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Tropical Atlantic low-cloud and radiation biases in CNRM-CM: from CMIP5 to CMIP6

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Most state-of-the-art coupled general circulation models have serious biases in the tropical Atlantic, which strongly impact their representation of the regional climate. The CMIP5 version of CNRM-CM has been shown to suffer from these typical biases, namely a westerly wind bias over the Equatorial Atlantic and a excess of solar radiation in the southeastern region.

Since CMIP5, a new atmospheric physics has been developed and implemented in the CNRM-CM model. It includes a new boundary-layer scheme based on a TKE prognostic equation, a detailed microphysics scheme, which describe liquid and ice cloud condensates as well as liquid and solid precipitating hydrometeors, and a new convective scheme aiming at representing in a unified way dry, shallow and deep convection. As a consequence, the representation of clouds and convection in the tropics is strongly impacted. The skills of this new CMIP6 version is assessed here more specifically in the southeastern tropical Atlantic in terms of mean climate and annual cycle.

First we use AMIP-type simulations to evaluate low-level clouds and atmospheric processes associated with them, in both CMIP5 and CMIP6 versions of the CNRM model. In particular, we focus on the vertical development of boundary-layer clouds and mixing, that could drive biases in the atmospheric and surface energy budgets. Second, short-term hindcasts following the Transpose-AMIP framework, are used to better assess the sources and timescales of cloud biases and highlight feedbacks leading to them .