

Jan. 22, 2003 T. Koza, Shimane University

APPENDIX 2

Major Engineering Parameters of the X-band Doppler Radar

Background

A collaborative Indonesia-Japan project has been initiated to study the Coupling Processes in Equatorial Atmosphere (CPEA) utilizing the Equatorial Atmosphere Radar (EAR), located at Koto Tabang, west Sumatra, Indonesia. Observation of tropospheric convective activities in maritime continents, most intense in the world, is an essential part of the CPEA project, because they are powerful atmospheric wave sources and heat engines affecting the upper atmosphere and global circulation. Our goal is to reveal dynamical behavior of such convective activities through continuous and systematic observations by the EAR, various remote sensors and in-situ measurement instruments. The X-band (about 10 GHz) Doppler rain radar system (XDR), to be installed at the EAR site in February 2004, can measure 3-D structure of wind as well as rain intensity of tropical convective systems. The advantage to use the XDR in addition to the existing X-band rain radar (XRR; installed in Sept. 2002) is that the XDR will provide both wind and rain fields just over the EAR site with higher sensitivity and resolution than those from the XRR, useful to make analyses in comparison with the EAR data.

System Description

The XDR is a pulsed Doppler radar to measure 3-D structure of rain field over a range of several tens of kilometers. It consists of the main radar and separate bistatic receivers (see Fig.1). The out-views of these subsystems are shown in Fig.2. The main radar will be installed at a remote site (about 20 km apart from the EAR) and the bistatic receiver will be installed at the tower of GAW station nearby the EAR if the communication line with the main radar is well established (see Fig.3). The bistatic receivers can enhance the ability of measure wind fields from Doppler information. A circular parabola antenna of 2.0-meter dish is mounted on a shelter as shown in Fig.4. The antenna rotates with 30 degrees per second in horizontal plane, and 18 degrees per second in vertical plane to make a fast volume scanning. The entire RF and signal processing units of the main radar are installed in the shelter as shown in Fig.4.

The major system parameters are summarized in Table 1.

The main radar is owned by the Institute of Low Temperature Science (ILTS), Hokkaido University, while the bistatic receivers are owned by the Frontier Observational Research System for Global Change (FORSGC), Japan. Shimane University will start the negotiation with these organizations soon to make the utilization at CPEA project possible.

Installation and Operation Plan

The radar will be shipped to Koto Tabang by the end of January 2004 and installation and tests will follow in February, 2004. The radar will mainly be used between March - April 2004 and in November 2005 to meet the intensive observation campaign, and if feasible, continuous observation will be considered.

Table 1. Major parameters of the main radar of the XDR.

Items	Description
Transmit frequency and polarization	9.445 GHz , Vertical
Transmit power	40 kW at magnetron output port
Feeder loss	0.5 dB
Antenna Gain, and beamwidth	2.0 m, 30 dB, 1.1 degrees
Pulse width	0.5 microseconds
Band width	8 MHz (Note 1)
Pulse repetition frequency	2000 Hz
Antenna rotation rate (max)	30 deg/sec (horizontal), 18 deg/sec (vertical)
Elevation angle	-5 deg to +185 deg.
Minimum detectable level	-110 dBm
Rain detection range	68 km max with 0.25 km resolution
Size and mass of shelter	5.5 m (L) x 2.5 m (W) x 2.4 m (H), 5 tons
Size & mass of antenna	2.0-m diameter dish, 1.5 tons
Power supply	220 V AC, 11 kVA max (3-line, single phase)
Bistatic receiver Configuration	Consists of a small antenna and a PC
Antenna size and weight	0.3 m (L) x 0.3 m (W) x 1.5 m (H), 20 kg
Power requirement	220 V AC, 1 kVA max

Note 1. The occupied bandwidth B is calculated with $B = 4/\tau$, where τ is the radar pulse width.

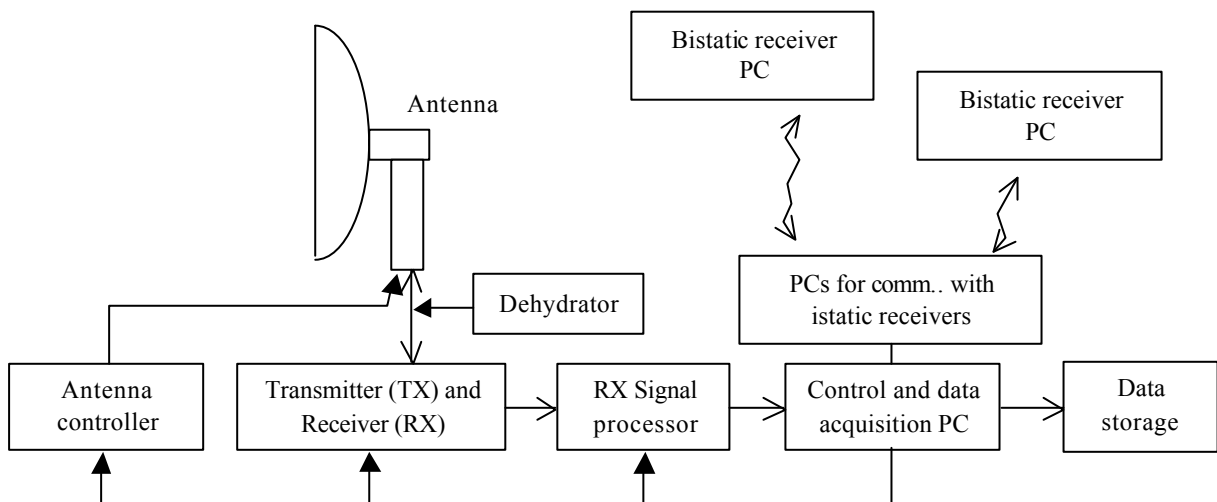


Fig. 1 Overall radar block diagram and signal flow

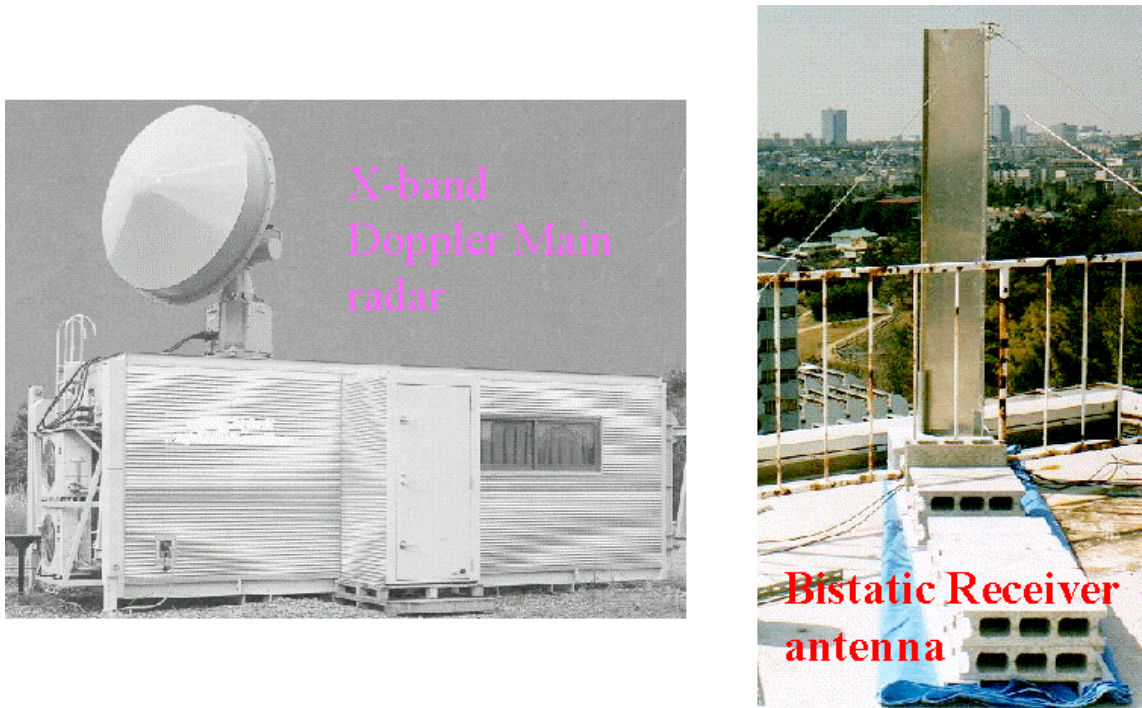


Fig.2. Outlook views of the XDR (left: main radar, and right: bistatic receiver antenna)

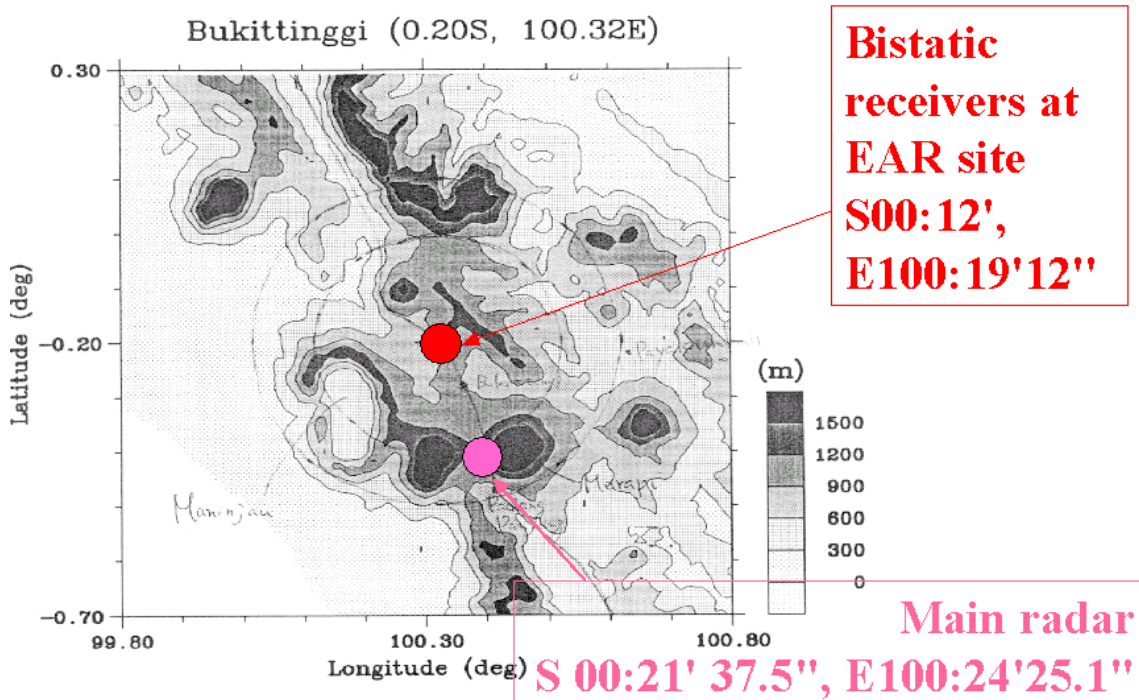


Fig.3. Planned location of the main radar and the bistatic receivers.

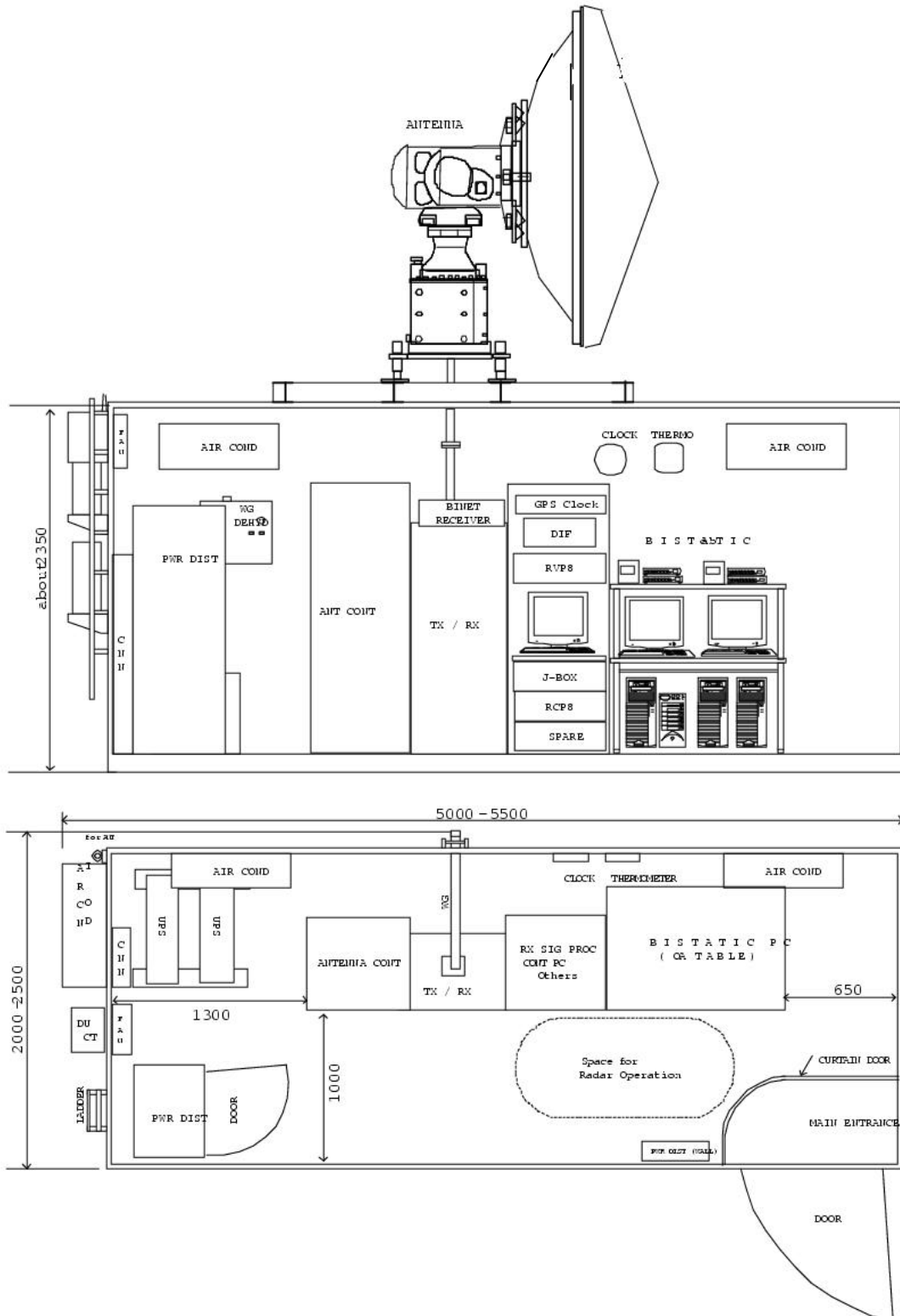


Fig.4. Configuration of the XDR shelter with dimensions. (Note: the configuration is under modification. New configuration will be supplied soon.)