

## ***Interactive comment on “Deep water formation in the North Atlantic Ocean in high resolution global coupled climate models” by Torben Koenigk et al.***

### **Anonymous Referee #2**

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This paper represents important material for further development of global climate model. The authors do a decent job in getting an overview of the different models and their performance. My comments are mainly regarding the formulations and figures, which could be improved.

#### Main comments:

Introduction: in many places, the style is a fast shift between presenting 'settled knowledge' and presenting the moerations. This leads to very long sentences, which are difficult to read. For instance: L 72-74 (and how is it questioned?) and l. 75-79. The whole section must be revised according to this to become more clearly structured.

The introduction, or may be the models and simulations section, must discuss 'high

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resolution' in relation to the Rossby radius and resolving eddies.

Power spectra calculated in Figs 6 and 9 and referred to in the text. As far as I can see, these 'spectra' are raw periodograms. They will have 100 independent points (for a 100 year simulation), and therefore, five points will exceed the 95% significance curve just by chance. So periodogram spectra don't tell much. There are ways to overcome this, see e.g. von Storch and Zwiers (1999). The spectral analysis must be improved along these lines. Also, it must be specified, how the red significance level is calculated. The spectra with red lines does not seem to describe the background spectra of the model data very well; this looks odd, and must be explained. Conclusions in text must be changed according to revised spectral analysis.

#### Minor comments:

L 1-2 (title): The paper is comparing what could be called (present-day) standard resolution with higher resolution. The title should reflect this. L. 82: '..future model simulations ..', write e.g: '.. model simulations of future climate...'. L. 87: 'The question whether ...'. Why not write: 'It is still discussed ...'. L. 107: '..important role.' For what? L. 110: 'Climate-related processes' Be more specific, please. L. 113: 'increasing the horizontal resolution' .. of GCMs. L. 117: Here you refer to a study with an eddy-resolving model. It should be made clear, that the present paper is not about eddy-resolving models. L. 134: An outline of the HighResMip-protocol and a reference are needed here. L. 154-158: Some more description of these fluxes is needed. L. 161: I cannot find a detailed description on how MLD is calculated in observations and in models. This must be added. L. 220: Where do you see that? L. 231: Well , I se an around 50/50 split. L. 259-261: I don't understand this sentence. l. 274: What is the spinup period? L. 315: 'melting heat water fluxes'. What is that? L. 349 'high-resolution models'. In ocean or in atmosphere? L. 419: What does this sentence mean? L. 443: add '... non eddy-permitting...'

Table 3. Add columns with histoirical trend – control trend.

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Fig. 2: Dont you yellow lines. They are really difficult to see.

Add a Fig. 2  $\frac{1}{2}$  showing MLD for models + ARGO (analogous to Fig. 3)

Fig. 3: Labels like 5e+14 a really not nice to look at, please change them. Why is there only two lines in panel a). And please add a panel based on ARGO data.

Fig. 4: Instead of having a separate panel (a) for ARGO, put the argo stratification in the model-panels.

Fig. 10: Colors for HadGEM3 and CNRM-CM6 are indistinguishable, please change. Also the figure is hard to understand. May be points referring to the same model in different resolution can be connected with thin lines. You must experiment, and improve the figure.

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