Volcanoes cause climate gas concentrations to vary

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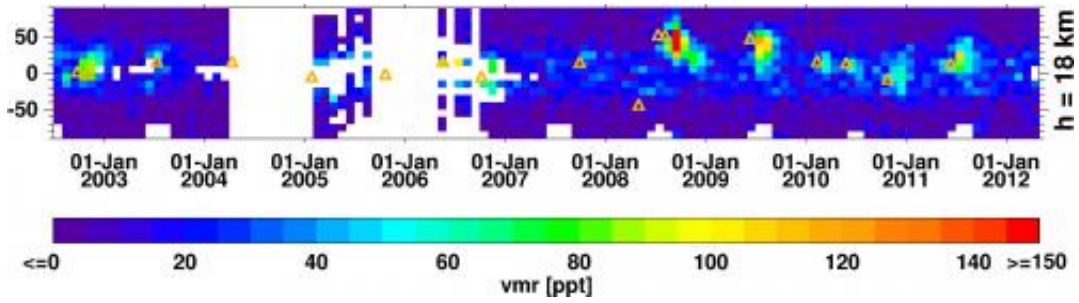

MIPAS data confirm the correlation between high sulfur dioxide concentrations (yellow-red) and high-reaching volcano eruptions (triangles). Credit: KIT/M. Höpfner

Trace gases and aerosols are major factors influencing the climate. With the help of highly complex installations, such as MIPAS on board of the ENVISAT satellite, researchers try to better understand the processes in the upper atmosphere. Now, Karlsruhe Institute of Technology presents the most comprehensive overview of sulfur dioxide measurements in the journal of *Atmospheric Chemistry and Physics*.

"Sulfur compounds up to 30 km altitude may have a cooling effect," Michael Höpfner, the KIT scientist responsible for the study, says. For example, sulfur dioxide (SO2) and water vapor react to sulfuric acid that forms small droplets, called aerosols, that reflect solar radiation back into universe. "To estimate such effects with computer models, however,

the required measurement data have been lacking so far." MIPAS infrared spectrometer measurements, however, produced a rather comprehensive set of data on the distribution and development of sulfur dioxide over a period of ten years.

Based on these results, major contributions of the sulfur budget in the stratosphere can be analyzed directly. Among others, carbonyl sulfide (COS) gas produced by organisms ascends from the oceans, disintegrates at altitudes higher than 25 km, and provides for a basic concentration of sulfur dioxide. The increase in the stratospheric aerosol concentration observed in the past years is caused mainly by sulfur dioxide from a number of volcano eruptions. "Variation of the concentration is mainly due to volcanoes," Höpfner explains. Devastating volcano eruptions, such as those of the Pinatubo in 1991 and Tambora in 1815, had big a big effect on the climate. The present study also shows that smaller eruptions in the past ten years produced a measurable effect on sulfur dioxide concentration at altitudes between 20 and 30 km. "We can now exclude that anthropogenic sources, e.g. power plants in Asia, make a relevant contribution at this height," Höpfner says.

"The new measurement data help improve consideration of sulfur-containing substances in atmosphere models," Höpfner explains. "This is also important for discussing the risks and opportunities of climate engineering in a scientifically serious manner."

MIPAS (Michelson Interferometer for Passive Atmospheric Sounding) was one of the main instruments on board of the European environmental satellite ENVISAT that supplied data from 2002 to 2012. MIPAS was designed by the KIT Institute of Meteorology and Climate Research. All around the clock, the instrument measured temperature and more than 30 atmospheric trace gases. It recorded more than 75 million infrared spectra. KIT researchers, together with colleagues from Forschungszentrum Jülich, have now developed the MIPAS successor

GLORIA that may be the basis of a future satellite instrument for climate research.

More information: Hopfner, M. et al. Sulfur dioxide (SO2) as observed by MIPAS/Envisat: temporal development and spatial distribution at 15–45 km altitude, *Atmos. Chem. Phys. Discuss.*, 13, 12389-12436, doi:10.5194/acpd-13-12389-2013, 2013.

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