Interactive comment on “Quality assessment of the TOPAZ4 reanalysis in the Arctic over the period 1991–2013” by Jiping Xie et al.

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Referee #2 The manuscript provides a detailed description of the results of the 23-year reanalysis of the Arctic computed with the TOPAZ4 model system. 1. The manuscript appears more like a report than a scientific paper tackling a scientific or methodological issue. The model system is described elsewhere and has undergone very little changes with respect to previously published information. The assessment of the quality of the products uses a rather elementary approach.

Reply: The paper by Sakov et al. (2012) was a proof of concept that an EnKF-based assimilation system can be used with a coupled ocean and sea ice for long reanalysis. This study does not propose new methodological development but it verifies that the proof of concept holds when applied for a longer period (23 years are more relevant to the community than 6 years) with a more heterogeneous observation network (spatially, temporally and various data sources). The main purpose of the manuscript is to present and validate the official Copernicus CMEMS product for the Arctic region. The proposed reanalysis is unique (see table below extracted from Chevalier et al. 2016) as it proposes a long high-resolution dynamical reconstruction of the ocean and sea ice, and assimilates a complete set of observations available in the Arctic region with an advanced ensemble data assimilation method and with strongly coupled data assimilation between ocean and sea-ice. We have tried to present this achievement in a concise manner, with a primary focus to inform the end-user about the strength and weaknesses of our data set. As a response to the recommendation of the first reviewer (and your following comment), we will extend the current validation with an analysis of the ensemble reliability, and assess whether our system manage to provide a dynamical reconstruction that falls within the uncertainty of the different observational data sets that are assimilated. We believe that this will increase the scientific value of our manuscript as it would confirm or infirm the underlying assumptions on model and observation errors.

2. The results discussed in the manuscript can be useful as a support of further studies using the reanalysed fields but, as it stands, the manuscript is merely descriptive. Also, little information is given about the ensemble and this information is not used to assess the quality of the reanalysis: only the ensemble mean are used for this purpose.

Reply: We agree and this will be investigated using the ensemble statistics at assimilation time. See also our answer to the other reviewer.

3. The quality of the reanalysis obtained using TOPAZ4 could also be compared with the quality of similar other products.

Reply: We think that such comparison is beyond the scope of our paper and, for the sake of diplomatic correctness, is better undertaken in a separate collaborative initiative (The ongoing Ocean Synthesis COST action, a follow-up of the ORA-IP Arctic paper...
by Chevallier et al.). A primary comparison of the ocean part of our analysis has been compared with other existing systems (Lien et al. 2016, cited in the manuscript).