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A Novel Approach Utilizing pnetCDF applying to the WRF-CMAQ two-way coupled model

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I/O is part of a scientific model and it takes up a significant portion of the simulation. There is no exception for the newly developed WRF-CMAQ two-way coupled model at US EPA. This two-way coupled meteorology and air quality model is composed of the Weather Research and Forecasting (WRF) model and the Community Multiscale Air Quality (CMAQ) model. We are using this two-way model to evaluate how accurate it simulates the effects of aerosol loading on radiative forcing between 1990 and 2010 when there were
substantial aerosol emissions such as SO_2 and NO_x, reduction in North America and Europe.

The I/O scheme in the current model does not make use of any parallel file system or parallel I/O approach. In addition the I/O takes about 15% - 28% of the entire simulation. Our novel approach not only utilizes pnetCDF parallel I/O technique but goes one step further to aggregate the
data locally, i.e. along column dimension or row dimension in the spatial domain. This approach not only reduces the I/O traffic contention but also aggregated data enhances the I/O efficiency. In terms of I/O time, we have shown this method is about 6 to 10 times faster than the current existing
I/O scheme in the model and about 20% - 3 times faster than strict application of pnetCDF.

We are currently running the model on a Cray XE6 machine and finding ways to reduce the overall simulation time is crucial to the success to achieve our objective.