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Spatial and temporal patterns of agrometeorological indicators in maize producing provinces of South Africa

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Abstract

Climate change impacts on maize production in South Africa, i.e., interannual yield variabilities, are still not well understood. We here present a pioneer study based on a recently released reanalysis of climate observations (AgERA5), such as temperature, precipitation, solar radiation, and wind speed data. We assess climate change effects by quantifying the trend of agrometeorological indicators (Mann-kendall and sens slope), their correlation with maize yield, and analysing their spatiotemporal patterns (EOF analysis). Thereby, we derive the main factors that affected yield variability for the last 30 years (1990 2020) in major maize production provinces, namely Free State, KwaZulu-Natal, Mpumalanga, and North West. Results show that there was a significant positive trend in temperature that averages 0.03 0.040C per year and 0.02 0.040C per growing season. There was a decreasing trend in precipitation in Free State with 0.01 mm per year. Solar radiation did not show a significant trend in all regions. Wind speed in Free State increased at a rate of 0.01 ms^{-1} per growing season. Yield variabilities in Free State, Mpumalanga, and North West show a strong positive correlation ($r>0.43$) with agrometeorological variables. Yield in KwaZulu-Natal is not influenced by climate factors. The leading mode (50 80 % of total variance) of each agrometeorological variable indicates a homogenous pattern across the regions. The dipole patterns result illustrate that the variabilities of agrometeorological indicators are linked to South Indian high pressure and the warm Agulhas stream. Its corresponding temporal pattern demonstrates extreme events with strong positive and negative anomalies. Results form this study could be used to assist South Afria's government in favour of policy development to prevent famine due to climate change impact.

Keywords: Agrometeorological, maize yield, spatial-temporal trend

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