

ANSWER TO REVIEWER #2

We thank the reviewer for their careful reading of the manuscript and constructive comments. Their feedback has helped improve the clarity and presentation of the study. Our responses are shown in italic while the reviewer comments are in blue.

The Authors use a 39-year, 30-member ensemble ocean simulation to assess basin-wide contributions of externally forced and intrinsic variability to key components of Mediterranean circulation across different scales.

Overall, the manuscript is well written, presents a relevant scientific topic, and employs appropriate methods. It is therefore suitable for acceptance after a few minor revisions suggested below.

- L33. Can you add one or more references where “chaotic intrinsic variability” (CIV) is first introduced/studied?

To our knowledge, this expression has been first used in Bessières et al (2017) and Wolfe et al (2017). Both references have been added in the introduction.

- L70. I suggest adding the approximate horizontal resolution in kilometers after „1/12°“.

Thank you for the suggestion, we have added the approximate horizontal resolution in kilometers after “1/12°” as requested.

- L209. Please check the specified locations of the maximums and the corresponding potential densities in Figure 2a. The listed densities and the second location (24° E) do not appear to match the plotted values.

Thank you very much for your careful reading. You are correct that the locations did not correspond to the maximum visible in Figure 2a. We have revised the manuscript accordingly.

- L213 and L215. Typo „Straits“ to „Strait“.

Corrected.

- L355. I recommend rephrasing as: „Contrary to previous Mediterranean Sea multi-model evaluation studies (e.g., Dunić et al., 2019),...“

In response to your comment, we have re-evaluated the relevance of comparing our results with a multi-model study, as it does not directly contribute to the discussion in our case. We now consider it more appropriate to focus on the agreement between our simulation and the observations, which is the key criterion for this study, and have therefore decided to remove the reference to Dunić et al. (2019).

- L357-360 and L428-431. Could you elaborate further on the conclusion that the atmosphere is the predominant external driver of decadal fluctuations of the NIG (i.e., BiOS)?

This is an interesting question. Our ensemble run indeed indicates that decadal NIG fluctuations mostly belong to the ensemble mean ocean response, i.e. that they are mostly forced externally. The atmosphere is the only external driver that can force interannual variability in our simulation since all other external drivers (western boundary forcing and runoffs) are devoid of interannual fluctuations. We realize that we did not comment much on the mostly forced character of NIG variability in the former version of the conclusion, that we have complemented with the following lines : *“This result contrasts with some previous studies based on observational data, idealized simulations, and laboratory experiments, which*

highlighted the potentially dominant role of CIV in NIG fluctuations (see introduction). Our simulation confirms that CIV has an impact on the NIG behavior, but suggests, as do other realistic ocean modeling studies, that taking into account complex stratification, basin geometry, and fully variable atmospheric variability gives more weight to external factors than to intrinsic processes in the timing of these fluctuations. Future studies will help further assess the robustness of these conclusions.”

- L434 and L451. Typo „sea“ to „Sea“.

Thanks for mentioning this error. Corrected.

- I suggest adding a short discussion on how horizontal resolution may influence the intrinsic variability.

Thanks for suggesting (as did the other reviewer): this is now done in the conclusion.