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BUTLER AND GERBER

Optimizing the Definition of a Sudden Stratospheric Warming

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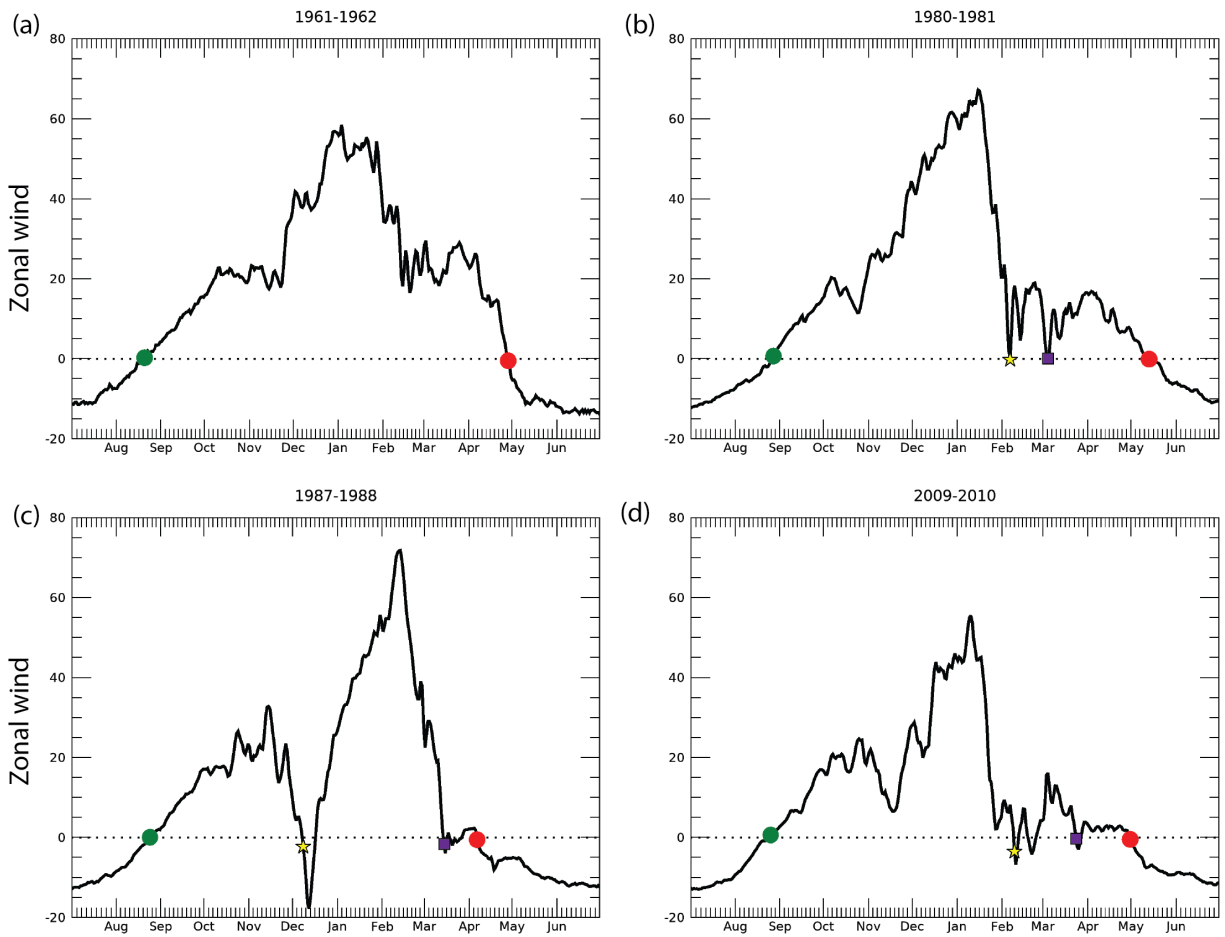
Supplemental Material

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28 **Supplementary Table 1.** Final warmings (FWs) in the Northern Hemisphere, defined by
 29 reversals of the zonal wind at 60°N and 10 hPa with no recovery to westerlies for more than 10
 30 consecutive days, based on JRA-55 reanalysis. Note, every year has a final warming date. The
 31 Hu et al. (2014) method uses NCEP-NCAR reanalysis from 1958-2012 and zonal winds at 65°N
 32 and 10 hPa (see their Table 1). Their FW detection method follows (Black et al. 2006), and
 33 introduces a condition that westerlies beyond the final reversal do not persist beyond 5 days or
 34 become stronger than 5 m s⁻¹. The Hu et al. (2014) dates agree fairly well with Ayarzagüena &
 35 Serrano (2009), which is based on zonal winds at 50 hPa and 70°N. Because the Hu et al (2014)
 36 dates are more recently updated and more similar in latitude/pressure to the zonal winds we
 37 use here, we only compare to them here.

FWs This study	FWs Hu et al. (2014)
3-May-58	2-May-58
18-Mar-59	12-Mar-59
2-Apr-60	11-Apr-60
11-Mar-61	11-Mar-61
28-Apr-62	25-Apr-62
3-May-63	9-Apr-63
19-Mar-64	13-Mar-64
19-Apr-65	19-Apr-65
9-Apr-66	6-Apr-66
14-Apr-67	25-Apr-67
21-Apr-68	27-Apr-68
13-Apr-69	6-Apr-69
12-Apr-70	10-Apr-70
24-Apr-71	6-May-71
25-Mar-72	22-Mar-72
6-May-73	3-May-73
12-Mar-74	12-Mar-74
17-Mar-75	16-Mar-75
30-Mar-76	31-Mar-76
1-Apr-77	31-Mar-77
12-Mar-78	24-Mar-78
8-Apr-79	4-Apr-79
8-Apr-80	6-Apr-80
13-May-81	12-May-81
4-Apr-82	4-Apr-82
1-Apr-83	19-Mar-83
25-Apr-84	25-Apr-84
24-Mar-85	23-Mar-85
19-Mar-86	22-Mar-86

FWs This study	FWs Hu et al. (2014)
2-May-87	24-Apr-87
6-Apr-88	6-Apr-88
15-Apr-89	16-Apr-89
8-May-90	9-May-90
10-Apr-91	8-Apr-91
22-Mar-92	19-Mar-92
12-Apr-93	6-Apr-93
2-Apr-94	2-Apr-94
8-Apr-95	6-Apr-95
10-Apr-96	9-Apr-96
30-Apr-97	29-Apr-97
28-Mar-98	25-Mar-98
2-May-99	29-Apr-99
9-Apr-00	9-Apr-00
10-May-01	13-May-01
2-May-02	5-May-02
14-Apr-03	15-Apr-03
29-Apr-04	29-Apr-04
13-Mar-05	12-Mar-05
7-May-06	9-May-06
19-Apr-07	18-Apr-07
1-May-08	28-Apr-08
10-May-09	7-May-09
30-Apr-10	17-Apr-10
5-Apr-11	6-Apr-11
18-Apr-12	18-Apr-12
3-May-13	n/a
27-Mar-14	n/a
28-Mar-15	n/a
5-Mar-16	n/a



Supplementary Figure 1. Time series of zonal-mean zonal wind [m s^{-1}] at 10 hPa and 60°N for four different years. (a) 1961-1962 had no SSWs; (b)-(d) show winters where the detection of SSWs was different than CP07. Green dot indicates start date of vortex, red date indicates end date of vortex (FW), yellow stars indicate SSWs (detected in this study and CP07), and purple squares indicate SSWs detected in CP07 but not in this study.

References

- Ayarzagüena, B. & Serrano, E., 2009. Monthly Characterization of the Tropospheric Circulation over the Euro-Atlantic Area in Relation with the Timing of Stratospheric Final Warmings. *Journal of Climate*, 22(23), 6313–6324. doi: 10.1175/2009JCLI2913.1.
- Black, R.X., McDaniel, B.A. & Robinson, W.A., 2006. Stratosphere–Troposphere Coupling during Spring Onset. *Journal of Climate*, 19(19), 4891–4901. doi: 10.1175/JCLI3907.1.
- Hu, J., Ren, R. & Xu, H., 2014. Occurrence of Winter Stratospheric Sudden Warming Events and the Seasonal Timing of Spring Stratospheric Final Warming. *Journal of the Atmospheric Sciences*, 2319–2334. doi: 10.1175/JAS-D-13-0349.1.