Documentation for NRC *Bulk Properties: Nevzorov Probe Data* release in the ESCAPE flight campaign 2022

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Ver. 1.0

Data level: 2 ("Derived geophysical variables with limited corrections applied")

Data from the NRC Nevzorov hot-wire probe, acquired on NRC M300 data acquisition system at 1 Hz rate, processed and packaged in NetCDF format.

Nevozorv Instrument description:

The Nevzorov (Figure 1) provides bulk water content quantities. The LWC sensor of the Nevozorv is cylindrical and foreward facing. The solid ice particles break away but liquid droplets will create a film and evaporate on contact. The TWC sensor of the Nevzorov has a cone geometry, allowing all water to be captured and evaporated.

The Nevzorov has reference wires with similar aerodynamics to the aforementioned LWC and TWC sensor wires, but these are shielded from both liquid water and ice. Sensor performance in supercooled liquid droplet condition was recently documented in Esposito et al., 2023.

Figure 1. The Nevzorov, installed on NRC Convair-580 aircraft in starboard scalar boom (ssb) location.

General notes:

Nevzorov hotwire probe was installed on NRC's Convair-580 research aircraft to collect bulk cloud properties data during the ESCAPE flights. The data accompanying this document includes processed measurements. This document provides information about the time of operation, and an estimate of collected data quality.

- The release contains datasets from the following instrument:
  - ○ Nevzorov hotwire cloud water content probe: sensor heads #301, #299, #300 (Korolev et al., 2003)
- Data acquired in May-June 2022 during the ESCAPE campaign, based out of Houston, Texas.
- Nevzorov TWC Sensor (#301) was damaged due to graupel and non-functional for majority of C-RF08. Sensor head was replaced (#299) before C-RF11. New sensor head was damaged in C-RF12, and replaced before C-RF13 to #300. That sensor had been previously damaged (a crack to the TWC cone). The third head was damaged in C-RF13.

Nevzorov data acquisition during the ESCAPE campaign

Table 1. Summary of data quality per flight

NRC flight #	Nezorov data quality
C-RF01	Good
C-RF02	Good
C-RF03	Good
C-RF04	Good
C-RF05	Good
C-RF06	Good
C-RF07	Good
C-RF08	Questionable
C-RF09	Instrument off
C-RF10	Instrument off
C-RF11	Good
C-RF12	Questionable
C-RF13	Questionable

Data files

Format: Dataset is provided in the NETCDF4 format.

Variables:

- Liquid water content of clouds in [g/m3] from the NRC Nevzorov LWC and TWC sensors.
- Total (ice plus liquid) water content of clouds in [g/m3] from the NRC Nevzorov LWC and TWC sensors.

Processing:

Nevzorov probe data was processed with NRC Nevzorov Processing code, as outlined below.

1. Clear air baseline of dissipated power ('dry term') on each collector wire was calculated via an estimation from ambient parameters (pressure, temperature, air speed), with fitting per flight. Uncertainty of baseline calculations is estimated to be within 0.04 [g/m3].
2. Upon removing the baseline, conversion from power units to LWC and TWC was implemented according to Nevzorov user manual (SkyPhysTech Inc.). Corrections on cloud phase and residual effects of ice or water have been applied in this version. Corrections on collection efficiency have not been applied.
3. No data quality flagging is provided in this version.

Data Quality: No filtering or corrections have been applied to the data. This includes, but is not limited to, 'dry term' baseline, collection efficiency, artifacts due to icing on the probe etc.

Examples of bulk measurements during the ESCAPE campaign

Figure 2 shows examples of bulk measurements made between 18:00 and 19:00 during flight 11 (C-RF11) on Jun. 16, 2022. The blue and red lines indicate Nevzorov total water content and Nevzorov Liquid water content, respectively.

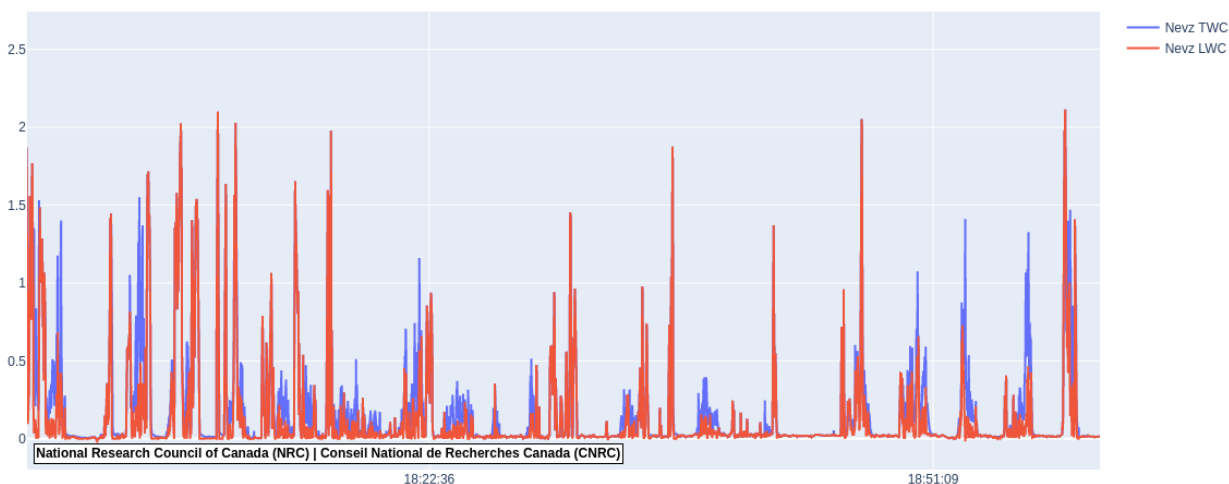20220616_C-RF11 : Water Content Measured Onboard NRC Convair 580

Figure 2: Nevzorov total water content (blue) and liquid water content (red) during flight 11 on Jun. 16, 2022.

References

- Korolev, A.V., Isaac, G.A., Cober, S.G., Strapp, J.W. and Hallett, J., 2003. *Microphysical characterization of mixed-phase clouds.* Quarterly Journal of the Royal Meteorological Society: A journal of the atmospheric sciences, applied meteorology and physical oceanography, 129(587), pp.39-65.
- Esposito, B.M., Orchard, D., Lucke, J., Nichman, L., Bliankinshtein, N., Lilie, L., Catalano, P., D'Aniello, F. and Strapp, J.W., 2023. *Comparability of Hot-Wire Estimates of Liquid Water Content in SLD Conditions* (No. 2023-01-1423). SAE Technical Paper.