NetCDF Point Observation Format
MET version 1.0
MET Development Team

In METv1.0 the only fully supported point observation format is PREPBUFR. 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. However, several users of MET would like to use observations that are not available in the PREPBUFR format. In order to use their observations in MET, many users have attempted to reformat them into this intermediate NetCDF file format.

The intermediate NetCDF file is structured in a way similar to how observations are stored in PREPBUFR. However, it retains many data fields from the PREPBUFR file that are not actually used by the Point-Stat tool. In future releases, the MET development team would like to modify this intermediate NetCDF format to make it more straightforward and simple. In addition, the MET development team would like to provide a tool to enable users to reformat their own observations from a simple ASCII format to this intermediate NetCDF format.

However, until that tool is available, users will need to perform that reformatting step themselves to use observations not available in PREPBUFR. The following description of the intermediate NetCDF format is meant to provide guidance to those wishing to reformat their observations in this way. It describes how the file is structured and which data fields must contain valid data values, as opposed to the fill data value.

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 observation type, the station id, the valid time, the latitude, the longitude, and five additional fields not currently used by the Point-Stat tool. Those fields include the elevation, the PREPBUFR report type, the input report type, and the instrument type.

The actual observation data consist of the id of the header data to which the observation corresponds, the pressure level at which the observation occurred, the grib code to which the observation corresponds, the observation value, and seven additional fields not currently used by the Point-Stat tool. Those fields include the vertical level (value from 1 to 255), the quality mark, the reason code, the forecast value, the analyzed value, and the data level category.

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 scripts distributed with METv1.0:

```
dimensions:
    mxstr = 15 ;
    hdr_arr_len = 7 ;
    obs_arr_len = 11 ;
    nobs = UNLIMITED ; // (89759 currently)
    nmsg = 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 level p_level gc ob qm pc rc fc an cat" ;
        obs_arr:hdr_id_long_name = "index of matching header data" ;
        obs_arr:level_long_name = "vertical level" ;
        obs_arr:p_level_long_name = "pressure level in hPa" ;
        obs_arr:gc_long_name = "grib code corresponding to the observation type" ;
        obs_arr:ob_long_name = "observation value" ;
        obs_arr:spfh_units = "kg/kg" ;
        obs_arr:tmp_units = "K" ;
        obs_arr:hgt_units = "m" ;
        obs_arr:ugrd_units = "m/s" ;
        obs_arr:vgrd_units = "m/s" ;
        obs_arr:dpt_units = "K" ;
        obs_arr:wind_units = "m/s" ;
        obs_arr:rh_units = "%" ;
        obs_arr:mixr_units = "kg/kg" ;
        obs_arr:prmsl_units = "Pa" ;
        obs_arr:qm_long_name = "quality mark" ;
        obs_arr:pc_long_name = "program code" ;
        obs_arr:rc_long_name = "reason code" ;
        obs_arr:fc_long_name = "forecast value" ;
        obs_arr:an_long_name = "analyzed value" ;
        obs_arr:cat_long_name = "data level category" ;
    char hdr_typ(nmsg, mxstr) ;
        hdr_typ:long_name = "message type" ;
    char hdr_sid(nmsg, mxstr) ;
        hdr_sid:long_name = "station identification" ;
    char hdr_vld(nmsg, mxstr) ;
        hdr_vld:long_name = "valid time (observation time plus dhr)" ;
        hdr_vld:units = "YYYYMMDD_HHMMSS UTC" ;
    float hdr_arr(nmsg, hdr_arr_len) ;
        hdr_arr:long_name = "array of observation station header values" ;
```

```
hdr_arr:_fill_value = -9999.f ;
hdr_arr:columns = "lon lat dhr elv typ t29 itp" ;
hdr_arr:lon_long_name = "longitude" ;
hdr_arr:lon_units = "degrees_east" ;
hdr_arr:lat_long_name = "latitude" ;
hdr_arr:lat_units = "degrees_north" ;
hdr_arr:dhr_long_name = "observation time minus cycle time" ;
hdr_arr:dhr_units = "hours" ;
hdr_arr:elv_long_name = "elevation" ;
hdr_arr:elv_units = "meters" ;
hdr_arr:typ_long_name = "prepbufr report type" ;
hdr_arr:t29_long_name = "input report type" ;
hdr_arr:itp_long_name = "instrument type" ;

// global attributes:
        :FileOrigins = "File ../out/pb2nc/sample_pb.nc generated 2008-01-07_19:27:32
UTC on host pigpen" ;
        :obs_time = "2007-03-31_12:00:00" ;
```

Example Description

In the sample file above, there are 9716 header messages corresponding to 89759 observation values.

The 9716 header messages are indexed by the dimension "nmsg" 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/prepbufr.doc/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 contains seven float values consisting of the longitude and latitude followed by five values that are not actually used by Point-Stat. Those five values may be filled with the fill value of -9999.

The 89759 observations are indexed by the dimension "nobs" and are stored in one variable: obs_arr. The "obs_arr" variable contains eleven float values, only four of which are actually used by the Point-Stat tool.

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 "level" contains to the vertical level set in the PREPBUFR observations between 1 and 255. However the vertical level value is not used by the Point-Stat tool and may be filled with the fill value of -9999.

The third entry for "p_level", or pressure level, contains the pressure in hPa at which the observation occurred. The Point-Stat tool performs verification on pressure levels (in hPa) or at the surface. For observations at the surface, this entry may be filled with the fill value of -9999. However, for surface observations, the header type (hdr_typ) should be set to either ADPSFC or SFCSHP.

The fourth 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 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 above.

The last six entries for "qm pc rc fc an cat", or quality mark, program code, reason code, forecast value, analyzed value, and data level category, are not used by the Point-Stat tool and may be filled with the fill value of -9999.

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: lon = longitude
hdr_arr: lat = latitude
obs_arr: hdr_id = index of the header data
obs_arr: p_level = pressure level (not required for surface observations)
obs_arr: gc = grib code
obs_arr: ob = observation value

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