Abstract

This dissertation describes the analysis of the monthly, seasonal and interannual rainfall variabilities over the Maritime Continent and describes the potentials and limits of a wide range of climate models in simulating these variabilities. The study analyzes the simulated rainfall variability from two global reanalyses, an atmospheric general circulation model (AGCM), an atmospheric regional climate model (RCM) and an ocean general circulation model (OGCM). The two reanalyses and the AGCM output is available at T42 and T106 resolutions, while the RCM resolves 0.5° and $1/6^{\circ}$. The study explores the uncoupled as well as the coupled mode of RCM and OGCM and focuses mainly on the period 1979 to 1993.

With a regionalization method introduced in this study, the Maritime Continent is divided into three distinct climate regions, the south monsoonal, the northwest semi-monsoonal and the Molucca anti-monsoonal region. All three regions show different responses to monsoon and El Niño/Southern Oscillation (ENSO).

Two important rainfall variabilities ranging from monthly to interannualy time scale are the annual monsoon cycle and the irregular ENSO. The monsoon regulates local SST variability via ocean circulation, which in turn influences heat content of the upper ocean and eventually local rainfall. The study points to remote ENSO influences through SST forcing. Indeed, there is a local ocean circulation mechanism that drives the ENSO impact on Indonesian rainfall.

The rainfall climate of this region is potentially predictable on monthly and seasonal scales but only for limited and specific periods and regions. Despite such a potential, the study shows a consistent predictability barrier in spring as an intrinsic character of the Indonesian rainfall and a challenge to climate modeling in the region, because it limits model applications. The barrier is found by all models and at different resolutions.

The RCM and the OGCM have been especially tailored to the region and they produce realistic results. The global atmospheric model produces the large scale system well and the nested regional model shows a local phenomenon obscured in the global. A coupled atmosphere/ocean regional model shows improved dynamics through a better sea-air interaction and ocean/atmosphere feedback. However, also the uncoupled ocean and atmosphere models, separately, produce realistic results of rainfall and ocean variability albeit with some drawbacks. The quality of the RCM simulations is confined, in most cases, to the quality of the prescribed boundary forcings.