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APPLICATION OF ZPHI® ALGORITHM ON AMMA RADAR DATA : DESCRIPTION OF WEST AFRICAN SQUALL LINES

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1. INTRODUCTION

During the 2006 Special Observation Period of the African Monsoon Multidisciplinary Analysis (AMMA) different instruments and especially radars and raingauges were deployed over West Africa. Among those radars the C-band RONSARD in Kopargo (Benin) and X-band XPORT in Djougou (Benin) were almost co-localized (18 km apart). The data from these two weather polarimetric Doppler radars can be processed by Zphi® to correct for attenuation effects and retrieve microphysics information. Zphi® is a French software making use of the polarization variables measured by radar that allows us to perform quantitative rain estimates (QRE). The aim of using these radars was to analyze the microphysics structure of west African squall lines. The microphysics observed differences can be explained by the dynamics which is available with the Doppler feature of the radars. More specifically our study of squall lines microphysics and dynamics, is based on a systematic processing of the whole radar dataset including correction of ground clutters, noise, calibration and inter-calibration between the two radars and also with respect to the raingauges. The Zphi® algorithm taking care of attenuation correction. We also developed a specific method to dealias wind Doppler fields on both radars. This presentation will focus on the comparison between both C-band and X-band radars in terms of could microphysics and dynamics.

2. METHODOLOGY FOR RADAR PROCESSING

2.1 CLASSICAL PROCESSING

First a background noise filtering is performed using the availability of vertical and horizontal polarized horizontal velocity. Indeed a relatively big difference (~0.5 m/s) between the fields indicates the presence of noise.

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Then a ground clutter filtering is performed using the persistence of echoes on different data fields at different time. A Numerical Terrain Model (NTM) which model the ground clutter is also used to enhance the filtering. The calibration/intercalibration is performed using radars, raingauges.
For the dynamics we developed a specific algorithm for dealiasing wind Doppler velocity from AMMA radars.
This development was very important because of the low Nyquist value of the Doppler velocity for the different radars (20 and 10 m/s for Ronsard, 8 m/s for Xport).
In addition to this systematic processing of data, specific corrections were applied especially azimuth correction for Xport and Ronsard. Finally the whole processing allows us to perform a quality control of the dataset. And the intercalibration with different types of instruments ensure a good quality control.

2.2 ZPHI® APPLICATION

Attenuation correction is performed using Zphi® algorithm. Indeed processing the different polarimetric data, it corrects the attenuation of reflectivity by the rain. Zphi® allows also to distinguish the different types of precipitation while retrieving an hydrometeore classification. Doing so it can also filter the ground clutter. The microphysical variables (Zh, Zv, Zdr, RhoHV, PhiDP) processed with Zphi® allows then to explore microphysical structure. Indeed rainfall rate and DSD characteristics via N0* are also available. Figure 1 shows an example of rain retrieval field and its associate reflectivity field for the Ronsard.

3. RESULTS

The case of 06/07/28 was one of the most interesting and intense case observed by both radars. Figure 2 shows the reflectivity field from both radars as they both sampled the event. The two radars observed almost the same features. Especially in this case the squall line was moving in two directions, which was well captured by the combination of both radars. Moreover the rain estimation are quasi identical in intensity and location which means that Zphi® might retrieve a good rain field in term of

intensity and location.
Another study consist in coupling wind fields with VAD algorithm to perform dynamical structure analysis. Doing so the case of 06/07/28 is very intersting as it was also a very strong case of squall line (Fig. 3). Moving from east to west this squall line was detected and sampled by Xport and Ronsard radars. Coupling the dealiased wind data with VAD algorithm give some clue to explain the 3D structure of the system. In horizontal cross section, we retrieve a classical wind and reflectivity fields associated with squall line. In vertical cross section interesting features are observed: high convection tower on the front of the system; density current just behind the tower which enhances the upward motion by rising; stratiform cloud region characterized with bright band on the rear part of the system.

4. CONCLUSION

The combination of Xport and Ronsard polarimetric Doppler radars processed by Zphi® algorithm is very useful to investigate the inner structure of squall line. Applying this process to all the other polarimetric radars such as Npol which was situated in Dakar will allow to compare the different structures of the east/west squall line. Doppler feature is also very useful to complete the study.

5. REFERENCES

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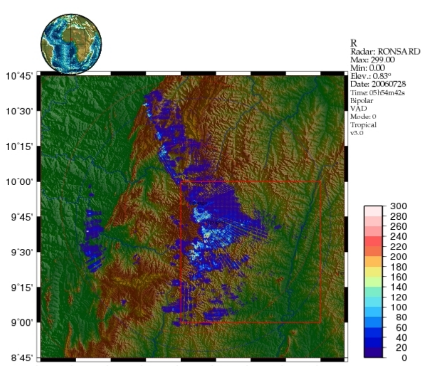


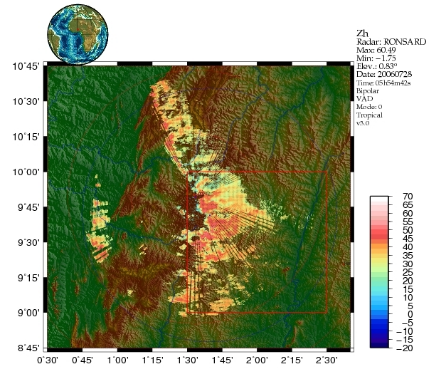
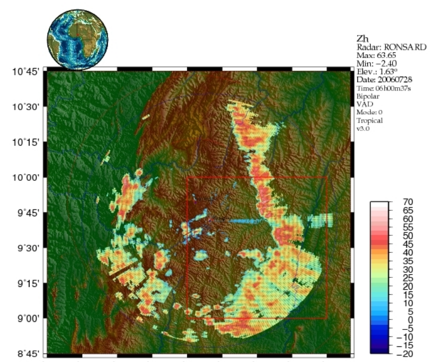


Figure 1: (up) rain rate for Ronsard 06/07/28 at 0554UTC.
(down) reflectivity for Ronsard 06/07/28 at 0554UTC.



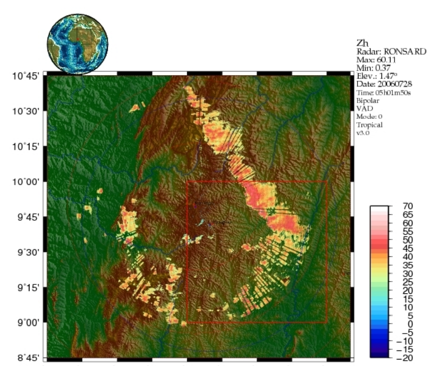


Figure 2: (up) reflectivity for Xport 06/07/28 at 0500UTC.
(down) reflectivity for Ronsard 06/07/28 at 0501UTC.

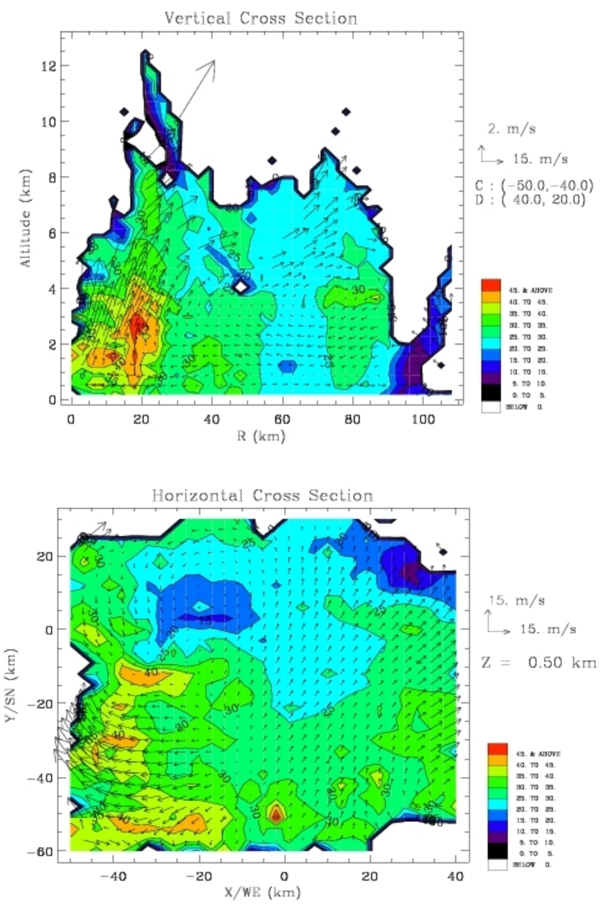


Figure 3: (up) vertical cross section from VAD applied on Ronsard 06/07/28 at 0630UTC. (down) horizontal cross section from VAD applied on Ronsard 06/07/28 at 0630UTC