MMM SEMINAR SERIES

Influence of Warm Mediterranean Sea Surface Temperatures on Tropical-like Cyclone Daniel

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In September 2023, Cyclone Daniel became the deadliest storm in Mediterranean history, producing catastrophic flooding and record-breaking rainfall in Greece and Libya. This seminar explores how exceptionally high Mediterranean Sea Surface Temperatures (SSTs), reaching up to 5.5°C above historical averages, contributed to the storm's rapid intensification and extreme precipitation rates.

Using high-resolution convection-permitting simulations with the Weather Research and Forecasting (WRF) model, we analyze Daniel's evolution under actual 2023 SST conditions and a counterfactual scenario in which the long-term warming trend was removed. Results indicate that the anomalously warm waters played a crucial role in enhancing atmospheric instability, fueling the storm's development, and dramatically increasing precipitation totals. Rainfall rates reached unprecedented levels, with Greece experiencing 754 mm in just 18 hours and Libya recording 414 mm in a single day—both exceeding historical maxima. The simulations confirm that these extreme rainfall amounts would have been significantly lower without the warm SST anomalies, underscoring the direct role of climate-driven oceanic heating in amplifying storm impacts.

Further analysis reveals distinct regional differences in rainfall generation. Over Greece, extreme precipitation resulted from both enhanced local evaporation and remote moisture advection, while in Libya, the storm's intensification into a tropical-like system was primarily driven by the heat and moisture fluxes from the exceptionally warm Mediterranean waters. The findings highlight the growing threat of high-impact Mediterranean storms in a warming climate and emphasize the need for improved forecasting techniques, early-warning systems, and adaptation strategies to mitigate future risks.

Thursday, 06 March 2025, 2:00PM

Refreshments 1:45PM

Please also join colleagues for refreshments and informal discussion after the seminar until 3:30pm

NCAR-Foothills Laboratory, 3450 Mitchell Lane

FL2-1022, Large Seminar

Seminar will also be live webcast

https://sundog.ucar.edu/public/page/MMM

Participants may ask questions during the seminar via Slido.