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# Development of GCOM-C1 land surface reflectance product

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Land-surface reflectance (RSRF) product is one of the essential products of Global Change Observation Mission-Climate 1/ Global Imager (GCOM-C1/SGLI; to be launched in JFY 2016); it is an input of other land algorithms, such as Leaf Area Index (LAI) and land cover classification (LCC), and will be used for surface albedo in the radiation budget, and used as the background of aerosol and cloud estimation. RSRF is estimated by subtracting scattering and absorption of an atmospheric molecule and aerosol from the top-of-atmosphere (TOA) radiance in cloud-free areas observed by the satellite (i.e., atmospheric correction). However, in order to extract the information on aerosols from the TOA radiation, it is necessary to know the information on land surface used as a background beforehand.

Experiential assumption and a candidate model about the spectral characteristic of aerosol and surface reflectance are often used in the presumption. Since the presumption can influence the output results, it is necessary to accumulate the knowledge of the various spectral characteristics and to perform suitable selection. Change of RSRF by the sun and the satellite geometries (BRDF) should be modeled when we preset the land-surface reflectance, because the satellite observes targets from a specific direction.

Candidate models of aerosol in the atmospheric correction (size distribution and vertical distribution, refractive index, etc.) may be able to be consistent with ones in the traditional aerosol-estimation algorithms which use candidate models as well. Since RSRF is used as a background of aerosol estimation, the consistency will be important for the product evaluation and accuracy improvement. There are groups which study aerosol properties by ground observation network, SKYNET, AERONET, etc., their regional characterization, spectral reflectance of the land surface, and observation and modeling (canopy radiation transfer) of the BRDF in the GCOM-C1 science team. The GCOM-C1 science team held a mini-workshop in summer of 2012, and decided that JAXA develops the land-surface atmospheric correction algorithm step by step by integrating their results . We confirmed importance of the consistency with the algorithms, such as LCC, LAI, albedo, etc., which use the estimated RSRF and BRDF.

We plan to develop the algorithm based on the existing knowledge (i.e., a traditional algorithm) for the at-launch version. Gas absorption of SGLI bands by water vapor, ozone, oxygen, and NO2 will be considered by using objective analysis data or Climatology. The surface elevation will be corrected by using objective-analysis sea-level pressure data and high-spatial resolution digital elevation data, DEM. Influence of surface slope will be reduced by using surface normal vector calculated by the DEM and solar vector. GCOM-C1/SGLI has an near-ultra violet (NUV) 380nm band, which will be used for the presumption of surface reflectance in the GCOM-C1 atmospheric correction, because reflectance and its directionality is generally small in the NUV and blue wavelengths. The presumption of the NUV band uses vegetation and land-cover information assumed from near infrared (NIR) and short-wave infrared (SWIR) reflectance, which are not so much affected by aerosols, and RSRF in the previous days by assuming temporal change of RSRF is generally smaller than the change of the atmosphere.

For the future algorithm version after the satellite launch, we expect to improve the presumption by knowledge from the canopy radiation transfer, LCC and vegetation phenology, adopt new aerosol estimation schemes, or use results of the aerosol-transport model to find the optimal aerosol models. SGLI has a polarization radiometer which observes the Stokes vector of red and NIR bands with 45-deg along-track slant view. It may be able to improve atmospheric correction accuracy after accumulation of surface BRDF and polarization knowledge in the future.

Keywords: GCOM-C1, SGLI, land surface reflectance, atmospheric correction