Modelling the variability of convective activity over East Rand South Africa

Sifiso Mbatha[1,2] Mary-Jane Bopape[1] Hector Chikoore[2] Nthaduleni Nethengwe[2]

[1]South African Weather Service, Pretoria, South Africa

[2]Geography and Geo-Information Sciences, University of Venda, Thohoyandou South Africa

South African Weather Service

South African Weather Service

ISO 9001 Certified Organisation

Introduction

- Extreme weather events such as floods and droughts have been recurrent over South Africa.
- Heavy precipitation leading to flooding events threatens human life and economy
- On average, rainfall over South Africa is greatest over the eastern part and gradually decreases westward
- South African Weather Service (SAWS) has been monitoring weather and climate all over the region by setting up weather networks (weather stations, radar and lightning detection networks)

South African Weather Service
ISO 9001 Certified Organisation

Defining Heavy Precipitation

- Zhang et al (2001) indicates that extreme precipitation is usually defined when daily amount exceeds certain threshold for a particular region
- There is no single definition for an extreme precipitation since different threshold values apply for different parts of the world
- This study defines heavy rainfall as an event where an area receive amount of more than 25 mm in 24 hrs

Focus Area - Motivation

- East Rand has been experiencing flooding events in recent years to date
- In November 2016, the region was dubbed natural catastrophe zone by insurers (Kempton Express, 2016)
- The susceptibility of East Rand to extreme weather events associated with convection necessitate the need to investigate the variability of convection as it has not received thorough attention

Aim of the study

- The main aim of the study is to analyze the nature and variability of convection over East Rand, South Africa for the period 2011-2016.
- Study how the convection is simulated by a numerical weather prediction model.

South African Weather Service
ISO 9001 Certified Organisation

Data and Methods

- Daily rainfall data was obtained from SAWS
- Extreme rainfall cases were Identified
- Geopotential height, relative humidity, Convective Available Potential Energy (CAPE) ,convective Precipitation and large scale precipitation data were obtained from European Center for Medium-Range Weather Forecast (ECMWF) Re-Analysis (ERA)
- The Grid Analysis and Display system (GrADS) tool was employed to plot the above mentioned variables to gain the insight of synoptic system associated with extreme rainfall event

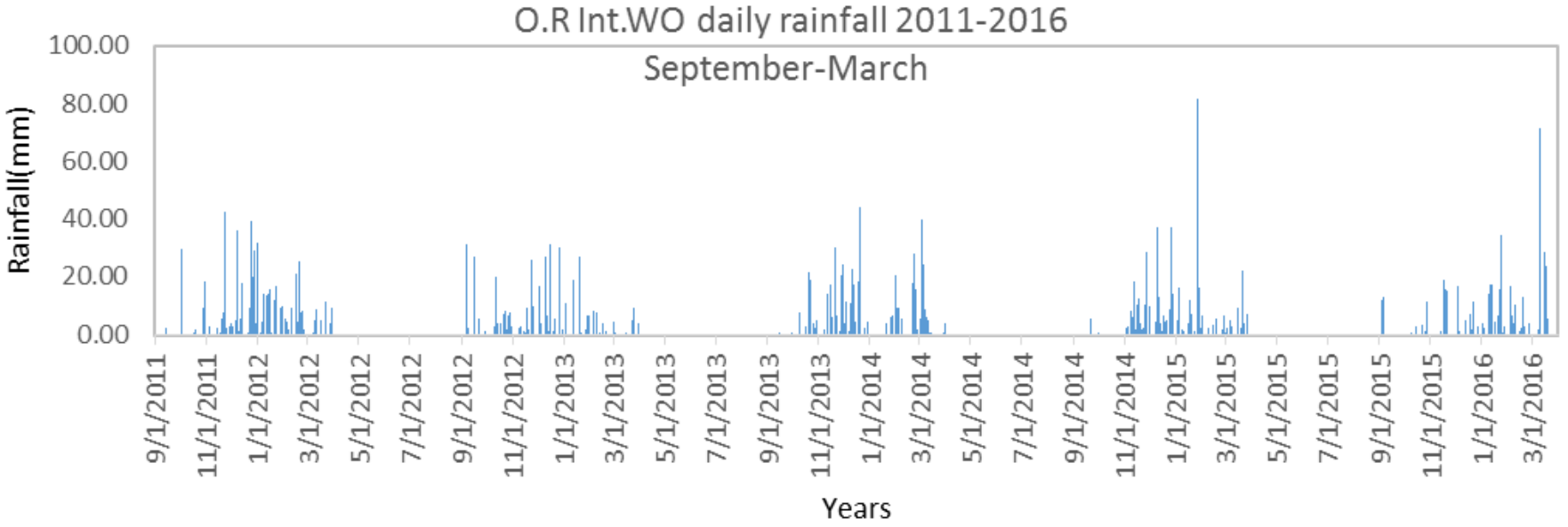
South African Weather Service
ISO 9001 Certified Organisation

Simulations

- The Weather Research and Forecasting (WRF) model used for one case
- Forcing data: Global Forecast System which has a grid spacing of 0.25 deg
- WRF forced three-hourly
- Grid spacing used: 4 km
- Domain size : over whole of SADC similar to UM 4km

South African Weather Service
ISO 9001 Certified Organisation

Preliminary results: Observed rainfall – OR Tambo



South African Weather Service
ISO 9001 Certified Organisation

Preliminary results: Observed rainfall – Nigel

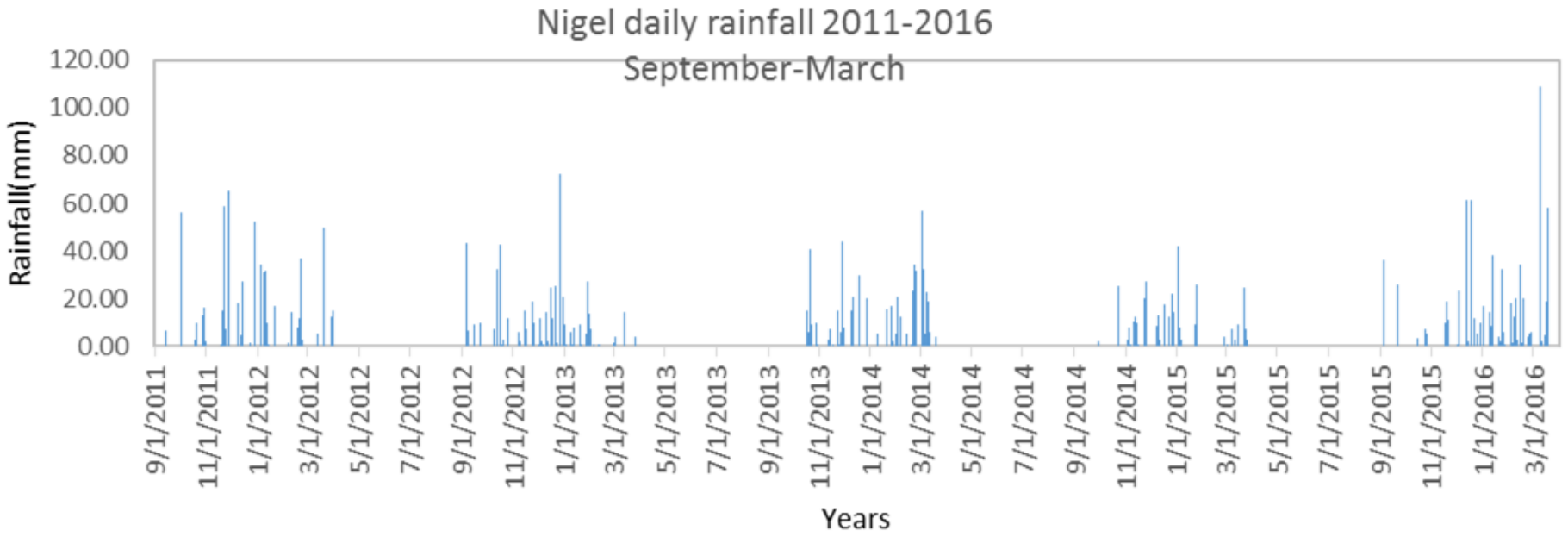


Figure 1: rainfall patterns over East rand stations

South African Weather Service
ISO 9001 Certified Organisation

Monthly rainfall

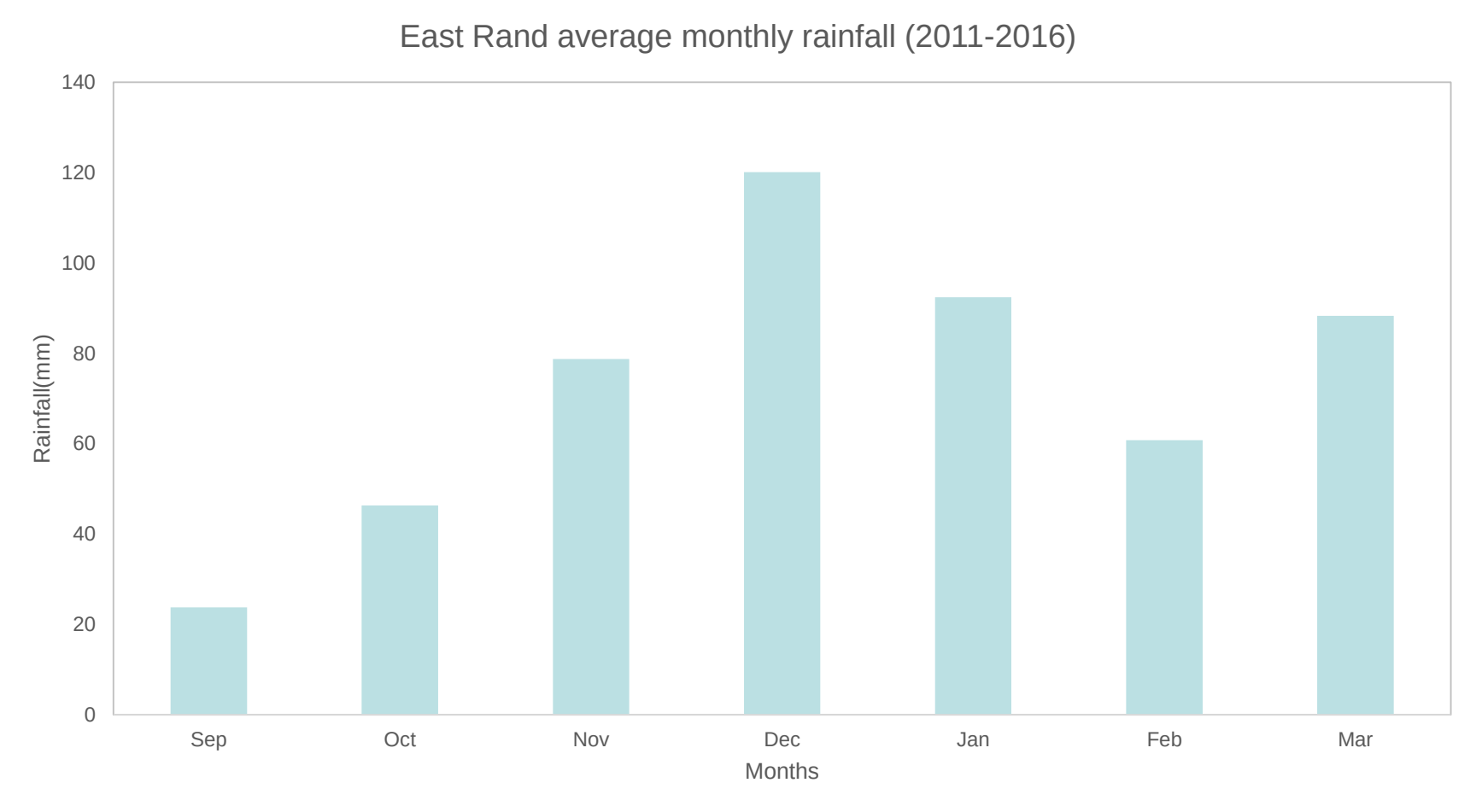
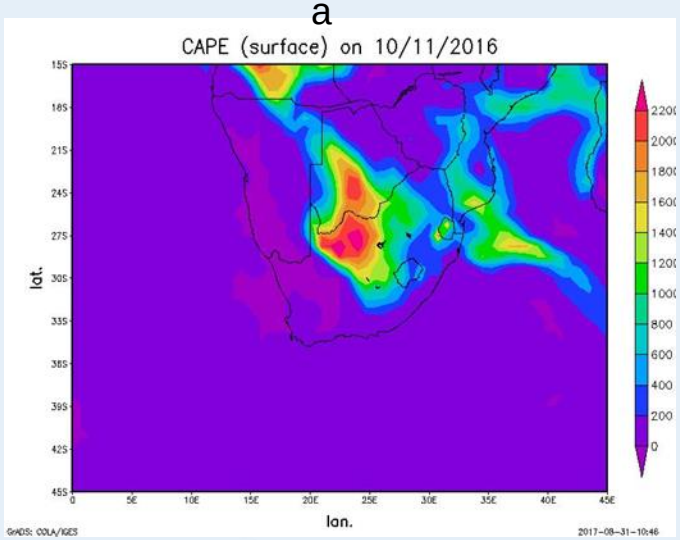
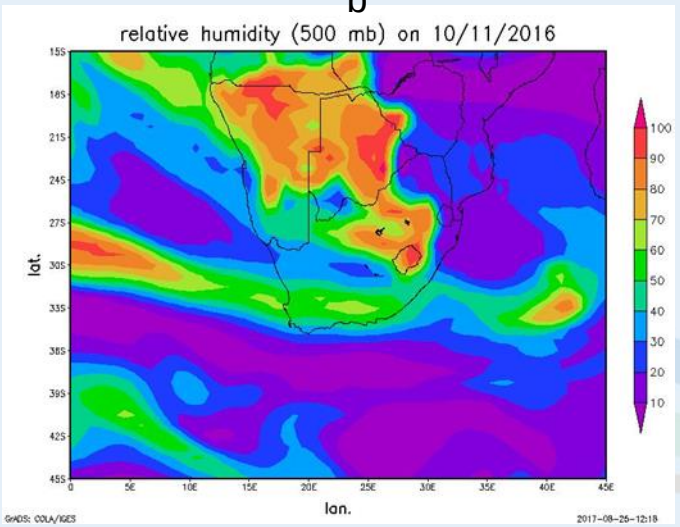


Figure 2. Annual cycle of rainfall over East Rand

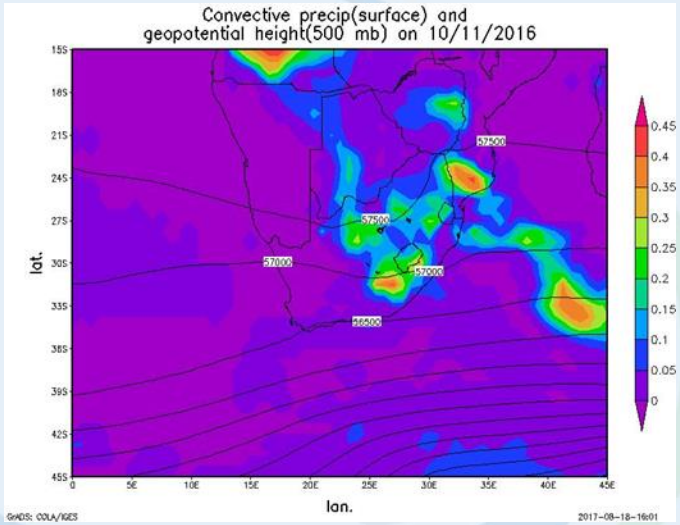
a



b



c



d

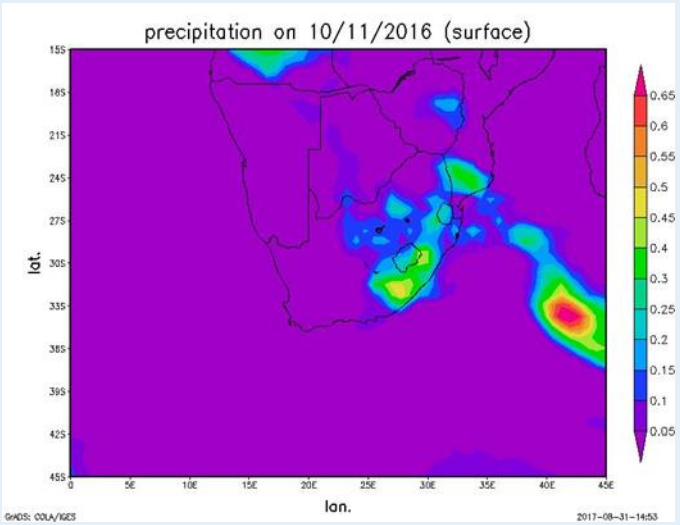
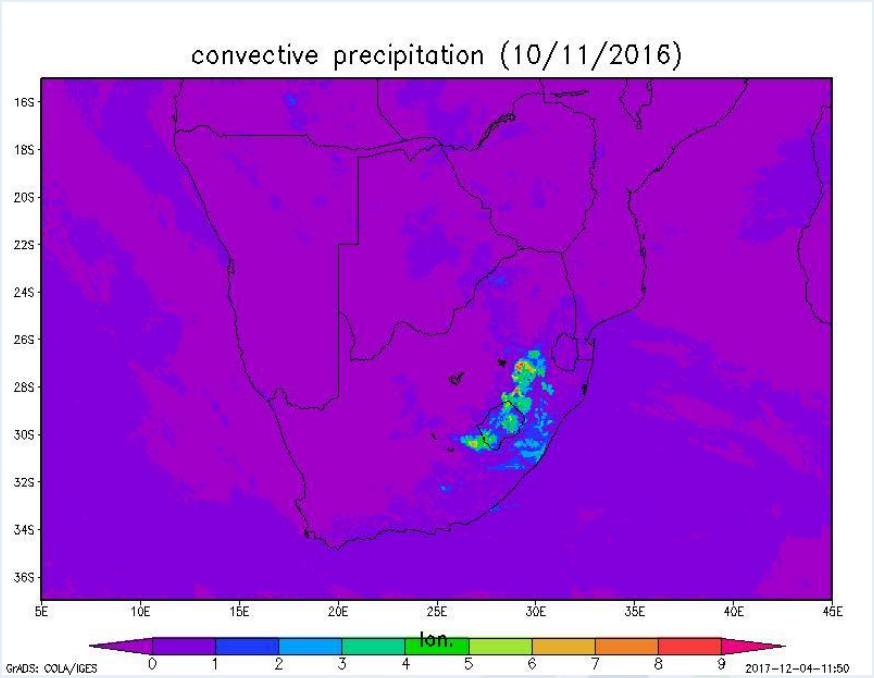
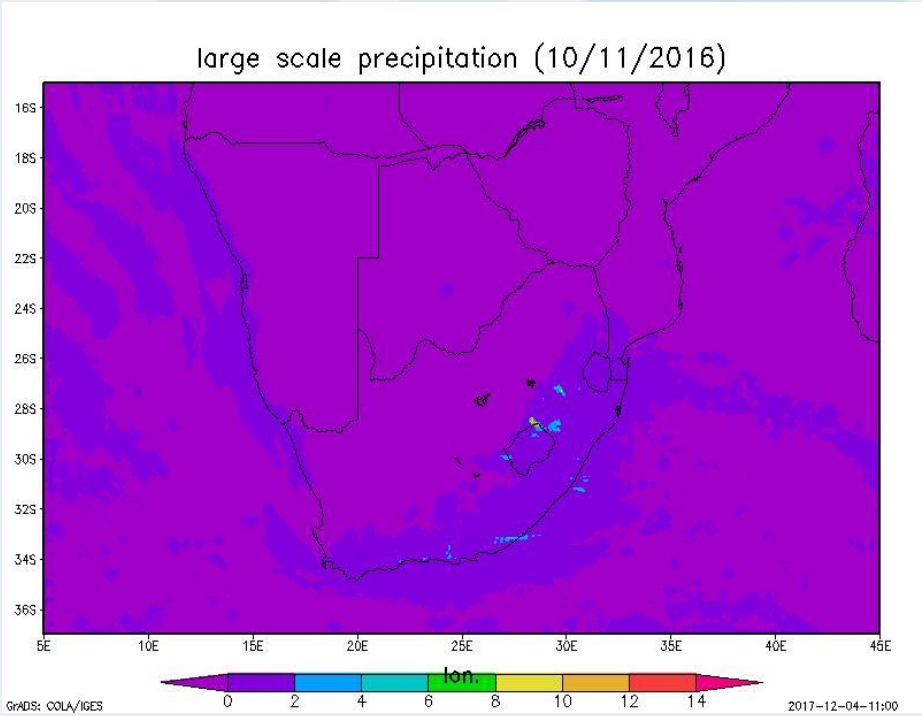


Figure 2. CAPE at the surface (a), relative humidity at 500 mb (b), convective precipitation at the surface & geopotential height at 500 mb (c) and precipitation at the surface on the 10th of November 2016.

South African Weather Service

WRF simulations





South African Weather Service
ISO 9001 Certified Organisation

Concluding remarks

- Observations East-rand receives heavy precipitation
- Details of convection can be better simulated with high resolution models which require High Performance Computing
- 1.5km and 300m will be used for 3 cases
- All made possible by CHPC cluster

South African Weather Service
ISO 9001 Certified Organisation