ESM Algorithmic Acceleration for Petascale Systems

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In their current formulations a simple calculation, for the current state-of-the-art in geoscience simulation technologies (explicit time-stepping, structured meshes), reveals that in order to produce five years of simulated climate at a resolution of 4km per day of computing, an increase of 10^4 to 10^6 in compute power will be required. Following Moore's Law, such an increase will occur predictably in 13 to 20 years from now. In this talk, I will discuss potential algorithms that could possibly avoid the barrier set by Moore's prediction. Results of geophysical flows on unstructured meshes, using h-p adaptive techniques combined with linearly implicit time-stepping schemes will be shown. Finally, I expose a path forward for the geosciences in terms of modeling in general and talk about future research directions.