# ANALYSIS FOR EVALUATING GEOMETRIC ACCURACY OF GEMS LEVEL 1B DATA

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**ABSTRACT:** The Geostationary Environment Monitoring Spectrometer (GEMS) was successfully launched in 2020 onboard the GEO-KOMPSAT-2B (GK-2B). It is currently performing missions such as monitoring and predicting climate change over East and Southeast Asia. As the world's first geostationary hyperspectral satellite, there is a need to enhance the quality and high reliability of GEMS data. A geometric correction of satellite images is required for image comparison and analysis. We need to improve geometric accuracy of image pixels and address latitude and longitude errors caused by attitude determination and other factors. GEMS is designed to achieve a target geometric accuracy solely through initial sensor modeling. Therefore, in order to ensure accuracy of time series analysis of GEMS data, it is necessary to evaluate the geometric accuracy of GEMS data and check whether the designed geometric accuracy is satisfied.

In this paper, we aimed to evaluate the geometric accuracy and stability of GEMS data acquired during a certain period. We proposed a procedure for evaluating and analysis the geometric accuracy of GEMS Level 1B (L1B) data. Based on evaluation results, we seek to develop performance improvement strategies for geometric correction technology in GEMS. At this time, the study was conducted by determining the AMI(Advanced Meteorological Imager) for which geometric correction was completed as a reference image having true geometric coordinates values.

We evaluated the relative geometric accuracy of GEMS L1B data with respect to the reference AMI L1B data. First, we prepared GEMS and AMI images acquired at the same time period and then converted their raw data to GeoTIFF format based on their metadata. We selected the blue band (VIS04) of the AMI images and the band at 470nm wavelength of the GEMS images. These bands were chosen to highlight clouds within image extents and use the texture differences between cloud and non-clouds for analysis. Next, we converted the original AMI data with the LCC (Lambert Conformal Conic) projection into WGS84 coordinates and down-sampled AMI imagery to the spatial resolution of GEMS. We created cropped images that contained overlapping areas of GEMS and AMI based on their latitude and longitude ranges and defined them as the Region of Intersect (ROI). Finally, we performed automated matching against the ROIs of the two dataset by correlation calculations and estimated shifts between them. The magnitude of the shift values were used to assess the extent of errors occurring in the GEMS L1B data.

For the robustness of our experiments, the possibility of using AMI imagery for reference data needs to be confirmed. Therefore, we conducted a geometric accuracy verification for AMI, independently. This verification has to analysis the geometric accuracy of AMI. We verified whether geometric accuracy of AMI achieved the target accuracy corresponding to the 1km resolution of Google Satellite Map. Firstly, we created observation points along the coastlines in the AMI images and then found corresponding points with the same latitude and longitude coordinates on Google Satellite Map to assess geometric accuracy. According to the results, we observed that the AMI imagery had a suitable accuracy as a reference image.

After this verification, we performed a geometric correction accuracy evaluation of GEMS using AMI with completed geometric calibration. For the experiment, we use 100 datasets of GEMS L1B images photographed on the 1st day of each month throughout the year 2022 and AMI L1B images captured during the same period. As a result, we confirmed that the result of verifying GEMS geometric accuracy showed an average geometric error of 2.6pixels, equivalent to 19.6km. The overlapping area between GEMS and AMI used in this research corresponds only to part of the GEMS imagery. For the future, we plan to conduct research to evaluate geometric accuracy of the entire field of regard for GEMS and to develop precise geometric correction techniques for improving the accuracy of geometric correction in GEMS.

Table 1. The evaluate result of GEMS geometric accuracy

| Date | Pixel RMSE | | Number of tie-point |
|---|---|---|---|
| | - | km | |
| 2022.01.01 | 2.33 | 17.49 | 984 |
| 2022.02.01 | 2.36 | 17.72 | 743 |
| 2022.03.01 | 3.01 | 22.58 | 650 |
| 2022.04.01 | 2.83 | 21.21 | 715 |
| 2022.05.01 | 2.78 | 20.87 | 766 |
| 2022.06.01 | 3.04 | 22.76 | 760 |
| 2022.07.01 | 2.74 | 20.53 | 949 |
| 2022.08.01 | 2.52 | 18.87 | 1112 |
| 2022.09.01 | 2.55 | 19.10 | 842 |
| 2022.10.01 | 2.50 | 18.79 | 762 |
| 2022.11.01 | 2.71 | 20.30 | 618 |
| 2022.12.01 | 2.10 | 15.72 | 764 |

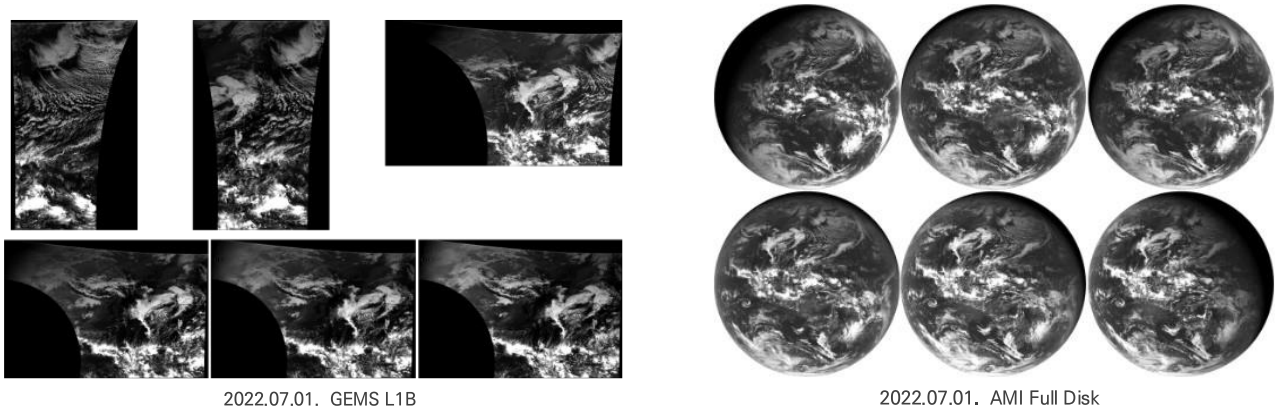


Figure 1. Multi-temporal GEMS L1B and AMI FD(Full Disk) images.