

## RPG-LWP-G5 series

The **RPG-LWP-G5** radiometers are designed for the remote sensing of Integrated Water Vapor (**IWV**) and Liquid Water Path (**LWP**). Both quantities give column-integrated (total) values rather than vertically resolved profiles.

## Applications



- Liquid Water Path (LWP)
- Integrated Water Vapour (IWV)
- Attenuation monitoring
- Beacon experiments
- Cloud observations
- Climate monitoring
- Satellite tracking

## Models

- **RPG-LWP** (Standard dual-channel radiometer)
  - Channel-1: 23.8 GHz direct detection, 230 MHz bandwidth
  - Channel-2: 31.4 GHz direct detection, 230 MHz bandwidth
- **RPG-LWP-U72**
  - As RPG-LWP + additional channel 72.5 GHz (2.000 MHz bandwidth)
- **RPG-LWP+82**
  - As RPG-LWP + additional channel at 82.5 GHz (2.000 MHz bandwidth)
- **RPG-LWP-U72+82**
  - As RPG-LWP + additional channels at 72.5 GHz and 82.5 GHz (both with 2.000 MHz bandwidth)

## Hardware Features

### Integrated GPS Receiver

for accurate timing and North alignment\*\*

### Integrated Automatic Weather Station

Lufft® WS600-UMB to measure wind, rain rate, pressure, temperature, relative humidity

### Mitigation System for Rain/Fog/Dew

- Strong blower
- Radome with hydrophobic coating
- Efficient heater system (1.8 kW)

### IR Scanner

for synchronous IR and microwave observations\*

### Ethernet Interface

for network capability

### IR Radiometer

for ice cloud detection\*

### Azimuth Positioner

for full sky scanning\*

### Large Operating Temperature Range

40 °C to +45 °C

### Standalone Operation

- Data backup on embedded PC
- Automatic recovery after power failures



\*optional, \*\*only with azimuth positioner

## Software Features

### Atmospheric Data Products

- Integrated water vapour (IWV)
- Integrated cloud liquid (LWP)
- Atmospheric attenuation

### Accurate North-Alignment sun-tracking\* plus GPS

### State-of-the-art Retrievals

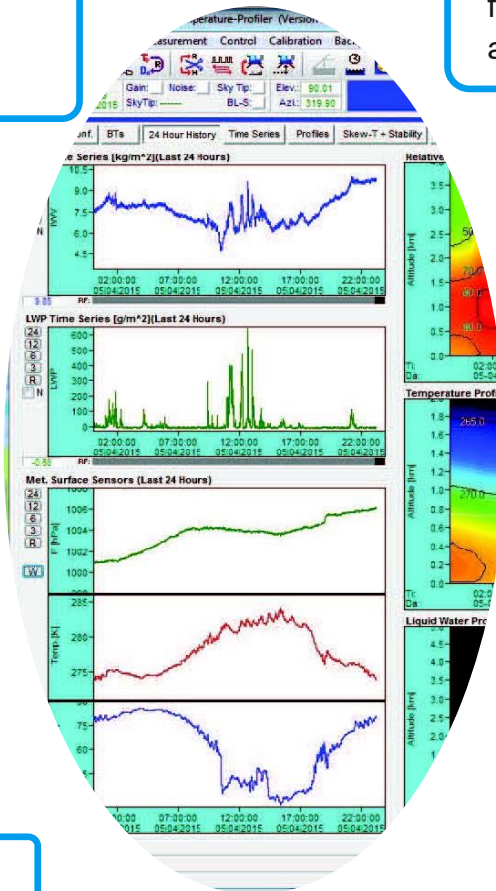
- Neural Network (NN)
- Customized

### Sun Switching Mode

attenuation estimates from observation “on” and “off” the sun\*

### 2D Sky Mapping

300 samples in 8 min\*



### Free Software Updates

### Satellite Tracking

- Attenuation
- Wet delay

### Output Data

- Level 1 (brightness temperatures)
- Level 2 (retrieved products)
- Automatic conversion to netCDF, ASCII, BUFR, RAOB®

### Calibration

- Short calibration cycles
- Automatic sky-tipping
- Automatic internal calibrations including noise sources
- Manual liquid nitrogen calibration (every 6 months)

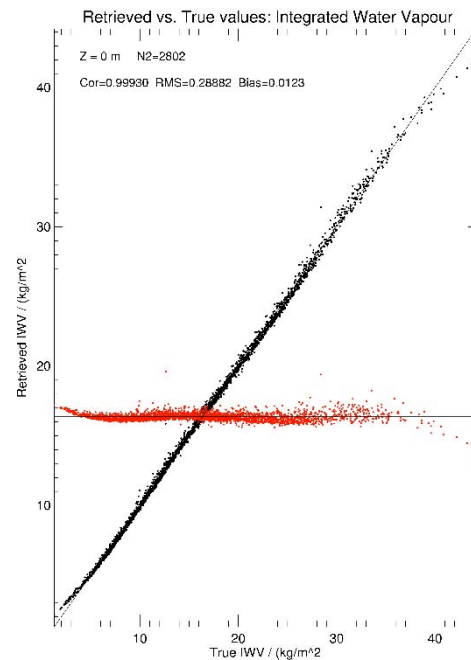
\*only with azimuth positioner

## Meteorological Products

### IWV (Integrated Water Vapor)

column amount of water vapour

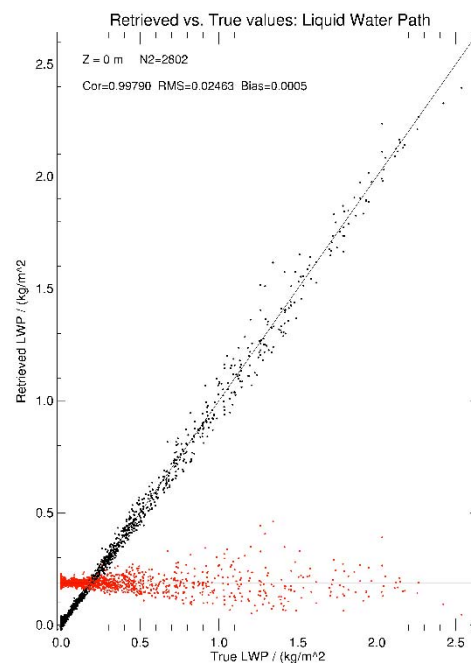
- Very robust retrieval
- Sensitivity: 0.1 kg/m<sup>2</sup> RMS
- Accuracy: 0.3 kg/m<sup>2</sup> RMS
- Range: 1.0 to 80.0 kg/m<sup>2</sup>
- Still works in moderate rain

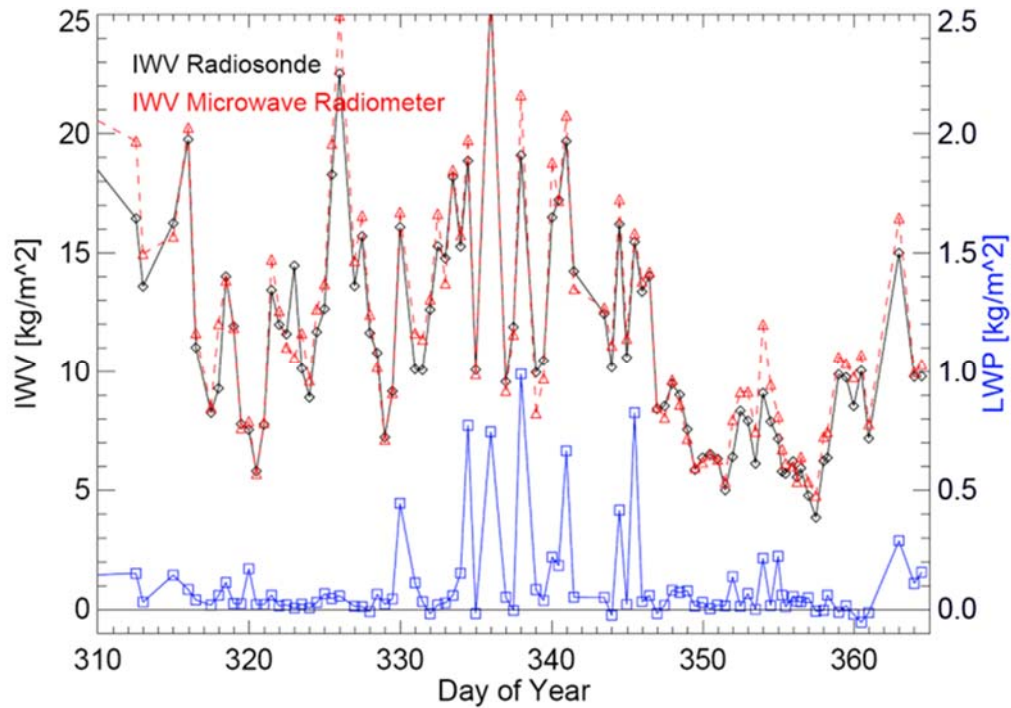


### LWP (Liquid Water Path)

column amount of cloud liquid water

- Sensitivity: 10 g/m<sup>2</sup> RMS
- Accuracy: 30 g/m<sup>2</sup> RMS
- Range: 0.0 to 3.0 kg/m<sup>2</sup>
- Expandable by 72 / 82 / 90 GHz

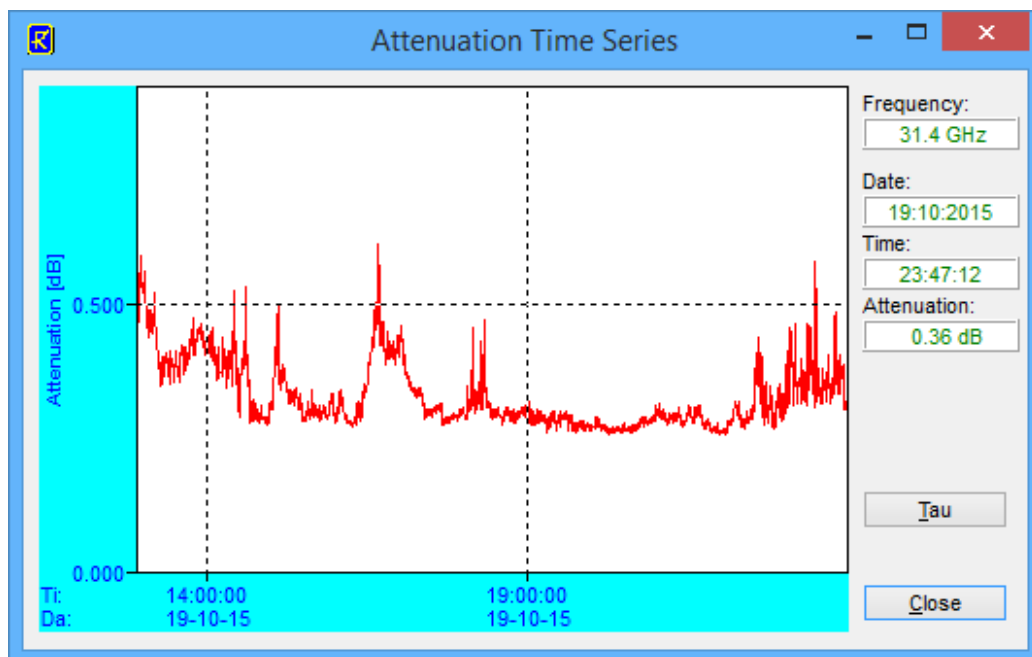




IWV measurements remain accurate even with LWP of 1000  $\text{g/m}^2$ .

### Atmospheric Attenuation

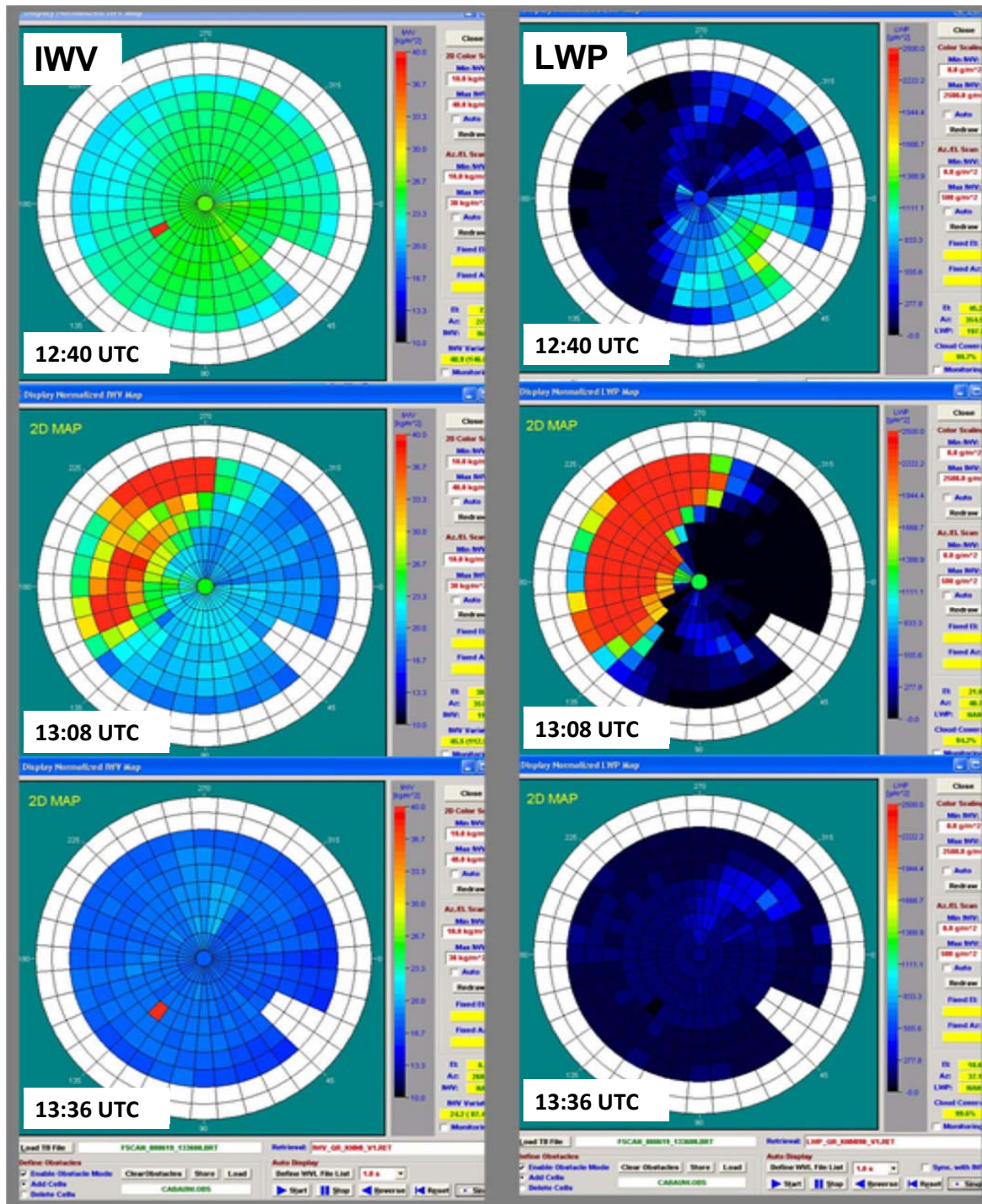
Atmospheric attenuation is calculated along the line of sight at the channel frequencies.





### 2D Sky Maps of IWV and LWP\*

Full sky IWV and LWP maps below show inhomogeneous water vapour distributions and cloud coverage.



\*only with azimuth positioner



## Detailed Instrument Specifications

Parameter	Specification
LWP	Accuracy: 30 g/m <sup>2</sup> RMS, sensitivity: 10 g/m <sup>2</sup> RMS
IWV	Accuracy: 0.3 kg/m <sup>2</sup> RMS, sensitivity: 0.1 kg/m <sup>2</sup> RMS
Full sky IWV and LWP maps (only with azimuth positioner)	350 points in 6 minutes rapid scanning
Satellite tracking mode (only with azimuth positioner)	Determines wet delay, atmospheric attenuation and humidity profiles along line of sight for all visible GPS / Galileo satellites in a single scan (2 minutes) scanning with RINEX navigation file or direct GPS vector reading from GPS clock
Channel centre frequencies	23.8 + 31.4 (36.5, 72.5, 82.5, 90) GHz
Channel bandwidth	2 GHz @ 72 to 150 GHz, 230 MHz @ all other
System noise temperatures	< 400 K typical, < 750 K at 70 to 90 GHz typical
Radiometric resolution	K-Band: 0.07 K RMS, @ 1 s integration time V-Band: 0.07 – 0.15 K RMS @ 1 s integration time W-Band: ~0.1 K RMS @ 1 s integration time
Absolute brightness temp. accuracy	±0.1 K
Radiometric range	0-800 K
Absolute calibration	with internal ambient & external cold load
Internal calibration	<ul style="list-style-type: none"><li>• gain: with internal noise standard</li><li>• gain + system noise: ambient temperature target + noise standard</li><li>• abs. cal. of humidity profiler: sky tipping calibration</li></ul>
Receiver and antenna thermal stabilization	Stability better than 0.03 K over full operating temperature range
Gain non-linearity error correction	Automatic, four point method
Brightness calculation	Based on exact Planck radiation law
Integration time	≥ 0.4 seconds for each channel, user selectable
Sampling rate for profiles	≥ 1 second (user-selectable)



Rain / fog / dew mitigation system	Highly efficient blower system (130 Watts), hydrophobic coated microwave transparent window, 1.8 kW heater module to prevent formation of dew.
IR radiometer option	9.6-11.5 $\mu\text{m}$ band, accuracy 1 K, noise: 0.2 K RMS
Data interface / rate	Ethernet (TCP/IP)
Instrument control (external PC)	Windows™ System with Ethernet interface
Instrument control (internal PC)	Embedded PC, controls all internal calibrations, data acquisition, data file backup on 10 GB flash memory, control of azimuth positioner, communication with host, can run measurements independently from host PC
Housekeeping data	Detailed instrument status information, including health checks, quality flags, calibration history and log files
Retrieval algorithms	Neural Network algorithms
Optical resolution	HPBW: $\leq 4^\circ$ ( $\leq 2^\circ$ at 72 GHz and above)
Side-lobe level	$< -30$ dBc
Pointing range / resolution	Elevation: $0^\circ$ to $180^\circ$ ( $0.15^\circ$ steps), Azimuth (optional): $0^\circ$ to $360^\circ$ ( $0.1^\circ$ steps), full s/w control
Pointing speed	$45^\circ/\text{sec}$ (elevation), $40^\circ/\text{sec}$ (azimuth, optional)
Operating temperature range	$-40^\circ\text{C}$ to $+45^\circ\text{C}$
Power consumption	$< 120$ Watts average, 350 Watts peak for warming-up (without dew blower heater), blower: 130 Watts max.
Lightning protection	Power line: circuit breakers Data line: fibre optics cable (max. length: 1400 m)
Input voltage	90-230 V AC, 50 to 60 Hz
Weight	60 kg (without dew blower)
Dimensions	$63 \times 36 \times 90$ cm <sup>3</sup>
Integrated weather station	Lufft® WS600-UMB to observe surface temperature, pressure, relative humidity, wind and rain rate