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Understanding the evolution of the 2014–2016 summer rainfall seasons in southern Africa: Key lessons

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ABSTRACT

The recent 2015/16 summer rainfall season in the terrestrial Southern African Development Community (SADC) region appears to be the most severe since the droughts of the early 1980s and 1990s; with well-publicized significant impacts on agriculture and food security. Impacts have been particularly concerning since the 2015/6 season followed a poor rainy season in 2014/15, in certain areas compounding already compromised production (total maize production was, for example, down 40% relative to the previous 5 year average). This paper reviews climate forecasts and observations of the two seasons, and presents examples of the resulting impacts on agriculture within the region. We conclude by considering what may be learnt from this experience, focussing on operational recommendations for early warning within SADC, as well as longstanding needs for awareness raising and capacity building.

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1. Introduction

The 2015/16 summer rainfall season in the terrestrial Southern African Development Community (SADC) region appears to be the driest on record since the well-publicized droughts of the early 1980s and 1990s; with critical impacts on agriculture, water and food security well covered in the media. It has had particularly significant impacts, since it followed on from a poor rainy season in 2014/15. In this paper, we review climate forecasts and observations of the two seasons, and present selected examples of the resulting impacts on agriculture within SADC. We reflect on what may be learnt from this experience, focussing on operational recommendations for early warning within SADC.

2. Review of the 2014/15 and 2015/16 summer rainfall seasons

Southern Africa's seasonal rainfall and temperatures are strongly linked to ENSO (e.g. Mason and Jury, 1997), with predominantly dry and hot (wet and cool) conditions associated with El Niño (La Niña) events respectively. In addition to this

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observed association, seasonal rainfall forecasts for southern Africa work best when there is either an El Niño or a La Niña event, while they show less skill during ENSO-neutral seasons (Landman and Beraki, 2012). Moreover, it is during the austral mid-summer (December – February; DJF), when seasonal rainfall (Landman et al., 2012) and temperature (Lazenby et al., 2014) forecasts are most skilful, that ENSO events reach their peak in the tropical Pacific. Since seasonal rainfall forecasts for southern Africa are mostly skilful at 1–2 months lead-time (Landman et al., 2012), longer lead-time forecasts for the expected evolution of ENSO events, while potentially providing additional societal benefits if they support longer term planning, may be more difficult to use effectively.

Notwithstanding the ENSO focus of this paper as a consequence of the strong 2015/16 El Niño event and its impacts on southern Africa, ENSO is not the only seasonal climate driver of southern African seasonal-to-interannual variability. For example, the subtropical Indian Ocean SST Dipole (IOD) events also influence southern African rainfall variations and there is demonstrable co-variability between the basin-scale IOD and ENSO (Behera and Yamagata, 2003). One noteworthy difference between the strong 1997/98 El Niño and that during 2015/16 was the warmer Indian Ocean SSTs during 2015/16, which may explain some of the differences in resulting rainfall (the 1997/98 rainfall deficit was not as severe).

2.1. Comparing forecasts of El Niño and its evolution

Early in the 2014 calendar year, predictions gave a 50% chance that the 2014/15 austral summer season would be associated with an El Niño event (http://www.cpc.ncep.noaa.gov). The predicted probabilities of this El Niño event to occur continued to increase considerably over the following few months, even though the observed atmosphere and oceanic state remained ENSO-neutral throughout the austral mid-summer period. Ultimately, the 2014/15 season was not considered to be an El Niño season, because this event was associated with a notable absence of El Niño-like surface winds and convective anomalies. Notwithstanding, according to the most recent Oceanic Niño Index (ONI; http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml), the 2014/15 season may be considered to be a marginal El Niño event. However, such borderline events could swap around in terminology as reference climatologies and datasets change in the future.

This index is an indicator for monitoring El Niño and La Niña events. The ONI represents the running 3-month average sea-surface temperature (SST) of the Niño3.4 region (5°N-5°S, 120°W-170°W) and compared to a 30-year average. This difference from the average in that region is the ONI value for that 3-month season. El Niño conditions are considered to be present when the ONI is +0.5 °C or higher; La Niña conditions exist when the ONI is −0.5 °C or lower. Periods are regarded as warm episodes (El Niño) or cold episodes (La Niña) when the ±0.5 °C threshold is met for a minimum of 5 consecutive overlapping seasons.

Conversely, the weak central equatorial Pacific Ocean SST warming at the beginning of 2015 developed into a strong El Niño event by the end of that year. Forecast models picked up on the evolution towards an event of unprecedented strength at least six months prior to its peak at the end of 2015. Fig. 1 provides a comparison of observations and of multi-model forecasts of Niño3.4 SST (details of this multi-model approach is found in Beraki et al., 2013). The observed ONI values, as well as Niño3.4 SST forecasts produced by the multi-model forecast system (Beraki et al., 2013) of the Applied Centre for Climate and Earth System Science in South Africa (see forecasts produced via ACCESS; http://www.access.ac.za/), show the difference between the 2014/15 and 2015/16 events. The overly optimistic forecast for an El Niño event to occur in 2014/15 and the underestimation of the strong event of 2015/16 are particularly evident. Note that the forecasts presented in the figure

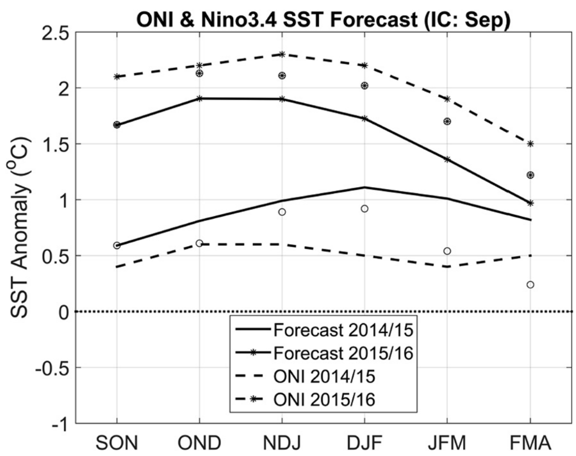

Fig. 1. Niño3.4 SST anomaly forecasts initialised in September (thick black lines) and ONI values (dashed lines) for the 2014/15 ENSO-neutral and 2015/16 El Niño seasons. The open circles and asterisked circles are Niño3.4 SST anomaly forecasts produced at a 0-month lead for the two seasons.

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