

**Drought-induced starvation of aardvarks in the Kalahari:
an indirect effect of climate change**

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Electronic supplementary material (S2): Temporal analyses of climatic variables generated over 35 years at Tswalu Kalahari Reserve (South Africa) using data derived from the Global Land Data Assimilation System (GLDAS).

The NASA's Global Land Data Assimilation System combines land surface modeling and data assimilation techniques to generate optimal fields of land surface states and fluxes by integrating satellite- and ground-based observational data products [1]. Accuracy and relevance of GLDAS data to infer local climate variables has been demonstrated repeatedly by comparing modeled data with in situ observations [2, 3].

Here, climatic variables were generated over a 12 x 5 km area (6000 ha; 22°21'18.30; 27°11'53.61; 22°24'20.31; 27°18'23.30) consisting of sand dunes covered by low vegetation (Shrubby Kalahari Dune Bushveld). The selected surface included all 142 active aardvark burrows located by radio-tracking implanted aardvark during the study period. Analysis of climatic variables revealed that surface temperatures at our field site were abnormally

elevated during the austral summer 2012-2013. During this period, rainfalls were in the lower quartile range of values recorded during the preceding 35 years. Wind strength was higher than what observed over 35 years. The austral summer 2012-2013 was also characterized by very low soil water content.

We also provide year-by-year information about past climate during the hottest month of the year (January, Figure S2 right panels). This temporal analysis reveals that precipitation was 48% lower in January 2013 as compared to other years, but because of high inter-annual variability this value remained within the 35-year 95% confident interval. In contrast, average air temperature (+2.8°C) and wind speed (+32%) observed in 2013 (grey bar) were at their highest values since 1980. Soil water content was the lowest (-23%) value ever observed in January.

Climatic variables showed no significant trends except for wind strength which increased linearly between 1980 and 2015 ($y = 0.024x - 44.92$, $R^2 = 0.35$, $p < 0.01$) and soil water content which showed a marginally significant decline over years ($y = -0.231x + 515$, $R^2 = 0.11$, $p = 0.053$).

Since 1980, inter-annual variability of ambient temperature in the Kalahari fluctuate in an unpredictable manner, but frequency and severity of hot extremes are likely to increase as climate changes progresses. The observed linear trend in wind speed is congruent with the global annual changes in wind speed observed at a larger scale in most southern African regions, with particularly strong anomalies occurring in the Kalahari during the El Niño Southern Oscillation phenomena [4]. Wind speed and ambient temperature are key contributors of evaporative loss and explained 30% of the between-year variability in soil moisture observed at our field site. Further local drought episodes are thus to be expected with a feared impact on predator-prey systems and aardvark populations.

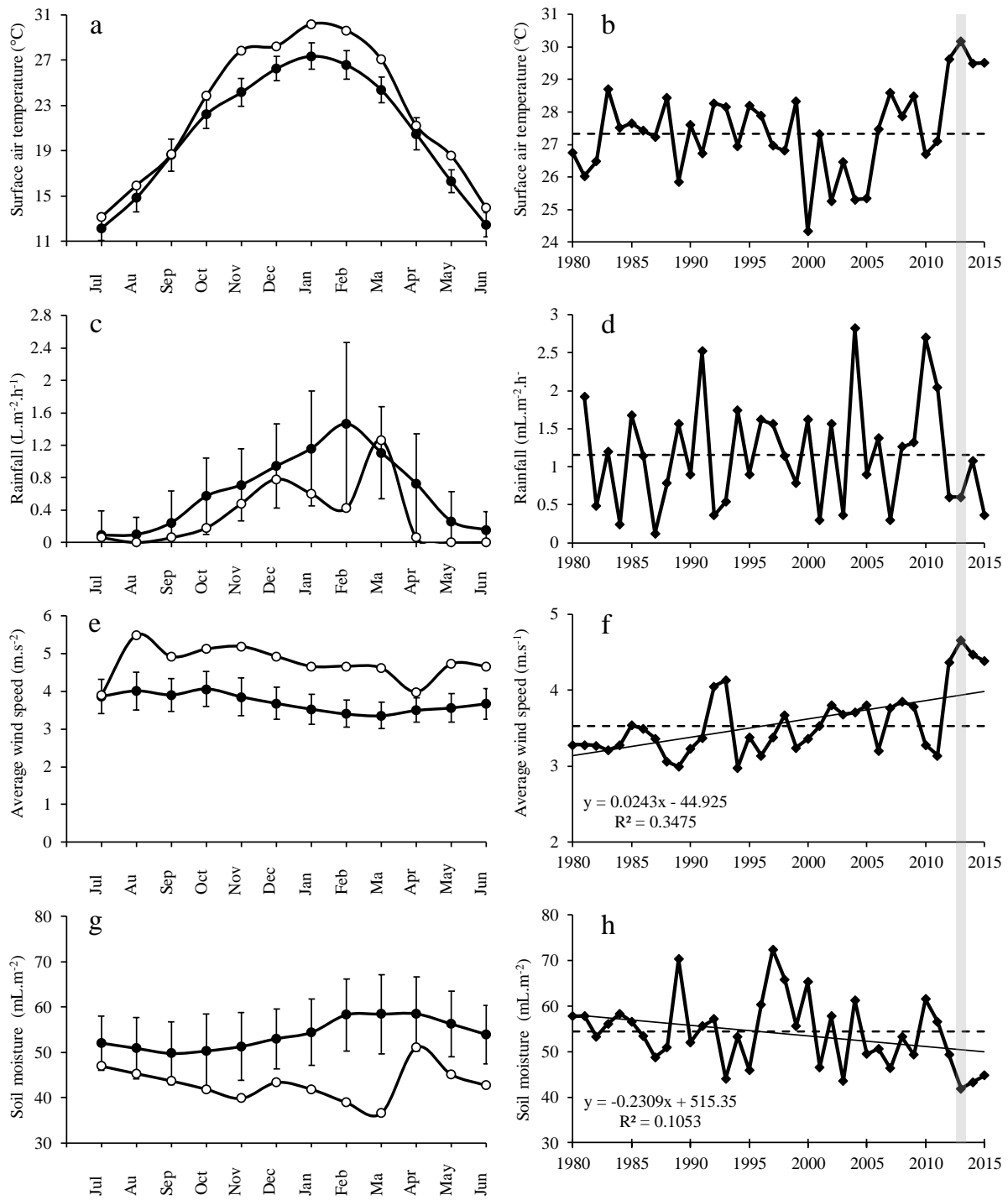


Figure : (a, b) surface air temperature at 2m above ground, (c, d) precipitations, (e, f) wind strength at 10m, and (g, h) soil water content estimated at 0.1-0.4m depth. Left panels show, for each climatic variable, monthly values averaged (\pm SD) between 1980 and 2015 (filled symbols) except for the year of our study i.e. 2012 (July to December) and 2013 (January to June), which are represented separately (white symbols). Right panels show the annual variability of climatic variables estimated during of the hottest month of the year (January). Dashed lines represent the mean over 35 years.

References

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