

A 35-GHz FMCW Radar for Long-Term Observations of Cloud Parameters in Tibet Plateau

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A new Ka-band frequency-modulated continuous wave (FMCW) Doppler cloud radar for long-term unattended observation of macro- and microphysical properties of cloud and precipitation has been installed at the Yangbajin (YBJ) International Cosmic Ray Observatory (30.21°N, 90.43°E; 4300 m MSL), about 90 km northwest of the Lasa city, the Tibet Autonomous Region, China. The radar has a high-sensitivity of -32 dBZ at 10-km height for a 1-s averaging time and the dynamic range of the radar is critical for the detection of clouds from the boundary layer up to the upper troposphere. The radar has started 24-hour continuous observation since March 2018 and has been in operation for about a year now.

The Ka-band FMCW cloud radar was operated using Frequency modulated continuous wave at high duty ratio (about 48%), with two Cassegrain antennas, one for transmitting and one for receiving. The Cassegrain antenna has a diameter of 1.5m and a 3-dB beam width of 0.38 degree, which yields a gain of 50.9 dBi. The level of the first sidelobes (at about 1° off axis angle) is below -18.6 dB.

The transmitter uses solid-state technology, leading to a long lifetime and low costs. The final amplifier module of 8 channels is synthesized by the power synthesizer to get the output power of 41.4 W. To ensure linear detection while observing from thin cirrus to precipitation liquid clouds (a high dynamic range of input power signal), the radar was operated in two modes, the clear day mode with 120 us pulse width and the precipitation mode with 10 us of pulse width, these modes can be switched automatically based on the measurement of reflectivity.

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