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Interactive comment on "Performance evaluation of throughput-aware framework for ensemble data assimilation: The case of NICAM-LETKF" *by* H. Yashiro et al.

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We appreciate your careful reviewing and valuable comments and suggestions. Point-by-Point replies to your comments are as follows.

1) It seems from Figure 4 that the biggest gain going from the old to the new setup is for StoO. Could this gain not have been accomplished by integrating the StoO code into the model (perhaps with a coupler)? Both model and StoO are independent between different ensemble members.

[reply]

In this study, the program of StoO is separated from the atmospheric model and is

executed individually. The gain of the StoO from old to new setup is mainly come from the improvement of poor I/O throughput and the collision of I/O requests. Following Miyoshi et al. (2010), multiple time slots of the observation and model output are used for StoO calculation in the data assimilation system of this study. The amount of model data inputted in the StoO is 7 times larger than that in the LETKF. For the LETKF, elapse times of both file I/O and MPI communication are decreased in the new framework. We explain above in revision.

2) The timings presented are without any user output what so ever as far as I can see. In a operational scenario you would assume that at least the final analysis need to be output in a form that is suitable for producing maps,verification and to provide initial states for an ensemble forecast. This would entail moving the data from local storage to global and "gluing" together the parts of the globe. The time this takes and its scaling behaviour would also need to taken into account.

[reply]

We agree that the scalability should be discussed according to the operational scenario. We did not take the time for post-processes of data assimilation cycle into account. This is because that such processes will be executed on the other nodes. We can choose appropriate time to copy the local data to global file system and/or the other node. Thus, the post-processes do not block the sequential cycle of the data assimilation. The post-processes should be executed by the multiple nodes. Remapping of the grid system is one of the most time-consuming part in the post-processes. We remap the variables from the icosahedral grid to the geodesic grid. This process takes similar time to the StoO program. Initial data for an ensemble forecast, which usually has higher spatial resolution than the ensemble analysis, is also prepared by remapping.

3) Related to 2/ above is the issue of resilience of the cycling system. If one of the nodes on which this assimilation system is cycling crashes and its data is lost we need

somewhere to have a backup from which the data can be restored on a different node.

[reply]

As discussed in the reply of comment 2), we can copy the data as a background process from the local storage to the global storage at the time when the data files are not busy. If the data assimilation cycle is crush due to the node failure, we can restart the cycle by using the latest dataset in the global storage.

4) One thing that is not clear in the presentation is the amount of observations used and if this is representative of today's operational data assimilations schemes (typically of the order of 10.000.000 observations/6 hour period). It is possible, if this number is much lower in the experiments presented, the issue of load-balancing , acknowledged by the authors, might become a much more important factor. The statement that the observation coverage will become homogeneous with the introduction of more satellite platform is dubious. This may be true in a time averaged sense, say over a day, but may not be true if the observation window is reduced to let say 3 hours in order to produce more frequent forecasts.

[reply]

Thank you for the valuable comment. We agree what you pointed out. When we conduct high-resolution data assimilation with frequent assimilation cycle, the inhomogeneity of the observation become larger. This is true even if we use satellite observations. We explain it in revision. The amount of the observation data per 6 hour period in this study was about 50,000. This is the number after the quality check and thinning from 1,000,000 observations. We received similar comment from referee #1. There is a trade-off between computational load balancing and data movement. The best setting is also depends on the machine. The number of observation and model resolution in this study will be insufficient to evaluate the future operational DA system. We will push forward the performance study of dynamic load balancing such as the technique described in Humrud et al. (2015) in the future. On the other hand, we argue that the

speedup in computation in the LETKF is easier than that of global communication with massive nodes. The ratio of floating point operations to memory accesses in LETKF analysis is large. This type of calculation is expected to become faster by performance enhancement in future processors.

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