



## ***Interactive comment on “Benefits of sea ice thickness initialization for the Arctic decadal climate prediction skill in EC-Earth3” by Tian Tian et al.***

### **Anonymous Referee #2**

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The article of “Benefits of sea ice thickness initialization for the Arctic decadal climate prediction skill in EC-Earth3” uses different anomaly initializations of ocean, SIC and SIT in the EC-Earth3 climate prediction system from 1987-2016. These three ensemble prediction experiments investigate the hindcast prediction skills for sea ice and air temperature near surface at different time-scales. The concerned conclusions are very interesting to well understanding the initialization uncertainty for the Arctic climate prediction from seasonal to interannual variabilities. It has a close relation for this journal, but there are some factors should be more clarification before published. All the experimental runs are no more than 10 years. So a little adjustment of this title could

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be better like using “Benefits of sea ice thickness initialization for the Arctic climate prediction from seasonal to interannual in EC-Earth3” A limit of SIT from ORAS5 which has no constraint by the SIT observations. It may result in the underestimation of the SIT initialization impact on the Arctic system. In fact, some SIT assimilation work like Xie et al. (2018) shows the perennial ice in CAO could be remarkably corrected if compared with the SIC assimilation. Xie, J., Counillon, F., and Bertino, L.: Impact of assimilating a merged sea-ice thickness from CryoSat-2 and SMOS in the Arctic reanalysis, *The Cryosphere*, 12, 3671-3691, <https://doi.org/10.5194/tc-12-3671-2018>, 2018. So this limit should be clearly mentioned in the text. Line 98-103: A 25-member ensemble has been generated by the EC-Earth3, but this study only uses the 5 members of them. What reasons has been used to choose the rest 4 members excluding the FREE1? If no direct relation between these 25 members and the used 5 members, the concerned statements may be redundant for the readers. In these sensitive experiments, the derived anomaly for initialization is quite important. So as my understanding from Table 2, the initialization anomaly for sea ice on average is equivalent to the model biases shown in Fig. 2. Could you give some comments about their differences. furthermore, if comparing the stippled SIT in Fig. 2b and in Fig. 6, they look different, is it true and the reasons? Fig. 2b shows the SIT with dots covers a considerable area in the Arctic. Does it necessary to skip so wide area like in the Laptev Sea and the East Siberian Sea, or give more explanation for the threshold of 100 m? Line 314: “. . . , RMSESS>0.2 is commonly found poleward of the September sea ice edge determined by FREE (Fig. 2a), . . .” Clearly, this inferred statement lack of enough proofs to attribute to the misfits in September alone. Figure 7 show the 95% confidence lines which is quite interesting for me. Could you introduce some words how to evaluate these results? If possible, add one paragraph for this methodology in text.

Other small comments: Does the TAS (near surface air temperature) mean the air temperature at 2 m? In Table 1, the reference dataset of ORAS5 has been signed 5 for the ensemble size. As we known, the ORAS5 reanalysis assimilated the

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observations in ocean and the satellite-based sea ice concentration. The related 5 members from ORAS5 are not clear, and especially for their differences.    Line 304: replace “INIT denote experiments with different initialization methods, i.e. ...” with “INIT denotes the different experiment, i.e. ...”    Line 345: It said the polar cap domain (see Fig. 2a), but the caption of Fig. 5 also mentions the polar cap domain (north of 70N). To avoid the confuse, please keep the same concept in this study.    Checking the abbreviations are explained when they emerge at first time: ORCA at Line 94; ORAS4 at Line 106; SSP2-4.5 at Line 192;

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-331>, 2020.