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NGM-Based MOS Wind Guidance for the Contiguous United States

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FIRST BULLETIN ON THIS SUBJECT

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This Technical Procedures Bulletin, written by Major David T. Miller, USAF, of the Techniques Development Laboratory (TDL), describes the development and implementation of the Nested Grid Model (NGM)-based Model Output Statistics (MOS) wind guidance.

TDL has derived new regression equations to predict surface wind direction and speed (1-minute average wind speed) by applying the MOS technique to output from the NGM. These new equations were implemented operationally on the NMC mainframe computers in October, 1991 and the wind guidance is included in the NGM MOS bulletin (FOUS14 KWBC, or AFOS category FWC) which has been available operationally on AFOS and to the Family of Services' Domestic Data Service since November 4, 1992. The MOS wind forecasts are available for 3-h projections from 6 to 60 hours after 0000 and 1200 Universal Coordinated Time (UTC).

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NGM-BASED MOS WIND GUIDANCE FOR THE CONTIGUOUS UNITED STATES

by Major David T. Miller, USAF, Techniques Development Laboratory

1. INTRODUCTION

The Techniques Development Laboratory (TDL) of the National Weather Service (NWS) has derived new regression equations to predict surface wind direction and speed (1-minute average wind speed) by applying the Model Output Statistics (MOS) technique (Glahn and Lowry, 1972) to output from the Nested Grid Model (NGM) (Hoke et al., 1989). These new equations were implemented operationally on the NMC mainframe computers in October 1991.

In addition, MOS wind forecasts are available for 3-h projections from 6 to 60 hours after 0000 and 1200 Universal Coordinated Time (UTC), as of November 4, 1992. Previously, wind guidance was generated only for 6-h projections from 6 to 48 hours after 0000 and 1200 UTC (Jacks et al., 1990a). The updated wind forecast equations were developed from a larger, more recent developmental sample than were the original equations. In addition, forecasts are potentially available for many more stations than in the original NGM MOS system.

2. METHOD

The MOS approach correlates predictand data (local weather observations) with combinations of predictor data (output from dynamical models, surface observations, and climatic information). In this application of MOS, a multiple linear regression technique (forward selection) was used to determine statistical relationships between the predictand and predictors. The technique selects the predictor which yields the highest reduction of variance for any one of the three predictands (u-wind component, v-wind component, or wind speed) when combined with the other terms already selected for the multiple regression equation (Schwartz and Carter, 1985). We simultaneously developed regression equations to predict the u- and v-wind components and the wind speed. That is, rather than individually developing the equation for the u-wind component, the v-wind component, and the wind speed, we developed three equations at the same time. The equations use the same predictors, but have different coefficients. This method provides consistency among the equations. As discussed in Carter (1975), the u- and v-wind components are used to obtain a forecast wind direction. Glahn (1970) showed that the unbiased u- and v-wind component forecasts produced an underforecast of the wind speed; hence, a forecast equation is required for the speed itself.

3. DEVELOPMENT AND DEFINITIONS

a. Seasons

Developmental data from October 1986 through March 1991 were stratified into two, 6-month seasons: cool (October-March) and warm (April-September). Four seasons of data (approximately 800 days) were used to develop the warm season equations and five seasons of data (approximately 900 days) were used for the cool season equations. When feasible, we also allowed 8 days of seasonal overlap on either side of each season. By this approach, we attempt to smooth the transition between warm and cool season equations.

b. Predictands

Wind direction and speed are reported every hour on the hour at surface reporting stations. The u- and v-wind components are computed from the reports of direction and speed. TDL archives the surface reports from the hourly data for all available stations in the contiguous United States. For 666 stations available in the TDL hourly data archives and included in the MOS forecast system, we extracted the reports of the wind components and speed during the developmental period for the specific hours of 0000, 0200, 0300, 0600, 0900, 1200, 1400, 1500, 1800, and

2100 UTC. The observations valid at 0000, 0300, ..., and 2100 UTC provided the predictand data sample. These observations were then used to form predictands valid 6, 9, 12, 15, ..., and 60 hours after either 0000 or 1200 UTC.

c. Predictors

Potential predictors used to derive the wind forecast equations included NGM grid point fields interpolated to individual stations, surface wind observations, and climatic variables. We included NGM forecasts of the u-wind, v-wind, and speed components at the 10-meter and 950-, 850-, and 700-mb levels. Geostrophic as well as actual model winds were considered. Additionally, we included 850- and 700-mb relative vorticity, 850-mb vertical velocity, and the K index. Model predictors were available at 6-h intervals from 6 to 48 hours after either 0000 or 1200 UTC. For most predictand projections, the model predictors were valid within 6 hours of the predictand observation. Thus, for example, predictors valid at 6, 12, and 18 hours after 0000 or 1200 UTC were used for the 12-h MOS forecast equations. For the 6-h MOS forecast equations, only predictors at 6 and 12 hours were included; for the 48-h MOS equations, only predictors at 42 and 48 hours were included. For the 51-, 54-, 57-, and 60-h forecast equations, predictors at 48 hours were used. Since the model forecasts were only available at 6-h intervals, we included time averages of the NGM forecasts for predictand projections of 9, 15, 21, 27, 33, 39, and 45 hours. For example, the NGM 10-meter wind speed forecasts at the 6- and 12-h projections were averaged together to produce a 10-meter wind speed forecast nominally valid at the 9-h projection.

As potential predictors for the 6-, 9-, and 12-h forecast equations, we also considered the observed wind direction and speed valid two hours after 0000 or 1200 UTC. We decided to use this observation because it added a factor of persistence into the regression equations. We also used the 0200 or 1400 UTC observations because they will usually be available when the NGM MOS program is run operationally. The 0300 or 1500 UTC observations usually are not available. Climatic predictors for all projections included the first and second harmonics of the day of the year. Use of these predictors attempts to account for seasonal trends in the surface winds.

Most of the NGM predictors were space-smoothed over 5 or 9 model grid points at 6, 12, 18, 24, 30, and 36 hours. At 42 and 48 hours, predictors were space-smoothed over 9 and 25 model grid points. The smoothing reduces small-scale noise found in model forecasts. More smoothing takes place at later hours as the amount of information from the model decreases.

d. Equation Development

As previously mentioned, we simultaneously derived three separate equations for the u- and v-wind components and the wind speed. In this approach, the three equations contain the same predictors, but with different regression coefficients. We derived single station and regional equations for all forecast projections, both forecast cycles (0000 and 1200 UTC), and both seasons. In the single station approach, observational data from a particular station are correlated to predictors interpolated to the station. In the regional approach, the observational and predictor data from several stations within a similar geographical or climatic area are pooled, and one equation is derived for the region. We developed single station equations at every projection, both cycles, and both seasons for the stations listed in Appendix A. For stations listed in Appendix B, a partial suite of single station equations was developed, usually because the station was not open 24 hours. Regional wind equations were also developed for the stations listed in Appendix C, where no observations were available and/or a full set of forecasts was required. The regions for the warm and cool seasons (Figure 1) have not changed since the 1989 NGM MOS system was developed (Jacks et al. 1990b); however, more stations have been included in the regional development.

There were several reasons we elected not to develop regional equations for the stations in Appendix B , but did develop equations for the stations in Appendix C. First, we had definite requirements to produce forecasts for all projections for the stations in Appendix C. Second, mixing regional equations with single station

equations could cause temporal continuity problems in the surface wind forecasts. For example, during a frontal passage, wind speed could be strong in the single station forecast but then be underforecast in the regional forecast. With no strong requirement to produce forecasts at all projections for the stations in Appendix B, we did not wish to compromise the quality of the forecasts for those sites. Third, we wished to avoid spatial inconsistencies between single station and regional wind forecasts that could appear on graphical products.

As a major part of increasing the number of stations for which guidance is available, single station equations were developed for a number of USAF-supported stations. Observations from military sites were also used in the regional equation development. This development represented a significant change from previous developments, as almost none of the Limited-Area Fine-Mesh Model (LFM) MOS or old NGM MOS wind forecasts for USAF sites came from single-station equations. In the past, most of the USAF-supported sites received generalized-operator wind forecasts from LFM MOS (generally less skill than the regional approach) and regional wind forecasts from the NGM. Additionally, none of the observations or predictor data for the USAF-supported sites were used in the previous NGM MOS regional equation development. Therefore, we think that the NGM MOS wind forecast skill at USAF-supported sites will improve overall. The regional equations will also be aided by the additional observations and predictors from the USAF-supported sites.

Two sets of equations were derived for the 6-, 9-, and 12-h projections. In the first ("primary") set, surface weather observations at 0200 or 1400 UTC, NGM forecasts and climatic variables were included as predictors. In the second ("backup") set, we used only NGM and climatic variables as predictors. In operations, the primary equations are first used to generate the 6-, 9-, and 12-h wind direction and speed forecasts. However, if observations are unavailable as predictors, the backup equations are used to generate forecasts.

During equation development, we allowed the regression process to continue until a maximum of 12 predictors were chosen or until none of the remaining predictors contributed an additional 0.75% to the reduction of variance for any one of the three predictands. At most stations and projections, nine to 12 predictors were usually chosen for an equation. However, in some instances, only three to six predictors were chosen before the 0.75% reduction of variance limit was met. In the 6-, 9-, and 12-h projections (primary equations), the observations or the NGM forecasts of the 10-meter and/or 950-mb wind components usually contributed most of the reduction of variance. Wind components at 850 mb and 700 mb contributed more in mountainous terrain areas. At later projections, climatic and relative vorticity predictors were chosen more often. Time-averaged predictors were often chosen during forecast projections of 9, 15, 21, 27, 33, 39, and 45 hours.

The resulting wind speed forecasts are inflated before transmission to the field. Inflation is a process which spreads the forecasts away from the mean, thereby increasing variability in the forecasts, and producing about as many strong wind forecasts as occur (Klein et al., 1959; Schwartz and Carter, 1985).

4. ALPHANUMERIC AND GRAPHICAL PRODUCTS

NGM MOS guidance is produced twice daily around 0330 and 1530 UTC for the stations listed in Appendix D. AFOS users may obtain the guidance through the FWCxxx message, where xxx are the call letters of the station requested. The guidance is also available as a collective through the Family of Services' Domestic Data Service and the Information Stream Project for AWIPS/NOAAPORT (ISPAN) as the FOUS14 KWBC product. A sample of the AFOS FWC message is shown in Figure 2. For more information on how to read the FOUS14/FWC product, refer to Dallavalle et al. (1992).

In the FOUS14/FWC message, the wind direction (WDIR) is on one line, followed on the next line by wind speed (WSPD). The wind direction is given to the nearest 10 degrees, and varies from 01 (10 degrees) to 36 (360 degrees). Wind speed is given in knots (kt). The maximum wind speed

forecast allowed is 98 kt. An indicator of 99 for both direction and speed is used for stations and projections where forecasts are unavailable. An indicator of 00 for wind direction and speed denotes a calm wind. If wind forecasts are unavailable for a particular station, the WDIR and WSPD lines will not appear in the FOUS14 message for that station. Wind forecasts at some projections will be missing at offices which are (or have been) closed at night.

Graphics products for the NGM MOS surface wind forecasts are currently not available.

5. OPERATIONAL CONSIDERATIONS

MOS wind direction and speed forecasts are based on the NGM output. If a forecaster suspects that the NGM output contains errors, he/she should adjust the MOS forecasts accordingly. The multiple linear regression technique can account for some systematic biases in the NGM, but cannot correct bad model forecasts.

We found high reductions of variance (60%-80%, at early projections) in many stations east of the Rocky Mountains, especially the Plains states. This suggests that MOS forecasts will have more skill where terrain has little influence. Unfortunately, reductions of variances near and in mountainous areas were considerably lower (less than 30%), even in the early projections. For some of the stations in higher or irregular terrain, the MOS equations may have little skill in predicting the wind speed and direction.

By the same token, reductions of variance were overall higher in the cool season equations than in the warm. We believe the primary reason was due to consistent synoptic-scale forcing during the cool season as opposed to inconsistent, convective (mesoscale) forcing during the warm season. The implication is that the MOS forecasts should show more skill during the cool season than during the warm season.

Since the new MOS wind forecast equations were developed on a larger, more recent data base, the forecasts are expected to be more skillful overall than in the past. Figure 3 compares verifications of LFM MOS, old NGM MOS, and new (current) NGM wind forecasts made on a test sample of independent data. The forecasts generated by each of these were verified for 203 stations across the contiguous United States. This sample included forecasts for April to September 1990. Forecasts were evaluated on the basis of the Heidke Skill Score (Dagostaro, 1985); higher values indicate greater skill. The results show the new wind equations produced more skillful forecasts than the old equations at nearly every projection.

Forecasters should also be aware that wind speed forecasts are for sustained (1-minute average) winds. Forecasts for wind gusts are not provided at this time.

Finally, since the implementation of the wind equations in October 1991, we have noticed a tendency in the MOS guidance to overforecast wind speeds when a very large surface pressure gradient is forecast by the NGM. In these situations, the NGM MOS forecast wind speeds appear to be closer to wind speed gusts than to the observed sustained wind speeds. We suspect the combination of high 10-meter or 950-mb wind speeds forecast by the NGM and the MOS inflation technique may cause this overforecast. In large surface pressure gradient cases, observed wind speeds are usually above the mean of the developmental sample. In these situations, even without inflation, the MOS forecast wind speed may already be close to actual observed wind speed. Since the inflation technique spreads forecasts even farther away from the mean, the resulting wind speed is overforecast.

6. REFERENCES

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NGM MOS WIND REGIONS

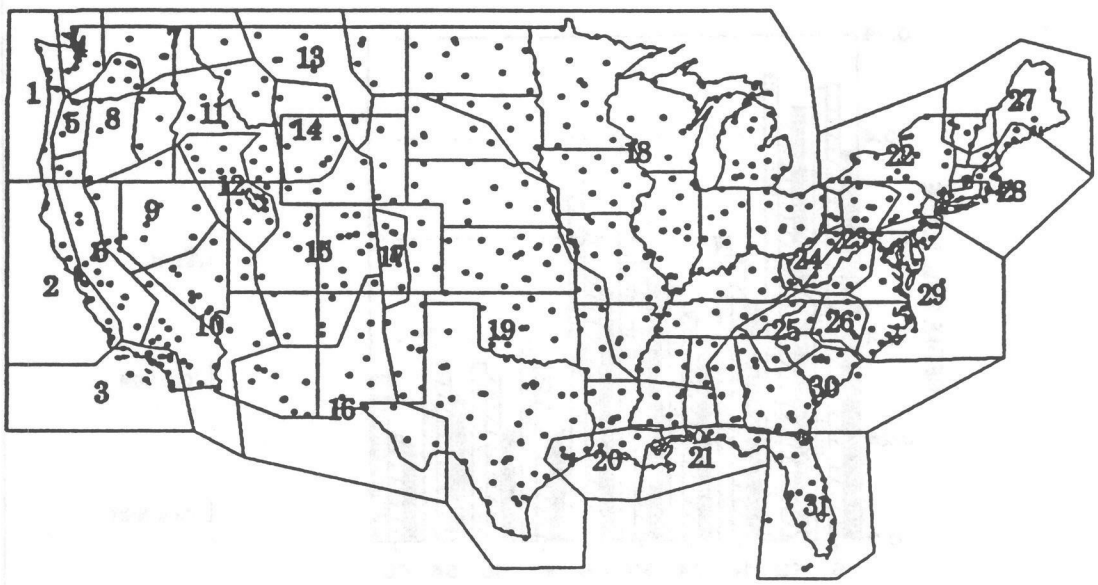

Figure 1. 31 regions used during NGM MOS regional wind equation development for both cycles and both seasons.

```
NMCFWCDCA
FOUS14 KWBC 060357
DCA  ESC  NGM MOS GUIDANCE   3/06/91  0000 UTC
DAY /MAR   6                /MAR   7                /MAR   8
HOUR    06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12
MX/MN                     59          39          54          24
TEMP    37 34 33 38 45 53 52 49 46 43 40 42 47 51 42 39 35 30 24
DEWPT   27 28 28 30 32 36 40 38 41 41 37 33 28 27 25 21 20 19 19
CLDS    OV OV OV OV OV OV OV OV OV OV BK BK BK SC SC SC CL CL CL
WDIR    26 18 08 12 14 14 15 18 24 27 28 29 29 29 29 33 01 02 00
WSPD    01 04 06 10 11 12 16 18 13 15 12 20 24 22 14 12 14 08 00
POP06          4     9    46    85    62     3     7    12     8
POP12                     49          91          8          19
QPF          0/    0/    1/1   3/    2/4   0/    0/0   0/    0/0
TSV06       2/ 0  3/ 0  4/ 1  5/ 1  6/ 2 16/ 3 11/ 1  8/ 0  0/ 0
TSV12             4/ 0        8/ 1       21/ 4        9/ 1
PTYPE    S  S  S  S  S  R  R  R  R  R  R     R     R     S     Z
POZP     8 10 12  6  0  0  0  0  0  1  3     0     2    24    35
POSN    65 67 70 48 41 14 11 13 15 16 20     9    16    50    42
SNOW         0/    0/    0/1   0/    0/0   0/    0/0   0/    0/0
CIG      4  5  4  4  5  6  7  6  3  2  1     5     6
VIS      3  4  3  5  5  5  5  4  2  2  1     3     4
OBVIS    H  H  H  N  N  N  N  F  F  F  F     H     N
```

Figure 2. Sample FOUS14 KWBC (FWC) message for Washington, D.C. (DCA) for the 0000 UTC cycle on March 6, 1991. Wind direction (WDIR) and wind speed (WSPD) guidance are highlighted.

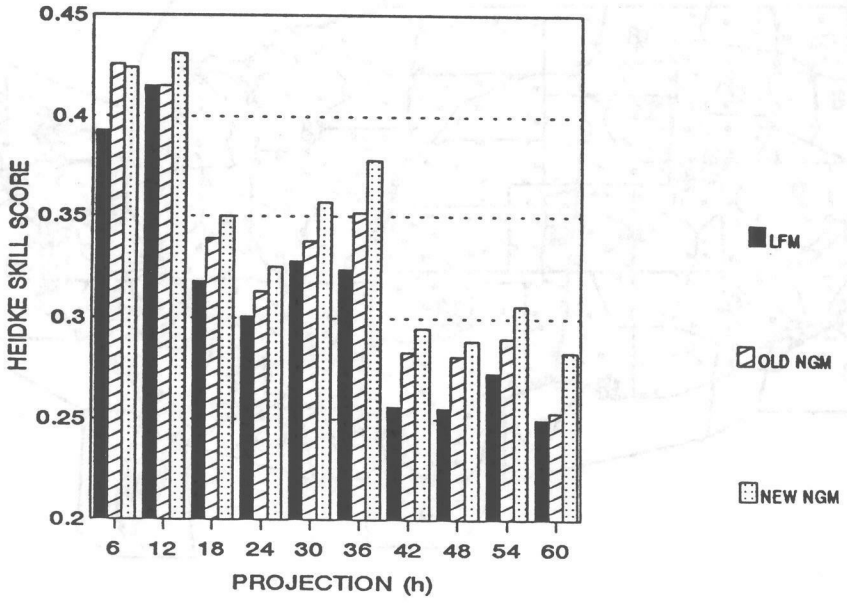

Figure 3. Wind speed (WSPD) Heidke skill score comparisons between the LFM MOS, Old NGM MOS (before Oct. 24, 1991), and New (current) NGM MOS for 203 stations. Verification performed on data from April to September, 1990 (independent data, warm season) for projections every 6 hours from the 0000 UTC cycle.

TPB 399 - APPENDIX A

Single station equations at every projection, both cycles, and both seasons were developed for the following sites. Sites are listed alphabetically by call letter (ID).

ID	WBAN NO.	NAME
ABE	14737	Allentown, PA
ABI	13962	Abilene, TX
ABQ	23050	Albuquerque, NM
ABR	14929	Aberdeen, SD
ABY	13869	Albany, GA
ACT	13959	Waco, TX
ACV	24283	Arcata, CA
ACY	93730	Atlantic City, NJ
ADW	13705	Andrews AFB, MD
AEX	13934	England AFB, LA
AGC	14762	Allegheny Co. Arpt. PA
AGS	3820	Augusta, GA
AHN	13873	Athens, GA
AKO	24015	Akron, CO
ALB	14735	Albany, NY
ALO	94910	Waterloo, IA
ALW	24160	Walla Walla, WA
AMA	23047	Amarillo, TX
ANB	13871	Anniston, AL
AND	93846	Anderson, SC
AOO	14736	Altoona, PA
APN	94849	Alpena, MI
AQQ	12832	Apalachicola, FL
ART	94790	Watertown, NY
AST	94224	Astoria, OR
ATL	13874	Atlanta, GA
AUG	14605	Augusta, ME
AUS	13958	Austin, TX
AUW	14897	Wausau, WI
AVL	3812	Asheville, NC
AVP	14777	Scranton, PA
AXN	14910	Alexandria, MN
AYS	13861	Waycross, GA
BAB	93216	Beale AFB, CA
BAD	13944	Barksdale AFB, LA
BDL	14740	Hartford, CT
BFD	4751	Bradford, PA
BFF	24028	Scottsbluff, NE
BFL	23155	Bakersfield, CA
BGM	4725	Binghamton, NY
BGR	14606	Bangor, ME
BHM	13876	Birmingham, AL
BID	94793	Block Isl. (AMOS), RI
BIL	24033	Billings, MT
BIS	24011	Bismarck, ND
BIX	13820	Biloxi, MS
BKE	24130	Baker, OR
BKF	23036	Buckley ANGB Arpt., CO
BKW	3872	Beckley, WV
BLF	3859	Bluefield, WV
BLH	23158	Blythe, CA
BLI	24217	Bellingham, WA
BLU	23225	Blue Canyon (AMOS), CA
BLV	13802	Scott AFB, IL
BNA	13897	Nashville, TN
BNO	24134	Burns (RAMOS), OR
BOI	24131	Boise, ID
BOS	14739	Boston, MA
BPI	24164	Big Piney (AMOS), WY
BPT	12917	Port Arthur, TX
BRL	14931	Burlington, IA
BRO	12919	Brownsville, TX
BSM	13904	Bergstrom AFB,TX
BTM	24135	Butte, MT
BTR	13970	Baton Rouge, LA
BTV	14742	Burlington, VT
BUF	14733	Buffalo, NY
BUR	23152	Burbank, CA
BWG	93808	Bowling Green, KY
BWI	93721	Baltimore, MD
BYH	13814	Eaker AFB, AR
BYI	24133	Burley, ID
BZN	24132	Bozeman, MT
CAE	13883	Columbia, SC
CAG	24046	Craig (AMOS), CO
CAK	14895	Akron-Canton, OH
CAO	23051	Clayton (AMOS), NM
CBM	13825	Columbus AFB, MS
CDC	93129	Cedar City, UT
CEF	14703	Chicopee Falls, MA
CGI	3935	Cape Girardeau, MO
CHA	13882	Chattanooga, TN
CHS	13880	Charleston, SC
CID	14990	Cedar Rapids, IA
CKL	3881	Centreville, AL
CLE	14820	Cleveland, OH
CLL	3904	College Station, TX
CLT	13881	Charlotte, NC
CMH	14821	Columbus, OH
CMX	94885	Hancock, MI

ID	WBAN NO.	NAME
CNK	13984	Concordia, KS
CNM	93033	Carlsbad, NM
COD	24045	Cody (AMOS), WY
CON	14745	Concord, NH
COS	93037	Colorado Springs, CO
COU	3945	Columbia, MO
CPR	24089	Casper, WY
CRP	12924	Corpus Christi, TX
CRW	13866	Charleston, WV
CSG	93842	Columbus, GA
CSV	3847	Crossville, TN
CTY	12833	Cross City (AMOS), FL
CVG	93814	Covington, KY
CVS	22008	Cannon AFB, NM
CXY	14751	Harrisburg, PA
CYS	24018	Cheyenne, WY
DAA	93728	Fort Belvoir, VA
DAB	12834	Daytona Beach, FL
DAG	23161	Daggett, CA
DAL	13960	Dallas, TX
DAY	93815	Dayton, OH
DCA	13743	Washington, DC
DDC	13985	Dodge City, KS
DEC	3890	Decatur, IL
DEN	23062	Denver, CO
DFW	3927	Dallas-Ft. Worth, TX
DHN	93843	Dothan, AL
DIK	24012	Dickinson, ND
DLF	22001	Laughlin AFB, TX
DLH	14913	Duluth, MN
DMA	23109	Davis-Monthan AFB, AZ
DOV	13707	Dover AFB, DE
DRA	3109	Mercury, NV
DSM	14933	Des Moines, IA
DTW	94847	Detroit, MI
DUG	93026	Douglas, AZ
DUJ	4787	DuBois, PA
DYS	13910	Dyess AFB, TX
D45	94944	Warroad (AMOS), MN
EAT	94239	Wenatchee, WA
EAU	14991	Eau Claire, WI
EFD	12906	Ellington AFB, TX
EKO	24121	Elko, NV
ELM	14748	Elmira, NY
ELP	23044	El Paso, TX
ELY	23154	Ely, NV
END	13170	Vance AFB, OK
ERI	14860	Erie, PA
EUG	24221	Eugene, OR
EVV	93817	Evansville, IN

ID	WBAN NO.	NAME
EWN	93719	New Bern, NC
EWR	14734	Newark, NJ
EYW	12836	Key West, FL
E74	93079	Safford (RAMOS), AZ
FAR	14914	Fargo, ND
FAT	93193	Fresno, CA
FCA	24146	Kalispell, MT
FDY	14825	Findlay, OH
FFO	13840	Wright-Patterson AFB, OH
FLG	3103	Flagstaff (RAMOS) AZ
FLL	12849	Fort Lauderdale, FL
FLO	13744	Florence, SC
FMH	14704	Otis AFB, MA
FMN	23090	Farmington, NM
FMY	12835	Ft. Myers, FL
FNT	14826	Flint, MI
FOD	94933	Ft. Dodge (AMOS), IA
FOE	13920	Forbes AFB, KS
FRI	13947	Fort Riley, KS
FSD	14944	Sioux Falls, SD
FSI	13945	Fort Sill, OK
FSM	13964	Fort Smith, AR
FTK	13807	Fort Knox, KY
FWA	14827	Fort Wayne, IN
FWH	13911	Carswell AFB, TX
FYV	93993	Fayetteville, AR
GAG	13975	Gage, OK
GCC	94023	Gillette (AMOS), WY
GCK	23064	Garden City, KS
GDP	23055	Guadalupe Pass (AMOS), TX
GEG	24157	Spokane, WA
GFA	24112	Malmstrom AFB, MT
GFK	14916	Grand Forks, ND
GFL	14750	Glens Falls, NY
GGG	3901	Longview, TX
GGW	94008	Glasgow, MT
GJT	23066	Grand Junction, CO
GLD	23065	Goodland, KS
GNV	12816	Gainesville, FL
GRB	14898	Green Bay, WI
GRF	24201	Fort Lewis, WA
GRI	14935	Grand Island, NE
GRK	3993	Robert Gray AAF, TX
GRR	94860	Grand Rapids, MI
GSB	13713	Sey. Johnson AFB, NC
GSO	13723	Greensboro, NC
GSP	3870	Greenville-Spart., SC
GTF	24143	Great Falls, MT
GUP	23081	Gallup, NM
GUS	94833	Grissom AFB, IN

ID	WBAN NO.	NAME
GWO	13978	Greenwood, MS
HAT	93729	Cape Hatteras, NC
HBR	93986	Hobart, OK
HDO	12962	Hondo, TX
HIB	94931	Hibbing, MN
HIF	24101	Hill AFB, UT
HKY	3810	Hickory, NC
HLN	24144	Helena, MT
HMN	23002	Holloman AFB, NM
HMS	94187	Hanford, WA
HON	14936	Huron, SD
HOP	13806	Ft. Cambell AAF, KY
HOU	12918	Houston/Hobby Arpt., TX
HPN	94745	White Plains, NY
HRO	13971	Harrison, AR
HRT	3854	Hurlburt Field, FL
HST	12866	Homestead AFB, FL
HSV	3856	Huntsville, AL
HTS	3860	Huntington, WV
HUF	93823	Terre Haute, IN
HUL	14609	Houlton, ME
HVR	94012	Havre (RAMOS), MT
IAB	3923	McConnell AFB, KS
IAD	93738	Washington-Dulles Arpt., VA
IAG	4724	Niagara Falls, NY
IAH	12960	Houston, TX
ICT	3928	Wichita, KS
IDA	24145	Idaho Falls, ID
IGM	93167	Kingman (AMOS), AZ
ILG	13781	Wilmington, DE
ILM	13748	Wilmington, NC
IND	93819	Indianapolis, IN
INL	14918	International Falls, MN
INT	93807	Winston-Salem, NC
IPL	3144	Imperial, CA
IPT	14778	Williamsport, PA
ISN	94014	Williston, ND
ISP	4781	Islip, NY
JAN	3940	Jackson, MS
JAX	13889	Jacksonville, FL
JBR	1	Jonesboro, AR
JCT	13973	Junction (AMOS), TX
JDN	94026	Jordon (RAMOS), MT
JFK	94789	New York-Kennedy Arpt., NY
JKL	3899	Jackson (RAMOS), KY
JLN	13987	Joplin, MO
JMS	14919	Jamestown, ND
JXN	14833	Jackson, MI
LAF	94886	Lafayette, IN
LAN	14836	Lansing, MI

ID	WBAN NO.	NAME
LAR	24022	Laramie, WY
LAS	23169	Las Vegas, NV
LAX	23174	Los Angeles, CA
LBB	23042	Lubbock, TX
LBF	24023	North Platte, NE
LCH	3937	Lake Charles, LA
LCK	13812	Rickenbacker AFB, OH
LEB	94765	Lebanon, NH
LEX	93820	Lexington, KY
LFI	13702	Langley AFB, VA
LFT	13976	Lafayette, LA
LGA	14732	New York-Laguardia Arpt., NY
LHX	23067	La Junta, CO
LIC	93010	Limon, CO
LIT	13963	Little Rock, AR
LIZ	14623	Loring AFB, ME
LMT	94236	Klamath Falls, OR
LND	24021	Lander, WY
LNK	14939	Lincoln, NE
LRD	12907	Laredo AFB, TX
LRF	3930	Little Rock AFB, AR
LSE	14920	La Crosse, WI
LSF	13829	Lawson AFB, GA
LSV	23112	Nellis AFB, NV
LTS	13902	Altus AFB, OK
LUF	23111	Luke AFB, AZ
LWS	24149	Lewsiton (RAMOS), ID
MAF	23023	Midland, TX
MBS	14845	Saginaw, MI
MCB	93919	McComb, MS
MCC	23208	McClellan AFB, CA
MCF	12810	Mac Dill AFB, FL
MCI	3947	Kansas City, MO
MCN	3813	Macon, GA
MCO	12815	Orlando Intl. Arpt., FL
MCW	14940	Mason City, IA
MDT	14711	Middletown, PA
MDW	14819	Chicago-Midway (AMOS), IL
MEI	13865	Meridian, MS
MEM	13893	Memphis, TN
MER	23203	Castle AFB, CA
MFE	12959	McAllen, TX
MFR	24225	Medford, OR
MGM	13895	Montgomery, AL
MGW	13736	Morgantown, WV
MHR	23206	Mather AFB, CA
MHS	24215	Mt. Shasta (AMOS), CA
MIA	12839	Miami, FL
MIB	94011	Minot AFB, ND
MIV	13735	Millville, NJ

ID	WBAN NO.	NAME
MKC	13988	Kansas City Dwntn., MO
MKE	14839	Milwaukee, WI
MKG	14840	Muskegon, MI
MKL	3811	Jackson, TN
MLB	12838	Melbourne, FL
MLC	93950	McAlester, OK
MLI	14923	Moline, IL
MLS	24037	Miles City, MT
MLU	13942	Monroe, LA
MMO	94887	Marseilles (AMOS), IL
MOB	13894	Mobile, AL
MOT	24013	Minot, ND
MPV	94705	Montpelier, VT
MQT	94850	Marquette, MI
MRB	13734	Martinsburg, WV
MRF	93080	Marfa (AMOS), TX
MSL	13896	Muscle Shoals, AL
MSN	14837	Madison, WI
MSO	24153	Missoula, MT
MSP	14922	Minneapolis, MN
MSS	94725	Massena, NY
MSY	12916	New Orleans, LA
MTC	14804	Mt. Clemens, MI
MUO	24106	Mountain Home AFB, ID
MXF	13821	Maxwell AFB, AL
MYR	13717	Myrtle Beach AFB, SC
NBC	93831	Beaufort MCAS, SC
NBE	93901	Dallas NAS, TX
NBG	12958	New Orleans NAS, LA
NBU	14855	Glenview NAS, IL
NCA	93727	Jacksonville MCAS, NC
NFG	3154	Camp Pendleton, CA
NGP	12926	Corpus Christi NAS, TX
NGU	13750	Norfolk NAS, VA
NGZ	23239	Alameda NAS, CA
NHK	13721	Patuxent River NAS, MD
NHZ	14611	Brunswick NAS, ME
NIP	93837	Jacksonville NAS, FL
NIR	12925	Beeville NAS, TX
NKT	13754	Cherry Point MCAS, NC
NKX	93107	Miramar NAS, CA
NLC	23110	Lemoore NAS, CA
NMM	3866	Meridian NAS, MS
NPA	3855	Pensacola NAS, FL
NQA	93839	Memphis NAS, TN
NQI	12928	Kingsville NAS, TX
NQX	12850	Key West NAS, FL
NRB	3853	Mayport NAS, FL
NSE	93841	Milton NAS, FL
NTD	93111	Point Mugu NAS, CA

ID	WBAN NO.	NAME
NTK	93114	Santa Ana MCAS, CA
NTU	13769	Oceana NAS, VA
NUQ	93207	Mountain View NAS, CA
NUW	24255	Whidbey Is. NAS, WA
NXX	14793	Willow Grove NAS, PA
NYG	13773	Quantico MCAS, VA
NZC	93832	Jacksonville NAS, FL
NZJ	3153	El Toro MCAS, CA
NZW	14790	S. Weymouth NAS, MA
NZY	93112	North Island NAS, CA
OAK	23230	Oakland, CA
OFF	14949	Offutt AFB, NE
OFK	14941	Norfolk, NE
OKC	13967	Oklahoma City, OK
OLM	24227	Olympia, WA
OMA	14942	Omaha, NE
ONT	3102	Ontario, CA
ORD	94846	Chicago-O'Hare, IL
ORF	13737	Norfolk, VA
ORH	94746	Worcester (AMOS), MA
OSC	14808	Wurtsmith AFB, MI
OTH	24284	North Bend, OR
OTM	14950	Ottumwa, IA
OVN	94918	Omaha North, NE
OZR	3850	Ft. Rucker, AL
PAH	3816	Paducah, KY
PAM	13846	Tyndall AFB, FL
PBF	93988	Pine Bluff, AR
PBG	4742	Plattsburgh AFB, NY
PBI	12844	West Palm Beach, FL
PDT	24155	Pendleton (RAMOS), OR
PDX	24229	Portland, OR
PGA	3162	Page (AMOS), AZ
PHL	13739	Philadelphia, PA
PHX	23183	Phoenix, AZ
PIA	14842	Peoria, IL
PIH	24156	Pocatello, ID
PIR	24025	Pierre, SD
PIT	94823	Pittsburgh, PA
PKB	3804	Parkersburg, WV
PLN	14841	Pellston, MI
PNC	13969	Ponca City, OK
PNE	94732	N. Philadelphia, PA
PNS	13899	Pensacola, FL
POB	13714	Pope AFB, NC
POE	3931	Ft. Polk AAF, LA
POU	14757	Poughkeepsie, NY
PRB	93209	Paso Robles, CA
PRC	23184	Prescott, AZ
PSM	4743	Portsmouth, NH

ID	WBAN NO.	NAME
PSX	12935	Palacios, TX
PUB	93058	Pueblo, CO
PUC	93141	Price (RAMOS), UT
PVD	14765	Providence, RI
PWM	14764	Portland, ME
P02	3956	Poplar Bluff (AMOS), MO
P07	93081	Sanderson (RAMOS), TX
P11	14912	Devils Lake (AMOS), ND
P24	94021	Roseglen (AMOS), ND
P28	3957	Medicine Lake (AMOS), KS
P35	94953	Spickard (AMOS), MO
P38	3163	Caliente (AMOS), NV
P39	94945	Pequot Lake (AMOS), MN
P58	94898	Port Hope (RAMOS), MI
P59	94899	Copper Harbor (RAMOS), MI
P60	94173	Yellowstone (AMOS), WY
P61	94954	Grand Mara (RAMOS), MN
P67	94955	Lidgerwood (RAMOS), ND
P68	3170	Eureka (RAMOS), NV
P69	94174	Elk City (RAMOS), ID
P75	4801	Seul Choix (AMOS), MI
RAP	24090	Rapid City, SD
RCA	24006	Ellsworth AFB, SD
RDD	24257	Redding, CA
RDM	24230	Redmond, OR
RDR	94925	Grand Forks AFB, ND
RDU	13722	Raleigh-Durham, NC
REE	23021	Reese AFB, TX
REJ	94022	Redig (AMOS), SD
RFD	94822	Rockford, IL
RIC	13740	Richmond, VA
RIV	23119	March AFB, CA
RKS	24027	Rock Springs, WY
RME	14717	Griffiss AFB, NY
RMG	93801	Rome (RAMOS), GA
RND	12911	Randolph AFB, TX
RNO	23185	Reno, NV
ROA	13741	Roanoke, VA
ROC	14768	Rochester, NY
ROW	23043	Roswell, NM
RSL	93997	Russell, KS
RST	14925	Rochester, MN
RWF	14992	Redwood Falls, MN
SAC	23232	Sacramento, CA
SAN	23188	San Diego, CA
SAT	12921	San Antonio, TX
SAV	3822	Savannah, GA
SAW	94836	Gwinn, MI
SBD	23122	San Bernardino, CA
SBN	14848	South Bend, IN

ID	WBAN NO.	NAME
SBY	93720	Salisbury, MD
SCK	23237	Stockton, CA
SDF	93821	Louisville, KY
SEA	24233	Seattle-Tacoma, WA
SFO	23234	San Francisco, CA
SGF	13995	Springfield, MO
SHR	24029	Sheridan, WY
SHV	13957	Shreveport, LA
SJT	23034	San Angelo, TX
SKA	24114	Fairchild AFB, WA
SKF	12909	Kelly AFB, TX
SLC	24127	Salt Lake City, UT
SLE	24232	Salem, OR
SLN	3919	Salina, KS
SMP	24237	Stampede Pass (AMOS), WA
SNS	23233	Salinas, CA
SNY	24030	Sidney (AMOS), NE
SPI	93822	Springfield, IL
SPS	13966	Sheppard AFB, TX
SSC	13849	Shaw AFB, SC
SSI	13878	Brunswick, GA
SSM	14847	Sault Ste. Marie, MI
STL	13994	St. Louis, MO
SUS	3966	Spirit of St. Louis, MO
SUU	23202	Travis AFB, CA
SUX	14943	Sioux City, IA
SVN	13824	Hunter AFB, GA
SWF	14714	Newburgh, NY
SXT	24235	Sexton Summit (AMOS), OR
SYR	14771	Syracuse, NY
SZL	13930	Whiteman AFB, MO
TAD	23070	Trinidad, CO
TCL	93806	Tuscaloosa, AL
TCM	24207	McChord AFB, WA
TCS	93045	Truth or Con. (AMOS), NM
TEB	94741	Teterboro, NJ
TIK	13919	Tinker AFB, OK
TLH	93805	Tallahassee, FL
TOL	94830	Toledo, OH
TOP	13996	Topeka, KS
TPA	12842	Tampa, FL
TPH	23153	Tonopah, NV
TRI	13877	Bristol, TN
TRM	3104	Thermal, CA
TUL	13968	Tulsa, OK
TUP	93862	Tupelo (RAMOS), MS
TUS	23160	Tuscon, AZ
TVC	14850	Traverse City, MI
TXK	13977	Texarkana, AR
TYS	13891	Knoxville, TN

ID	WBAN NO.	NAME
UCA	94794	Utica, NY
UIL	94240	Quillayute, WA
UIN	93989	Quincy, IL
U15	99155	Challis (RAMOS), ID
VAD	13857	Moody AFB, GA
VCT	12912	Victoria, TX
VCV	23131	George AFB, CA
VLD	93845	Valdosta, GA
VPS	13858	Eglin AFB, FL
VRB	12843	Vero Beach, FL
VTN	24032	Valentine (AMOS), NE
WJF	3159	Lancaster, CA
WRB	13860	Robins AFB, GA
WRI	14706	McGuire AFB, NJ

ID	WBAN NO.	NAME
WRL	24062	Worland, WY
X68	12892	Cape Canaveral AFS, FL
YKM	24243	Yakima, WA
YNG	14852	Youngstown, OH
YUM	23195	Yuma, AZ
Y22	24052	Lemmon, SD
ZZV	3891	Zanesville, OH
0V1	94032	Custer, SD
1K5	93072	Elkhart (AMOS), KS
3B1	94603	Greenville, ME
3OI	14970	Lamoni, IA
5I3	93895	Pikeville (RAMOS), KY
9B2	54742	St. Johnsbury (AMOS), VT
9V9	94943	Chamberlain (AMOS), SD

TPB 399 - APPENDIX B

Part-time stations for which a partial suite of NGM MOS wind forecast equations were developed. Sites are listed alphabetically by call letter (ID).

ID	WBAN NO.	NAME
ACK	14756	Nantucket, MA
ALI	12932	Alice, TX
ALS	23061	Alamosa, CO
AMG	13870	Alma, GA
ATW	4825	Appleton, WI
ATY	14946	Watertown, SD
AZO	94815	Kalamazoo, MI
BAF	14775	Westfield, MA
BDR	94702	Bridgeport, CT
BJI	14958	Bemidji, MN
BRD	94938	Brainerd, MN
BTL	14815	Battle Creek, MI
CAR	14607	Caribou, ME
CDR	24017	Chadron, NE
CHO	93736	Charlottesville, VA
CKB	3802	Clarksburg (AMOS), WV
CMI	94870	Champaign, IL
CNU	13981	Chanute, KS
COT	12947	Cotulla (RAMOS), TX
CTB	24137	Cutbank, MT
CT9	94110	Castlegar, BC
DAN	13728	Danville, VA
DBQ	94908	Dubuque, IA
DLS	24219	The Dalles, OR
DMN	23078	Deming, NM
DXR	54734	Danbury, CT
DYR	3809	Dyersburg, TN
ECG	13786	Elizabeth City, NC
EED	23179	Needles, CA
EGE	23063	Eagle, CO
EKN	13729	Elkins, WV
ELD	93944	El Dorado, AR
EMP	13989	Emporia, KS
EPH	24141	Ephrata, WA
ESF	13935	Alexandria, LA
FAY	93740	Fayetteville, NC
FOK	14719	Westhampton Beach, NY
GLH	13939	Greenville, MS
GLS	12923	Galveston (AMOS), TX
GON	14707	Groton, CT
GPT	93874	Gulfport, MS
GVW	3929	Grandview, MO
HLC	93990	Hill City, KS
HOB	93034	Hobbs, NM
HOT	3962	Hot Springs, AR
HQM	94225	Hoquiam, WA
HTL	94814	Houghton Lake, MI
HVN	14758	New Haven, CT
IMT	94893	Iron Mountain, MI
IRK	14938	Kirksville, MO
ITH	94761	Ithaca, NY
IWD	94926	Ironwood, MI
JAC	24166	Jackson, WY
JHW	4720	Jamestown, NY
JST	4726	Johnstown, PA
LAL	12883	Lakeland, FL
LFK	93987	Lufkin, TX
LGB	23129	Long Beach, CA
LOZ	3849	London, KY
LVS	23054	Las Vegas, NM
LWT	24036	Lewistown, MT
LYH	13733	Lynchburg, VA
MCK	24004	McCook, NE
MDH	93810	Carbondale, IL
MFD	14891	Mansfield, OH
MHK	3936	Manhatten, KS
MLD	24151	Malad City, ID
MRY	23259	Monterey, CA
MTN	93744	Glenn Martin Arpt., MD
MWA	3865	Marion, IL
MWH	24110	Moses Lake, WA
NEL	14780	Lakehurst NAS, NJ
NFL	93102	Fallon NAS, NV
NID	93194	China Lake NAS, CA
NUC	93117	San Clem. Isl. NAS, CA
OGD	24126	Ogden, UT
PAE	24222	Everett, WA
PFN	3882	Panama City, FL
PIB	53808	Laurel-Hatiesburg, MS
PSC	24163	Pasco, WA
PSP	93138	Palm Springs, CA
PVU	24174	Provo, UT
RIW	24061	Riverton, WY
RWL	24057	Rawlins, WY
SAF	23049	Santa Fe, NM
SBA	23190	Santa Barbara, CA
SBP	93206	San Luis Obispo, CA
SJC	23293	San Jose, CA
SMX	23273	Santa Maria, CA
SNA	93184	Santa Ana, CA

ID	WBAN NO.	NAME
SRQ	12871	Sarasota-Bradenton, FL
STC	14926	St. Cloud, MN
STJ	13993	St. Joseph, MO
STS	23274	Santa Rosa, CA
SUN	94177	Hailey, ID
TCC	23048	Tucumcari, NM
TRK	93212	Truckee, CA
TTD	24242	Troutdale (AMOS), OR
TVL	93230	South Lake Tahoe, CA
TWF	94178	Twin Falls, ID
TYR	13972	Tyler, TX

ID	WBAN NO.	NAME
UKI	23275	Ukiah, CA
UNV	54739	University Park, PA
U28	93132	Green River, UT
VIH	13997	Vichy-Rolla, MO
VNY	23130	Van Nuys, CA
WMC	24128	Winnemuca, NV
Y26	24053	Mobridge, SD
3SE	14972	Spencer, IA
4DG	24019	Douglas, WY
4OM	94147	Omak, WA

TPB 399 - APPENDIX C

Sites receiving NGM MOS wind forecasts from regional equations. Sites are listed alphabetically by call letter (ID).

ID	WBAN NO.	NAME
AFF	99180	Air Force Academy, CO
AGR	12804	Avon Park Gun Range, FL
AT2	99180	Atterbury AFR, IN
AYE	4779	Ft. Devens, MA
COF	12867	Patrick AFB, FL
DPG	24103	Dugway Proving Gnds, UT
DP1	99173	Eglin 52 AFR, FL
DVD	99181	Camp David, MD
EDW	23114	Edwards AFB, CA
FAF	93735	Ft. Eustis, VA
FCS	94015	Ft. Carson, CO
FEW	24100	F.E. Warren AFB, WY
FHU	3124	Ft. Huachuca, AZ
FLV	13921	Ft. Leavenworth, KS
FME	93733	Ft. Meade, MD
GBN	99175	Gila Bend, AZ
GTB	14715	Ft. Drum, NY
INS	99177	Nellis 655 AFR, NV
IWA	23104	Williams AFB, AZ
LHW	13700	Ft. Stewart, GA
MC2	99174	Ft. Carson AFR, CO
MGE	13864	Dobbins AFB, GA
MI1	94158	Saylor Creek AFR, ID

ID	WBAN NO.	NAME
MMT	13830	McEntire ANGB Arpt., SC
MUI	99190	Ft. Indiantown Gap, PA
NC1	3147	Cuddeback AFR, CA
OAR	93217	Ft. Ord, CA
QOS	99179	Oscura AFR, NM
TBN	3938	Ft. Leonard Wood, MO
TNX	3191	Tonopah TR, NV
T01	99182	Wallops Is. TACR, VA
T02	99183	Ft. Jackson TACR, SC
T03	99184	Myrtle Beach TACR, SC
T04	99185	Sarasota TACR, FL
T05	99186	Smokey Hill TACR, KS
T06	99187	Camp Shelby TACR, MS
T07	99188	Green River TACR, UT
T08	99189	Hill/Eagle TACR, UT
UCC	99178	Yucca Flat Air SP, NV
VBG	93214	Vandenberg AFB, CA
01R	99171	Clairborne AFR, LA
2DP	99172	Stumpy Point, NC
2PJ	3880	Sumter, SC
3RN	99176	Grayling AFR, MI
4MR	93064	Melrose AFR, NM

TPB 399 - APPENDIX D

Stations for which NGM MOS guidance is produced twice daily. Stations marked with an asterisk (*) are not currently available on AFOS, but are available on Department of Defense communication circuits. Sites are listed alphabetically by call letter (ID).

ID	WBAN NO.	NAME
ABE	14737	Allentown, PA
ABI	13962	Abilene, TX
ABQ	23050	Albuquerque, NM
ABR	14929	Aberdeen, SD
ACK	14756	Nantucket, MA
ACT	13959	Waco, TX
ACV	24283	Arcata, CA
ACY	93730	Atlantic City, NJ
*ADW	13705	Andrews AFB, MD
AEX	13934	England AFB, LA
*AFF	93605	Air Force Academy, CO
*AGR	12804	Avon Park Gun Range, FL
AGS	3820	Augusta, GA
AHN	13873	Athens, GA
ALB	14735	Albany, NY
ALO	94910	Waterloo, IA
ALS	23061	Alamosa, CO
ALW	24160	Walla Walla, WA
AMA	23047	Amarillo, TX
AOO	14736	Altoona, PA
APN	94849	Alpena, MI
AQQ	12832	Apalachicola, FL
ART	94790	Watertown, NY
AST	94224	Astoria, OR
ATL	13874	Atlanta, GA
*AT2	99180	Atterbury AFR, IN
AUG	14605	Augusta, ME
AUS	13958	Austin, TX
AUW	14897	Wausau, WI
AVL	3812	Asheville, NC
AVP	14777	Scranton, PA
AXN	14910	Alexandria, MN
*AYE	4779	Ft. Devens, MA
*BAB	93216	Beale AFB, CA
*BAD	13944	Barksdale AFB, LA
BCE	23159	Bryce Canyon, UT
BDL	14740	Hartford, CT
BDR	94702	Bridgeport, CT
BFD	4751	Bradford, PA
BFF	24028	Scottsbluff, NE
BFL	23155	Bakersfield, CA
BGM	4725	Binghamton, NY
BGR	14606	Bangor, ME
BHM	13876	Birmingham, AL

ID	WBAN NO.	NAME
BID	94793	Block Island, RI
BIH	23157	Bishop, CA
BIL	24033	Billings, MT
BIS	24011	Bismarck, ND
*BKF	23036	Buckley ANGB Arpt., CO
BKW	3872	Beckley, WV
*BLV	13802	Scott AFB, IL
BNA	13897	Nashville, TN
BNO	24134	Burns, OR
BOI	24131	Boise, ID
BOS	14739	Boston, MA
BPT	12917	Port Arthur, TX
BRL	14931	Burlington, IA
BRO	12919	Brownsville, TX
*BSM	13904	Bergstrom AFB, TX
BTR	13970	Baton Rouge, LA
BTV	14742	Burlington, VT
BUF	14733	Buffalo, NY
BVE	12884	Boothville, LA
BWG	93808	Bowling Green, KY
BWI	93721	Baltimore, MD
*BYH	13814	Eaker AFB, AR
CAE	13883	Columbia, SC
CAK	14895	Akron-Canton, OH
CAO	23051	Clayton, NM
CAR	14607	Caribou, ME
*CBM	13825	Columbus AFB, MS
CDC	93129	Cedar City, UT
*CEF	14703	Chicopee Falls, MA
CHA	13882	Chattanooga, TN
CHO	93736	Charlottesville, VA
CHS	13880	Charleston, SC
CIR	2	Cairo, IL
CLE	14820	Cleveland, OH
CLT	13881	Charlotte, NC
CMH	14821	Columbus, OH
CMI	94870	Champaign, IL
CNK	13984	Concordia, KS
CNU	13981	Chanute, KS
*COF	12867	Patrick AFB, FL
CON	14745	Concord, NH
COS	93037	Colorado Springs, CO
COU	3945	Columbia, MO
CPR	24089	Casper, WY

ID	WBAN NO.	NAME
CRP	12924	Corpus Christi, TX
CRW	13866	Charleston, WV
CSG	93842	Columbus, GA
CVG	93814	Covington, KY
*CVS	22008	Cannon AFB, NM
CXY	14751	Harrisburg, PA
CYS	24018	Cheyenne, WY
*DAA	93728	Fort Belvoir, VA
DAB	12834	Daytona Beach, FL
DAG	23161	Daggett, CA
DAL	13960	Dallas, TX
DAY	93815	Dayton, OH
DBQ	94908	Dubuque, IA
DCA	13743	Washington, DC
DDC	13985	Dodge City, KS
DEN	23062	Denver, CO
DFW	3927	Dallas-Ft. Worth, TX
*DLF	22001	Laughlin AFB, TX
DLH	14913	Duluth, MN
*DMA	23109	Davis-Monthan AFB, AZ
DMN	23078	Deming, NM
DOV	13707	Dover AFB, DE
*DPG	24103	Dugway Proving Gnds., UT
*DP1	99173	Eglin 52 AFR, FL
DRT	22010	Del Rio, TX
DSM	14933	Des Moines, IA
DTW	94847	Detroit, MI
DVD	99181	Camp David, MD
*DYS	13910	Dyess AFB, TX
EAU	14991	Eau Claire, WI
*EDW	23114	Edwards AFB, CA
*EFD	12906	Ellington AFB, TX
EKA	24213	Eureka, CA
EKN	13729	Elkins, WV
EKO	24121	Elko, NV
ELP	23044	El Paso, TX
ELY	23154	Ely, NV
*END	13170	Vance AFB, OK
ENV	24193	Wendover, UT
ERI	14860	Erie, PA
ESF	13935	Alexandria, LA
EUG	24221	Eugene, OR
EVV	93817	Evansville, IN
EWN	93719	New Bern, NC
EWR	14734	Newark, NJ
EYW	12836	Key West, FL
*FAF	93735	Ft. Eustis, VA
FAR	14914	Fargo, ND
FAT	93193	Fresno, CA
FAY	93740	Fayetteville, NC

ID	WBAN NO.	NAME
FCA	24146	Kalispell, MT
*FCS	94015	Ft. Carson, CO
*FEW	24010	F.E. Warren AFB, WY
*FFO	13840	Wright-Patterson AFB, OH
*FHU	3124	Ft. Huachuca, AZ
FLG	3103	Flagstaff, AZ
FLO	13744	Florence, SC
*FLV	13921	Ft. Leavenworth, KS
*FME	93733	Ft. Meade, MD
*FMH	14704	Otis AFB, MA
FMN	23090	Farmington, NM
FMY	12835	Ft. Myers, FL
FNT	14826	Flint, MI
*FOE	13920	Forbes AFB, KS
*FRI	13947	Fort Riley, KS
FSD	14944	Sioux Falls, SD
*FSI	13945	Fort Sill, OK
FSM	13964	Fort Smith, AR
*FTK	13807	Fort Knox, KY
FWA	14827	Fort Wayne, IN
*FWH	13911	Carswell AFB, TX
GAG	13975	Gage, OK
*GBN	99175	Gila Bend, AZ
GEG	24157	Spokane, WA
*GFA	24112	Malmstrom AFB, MT
GFK	14916	Grand Forks, ND
GGW	94008	Glasgow, MT
GJT	23066	Grand Junction, CO
GLD	23065	Goodland, KS
GLS	12923	Galveston, TX
GRB	14898	Green Bay, WI
*GRF	24201	Fort Lewis, WA
GRI	14935	Grand Island, NE
*GRK	3993	Robert Gray AAF, TX
GRR	94860	Grand Rapids, MI
*GSB	13713	Sey. Johnson AFB, NC
GSO	13723	Greensboro, NC
GSP	3870	Greenville-Spart., SC
GTB	14715	Ft. Drum, NY
GTF	24143	Great Falls, MT
*GUS	94833	Grissom AFB, IN
GWO	13978	Greenwood, MS
HAT	93729	Cape Hatteras, NC
HBR	93986	Hobart, OK
*HIF	24101	Hill AFB, UT
HKY	3810	Hickory, NC
HLN	24144	Helena, MT
*HMN	23002	Holloman AFB, NM
HON	14936	Huron, SD
HOP	13806	Ft. Cambell AAF, KY

ID	WBAN NO.	NAME
*HRT	3854	Hurlburt Field, FL
*HST	12866	Homestead AFB, FL
HSV	3856	Huntsville, AL
HTL	94814	Houghton Lake, MI
HTS	3860	Huntington, WV
HVR	94012	Havre, MT
*IAB	3923	McConnell AFB, KS
IAD	93738	Washington-Dulles Arpt., VA
IAH	12960	Houston, TX
ICT	3928	Wichita, KS
ILG	13781	Wilmington, DE
ILM	13748	Wilmington, NC
IND	93819	Indianapolis, IN
INL	14918	International Falls, MN
*INS	99177	Nellis 655 AFR, NV
INW	23194	Winslow, AZ
IPT	14778	Williamsport, PA
ISN	94014	Williston, ND
ISP	4781	Islip, NY
*IWA	23104	Williams AFB, AZ
JAN	3940	Jackson, MS
JAX	13889	Jacksonville, FL
JBR	1	Jonesboro, AR
JFK	94789	New York-Kennedy Arpt., NY
LAL	12883	Lakeland, FL
LAN	14836	Lansing, MI
LAS	23169	Las Vegas, NV
LAX	23174	Los Angeles, CA
LBB	23042	Lubbock, TX
LBF	24023	North Platte, NE
LCH	3937	Lake Charles, LA
*LCK	13812	Rickenbacker AFB, OH
LEB	94765	Lebanon, NH
LEX	93820	Lexington, KY
*LFI	13702	Langley AFB, VA
LFK	93987	Lufkin, TX
LGA	14732	New York-Laguardia Arpt., NY
LGB	23129	Long Beach, CA
*LHW	13700	Ft. Stewart, GA
LIT	13963	Little Rock, AR
LIZ	14623	Loring AFB, ME
*LMT	94236	Klamath Falls, OR
LND	24021	Lander, WY
LNK	14939	Lincoln, NE
LOL	24172	Lovelock, NV
LOZ	3849	London, KY
*LRD	12907	Laredo AFB, TX
*LRF	3930	Little Rock AFB, AR
LSE	14920	La Crosse, WI
*LSF	13829	Lawson AFB, GA

ID	WBAN NO.	NAME
*LSV	23112	Nellis AFB, NV
*LTS	13902	Altus AFB, OK
*LUF	23111	Luke AFB, AZ
LWS	24149	Lewiston, ID
LYH	13733	Lynchburg, VA
MAF	23023	Midland, TX
MCB	93919	McComb, MS
*MCC	23208	McClellan AFB, CA
*MCF	12810	Mac Dill AFB, FL
MCI	3947	Kansas City, MO
MCN	3813	Macon, GA
MCO	12815	Orlando Intl. Arpt., FL
MCW	14940	Mason City, IA
*MC2	99174	Ft. Carson AFR, CO
MDW	14819	Chicago-Midway, IL
MEI	13865	Meridian, MS
MEM	13893	Memphis, TN
*MER	23203	Castle AFB, CA
MFR	24225	Medford, OR
*MGE	13864	Dobbins AFB, GA
MGM	13895	Montgomery, AL
MGW	13736	Morgantown, WV
*MHR	23206	Mather AFB, CA
MIA	12839	Miami, FL
*MIB	94011	Minot AFB, ND
*MI1	94158	Saylor Creek AFR, ID
MKC	13988	Kansas City Dwntn., MO
MKE	14839	Milwaukee, WI
MKG	14840	Muskegon, MI
MLB	12838	Melbourne, FL
MLC	93950	McAlester, OK
MLI	14923	Moline, IL
*MMT	13830	McEntire ANGB Arpt., SC
MOB	13894	Mobile, AL
MOT	24013	Minot, ND
MPV	94705	Montpelier, VT
MQT	94850	Marquette, MI
MRB	13734	Martinsburg, WV
MSN	14837	Madison, WI
MSO	24153	Missoula, MT
MSP	14922	Minneapolis, MN
MSS	94725	Massena, NY
MSY	12916	New Orleans, LA
*MTC	14804	Mt. Clemens, MI
*MUI	99190	Ft. Indiantown Gap, PA
*MUO	24106	Mountain Home AFB, ID
*MXF	13821	Maxwell AFB, AL
*MYR	13717	Myrtle Beach AFB, SC
NBC	93831	Beaufort MCAS, SC
NBU	14855	Glenview NAS, IL

ID	WBAN NO.	NAME
NCA	93727	Jacksonville MCAS, NC
*NC1	3147	Cuddeback AFR, CA
NEL	14780	Lakehurst NAS, NJ
NGP	12926	Corpus Christi NAS, TX
NHK	13721	Patuxent River NAS, MD
NKT	13754	Cherry Point MCAS, NC
NQI	12928	Kingsville NAS, TX
NTU	13769	Oceana NAS, VA
OAK	23230	Oakland, CA
*OAR	93217	Ft. Ord, CA
*OCS	3154	Camp Pendleton, CA
*OFF	14949	Offutt AFB, NE
OFK	14941	Norfolk, NE
OKC	13967	Oklahoma City, OK
OLM	24227	Olympia, WA
OMA	14942	Omaha, NE
ORD	94846	Chicago-O'Hare, IL
ORF	13737	Norfolk, VA
ORH	94746	Worcester, MA
*OSC	14808	Wurtsmith AFB, MI
OTH	24284	North Bend, OR
*OZR	3850	Ft. Rucker, AL
*PAM	13846	Tyndall AFB, FL
PBG	4742	Plattsburgh AFB, NY
PBI	12844	West Palm Beach, FL
PDT	24155	Pendleton, OR
PDX	24229	Portland, OR
PHL	13739	Philadelphia, PA
PHX	23183	Phoenix, AZ
PIA	14842	Peoria, IL
PIH	24156	Pocatello, ID
PIR	24025	Pierre, SD
PIT	94823	Pittsburgh, PA
PKB	3804	Parkersburg, WV
PNS	13899	Pensacola, FL
*POB	13714	Pope AFB, NC
*POE	3931	Ft. Polk AAF, LA
POM	3	Pomona, CA
POU	14757	Poughkeepsie, NY
PSB	14761	Philipsburg, PA
*PSM	4743	Portsmouth, NH
PUB	93058	Pueblo, CO
PVD	14765	Providence, RI
PWM	14764	Portland, ME
*QOS	99179	Oscura AFR, NM
RAP	24090	Rapid City, SD
RBL	24216	Red Bluff, CA
*RCA	24006	Ellsworth AFB, SD
RDD	24257	Redding, CA
RDM	24230	Redmond, OR

ID	WBAN NO.	NAME
*RDR	94925	Grand Forks AFB, ND
RDU	13722	Raleigh-Durham, NC
*REE	23021	Reese AFB, TX
RFD	94822	Rockford, IL
RIC	13740	Richmond, VA
*RIV	23119	March AFB, CA
RKS	24027	Rock Springs, WY
RME	14717	Griffiss AFB, NY
*RND	12911	Randolph AFB, TX
RNO	23185	Reno, NV
ROA	13741	Roanoke, VA
ROC	14768	Rochester, NY
ROW	23043	Roswell, NM
RSL	93997	Russell, KS
RST	14925	Rochester, MN
SAC	23232	Sacramento, CA
SAN	23188	San Diego, CA
SAT	12921	San Antonio, TX
SAV	3822	Savannah, GA
SAW	94836	Gwinn, MI
SBA	23190	Santa Barbara, CA
*SBD	23122	San Bernardino, CA
SBN	14848	South Bend, IN
SBY	93720	Salisbury, MD
SCK	23237	Stockton, CA
SDF	93821	Louisville, KY
SEA	24233	Seattle-Tacoma, WA
SFO	23234	San Francisco, CA
SGF	13995	Springfield, MO
SHR	24029	Sheridan, WY
SHV	13957	Shreveport, LA
SJT	23034	San Angelo, TX
*SKA	24114	Fairchild AFB, WA
*SKF	12909	Kelly AFB, TX
SLC	24127	Salt Lake City, UT
SLE	24232	Salem, OR
SMX	23273	Santa Maria, CA
SPI	93822	Springfield, IL
SPS	13966	Sheppard AFB, TX
*SSC	13849	Shaw AFB, SC
SSM	14847	Sault Ste. Marie, MI
STC	14926	St. Cloud, MN
STJ	13993	St. Joseph, MO
STL	13994	St. Louis, MO
*SUU	23202	Travis AFB, CA
SUX	14943	Sioux City, IA
*SVN	13824	Hunter AFB, GA
SYR	14771	Syracuse, NY
*SZL	13930	Whiteman AFB, MO
*TBN	3938	Ft. Leonard Wood, MO

ID	WBAN NO.	NAME
TCC	23048	Tucumcari, NM
*TCM	24207	McChord AFB, WA
TCS	93045	Truth or Con., NM
*TIK	13919	Tinker AFB, OK
TLH	93805	Tallahassee, FL
*TNX	3191	Tonopah TR, NV
TOL	94830	Toledo, OH
TOP	13996	Topeka, KS
TPA	12842	Tampa, FL
TPH	23153	Tonopah, NV
TRI	13877	Bristol, TN
TUL	13968	Tulsa, OK
TUS	23160	Tuscon, AZ
TVC	14850	Traverse City, MI
TXK	13977	Texarkana, AR
TYS	13891	Knoxville, TN
*T01	99182	Wallops Is. TACR, VA
*T02	99183	Ft. Jackson TACR, SC
*T03	99184	Myrtle Beach TACR, SC
*T04	99185	Sarasota TACR, FL
*T05	99186	Smokey Hill TACR, KS
*T06	99187	Camp Shelby TACR, MS
*T07	99188	Green River TACR, UT
*T08	99189	Hill/Eagle TACR, UT

ID	WBAN NO.	NAME
UCA	94794	Utica, NY
*UCC	99178	Yucca Flat Air SP, NV
UIL	94240	Quillayute, WA
*VAD	13857	Moody AFB, GA
*VBG	93214	Vandenberg AFB, CA
VCT	12912	Victoria, TX
*VCV	23131	George AFB, CA
*VPS	13858	Eglin AFB, FL
VTN	24032	Valentine, NE
WAL	93739	Wallops Island, VA
WMC	24128	Winnemuca, NV
*WRB	13860	Robins AFB, GA
*WRI	14706	McGuire AFB, NJ
*X68	12892	Cape Canaveral AFS, FL
YKM	24243	Yakima, WA
YNG	14852	Youngstown, OH
YUM	23195	Yuma, AZ
ZUN	93044	Zuni, NM
*01R	99171	Clairborne AFR, LA
*2DP	99172	Stumpy Point, NC
*2PJ	3880	Sumter, SC
*3RN	99176	Grayling AFR, MI
*4MR	93064	Melrose AFR, NM