Topic: Winter Monsoon Variability over the Indochina Peninsula and Its Association with Other Climate Modes

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ABSTRACT

This study emphasizes a low-level wintertime EOF analysis for complex numbers to reveal the variability of the winter monsoon over the Indochina Peninsula (IDP). The first EOF mode related to the prevailing northeasterly wind (NE monsoon) over the IDP, and presents the interannual variations of the first principal component (PC1), whereas the second presents the easterly wind in the southern part of the IDP. The correlation analyses show that there is a connection of NE monsoon with a branch of the East Asian winter monsoon (EAWM) over the South China Sea, but the second mode does not significantly correlated to the EAWM. On the other hand, investigation of correlation between PC1 representing NE monsoon variability to sea surface temperature (SST) was done. The correlation maps show good correlation over the Pacific Ocean and less correlation at the Indian Ocean. The strong (weak) phase of NE monsoon related to cooling (warming) of SST in the central-east equatorial Pacific Ocean and warming (cooling) in the west Pacific Ocean. The vertical circulation cells were investigated to reveal the different mechanisms in strong and weak phases of NE monsoon that agrees with the correlation to the SST. Therefore, NE monsoon over the Indochina peninsula is influenced by the forcing from the Pacific Ocean, and shows more possible linkage with the SST forcing from the Pacific Ocean than that of the Indian Ocean.

The correlation analyses show that there is an association between the El Niño-Southern Oscillation (ENSO) and the NE monsoon, represented by Niño 3.4 and PC1, respectively, whereas a significant correlation of PC1 with the dipole mode index representing the variability of the Indian Ocean Dipole (IOD) mode was not found. The concurrences of them show that strong NE monsoon tends to presents during La Niña event, whereas the weak NE monsoon tends to occur during El Niño event, and none of strong and weak NE monsoon presents during the neutral ENSO phase. In addition, this study newly introduced the simple index, v-index, to represent the NE monsoon variability. The v-index significantly correlated with PC1. Three indices (primary part of PC1,

secondary part of PC1, and v-index) were used for regression analyses to present spatial maps of the possible impacts of NE monsoon on precipitation and temperature over the IDP. These results give a basic understanding, but are useful for management in the IDP region to indicate what will happen during different phases of the NE monsoon and the ENSO during the winter season.

Keywords: Winter monsoon; Indochina peninsula; Empirical orthogonal function; Complex number; ENSO; IOD

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NOMENCLATURE

AL	Aleutian Low
AO	Arctic Oscillation
DMI	Dipole Mode Index
EAWM-L	The EAWM Index for Low-Latitude introduced by Liu (2012)
EAWM-M	The EAWM Index for Mid-Latitude introduced by Liu (2012)
EAWMI	The EAWM Index introduced by Chen (2000)
ENSO	El Niño-Southern Oscillation
EOF	Empirical Orthogonal Function
HadISST	The Hadley Centre Sea Ice and Sea Surface Temperature Data
IDP	Indochina Peninsula
IOD	Indian Ocean Dipole
ITCZ	Intertropical Convergence Zone
JMA	The Japan Meteorological Agency
JRA-25	The Japanese 25-Year Reanalysis Data
MI1	Monsoon Index introduced by Xu (2001)
MI2	Monsoon Index introduced by Wu (2002)
NCAR	The National Center for Atmospheric Research
NCEP	The National Centers for Environmental Prediction
NE	Northeast
PC	Principal Component
SCS	South China Sea
SH	Siberian High
SIO	Southern Indian Ocean
SOI	Southern Oscillation Index
SST	Sea Surface Temperature
SSTA	Sea Surface Temperature Anomaly
U300	The EAWM Index defined for Upper Level introduced by Jhun (2004)
UMI	A Unified Monsoon Index introduced by Lu (1999)
VI	The EAWM Index introduced by Ji (1997)