

Author Responses to Editor Comments

We thank the Editor for their useful and constructive comments/feedback on the Abstract. We are pleased to hear our manuscript has been accepted to ACP subject to these changes to the Abstract length. Below is a copy of the new abstract (243 words < 250-word ACP limit) in italics.

Abstract:

Tropospheric ozone (O_3) is a harmful secondary atmospheric pollutant and an important greenhouse gas. Multiple satellite records have shown conflicting long-term O_3 trends across regions of the globe, including Europe. Here, we investigate lower-tropospheric sub-column O_3 ($LTCO_3$, surface – 450 hPa) records from three ultraviolet (UV) sounders produced by the Rutherford Appleton Laboratory (RAL): the Global Ozone Monitoring Experiment (GOME, 1996-2010), Scanning Imaging Absorption Spectrometer for Atmospheric Chartography (SCIAMACHY, 2003-2011) and Ozone Monitoring Instrument (OMI, 2005-2017). GOME and SCIAMACHY detect negative trends of approximately -0.2 DU yr^{-1} , while OMI indicates a negligible trend. The TOMCAT 3-D chemical transport model was used to investigate processes driving simulated trends and identify possible reasons for satellite trend discrepancies. The simulated $LTCO_3$ trends were negligible (consistent with ozonesonde trends), even when spatiotemporally co-located to the satellite level-2 swath data and convolved by averaging kernels (i.e. a measure of the satellite retrieval vertical sensitivity). Model sensitivity experiments with the emissions or meteorology fixed to 2008 also showed negligible $LTCO_3$ trends between 1996 and 2018, indicating that changes in emissions and meteorology had limited impact on $LTCO_3$ temporal evolution. Given the substantial decrease in air pollutant emissions, this was unexpected, while year-to-year variability dominated the meteorological influence on $LTCO_3$. Finally, we find a negligible trend in the long-term stratosphere O_3 flux into the free troposphere over this period arriving over Europe. Overall, our observational and modelling analysis indicates that European $LTCO_3$ trends have been stable between 1996 and 2018.