



Supplement of

Quasi-10 d wave activity in the southern high-latitude mesosphere and lower thermosphere (MLT) region and its relation to large-scale instability and gravity wave drag

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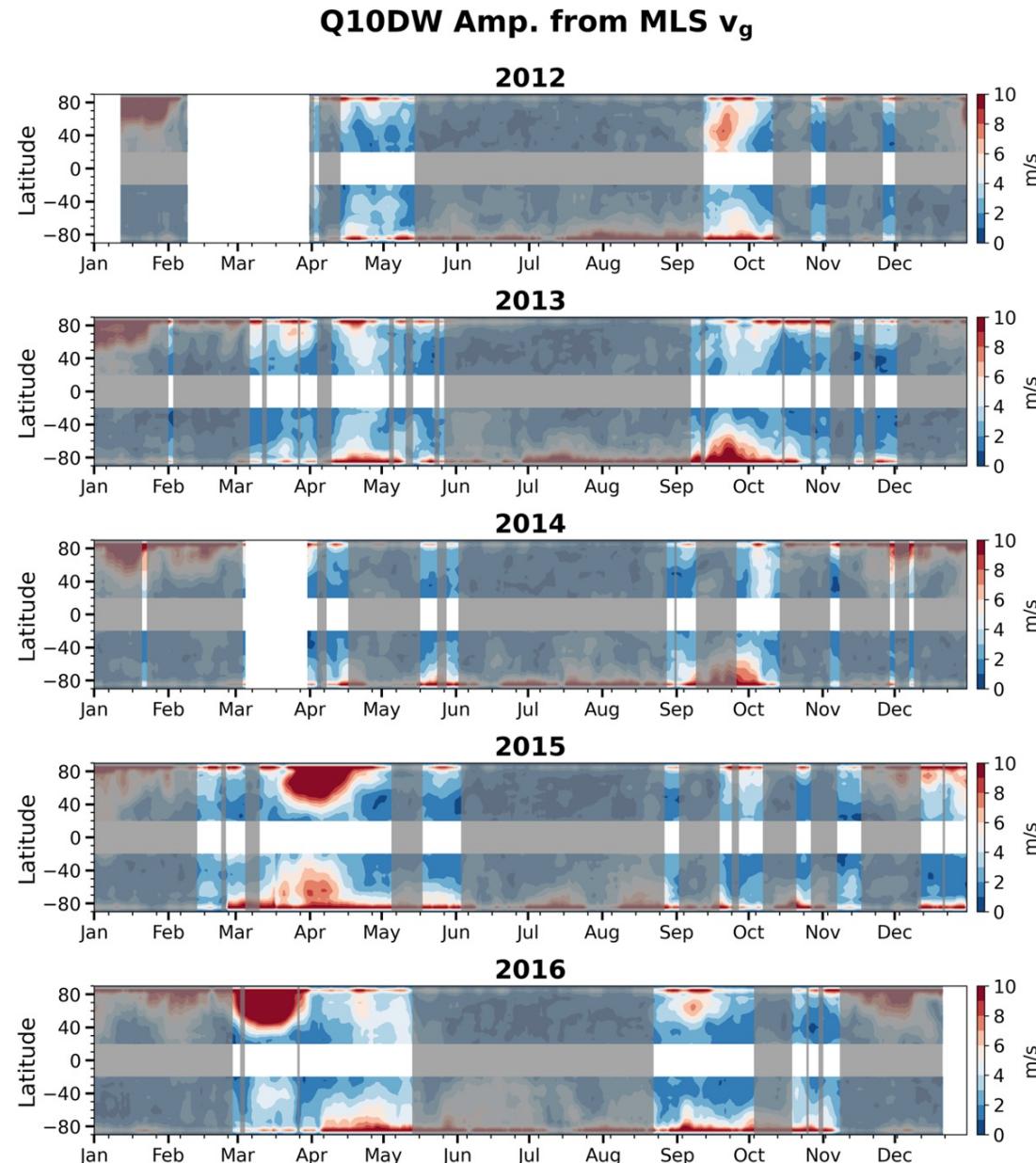


Figure S1. Time-latitude distributions of the amplitudes of Q10DWs (unshaded regions) and Q10DOs (shaded regions) derived from the vertically averaged (80–90 km) MLS meridional geostrophic winds for each year from 2012 to 2016. The gray shading represents time periods where the hemispheric symmetry is unclear in the MLS results.

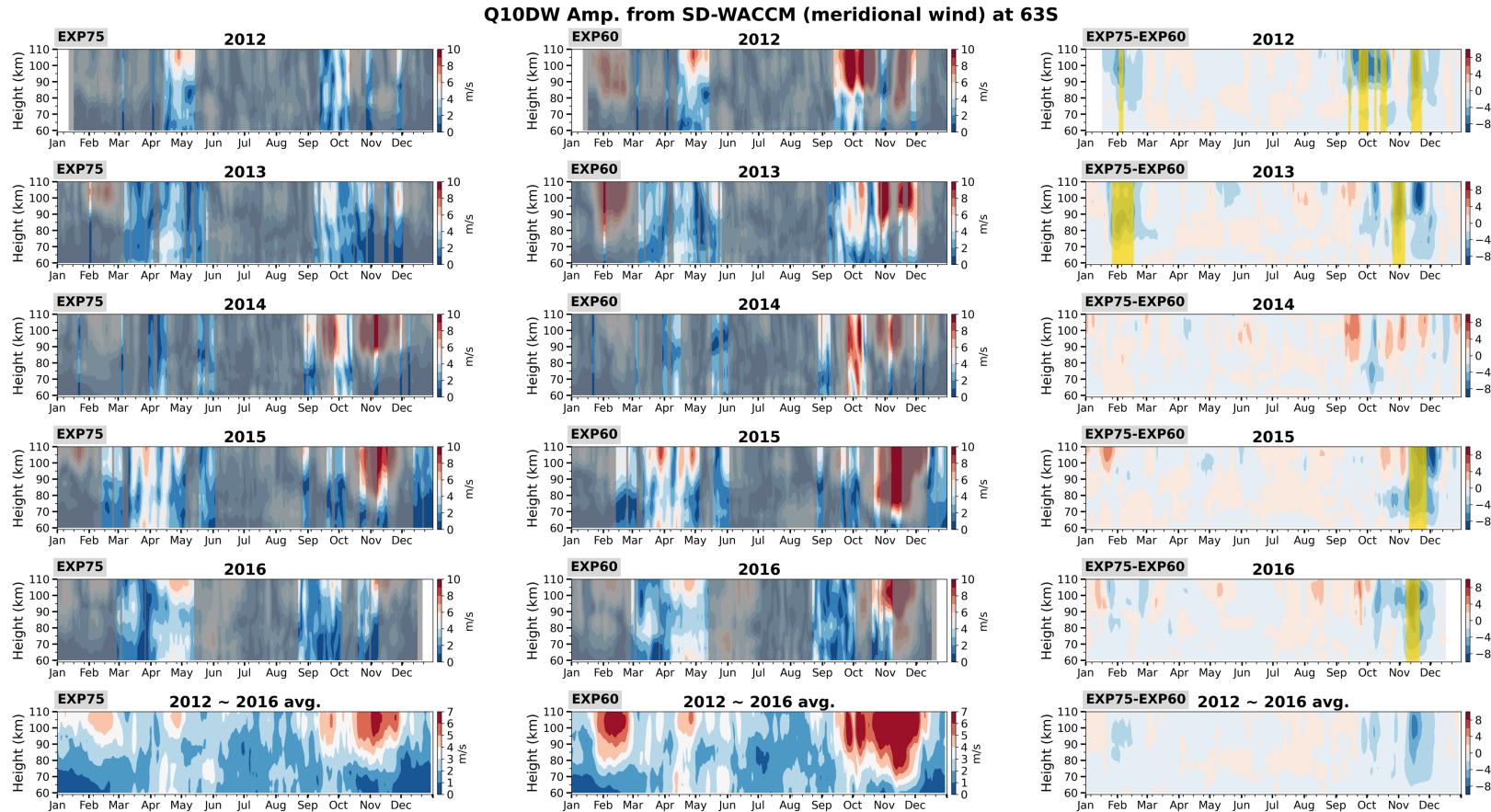


Figure S2. Time-height distributions of the amplitudes of Q10DWs and Q10DOs around 63°S for 2012–2016 in (left) the EXP75 and (middle) the EXP60. Their difference (EXP75–EXP60) is shown in right panels, where the yellow shadings indicate date ranges when the difference is larger than averaged difference plus two standard deviations. The bottom-most panels show the 5-yr average between 2012 and 2016. The gray shaded areas represent periods where hemispheric symmetry is not observed in the MLS results.

30 Apr 2012

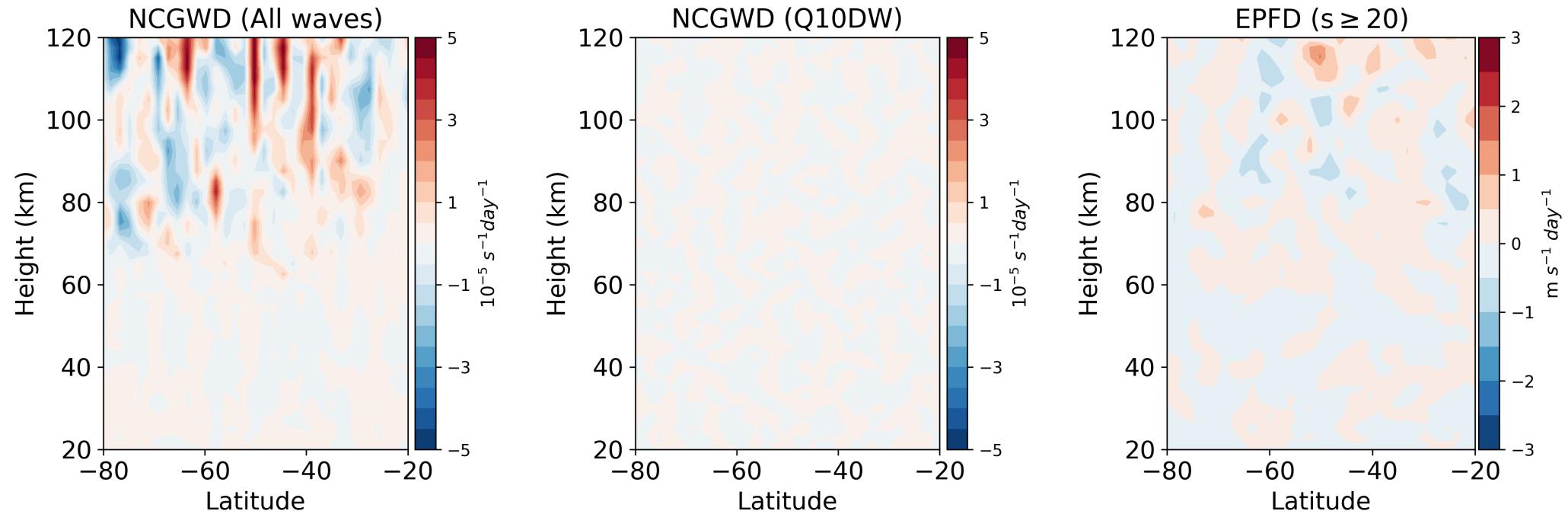


Figure S3. Latitude-height distributions of zonal-mean amplitudes of NCGWD due to (left) all parameterized GWD and (middle) due to the parameterized GWD with quasi-10-day periodicity in 30 April 2012. The resolved GWD (i.e., EPFD with $s \geq 20$) is shown in right panel.

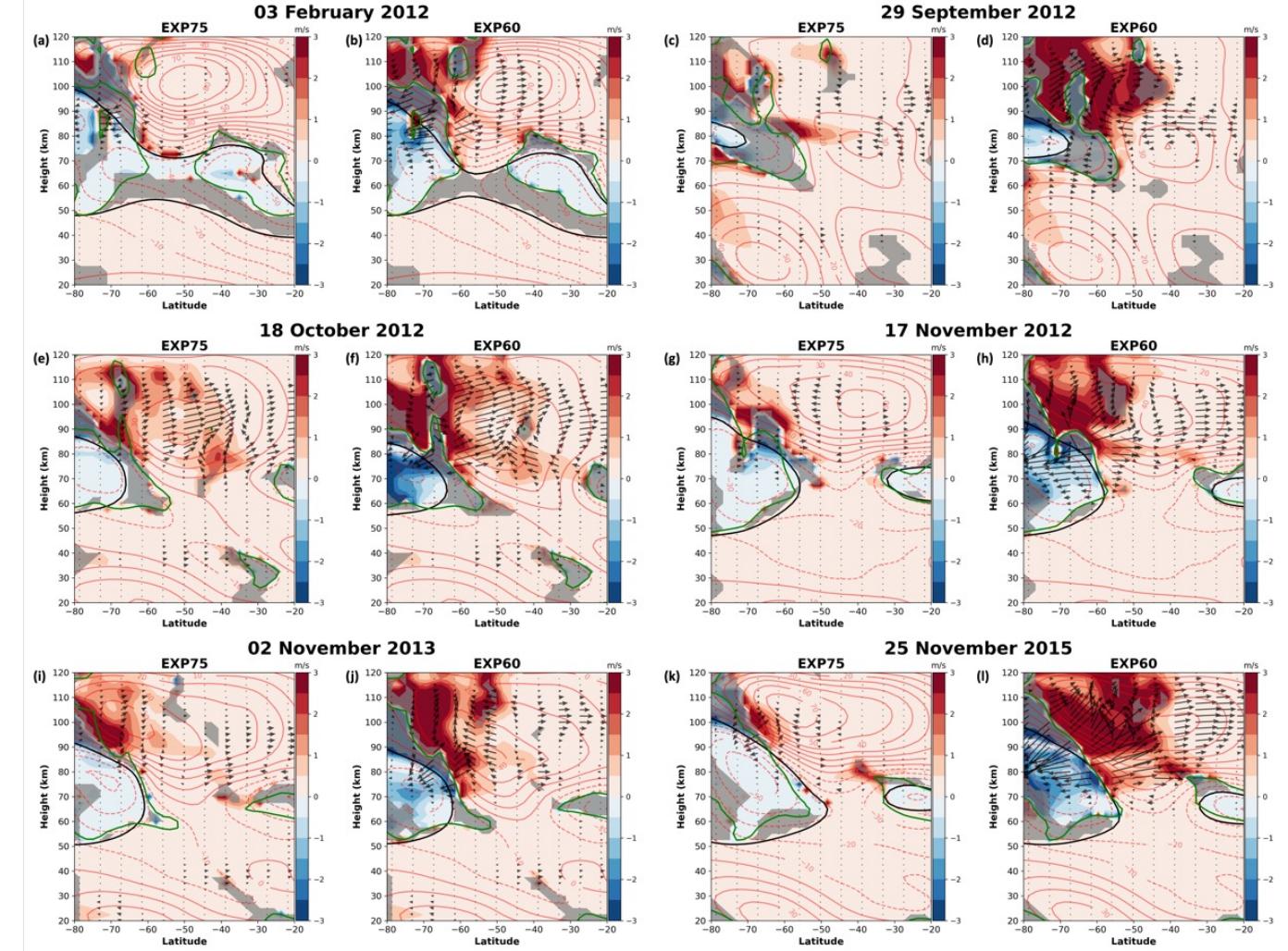


Figure S4. EP flux parallel to local group velocity [$F/\text{sgn}(A)$] and normalized wave activity density [$A (\rho_0 a \cos \phi)^{-1}$ given in the unit of m s^{-1}] for the Q10DWs on (a and b) 3 February 2012, (c and d) 29 September 2012, (e and f) 18 October 2012, (g and h) 17 November 2012, (I and j) 2 November 2013, and (k and l) 25 November 2015. The first and third columns and second and forth columns represent the results from EXP75 and EXP60, respectively. The activity density A is shaded in blue and red depending on its sign. The boundaries of the instability regions ($\bar{q}_\phi = 0$, green lines), the negative n^2 regions (grey shading), and the red contours for zonal-mean zonal wind are overplotted. For eastward (westward) zonal-mean zonal wind, contours are plotted in solid (dashed) lines, and contour interval is 10 m s^{-1} .

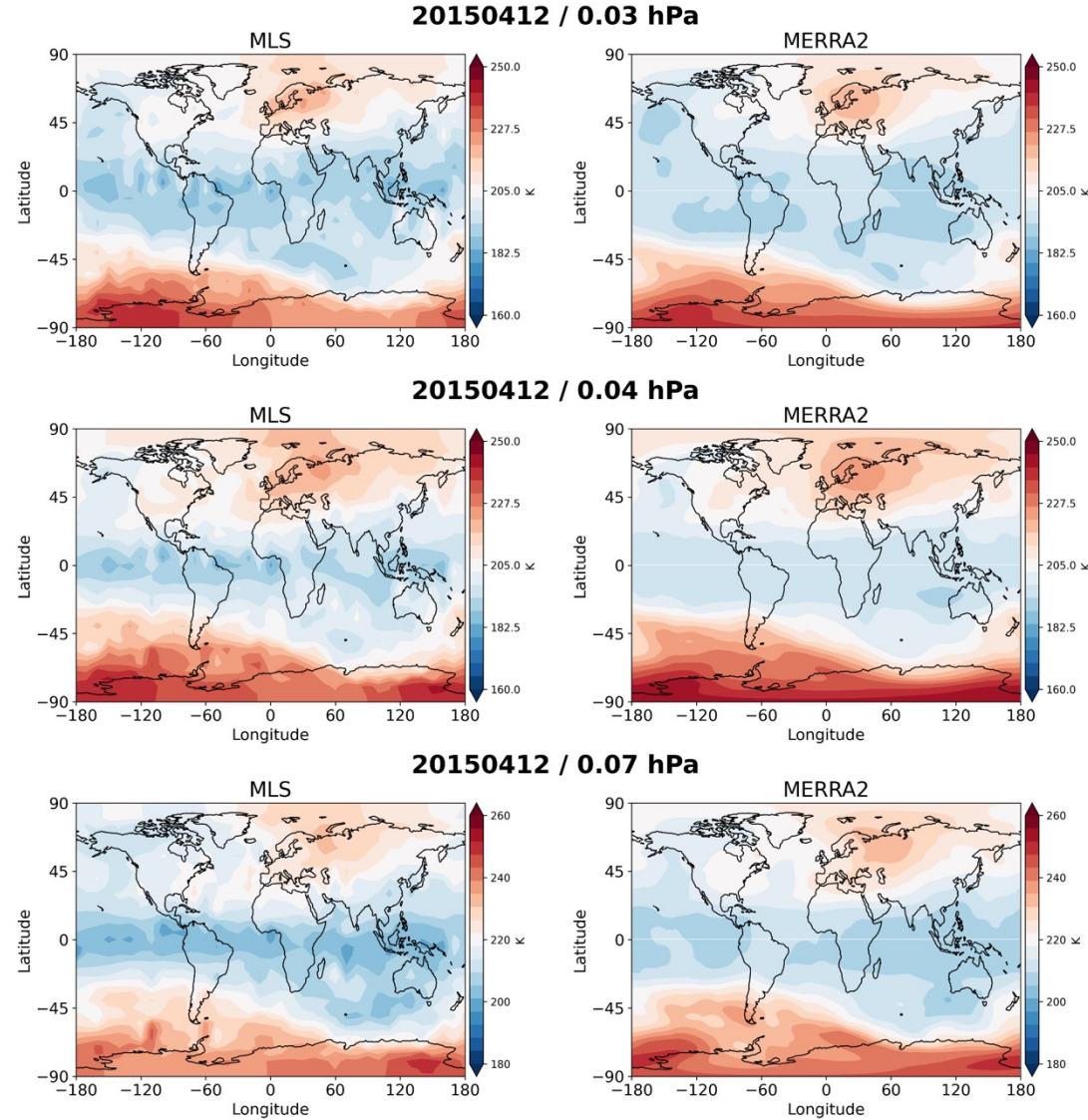


Figure S5. Longitude-Latitude distributions of temperature at three different pressure levels of 0.03 hPa, 0.04 hPa, and 0.07 hPa on 12 April 2015. For each pressure level, the temperature distributions from (left) MLS and (right) MERRA-2 are presented.