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Performance of the MONAN Model in Forecasting Cyclone Akará and Associated Precipitation Using Object-Oriented Evaluation

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Cyclones are frequent meteorological phenomena in Brazil, commonly associated with intense rainfall and strong winds. Most of them are extratropical systems, although subtropical and, more rarely, tropical cyclones also occur. Due to the impacts they cause, understanding the intensity and dynamics of these systems is essential for the scientific community, particularly regarding the ability of numerical models to predict their formation, associated precipitation, and wind fields. In February 2024, Cyclone Akará developed near the southeastern coast of Brazil and, as the third system classified as a tropical cyclone in the South Atlantic, represented a unique opportunity for study. With the development of the MONAN model (Model for Ocean-laNd-Atmosphere predictioN), built through a multi-institutional effort, the need arose to evaluate its performance in forecasting extreme events, especially those associated with cyclones that directly affect the country. This study aimed to analyze MONAN's ability to represent precipitation fields and mean sea level pressure (MSLP) associated with Cyclone Akará, comparing different versions of the model from the implementation/development process. To achieve this, an object-based approach was adopted using the MODE tool (Method for Object-Based Diagnostic Evaluation). ERA5 reanalysis data (ECMWF) were used as reference to compare the cyclone's position and intensity, while precipitation was assessed using the MERGE product (CPTEC/INPE), a high-resolution, blended rainfall dataset that combines satellite information with in situ gauge measurements to create a homogeneous daily record for South America. The evaluation focused on the intensification phase of the cyclone (February 16), considering attributes such as centroid distance, area, and total interest of the objects, in addition to traditional metrics such as RMSE, BIAS, and CSI. The results showed that the updated version performed better in forecasting intense precipitation. The detailed assessment of this event offered valuable insights for the continuous improvement of the model, contributing to the strengthening of the Brazilian numerical weather prediction system.

Keywords: Cyclone Akará, MONAN model, Precipitation, Model Evaluation, MODE.

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