

Standardized precipitation index によるインドネシアの旱魃傾向の評価 Evaluation of recent Indonesian drought conditions by standardized precipitation index

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1. Background

In South Asia, an increasing population and frequent droughts have been significant factors to deeply affect water deficit of this region. Though the droughts are socio-ecological phenomena, the primary factor is extreme rainfall deficits. Thus, evaluation of the degree of recent rainfall deficits is critical to understand and cope with droughts in the future. In this study, recent drought conditions were evaluated by calculating standardized precipitation index (SPI) for the period of 1991-2006, based on the past data during the period from 1961-1990. Based on the SPI values, we attempted to discuss on drought conditions of Indonesia.

2. Material and Methods

The study area is the whole area of Indonesia. For the precipitation data, APHRODITE MA V1101R1 covering 57-years daily rainfall from 1951 to 2007 was utilized (Yatagai et al., 2012). APHRODITE data series were constructed by statistical interpolation of observed data. And, the spatial resolution of the dataset is $0.25 \times 0.25^\circ$ (Figure 1). Two steps are required to calculate SPI. For the first step, a gamma distribution is fitted to statistical data composed of rainfall amounts of the specific period of each year during the certain length of years. In this study, we chose the monthly data of April to September, and 3 months data of April to June, and July to September. And the period to get gamma distributions was set as 1961 – 1990. Then, obtained gamma distribution is transformed into a normal distribution with mean of 0 and standard deviation of 1. This make it possible to compare the rainfall conditions of different grid points. Since SPI values less than -2 in the transformed normal distribution is defined as extreme drought, we calculated probability of SPI of which values were less than -2 at each grid during the period from 1991 to 2006 to evaluate recent Indonesian drought conditions compared with the drought conditions during the period from 1961 to 1990.



Figure 1 Study site and grid points of precipitation data. Total grid numbers are 3,835.

3. Results and Discussions

If SPI values are less than -2, this means the occurrence probability is about 0.23%. Thus, if the probability of SPI values less than -2 at a grid during the period from 1991 to 2006 is significantly larger than 0.23%, this will indicate that severe drought frequencies are increasing during the

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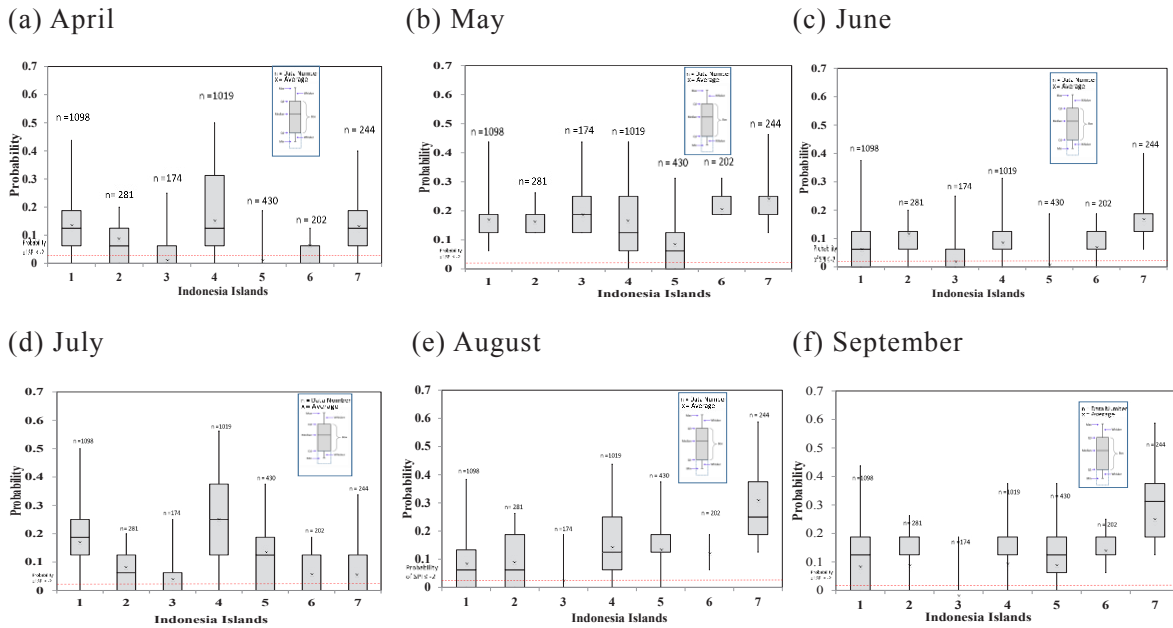


Figure 2 Probability of SPI values less than -2 during the period of 1991 - 2006 in Indonesia For x axis: (1) Sumatera and Belitung, (2) Java and Bali, (3) Nusa Tenggara Island, (4) Borneo, (5) Celebes, (6) Maluku Island, (7) West Papua

period from 1991 to 2006. The result is summarized with seven main islands, i.e. Sumatera and Belitung, Java and Bali, Nusa Tenggara, Borneo, Celebes, Maluku, and West Papua (**Figure 2**). Probability line of 0.23% which is corresponding to SPI = -2 is also shown by red dotted line in the figure. Except for Nusa Tenggara Island, both average and median values of probability of each Island is significantly higher than 0.23%, indicating that the most part of Indonesian Island have been experiencing severe drought during 1991 to 2006. Especially, Borneo Island seems encountered the extreme drought on the beginning and the mid of the dry seasons (April, May, and July). The most extreme drought area was the Southern part of Borneo which consists of the province of South, West and Central Borneo. However, it should be noted that rain gauge numbers used for constructing APHRODITE MA V1101R1 in Borneo Island is relatively small. Thus, we further need detail inspection on the variability of Borneo Island. On the other hand, in the end of dry seasons, August to September, the Island which has encountered the extreme drought seems shifted to West Papua. El Nino may have effect in decreasing the rainfall intensity. The increase of air temperature in Pacific Ocean causes the wind movement and air pressure in the ocean is changed. This change may affect to decrease in rainfall intensity.

4. Conclusion

The result of SPI in Indonesia describe that most part of Indonesia has encountered the severe and extreme drought for the period of 1991-2006. Though further inspection is required, based on SPI interpretation, Borneo Island and West Papua are the island which encountered the most extreme drought during the dry seasons.

Reference

Yatagai A. et al. (2012): APHRODITE: Constructing a Long-Term Daily Gridded Precipitation Dataset for Asia Based on a Dense Network of Rain Gauges, BAMS, pp.1401-1415