Towards Improving the Performance of ADCIRC Storm Surge Modeling Software

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Background
Storm-Surge modeling is an incredibly demanding computational task that requires the use of powerful supercomputing resources. Modern day storm-surge modeling applications perform complex mathematical calculations on geographical areas using the Finite-Element mathematical method that represents the area using a grid of varying sized triangles. The smaller the triangle the better the resolution, but at the cost of more data points that take more time to compute. The figure below showcases a coast where the lighter sections cover open water, and the darker sections cover the actual coast where more data is computed.

Objectives
• Identify computation “hotspots” on the host processor
• Implement OpenMP threading on expensive routines
• Increase speed by offloading threaded parallel work

Profiling
Figure below showcases a profile run over 128, 256, and 512 cores. It is important to focus on the most expensive routines. The profiling used the Tuning and Analysis Utilities (TAU) at TACC.

Xeon Phi Co-Processor
- Research done on the Texas Advanced Copmuting Centers (TACC) Stampede Super Computer
- Each host processor is paired with an Intel Xeon Phi Co-Processor
- Host processors have 16 threads per
- Xeon-Phis have 240 per that are 2.5 times slower

OpenMP & Offloading
OpenMP threading and offloading is achieved by wrapping directives around code regions. When execution arrives at these blocks, the work will be offloaded to the coprocessor. This requires identification of the global variables used which can result in extra computation time. The following is an example using OpenMP and offloading.

Current and Future Work
• Offloading the OpenMP code sections to the Xeon Phi
• Optimize code by directing the flow of necessary information between the co-processors and the host
• Compare the timings of Xeon-Phi offloading with just OpenMP tests

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