Parallel Analog Ensemble: The Power of Weather Analogs

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We present the newest release of a parallel, scalable, and extensible implementation of the Analog Ensemble technique, called PAnEn. Forecast ensembles are usually generated using multi-model or multi-initialization approaches. These approaches become computationally expensive rapidly when the spatial and temporal resolution increases. On another hand, Analog Ensemble generates forecast ensembles relying on a single deterministic model simulation and the corresponding observations or model analysis.

Weather analogs are defined using a multi-variate linear distance function. According to the calculated distance metric, the most similar past forecasts to the current forecasts are identified, and the observations associated with the most similar past forecasts are selected as analog ensemble members. Analog Ensemble has been successfully applied to various projects across the fields including weather forecasting, air quality control, and renewable energy forecasting.

PAnEn implements the complete framework of data pre-processing, analog generation, post-processing, and data visualization. It also ships with a set of command-line utilities to generate and evaluate analogs. The core libraries are implemented in C++ for performance and the programming interfaces are available both in C++ and R. The package is opensource and documented. To harness the power of high-performance computing, PAnEn can be deployed with RADICAL EnTK and run on supercomputers such as XSEDE Summit and NCAR Cheyenne. The implementation achieves 92% overall parallelization.

PAnEn is a well-suited solution for problems where calibrated forecast ensembles are needed but computation remains a constraint. It can also be applied to uncertainty quantification and model downscaling. We hope to present these use cases and support collaborations.

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