BLUE WATERS
SUSTAINED PETASCALE COMPUTING

Allocation: Illinois/500 Knh

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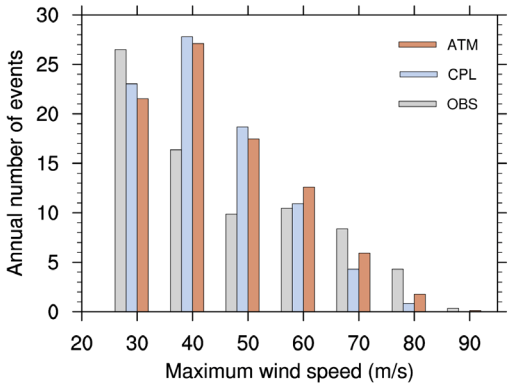
Geoscience

THE RESPONSE OF TROPICAL CYCLONE ACTIVITY TO GLOBAL WARMING IN THE COMMUNITY EARTH SYSTEM MODEL

Research Challenge

Tropical cyclones are rare weather events, yet they consistently rank among the world's deadliest and costliest natural hazards. These cyclone–climate connections are poorly understood and largely missing from today's generation of Earth system models, yet they may be fundamentally important to understanding the mechanisms influencing climate variability and to improving projections of future climate change.



Binned frequency distribution of global annual average number of tropical cyclones for different maximum wind speeds from observations (grey), coupled CESM (steel blue), and atmosphere-only CESM (salmon)

Methods & Codes

The Community Earth System Model (CESM) is a comprehensive global climate model that consists of atmosphere, land, ocean, and sea ice components that are connected via a central coupler that exchanges state information and fluxes between the components. The Community Atmosphere Model has improved microphysics and cloud properties, and the prognostic modal aerosol package is activated in the current experiments.

Results & Impact

In this research project, the team is building on their recent work analyzing the relationship between TCs and climate using a high-resolution, state-of-the-art Earth system model. The comprehensive suite of model experiments have provided them with thousands of simulated cyclone tracks for different climate conditions and coupling configurations using a dynamically consistent Earth system modeling framework, enabling robust assessment of cyclone activity and variability in response to changes in climate.

Why Blue Waters

Tropical cyclones (TC) climate research falls at the interface between weather and climate modeling, requiring high-resolution grid spacing to resolve weather-scale TC features, as well as global-scale coverage and decades of integration time. Blue Waters provides the unique capabilities of handling the computational demand associated with running the model at ultra-high resolutions, including scalability to over 15,000 cores, high frequency input and output, and postprocessing and visualization of model results.