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Interactive comment on "Holocene trends in the foraminifer record from the Norwegian Sea and the North Atlantic Ocean" *by* C. Andersson et al.

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General comments: The manuscript discusses the Holocene paleoceanography of the northern North Atlantic and addresses the fundamental question of the paleotemperature signal carried by various proxies. The reconstructed temperatures based on planktonic foraminifers are revisited taking into account the fact that they may represent sub-surface conditions instead of real surface water. By combining results from different proxies, the authors make assessment in terms of upper water mass stratification and propose differential trends in surface and sub-surface layers. They finally compare their results with model simulation outputs. Most data presented in the manuscript are already published but the compilation is very interesting as it shows a consistent mid to late Holocene trend of cooling in surface waters (alkenones and diatoms), whereas other proxy records suggest warming in subsurface waters (Mg/Ca and planktonic foraminifers). Although the precise interpretation in terms of subsurface

temperature can be discussed, the data demonstrate a regional change in the structure of upper water masses, which is very important.

Specific comments: Beyond the above consideration, the approach may lead to some questions. The inferred variation in the thermocline or pycnocline is challenging because it introduces uncertainties in the SSTs estimated from planktonic foraminifers. As discussed in the text, planktonic foraminifers inhabit a wide range of depths. Thus, the calibration based on surface temperature relies on the implicit assumption that the thermocline remains uniform (otherwise the relationships between surface temperature and foraminiferal populations may change). As a consequence, the interpretation of the planktonic foraminifer data in terms of sub-surface conditions makes sense but the quantitative estimates of temperature based on a calibration with the surface temperature are debatable, especially because significant changes in the thermocline likely occurred. From this view point, I would be more confident with temperature estimates based on Mg/Ca than from transfer functions using foraminifers or radiolarians. Mg/Ca data are particularly interesting and it would have been relevant to illustrate the results from different species (i.e., different water depths) as done by Thornally et al. (2009). The interpretation of data from core RAPID-12-1K (Fig 3 C) may differ by considering Mg/Ca from G. inflata in addition to Mg/Ca from G. bulloides alone. The authors should report both records in figure 3.

The interpretation in terms of water mass structure should also take into account possible variations in salinity, thickness of the surface layer, thermal inertia and seasonal contrast of temperatures as changes in these parameters might explain the apparent discrepancy of the temperatures estimated from various proxies. Such changes in the upper water mass properties are illustrated by Thornally et al. (Nature 2009). Previous studies from the northeastern and northwestern Atlantic also indicate variations in these parameters and suggest a trend towards increasing surface salinity and reduced seasonal contrast of SSTs from the mid to late Holocene (Solignac et al., Quat. Sci. Rev. 2004; Paleoceanography 2006; Can. J. Earth Sci. 2008; de Vernal and Hillaire-

Marcel, Global and Planetary Change 2006). Nevertheless, despite uncertainties in the respective interpretation of proxies, the studies mentioned above are consistent with the interpretation made in the manuscript inasmuch as they all support the hypothesis of stronger stratification during the mid Holocene and further demonstrate the complexity of the ocean dynamics in the northern North Atlantic.

The manuscript also includes a model-data comparison section. The consistency between model and proxy data as shown Fig. 8 (or from the literature) is not unequivocal and the point the authors want to make from this comparison is not clear. A critical assessment of the ocean component in the model for the subpolar regions would be necessary.

Technical corrections: Page 2086.Line 3 : the warming in the Arctic is far to be uniform and 1.6°C is a value that can be challenged Page 2086. Line 4: I suppose the authors misspelled “northwest”. Page 2089. Line 17: Arctic is misspelled

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