Dual Ice Crystal Imager (D-ICI): images of snow particles from Kiruna on 2014-10-19 with size, area, and fall speed measurements

SND-ID: snd1129-1. **Version**: 1.0. **DOI**: https://doi.org/10.5878/rhwc-7093

Download data

SND1129-001-V1.0.zip *(539.21 MB)*

Citation

Kuhn, T. (2019) Dual Ice Crystal Imager (D-ICI): images of snow particles from Kiruna on 2014-10-19 with size, area, and fall speed measurements (Version 1.0) [Data set]. Luleå University of Technology. Available at: https://doi.org/10.5878/rhwc-7093

Creator/Principal investigator(s)

Thomas Kuhn - Luleå University of Technology, Department of Computer Science, Electrical and Space Engineering

Research principal

Luleå University of Technology - Department of Computer Science, Electrical and Space Engineering

Description

Accurate predictions of snowfall require good knowledge of the microphysical properties of the snow ice crystals and particles. Shape is an important parameter as it influences strongly the scattering properties of the ice particles, and thus their response to remote sensing techniques such as radar measurements.
The fall speed of ice particles is another important parameter for both numerical forecast models as well as representation of ice clouds and snow in climate models, as it is responsible for the rate of removal of ice from these models.

A new ground-based in-situ instrument, the Dual Ice Crystal Imager (D-ICI), has been developed to determine snow ice crystal properties and fall speed simultaneously. The instrument takes two high-resolution pictures of the same falling ice particle from two different viewing directions.
Both cameras use a microscope-like set-up resulting in an image pixel resolution of approximately 4µm/pixel. One viewing direction is horizontal and is used to determine fall speed by means of a double exposure. For this purpose, two bright flashes of a light-emitting diode behind the camera illuminate the falling ice particle and create this double exposure and the vertical displacement of the particle provides its fall speed. The other viewing direction is close to vertical and is used to provide size and shape information from single-exposure images.
This viewing geometry is chosen instead of a horizontal one because shape and size of ice particles as viewed in the vertical direction are more relevant than these properties viewed horizontally as the vertical fall speed is more strongly influenced by the vertically viewed properties.
In addition, a comparison with remote sensing instruments that mostly have a vertical or close to vertical viewing geometry is favoured when the particle properties are measured in the same direction.

The instrument has been tested in Kiruna, northern Sweden (67.8N, 20.4E). First measurements from

2014-10-19 are presented with images and determined snow ice crystal properties.

The dataset is the basis of Kuhn, T. and Vázquez-Martín, S.: Microphysical properties and fall speed measurements of snow ice crystals using the Dual Ice Crystal Imager (D-ICI), Atmos. Meas. Tech., 13, 1273–1285, https://doi.org/10.5194/amt-13-1273-2020, 2020.

The data consist of images of individual snow crystals or snowflakes taken by the two cameras of D-ICI. Images from the top-view camera are in the folder named "20141018_180609_top" and the side-view images in the folder "20141018_180728_side". The folder of top-view images contains a subfolder called "detected" that contains results from image processing to detect particles and determine their edge, size (maximum dimension), and cross-sectional area (area inside boundary). These results consist of images where the background (first image in folder "20141018_180609_top") is removed (in folder "bck_removed"), black-and-white images where black marks detected snow particles (in folder "bw"), images representing the used Sobel gradient matrix (in folder "bw", file name contains "gm"), particle cut-out images (in folder "particles"), particle cut-out images with the particle edge visualized (in folder "borders"). In addition, the file "particles_output.txt" lists Particle name (image name including a running number starting at 1 for all particles found on the same image), area (in number of pixels), size (maximum dimension in number of pixels), and area ratio. The file "particles.log" is a log file from image processing containing information (described in the header), for example the maximum gradient of the Sobel gradient matrix.
The side-view images in the folder "20141018_180728_side" show double exposures of the snow particle, from which the fall speed is determined. Apart from very few exceptions where one of the cameras missed to take an image, each side-view image has a corresponding top-view image taken at the same time. However, the timestamps are not identical (but usually within one second) as the two computers saving the data were not exactly synchronized.

Four text files contain size, area and fall speed data derived from images and used for Area versus Maximum dimension and Fall speed versus Maximum dimension figures:

Size and area data:
20141018_all_particles.txt
Columns contain:
1: imagename
2: particlename
3: dmax/um (micrometre)
4: area/m2
5: Ar (area ratio)
6: m09/kg (particle mass determined from Schmitt and Heymsfield (2009), Eq.2.
7: date_time

Size and fall speed data:
20141018_fallspeed.txt
Columns contain:
1: speed_y/(m/s)
2: folder
3: particle_name
4: max_dimx (maximum width in x direction in pixels)
5: max_dimy (maximum width in y direction in pixels)
6: area(px)
7: area/m2

8: Dmax(px)
9: Dmax/um (micrometre)
10: area_ratio

Same data but only for particles of certain shapes is contained in:
droplets_20141018.txt: droplets
needles.txt: needles and agglomerates of needles
rimed.txt: rimed particles

References:
Schmitt and Heymsfield (2009), J. Atmos. Sci., 66 (7), pp2013-2028.

Data contains personal data

No

Language

English

Time period(s) investigated

2014-10-19 – 2014-10-19

Data format / data structure

Numeric

Still image

Geographic spread

Geographic location: Sweden, Kiruna Municipality, Norrbotten Province

Geographic description: Data from snowfall in Kiruna, northern Sweden (67.8°N, 20.4°E).

Responsible department/unit

Department of Computer Science, Electrical and Space Engineering

Funding

- Funding agency: The Kempe Foundations

Research area

Earth and related environmental sciences (Standard för svensk indelning av forskningsämnen 2011)

Natural sciences (Standard för svensk indelning av forskningsämnen 2011)

Climatology / meteorology / atmosphere (INSPIRE topic categories)

Keywords

Snow, Atmospheric conditions, Snow crystals, Snow fall, Snow fall speed

Publications

Vázquez-Martín, S., Kuhn, T., & Eliasson, S. (2020). Shape Dependence of Falling Snow Crystals' Microphysical Properties Using an Updated Shape Classification. Applied Sciences, 10(3), Article 1163.

https://doi.org/10.3390/app10031163
Link to full text
URN: urn:nbn:se:ltu:diva-78099
DOI: https://doi.org/10.3390/app10031163

Kuhn, T., & Vázquez-Martín, S. (2020). Microphysical properties and fall speed measurements of snow ice crystals using the Dual Ice Crystal Imager (D-ICI). Atmospheric Measurement Techniques, 13, 1273–1285. https://doi.org/10.5194/amt-13-1273-2020
Link to full text
URN: urn:nbn:se:ltu:diva-78097
DOI: https://doi.org/10.5194/amt-13-1273-2020

Accessibility level

Access to data through SND
Data are freely accessible

Use of data

Things to consider when using data shared through SND

License

CC BY 4.0

Versions

Version 1.0. 2019-10-31

Download metadata

DataCite
DDI 2.5
DDI 3.3
DCAT-AP-SE 2.0
JSON-LD
PDF
Citation (CSL)
File overview (CSV)

Published: 2019-10-31
Last updated: 2021-03-26