Reply to the Comments by Referee #1 for Manuscript gmd-2021-143 "A micro-genetic algorithm for combinatorial optimization of physics parameterizations in Weather Research and Forecasting model for quantitative precipitation forecast in Korea"

General Comment:

The paper "A micro-genetic algorithm for combinatorial optimization of physics parameterizations in Weather Research and Forecasting model for quantitative precipitation forecast in Korea", by S. Park and S. K. Park, analyzes the importance of optimizing the selection of the parameterization physics schemes, and their parameters, in improving the prediction of extreme rainfall at the mesoscale in Korea.

The paper is generally well written and carefully describes the performed experiments. The paper appears scientifically sound and the degree of novelty is high. However there are some small points to be improved before publication, in my opinion.

⇒ We appreciate the positive and valuable comments by the referee, which helped us improve the quality of the manuscript. We have revised the manuscript following the referee's specific comments, including some corrections and suggestions. An item-by-item response to the comments is provided below.

Specific comments:

i) *The paper is based on the comparison between several simulations performed with optimized WRF and a single meteorological event. However, the event is only shortly described (section 4.1). There are two references: KMA (2018) shows a page in Korean in which, for a foreigner, is not easy to understand (and in any case does not contain a meteorological description of the event). Park and Park (2020) is another paper. In my opinion, a paper should be self-consistent and contain all indication to understand the problem; reference to other papers could be used only for details. For instance, Sokcho was the location showing the largest precipitation? During the 27 hours of rainfall there, there were some time periods in which rainfall was more intense?*

⇒ We appreciate the referee pointing this out. We have revised the manuscript by adding the detailed description of the event as the followings:

3.3. Experimental design
… During the 12-hr period from 1200 UTC 5 to 0000 UTC 6 August 2018, **including the first and second periods of intense rainfall (see Section 4.1),** precipitation was evaluated by fitness functions…

4.1 Case description
… For the period from 1100 UTC 5 to 1400 UTC 6 August, 294.5 mm of precipitation was recorded at Sokcho**: the first intense rainfall continued for 4 hrs (13:00 UTC – 17:00 UTC 5 August) with the maximum precipitation rate of 35.3 mm/h and total rainfall amount of 83.5 mm, whereas the second intense rainfall (17:00 UTC 5 – 0:00 UTC 6 August) recorded the maximum precipitation rate of 54.9 mm/h and total rainfall amount of 192 mm, due to the**

quasi-stationary MCS. To predict more accurately, forecasters essentially need the mesoscale information from NWPs …

ii)   *Maps in figures 5 and 8 show the precipitation in the second domain for all simulations. Since the portion of Korean territory (and adjacent sea) interested by the event is much smaller than the domain, I suggest to zoom on the portion of territory interested by the rainfall (about a quarter of the domain), in order to highlight the details. The other part of the territory is not important in this sense, since there was no any precipitation. In this way, it could be possible to better appreciate the structure of the precipitation area.*

⇒   Figures 5 and 8 have been modified to zoom in on the area of interest, showing the major precipitation systems in more detail.

iii) *it is very clear that this result appears quite interesting, since it shows the importance of using an accurate choice of the physics parameterizations schemes. However, this result could be dependent on the case study. In this sense, if possible, it could be interesting for the reader to add, in the discussions, a sentence in which there is an attempt to understand why some schemes perform better than others, from a physical point of view.*

⇒   We appreciate the referee pointing this out. We explained why the selected schemes have better forecast performance than the others in the revised manuscript as:

A typical cumulus convection can be represented by the CU schemes at horizontal grid spacing of about 25 km. However, the selected CU scheme (i.e., MSKF) has been improved for use in the so-called grey zone scales (e.g., 5 km used in this study); thus, it can outperform the other CU schemes. On the other hand, the KFCP scheme that is modified to better account for the presence of shallow clouds was selected for OPT-EXP2 and OPT-EXP5 possibly because their fitness functions were focused on the precipitation occurrence. Note that the single-moment MP schemes predict the mixing ratio of hydrometeors by representing the hydrometeor size while the double-moment schemes also predict number concentrations of hydrometeors. Thus, the double-moment schemes (e.g., NSSL 2-moment, WDM 6, Morrison) can produce a reasonable concentration of large droplets for a heavy precipitation system, compared to the single-moment schemes (Lim and Hong, 2010). In addition, the YSU scheme, representing the PBL process, more accurately simulates a deeper vertical mixing in the thermally-induced free convection regime covering multiple vertical levels (Hong et al., 2006), thus being superior to the other schemes for the simulated precipitation.

Lim, K.-S.S. and Hong, S.-Y.: Development of an effective double-moment cloud microphysics scheme with prognostic cloud condensation nuclei (CCN) for weather and climate models, Mon. Wea. Rev., 138, 1587–1612, doi:10.1175/2009MWR2968.1, 2010.
Hong, S.-Y., Noh, Y., and Dudhia, J.:   A new vertical diffusion package with an explicit treatment of entrainment processes, Mon. Wea. Rev., 134, 2318–2341, doi:10.1175/MWR3199.1, 2006.

Language: I am not a native speaker, so my opinion on the language, very good, could be biased. There are some minor typos to be corrected (e.g .: gird -> grid, Ninno -> Niño).

⇒   Corrected. We appreciate the reviewer for checking out these typos.