Seasonal impact of biogenic very short-lived bromocarbons on lowermost stratospheric ozone between $60^\circ$ N and $60^\circ$ S during the 21st century

Javier Barrera$^1$, Rafael Fernandez$^{1,2,3}$, Fernando Iglesias-Suarez$^{2,4}$, Carlos A. Cuevas$^2$, Jean-Francois Lamarque$^5$, and Alfonso Saiz-Lopez$^2$

$^1$Institute for Interdisciplinary Science, National Research Council (ICB-CONICET), FCEN-UNCuyo, Mendoza, 5500, Argentina
$^2$Department of Atmospheric Chemistry and Climate, Institute of Physical Chemistry Rocasolano, CSIC, Madrid, 28006, Spain
$^3$Atmospheric and Environmental Studies Group (GEAA), UTN-FRM, Mendoza, 5500, Argentina
$^4$Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany.
$^5$Atmospheric Chemistry, Observations & Modelling Laboratory, National Center for Atmospheric Research, Boulder, CO 80301, USA

Biogenic very short-lived bromocarbons (VSLBr) currently represent $\approx 25\%$ of the total stratospheric bromine loading. Owing to their much shorter lifetime compared to anthropogenic long-lived bromine (e.g. halons) and chlorine (e.g. chlorofluorocarbons), the impact of VSLBr on ozone peaks in the lowermost stratosphere, which is a key climatic and radiative atmospheric region. Here we present a modelling study of the evolution of stratospheric ozone and its chemical loss within the tropics and at mid-latitudes during the 21st century. Two different experiments are explored: considering and neglecting the additional stratospheric injection of 5 ppt biogenic bromine naturally released from the ocean. Our analysis shows that the inclusion of VSLBr results in a realistic stratospheric bromine loading and improves the agreement between the model and satellite observations of the total ozone column (TOC) for the 1980–2015 period at mid-latitudes. We show that the overall ozone response to VSLBr at mid-latitudes follows the stratospheric evolution of long-lived inorganic chlorine and bromine throughout the 21st century. Moreover, the seasonal VSLBr impact on lowermost stratospheric ozone at mid-latitude is influenced by the seasonality of the heterogeneous inorganic-chlorine reactivation processes on ice crystals. Indeed, due to the more efficient reactivation of chlorine reservoirs (mainly ClONO2 and HCl) within the colder SH-ML lowermost stratosphere, the seasonal VSLBr impact shows a small but persistent hemispheric asymmetry through the whole modelled period. We conclude that the link between biogenic bromine sources and seasonal changes in heterogeneous chlorine reactivation is a key feature for future projections of mid-latitude lowermost stratospheric ozone during the 21st century.