



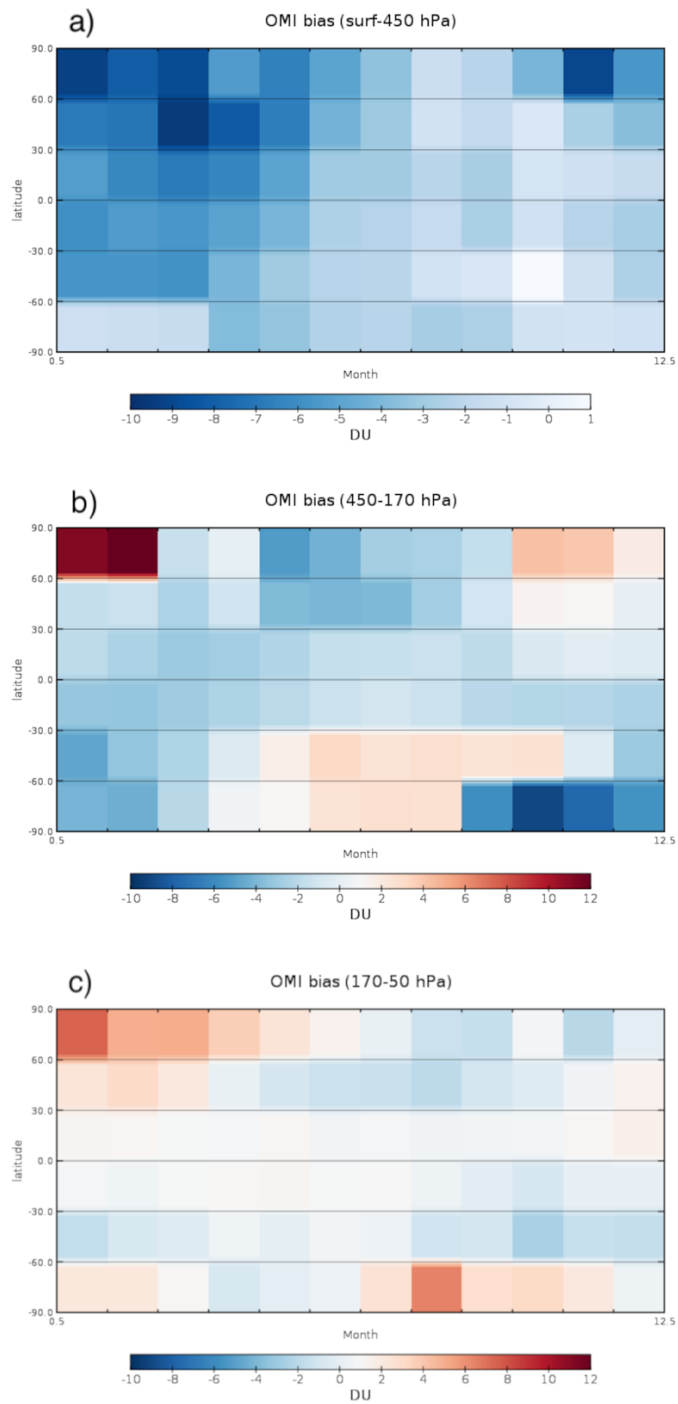
*Supplement of*

**Seasonal, interannual and decadal variability of tropospheric ozone in the North Atlantic: comparison of UM-UKCA and remote sensing observations for 2005–2018**

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**Figure S1: OMI bias relative to ozone sonde ensemble as a function of latitude and month for surf-450 hPa column (a), 450-170 hPa column (b), 170-50 hPa column (c).**

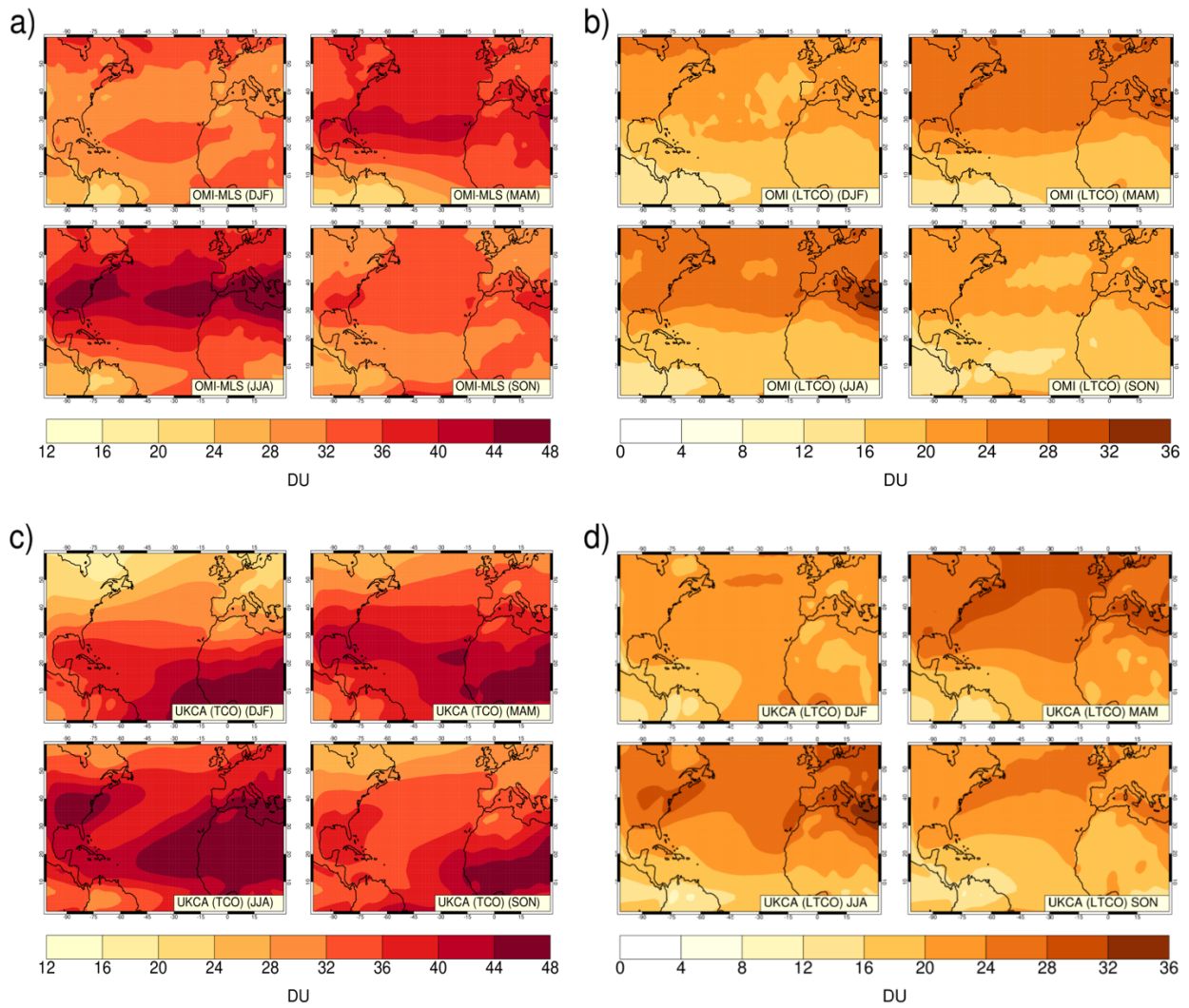
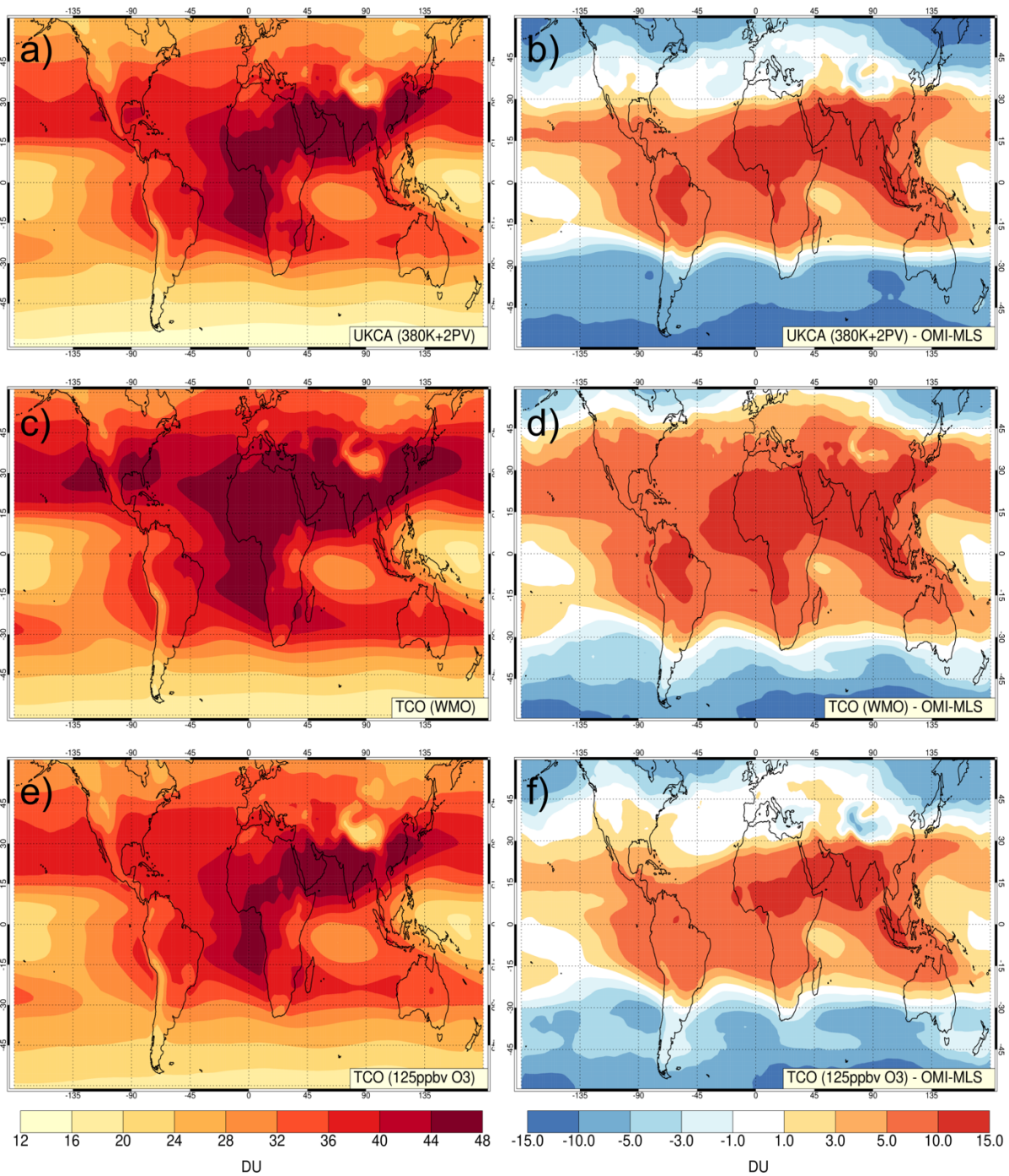


Figure S2: TCO and LTCO multi annual seasonal mean maps for the period 2005-2018. OMI-MLS TCO (a), OMI LTCO (b), UKCA TCO (c), and UKCA LTCO (d).



10 **Figure S3: Sensitivity of Tropospheric ozone column to tropopause definition for UKCA multiannual mean (2005-2018). Left column shows multiannual means and right column shows difference between modelled TCO and OMI-MLS TCO. The tropopause is defined as follow: a) and b) 380K + 2PV (ozone burden 60° S:60° N = 301 Tg ) ; c) and d) WMO tropopause (ozone burden 60° S:60° N = 332 Tg); e) and f) 125ppbv ozonepause (ozone burden 60° S:60° N =308 Tg). OMI-MLS ozone burden 60° S:60° N = 297 Tg**

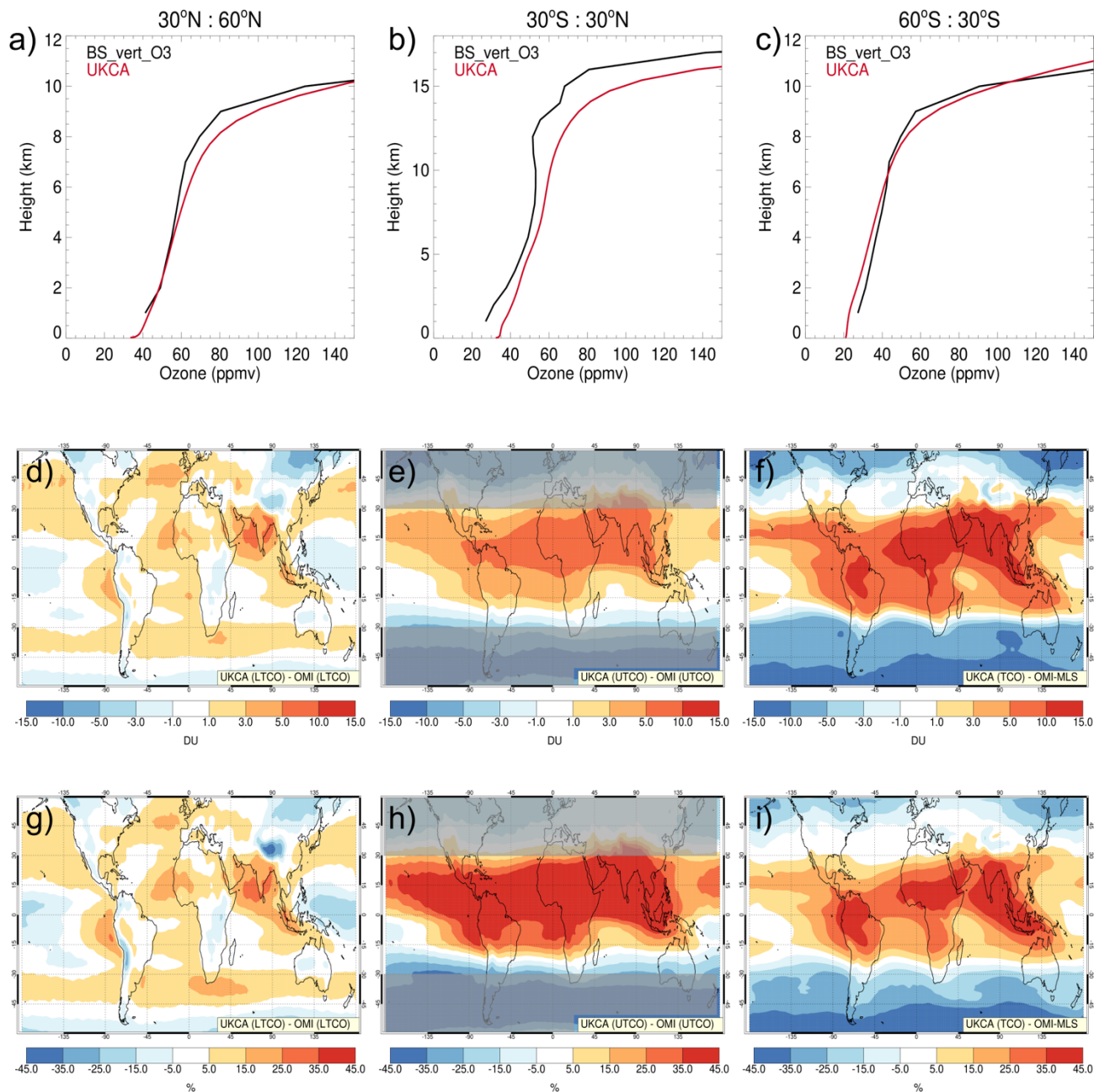
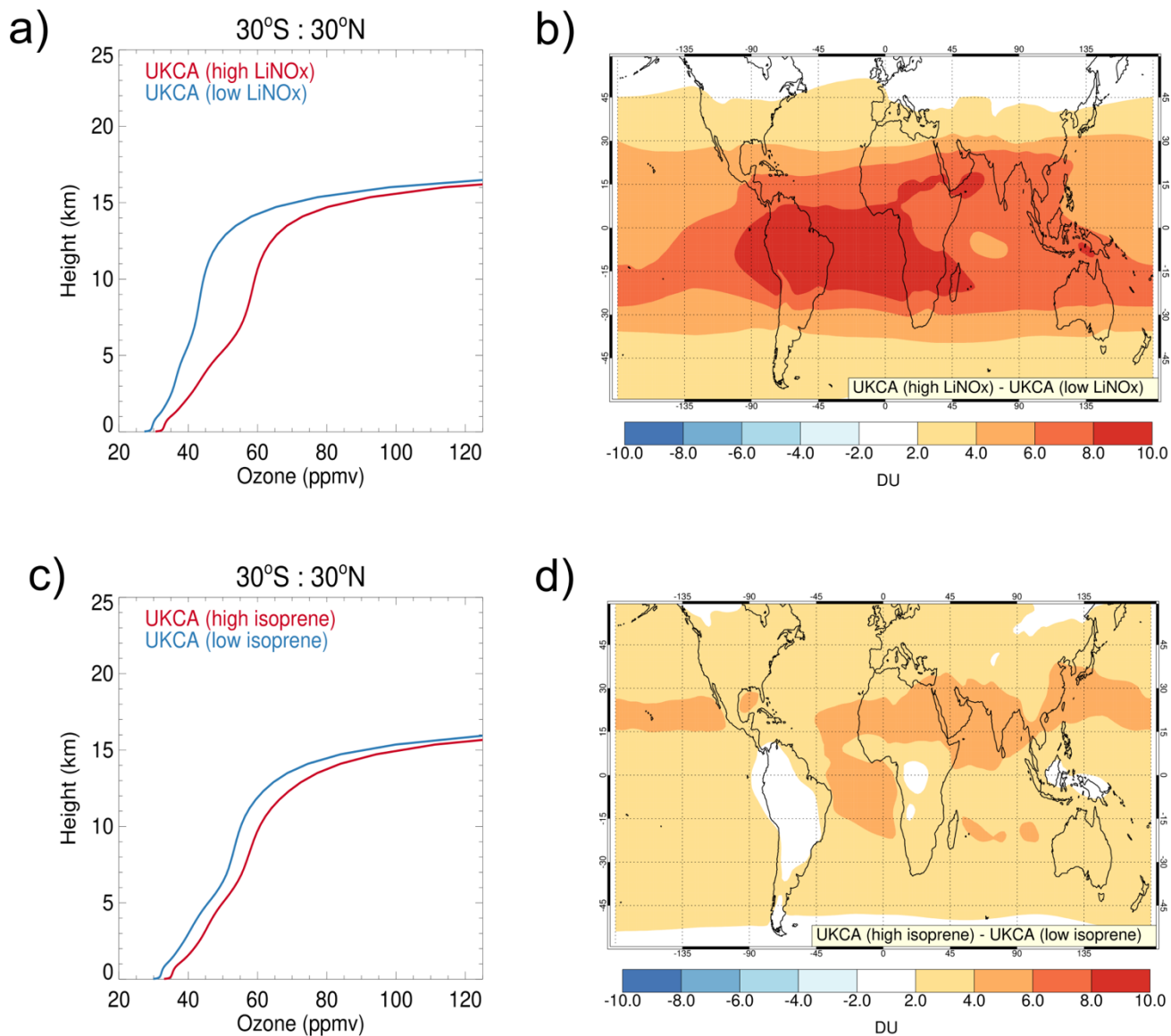
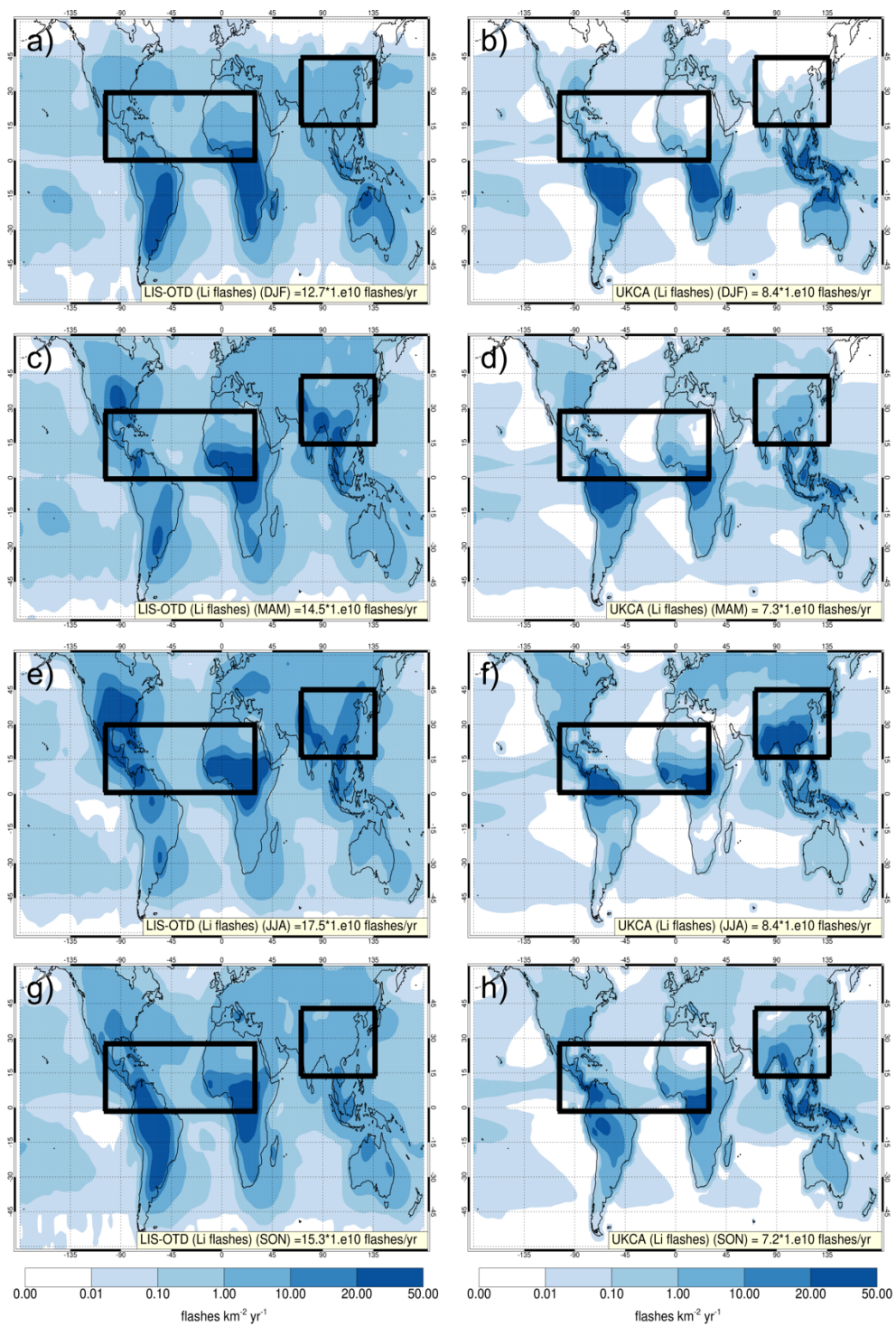


Figure S4: Global Tropospheric ozone. Top row shows zonally averaged, multiannual mean vertical profiles of modelled ozone compared to Bodeker Scientific vertical ozone dataset: a) northern mid latitudes, b) Tropics, c) southern mid latitudes. Second row shows multi annual mean absolute difference maps between modelled and observed ozone in three different vertical columns: d) LTCO, e) UTCO, f) TCO. Third row is the same as second row but for percentage difference. Note that UTCO data is shaded outside the Tropics since this ozone subcolumn, at mid latitudes, samples the lower stratosphere as well as the upper troposphere.

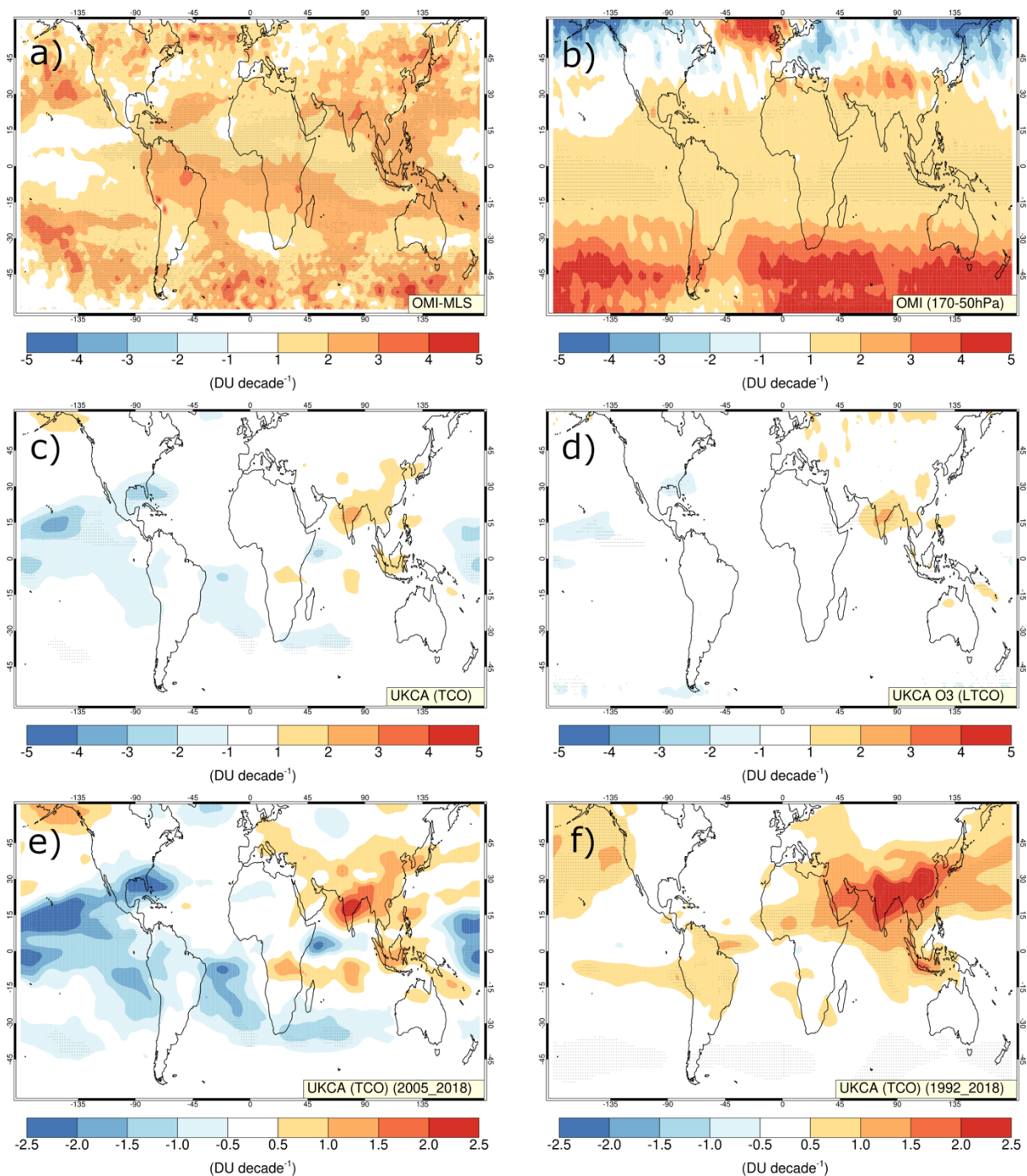


25 **Figure S5:** First column shows comparison of mean ozone vertical profiles, averaged over the Tropics, for: a) a UKCA simulation with high LiNOx emissions ( $\sim 7 \text{ Tg(N)}^{-1}\text{yr}$ ) and a UKCA simulation with low LiNOx emissions ( $\sim 2 \text{ Tg(N)} \text{ yr}^{-1}$ ); c) a UKCA simulation with high isoprene emissions ( $\sim 800 \text{ Tg yr}^{-1}$ ) and a UKCA simulation with low isoprene emissions ( $\sim 260 \text{ Tg yr}^{-1}$ ). Second column shows difference between sensitivity experiments (same as first column) but as a difference in TCO. Note that in the control simulation LiNOx emissions are  $\sim 6 \text{ Tg(N)} \text{ yr}^{-1}$  and isoprene emissions are  $\sim 530 \text{ Tg yr}^{-1}$ . The difference in global ozone burden between high and low sensitivity experiments is  $\sim 50 \text{ Tg}$  (for LiNOx) and  $30 \text{ Tg}$  (for isoprene).



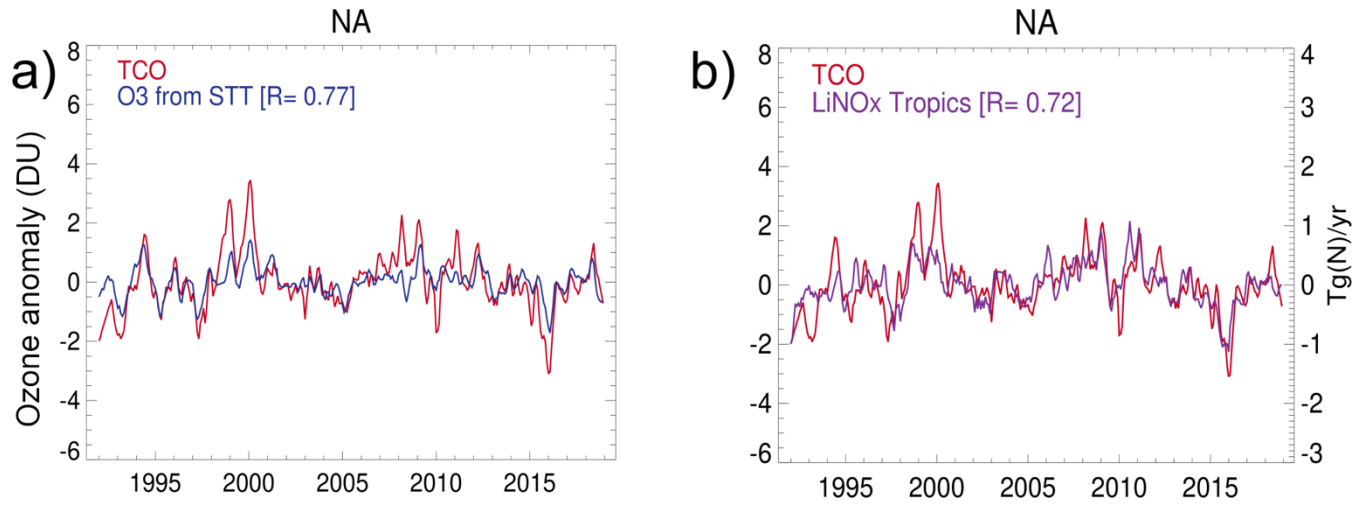
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**Figure S6: Seasonal maps of observed (first column) and modelled (second column) lightning flashes for the period 1996-2013. Top row to bottom row respectively for DJF, MAM, JJA, SON.**



35 **Figure S7: Tropospheric ozone trends: OMI-MLS TCO (a); OMI LTGO (b); UKCA TCO (c) and UKCA LTGO (d) for the period 2005-2018. (e) is the same as c but with different scale; this is to allow for better comparison with (f), which shows UKCA TCO trends for 1992-2018. The stippling indicates where trends are significant to the 95 % confidence level, based on the standard error of the residuals.**





**Figure S8: deseasonalised and detrended timeseries anomalies for the period 1992-2018, showing temporal correlation (R) between modelled TCO in the North Atlantic and its key drivers: ozone from STT in the North Atlantic and LiNO<sub>x</sub> emissions in the Tropics.**