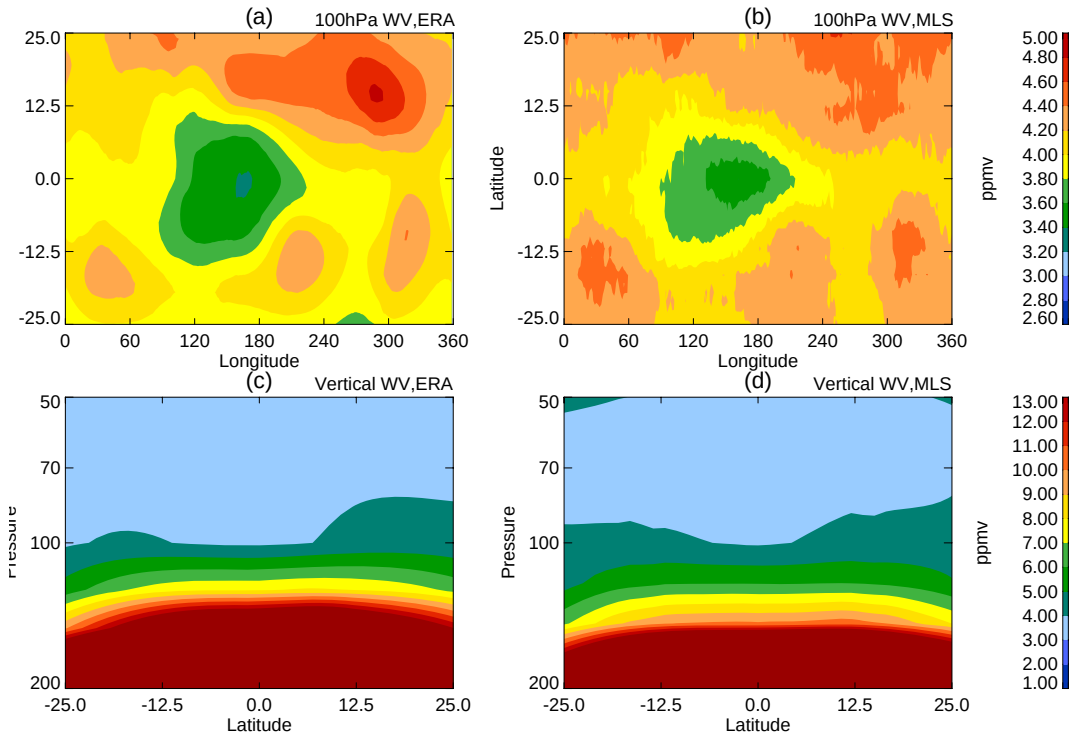

Figure 1. (a) ERA-Interim water vapor distributions at 100 hPa averaged for the period 1989 to 2010. (b) MLS water vapor distributions at 100 hPa averaged for the period 2005 to 2010. (c) Latitude-height cross-sections of zonal mean ERA-Interim water vapor and (d) MLS water vapor. Contour intervals are 0.2 ppmv for (a)/(b) and 1 ppmv for (c)/(d).

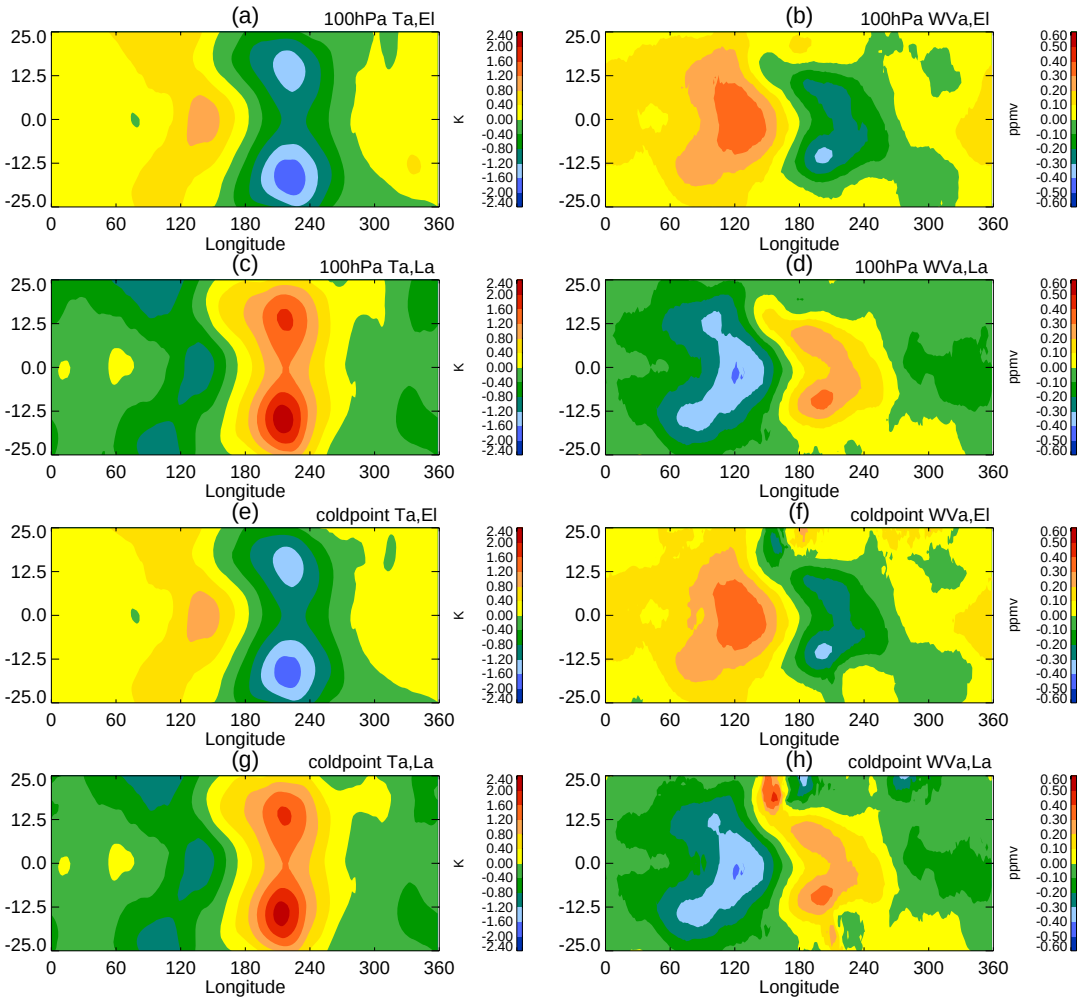

Figure 2. (a,c) Temperature and (b, d) water vapor anomalies at 100 hPa composited for (a, b) El Nin˜o and (c,d) La Nin˜a events based on ERA-Interim data. Contour intervals for temperature and water vapor anomalies are ±0.2 K and ±0.1 ppmv, respectively. (e, g) as (a, c), but for cold point tropopause temperature. (f, h) as (b, d), but for cold point tropopause water vapor.

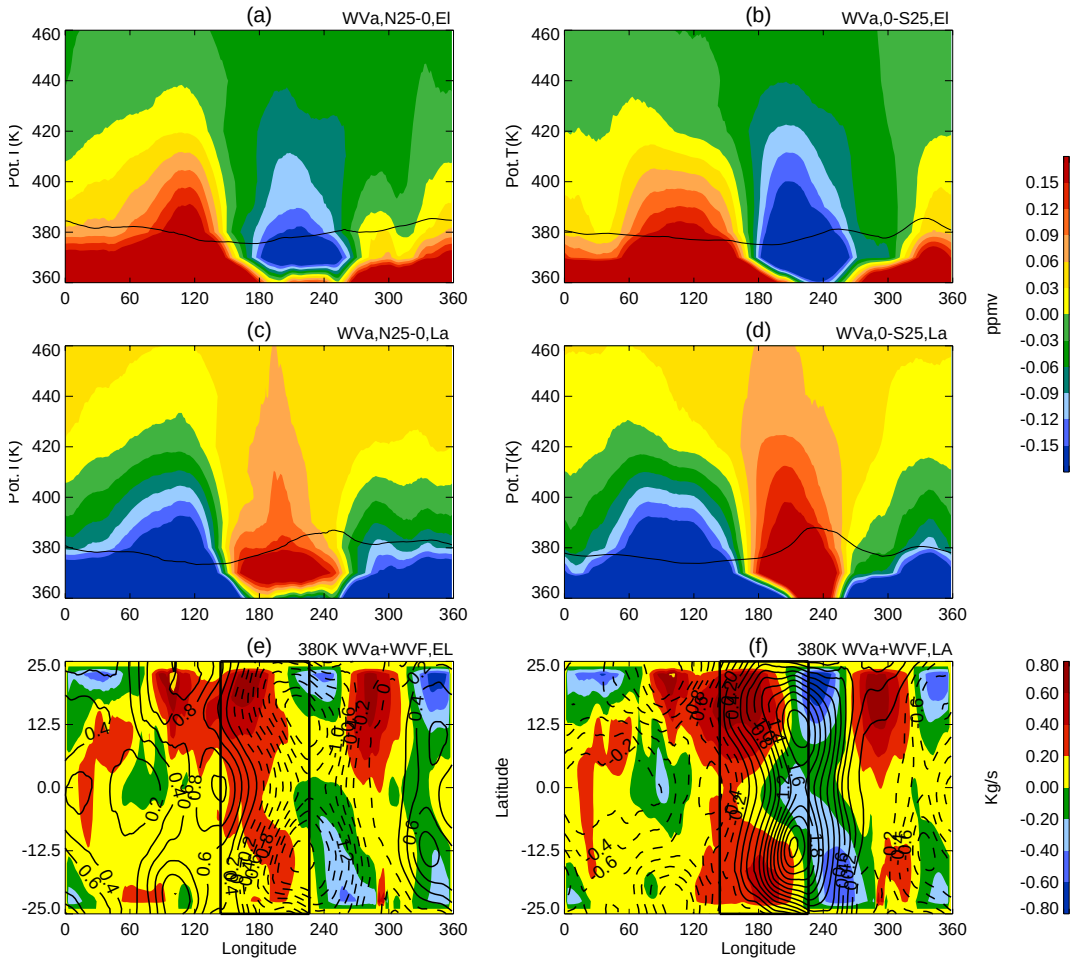

Figure 3. Longitude-height cross sections of water vapor anomalies averaged between (a, c) 25°N-0° and (b, d) 0°-25°S latitudes bands composited for (a, b) El Nin˜o and (c, d) La Nin˜a events based on ERA-Interim data. Contour interval is ±0.03 ppmv. The tropical cold point tropopause is delineated in each panel with solid lines. (e, f) The lower stratospheric water vapor flux (filled contours) and temperature anomalies on 380 K isentropic surface (line contours) composited for (e) El Nin˜o and (f) La Nin˜a events. Dashed and solid lines represent negative and positive anomalies, respectively. The black frames in (e) and (f) represent the area with most pronounced ENSO temperature anomalies and large water vapor fluxes.

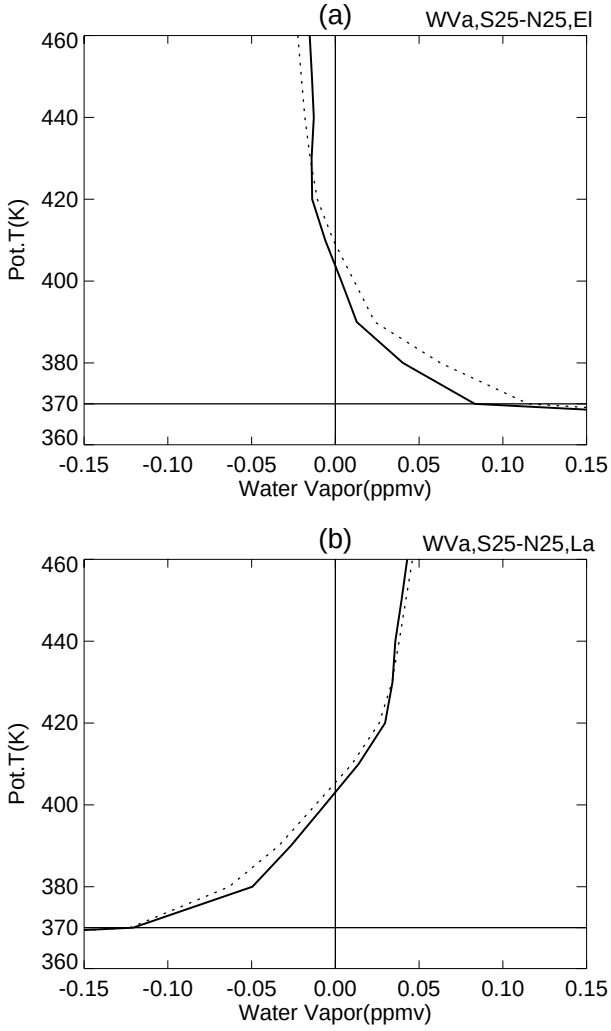

Figure 4. Vertical profiles of zonal mean water vapor anomalies for (a) El Nin˜o events and (b) La Nin˜a events based on ERA-Interim data. Solid and dotted lines are for zonal mean anomalies averaged between 0^{o}-25^{o}S and 0^{o}-25^{o}N, respectively. 380 K potential temperature, which roughly represents the tropical tropopause level, is delineated in each panel with solid lines.

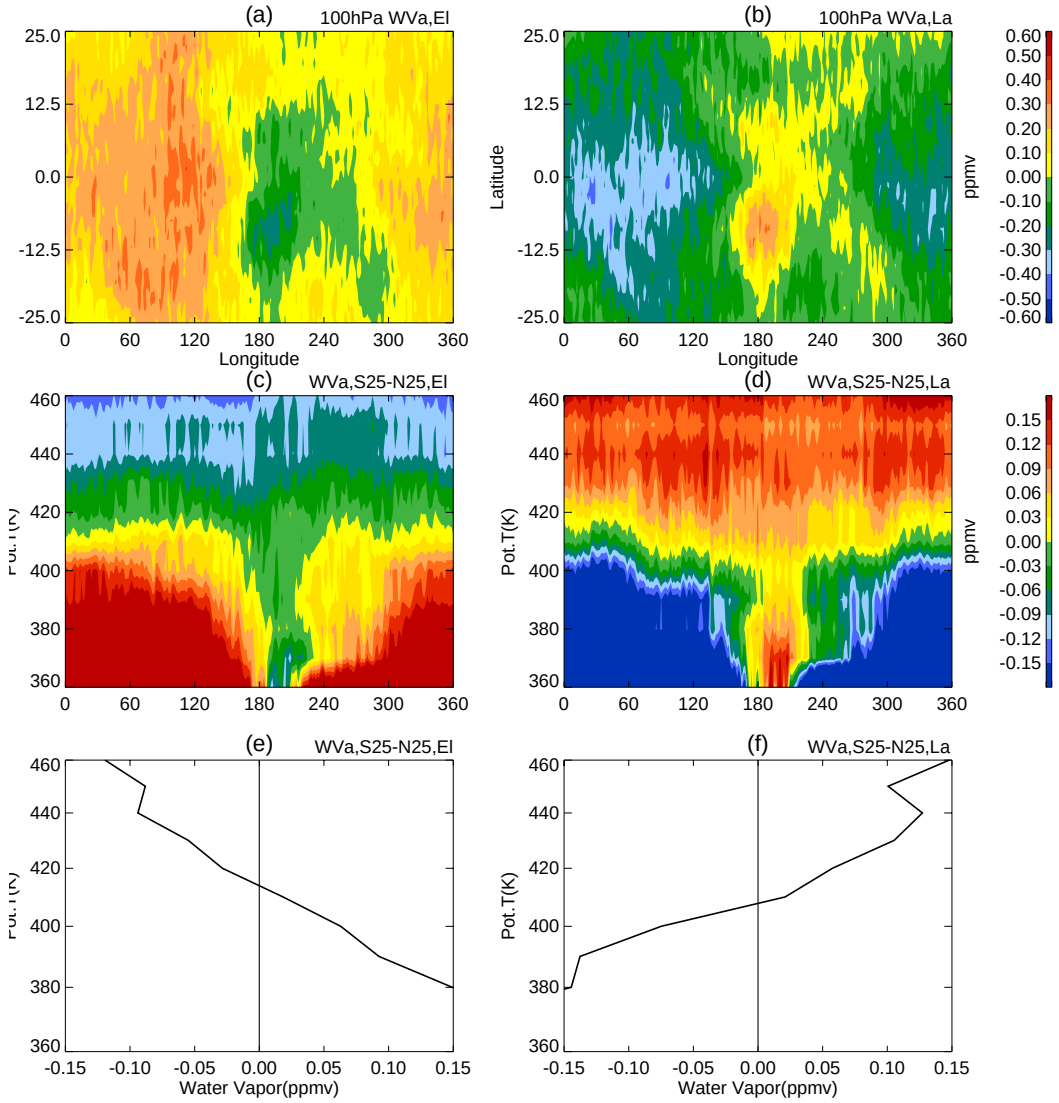

Figure 5. MLS water vapor anomalies at 100 hPa composited for (a) El Nin˜o and (b) La Nin˜a events. (c, d) Longitude-height cross sections of MLS water vapor anomalies averaged between the 25°N-25°S latitude band composited for (c) El Nin˜o and (d) La Nin˜o events. Contour intervals are ±0.1 ppmv for (a) and (b), and ±0.03 ppmv for (c) and d**.** (e, f) Vertical profiles of zonal mean MLS water vapor anomalies averaged between the latitude band 25°S-25°N for (e) El Nin˜o events and (f) La Nin˜a events.

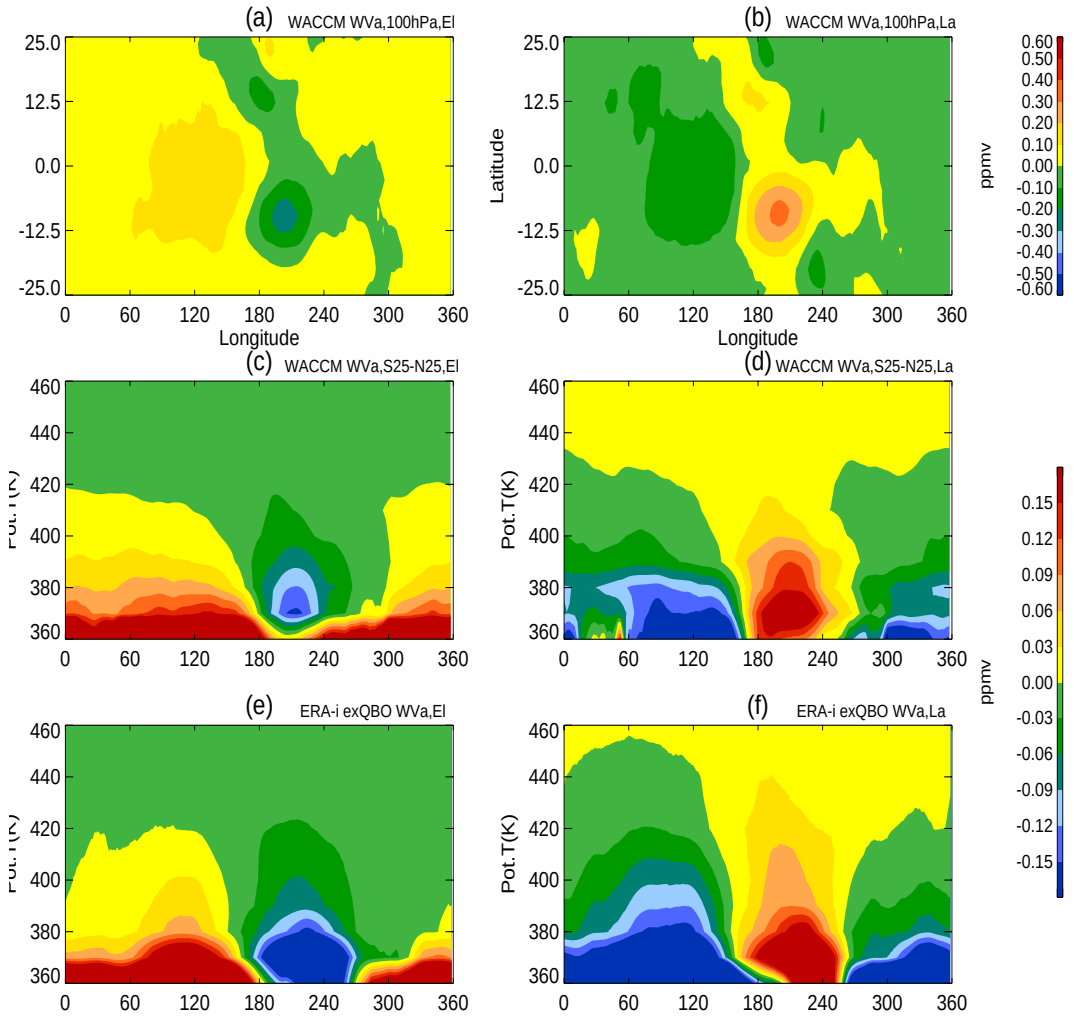

Figure 6. (a, b) Water vapor anomalies at 100 hPa composited from 30 years of WACCM model simulations for (a) El Nin˜o and (b) La Nin˜a events. Contour intervals are ±0.1 ppmv. (c, d) Longitude-height cross sections water vapor anomalies averaged between the 25°N-25°S latitudes band composited from 30 years of WACCM model simulations for (c) El Nin˜o and (d) La Nin˜o events. Contour intervals are ±0.03 ppmv**.** (e, f) Longitude-height cross sections of water vapor anomalies averaged between the 25°N-25°S latitudes band composited from filtered ERA-Interim data (see text for more details) for (e) El Nin˜o and (f) La Nin˜o events. Contour intervals are ±0.03 ppmv**.**

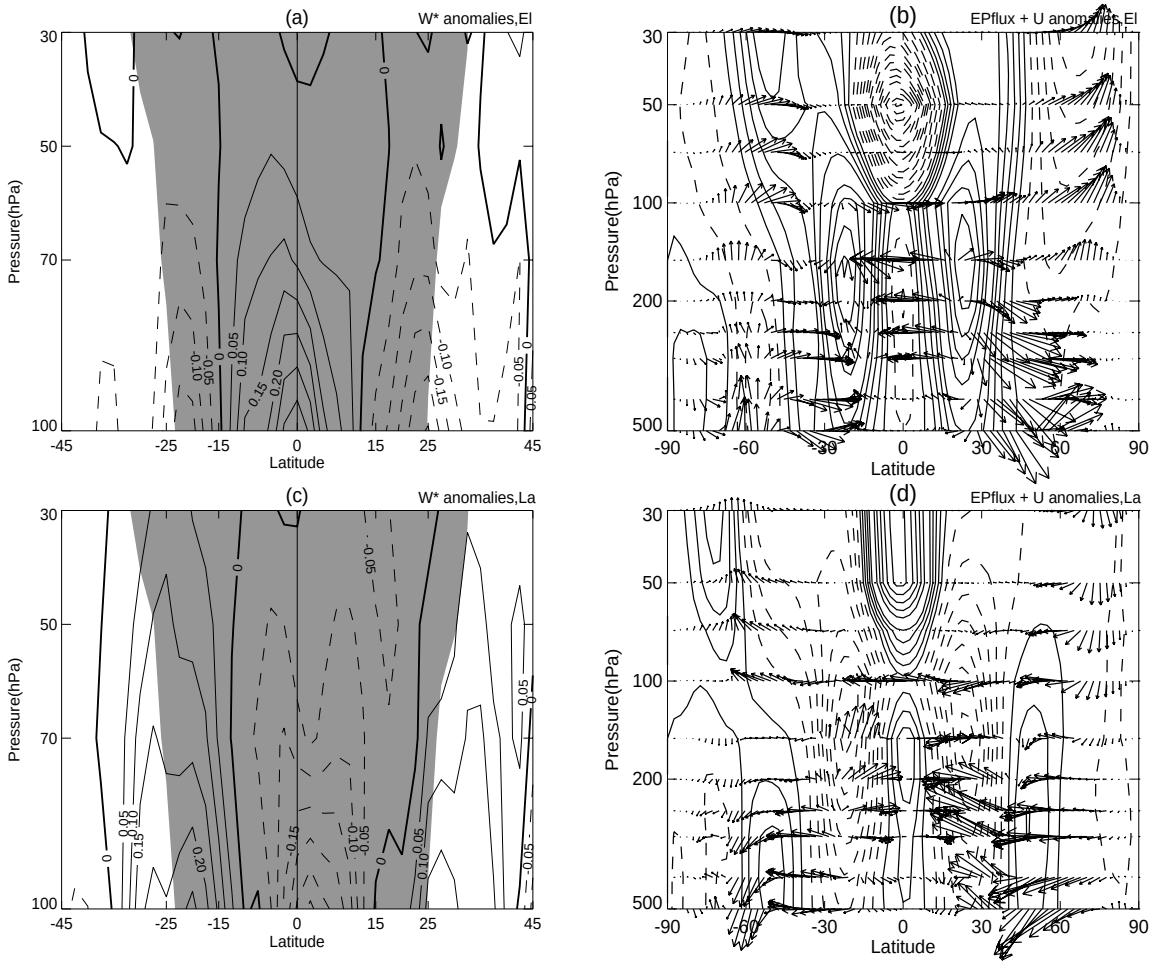

Figure 7. Vertical velocity anomalies of BD circulation (w^*') for (a) El Nin˜o events and (c) La Nin˜a events based on ERA-40 data. The contour interval is ±0.05 mPa s^{-1}. The zero contour lines are delineated as think black solid lines. Positive and negative contours are represented by thin solid lines and dashed lines, respectively. The regions where climate mean vertical velocity of BD circulation (w^*) is upward are shaded. Composited anomalies of the E-P flux and zonal wind for (b) El Nin˜o events and (d) La Nin˜a events based on ERA-40 data. The unit of horizontal vector is 10^7 kg s^{-1} and vertical vector is 10^5 kg s^{-1}. The contour interval for zonal wind anomalies is ±0.5 m s^{-1}. Solid lines and dashed lines in (b) and (d) represent positive and negative zonal wind anomalies, respectively.