Intraseasonal oscillation of Meiyu rainy season over East Asia

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Introduction

As the special rainy season during East Asia summer monsoon intraseasonal movement, Meiyu over East Asia (including Meiyu in China, Baiu in Japan and Changma in Korea) is in close association with intraseasonal oscillation (ISO). By using the latest data analysis method EEMD and NCEP/NCAR daily reanalysis, pentad CMAP data etc., ISO characteristics of rainfall and its relating circulation variation during rainy season of East Asia Meiyu region are investigated in this paper.

Data and Methods

(1) Determining East Asia Meiyu region: By use of EOF analysis to rainfall (CMAP) over East Asia, East Asia Meiyu region is shown in Fig. 1. (2) Diagnosing East Asia Meiyu : We combine the normalized rainfall index with monsoon wind influence (meridional wind along 110° -140° E≥2m/s) to determine Meiyu period over East Asia. Fig.2 shows Meiyu rainfall belt over East Asia determined by the above Meiyu criteria. (3)Identifying LFO signal of rainfall over East Asia Meiyu region: a noise assisted time frequency analysis method EEMD proposed by Wu et al.

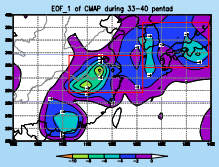

Fig.1 EOF1 mode of rainfall over East Asia during June-July (red rectangles denoting Meiyu region including Meiyu region over both Yangtze-huaihe Basin and Japan-Korea)

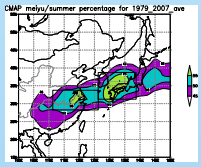

Fig.2 Composite percentage of Meiyu rainfall amount accounting for summer rainfall amount during 1979-2007

Results and Discussion

(1) Climatically, variation of rainfall over East Asia Meiyu region exhibits distinct three-peak mode distribution (Fig.3a), i.e. 27th pentad, 35-37th pentad and 47th pentad respectively. The three-peak distribution of rainfall amount variation is mainly influenced by 30-60 day and 10-20 day low frequency oscillation (Fig.3b-c). Thereinto, 30-60dy LFO accounts for three-peak mode much more than 10-20 day LFO.

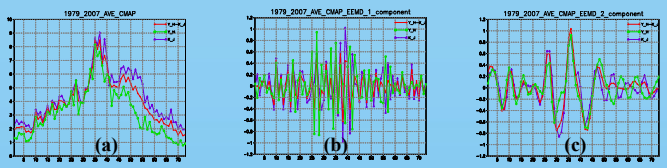

Fig.3 Pentad by pentad variation of rainfall over East Asia Meiyu region (a) and its 1st/2nd (b/c) IMF of EEMD (red, green and purple lines denoting rainfall over East Asia Meiyu region, Yangtze-huaihe Basin and Korea-Japan)

(2) The occurrence of peak phases of rainfall over Meiyu region in East Asia is in close association with tropical MJO and mid-high latitude ISO. Over the mid-low latitudes, northward propagation of abnormal heat source at low level forms the meridional distribution of cyclone-anticyclone-cyclone-anticyclone from the west Pacific to Northeast China (Fig.4). Over the mid-high latitudes, LFO of cold air from Caspian Sea as well as Sea of Okhots respectively eastward and southwestward propagate to the north part of Meiyu region (Fig.5). Thus, north wind from the mid-high latitudes converges with south wind from the mid-low latitudes over the Meiyu region, which provides favorable conditions for the peak phase rainfall (the sketch map is shown as Fig.6). Meanwhile, the atmospheric LFO on middle as well as high level also exert influences on the formation of peak phase. For the trough phase of rainfall over Meiyu region, contrary is the case.

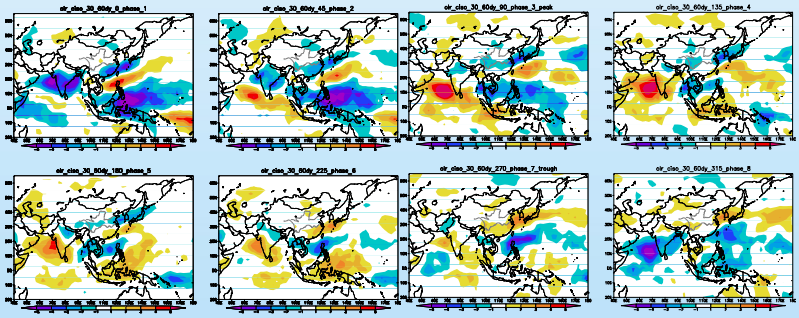

Fig.4 CISO of OLR during 1-8 phase of 30-60dy LFO for East Asia meiu (3/7 pahse denoting peak/trough pahse of LFO of East Asia Meiyu)

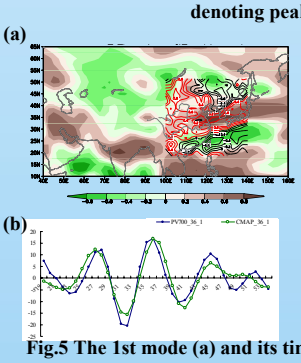

Fig.5 The 1st mode (a) and its time coefficients of SVD between LFO of potential vorticity at 700 hPa (PV700) and rainfall over East Asia (a: shading area denoting PV700, red/black contours denoting positive/negative rainfall LFO; b: blue/green denoting PV700/rainfall)

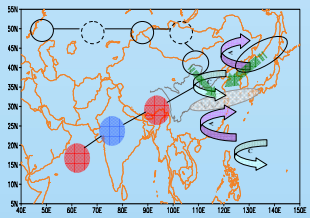

Fig.6 Sketch map of influencing systems for peak phase of CISO of Meiyu rainfall over East Asia (gray shading area denoting Meiyu region; red/blue shading area denoting suppressed/active convection; solid/dashed eclipse denoting positive/negative potential vorticity; green arrows denoting positive potential vorticity influence; purple/blue arrows denoting low level anticyclonic/cyclonic circulation)

(3) There exists remarkable difference between ISO of the climatic rainfall variation over East Asia Meiyu region and that of abnormal Meiyu year. As shown in Fig.7, amplitude as well as period of 30-60 day LFO during abundant Meiyu rainfall year is larger than those during scarce year. Different from climatic LFO feature, 10-30 day LFO do much more contribution to abnormal rainfall activity and its relative circulation during late or scarce Meiyu year, while the 30-60 day LFO is unconspicuous during those years.

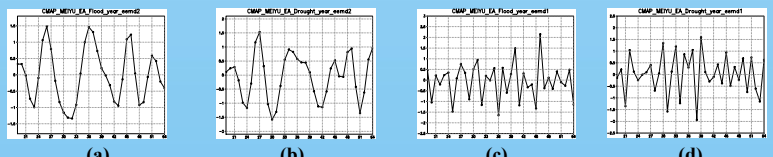

Fig.7 30-60dy and 10-20dy LFO of rainfall over East Asia Meiyu region during flood and drought years East Asia (a/b: 30-60dy LFO during flood/drought years; c/d: 10-20dy LFO during flood/drought years)

Acknowledgement

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