Characterization of Monthly Precipitation over Indochina Region to Evaluate CMIP5 Historical Run

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1. Introduction

Indochina which includes Myanmar, Thailand, Laos, Cambodia, and Vietnam is influenced by Asian monsoon system: Indian monsoon, East Asian monsoon, and Western North Pacific monsoon subsystems (Wang et al., 2003) and other tropical weather systems (MRC, 2012). The south-west monsoon from mid-May to October, which is the dominant climatic feature, generates a distinctly biseasonal pattern of wet and dry periods of more or less equal length (MRC, 2010). Precipitation in Indochina Region (ICR) is highly and remotely connected with ENSO with negative (positive) anomaly during warm (cold) phase (Räsänen et al., 2016). This study aims at exploring the characteristics of precipitation of datasets focusing on ICR, and identifying important experimental design (e.g horizontal resolution, and parameterization) for General Circulation Models (GCMs) to capture well the precipitation structure over the region dominantly influenced by monsoon.

2. Data and Method

In this study, inter-comparison between gridded and station datasets is performed to select a proper gridded dataset to characterize precipitation over ICR. Four gridded datasets namely TRMM (1998-present), APHRODITE (1951-2007), GPCP (1996-present), and CMORPH (2003-present) are among candidates to be compared. The station data were obtained from GSOD of National Climate data center (NCDC), US, and station observation of Department of Meteorology of Ministry of Water Resource and Meteorology (MOWRAM), Cambodia. The characterization and exploration of climatic condition over ICR are based on the selected dataset. Moreover, 43 GCMs of CMIP5 will be evaluated based on the selected dataset over ICR. Empirical Orthogonal Function (EOF) is applied to characterize the precipitation over ICR and then that way of characterization will be employed to evaluate the 43 GCMs.

3. Results

3.1 Inter-comparison of Gridded Datasets

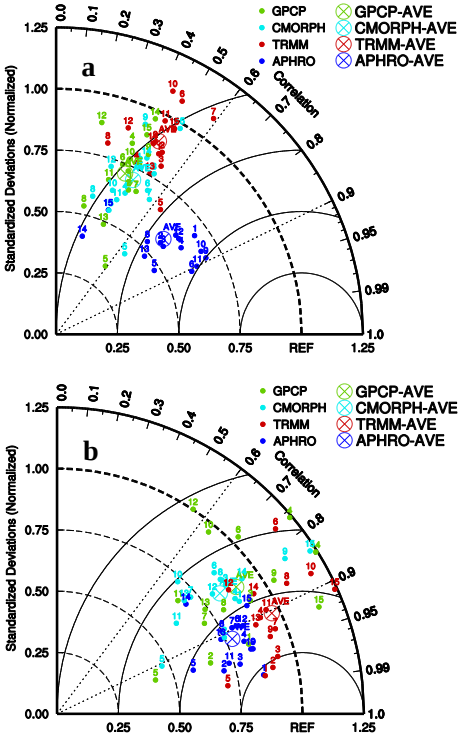

Figure 1. Taylor diagram of the 4 datasets with 15-station data over ICR as reference for period 2003-2007. a) daily basis comparison, and b) monthly basis comparison. Note: AVE means the average among 15 stations.

Fifteen stations data are used as references and the nearest grid to stations' location of the 4 datasets will be compared. Taylor diagrams in Figure 1 show the results of that comparison. Figure 1a is comparison based on daily data. APHRODITE data have a good correlation with station data with average around 0.75 comparing to the others only around 0.44. However,

the standard deviation of APHRODITE is a bit far from reference comparing to the others. For monthly basis, APHRODITE still have a good correlation with station (0.92), and interestingly, TRMM also has comparable correlation (0.905) as APHRODITE (Figure 1b). Therefore, APHRODITE is a proper dataset for climate study in ICR for its better representing surface observation and longer time range comparing to the others. Figure 2 shows the annual precipitation of APHRODITE over Asian monsoon region with small window over ICR.

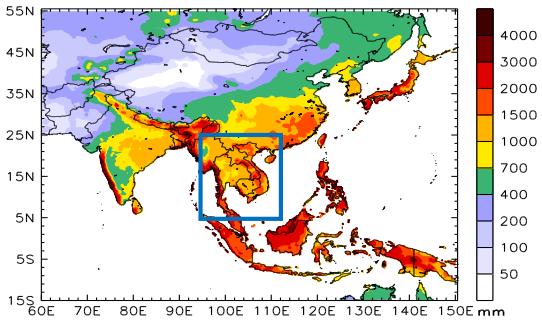

Figure 2. Annual precipitation over Asian monsoon region. Small window inside the domain is ICR.

3.2 Characterization of Precipitation over ICR

EOF analysis on monthly precipitation over ICR is performed and two leading modes from this analysis are taken into account after examination of domain choice sensitivity of EOF method. First leading mode explains around 69 % and second around 10% of total variance (Figure 3). EOF1 shows a monotonic pattern and EOF2 shows a see-saw pattern (Figure 3). Time variation Principle Component (PC) which is constructed from anomaly field of precipitation and Eigen vector (or EOF) shows seasonal variation of precipitation in this region (maximum in August) in PC1, and sub-seasonal variation (maximum in May and October) in PC2. Moreover, the attribution of those PCs is examined (not shown here). The results show that PC1 is strongly connected with monsoon with minor connection with ENSO and IOD events. In PC2, the connection with monsoon is weaker, but increase the connection with ENSO and IOD events comparing to PC1. Additionally, we do a composite analysis on of precipitation based on PC1 and PC2 signal, and then we continue to check the consistency of those signal with disaster events over the region (not shown here). We observe that those PCs signal have a good agreement with precipitation pattern and disaster occurrences in this region. Therefore, those two leading components of EOF analysis can represent the climatological information of

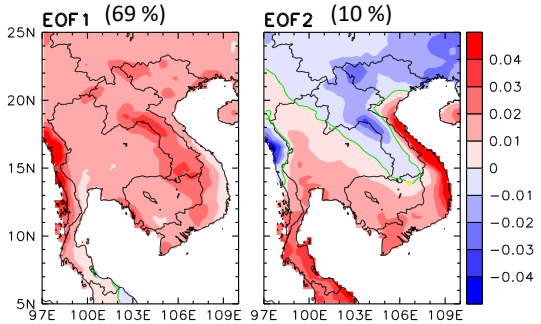

Figure 3. Two leading EOF pattern of monthly precipitation over ICR. Number in bracket is explained variance.

precipitation over ICR. Then, it is meaningful to evaluate GCMs based this method since it helps to reduce degree of freedom of actual precipitation dataset over the whole region.

4. Concluding Remarks

APHRODTE is a proper dataset for characterization of precipitation and evaluation of GCMs over ICR. EOF analysis suggests that precipitation in ICR is dominantly influenced by monsoon, and remotely connected with ENSO and IOD. The two modes from EOF analysis of monthly precipitation over ICR can represent climate information which is meaningful to evaluate GCMs using those modes.

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