During the last decades millimeter-wave radars have been established as valuable systems for remote sensing of cloud processes and structures, whereas the number of systems increased significantly during the last years. The type and characteristic of instrument (35 or 94 GHz, scannable or fixed antenna, transmitting power, etc) depends essentially on the object of investigation and site of operation (ground based, spaceborne). Furthermore, the configuration and setup influence the performance of the system. Quality assurance of measured data is closely associated with regular maintenance.

1 System setup: Configuration and sampling strategy

2 Sensitivity

The radar sensitivity is crucial for the ability of the radar to detect the different cloud types. It depends on system properties, the distance between radar and the sensed volume as well as on signal processing and parameter settings. Rewriting eq. 1 in fundamentals to Z, substituting p_r by $SNR = p_r/p_N$, where p_N is the noise power, and converting to logarithm lead to:

$$Z_{min} = 10log(C) + 20log\ r + 10logSNR_{min}$$

where C is the radar constant summarizing all hardware specific parameters.

$$C = \frac{1024ln(2)\lambda^2 p_N}{\pi^3 p_t g \Theta^2 h |K|^2}$$

It can be seen that the sensitivity increases (i.e. Z_{min} becomes smaller) with increasing transmitting power, increasing antenna gain and smaller receiver noise figure. Furthermore, the sensitivity decreases with increasing range. SNR_{min} is inversely proportional to integration time (see Moran et al. 2011), i.e., the greater the avaraging time the higher the sensitivity.

How sensitive a radar has to be depends on the clouds of interest. In literature few recommandations conserning the necessary sensitivity can be found. Brown et al. 1995 reported that a radar with $Z_{min} = -30dBz$ should detect more than 99 % of all radiatively significant cirrus clouds. Borg et al. 2011 found out that the MMCR radar ($Z_{min} = -50dBz(5km)$) detects 70 % of all clouds with a optical thickness (OD) less than 2.0, whereas cloudnet recommend a $Z_{min} = -55dBz(1km)$ to measure all clouds with OD less than 0.05. For fog a sensitivity of $Z_{min} = -45dBz$ seems to be enough (Hamazu et al. 2003, Bauer-Pfundstein 2012)

3 Maintenance

4 Siting, frequency management

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