# High-Detail Simulation of Tropical Convection

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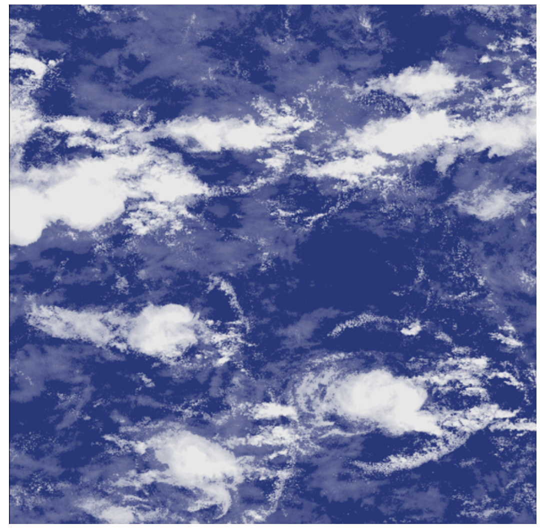
The hydrological and energy cycles of the Earth's atmosphere involve a wide range of clouds, from shallow puffy cumulus clouds to thunderstorms. Although clouds are among the most important factors regulating the Earth's climate, they are poorly represented in current global climate models (GCMs) due to inadequate spatial grid resolution.

In order to improve the representation of clouds in GCMs, scientists need to understand better and in greater detail how clouds interact with their environment as well as with the terrestrial and solar radiation. Cloud-Resolving models (CRMs) are the leading tool for advancing our understanding of how clouds "work." The CRMs solve dynamical equations describing the motion of the air and thermodynamics as well as microphysical transformations involving rain and. The solutions can have a high degree of detail and realism.



Simulated view from a satellite of a cloud field from a high-detail computer simulation of tropical convection over the ocean with 100m horizontal grid spacing. The horizontal domain size is about 200 km.

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Credit: Marat Khairoutdinov

Dr. Marat Khairoutdinov, associate professor at the School of Marine and Atmospheric Sciences of the State University of New York at Stony Brook and one of the scientists of the Center for Multiscale Modeling of Atmospheric Processes, an NSF Science and Technology Center, has recently performed a very detailed simulation of tropical thunderstorms. To perform a one-day simulation, a CRM using a mesh composed of 1 billion cells was run for several real days on 2048 processors of the IBM BlueGene/L 'New York Blue' supercomputer housed by the New York Center for Computational Science. The grid cells are 100 m across, and the full domain of the simulation is over 200 km across.

The detailed spatial and temporal output from the simulation fills about 5.5 TB of disk space. It is being shared with many scientists both inside and outside of CMMAP. They are using the simulation to study how small and big clouds grow and interact, how they organize themselves on spatial scales of several tens of kilometers, and how they interact with the small-scale turbulence. The model output will also be used as a benchmark simulation to evaluate results from less detailed models. The aim of this research is to improve the representation of clouds in global climate models.