

We would like to thank the reviewer for the assessment of our manuscript and for the recommendations for improvements. Responses to the comments and the proposed revisions to the manuscript are included below.

The manuscript is solid study of the different contributions to the multi-year IOD event of 2021-2022 and a good timeline of how the 2021-22 event came to be. However, the manuscript's stated goal is to explore how unusual the characteristics of the 2021-22 IOD event are. Here, the manuscript fails to explore in greater detail the uniqueness of the 2021-22 period or its similarities to other multiyear IOD events in the record. Part of this is the record length. For the detailed part of the study, many of the datasets used are not long enough to get produce a detailed exploration of the extended IOD event and its relationship with the unusual multi-year La Niña event in the Pacific. However, even without all the detail, some of the reanalysis products used do have extended records that would allow for comparisons of other extended IOD events and the potential for co-occurrence of extended La Niña events. In addition to looking at canonical definitions of La Niña, I would recommend considering using the relative Niño Index (van Oldenborgh et al 2021), for a better understanding of ENSO state and climate change and La Niña in relationship to the rest of the tropics. Further, an expanded exploration of long lasting La Niña and IOD events would also provide more information on the importance of multi-year events for Indian Summer Monsoon Rainfall and how anomalous summer rainfall was during this event compared with other extended IOD or ENSO events as discussed in section 3.4.

Sources:

Van Oldenborgh GJ, Hendon H, Stockdale T, L'Heureux M, De Perez EC, Singh R, Van Aalst M. Defining El Niño indices in a warming climate. Environmental Research Letters. 2021 Mar 11;16(4):044003

Response: We read “2021-22 period or its similarities.....” the reviewer’s comment as “2021-22 period or its similarities.....” as we believe 2012 is a typo.

1. Record length and uniqueness of 2021-22 event:

- a. We focus on the occurrences of nIOD events in the 1960-2022 period, as systemic observations of the Indian Ocean started later compared to other ocean basins (Masumoto et al. 2010; Zeng et al., 2020). Indian Ocean exploration started in the 1960s with the first International Indian Ocean Expedition (Knauss, 1961) and was followed by various other exploration programs. Extended records include periods with sparse observation, and even the tropical Pacific has sparse observations prior to about 1955 (D'Arrigo et al., 2008; Kaplan et al., 1998). Thus, studies of the Indian Ocean often utilize data post-1960s (for eg. Alory et al., 2007; Murtugudde et al., 2000; Nyadjro et al., 2013; Saji et al., 1999; Zhang and Du, 2021).

- b. However, following the reviewer's suggestion, we verified our findings in a longer observational record. ERSST data for the period 1900-2022 is used to compute the standardized DMI index from detrended SON SST anomalies. We categorize the events as nIOD if the standardized DMI is less than -1. Using these nIOD events, we count the length of contiguous periods (in months) with monthly DMI < -0.5 (shown in Fig. R1). For example, if a particular year is categorized as an nIOD event based on SON DMI, we calculate the duration of that event based on the number of contiguous months where the index remained less than -0.5. It is evident that 2021-2022 was the only event during 1900-2022 when the DMI < -0.5 for more than 12 months at a stretch.

In view of (a) and (b) above, we propose to retain the period of analysis as 1960-2022, as in the original manuscript.

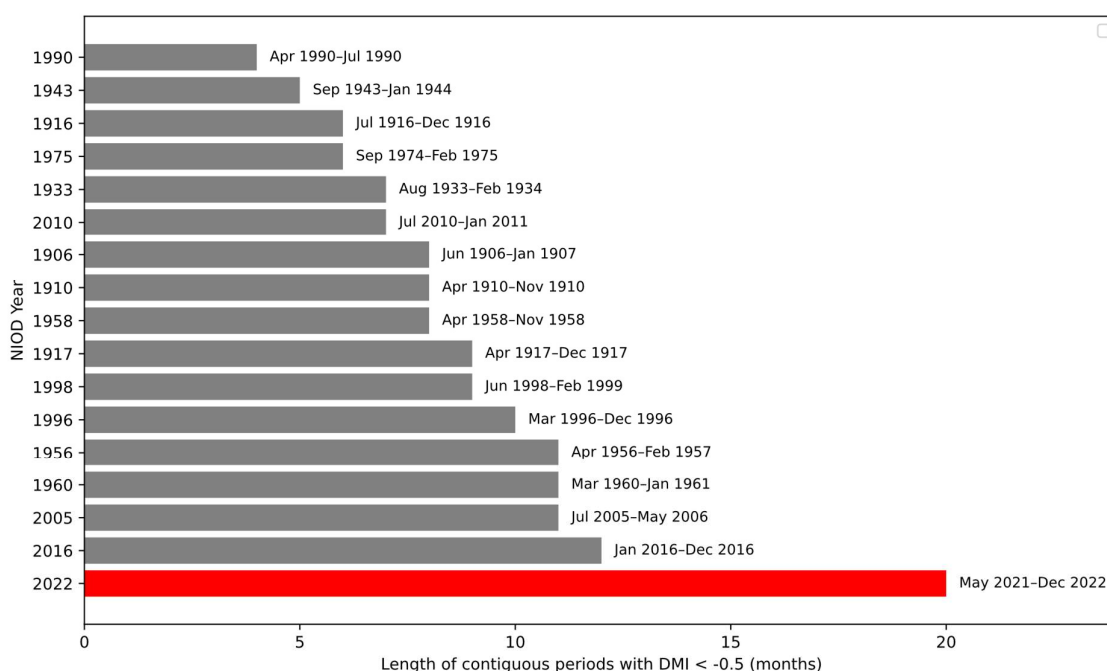


Fig. R1 The length of contiguous periods (in months) with monthly DMI < -0.5 for the nIOD events in the period 1900-2022. The 2021-22 event is highlighted in red.

There are no other such prolonged nIOD events to compare with in the 1960-2022 period, or even in a longer 1900-2022 period. The other unique features of this event are highlighted in the manuscript in terms of unusual occurrences of anomalous westerlies over the equatorial Indian Ocean (Fig. 2), record occurrences of WWBs (Fig. 3), anomalous sub-surface ocean conditions (Figs. 7 & 8), and the associated discussions.

2. **Use of relative Niño Index** – Thank you for the suggestion. We propose to modify Fig. 1c to include the monthly relative oceanic Niño index (RONI) obtained from <https://www.cpc.ncep.noaa.gov/data/indices/>. Modified Fig. 1 (b & c) is reproduced below. Using the RONI index does not change our inferences.

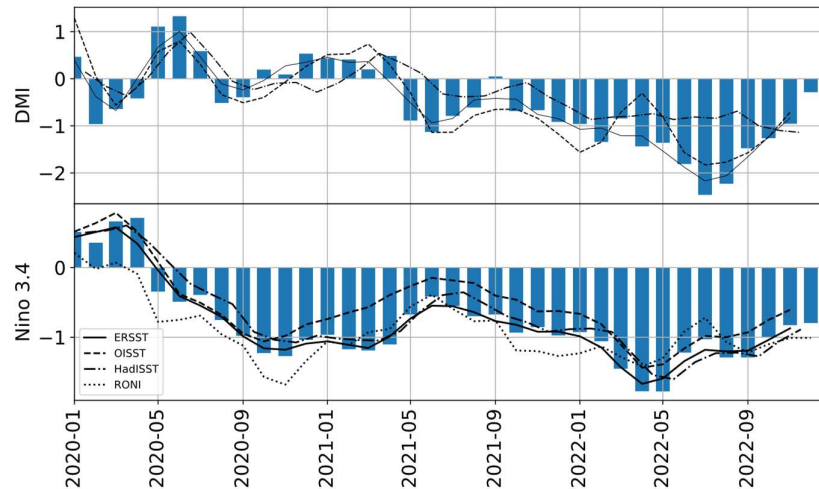


Fig. R2 The monthly DMI index from ERSST (bars), and the three-month running mean for ERSST, OISST, and HadISST (lines) for the period 2020-2022 (top-panel); bottom-panel same as top-panel but for the Niño 3.4 index. Also shown in the bottom panel is the monthly relative oceanic Niño index (RONI) obtained from <https://www.cpc.ncep.noaa.gov/data/indices/>.

We propose to rewrite the discussion at line 41 to reflect the use of the RONI index, the associated reference, and in Section 2, Data and Methods.

Line 40 “(as is seen from the Niño 3.4 index, and the relative Niño 3.4 index, Fig. 1c).”

Line 100 “The relative Niño 3.4 index (L’Heureux et al., 2024; Van Oldenborgh et al., 2021) is obtained from <https://www.cpc.ncep.noaa.gov/data/indices/>”

3. Exploration of other long-lasting La Niña and IOD events – As seen from Fig. R1 above, there were no other prolonged nIOD events, even for an extended period of 1900-2022. Therefore, it is not possible to compare the 2021-22 nIOD event with other events. The impact of long-lasting La Niña events has been explored in recent studies (Ratna et al., 2024; Sharma et al., 2024). We propose to add these references to the manuscript at lines 56-57.

“La Niña years are associated with notably decreased (increased) ISMR when preceded by La Niña (El-Niño) conditions during the previous winter (Sharma et al., 2024), and triple-dip La Niña events are often associated with positive ISMR anomaly (Ratna et al., 2024)”

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