



## FMCW Cloud Radar Applications



### High Resolution Profiles

- radar reflectivity dBZ
- LWC (Liquid Water Content)
- vertical velocity and higher moments from Doppler spectra

### Now-Casting

- cloud formation
- fog observation
- urban weather

### 3D Cloud Studies\*\*

### Hydrometeor Classification\*

### Weather Modification

**Operational Deployments**  
in all weather conditions

\*only with Dual Polarisation option (DP), \*\*only with optional positioner

## Unique Features

### High Transmitter Power

- 2 W continuous wave
- automatically adjusted

### Built-in Passive Channel at 89 GHz

→ LWP to constrain retrieved LWC profile

### Low Noise Receiver

typical system noise temperature: 400 K

### Adaptable Chirp Parameters

optimized to observation mode

### Adjustable Centre Frequency

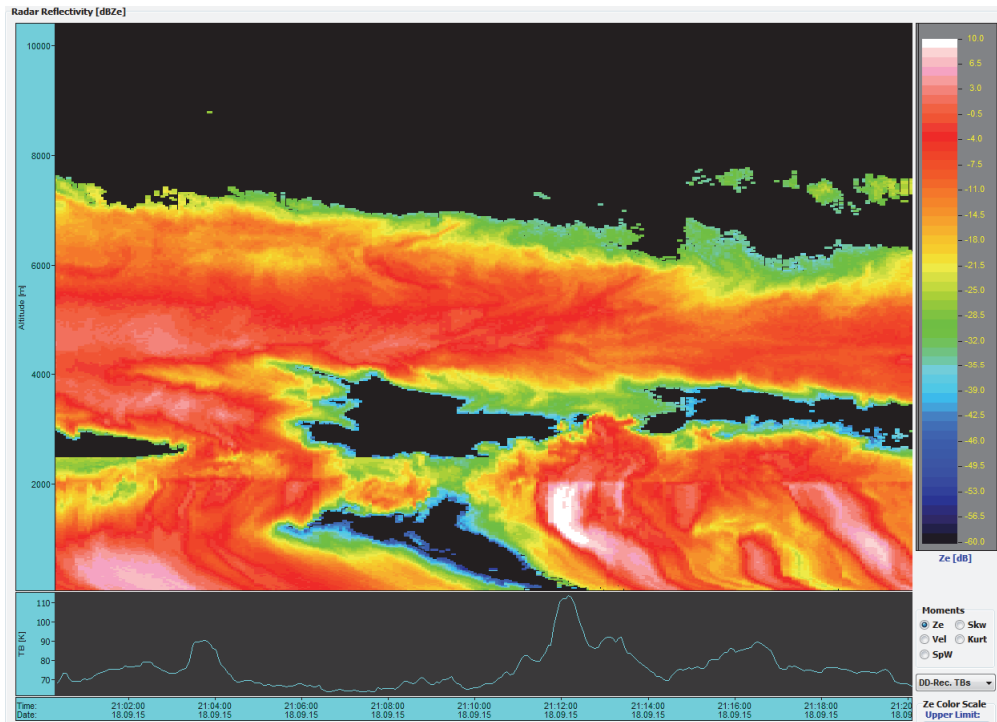
92.3-95.7 GHz

### Mitigation System for Rain/Fog/Dew

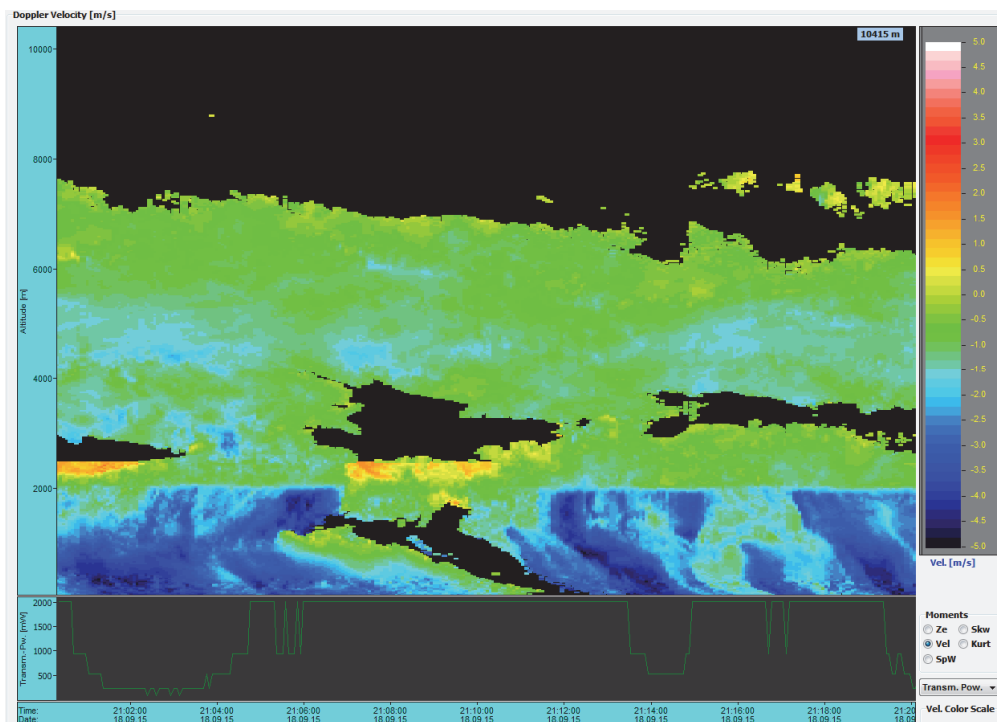
- strong blower
- hydrophobic radomes
- optional heater system



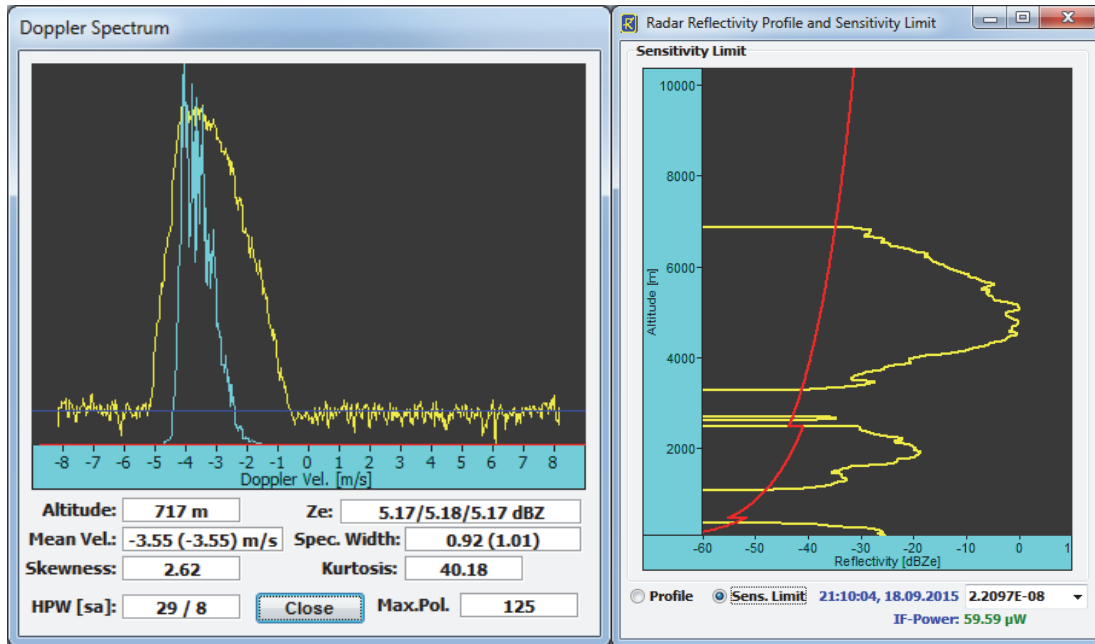
## Measurements Examples



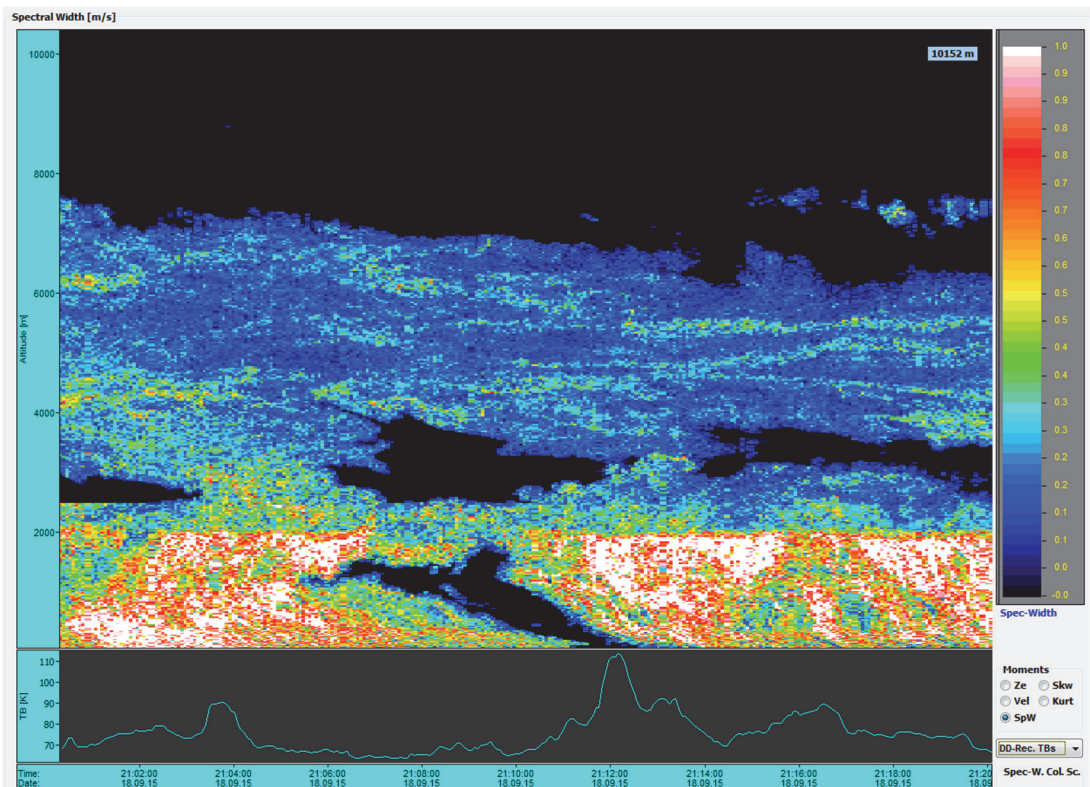
**Figure 1: Time Series of vertical dBZ profiles (plotted range: +10 to -60 dBZ) and TB (brightness temperature) observations at passive 89 GHz channel (blue line); TB signal is proportional to the LWP (Liquid Water Path)**



**Figure 2: Time Series of vertical velocity profiles (plotted range: -5 to +5 m/s) and the automatically adjusted transmitter power (green line)**



**Figure 3:** Left: Observed Doppler spectrum with calculated mean velocity and higher moments. Right: Example of a vertical dBZ profile including sensitivity limit (red line)



**Figure 4:** Vertical profiles of Doppler spectral widths and TB (brightness temperature) observations at passive 89 GHz channel (green line); TB signal is proportional to the LWP (Liquid Water Path)



## Specifications

| Parameter  | Specification   |
|--|---|
| Centre Frequency   | 94 GHz ( $\lambda=3.19$ mm) $\pm$ 100 MHz typical, (adjustable by software between 92.3 and 95.7 GHz)   |
| IF range   | 350 kHz to 3 MHz  |
| Transmitter power  | 2 W typical (solid state amplifier)<br>Lower transmitter powers are available for reduced priced  |
| Antenna type   | Bi-static Cassegrain with 500 mm aperture   |
| Antenna gain   | 51.5 dB   |
| Beam width   | 0.48° FWHM  |
| Polarisation   | V (optional V & H)  |
| Rx System Noise Figure                                   | 4 dB (400 K system noise temperature)   |
| Typical Dynamic range (sensitivity) with 2 W transmitter | -60 dBz to +20 dBz (at 500 m height / 5 m resolution)<br>-50 dBz to +20 dBz (at 2 km height / 10 m resolution)<br>-47 dBz to +20 dBz (at 4 km height / 30 m resolution)<br>-36 dBz to +20 dBz (at 10 km height / 30 m resolution) |
| Ranging  | 100 m to 12 km typical, 16 km maximum   |
| Maximum vertical resolution                              | 1 m (range: 0.1 km – 0.6 km),<br>2 m (range: 0.6 km – 1.0 km),<br>4 m (range: 1.0 km – 2.5 km),<br>8 m (range: 2.5 km – 5.0 km),<br>16 m (range: 5.0 km – 12.0 km)  |
| Calibrations (automatic)                                 | Power monitoring of the transmitter, plus receiver Dicke-switch for gain drift compensation (radar and passive channel)   |
| Calibrations (maintenance)                               | Liquid nitrogen receiver calibration, external reference sphere   |
| A/D Sampling rate  | 8.2 MHz (data processing between 0.35 and 3 MHz)  |
| Data processing system                                   | High-Performance embedded PC  |
| Sampling rate (full profiles)                            | Adjustable: $\geq$ 1 second   |
| Doppler range  | $\pm$ 9 m/s unambiguous velocity range (0-2500 m), $\pm$ 4.2 m/s above  |
| Doppler resolution                                       | $\pm$ 1.5 cm/s or higher  |
| Chirp variations   | 3 typical, 10 possible, re-programmable   |
| Passive channels   | 89 GHz for integral LWP detection   |
| Control connection                                       | TCP/IP connectivity via fibre optics data cable to internal PC  |
| Operation software                                       | Real time visualization, real time data extraction, real time control (adaptive observation modes depending on context)   |
| Data products (available as files)                       | Reflectivity, Doppler spectra (including calculated moments), LWC profiles. Data levels: L1: calibrated dBZ, L2: retrieved data   |
| Data formats   | netCDF (CF convention), proprietary binary, ASCII   |
| Mitigation system for rain/fog/dew                       | Strong dew blower (approx. 2000 m <sup>3</sup> /h), radomes with hydrophobic coating ,optional heater (additional 2-4 kW)   |
| Additional sensors                                       | Automatic weather station with P, T, RH, RR, Snow, WS, WD   |
| Scanning / mounting                                      | Baseline: mounted on a fixed stand of 0.5 m height<br>Optional: scanner unit for full sky scanning capability   |
| Dimensions   | 115×56×82 cm <sup>3</sup> (with antennas),(80×40×40 cm <sup>3</sup> (box only)  |
| Weight   | Approx. 280 kg/80 kg with/without stand & blower (w/o scanner)  |