Geophysical Research Abstracts
Vol. 20, EGU2018-9752-1, 2018
EGU General Assembly 2018

Interactive stratospheric ozone chemistry: an important feedback for climate change projections

Gabriel Chiodo (1) and Lorenzo M. Polvani (1,2,3)

(1) Department of Applied Physics and Applied Mathematics, Columbia University, New York (NY), United States (chiodo@columbia.edu), (2) Lamont Doherty Earth Observatory, Palisades (NY), United States, (3) Department of Earth and Environmental Sciences, Columbia University, New York (NY), United States

Interactive stratospheric ozone chemistry is commonly neglected in state-of-the-art climate models involved in future climate projections. Therefore, the coupling between ozone, the circulation and climate is not well represented in climate models: the impact of this simplification on model predictions of climate change remains largely unexplored.

Here, we present an analysis of the ozone layer response to increased CO_2 concentrations in four different CMIP5 models. We show that increased CO_2 levels lead to a decrease in ozone concentrations in the tropical lower stratosphere, and an increase over the high latitudes and throughout the upper stratosphere. This pattern is robust across all models examined here, although important inter-model differences in the magnitude of the response are found.

Then, we quantify the radiative and dynamical feedbacks induced by these ozone changes, by imposing the ozone response to increased CO_2 levels in climate sensitivity experiments from the Whole Atmosphere Community Climate model. We show that the global mean radiative forcing induced by the ozone responses to CO_2 is small. As a consequence, the effects of ozone on global mean surface temperature are negligible. However, stratospheric ozone has a considerable impact on the tropospheric circulation response to increased CO_2 in both hemisheres, leading to sizable changes in regional patterns of climate change, such as a negative North Atlantic Oscillation, and an equator-ward shift of the mid-latitude jet in the Southern Hemisphere. These changes oppose the effects of increased CO_2 levels.

Our findings demonstrate that stratospheric ozone feedbacks likely play an important role in shaping the projected climate change patterns in both hemispheres. Neglecting ozone feedbacks in climate models results in an overestimate of the climate system response to increased CO_2.