SIMULATING FUTURE RANGELAND PRODUCTION IN CENTRAL SOUTH AFRICA

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INTRODUCTION

The Grassland Biome of South Africa (covering approximately 30% of the country's land area) is mainly found on the high central plateau and the inland areas of KwaZulu-Natal and the Eastern Cape. Grasslands provide various natural resources but as a feed source can only be used for animal production. It is noted that there is a slow progress of research regarding the environmental impacts on grass and that the reason lies with the complexity of the interaction between the animal and veld production systems. The introduction of modern technology over the last few decades means that with simulation models these interactions can be dealt with. These models are artificial "laboratories" where the interactions are investigated and the information generated by the models can be used to point out any gaps and open new research fields. A growth model is the integration of mathematical equations and algorithms which describe the interaction of the biotic and abiotic components of the grassland ecosystem. The research questions are whether biophysical models can accurately simulate historical rangeland production and if rangeland production will differ significantly under future climate scenarios.

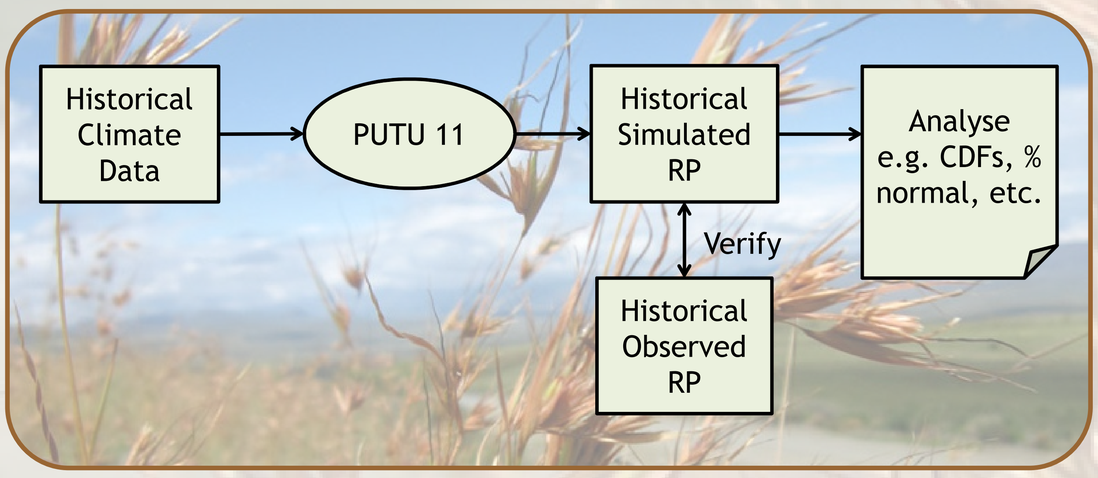
OBJECTIVES

There are two main objectives for the study:

Objective 1: To assess the historical rangeland production (RP) over the study area.

Specific objectives:

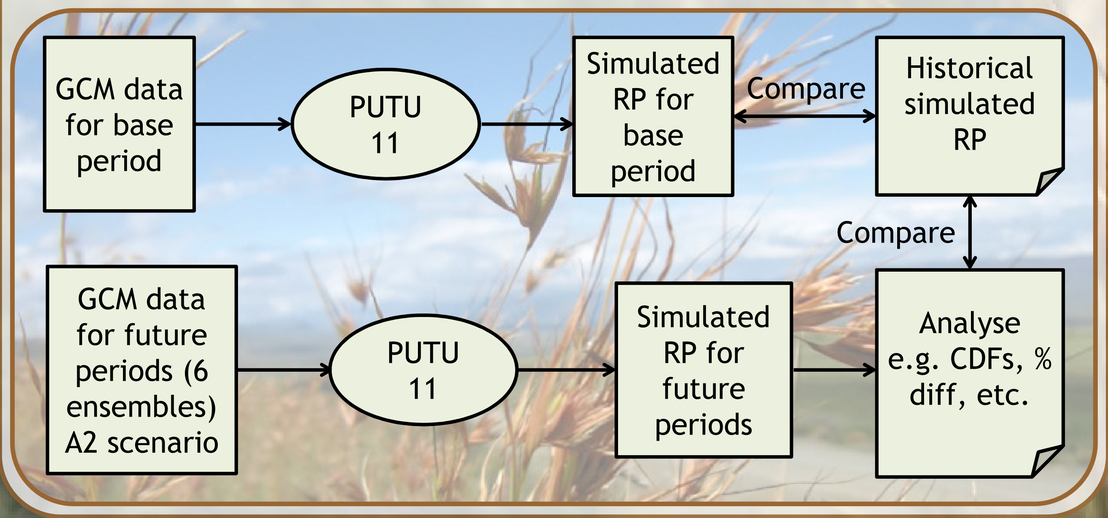
- Verify PUTU 11 against historical data
- Simulate rangeland production using PUTU 11 and observed climate data for the historical period (1980/81 - 2009/10)
- Evaluate the simulated RP for the historical period



Objective 2: To simulate the rangeland production over the study area under future climate scenario(s).

Specific objectives:

- Simulate RP using PUTU 11 and CCAM climate data for the historical (base) period
- Compare RP using observed and model generated climate data
- Simulate RP using PUTU 11 and model generated climate data for future periods:
  - 2010/11 - 2039/40
  - 2040/41 - 2069/70
  - 2070/71 - 2099/2100
- Calculate percentage differences in order to describe expected changes in RP



MATERIALS AND METHODS

The PUTU 11 model is a deterministic, mathematical program that determines the rangeland dry matter production in $kg.ha^{-1}$.

The inputs for the PUTU 11 model are:

- Daily mean maximum and minimum temperatures (°C)
- Daily total rainfall (mm)
- Daily sunshine duration (h)

The outputs from the PUTU 11 model are:

- Biomass production ($kg.ha^{-1}$)
- Maximum biomass production ($kg.ha^{-1}$)
- Reserves ($kg.ha^{-1}$) on 1 July
- Growth pattern of accumulated dry matter production

Data sources:

- Historical data from SAWS (Bloemfontein Airport)
  - 1980/81 - 2009/10
- GCM data (CCAM) from CSIR (Bloemfontein Airport)
  - 1980/81 - 2009/10
  - 2010/11 - 2099/2100
  - 6 ensembles
- Observed RP data from Sydenham Experimental Farm

DATA ANALYSIS

In order to achieve objective 1 the following analysis will be performed:

- Results from the historical simulations will be verified against the observed data from Sydenham using R^2, MSE, *r* and *d*
- Graph of historical RP vs. temperature and rainfall
- Graph of accumulated RP vs. time in order to describe the historical production cycle

In order to achieve objective 2 the following analysis will be performed:

- For the base period, compare the simulated RP using historical data to simulated RP using CCAM data (R^2, MSE, *r* and *d*)
- RP will be determined for the future periods (2010/11 - 2039/40, 2040/41 - 2069/70 and 2070/71 - 2099/2100) and for 6 ensembles
- Percentage differences and return periods of obtaining several threshold values will be calculated and compared against the different time periods as well as the base period
- Graph of RP vs. temperature and rainfall will be compared to historical simulated RP graph
- Graph of accumulated RP vs. time in order to describe the possible changes in future production cycles

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