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Does climate change affect population dynamics of endemic succulent plants on quartz fields in South Africa?

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1. Introduction

Quartz fields in the Succulent Karoo of southern Africa, a biodiversity hotspot, are covered with white, angular quartz gravel. They are edaphically arid special habitats (Schmiedel & Jürgens 1999) with special microclimatic conditions (Schmiedel & Jürgens 2004). They are characterised by a vegetation of leaf-succulent dwarf shrubs, many of which are local endemics (Schmiedel 2004).

Climate change projections predict increase in temperature and decrease in winter rainfall (JJA) for southern Africa (Fig. 1).

For this study, we formulated the following hypotheses:

- Anthropogenic climate change already affects recent weather conditions in the arid winter rainfall region (Succulent Karoo) of southern Africa .
- These recent changes have a negative impact on succulent plant populations.

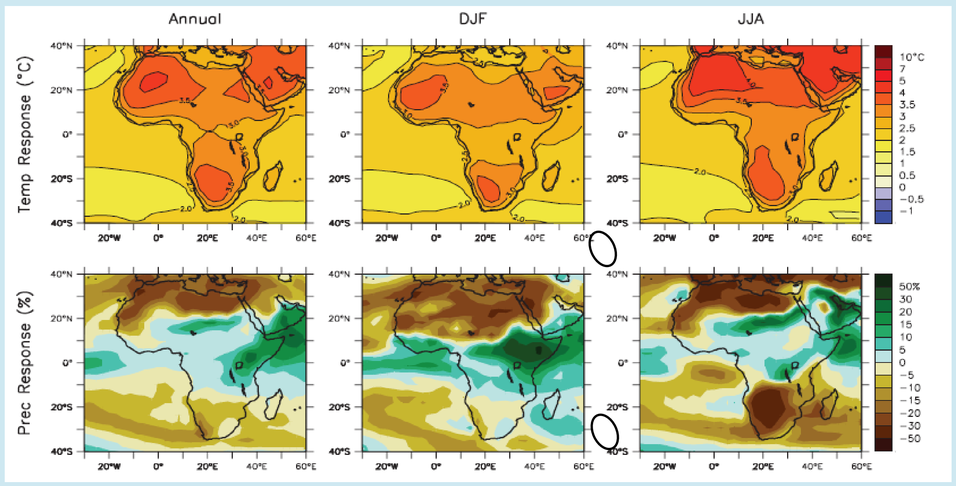

Fig.1 Top row: Annual temperature change between 1980 to 1999 and 2080 to 2099. Bottom row: Same as top, but for change in precipitation, IPCC Report 2007

2. The study site (Knersvlakte)

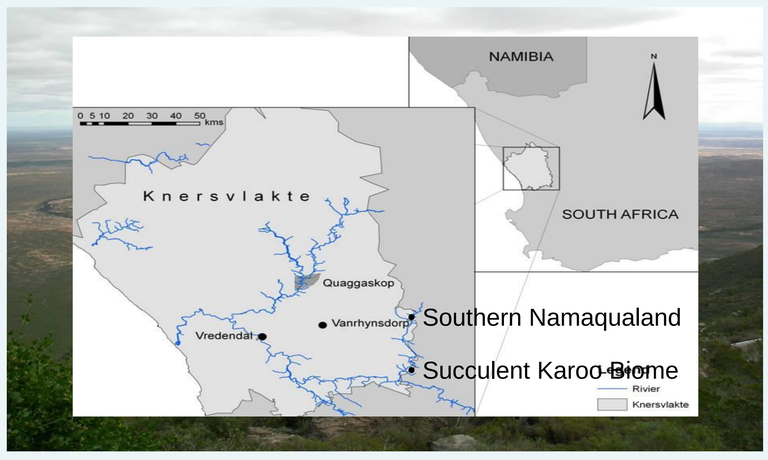

Fig.2 Study site

3. Methods

- Quaggas Kop farm in central Knersvlakte, no grazing for more than 40 years
- Winter rainfall (JJA): 120 mm /a; frequent fog and dew
- Eight permanent plots (25 m²) at different vegetation types established in 1993/1995
- Monitored annually between 1993/95 and 2000, revisited in 2005
- Assessment of species occurrence & abundance per species
- Analysed weather data from nearest weather stations

4. Results

Observed trends in weather:

- Annual mean and maximum temperatures increased significantly
- No significant linear trend for annual minimum temperature and annual temperature amplitude
- Long-term average annual rainfall 150 mm, no change over time
- Significant increase of extreme rainfall years
- Slight increase of rainfall during dry seasons

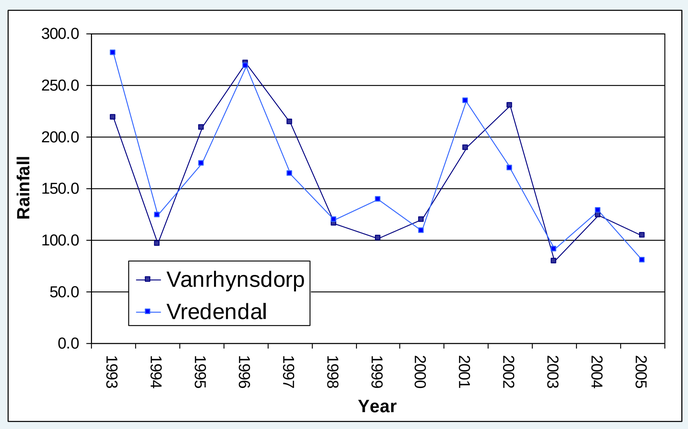

Fig. 3 Rainfall during study period

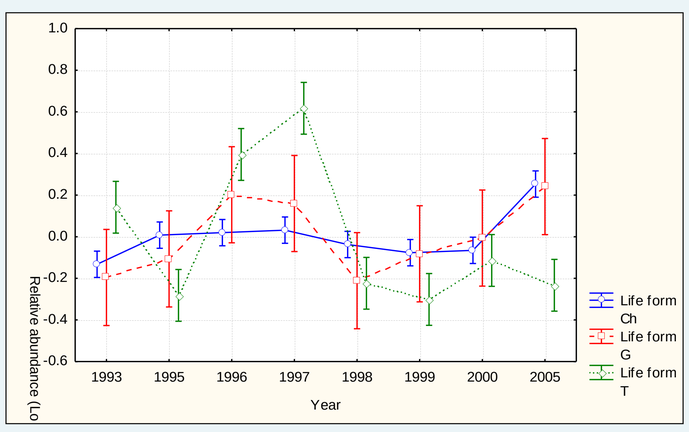

Fig. 4 Relative population sizes: life forms, Two-way ANOVA F (14, 1256) = 13.949; p = 0.00001

5. Conclusions

- Indication for changing climate in the Knersvlakte
- Strong response of populations to extreme rainfall years
- Overall positive trends in populations of perennial plants (compare also Poster by Hanke et al.)
- System seems to be buffered against recent thermal and rainfall extremes

6. Future prospect

- **No reason to give all-clear**: Stronger changes are predicted (IPCC 2007)
- Experimental passive warming (Musil et al. 2009) and rainfall exclusion (Midgley & van der Heyden 1999) showed significant negative effects on succulents

Research needs:

- Ecological research for baseline data
- Long-term, in-situ observation
- Experimental approaches
- More empirical data to validate models on climate change effect on biodiversity and conservation planning