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A preliminary look at the impact of warming Mediterranean Sea temperatures on some aspects of extreme thunderstorm events in Italy

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As the global climate has warmed in recent decades, interest has grown in the impacts on extreme events associated with thunderstorms such as tornadoes and intense rainfall that can cause flash flooding. Because warmer temperatures allow the atmosphere to contain larger values of water vapor, it is generally accepted that short-term rainfall may become more intense in a future warmer climate. Regarding tornadoes, it is more difficult to say what might happen since although increased temperatures and humidity in the lowest part of the troposphere should increase thermodynamic instability, allowing for stronger thunderstorm updrafts, vertical wind shear necessary for storm-scale rotation may decrease as the pole to equator temperature gradient weakens.

The Mediterranean Sea is an important source for moisture that fuels thunderstorms in Italy, and it has been warming faster than most water bodies in recent decades. The present study uses three methods to gain preliminary insight into the role that the warming Mediterranean may have on tornadoes and thunderstorms with intense rainfall in Italy. First, a historical archive of Italian tornadoes has been updated for the 1990s, and it will be used along with other data from the European Severe Weather Database to discuss possible trends in tornado occurrence. Second, convection-allowing Weather Research and Forecasting (WRF) model simulations have been performed for three extreme events to examine sensitivity to both the sea surface temperatures and other model parameters. These events include a flash flood-producing storm event near Milan, a non-tornadic severe hail event in far northeastern Italy, and the Mira EF-4 tornado of July 2015. Sensitivities in rainfall amount, radar reflectivity and storm structure, and storm rotation will be discussed. Finally, changes in the frequency of intense mesoscale convective system events in and near the Ligurian Sea, inferred from the presence of strong convergence lines in EXPRESS-Hydro regional climate model output, will be examined.