Table S1: As in Table 1, but for the CESM1(WACCM) simulation.

Dates	$\min_{60-90^oN}\overline{v'T'}_{k=1}$	$\min_{60-90^oN} dO_3/dt$	Dates	$\min_{60-90^oN}\overline{v'T'}_{k=1}$	$\min_{60-90^oN} dO_3/dt$
18 Mar 1956	-41.41	-23.91	19 Feb 2007	-88.41	-10.96
6 Feb 1958	-61.16	-25.89	28 Feb 2008	-104.6	-12.3
12 Jan 1959	-54.95	-7.81	16 Jan 2010	-71.58	-4.94
14 Jan 1961	-125.9	-5.68	5 Mar 2010	-19.27	-9.61
28 Jan 1962	-92.87	-32.55	3 Feb 2011	-37.05	-7.15
31 Mar 1964	-68.39	-3.13	26 Mar 2011	-157.2	-16.95
10 Feb 1965	-144.5	-47.87	5 Jan 2012	-46.41	-7.46
10 Feb 1966	-64.27	-9.84	29 Jan 2012	-71.7	-54.92
4 Feb 1968	-59.48	-4.51	1 Jan 2014	-37.47	-16.45
28 Mar 1969	-54.76	-16.64	16 Feb 2015	-88.92	-11.65
5 Feb 1970	-91.87	-16.12	25 Jan 2016	-40.82	-9.69
1 Feb 1972	-38.3	-4.73	17 Mar 2016	-70.51	-26.1
6 Jan 1974	-44.33	-8.27	8 Jan 2018	-81.6	-13.93
21 Jan 1977	-63.08	-5.09	15 Feb 2019	-47.7	-22.88
9 Mar 1981	-45.79	-17.27	23 Mar 2019	-55.67	-9.63
5 Feb 1982	-69	-28.15	15 Feb 2023	-70.42	-31.56
27 Mar 1982	-43.4	-25.63	3 Mar 2023	-82.45	-56.34
17 Jan 1984	-62.91	-8.39	13 Jan 2024	-38.01	-13.94
4 Mar 1984	-50.41	-9.26	2 Feb 2025	-103.6	-6.57
20 Jan 1985	-56.24	-9.08	10 Jan 2029	-87.6	-16.32
14 Feb 1985	-120.2	-15.66	29 Jan 2030	-101.3	-8.91
15 Jan 1986	-48	-9.79	31 Jan 2031	-93.74	-5.11
2 Feb 1987	-38.41	-6.21	29 Mar 2034	-69.24	-9.68
10 Mar 1987	-94.01	-19.39	3 Mar 2037	-59.01	-10.83
26 Feb 1990	-84.78	-14.46	2 Mar 2038	-71.45	-19.67
19 Jan 1999	-55.01	-87.78	6 Feb 2042	-73.8	-5.08
11 Feb 1999	-115.7	-23.19	3 Feb 2049	-65.93	-15.85
3 Jan 2004	-73.3	-24.37	20 Jan 2054	-47.82	-34.82
11 Jan 2005	-77.26	-8.04			
16 Feb 2006	-90.56	-47.08			

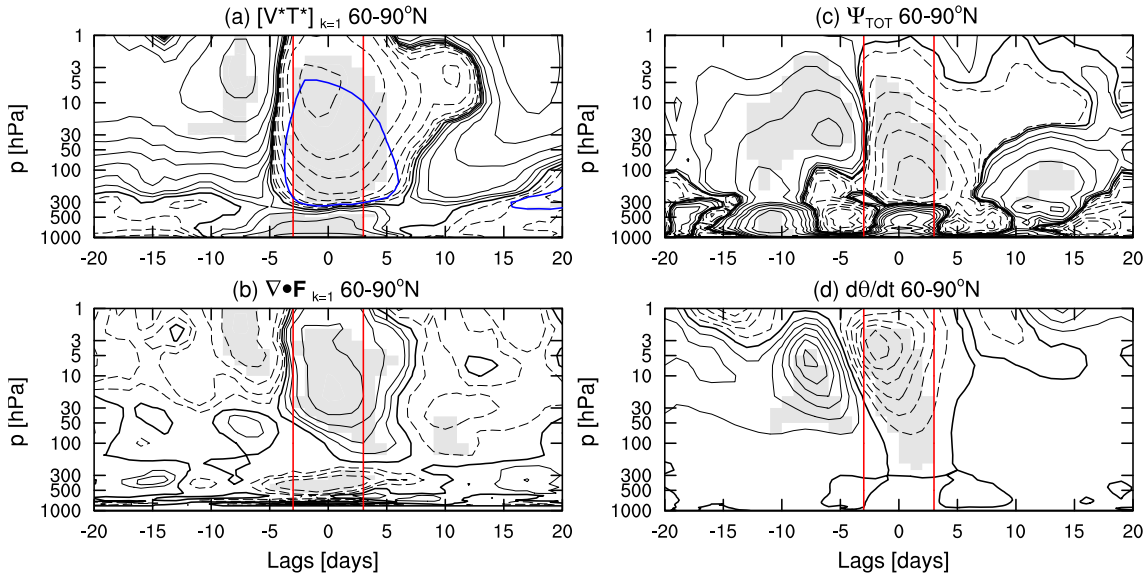

Figure S1: Evolution of the downward planetary wave events as a function of time from days -20 to +20 and pressure: (a) wave-1 meridional heat flux anomaly (black contours) and zero contour of the total wave-1 meridional heat flux (blue contour), (b) wave-1 EP flux divergence anomaly, (c) residual mass-streamfunction anomaly, and (d) potential temperature tendency averaged from 60 to 90^0N. The black contour intervals are: $\pm$ 1 x 10^9 [0.5, 1, 2, 4, 8, 16, 32, 64,..] kg s^{-1} for Fig. S1c and $\pm$ 0.5 K day^{-1} for Fig. S1d. The gray shading indicates statistical significance at the 95%. The periods of the maximum DWC event (days -3 to +3) are bounded by two vertical red lines.

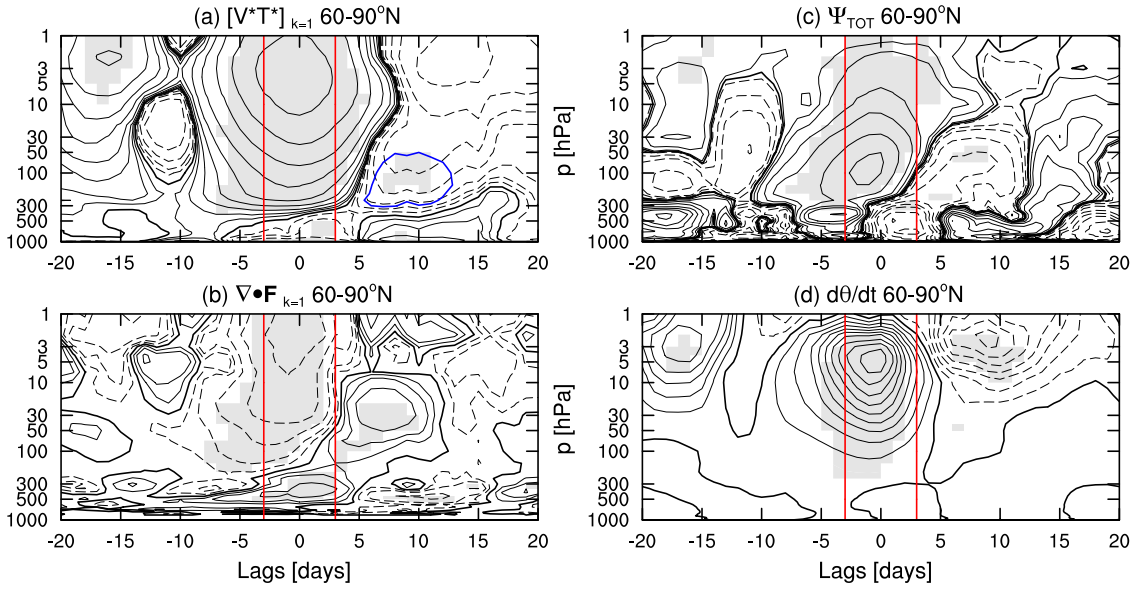

Figure S2: Same as Fig. S1, but for the evolution of the upward planetary wave events as a function of time from days -20 to +20 and pressure. The gray shading indicates statistical significance at the 95%. The periods of the maximum DWC event (days -3 to +3) are bounded by two vertical red lines.

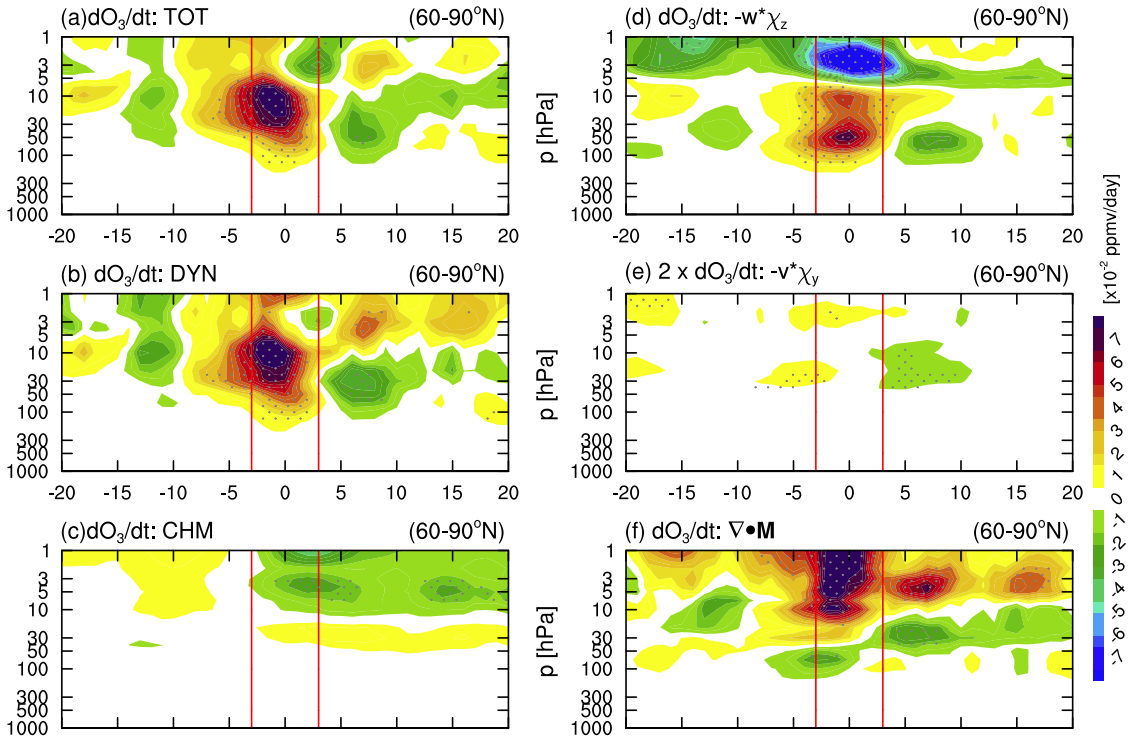

Figure S3: Same as Fig. 2, but for the evolution of the upward planetary wave events as a function of time from days -20 to +20 and pressure. The stippling indicates statistical significance at the 95%. The periods of the maximum DWC event (days -3 to +3) are bounded by two vertical red lines.