



Supplement of

Deepening mechanisms of cut-off lows in the Southern Hemisphere and the role of jet streams: insights from eddy kinetic energy analysis

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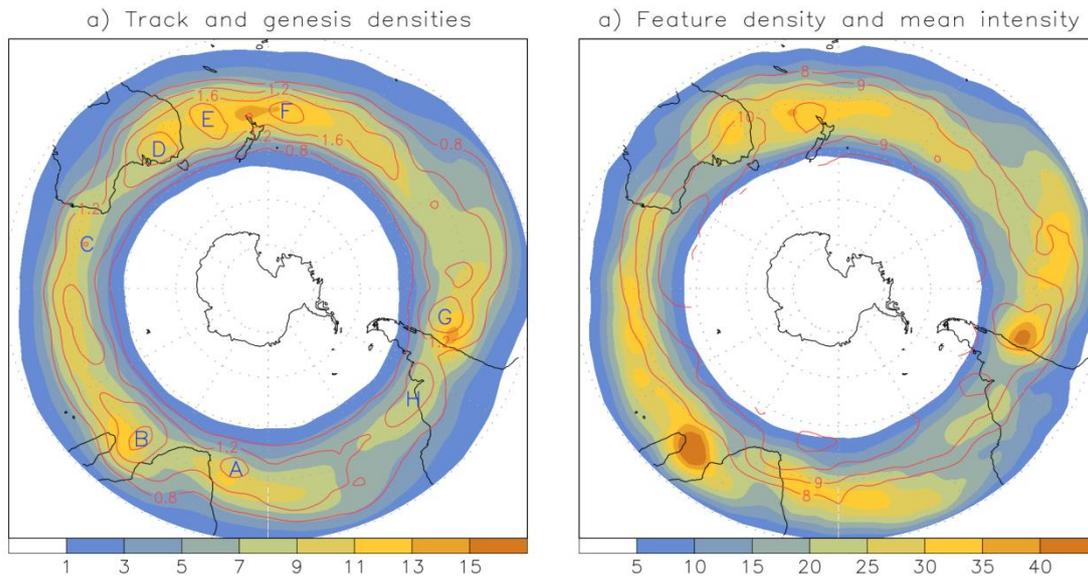


Figure S1: (a) Track density (shaded) with genesis density (contour) and (b) feature density (shaded) with mean intensity (contour) for all identified 300-hPa vorticity COLs. Regions of maximum genesis are denoted by A(32°S 10°E), B(29°S 39°E), C(33°S 105°E), D(34°S 142°E), E(33°S 161°E), F(34°S 166°E), G(34.5°S 80°W) and H(35°S 57°W). Unit is 10^{-1} s^{-1} for mean intensity and number per season per unit area for the other densities, where the unit area is equivalent to a 5° spherical cap ($\cong 10^6 \text{ km}^2$). Mean intensity is suppressed for track density below 1.0. Feature density is calculated using all track points, implying a concentrated density contribution in a small region for slow-moving systems due to the higher point density.

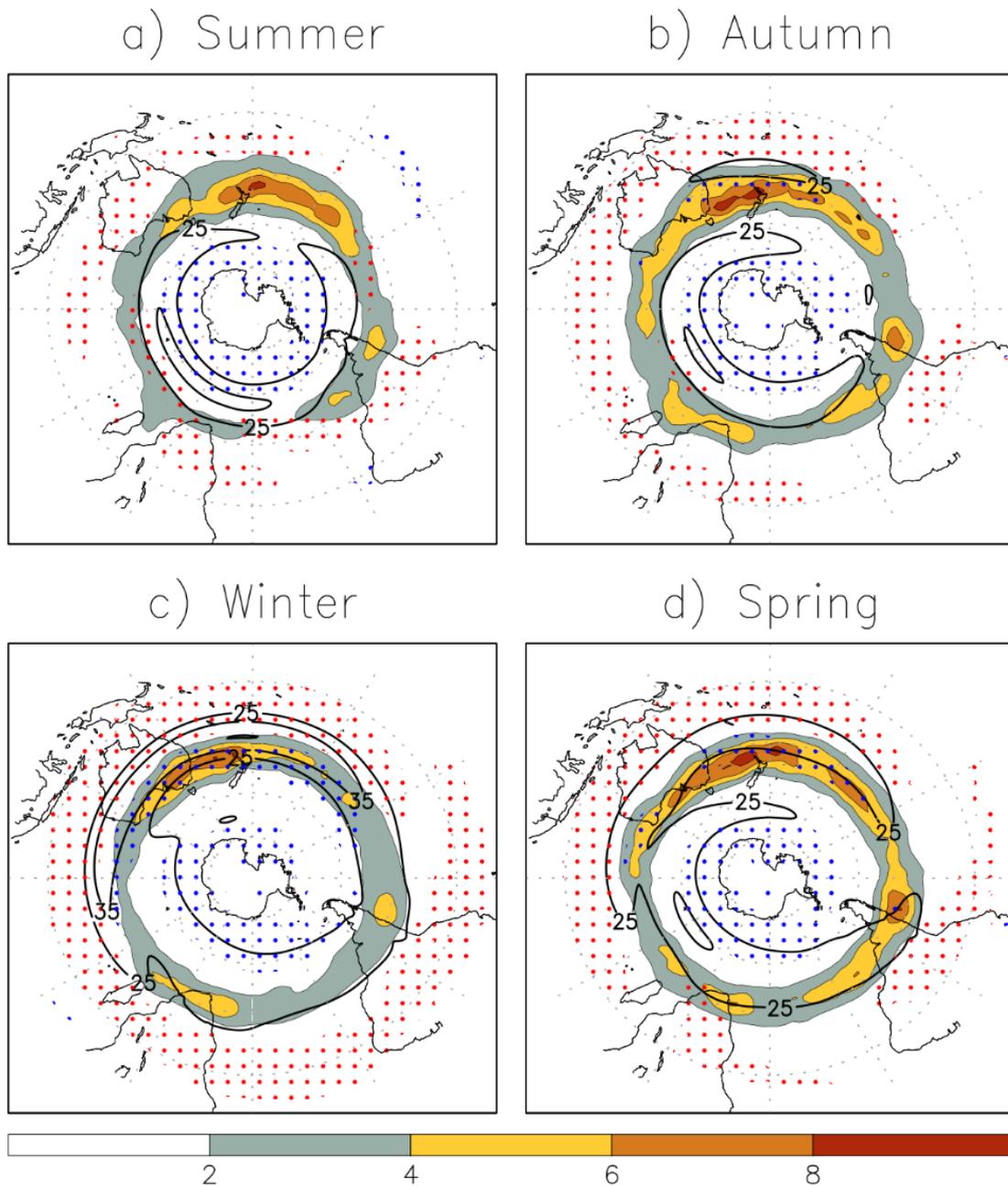


Figure S2: Zonal mean wind (black contour), relative vorticity (dots), and track density for deep COLs in the Southern Hemisphere for a) Summer (DJF), b) Autumn (MAM), c) Winter (JJA) and d) Spring (SON). Unit is as in Fig. 1 for track density. Zonal winds above 25 m.s⁻¹ are plotted for 10 m.s⁻¹ contour intervals. Blue (red) dots indicate values negative (positive) below (above) $1.0 \times 10^{-5} \text{ s}^{-1}$, respectively. All fields are represented at the 300-hPa level.

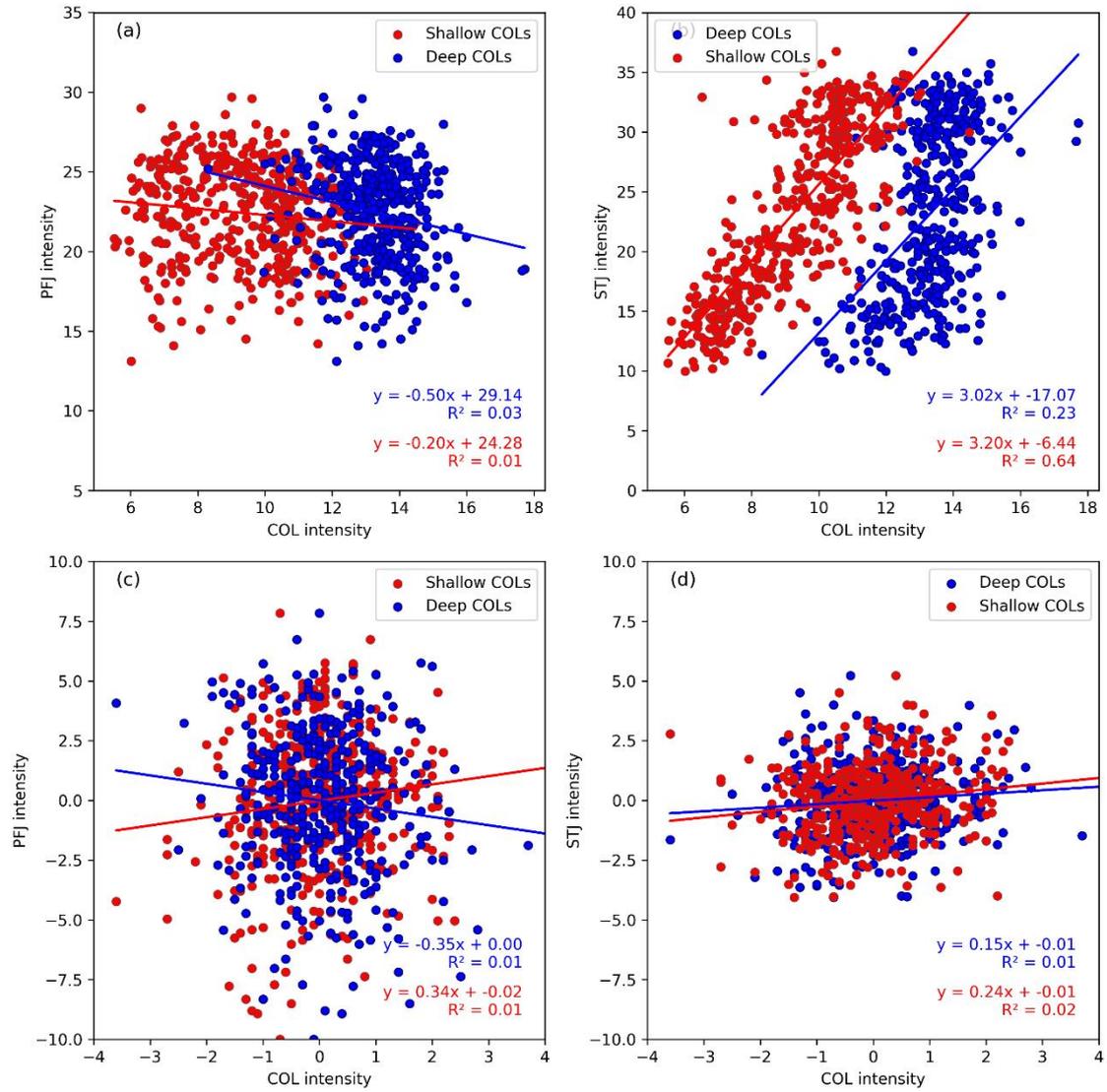


Figure S3: Scatter plots indicating the relationships between monthly mean COL intensity and jet intensity for (a, c) polar front jet and (b, d) subtropical jet using (a, b) raw values and (c, d) anomaly values. Anomalies are calculated by subtracting the monthly climatological mean from the observed value. Deep and shallow COLs are depicted by blue and red colors, respectively. Deep and shallow COLs are depicted by blue and red colors, respectively. Unit is in $\text{m}\cdot\text{s}^{-1}$ for jet intensity and 10^{-5} s^{-1} for COL intensity (scaled by -1) as measured by the 300-hPa vorticity.

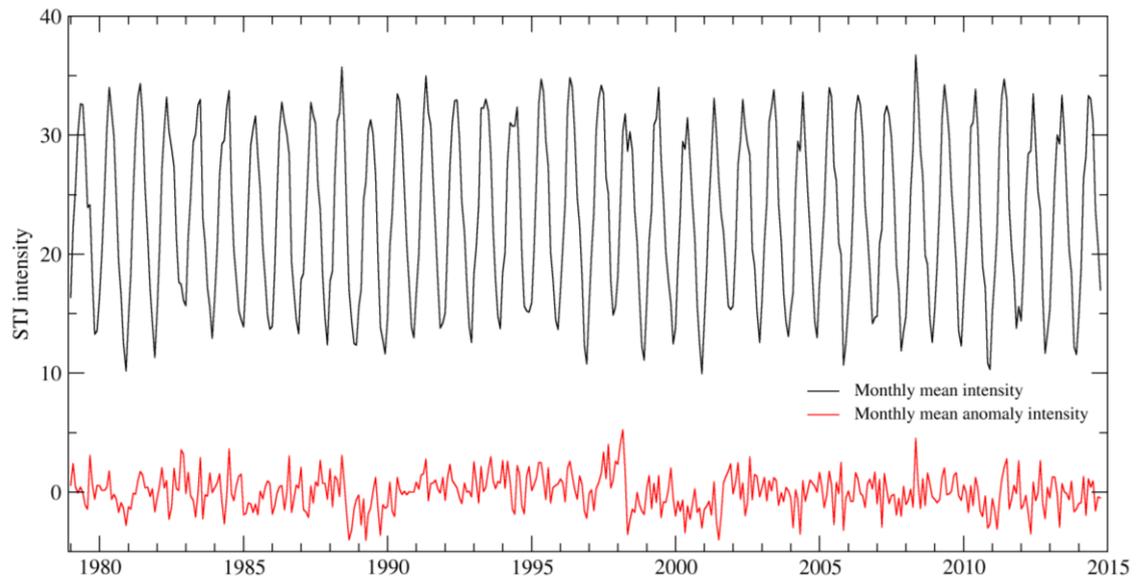


Figure S4: Monthly variations of mean intensity (black lines) and mean anomaly intensity (red line) of subtropical jet for the period from 1979 to 2014. Unit is $\text{m}\cdot\text{s}^{-1}$.

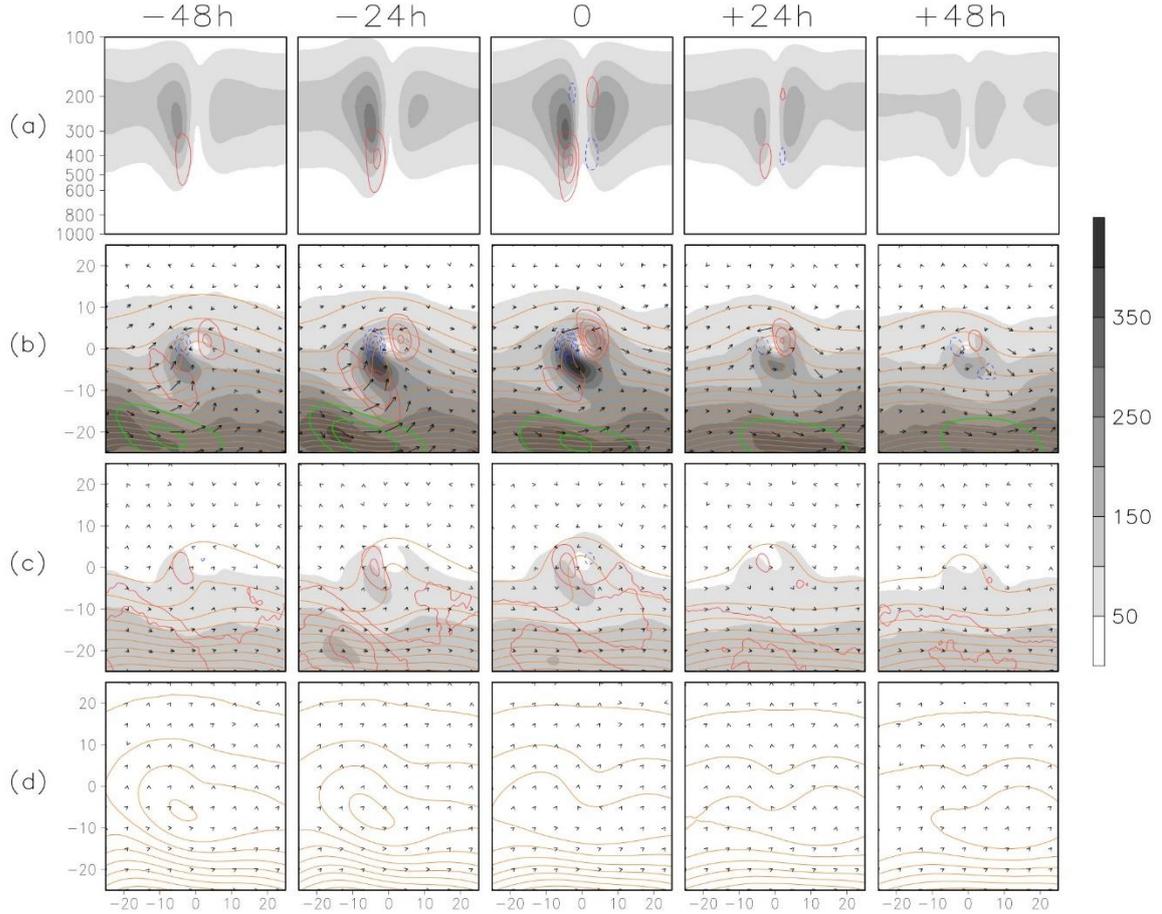


Figure S5: Temporal evolution of shallow COLs in the Southern Hemisphere relative to the time and space of maximum intensity in ξ_{300} . The panels depict: (a) vertical cross-sections of total EKE (shaded) with baroclinic conversion (contour); (b) vertically integrated ageostrophic flux convergence (blue and red contours) with EKE (shaded), geopotential height (orange line), zonal wind mean (green line) and ageostrophic fluxes (vectors) at 300 hPa; (c) vertically integrated baroclinic conversion (red contour) with EKE (shaded), geopotential height (orange line) and ageostrophic fluxes (vectors) at 500 hPa; and (d) EKE, geopotential height (orange line) and ageostrophic fluxes (vectors) at 1000 hPa. Contours represent 0.003×10^{10} Joule. s^{-1} for integrated quantities, 50 gpm for geopotential height at 300 and 500 hPa, and 20 gpm for geopotential height at 1000 hPa, while total EKE is indicated by 10^9 Joule.