

Supplementary Information

Stabilisation of dense Antarctic water supply to the Atlantic Ocean overturning circulation

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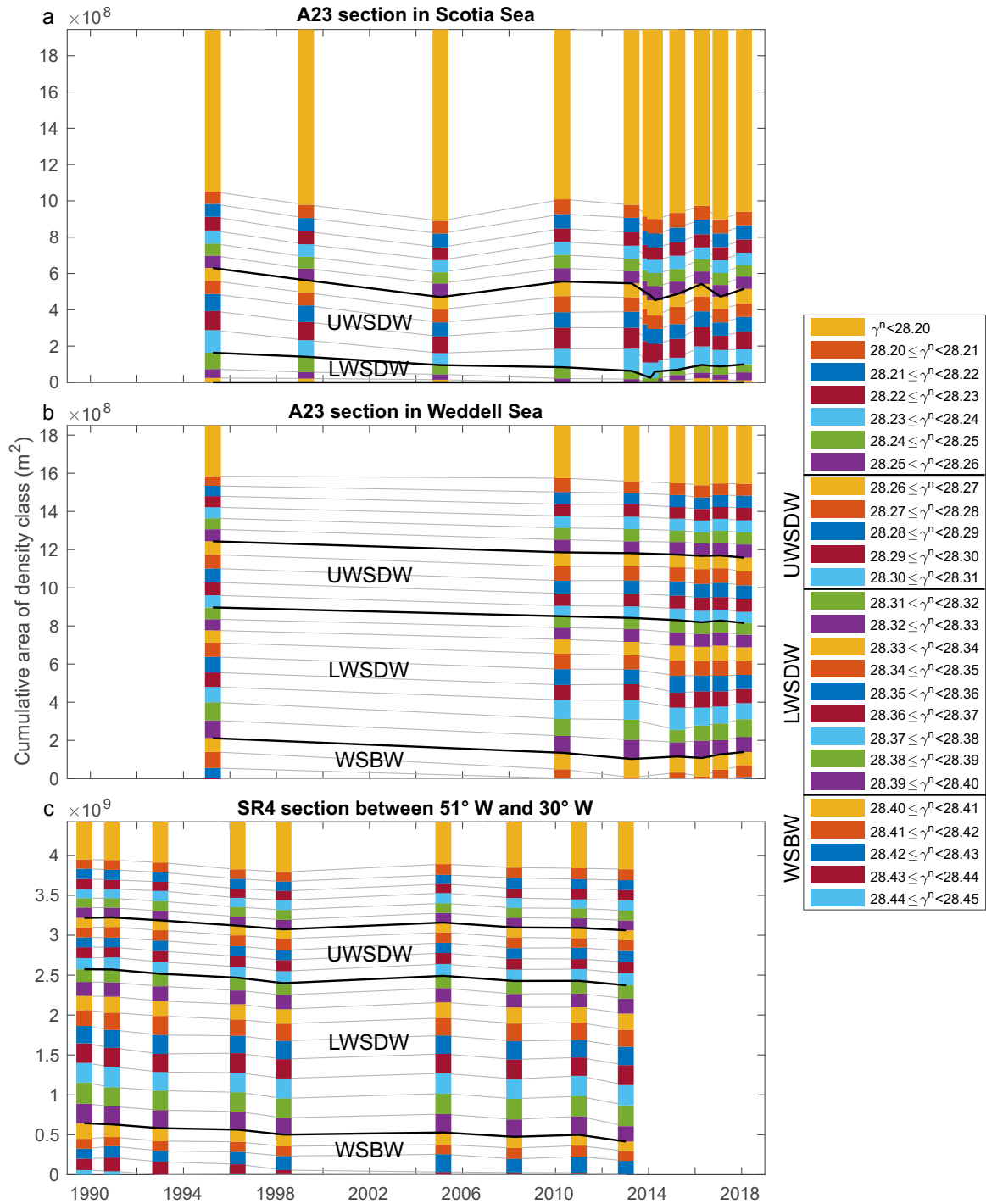
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Supplementary Information Table 1. Cruises and data availability

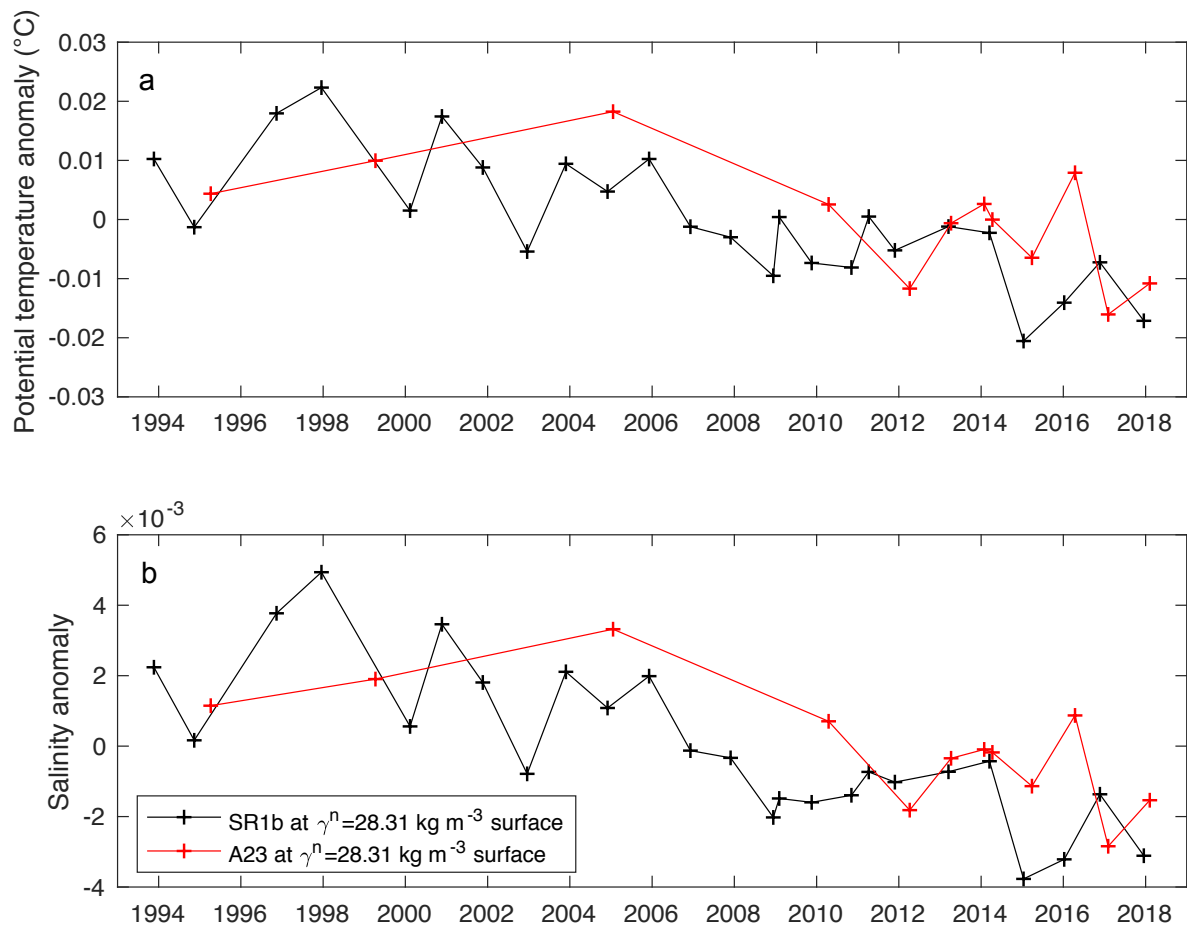
Section	Dates	Ship	Cruise	Data link
A23	4 Apr 1995 – 12 Apr 1995	RRS James Clark Ross	JR10	https://www.bodc.ac.uk/data/documents/cruise/4146/
A23*	8 Apr 1999 – 12 Apr 1999	RRS James Clark Ross	JR40	https://www.bodc.ac.uk/data/documents/cruise/5995/
A23*	17 Jan 2005 – 20 Jan 2005	RV Ronald H. Brown	33RO200501	https://cchdo.ucsd.edu/cruise/33RO200501
A23	14 Apr 2010 – 20 Apr 2010	RRS James Clark Ross	JR239	https://www.bodc.ac.uk/data/documents/cruise/9972/
A23	4 Apr 2012 – 9 Apr 2012	RRS James Clark Ross	JR272A	https://www.bodc.ac.uk/data/documents/cruise/11431/
A23*	6 Apr 2013 – 11 Apr 2013	RRS James Clark Ross	JR281	https://www.bodc.ac.uk/data/documents/cruise/11608/
A23*	26 Jan 2014 – 29 Jan 2014	RV Ronald H. Brown	33RO20131223	https://cchdo.ucsd.edu/cruise/33RO20131223
A23	8 Apr 2014 – 13 Apr 2014	RRS James Clark Ross	JR299	https://www.bodc.ac.uk/data/documents/cruise/15248/
A23	24 Mar 2015 – 31 Mar 2015	RRS James Clark Ross	JR310	https://www.bodc.ac.uk/data/documents/cruise/15044/
A23	11 Apr 2016 – 16 Apr 2016	RRS James Clark Ross	JR15006	https://www.bodc.ac.uk/data/documents/cruise/16042/
A23	30 Jan 2017 – 6 Feb 2017	RRS James Clark Ross	JR16004	https://www.bodc.ac.uk/data/documents/cruise/16298/
A23	3 Feb 2018 – 10 Feb 2018	RRS James Clark Ross	JR17003	https://www.bodc.ac.uk/data/documents/cruise/16403/
SR1b	21 Nov 1993 – 26 Nov 1993	RRS James Clark Ross	JR00a	https://www.bodc.ac.uk/data/documents/cruise/6339/
SR1b	16 Nov 1994 – 21 Nov 1994	RRS James Clark Ross	JR00b	https://www.bodc.ac.uk/data/documents/cruise/6332/
SR1b	15 Nov 1996 – 20 Nov 1996	RRS James Clark Ross	JR16	https://www.bodc.ac.uk/data/documents/cruise/6334/
SR1b	30 Dec 1997 – 7 Jan 1998	RRS James Clark Ross	JR27	https://www.bodc.ac.uk/data/documents/cruise/6335/
SR1b	12 Feb 2000 – 16 Feb 2000	RRS James Clark Ross	JR47	https://www.bodc.ac.uk/data/documents/cruise/6767/
SR1b	23 Nov 2000 – 28 Nov 2000	RRS James Clark Ross	JR55	https://www.bodc.ac.uk/data/documents/cruise/5582/
SR1b	20 Nov 2001 – 25 Nov 2001	RRS James Clark Ross	JR67	https://www.bodc.ac.uk/data/documents/cruise/5631/
SR1b	27 Dec 2002 – 1 Jan 2003	RRS James Clark Ross	JR81	https://www.bodc.ac.uk/data/documents/cruise/6096/
SR1b	11 Dec 2003 – 15 Dec 2003	RRS James Clark Ross	JR94	https://www.bodc.ac.uk/data/documents/cruise/6078/
SR1b	3 Dec 2004 – 8 Dec 2004	RRS James Clark Ross	JR115	https://www.bodc.ac.uk/data/documents/cruise/6720/
SR1b	7 Dec 2005 – 12 Dec 2005	RRS James Clark Ross	JR139	https://www.bodc.ac.uk/data/documents/cruise/8354/
SR1b	8 Dec 2006 – 12 Dec 2006	RRS James Clark Ross	JR163	https://www.bodc.ac.uk/data/documents/cruise/8422/
SR1b	29 Nov 2007 – 5 Dec 2007	RRS James Clark Ross	JR193	https://www.bodc.ac.uk/data/documents/cruise/8516/
SR1b	13 Dec 2008 – 19 Dec 2008	RRS James Clark Ross	JR194	https://www.bodc.ac.uk/data/documents/cruise/9406/

Section	Dates	Ship	Cruise	Data link
SR1b	20 Feb 2009 – 26 Feb 2009	RRS James Cook	JC31	https://www.bodc.ac.uk/data/documents/cruise/9358/
SR1b	19 Nov 2009 – 25 Nov 2009	RRS James Clark Ross	JR195	https://www.bodc.ac.uk/data/documents/cruise/9996/
SR1b (partial)	7 Dec 2010 – 9 Dec 2010	RRS James Clark Ross	JR242	https://www.bodc.ac.uk/data/documents/cruise/10649/
SR1b	21 Apr 2011 – 25 Apr 2011	RRS James Clark Ross	JR276	https://www.bodc.ac.uk/data/documents/cruise/10811/
SR1b	28 Nov 2011 – 5 Dec 2011	RRS James Clark Ross	JR265	https://www.bodc.ac.uk/data/documents/cruise/10599/
SR1b	19 Mar 2013 – 27 Mar 2013	RRS James Clark Ross	JR281	https://www.bodc.ac.uk/data/documents/cruise/11608/
SR1b	13 Mar 2014 – 1 Apr 2014	RRS James Clark Ross	JR299	https://www.bodc.ac.uk/data/documents/cruise/13406/
SR1b	13 Jan 2015 – 18 Jan 2015	RRS James Clark Ross	JR306	https://www.bodc.ac.uk/data/documents/cruise/15040/
SR1b	6 Jan 2016 – 11 Jan 2016	RRS James Clark Ross	JR15003	https://www.bodc.ac.uk/data/documents/cruise/16039/
SR1b	18 Nov 2016 – 24 Nov 2016	RRS James Clark Ross	JR16002	https://www.bodc.ac.uk/data/documents/cruise/16296/
SR1b	15 Dec 2017 – 18 Dec 2017	RRS James Clark Ross	JR17001	https://www.bodc.ac.uk/data/documents/cruise/16401/
SR4	12 Sep 1989 – 8 Oct 1989	RV Polarstern	ANT-VIII/2 ⁴⁶	https://doi.org/10.1594/PANGAEA.742580
SR4	21 Nov 1990 – 23 Dec 1990	RV Polarstern	ANT-IX/2 ⁴⁷	https://doi.org/10.1594/PANGAEA.735277
SR4	18 Dec 1992 – 12 Jan 1993	RV Polarstern	ANT-X/7 ⁴⁸	https://doi.org/10.1594/PANGAEA.742651
SR4	25 Apr 1996 – 8 May 1996	RV Polarstern	ANT-XIII/4 ⁴⁹	https://doi.org/10.1594/PANGAEA.738489
SR4	1 Apr 1998 – 11 Apr 1998	RV Polarstern	ANT-XV/4 ⁵⁰	https://doi.org/10.1594/PANGAEA.742626
SR4	20 Feb 2005 – 16 Mar 2005	RV Polarstern	ANT-XXII/3 ⁵¹	https://doi.org/10.1594/PANGAEA.733664
SR4	15 Mar 2008 – 29 Mar 2008	RV Polarstern	ANT-XXIV/3 ⁵²	https://doi.org/10.1594/PANGAEA.733414
SR4	24 Dec 2010 – 8 Jan 2011	RV Polarstern	ANT-XXVII/2 ⁵³	https://doi.org/10.1594/PANGAEA.772244
SR4	28 Dec 2012 – 14 Jan 2013	RV Polarstern	ANT-XXIX/2 ⁵⁴	https://doi.org/10.1594/PANGAEA.817255

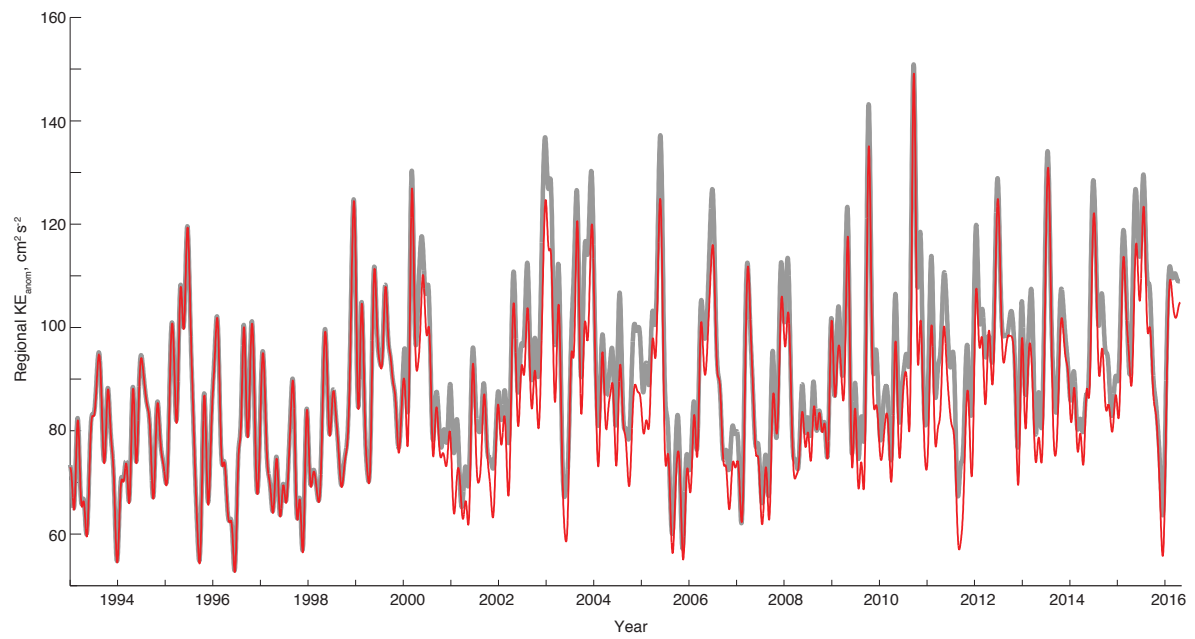
* indicates those A23 sections that do not have full coverage to 64°S in the Weddell Sea



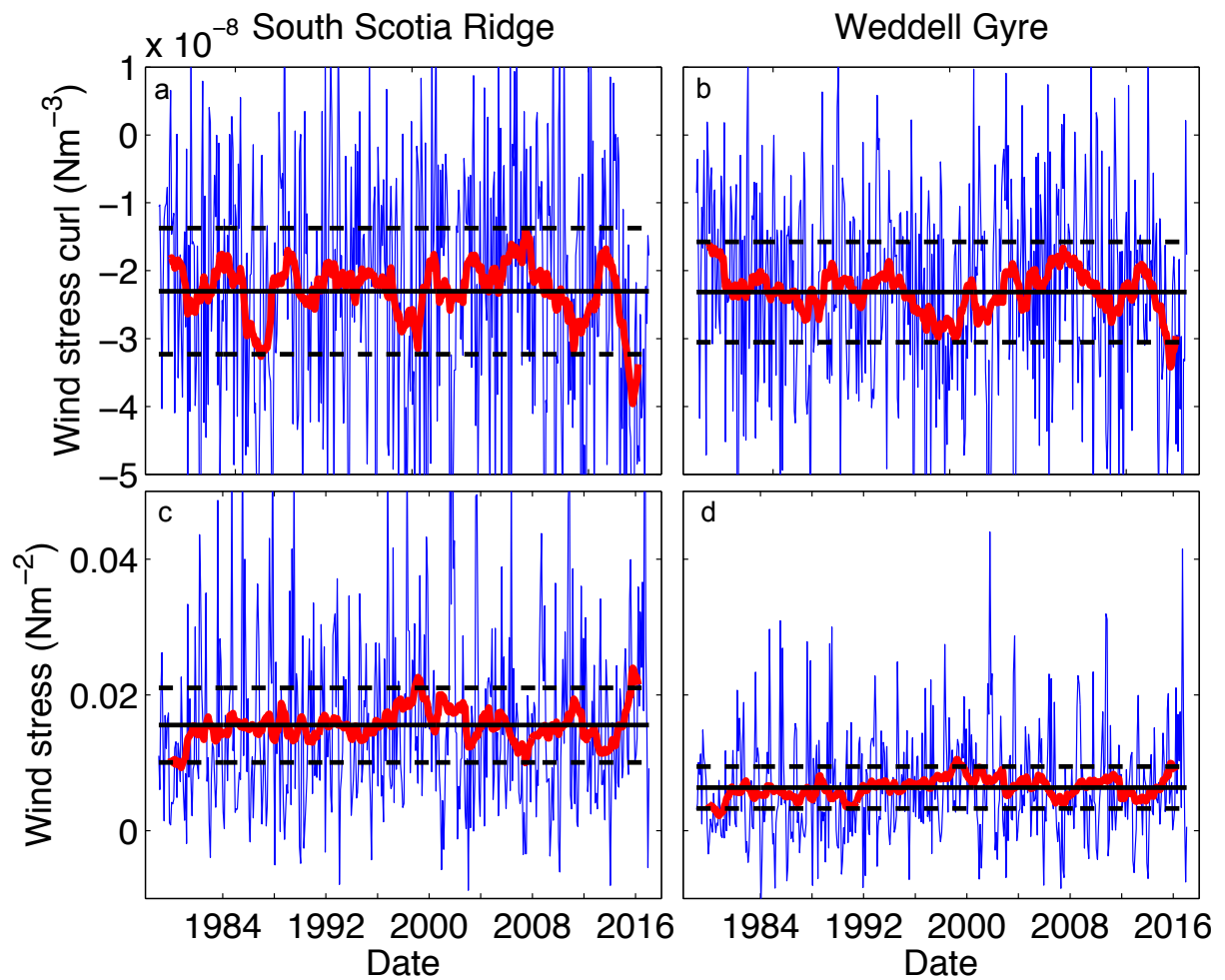
Supplementary Information Figure 1. Cumulative areas of neutral density classes on the A23 section in the Scotia Sea (panel a) and Weddell Sea (panel b), and the western part of the SR4 section (panel c). The upper boundaries of UWSDW ($\gamma^n=28.26\text{kg m}^{-1}$), LWSDW ($\gamma^n=28.31\text{kg m}^{-1}$), and WSBW ($\gamma^n=28.40\text{kg m}^{-1}$) are indicated with thick black lines. Note that not all of the A23 sections extended into the Weddell Sea; only those that extend to 64°S are included in panel b.



Supplementary Information Figure 2. Anomalies in average potential temperature and salinity on the $\gamma^n=28.31 \text{ kg m}^{-3}$ surface (the upper boundary of LWSDW). These anomalies were subtracted from the respective properties to compute the corrected LWSDW areas in Figure 2.



Supplementary Information Figure 3. Time series of 45-day low-pass-filtered altimetric surface kinetic energy anomaly (KE_{anom}) between 54-62° S and 30-50° W for the two-satellite merged product (red) and the all-satellite merged product (gray).



Supplementary Information Figure 4. ERA interim monthly mean wind stress curl (top panels) and wind stress (bottom panels) over the South Scotia Ridge (left panels; 60-20° W, 60-65° S) and Weddell Gyre (right panels; 60-0° W, 62-70° S). Red line indicates twelve month running mean, while dashed lines indicate two standard deviations about the running mean. See Methods section for exact regions over which wind stress and curl were averaged.