
PHIPS-HALO Single Particle Data

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1.0 Data Set Overview

This data set presents the single particle measurements performed by PHIPS-HALO. It comprises the particle microphysical properties deduced from the stereo imaging as well as the angular light scattering measurements.

Data was collected during the SOCRATES field project onboard the NSF/NCAR HIAPER aircraft.

Maximum (North) Latitude: -30.00, Minimum (South) Latitude: -70.00
Minimum (West) Longitude: 130.00, Maximum (East) Longitude: 180.00

https://www.eol.ucar.edu/field_projects/socrates

2.0 Instrument Description

PHIPS-HALO is a single particle cloud probe developed at Karlsruhe Institute of Technology, Germany. The probe is installed underwing in a standard PMS canister. The instrument takes stereo micrographs of single cloud particles entering its sensing area under an angular viewing distance of 120°. For the same particles angular light scattering functions are measured from 18° forward direction to 170° backward direction with 8° angular resolution. Technical details can be found in:

Schnaiter, M., Järvinen, E., Abdelmonem, A., Leisner, T., "PHIPS-HALO: the airborne particle habit imaging and polar scattering probe – Part 2: Characterization and first results.", *Atmospheric Measurement Techniques*, 11, 341-357, 2018, doi:10.5194/amt-11-341-2018

Abdelmonem, A., Järvinen, E., Duft, D., Hirst, E., Vogt, S., Leisner, T., and Schnaiter, M., "PHIPS-HALO: the airborne Particle Habit Imaging and Polar Scattering probe – Part 1: Design and operation.", *Atmospheric Measurement Techniques*, 9, 3131-3144, 2016, doi:10.5194/amt-9-3131-2016

3.0 Data Collection and Processing

From the individual stereo micrographs a set of particle properties like equivalent diameter and area are deduced as described in:

Schön, R., M. Schnaiter, Z. Ulanowski, C. Schmitt, S. Benz, O. Möhler, S. Vogt, R. Wagner, U. Schurath, "Particle habit imaging using incoherent light: a first step toward a novel instrument for cloud microphysics", *Journal of Atmospheric and Oceanic Technology*, 28, 493–512, 2011

Stereo micrographs are acquired with a maximum repetition rate of 3 Hz.

In addition to the micrographs angular light scattering functions are measured and digitised with 11 bit resolution.

Single particle light scattering functions are acquired with a maximum repetition rate of 3.5 Hz without data loss.

4.0 Data Format

Data is provide as the level 4 product, i.e. containing both the microphysical properties and the angular light scattering functions on a single particle basis. Typically, one level 4 data file per research flight number is generated. The files have the following name structure PhipsData_YYYYMMDD-HHMM_level_4.csv. The time stamp in the name corresponds to the time when the data acquisition was started.

4.1 Column Names

Table 1: Description of the columns in level 4 file

DataSet	Dataset number that is unique for each flight
RealTimeStamp	UTC time in format YYYY-MM-DD hh:mm:ss.sss
ParticleTimeStamp	System time in ms
ElapsedParticleTime	Time elapsed between two triggers in ms
ParticleTimeOfFlight	Particle time of flight in ms
ImageCamera1	Image number for camera 1 and 2. If no image was taken or an image is missing, a fill value NaN is used.
ImageCamera2	
DropletFlag_Algorithm	Discrimination flag based on automatic discrimination algorithm. 0 for ice and 1 for droplets.
Plate	Ice particle habit based on manual inspection. The appropriate class has a number 1 and other classes are marked with 0. A fill value NaN is used if an image was taken but no particle was present, or the image was identified as a shattering event.
Skeleton_Plate	
Sectored_Plate	
SidePlane	
Dendrite	
Column	
Hollow_Column	
Sheath	
CappedColumn	
Needle	
Frozen_droplet	
Bullet_rosette	
Graupel	

Irregular	
Small_irregular	
Droplet	
Aggregate	
Rimed	Additional information on the particle morphology. A value 1 means that this feature was observed. Otherwise a value 0 or NaN is given.
Pristine	
proj_area_C1	Particle's projected area analyzed from camera 1.
perimeter_C1	Particle's perimeter analyzes from camera 1.
diameter_C1	Sphere equivalent diameter analyzed from camera 1.
dmax_C1	Particle's maximum diameter analyzed from camera 1.
dw_C1	The maximum diameter that is perpendicular to Dmax.
aspect_ratio_C1	Aspect ratio analyzed from camera 1.
roundness_C1	The ratio between the projected area of the particle and the area of a circle with a diameter of Dmax analyzed from camera 1.
x_Position_C1	x-Position of the first pixel in camera 1.
y_position_C1	y-Position of the first pixel in camera 1.
proj_area_C2	Particle's projected area analyzed from camera 2.
perimeter_C2	Particle's perimeter analyzes from camera 2.
diameter_C2	Sphere equivalent diameter analyzed from camera 2.
dmax_C2	Particle's maximum diameter analyzed from camera 2.
dw_C2	The maximum diameter that is perpendicular to Dmax.
aspect_ratio_C2	Aspect ratio analyzed from camera 2.
roundness_C2	The ratio between the projected area of the particle and the area of a circle with a diameter of Dmax analyzed from camera 2.
x_Position_C2	x-Position of the first pixel in camera 2.
y_position_C2	y-Position of the first pixel in camera 2.
TriggerIntensity	Trigger intensity in counts
ScatteringAngle18	
ScatteringAngle26	
ScatteringAngle34	
ScatteringAngle42	
ScatteringAngle50	
ScatteringAngle58	

ScatteringAngle66	
ScatteringAngle74	
ScatteringAngle82	
ScatteringAngle90	The scattering intensity in counts for each scattering angle. The intensity measurements are digitalized with 11 bits which corresponds to a maximum count value of 2048.
ScatteringAngle98	
ScatteringAngle106	
ScatteringAngle114	
ScatteringAngle122	
ScatteringAngle130	
ScatteringAngle138	
ScatteringAngle146	
ScatteringAngle154	
ScatteringAngle162	
ScatteringAngle170	

5.0 Data Remarks

No data for research flight RF01 due to a failure of the imaging laser.

Manual classification of particle habits not performed for RF03 due to image quality problems.