ERC Instrument for Chemical composition of Aerosols – Laser Ablation Mass Spectrometer (ERICA-LAMS) Data – Readme

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1.0 Data Set Description

The data set includes bipolar mass spectra and associated vacuum aerodynamic diameter of individual particles obtained by the ERICA-LAMS during the ACCLIP activities. This data set is the first submission (Revision 0) and was last checked on March 08, 2023

The data set includes measurements from research flights 1 - 14 (July 31 - August 31, 2022).

The status of the data is final, except for two files from research flight 1 and 2 (July 31 and August 4, 2022). The latter ones are not selected for in-cloud measurement periods due to missing cloud flag. We will provide the revised version as soon as the cloud information is provided.

The location of the research aircraft during the measurements can be found in the navigation, state parameter and microphysics dataset of the NCAR GV measurements (NSF/NCAR GV Team, 2023)

The frequency of data collection is irregular based on our measurement technique (see below). Thus, the frequency depends on the presence of particles, the particle detection efficiency, and the hit rate of the instrument. However, the maximum sampling frequency is 10 Hz given by the idle time of the UV laser. In addition, data were recorded in during a 5 sec sampling interval (AMS shutter closed) with subsequent 5 sec idle time (AMS shutter open) due to possible interference with ERICA-AMS measurements (see documentation file of ERICA-AMS data for further information).

2.0 Instrument Description

The ERICA instrument (ERC Instrument for the Chemical Composition of Aerosols) combines two commonly adopted methods for in situ real-time mass spectrometric analysis of aerosol particles. The first method is the laser desorption ionization (LDI) method followed by the thermal desorption with subsequent electron-impact ionization (TDI) as implemented in the Aerodyne aerosol mass

spectrometer (AMS) (Drewnick et al., 2005; Canagaratna et al., 2007). The ERICA has been described in detail by Hünig et al. (2022) and Dragoneas et al. (2022).

This data set refers to the ERICA-LAMS (ERICA laser ablation mass spectrometer) measurements based on the LDI technique. Single particles are detected and classified by size using two continuous wave lasers. The vacuum aerodynamic diameter of the particles is derived from the particle velocity and a calibration with monodisperse polystyrene latex particles. The information of particle velocity is further used to trigger a pulsed UV desorption/ionization laser (wavelength 266 nm). The generated ions are extracted by switched electrical fields. A time-of-flight mass spectrometer is operated to achieve ion mass spectra for both polarities.

The particle (vacuum aerodynamic) size range detectable by the ERICA-LAMS is between ~180 nm and 3000 nm (d_{50} cutoff; Hünig et al. (2022)).

The detection limit for the ion signals is 7 mV x sample for both polarities.

3.0 Data Collection and Processing

Single-particle mass spectra (including particle size information) were obtained by the ERICA-LAMS onboard the NCAR GV "HIAPER" aircraft during the ACCLIP activities in July/August 2022. We used the software package CRISP (Concise Retrieval of Information from Single Particles; Klimach, 2012) to perform m/z (ion mass-to-charge ratio) calibration and peak area integration. The m/z values are given in the unit of mv x sample. To achieve the vacuum aerodynamic diameter of each particle, we used data from a size calibration that was done prior in the laboratory in Mainz.

We removed data that were collected during in-cloud measurement periods based on the cloud flag provided by Sarah Woods. The cloud flag is included in the navigation, state parameter and microphysics dataset (NSF/NCAR GV Team, 2023). We further removed mass spectra, where none of the m/z signals show values above 7 mv x sample.

The mass spectra look similar to high altitude measurements that were performed earlier to ACCLIP (e.g., StratoClim; Appel et al (2022)).

4.0 Data Format

The ERICA-LAMS data set for the individual ACCLIP flights is provided in the ICARTT format. The filenames for the ERICA-LAMS product from ACCLIP 2022 are given in the following format:

ERICA-LAMS_SingleParticleCompo_GV_20220731_RF01_R0.ict

ERICA-LAMS is the acronym for the instrument, SingleParticleCompo is the abbreviation of the data product type (single particle chemical composition), GV is the platform (NCAR GV aircraft), 20220731 is the date of take-off time given as YYYYMMDD format (UTC), RF## is the flight mission number during ACCLIP campaign, R0 is the Revision no. 0.

Parameters include the signals for m/z 1-250 (for positive polarity) and m/z -1- -250 (for negative polarity) as well as the vacuum aerodynamic diameter (d_{va}). Further processing of the data

regarding the classification of particle types (e.g., elemental carbon, minerals) and substances (e.g., sulfate) needs further correspondence with the lead author.

5.0 Data Remarks

For RF01 and RF02, the data quality is only prefinal since in-cloud measurement periods could not be determined due to missing cloud flag. We will provide the revised version as soon as the cloud information is available.

For RF03, 04, 05 and 07, the cloud flag was missing for some periods, in particular for the beginning and/or end of the flight. Therefore, the ERICA-LAMS data might be affected by cloud artefacts during these periods.

6.0 References

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