Supporting Information for "Insights on Lateral Gravity Wave Propagation in the Extratropical Stratosphere from 44 Years of ERA5 Data"

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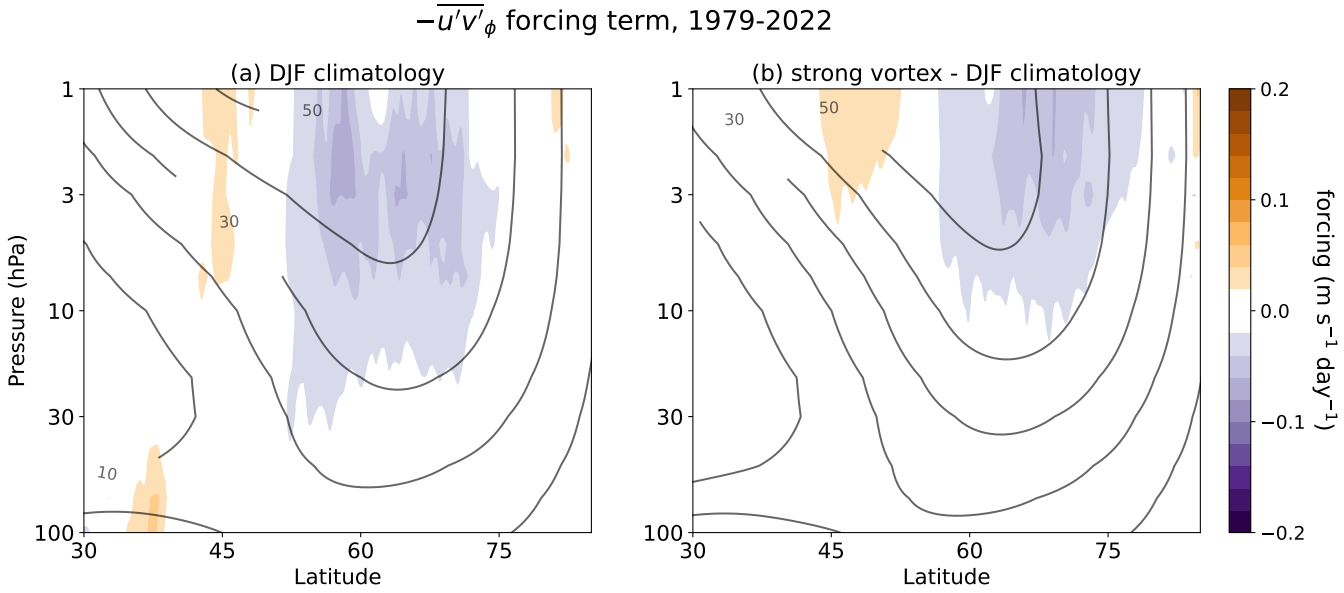

Figure S1. (a) DJF climatology of the $\overline{u'v'}_\phi$ forcing term, and (b) the difference between the climatology and $\overline{u'v'}_\phi$ terms for strong vortex days. A strong vortex day is identified as the day for which the zonal mean zonal wind at 60°N and 10 hPa is greater than 30 m/s. The negative values in (b) indicate that the deceleration provided by meridional convergence of lateral fluxes is much stronger for strong vortex days as compared to the climatology.

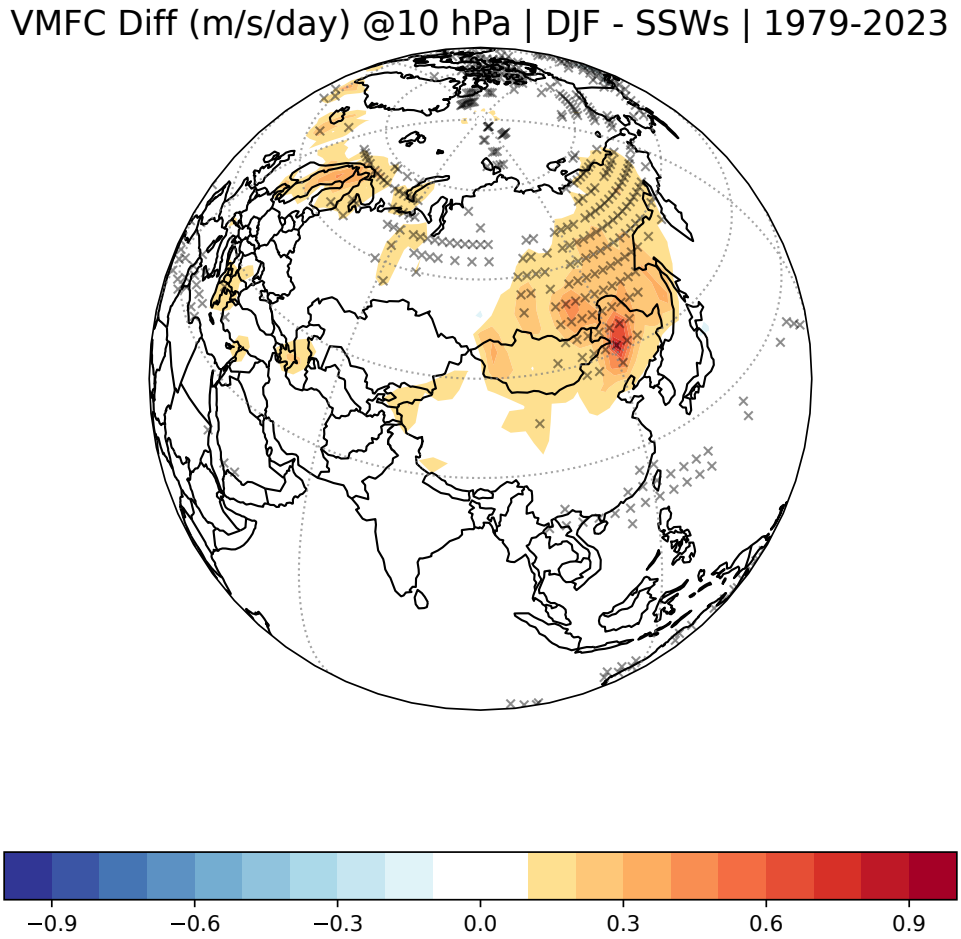

Figure S2. Vertical momentum flux convergence difference (in m/s/day) between the DJF climatology and the composite mean around major northern hemispheric SSWs. The difference is shown at 10 hPa altitude. Stipling indicates that the differences are statistically significant with 95% confidence.

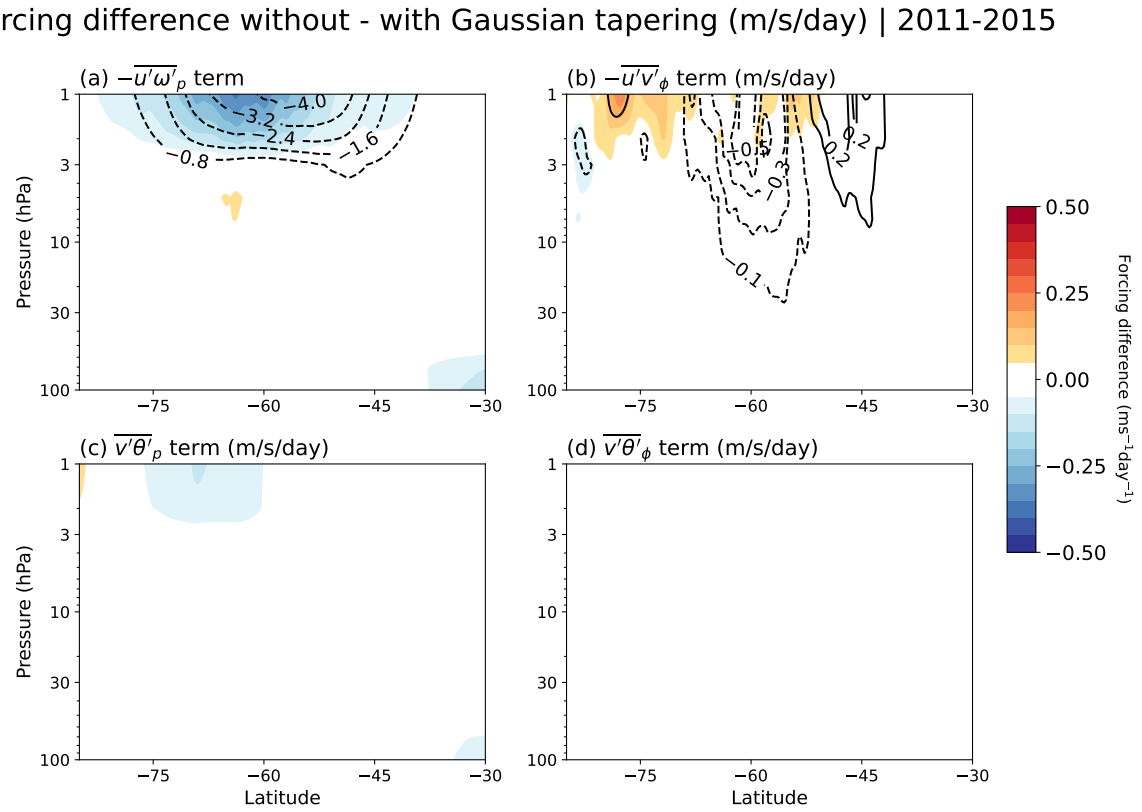

Figure S3. Difference in the obtained small-scale forcing (in m/s/day) with and without Gaussian tapering during 2011-2015 Southern Hemisphere winters. For the "without Gaussian tapering" case, a high-pass filter with a hard cutoff of total wavenumber 21 was applied to filter out the large scales. The net forcing from the 21 cutoff is shown using black curves in (a) and (b). The differences are strongest for the $-\overline{u'\omega'}_p$ term, and are mostly negligible below 2 hPa. Colors associated with negative values in (a) indicate a stronger westward forcing when a fixed cutoff is used instead of a Gaussian tapering and highlight an additional westward deceleration provided by wavenumbers 21 to 42 which are otherwise partially/fully tapered by the Gaussian tapering. Colors associated with positive values in (b) indicate a weaker westward forcing for the hard cutoff case, primarily due to a reduced focusing of wavenumbers 21 to 42 towards the jet, and hence an increased spreading of the lateral fluxes for the Gaussian tapering case. These differences are weak and restricted to regions with pressure lower than 2 hPa.

Table S1. Northern Hemisphere sudden stratosphere warmings (SSWs) and Southern Hemisphere final warming (FWs) dates for the period 1979-2023.

Year	Final Warming Date	Major SSW Dates
1979	16 November	22 February
1980	16 November	29 February
1981	16 November	6 February, 4 March, 4 December
1982	18 November	
1983	6 November	
1984	5 November	24 February
1985	10 November	1 January
1986	12 November	
1987	30 November	23 January, 8 December
1988	26 October	14 March
1989	9 November	21 February
1990	3 December	
1991	13 November	
1992	19 November	
1993	21 November	
1994	10 November	
1995	23 November	3 February
1996	3 December	
1997	16 November	
1998	6 December	15 December
1999	4 December	26 February
2000	2 November	20 March
2001	6 December	11 February, 30 December
2002	30 November	18 February
2003	5 November	18 January
2004	15 November	5 January
2005	9 November	
2006	2 December	21 January
2007	26 November	24 February
2008	30 November	22 February
2009	15 November	24 January
2010	10 December	9 February
2011	23 November	
2012	4 November	
2013	1 November	6 January
2014	20 November	
2015	9 December	
2016	8 November	
2017	8 November	
2018	23 November	12 February
2019	29 October	2 January
2020	12 December	
2021	12 December	5 January
2022	27 November	
2023		15 February