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Supplementary Materials for

Wind causes Totten Ice Shelf melt and acceleration

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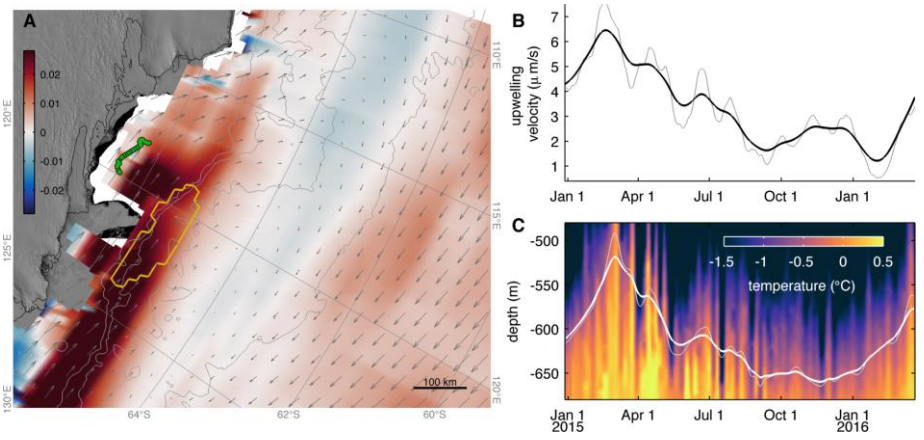

fig. S1. Upwelling brings warm water onto the continental slope. (**A**) Following Fig. 3D, regression coefficients ((μm s^{-1})/m) of upwelling as a function of the T = –0.4˚C isotherm depth by a profiling float, whose westward-drifting path is depicted in green. Dashed regions indicate interpolated float locations. (**B**) Time series of upwelling averaged within the gold polygon in panel (A). (**C**) Color-scaled time series of temperature logged by the profiling float overlaid with the T = –0.4˚C isotherm depth in white. Heavy and light lines in panels (B, C) are lowpass filtered to 90 and 45 days, respectively.

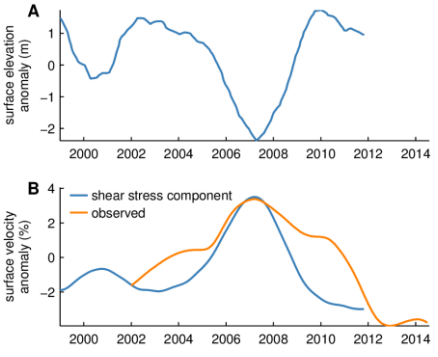

fig. S2. Ice-shelf thinning drives acceleration. (**A**) TIS-averaged surface elevation anomaly from a previous study by Roberts et al. (*6*). (**B**) orange line shows surface velocity averaged over the main trunk of TIS; blue line shows ice velocity anomaly predicted from observed ice thickness anomalies. Secondary peaks in surface velocity observed in 2003 and 2010 are attributed to loss of basal stress and short-term acceleration observed in the western grounding zone of TIS. Both time series in panel (B) are lowpass filtered to 24 months.

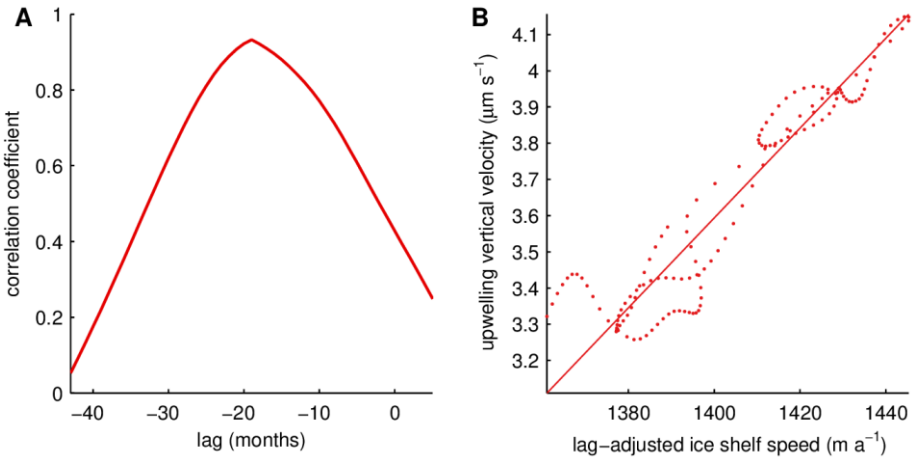

fig. S3. Regression of upwelling and TIS velocity. (**A**) Correlation coefficient of 24 month lowpass filtered time series of upwelling and TIS velocity, plotted as a function of lag time. Lag time corresponding to the correlation maximum (r=0.92) indicates TIS accelerates 19 months after upwelling occurs within the gold polygon shown in Fig. 3. (**B**) Linear regression relates upwelling to TIS velocity as 0.0125 (μm s^{-1}) /(m a^{-1}).

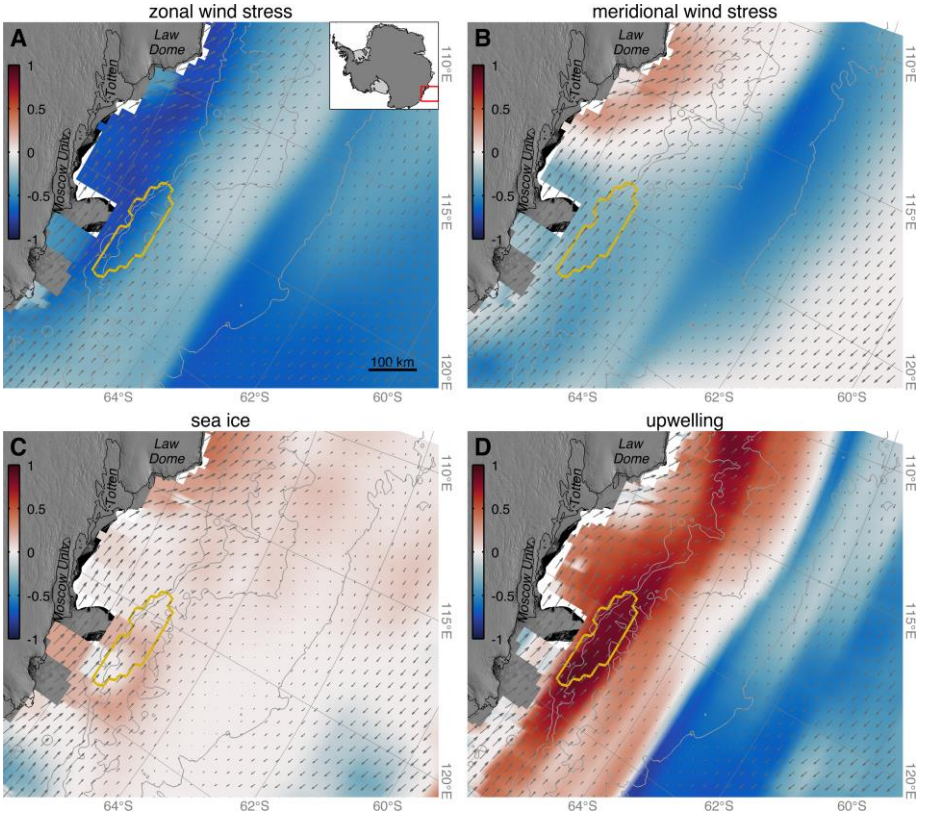

fig. S4. Coefficients of determination. Values of $r \cdot |r|$ indicate the strength and sign of the relationship between TIS velocity and reanalysis fields for respective linear regressions in Fig. 3.

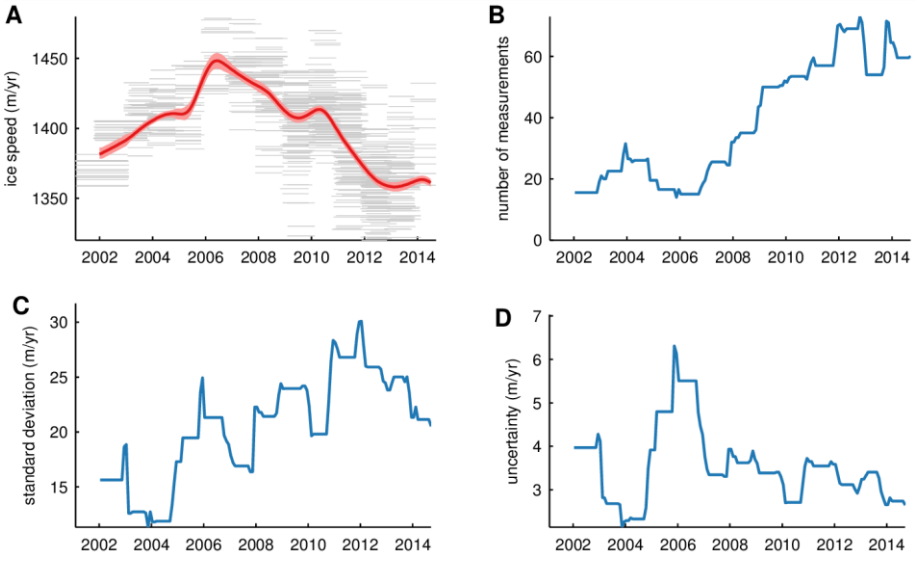

fig. S5. Uncertainty estimates for TIS velocity time series. Surface velocities are obtained by feature tracking using 629 overlapping image pairs. (**A**) TIS velocity measurements as in Fig. 2A. Grey lines indicate velocity measurements from each image pair; dark red line is obtained by averaging velocity measurements at monthly postings; the shaded region bounding the velocity curve is the uncertainty estimate shown in panel (**D**). (**B**) Number of displacement measurements contributing to each monthly posting. (**C**) Standard deviation of velocity measurements at each monthly posting. (D) Velocity uncertainty estimate from panels (B) and (C).