Study on Characteristic of Asian Summer Monsoon by Satellite data and Re-analysis data

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Abstract

The characteristic of East Asian summer monsoon is investigated using 8-year (March 1987-February 1995) - averaged monthly and 5-day mean 1 degree latitude-longitude gridded GMS high-cloud-amount data (HCA). An analysis of these data shows the convective zone (ITCZ) clouds which defined as the percentage of the total grid area covered by clouds with a cloud-top temperature below the 400 hPa-level climatological temperature. The HCA increased clearly over equatorial zone during December and January and 30 - 40 °N during May and June. These HCA patterns are coincided with seasonal cycles of summer monsoon which is introduced in historical references.

The relationship with the summer monsoon winds as climatorogical changing of wind direction is analyzed by ECMWF re-analysis 2.5-degree latitude-longitude grid surface data which is calculated with 8-year averaged from January 1987 to January 1995. In addition, the monsoon winds are showed by separated U, V-wind components for manifestation a tendency of onset and retreat data of seasonal monsoon.

1. Introduction

The tropical 40-50-day oscillation which also known as 30-60-day oscillation first discovered by Madden and Julian(1971) using spectral analysis of ten years data at Canton Island. They (1972) found also this oscillation was of a global scale but was confined to the tropics.

Maruyama (1981) detected a large-scale upper tropospheric zonal wind oscillation with a period of 30-50-day by cloud movement vectors which was observed by GMS.

The summer monsoon in East Asia, Southeast Asia and the Western Pacific regions were analyzed by Tanaka (1991). He found that the summer monsoon cloud band sudden northward advances during June and July and these changes are associated with the phase-locking between the intraseasonal oscillation and the seasonal cycle of the monsoon clouds. Further study(1994) showed that convective clouds are enhanced over the land areas over northern Australia,where a tendency for early onset and late retreat of the summer monsoon clouds by comparison of the simultaneous observation of 850hPa and 200hPa winds with High Cloud Amount(HCA).

In the present study, we analyzed the relationship between the distribution of the summer monsoon clouds and the 10-m height wind direction similarly to the historical references.

2. Data Sets and Method

The data(Table 1) used in this study are the climatological 8-year (March 1987-February 1995)-averaged monthly and 5-day mean 1 degree latitude-longitude gridded GMS high-cloud-amount (HCA) which defined as the percentage of the total grid area, covered by clouds with a cloud-top temperature below the 400 hPa-level climatological temperature. And we analyzed the wind data by European Center for Medium range Weather Forecast (ECMWF) re-analysis 2.5-degree latitude-longitude grided surface data which is calculated with 8-year averaged from January 1987 to January 1995. The empirical orthogonal function(EOF) analysis is applied to the HCA time series in order to show characteristics of temporal and spatial structure.

3. Results and Discussion

a. High Cloud Amount

In the East Asia area, we showed the distribution of monthly averaged HCA from 1987 to 1994 (Figure 1) which are specially concentrated in the inter-tropical convergence zone. It represents that in July (summer) HCA extend over northern around 25°N. We can guess that this extension is related with the summer monsoon. And we applied the EOF analysis method to the HCA time series. The first five principal components resulted from EOF analysis explain the most of variability more than 78% of the total variances for 8-years in the upper area(Figure 2). Also Figure 3 shows the spatial structures of the first and second principal components which is revealed from EOF statistical method.

b. Wind

Usually, many researches have been done on the phenomena in the monsoonal winds using upper air data set, for example the 850 hPa or 200 hPa level. In this section, we used the surface wind field with 10 m height re-analyzed by ECMWF in order to detect the relationship with the summer monsoon. The climatorlogical changing distribution of wind speeds and directions are calculated with 8-year monthly averaged from January 1987 to January 1995 over global area(omitted in this paper). In addition, the monsoon winds are separated U, V-components for manifestation a tendency of onset and retreat data of seasonal monsoon. The figure 4 are the latitude-time section at 125°E-fixed with five day mean high cloud amount in 1987 and 1988 from June to December and over north hemisphere. Specially, it represents that the u-wind speed from 31-pentad(June) to 43-pentad (August) in 1987 propagated to northward over tropical area. We guess this propagation will be related with the ElNino phenomena.

4. Conclusion

In this study, we know that High Cloud Amount and Wind Data indicated the relationship with summer monsoon in the East Asia. And also we can guess the relationship between propagation of wind data toward northern and ElNino phenomena. Finally, it is necessary that more effective statistical method must be applied for evidence of mechanism of East Asia monsoon. And we appreciate data providing of Tokyo Univ. CCSR European Center for Medium range Weather Forecast.

Table 1. Comparison of GMS-High Cloud Amount data with Wind Data sets from ECMWF

	High Cloud Amount	Wind (ECMWF)
Year	March 1987 - February 1995	January 1987 - January 1995
Resolution	1° x 1°	2.5° x 2.5°
Area	80.5°E - 160.5°W / 59°N - 59°S	Whole globe

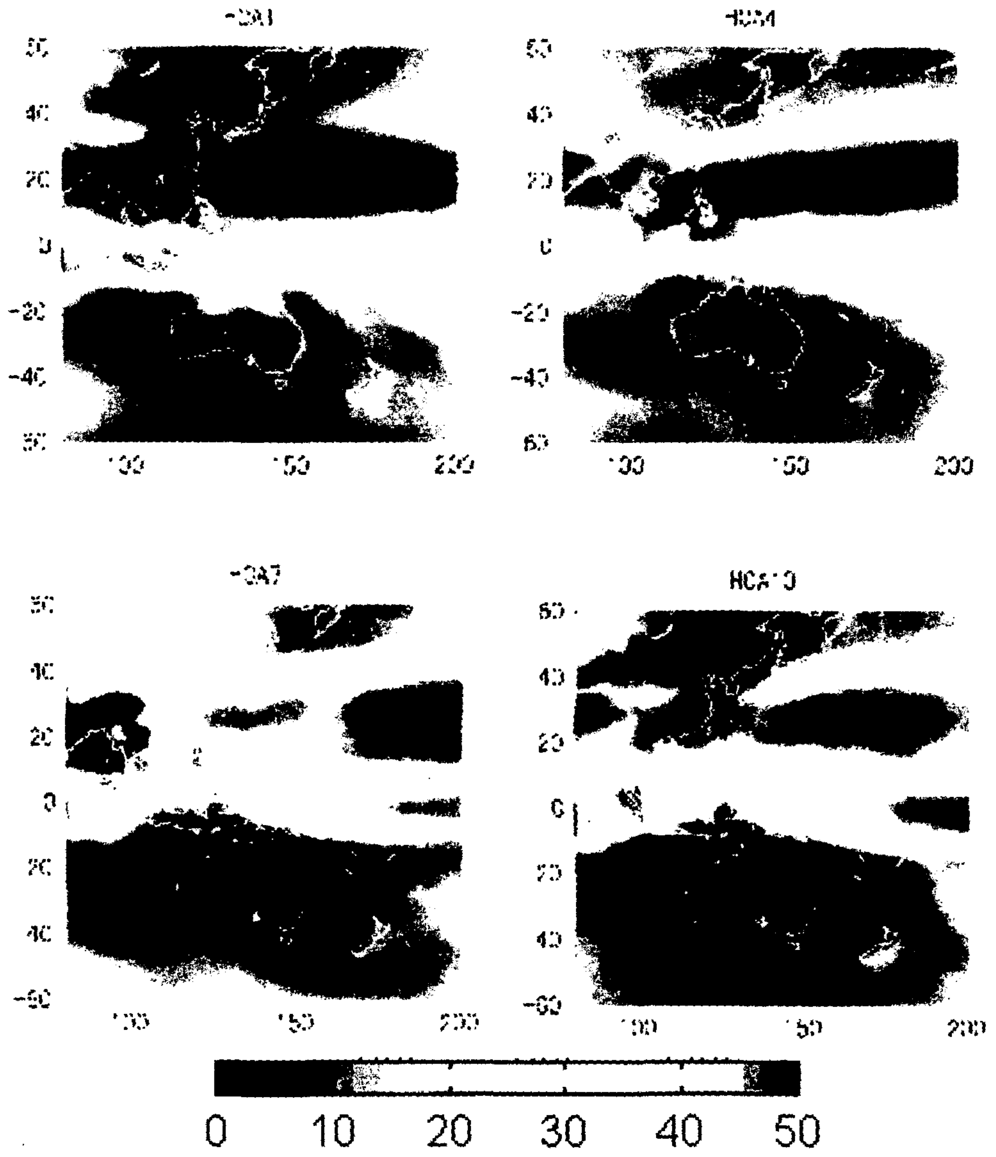

Figure1. HCA' distribution at January, April, July and October during 8-years averaged

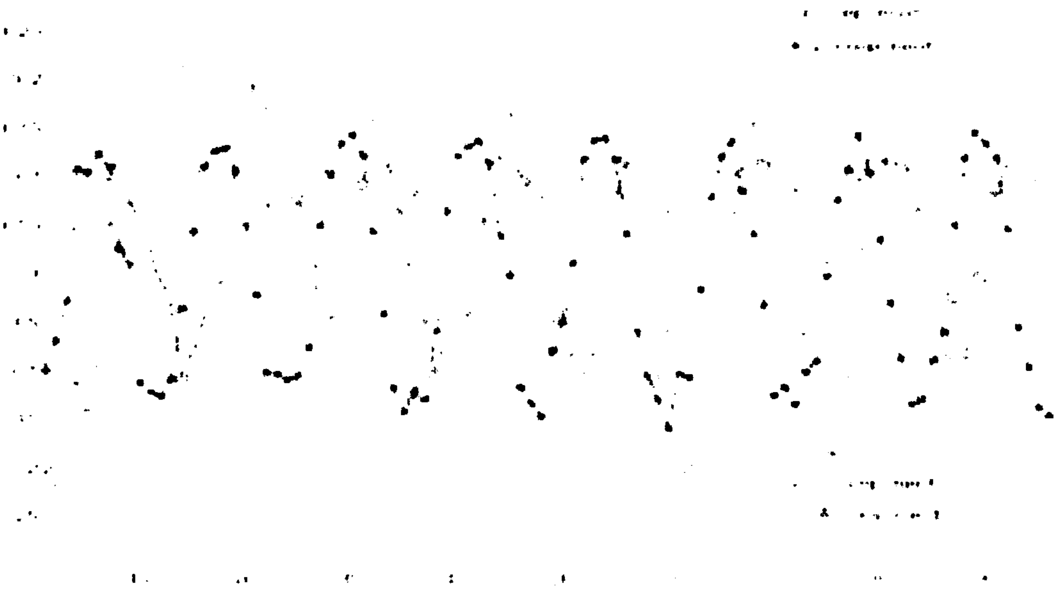

Figure 2. First four principal components resulted from EOF analysis of HCA

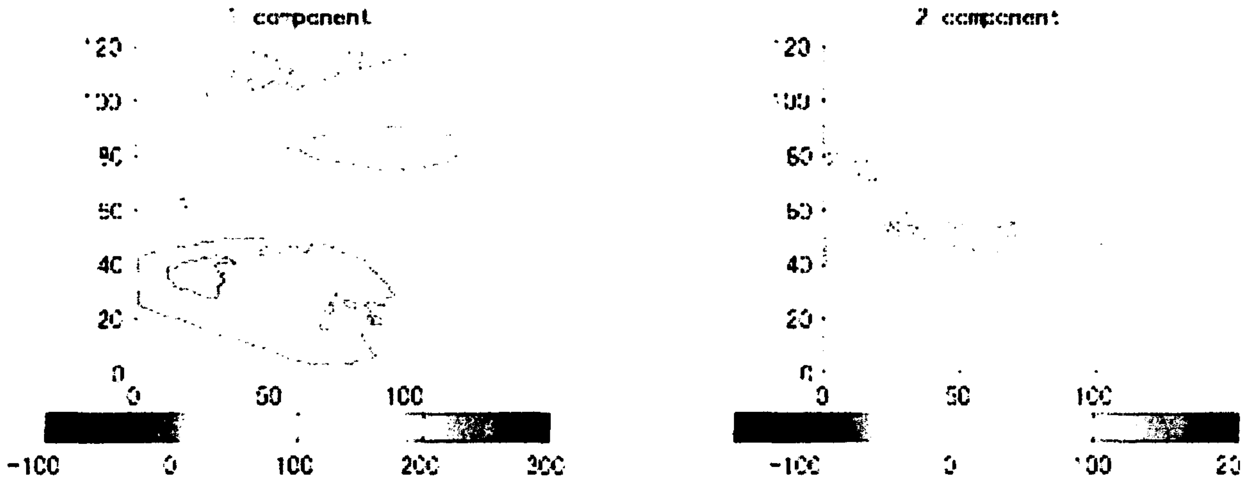

Figure 3. Spatial structure of HCA derived from EOF analysis

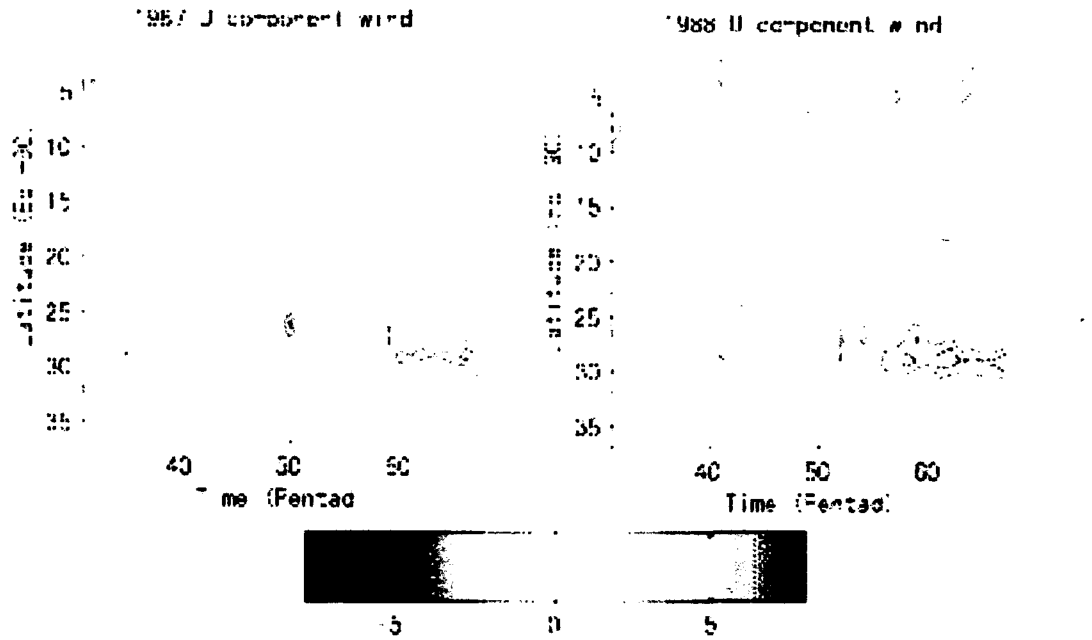

Figure 4. U-component wind speed in 1987 and 1988

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