The distribution of glacial meltwater in the Amundsen Sea, Antarctica, revealed by dissolved helium and neon

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The light noble gases, helium (He) and neon (Ne), dissolved in seawater can be useful tracers of freshwater added by the glacier melting since the dissolution of air bubbles trapped in glacial ice results in about ten-fold supersaturation. Using He and Ne tracers, we present the distributions of glacier meltwater (GMW) along the water columns of a long troughs and ice shelves in the western Amundsen Sea, Antarctica in the austral summers of 2011 and 2012. The measured saturation anomalies of He and Ne (ΔHe and ΔNe) (ΔC = (C/Ceq– 1) × 100%, where C and Ceq are measured and the air-saturated concentrations of a gas, respectively were in the range of 3 – 35% and 2 – 12%, respectively, at the Dotson– and Getz Ice Shelves (DIS and GIS). Throughout the DT, the maxima of ΔHe (and ΔNe) (up to 21%) were observed at the depth of 400 – , the layer between the incoming Circumpolar Deep Water (CDW) and overlying Winter Water (WW). This large extent of ΔHe even appeared nearly 300 km away from the ice shelves, suggesting that GMW can be transported more than several hundred kilometers offshore. Along the ice shelves, the the ΔHe (and ΔNe) were substantially higher in DIS than those in GIS and the largest ΔHe were observed in the western part of DIS, where concentrated outflow from the shelf were observed. Compared to 2011, the GMW fractions in 2012 decreased by up to 30 – 40% in DIS and GIS, respectively, indicating a strong temporal variability in glacial melting. Our results imply that ΔHe and ΔNe are sensitive GMW tracers with high spatio-temporal resolutions.