Life can only be understood backwards, but it must be lived forwards.

Søren Kierkegaard

changing the world of precipitation measurement

OTT Pluvio2 – weighing precipitation gauge
OTT Parsivel2 – laser-based optical disdrometer

The new generation precipitation gauges are made for long term unattended operation. They deliver highly accurate data for all kinds of precipitation and help you spend your time on more important things than maintenance.

Worldwide, at any site, whatever the weather.

Here Comes the Rain

High-precision measurement of hydrometeors

A new version of the Parsivel laser-based disdrometer offers greater levels of accuracy in the precise identification of hydrometeors

A new system, the OTT Parsivel2, is able to measure hydrometeors less than 2mm with an uncertainty of ±1 class, and hydrometeors over 2mm with an uncertainty of ±0.5 classes. As a result, Parsivel2 will improve the characterization and typing of precipitation, derived precipitation rate, visibility in precipitation, and radar reflectivity.

Standard rain gauges record the amount of precipitation, and many also provide an approximate value for intensity. An electronic disdrometer records the size and number of precipitation particles and, in addition to the amount and intensity, also determines the type of precipitation. Depending on the measurement method selected, the individual hydrometeor is recorded either mechanically when it hits a membrane or optically.

The extinction principle was first proposed in 2000 for the measurement of precipitation. This direct physical measurement principle registers precipitation particles on the basis of the shadowing effects that they generate when falling through a light band. From the degree and duration of the shadowing effects, the size and rate of fall of the particles can be derived. As a result, the precipitation event can be classified within a range of 32 precipitation classes, e.g. as drizzle or snow.

The extinction principle made it possible, for the first time, to classify hydrometeors and to determine their distribution and derive a number of further parameters. These included the kinetic precipitation energy, visibility during precipitation spectrum analyses, and the determination of weather codes.

Laser-based disdrometer

Employing the extinction principle, OTT Hydromet developed a new kind of laser-based disdrometer in 2005. The OTT Parsivel was drift-free and automatically compensated for the influence of temperature and the aging characteristics of the laser diodes. It was comprised of two symmetrically arranged measuring heads. One of them housed the transmitting unit, which generated a horizontal laser beam, the other accommodated the receiving unit, which converted the beam into an electrical signal.

The absolute measurement accuracy of a laser-based disdrometer is proportional to the homogeneity and therefore to the quality of the laser energy concentration of the laser band. Although the OTT Parsivel showed device-specific, heterogeneous characteristics, these were individually calibrated using simulation with reference particles and statistical correlation methods, thereby enhancing the statistical measurement accuracy. However, the spectrum of the classes for size and velocity were corrected by the calibration data. This led to measurement uncertainties for the raw data classification (±2 to ±3 classes) for a range of 32 precipitation classes, e.g. ±0.5 classes.

Laser energy concentration

OTT Parsivel2 provides homogeneous laser energy concentration over the complete laser bandwidth, offering an impressive measurement accuracy of ±0.5 classes, which until now has only been available in expensive disdrometers. 0.2 to 2mm, ±1.0 size class; 2 to 25mm, ±0.5 size class.

Naturally, the high accuracy of the raw data also has a direct effect on the calculation of precipitation intensity, present weather codes, visibility during precipitation, and radar reflectivity.

In addition to optimization of raw data accuracy, a number of further enhancements have been incorporated into the design of the Parsivel2. These include:

Precipitation measurement

by Kurt Nemeth & Eduard Beck

Figure 1: New laser-based disdrometer OTT Parsivel2

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Precipitation measurement

At the end of the production process for each new OTT Parsivel\textsuperscript{2}, the raw data is accurately and reproducibly checked. For this, the primary data, particle size and velocity are simulated with a transparent drop shape model, and factors such as edge effects are taken into account. The detailed raw data is then evaluated, the maximum measurement uncertainty of ±1 size class is obtained and displayed graphically and is easy for an observer to interpret, so that it can be used for any corrections to the automatic weather code. Naturally, checks are also possible via software routines at the control center, so that high observer quality can be maintained while manpower can be reduced at the measuring stations.

Optimizing weather radar through ground-based disdrometer data

To ensure timely warning of impending flooding, it is necessary to measure the amount and spatial distribution of precipitation quickly and accurately. This goal is achieved with a combination of weather radar measurements (spatial information with reduced accuracy) and ground-based disdrometer measurements.

Currently, a precipitation radar measures the radar reflectivity (Z) on the basis of ground shadowing only from a height of 100 to 200 m above the ground, therefore providing information with reduced accuracy. In order to accurately determine the precipitation input, a quantitative recording of the precipitation intensity (R) on the ground is required. This requires both extrapolation of the radar data to the ground and determination of the reflectivity factor Z to the precipitation rate R. Naturally, checks are also possible via software routines at the control center, so that high observer quality can be maintained while manpower can be reduced at the measuring stations.


detail factory acceptance test (FAT) for a specific Parsivel\textsuperscript{2}

Classification of precipitation by drop size and velocity. The Guen-Kinzer line indicates the terminal fall velocity for raindrops of various sizes.

Displays of raw data spectra, showing Guen-Kinzer line and automatic PW code (above “Light small hail”; below “Light snow”). The color code indicates the frequency of measured hydrometeors.