

Dear Editor and Reviewers,

We would like to thank you for your constructive and insightful comments, which have significantly helped improve the quality and clarity of our manuscript. All comments have been carefully addressed in this response document, and the corresponding revisions have been implemented throughout the revised manuscript.

Reviewer 1:

General comments: The paper is a novel and timely contribution to the literature concerning the oceanography of the Persian Gulf. It is not only useful for the narrow field of physical oceanography itself, but also very useful and informative for neighboring sciences, such as the biological ones. The paper is very well written and there are only trivial changes to make. It is very strong in methodology. This paper should find enthusiastic uptake by the research community.

R: We thank the reviewer for the positive assessment of our manuscript and for highlighting its relevance to both physical oceanography and related biological research. We greatly appreciate the encouraging comments regarding the novelty, methodology, and potential contribution of the study to the wider research community.

Specific comments: The paper is well-written, but still a bit verbose in some parts. If the authors choose to leave it that way, it's ok (it is not painful to read) but some more shortening would make some statements more concise and the text shorter.

R: We thank the reviewer for this suggestion. We reviewed the manuscript throughout and shortened several passages, particularly in the Results and Discussion, to reduce repetition and improve concision while retaining the information needed to describe the analyses and their interpretation.

In the results, the tenses are mixed. I would suggest going over the results section and making sure that everything is in the "past tense". Mixing tenses is not a factual, or fatal, flaw - but the paper will read better if this is addressed. There is presently little logic as to when and where the present and the past tenses alternate. On the bright side, the fact that this is my major beef with this manuscript underlines its scientific quality.

R: We thank the reviewer for this suggestion. We reviewed the results section throughout and adjusted all tense inconsistency, to make sure all the Results are predominantly in the "past tense".

Line 32: "...leaving significant subtidal variability...": is this really "subtidal" (as in the depth below the tidal range), or is this really "non-tidal" (for lack of a better word) influence? The

question arises from the sentence stating that tidal forcing is important ... and then saying the rest of the forcing is subtidal. But wind-forcing would not be necessarily subtidal...

R: We thank the reviewer for highlighting this ambiguity. Here, “subtidal” was used in its physical-oceanographic sense to refer to variability at frequencies below the tidal band, which can include wind-driven variability. However, we agree that the original wording could incorrectly imply that all variance not explained by the tidal analysis was necessarily subtidal. We have therefore revised the Abstract to remove this ambiguous usage. We retain the term “subtidal” only where it specifically refers to circulation or variability at frequencies below the tidal band.

Line 36: " ...a persistent seasonal thermocline..."; at what depth?

R: We agree that the term “thermocline” implies identification of the depth range containing the strongest vertical temperature gradient. Because our fixed-depth temperature measurements resolve changes in vertical thermal structure but do not provide sufficient vertical resolution to define thermocline depth continuously, we have removed the term “seasonal thermocline.” The revised Abstract instead describes the observed vertical temperature differences and their rapid transitions toward thermal homogeneity.

Line 54: "...cyclonic gyre currents"....remove the "s" from currents.

R: Done.

Line 87: introduce blank before "may"

R: Done.

Line 737 and 748: "Acropora" should be italics

R: Done.

Reviewer 2: This manuscript aims at understanding the local physical processes governing circulation and temperature variability in the Sir Bu Nair Island (SBN) of the Gulf. To do so, it mainly analyzes observed currents, temperature, and sea level from bottom-mounted ADCPs and multi-depth temperature moorings, and analyzes ERA5 reanalysis wind.

This manuscript is interesting and well-structured, making it easy to follow the stream of thoughts. It addresses the scientific question of better understanding the drivers of temperature and circulation variability in the SBN how it could affect the coral reefs in the region.

R: We thank the reviewer for the positive assessment of the manuscript and for the constructive comments. We have addressed both major comments through additional analyses and by revising the interpretation of the results. In particular, we have added regional and long-term SST and circulation analyses to evaluate the spatial and temporal representativeness of the SBN observations, and we have revised our interpretation of the rapid loss of thermal stratification to distinguish more clearly between observed relationships and mechanisms that cannot be resolved with the available measurements. We have also revised the manuscript throughout for clarity and conciseness.

I have two major comments and a few minor remarks which I think should be addressed before publication.

Major comment:

My first major comment is the lack of analysis to assess the spatial extent to which observations at the SBN reflect currents and thermal condition away from the Island, and the lack of analysis to determine the temporal stability of the observed data (i.e., do these relatively short observations represent a typical year? What is the interannual variability of the variables analysed?). The first part of this comment shows the spatial extent for the interpreted results, while the second shows whether the interpretation of the obtained results are recurring or anomalous.

I suggest that the authors include these analyses, both of which can be done using the same technique already applied in the paper for wind.

R: We agree that the original manuscript did not sufficiently establish the spatial and temporal context of the observations. We therefore added analyses using long-term NOAA Coral Reef Watch SST (1985–2025) and CMEMS surface currents (1993–2025). NOAA CRW SST was first compared with the shallow in situ temperature records at SBN and showed strong agreement ($r = 0.964\text{--}0.996$; $\text{RMSE} = 0.44\text{--}0.57\text{ }^{\circ}\text{C}$). The long-term and spatial analyses showed that the warm conditions observed in 2021 were anomalous and extended across the southeastern Gulf, whereas 2022 was close to climatological conditions. The CMEMS analysis showed that regional surface-current conditions during the 2021 observational period were within historical variability, while comparison with the ADCP observations indicated spatial differences in how the regional flow was expressed around SBN.

These analyses and the corresponding methodological details have been added to Section 2.2 [Environmental data/Pg. 7-8, lines 176-186] and Section 3.2 [Results/Pg.13, lines 305-311] and Section 3.3 [Results/Pg. 15, lines 345-351], with the long-term and regional fields presented in Figs. S1–S2 in Supporting Information S1. We also clarified in the revised manuscript that CMEMS was used to provide regional circulation context rather than to validate the island-scale ADCP observations.

My second major comment is about the proposed mechanism of de-stratification, a combination of rapid mechanical mixing and oscillatory advection (line 570–571). In my opinion, the manuscript does not provide enough evidence to establish these processes as drivers of the rapid collapse of stratification. The authors co-relate several variables at differing frequencies, finding differing contributions of the variables to delta T variance in the north and south observation sites. However, the operating mechanism of the advection and/or wind that removes the vertical stratification across the whole column is not clear to me. What are the temporal characteristics of the synoptic wind or advective process? Given the proximity to land, are these wind/advective processes regional or local to the SBN? The proposed mechanism for de-stratification could be valid but should be presented with more care if they are not demonstrated more convincingly. It would be possible to strengthen this hypothesis through the analysis of salinity, which may be viewed as a tracer particularly at the short time scales relevant here.

R: We agree that the original manuscript attributed the rapid loss of thermal stratification too specifically to mechanical mixing and oscillatory advection. We have revised this interpretation throughout the manuscript and now describe the observed events as rapid thermal homogenization, rather than as direct evidence of complete water-column mixing. The frequency-based and variance analyses are now interpreted as identifying associations between currents, wind, and changes in vertical temperature structure, rather than establishing a unique causal mechanism.

We have also clarified the spatial context of the circulation using the new regional CMEMS analysis and explicitly acknowledged the absence of salinity measurements as a limitation. Without concurrent salinity observations, we cannot determine changes in density stratification or conclusively distinguish vertical mixing from horizontal advection. These processes are therefore now presented as plausible contributors to the observed thermal homogenization rather than as demonstrated mechanisms.

These revisions have been incorporated throughout the Results [section 3.3/ pg. 15, lines 345–351 and section 3.5/ pg. 19, lines 399–405] and Discussion [sections 4.3], with the additional regional circulation analysis presented in Fig. S2 in Supporting Information S1.

Related to this, the one-month period that is used for the analysis of stratification (line 474–475) may be unsuitable for this purpose because of the strong seasonality in the Gulf.

R: We agree. The original wording gave too much weight to this relatively short interval. We have revised the manuscript to clarify that this period was selected because simultaneous measurements were available across the relevant sites and depths and was used as a case-study interval to examine short-timescale changes in vertical temperature structure, rather than to characterize the seasonal stratification regime at SBN.

To provide broader temporal context, we also added a spectral analysis using the full SBN-S record, which showed that the diurnal and lower-frequency signals identified during the case-study interval were also evident over the longer observational period (Fig. S3) [sections 3.5/pg.21, lines 445–446]. The long-term NOAA SST analysis further provided seasonal and interannual context for the observations (Fig. S1 in Supporting Information S1). The scope of the conclusions based on the case-study interval has been revised accordingly.

Minor comments:

Line 248: SBN, not the Gulf

R: Corrected. The text now refers specifically to SBN rather than the Gulf.

Figure 5: Perhaps, it can be plotted differently, the temperature curve at different depths and the rolling envelop are difficult to distinguish.

R: We agree. Figure 5 has been revised to improve the distinction among temperature records at different depths. The rolling envelope has been removed, and the depth-specific temperature records and legends have been simplified, making periods of vertical temperature separation and convergence easier to distinguish.

Line 720: is the Shamal wind event a seasonal or a diurnal event?

R: We have clarified this point. The Shamal referred to here is a synoptic, multi-day wind event, not a diurnal event. We have revised the text to make this distinction explicit and to separate the synoptic Shamal variability from the diurnal wind variability observed at SBN.

Line 209, and throughout the manuscript: please re-write for clarity and conciseness.

R: We have revised the manuscript throughout to improve clarity and conciseness, including shortening several methodological descriptions, removing repetition, and simplifying the interpretation where appropriate.