4B.2 NUMERICAL INVESTIGATION OF THE 2002 MONSOON ONSET

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1. Introduction

The timing of the Indian monsoon onset in 2002 was somewhat controversial. While the India Meteorological Department declared the onset of monsoon over Kerala on June 29 (3 days earlier then climatological onset date at June 1), our observational analysis (Flatau, et al., 2003) indicates that the monsoon was in fact delayed, and followed the "bogus onset" scenario described in (Flatau, et al., 2001). The development of "bogus onset" depends on timing of the intraseasonal oscillation in the Indian Ocean and propagation of convection into the Western Pacific. An eastward moving convective system triggers convection in the Bay of Bengal, but suppresses the convective activity over the Indian Ocean after its propagation over the Western Pacific.

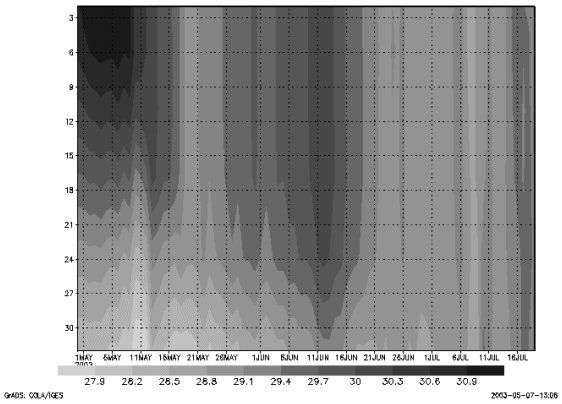

Figure 1 Ocean temperature in the upper 30m in the central Bay of Bengal (85E-90E, 10N-15N), from the Navy global ocean analysis system. Large cooling in the Bay of Bengal is visible in mid-May, 2002. (From Flatau, et al., 2003)

As shown in Fig.1, strong convection over the Bay of Bengal significantly cools the ocean surface in May--before monsoon arrival. The purpose of this paper is to investigate the role of this ocean cooling on the delay of the monsoon.

2. The numerical experiment

The development of 2002 monsoon onset is investigated using the Navy coupled analysis and prediction system. The Navy Global Coupled System consists of global circulation models of the atmosphere (Navy Operational Global Atmospheric and Prediction System) and the ocean (Parallel Ocean Program) together with the data assimilation procedures in the atmosphere and the ocean. An analysis of the ocean state is produced on the daily basis (May et al, 2002)

Using this system we performed two experiments. In each experiment the coupled model is integrated for 20 days, starting on June 1, 2002. The initial state of the atmosphere is identical in both experiments, but the initial conditions for the ocean model differ in the Bay of Bengal. In the first experiment we use the initial condition estimated from the ocean data available on June 1. In the second experiment the ocean state is modified to counteract the effect of cooling in the Bay of Bengal in the middle May. This ocean state is obtained by integrating the ocean model from May 15 for two weeks, using the forcing from the NOGAPS analysis for this period and adding additional heat to the ocean over the Bay of Bengal. The magnitude of the added heat flux was chosen experimentally, to compensate for the heat loss caused by convection during the "bogus onset"

3. The results

The development of the 2002 monsoon is illustrated by the Monsoon Circulation Index--MH (Goswami, et al., 1999). MH measures the local Hadley Circulation created by off-equatorial monsoon heating. As shown in Fig. 2, adding heat to the upper ocean surface in the Bay of Bengal significantly increases the strength of the monsoon circulation at the beginning of June. From this we infer that the cooling in this region, caused by convective fluxes related to "bogus onset", contributed to the delay of the real onset. As a

consequence, information about the heat content in the Bay of Bengal should be considered an important predictor for forecasting the onset of the monsoon. In addition, the dependence of the onset of the oceanic processes should make the extended range, numerical prediction of the onset with more feasible.

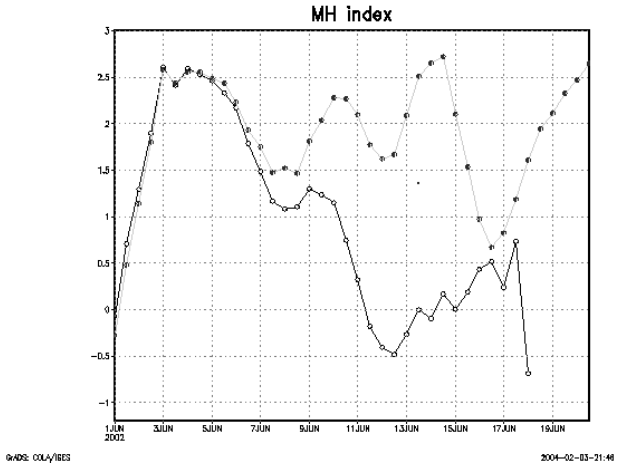

Figure 2. The monsoon circulation index MH with (gray) and without (black) added heat in the Bay of Bengal.

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