Supporting Information for 'Antarctic icebergs distributions 1992-2014'

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Contents of this file

1. Figures S1 to S6

Additional Supporting Information (Files uploaded separately)

Introduction

Figures S1 and S2 presents the correlation analysis between the monthly volume of small icebergs from the Altiberg data base and the SSM/I monthly sea ice extent. Figures S3 and S4 present the mean annual volume of small icebergs from 1992 to 2014. Figure S5 presents the seasonal mean volume of ice. Figure S6 presents cross correlation analysis between the large and small icebergs ice volumes distant by less and more than 500 km from a large ones.

Text S1 to S6

1. Analysis of correlation between sea ice extent and volume of small icebergs

Figure S1 presents the normalized (by the time series maximum) monthly sea ice extent and volume of small icebergs for the Southern Ocean and the three ocean bsains (South Atlantic, Indican and Pacific Oceans). The monthly sea ice extent is computed using the monthly SSM/I sea ice concentration maps avalailable at CERSAT (http:www.cersat.ifremer.fr) . The description of the SSM/I data is given in *Kaleschke et al.* [2001] and *Ezraty et al.* [2007]. The correlation coefficient between the sea ice extent and volume are also given in the Figure.

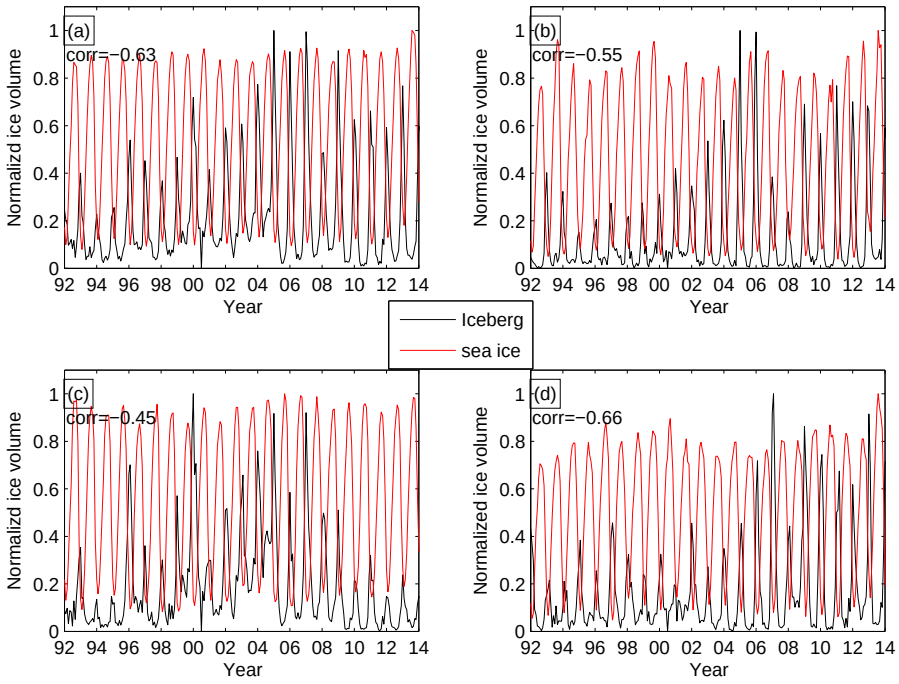

Figure S1. Sea ice extent (red lines) and volume of small icebergs (black lines) in the Southern Ocean (a), the South Atlantic Ocean (b), the South Indian Ocean (c) and the South Pacific Ocean (d). The variables have been normalized by their maximum for a better comparison.

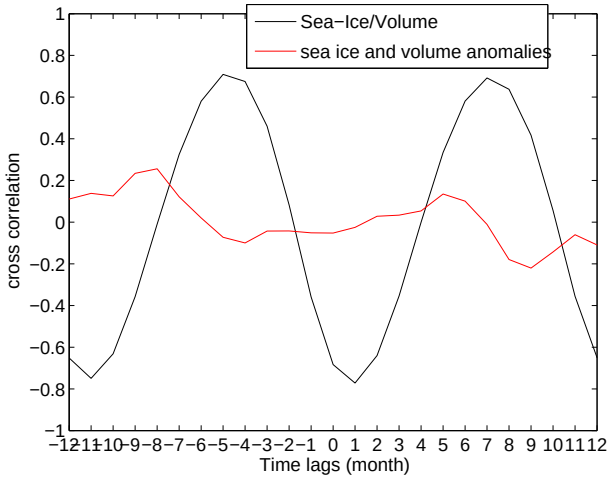

Figure S2. Crosscorrelation of monthly sea ice extent and volume of small icebergs (black line) and anomalies of sea ice extent and volume of small icebergs (red line) in the Southern Ocean.

Figure S2 present the cross correlation bewteen the sea ice extent and the volume of small icebergs for the Southern Ocean as well as the cross correlation between the sea ice extent and volume anomlaies. The anomalies are obtained by substracting the 23-year monthly average to the time series.

2. Mean volume of small icebergs

The mean annual volume of small icebergs, computed considering only the ice free months at each grid point is presented in Figure S3 for 1992 to 2003 and Figure S4 for 2004 to 2014 .

The mean 1992-2014 seasonal volume of ice for the four seasons (J-F-M, A-M-J, J-A-S, O-N-D) is presented in Figure

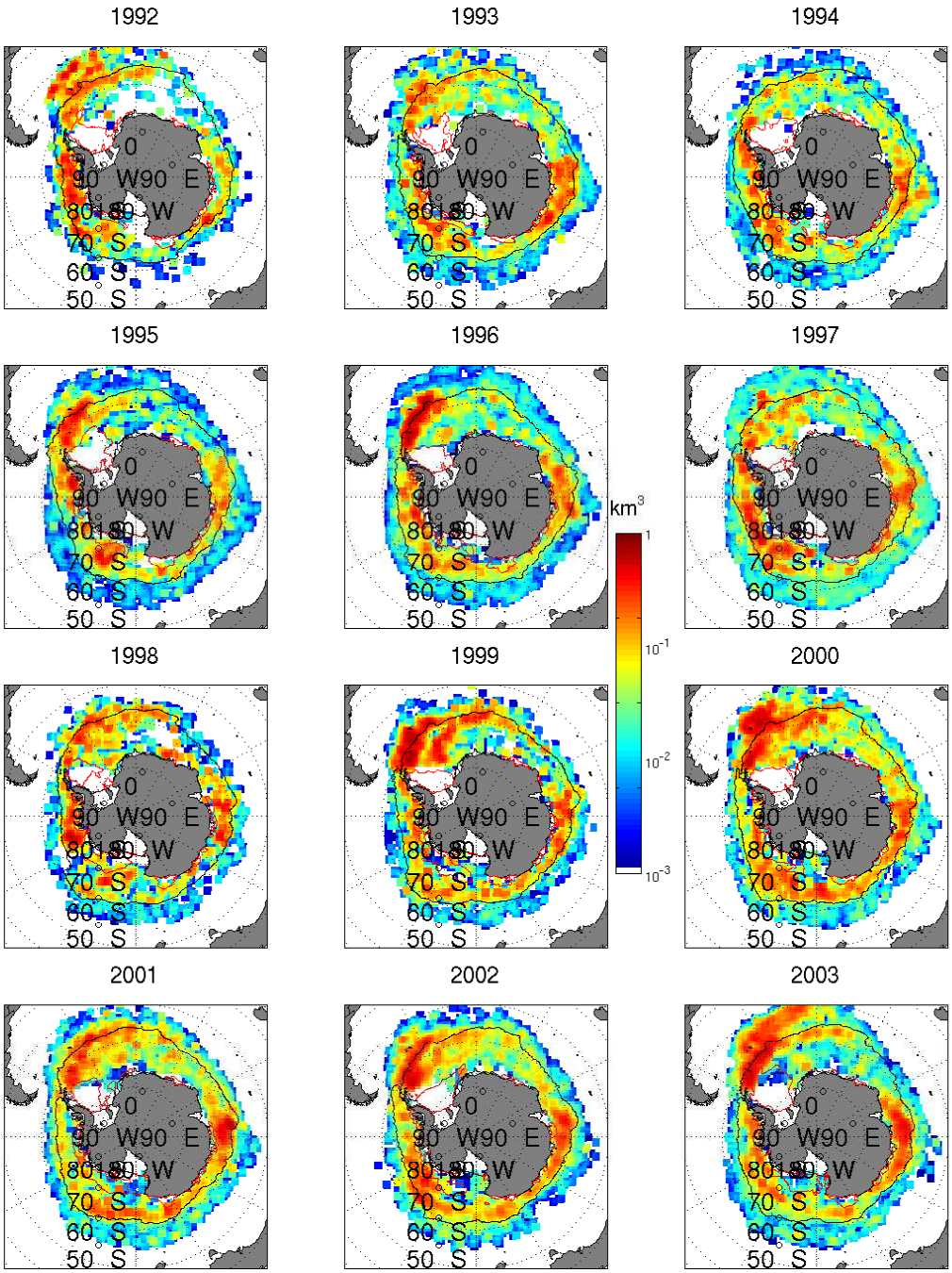

Figure S3. Mean annual volume of ice (in km^3/month) of small icebergs from 1992 to 2003. The black lines indicate the maximum sea ice extent from SSM/I

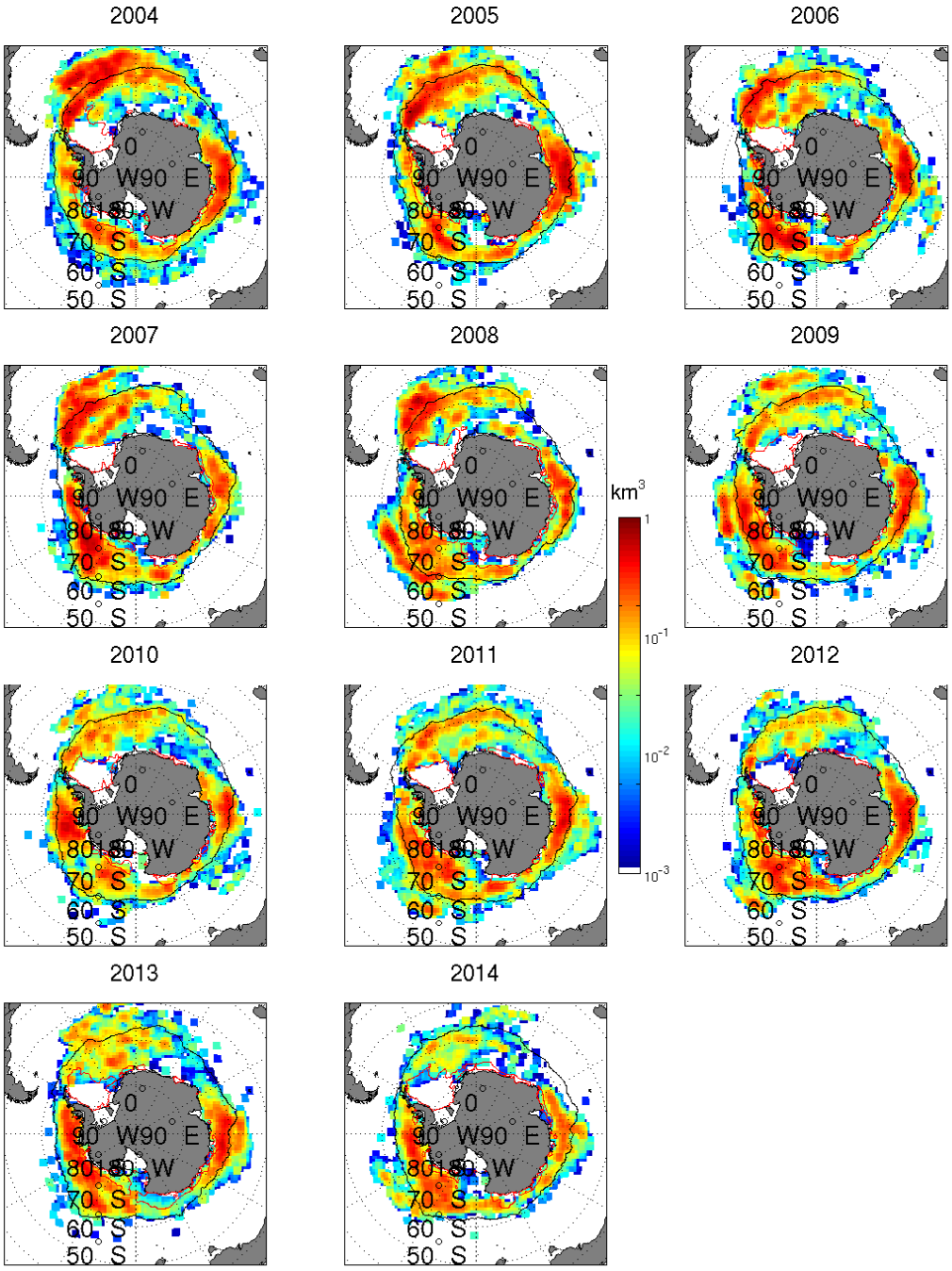

Figure S4. Mean annual volume of ice (in km^3/month) of small icebergs from 2003 to 2014. The black lines indicate the maximum sea ice extent from SSM/I

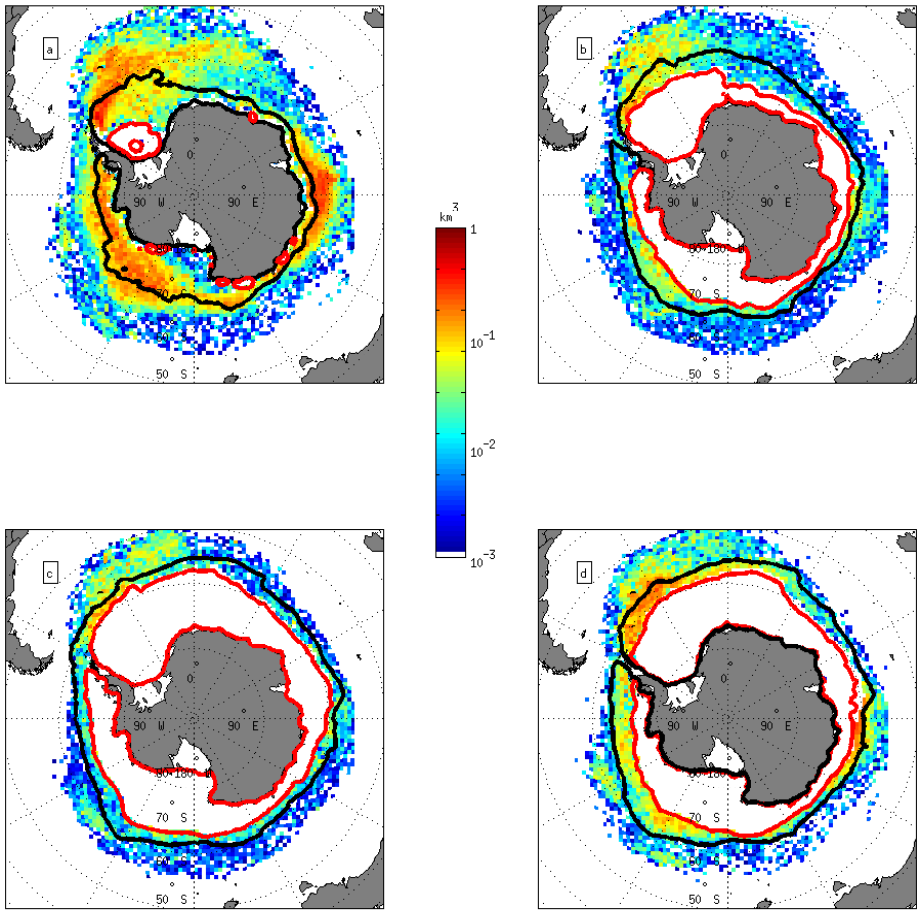

Figure S5. Mean 1992-2014 seasonal volume of ice (a) Summer (J-F-M), (b) Fall (A-M-J), (c) Winter (J-A-S), (d) Spring (O-N-D). The red and black lines indicate the maximum and minimum seasonal sea ice extent.

3. Cross correlation between the small and large icebergs volumes.

The cross correlation between the small (distant by less or more than 500 km from a large one) and large icebergs volume anomalies is computed as follow. Only grid points where the sea is ice-free for more than 6 month per year are considered for the small iceberg volume. For each grid point (i, j), the cross correlation C between the time series of the anomalies of the volume of large icebergs ($V_L(t, i, j)$) and the time series of the anomalies of small iceberg volume ($V_s(t, i_k, j_k)$) for grid points within a neighbourhood of $\pm$2000 km in longitude and $\pm$500 km in latitude are computed using

$$C(i, j, i_k, j_k, \tau) = \frac{1}{\sigma_{V_L}\sigma_{V_S}} \sum_{t=1}^{M-\tau} V_L(i, j, t)V_S(i_k, j_k, t + \tau) \quad (1)$$

where σ_{V_L} andσ_{V_S} are the standard deviation of the volumes of large and small iceberg. For each grid point (i, j), the maximum of C, C_{max} is estimated as well as the small iceberg grid point (i_k, j_k) and time lag τ associated with the maximum of C. The distance between grid point (i, j) and (i_k, j_k) is computed. Only grid points with correlation than 0.55 are considered.

The maximum correlation, time lag and distance between the large and small grid points are given in Figure S5.

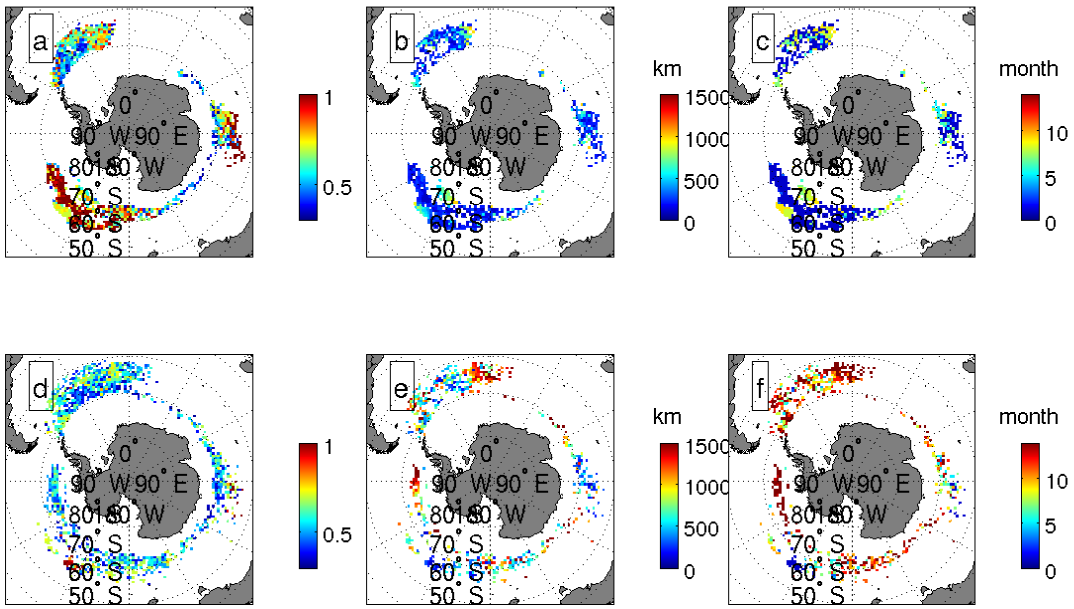

Figure S6. Cross correlation between the large and small icebergs ice volume anomalies distant by less (a, b, c) and more (d, e, f) than 500 km from a large ones. Maximum correlation C_{max}(a, d), distance (b, e), and time lag τ(c, f).

References

Ezraty, R., F. Girard-Ardhuin, J. Piolle, L. Kaleschke, and G. Heygster (2007), Arctic and Antarctic sea ice concentration and Arctic sea ice drift estimated from Special Sensor MIcrowave data; User's manual v2.1, *Tech. Rep. User's Manuel V1.2*, IFREMER, www.cersat.ifreme.fr.

Kaleschke, L., C. Lupkes, T. Vihma, J. Haarpaintner, A. Bochert, J. Hartmann, and G. Heygster (2001), SSM/I sea ice remote sensing for mesoscale ocean-atmosphere interaction analysis, *Can. J. Rem. Sens.*, *27*, 526–537.