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Variability of Climate Over Molucca Determined from the Local Ocean Circulation and Air Sea Interaction

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The rainfall climate over Maluku is quite unique, since, instead of having the peak at the end or beginning of the year as with other tropical monsoonal regions, this region has the rainfall annual peak in the middle of the year or the anti-monsoonal pattern. This fact has been long known, but there is no satisfactory explanation of the possible causes. This study describes a possible local air-sea interaction that interplays in the region. To grasp the air-sea processes comprehensively, an integrated assessment using integrated ocean atmosphere climate models is needed. This study presents climate simulations from three different setups using a regional climate model (REMO), a global ocean model (MPI-OM) and an integrated coupled between those atmospheric and oceanic models from Max Planck Institute for Meteorology. REMO has a spatial resolution of 0.50 and 20 vertical layers, while MPI-OM has a special conformal grid focused on the eastern part of the maritime continent and 30 vertical layers. The simulations were performed for a period between 1979 and 1993, whose monthly average output values are used in the analyses. The analyses focus on the rainfall variability for the atmosphere and upper ocean variability for the ocean in comparison to observed rainfall and sea surface temperature (SST). With an assessment study using a global climate study (ECHAM4) and reanalyses from the European Centre for Medium-range Weather Forecast, the Maluku climate pattern is obscured and the annual peak occurs two months in advance. However, when we apply the regional climate model, which is, interestingly, driven by the same reanalyses, the obscured climate pattern appears. The regional climate model uses a similar physical parameterization as the global model, but with higher resolution topography. Thus the topography offers the first reason why there is such an anti-monsoonal pattern. The missing local small islands in the Maluku regions are attributed to the local heat engine, which eventually props up local convections. The second question arises as to what role the local ocean plays in determining the peak in the middle of the year and why the convections do not favor other periods. In order to see the local ocean role, serial simulations of the ocean model, which focus on this region, were performed. The results show a lagging mechanism between the surface ocean current and the built up ocean heat content and then to the observed local SST. The surface ocean current brings warm water from the warm pool area, which has similar anti-monsoonal climate pattern. From the local SST and rainfall analyses, there is a possibility of ocean circulation driving the favorable SST range for the convection to occur in the middle of the year. This is the second reason why there is such a Maluku climate type. Then having done both ocean atmospheric models separately, we are interested in the result of a coupling between those models in order to strengthen our argument that the cause of the Maluku climate pattern is due to local oceanic and atmospheric phenomena. As a result of the coupling between those two models, the coupling damps both atmospheric and oceanic components. In the stand alone atmospheric model, over the local sea there are significant overestimations of rainfall, which are minimized in the coupled simulation. Thus the coupled model simulates an even better climate, which supporting our previous argument that the local ocean atmosphere plays in creating the local Maluku climate phenomenon.