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

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Biogenic very short-lived bromocarbons (VSLBr) currently represent ∼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.