The referee's comments are in italics, and our responses are non-italics.

**Comment 1:** *Review on "Sea Surface Temperature over the Bay of Bengal: A key driver for South Asian Summer Monsoon rainfall during past 31 kiloyears" by Sakthivel et al.,*

*This topic is of scientific relevance, identification paleo-hydroclimates and a key driving forcing of South Asian Summer Monsoon from MIS 3 by using clumped isotopes and stable isotope records of Central West Bay of Bengal (CWBoB). I would suggest to reject this MS because the authors have some big problems on their data and interpretations. To sum up, these data cannot support the main points of the MS. Here I draw my comments as follows.*

**Response:** We appreciate the time and effort the referee has dedicated to reviewing our manuscript. We value their feedback and would like to address their comments constructively.

However, the comment regarding the scientific relevance of our manuscript may require further clarification. Specifically, we are uncertain about the nature of the concerns raised about the data and its interpretation. Our manuscript focuses on the role of SST over the CWBoB in regulating moisture transport over the NBoB and South Asia, as detailed in Section 3.4 and illustrated in Figure 3.

Given this context, we would appreciate additional details from the referee to understand their concerns better and to address them effectively.

**Comment 2:** *1. In the Results and Discussion 3.2, the authors mentioned that the relationship existing between cloud cover and the depth of Chl a maxima, as well as the influence of Chl a on planktic foraminiferal abundance (Line 382-384). Cloud cover index was inferred from the abundance ratio of planktic foraminifera Globigerina bulloides to Neogloboquadrina dutertrei. The authors further suggest that internal feedback processes involving cloud cover index serve as significant factors in SST modulation in the BoB. However, the authors met some fundamental problems. Salinity, nutrient level, prey abundance, turbidity and illumination also affect their diversity, abundance and distribution locally. Besides, depth habitats of cold water dweller bulloides and N. dutertrei live at thermocline. Thus, the relationship between Chl a and planktic foraminifera cannot be applicable to all species. The authors ignore the important component - ocean where planktic foraminifera live. The abundance ratio of planktic foraminifera G. bulloides to N. dutertrei should be reflected changes in ocean hydrography, not only for cloud cover itself. In the MS, cloud cover index and related interpretation are incorrect.*

**Response:**

We agree that factors like salinity, nutrients, prey availability, turbidity, light, and the species' depth habitat are important in controlling their distribution. Our habitat depth inference is based on previous studies using multi plankton net samples from the Northern Indian Ocean (lines 379–381; Fig. S5), which suggest that *G. bulloides* thrives at 0–50 m and *N. dutertrei* at 50–100 m.

We did not intend to suggest that the relationship between chlorophyll-a and planktic foraminifera applies universally to all species. Rather, this relationship specifically applies to *G. bulloides* and *N. dutertrei* in the region of the Bay of Bengal. We also discussed the limitations of this proxy, such as the effects of suspended sediment and upwelling on the depth of chlorophyll-a maxima (lines 389–412).

In the revision, we will the update lines 378–381 with a more detailed explanation, as follows:

"The premise behind our analysis on the abundance of two planktic foraminiferal species, *Globigerina bulloides* and *Neogloboquadrina dutertrei*, which exhibit optimal thriving conditions at water depths of 0-50 meters and 50-100 meters, respectively, based on multi-plankton net samples from the northern Indian Ocean (Tapia et al., 2022) (Fig. S5). The oxygen isotope-based apparent calcification depths of these species further indicate shallow water habitat for *G. bulloides* and deeper water habitat for *N. dutertrei* (Stainbank et al., 2019). Given that the salinity and temperature of both shallow and deeper waters in the BoB align with these species' ecological niches, the Chl a concentrations regulates their populations (Lombard et al., 2009; Bijma et al., 1990; Munir et al., 2022; Kuroyanagi and Kawahata, 2004; Maeda et al., 2022)."

**Comment 3:** *2. The authors calculated relationship between SST and ice core $CO_2$ concentration/solar insolation at 30$^o$ These R-sq values explain 54% and 8% variability of internal and external earth system forcing, respectively (Line 354-355). However, the authors had big problem on statistics. A correlation between two variables cannot be interpreted as they mentioned. These data should be performed by factor analysis, EOF or principal component analysis. Moreover, in the Results and Discussion 3.1, 19 samples were analyzed for reconstruction of past SST variations. The authors calculated an average SST at a specific time window. It makes no sense that an average temperature with 1 STD was calculated by only 3-4 data at the time window.*

**Response:**

We conducted a correlation analysis to assess the sensitivity between SST and ice core $CO_2$ concentrations/solar insolation. This is standard practice for examining numerical relationships between these variables (https://doi.org/10.1175/2011JCLI4078.1).

The referee's suggestion to apply factor analysis, EOF, or PCA may be more suited for multivariate datasets. However, we find it unclear what exactly the referee is proposing without further clarification. Applying PCA to just three-time series (SST, $CO_2$ & insolation) would not yield meaningful statistical significance.

As for the averaging of SST, the mean values and standard deviations were calculated using all available data points within each time window. Although some windows contained only 3-4 data points, the averages and standard deviations remain statistically valid for capturing the central tendency and variability. While a larger sample size would offer stronger statistical power, this constraint is inherent to paleoclimate data.

**Comment 4:** *3. Line 180-183: The authors mentioned that a strong coherence of $\delta^{18}O$ variability in ruber was observed in multiple sites adjacent to our core location (Rashid et al., 2011; Govil and Divakar Naidu, 2011; Clemens et al., 2021) confirming the proposed age-depth model. A good age model is dependent on how precise of radiocarbon dates, not for similar variations of adjacent cores. Some discrepancies can be found among these stable oxygen isotope records (Figure S3).*

**Response:**

Our age-depth model is constructed from 7 radiocarbon ages and interpolated for each depth strata using Bayesian statistics. The observed strong coherence of $\delta^{18}O$ variability in *G. ruber* between our core site and adjacent sites supports the validity of our age-depth model. We will revise lines 180-183 to read as follows:

"A strong coherence of $\delta^{18}O$ variability in *G. ruber* was observed across multiple adjacent sites (Rashid et al., 2011; Govil and Divakar Naidu, 2011; Clemens et al., 2021), which substantiates the proposed age-depth model (Fig. S3)."

The discrepancies observed in the $\delta^{18}O$ records from multiple sites can be attributed to inter-site hydrographic variations. Nevertheless, the overall temporal trends are consistently recorded across all sites.

**Comment 5:** *4. Introduction, method and results of the MS are jumbled up. Core information and results of age model have too many redundancies. The information can be found in several paragraphs.*

**Response:**

We did not understand the referee's comments on the manuscript structure. We would appreciate it if the referee could provide more explicit feedback on this issue.

**Comment 6:** *5. Discussions with multiple SST records are unclear.*

**Response:**

The discussion addresses the discrepancies in SST differences between the Late Holocene and the LGM as reported by different temperature proxies from BoB. We have examined the reasons for these discrepancies in lines 329–351.

**Comment 7:** *6. Paragraph of 2. Materials and Methods is too long.*

**Response:** Our materials and methods section is as streamlined as possible.

**Comment 8:** *7. Technical aspects: Figure 1: surface currents cannot be excluded.*

**Response:**

Thanks! We have included surface currents in the revised Figure 1 (attached below).

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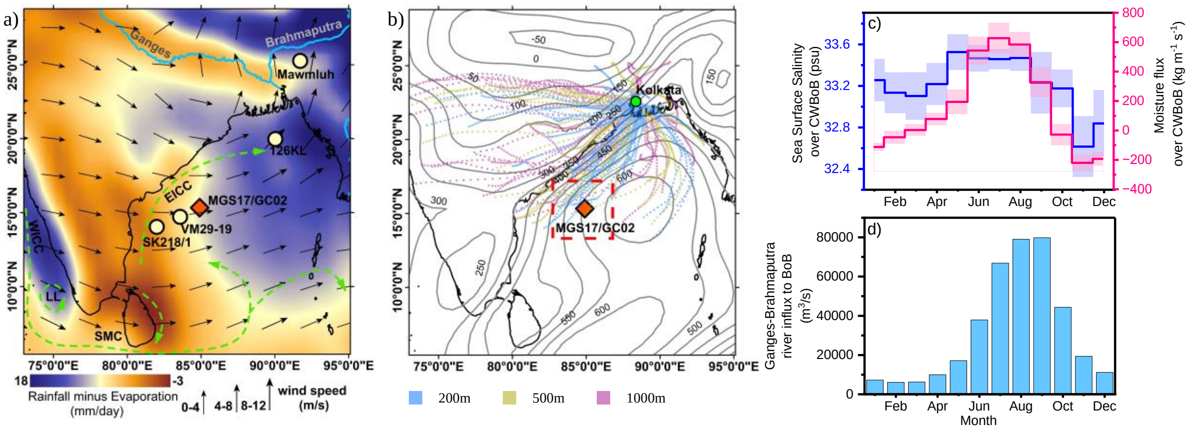


**Figure 1: Site map and climatology.** a) modern-day climatology (1998 – 2019) showing the distribution of rainfall minus evaporation (mm/day), wind vectors (black arrow), and surface ocean circulation (green dashed arrow) during the period of SASM (June, July, August, and September) (Kalnay et al., 1996; Schneider et al., 2013; Phillips et al., 2021). The study site, MGS17/GC02 (depicted as a filled orange diamond with a black boundary), along with other locations (represented by light yellow-filled circles with black boundaries), which are discussed in the text; b) contours of mass-corrected vertically integrated moisture flux during the SASM for the period of 1979 - 2017 (Trenberth and Fasullo, 2022), superimposed with 48-hour HYSPLIT backward air mass trajectories (Stein et al., 2015) at multiple altitudes (200 m, 500 m, and 1000 m above mean sea level) for the days prior to SASM precipitation events in 2023 at Kolkata. c) Plot of monthly Sea Surface Salinity (Reagan et al., 2024) and moisture flux (Trenberth and Fasullo, 2022) distribution over the study site (MGS17/GC02) obtained from world ocean atlas climatology resolved at 4°x4° grid space (indicated by the red dashed square in panel b); d) Long-term average monthly river discharge of Ganges and Brahmaputra to BoB (Jana et al., 2015).”

**Comment 9:** *8. Others: Abbreviations: Bay of Bengal (BoB), sea surface temperature (SST), kilo years (kys)*

**Response:** Thanks! We will address the abbreviation issue in the revised manuscript.

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