

NetCDF Point Observation Format

MET version 1.1

MET Development Team

In METv1.1, point observations may be supplied in PREPBUFR or ASCII format. The PREPBUFR observation files are reformatted by the PB2NC tool to create an intermediate NetCDF file that is then read by the Point-Stat tool. Similarly, the ASCII observation files are reformatted by the ASCII2NC tool to create an intermediate NetCDF file for Point-Stat as well.

Some users of MET may prefer to use point observations that are not available in the PREPBUFR format. For many of these users the ASCII2NC tool will provide a relatively simple interface for utilizing their point observation in MET. However, some users may prefer to encode their point observations directly into NetCDF. The description of the NetCDF format below should serve as a guide for doing so.

The intermediate NetCDF file is structured in a way similar to how observations are stored in PREPBUFR. In METv1.0, the intermediate NetCDF format retained many data fields from the PREPBUFR file that are not actually used by the Point-Stat tool. In METv1.1, those unused data fields have been removed, and only those data fields actually read by the Point-Stat tool are retained.

Structure of the NetCDF Point Observation Format

The intermediate NetCDF format for point observations contains header location and timing information followed by the actual observation values which correspond to those headers.

The header data consists of the following:

- Observation message type
- Station ID text string
- Valid time in YYYYMMDD_HHMMSS format
- Latitude in degrees north
- Longitude in degrees east
- Elevation of the observing location in meters above sea level

The actual observation data consist of the following:

- ID of the header data to which the observation corresponds
- GRIB code to which the observation corresponds
- Pressure level (in hPa) at which the observation occurred or accumulation interval for precipitation fields (in hours)
- Height at which the observation occurred in meters above sea level
- Observation value in prescribed units

Please note that it is the user's responsibility to convert their observation values to the units defined for the GRIB code indicated. The Point-Stat tool assumes that the units of the observations match the units of the GRIB code indicated.

Example NetCDF Point Observation File

Listed below are the dimensions and variables defined for a sample intermediate NetCDF file. This is the output of the **ncdump** tool run on the **sample_pb.nc** file which is generated by the test script **test_pb2nc.sh** distributed with METv1.1:

dimensions:

```
mxstr = 15 ;
hdr_arr_len = 3 ;
obs_arr_len = 5 ;
nobs = UNLIMITED ; // (89759 currently)
nhdr = 9716 ;
```

variables:

```
float obs_arr(nobs, obs_arr_len) ;
  obs_arr:long_name = "array of observation values" ;
  obs_arr:_fill_value = -9999.f ;
  obs_arr:columns = "hdr_id gc lvl hgt ob" ;
  obs_arr:hdr_id_long_name = "index of matching header data" ;
  obs_arr:gc_long_name = "grib code corresponding to the observation type" ;
  obs_arr:lvl_long_name = "pressure level (hPa) or accumulation interval (h)" ;
  obs_arr:hgt_long_name = "height in meters above sea level (msl)" ;
  obs_arr:ob_long_name = "observation value" ;
char hdr_typ(nhdr, mxstr) ;
  hdr_typ:long_name = "message type" ;
char hdr_sid(nhdr, mxstr) ;
  hdr_sid:long_name = "station identification" ;
char hdr_vld(nhdr, mxstr) ;
  hdr_vld:long_name = "valid time" ;
  hdr_vld:units = "YYYYMMDD_HHMMSS" ;
float hdr_arr(nhdr, hdr_arr_len) ;
  hdr_arr:long_name = "array of observation station header values" ;
  hdr_arr:_fill_value = -9999.f ;
  hdr_arr:columns = "lat lon elv" ;
  hdr_arr:lat_long_name = "latitude" ;
  hdr_arr:lat_units = "degrees_north" ;
  hdr_arr:lon_long_name = "longitude" ;
  hdr_arr:lon_units = "degrees_east" ;
  hdr_arr:elv_long_name = "elevation" ;
  hdr_arr:elv_units = "meters above sea level (msl)" ;
```

// global attributes:

```
:FileOrigins = "File ../out/pb2nc/sample_pb.nc generated 20080714_234830  
UTC on host pigpen by the PB2NC tool" ;
```

Example Description

In the sample file above, there are 9716 header messages (**nhdr**) corresponding to 89759 observation values (**nobs**).

The 9716 header messages are indexed by the **nhdr** dimension and are stored in four variables: **hdr_typ**, **hdr_sid**, **hdr_vld**, and **hdr_arr**.

The **hdr_typ** character string variable contains the message type which may be set to one of the 19 values listed on NCEP's website in Table 1.a of http://www.emc.ncep.noaa.gov/mmb/data_processing/prepbuf/fr/table_1.htm.

The **hdr_sid** character string variable contains the name of the station ID. The Point-Stat tool may be used to compute statistics at individual stations. In doing this, all observations with the same value for **hdr_sid** are grouped together.

The **hdr_vld** character string variable contains a formatted string indicating the time of the observation. The time string must be formatted as YYYYMMDD_HHMMSS.

The **hdr_arr** variable is an array indexed by the **hdr_arr_len** dimension which is set to 3. This array consists of the latitude in degrees north, longitude in degrees east, and the elevation in meters above sea level of the observing location. The elevation value is not currently used by the Point-Stat tool and may be filled with the fill value of **-9999**. However, in future versions of MET it may be used to perform verification at additional vertical levels.

The 89759 observations are indexed by the **nobs** dimension, which is set to 5, and are stored in the **obs_arr** variable. The **obs_arr** variable contains entries for the following.

The first entry for **hdr_id** contains the index of the header message to which this observation corresponds. In the example above, the header ID would be set between 1 and 9716.

The second entry for **gc**, or GRIB code, contains the GRIB code to which this observation corresponds. For example, an observation of temperature corresponds to a GRIB code of 11. Please refer to parameter table version 2 listed on NCEP's website for a list of GRIB codes: <http://www.nco.ncep.noaa.gov/pmb/docs/on388/table2.html>.

The third entry for **lvl** contains the pressure in hPa at which the observation occurred or the accumulation interval in hours for precipitation. The Point-Stat tool performs verification on pressure levels (in hPa) or at the surface. For surface observations, the header type (**hdr_typ**) should be set to either ADPSFC or SFCSHP to indicate that it should be matched to forecasts for the surface. For surface observations, the **lvl** value may be filled with the fill value of **-9999** since it is not used for matching.

The fourth entry for **hgt**, or height, contains the height in meters above sea level at which the observation occurred. In METv1.1, point observations may only be matched to forecasts on pressure levels or at the surface. Therefore, this field is not currently used by the Point-Stat tool and may be filled with the fill value of **-9999**. However, in future versions of MET, the capability to verify at additional vertical levels may be added at which point this field would be used.

The fifth entry for **ob**, or observation, contains that actual observation value. The observation value should be in the units prescribed for the GRIB code indicated: <http://www.nco.ncep.noaa.gov/pmb/docs/on388/table2.html>.

Required Variables

Any NetCDF file created by the user should contain all of the dimensions and variables defined above. However, the following list summarizes the minimum set of variables that must contain valid data to be used by the Point-Stat tool:

hdr_typ = message type

hdr_sid = station ID

hdr_vld = valid time

hdr_arr: lat = latitude

hdr_arr: lon = longitude

obs_arr: hdr_id = index of the header data

obs_arr: gc = GRIB code

obs_arr: lvl = pressure level (not required for surface observations)

obs_arr: ob = observation value

Please contact the MET development team via with any questions or problems via met_help@ucar.edu.