Supplement of

Volcanic stratospheric sulfur injections and aerosol optical depth during the Holocene (past 11,500 years) from a bipolar ice core array

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Table S1: Dating assessment using tree-rings. Marker events in which a ring-width minima (Salzer et al., 2014) corresponded with a frost damaged ring within an error margin of ±1 year (Salzer and Hughes, 2007) in relation to reconstructed volcanic deposition events over the Late Holocene (this study) and the past 2,500 years (Toohey and Sigl, 2017). WD2014 ages are provided for bipolar eruption signals (Sigl et al., 2016). Ages from attributed Northern Hemisphere extratropical eruptions are on the NS1-2011 chronology (Sigl et al., 2015).

Ring-width minima year (BCE/CE)	Frost-ring year (BCE/CE)	Cooling start year (BCE/CE)	WD2014 start year (BCE/CE)	eVolv2k start year (BCE/CE)	Age difference (year)	VSSI (Tg S)
-2841	-2841	-2841	no match	N/A	N/A	N/A
-2732	-2731	-2732	no match	N/A	N/A	N/A
-1652	-1653	-1653	**-1656**	N/A	**-3**	**45**
-1626	-1627	-1627	**-1628**	N/A	**-1**	**23**
-1418	-1419	-1419	**-1423**	N/A	**-4**	**33**
-1135	-1135	-1135	-1139	N/A	-4	3
-476	-476	-476	(NHET)	-478	-1	2
-245	-244	-245	-248	-247	-3	9
-42	-43	-43	-47	**-44**	**-4**	**39**
274	273	273	no match	N/A	N/A	N/A
627	627	627	(NHET)	**626**	**-1**	**13**
681	681	681	682	**682**	**1**	**27**
990	989	989	990	990	1	0
1201	1200	1200	(NHET)	1200	0	3
1288	1287	1287	1286	**1286**	**-1**	**15**
1458	1457	1457	1458	**1458**	**1**	**33**
1471	1470	1470	(NHET)	1470	0	1
1578	1577	1577	no match	1576	-1	0
1602	1601	1601	1600	**1601**	**-1**	**19**
1641	1640	1640	1640	**1641**	**0**	**19**
1681	1680	1680	no match	N/A	N/A	N/A

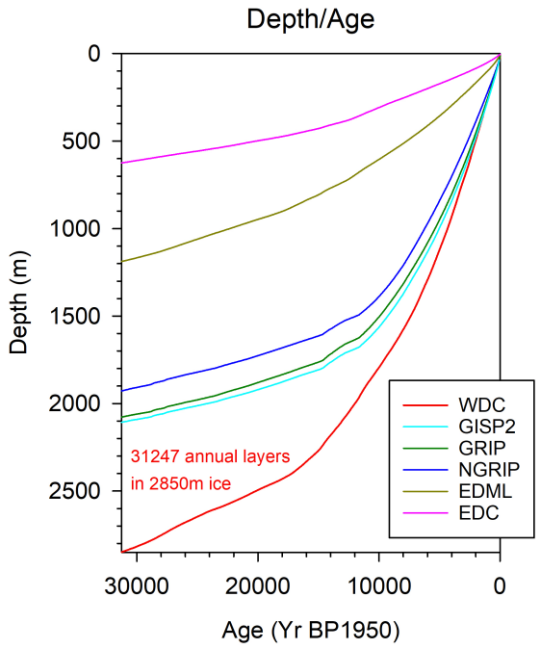

Figure S1: Depth-age relationship for six deep ice cores from Antarctica and Greenland discussed in the paper. All ice core records have been transferred to the WD2014 annual-layer counted ice-core chronology (Sigl et al., 2016) using volcanic tie points during the Holocene (this study) and the last Glacial (Svensson et al., 2020).

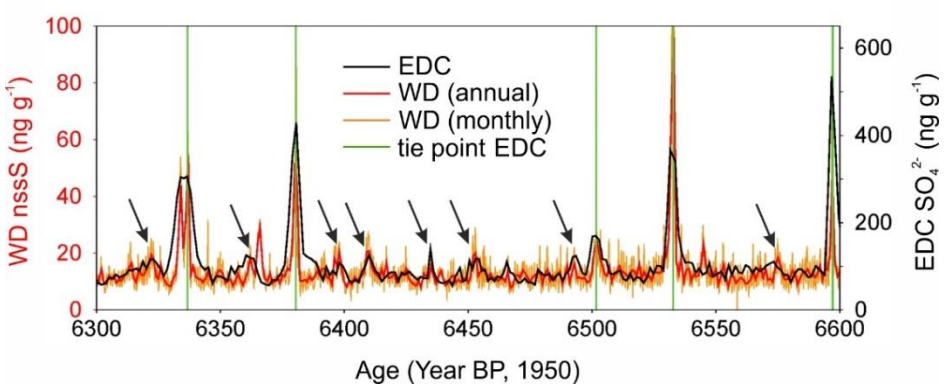

Figure S2: Sulfur concentration record from WD (monthly and annual) and EDC ice cores synchronized on the WD chronology using five volcanic tie points (green lines) and linear interpolation. Note that numerous smaller volcanic signals (arrows) are closely aligning without being used as fixed tie points during the first iteration of the synchronization.

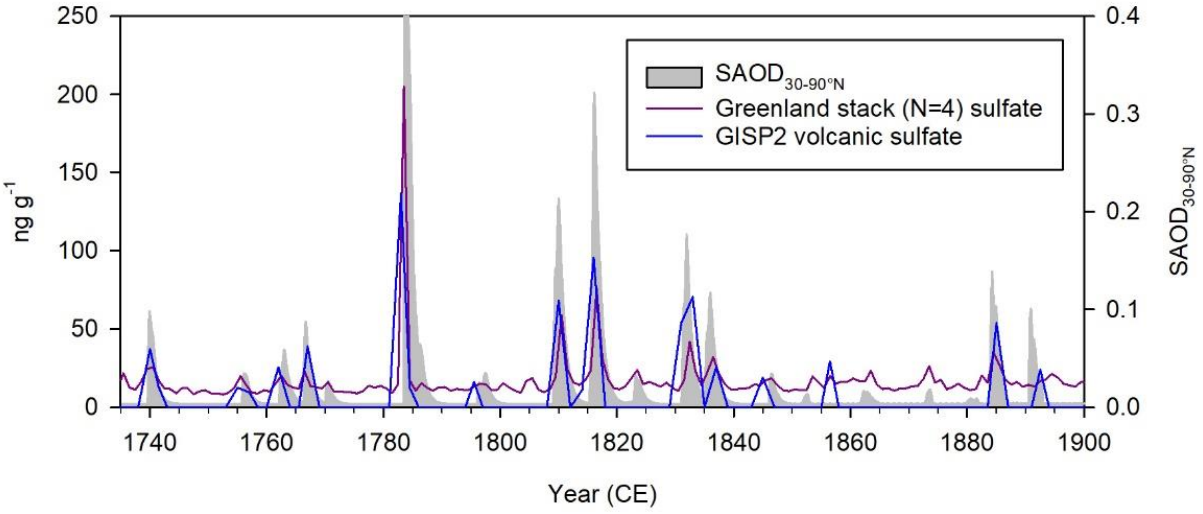

Figure S3: Reconstructed stratospheric Aerosol Optical Depth (SAOD) between 30-90°N (Toohey and Sigl, 2017), mean sulfate concentrations from four ice cores (Summit 2010, D4, NEEM-2011-S1, TUNU2013) from Greenland (Maselli et al., 2017; McConnell et al., 2007; Sigl et al., 2013) and volcanic sulfate from GISP2 (Mayewski et al., 1997).

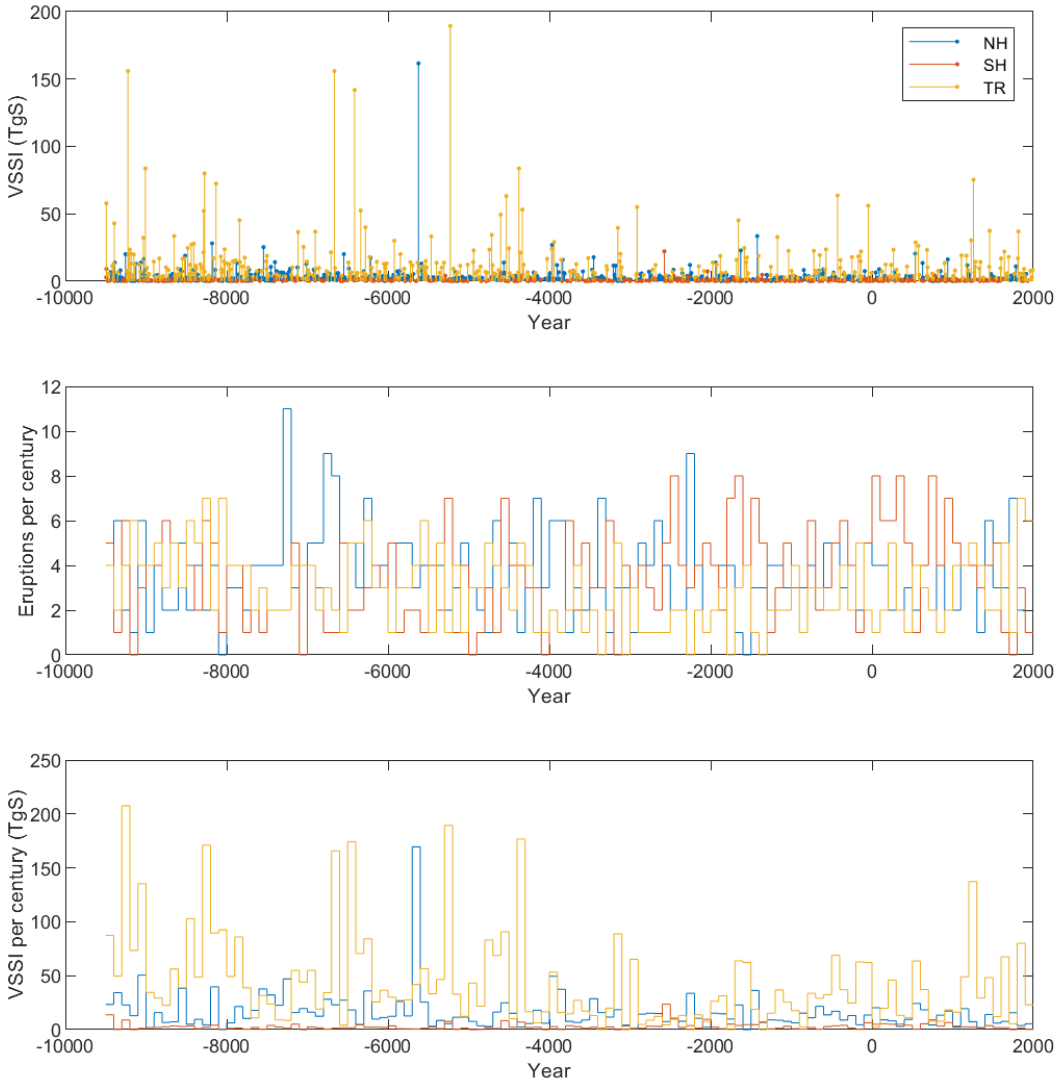

Figure S4: Holocene volcanic stratospheric sulfur injection (VSSI) from tropical, NH and SH extratropical explosive volcanic eruptions. (Top) Reconstructed VSSI for single eruptions over the Holocene, (middle) number of eruptions per century, (bottom) total VSSI per century.

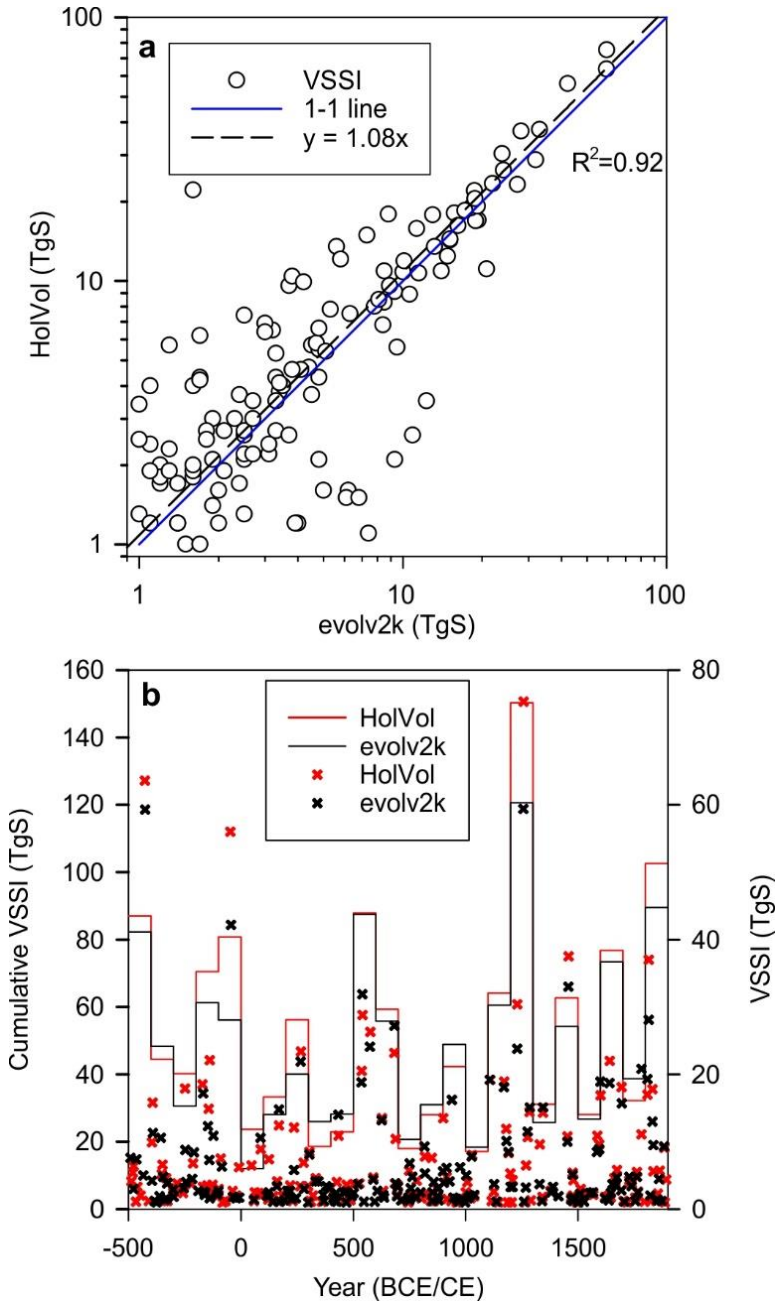

Figure S6: a. Scatterplot of volcanic stratospheric sulphur injections (VSSI) during the Common Era in HolVol v.1.0 and evolv2k. b. Cumulative centennial and individual event-integrated (cross) VSSI in HolVol v.1.0 and evolv2k, respectively. Only eruptions with VSSI >1 Tg S are shown.

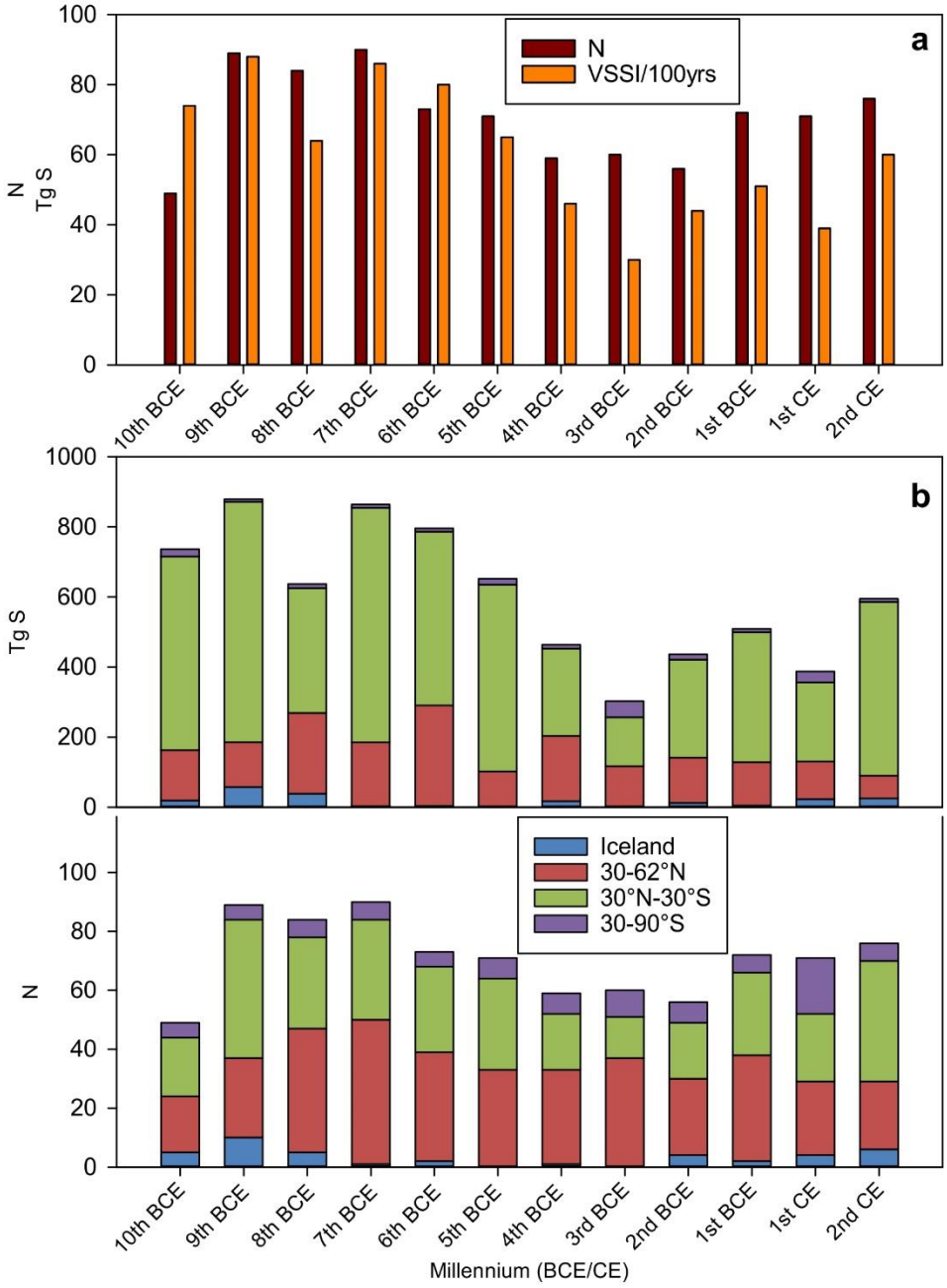

Figure S5: a. Total number of volcanic reconstructions and mean volcanic stratospheric sulphur injection (VSSI) per century for each millennia; b. Cumulative VSSI and number of eruptions grouped by their estimated location in Iceland and three latitudinal bands. Only eruptions with VSSI >1 Tg S are included. Note that the value of 10th millennia BC only contains eruptions starting in 9500 BCE.

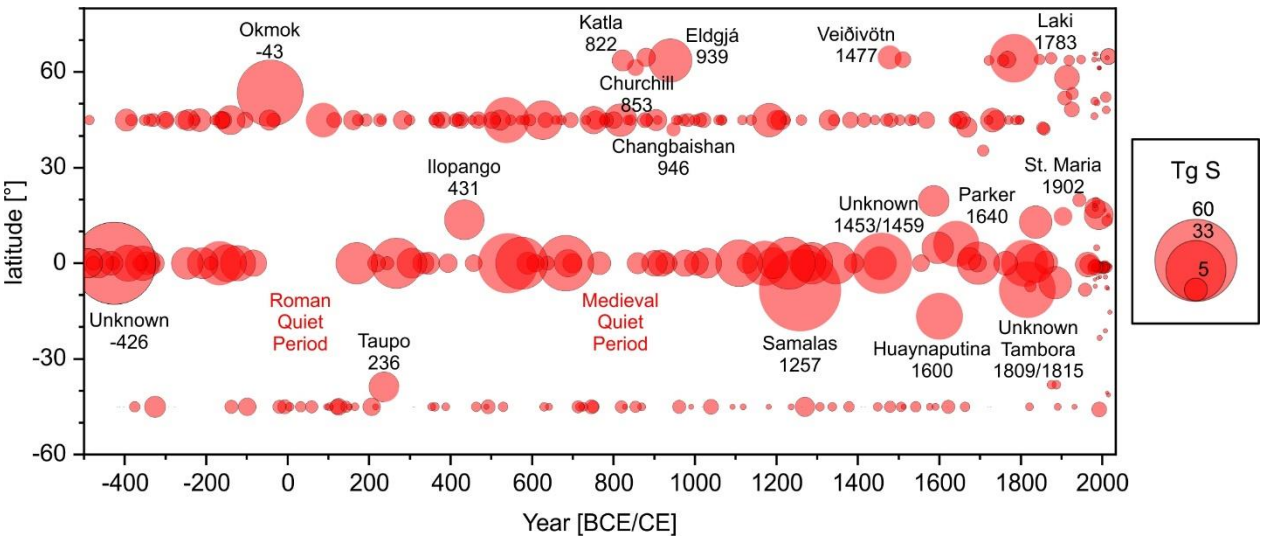

Figure S7: Number and volcanic stratospheric sulphur injection (VSSI) of volcanic eruptions over the past 2,500 years from evolv2k (Toohey and Sigl, 2017) grouped by their known and estimated location (NHET 30-90°N; tropics 30°-30°S; SHET 30-90°S). Estimates from 1979 AD onwards are based on satellite retrievals (Carn et al., 2016). Only eruptions with VSSI >1 Tg S are included; source attributions for NHET and for Samalas 1257 CE are based on geochemistry of cryptotephra from Greenland ice cores (Abbott and Davies, 2012; Abbott et al., 2021; Jensen et al., 2014; Lavigne et al., 2013; McConnell et al., 2020; Oppenheimer et al., 2018; Oppenheimer et al., 2017; Plunkett et al., 2020; Smith et al., 2020; Sun et al., 2014).

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