http://joyce.cloud

Mobile trailer for precipitation observation

Instrument name: Trailer
Instrument type: diverse (see tables below)
Manufacturer: diverse (see tables below)
Location: mobile (Institute for Geoscience, Section Meteorology, Bonn)
Coordinates: Lat: 50.731233° N, Lon: 7.070733° E, Alt: 66 m asl

The mobile trailer for precipitation observation allows synergistic observations of the atmosphere with a focus in precipitation observation. The set of instruments allows simultaneous observations in precipitation and additionally is able to choose the position of observation for hot spot analyses.

The trailer is carrying a Micro Rain Radar (MRR) from Metek, which is mounted on a rotor together with a ceilometer ct25k (Vaisala). The MRR and Ceilometer allow cloud and precipitation observation and profiles. The ceilometer detects up to 3 different cloud height levels and their development. The MRR detects clouds and precipitation with height to get profiles in their layers and development. Both instruments are mounted on a rotor to be able to make non vertical scans through the cloud or upcoming storms, or weather situations.
A parsivel laser distrometer from the manufacturer OTT detects precipitation on the ground with insights into the particle size, phase and speed, which allows conclusions about the drop size distribution
A hemispheric camera from Axis observes the sky for additional analyses of the other observations. The observations by the camera can also be evaluated for cloud cover and other development.
The multiple weather sensor WXT520 from Vaisala is able to capture several meteorological observations, like temperature, humidity, pressure, and is also able to detect wind speed and direction (ultrasonic anemometer), and precipitation intensity and phase (liquid or hail).
Additionally the trailer is equipped with a GPS sensor for exact localization tracking, a spirit level for optimal positioning, and can be operated self-sustaining by the use of batteries.

The trailer is located in the Section Meteorology, Institute for Geoscience, University of Bonn, Bonn, but as it is mobile it can operate anywhere where it is needed. In a majority it is used in observations in 100 km radius around Bonn for supporting hot spot observations of one of the two weather X-band radars BoXPol or JuXPol.
The trailer was installed in 2014 and is used for campaigns or other observations. During summer season (May, June, July, August) it is uses for student laboratory, but can be used for smaller events as well. In 2016 the GPS sensor and the camera had to be replaced.

Instrument specifications

MRR:

Parameter	Specification
Manufacturer	Metek GmbH
Instrument type	MRR-1
Frequency	24.1 GHz
Wavelength	12.4 mm
Radar Type	FM-CW
Transmit Power	50 mW
Receiver	Single Polarization
Power consumption (radar)	25 W
Total power cons. incl heating	525 W
Max. range	6 km
Range Resolution	10 - 200 m
No. of range gates	30
Temporal resolution	10 s
Antenna diameter	0.5 m
Beam width (2-way, 6 dB)	1.5°

Ceilometer:

Parameter	Specification
Manufacturer	Vaisala
Instrument type	CT25K
Wavelength	905 nm
Pulse Power	16 W typical
Pulse energy	1.6 µJ ±20%
Average Power	8.9 mW
Pulse Width	100 ns
Pulse Repetition Rate (PRR):	5.57 kHz
Number of pulses (PQTY):	65536
Averaging time:	11.7 s (=PQTY/PRR)
Time resolution	15 sec
Range resolution	15 m
Range	0 - 7500 m
Laser Divergence	± 0.53×0.75 mrad (edge x diagonal)
Field-of-View Divergence	± 0.66 mrad
Telescope diameter	145 mm
Size	760 x 280 x 245 mm
Power Consumption	365 W
Weight	40 kg

Laser distrometer:

Parameter	Specification
Manufacturer	OTT
Instrument type	Parsivel^2
Wavelength	780 nm
Output power (peak)	0.2 mW
Laser class	1 (IEC/EN 60825-1:2014)
Light strip surface (W x D)	30 x 1 mm
Measuring surface (W x D)	180 x 30 mm

Measuring range Particle size (liquid) Particle size (solid) Particle speed	 0.2 … 8 mm 0.2 … 25 mm 0.2 … 20 m/s
Design	32 size classes 32 speed classes
Radar reflectivity Z	-9.999 … 99.999 dBz
Rain rate Minimum intensity Maximum intensity Accuracy	 0.001 mm/h drizzle rain 1200 mm/h +-5 % (liquid) / +-20 % (solid)
Weight	Max. 6.4 kg
Temperature range	-40 … +70 °C
Size (H x W x D)	670 x 600 x 114 mm

Camera:

Parameter	Specification
Manufacturer	Axis
Instrument type	M3027-PVE
Wavelengths	~560, ~540, ~420 nm
Repetition Rate	20 s
Resolution	0.15 deg
Field-of-View	90 deg
Image size	800×600 pixel (=0.46MPx)
Image size	316 pixel (=0.30MPx)
Sensitivity	1300 mV/(Lux s)
Dyn. range	69 dB
Max S/N	37 dB
Size	~20x20x15 cm^3
Average Power consumption	< 4.5 W
Weight	0.5 kg

Weather sensor:

Parameter	Specification
Manufacturer	Vaisala
Instrument type	WXT520
Barometric pressure: Range Accuracy Resolution	 600 – 1100 hPa ± 0.5 hPa at 0 – +30 °C 0.1 hPa
Air temperature: Range Accuracy Resolution	 -52 - +60 °C ± 0.3 °C 0.1 °C
Wind speed: Range Response time Accuracy Resolution	 0 – 60 m/s 0.25 s ± 3 % at 10 m/s 0.1 m/s
Wind direction: Azimuth Response time Accuracy	 0 – 360 ° 0.25 s ± 3.0°

Resolution	1°
Relative humidity: Range Accuracy Resolution	 0 – 100 %RH ± 3%RH at 0 – 90 %RH 0.1 %RH
Precipitation: Collecting area Resolution (rain) Resolution (hail) Accuracy (rain) Range (rain)	 60 cm^2 0.01 mm 0.1 hit/(cm^2 h) 5 % 0 – 200 mm/h
Operating voltage	5 – 32 VDC
Weight	650 g
Dimension	Ø 115 x 238 mm

Instrument time-line

01/04/2014 – today	Trailer at Institute of Geoscience, Section Meteorology, University of Bonn, Bonn
01/04/2014 – 15/07/2014	Student laboratory storm chasing, University of Bonn and University of Cologne
01/04/2015 – 15/07/2015	Student laboratory storm chasing, University of Bonn and University of Cologne
01/10/2015 – 28/02/2016	Winter precipitation Section Meteorology, Institute for Geoscience, University of Bonn and University of Cologne
01/04/2016 – today	New camera, old was lost in campaign
01/04/2016 – 15/07/2016	Student laboratory storm chasing, University of Bonn and University of Cologne
01/04/2017 – 15/07/2017	Student laboratory storm chasing, University of Bonn and University of Cologne
01/04/2018 – 15/07/2018	Student laboratory storm chasing, University of Bonn and University of Cologne
01/04/2019 – 15/07/2019	Student laboratory storm chasing, University of Bonn and University of Cologne
01/08/2019 – 31/03/2020	Meteo France Campaign, France, University of Cologne

Available measurement modes

- The trailer can be used for any field campaign
- All instruments are permanently mounted, individual additions are possible
- Not all instruments need to be used permanently
- Instruments can be configured as possible by manufacturer

JOYCE-CF Standard Operation Procedures

- Summer season used for student laboratory storm chasing event

Data quality assurance procedures

- Raw data provided by the instrument(s). Quality control by operator.

Available datasets

Raw data is stored and provided as needed for campaign. Data format usually provided as manufacturer intends.
Data, measurement time or any campaigns can be requested via the JOYCE-CF request sheets.

MRR:

Level 2

- Available data per scan:
    - measurement height H (m)
    - liquid water content LWC (g m^{-3})
    - path integrated attenuation PIA (dB)
    - rain rate RR (mm h^{-1})
    - transfer function TF (dimensionless)
    - fall velocity W (m s^{-1})
    - radar reflectivity attenuation corrected Z (dBZ)
    - attenuated radar reflectivity z (dBZ)

- Resolution:
    - Temporal resolution: approx. 1 min
    - Beam width: 2 deg
    - range resolution: 10 m to 200 m

Ceilometer:

Level 2:

- Available Data:
  - Cloud height (up to 3 layers)
  - vertical visibility
  - Cloud amount / sky condition
  - Backscatter profile
- Resolution:
  - Temporal resolution: 15 s
  - Range resolution: 15 m (0 – 7500 m)

Distrometer:

Level 1

- Available Data:
  - spectral density
  - rain intensity
  - rain sum
  - weather code (Table 4680)
  - reflectivity
  - signal amplitude
  - number of particles
  - total precipitation
  - average volume diameter
  - average particle speed
  - number of particles per speed and diameter class
- Resolution:
  - Temporal resolution 1 min

Camera:

Level 1:

- Available Data:
  - Sky picture
- Resolution:
  - Temporal resolution: 5 s

WXT:

Level 1

- Available Data:
    - Wind speed (minimum, maximum, average)
    - Wind direction (minimum, maximum, average)
    - Air pressure
    - Air temperature
    - Internal temperature
    - Relative humidity
    - Rain (accumulation, duration, intensity, peak intensity)
    - Hail (accumulation, duration, intensity, peak intensity)
    - Heating (temperature, voltage)
    - Voltage (supply, 3.5 V reference)
    - Id
- Resolution:
    - Temporal resolution 30 or 60 s

Contact

Josephin Beer
University of Bonn
Institute of Geoscience and Meteorology
Auf dem Hügel 20
53121 Bonn, Germany
Tel.: +49 (0)228 73-3152
E-mail: jbeer@uni-bonn.de