

## NCEP Verification Documentation

Environmental Modeling Center (EMC) is responsible for producing the official NCEP Model Verification output. The NCEP Verification processing can be broken down into daily and monthly statistics. The monthly statistics are distributed to registered users around the 5th of the month. The seasonal stats are no longer produced.

The daily and monthly verification processing is broken down into three main programs: QCMON, SUMAC4, and ANLVER. Each of the processing will be described separately.

### NCEP Quality Control and Monitoring (QCMON)

#### Daily Processing

The QCMON daily processing uses reports of ACARS, AMDAR/ASDAR, ship-based radiosonde observations, and satellite data. These data are read from the daily `gdas1.t(00,06,12,or 18)z.prepbufr` files to obtain the mandatory pressure levels at 1000MB, 850MB, 700MB, 500MB, 400MB, 300MB, 200MB, 150MB, 100MB and 50MB.

The processing generates 8 files per day. The ACARS, ASDARS and aircraft report wind and temperature observations. The radiosondes report wind and geopotential height observations. The ship-based radiosondes report wind and geopotential height observations and satellite-derived wind observations are also included.

#### Monthly Processing

The QCMON monthly processing produces reports of aircraft, AMDAT/ASDAR, ACARS, satellite wind, ship-based radiosonde observations, and radiosonde observations of geopotential height and wind using the daily statistics from the `gdas1.t (00, 06, 12, or 18) Z.prepbufr` files.

The statistics calculated include: 1. means, 2. mean speed differences, 3. RMS vector differences, 4. mean temperature differences and 5. RMS temperature differences.

The completion of executing a script (`exwmo_qcmon_rpts.sh`) on NCEP's Central Computing System (CCS) generates a total of 5 individual reports. These reports along with two additional reports (Complex Quality Control Tables and Marine Platform data) are linked in the following order to generate NCEP's Quality Monitoring Report:

1. Complex Quality Control Tables,
2. Monthly summaries for radiosondes geopotential heights and wind,
3. Monthly summaries of aircraft reports,

4. Monthly summaries of ASDAR reports,
5. Monthly summaries of ACARS reports,
6. Marine Platform data,
7. Monthly summaries of ship-based radiosondes.

#### The NCEP Model Forecasts vs. Radiosondes Verification Processing (SUMAC4)

##### Daily Processing

The SUMAC4 programs (qcadp.f and sumac4.f) are set up to verify gridded forecast fields against quality-controlled radiosondes. Program qcadp.f compares the differences between the observed data minus the input analysis fields. If the ADPUPA data (radiosondes) differ from the interpolated analysis value by a certain threshold, the value is tossed. ADPUPA data (the observation and the first guess increments better known as the 6hr forecasts valid at the observation time) is extracted from BUFR file gdas1.t(00, 06, 12 and 18)Z.prepbuf which is compared against the GFS analysis. Additional processes of qcadp.f includes: 1. Hydrostatic checks; 2. derives an analysis file; 3. uses a quadratic method for interpolating analyzed value to an observation; 4. computes a mean and standard deviation; 5. creates a "TOSS" file of rejected observations; 6. creates a "qcadp" file containing good observations of heights, temperature, relative humidity, horizontal(U) and vertical(V) wind components at 850MB, 500MB, 250MB and 100MB; and, 7. creates an "qcadp.f" file used to verify forecasts observations.

Program sumac4.f verifies the GFS, NAM and UKMET model forecasts of height, temperature, relative humidity and wind at 850MB, 500MB, 250MB and 100MB against radiosonde observations. The GFS model extends outward to 240HR with 12HR intervals up to 120HR (00 12 24 36 48 60 72 84 96 108 120); with 24HR intervals thereafter (144 168 192 216 240). The NAM model extends outward to 84HR with 12HR intervals (00 12 24 36 48 60 72 84). Finally, the UKMET model extent outwards to 72HR with 12HR interval (00, 12 24 36 48 60 72).

Sumac4.f depends upon four data files to generate daily statistics. First, there are data cards which provides the latitude/longitude, area and hour being verified. Secondly, there is a data card which provides the first grib index forecast (or analysis) file to N\*file grib index forecast(or analysis) files to be verified. There is data card providing a list of require WMO radiosonde stations used to standardize verification results. ECMWF has the responsibility for modifying this list and to notify individuals of these changes. Finally, there is a data card for identifying the following eight official WMO verification regions: 1. Northern Hemisphere (NH102); 2. Southern Hemisphere (SH31); 3. North America (NA110); 4. South America (SAM30); 5. Tropics; 6. Europe (EUR96); 7. Australia and New Zealand (AUS24); and, 8. Asia.

Daily S1 scores, mean errors, root mean square errors (RMSE), mean speed errors and vector wind errors (RMSEV) of heights, temperatures and winds for the 850MB, 500MB, 250MB and 100MB levels for the GFS and NAM models. Using both the GFS and UKMET models, files containing the daily 24hr and 36hr MAX (winds stronger than 120 knots) and MIN (winds stronger than 80 knots) jet winds at the 250MB level are generated over the Northern Hemisphere and North America. Program sumac4.f generates 4 files per day.

#### Monthly Processing

Daily statistics of observed heights, temperatures and winds (speed and vector) are used to generate time-series records which are written using the following format: 1. model; 2. forecast area; 3. year/month; 4. level (850MB, 500MB, 250MB and 100MB); 5. S1 scores; 6. bias; 7. standard deviation; 8. root mean square errors (RMSE); 9. mean; and, 10. standard deviation. The GFS time-series records are used to generate the monthly averages for the GFS statistics. And, the NAM time-series records are used to generate the monthly averages for the NAM statistics.

Monthly statistics generated from time-series records of the GFS and UKMETS models are graphically displayed. Results, showing a comparison between the GFS and UKMET models, are separated into two distinct regions. The first region covers Asia and Australia. The second region covers the Northern Hemisphere; Southern Hemisphere, North America, South America and the Tropics.

Monthly jet wind verification generated from time-series records of the GFS and UKMETS models verifies the 250MB mean speed error and vector wind error at 24HR and 36HR forecasts over the Northern Hemisphere and North America. Results are based upon forecasting winds falling into two categories. First category sets a minimal having forecast winds stronger than 80 knots. And, the second category sets a minimal having forecast winds stronger than 120 knots.

Finally, daily statistics for the GFS, NAM and UKMET models are transferred to EMC database known as "VLCEK" in ASCII text file.

The completion of executing a script (exwmo\_sumac4\_rpts.sh) on NCEP's Central Computing System (CCS) generates a total of 5 individual reports.

The NCEP Model Forecasts vs. Analyses Verification Processing (ANLVER)

#### Daily Processing

ANLVER verifies a 1-degree grid forecasts against a 1-degree grid analysis using the GFS model for the Northern Hemisphere, the Southern Hemisphere and the Tropics.

Daily S1 scores from the GFS and NAM models are generated for the Mean Sea Level and the 500MB heights. Tables of daily S1 scores have 9 defined regions (GBL, 59, W33, E33, 49, RGNAR1, LL59, LLW33 and LLE33) and may

have up to six pressure levels and ten forecast periods. The region names were defined over 30 years ago. Codes sldaily computes these statistics and generates three files per day.

Daily WMO standard verification scores of the GFS winds forecasts against the analysis at 850MB, 500MB and 250MB for the Tropics, the Northern Hemisphere and the Southern Hemisphere. Statistics generated includes: 1.mean error; 2. root mean square error; 3. mean speed errors and vector wind errors; 4. average max forecast; 5. absolute max forecast; and, 6. analysis of the wind. Codes wmwow computes these statistics and generates six files per day.

Daily WMO standard verification scores of the GFS heights and temperatures against the analysis at 850MB, 500MB and 250MB for the Tropics, the Northern Hemisphere and the Southern Hemisphere. Statistics generated includes: 1.mean error; 2. root mean square error; 3. mean height/temperature errors and vector height/temperatures; 4. average max forecast; 5. absolute max forecast; and, 6. analysis of the height/temperature. Codes wmox computes these statistics and generates fourteen files per day.

#### Monthly Processing

Monthly statistics of mean sea level pressure, heights, temperatures, winds and S1 scores of the GFS model against the analysis are computed for the Northern Hemisphere, Southern Hemisphere and the Tropics.

Daily S1 scores, heights and temperatures are averaged for the GFS model to generate nonstandard tables of monthly totals which are based upon selection the 49-points region (1 file).

Daily S1 scores of the NAM and GFS models are averaged to generate monthly summaries of S1 scores for the GFS using 12HR interval; the GFS using 24HR interval; and, the NAM using 12HR intervals at Mean Sea Level Pressure and 500MB levels (3 files).

Monthly data of S1max (max value minus gradient value summarizes) and S1tru (true value minus forecast to gradient summarizes) scores at mean sea level and 500MB for both the GFS and NAM models are archive in a database (12 files).

Monthly summary of WMO wind scores of the GFS model are generated from the daily verification wind scores.

The completion of executing a script (exwmo\_anlver\_rpts.sh) on NCEP's Central Computing System (CCS) generates a total of sixteen individual reports.