Yamaura, T., 2025: Generation of ensemble perturbations using low-precision floating-point numbers. *J. Meteor. Soc. Japan*, **103**, http://doi.org/10.2151/jmsj.2025-022.

Plain Language Summary: This study aims to improve ensemble spreads using low-precision floating-point arithmetic. Two methods were tested: reducing the precision of initial conditions (initial value ensemble) and reducing the precision of model calculations (model ensemble). The model ensemble proved more effective. Combining it with conventional ensemble methods further improved spreads, suggesting that implementing low-precision arithmetic in hardware like Field Programmable Gate-Arrays (FPGAs) could enable faster processing without compromising forecast quality.

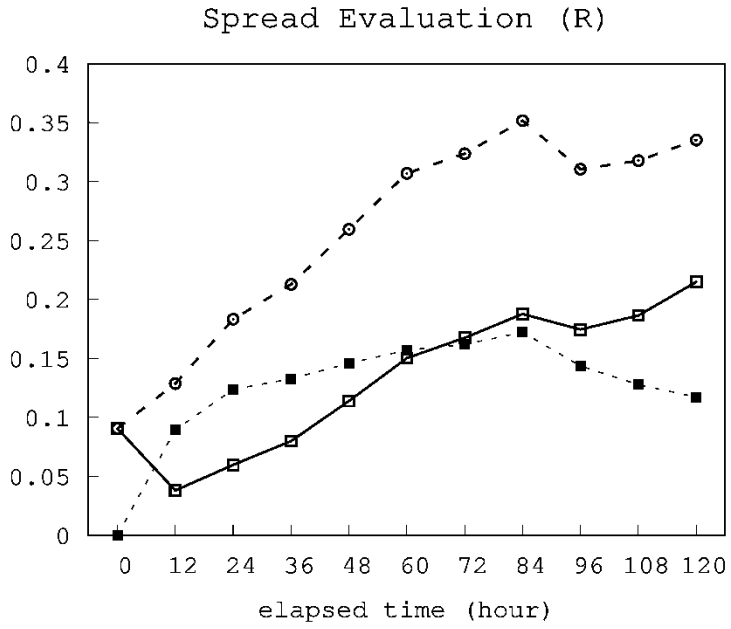

Figure 1. Spread Evaluation Index evaluated in terms of geopotential height at 500 hPa from the start to the end of time integration for 24 cases with initial values at 00 UTC on the 1st and 15th of each month in 2019. The horizontal axis indicates elapsed time and the vertical axis indicates the magnitude of Spread Evaluation Index. Solid lines indicate results for the conventional method, dotted lines for the rounding error-based method, and dashed lines for the combination method.

- **Rounding Errors in Ensemble Methods**: The study explores using rounding errors from low-precision floating-point arithmetic in ensemble forecasts. While this method was unsuitable for initial value ensembles, it effectively improved model ensemble methods by expanding the ensemble spread.
- **Improved Forecast Accuracy**: Combining the rounding error-based method with conventional ensemble methods enhanced ensemble spreads, likely by compensating for the randomness that standard weather models tend to suppress.
- **Potential and Challenges of FPGA Implementation**: Implementing low-precision floating-point arithmetic on FPGAs could improve computational speed without reducing accuracy, but adoption is limited due to compatibility issues with traditional meteorological programming languages.