

Driving Mechanism of Inter-Annual Precipitation Variability during Monsoon Season over the Northern Part of Sumatra Island, Indonesia

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The precipitation variability of the Northern part of Sumatra Island in Indonesia has been driven by the complex tropical climate systems along with the local factors. The aim of this study is to investigate the driving mechanism of precipitation variability during the JJA-periods (June, July, and August) over the northern part of Sumatra. Moist Static Energy (MSE) budget analysis was used to model the source of energy which supports the precipitation anomalies. Composite analysis and statistical methods were used for confirming the result of MSE budget. By using 36 years of ERA-interim data, precipitation anomalies of JJA periods were classified into two categories, namely: wet years and dry years. Positive precipitation anomalies are found during the wet years which are supported by the upward motion of vertical velocity. During the wet years, the weaker easterly wind of Indian Summer Monsoon (ISM) associated with the westerly winds of a negative El Niño–Southern Oscillation (ENSO), a positive Indian Ocean Dipole (IOD), and a strong Western North Pacific Subtropical High (WNPSH). As a consequence, these anomalous circulations trigger a moisture flux convergence and positive precipitation anomaly. In the dry years, the downward of vertical velocity leads to negative precipitation anomaly. Generally, a stronger easterly wind of ISM was found during the dry years which is associated with a positive ENSO, a negative IOD, and a weak WNPSH. Even though the precipitation anomalies occur due to the collaboration of those winds, a new finding shows that WNPSH has a stronger impact to the precipitation anomalies than ENSO and IOD in the Northern part of Sumatra Island. In addition to those circulations, higher topography of the Barisan Mountains supports the ascending motion to moisten the lower troposphere and induces a positive precipitation anomaly in this maritime continent.

Keywords: Precipitation, MSE, ENSO, IOD, ISM, Sumatra Island