RPG-LWP-G5 series

High-precision microwave radiometers for continuous observations of water vapour and Liquid Water Path (LWP)

Applications

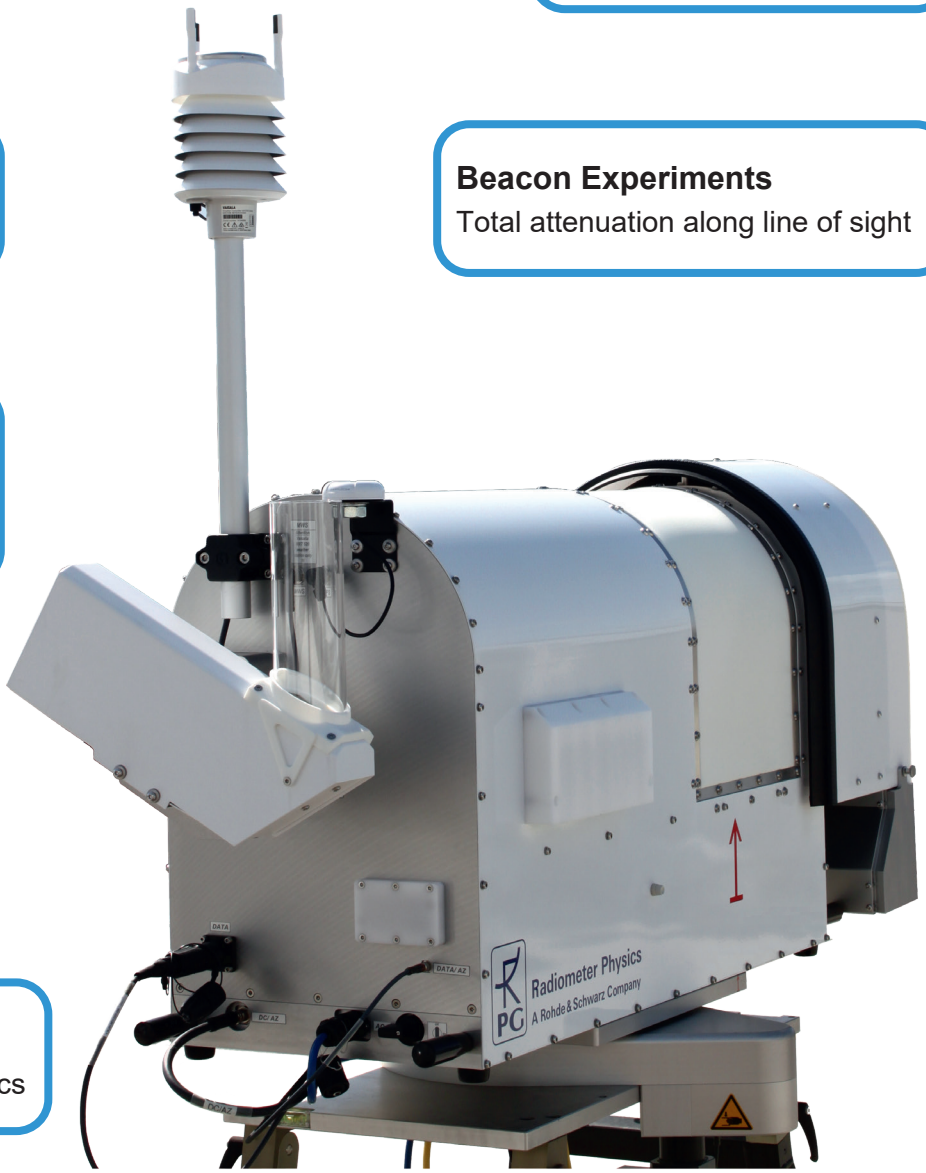
Atmospheric Attenuation
for satellite communication

Water Vapour Monitoring
e.g. at astronomical sites

Cloud Observations
Accurate LWP measurements

Beacon Experiments
Total attenuation along line of sight

Satellite Tracking
Tropospheric attenuation and delay along line of sight



Data Assimilation
Input for weather and climate models

Climate Tracking
Long-term LWP and IWV statistics

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Design

Direct Detection Filter-Bank Receivers

Narrow Antenna Beams
(~2° - 5° HPBW)

Parallel Detection
at all channels

Immune to RFI
< 18 GHz*

Fast Data Acquisition

100% Duty Cycle

High Temporal Resolution
- 1 second resolution
- Ideal for fast LWP sampling applications

High Spatial Resolution
- 2D sky mapping**

RPG-HATPRO-G5 radiometer during the absolute calibration prodecure with RPG's LN2-cooled target PT-V2.

*e.g. radio transmitters or mobile phones, **only with azimuth positioner

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Hardware Features

Integrated Automatic Weather Station

Vaisala® WXT536 to measure wind, rain rate, pressure, temperature, and relative humidity

Mitigation System for Rain / Fog / Dew

- Powerful blower
- Radome with hydrophobic coating
- Efficient heater system

Azimuth Positioner

for full sky scanning*

Data Backup

on embedded Radiometer-PC

IR Radiometer

for cloud base height detection**

Ethernet Interface

for network capability

Fibre-Optical Data Cable

for lightning protection and secure data transmission

IR Scanner

for synchronous IR and microwave observations**

*only with azimuth positioner, **optional

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Software Features

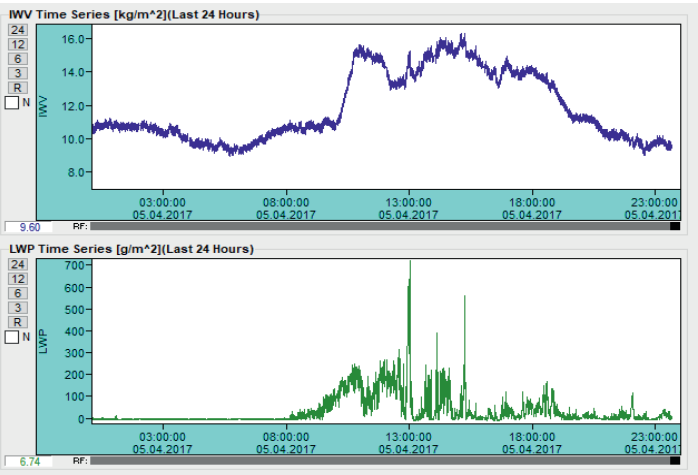
Atmospheric Data Products
- Integrated Water Vapour (IWV)
- Integrated cloud liquid (LWP)
- Atmospheric attenuation

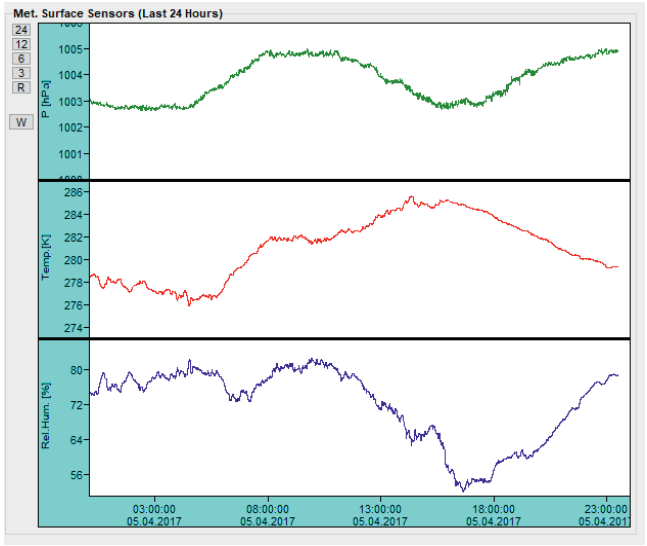
Accurate North-Alignment
via sun-tracking* and positioning with the integrated GPS receiver

State-of-the-art Retrievals and Free Software Updates

Satellite Tracking*
with satellite navigation files

Sun Switching Mode
attenuation estimates from observations „on“ and „off“ the sun*





Detailed Housekeeping Data
- Instrument status / control
- Digital status / data flagging

Calibration
- Short calibration cycles
- Automatic sky-tipping
- Automatic internal calibrations including noise sources
- Manual liquid nitrogen calibration

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

*only with azimuth positioner

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Integrated water vapour (IWV) and liquid water path (LWP)

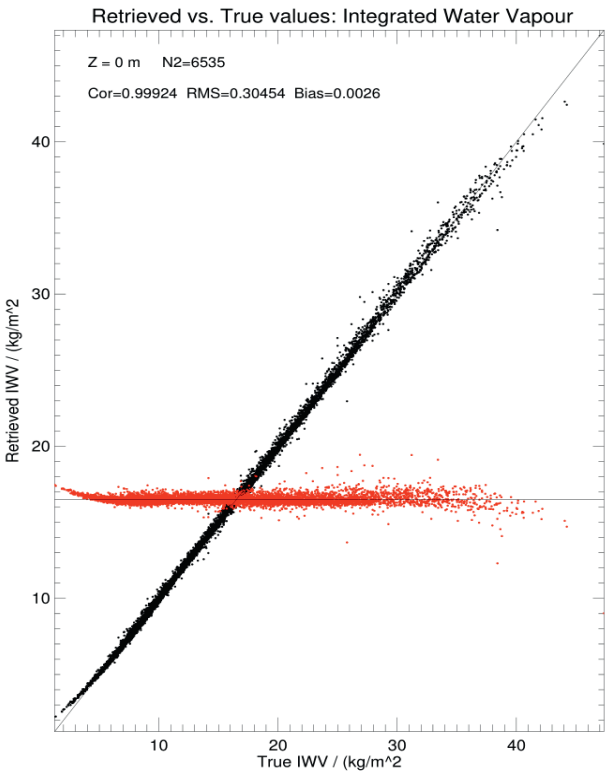
retrieved from observations of a RPG-LWP-U72+82-G5 radiometer

IWV (Integrated Water Vapour)

column amount of water vapour

The scatter plot on the right shows a comparison between retrieved and true IWV values. Red dots indicate the difference. Dots on the horizontal black line indicate a perfect match.

- Very robust retrieval
- Sensitivity: 0.1 kg/m² typical
- Accuracy: 0.3 kg/m² RMS typical
- Range: 1.0 to 80.0 kg/m²
- Still works in moderate rain

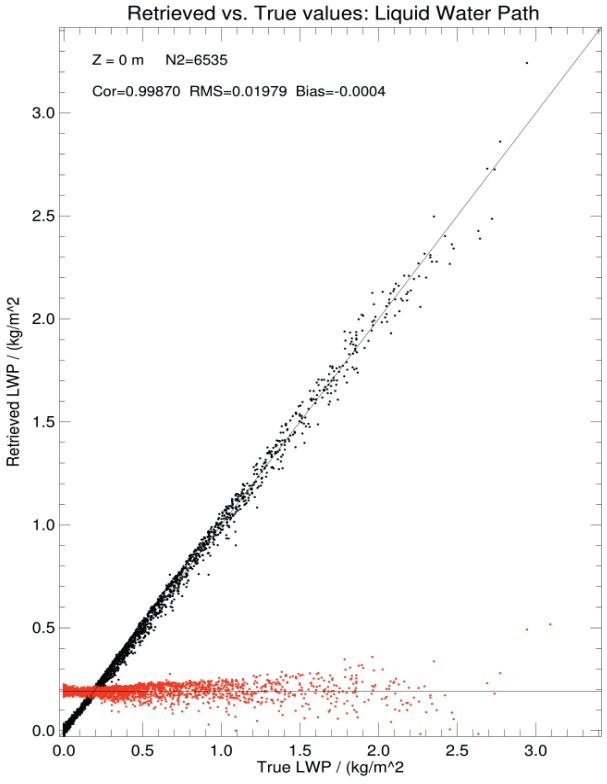


LWP (Liquid Water Path)

column amount of cloud liquid water

The scatter plot on the right shows the comparison between retrieved and true LWP values. Red dots indicate the difference. Dots on the horizontal black line indicate a perfect match.

- Sensitivity: 6 g/m² typical
- Accuracy: 20 g/m² RMS typical
- Range: 0-2000 g/m²



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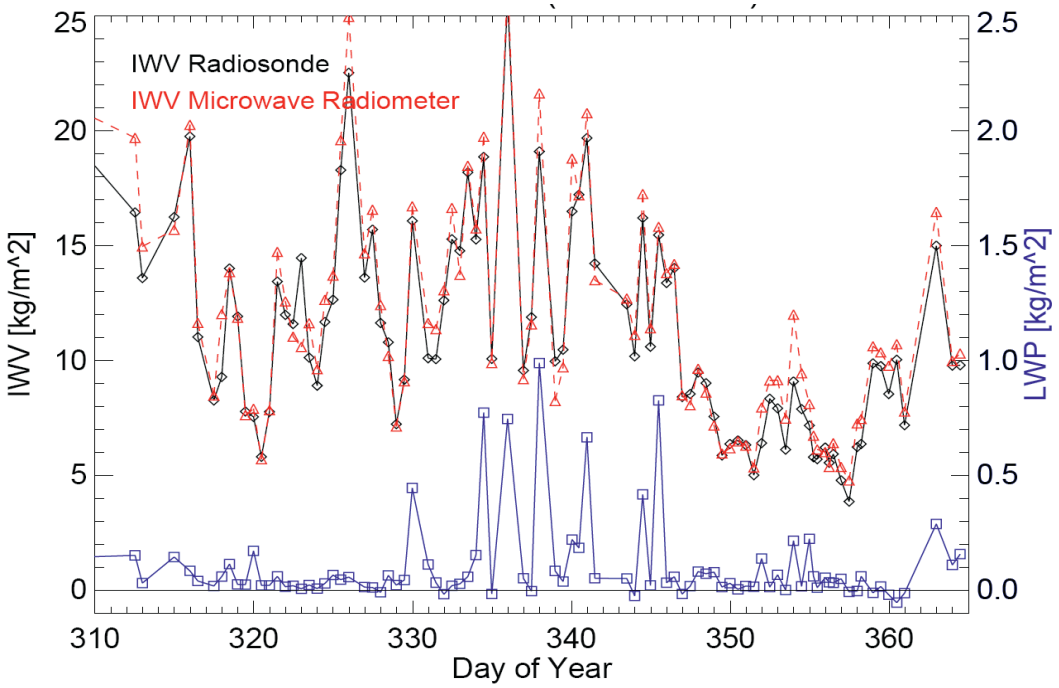
IWV measurements remain accurate even with LWP of 1000 g/m².



The figure above shows that accurate measurements of IWV and LWP are recorded simultaneously. IWV accuracy is maintained even in case of thick clouds and light rain. Retrieved IWV is plotted against IWV calculated from 2 month of radiosonde profiles.

LWP Radiometer Models

- **RPG-LWP-U72+82**
  - Estimation of IWV and LWP
  - 4 channels: 23.84, 31.40, 72.50, and 82.50 GHz
  - High sensitivity to thin clouds (LWP < 50 g/m²)
  - Attenuation measurements for data links

- **RPG-LWP-U90 and RPG-LWP-U150**
  - Estimation of IWV and LWP
  - 3 channels: 23.84, 31.4 GHz, and 90 GHz or 150 GHz
  - High sensitivity to thin clouds (LWP < 50 g/m²)

- **RPG-LWP**
  - 2 channel radiometer for IWV and LWP estimation
  - 2 channels: 23.84 and 31.40 GHz

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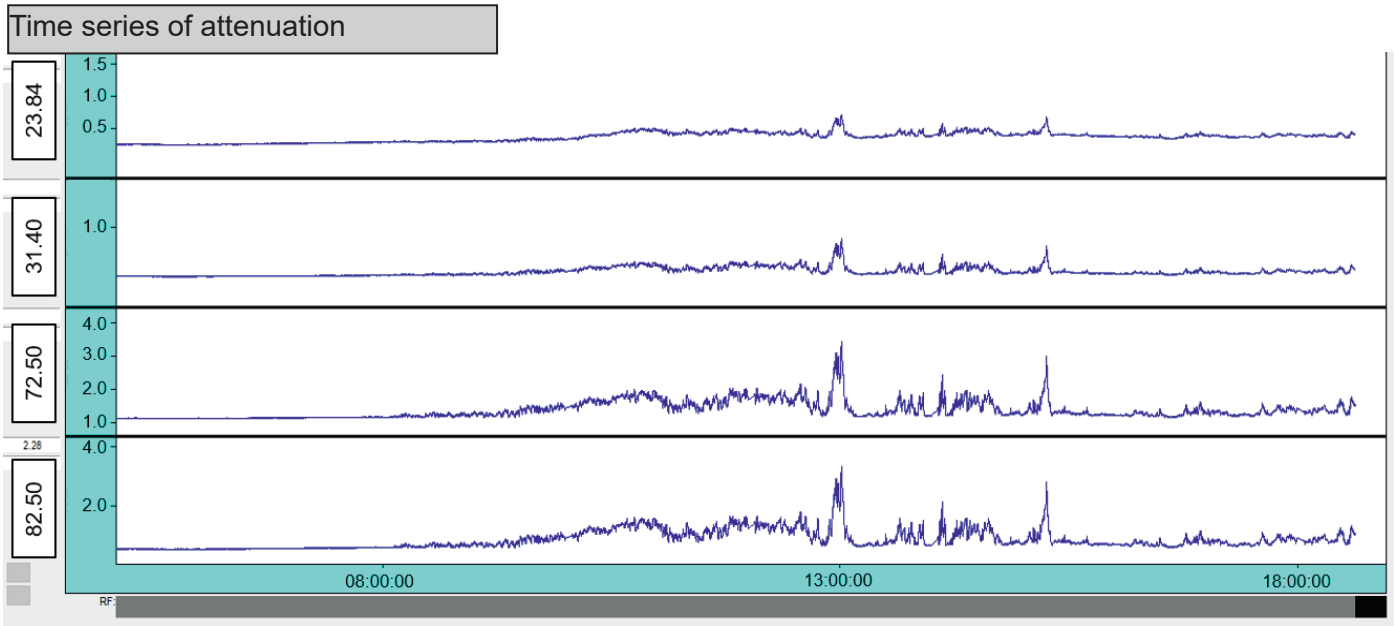
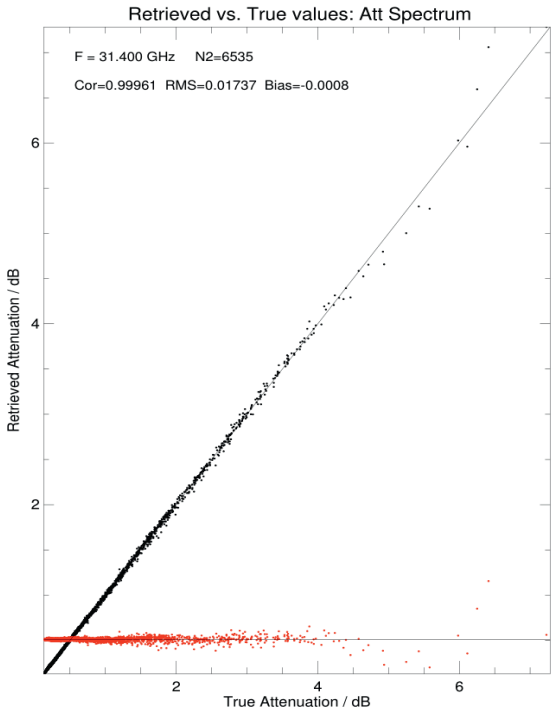
Attenuation Measurements

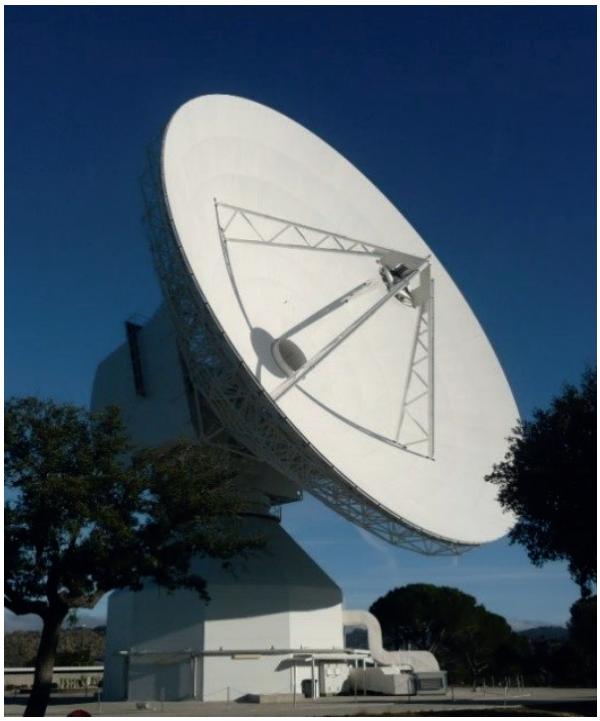
RPG-LWP-U72+82 measurements at 4 radiometer channels allow for an accurate retrieval of **total atmospheric attenuation** at the instrument‘s channel frequencies.

The figure below shows attenuation time series from RPG-LWP-U72+82 observations at 23.84, 31.40, 75.50, and 82.50 GHz.





Scatter plot for “Retrieved Attenuation“ vs. “True Attenuation” (black), de-trended in red.



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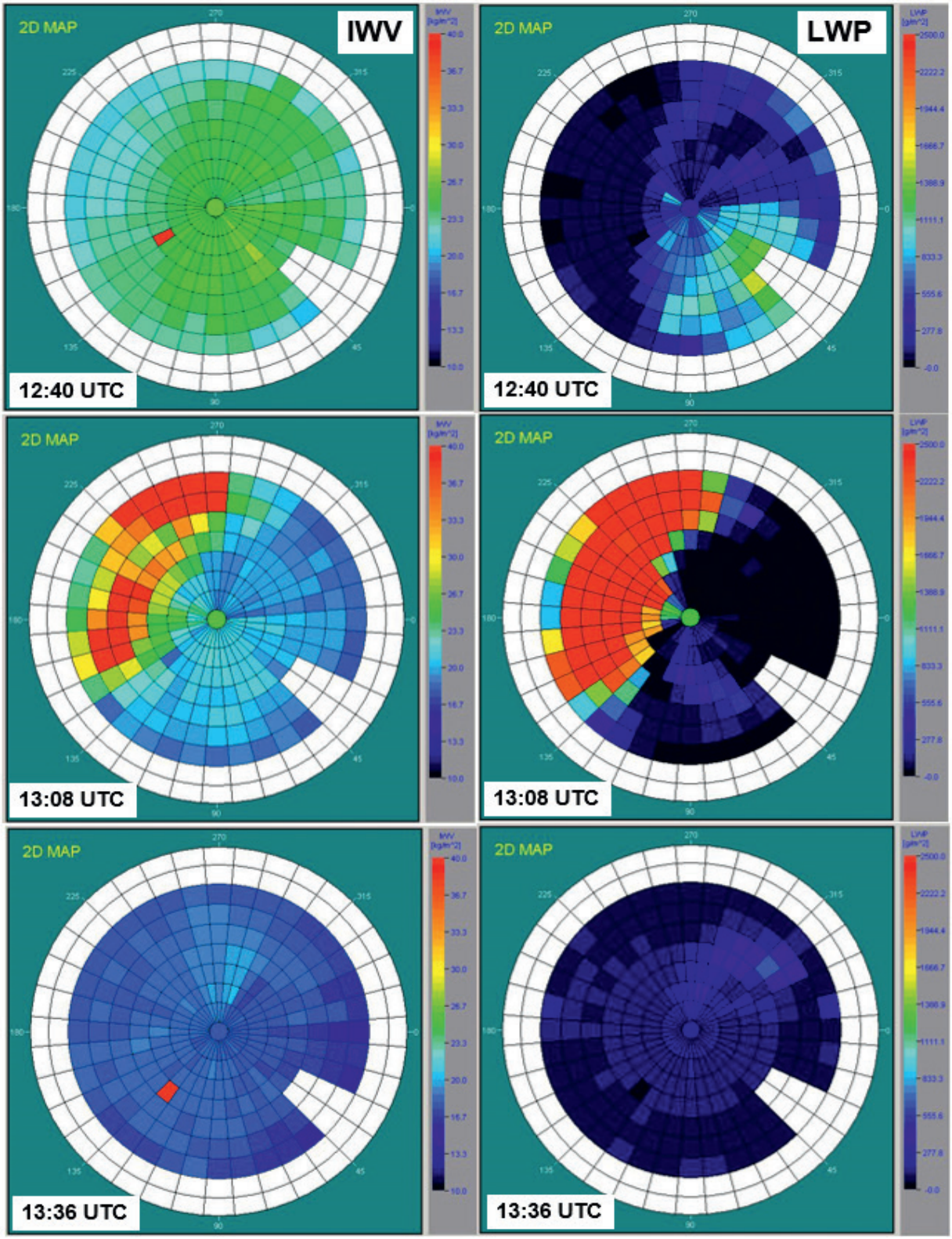
2D sky maps*



Full Sky IWV and LWP maps show inhomogenous water vapour distributions and cloud coverage:*

*only with azimuth positioner

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