METEOROLOGICAL DROUGHT ASSESSMENT USING SATELLITE-BASED TRMM PRODUCT IN VIETNAMESE MEKONG DELTA

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ABSTRACT

Drought is a phenomenon related to water shortage that affects various aspects of life, economy and environment. The Vietnamese Mekong Delta (VMD) of Vietnam has recently experienced more frequent extreme weather events, notably drought. Nevertheless, few studies have focused on drought monitoring in this region. Furthermore, the lack of observation stations reduces the reliability of monitoring results. The Tropical Rainfall Measuring Mission (TRMM) with a long-term record and high resolution has a great potential for drought monitoring. Based on the assessment of TRMM products, the paper aims to evaluate meteorological droughts via estimating the standardized precipitation index (SPI) at various time scales (1–12 months) in LMB from 1998 to 2018. In this approach, TRMM performs well in the monthly precipitation estimation. Based on the analysis of the results, it is found that the driest time period was 2015–2016. Droughts tend to occur over the north part of LMB with higher frequency.

Key words: Drought, TRMM, SPI, remote sensing, Vietnam Mekong Delta

1. INTRODUCTION

Drought is a type of disaster with widespread consequences, that affects many economic sectors as well as environment of various countries. To prevent and mitigate drought, statistical modelling and prediction plays an important role. This is especially relevant in Vietnam, where drought disaster ranks third after typhoon and flooding, in terms of frequency.

The VMD is home to about 17 million people and yields over half the rice production of Vietnam. However, the area is prone to drought risk, with notable shortage of water in 2005, 2013, and 2016 [3]. To ensure food security of the region, drought prediction and warning must be improved. Using remote sensing technology is one efficient way besides traditional (in-situ) observing method.

2. DATA AND METHOD

TRMM is a satellite mission offering multiple bands, from which precipitation data can be retrieved. The resolution of TRMM samples is 0.25 degree geography. As such, they are denser and more regularly distributed compared to meteorological gauges in the region. The concept of SPI is basically the deviation of precipitation amount from its mean value, normalized by the standard deviation [4]. A more sophisticated procedure to estimate SPI was given by Jang [1].
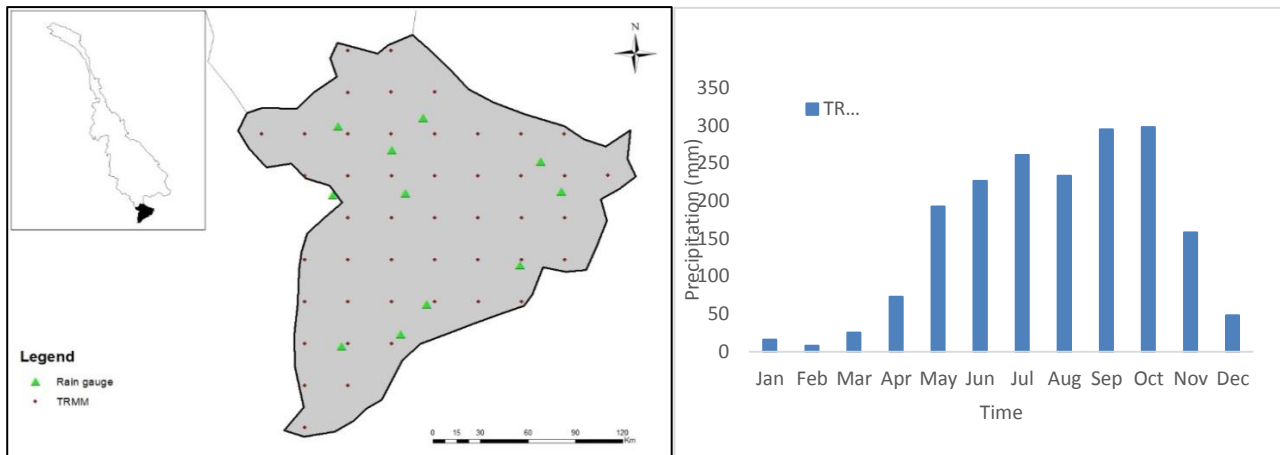
Figure 1. (Left) Distribution of TRMM sampling locations and rain gauges in VMD
(Right) Monthly precipitation data extracted from the TRMM product

3. RESULTS AND DISCUSSION

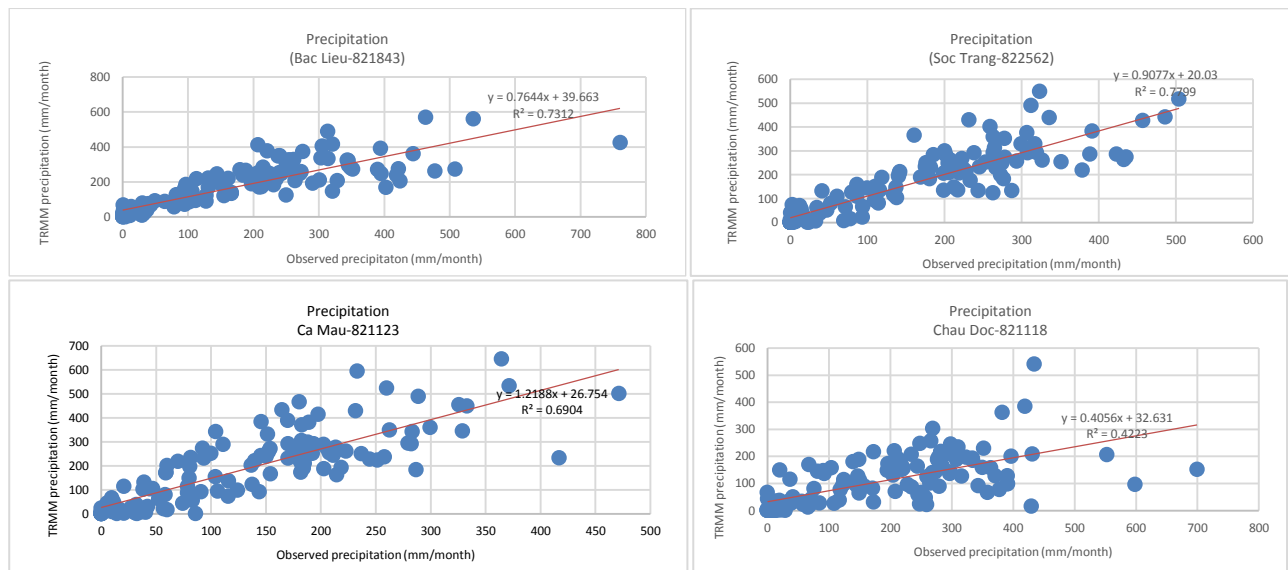### 3.1. Overall assessment

Figure 2: Correlation between observed and TRMM precipitation for locations in VMD

The TRMM data shows good agreement with observed data. Strong correlation is found in most stations, particularly for Bac Lieu and Soc Trang locations, with $R^2 > 0.7$.

3.2. SPI time variation

Average monthly SPI3 values of over 20 years (1998-2018) for entire the delta showed that drought occur almost every year with different level of severity, where the driest year is found in 2015-2015 and 2010-2011.

3.3. The drought in 2015 and 2016

From figure 3 it is seen that droughts occur during 2014–2016, with driest period during 2015–2016. In figure 4, the red colour denotes drought area (SPI < −1.5; severely/extremely dry), with most widespread during the months of this period. The northern part of VMD (Dong Thap and Tien Giang provinces) are experiences most severe drought.
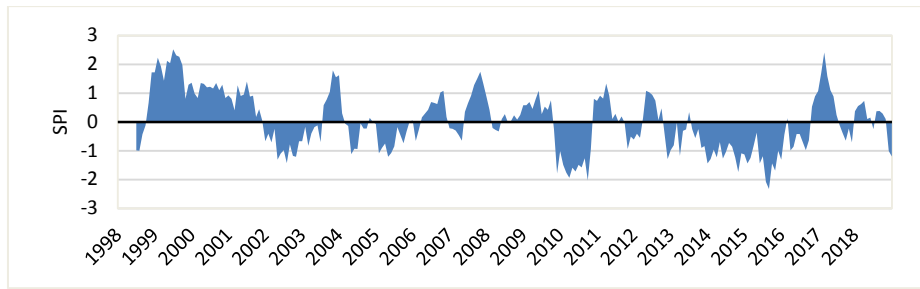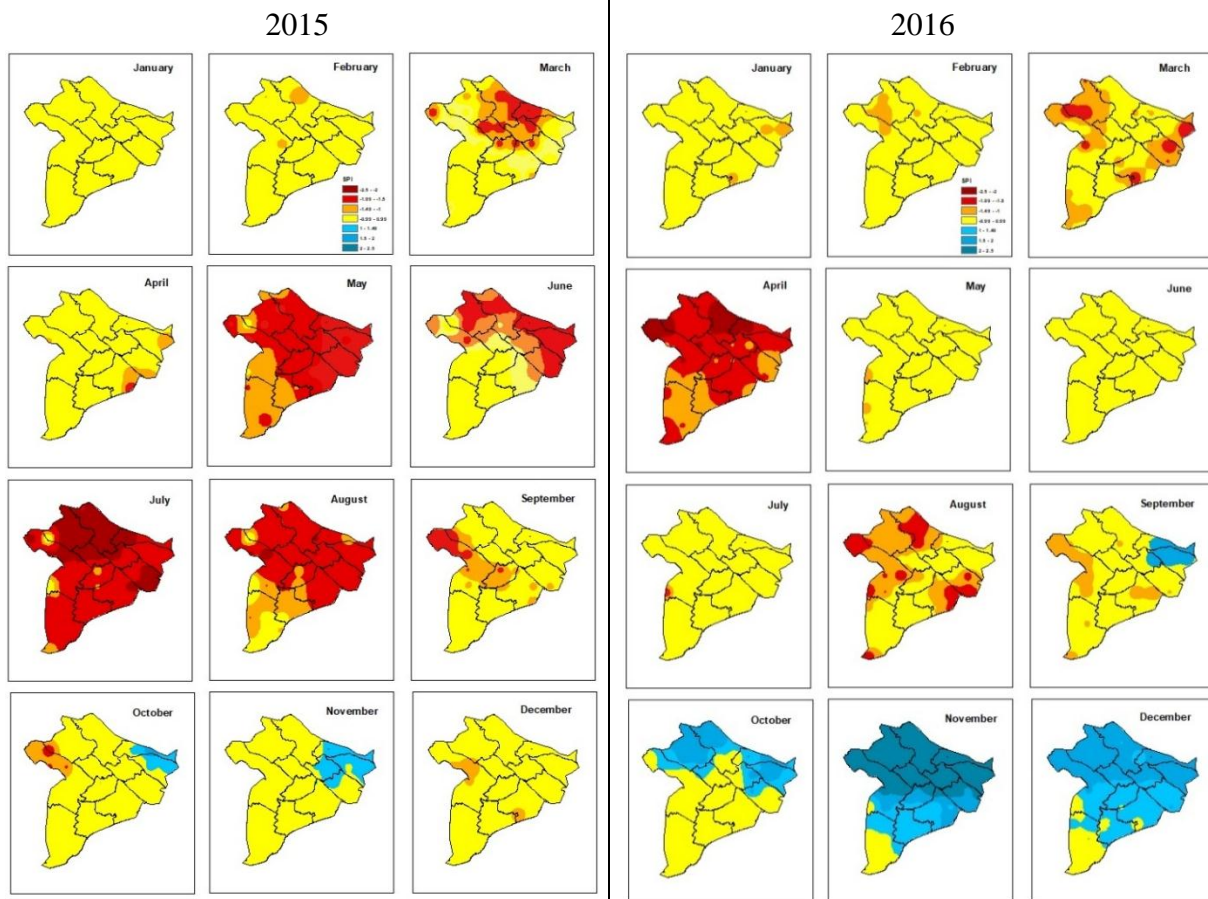
Figure 3: Monthly SPI3 values for the study period

2015   2016

Figure 4: Spatial distribution of monthly SPI3 index in VMD

4. CONCLUSION

We extracted monthly precipitation data from the TRMM products within VMD region, then showed strong correlations between TRMM-derived precipitation and the gauged rainfall in certain locations (Bac Lieu, Soc Trang) of VMD. The standardized precipitation index (SPI) was calculated, and we used this index to evaluate the drought severity through the classification method by McKee [3].

The time series of SPI was created for the time period 1998–2018, and periods of low SPI values (2015–2016) had been identified. By visualization of monthly SPI3 index for VMD, it can be seen that drought widespreads during dry season, from March to August. The northern part of VMD tend to experience most severe drought.

The use of TRMM product has a major advantage: it offers better spatial resolution and the sampling points are uniform in space (Figure 1). The data can be download from web servers, so the data availability is clearly better than the traditional data-upon-request of the national hydro-meteorological network. Therefore, it is recommended to annex appropriate TRMM products to the traditional dataset in drough research for regions of Vietnam.

Acknowledgment

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