Supporting Information for "How well do we know the surface impact of sudden stratospheric warmings?"

Jessica Oehrlein[1,2], Lorenzo M. Polvani[2,3,4], Lantao Sun[5], Clara Deser[6]

[1]Dept. of Mathematics, Fitchburg State University

[2]Dept. of Applied Physics and Applied Mathematics, Columbia University

[3]Dept. of Earth and Environmental Sciences, Columbia University

[4]Lamont-Doherty Earth Observatory

[5]Dept. of Atmospheric Sciences, Colorado State University

[6]National Center for Atmospheric Research

Contents of this file

1. Figures S1 to S7
2. Table S1

In this supplementary section, we show statistics of our bootstrapping procedure overall (Figure S1) and for particular composites of interest (Table S1). We show the 10th and 90th percentile surface responses with corresponding Northern Annular Mode plots for four of those regions (Figures S2 and S3), complementing a parallel figure for the other two

regions shown in Figure 3. We consider any impact on the El Niño-Southern Oscillation on our results in the North Pacific (Figure S4). Finally, we consider how the spread in surface responses relates to the spread in stratospheric anomalies at different pressure levels and time lags (Figures S5 and S6).

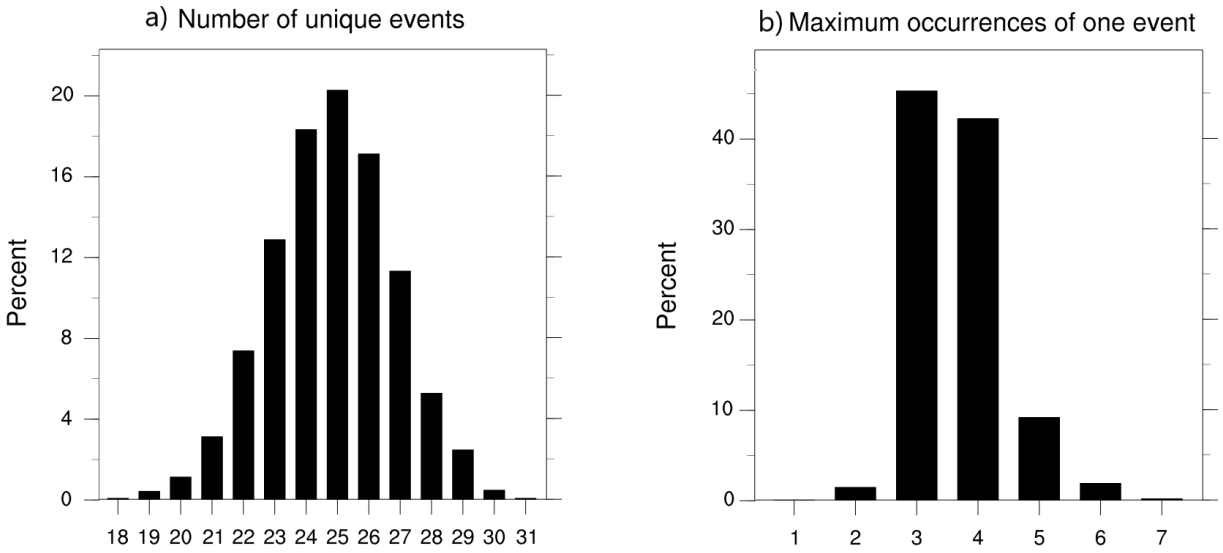

Figure S1. Distributions across all 2000 composites of a) the number of distinct events in each bootstrapped composite and b) the maximum number of occurrences of a single event in each composite.

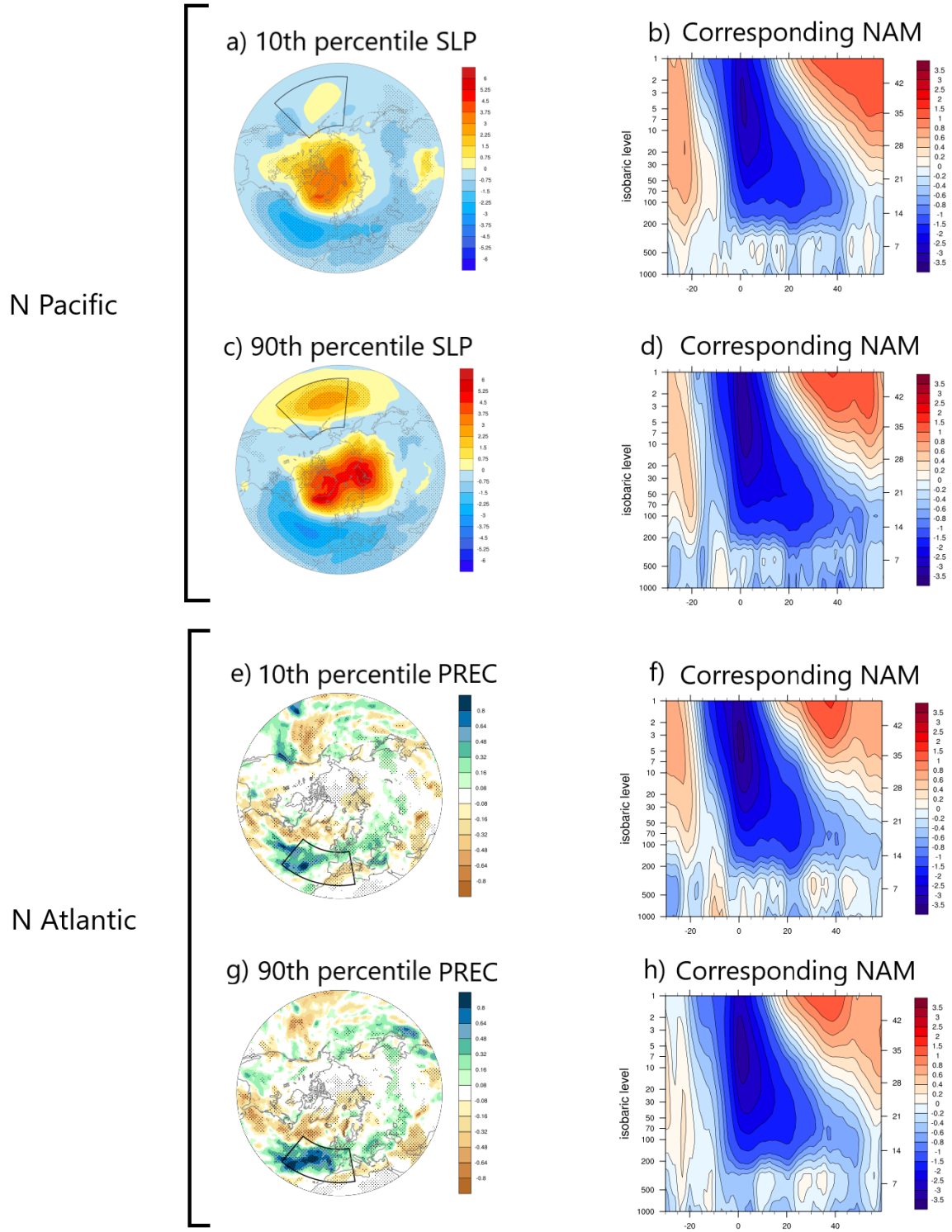

Figure S2. As in Figure 3, but for North Pacific sea level pressure (a-d) and North Atlantic precipitation (e-h).

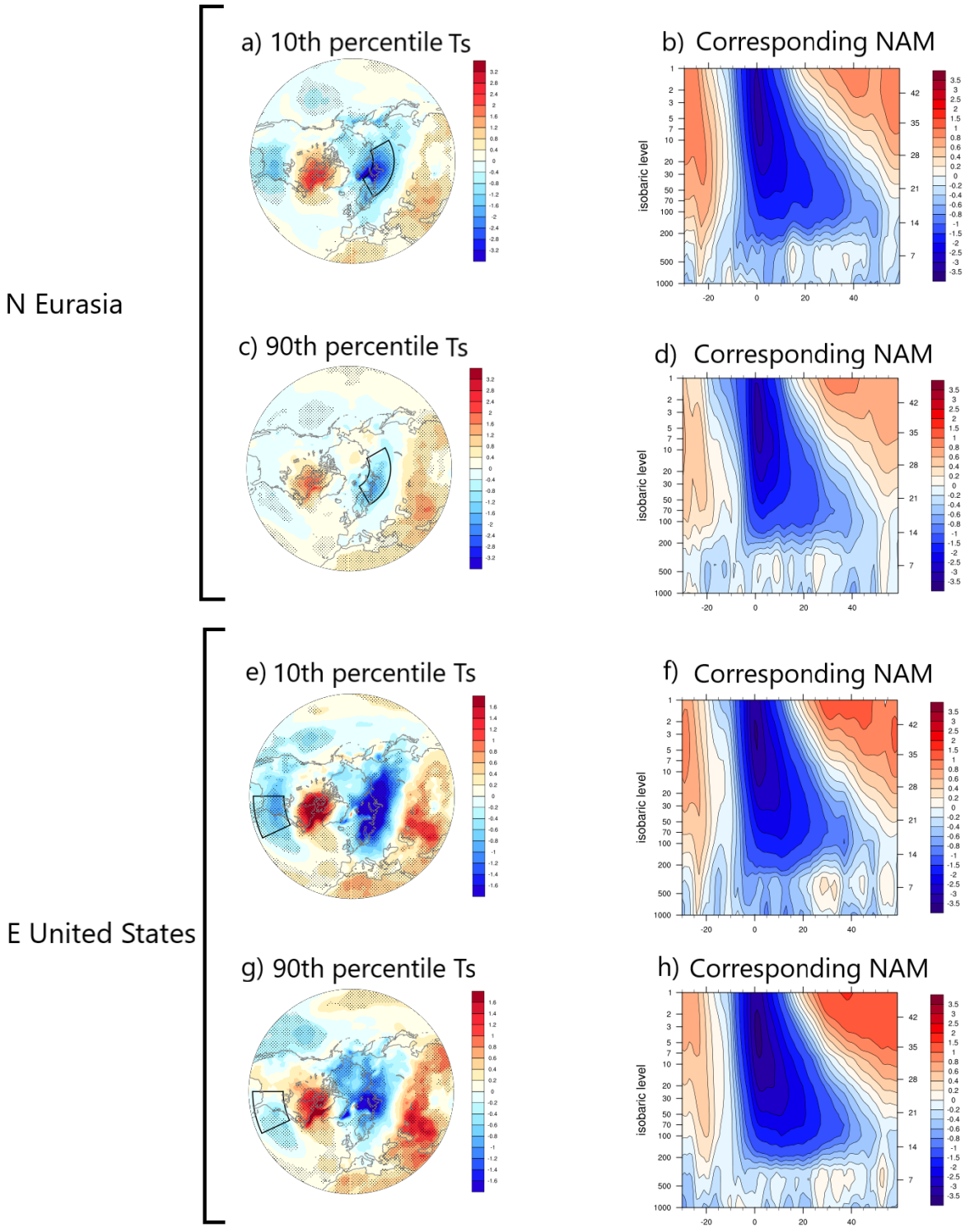

Figure S3. As in Figure 3, but for Northern Eurasian (a-d) and Eastern US (e-h) surface temperature.

Table S1. The number of occurrences of each SSW events in the 10th and 90th percentile composites for the regions of interest.

Event	NAO 10th	NAO 90th	E. Canada 10th	E. Canada 90th
30 Jan 1958	1	0	1	1
17 Jan 1960	3	0	1	1
30 Jan 1963	1	0	3	2
18 Dec 1965	0	1	1	4
23 Feb 1966	2	1	0	2
7 Jan 1968	2	0	1	0
29 Nov 1968	2	1	1	1
2 Jan 1970	1	1	2	1
18 Jan 1971	2	0	2	0
20 Mar 1971	0	0	0	2
31 Jan 1973	0	1	2	0
9 Jan 1977	3	3	0	0
22 Feb 1979	0	0	0	1
29 Feb 1980	1	1	0	1
6 Feb 1981	0	2	1	3
4 Mar 1981	1	0	0	2
4 Dec 1981	1	1	0	0
24 Feb 1984	2	2	2	0
1 Jan 1985	2	0	2	0
23 Jan 1987	1	1	1	0
8 Dec 1987	0	1	0	2
14 Mar 1988	0	2	1	4
21 Feb 1989	1	0	1	1
15 Dec 1998	1	2	1	0
26 Feb 1999	2	1	2	1
20 Mar 2000	0	0	1	3
11 Feb 2001	1	1	1	0
31 Dec 2001	1	3	1	1
18 Jan 2003	1	0	2	1
5 Jan 2004	2	1	3	1
21 Jan 2006	0	0	0	2
24 Feb 2007	1	3	1	1
22 Feb 2008	0	1	1	0
24 Jan 2009	1	2	0	0
9 Feb 2010	0	2	1	1
24 Mar 2010	0	2	0	0
7 Jan 2013	3	1	1	0
12 Feb 2018	0	0	2	0
2 Jan 2019	0	2	0	0

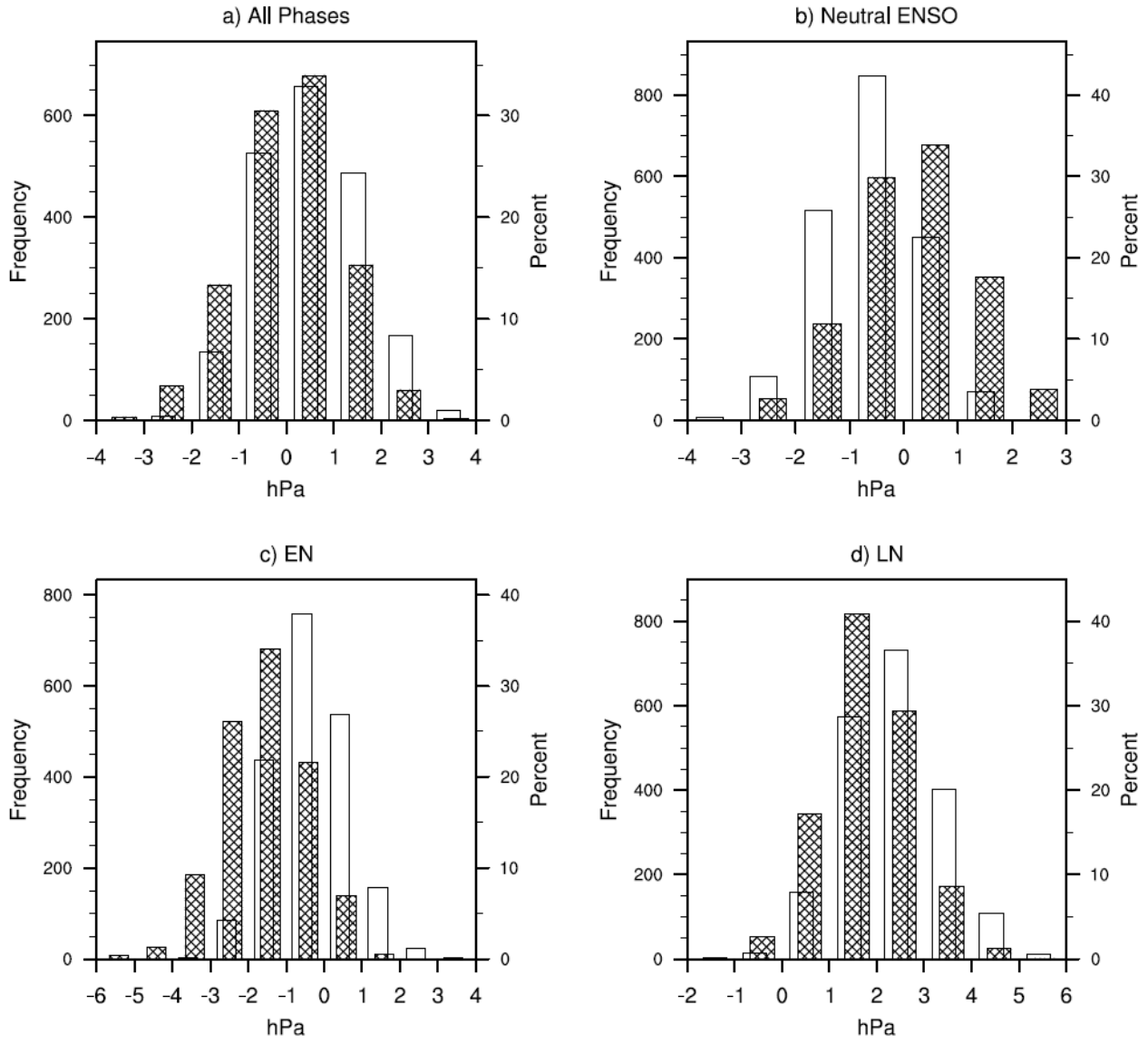

Figure S4. As in Figure 4c, but grouped by ENSO phase: (a) all phases, (b) neutral ENSO, (c) El Niño (EN), and (d) La Niña (LN). SLP anomalies after SSWs are shown in unfilled bars; those after 0-60 day periods across all winters (of that phase where applicable) are hatched.

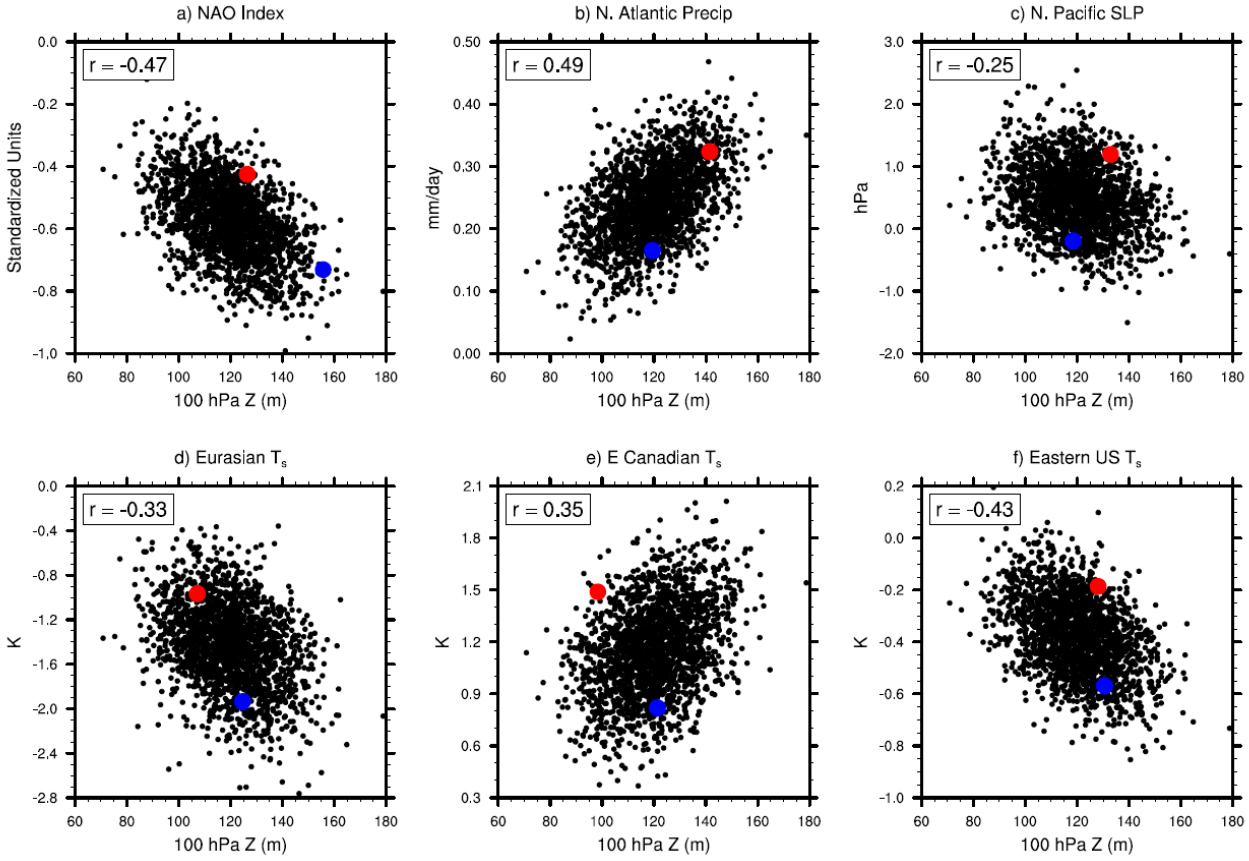

Figure S5. As in Figure 5, but for stratospheric polar vortex strength calculated at 100 hPa.

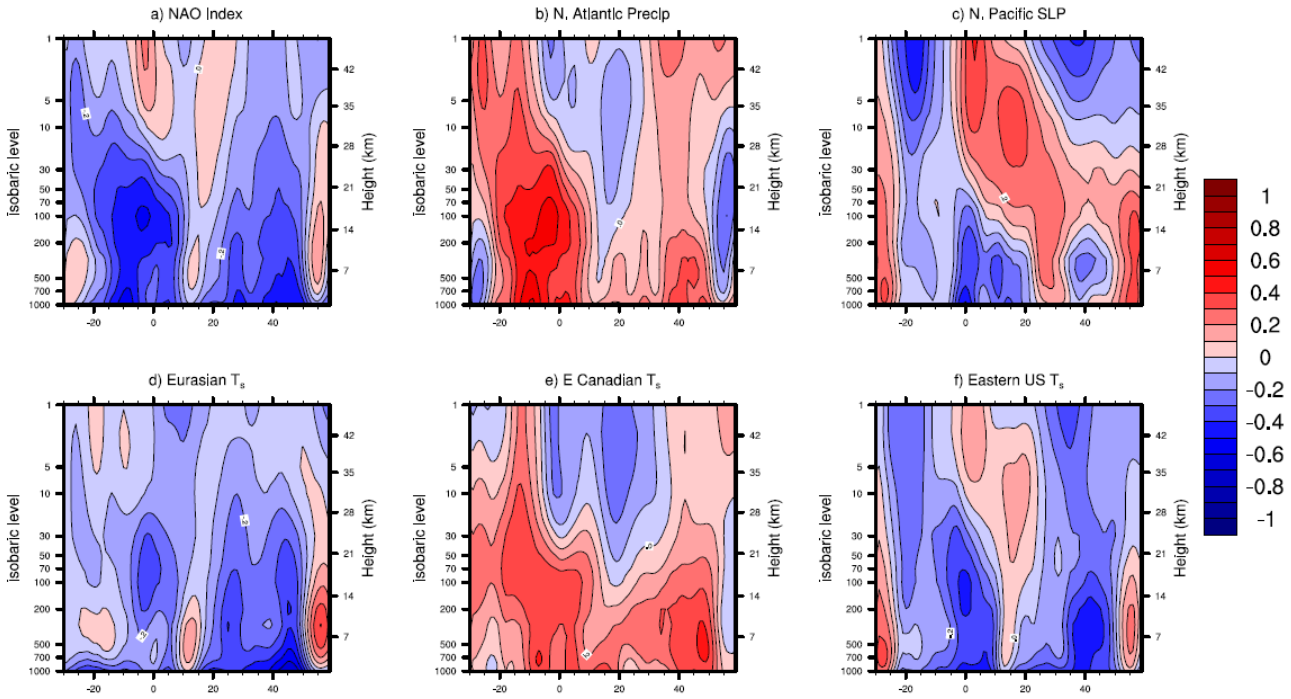

Figure S6. Correlations at each pressure and lag between a five-day geopotential height anomaly and the 0-60 day surface response.