

# Lidar observations of Nabro volcano aerosol layers in the stratosphere over Gwangju, Korea

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## Stratospheric aerosol

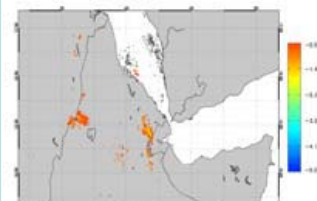
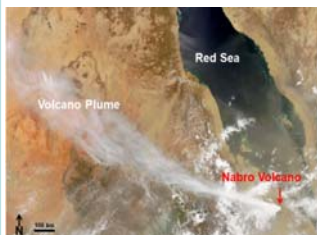
- Particles and trace gases which are injected into the stratosphere by volcanic eruptions are the biggest source of natural pollution in the stratosphere (Robock, 2000).
- Large amounts of sulfur dioxide (SO<sub>2</sub>) is one of the main components of gases from these eruptions and they increase the optical thickness in stratospheric heights. These layers exert a cooling effect of Earth's atmosphere (Hofmann and Solomon, 1989) and influence chemical processes in the lower stratosphere (Rodriguez et al., 1991; Solomon et al., 1993).
- Stratospheric aerosols have notable impact on global climate because of their long residence time in the stratosphere and their large scale dispersion (Hofmann et al., 2009).

## Mt Nabro volcano: Eruption and Transport of Plume

### Eruption of the Nabro volcano

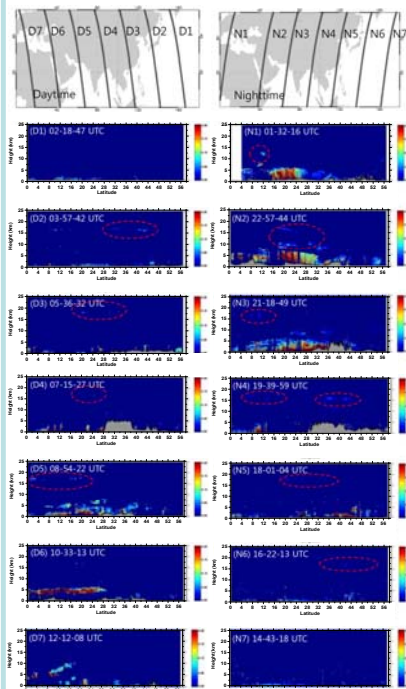
#### MODIS image

The eruption of the Nabro volcano at 10:45 UTC on 13 June 2011

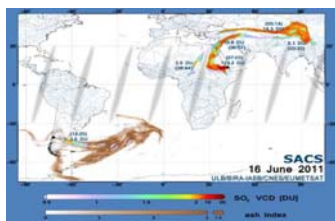


- Mt. Nabro has an elevation of 2218 m asl.
- The volcano is located at the border between Eritrea and Ethiopia in Northeast Africa near the Red Sea.
- Visible plumes were rising to an altitude of 13 km asl and continued emissions were observed for several weeks.
- An estimated 1.3–2.0 Tg total mass of SO<sub>2</sub>, ash, and water vapor were injected up to the stratosphere.

### Transport of volcanic ash observed with CALIPSO



## Transport of SO<sub>2</sub> emitted from Mt Nabro



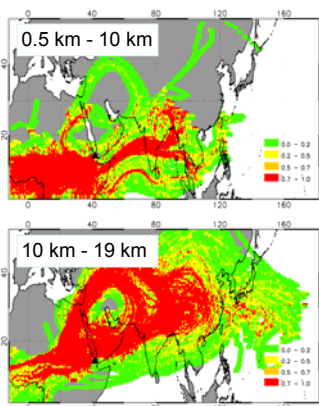
Average concentration of SO<sub>2</sub> is 0.5 DU over Korea.

## The potential receptor contribution function (PRCF) analysis

$$w = \begin{cases} 1.00, & 12 < n_{ij} \\ 0.7, & 6 < n_{ij} < 12 \\ 0.42, & 2 < n_{ij} < 6 \\ 0.17, & n_{ij} < 2 \end{cases}$$

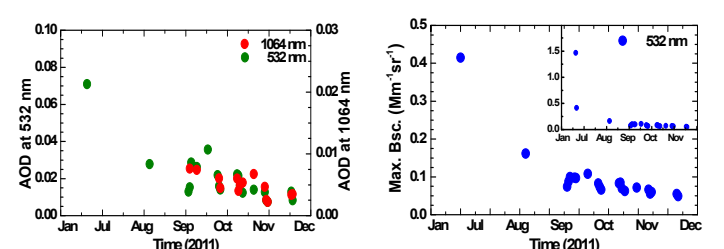
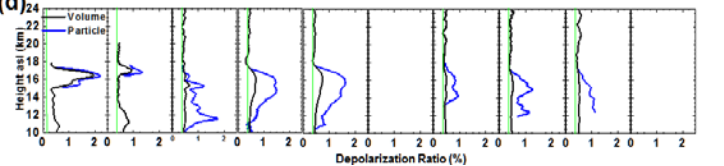
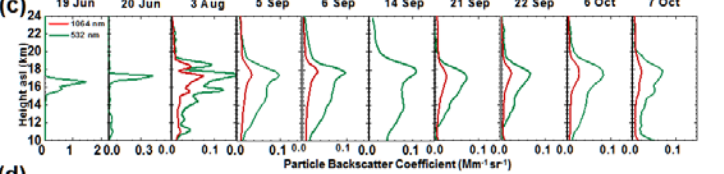
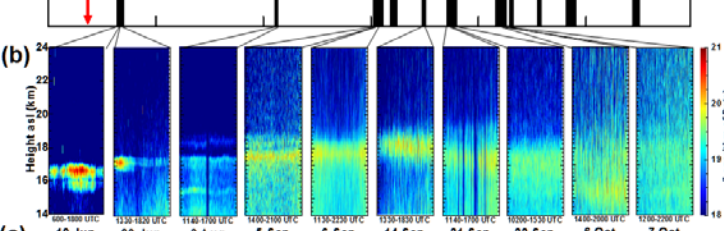
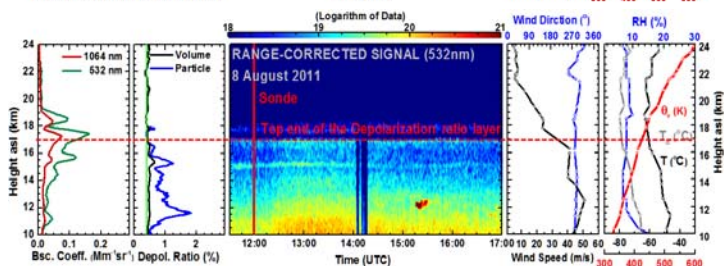
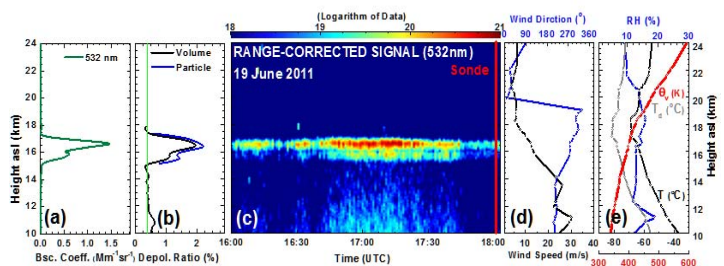
W: an arbitrary weight function  
 $i^{th}$  cell : Conditional probability  
 $n_{ij}$  : The number of segment trajectory endpoints  $n$  that fall into the  $i^{th}$  cell.

- A grid-cell size of  $0.5^\circ \times 0.5^\circ$
- 0.5 km to 10 km height asl and from 10 km to 19 km height asl
- time steps of 1 h from 12 (start time in 0000 UTC) to 13 June 2011 (end time in 2400 UTC)



## MRS.LEA;

## Multi-wavelength Raman/ Spectrometer Lidar in East Asia



- The Nabro particles were distributed non-uniformly during June through June.
- Sedimentation of glass- and mineral particles might be responsible for the higher depolarization ratios below 17 km height asl.
- The maximum backscatter coefficient and the aerosol optical depth of the stratospheric aerosol layer decreased with time until the end of the observation period.
- The geometrical depth of the aerosol layer did not change significantly