Webinar 2017

Precipitation Measurement

Lufft WS100

The presenters

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…is a certified electrical engineer. Since 1999, he has been responsible for the Lufft technical hotline as well as training events. Thus, he maintains close contact with end users and continually gains valuable market insights.

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Kurt Nemeth

…is Program Manager for precipitation sensors at OTT Hydromet. With 35 years of industry experience and an advanced degree in measurement technology, Kurt has a breath of knowledge in virtually all types of precipitation monitoring technologies allowing him to support customer needs in a multitude of applications.

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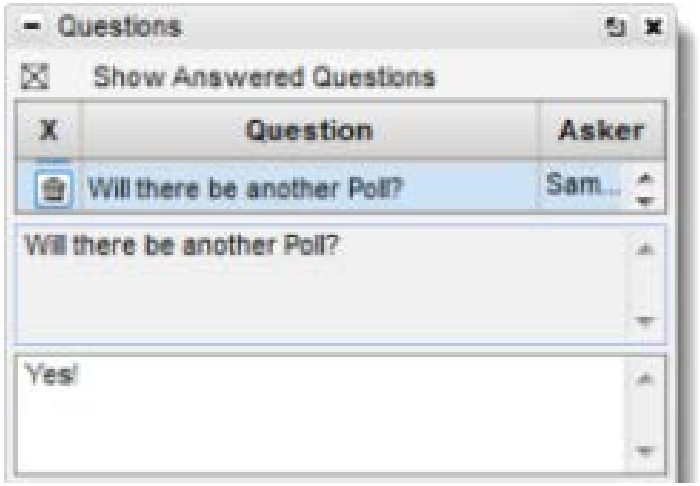
Questions & Housekeeping Rules



For questions please use the „Questions“ function

We will gladly answer all your questions!

G. Lufft Mess- und Regeltechnik GmbH

More than 130 years in the environmental sector

Headquarters in Fellbach (near Stuttgart)

Subsidiaries in Berlin, USA & China

Part of a strong corporate group since Jan. 2016

OTT Hydromet Group

OTT Lufft SUTRON ADCON TELEMETRY

Market Segments

- Traffic
- Renewable energy
- Meteorology
- Industrial data acquisition

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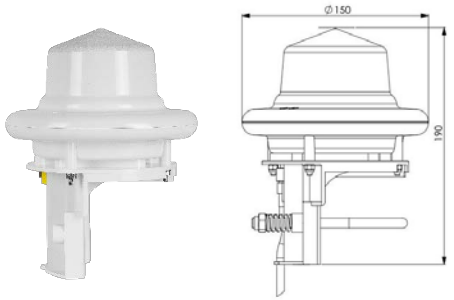
Agenda

Precipitation WS100

1. Overview – Precipitation Sensor WS100
2. Connection Options and Calibration
3. Target Group and Typical Customer Problems
4. Other Product Information
5. Comparison: OTT Hydromet Group Sensors
6. Summary: Sales Arguments



1. Overview – Precipitation Sensor WS100

USP:

- Maintenance-free operation

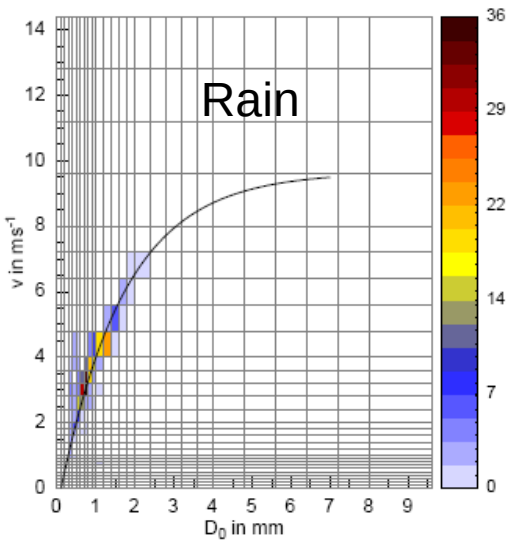
Benefits:

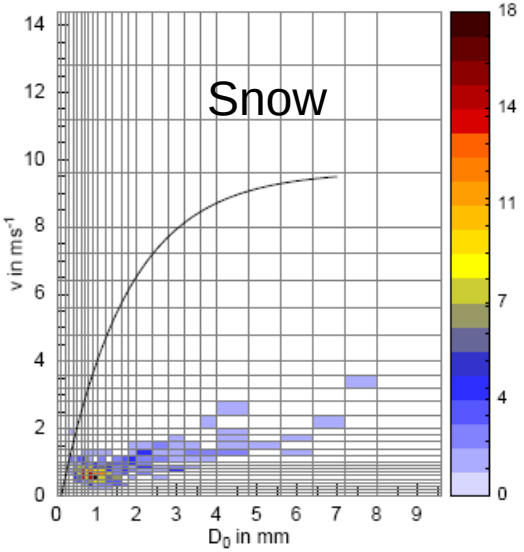
- Direct dome heating
- Use of a lens for focusing the measuring beam
- Extremely fast measurement (first drop detected)
- Precipitation type detection (rain, snow, sleet, freezing rain, hail)
- Multiple and simultaneous interfaces for data output and communication
- Optimized power consumption and ECO mode

1. Overview - WS100-UMB Measuring Principle

24 GHz Microwave Doppler Radar works with the radar reflection method and measures the precipitation quantity or precipitation intensity by means of the correlation of drop size and velocity.

Drop Size distribution matrix to calculate intensity of precipitation and to determine type of precipitation according fundamental meteorological relationships





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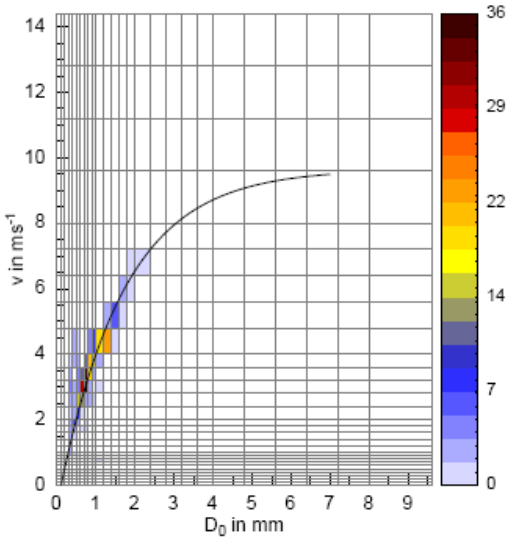
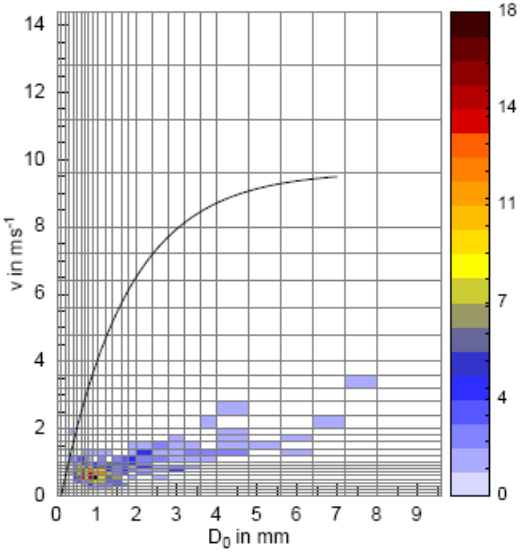
1. Overview – R2S-UMB Measuring Principle

24 GHz Microwave Doppler Radar measures the precipitation quantity or precipitation intensity by means of the correlation of drop size and velocity.

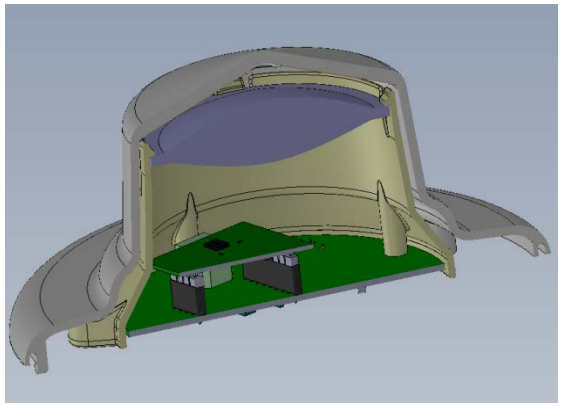
Examples of the distribution of drop size and velocity in different types of precipitation:





1. New Hardware Features – WS100-UMB

- New Radar Sensor
  - Radar sensor developed by Lufft
- Revised Housing Design
  - Optimized measurement
  - Use of a lens for focusing the measuring beam
  - Heating directly on the dome wall
  - Reduction of heating capacity to 9VA
  - Power consumption ECO mode 0.4VA

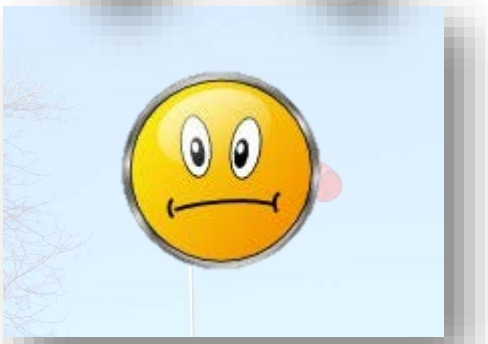


1. Previous Solution R2S

- Previous sensor: R2S

- Measurement Accuracy

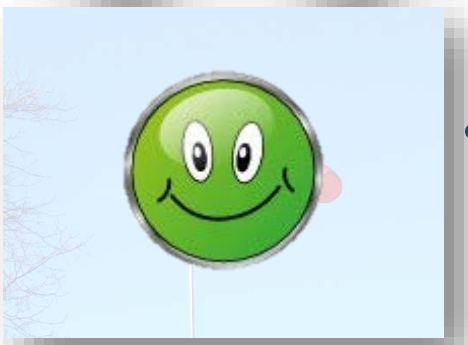
- Maintenance Frequency



- Influence of Wind on Measurement

1. New Solution WS100

- New Sensor: WS100



- **Measurement Accuracy**
  - Improved version of R2S
  - Accuracy of ±10% (acc. Lufft test system)
  - Low response threshold
  - Differentiates between 11 drop size classes

- **Maintenance Frequency**
  - No maintenance required
  - Low energy consumption

- **Low Influence of Wind on Measurement**

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1. WS100 - Technical Data

Electrical parameters	
Power supply	10...28 VDC
Power consumption without heating	1 VA / 0.4 VA (low power mode)
Heating power	9 VA
Operating parameters	
Operat. temp. range	-40...60 °C
Operat. humidity range	0...100 %
Protection class	IP66
Survival wind speed	75 m/s
Data transfer	
Interfaces/ protocols	RS-485 semi-duplex two-wire, SDI-12, pulse interface / UMB protocol, Modbus
(Pluggable) cable length	10 m
Transmission frequency	24 GHz

Precipitation	
Measurement surface	9 cm²
Precipitation types	Rain, snow, sleet, freezing rain, hail; No precipitation (SYNOP 4677)
Principle	Doppler radar
Accuracy	±10%
Resolution liquid preciptiation	0.01 / 0 .1 / 0.2 / 0.5 / 1.0 mm (pulse interface)
Measurement ranges	
Droplet size	0.3...5.0 mm
DSD	11 drop size classes with bandwidth of 0.5 mm
Precipitation intensity	0.01...200 mm/h / 0...7.874 inch/h
Particle velocity	0.9...15.5 m/s
Solid precipitation	5.1...~30 mm

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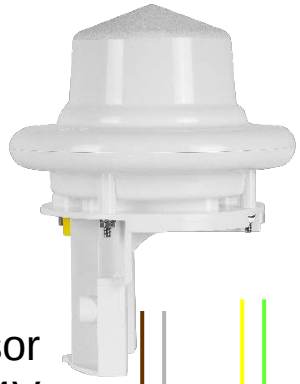
2. Connection Options and Calibration

2. Connection via UMB & ISOCON

- Connection via WS100-UMB



Power supply sensor
brown: +24V
white: GND2

RS485 interface sensor
green: A
yellow: B

ISOCON-UMB
(8160.UISO)

RS232 interface
For master (PC/EAK/modem or Com-server) and configuration of sensors in network

Power supply for all modules and sensors via bus-connector

2. Calibration – WS100 / R2S

- On-site calibration is not possible
  - ➢ However, calibration can be performed by Lufft

2. Calibration – WS100 / R2S

- Calibration by Lufft in the Rain Simulator

- Rain Simulator “RaiSi”

3. Target Group and Typical Customer Problems

3. Typical Customer Problems

- Measurement Accuracy
  - High precision required
  - Low response threshold
  - Differentiation of various precipitation types etc.
- Maintenance Frequency
  - Contamination - especially of mechanical parts; hence frequent maintenance required
- Influence of Wind on Measurement

3. Target Group of WS100

- **Traffic Management on Roads**
  - When information about the first drop / snow counts!

- **Meteorological Services**
  - Cost-effective expansion of the measuring network, especially in urban areas

- **Hydrology / Heavy Rain and floods**
  - Cost-effective expansion of the measuring network, especially in urban areas

WS100 in Traffic Management Applications

- VMS (Variable Message Signs)

Targets:

- Increase traffic safety
- Reliable dynamic response to current environmental conditions
- Weather-induced control based on precise detection of road surface wetness, **precipitation** and visibility

WS100 the "ideal Sensor":

- Maintenance free
- Measurement of precipitation intensity and type using the drop speed method
- Shortest response times
- Detects also "drizzle"

WS100 for Traffic Management

- RWIS (Road Weather Information Systems)

Targets:

- Recognize risk of icing
- Fast reaction times on weather changes
- Detection of actual weather data on roads and environment

WS100 the ”ideal Sensor“:

- Maintenance free
- Shortest response times
- Detects rain/snow etc.

4. Other Product Information

4. Sales Information WS100

- The scope of delivery of the WS100 includes:
  - Sensor
  - 10m connection cable
  - Operating instructions

4. Sales Information WS100

- Optional Accessories

- Digital interface converter
  - ISOCON: 8160.UISO
- Connection cable 10m
  - 8366.UKAB10
- Power supply unit
  - Power supply unit 24V/4A: 8366.USV1
- Surge protector
  - 8379.USP

5. Comparison with OTT Hydromet Group Precipitation Sensors

5. Overview of Different Measurement Principles

Tipping Bucket

Weighing Gauge

Hybrid

Radar

Disdrometer

Laser/Light Scatter

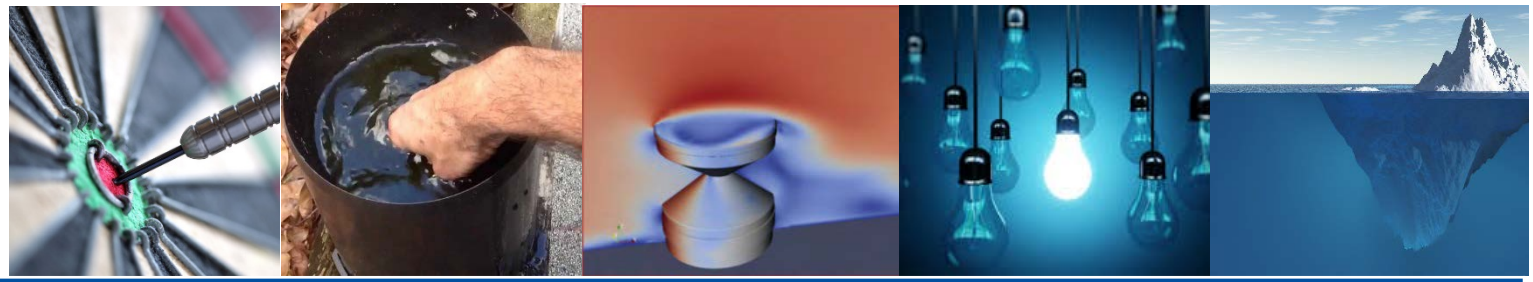
Accustic

5. Overview of Different Measurement Principles

	Tipping Bucket	Weighing Gauge	Hybrid	Radar	Disdrometer
Accuracy & measurement range (liquid)	Tipping bucket/ intensity error: ±2 / ±20%	Precise weight measurement: ±1%	Precise weight measurement: ±1%	Measurement of droplet velocity: ±10%	Measurement of droplet size/ velocity: ±5%
Maintenance	Cleaning of measurement system	Emptying bucket	Cleaning of measurement system	None	Cleaning of the screen
measurement uncertainty (solid)	Heating and evaporation: ±20%	Heating ring / antifreeze: ±1%	Heating and evaporation losst: ±20%	Dome heating meas. uncertainty: ±30%	Head heating: ±20%
Response threshold	±0.1 mm/h	±0.05 mm/h	±0.01 mm/h	±0.01 mm/h	±0.01 mm/h
TCO / Data Availability	High / 80%	Low / 100%	Medium / 90 %	Low / 100%	Low / 100%

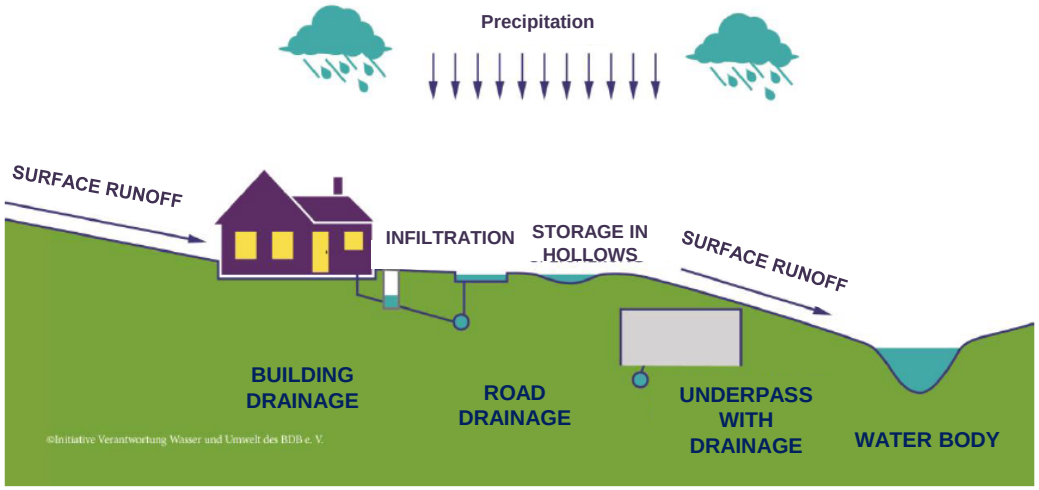
5. Differences of precipitation measurement principles

Fields of application



Tipping bucket	Reference measuring networks in hydrology, meteorology
Weighing gauge	Reference measuring networks in hydrology, meteorology
Hybrid	Reference measuring networks in hydrology, meteorology
Radar	Traffic weather, Hydrology (Flash flood warning, flood warning, especially in urban areas), meteorology, building automation, agricultural meteorology, …
Disdrometer	Reference measuring networks in hydrology, meteorology

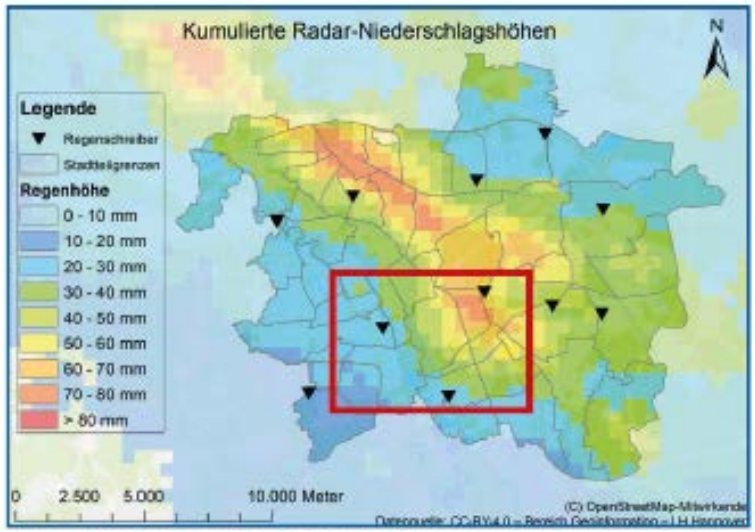
5. Urban System: Precipitation & drainage



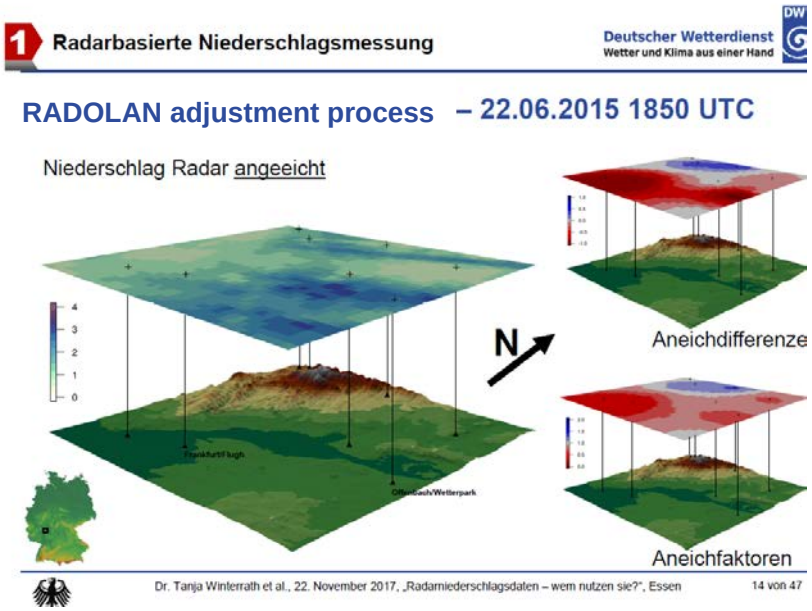
Components of Precipitation Drainage Process in the Urban Space

- Increase in frequency and intensity of extreme weather and convective rain events
- Impact of storms, hail, thunderstorms and heavy precipitation on buildings and facilities of the urban system
- Fallen precipitation flows off superficially as soon as the precipitation intensity exceeds the infiltration rate of the soil

5. Urban System: Precipitation & drainage

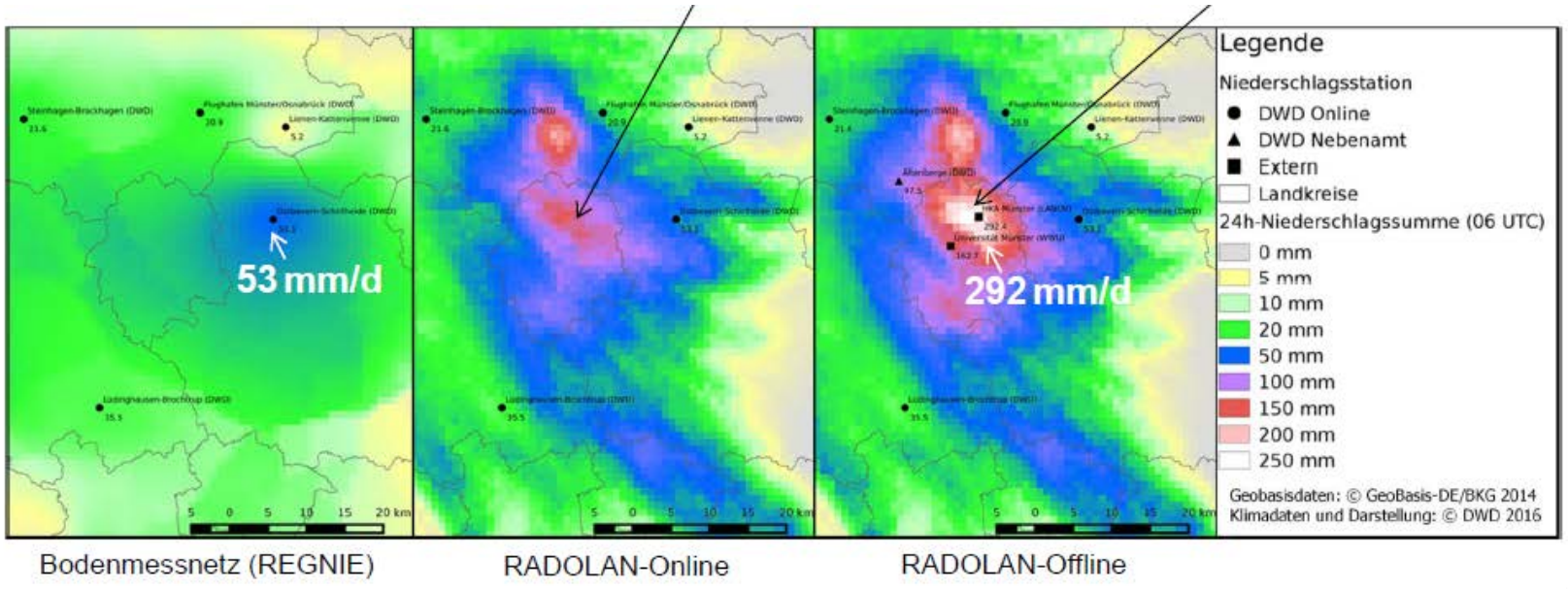


Illustation of event rain levels for a convective rain event



- Radar data provides precipitation information in high temporal and spatial resolution
- Radar data can be used to improve the quality of precipitation-runoff simulations
- Only an event-specific preparation and calibration and thus adaptation of the raw data to ground data ensures the necessary radar data quality for the relevant area.

5. Urban System: Precipitation & drainage



- A sufficient number of precipitation sensors support the spatial resolution of 1 km² (Dual Pol C-band) or even 2500 m² (X-band radar) and improve the spatially corrected precipitation data
- Representative measurement network grid equates to precipitation station distance from 5 to 10 km in urban areas
- Geo-referencing of the radar data into the system of coordinates of the sewer system enables a precise simulation of the runoff

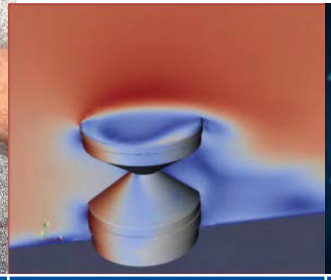
5. Urban System: Precipitation and discharge

- Common Pilot Project with Rain-Radar Software, Dual Pol X-Band Weather radar and OTT Parsivel² as Disdromter to provide DSD-Matrix, Radar-Refelectivity and Intensity.
- Weight 68 kg and size approx 100 cm in diameter
- 30 to 50 km and max resolution to 50 m.

5. Precipitation measurement principles - trends

Comparison of the methods according to applications





	Meteorology	Hydrology	Traffic	Agro-Met	Urban
Tipping bucket	☂☂	☂	☂	☂☂	☂
Weighing gauge	☂☂☂☂	☂	☂	☂☂☂	☂☂
Hybrid	☂☂☂	☂☂	☂☂	☂☂☂	☂☂
Radar	☂	☂☂☂☂	☂☂☂☂	☂☂☂☂	☂☂☂☂
Disdrometer	☂☂☂	☂	☂		☂

5. Comparison WS100 with OTT Sensors

Facts	ADCON RG- TBR	OTT Pluvio²	Lufft WS100	OTT Parsivel²
Orifice cm²	200	200	Radar reflection method: 9 cm²	Extinction method: 54 cm²
Intensity Range mm/h	480 @ 0.1 mm	3000	200	1200
Resolution in mm	0.1	0.01	0.01	0.001
Accuracy @ liquid precipitation) WMO No 8 Guide Line	±0.1 mm or ±2% (intensity correction) Yes	±0.1 mm or ±1% Yes	±0.16 mm or ±10% No	±0.1 mm or ±5% Yes
Calibration factory / recalibration user (accuracy test)	Water Volume / Water Volume	Weight / Weight	Lufft-Equipment / none	OTT-Equipment / none
Life cycle in years	25	15	15	10
MTBF in years	100	100	New: No data	50
Maintenance per year	4-6 / Cleaning	1 / Annual drain off	0 / Open measuring area	0 / Open measuring area
List Price in €	**400 to 600,-**	**2500 to 4000,-**	**1000 to 1200,-**	**4000 to 5000,-**

Results of Comparison

- Result
  - Precipitation amount and intensity: 0 to 200 mm/h
  - Precipitation typification:
    Rain, drizzle, snow, freezing rain, sleet, hail; no precipitation (SYNOP 4677)
  - 11 drop size classes with a bandwidth of 0.5 mm
  - Measurement uncertainty (rain) greater than ±5% - doesn't meet WMO Guide Line No. 8
  - Cost-effective increase in network density and installation in urban areas
  - The calibration/adjustment with a reference precipitation station relativizes the individual measurement uncertainty of the radar principle

	Lufft WS100 
Accuracy	±10%
Influence by wind	improved
Maintenance time	none
Heating	improved
Power consumption	9VA with heating
Price / Total Cost of Ownership	Low

6. Summary: Sales Arguments for the WS100

6. Sales Arguments for WS100

- 100% Maintenance-free
  - Measuring principle allows 100% maintenance-free use
- Reliable differentiation of type of precipitation
  - Differentiation between rain, hail and snow is an important factor in many application areas (example traffic)
- When the first drop counts
  - The main strength of the measuring principle, alongside maintenance-free operation, is the velocity. The first drop or the first snow.
- Purchase Price or Total Cost of Ownership
  - Very competitive price combined with maintenance-free operation are key factors
- Simple connection to existing systems
  - Digital interface:
    - » Digital: RS485 with UMB protocol or SDI12
  - Hence simple connection to existing systems (including non-Lufft)
- Improved power consumption, including with heating
- Free configuration software(ConfigTool.net)

6. Further Information…

…on the WS100 product page:

- DE: https://www.lufft.com/de-de/produkte/niederschlags-sensoren-304/ws100-radar-niederschlagssensor-intelligenter-disdrometer-2360/
- EN: https://www.lufft.com/products/precipitation-sensors-287/ws100-radar-precipitation-sensor-smart-disdrometer-2361/

… on the WS100 landing page:

- DE: https://www.lufft.com/de-de/intelligente-niederschlagsmessung-mit-radar-niederschlagsmesser-niederschlagssensor/
- EN: https://www.lufft.com/smart-precipitation-measurement-with-radar-precipitation-sensor/

Thanks a lot for your attention!

Time for Q&A