M.S. Defense Announcement
Zoe Douglas
Wednesday, November 1, at 2:00 pm

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M.S. Defense

November 1, 2023
2:00 pm

Defense
ATS Large Classroom (101 ATS) or Teams

Post Defense Meeting
ATS Teaching Lab (323 ATS)

Committee:
Kristen Rasmussen (Advisor)
Michael Bell
Stephanie Kampf (Ecosystem Science and Sustainability)

TOPOGRAPHIC AND DIURNAL INFLUENCES ON STORMS ASSOCIATED WITH HEAVY RAINFALL IN NORTHERN COLORADO

Despite its profound impacts on agricultural and socioeconomical conditions globally, heavy rainfall is a high-impact weather phenomenon of which we have limited quantitative understanding and forecast skill. The Prediction of Rainfall Extremes Campaign in the Pacific (PRECIP) planned to observe the spectrum of heavy rainfall events in the moisture-rich environment of Taiwan and Japan during 2020, but was delayed until 2022 due to the global COVID-19 pandemic. As a result of this unanticipated delay, the PRECIP science team conducted the Preparatory Rockies Experiment for the Campaign in the Pacific ("PRE"-CIP), which observed precipitation over northern Colorado from May to August 2021 using Colorado State University's ground-based research radars and radiosondes. Extreme precipitation features are identified in the radar data and organized into storm modes based on prior research on the Tropical Rainfall Measuring Mission satellite's Precipitation Radar. An "ingredients-based" approach provides a theoretical framework to separate the storm modes into a spectrum of storm intensity and duration during the entire "PRE"-CIP field project, allowing us to connect storm modes to the topography, diurnal cycle, and overall rainfall characteristics in northern Colorado.

While precipitation occurred from the mountains to the plains, the highest concentration of storm tracks calculated from all ground-based radar observations occurred over the Rocky Mountains, regardless of storm duration. The majority of storm tracks are of low intensity and short duration, with over 80% of tracked storms having lifetimes of 1 h or less, suggesting that the general population of warm-season precipitation in northern Colorado is short-lived and of weak intensity. When considering heavy rainfall-producing storms, deep convection is the most dominant storm mode in northern Colorado by up to three orders of magnitude over broader convective and stratiform systems. Deep convection most frequently occurred over the Rocky Mountains in the afternoon, while broader convective and stratiform systems most frequently occurred over the foothills and plains in the evening to nighttime hours. Therefore, diurnal forcing and orographic lift play important roles in the morphology of warm-season precipitation in northern Colorado, as has been seen in mountainous regions across the world. The frequent occurrence of deep convective storms directly over the Rocky Mountains, however, differs from the deep convective hotspots seen in the lowlands downstream of similarly large mountain barriers like the Andes and Himalayas. Ultimately, these radar-based analyses are important for the eventual comparison of heavy rainfall in a semi-arid midlatitude region (Colorado) and a moisture-rich tropical environment (Taiwan and Japan), thus providing an enhanced global understanding of the commonalities of heavy rainfall processes.