https://doi.org/10.5194/essd-2022-317
Preprint. Discussion started: 7 November 2022

Database of the Italian disdrometer network

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Abstract. In 2021, a group of seven italian institutions decided to bring together their know-how, experience, and instruments for measuring the drop size distribution (DSD) of atmospheric precipitation giving birth to the Italian Group of Disdrometry (in Italian named: Gruppo Italiano Disdrometria, GID, https://www.gid-net.it/). The GID has made freely available a database of 1-minute records of DSD collected by the disdrometer network along the Italian peninsula. At the time of writing, the disdrometer network is composed of eight laser disdrometers belonging to six different Italian institutions (including research centers, universities and environmental regional agencies). This work aims to document the technical aspects of the italian DSD database consisting of 1-minute sampling data from 2012 to 2021 in a uniform standard format defined within GID. Although not all the disdrometers have the same length of the data record, the DSD data collection effort is the first of its kind in Italy, and from here onwards, it opens new opportunities in the surface characterization of microphysical properties of precipitation in the

perspective of climate records. The GID database can be downloaded here https://doi.org/10.5281/zenodo.6875801 (Adirosi et al., 2022).

1 Introduction

Disdrometers are punctual, non-captative devices able to measure the size and fall velocity (most of them) of each single hydrometeor (solid or liquid) that falls into their measuring area is at most 100 cm^2. Just to have an order of magnitude, on average, 1 m^3 of air contains about 10^3 raindrops during precipitation, including many more small drops than large ones (Uijlenhoet and Sempere Torres, 2006). Particle size and fall velocity measurements allow computing the Particle Size Distribution (PSD) or the Drop Size Distribution (DSD) in case of rain. Knowing the PSD or the DSD, several rainfall parameters can be obtained, such as rainfall rate, rainfall amount (as the rain gauge does), radar reflectivity factor, liquid water content, and kinetic energy of the falling particles.

Disdrometer data are useful for several applications that range from climatological, meteorological, and hydrological uses to telecommunications, agriculture, and conservation of cultural heritage exposed to precipitation. With respect to rain gauges, disdrometers provide more complete precipitation information, providing not only the rainfall amount but also microphysical measurements. Considering only the rainfall rate, disdrometers provide, with respect to rain gauge, a huge improvement in detecting low intensity rain rate and solid precipitation. Tipping bucket rain gauges, one of the widest adopted, provide a measurement each 0.2 mm of precipitation amount that, in 1 minute of constant precipitation, corresponds to a rainfall intensity of 12 mm h^{-1}, while disdrometers have a greater sensitivity reaching much lower precipitation intensity. Estimation of solid precipitation from remote sensing and in-situ devices still represents a great challenge due to the higher variability, with respect to liquid precipitation, of shape, dimension, orientation, density and habit of the solid hydrometeors. Microphysical information obtained by disdrometers can improve both the quantitative estimation of solid precipitation (Capozzi et al., 2020; Bracci et al., 2021) and the classification of precipitation types (Fehlmann et al., 2020).

An accurate characterization of PSDs, and much more DSDs, is useful for different applications such as to:

- Improve the accuracy of numerical weather prediction (NWP) models for precipitation forecasting (Van Den Heever and Cotton, 2004; Yang et al., 2019),
- increase the knowledge of the physical processes involved in the formation and evolution of precipitation, also considering the aerosol-hydrometeor interaction and the spatial variability at small scale (Tapiador et al., 2010; Tokay and Short, 1996; Bhupendra et al., 2021; Abbott and Cronin 2021),
- evaluate the effects of climate change on precipitation characteristics and intensity (Leinonen et al., 2012; Hachani et al., 2017),
- quantify the erosion effects of the precipitation on the soil and on the cultural heritage exposed to precipitation due to the kinetic energy of the hydrometeors (Kinnell, 2005; Serio et al., 2019),
- improve and validate the quantitative precipitation estimation (QPE) from remote sensing devices such as ground-based (Villarini, and Krajewski, 2010; Adirosi et al., 2018) and space-borne (Iguchi et al., 2009; Adirosi et al., 2021) weather radars,
- characterize the precipitation attenuation effects on the microwave telecommunication links in order to properly design links but also to estimate precipitation from opportunistic signals along these links (Giannetti et al., 2017; de Vos et al. 2019).

Disdrometers are classified according to their measurement principle: impact-type, infrared (laser or scatter), video, and radar type. To date, laser disdrometers typology is the most widely adopted for precipitation measurements, thanks to its good trade-off between accuracy, purchase and installation cost, and low maintenance. The presented database is composed of data collected by laser disdrometers of two different manufacturers (namely the OTT and the Thies Clima) that represent the overwhelming majority of the disdrometers used world wide.

In general, disdrometric measurements are affected by several errors caused by: (i) statistical sampling, (ii) instrument limitations (i.e., resolution and sensitivity), and (iii) environmental factors such as wind effect, splashing or external interference from, e.g., insects or spider webs. Among the environmental factors, wind is recognized as the most significant source of measurement biases, and some studies have been presented in order to mitigate its effects on disdrometers data (Friedrich et al., 2013; Capozzi et al., 2021). Errors due to instrumental limitations depend on the type of disdrometer and the measurement principle adopted and can affect the measured DSD in different ways. Several authors have compared measurements of different disdrometers and have found systematic differences in the shape of measured drop spectra and corresponding integral parameters (e.g., Tokay et al., 2001; Krajewski et al., 2006; Thurai et al., 2011; Adirosi et al., 2020; Fehlmann et al., 2020, among others).

Despite their potential role, disdrometers are not widely employed yet by meteorological and hydrological operational services, likely because of the lack of both knowledge about their performance and accuracy in relation to environmental conditions and of standards for calibration, maintenance, and processing (Lanza et al., 2021). On the other hand, the use of disdrometers data for research purposes is increasing worldwide, and few attempts to network these devices are growing. One example is the UK disdrometers validation network set up in 2017 (Pickering et al., 2019). Another example is the network realised by the Italian Group of Disdrometry (in Italian name: Gruppo Italiano Disdrometria, GID, https://www.gid-net.it/) here presented. GID was born in 2021 thanks to a spontaneous collaboration of different Italian institutions (including research centers, universities, and environmental regional agencies) that manage disdrometers over the Italian peninsula.

The main aim of GID is to create a network between owners and users of disdrometers data in Italy in order to capitalize the instrumental resources and the know-how available, and to maximize the usefulness of these precious measures in various fields of application. For these reasons, GID believes it is important to make freely available its own database that is composed of several years of 1-minute DSD collected by 8 laser disdrometers along the Italian peninsula and provided with a common standard format defined within GID.

In section 2, a brief technical description of the laser disdrometers adopted in the GID network is provided along with a detailed description of the network organization; Section 3 describes the common processing adopted by GID in order to provide a uniform and accurate database of disdrometer data; Section 4 describes the GID database, and finally in Section 5, all necessary information on data access is reported.

2 Device and network description

Following a brief description of the two types of laser disdrometers available in the GID network is provided.

2.1 Thies Clima Laser Precipitation Monitor

The Laser Precipitation Monitor (LPM) manufactured by Thies Clima GmbH (www.thiesclima.com), hereinafter TC, is a laser disdrometer and consists of a laser diode and optics which produce a parallel beam of infrared light of 780 nm thickness with a detection area of 20 × 228 mm (45.6 cm^2). When the precipitation particle falls through the light beam, the received signal is reduced; the amplitude of the reduction is related to the size of the particle, and the duration of the reduction is related to the fall speed. The number of detected particles is recorded in a 22 size x 20 fall velocity matrix (although the first version of the TC recorded data in a 20 x 20 matrix). The particle diameter classes range between 0.125 mm and 8 mm, while the fall velocity ranges between 0.2 m s^{-1} to 10 m s^{-1}. Lanzinger et al. (2006) and de Moraes Frasson et al. (2011) provided information regarding the factory calibration process and apparent accuracy of TC. The measurement uncertainty for the volume measurement under laboratory conditions is 2.2%. Upton and Brawn (2008) compared the DSD measured by the OTT Parsivel (first version) and the TC disdrometer. They found that TC measures a higher number of drops respet to OTT Parsivel (i.e., Parsivel counts 74% of the drops recorded by TC in light rain, R<1mm h^{-1}, and 80% for R>1mm h^{-1}), however this difference in the drop count depends mainly to the fact that the TC measures about three times the number of small drops (D less than about 0.6 mm) recorded by the OTT Parsivel. Nevertheless, it has been founded a good agreement between the precipitation amount recorded by a collocated rain gauge and the TC disdrometer (Upton and Brawn 2008). Similar conclusions have been found by Angulo-Martínez et al. (2018), who compared two years of TC data with a collocated OTT Parsivel2 data**.** They found that TC recorded in average double number of particles than Parsivel2, but the majority of the differences is observed for very small drops. The application of a filter criterion to the size-fall velocity matrix strongly reduces these discrepancies. In terms of rainfall rate, the TC is more sensitive to precipitation detection but overestimates rainfall amount with respect to Parsivel2. Fehlmann et al. (2020) compared 2-year of TC data with the most accurate 2 Dimensional Video Disdrometer (2DVD) and found that the number of particles with diameters between 0.5 and 3.5 mm is slightly

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underestimated by TC. In contrast, the number of the smaller and larger particles is overestimated, however the discrepancy for the larger drops (D >5 mm) is much higher than the one for the smaller drops. Finally, Adirosi et al. (2018) found negligible differences in terms of weather radar algorithms between TC, Parsivel2, and 2DVD.

2.2 OTT Parsivel 2

The OTT Parsivel2 (hereinafter P2) is a laser-based optical disdrometer to simultaneously measure PARticle SIze and VElocity of liquid and solid precipitation. The disdrometer has an optical sensor that produces a horizontal sheet of light (30 mm wide and 1 mm high, 180 mm long). In the receiver the light sheet is focused in a single photodiode. In clear sky conditions, the receiver produces a 5-V signal at the output of the sensor. Passing through the light sheet, particles partially block this light sheet causing a temporary reduction of the voltage. The reduction of the signal amplitude provides information on the size of the particle, while the signal duration reduction allows an estimation of the particle velocity. The manufacturer's software computes the diameter of the hydrometeors based on the assumption that the particles have an axis ratio (Tokay et al., 2014) with a diameter corresponding to the width of the maximum blocked area. This assumption is reliable for rain, but it is not appropriate for solid precipitation.

The raw output provided by the manufacturer's software, either at 10-second or 1-minute intervals, is the number of drops in 32 size and 32 fall velocity categories, with variable widths. The particle size ranges from 0.062 to 24.5 mm, while the fall velocity goes from 0.05 to 20.8 m s^{-1}. However, the first two size categories, which correspond to sizes less than 0.2 mm, have been left empty due to the low signal-to-noise ratio. The Parsivel was originally designed for the determination of radar reflectivity-rainfall relations, therefore its drop detection capability is lower in the left end of the drop spectrum (namely the small diameters). Indeed this part of the spectrum has less influence on rain rate and radar reflectivity, but may be important for cloud physics. The measurement accuracy was reported to ± 1 size class up to

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2 mm, and ± 0.5 size class for particles above 2 mm. In terms of rainfall rate for liquid precipitation is ±5%.

Regarding the comparison of P2 with 2DVD, which is considered the most accurate commercial disdrometer for DSD measurements, Tokay et al. (2016) and Park et al. (2017) found a very good agreement in the concentration of midsize drops (0.6–4.0 mm in diameter), and, as a consequence, in the rainfall rate for light and moderate precipitation, while for heavy rainfall rate P2 tends to overestimate large drops (likely due to binning effects). Finally, P2 detects a higher number of very small drops.

2.3 GID Network

At the time of publication of the database and of the writing of this paper, the GID network is composed of 6 TC and 2 P2 located along the Italian peninsula, as shown in Figure 1, along with some pictures of the installed devices.

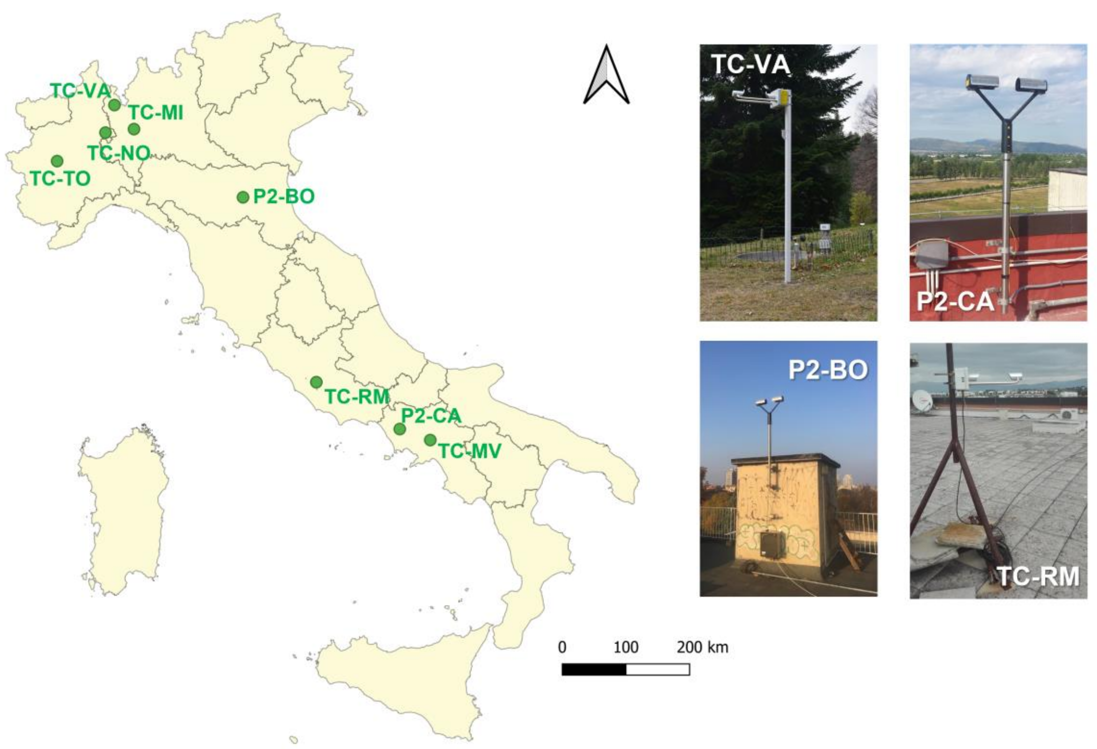

Figure 1: Locations of the GID network disdrometers along with pictures of some installations. In the left panel, the prefix TC and P2 stand for Thies Clima and Parsivel 2 type disdrometer, respectively, whereas the suffixes indicate the locations: VA (Varese), MI (Milan), NO (Novara), TO (Turin), BO (Bologna) RM (Rome), CA (Capua) and MV (Montevergine).

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The geographical distribution of the disdrometer is not homogeneous along Italy (see Figure 1, left) due to the nature of the GID network. In fact, it was born thanks to the spontaneous collaboration of different Italian disdrometer owners without the possibility to decide the installation locations. However, one of the aims of GID is to enlarge the network with other disdrometers already available in Italy (if any) or with new devices. In the latter case the site identification will be driven by the goal of providing a much homogeneous distribution of disdrometers, covering in particular the South and the two main Italian islands (i.e., Sicily and Sardinia).

The following Italian institutions are in the GID network

- National Research Council of Italy, Institute of Atmospheric Sciences and Climate (ISAC-CNR)
- National Research Council of Italy, Institute for the BioEconomy (IBE-CNR)
- Laboratory of Environmental Monitoring and Modelling for the sustainable development (LaMMA)
- Italian Aerospace Research Centre (CIRA), Meteorology Laboratory
- Department of Physics and Astronomy "Augusto Righi", University of Bologna (UniBo)
- Department of Science and Technology, University of Naples “Parthenope” (UniParth)
- Regional Agency for the Protection of the Environment of Lombardia (ARPA Lombardia)
- Regional Agency for the Protection of the Environment of Piemonte (ARPA Piemonte)
- Società Astronomica Schiaparelli, Centro Geofisico Prealpino (CGP)

Table 1 summarizes the primary information regarding the disdrometers of the GID network. In particular, in addition to the station's name (ID), Table 1 provides the location and coordinates of the installation site, the name of the owner institution and of the one that manages the device and the data, and also the month and year of the first measurement. The disdrometer coordinates are referred to the World Geodetic System-84 (WGS-84). The longest dataset is the one collected by TC-RM, which consists of almost 10 years of disdrometer data. However, it should be noted that these are not operational devices, therefore some interruptions due to different causes can be present in the time series of the disdrometer measurements. Most of the devices are installed in research facilities or measurement sites, allowing the presence of other meteorological devices (such as pluviometer, wind profiler, radar, visibilimeter, optical particle counter, etc.) nearby.

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With the exception of the TC-MV and TC-VA, the disdrometers are located in relatively flat terrain, in particular TC-MV is the only device located in a mountain environment. Furthermore, 4 disdrometers are located in urban areas and 4 in rural areas (namely TC-RM, TC-MV, P2-CA, TC-VA). Following the Köppen–Geiger climate classification (Kottek et al., 2006), all the disdrometers are located in group C (temperate climate); however, the TC-MI, TC-TO, TC-VA, TC-NO, and P2-BO fall into the Csc (Mediterranean cold summer climates) area while the others in the Csa (Mediterranean hot summer climates) area.

ID	Location	Latitude	Longitude	Height ASL (m)	First measurement	Owner	Manager	site classification
TC-VA	Varese	45.8316	8.7989	433	April 2021	CGP	CGP	rural, Csc
TC-MI	Milano	45.4904	9.1947	150	April 2014	ARPA Piemonte	ARPA Lombardia	urban, Csc
TC-NO	Novara	45.4402	8.6198	157	August 2021	ARPA Piemonte	ARPA Piemonte	urban, Csc
TC-TO	Torino	45.0294	7.6549	250	January 2014	ARPA Piemonte	ARPA Piemonte	urban, Csc
P2-BO	Bologna	44.4993	11.3538	65	December 2018	UniBo	UniBo	urban, Csc
TC-RM	Roma	41.8425	12.6464	102	September 2012	ARPA Piemonte	ISAC-CNR	rural, Csa
P2-CA	Capua	41.1192	14.1721	70	July 2015	CIRA	CIRA	rural, Csa
TC-MV	Osservatorio di Montevergine	40.9365	14.7291	1280	December 2018	UniParth	UniParth	rural, Csa

Table 1: Information regarding the disdrometers of GID network. In the last column the site classification includes information on the surrounded area (i.e. urban or rural) and the Köppen–Geiger climate classification (Kottek et al., 2006).

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3 Data Processing

The TC and P2 raw data consist of a 1-minute size-velocity matrix that contains the number of hydrometeors collected by the device for each drop size and fall velocity bin. The dimension of the matrix depends on the device: a 32x32 matrix for P2; a 22x20 matrix for TC (20x20 for the old version of TC). Knowing the size-velocity matrix, the DSD and the corresponding rainfall parameters can be obtained. However, in order to limit the differences between TC and P2 and to improve the accuracy of the obtained DSD and geophysical parameters, a filter criterion has been applied to the raw data. The latter is a common procedure adopted in the vast majority of disdrometer-related studies.

The data processing adopted by GID and applied to all the disdrometers of the GID network is described below. The latter is valid only for liquid precipitation since the accurate estimation of PSD for mixed or solid precipitation is more challenging and will be the main goal of further investigations. The selection of liquid precipitation samples has been made by applying the fall velocity filter criterion described below, and when temperature data nearby the disdrometer are available, a further filtering criterion based on the temperature is applied. The latter consists in eliminating the rainfall minutes with air temperature below 4°C.

Following the Version 01 of GID data processing:

1. Application of the fall velocity filter criterion to the 1-minute size-velocity matrix. The adopted criterion eliminates drops with a fall velocity outside the ±50% of the theoretical diameter-fall velocity relation proposed by Atlas et al. (1973) and based on the observations of Gunn and Kinzer (1949). The filter mask used is shown in Figure 2 for P2 and TC. Please note that the latter criterion is widely adopted in the literature and can be applied to any disdrometer raw data, as long as independent size and fall velocity data are available.
2. Computation of the DSD. The following equation has been used to compute the DSD only for 1-minute sample with at least 11 drops:

$$N^{P2;TC}(D_i) = \frac{1}{A^{P2;TC}\Delta t\ \Delta D_i^{P2;TC}} \sum_{j=1}^{C_v^{P2;TC}} \frac{n_{j,i}}{v_j} \tag{1}$$

where the superscript indicates the specific instrument, $N(D_i)$ is the drop size distribution (mm^{-1} m^{-3}), Δt is the sampling time (namely 60 s), A is the instrumental measuring area (m^2), v (m s^{-1})

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is the theoretical fall velocity of Atlas et al. (1973), ΔD is the width of the size bin, $n_{j,i}$ is the number of drops measured in the i-th diameter class and j-th fall velocity class, and C_v is the total number of fall velocity bins. The width of each diameter class is provided by the manufacturers.

3. Application of the rain/no-rain criterion. Knowing the DSD, the rainfall rate (R in mm h^{-1}) can be easily computed:

$$R = 6\,\pi\,10^{-4} \sum_{D_{min}}^{D_{max}} v(D)N(D\,)D^3\,dD \tag{2}$$

A 1-minute sample is considered a rainy minute if $R > 0.1$ mm h^{-1}.

4. Data organization. Only the DSDs computed for the rainy minutes are saved. The data are saved in 1-year files named as "GIDVxx_ID_YEAR" where, Vxx indicates the version of the GID data processing, ID is the identification number of the disdrometer as shown in the first column of Table 1, and YEAR is the year when the data have been collected. Each file contains:
    a. Column 1: year
    b. Column 2: month
    c. Column 3: day
    d. Column 4: hour
    e. Column 5: minute
    f. Column 6 to end: DSD i.e., values of $N^{P2;TC}(D_i)$ in Eq. (1) for each bin D_i.

Time is in the UTC format.

Please note that in the GID database, only the DSDs are made available. However, from DSD data, a number of further DSD and rainfall parameters can be derived, such as: mass-weighted mean raindrop diameter (D_m), DSD intercept parameter (N_w), rainfall rate (R), kinetic energy (K), liquid water content (LWC), and, assuming a microphysical model and a scattering model for drops, radar reflectivity factor at horizontal polarization (Z_h), specific attenuation due to rainfall (k), differential reflectivity (Z_{dr}), specific differential propagation phase shift (K_{dp}) and many others.

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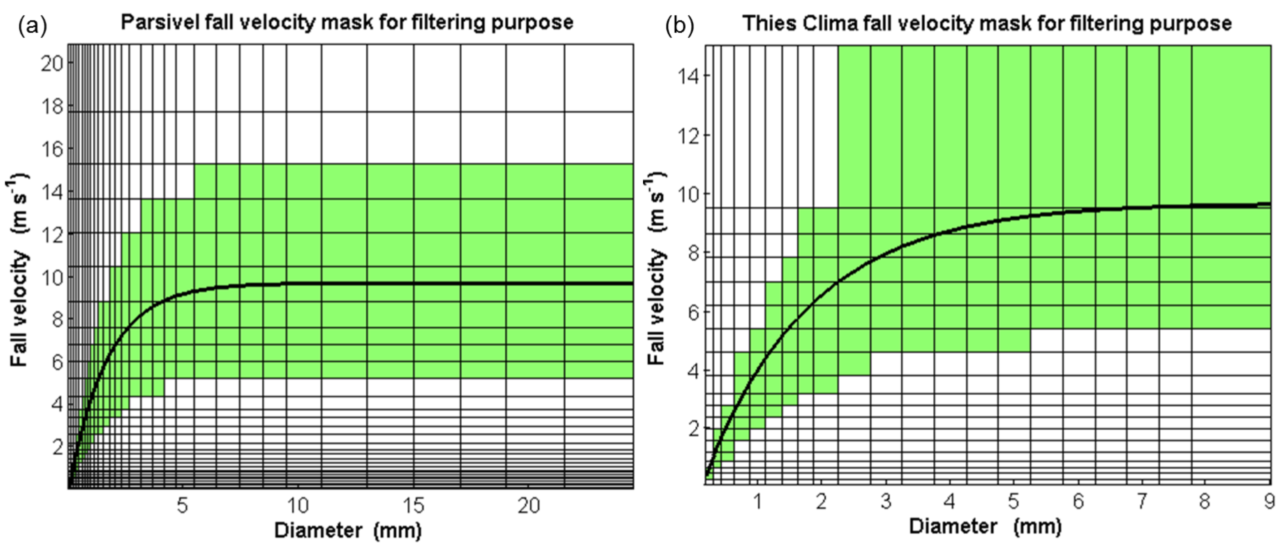

Figure 2: fall velocity masks for P2 (a) and TC (b) disdrometers. The white bins are the ones that will be eliminated by the filtering criterion.

4 GID Database structure

The GID database is freely available as described in section 5 and is structured as detailed in section 3. It is composed of the DSDs collected by the eight laser disdrometers afferent to the GID network during rainy minutes. For each disdrometer, data range from the first measurement available (see Table 1) to 31 December 2021. All the GID disdrometers keep going measuring and, in the future, the GID is planning to upgrade the published database yearly with new measurements/new sensors. The main folder of the GID database is "GID_database_untill_Dec2021" that contains 8 sub-folders, one for each disdrometer of the GID network. The name of these subfolders is the disdrometer ID in 5 digits (for example "TC-RM"). In each of these folders, there is one XLSX file for each year of measurement. The latter file reports the time and the DSDs collected by the selected disdrometer during a given year. The name of the file follows the rule explained in section 3. For example, if the DSDs collected by the disdrometer in Rome during 2016 are needed, the path is the following: "GID_database_untill_Dec2021/TC-RM/" and the file name is "GIDV01_TC-RM_2016.xlsx". Furthermore, in each device sub-folders, there is one txt file named "read_me_ID.txt" (where ID stands for the ID of the disdrometer as shown in Table 1) in which the following metadata are reported:

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- General information: station ID, latitude, longitude and height ASL of the disdrometer, url for the data visualization and first measurement date
- Technical information: disdrometer type, processing version, units of latitude, longitude height, and DSD, time standard, and time resolution
- Reference: DOI of the database and how to cite it, DOI of the reference paper and how to cite it, name of the owner institution, and email of the contact person
- Note: this section reports any useful information, such as interruptions due to technical issues or changes in the disdrometer location.

Figure 3 shows the schematic structure of the GID database from the main folder to the file header. As example, in the scheme only the "TC-NO" folder is open which contains the files named .txt and .xlsx. The header of the .xlsx file and the main sections of the .txt file are also reported. The scheme for the other folders is identical expect that there may be present several .xlsx files (i.e., a file for each year of measurement), depending on the selected site. Furthermore, the header of the .xlsx file for the P2 disdrometer is a bit different from the TC one due to the higher number of size classes. For the P2 disdrometer the header is: {year, month, day, hour, min, ND1, ND2, ND3, ND4, ND5, ND6, ND7, ND8, ND9, ND10, ND11, ND12, ND13, ND14, ND15, ND16, ND17, ND18, ND19, ND20, ND21, ND22, ND23, ND24, ND25, ND26, ND27, ND28, ND29, ND30, ND31, ND32}.

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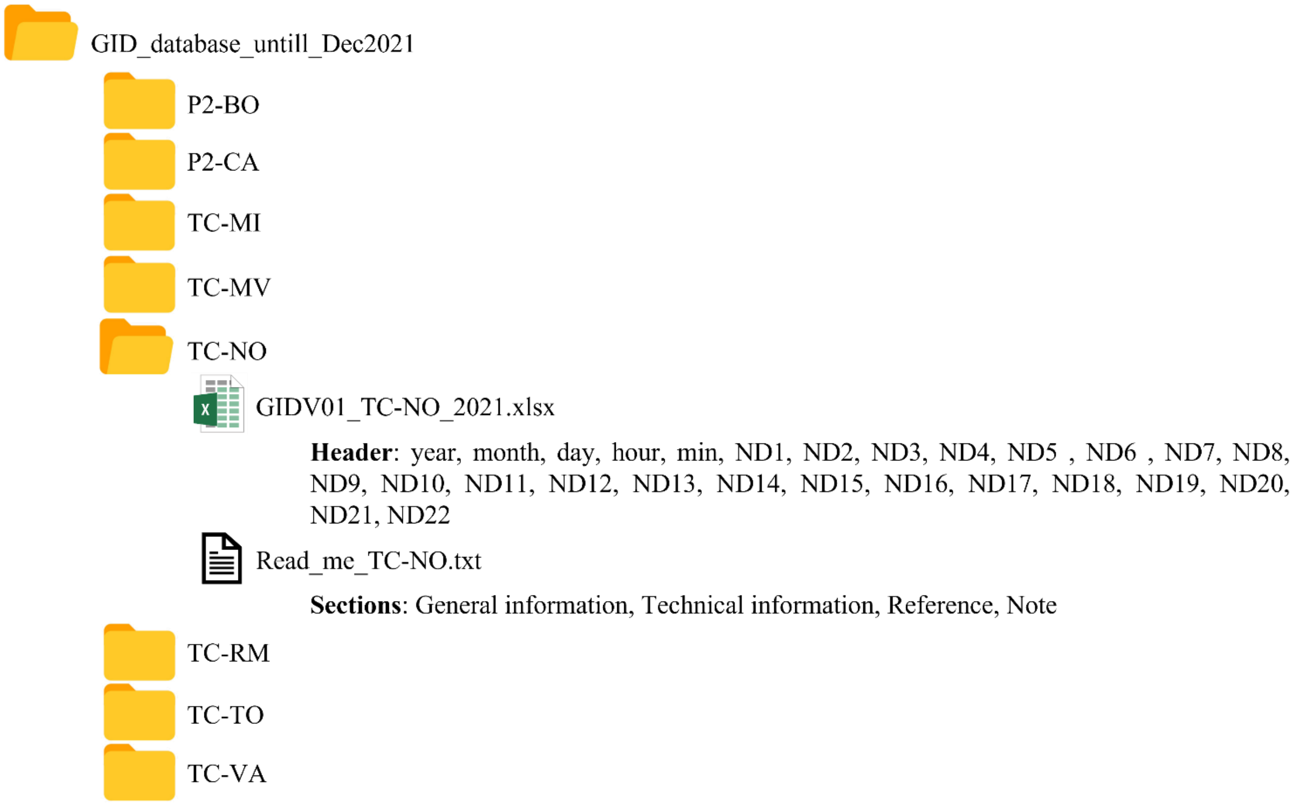

Figure 3: schematic structure of the GID database.

As an example, Figure 4 shows the DSDs collected by TC-RM around the precipitation peak (i.e., 138.1 mm h^{-1}) of an intense rainfall event on 14 February 2016. These DSDs are stored in the file called "GIDV01_TC-RM_2016.txt". The DSDs have the typical shape of natural DSD with a peak in the small diameter range (in this case around 0.5 mm). Knowing the DSD, the corresponding rainfall rate can be computed using Eq. (2). The maximum rain rate occurred at 22:56 UTC and the DSDs during and around this time have a quite high concentration of large drops, while at the beginning of the shown precipitation period (i.e., at 22:52 UTC), the rainfall rate was 2.9 mm h^{-1} and the corresponding DSD in Figure 4 has a maximum drop diameter less than 3 mm.

Figure 5 shows, for each disdrometer of the GID network, the seasonal mean DSDs. With very few exceptions, the DSD shapes are very close for small diameters (less than 2 mm), while more differences are evident for mid-size and large diameters. In particular, the summer DSD is the one with the highest concentration of mid-size and large diameters while winter DSD is the one with the smallest

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concentration; autumn and spring DSD are very close with intermediate values with respect the other two seasons.

Finally, Figure 6 shows the annual mean DSDs. For the disdrometers with more than 1 year of measurements, the shapes of the DSD are almost similar each other with the majority of differences concentrated in the large drop range (D > 5 mm). For example, the TC-RM dataset for 2017 shows the highest concentration of large drops (D > 5 mm) and 2016 the lowest concentration of large drops. P2-BO and TC-MV datasets 2018 show smaller diameters with respect to the other years, but the latter is due to the fact that data are not available for the whole year; in fact both have been installed on December 2018.

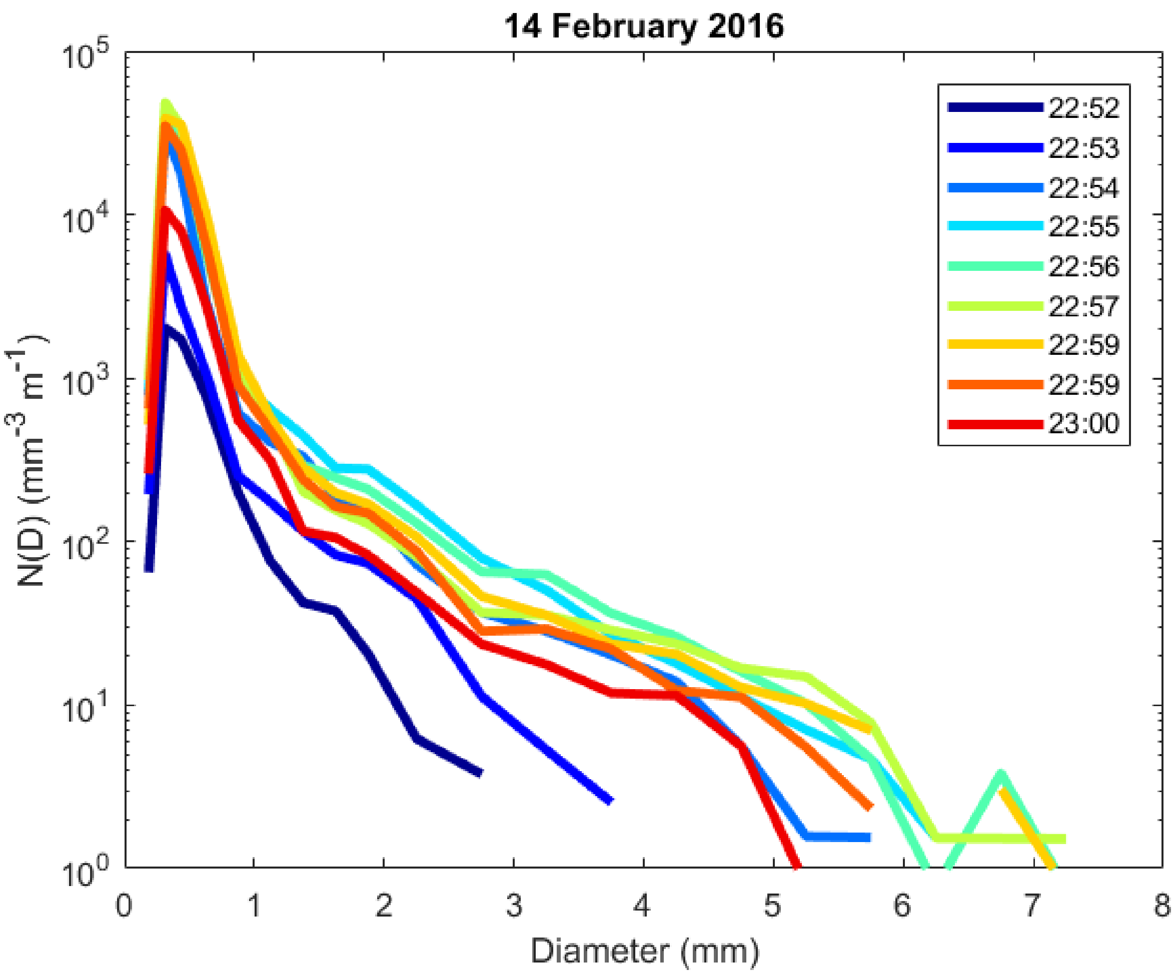

Figure 4: example of DSDs collected by TC-RM. Time, coded according the legend, is in UTC.

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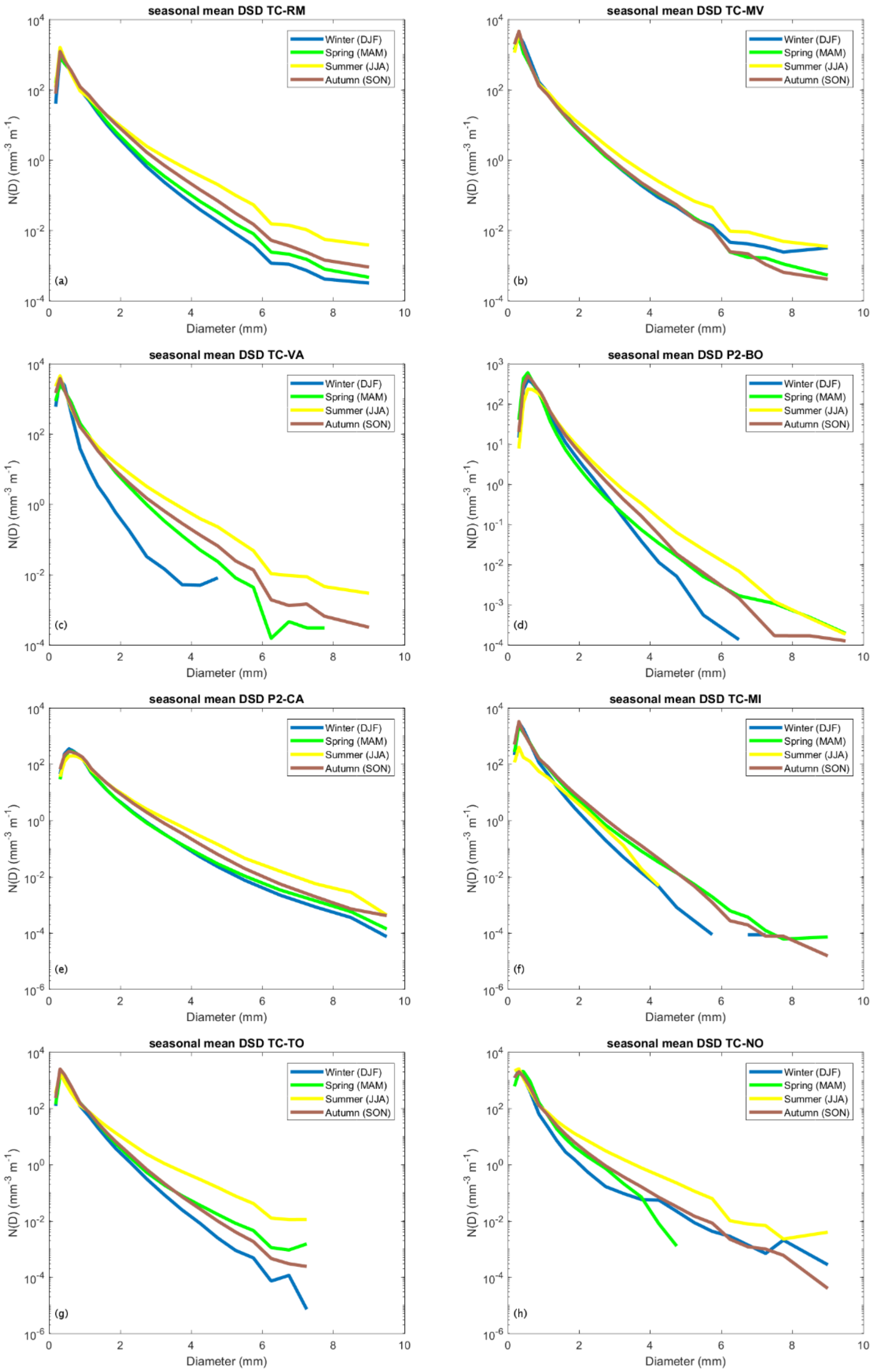

Figure 5: seasonal mean DSDs: (a) TC-RM, (b) TC-MV, (c) TC-VA, (d) P2-BO, (e) P2-CA, (f) TC-MI, (g) TC-TO, (h) TC-NO.

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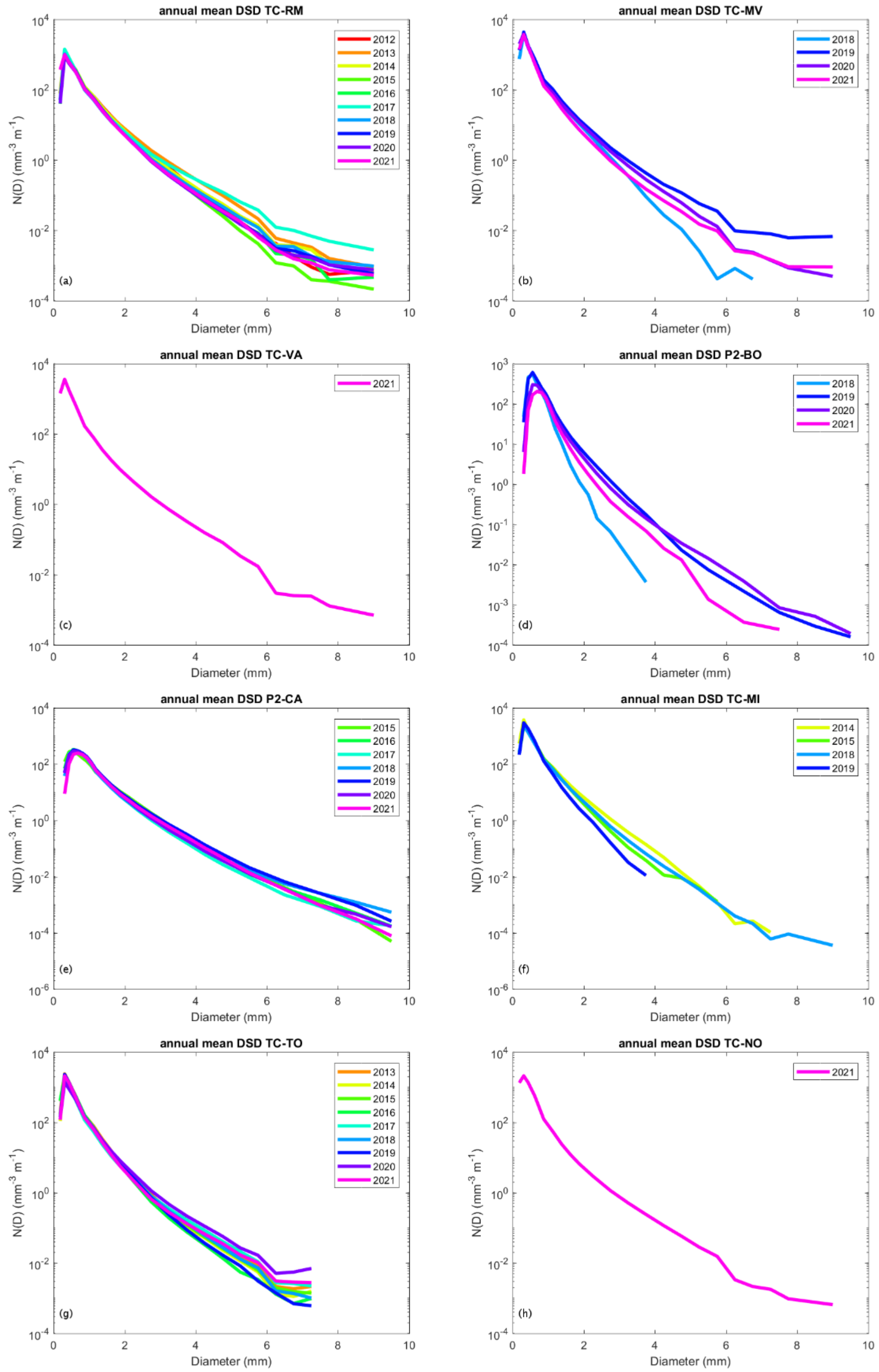

Figure 6: annual mean DSDs: (a) TC-RM, (b) TC-MV, (c) TC-VA, (d) P2-BO, (e) P2-CA, (f) TC-MI, (g) TC-TO, (h) TC-NO.

https://doi.org/10.5194/essd-2022-317
Preprint. Discussion started: 7 November 2022

Open Access Earth System Science Data Discussions

5 Data availability

One-minute DSDs obtained by processing the raw data collected by GID network disdrometers are available for free download under CC BY 4.0 licence. The adopted processing has been described in section 3, while the database structure is detailed in section 4. The GID database is available at https://doi.org/10.5281/zenodo.6875801 (Adirosi et al., 2022). The following citations should be used for every use of the data belonging to the GID database:

- Elisa Adirosi, Federico Porcù, Mario Montopoli, Luca Baldini, Alessandro Bracci, Vincenzo Capozzi, Clizia Annella, Giorgio Budillon, Edoardo Bucchignani, Alessandra Lucia Zollo, Orietta Cazzuli, Giulio Camisani, Renzo Bechini, Roberto Cremonini, Andrea Antonini, Alberto Ortolani, Samantha Melani, Paolo Valisa, & Simone Scapin. (2022). Database of the Italian disdrometer network (Version V01) [Data set]. Zenodo.

These disdrometers are still collecting data and regular updates of their status along with updates of the GID network are provided through the GID web site (www.gid-net.it). Furthermore, the raw data of the GID network disdrometers can be provided under specific agreement. If interested in the raw data of a specific disdrometer, please contact the reference person listed in the Read-me.txt file while if the raw data of the whole GID database is of interest please email to gid.info@gid-net.it.

6 Conclusion

In this work, a centralizing effort of drop size distribution measurements is described for the Italian territory. The result is the set-up of a spontaneous entity named GID (Group of Italian Disdrometers). GID, so far, has put together eight disdrometers over the italian peninsula and centralized the data acquisition on yearly basis. More important, the centralized data are stored on a public database and made freely available. The hope of this initiative is to sensibilize the national and regional weather services, and in general all the stakeholders (e.g., in the hydro-meteorological sector) to invest in the enhancement of existing and future disdrometer networks. Such strategy would be relatively cost-effective and will provide new insights into the microphysical properties of precipitation on a national scale, thus opening up to a plenty of new applications and enhancing the accuracy of ground precipitation estimates. This could be relevant for a proper management of territory (from mitigation to risk) as well as provide important feedback in the understanding of atmospheric processes and how these are strictly interlinked to a changing climate.

Acknowledgements

The Department of Science and Technology of the University of Naples "Parthenope" and the authors of this work are grateful to the Benedectine Community of Montevergine Abbey for affording the opportunity to install the laser-optical disdrometer on the Montevergine observatory terrace.

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