SCIENCE

The Effects of Climate Change on the Vertical Structure of Severe Weather Environments

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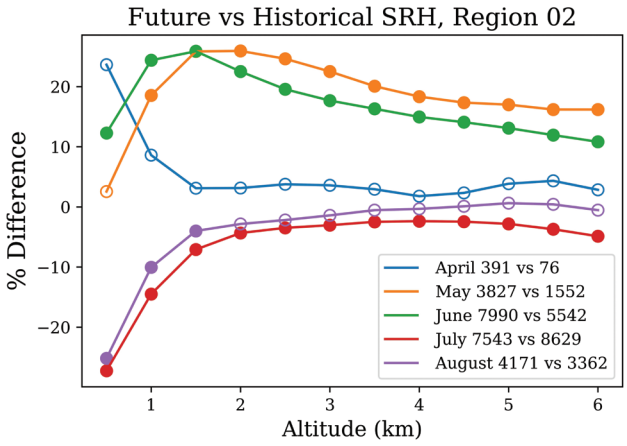
Climate change is a global problem that will have many diverse impacts. The intent of this research is to shed light on one of these impacts: how the intensity and frequency of severe storms may change with our changing climate.

Some parameters relating to severe storms have been well analyzed, specifically convective available potential energy (CAPE), vertical wind shear in the first 6km of the troposphere (s06), and storm relative helicity in the first 3km of the troposphere (SRH03). However, there are many complex ways in which the vertical structure of the atmosphere can vary without changing CAPE, s06, or SRH03. These include differences in temperature and moisture profiles and how wind and SRH change with altitude rather than just their value at a certain height. These other parameters are also known to be important in the development of severe storms, but there has been no significant investigation in literature on how they may change in the future.

The research consisted of analyzing reanalysis data as well as a high-preforming climate model that simulated past and future climates in two regions. The necessary parameters (lapse rates, relative humidity curves, wind shear profiles, and SRH profiles) were calculated and analyzed for differences. The answer to the research question is complex, but we found that climate change will lead to an increased likelihood for severe storms in some months and regions and a decrease in likelihood in other regions and months.

Research advisor Dan Chavas writes: "Severe thunderstorms and tornadoes depend on how temperature, moisture, and wind vary with height. How the details of this variation will change in a future warmer climate is currently unknown. Isaac's research is the first to quantify how the complete vertical thermodynamic and kinematic structure may change in the future using climate model projections."



A graph of the percent difference in mean SRH in the future versus the past at varying altitudes up to 6km for different months in the Great Plains region. A filled-in circle indicates a statistically significant difference in the means. The numbers in the key indicate sample size for the future versus past data sets. (High values of SRH correlate with increased likelihood for severe storms.)

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