UNIVERSITY of HAWAI'I MĀNOA

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M.S. Defense Announcement

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SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

High Resolution Modeling of Hurricane Impacts in the Hawaiian Islands under Present and Future Climate Conditions: A Case Study of 2018 Hurricane Lane

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You are invited to a Zoom meeting.
When: May 10, 2021 at 12:30PM HST

Register in advance for this meeting:
https://hawaii.zoom.us/meeting/register/tJAtdeisqzsoG9ftWd-nRoAMJ_8oD42082Y1

After registering, you will receive a confirmation email containing information about joining the meeting.

Abstract:

Hurricanes are of great interest to weather and climate scientist alike due to their destructive tendency. Though Hawaii has historically avoided being hit directly, it is certain that the islands are uniquely vulnerable to cyclone impacts. Thus, it is important to ask if the vulnerability of Hawaii could be further exploited in the future due to changes in tropical cyclones that may arise from anthropogenic global warming. Previous studies have used various GCM downscaling approaches and hybrid models to simulate these future conditions. However, these methods have inherent biases in TC simulation that can affect the ability to assess whether localized impacts will change.

This study uses a Pseudo-Global Warming technique, whereby changes in background conditions (SST, wind, geopotential height, pressure, mean sea level pressure, soil moisture, two meter temperature, and relative humidity) are imposed on the forcing fields of a historical simulation of a hurricane with the Weather Forecasting and Research (WRF) model to simulate changes in its trajectory and impacts under a global warming scenario. First, an ensemble of historical simulations of Hurricane Lane, a recent non-landfalling hurricane with significant impacts on the islands, was performed in order to identify the optimal parameterization schemes. To quantify the performance of each scheme in simulating accumulated precipitation across a number of stations, a novel application of a categorical agreement metric, Cohen's kappa, was employed. The optimal simulation chosen was one that utilized WSM 3-class microphysics scheme, RRTM Longwave radiation scheme, CAM Shortwave radiation scheme, had cumulus scheme turned off for inner domain, and spectral nudging turned on. Then, PGW experiments were performed in order to assess the response of Lane to changing background conditions under a high emissions scenario. The simulation (WSM3) responded significantly to changes in background conditions enacted by the PGW technique. The result was a Lane that tracked more South of the Islands, creating areas in excess of 200mm drier over the 9 day period considered.

This study demonstrates the usefulness of a new statistical method for comparing station data to gridded model output, validating further use for extended topics. This research also illustrates the utility of PGW technique in assessing the impact of climate change on localized impacts of hurricanes in Hawaii.