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Using Stochastic Physics to Determine the Required Numerical Precision for Parametrization Schemes

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Reducing the numerical precision in weather and climate models can save computational costs. Since parametrization schemes have a large inherent uncertainty, often explicitly considered in simulations by stochastic physics schemes, it is unlikely they need to be represented at high precision. Here, we consider how SPPT (stochastic perturbation of parametrization tendencies) can mask rounding errors introduced by reduced-precision computing in parametrization schemes. We find that SPPT allows us to reduce precision further than would be expected from deterministic model runs. By comparing the errors in the parametrization tendencies to SPPT perturbations we see that the SPPT perturbations mask random rounding errors at low precisions. Where the model starts to fail is when the rounding errors become biased at low precision and are not well masked by SPPT. These biased errors come from parametrization schemes "switching off" or "switching on" more than expected. There are some simple code changes that can be made to mitigate these biases allowing us to gain extra bits of precision for little cost.