

Can scalable development lead to scalable execution?

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The multidisciplinary nature of geophysical simulations has led to considerable interest in managing software complexity. With increasing numbers and types of models being integrated into simulations, the process of scaling up to hundreds of program units (e.g., procedures, modules, components, or classes) impacts project budgets and timelines at least as much as the process of scaling up to hundreds of execution units (e.g., processors, processes, threads, or cores). This talk analyzes the scalability of the software development process and proposes a strategy for taming code complexity when adding new physics or numerics. The proposed approach decomposes applications into mathematical or physical objects that support an abstract data type calculus. Applications of this approach in a range of problems, including atmospheric boundary layer (ABL) simulations, will be discussed along with fundamental questions about turbulence physics that can be answered at the petascale. While this work has gelled into a coherent design philosophy and produced publishable new science, the principle remaining task is demonstrating runtime scalability. This talk will present preliminary thoughts on the potential roadblocks and how they can be surmounted.