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Supplement of

Brief communication: Evaluation of multiple density-dependent empirical snow conductivity relationships in East Antarctica

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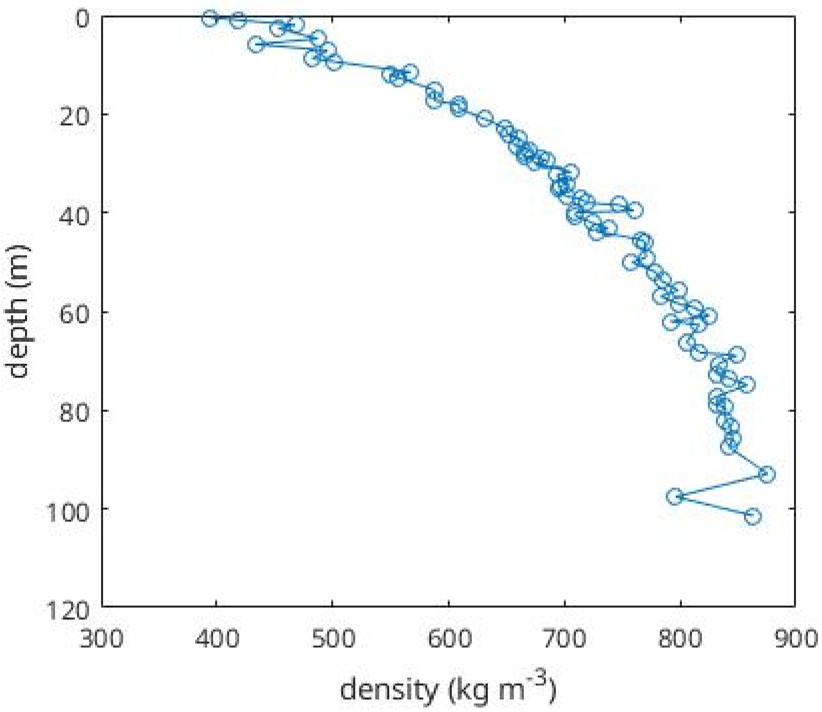

Figure S1. The firn depth-density profile at LGB69

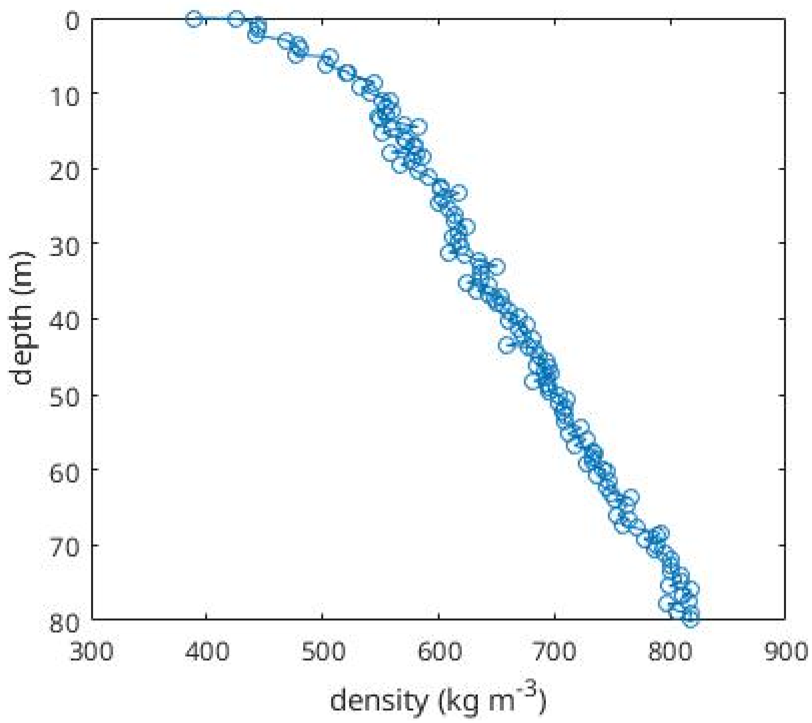

Figure S2. The firn depth-density profile at Eagle

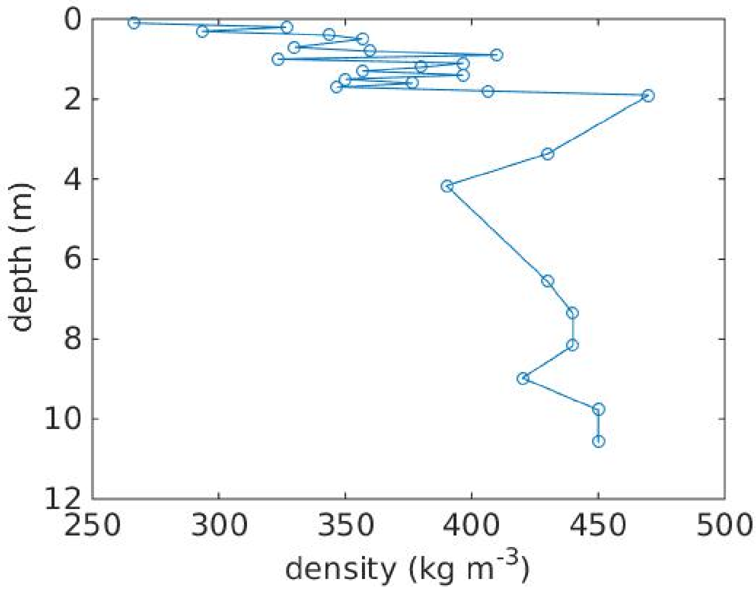

Figure S3. The firn depth-density profile at Dome A

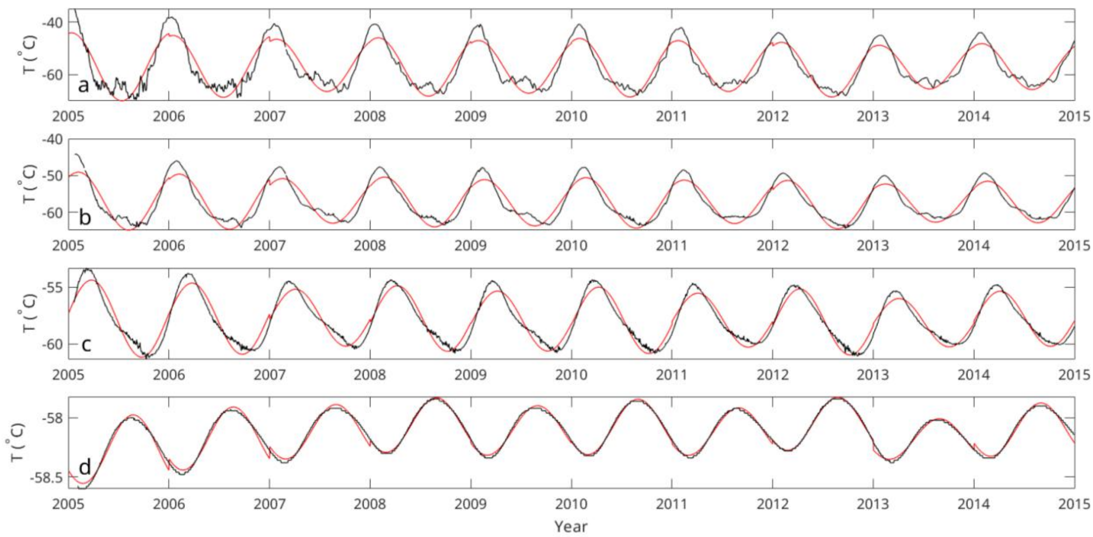

Figure S4. The annual cycles of firn temperatures (black curves) and their sinusoidal best-fit (red curves) at the nominal depth of 0.1 m (a),1 m (b), 3 m (c) and10 m (d) for 2005—2014 at the Dome A station.

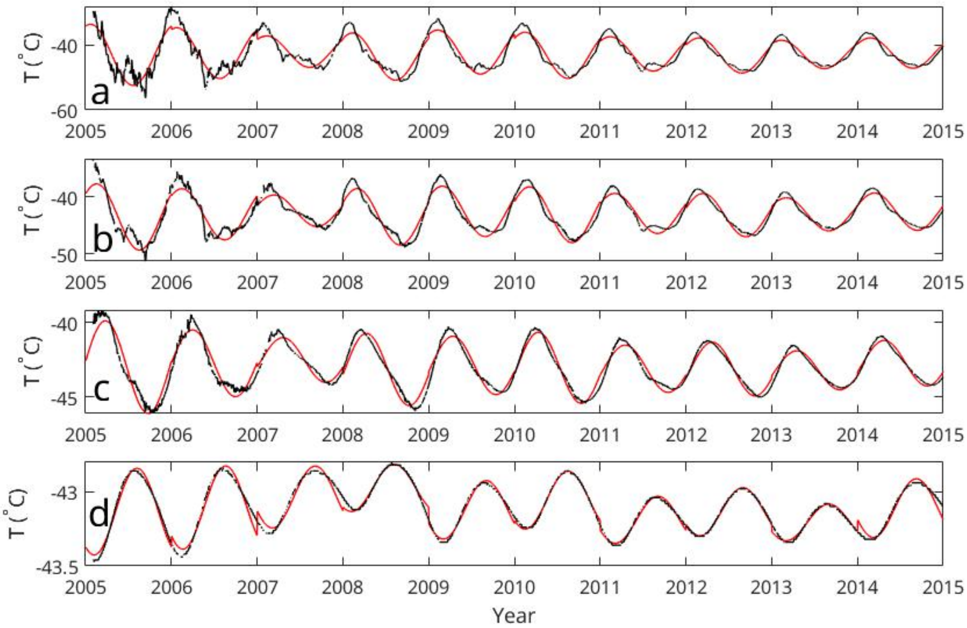

Figure S5. The annual cycles of firn temperatures (black curves) and their sinusoidal best-fit (red curves) at the nominal depth of 0.1 m (a),1 m (b), 3 m (c) and10 m (d) for 2005—2015 at the Eagle station.

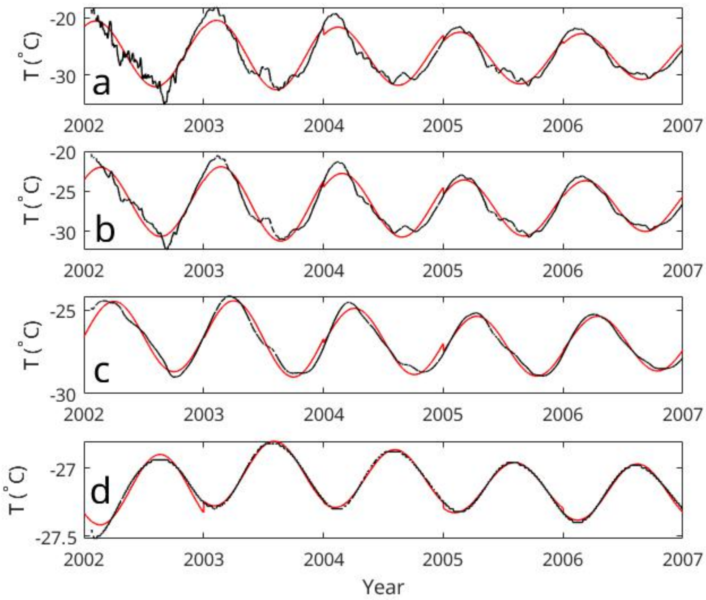

Figure S6. The annual cycles of firn temperatures (black curves) and their sinusoidal best-fit (red curves) at the nominal depth of 0.1 m (a),1 m (b), 3 m (c) and10 m (d) for 2002—2007 at the LGB 69 station.

Table S1. Brief introductions of the density-dependent relationships used in this study

Code	formula	density (kg m-3)	temperature (℃)	description	reference
Jor	$k = k_a + (7.75e^{-5}\rho/1000 + 1.105e^{-6}(\rho/1000)^2)(k_i - k_a)$	376-472	-7 to -17	Experimental measurements	Jordan (1991)
Ca1	$k = 0.024 - 1.23e^{-4}\rho + 2.5e^{-6}\rho^2$	100-550	-3	3D images-based computations	Calonne et al., (2011)
Ca2	See Eqn (5) in Calonne et al., (2019)	0–917	temperature dependent	3D images-based computations	Calonne et al., (2019)
Stu	$k = 10^{(2.650\rho - 1.652)}$	70-560	-1 to -77	needle probe measurements	Sturm et al., (1997)
Yen	$k = 2.22362(\frac{\rho}{1000})^{1.885}$	80-600	-	Experimental measurements	Yen (1981)
And	$k = 0.021 + 2.5(\frac{\rho}{1000})^2$	-	-	Experimental measurements	Anderson (1976)
Van	$k = 2.1e^{-2} + 4.2e^{-4}\rho + 2.2e^{-9}\rho^3$	-	0 to -30	Experimental measurements	Van Dusen and Washburn (1929)
Sch	$k = k_i(\frac{\rho}{\rho_i})^{2-0.5\frac{\rho}{\rho_i}}$	-	-	Experimental measurements	Schwander et al., (1997)
Lan	$k = 10^{6.8\rho - 3.0}$	230 to 480	-4.4 to -19.5	Experimental measurements	Lange (1985)

Table S2. Comparisons between density-dependent empirical conductivity and phase change recovered (PCR) conductivity (W m^{-1} K^{-1}) at three depth intervals, 0.1-1 m, 1-3 m and 3-10 m. The three overall best relationships for different depths are shown in bold and italic.

		PCR	Yen	Ca1	Jor	Stu	Lan	Van	Sch	Ca2	And
Dome A	0.1-1m	0.26	***0.30 (+15.4%)***	***0.28 (+7.7%)***	0.38 (+46.2%)	0.18 (-30.8%)	0.22 (-15.4%)	***0.26 (0%)***	0.39 (+50%)	0.31 (+19.2%)	0.32 (+23.1%)
	1-3 m	0.31	***0.33 (+6.5%)***	***0.31 (0%)***	0.42 (+35.5%)	0.20 (-35.5%)	0.29 (-6.5%)	***0.28 (-9.7%)***	0.43 (+38.7%)	0.34 (+9.7%)	0.35 (+12.9%)
	3-10 m	0.46	***0.42 (-8.7%)***	***0.40 (-13.0%)***	0.52 (+13.0%)	0.27 (-41.3%)	0.64 (+39.1%)	***0.35 (-23.9%)***	0.55 (+19.6%)	0.43 (-6.5%)	0.44 (-4.4%)
Eagle	0.1-1m	0.39	***0.42 (+7.7%)***	***0.40 (+2.6%)***	0.52 (+33.3%)	0.27 (-30.8%)	0.64 (64.1%)	0.35 (-10.3%)	0.55 (+41.0%)	0.45 (+15.4%)	0.44 (+12.8%)
	1-3 m	0.54	***0.51 (-5.6%)***	***0.48 (-11.1%)***	0.62 (+14.8%)	0.36 (-33.3%)	1.24 (+130%)	0.42 (-22.2%)	0.67 (+24.1%)	0.49 (-9.3%)	***0.54 (0%)***
	3-10 m	0.73	***0.62 (-15.1%)***	***0.60 (-17.8%)***	0.76 (+4.1%)	0.49 (-32.9%)	2.90 (+297%)	0.52 (-28.8%)	0.82 (+12.3%)	0.65 (-11.0%)	***0.66 (-9.6%)***
LGB69	0.1-1m	1.02	0.47 (-53.9%)	0.44 (-56.9%)	***0.58 (-43.1%)***	0.32 (-68.6%)	0.91 (-10.8%)	0.39 (-61.8%)	***0.62 (-39.2%)***	0.42 (-58.8%)	***0.49 (-52.0%)***
	1-3 m	0.62	0.50 (-19.4%)	0.48 (-22.6%)	***0.61 (-1.6%)***	0.35 (-43.6%)	1.16 (87.1%)	0.41 (-33.9%)	***0.66 (+6.5%)***	0.54 (-12.9%)	***0.53 (-14.5%)***
	3-10 m	0.81	0.59 (-27.2%)	0.57 (-29.6%)	***0.72 (-11.1%)***	0.45 (-44.4%)	2.34 (+189%)	0.49 (-39.5%)	***0.79 (-2.5%)***	0.78 (-3.7%)	***0.63 (-22.2%)***