EGU2020-17593
https://doi.org/10.5194/egusphere-egu2020-17593
EGU General Assembly 2020

Why we believe there is still a model ozone deficit in the upper stratosphere

Jonas Debosscher, Quentin Errera, Simon Chabrillat, Daniele Minganti, Yves Christophe, and Didier Fussen
The Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium (jonas.debosscher@aeronomie.be)

Historically, many photochemical models suffered from an underestimation of the ozone abundance in the upper stratosphere – lower mesosphere, known as the “Ozone deficit problem” (Prather, 1981; Eluszkiewicz et al., 1993, Siskind at al., 2013). Despite improvements in models and increased accuracy of observations, it seems this problem is still present, as evidenced by comparing models participating in the Chemistry-Climate Model Initiative (CCMI) with observations.

The Belgian Assimilation System for Chemical ObsErvations (BASCOE), developed at BIRA-IASB, is used to study and monitor the chemical composition of the stratosphere. It consists of a 3D chemical transport model (CTM) in combination with two data-assimilation methods (4D-Var and EnKF). BASCOE shows an ozone deficit of ~20 % against MLS observations around 1hPa. Since BASCOE will provide operational analysis of ozone based on the assimilation of the future ALTIUS satellite data, and is part of the Integrated Forecasting System of the ECMWF (C-IFS-CB05-BASCOE, Huijnen et al., 2016), the CTM needs to better model the ozone observations in this region of the stratosphere.

We present the results of a sensitivity study using the BASCOE CTM to identify factors that have the largest influence on the ozone budget in the upper stratosphere and can provide clues to solve the ozone deficit. We investigated the effects of solar spectral irradiance, surface albedo, photo-dissociation computation, reaction rate uncertainties and temperature.

Ozone concentrations in the upper stratosphere turned out to be very sensitive to temperatures and to a lesser degree to the solar spectral irradiances used to drive the model. The sensitivity to temperature is compatible with predictions made using a photochemical equilibrium approximation based on pure oxygen chemistry. Given the relatively large temperature uncertainties in the upper stratosphere, we believe temperature biases could substantially contribute to the ozone deficit.