Dataset Title:
CAESAR C-130 Manually Corrected Nevzorov Liquid/Total/Ice Water Content

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Dataset version & version history:
The flight data used in processing the Nevzorov data was the Low Rate (LRT - 1 sps) Navigation, State Parameter, and Microphysics Flight-Level Data, processed by the NSF/NCAR EOL C-130 Team. The C-130 LRT file version used in each Nevzorov version file is denoted by "(NCAR LRT – Version: 0.1)" (for example), where NCAR aircraft data in this case was the original field data.

(The most recently produced Nevzorov file version is denoted with a preceding **Version X,* final/published data will be denoted as Version X - Final)

Version 0.1 – Processed Nevzorov using field data, only for internal UW use for testing. NCAR LRT – Version: 0.1

Version 0.2 – Re-processed data for updated NCAR aircraft files, and for initial release through NCAR EOL. Data file doesn't include ice water content or subsequent flags but can be calculated independently as a first estimate. NCAR LRT – Version: 1.2

Version 1.0 – Final – Re-processed data for updated NCAR aircraft files, and for initial release/publication. Files and data are verbatim of Version 0.2, but has been quality checked again for official doi publication. Data files don't include ice water content or subsequent flags but can be calculated independently as a first estimate. Future versions will add these variables. NCAR LRT – Version: 1.2

Data status:
Final/ Published– as of latest version release above.

Platforms:
NSF/ NCAR C-130

General description of the dataset:

There exists one file from each NCAR C-130 research flight from CAESAR. The files contain each of the following from the manually corrected Nevzorov data: Time in seconds, liquid water content (LWC), total water content (TWC), and ice water content estimate (IWC). It is important to check the version history to see what is included in each version of the data files.
In addition to these variables, data quality flags are included for each of the corrected variables:

- Flag 1: Good – raw data, Excellent data quality (uncertainty within ~ $\pm$ 0.01 gm^{-3})
- Flag 2: Good – corrected, Excellent data quality (uncertainty within ~ $\pm$ 0.01 gm^{-3})
- Flag 3: Good – non-correctable data, acceptable data quality (uncertainty within ~ $\pm$ 0.02 gm^{-3})
- Flag 4: Conditional – non-correctable, usable data (uncertainty outside ~ $\pm$ 0.02 gm^{-3}); Data could not be adjusted to flags 2 or 3, use with some caution.
- Flag 5: Bad/Poor – use with extreme caution, data not recommended for use.

Data coinciding with flags 4 and 5 was not omitted from the corrected variables. Every instrument turn on/off, results in a power spike in the data resulting in a Flag 5 data partition. Aircraft takeoff and landing were designated as Flag 4 if close enough to Flag 5, where the baseline hasn't flattened out to near zero yet. Any other circumstances of Flags 4 and 5 are true to the flag descriptions above.
Note – these data descriptions are of the most recent version, in the version history.

Times of interest:
(Times are in UTC | seconds)
RF01: 02-28-2024: 11:39:00 – 18:36:44 | 41940 - 67004
RF02: 02-29-2024: 11:07:00 – 18:16:00 | 40020 - 65760
RF03: 03-02-2024: 09:26:00 – 11:01:00 | 33960 - 39660
RF04: 03-05-2024: 06:02:00 – 12:40:00 | 21720 - 45600
RF05: 03-11-2024: 06:54:00 – 12:51:00 | 24840 - 46260
RF06: 03-12-2024: 06:06:00 – 12:29:00 | 21960 - 44940
RF07: 03-16-2024: 09:45:00 – 17:35:00 | 35100 - 63300
RF08: **The data has been omitted from the field campaign**
RF09: 04-02-2024: 08:00:00 – 16:02:00 | 28800 - 57720
RF10: 04-03-2024: 08:22:00 – 15:57:00 | 30120 - 57420

File naming and format:
The naming convention for each file contains the research flight number [rf**], the date of that research flight [YYYYMMDD], and 'nevzcorr' signifying that this file is the corrected Nevzorov data. The file name follows this structure in a netCDF file:
{**date of research flight**}.{**research flight number**}.**nevzcorr**.nc
Where an example of this for research flight 9 on April 2nd, 2024, would be:
20240402.**rf09**.**nevzcorr**.nc

Corrected Nevzorov file names:
RF01: 20240228.rf01.nevzcorr.nc

RF02: 20240229.rf02.nevzcorr.nc
RF03: 20240302.rf03.nevzcorr.nc
RF04: 20240305.rf04.nevzcorr.nc
RF05: 20240311.rf05.nevzcorr.nc
RF06: 20240312.rf06.nevzcorr.nc
RF07: 20240316.rf07.nevzcorr.nc
RF09: 20240402.rf09.nevzcorr.nc
RF10: 20240403.rf10.nevzcorr.nc

List of variables:
Note: Check each file version in the version history to see which variables listed below are included in the file.

Variable name:	**Long name:**	**Units:**	**Data Type:**
Time	Time in Seconds, Since Start of Day	seconds	int
Nev_LWC	Nevzorov Liquid Water Content	gm^{-3}	float
Nev_TWC	Nevzorov Total Water Content	gm^{-3}	float
Nev_IWC	Nevzorov Ice Water Content	gm^{-3}	float
Nev_LWC_Flag	Liquid Water Content Quality Flags	n/a	int
Nev_TWC_Flag	Total Water Content Quality Flags	n/a	int
Nev_IWC_Flag	Ice Water Content Quality Flags	n/a	int

Areas of interest:
Locations are specific to the gridded domain of the field campaign, and aircraft flight tracks flown for each date/flight/file.

Data frequency:
1 Hz

Project spatial coverage:
Data was collected via the NSF/NCAR C-130 aircraft and are both time and lat/lon-tagged from flight tracks. The geographical grid that encompasses all flights are:

- Maximum (North) Latitude: 82.00

- Minimum (South) Latitude: 66.00
- Minimum (West) Longitude: -14.00
- Maximum (East) Longitude: 24.00

Project temporal coverage:
The field campaign operated 10 intensive operating periods or research flights on the NSF/NCAR C-130 throughout the time window outlined below:

- Begin Date Time: 2024–02–28 | 11:40:00 UTC
- End Date Time: 2024–04–03 | 16:00:59 UTC

Data Restrictions:
Acquisition authorization through NCAR EOL required until public release.

Data collection and processing:

Data collection:
Data was collected using the NSF/NCAR C-130 research aircraft during the CAESAR field campaign in 2024.

Related project:
CAESAR: Cold Air Outbreak Experiment in the Sub-Arctic Region
https://data.eol.ucar.edu/project/CAESAR

Processing Procedures:
The raw Nevzorov output is a series of voltages and currents, that are then translated into the power supplied to each element required to keep the probe at the operating temperature of 70°C. In order to calculate the LWC and TWC, the 'wet power' must be isolated from the power originally being a function of hydrometeor impact, airspeed, and pressure. By calculating independent fits for the indicated air speed, and static pressure during in flight speed runs (RF03), the dry air coefficient is then applied across all reference powers so the power supplied is solely a function of hydrometeors impacting the sensing elements.

Quality Assurance & Control Procedures:
Data quality control procedures for the Nevzorov hot-wire probe were applied manually using some assumptions since a baseline shift can occur at any time in or out of cloud. These assumptions are discussed below.
After processing the data, any baseline shift outside the uncertainty described in the general description of the dataset, was subsequently flagged for correction. If the data was outside the flag 1 threshold and could be corrected to a flag 1 baseline, the data was flagged as 2. Any data that could be corrected but only within $\pm$ 0.02 gm^{-3}, or any data that could not be corrected but was within this uncertainty range, was flagged at a 3. Any data outside these uncertainty ranges were flagged at flags 4 or 5 accordingly.

When the CDP LWC is near 0 gm^{-3}, the Nevzorov LWC should be as well. Therefore, the baseline was adjusted as needed. This adjustment was made consistently with time until a new baseline shift was apparent. If no baseline shift was obvious, no new correction was made. Additionally, if a baseline shift occurred, but remained within the flag 1 threshold, no correction was applied.
The TWC adjustments were made similarly, when the CDP LWC is near 0 gm^{-3} and no ice was present. With ice being present, it is expected that the Nevzorov TWC will show values > 0 gm^{-3} even though the CDP LWC is near 0 gm^{-3}, so no correction could confidently be applied here. Other indications from the King probe reacting similarly to the Nevzorov, are also indicative of icing regimes. Any adjustments were made consistently until a new shift was apparent.

Instrument Description & Operating Principles:

The Nevzorov Hot-wire probe utilizes a constant-temperature hot-wire that evaporates or sublimates hydrometeors upon contact with its heated sensing elements. The power required to maintain the sensor at its operating temperature, **70°C** during CAESAR, directly correlates to the condensed water mass in the cloud. The instrument measures **TWC**, which includes both liquid and ice hydrometeors, and **LWC**, which only captures liquid droplets. The LWC sensor achieves this by relying on the shattering of ice particles upon impact, whereas the TWC sensor, with its conical shape, collects both phases. Each sensing element is paired with a reference sensor that compensates for convective heat loss, ensuring accuracy across varying flight conditions. Any inaccuracies in the baseline, identifiable out of cloud, have been corrected while being processed.

Citation:

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https://data.eol.ucar.edu/