Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

ACG09-06 Room:301B Time:May 27 10:30-10:45

Scanning cloud profiling radar concept for ISS/JEM

TAKAHASHI, Nobuhiro[1*] ; HORIE, Hiroaki[1] ; HANADO, Hiroshi[1] ; NAKAGAWA, Katsuhiro[1] ; OHNO, Yuichi[1]

[1]National Institute of Information and Communications Technology

Spaceborne cloud profiling radars are one of the promising tools for studies on cloud-radiation interactions and cloud-precipitation interactions by providing vertical cloud profiles. The CloudSat is the first and the only satellite operating in orbit that equips the cloud profiling radar (CPR). The EarthCARE satellite, planned to be launched in 2018, also equips the cloud profiling radar (CPR) with better sensitivity than the CloudSat/CPR and the world first Doppler velocity measurement capability from space. Since both radars are nadir pointing and both satellites are sun-synchronous orbit, actual three-dimensional structure of clouds and their diurnal changes cannot be obtained from these missions.

In 2013, JAXA announced an opportunity for ISS (International Space Station) JEM (Japanese Experimental Module) for the 2019 launch. In order to propose a cloud observation mission that takes an advantage of the ISS/JEM, we have studied conceptual design of W-band scanning radar based on the ground-based W-band scanning radar developed by NICT. Considering that the orbit and altitude of ISS and the issues on current cloud profiling radar programs, the mission targets are defined as follows: the primary target is to fill the observation gap for the studies on climate change and global warming. Since both CloudSat and EarthCARE are sun-synchronous orbit, only early afternoon and mid-night data are available. In addition, the evaluations of the cloud effect on the global warming, information of the three-dimensional variability of clouds are essential whereas the CloudSat and the EarthCARE/CPR are nadir looking radar. The proposed mission can observe the diurnal change of clouds by ISS that is on non-sun-synchronous orbit and development of scanning radar. The secondary target is evaluation of GPM/DPR products, especially for weak precipitation (rain and snow). Considering that the sensitivity of the KaPR on GPM core satellite is 12 dBZ, snowfall observation is one of the issues of GPM mission (GPM is expected to survive until 2019). Three-dimensional observation of both cloud and precipitation can be useful for the studies on cloud-precipitation interactions.

The proposed radar system is W-band scanning cloud profiling radar. The scanning mechanism is realized by the phased array radar system; the receiver system introduced a two-dimensional array antenna consists of horn antennas. The transmitter uses the EIK as the amplifier (that is same as CloudSat/CPR and EarthCARE/CPR) and is connected to the fan-beam antenna. Therefore, wider (e.g. 8 degrees) beam is transmitted and the return signals from clouds are received by phased array antenna and sharp beam images are obtained by signal processing (digital beam forming technology). In the current design, swath width of 30 to 50 km can be achieved. The receiver antenna size is about 60 cm x 60 cm because of the constraints of ISS/JEM. For these reasons, the minimum detectable sensitivity will be about -10 dBZ. This sensitivity may not be enough for the studies on the cloud-radiation interaction but enough for the studies on the cloud-precipitation interactions.

Keywords: cloud radar, cloud-radiation, precipitation, ISS