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Studying a new GPU treatment for chemical modules inside CAMP

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A novel solution to speedup chemistry modules in atmospheric models will be presented. The Chemistry Across Multiple Phases (CAMP), a new flexible treatment for gas- and aerosol-phase chemical processes, is used as our testbed. The model allows multiple chemical processes (e.g., gas- and aerosol-phase chemical reactions, emissions, deposition, photolysis, and mass-transfer) to be solved simultaneously as a single system. In this particular contribution not only CAMP is presented, but also the innovative solutions to adapt CAMP for GPU accelerators. CAMP is adapted to allow the solving of multiple atmospheric grid-cells in a given spatial region as a single system, as opposed to the common practice of solving them individually. It reduces the number of solving iterations and the memory required to solve the cells in a parallel environment. In this work, the new implementation is tested on the linear solving routine. The KLU Sparse and the Biconjugate Gradient algorithms are used for taking CPU and GPU measurements respectively. Preliminary results present up to 35x speedup in the GPU solution compared to the original CPU version. The results also show a possible 70x speedup by avoiding the continuous data movement between CPU and GPU during the solving. Finally, a future version of a complete GPU chemical solver will be explored. For the complete version, we aim for 1) A full heterogeneous version using CPU and GPU resources and 2) Minimizing and hiding data movement between host and device.

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