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Influence of the dynamics on the microphysics in the West African squall lines

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My goal is to study microphysics and dynamics in West African squall lines using AMMA data(radiosoundings and radars), the sensitivity to ice parameterization, and the role of dynamics on microphysics. So we develop a diagnosis tool to infer the best microphysics suitable for radiative transfer studies.

Microphysics plays an essential role in the life cycle of tropical squall lines. Moreover, its characterization is essential to the retrieval of rainfall by radar or space radiometry. The microphysics is strongly determined by the dynamics involved.

Through AMMA, we have access to ground radar data (Ronsard and Xport) that allows us to reconstruct a field of wind. We use this wind field in stationary mode as an entry to a microphysics model (V. Marecal and D. Hauser - 1992). This two-dimensional model is much simpler to implement than a cloud model . It allows us to conduct a series of sensitivity tests on the influence of the dynamics on the microphysics. Thus, we can implement an adequate simplified microphysics parameterization in radiative transfer models while providing maximum consistency with the observed dynamic fields.

We use a microphysical retrieval model wich is two-dimensional and time independent with a bulk parameterization, and an Marshall Palmer equivalent DSD for liquid precipitation and locatelli and hobbes PSD for ice precipitation.

The microphysics model was first designed by Virginie Marecal and Daniele Hauser (1992). It was extensively used on FRONTS 87 data to diagnose microphysics in frontal rainbands. Attempts were made to use it on TOGA CORE data for tropical convection.
The equations of evolution of the water mass and the temperature are solved using a wind, humidity, pressure and temperature fields.
This model is extremely sensitive to the accuracy of continuity equation of water mass and to the humidity profile. As the model is also sensitive to the resolution of the grid, we must have a good resolution. So for a better control on input data, we begin with a synthesic relative two-dimensional wind field which respects this continuity equation.
As for the thermodynamics input data, we choose radiosounding data.
The microphysical model was improved and adapted to tropical conditions.

We initially tested the model behavior with a simulated wind field and thermodynamic fields from radiosounding. We then used wind fields from the Ronsard radar.

The model is stable under tropical conditions with 2D Ronsard wind field. We tested different parameterizations for ice species and microphysical processes, and studied the influence of the environment (humidity and temperature).
We retrieved microphysics (clouds and precipitations) processes, precipitation rate, fall speed and reflectivity fields.Results are consistent with expectation, other models and Ronsard observations.

We have made a comparison with polarimetric classification (R. Evaristo, 2008) based on particle types and precipitation intensity.

A systematic study of all cases observed by Ronsard, allowed classifying the systems and establishing statistical relationships between the microphysics and dynamic characteristics. This information could then be used in rain restitution algorithms from satellite data.