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Supplement of

The influence of mixing on the stratospheric age of air changes in the 21st century

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1 Introduction

This supplement contains additional material to the article "The influence of mixing on the stratospheric age of air changes in the 21st century". We provide additional figures for Sect. 3.4 of the paper. In the main article, the multi-model-means of the zonal wind \overline{u} , the Eliassen-Palm flux divergence, the meridonal residual circulation v*, the meridonal PV-gradient $(\partial PV/\partial y)$, the diffusivity coefficient K_{yy} and the ratio $K_{yy}/|v^*|$ of eight model simulations are presented. Here, we show these quantities for each of the eight CCMI-1 (Chemistry Climate Model Intercomparison project) REF-C2 model simulations individually. The models that were used in this analysis are ACCESS, CMAM, EMAC-L47, EMAC-L90, GEOSCCM, MRI, NIWA-UKCA and WACCM. For more information on these models, the simulation setup and the selection of the models, see main article.

10 2 Additional figures

ACCESS

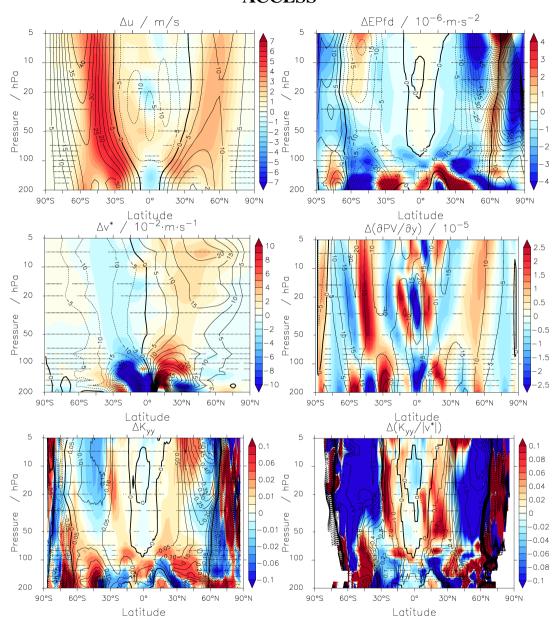


Figure 1. ACCESS CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridonal PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.

CMAM $10^{-6} \cdot \text{m} \cdot \text{s}^{-2}$ $\Delta u / m/s$ ΔEPfd / 6 5 4 3 2 10 10 hPa / hPa 20 20 Pressure 50 50 100 -5 100 -6 200 200 30°S 0° 30°N 90°N 90°S 60°S 30°S O° 30°N 60°N 90°N 90°S 60°S 60°N Latitude / 10⁻²·m·s⁻¹ Latitude 10^{-5} Δν* $\Delta(\partial PV/\partial y)$ / 5 10 1.5 / hPa 20 20 0.5 Pressure 0 0 -0.5 50 100 100 2.5 200 200 90°S 60°S 30°S 0° 30°N 60°N 90°N 90°S 60°S 30°S 0° 30°N 60°N 90°N 0.08 0.06 10 10 0.06 / hPa 0.02 0.04 0.04 0.02 0 -0.02 -0.04 -0.06 20 0.01 Pressure 0 0 -0.01 50 -0.02 d -0.06 100 100 -0.06 -0.08 -0.1 200 200 90°N 30°S 30°N 90°N 90°S 60°S 30°S 30°N 60°N 90°S 60°S 0° Latitude Latitude

Figure 2. CMAM CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridonal PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.

EMAC-L47

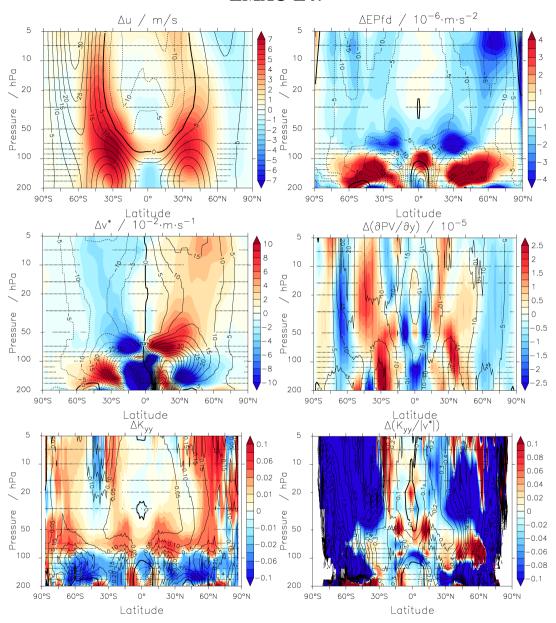


Figure 3. EMAC-L47 CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridional PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.

EMAC-L90

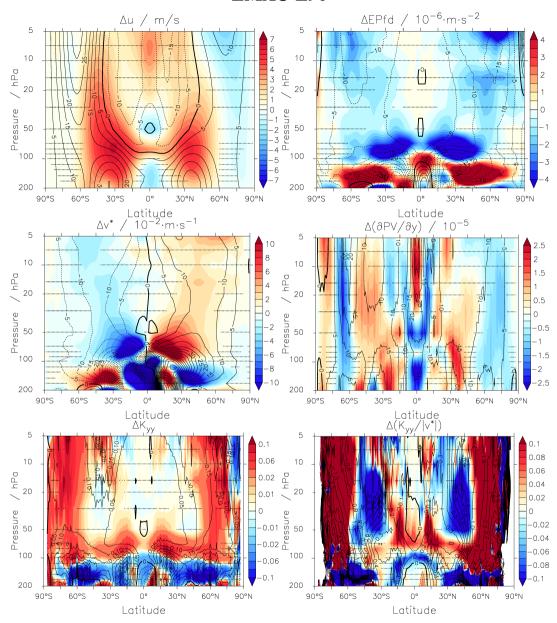


Figure 4. EMAC-L90 CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridonal PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.

GEOSCCM

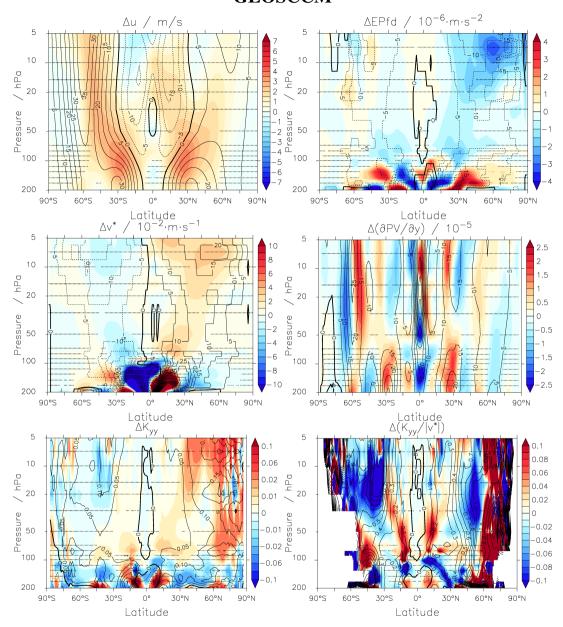


Figure 5. GEOSCCM CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridonal PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.

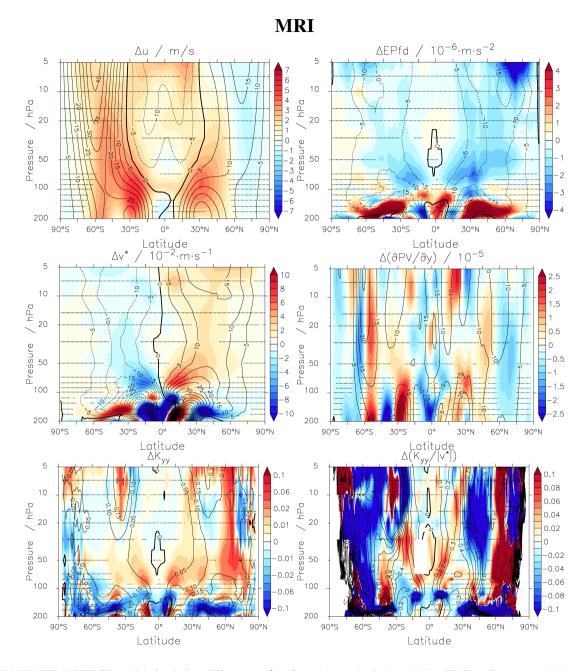


Figure 6. MRI CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridonal PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.

NIWA-UKCA

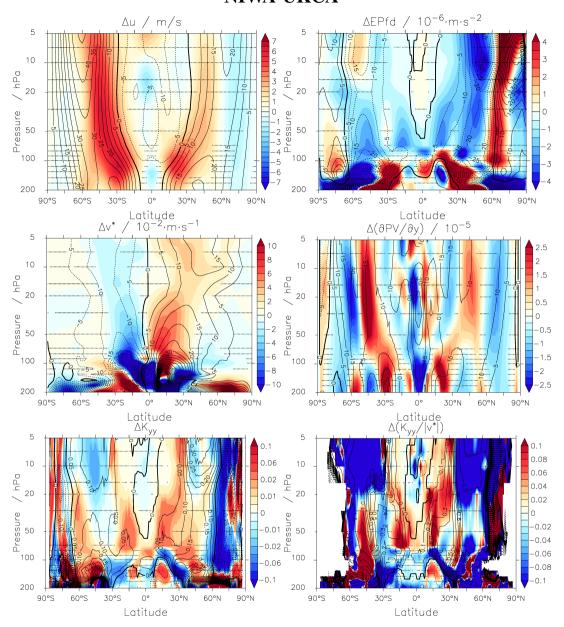


Figure 7. NIWA-UKCA CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridonal PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.

WACCM

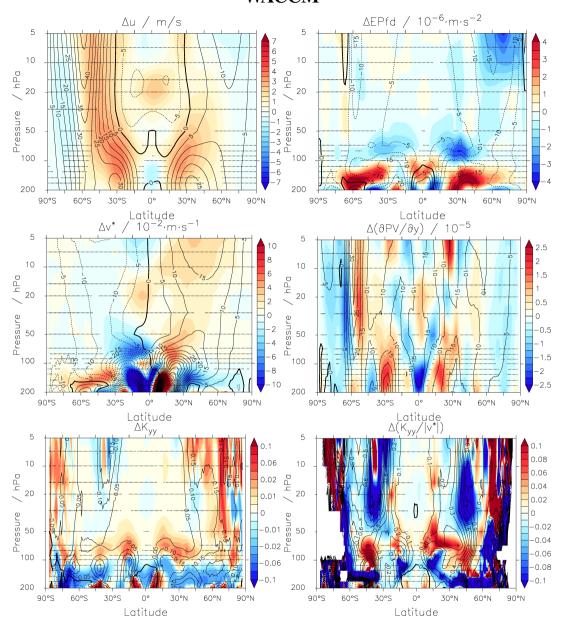


Figure 8. WACCM CCMI REF-C2 model simulation differences (Δ) of (a) the zonal wind \overline{u} , (b) the EP flux divergence, (c) the meridonal residual circulation v^* , (d) the meridonal PV-gradient ($\partial PV/\partial y$), (e) the diffusivity coefficient K_{yy} and (f) the ratio $K_{yy}/|v^*|$ between the periods 1970-1990 and 2080-2100. The contour lines show the multi-model mean climatology of the first period of the respective quantity. Stippled regions show where the statistical significance of the difference is below the threshold 95%.