Managing Complex Scientific Applications - A Climate Modeling Perspective

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Over the past 30 years climate models have evolved from relatively simple representations of a few atmospheric processes to complex multi-disciplinary system models which incorporate physics from bottom of the ocean to the mesopause and are used for seasonal to multi-million year timescales. Computer infrastructure over that period has gone from punchcard mainframes to modern parallel clusters. Constraints of working within an ever evolving research code mean that most software changes must be incremental so as not to disrupt scientific throughput. Unfortunately, programming methodologies have generally not kept pace with these challenges, and existing implementations now present a heavy and growing burden on further model development as well as limiting flexibility and reliability. Professional software engineers have developed techniques, tools, and processes which ameliorate these problems, but these often must be tailored to the unique characteristics of scientific software development.

After a brief overview of the basic scientific principles and computational algorithms used to model the Earth's climate, the presentation will highlight some of the best practices for managing software within the climate modeling community. Drawing on direct experience with the NASA climate model, GISS ModelE, the presenter will comment on the challenges and benefits as some of these practices were introduced. The presentation will conclude with discussion of avenues for further improvement to scientific productivity.