EGU23-15043, updated on 20 Apr 2024
https://doi.org/10.5194/egusphere-egu23-15043
EGU General Assembly 2023

Investigating the Role of Weather Patterns in Crop Yield Variability and Predictability

Chris Knight, Abdou Khouakhi, and Toby Waine
Cranfield University, United Kingdom of Great Britain – England, Scotland, Wales (chris.knight@cranfield.ac.uk)

Climate change is causing disruptions in Earth's weather patterns, leading to an increase in the frequency and severity of extreme weather events such as droughts, floods, frost, and heatwaves. These events can impact food production and lead to challenges in meeting the food needs of a growing population. Previous research has documented the role of temperature and precipitation during the growing season in explaining crop yield variability. For example, droughts and extreme heat can reduce cereal production by 9-10%.

Current crop yield models use only a few meteorological variables to represent weather conditions. However, weather patterns or weather regimes, (i.e., persistent, and recurrent flow patterns of the large-scale atmospheric circulation) can provide a more comprehensive view of weather conditions, and can be used to predict and characterise extreme weather events and explain crop yield variation.

In this study, we first conducted a literature review to examine the links between extreme weather events, such as heat waves, and droughts with weather patterns and regimes. One of the main findings of that review was the need to define what extreme weather is in the context of agriculture. The new definition is based on studies that identified optimal and terminal weather conditions for winter wheat at specific phenological stages. Using this definition of extreme weather, we analyse historic yields in East Anglia, UK, forming statistically based relationships between low yield years with a set of classified weather patterns from the UK Met Office. We focused on the weather patterns frequency of occurrence and persistence with additional consideration given to potential microclimates as we compare the effects weather patterns have on a specific farm with a long-term data set to the effects of the larger region. Preliminary analyses shows that a small number of these weather patterns are associated with high impact weather events that cause yield limiting conditions or physical damage to the crop such as wind lodging.

It is hoped that further research will lead to the development of a next-generation crop yield variation model taking into account the weather patterns, which can provide longer-term predictions of regional crop yield variability to help agri-businesses, crop insurers and farmers to facilitate decision making, respond effectively to regional and global crop production shocks and food price spikes, and develop adaptation strategies to reduce the potential impact of extreme weather events.