Sulfur dioxide in Venus' atmosphere could be key to fighting global warming on Earth

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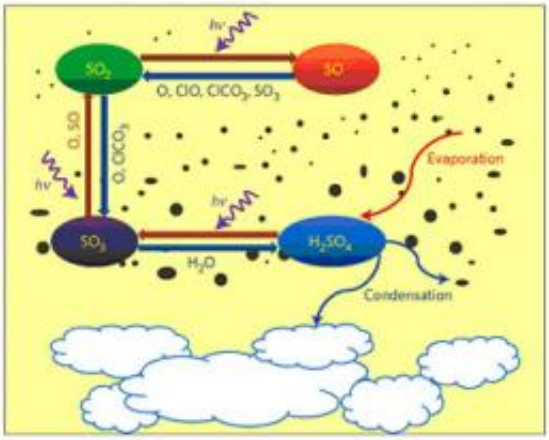

The reactions connecting SO, SO2, SO3 and H2SO4 in the fine mist of small droplets above the main cloud layer of Venus. © Nature GeoScience

An international team, including Jean-Loup Bertaux, CNRS senior researcher, has discovered a layer of sulfur dioxide (SO_2) in the upper atmosphere of Venus. The researchers obtained this result using measurements performed by ESA's Venus Express spacecraft. They propose a new mechanism to explain this unexpected result. SO_2 is of particular interest to them since this gas could be used to cool down the Earth via a geo-engineering process put forward by Chemistry Nobel Laureate Paul Crutzen.

Venus is entirely covered by a thick layer of clouds, between 50 and 70

km altitude, above which a thinner mist extend s to around 100 km altitude. The clouds and mist consist of droplets of concentrated sulphuric acid.

Using ESA's Venus Express spacecraft, in orbit a round Venus since 2006, and its on-board SPICAV instrument, the researchers discovered the presence of gaseous sulfur dioxide high up in the atmosphere, at an altitude of 90- 110 kilometers.

This discovery was confirmed by US researchers , who detected sulfur dioxide in Venus's atmosphere using a different method (i.e. by observing micro-wave radiation from an Earth-based observatory), but were not able to specify its altitude.

The researchers believe that the sulfur dioxide derives from the sulphuric acid mist in the upper atmosphere of Venus. On the day side of Venus, the temperature increases with altitude above 90 kilometers , which causes the sulphuric acid to evaporate. It then decomposes under the effect of solar radiation, producing sulfur dioxide (see diagram above).

Sulfur dioxide is also found on Earth, released mainly by volcanic eruptions. Sometimes reaching altitudes as high as 20 kilometers , it turns into sulphuric acid, causing the formation of small droplets. The droplets reflect part of the solar radiation back out to space, leading to a fall in surface temperatures. Drawing inspiration from this process, chemist and meteorologist Paul Crutzen, winner of the 1995 Nobel Prize in Chemistry, suggested several years ago that it would be possible to artificially release massive quantities of sulfur dioxide at an altitude of 20 kilometers in order to cool down surface temperatures and offset the growing greenhouse effect.

Although we are not technically or ethically prepared to undertake this

type of operation, known as geo-engineering, we might be forced to do so in 20 or 30 years' time if global warming becomes unbearable. From this viewpoint, it is necessary to study the effects that releasing the SO_2 would have, and consider all potential reaction chains. Understanding the reactions that take place in Venus's atmosphere will help us to do so.

More information: Photolysis of sulphuric acid as the source of sulphur oxides in the mesosphere of Venus, Xi Zhang, et al. *Nature Geoscience*, published online on 1 November 2010.

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