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Ozone recovery and climate change: Towards an interactive representation of stratospheric ozone in Earth System Models

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The Montreal Protocol and its amendments are perhaps the most successful international agreements for protecting the environment on a global scale. As a result the ozone layer is expected to recover by the end of the century. But interactions between climate change and stratospheric ozone modify both, the evolution of surface climate and the recovery of the stratospheric ozone layer. In the changing climate the ozone layer will recover into a state that will be significantly different from its state before the rise of anthropogenic ozone depleting substances and the evolution of surface climate is significantly affected by ozone recovery. Accounting for the climate feedbacks from changing ozone as well as the impact of climate change on the evolution of the ozone layer requires the interactive representation of stratospheric chemistry in Earth System Models.

The presentation will demonstrate that our understanding of stratospheric chemistry and the polar ozone loss processes is now mature at the process scale and that state of the art Chemical Transport Models (CTM) result in a realistic representation of the global ozone layer and the chemical processes affecting it. However, due to the huge computational effort of these models representing the ozone layer interactively in Earth System Models (ESMs) remains a challenge. Fully coupled Chemistry Climate Models (CCMs) are numerically so demanding that they can neither be used to explore a wide range of scenarios nor for ensemble simulations, which are needed to account for the internal variability of the climate system.

We have developed SWIFT, an extremely fast module for interactive ozone chemistry in climate models. SWIFT allows for an interactive treatment of stratospheric ozone in standard ESMs with little numerical overhead. We will present the current status of SWIFT and results from coupling SWIFT to a climate model.