

Global environment change monitoring using the next generation satellite sensor, SGLI/GCOM-C

Yoshiaki HONDA

Center for Environmental Remote Sensing (CEReS)
Chiba University
1-33, Yayoi-cho, Inage-ku, Chiba JAPAN 263-8522
e-mail : yhonda@cr.chiba-u.ac.jp

Hirokazu YAMAMOTO, Masahiro HORI, Hiroshi MURAKAMI, and Nobuyuki KIKUCHI
Earth Observation Research and application Center (EORC)
Japan Aerospace Exploration Agency (JAXA)
1-8-10-X23, Harumi, Chuo-ku, Tokyo JAPAN 104-6023
e-mail : { kath, hori, murakami, kikuyuki }@eorc.jaxa.jp

Abstract— The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) concluded that many collective observations gave a aspect of a global warming and other changes in the climate system. Future earth observation using satellite data should monitor global climate change, and should contribute to social benefits. Especially, human activities has given the big impacts to earth environment. This is a very complex affair, and nature itself also impacts the clouds, namely the seasonal variations. JAXA (former NASDA) has the plan of the Global Change Observation Mission (GCOM) for monitoring of global environmental change. SGLI (Second Generation GLI) onboard GCOM-C (Climate) satellite, which is one of this mission, is an optical sensor from Near-UV to TIR. This sensor is the GLI follow-on sensor, which has the various new characteristics. Polarized/multi-directional channels and 250m resolution channels are the unique characteristics on this sensor. This sensor can be contributed to clarification of coastal change in sea surface. This paper shows the introduction of the unique aspects and characteristics of the next generation satellite sensor, SGLI/GCOM-C, and shows the preliminary research for this sensor.

Keywords: GCOM-C, SGLI, IPCC, human activity, global climate change

I. BACKGROUND

A fact and a prediction of global warming are serious. There is it in the third report of IPCC. The following serious actual conditions and predictions are reported by the third report. There is most cause of a global warming for human activities. That is provided from the past 100 years observation data. It is reported that global average temperature of the 21st century will rise 1.4-5.8 degrees Celsius. There is a reason of improvement of prediction for satellite observation data. There is the high conviction why a change of recent local temperature has an influence on for much global ecosystems by many evidence.

In the 21st century, big influence is predicted in broad fields such as destruction, intensification of a drought, influence to food production, frequent occurrence of a flood, increase of tropical disease. Furthermore, increase of observation data including satellite data and improvement of

precision of a climate model are necessary to raise precision of a prediction. Following two points of next are reported as expectation of mitigation for a global warming prediction by the third report.

Big development was seen in technical measures, and it became clear in an anti-mitigation measure that there was big potential. Many technical mitigation methods have been developed. There are big potential for global warming mitigation. Global social economic obstacle must be overcome to enforce effective mitigation plan. Both global warming cause and mitigation depend on human activities and have to watch human activities in itself closely. At first, it is important that interference is analyzed social scientifically, scientifically. Artificial interference to climate system has to been attracted attention in satellite observation. The atmosphere field, ocean field, land (including cryosphere) field around the land should attract attention. The reason is almost because human activities are performed on the land. As for the scientific information that earth observation gives, and is offered, the next thing should be considered.

The atmosphere : Land level aerosol, marine absorption-related aerosol, cloud distinction, cloud geometry thickness, cloud optics thickness, quantity of steam

The land : vegetation indices, quantity of biomass, quantity of photosynthesis, vegetation volume of production, earth surface temperature, frozen snow distribution, frozen snow side temperature, snow particle size

The ocean : CDOM, a suspenoid. Chlorophyll a, sea surface temperature

II. EXPECTED RESULT FROM SGLI

A high thing of the most uncertain part is an indirect effect of aerosol and aerosol among emission compelling force now so that the third IPCC report has me (interaction with a cloud).

Therefore decreasing these uncertain part in an indirect effect of aerosol and interaction between aerosol and cloud among radiative forcing. And a high-precision quantity of physical value of ocean aerosol was demanded for the first time

in the world by ADEOS / OCTS and ADEOS II / GLI. However, there were the following not enough points for these results. The first point is high-precision quantity of physical value of land aerosol was not provided. About land aerosol, there is a thing provided from ADEOS / POLDER, but it is not enough resolution for land cover analysis. In addition, similarly there is a thing provided from ADEOS / TOMS, but this is an aerosol index and does not give it off with quantity of physical value of aerosol. There is a problem that a kind of aerosol or the quantity of physics measurement of highly precise land area aerosol cannot distinguish very much in technique conventionally. Therefore it was decided that SGLI will have a channels of multi angular, Ultra Violet (380 nm), polarized light. at the quantity of physics measurement of highly precise land area aerosol. Furthermore, SGLI data express a property of land aerosol and can grasp radiative forcing precisely. The 2nd point is to make influence of human activities clear using SGLI data. Therefore it is necessary to improve precision of various products of the land and around land.

area. Many small human impacts make a tiny change of land cover (for example, deforestation by personal farmer etc.).High resolution (250 m) is necessary to do these grasp precise. For example, an error of 3% is anticipated for an error of forest rate in a region in a low latitude without atmosphere correction of aerosol. In a district in a high latitude, as for the error, it is anticipated around 8%.

The frozen snow area which is the chilliness zone for a heat environment change such as aerosol pollution and a temperature rise of the surface of the snow by a change of these atmosphere environment; by of an aspect and monitoring what kind of reply in quality show in detail; of elucidation of a role in a climate system, a climate prediction model; is highly precise, and is expected. Specifications of SGLI are shown for table 1.

In land vegetation monitoring, it was lowness of the precision of atmospheric correction conventionally that was put up as big problems. In visible red and near infrared channels which are effective for vegetation observation, and many of the problems are dispersion by aerosol. However, the detection of land aerosol (over land) was difficult conventionally. Therefore I suggest ultra violet channel (VN1), polarized channels (678-P, 865-P) of visible red and near infrared for the land aerosol detection at SGLI . Precise atmosphere revision is enabled in quantity of emission revision of land level by these channel data. As a result, it can be expected that precision of a highly advanced product (NPP, LAI, fAPAR, biomass) about land vegetation improves remarkably. In change extraction of land vegetation and grasp of quantity, vegetation index becomes a basic parameter. However, a conventional vegetation indexes was two dimensional information, and there was a limit for grasp of vegetation to own complicated structure. On the other hand, what could detect roughness of vegetation surface by observing an earth surface with many courses became clear recently (BRf model simulation and measurement). SGLI sensor will have three directionality reflection characteristics by a difference of an observation angle (visible red and infra red : polarization and non polarization). By data acquired with these channels, a process of the desert which was impossible of grasp and distinction of artificial plantation / nature forest are enabled only by a conventional vegetation index till now. The change that happened at these land goes through rivers and gives influence to the ocean from the coast to the open sea. Those changes are near to the coast, and a spatial expanse is small. I can expect elucidation of coast ocean change process, monitor of behavior of river mouth water, a fishing ground prediction of the sea near the shore and support to grasp and human activities of influence of human activities for the ocean such as an estimate of a catch of fish by 250 m observation of SGLI is effective in elucidation of coast ocean change process, monitoring of behavior of river estuary and fishery industry etc. Change of the land surface caused by human activities and a change of atmosphere environment with it, a change of frozen snow domain cloth are useful for grasp of a climate system change.

TABLE I. SPECIFICATIONS OF SGLI

SGLI/VN R Non-polarized

Ch.	Center of Wavelength	$\Delta\lambda$	Lstd	Lm ax.	S/N	FOV
	nm			[W/m ² /str/um]	---	m
VN1	380	10	60	210	250	250
VN2	412	10	75	250	400	250
VN3	443	10	64	400	400	250
VN4	490	10	53	120	400	250
VN5	530	20	41	350	400	250
VN6	565	20	33	90	400	250
VN7	670	10	23	62	400	250
VN8	670	20	25	210	250	250
VN9	865	20	8	30	400	250
VN10	865	20	30	300	250	250

SGLI/VN R polarized/multiangle

Ch.	Center of Wavelength	$\Delta\lambda$	Lstd	Lm ax.	S/N	FOV
	nm			[W/m ² /str/um]	---	m
670-P	670	20	40	400	250	1000
865-P	865	20	48	270	250	1000

SGLI/SW I

Ch.	Center of Wavelength	$\Delta\lambda$	Lstd	Lm ax.	S/N	FOV
	nm			[W/m ² /str/um]	---	m
SW 1	1050	20	8	248	300	1000
SW 2	1380	20	8	103	150	1000
SW 3	1640	200	3	50	57	250
SW 4	2210	50	6.7	14	720	1000

SGLI/TM I

Ch.	Center of Wavelength	$\Delta\lambda$	Tstd	Tm in/Tmax	NEdT@Tstd	FOV
	[um]			K	---	m
T1	10.8	0.7	300	180/340	0.2	500
T2	12.0	0.7	300	180/340	0.2	500

As a strategy of precision improvement, Characteristics of SGLI are 250 m high IFOV and Derivation of correct land aerosol. Total human impacts become a changing large area of land cover. However, individual human impact is not so big

III. SUMMARY

Aspects of SGLI are following 5 points.

1) SGLI has a 380nm channel (ultra violet), and the detection of high-resolution land aerosol is possible.

2) SGLI can acquire NDVI/EVI of 250m resolution in two), and one of a vegetation index product of SGLI is high whether resolution is made.

3) SGLI polarized channels in visible red and infrared, and has a channel in ultra violet, wherewith the detection of land level aerosol is possible.

4) SGLI can detect roughness of vegetation surface using multi angular observation. This information will give smaller land cover change.

5) SGLI spatially from the open sea. SGLI can acquire sea ice distribution of 250m high definition.

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