Intraseasonal and diurnal variations in the Indian sector

***Kiyotoshi Takahashi**
(Meteorological Research Institute/Japan Meteorological Agency)
Climate Research Department,MRI,Nagamine 1-1,Tsukuba,Ibaraki,305-0052,Japan
E-mail: ktakahas@mri-jma.go.jp

Abstract

Relationship between intraseasonal and diurnal variabilities in the Indian sector is investigated using daily rainfall data and cloudiness observed by geosynchronous satellites. Relative diurnal activity defined as the ratio of variance of diurnal activity to the total one tends to be enhanced just before the onset of monsoon and in inactive phases of intraseasonal variation.

Keywords: Intraseasonal, diurnal, cloudiness

1.Introduction

Intraseasonal variation (ISV) and diurnal one of convective activity are known as most dominant variabilities in the tropical monsoon regions. Many studies have been done about both variabilities.

However, their relationship and a role of diurnal variation in the monsoon processes are not yet understood fully. It isn't still clear what a role diurnal activity plays in the monsoon processes. On that point, revealing the relationship of these both modes is considered to be important in understanding the variability in the tropical monsoon.

The Indian sector is the region where the ISV is observed most prominently. Taking this into consideration, we selected this region for investigating the relationship between ISV and diurnal variation.

The purpose of this research is to depict observational aspects of their relationship and examine a role of diurnal variations in monsoon processes.

2. Data and method

In this study, to investigate the relationship between ISV and diurnal activities of convection, we used following data.

To examine convective activity, we used cloudiness data obtained from geostationary satellite IR observation by GMS and Meteosat-5.

Especially, availability of Meteosat-5 data is one of major reasons to conduct this study. Metosat-5 was relocated on 63E to support the INDOEX project in June 1998. Since then, it has been providing useful data which can cover the whole Indian sector.

Cloudiness data are compiled 3 hourly into one degree gridded data with several thresholds, 270K, 255K, 240K, 225K, 210K, together with mean TBB (equivalent black body temperature) for both GMS and Meteosat-5. Here each cloudiness data with each threshold value as mentioned above is denoted as C270, C255, C240, C225 and C210 respectively. An advantage of these data are produced based on original pixcel data to reduce affection by the ground surface information.

Rainfall data observed at surface stations are used to identify active phases of ISV, and some sorts of reanalysis data (ERA40,GAME-reanalysis, JRA-25, etc) are used for the large scale features of related atmospheric conditions and circulation field.

Analyses were done based on pentad data. Phase of ISV is monitored by pentad-accumulated precipitation observed at surface stations. And relative activity of diurnal variation is evaluated as the ratio of variance of diurnal activity to the total variance of 3-hourly cloudiness derived from the IR observation by satellites in each pentad.

3. Result

Figure 1 shows a time-latitude section for 71-75E for 30-60day band-passed anomaly of C255.

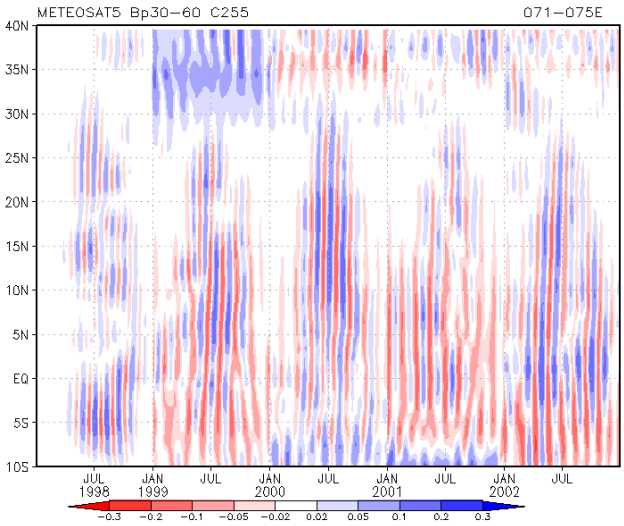

Fig. 1: Time-latitude section of 30-60 day band-passed anomaly of C255 for 71-75E. Blue (Red) indicates more (less) cloudiness.

In this Fig.1, you can see that ISV activity is enhanced in every summer season. Particularly, ISV is stronger in summer of 2000 than in other years.

Next we examined the sequence of relative diurnal activity in association with ISV indicated in pentad accumulated rainfall.

Fig.2 shows the time-series of these quantities at Poona (located at 18.5N,73.8E).

There are four major active phases of ISV in 2000 summer season. The first one corresponds to monsoon

onset around June of the year. As can be seen clearly in this figure, relative activity of diurnal variability tends to be enhanced just before the onset and in each inactive phases of ISV.

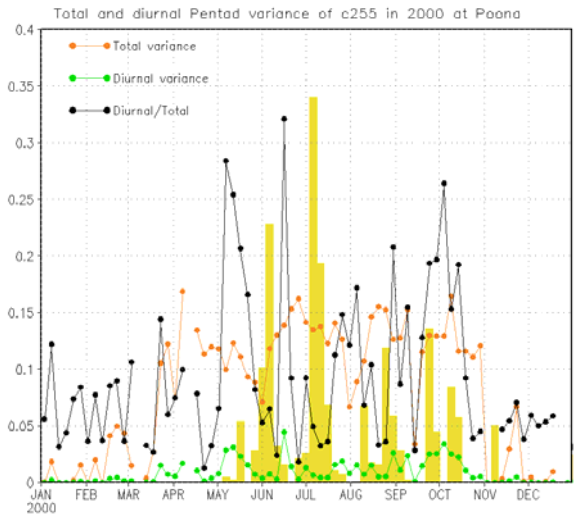

Fig. 2: Time-series of pentad accumulated rainfall (yellow bar), total variance of C255 (TVC255: orange), diurnal variance (DVC255: green) and relative diurnal activity defined as a ratio (=DVC255/TVC255: black) within each pentad period at Poona. This is a case for 2000.

The phase of ISV identified with pentad accumulated rainfall can be confirmed with cloudiness data, too. Fig.3 shows the situation of C255 anomalies corresponding to the peak phase of relative diurnal activity before the monsoon onset of monsoon in 2000. On the other hand, fig.4 corresponds to the peak phase of ISV in the end of May 2000. Anomaly is defined as deviation from a simple average of 5 years (1998-2002).

These figures confirm validness of identification of ISV phase by rainfall from the view point of cloudiness change.

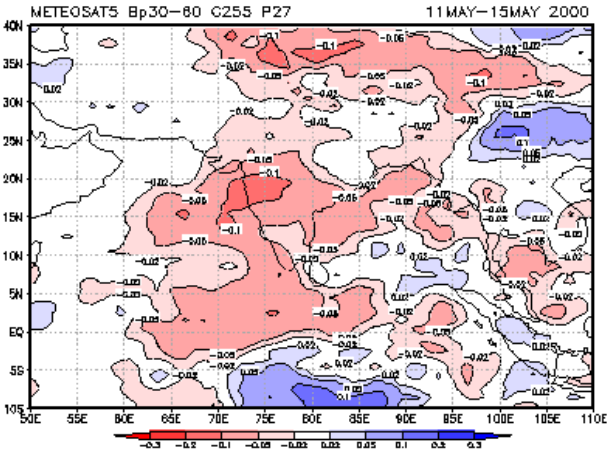

Fig. 3: Horizontal distribution of 30-60 day band-passed anomaly of C255 at the pentad (11May-15May,2000). Positive anomalous region of C255 is showed with bluish coloring and negative is with reddish coloring.

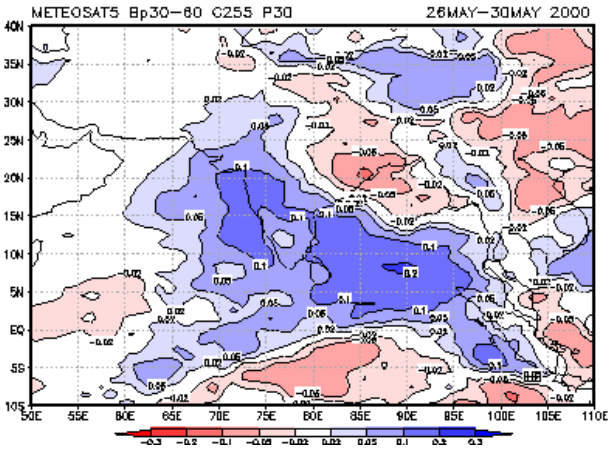

Fig. 4: Horizontal distribution of 30-60 day band-passed anomaly of C255 at the pentad (26May-30May,2000).

4. Summary

We investigated the relationship of ISV and diurnal variation using satellite data, station data and so on. Results of this research are summarized as follows.

1) Diurnal convective activity tends to be relatively enhanced in monsoon season.
2) Diurnal activity tends to be enhanced in inactive phases or just before and after rainy pentads.
3) At one month before the onset of monsoon, enhancement of diurnal activity was already started.