OVERVIEW of GCOM

Haruhisa Shimoda

EORC, JAXA
2-1-1, Sengen, Tsukuba, Ibaraki, Japan
TEL : +81-29-868-2711
FAX : +81-29-868-2961
e-mail : shimoda.haruhisa@jaxa.jp

1. INTRODUCTION

In the late 20th century, it has been pointed out that changes of the global environment could alter the living environment for human being. Such global environmental changes include, but not limited to, climate warming, the sea level rise, decrease of tropical forests, desertification, destruction of the ozone layer, acid rain and the decrease of bio-diversity. What makes global changes different from conventional natural fluctuations is that many of them have been taking place due to anthropogenic causes. Although these changes have not yet reached the stage of directly affecting the life of humankind, there is a possibility that they will have major impacts in the latter half of 21st century.

In order to meet the requirements of Global Earth Observation System of Systems (GEOSS) as well as to continue the ADEOS and ADEOS missions, JAXA is now planning the GCOM mission which is composed of a series of satellites. There are two series of satellites, and they are now called GCOM-W and GCOM-C satellites. Both series are composed of 3 satellites with 5 years lifetime. Hence, 13 years of continuous observation can be assured with 1 year overlaps. The first satellite of GCOM-W will be launched in fiscal 2011 while the first one of GCOM-C will be launched in fiscal 2013.

2. Subjects of GCOM

The GCOM aims at continuing and improving the observation conducted by the ADEOS and ADEOS with a view to accumulating the scientific knowledge necessary to elucidate global environmental problems. In regard to global warming, the GCOM intends the measurement of most factors involved in the energy and water cycle and material cycle, which are the main mechanisms determining climate change, and also analysis of the relevant processes. While the measurable geophysical parameters are not detailed here, the parameters directly related to the energy and water cycle are temperature, water vapor, precipitation, clouds, aerosols, albedo, heat radiation from the atmosphere and estimated air-sea energy flux, etc.

Within the material cycle, measurement of the carbon cycle is a key subject. In this particular field, the GCOM aims at estimating the primary production as well as carbon flux based on measurement data on land vegetation and phytoplankton. In regard to changes of the land environment, the measuring subjects are tropical forests and the global distribution of vegetation and its changes. In regard to the cryosphere, the sea ice concentration and snow coverage are measured and their interaction with the climate is analyzed.

3. GCOM-W1

GCOM-W1 will carry AMSR2 (AMSR F/O). AMSR2 will be very similar to AMSR on ADEOS and AMSR-E on EOS-Aqua with some modifications. The frequencies are 6.9, 7.3, 10.65, 18.7, 23.8, 36.5 and 89 GHz. 7.3 GHz channel was added to mitigate ground based radio interferences observed on AMSR and AMSR-E. All channels have vertical and horizontal polarizations and quantization is 12 bits for all channels. Unlike AMSR on ADEOS , we have deleted 50 GHz channels which were used for temperature retrieval. The aperture of AMSR2 is 2m, and AMSR2 will have more accurate hot load than AMSR. Two kinds of modification are introduced. One is to use an actively controlled thermal reflector over the hot load. This reflector is called a temperature controlled plate (TCP). Another modification is to shield the ambient emissions. The incidence angle of AMSR2 is 55 degree and the dynamic range is from 2.7 K to 340 K.

Standard products from GCOM-W are listed below. 1) brightness temperature 2) total water vapor 3) total cloud liquid water 4) precipitation 5) sea surface temperature 6) sea surface wind speed 7) sea ice concentration 8) snow amount 9) soil moisture

4. GCOM-C1

GCOM-C1 will carry GLI F/O (tentatively called the second generation GLI : SGLI). The SGLI will be rather different from GLI on ADEOS . The main targets of SGLI are atmospheric aerosols, coastal zone and land. In order to measure aerosols over both ocean and land, it will have a near ultra violet channel, as well as polarization and bi-directional observation capability. The instrument will be composed of several components. They are VNR (visible and near infrared), polarization (POL), and IRS (short wave to long wave infrared (SWI & TMI). The VNR and POL will adopt push broom scanners, while IRS will use a conventional whisk broom scanner. VNR is composed of 3 cameras. They have rather small FOVs and cover total of 70 degrees with 3 cameras. VNR is an 11 channel scanner. The center wavelengths of these channels are 380, 412, 443, 490, 530, 565, 670, 763, 865 nm. For 670 and 865 nm, there are 2 channels for each with different sensitivity. These 11 detectors are linear array CCDs and placed on the focal plane of each camera. POL will have two spectral channels, i.e. 678nm and 865 nm, while each spectral channel is composed of 3 polarizations. Further, they have 3 different look angles, i.e. fore (+45°), nadir (0°) and aft (-45°) to obtain forward scatterings. POL is composed of 2 cameras, each corresponding to different channel. The FOV of POL is 55 degree. SWI will have 4 channels, i.e. 1.05, 1.38, 1.64 and 2.21 μm. TMI will have 2 split window channels, 10.8 and 12.0 μm. For, coastal zone and land observation, the IFOV of SGLI for these targets will be around 250m. All channels of VNR except 763 nm and 1.64 μm channel of SWI have 250m IFOV. TMI channels have 250m IFOV and all the other channels have 1000m IFOV.

Standard products from GCOM-C are listed below. Land : 1) radiance 2) surface reflectance 3) vegetation index 4) vegetation roughness index 5) shadow index 6) land surface temperature 7) FAPAR 8) LAI 9) above ground biomass. Atmosphere : 1) cloud flag 2) cloud amount 3) cloud top height & temperature 4) water cloud optical depth & size 5) cirrus droplet size 6) aerosol over ocean 7) aerosol over land (near UV) 8) aerosol over land (polarization). Ocean : 1) normalized water leaving radiance 2) atmospheric correction parameter 3) PAR 4) Chlorophyll-a 5) suspended solids 6) CDOM 7) SST. Cryosphere : 1) snow & sea ice distribution 2) ice distribution over Okhotsk sea 3) snow & ice surface temperature 4) shallow snow particle size.

5. ORBITS OF GCOM

There are several options on the orbit. The baseline option is 700km afternoon orbit for GCOM-W1 and 800km morning orbit for GCOM-C1 to continue the AMSR-E observation and GLI observation. Now, it is decided that GCOM-W1 will be in A-Train. By getting into A-train, cross calibration with AMSR-E will be very easy, and there could be many new products with other A-Train sensors. However, if AMSR-E will be operated a long time after GCOM-W1 launch, this orbit will miss observation frequency. Both satellites are medium sized spacecraft, i.e. 1.9 to 2.0 tons.

6. CONCLUSION

With GCOM mission, JAXA will contribute to GEOSS in the area of climate, weather and water cycle as well as ecosystems, agriculture, and several other societal benefit areas. The main scientific targets are to clarify radiative forcing of aerosols, to validate climate models and to achieve accurate NPP estimates. For operational use, areas like NWP input, fisheries, ship navigation, coastal managements, deforestation monitoring, and fire warnings are typical applications.

bibliography