNO | MEXNE1 |
| Southeast | FEUS22 KWNO | MEXSE1 |
| North Central | FEUS23 KWNO | MEXNC1 |
| South Central | FEUS24 KWNO | MEXSC1 |
| Rocky Mountain | FEUS25 KWNO | MEXRM1 |
| West Coast | FEUS26 KWNO | MEXWC0 |
| Southeast Alaska | FEAK37 KWNO | MEXAJK |
| Central Alaska | FEAK38 KWNO | MEXAFC |
| Northern Alaska | FEAK39 KWNO | MEXAFG |

Separate WMO Headings and AWIPS ids are used to distribute extended-range GFS-based MOS guidance for a subset of stations to the Air Force Weather Agency (AFWA). These messages are only distributed over military communication lines. Twenty-seven messages contain guidance for stations in the contiguous U.S., three contain guidance for Alaskan sites, one contains guidance for stations in Hawaii, and one contains guidance for Puerto Rico. The following two-line headers are used:

| <u>REGION</u> | <u>WMO HEADING</u> | <u>AWIPS ID</u> |
|-----------------|--------------------|--------------------------------|
| Contiguous U.S. | FEUS30 KWNO | MEXFxx, where xx=01 through 27 |
| Alaska | FEAK30 KWNO | MEXFxx, where xx=50 through 52 |
| Pacific | FEPA30 KWNO | MEXF70 |
| Caribbean | FECA40 KWNO | MEXF80 |

20. STATION LIST

As of August 2001, the extended-range MOS guidance was available for 1060 stations in the United States. Guidance for additional sites was added in 2002, 2003, 2006 and 2010. At the time of this writing, guidance is available for 1693 stations. The reader may check the following web page for the complete station list by WMO Heading:

<http://www.nws.noaa.gov/mdl/synop/stadrg.php>

As of September 2001, the Air Force messages are available for 273 stations in the United States. The complete station list, organized by WMO Heading, can be found on the following web page:

<http://www.nws.noaa.gov/mdl/synop/afstadrg.php>

Figure 1. Sample 1200 UTC message.

| KFSD | GFSX | | MOS | | GUIDANCE | | 3/03/2010 | | | | 1200 UTC | | | | |
|------|------|----|-----|----|----------|----|-----------|-----|-----|-----|----------|-----|-----|-----|-----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| | THU | 04 | FRI | 05 | SAT | 06 | SUN | 07 | MON | 08 | TUE | 09 | WED | 10 | THU CLIMO |
| N/X | 16 | 35 | 25 | 37 | 27 | 36 | 26 | 42 | 27 | 42 | 25 | 41 | 22 | 41 | 24 19 41 |
| TMP | 20 | 32 | 29 | 34 | 29 | 33 | 29 | 38 | 30 | 38 | 27 | 37 | 25 | 36 | 27 |
| DPT | 16 | 26 | 24 | 28 | 25 | 28 | 25 | 29 | 25 | 29 | 22 | 26 | 20 | 24 | 21 |
| WND | 5 | 10 | 9 | 14 | 14 | 11 | 7 | 7 | 8 | 17 | 17 | 12 | 9 | 11 | 9 |
| P12 | 0 | 2 | 3 | 13 | 39 | 37 | 15 | 15 | 12 | 19 | 14 | 13 | 10 | 15 | 12 22 20 |
| P24 | | 2 | | 16 | | 59 | | 23 | | 28 | | 22 | | 22 | 32 |
| Q12 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| Q24 | | 0 | | 0 | | 2 | | 0 | | 0 | | 0 | | | |
| T12 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| T24 | | | 0 | | 1 | | 1 | | 0 | | 2 | | 1 | | 2 |
| PZP | 17 | 32 | 35 | 29 | 31 | 37 | 22 | 11 | 11 | 19 | 10 | 10 | 9 | 9 | 8 |
| PSN | 78 | 51 | 21 | 0 | 0 | 25 | 45 | 26 | 16 | 28 | 40 | 60 | 50 | 56 | 50 |
| PRS | 5 | 1 | 24 | 20 | 22 | 29 | 28 | 15 | 14 | 25 | 26 | 15 | 22 | 18 | 20 |
| TYP | S | Z | Z | Z | Z | Z | Z | RS | R | Z | S | S | S | S | S |
| SNW | | 0 | | 0 | | 1 | | 0 | | 0 | | 0 | | | |

Note the missing CLD line in the 1200 UTC sample message.

Figure 2. Sample 0000 UTC message.

| KFSD | GFSX | | MOS | | GUIDANCE | | 3/03/2010 | | | | 0000 UTC | | | | |
|------|------|-----|-----|-----|----------|-----|-----------|-----|-----|-----|----------|-----|-----|-----|----------|
| FHR | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 |
| WED | 03 | THU | 04 | FRI | 05 | SAT | 06 | SUN | 07 | MON | 08 | TUE | 09 | WED | 10 CLIMO |
| X/N | 33 | 15 | 34 | 27 | 37 | 26 | 38 | 26 | 43 | 27 | 44 | 28 | 45 | 28 | 42 19 41 |
| TMP | 28 | 18 | 32 | 30 | 34 | 29 | 34 | 29 | 39 | 30 | 40 | 31 | 40 | 31 | 38 |
| DPT | 21 | 14 | 26 | 25 | 28 | 24 | 28 | 25 | 30 | 25 | 32 | 26 | 31 | 25 | 29 |
| CLD | CL | CL | PC | OV | OV | OV | OV | OV | OV | OV | OV | OV | OV | OV | OV |
| WND | 5 | 5 | 10 | 9 | 12 | 13 | 9 | 8 | 9 | 12 | 19 | 20 | 15 | 15 | 15 |
| P12 | 2 | 1 | 1 | 3 | 14 | 48 | 34 | 12 | 14 | 22 | 34 | 39 | 31 | 36 | 12 22 20 |
| P24 | | | 1 | | 16 | | 56 | | 19 | | 38 | | 48 | | 36 32 |
| Q12 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 2 | 1 | | | |
| Q24 | | | 0 | | 0 | | 2 | | 0 | | 1 | | | | |
| T12 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 2 | 3 | 3 | 3 | 2 |
| T24 | | 0 | | 1 | | 1 | | 1 | | 0 | | 3 | | 5 | |
| PZP | 5 | 14 | 32 | 38 | 22 | 34 | 35 | 26 | 20 | 12 | 19 | 6 | 8 | 6 | 7 |
| PSN | 90 | 73 | 50 | 42 | 0 | 10 | 22 | 29 | 19 | 10 | 11 | 20 | 26 | 32 | 41 |
| PRS | 5 | 14 | 3 | 12 | 16 | 33 | 26 | 29 | 19 | 13 | 14 | 10 | 9 | 12 | 12 |
| TYP | S | S | Z | Z | R | Z | Z | Z | Z | R | Z | R | R | RS | RS |
| SNW | | | 0 | | 0 | | 0 | | 0 | | 0 | | | | |

Appendix A. The following changes have been made to the extended-range GFS MOS text product since its initial implementation in May 2000. More details about changes to the MOS system can be found at <http://www.weather.gov/mdl/synop/changes.php> .

| | |
|-------------------|--|
| May 31, 2000 | First product issued containing 2-m temperature, dewpoint temperature, and maximum and minimum temperature based on the 0000 UTC model cycle. |
| July 19, 2000 | Probability of precipitation (POP) and quantitative precipitation amount added to product. |
| October 4, 2000 | Precipitation type and mean total sky cover guidance added to product. |
| May 9, 2001 | Thunderstorm and severe thunderstorm guidance added to product. |
| Sept. 26, 2001 | Separate products for military sites added. |
| January 22, 2002 | 323 stations added to guidance. |
| July 30, 2002 | Climatological values of max/min temperature and POP added to product for select sites. |
| Sept. 17, 2002 | Wind speed guidance added to product. |
| December 16, 2003 | Snowfall amount guidance added to product. 145 stations added to guidance. "MRF MOS" heading changed to "GFSX MOS" to reflect consolidation of AVN and MRF runs of NCEP's Global model into one Global Forecast System (GFS) model. |
| Sept. 27, 2005 | MEX product added for 1200 UTC cycle. 1200 UTC product contains all elements except for wind, precipitation type and mean total sky cover. |
| April 25, 2006 | Probability of thunderstorm guidance changed from representing the likelihood within a box approximately 47 km on a side to a box 40 km on a side. |
| July 11, 2006 | Wind guidance changed from the maximum speed occurring at any of the hours in the 12-h period to the current definition. Wind guidance made available in 1200 UTC product. |
| March 3, 2010 | Precipitation type guidance for all periods and snowfall amount guidance for days 3 - 6 added to 1200 UTC cycle. Nineteen stations were removed and 118 stations were added to the message. The time periods used to define the daytime maximum and nighttime minimum temperatures for stations in Alaska were expanded to 5 a.m. to 8 p.m. and 5 p.m. - 11 a.m. LST respectively. All other geographic regions remain 7 a.m. to 7 p.m. and 7 p.m. to 8 a.m. |