Reply to Referee #3

Major comments:

Overall the manuscript is clear and the subject is much interesting to the readers of the GMD. I have a couple of questions and suggestions.

: We grateful to this reviewer for careful reading of the manuscript and providing valuable and detailed comments. We tried to revise the article carefully as the reviewer's commented.

1. Computational burden: With the NDSL, is there any extra computational burden? In either case, it's better be described and discussed in the manuscript.

: Thank you for the reviewer's comment. We also considered describing this issue in the manuscript. The current NDSL scheme in the RSM brings approximately 35% increased computational cost with respect to the original version. However, there still exist the spectral advection calculation in the RSM with the NDSL even the spectral advection result is not used any more. Thus, it is hard to estimate the computational burden when the NDSL replaces the original spectral advection. Removing spectral calculation for tracers when the NDSL is used is the work to do before official release. We added follow in the revised manuscript.

"When the NDSL advection used (the SL experiment), there occurs extra computation cost of 35% with respect to the ORG run. However, the current version of the NDSL in the RSM still calculates spectral tracer advections even the result is not used any more. It means that the computational burden with the current NDSL in the IsoRSM is purely the increased computational cost which is required for the NDSL tracer advections. In updated release, this inefficiency will be solved."

2. What is the order of the accuracy in the NDSL?

: The NDSL uses three-time-level differential which has second-order of the accuracy in time. For spatial interpolation and remapping, the piecewise parabolic method is used in the NDSL which has third order accuracy.

3. boundary/buffer zones: What are the minimum numbers of the grid points for these two zones? It is not uncommon to have these in the regional model. In real case, 5 times delta_x is used. Is it the minimum recommended by the authors?

: When we tested the real-case experiment, the minimum grids for boundary and buffer zone was 2-grids for each direction. We recommended 5-grids for boundary and buffer zone with some stability. In our case, 10 km horizontal resolution and 40 sec time step interval are used. If these resolutions are changed, those boundary and buffer zone setup may be changed accordingly. The guide line will be provided in the manual.

4. For idealized experiment, can the authors provide the original advection scheme's error? Also, I'd be interesting to know if one uses a longer time step (2 x delta_t). However, it is not necessary to perform this extra experiment.

: Thank you for the reviewer's constructive recommendation. We made a simple advection driver for the NDSL scheme in this study. It's not much complicated to make the driver because tracers always exist on grid-spaces. To make the same driver for the original advection scheme, wave-grid spatial transform part should be included. It is absolutely possible to make the spectral driver for ideal test, but we could not make the driver in this review process. We will make the frame for idealized experiment as the reviewer commented.

For longer time step in ideal test, we checked 2dt and 3dt cases. Figure C1 shows x-directional advection test for the NDSL. Conditions are same as in the manuscript, but for x-direction only. It is shown that results from 3 different time steps are almost overlapped.

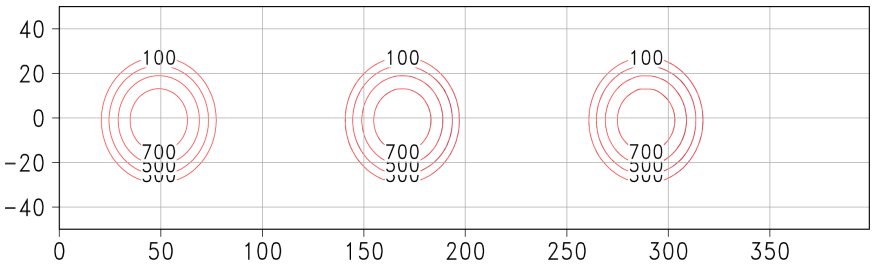

Fig. C1. Idealized x-directional advection with different time steps. Black, blue, and

red contours indicate the results with Δt of 100s, 200s, and 300s.

5. I want to confirm that these tracers don't have sink terms as of the current implementation, right?

: In dynamical advection process for the NDSL, there is no sink terms. However, there are dry and wet deposition processes for radioactive tracers as described in section 2.1. These depositions are considered in physical process, and it works as a sink terms for tracers.

Finally, I'm wondering if the NDSL will be included in the official release of the RSM.

: The NDSL will be a part of officially distributed RSM.