
Supplementary Material

Composite ETC lifecycles

Several key figures are included in animated format as electronic Supplementary Material. All the supplementary figures show fields throughout the composite lifecycle in Figure 1. In all animations, the time (in hours) is denoted as relative to the time of maximum dynamical intensity.

Figure S1: Composite cloud fraction (a-c, CF, %) cloud top pressure (d-f, CTP, hPa) and optical depth (g-i, TAU) for HiGEM, ERAI and ISCCP, as for Figure 3.

Figure S2: Composite heating tendencies (K hr^{-1}) in HiGEM (a-c) and ERAI (d-f) associated with both the large-scale cloud and convection (Total, a,d), the large-scale cloud (LS, b,e) and convection parameterisation schemes (CV, c,f) at 700hPa, as for Figure 10.

Figure S3: Vertical transect taken along the line A-B shown in Figure 10 of heating tendencies (K hr^{-1}) in HiGEM (a-c) and ERAI (d-f) associated with both the large-scale cloud and convection (Total, a,d), the large-scale cloud (LS, b,e) and convection parameterisation schemes (CV, c,f) with dashed lines showing equivalent potential temperature (θ_e , K), as for Figure 11.

Figure S4: Composite PV (PVU, $1\text{PVU} = 10^{-6} \text{ K m}^2 \text{ kg}^{-1} \text{ s}^{-1}$, colours) in HiGEM (a,c) and ERAI (b,d) in vertical cross-sections denoted as A-B (a,b) and C-D (c,d) in Figure 10. Total latent heating tendency (large-scale and convection) is shown as closed contours at 0.4, 0.5 and 0.6 (K hr^{-1}). θ_e is shown with narrowly dashed lines with contours as labelled (K), as for Figure 12.

Figure S5: Composite PV (PVU, $1\text{PVU} = 10^{-6} \text{ K m}^2 \text{ kg}^{-1} \text{ s}^{-1}$) on the 315K θ surface in HiGEM (a) and ERAI (b). The 2PVU contour, denoting the approximate height of the tropopause, is shown as a black line, as for Figure 13.