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Evaluation of the convection closure assumption in BRAMS version 3.2: a case study.

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The options for the convection closure assumption available in the Brazilian Regional Atmospheric Modeling System (BRAMS), version 3.2 were evaluated. The subgrid convection is parameterizated following Grell et al (2002) scheme, which provides 6 closure assumption options: a) Grell standard (GR); b) Low level Omega (LO); c) Moisture Convergence (MC); d) like Fritsch-Chappel (SC); (e) Arakawa-Schubert (AS); and (f) Ensemble (EN). Simulations with these options were compared with rain rates estimated by Tropical Rainfall Measuring Mission (TRMM). This dataset was produced by algorithm 3B42RT, which presents 0.25o lat. x long. spatial resolution and 3-hour temporal resolution. The 3-day simulations were realised with a 0.18o x 0.20o lat. x long. horizontal resolution and lateral boundary information provided by Global Forecast System (GFS, formally AVN/MRF) analyses, which have 1o x 1o of lat. x long. horizontal resolution, every 6 hours. The simulations were evaluated at the area that goes from latitudes 27oS to 35oS and from longitudes 297oE to 312oE. This area corresponds to almost 40% of the total domain, covering parts of Brazil, Argentina, Paraguay and the entire Uruguay country. The 24-h accumulated rain rate was classified into 4 categories: a) Total Rain (TR, greater than 0.5mm/h); b) Light Rain (LR, between 0.5 and 2 mm/h); c) Moderate Rain (MR, between 2 and 5mm/h); and d) Heavy Rain (HR, between 5 and 20mm/h). For each of the 4 categories, two characteristics were obtained: a) area coverage (given in % of the entire area for TR category and given in % of the area with TR for other categories); and b) rain rate areal average (given in mm/h.m2). These characteristics are complementary because

the former regards the spatial distribution of the rain generated in each category and the later reports the amount of rain generated in each of them. The case selected refers to a cold front passage over southern South America, characterized by light/absent precipitation inland and heavy precipitation offshore. The results show that, for most of the closure options, the TR coverage area was close to the value estimated by TRMM. The TRMM estimated the coverage area with TR as 9,6%, and the best result (9.3%) was provided by the LO option and the worst (6.9%) by AS option. For the MR and HR categories, all closure options trend to underestimate both the coverage area and the amount of precipitation. As an example, for the MR category, TRMM estimated an area of 29% (in relation to the area with TR), and the best result was obtained with MC (17.6%) and the worst with LO (11.6%) option. For HR category, TRMM estimated an area of nearly 6%, but the options indicate an area around 1%. In terms of rain rate areal average, taking the HR category as an example, the TRMM data estimates it to be 6.6mm/h.m2, while the best result was generated by EN (5.9mm/h.m2) and the worst by SC (5.5mm/h.m2) option. The LR was the only category in which the options tend to overestimate the covered area, but the underestimation in rain rate areal average continues. The TRMM estimated the covered area by LR category as 65%, while the closure options indicate an area over 81%. Therefore, for the case selected and the configuration and data employed, the BRAMS trends to overestimate the area with light rain (LR) and underestimate the area with moderate (MR) and heavy rain (HR), no matter which closure option used. Further studies are necessary to determine if the trend in the distribution of rain categories obtained in this study is an intrinsic characteristic of BRAMS 3.2.