The Understanding and Prediction of High Impact Weather in the Gulf of Guinea

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Summary

The Gulf of Guinea and adjacent coastal regions experience some of the most severe thunderstorms on the Earth, which pose a threat to local fisherman, shipping in the region, and the oil and gas industry. Over the Gulf of Guinea, the weather conditions can change quickly within an hour from seemingly calm conditions to strong winds, heavy rain and high waves.

This project aims to investigate the dynamics and predictability of organised thunderstorm complexes, which are called mesoscale-convective systems (MCSs) or squall lines, in the Gulf of Guinea. The project would include efforts to advance already existing methods to objectively identify and then track MCSs and squall lines.

These methods will be adapted for squall lines in the Gulf of Guinea so they can be used to track features in Met Office forecast products at different horizontal resolutions in the future. Once the squall lines have been objectively identified over coastal and oceanic regions we will investigate why and how they form, their evolution and what they have in common with land forming squall lines over West Africa. The investigation will be based on satellite data from geostationary and polar orbiting satellites, analysis and reanalysis datasets from the European Centre of Medium range Weather Forecast (ECMWF) as well as global and convection-permitting weather forecasts from the Met Office Unified Model (MetUM).

The overarching aim of the project will be to improve numerical weather prediction of squall events in the Gulf of Guinea, resulting in more accurate prediction and longer lead times for operational early warning systems. Scientific literature on these High Impact Weather (HIW) events is limited, despite the significant impact on human lives and livelihoods. This project is a real opportunity to contribute to fundamental understanding of storm genesis, lifecycle and physical impacts in a region that has had little attention to date.

The scientific objectives of the PhD project are:

(1) Objectively identify and track squall lines in the Gulf of Guinea and West Africa
(2) How and why do the squall lines from in this region? What are the geographic and synoptic/ large scale weather impacts on formation?
(3) What are the underlying dynamics of these squall lines? Are they different compared to squall lines over West Africa?
(4) How do numerical weather prediction models capture squall lines and can this be improved to provide longer-lead early warning times?
(5) Develop diagnostic evaluation tools to assess the evolution of squall lines in the Gulf of Guinea in the MetUM.

This project will be part of the Global Challenges Research Fund African Science for Weather Information and Forecasting Techniques (GCRF African-SWIFT) programme which aims to develop African weather forecasting capability to enhance the livelihood of African populations and improve African economies. By being part of this international project you will have the opportunity to work with both UK and African operational forecasters and connect with tropical scientists across the UK and the international partner countries (Senegal, Ghana, Nigeria and Kenya). The link to African-SWIFT will facilitate access to observations and to local stakeholders who are directly affected by squall lines in the Gulf of Guinea, and it will ensure that you are part of a vibrant scientific community in the UK and in Africa.

By being part of GCRF African-SWIFT you will have the opportunity to attend international training and knowledge-exchange events for scientists and forecasters in Africa (e.g. project meetings, SWIFT summer school). Close collaboration with the Met Office (the CASE partner) will ensure the results of this study will feed into operational model evaluation and development. Collaboration with researchers at Monash University in Melbourne, Australia, is also envisioned, potentially involving an extended visit.