We are grateful to Drs. Keith Makinson and Hartmut Hellmer for their thorough and thoughtful reviews. This manuscript will be much improved by their input. We have made changes to our document and are including below an overview of these changes.

Referee comments are in **bold**, responses are in *italics*, and corrected grammar indicated by ~~strikethrough.~~

Keith Makinson

Suggested minor revisions:

~~L39 remove 'the'~~

~~L58 change to 'over the observational record.'~~

~~L60 change 'the' to 'on'~~

~~L69 remove both 'the'~~

~~L71 Modified Warm Deep Water (MWDW)?~~

~~L73 MWDW also seen at Ronne Ice Front (Mooring R2 and CTD's Foldvik et al 2001 doi:10.1029/2000JC000217)~~

~~L90 change to 'pattern and magnitude of'~~

L118 Are these temperatures and salinities restored throughout the model runs? *Yes. We have augmented the text to explain:* "Model hydrography is restored to these initial temperatures and salinity along the boundaries using a mixed radiation and nudging condition (Marchesiello *et al.*, 2001) over a 20-day period."

L122 It would be worth mentioning the lack of an east to west density gradient and hence the reverse circulation in the cavity. *We agree with the need to highlight this limitation in our model setup but feel that this information is best contained in the discussion section rather than the methodology section. We now use this information to introduce the discussion section and establish how our results can be interpreted in the context of other studies. The paragraph in question in our methodology section now reads:*

> Our simulations were initialized with a homogeneous, stationary ocean that has a potential temperature of either θ_{init} = -1.9°C ("cold case") or θ_{init} = -1.4°C ("warm case"). Initial salinity is defined as S_{init} = 34.65 for all cases. Model hydrography is restored to these initial temperatures and salinity at the boundaries using a mixed radiation and nudging condition (Marchesiello *et al.*, 2001) over a 20-day period. The standard geometry cold case incorporates a uniform temperature and salinity that approximates conditions of the primary water mass entering the ice shelf cavity (Foldvik et al., 2001; Nicholls et al., 2001, 2009). The consequences to FRIS cavity circulation in choosing a uniform θ_{init} and S_{init} are discussed in **Sect. 4**. The warm case represents a moderate ocean warming scenario with an increase of 0.5°C in the temperature of water being advected into the FRIS cavity. This change is much smaller than the 2°C temperature increase in the inflowing water by the end of this century predicted by Hellmer et al. (2012), but was chosen to investigate whether initial

> feedbacks due to melt-induced changes in cavity shape from initial warming might be positive or negative. Our idealized simulations do not include wind forcing, frazil ice, or sea-ice formation.

The intro to the discussion section (Sect. 4) goes into more details as follows.

> Our results show that tide forcing is important to FRIS ice-ocean interactions over a range of initial temperatures and with large variations in regional impacts. The aim of these simulations was to apply temperatures and salinities that approximate (1) present-day inflow conditions and (2) a representative temperature of future inflow conditions, reflecting a modest increase in temperature. The choice of spatially constant initial temperature (θ_{init}) and salinity (S_{init}) does, however, influence circulation into and under the FRIS cavity. In the real ocean, spatial structure of the wind stress and production of dense HSSW by sea ice formation over Ronne Depression establishes an east-west density gradient across the continental shelf (e.g. Foldvik et al., 1985; Nicholls et al., 2009) that leads to stronger flows into the cavity across the RIS front than our model generates. Our "present-day" scenario should, therefore, be regarded as the basis of this sensitivity study rather than a prediction of known circulation within the cavity. In particular, our standard cold case misses the inflow in the Ronne Depression and a counter-clockwise circulation around Berkner Island (Foldvik et al. 2001). In contrast, our simulations for both the present-day and melt-adjusted cases predict the primary inflow through the FIS and a clockwise circulation around Berkner Island; this pattern of circulation is, however, consistent with the future warming scenario presented in Hellmer et al. (2012). The fundamental conclusions of our sensitivity analysis of ice-ocean interactions within FRIS are, however, independent of these differences from the real-world modern circulation.

L195-196 it would be useful to define what these numbers (Haney number and Beckmann and Haidvogel number), are if you are going to mention them.

The paragraph in question now includes the following description:

> The ice draft and bathymetry were each smoothed to minimize errors in the baroclinic pressure gradient that arises with the terrain-following coordinate system used in ROMS (Beckmann and Haidvogel, 1993; Haney, 1991). The two parameters used to quantify smoothing are the Beckmann and Haidvogel number, rx0 = |h(e) – h(e')| / (h(e) + h(e') (Beckmann and Haidvogel, 1993), and the Haney number, rx1 = |h(e, k) – h(e', k) + h(e, k-1) – h(e', k-1)| / (h(e, k) + h(e', k) – h(e, k-1) – h(e', k-1)) (Haney, 1991), where 1 ≤ k ≤ N and e and e' represent two adjacent cells. Together, these parameters establish that the surface (ice) and bottom bathymetry slopes are sufficiently small to reduce or eliminate spurious flows due to a horizontal pressure gradient and ensures hydrostatic consistency throughout the water column at adjacent horizontal grid nodes. Our Beckman and Haidvogel number, rx0, is less than 0.045 along both surface and bottom topographies, and our Haney number, rx1, is less than 10 in both surface and bottom levels except for

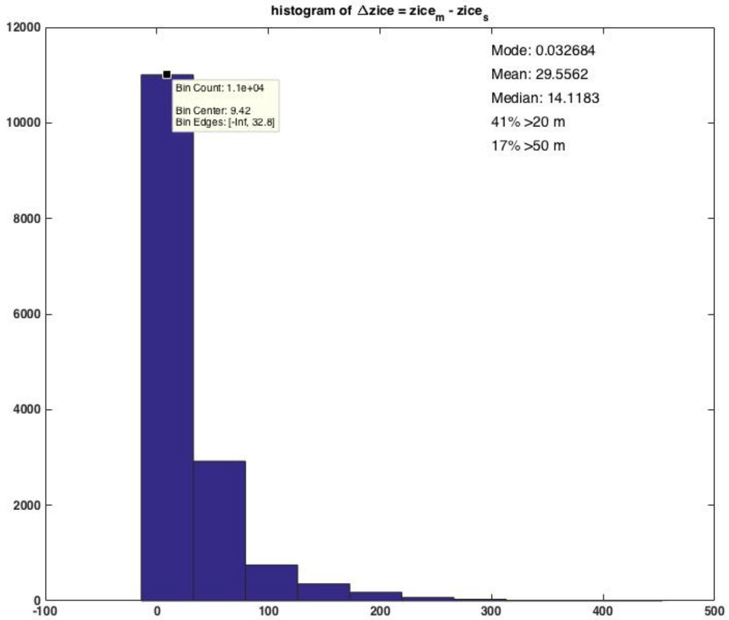
some areas along the ice shelf front, where rx1 is larger and reaches a maximum value of 17.

L203 extreme stratification profile – a little more explanation maybe? *The sentence now reads:* “We initialized these models with horizontally uniform temperature and salinity fields taken from a standard warm case profile, in the vicinity north of Bjerkner Island, where the strongest stratification of all runs is represented.”

L212 Mention that this is a known problem/limitation with this type of model. *We have included this information.*

~~**L216 1914 m. correct?**~~

L233 .03 is this correct? Remove ‘below’. *Yes. 0.03 is correct for the mode, but we agree that this number is a questionable asset to the discussion. We have changed the text to include information on the median: “…*and a median of 14 m*”. A graphic of the distribution is included below.*



~~**L234 remove ‘above freezing’**~~

~~**L236 consider removing ,. Given. . ..bathymetry.’**~~

~~**L239-40 consider changing to ‘conditions and ran with and without . . .’**~~

~~**L243 change to ‘tide-resolving with at temporal resolution of 2 hours and’**~~

~~**L270 change ‘over’ to ‘after’**~~

L286 section label needed. *Indeed! We have corrected this and other Section label errors.*

~~**L298 change to ‘maximum tidal currents along’**~~

Para L327-330 consider adding a value or percentage for the 'increased melt rates' and 'slightly modifies'. *We have modified the text to read:*

> The pattern of w_b for the standard warm no-tides case (**Fig. 5b**) is generally similar to the standard cold no-tides case (**Fig. 5a**) but with a 3.5 fold increase in the shelf-averaged value. Changing cavity shape while imposing the same initial ocean temperature in the modified warm case (**Fig. 5c**) only slightly reduces melt rates (by 10%) for the no-tides scenario (cf. **Fig. 5b and 5c)**.

~~L336 it should be noted that there is very limited freezing north of Henry ice rise. L415 'southern' rather than 'innermost'~~

~~L441 'these' to 'the'~~

~~L466 sources~~

~~L510 Fig. 10e~~

~~L543 'is' to 'are'~~

~~L706 Ronne Ice Front~~

~~L759 Any bathymetry data from beneath ice shelves is useful as it will help better define the cavity geometry which you have demonstrated to be important for the whole system (tides and circulation).~~

~~Fig 1. Add W and S labels for lon and lat.~~

~~L1010 remove 'than the standard geometry'~~

~~L1012 change to 'barotropic tidal transport'~~

~~L1017 change to 'continuous dye release'~~

~~Fig8 and 9. Mention in caption that this is after 2 years.~~

Fig12. Holland et al 2008 show similar melt figures over an extended range. doi:10.1175/2007jcli1909.1 *This is an important paper to cite here, and we have done so as follows:* "In general, our values are in range of those shown in Holland et al. (2008), (c.f. their Fig. 1 and our Fig. 12b),…."

Also Holland et al 2007 doi:10.1029/2006JC003915 show similar results to your dye tracer experiments. *We have included a reference to this important paper in the first paragraph of section 2.11:* "Our model excludes the influences of wind-driven circulation and sea-ice formation. As such, it is perhaps no surprise that these dye distributions are qualitatively similar to those shown by Holland et al. (2007)."