**Development of estimation method for essential climate variables using satellite data in South Korea**

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In order to produce a grid-based climate data for climate change monitoring and applying for climate models, and to provide a systematic advantage of the climate data applications through the quality control of the satellite data, Korea Meteorological Administration(KMA) of South Korea has conducted a project which is to continue to produce a satellite-based Essential Climate Variables (ECVs).

This project conducted in 2014 represents the establishment of a long-term plan for the development of ECVs and retrievals of Sea Surface Temperature (SST), Outgoing Longwave Radiation (OLR), and Insolation (INS) that ECV products using Communication, Ocean and Meteorological Satellite (COMS), also known as Thematic Climate Data Records (TCDR). Also, the project carried out a primary research of Level 3 data product using SST products.

First, this project provides a proposed procedure for the long-term plan for the TCDR, ECV production from COMS, include the initial development phase, continuing development and steady production phase, continuous production and services provision phase that each phase was specified with action plans. The phases were developed taking into account KMA’s international contribution for Sustained and coordinated processing of Environmental Satellite data for Climate Monitoring (SCOPE-CM) and priorities of the plan such as continuous production using the methodologies described in this project. In addition, the section includes an implementation plan for satellite-based standard climate Database.

One of ECVs, SST was retrieved using 3 years of COMS data from April 2011 to March 2014 using infrared channel that are intercalibrated using annual or monthly Global Space-based Inter-Calibration System (GSICS) coefficients. Each product of SST whose channel is not calibrated, or calibrated using either annual or monthly GSICS coefficients was then analyzed and validated its performance. The results showed that SST products using GSICS coefficients had improved RMSE that GSICS calibration is considered a significant factor for improving quality of COMS SST production. Also, we found the Nighttime SST was not as affected by GSICS correction as the Daytime SST when two were compared that Nighttime SST maintained high accuracy since solar radiation has relatively less impact. We found from our analysis that both annual and monthly GSICS corrections have similar degree of improvements of SST accuracy.

We assessed the impacts of the GSICS intercalibration on COMS-based OLR products. The data include infrared data (6.7 μm, 10.8 μm, 12.0 μm) of 3-year accumulation from April 2011 to 1 March 2014. We retrieved OLR in accordance with COMS Meteorological Data Processing System (CMDPS); also, we produced OLR applying GSICS annual and monthly coefficients. In order to validate its performance, we used Clouds and the Earth's Radiant Energy System (CERES), a sensor use broad-band to retrieve OLR, that we have found the OLR product used annual GSICS coefficients had the least difference with the reference data CERES. The GSICS corrected OLR had overall improvement of the data quality, but the difference between GSICS corrected and original OLR was trivial. We suspect that the spectral integration for the OLR production process negate the difference of GSICS corrected and original infrared channels. Obtaining improved quality of OLR has significant of KMA’s involvement in SCOPE-CM.

We have produced and analyzed insolation products both calibrated using annual and monthly coefficients of GSICS and not calibrated. The data used were COMS Level 1from beginning of April in 2011 to end of March in 2014, and the product procedure was obtained from the CMDPS. For the validation, we obtained ground truth data from37 stations operated by the KMA. We found from the validation that the difference of accuracy of products used annual GSICS coefficients and monthly GSICS coefficients were trivial. By comparing original INS and GSICS corrected INS, we found that the bias were significantly improved although only RMSE had minor changes. Especially in case of 13 × 13 pixels all covered by cloud, bias has been improved by up to 26.30099W/m2. The results conclude that GSICS correction of visible channel secured improved production of INS. KMA has further secured climate variable products for participation in the SCOPE-CM.

Finally, we developed algorithms for producing the SST the Level 3 data and validated the products. The Level 3 data was transformed from the satellite data into equal-grid, and then they were composited daily and averaged over 5-day (penta) and annually. The results of validation indicate that original Level 3 does not show significant difference of accuracy with the Level 2 SST. However, daily composite and long-term average data had cold-bias which can be contributed by the fact that the method for removing pixels from eliminating clouds. Thereby, the improvement of quality control of cloud identification process and the in-situ observations for SST were discussed.