In-Cloud Icing and Large-Drop Experiment (ICICLE) 2019
W-band and X-band radar data

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Data ver.: 1.1 (August 31, 2020)

Data level: 2 (NAWX netcdf file is generated for every binary radar data file. Up and down beams (antennas) are merged and projected to altitude and side data at the antenna beam direction. When an antenna is not active, data are replaced with filling values.)

General notes

- These are the datasets acquired between January and March 2019 with two radar systems (W-band (NAW) 94.05 GHz and X-band (NAX) 9.41 GHz) during the ICICLE project based out of Rockford, Illinois (USA).
- The radar antenna subsystem (three W-band and three X-band antennas and a two-axis motorized reflector plate for one of the W-band antennas) is housed inside an un-pressurized blister radome on the right side of the aircraft fuselage (Fig. 1).
- In general, data are available at nadir, zenith and side antennas. In some scenarios, one or two antennas are deactivated (e.g. when the aircraft is flying at low altitude, nadir antennas are terminated to avoid damaging RF components; or when the NAW aft antenna is steered to nadir or side for calibration purpose).

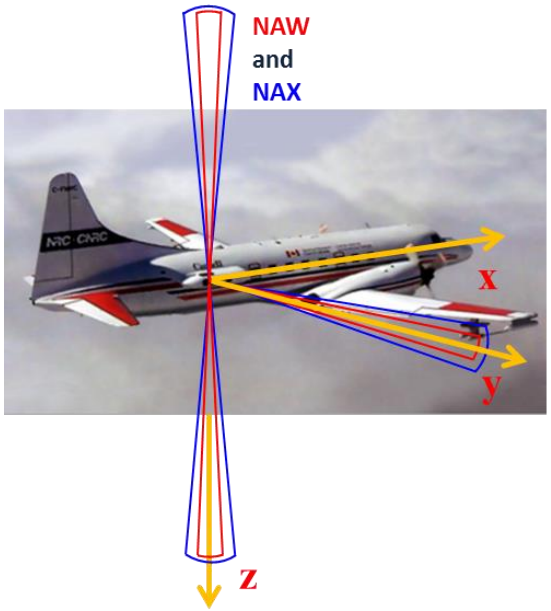

Figure 1: Locations and direction of NAWX antenna beams and the aircraft reference system.

Data files

Format: The NAWX processed data are provided in a netCDF format. For a sample file structure see the accompanying "NAW_L2_NCheader.txt".

Variables: The data include radar equivalent reflectivity factor and Doppler velocity corrected for aircraft motion. In addition complementary measurements of aircraft state parameters that were recorded in real time by the NAWX data acquisition systems are included for reference only.

Processing: The L2 NAWX data are processed with noise subtraction and a 3dB above noise level mask applied. NRC preformed dedicated radar calibration maneuvers for both reflectivity as well as antenna beam pointing. In addition, sophisticated cross-calibration (between antennas and W vs. X) was done to make sure that the data are consistent. The reflectivity values included in this release have accuracies of 1-1.5 dBZ for the W-band and 1-2 dBZ for the X-band and Doppler estimates have bias less than 0.5 ms^{-1} for the W-band and 1 ms^{-1} for the X-band. Basic information about the NAWX radar is given in Wolde and Pazmany (2005). A detailed descriptions of the NAWX data processing will be provided NRC Lab Technical Report (Nguyen and Wolde, 2020) and a journal paper (Nguyen and Wolde, 2020/1).

Quicklooks: For each flight there are multiple files, which correspond to the raw radar files as recorded by the NAWX Data Acquisition Systems. A new radar files are generated every time the radar configuration files changes during the flight, or when the size of the radar data reaches a certain size threshold. In order to aid the data users, a quicklook of the data are provided in PDF format. In these quicklook files, the aircraft altitude is shown in a dashed line with segments with the nadir antenna beam is off from vertical by greater than 10 degrees are shown in a thick black line (Fig. 2 and 3). Quicklooks for the entire flight generated by merging all the files are also included in PNG format (Fig. 4).

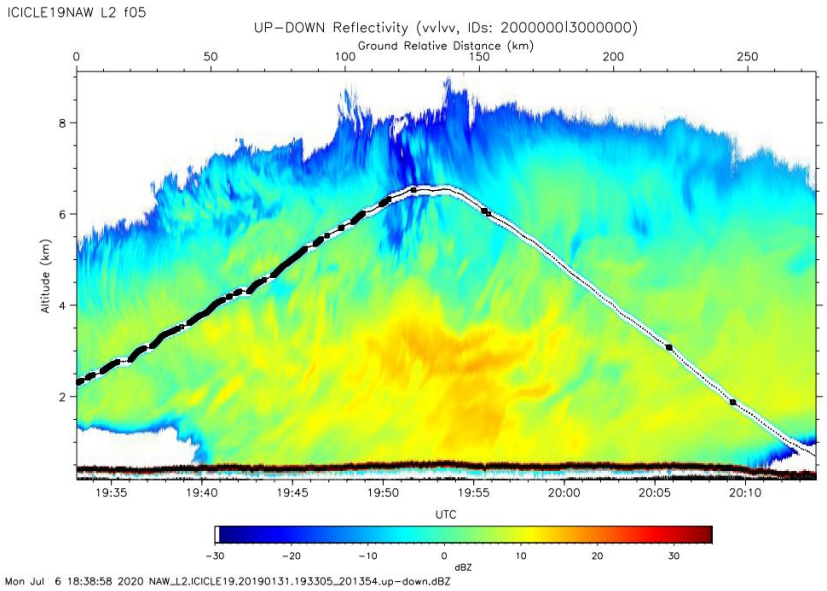

Figure 2: Merged up-down NAW reflectivity for a segment of flight 05 on 31 Jan, 2019.

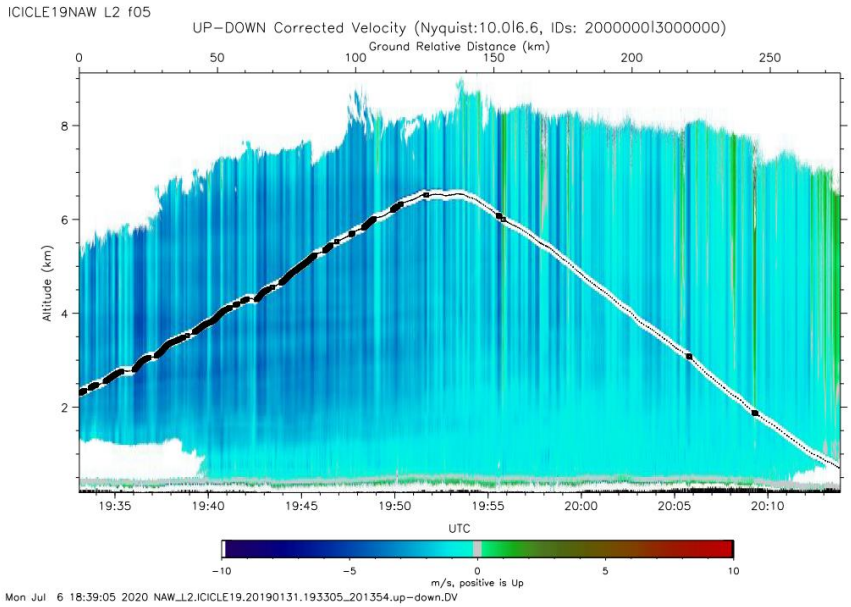

Figure 3: Same as in Fig. 2 but for Doppler velocity.

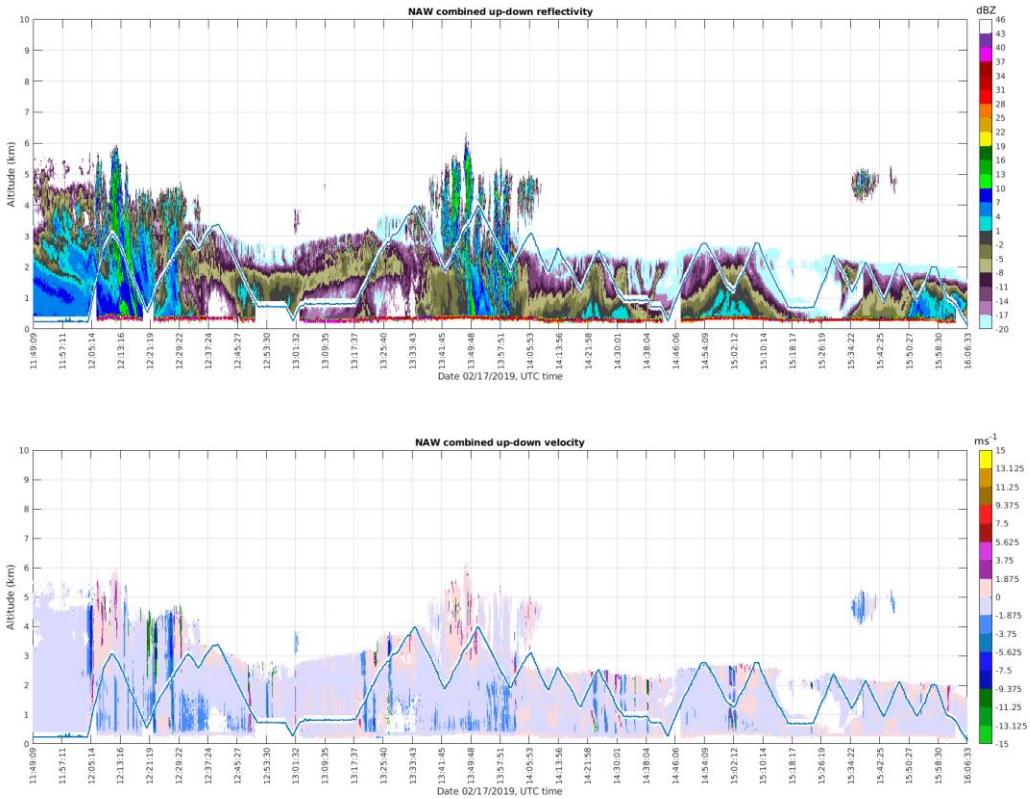

Figure 4: NAW reflectivity (top) and Doppler velocity (bottom) for entire flight 17 on 17 Feb, 2019.

Data Quality: The NAW radar has excellent receiver isolation and very stable providing high quality data. The NAX radar in contrast has lower circulators' isolation factor and poor sidelobe performance due to the limited antenna size. This results interference signals between the channels. In detail, a portion of the returned signal power from an antenna will leak into the other antenna's receiver (within a pair of nadir/zenith or side H/V) via the corresponding circulator and splitter. At zenith looking antenna, the leakage is most obvious at a range corresponding to the ground range of the nadir antenna or a range of strong precipitation target (melting layer, heavy rains …). At side looking antenna, when the sidelobes intercept with targets with strong returns below the aircraft such as the earth surface or a storm melting layer, significant returns from the sidelobes will contaminate signals coming via the antenna's main lobe. In this release, those contaminating signals are not filtered out.

Distribution and Publication:

Data distribution and data use for publications follow the data policy agreed upon by the NRC, ECCC and FAA. We request that the NRC is notified for any data distribution to 3rd parties before the public release.

References

Wolde, M. and Pazmany, A.: NRC dual-frequency airborne radar for atmospheric research, 32nd Conf. on Radar Meteorology, Albuquerque, NM, Amer. Meteor. Soc., P1R.9, 2005.

Nguyen, C. and Wolde, M.: NRC W-band and X-band airborne radars: signal processing and data quality control, Geoscientific Instrumentation, Methods and Data Systems Discussions, in preparation, 2020.

Nguyen, C. and Wolde, M. (2020), RadSnowExp/ICICLE 2019: NAWX Radar Data Signal Processing and Quality Control, NRC technical report, *in preparation, 2020*.