M.S. Defense Announcement
Michael DeCaria
Monday, October 25, 2021, at 11:00 a.m.

Michael DeCaria
M.S. Defense

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Defense
ATS Large Classroom (101 ATS) or via Zoom

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Peter Jan van Leeuwen (Adviser)
Elizabeth Barnes
Christine Chiu
Imme Ebert-Uphoff (Electrical and Computer Engineering)

Studying Tropical Cyclone Rapid Intensification with the Certainty Framework for Causal Discovery: A Case Study

Despite large advances in modeling tropical cyclone (TC) rapid intensification (RI), predicting TC RI still proves difficult. Predicting when RI occurs is one difficulty, and predicting how much a TC will intensify is another. Furthermore, there are many processes that combine and interact to drive RI, and showing how they combine and interact is an ongoing discussion. The certainty framework for causal discovery uses information theoretic measures to determine driver combination and interaction as well as show the relative strength of the drivers.

As a first application of the certainty framework, RI of Hurricane Patricia (2015) is studied. Data came from an ensemble Weather Research and Forecasting reanalysis of the 28 hours of Patricia's greatest intensification. The target process to explain was the hourly change in maximum tangential wind, and four potential driving processes were identified. These driving processes were azimuthal averages of outflow layer maximum radial windspeed, radial windspeed in the boundary layer at radius of maximum wind (BL-RMW), equivalent potential temperature at BL-RMW, and the temperature difference between the boundary and the outflow layers. Interestingly, equivalent potential temperature was found to be the most important driver and the BL-RMW radial wind speed was least important, while the other two drivers essentially tied for second in importance. A detailed decomposition of the driving process, a unique feature of the certainty framework, showed that equivalent potential temperature was dominant because of its strong interaction with other drivers rather than its direct influence. This points directly to the underlying physics of the processes at play, as will be explained in detail. Altogether, the four drivers explained about half of the intensification, pointing to the importance of other drivers not considered in this study.

In this talk I will introduce the causal certainty framework and its connection to information theory, illustrated with causal diagrams and its connection to thermodynamics. The specifics of the application to TC RI will be discussed, followed by an in-depth discussion of the results and the connection with existing theories on tropical cyclone rapid intensification.

Topic: M.S. Defense: Michael DeCaria
Time: Oct 25, 2021 11:00 AM Mountain Time (US and Canada)

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