# Possibility Study of Volcanic $SO_2$ Emission Monitoring with Geostationary Environment Monitoring Spectrometer (GEMS)

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**KEY WORDS:** GEMS, TROPOMI, Sulfur Dioxide, Volcanic activity

**ABSTRACT:** Conventional volcanic studies using seismometers, leveling, etc. are still important tools for monitoring volcano activity. Especially, sulfur dioxide ($SO_2$) has been proved to be a key factor in assessing volcanic activity and eruptions. Despite such importance, most volcanoes are not routinely observed by ground-based optical instruments to detect $SO_2$. On the other hand, satellite-based remote sensing may provide complementary information about volcanic activity by continuously monitoring using characteristic of strong absorption in the ultraviolet (UV) wavelength ranges. However, these satellite systems launched into polar orbit have a relatively long revisit period of 1 day. The Geostationary Environment Monitoring Spectrometer (GEMS), a newly developed hyper-spectrometer, planned to be launched in March 2020, will provide atmospheric column measurements of sulfur dioxide ($SO_2$) and other gases such as $NO_2$, $O_3$, HCHO and aerosols at least 8 times per day. In this study, we tested possibility of monitoring volcanic $SO_2$ emission around the Korean peninsula (e.g. Mt. Aso, Mt. Sakurajima) using TROPOMI which has similar spatial resolution as GEMS. The result demonstrates that GEMS will provide reliable, nearly real-time, high temporal resolution detection of SO2 in time series monitoring.

## 1. INTRODUCTION

Observation of volcanic SO2 is very important to understand state of underground magma that can lead to an eruption. However, it is difficult to continuously observe sulfur dioxide in most volcanoes because of accessibility, data connectivity and so on. On the other hand, satellite-based remote sensing may provide complementary information about volcanic activity by continuously monitoring using characteristic of strong absorption in the ultraviolet (UV) wavelength ranges. There exists a variety of satellite sensors to detect $SO_2$ such as the Total Ozone Mapping Spectrometer (TOMS), the Ozone monitoring instrument (OMI), and recently the Tropospheric Monitoring Instrument TROPOMI. However, these satellite systems launched into polar orbit have a relatively long revisit period of 1 day. The Geostationary Environment Monitoring Spectrometer (GEMS), a newly developed hyper-spectrometer, planned to be launched in March 2020, will provide atmospheric column measurements of sulfur dioxide ($SO_2$) and other gases such as $NO_2$, $O_3$, HCHO and aerosols at least 8 times per day. In this study, we tested possibility of monitoring volcanic $SO_2$ emission around the Korean peninsula (e.g. Mt. Aso, Mt. Sakurajima) using TROPOMI which has similar specifications as GEMS.

## 2. DATA AND METHOD

The GEMS is scheduled to be launched in 2020 so that we used TROPOMI dataset. The Sentinel-5p sensor TROPOMI is flying on a polar orbit with a swath and spatial resolution about 2600km and 7x3.5km, respectively. It has eight spectral bands covering ultraviolet (UV). The retrieve algorithm for SO2 columns from space UV measurements is based on differential optical absorption spectroscopy (DOAS; Platt and Stutz, 2008) method. Details can be found in Sentinel-5P TROPOMI SO2 Algorithm Theoretical Basis Document (ATBD). GEMS also have been developed based on DOAS method.

## 3. RESULT

Japan's 24-km-wide Aso caldera on the island of Kyushu has been active throughout the Holocene. The most recent major eruptive episode began in late November 2014 and continued through 1 May 2016. Asosan remained quiet until renewed activity from Crater 1 began in mid-April 2019 (Global Volcanism Program, 2019). Fig. 1 shows the distribution of total vertical column density on May 25, 2019. In Fig 1(a). we can see the dispersion of SO2 at two volcanoes (Mt.Aso, and Mt. Sakurajima). In time-series analysis, SO2 is increase in April, 2019.

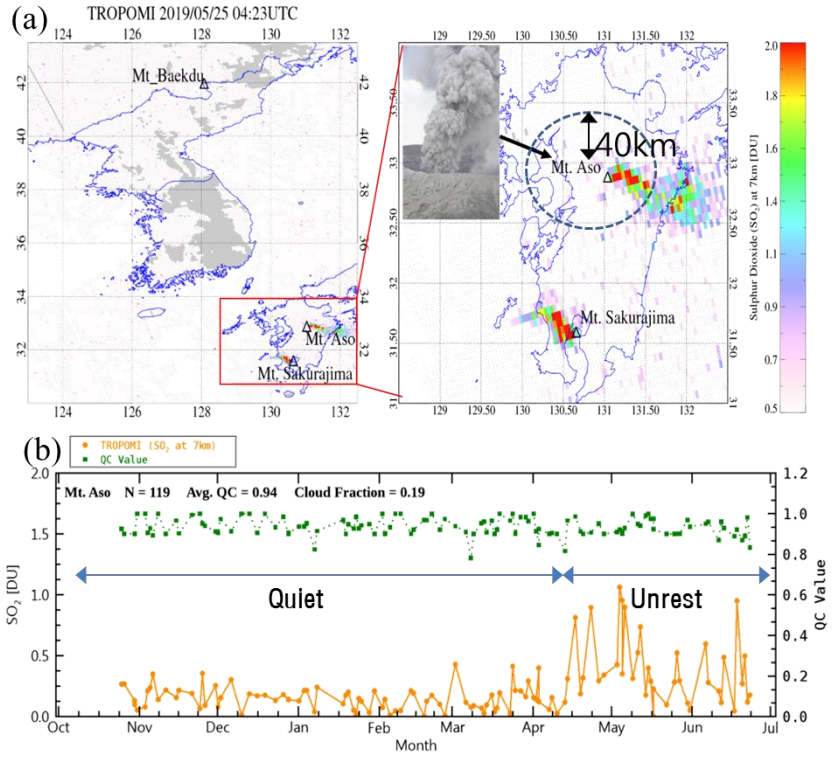


**Figure 1. (a) VCD of SO2 on May 25, 2019 and right image were enlarged the red box. (b) Time-series plot at Mt.Aso volcano.**

## 4. ACKNOWLEDGEMENTS

This work was supported by the Research Fund (NIER2019-01-01-028) of National Institute of Environmental Research (NIER)

## 5. REFERENCE

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