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Toward Performance Portability of the FV3 Weather Model on CPU, GPU and MIC Processors

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The U.S. National Weather Service has selected the FV3 (Finite Volume cubed) dynamical core to become part of the its next global operational weather prediction model. While the NWS is preparing to run FV3 operationally in late 2017, NOAA's Earth System Research Laboratory is adapting the model to be capable of running on next-generation GPU and MIC processors. The FV3 model was designed in the 1990s, and while it has been extensively optimized for traditional CPU chips, some code refactoring has been required to expose sufficient parallelism needed to run on fine-grain GPU processors. The code transformations must demonstrate bit-wise reproducible results with the original CPU code, and between CPU, GPU and MIC processors. We will describe the parallelization and performance while attempting to maintain performance portability between CPU, GPU and MIC with the Fortran source code. Performance results will be shown using NOAA's new Pascal based fine-grain GPU system (800 GPUs), and for the Knights Landing processor on the National Science Foundation (NSF) Stampede-2 system.