Aerosol particles impacts on the global climate

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Aerosol particles have critically important roles in the global climate system. They scatter and absorb atmospheric radiation affecting directly the radiation balance. They also can act as cloud condensation nuclei activating cloud droplets and changing indirectly cloud properties. The direct effect has a cooling effect, reducing the radiation flux at the surface by as much as 300 w/m² in areas heavily loaded with aerosols. The latest IPCC report calculates that in average the heating effect of CO2 is about +1.6 w/m², while the cooling effect of aerosol particles is -0.6 w/m². The indirect effect can be large, and is highly variable, being the largest source of uncertainty in the climate system. Due to the low residence time of aerosol particles, on the order of a few days to weeks, its effects tends to be can be local or regional, but when it is injected in the stratosphere such as in volcanic eruptions, it can last for many months in the atmosphere. The global and regional effects of aerosols on climate will be discussed in this talk.

Ion beam techniques such as PIXE have helped to measure trace elements in aerosols over the last 30 years. Its high sensitivity, high accuracy allows determination of aerosol size distribution for each trace element. Modern techniques such as Polarized Excitation X-ray Fluorescence are getting close to PIXE in terms of detection limits and accuracy.

A few geoengeneering options are based on aerosol injection in the atmosphere, and its side effects can be problematic and difficult to assess. The actual options on geoengeneering the global climate system will be discussed in this talk.