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The impact of iodine on ozone trends in the lower stratosphere

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Depletion of the stratospheric ozone layer by chlorine and bromine species has been a major environmental issue since the early 1970s. Following controls on the production of the long-lived halocarbons which transport chlorine and bromine to the stratosphere, the ozone layer is expected to recover over the course of this century. Decreases in the stratospheric loading of chlorine and bromine have been observed and there are signs of this resulting in an increase in ozone in the upper stratosphere and the Antarctic lower stratosphere. However, in contrast to this expectation of increasing stratospheric ozone, Ball et al. (ACP doi:10.5194/acp-18-1379-2018, 2018, ACP doi:10.5194/acp-19-12731-2019, 2019) have reported evidence for an ongoing decline in lower stratospheric ozone at extrapolar latitudes between 60°S and 60°N. Chipperfield et al. (GRL, doi:10.1029/2018GL078071, 2018) analysed these results using the TOMCAT 3-D chemical transport model (CTM). They reported that much of the observed ozone decrease could be explained by dynamical variability. Furthermore, they investigated the potential role for bromine and chlorine from very short-lived species (VSLS) but found only a small contribution.

Very recently, Koenig et al. (PNAS, doi:10.1073/pnas.1916828117, 2020) have reported quantitative observations of almost 1 pptv iodine in the lower stratosphere. They show that this iodine is an important contribution to the local iodine loss budget and speculate that a trend in iodine could therefore explain the observed downward trend in ozone.

Here we use an updated version of the TOMCAT CTM to investigate the impact of iodine on lower stratospheric ozone trends. We repeat the simulations of Chipperfield et al. (2018), using both ERA-Interim and ERA5 reanalyses (to compare the quantification of the dynamical contribution). We use assume trends in the stratospheric injection of iodine to quantify the possible impact of this on global ozone trends through both gas-phase chemistry and novel heterogeneous processes.