

SCIENCE

Influence of Atmospheric Circulation on Severe Flooding in the Atacama Desert

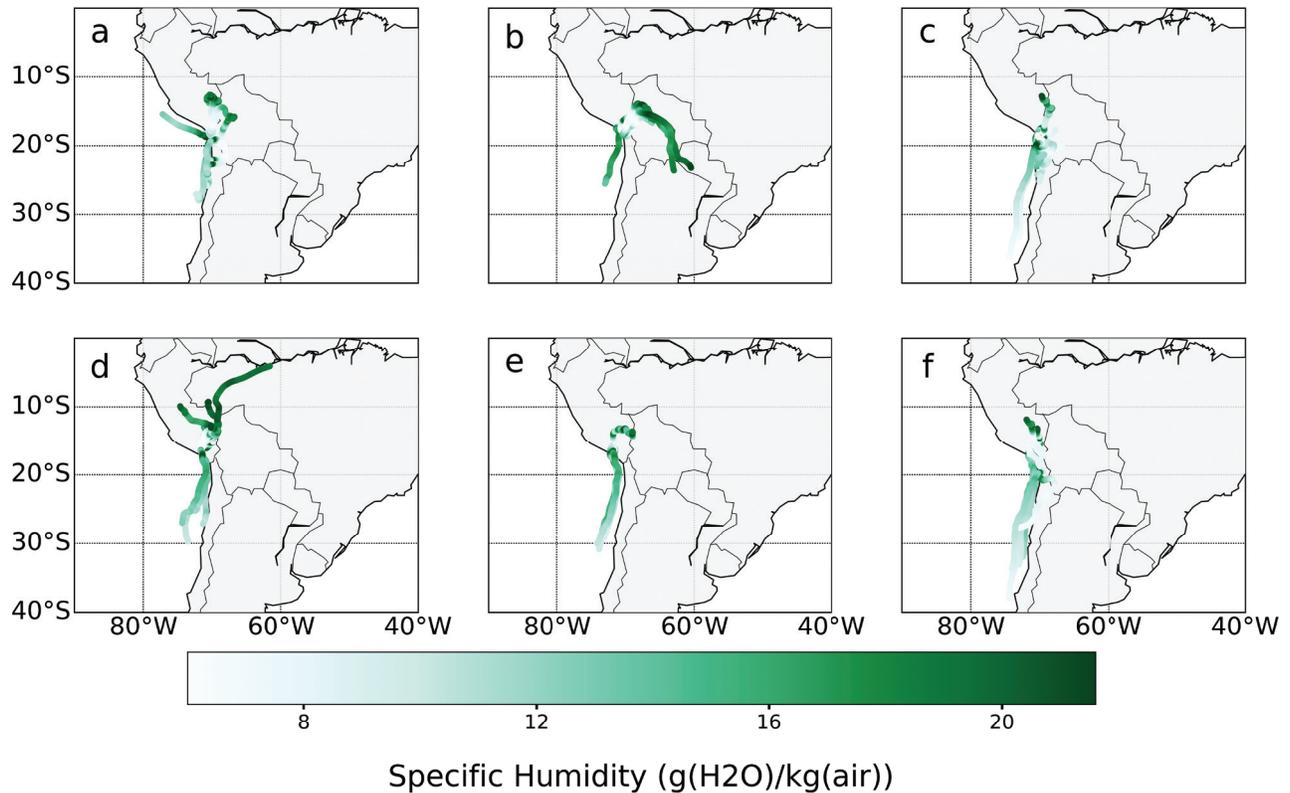
Student researcher: Jonathan DeGraw, Sophomore

The arid region encompassing the Atacama Desert stretching from northern Chile into southern Peru is one of the driest places on earth. During the 2019 austral summer, this region experienced severe flooding that killed an estimated 15 people and displaced thousands of others. The flooding was caused by abnormally high rainfall during two events, January 28–31 and February 6–8. Understanding weather patterns in this region is necessary to mitigate negative impacts caused by future flooding events.

Weather patterns in this region are dominated by upper atmospheric circulation. The position of the Bolivian High (BH) strongly influences this circulation. To understand the cause of these severe weather events, this study determines the location of the BH before, during, and after the rainfall events. It also determines the source location of the moisture fueling the rainfall.

Rainfall data from northern Chile and southern Peru was used to determine the timing and magnitude of the rainfall events. Global Data Assimilation System (GDAS) and reanalysis of meteorological data from the National Centers for Environmental Prediction (NCEP) were used to determine the location of the BH before, during, and after the rainfall events. GDAS data was used to run 48-hour back trajectories in National Oceanic and Atmospheric Administration's (NOAA's) Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPPLIT) model. Within the model, specific humidity along the path of the trajectories was calculated. The figure depicts an example of these trajectories. Model runs were analyzed to determine the source region of moisture transported to southern Peru and northern Chile, and to characterize the general atmospheric circulation in the region conducive to extreme rain events.

Research advisor Lisa Welp writes: "Jonathan's research supports a project in the Arequipa NEXUS Institute, a partnership with a Peruvian university and Purdue. Our goal is to provide scientific information to help manage water resources and flooding hazards. Additionally, a community science network is collecting rain for stable water isotope analysis to understand rainfall processes."



Example of HYSPLIT back trajectories for the February 6–8 rainfall event. 120-hr back trajectories ran at 2000 m above ground level. (a) Shows trajectories for February 3–5 for Arica, Chile. (b) Shows trajectories for February 6–8 for Arica, Chile. (c) Shows trajectories for February 9–13 for Arica, Chile. (d) As in (a), but for Arequipa, Peru. (e) As in (b), but for Arequipa, Peru. (f) As in (c), but for Arequipa, Peru.