ECOLE POLYTECHNIQUE D'ABOMEY-CALAVI (EPAC)

(UNIVERSITE D'ABOMEY-CALAVI, BENIN)

RESEARCH PROJECT

Topic: Simulating Tropical Cyclone using MPAS over the South West Indian Ocean(SWIO) and impact on developing countries in Africa

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1 Context and problem statement

Despite the technological advances in climate science and our understanding of the tropical cyclone, the losses and devastating impacts of tropical cyclones on societies are still severe. Each year, tropical cyclones affect dozens of countries around the world. These systems produce strong winds, intense rainfall, heavy swells and storm surges that induce floods, landslides, loss of life over lands. The socio- economic impacts of cyclones are usually daunting. In recent decades, the severity and frequency of natural disasters have typically increased more than humans can adapt to. This has been primarily linked to the anthropogenic forces. TCs have an inherent unpredictability which makes preparation and planning for countries an elusive job. In 2000 - 2009, more than 540 tropical cyclones have been reported worldwide to have killed more than 167,692 people, affected more than 286,222,030 and cost around damages worth US $ 385 billions (Vos et al., 2010) . The South-west Indian basin is one of the area in the world known for the development of Tropical Cyclones (TCs). Over the south-west Indian Ocean an average of 13 tropical cyclones develop every year with wind speed which can exceed 63 km/h (World Bank., 2017). TCs affected southern Africa countries often rely on international assistance to recover from the damages. In 2004, TC Gafilo was the most intense cyclone to have hit Madagascar. With a speed of up to 300 km/h, it caused damages from subsequent flooding, destroyed houses, rice and banana crops (Madagascar, 2004). Gafilo has killed at least 237 people in this area and had a financial impact of $250 million. TC Fantala, one of the most extreme storms ever to strike the Indian Ocean in the South West. It crossed Seychelles twice in April 2016, causing extensive damage to almost all private and public buildings, including the loss of vital desalination facilities, thus greatly affecting communities and living conditions in the archipelago (ACP-EU, 2017). The tropical cyclone Eline and Gloria were the source of much damage in Madagascar in 2000 and severe flooding with over 130 deaths were estimated and 10,000 people lost their houses (World Bank., 2017).

2 Background and motivation

The harm caused by TCs is direct and quantifiable impact on agriculture, tourist attractions, fisheries and building materials. There are also intangible socioeconomic impacts on the ecosystem, where species are lost, weed species invade an area, and time and energy are diverted from economic activities to environmental recovery. African countries in this area are poor and vulnerable to tropical cyclones. These countries must be better prepared for the destructive consequences of TCs which were very critical to many families who lost their loved ones and their livelihoods (Vos et al., 2010). To mitigate impacts and create resilient and sustainable societies, underlying factors and preconditions that make humans vulnerable to tropical cyclones need to be addressed. It appears very important to study and understand how a tropical cyclone occurs, the necessary conditions for its formation, and how to improve the prediction of future TCs in Africa. Knowing the past, the current and future environment is primarily based on using complex General or Regional Climate Models (RCGs) with high spatial and temporal resolution over different areas of interest (Heinzeller et al., 2016; Adeniyi, 2019).

These models currently exist (Weather Research and Forecasting (WRF) model, Model for Prediction Across Scales (MPAS)) and vary by their numerical solver implementation and the various physical parametization schemes applied (Adeniyi, 2019). MPAS is one of the best several numerical models which is widely used for seasonal forecasting of tropical cyclones, tornadoes, convection and also for real time weather forecasting. It is also applied to the study of past, present and future climates at regional scale, using high spatial resolution over the region of interest and implement different convection schemes. The goal of this research project is to simulate tropical cyclone over the South-west Indian Ocean using the New-Tiedtke (NT) and the Kain-Fritsch (KF) convective schemes in the Model for Prediction Across Scales (MPAS) and evaluates the performance of these schemes on cyclone Eline over the region. Basically, the objective is to: We would like to finish this study in no more than four (04) years:

- present the Model for Prediction Across Scales,
- describe the New-Tiedtke and Kain-Fritsch convective schemes in MPAS
- compare the two scheme to find out which one is more suitable to simulate cyclone over the region and also.
- analyze the impacts of Tropical cyclones on some African developing countries.

This will help to address the different factors which make humans vulnerable to tropical cyclones and help to predict the occurrence of TCs over the SWIO. Hence, the present study aims to evaluate the performance of the MPAS model in simulating a tropical cyclone over the SWIO (using the TC Eline as a case study) and investigate the sensitivity of the simulated TC to two convective parameterizations schemes. It will also analyze the impact of TC on African countries like Madagascar, Mozambique ...

References

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