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Characteristics of SST over the Arabian Sea and Bay of Bengal

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Abstract

Evolution of mini warm pool in the Arabian Sea just before the onset of southwest monsoon and behavior of SST in the vicinity of weather systems formed during the premonsoon, southwest monsoon and post monsoon seasons were studied using TMI SST data. The Arabian Sea mini warm pool is formed about three weeks ahead of onset of southwest monsoon. Maximum SST is found about one week ahead of monsoon onset and then the warm pool gradually dissipated. Generally, a low-pressure system is formed when the SST exceeds a certain threshold value for the formation of the system. Daily SST values are examined both in Arabian sea and Bay of Bengal to bring out the quantity of increase in SST just before the formation of the system, quantity of rapid decrease in SST during the formation of the system and the number of days required for returning to normal SST. Many cases were examined for pre-monsoon, southwest monsoon and post monsoon seasons to understand the behavior of SST pattern. It is found that the SST increases about 3° C just before the formation of the system and decreases about 4° C during the formation within 2 to 3 days and takes about 4 to 6 days to return to normal SST pattern. However, the SST pattern depends on the weather system.

Keywords: TMI SST, Arabian Sea warm pool, Low-pressure systems

Introduction

The sea surface Temperature (SST) in the Arabian Sea and Bay of Bengal arecharacterized by a bimodal distribution with heating during the pre monsoon and post monsoon seasons and cooling during the southwest monsoon and winter seasons. An important feature of the Arabian sea SST is the development of a mini warm pool prior to the onset of southwest monsoon season. It is defined as a pool of water with temperature in excess of 30.8oC that occurs in the southeastern Arabian Sea prior to the onset of summer monsoon [1]. The building up of this mini warm pool is attributed to the influence of both heat flux and entrainment [2]. The warm pool in the Arabian Sea is defined

here as a region of warm water (>30°C) that exists in the eastern Arabian Sea [3]. The present study deals with the analysis of SST features during the evolution of Arabian Sea warm pool and to bring out the characteristics of SST during formation of low-pressure systems in the Arabian Sea and Bay of Bengal. The thermal responses of Arabian Sea and Bay of Bengal to the passage of cyclonic storms were reported in some of the earlier studies (e.g. [4] - [6]). A cooling of SST of nearly 6°C was reported following the passage of a super cyclone over the Bay of Bengal [7].

Data and methodology

This study utilizes the high resolution (0.25° x 0.25°) TMI (TRMM Microwave Imager) sea surface temperature (SST) obtained from TRMM (Tropical Rainfall Measuring Mission) satellite for the Arabian Sea and Bay of Bengal. The characteristics during the evolution of the Arabian Sea mini warm pool were studied for the last five years, 2002 to 2006. The features during 2006 is presented as daily SST from 1st May to 31st May 2006. The features of mini warm pool were studied with respect to the onset and progress of monsoon. Also to quantify the drop in SST in association with the development and passage of low-pressure systems, several systems both in the Arabian Sea and Bay of Bengal occurred in different seasons are studied and the results are summarized.

Results and discussions

The evolution of the Arabian Sea mini warm pool during 2006 is shown in Fig. 1. It is observed that the maximum intensity of the warm pool was noticed on 17th May 2006 with a core temperature greater than 32.0°C. The onset of southwest monsoon over Kerala during 2006 was on 26th May. It is seen that the dissipation of the warm pool started nearly 8 days ahead of the monsoon onset over Kerala. The core of the warm pool at its fully developed stage is observed between latitudes 10°N - 12°N and longitudes 60°E -64°E. The temporal evolution of SST at a location near the core of the warm pool is shown in Fig. 2. The maximum temperature of 31.8°C at this location was observed on 17th May and the temperature decreased thereafter. A sharp decrease in SST was observed on 26th May due to the onset of southwest monsoon. The temporal evolution of SST (°C) at the location of the warm pool during April, May and June 2006 is shown in Fig. 3. This shows an increase in SST during the pre-monsoon season in the vicinity of the warm pool. After the onset of the southwest monsoon the temperature in the region decreased considerably. This is evidenced from the figure, as the SST during June was much lower than that during May.

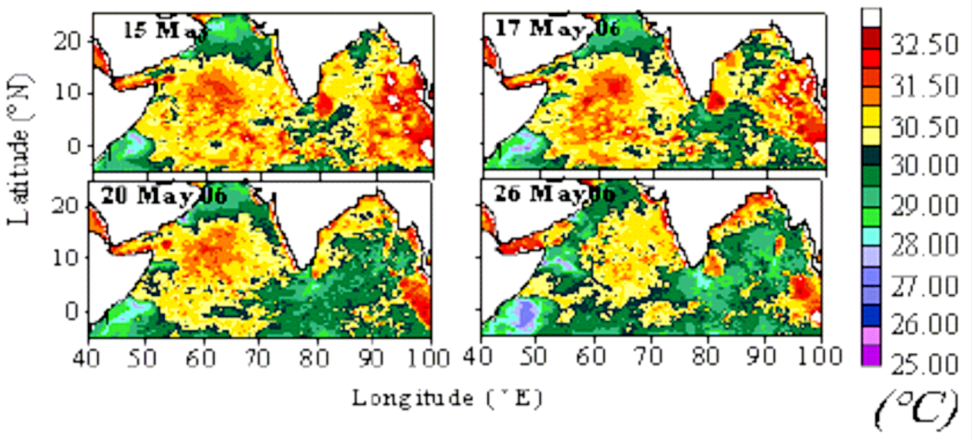

Figure 1: The evolution of warm pool during 2006

The characteristics of changes in the SST associated with the development and dissipation of low-pressure systems during different seasons in 2006 were studied. The features during the pre-monsoon, southwest monsoon and post monsoon seasons were discussed based on one case in each season in the following sections.

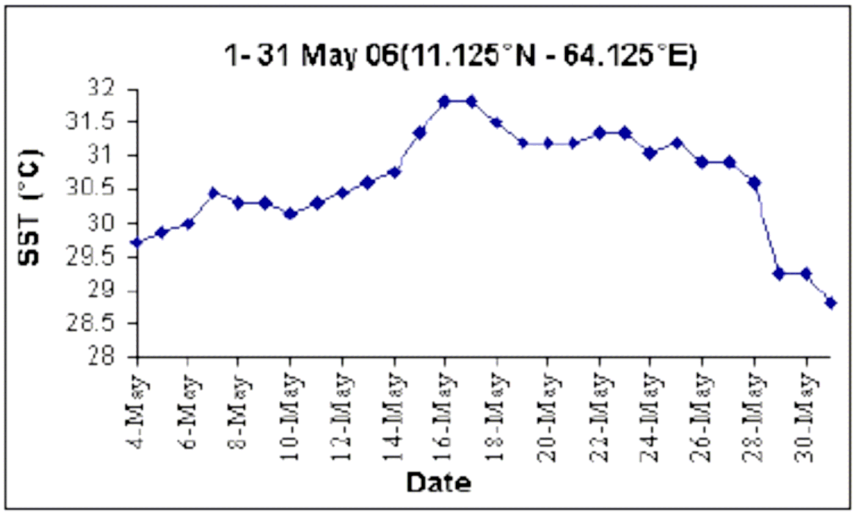

Figure 2: Time evolution of SST (^{O}C) during May 2006 at the location of maximum development of warm pool.

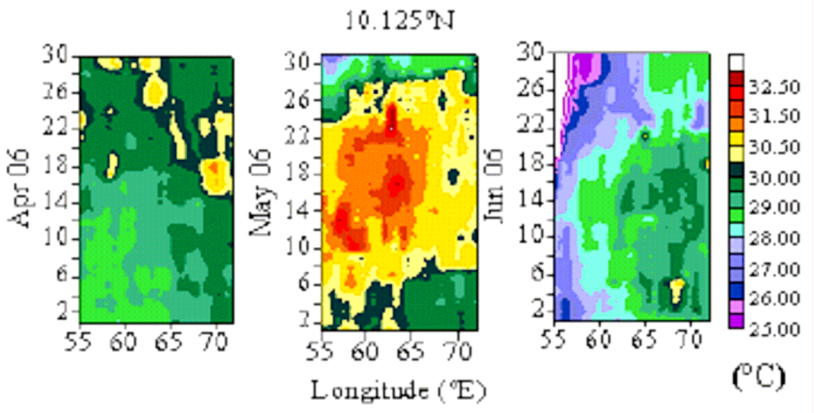

Figure 3: The temporal evolution of SST (OC) at the location of the warm pool during Apri, May and June 2006

Case 1

A low-pressure area was formed over southeast Bay of Bengal on 24th April 2006. It was intensified into a depression on 25th morning with its centre near the Lat. 8.5°N & Long 91.0°E. It rapidly intensified into a deep depression at 1430 hours IST and further into a cyclonic storm at 1730 hours IST of the same day, with its centre near Lat.10.0°N & Long. 89.5°E. It moved further slowly northwestwards and lay centred near Lat.10.5°N & Long.89.0°E at 0830 hours IST of 26th. It then moved in a north-northeastward direction and lay centred near Lat.11.5°N &Long.90.0°E at 1730 hours IST of 26th.

The temporal variation of SST during the development of a low-pressure system in April 2006 (pre-monsoon season) is shown in Fig. 4 and 5. From 18th April (30.75°C) onwards i.e., nearly 6 days ahead of development of the low-pressure system, the SST in the region started to increase and reached a maximum value on 21st April (32.1°C). It then decreased gradually till 23rd April (31.0°C). The SST pattern from 21st to 26th April indicates the formation of small-scale short-lived convective systems when the cyclonic shear is favorable over the region. After the development of the low-pressure system, the temperature decreased rapidly up to 28.2°C on 29th April. The SST regained its original value (30.2°C) on 8th May, 8 days after the development of the low-pressure system. A decrease of nearly 4°C occurred due to the formation of the low-pressure system.

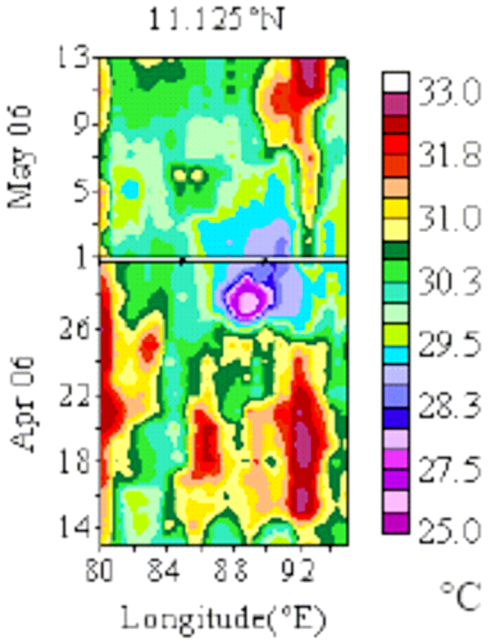

Figure 4: Time march of SST pattern during the passage of a deep depression over Bay of Bengal (24^{th} – 29^{th} April 2006)

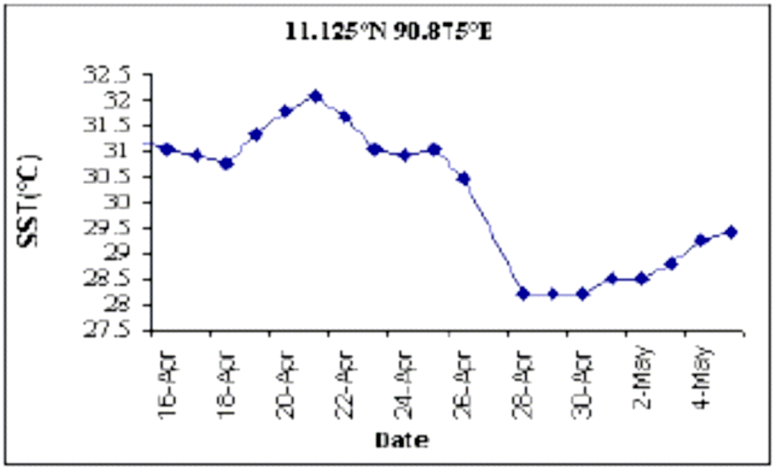

Figure 5: The temporal evolution of SST (^{O}C) from 16^{th} Apricl 2006 to 4^{th} May 2006 during the passage of a deep depresion over Bay of Bengal (24^{th} – 29^{th} April 2006)

Case 2

Another low-pressure area was formed over southwest Bay of Bengal on 28th October 2006 morning (post monsoon season). It intensified into a depression and lay centred near Lat 14.5°N and Long 80.5°E of 29th. It further intensified into a deep depression and lay centred on the same day near Lat 15.0°N and Long 80.5°E. Remaining practically stationary, it intensified into a Cyclonic storm "OGNI" at 1730 hours IST of the same day. It lay centred on 30th near Lat 15.6°N and Long 80.3°E. It moved slowly northward and weakened into a deep depression. It crossed land and weakened into a depression on 30th. It weakened further by 31st October.

It is observed that the temperature gradually increased (Fig. 6) from 26th October (28.7 °C) to 28th Oct (29.6 °C). After the development of the low-pressure system, the temperature started decreasing rapidly from 28th up to 30th October (with a minimum SST value of 28.2°C). The SST regained its original value on 3rd November, four days after the passage of the system. The decrease in the SST value was lower than that in pre-monsoon case.

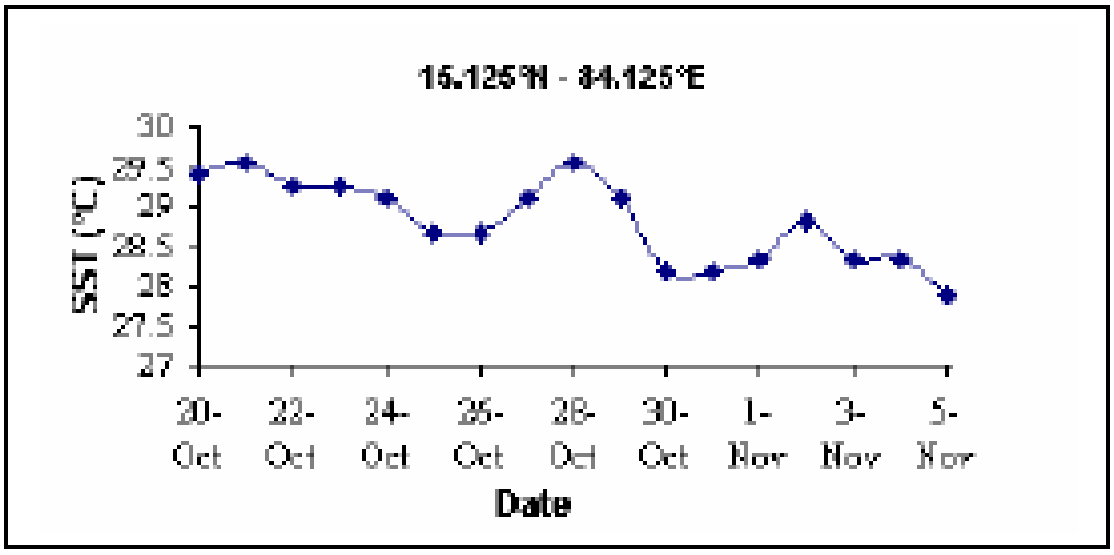

Figure 6: The evolution of SST (^{O}C) from 24th October 2006 to 1st November 2006 during the passage of a cyclonic stoem over Bay of Bengal (28th – 31st October 2006)

Case 3

A low-pressure area was formed over east central Arabian Sea near lat 19.5º N and long 66.0º E on September 21, 2006 (Southwest monsoon). It intensified into a depression and later into a cyclonic storm "Mukda" on September 22. It moved towards west northwesterly direction and intensified into a severe cyclonic storm. It weakened into a depression on September 24th and by September 28th it dissipated over the Arabian Sea without making any landfall.

Fig. 7 represents transects of SST along different latitudes in the vicinity of cyclone 'Mukda'. Before the development of 'Mukda', the SST in the region was above 27°C. The passage of the cyclone resulted in the lowering of the SST to nearly 24°C. The time series of SST at a particular location in the Arabian Sea during the passage of 'Mukda' is shown in Fig.8. At that location, the temperature was as high as 28.5°C on 17th September 2006. It decreased to 27.4°C on 21st September and to 26.8°C on 23rd September. It increased to 27.6°C on 25th September and to 28.5°C on 29th September.

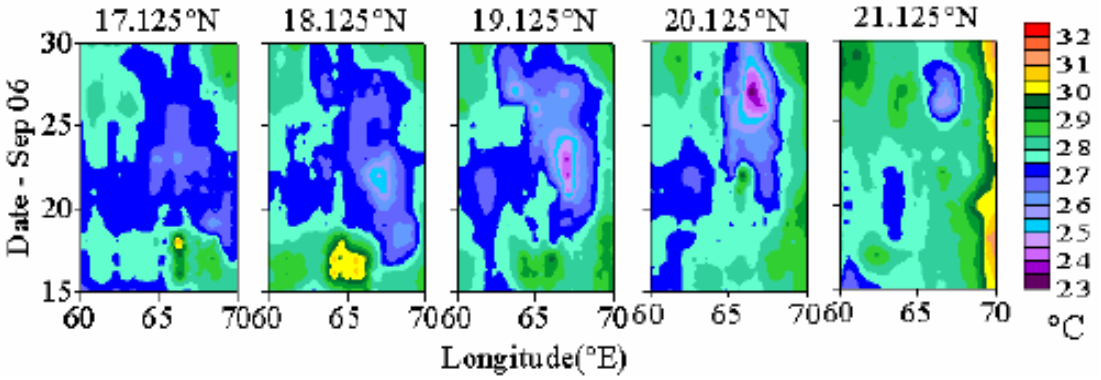

Figure 7: Transects of SST along east central Arabian Sea during the passage of cyclone Mukda (21st September – 24th September 2006)

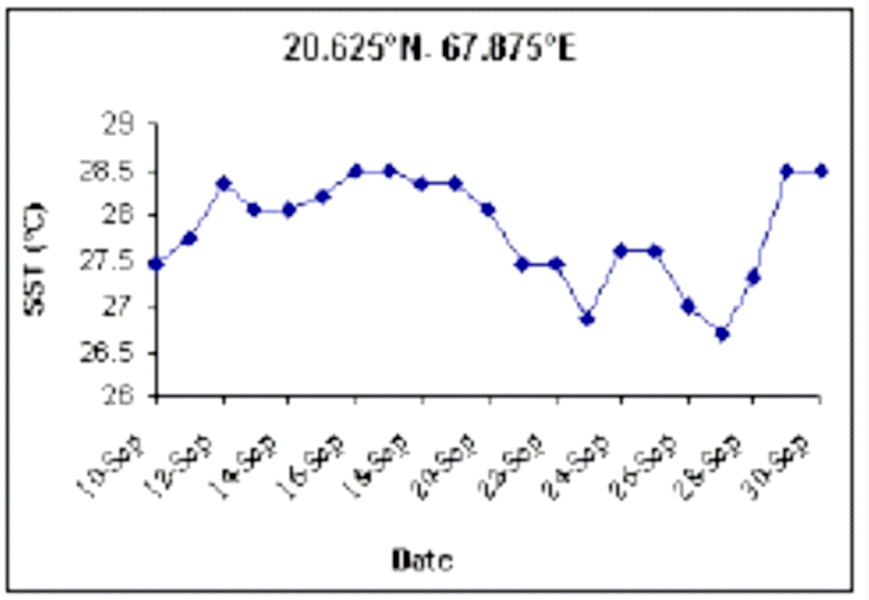

Figure 8: Time Evolution of SST (^{O}C) along east central Arabian Sea during the passage of cyclong Mukda (21st September – 24th September 2006)

Conclusion

The maximum intensity of warm pool is noticed on 17th May 2006 with its core location between latitudes 10°N –12°N and longitudes 60°E –64°E. A maximum temperature of 31.8°C was observed in the core of the warm pool. The dissipation of the warm pool started nearly 8 days ahead of the monsoon onset. Following the onset of southwest monsoon, the SST in the region of warm pool decreased rapidly. The warm pool characteristics were similar for all the years. The SST increased about 2° C just before the formation of the system and decreases about 3° C during the formation within 2 to 3 days and took about 4 to 6 days to return to normal SST pattern. SST characteristics associated with the low pressure systems were found to depend on the life time of the individual weather system.

Acknowledgement

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