Parsivel Weather Sensor

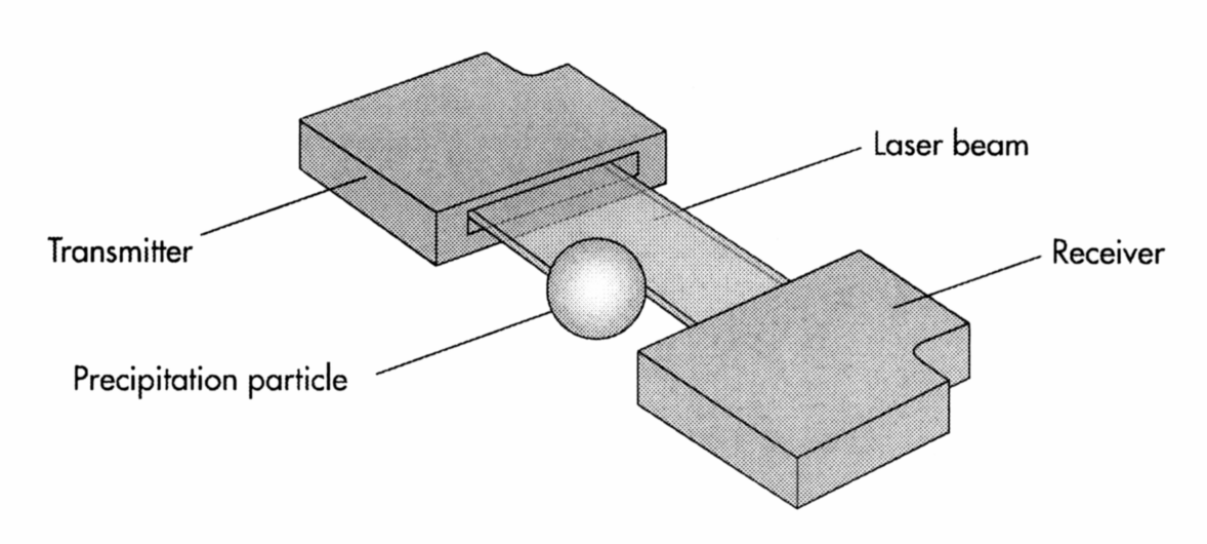
Parsivel is a laser-based optical system for complete and reliable measurement of all types of precipitation. The size range of measurable liquid precipitation particles is from 0.2 to 5 mm, for solid precipitation particles it is from 0.2 to 25 mm. In the process, precipitation particles can have a velocity of from 0.2 to 20 m/s. The precipitation particles are categorized as follows:

- Drizzle
- Drizzle with rain
- Rain
- Rain, drizzle with snow
- Snow
- Snow grains
- Freezing rain
- Hail

The precipitation measurements are carried out using a special sensor head that was developed for this particular purpose. It detects precipitation optically. The data thus determined are processed and stored by a fast digital signal processor. Parsivel issues one data telegram every 30 seconds.

Functional principle

The theory behind Parsivel is a laser sensor that produces a horizontal strip of light. The emitter and the receiver are integrated into a single protective housing.



Measurement of particle size

If there are no particles in the laser beam, the maximum voltage is output at the receiver. Precipitation particles passing through the laser beam block off a portion of the beam

corresponding to their diameter, thus reducing the output voltage; this determines the particle size.

Measurement of particle speed

To determine the particle speed, the duration of the signal is measured. A signal begins as soon as a precipitation particle enters the light strip and ends when it has completely left the light strip.

The following parameters can be derived from these two determined quantities:

- Size spectrum
- Type of precipitation
- Kinetic energy
- Intensity of the precipitation
- Radar reflectivity
- Visibility

The spray protection attached to the sensor head prevents precipitation particles from deflecting off the housing, falling into the laser beam and thus falsifying the measurements.

Appendix C: Characterization of precipitation type by precipitation codes

From the classification of precipitation particles, Parsivel calculates the rain rate. The type of precipitation is based on the number of particles within the measurement range, and the precipitation code is determined from the precipitation intensity R (in mm/h of an equivalent amount of water).

C.1 Precipitation code according to SYNOP

The definitions of the precipitation codes below are listed according to the following tables:

- SYNOP $w_a w_a$ Table 4680
- SYNOP ww Table 4677

Drizzle

Intensity	Rain rate [mm/h]	Tab. 4680	Tab. 4677
light	≤0.2	51	51
moderate	0.2 ...0.5	52	53
strong	≥ 0.5	53	55

Drizzle with rain

Intensity	Rain rate [mm/h]	Tab. 4680	Tab. 4677
light	≤0.2	57	58
moderate	0.2 ...0.5	58	59
strong	≥ 0.5	58	59

Rain

Intensity	Rain rate [mm/h]	Tab. 4680	Tab. 4677
light	≤0.2	61	61
moderate	0.5 ...4.0	62	63
strong	≥ 4.0	63	65

Rain, drizzle with snow

Intensity	Rain rate [mm/h]	Tab. 4680	Tab. 4677
light	≤0.5	67	68
moderate	> 0.5	68	69

Snow

Intensity	Rain rate [mm/h]	Tab. 4680	Tab. 4677
light	≤0.5	71	71
moderate	0.5 ...4.0	72	73
strong	≥ 4.0	73	75

Snow grains

Intensity	Rain rate [mm/h]	Tab. 4680	Tab. 4677
light	≤0.5	77	77
moderate	0.5 ...4.0	77	77
strong	≥ 4.0	77	77

Freezing rain

Intensity	Rain rate [mm/h]	Tab. 4680	Tab. 4677
light	≤0.4	87	87
moderate	> 0.4	88	88

Hail

C.2 Precipitation code according to the NWS and METAR/SPECI w'w', Table 4678

The definitions of the precipitation codes below are listed according to the following tables:

- NWS
- METAR/SPECI w'w' Table 4678

Drizzle

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤0.2	L	DZ
moderate	0.2 ...0.5	L	DZ
strong	≥ 0.5	L+	+DZ

Drizzle with rain

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤0.2	RL	RADZ
moderate	0.2 ...0.5	RL	RADZ
strong	≥ 0.5	RL+	+RADZ

Rain

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤0.2	R	RA
moderate	0.5 ...7.5	R	RA
strong	≥ 7.5	R+	+RA

Rain, drizzle with snow

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤0.5	RLS	RASN
moderate	> 0.5	RLS	RASN
strong		RLS+	+RASN

Snow

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤0.5	S	SN
moderate	0.5 ...2.5	S	SN
strong	≥ 2.5	S+	+SN

Snow grains

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤0.5	SG	SG
moderate	0.5 ...4.0	SG	SG
strong	≥ 4.0	SG	+SG

Freezing rain

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤0.4	SP	GS
moderate	> 0.4	SP	GS
strong		SP	+GS

Hail

Intensity	Rain rate [mm/h]	NWS	Tab. 4678
light	≤ 7.5	A	GR
moderate	≥ 7.5	A	GR