

# Supporting Information for ”Controls on Dense Shelf Water formation in four East Antarctic polynyas”

Esther Portela <sup>1,2</sup>, Stephen R. Rintoul <sup>3,4,5</sup>, Laura Herraiz-Borreguero <sup>3,5</sup>,

Fabien Roquet<sup>6</sup>, Sophie Bestley <sup>1,4</sup>, Esmee Van Wijk <sup>3,4</sup>, Takeshi Tamura <sup>7,8</sup>,

Clive R. McMahon <sup>1,9</sup>, Christophe Guinet <sup>10</sup>, Robert Harcourt <sup>11</sup>, and Mark

Hindell <sup>1</sup>

<sup>1</sup>Institute for Marine and Antarctic Studies, University of Tasmania, Hobart 7001, Australia

<sup>2</sup>Univ. Brest, Laboratoire d’Océanographie Physique et Spatiale, CNRS, IRD, Ifremer, Plouzané, France

<sup>3</sup>Commonwealth Scientific and Industrial Research Organization (CSIRO) Oceans and Atmosphere, Hobart 7001, Australia

<sup>4</sup>Australian Antarctic Program Partnership, Institute for Marine and Antarctic Studies, University of Tasmania, Hobart 7001, Australia

<sup>5</sup> Centre for Southern Hemisphere Oceans Research Centre (CSHOR), Hobart 7001, Australia Australia

<sup>6</sup>Department of Marine Sciences, University of Gothenburg, Gothenburg 40530, Sweden

<sup>7</sup>National Institute of Polar Research, Tachikawa 190-8518, Japan

<sup>8</sup>Graduate University for Advanced Studies (SOKENDAI), Tachikawa 190-8518, Japan

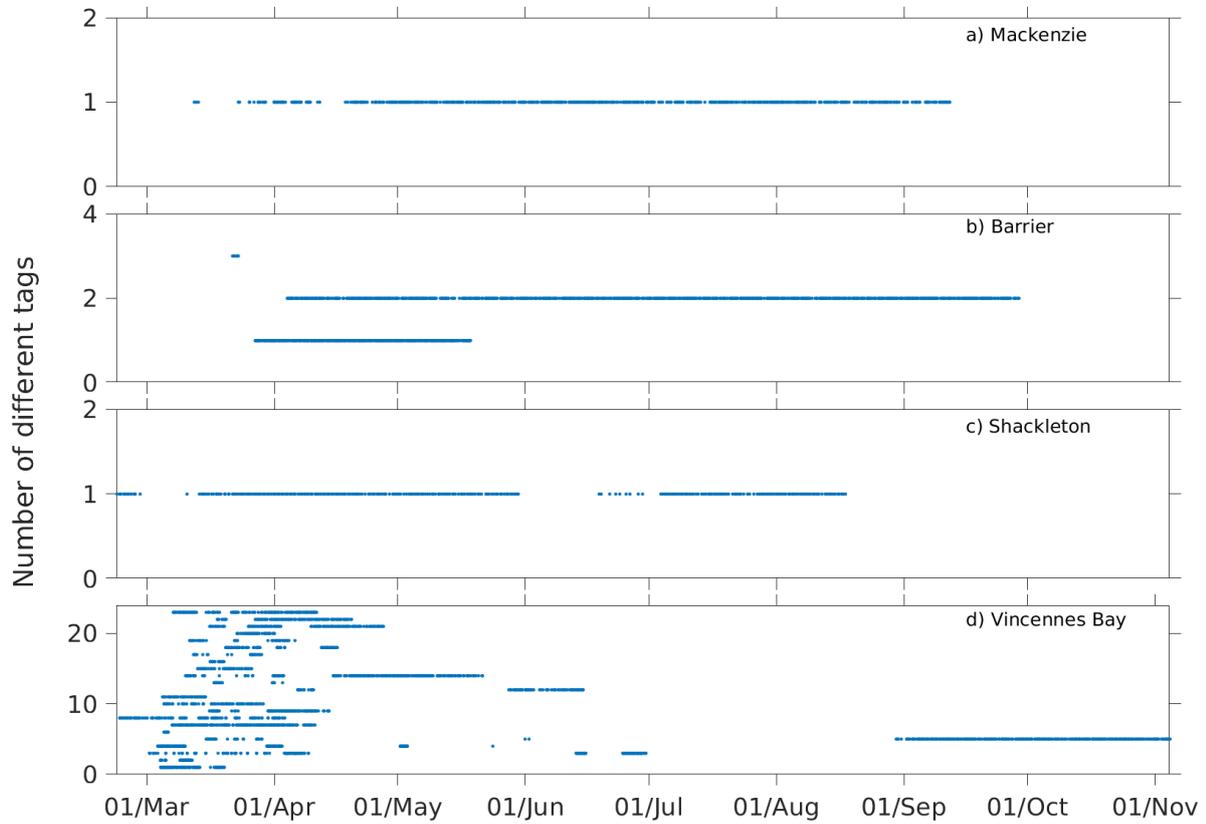
<sup>9</sup>Integrated Marine Observing System Animal Tagging sub-Facility, Sydney Institute of Marine Science, Mosman 2088, Australia

<sup>10</sup>Centre d’Etudes Biologiques de Chizé, CNRS, 79360 Villiers en Bois, France

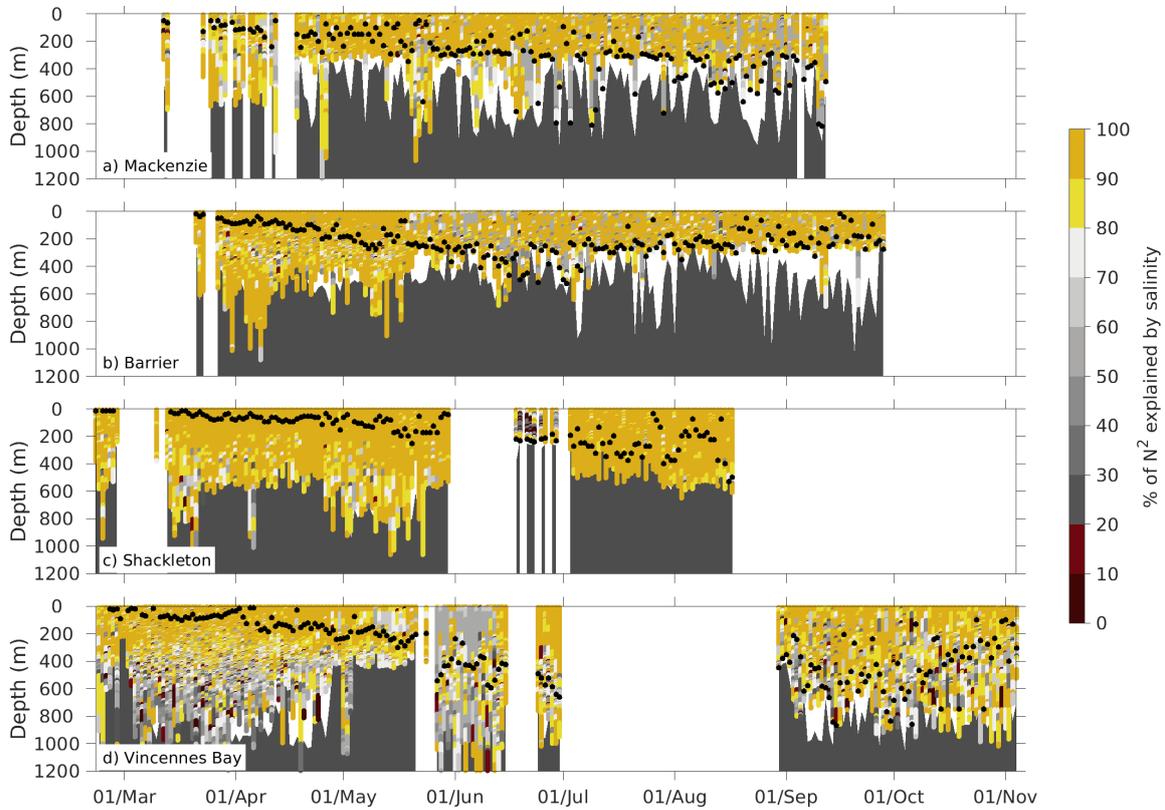
<sup>11</sup>Department of Biological Sciences, Macquarie University, Sydney 2109, Australia

**Contents of this file** Figures S1 to S5

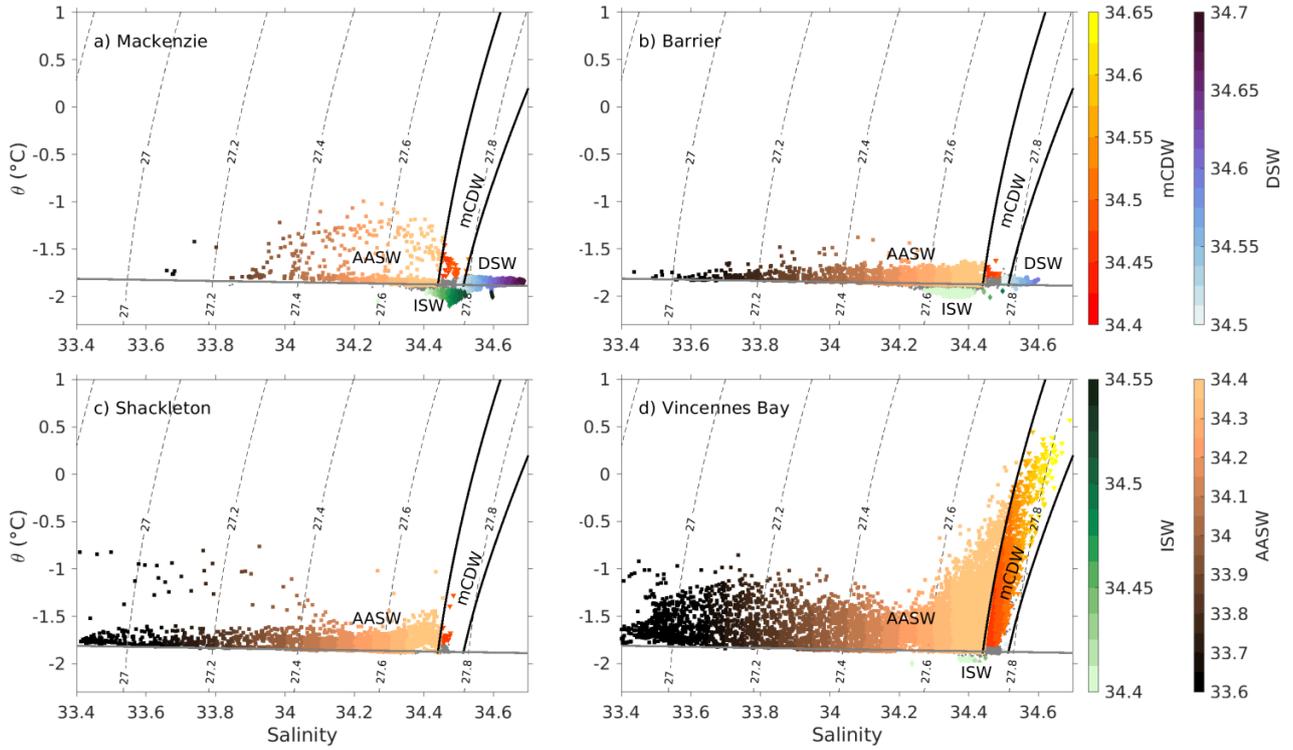
---



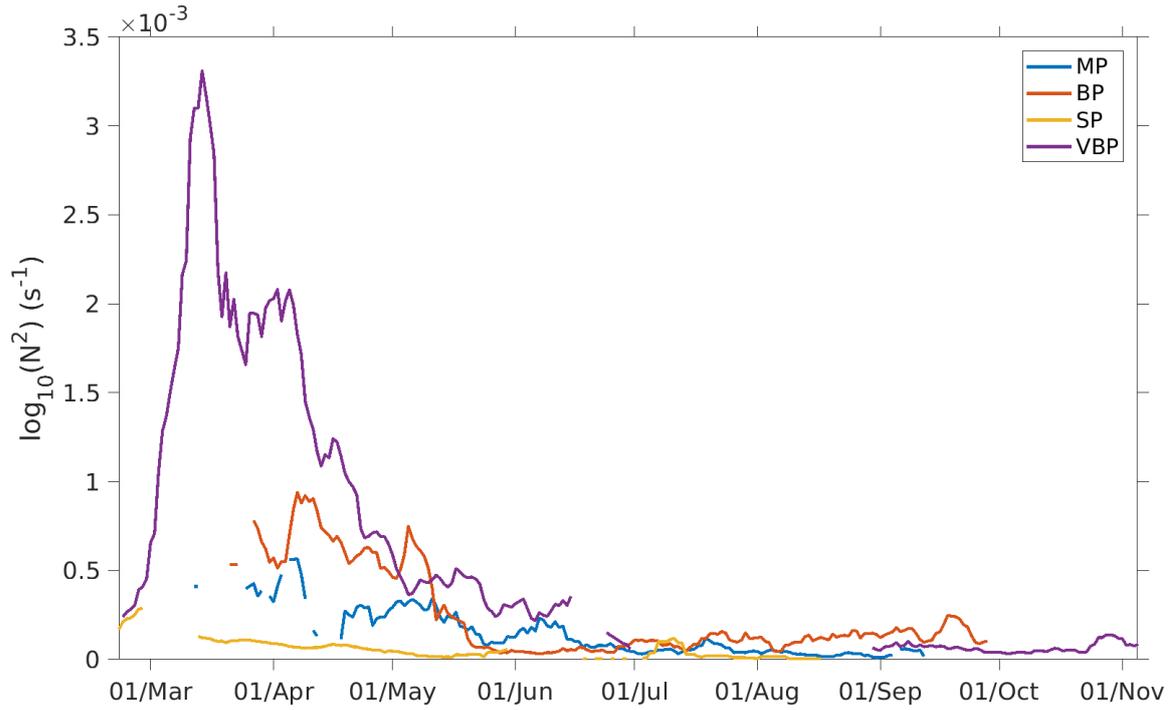
**Figure S1.** Time series of the number of different tags contributing to the dataset used in this study in all four polynyas. For reproducibility purposes, the tag numbers are: 34632 in MP, 19752 and 22374 in BP, 22476 in SP, and 22476, 22314, 19746, 19776, 19782, 19830, 22362, 22386, 22494, 22500, 22512, 22536, 24150, 24816, 24822, 24828, 24834, 24840, 24846, 24864, 24870, 24876, 24882, 24888, 24900 in VBP



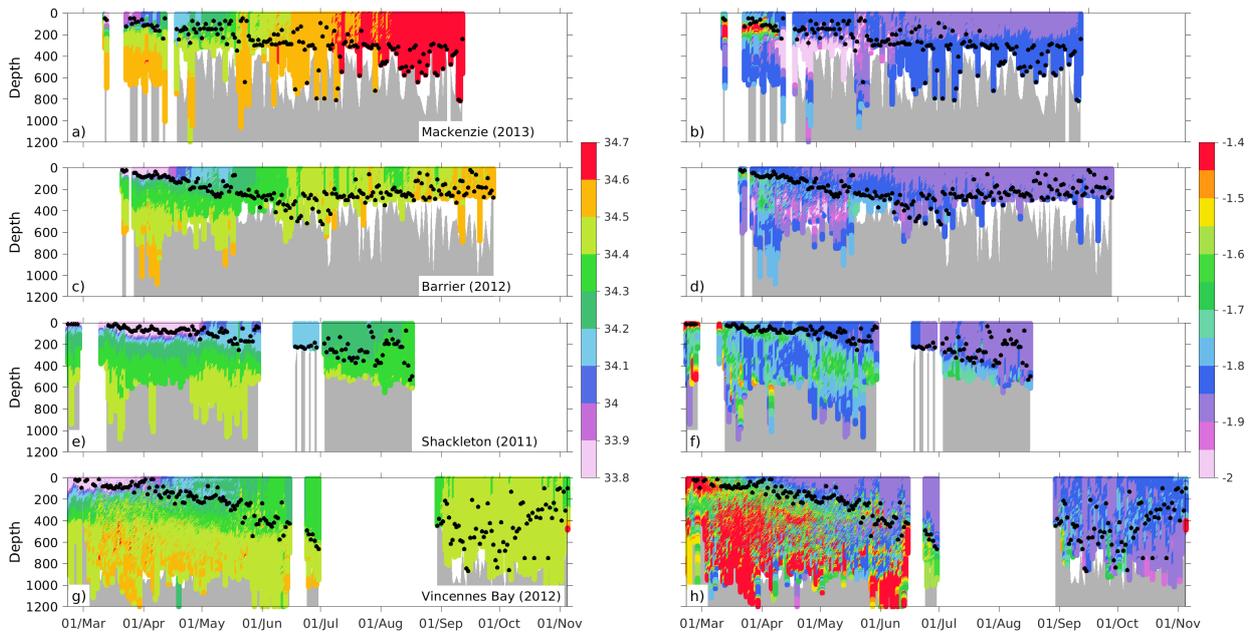
**Figure S2.** Relative contribution of the stratification by salinity ( $N_S^2$ ) to the total stratification ( $100 \cdot (g\beta \frac{\partial S}{\partial z} / N^2)$ ). (a) Mackenzie (MP), (b) Barrier (BP), (c) Shackleton (SP), and (d) Vincennes Bay (VBP). The bathymetry is shaded in grey and the black dots represent the mixed layer depth as computed with a  $\Delta\sigma$  criterion of  $0.03 \text{ kg m}^{-3}$ .



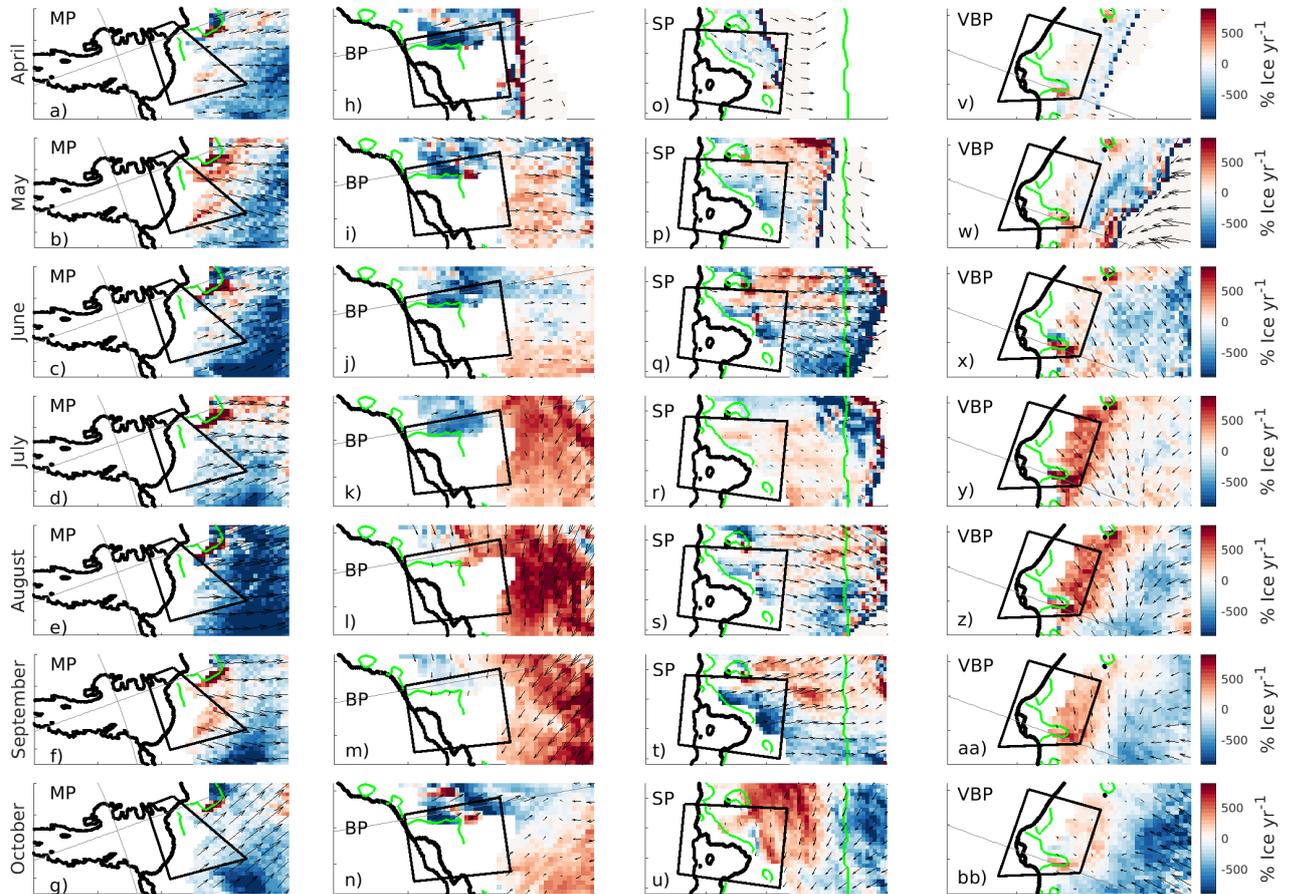
**Figure S3.** Potential temperature-salinity diagram in the four polynyas: (a) Mackenzie, (b) Barrier, (c) Shackleton, and (d) Vincennes Bay. The dashed lines represent the isopycnals and the thick black contours highlight the isoneutrals of 28 and 28.27  $\text{kg m}^{-3}$  that delimit the mCDW. The nearly horizontal grey line is the surface freezing point. The water masses are color-coded by their salinity with the different color palettes as shown in Figure 5 of the main manuscript.



**Figure S4.** Time series of the maximum stratification (expressed as the  $\log_{10}(N^2)$  in all four polynyas as indicated in the legend.



**Figure S5.** Time line of water column salinity (left column) and temperature (right column) for the four polynyas. (a-b) Mackenzie (MP), (c-d) Barrier (BP), (e-f) Shackleton (SP), and (g-h) Vincennes Bay (VBP). The bathymetry is shaded in grey and the black dots represent the mixed layer depth as computed with a  $\Delta\sigma$  criterion of  $0.03 \text{ kg m}^{-3}$ .



**Figure S6.** Sea-ice divergence in the region around each polynya between April and October. The sea-ice divergence is computed as  $\Delta \cdot (uC)$  where  $C$  is the sea-ice concentration and  $u(x, y, t)$  is the sea-ice velocity. Positive (negative) values indicate divergence (convergence) and the arrows are the sea-ice velocity vectors