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Major weather-related risks to crop performance along the Australian wheat belt for recent past and longer-term historical weather records

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Extreme events, such as drought, heat and/or frost are among the major weather-related causes of yield reduction and crop failure worldwide. Changes in the frequency and intensity of such weather extremes affect the shape and scale of yield distributions. Wheat growers, in Australia, are particularly vulnerable to climate due to its high variability. Risks of both, extremely high or low temperatures and water stress occurring simultaneously or at different crop stages within the growing season (May-October, e.g. frost mid-season, drought during the season and heat towards the end) often lead to yield reductions, or sometimes even to crop failure. In this study, we focused on assessing the frequency and impact of these relevant extreme weather events (i.e. drought, heat and frost) affecting wheat production in Australia. Specifically, we used a widely used and calibrated crop model (APSIM) to simulate wheat grain yield, and determine probability density functions (PDFs) of grain yield and crop failure. Chances of crop failure due to these extreme events are explored for the recent past (1991-2020) and the longer-term historical past (1901-1990). Key adaption strategies to minimise the impacts of these extreme events, and reduce crop failure risk are assessed in this study, including early sowing and cultivar choice. Our findings are in line with recent studies, indicating that drought and heat are major risk factors contributing to reduced yields or crop failure. However, due to the timing, frequency and impacts of frost events on wheat productivity, frost also remains a relevant risk for the wheat industry in Australia.