ESSD-2021-217
Response to RC1 (Referee 1)

The authors thank referee 1 for a thoughtful review of the manuscript. We agree with many of the referee's points and have made the necessary changes. The responses for the referee's specific comments are as follows.

Overall comments:

The authors have made some substantial improvements to the manuscript, and have addressed most of my concerns. While there are still several issues that should be addressed before publication. Thus, I recommend major revisions.

Major comments:

1. The authors have provided more information on the experimental design, however, the description of the experiments used in this study is still limited. Does the WRF-ERA5 experiment generate a 36-hour simulation for each run, driven by ERA5 as the initial and lateral boundary conditions? Does it run once per day? If so, the reinitialization method is used. More details should be given on the experiments used in the study.

Authors' response: Following the referee's suggestion, we have added more information on the experiments to Table 3 in the revised manuscript to clear up the ambiguity.

In this study, the WRF-based ERA5 experiment produces 36 hr forecasts from the initial condition (i.e., ERA5) every 6 hr (i.e., 00, 06, 12, and 18 UTC), which implies that there are 4 runs per day, and ERA5 reanalysis fields are used as the initial and lateral boundary conditions. This can be regarded as the re-initialization method. However, the term "re-initialization" is generally used in regional climate simulation studies and re-initialization frequency varies from a few days to a month. In contrast, in this study, the WRF-based ERA5 and ERA-I experiments are performed to be compared with data assimilation experiments (i.e., E3DVAR and AdvHG) and 36 hr forecast fields are generated every 6 hr for the experiments, which implies that forecast length (36 hr) is much shorter and re-initialization frequency (6 hr) is more frequent than general regional climate model (RCM) simulations where weekly or monthly re-initialization is applied for longer integration time. Furthermore, the comparison between experiments in this research is conducted to investigate the effect of assimilation and short-term predictability rather than climate simulations. For these reasons, the term "re-initialization" may not seem to be apposite to the description for experiments generated in this study.

2. I don't agree with the author's reply to comment 5. Figures 4 and 5 in the revised manuscript show that WRF-ERA5 presents the smallest RMSEs for both the 24h and 36h forecast fields. I am wondering what are the advantages of high-resolution regional reanalysis.

Authors' response: Although WRF-ERA5 shows the smallest RMSEs for 24 and 36 hr forecast fields, precipitation fields of WRF-ERA5 are less accurate than those of East Asia Regional Reanalysis (EARR). It may result from not only inconsistency between ECMWF modeling system to produce ERA5 and WRF model to produce forecast fields of ERA5 in this study, but also lack of smaller-scale features in an initial condition due to a relatively coarse resolution of ERA5. On the contrary, EARR uses the advanced hybrid gain data assimilation method (AdvHG) to add value to ERA5 global reanalysis. Combining the global reanalysis data (i.e., ERA5) characterized by the high quality of large-scale features with detailed smaller-scale features in the higher resolution represented by ensemble-based assimilation method (i.e., E3DVAR) as well as a community numerical weather prediction model (i.e., WRF model) is a key factor of EARR to be able to produce high-resolution initial conditions represented with regional features, which could contribute to reduction of forecast errors, especially for precipitation. Therefore, EARR has its own advantage of representing regional features of precipitation better than relatively coarse-resolution global reanalysis. To highlight the advantages of EARR, we have added them to section 6 in the revised manuscript as follows (underlined).

(L569-576) "Combining the global reanalysis data (i.e., ERA5) characterized by the high quality of large-scale features with detailed smaller-scale features in the higher resolution represented by ensemble-based assimilation method (i.e., E3DVAR) as well as a community numerical weather prediction model (i.e., WRF model) is a key factor of EARR to be able to produce high-resolution initial conditions represented with regional features, which could contribute to reduction of forecast errors, especially for precipitation. Therefore, EARR has its own advantage of representing regional features of precipitation better than relatively coarse-resolution global reanalysis."

ESSD-2021-217
Response to RC2 (Referee 2)

The authors thank referee 2 for a thoughtful review of the manuscript. We agree with many of the referee's points and have made the necessary changes. The responses for the referee's specific comments are as follows.

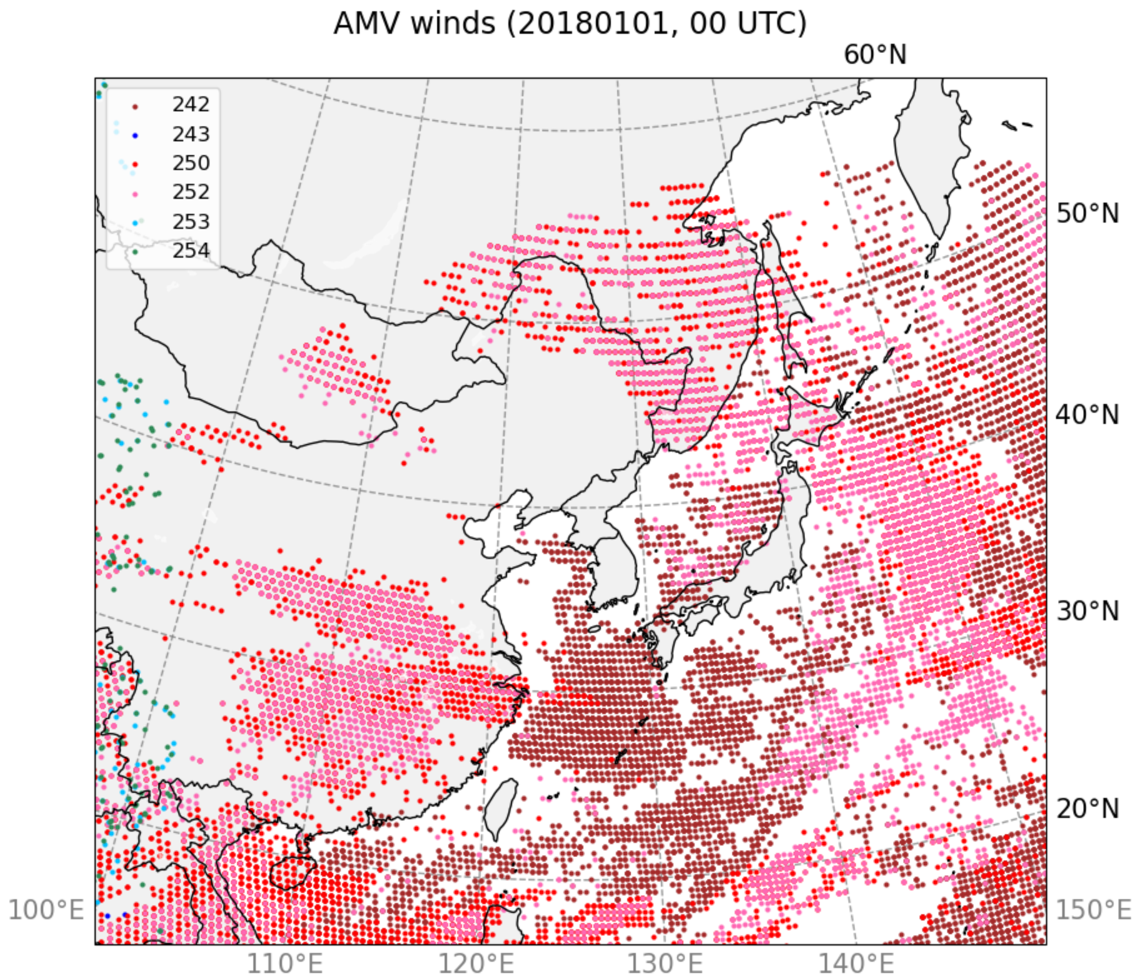
Overall comments:

The authors revised the paper well enough, especially the results of 2010-2019. Readers will benefit the careful revise. Some tiny problems are below, for your reference.

Minor comments:

1. Line 191 and Table 1. The conventional data includes AMVs, it should be AMVs from geostationary satellites and polar winds from polar winds. Suggest not to use "GEOAMV" in Line 191, and "geostationary" in Table1. Please check the actual data input again.

Authors' response: As the referee suggested, we have checked the actual AMV input data from NCEP Prepbufr observations and have revised Table 2 and Line 191 in the revised manuscript. Because most of the EARR domain is lower than 60 degrees north and polar orbiting satellites generally cover high latitude areas beyond 60 degrees north, in most cases, AMVs from geostationary satellites (Himawari-8 and Meteosat-8) account for most of AMVs in the EARR domain as shown in Figure_rev1. Each dot color in Figure_rev1 represents different report types of AMV winds from NCEP PrepBUFR observations available for assimilation at 00 UTC on 1st of January in 2018. The reddish colored dots for 242, 250, and 252 indicate AMV winds from Himawari-8 satellite and the bluish colored dots for 243, 253, and 254 indicate those from Meteosat-8 satellite. Although polar AMVs are rarely included in the EARR domain, it is more accurate to use the term AMV instead of GEOAMV. Therefore, we have revised Table 2 and Line 191 in the revised manuscript accordingly.



Figure_rev1. Each dot color represents different report types of AMV winds from NCEP PrepBUFR observations available for assimilation at 00 UTC on 1st of January in 2018. The reddish colored dots for 242, 250, and 252 indicate AMV winds from Himawari-8 satellite and the bluish colored dots for 243, 253, and 254 indicate those from Meteosat-8 satellite.

2. Delete "2017010100" on the upper right of Figure 1. Enough information in the title of the figure 1. Please avoid the misunderstanding to the readers. The scope is applied for 10 years. Please revise the title, the following is for your reference.
Figure 1. The East Asia Regional Reanalysis domain. The black dashed box denotes a verification area. Different types of NCEP PrepBUFR observations are available for assimilation at 00 UTC on 1st of January in 2017.

Authors' response: As the referee suggested, we have revised Fig. 1 and its title in the revised manuscript.