WCR User Notes for Level 2 Processed Data

Level 2 (L2) radar processed data are written in NetCDF files. The L2 files are generated using the L1 processed data (see WCR_L1_UserNotes.pdf for more information). The available L2 files from the experiment are cataloged in the WCR2_L2_Catalog.txt file. In addition a NetCDF header text file (a 'cdl' file WCR_L2_<....> .cdl) augmented with additional comments is also available to help browse and understand all the variables that may be present in every individual file.

When multiple WCR antennas are used, L1 files contain the data from all active antennas during data acquisition (which antennas are used depend on the selected radar acquisition mode). The L2 files, however, contain data from one antenna only. This means that, for example if L1 data file contains data from 3 active antennas (for example, 'up', 'down', and 'down-slant' pointing antennas) the L2 processing will generate separate files for each antenna. Also if data from both 'up' and 'down' antennas are collected an additional merged up-down L2 file is generated.

In addition to separating the radar products retrieved for each antenna (beam-pointing direction), the radar products are further processed from what is done for L1. The most important additional processing includes:

a) Reflectivity and velocity products are thresholded to remove the noise left in them at L1. The typical threshold is 3 standard deviations above the mean noise. Some additional noise removal is sometimes applied to remove noise artifact. It is expected that more than 95% of the noise is removed.
b) Reflectivity and velocity data are also averaged in such a way that L2 products along flight and across flight (radar range) spatial sampling ratio is near unity at 1 km distance.
c) The radar products from the 'up', 'down', and 'down-slant' beams are interpolated to a vertical plane and the corresponding altitude variable is also written in the files.
d) If a polarimetric antenna is used the available LDR and ZDR products are generated as separate variables.

1. Reflectivity and Doppler velocity variables (main attributes are listed)

```
float reflectivity(profile,range) ;
   reflectivity:long_name = "Equivalent reflectivity factor" ;
   reflectivity:units= "dBZ";
   reflectivity:_FillValue = -32767.f;
   reflectivity:nfilter=0;     // noise reduction filter
   reflectivity:status="range correction applied, noise threshold applied,
                        no atten.correction";
   reflectivity: threshold=
             "~10.*alog10(3*noisestd/sqrt(WCRavprofiles*WCRavrangegates))";

float min_reflectivity(profile);
//* minimum detectable signal at 1 km (equal to the reflectivity threshold)*//
  min_reflectivity:long_name = "Minimum detectable reflectivity at 1 km" ;
   min_reflectivity:units= "dBZ" ;
   min_reflectivity:_FillValue = -32767.f ;
```

```
  float velocity(profile,range) ;
        velocity:long_name = "Mean Doppler radial velocity" ;
        velocity:units = "m/s";
        velocity:_FillValue = -32767.f;
        velocity:maxvel = 0.f;      // Doppler Nyquist velocity
        velocity:refframe="Earth (x:East,y:North,z:Up)";
        velocity:status  = "scatterers mean radial velocity, thresholded";
```

2. **Reflectivity mask (**applicable to up, down, down-slant beams**)**

```
  short wcrmask(profile,gatealt);
        wcrmask:long_name = "Two byte target mask";
        wcrmask:units = "";
        wcrmask:activebits = 0,1,2,3,4,5,6,7,8; // currently active bits
        wcrmask:setbitname =
"beamID,beamID,beamID,Off6,blind_zone,surface,sub_surface,out_of_range";

Description of wcrmask:
LSB set bit # (bit decimal value):
   bit 0 (1) - beamID; set is up beam
   bit 1 (2) - beamID; set is down beam
   bit 2 (4) - beamID; set is down-slant beam
   bit 3 (8) - up or down beam is more than 6 deg off of vertical
   bit 4(16) - radar blind zone (for combined up-down beam only)
   bit 5(32) - estimated surface return gate
   bit 6(64) - sub-surface gate
   bit 7(128)- pixel outside maximum radar range

MSB set bit # (bit decimal value):
   bit 8(256)  - gate affected by surface clutter; set to max of
                 ~75 m above surface for the down beam and ~150 m
                 for the down-slant beam
   bit 11(2048)- transmitter leak for up beam only; mask first ~75 m
```

The **wcrmask** provides information for the content of each pixel. If bits 0,1, and 2 are set the pixel is considered a valid pixel. If it does not contain a target its value will be the **_FillValue**. It is possible on occasion to have residual noise, radar artifacts, or non-meteorological target whose values have not been masked and appear like legitimate meteorological targets. The pixel value when bits 4,5,6, or 7 is the **_FillValue**.