HYDROLOGICAL PROPAGATION OF ENSO IMPACTS ON DROUGHT RISK ACROSS SUB-SAHARAN AFRICA

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ABSTRACT

Sub-Saharan Africa is particularly susceptible to the effects of hydrological extremes, such as drought, due to the high dependency of much of the population, and national economies, on agriculture. Increased precipitation variability, as a result of climate change, has made the need for better and more reliable forecasts even more necessary. Furthermore, drought risk is generally quantified in terms of meteorological anomalies due to better availability of information on precipitation, yet drought impacts are most aligned with soil moisture and hydrological drought, which are more difficult to monitor and forecast. Initial results have shown that the positive and negative phases of ENSO have a strong impact on regional meteorological drought risk across the continent. As these trends propagate through the hydrological system, they manifest in other biophysical variables (such as soil moisture, stream flow and NDVI), with various time lags and differing spatial patterns.

OBJECTIVES

The aim of this paper is to quantify the enhanced risk of growing season drought in SSA due to ENSO events. This has been achieved by:

1) Quantifying the spatial and temporal variability and trends in growing season drought events over the past 67 years
2) Estimating the risk of drought and how it changes with the ENSO climate oscillation
3) Analysing how drought risk propagates through the hydrological cycle, from meteorological, to agricultural to hydrological drought
4) Identifying which staple crops are most at risk from drought in regions with high agricultural dependency

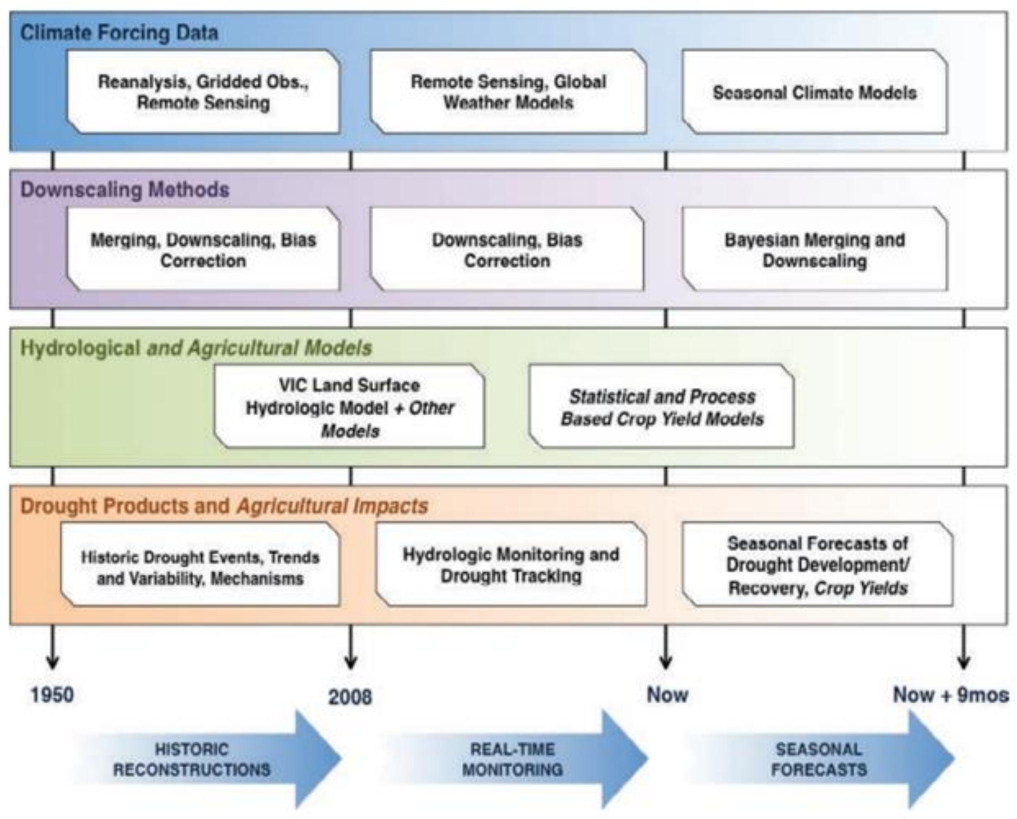
DATA & METHODS

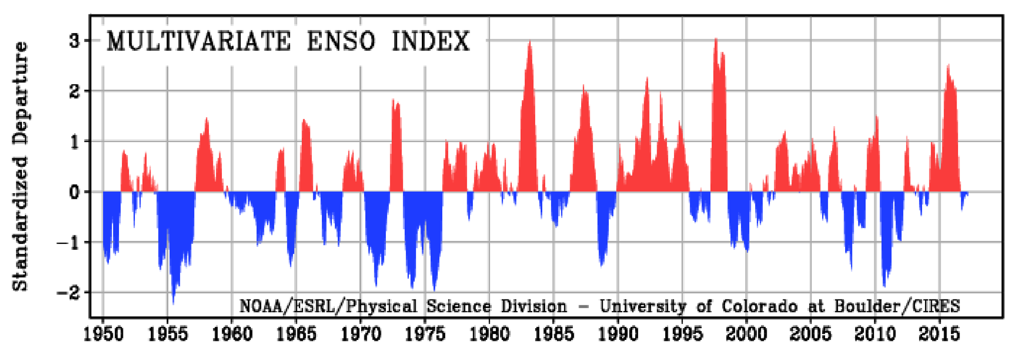
Climatic and hydrological data - African Flood and Drought Monitor [Sheffield et al., 2014]

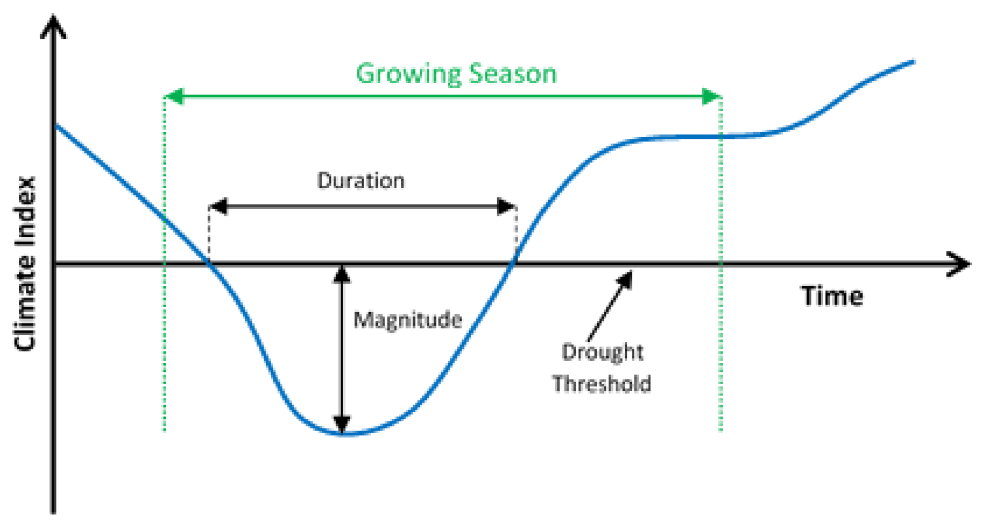
ENSO data - Multivariate ENSO Index (MEI) [NOAA]

Growing season data - Crop Calendar [Centre for Sustainability and the Global Environment]

1. Determine growing season start and end date for maize s for each grid cell
2. Define a drought year as a year with 2 or more months within the growing season that fall below the drought threshold
3. Calculate drought statistics (duration, magnitude etc…)
4. Repeat analysis for El Nino and La Nina years only
5. Repeat analysis with growing season data for other staple crops (cassava, sorghum and millet)

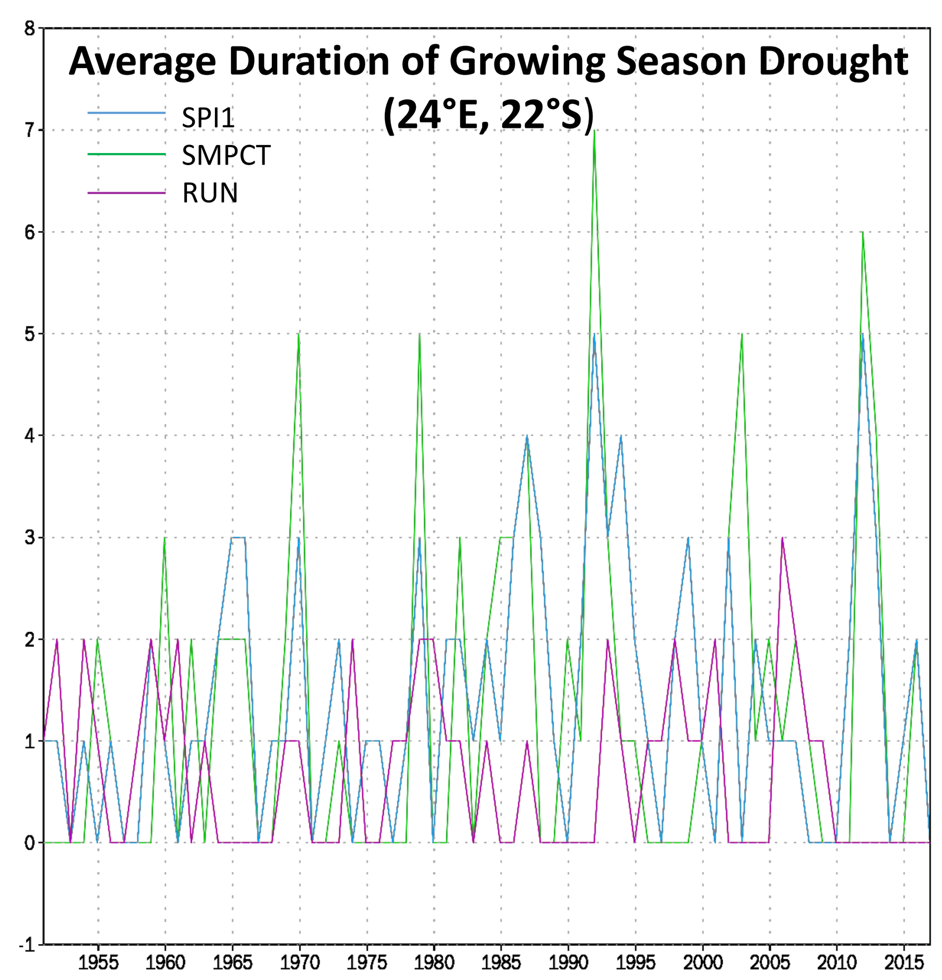






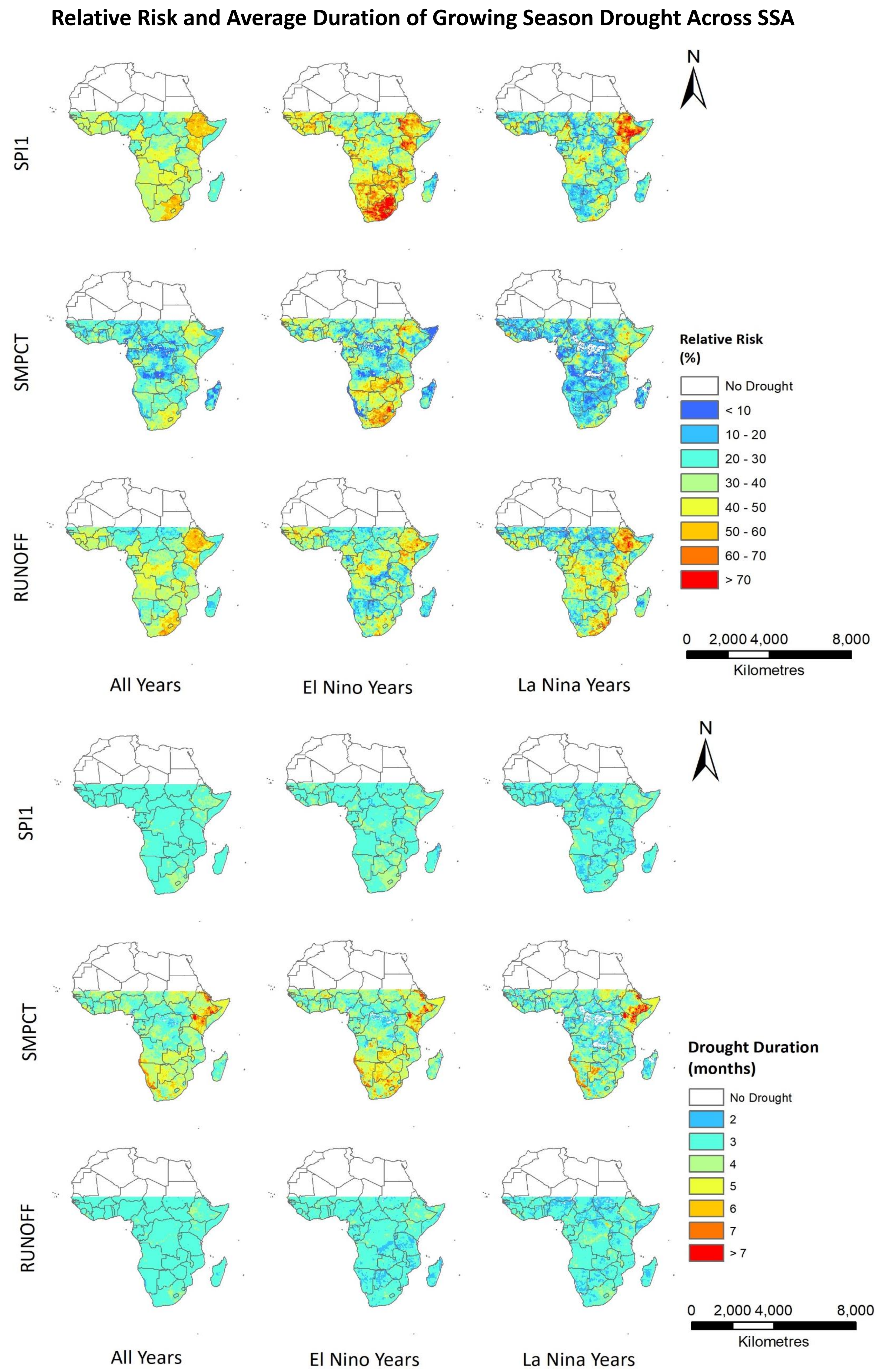
DISCUSSION

- Regional patterns between growing season drought risk and ENSO phases across SSA are clearly present
- In El Niño years, drought risk increases in areas of southern Africa, the western Sahel and the Horn of Africa



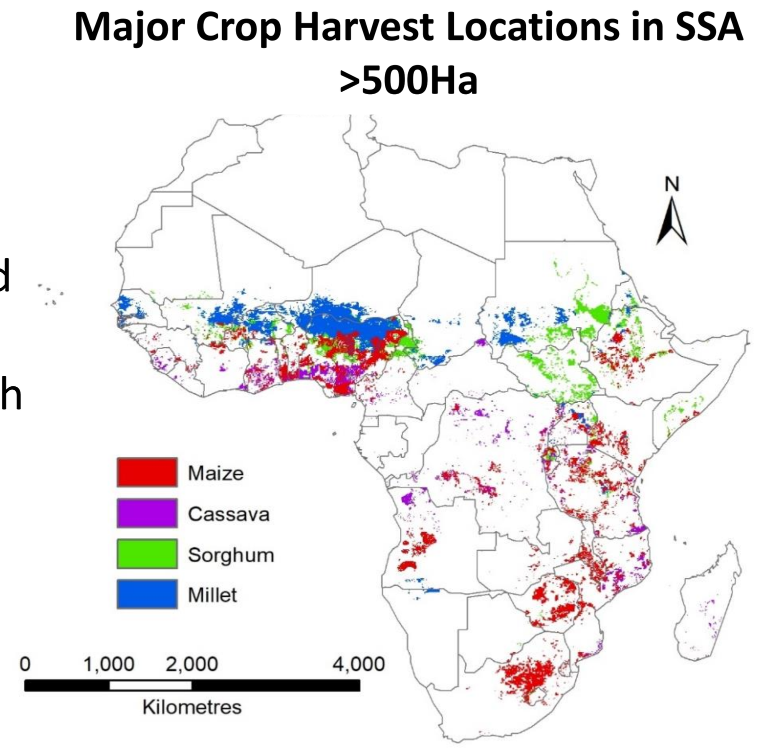
- In La Niña years, the risk of drought decreases across much of SSA, particularly in central Africa, but increases even further in the Horn of Africa
- These regional variations can be seen propagating through, from meteorological drought, to agricultural drought, with a minimal time lag
- For most of SSA, fewer years experienced hydrological drought, than meteorological and agricultural drought.

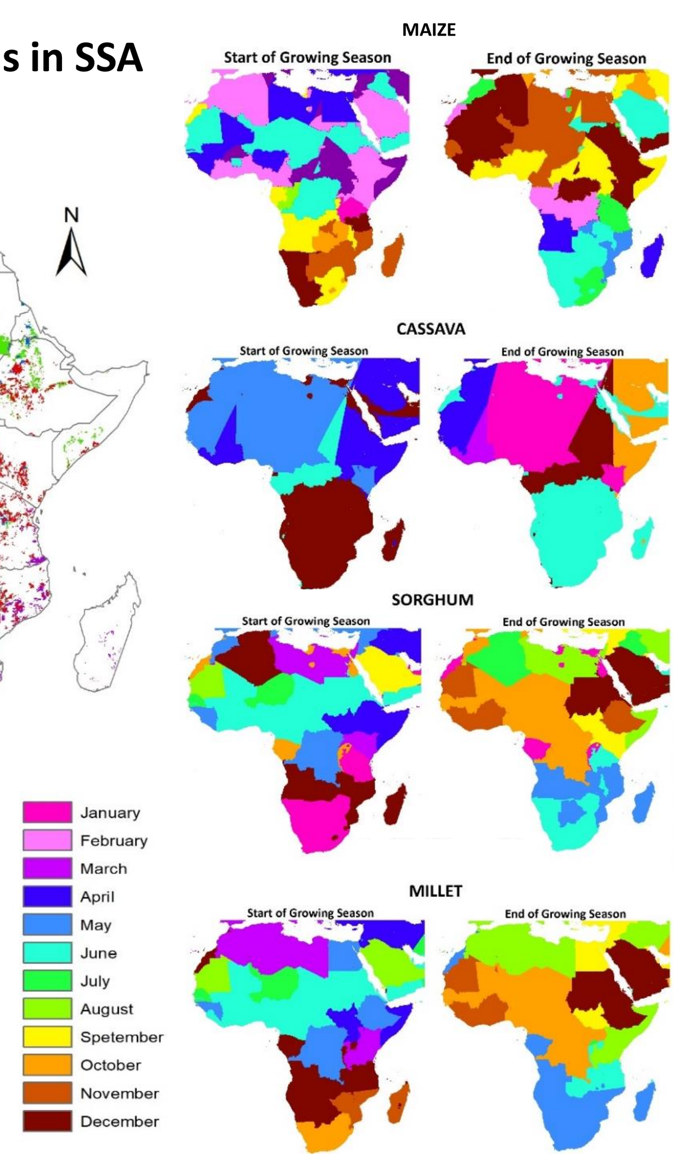
RESULTS



FUTURE WORK

- Quantitative time lag analysis to further understand how drought propagates through the hydrological system





- Analyse drought risk variance for other staple crops to asses which regions are most sensitive to drought events depending on the growing season of the most densely grown crop

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