Radar-based “Diurnal-Cycle Indices” for hydrometeorology over Indonesian maritime continent

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Hydrometeorology over Indonesian maritime continent (IMC) is characterized by dominant diurnal cycle rainfalls along the coastlines, for which radar installations, observations and nowcasting have been carried out, because the synoptic analysis and forecasting are almost useless. L-band and VHF wind profilers provide diurnal cycles such as sea-land breeze circulations and raindrop distributions just above stations. S-, X- and C-band weather radars show migrations of the diurnal-cycle precipitating cloud systems (see Fig. 1). Here we consider radar-based “Diurnal-Cycle Indices” (DCIs).

Using three-year mean TRMM-PR data, Mori et al. (2004) calculated differences between local AM and PM rainfalls (as in Fig. 1a), which may be regarded as an original form of DCI. This DCI takes positive and negative values on sea and land, respectively. We may consider a difference between sea and land values of this DCI at a coastal location. Using more continuous ground-based radar observations, diurnal cycle patterns of wind, rainfall and raindrop echo migration are calculated in each day (as in Figs. 1c and g) or for a monthly mean (as in Figs. 1e and i). A pattern in each day is changed probably with an intraseasonal variation, but the peak value is dependent almost on the monthly-mean value, which explains the systematic land-sea contrast of the original DCI for three years.

Theoretically a sea-land breeze circulation (SLBC) is driven by the land-sea surface temperature (LST-SST) difference, and precipitating clouds are developed with ascending motion and moisture transport of SLBC under the conditional instability situation. Since SST varies dominantly with seasonal and interannual scales, the SLBC intensity should be varied mainly with LST. Processes determining LST are studied both observationally and theoretically. The insolation on land during sunrise and noon is responsible for daytime sea wind and evening rainfall on land, and the land rainfall itself is responsible for subsequent midnight land wind and morning rainfall on sea. We may consider several types of DCIs based on radar-based rainfall data at several stations/areas over IMC.

Keywords: weather radar, Indonesia , diurnal cycle

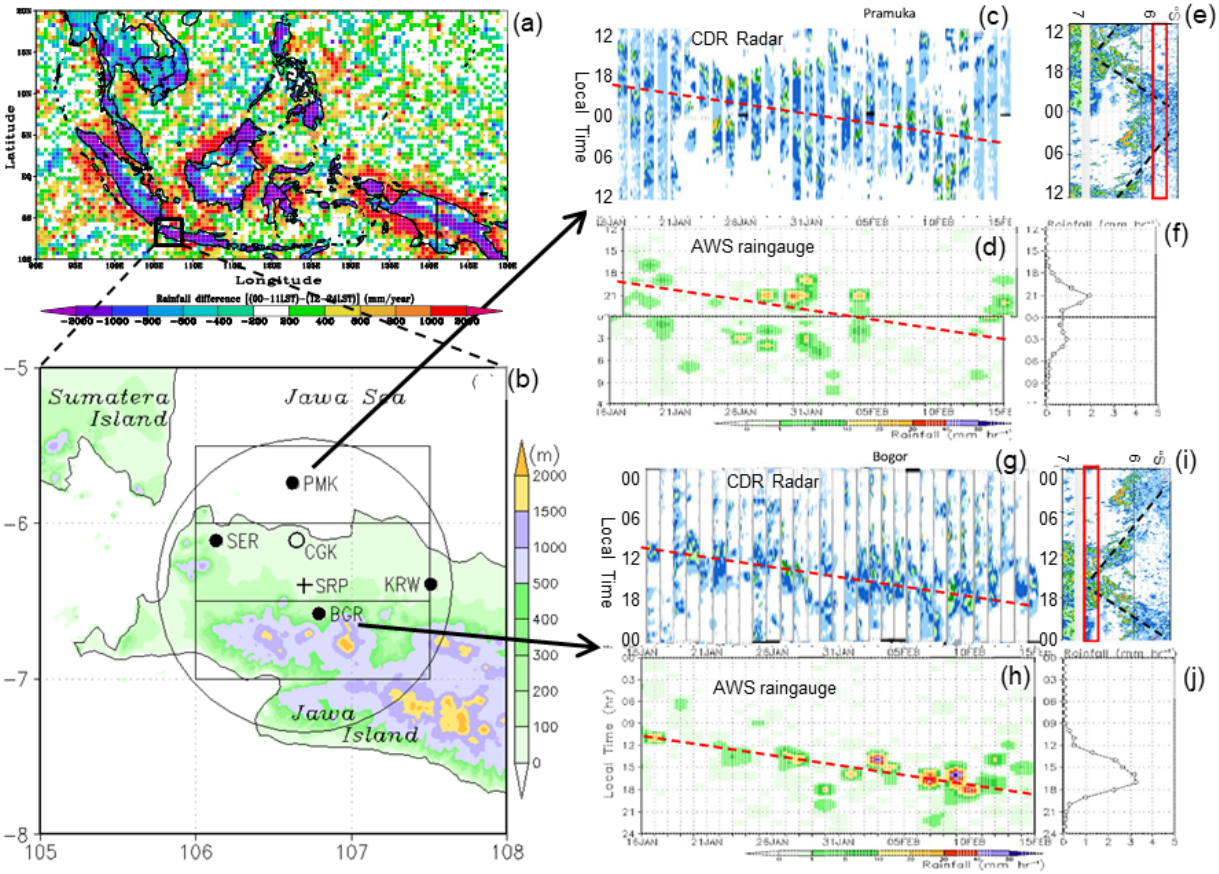

Fig. 1. (a) Distribution of an "original" diurnal cycle index from TRMM in 1998-2000 (Mori et al., 2004, *MWR*). (b) Stations of HARIMAU2010 campaign (16 Jan–15 Feb 2010) with a circle of 105 km range from a C-band Doppler radar (CDR) located at Serpong (SRP) (Mori et al., 2018, *PEPS*). Local time (LT) distributions of (c) CDR and (d) gauge rainfalls at Pramuka Island (PMK) with red dashed lines indicating a delay of 8 h/30days (≈ 16 min/day ≈ 1 cycle/90days). (e) Mean LT-latitude distribution of CDR rainfall with a red rectangle indicating latitudes near PMK. (f) Mean LT distribution of gauge rainfall at PMK. (g)–(j) Same as (c)–(f) but for Bogor (BGR) with LT centered at noon.