

## The Application of HPC in Cloud for Atmospheric Modeling

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As part of the ongoing efforts for numerical modeling in atmospheric science field, using HPC in cloud computing infrastructure will be required. For typical meteorological modeling tasks (e.g., Weather Research and Forecasting model; WRF), High Performance Computing (HPC) is needed to have peak performance at the expense of reliability. However, batch mode operation, poor data access and virtualization are some disadvantages of using HPC. While cloud computing are about scalable, on-demand reliable access and good for large scale data (i.e., big data) analysis and heavy use of virtualization.

Although distributed memory (MPI) implementations within clouds work, it can be further improved. In this research the shared memory (OpenMP) will be used instead of MPI to conduct meteorological simulations. It could be the best way to use cloud computing for HPC applications. Developers, such as Microsoft, are drastically increasing the number of cores on a chip. This proposed research will seek Microsoft's support to test cloud servers that composed of massive many-core processors (e.g., Intel knights landing). Therefore, a typical HPC tasks can run as separate cores or ganged. The other possible approach is to convert the WRF model to be able to run on Microsoft OS. Some modifications and appropriate compilers as well as libraries are needed to be in clouds.

In general, clouds are great when a "burst" computing is needed. It can build up and/or tear down virtual supercomputing clusters as users need them, at very little cost. The short-term goal of this project will be to take the advantages of clouds computing to expedite the research on extreme weather and climate change as well as their linkages to our environments and societal impacts. The long-term goal of this project will help to answer the question "Can we merge HPC and the cloud effectively for short-term (high impact weather events) and long-term (climate change) research?"