CE-03

Stratospheric Ozone Loss in Mid-latitudes in Summer – a Potential Risk of Climate Engineering?

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Summary

Recently, a new mechanism for ozone loss over populated areas is discussed in the scientific community warning of an increasing risk of ozone depletion in summer from convectively injected water vapour into the mid-latitude lower stratosphere. In this region, enhanced water vapour can yield chlorine-induced catalytic ozone loss caused by heterogeneous reactions on binary sulphate-water aerosol (H2SO4/H2O) sped up by increasing water vapour and low temperatures. Assuming that the intensity and frequency of convectively injected water vapour would increase in the next decades caused by anthropogenic climate change, a related increase in levels of ultraviolet radiation (UV) on Earth's surface over populated areas would follow. However, the details of this new ozone loss mechanism are not yet clear preventing an accurate quantification of the resulting ozone loss and its sensitivity on lower stratospheric sulphur and water vapour. Moreover, the injection of sulphate aerosol into the stratosphere proposed as one method of climate engineering to mitigate global warming could in addition intensify ozone loss in the mid-latitude lower stratosphere. Motivated by the lack of current understanding of ozone loss processes under conditions of enhanced water vapour and sulphate aerosol in the mid-latitude lower summer stratosphere, we propose a project in the frame of the DFG Priority
Program 'Climate Engineering' based on different simulations with the three-dimensional chemistry transport model (CLaMS). Our objectives are to understand and quantify the details of this new ozone loss mechanism and to simulate reliably possible ozone loss under climate engineering conditions. An algorithm linking the dependency of mid-latitude ozone loss on increased stratospheric sulphate will be provided to the climate engineering community as basis
for further economic analysis. Our findings will help possible future decisions about climate engineering to be assessed in order to maximise global welfare and minimise costs for the society.