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SYNOP13 年観測および GSMaP 降水データに基づくインドネシア・ジャカルタの雷気候学
Lightning climatology around Jakarta, Indonesia, based on 13-years SYNOP observation and GSMaP rainfall data

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Operational observation in Indonesia, where has much amount of active convections under the tropical maritime climate with high atmospheric and sea surface temperatures and abundant water vapor supply, showed more than 100-200 days of lightning a year and more than 10 times/km2/year of lightning density. Developed convective systems with lightning (thunderstorms) often generates severe mesoscale phenomena of heavy rainfall, gusty wind, and tornados, as well as lightning strikes at the ground. Indeed, much amount and kinds of serious damages caused by thunderstorms have been reported in Indonesia, e.g., massive blackout and serious damage on electrical devices in urban areas, and forest fires and burn-out of high voltage power lines in rural regions. Although Virts et al. (2013a, 2013b) clearly documented lightning climatology over Indonesia based on TRMM LIS and the World Wide Lightning Location Network (WWLLN) observations, temporal and spatial distributions of lightning activity and their dynamics have not been examined in detail because ground-based radar and lightning locating observations are not well organized and satellite observations have deficiencies in their spatial resolution and sampling frequency.

We started three years (JFY2013-2015) program to study lightning activity mainly over Jakarta, where is the capital megacity in Indonesia and has much risk to be damaged seriously by thunderstorms especially in the social sector, to clarify its characteristics from both the points of precipitation climatological and mesoscale meteorological views based on three approaches as follows: 1) statistical analyses for lightning activity by using operational surface observation and TRMM satellite, 2) case studies on environmental conditions for severe thunderstorms based on a C-band radar and surface observation data already obtained, and 3) campaign observation by using X-band dual-polarimetric radar, VLF receiver network, and hydrometeor video soundings.

We examined 13-years SYNOP data for statistical analysis of lightning activity around Jakarta and its relation to rainfall variation based on GSMaP data as the first step. Seasonal variation of lightning frequency shows two peaks in April and November, which correspond to periods just before and after the peak of the rainy season in February around Jakarta, at most of the stations over the inland region. However, these peaks are not clearly shown at stations close to the coastline of Java Sea and one peak in February is more predominant. Because previous studies (e.g, Hattori et al. 2011, Wu et al 2007) suggested the cross equatorial northerly surge (CENS) intensify local convection around Jakarta in the boreal winter season, the effect of CENS to generate thunderstorms was limited only along the coastal region but not for inland in February. Intraseasonal variation of lightning activity based on MJO index clearly shows a major peak in the MJO phases 3 (eastern Indian Ocean) and minor one in phase 7 (western Pacific). It suggested the lightning activity was intensified at the leading and trailing edges of MJO large scale disturbance which is consistent with previous studies (e.g., Morita et al. 2006). Whereas, GSMaP data show a peak of rainfall around Jakarta in the phase 3 at the same time of lightning peak, though the previous studies showed the rainfall was peaked in the phases 4-5 (maritime continent).

We plan to examine lightning characteristics more focused around Jakarta and its relation to rainfall quantitatively by adapting the rain-yields per flash (RPF) (Williams et al 1992, Takayabu 2006) and the other parameters. More than 15-years TRMM LIS and PR data shall be used in our future study as well as Asia VLF network (AVON) and WWLLN datasets.

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