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Thunderstorms over Southern Ghana on 3rd March, 2017

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Abstract

This script is to explain how anticyclonic convergence at the 200 hPa level with a corresponding cyclonic convergence at the 925 hPa level produced rainfall over Southern Ghana, specifically over the Brong Ahafo Region. Continental winds prevailed over the Brong Ahafo Region on that day which, under normal or usual circumstances would not have yielded any rainfall due to the dryness but the convergence was so deep and the atmosphere became absolutely unstable. Usually anticyclonic circulations are associated with divergence but the unusual occurred on that day over Ghana, it happens 'once in a blue moon'.

Keywords: Anticyclonic; Equatorial tough; Divergence fields; Harmattan haze; Satellite imagery

Abbreviations:

ET: Equatorial Tough; MLT: Mid Latitude Trough; ECMWF: European Centre for Medium Range Weather Forecasts; NOAA: National Oceanic and Atmospheric Administration

Introduction

Thunderstorms occurred when there was an expansion of the Equatorial Trough (ET) across Ghana and a corresponding lowering of surface pressure over North Africa. The interaction between the Equatorial tough and the Mid Latitude Trough (MLT) on that Friday, 3rd March, 2017 had been very spectacular. Certain meteorological model's proved clearly that such a situation will occur over certain areas as well as their intensities. The surface pressure chart, winds at various levels in the atmosphere and the divergence fields were taken into consideration to show how these products work together effectively.

Discussion

In Ghana, areas with pressure values of 1015 hPa or more are highlighted as highs and areas with 1010 hPa or below as lows. Previously, high pressure extended across North Africa, from the North Atlantic Ocean through to Saudi Arabia; the harmattan haze was by then affecting most parts of Ghana but as the lowering of surface pressures occurred over North Africa with a trough extending into that area, the pressure systems isolated themselves, formed segments and moisture was drawn into the sub region and created massive thundery activities over Ghana [1-3].

The Azores high pressure system, on that day had its central pressure value as 1030 hPa whilst the Arabian high pressure had its value as 1025 hPa with the Libyan high pressure cell, which is directly northwards of Ghana had its value as low as 1015 hPa indicating that pressures had really reduced and attracted moisture from the nearby oceans.

The opening between the two pressure cells (the Azores high and the Libyan high) could be visible across Algeria (Figure 1) and it had been a reliable feature for meteorologists in Ghana to easily predict thunderstorms over West Africa. The 1010 hPa isobar could be seen covering the whole of Ghana; the inner area is referred to as the Equatorial Trough. It extended sharply into the Sahel, across Niger with a corresponding 1010 hPa visible over the Mediterranean, just grazing the coast of Morocco and Algeria which justifies the interaction of these two low pressure systems. The High pressure systems over the Atlantic Ocean, the Azores and the St. Helena served as source regions for moisture which supported massive cloud build-ups over the West African sub region.

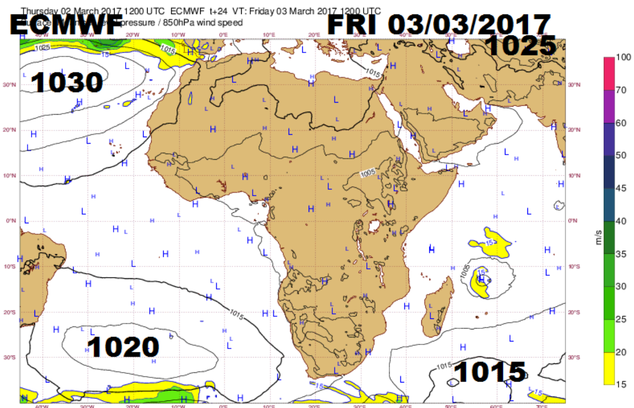

Figure 1: Surface pressure chart indicating lowering pressure over North Africa.

Yellow spots on the RGB Convection satellite imagery (Figure 2) at 1600 UTC on that day indicated that the storms were violent and later expanded to affect most parts of Southern Ghana. Satellite imagery is a snapshot (selfie) from the satellite but for early warnings and decision making purposes, information on storms and adverse weather events must be relayed in time, at least some couple of hours ahead and in

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doing this, models like the winds at various levels have to be considered.

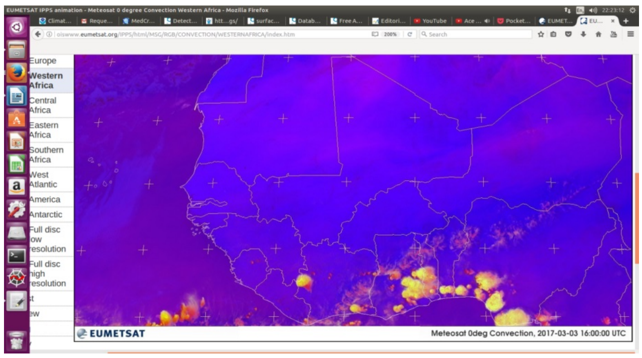

Figure 2: Satellite imagery (RGB convection) indicating violent storms over Southern Ghana.

On that fateful day, winds at the 925 hPa level, approximately 800 m from the surface of the earth, showed wind convergence close to the south-eastern borders of Ghana (Figure 3) which is close to the Eastern Region of Ghana. It indicated southerly winds from the Gulf of Guinea which has lot of moisture that affected most parts of Southern Ghana [4,5]. Also, there had been northerly winds over the Brong Ahafo Region indicating continental winds and they are relatively dry and dusty. That air mass brought dust particles to acts as condensation nuclei, and the mixture of these two air masses were lifted aloft for condensation to take place leading to the formation of massive clouds that produced the thundery activities.

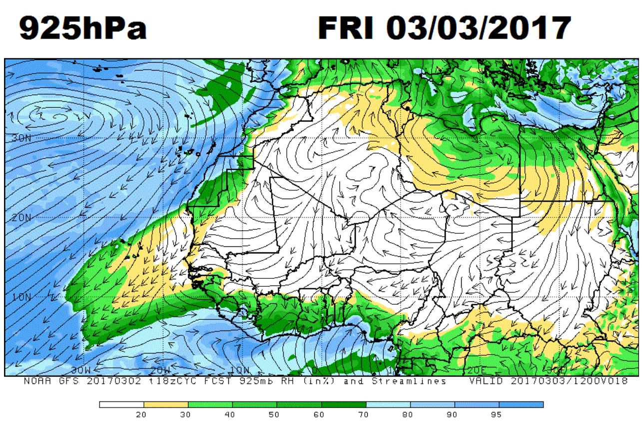

Figure 3: Winds (streamlines) at the 925 hPa level showing convergence close to the eastern borders of Ghana.

Anticyclonic wind convergence was observed over Southern Ghana (Figure 4) at the 200 hPa level which indicated the depth of the convergence. The deep convergence was manifested on the Divergence fields (Figure 5) from the PUMA platform [6-9]. Convergence extended from the 925 hPa level through to the 200 hPa level, mainly located over the mid-western portions of Ghana, precisely the Brong Ahafo Region but rain amounts recorded were just 6.5 mm over Sunyani and 8.9 mm over Wenchi because winds at the lower levels were mostly continental and over the Eastern Region, Akim Oda recorded 31.8 mm which is quite heavier; winds affecting that area were maritime and rich in moisture capable to support massive clouds that produced the thunderstorms on that day. The PUMA showed that the Eastern Region even had convergence at the 925 hPa with a corresponding divergence at the 200 hPa level in the divergence field which is another good sign of lifting moisture aloft; these are things meteorologist must consider when making predictions [10].

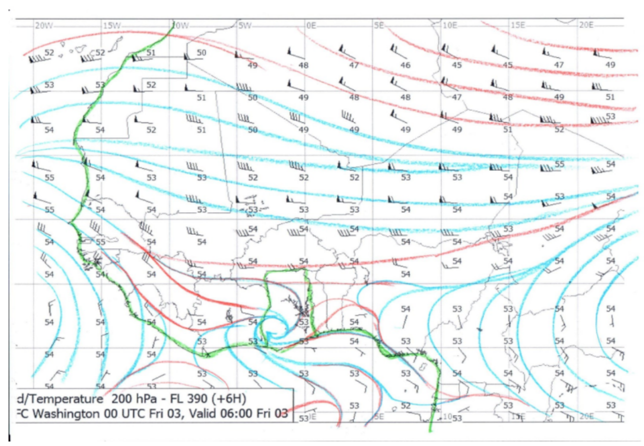

Figure 4: Analyzed winds at 200 hPa level indicating anticyclonic convergence over Southern Ghana.

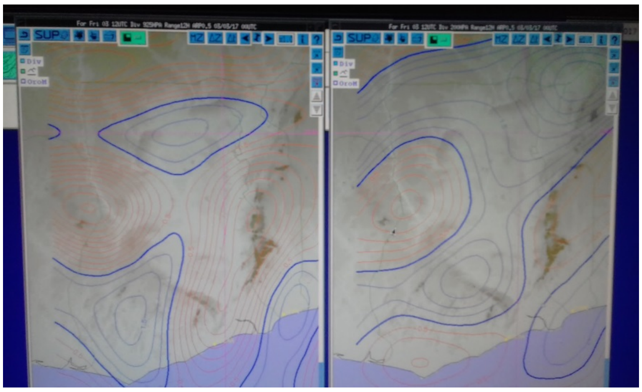

Figure 5: Divergence fields over Ghana for both 925 hPa (left) and 200 hPa (right) - Red means convergence and Blue means divergence.

Conclusion

It has been commonly known that when there is convergence at the lower level with a corresponding divergence at the upper level it gives rise to rainfall, but in this study it has been realized that when there is a deep convergence in the atmosphere on the divergence field rainfall is also produced, especially if there is some little amount of moisture indicated by the air mass. This will mean that when making a weather forecast, at least more than one parameters has to be considered in order to make the predictions very accurate.

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