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The Cape Town "Day Zero" Drought: Mechanisms behind early winter rainfall variability in the southwestern Cape, South Africa

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The southwest region of South Africa is the only part of southern Africa that predominantly receives its total annual rainfall during the austral winter months (April-September). In 2015-2017, this part of the country experienced extreme dry conditions which led to the severe water shortages experienced in the city of Cape Town, which is now commonly referred to as the "day zero" drought. The dry conditions played a central role in the City of Cape Town, the second largest city in South Africa (∼3.7 million people), enforcing the most severe water restrictions as the local water storage facilities levels fell dangerously low. In this study, focused is placed on understanding the contribution of the early winter period (April-May) to wet and dry years in the southwestern part of South Africa. This period is of particular interest given its key role in the recent drought, the lack of previous work on this season, and climate change projections that the winter rainy season may shorten in duration.

The early winter is found to be prone to dry conditions in recent decades, such that five of the six driest April-Mays in recent record have occurred after the year 2000. The dry early winters in particular tend to be associated with a weaker subtropical jet, less moisture flowing into the domain and a more stable atmosphere. Evidence also suggests a decline in the number of frontal systems reaching Cape Town during the early winter in recent decades. An analysis of CMIP5 models find that the projections portray the winter rainfall region in South Africa as being exposed to an increased likelihood of early winter dry conditions into the future (2040-2060). However, it remains a challenge for these models to reasonably capture the onset of winter rainfall in South Africa.