June 5, 2002 by T. Kozu, Shimane University
Updated July 1, 2002.

Major Engineering Parameters of the X-band Rain Radar and Scientific Significance

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) rain radar that is planned to be installed at the EAR site in the fall 2002 will play a key role to understand 3-D structure of the tropical convective systems.

System Description

The X-band rain radar is a pulse radar to measure 3-D structure of rain field over a range of several tens of kilometers. A circular parabola antenna of 1.2-meter dish is mounted on a shelter as shown in the attached figure. The antenna rotates with 2 revolutions per minute (RPM) and 16 elevation angles. It takes 8 minutes to make a volume scan. The radar data will be stored on a magneto-optical disk (MO) connected to the data collection computer and used for analyses.

The RF unit of the radar is installed in the shelter, and radar control and data collection computers are installed in a separate container. To obtain an antenna height of about 7.6 meters above the ground, the shelter will be installed on the roof of the container the height of which is about 2.4 meters. A concrete base with a height of about 1.6 meter may also be required.

The major system parameters are summarized in the attached table.

Scientific Importance of the X-band Radar

To accomplish our goal, *i.e.,* to understand the characteristics of 3-D structure of tropical convective systems, it is essential to measure various atmospheric parameters including wind, temperature, humidity and rainfall. In particular, it is important to measure 3-D structure of convective rain cells in addition to vertical profiles because the 3-D rain structure is closely related to the 3-D structures of latent heating, gravity wave generation and coupling to wider scale precipitation systems.

Installation and Operation Plan

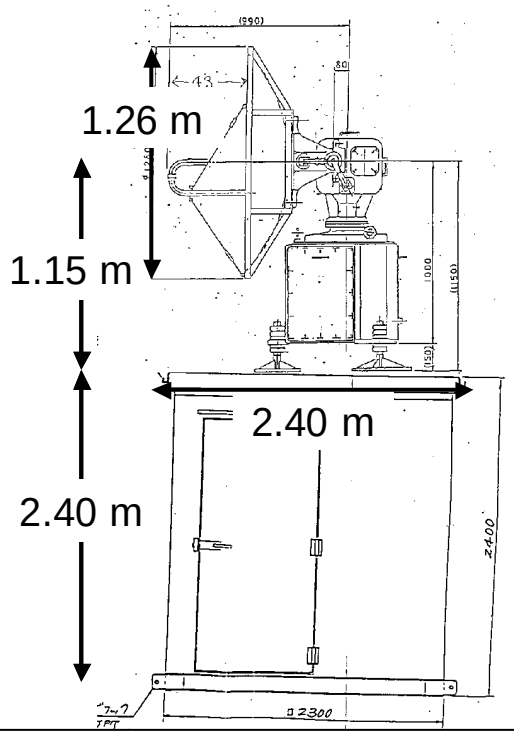
The radar will be shipped to Koto Tabang by middle September 2002 and installation and tests will follow in the last half of September. The radar will be installed in a corner of the EAR site and will be operated basically continuously until the end of our collaborative.

Major parameters of the X-band Rain Radar.

Items	Description
Transmit frequency	9.74 GHz
Transmit power	40 kW at magnetron output port
Feeder loss	1.3 dB (transmit), 3.7 dB (receive)
Antenna diameter	1.2 m
Pulse width	0.5 microseconds
Band width	8 MHz (Note 1)
Pulse repetition frequency	750 Hz
Antenna rotation rate	2 rpm, 16 elevation angles.
Elevation angle	0 deg - 30 deg.
Temporal resolution Rain detection range	8 minutes for one volume scan 64 km maximum
Size and mass of shelter	2.4 x 2.4 x 2.4 m, 1.3 tons
Size & mass of antenna	1.2-m diameter dish, 250 kg
Power supply	100 V 4 kVA maximum

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

Structure and size of the X-band Rain Radar



A container (2.4-m height) and a concrete base (1.6-m height) will be used to obtain 7.6 m height at the center of the antenna.