Response to reviewer 2

Dear reviewer,

We thank you very much for your constructive and relevant comments to our manuscript. Below, your reviews are reproduced in **black** font and our responses interspersed in **blue**.

Since the reviewer #1 also raised important points, we kindly suggest to take a look at our responses to Reviewer #1 as well.

Please, note that all **line numbers** in our responses refer to the clean version of the manuscript, not the tracked-changes version.

This study addresses the dense-shelf water and associated sediment transport in the Cap de Creus Canyon during the mild winter of 2021-2022. This canyon has been identified as a main pathway for the transfer of dense shelf water and sediments from the shelf to the slope and deep margin. The study bases on combination of data from gliders, ship-based CTD transects, instrumented mooring lines, and a reanalysis product.

The article is very clearly written and organized. The results are supported by a set of observations covering different spatio-temporal scales, which is an asset. I do not have any problem with the manuscript other than it is a bit hard to follow because of its very descriptive nature given the different datasets involved. In contrast, I think that the relevance of the study is not very clearly stated. However, I do not know the region very well, so I ignore the state of the scientific knowledge and the reach of the relevance or novelty of this study, so I prefer not to evaluate that point.

Reply: We appreciate the recommendation for minor revisions. However, we have thoroughly revised the manuscript, addressing all your comments in detail as if it had been a major revision. Your revisions have been very helpful in improving the clarity and strength of the manuscript, as well as in preparing a more focussed discussion and better contextualize our findings.

We have reorganized both the Introduction and Discussion sections to make the paper message more concise and impactful (see modified sections in the revised version of the manuscript). In this regard, we would like to briefly emphasize the novelty and significance of our study.

Most previous studies in the Cap de Creus Canyon (and more broadly in the Gulf of Lion) have primarily focused on intense dense shelf water cascading events (IDSWC). These events are more energetic and have greater effects, making their impacts easier to quantify. This explains the significant attention they have received over the past decades (e.g., Heussner et al., 2006; Canals et al., 2006; Puig et al., 2008; Ogston et al., 2008; Sanchez-Vidal et al., 2008; Durrieu de Madron et al., 2013). However, IDSWC are not the most frequent in the region. In contrast, mild dense shelf water cascading (MDSWC) events have been more common since the beginning of the observational era in the Gulf of Lion and are expected to become more prevalent under climate change scenarios (Herrmann et al., 2008).

Previous work, such as Ulses et al. (2008a), Martín et al. (2013), Rumín-Caparrós et al. (2013), or Mikolajczak et al. (2020), have provided valuable insights into the dynamics of MDSWC in the Cap de Creus Canyon. These studies have mostly relied on mooring time series acquired in the canyon head and/or model outputs to detect the presence of dense water and infer their export pathways. However, they do not offer a comprehensive observational characterization of the hydrographic properties of the water column, current dynamics, or the shelf-to-canyon export of dense waters during these events.

Our study builds on these studies and complements these papers by integrating a comprehensive observational dataset, which includes concurrent observations at the Cap de Creus Canyon and the adjacent continental shelf, with reanalysis data to analyze in detail a recent mild winter (2021-2022). We document in situ the presence of cascading waters in the canyon, which contribute to the body of Western Intermediate Water (WIW), at different locations from the shelf to the mid-canyon. In addition, and as recommended by the reviewer, we place this winter in a multi-winter context thank to reanalysis data, which allows us to compare it with other mild and intense winters over the past two decades.

To our knowledge, and thanks to the efforts of the FARDWO project and the MELANGE-DUNES experiment, this is the first time that a MDSWC event in the Cap de Creus Canyon has been characterized in such detail based on direct observations spanning the upper and mid sections of the canyon, as well as its adjacent shelf. We believe that, by addressing a relatively understudied but increasingly relevant phenomenon, our work fills an important knowledge gap and contributes to a better understanding of how moderate winters affect DSWC events in the Cap de Creus Canyon, and how these conditions may affect shelf-slope exchanges, WIW formation, and sediment transport pathways in the future. These are all crucial aspects for anticipating future changes in canyon functioning and deep-sea ecosystems.

Overall, it is a good paper. My main criticism is about the possibilities that the use of the reanalysis product offers, and which I feel it's not exploited. I wonder why not to (really, with numbers) validate this reanalysis with your observations, and make the same computations for several years, separating mild and intense winter conditions. This would greatly strengthen the paper's conclusions. So far, the article is a very nice compilation of observations from different datasets, but it is very descriptive and the cause-effect of the findings is often weakly sustained. I really think there is potential for more robust conclusions if further analysis were carried out by adding a longer time series from the reanalysis to put this winter, and other mild winters in context. This would allow to generalize your conclusions.

Due to this, I think that the paper can be accepted after minor revisions, but it would be a better paper with major revisions.

Reply: Thank you for your insightful comment. We fully agree that validating the reanalysis product and placing our observations in a broader temporal context would strengthen the conclusions of our paper.

Regarding the validation, we have not included it in this manuscript because it is the focus of a separate study of our group that we have recently submitted to the same journal (Fos et al., 2025). In that paper, we validate the Mediterranean Sea Physics reanalysis product against long-term mooring observations in both the Cap de Creus and Lacaze-Duthiers canyons. The preliminary results of that paper show that the reanalysis accurately reproduces DSWC events, matching 84% of IDSWC events within the same week and 56% on the exact date. These findings actually reinforce the reliability and applicability of reanalysis data in our study region. Nevertheless, in the Discussion section (5.3.), we have provided the root mean square errors (RMSE) resulting from the comparison between observational and reanalysis data for T1 and T2 transects at depth where dense shelf waters are detected, in order to validate the use of reanalysis data for our paper. We have also made the pertinent comments on the Discussion section.

Furthermore, we acknowledge the value of placing our MDSWC in a longer-term context. In response to your suggestion, we have currently extended the analyses to include a multi-year time series (from 1997 to 2022) of dense water transport through the canyon, based on the same reanalysis product (Fig. 10). This allows us to compare the 2021-2022 winter with previous IDSWC and MDSWC events and support more general conclusions of the variability of this process and how it has changed throughout the years.

<u>**General comments**</u>

Abstract:
I didn't really understand if the Cap de Creus Canyon is "**only a partial sink** of cascading waters" or if "remarkable dense shelf water and sediment transport occurs in the Cap de Creus Canyon, **even during mild winters**". Isn't this a bit contradictory? Or maybe I'm missing the difference between these

transports. In any case, please clarify. This is a question that remained even after reading the full manuscript.

Reply: We understand that the use of these terms is a bit contradictory. Our intention was to emphasize that, even during mild winters, the canyon still acts as a preferential pathway for the transport of dense shelf waters and associated suspended sediments, although their transport is mostly confined to the upper canyon and, to a lesser extent, to the mid canyon. We have removed these terms throughout the manuscript to avoid confusion.

Methods:
The interpolation method used in the sections should be stated. The figures look a bit weird and I think it might be an interpolation issue.

Reply: The interpolation method that we have used in the sections is "isopycnic gridding". This method is a gridding procedure that organizes the hydrographic data along surfaces of constant potential density (isopycnals) rather than constant depths. By doing so, it better preserves the vertical structure of water masses and reduces artificial smoothing across density gradients (Schlitzer, 2023).

In our work, the hydrographic profiles obtained from the CTD stations collected during the FARDWO-CCC1 cruise within the Cap de Creus Canyon, as well as those from the glider section, were interpolated onto a regular grid using this isopycnic gridding method.

We have clarified the interpolation method at the corresponding sections (lines 170-173 and 211-212).

Additionally, we have reorganized the Methods section to improve the clarity of the manuscript and ensure that each type of dataset is clearly introduced. In particular, we have incorporated the SOLA station observations into section 3.2.1. alongside with heat fluxes, wind and wave data, and river discharge. We have also renamed this section as "Environmental forcings and shelf observational data". We have also created the section titled "3.4. Estimation of dense water and SPM transports from observations". Here, we describe the methodology used to estimate both the dense shelf water transport (in Sv) and the associated suspended particulate matter (SPM) transport (in metric tons) for the canyon and continental shelf transects. In this new section, we aim to integrate and reorganize information that was previously spread across different parts of the manuscript. Finally, we have also created section 3.5, entitled "Reanalysis data", which includes the use of the Mediterranean Sea Physics Reanalysis product (Escudier et al., 2020; 2021) to extend the temporal analyses of dense water transport beyond the observational period, and allows to place the winter 2021-2022 in the context of cascading events over the past two decades.

<u>Particular comments</u>

L51. What "it" makes reference to?
Reply: This was a typo. It referred to "these overflows" in the previous version. In the revised version, we have changed the sentence as follows (lines 55-59):

"As they descend, these overflows reshape the seabed by eroding and depositing sediments, and promote the downslope transport of organic matter accumulated on the shelf. Ultimately, DSWC in the GoL has been observed to impact biogeochemical cycles and the functioning of deep-sea ecosystems (Bourrin et al., 2006, 2008; Heussner et al., 2006; Sanchez-Vidal et al., 2008)".

L74-75. More prevalent than the extreme ones, thus, reducing overall DSWC over time? Or more prevalent than the "no DSWC scenario", thus, increasing overall DSWC over time?

Reply: Our sentence referred to the fact that, under climate change scenarios, MDSWC events are expected to become more frequent, while IDSWC events are projected to drastically decrease (in occurrence and magnitude). We have revised the sentence in lines 85-87 as follows to make this statement clearer: “Although IDSWC events have drawn particular attention due to their significant impacts, mild DSWC (MDSWC) events are in fact the most frequent since the set of the observational era in the GoL, and they are expected to become more prevalent under the climate change scenario (Herrmann et al., 2008; Durrieu de Madron et al., 2023)”.

During cold years, when IDSWC events occurs, most of the dense water formed over the shelf sinks into the deep ocean by deep cascading. In contrast, during warmer years associated with MDSWC events, the dense water is mainly consumed by mixing with lighter surrounding water, and only a small quantity escapes the shelf and produces shallow cascading. According to Herrmann et al. (2008), future projections indicate a significant reduction of dense water formation over the GoL’s shelf, primarily due to the stronger stratification of the water column. This enhanced stratification results in a larger density gradient between surface and deep waters, making it more difficult for surface waters to break the stratification and reach deep layers. As a consequence, most of the dense water will be diluted through mixing, even in the coldest years, reducing the volume available to export. Thus, the fraction of dense water that effectively reaches the deep ocean through cascading will be much smaller in the future. Only a minimal amount is expected to escape the shelf, mainly flowing into the surface and intermediate layers (as MDSWC), leading to the disappearance of deep cascading (IDSWC).

L99-101. I’d remove: "which was monitored during the FARDWO-CCC1 cruise, and simultaneous measurements as its adjacent shelf acquired survey as part of the MELANGE-DUNES experiment" from here as it’s too much detail for the introduction.

Reply: Done.

L118. Export of what? Just precise

Reply: Export of shelf water. We have clarified that in line 121 of the revised manuscript.

L129. What do you mean with “the concentration of water”? Are you referring to the residence time? Please rewrite, the term is awkward.

Reply: We agree that the sentence “the concentration of water” was unclear. We have rephrased the sentence and it now reads as: “where the continental shelf rapidly narrows and the Cap de Creus Peninsula constraints the circulation, intensifying the water flow and increasing the particle concentration (Durrieu de Madron et al., 1990; Canals et al., 2006)” (lines 130-133).

L.136. The full water column gets mixed? It would be surprising.

Reply: Thank you for your observation. We agree that the mixing of the full water column across the entire Gulf of Lion is unlikely. Our statement refers specifically to the continental shelf region. We have clarified this sentence in lines 139-141, which now reads: “The surface layers over the GoL shelf stratify between late spring and autumn (Millot, 1990). In winter, surface cooling and wind-driven mixing weaken the stratification, leading to a vertically homogeneous water column over the continental shelf (Durrieu de Madron and Panouse, 1996).”

L.149. 300-400 m is the upper limit I guess, above which stratification prevents the full mixing of the water column? In that case that would rather be a re-stratification, because DSW forms from the surface forcing, and then a light water layer develops in the surface. Is that it?

Reply: Thank you for your thoughtful comment. In this case, it is not a re-stratification process or the development of a lighter surface layer that limit the descent of DSW. During autumn or mild winters, DSW do not gain enough density when they are formed in the GoL to sink into the deep basin. Instead, they reach their equilibrium depth at intermediate depths, where they spread and contribute to the body of

Western Intermediate Water (WIW). We have revised the text accordingly to clarify this point (lines 150-158):

"During mild winters, these dense waters do not gain enough density ($\sigma < 29.05$ kg·m^{-3}) to sink into the deep basin, and contribute to the Western Intermediate Water (WIW) (T = 12.6-13.0 ºC and S = 38.1-38.3) body found at upper slope depths (~380-400 m) (Dufau-Julliand et al., 2004; Durrieu de Madron et al., 2005; Juza et al., 2013). The formation of WIW is an important process in the Mediterranean Thermohaline Circulation (MTHC), as it contributes to the ventilation of intermediate layers and plays a role in preconditioning the region for deeper convection events (Juza et al., 2019). During extreme winters, the potential density of DSW exceeds that of the EIW (σ = 29.05-29.10 kg·m^{-3}) and even surpasses the density of the WMDW (σ = 29.10–29.16 kg/m³), enabling DSWC to reach the deep basin around 2000-2500 m depth. This process contributes to the ventilation of the deep waters and to the final characteristics of the WMDW (Durrieu de Madron, 2013; Palanques and Puig, 2018)".

L.151. Gain

Reply: We have actually rephrased the sentence (155-157) as follows: "During extreme winters, the potential density of DSW exceeds that of the EIW (σ = 29.05-29.10 kg·m^{-3}) and even surpasses the density of the WMDW (σ = 29.10–29.16 kg·m^{-3}), enabling DSWC to reach the deep basin around 2000-2500 m depth".

L.164-165. However, all the point of TEOS10 is to promote the use of the more adequate conservative temperature and absolute salinity instead.

Reply: As we opted to use potential temperature and practical salinity to ensure consistency with previous studies and methodologies applied in the study area, we have removed the reference TEOS10 equation in the manuscript and deleted the corresponding references from the bibliography.

L.193-194. But what's the range of the bottom depth?

Reply: Thank you for your suggestion. We have now specified the bottom depth range along the glider section (83-92 m) in the revised version of the manuscript (lines 200-202).

L.216. Data is a plural noun: "Data were..."

Reply: Thank you. We have changed it throughout the revised version of the manuscript.

L.226-228. What type of data were used? Is it discharge volume?

Reply: The data correspond to river water discharge (expressed in liters per second) measured by gauging stations located near river mouths and provided by Hydro Portail v3.1.4.3 (https://hydro.eaufrance.fr). We have modified the text to add this information, which now stands as "Water discharge of rivers opening to the GoL was measured by gauging stations located near river mouths and provided by Hydro Portail v3.1.4.3 (https://hydro.eaufrance.fr)." in the revised version of the manuscript (lines 230-232).

L.286. Low compared to what? Give a reference please.

Reply: We agree that using the term "low" requires a reference or a baseline for comparison. To clarify our sentence, we have removed the word "low" (which is qualitative), and have rephrased the sentence as: "Significant wave height (Hs) ranged between 0.5 and 2.0 m (Fig. 3c) during winter" (329-332).

L.287. That's kind of surprising the existence of a storm that is not cause by strong winds, isn't it? Can you provide an explanation?

Reply: Thank you for your comment. We agree that labelling the storm as being caused by a "moderate" wind event might be confusing, given that Hs exceeded 3 m. To clarify, we have now specified in the manuscript that wind speeds reached ~19 m·s^{-1} and that the wind direction was easterly/southeasterly (E-SE) (lines 331-332). In the NW Mediterranean, E-SE winds are less frequent than the more dominant N-NW winds, but are typically associated with larger swells (Hs > 2 m and occasionally up to 10 m). They often occur simultaneously with river floods as the transport of humid marine air over the coastal promontory promotes heavy precipitation. The N-NW winds tend to produce only small waves (Hs < 2 m) over the inner shelf (Palanques et al., 2006).

The revised sentence in the manuscript states as: "Significant wave height (Hs) ranged between 0.5 and 2.0 m during winter (Fig. 3c). During this period, only one marine storm, defined as sustained Hs > 2 m for more than 6 hours (Mendoza and Jimenez, 2009), was recorded on March 13, 2022. This storm was associated with an easterly/south-easterly wind event with maximum speeds of ~19 m·s^{-1}, and generated Hs > 3 m for over 20 hours (Fig. 3c)".

L292. This is also surprising!

Reply: Following your observation, we carefully revised the time series of daily river discharge and the corresponding wind data (speed and direction). We realized that some wind directions were missing in the original plot. We have updated the figure accordingly, and we have found that the peak discharge over 5000 m^3·s^{-1} in late December was indeed associated with a brief easterly/southeasterly wind event. We have modified the text as follows: A peak discharge of over 5000 m^3·s^{-1} occurred in late December, associated with a brief easterly/south-easterly wind event (Fig. 3c)" (lines 335-336).

L.293. Low compared to which reference value?

Reply: Thank you for your question. We have now clarified this point by adding a reference to Bourrin et al. (2006), who provides daily average water discharges for the main coastal rivers discharging into the Gulf of Lion, including the Tech, Têt, Agly, Aude, Orb, Hérault, Lez, and Vidourle. We have included this citation in the text, and it now reads as "Coastal river discharges remained relatively low (see average daily water discharge values in Bourrin et al., 2006) during all the time period…" (lines 336-338), in order to provide context for what we considered "low" discharge.

Fig 3. It would be better to inverse the y-axis for density, so the densest water corresponds to the bottom layers.

Reply: Thank you for your comment. We agree with your suggestion, and have inverted the y-axis for density.

L319 and throughout the manuscript. It would be better to refer to the Moose stations by their location instead of LDC or CCC, which is complicated to remember.

Reply: As recommended, we change replaced the abbreviations "LDC" and "CCC" for the full names of the locations (Lacaze-Duthiers Canyon and Cap de Creus Canyon) throughout the manuscript to improve clarity. Additionally, we have slightly modified the text of this section as well as the caption of Figure 4 to clarify that LDC and CCC refer to Lacaze-Duthiers Canyon and Cap de Creus Canyon, respectively. We have retained the abbreviations in the figure.

L.336. Compared to what reference values? (please provide references whenever you state that XX values are low or high).

Reply: Noted. We have changed the text to avoid any confusion (lines 385-387).

Fig 5. Please avoid the used of divergent color maps for non-divergent fields as in the left column. This is misleading. Also, I'd personally prefer to see latitude instead of distance in the x-axis. I think it helps the readers to know where they are.

Reply: We agree with your comment. We have replaced the divergent colormap used for temperature in the left column of Fig. 5 for a non-divergent one, which we agree is more appropriate for representing this type of variable.

Moreover, we agree that using latitude can help the reader with geographic orientation. However, we have chosen to keep distance along the section on the x-axis because it is the most common approach in the literature, including the majority of the works cited in our manuscript. Additionally, in our case, the latitudinal variation along the section is relatively small, so we believe that replacing the distance with latitude will not substantially improve the interpretation of the figure. Nevertheless, the orientation and extent of the section is shown in Figure 1.

L341. This information belongs to methods. I actually missed it when I read it.

Reply: We agree with this comment. We have added this information to "Methods" (section 3.1.3, lines 200-202).

L.340-350. I suggest to better indicate what is from glider and what from cruise. It took me a moment to understand.

Reply: Thank you for your comment. We understand that the distinction between the glider-based data and cruise observations was not sufficiently clear at the beginning of this section. We have revised the first paragraph to explicitly indicate that it refers to glider data. Also, we have added a transition sentence at the end of the paragraph and at the beginning of the second one to specify that the T1 and T2 transects were conducted during the FARDWO-CCC1 Cruise. We hope these changes make it easier to follow the different observations in the Cap de Creus Canyon and the continental shelf.

We have also renamed the transects in Figures 5, 6, and 7 by location, which now are "Continental shelf (glider transect)", "Upper canyon (T1 transect)", and Mid canyon (T2 transect)".

Fig 6: The color bars for panels f and i are not the same, even if they have the same limits and correspond to the same variables, which is misleading and makes comparison difficult.

Reply: We have carefully reviewed the figure. We have replaced the previous colour scale for a continuous one and ensured that panels **(f and i)** share the same limits and colour mapping. Moreover, we have updated the colour scale in the glider transect (Fig. 6c), although it has a different range to better visualize the oxygen values in the continental shelf.

L430. However, the discharge was low this winter, and dense water forms other years. This makes me think that this is not a reason to justify the low density.

Reply: We agree that the way the text was written may suggest that river discharge was the main reason for the density gained by shelf waters. In fact, the density gained by shelf waters depends mostly on the atmospheric forcings (heat losses). Freshwater inputs from the Rhône River and the coastal rivers contribute to localized freshening. We have rewritten this section (5.1.) to make this statement clearer.

L.432-435. I can't really see a decrease in density, which makes me think that river discharge is not a key factor.

Reply: You are right. The higher discharge of the Rhône River and coastal rivers during winter 2021-2022 does not show a direct or clear link to a decrease in shelf water density. We have revised Section 5.1. to better reflect this point. In fact, the density of shelf waters reached 28.9 $kg \cdot m^{-3}$, which was insufficient to overcome the Eastern Intermediate Water (EIW) layer and trigger deep cascading. Instead, this MSWC event likely contributed to the body of Western Intermediate Water (WIW), as described in previous studies (Dufau-Julliand et al., 2004).

Fig 8. Wouldn't it be better to plot bottom density in order to identify dense water? Also, please change the color map for a non-divergent one. This one is misleading.

Reply: We agree with your suggestion. The figure now shows the bottom density to better identify dense shelf waters over the continental shelf. Also, we have also replaced the previous colormap with a non-divergent one.

L.446-447. As I said above, we cannot judge if the values are low or high if we don't have references.
Reply: Agree. We now mention reference values instead of "low/high" and include a comparison with previously reported IDSWC events (Canals et al., 2006) at the end of Section 5.1 (lines 498-500).

L479. Suggest.
Reply: Changed.

L489. Flows.
Reply: Changed.

L.500-510. This paragraph should definitely go to Methods and not in the discussion.

Reply: As suggested, we have moved this information to a new dedicated section in Methods ("3.4. Estimation of dense water and SPM transports from observations").

L.513. 0.05 Sv is practically zero, taking into account the strong variability. I actually would say the mean is negative? Have the authors double checked this mean? In any case, given the difference in the T1 and T2 value, I would not define the Cap de Creus Canyon as a partial sink, it is rather not at sink during mild winters. Whether or not this canyon is a sink, or export occurs through it remains confusing to me throughout the manuscript.

Reply: We have double checked our calculations and confirm that they are correct, even if the resulting transport is low. However, we acknowledge that referring to the Cap de Creus Canyon as a "partial sink" may have caused a bit of confusion. Our point was to highlight that during mild winters, such as the presented in our paper, the canyon still acts as a conduit for dense shelf waters, but only to a limited extent (upper canyon), in contrast to extreme winters. We have removed this term throughout the manuscript and revised the text to emphasize that cascading was mainly confined to the upper canyon, with weaker signals reaching the mid-canyon section. We hope that this interpretation is now clearer.

L519-520. You state you used the reanalysis "to assess the variability of dense shelf water export in the Cap de Creus Canyon during the mild winter of 2021-2022." but the computation spans the October-May period, so, beyond winter.

Reply: You are correct that the original analysis expanded beyond the winter season. We have revised the figure and changed the timeframe to include only the winter months (December, January, February, and March), which are the most relevant for the occurrence of cascading events. The manuscript has also been updated to reflect this change in section 5.3.2.

L.525. I miss having some numbers to compare the reanalysis with the observations and quantify how well they match. You should plot the same variable for the T1 and T2 transects, integrated over the same depths. You could event add a line for the value of each variable in your observations. This would provide robustness to the reanalysis results.

Reply: It is not possible to add a line for each of our observation values on the reanalysis time series of Figure 9 because our observations are based on data from CTD casts obtained on a specific day (a snapshot). Therefore, we cannot provide this comparison on a time series.

Nevertheless, we carried out a comparison between our observations and reanalysis data. First, we analysed all stations by filtering those that met the dense water temperature criteria (T < 12.9 ºC). For these stations, we calculated the depth-averaged temperature within the range occupied by the dense waters. We applied the same procedure to the reanalysis data over the corresponding locations and time. Finally, we compared the resulting depth-averaged temperatures from observations and reanalysis using the root mean square method (RMSE) statistical method, which allows to estimate the deviation (or residuals) of the predicted values (reanalysis) from the observations (Table 1). In general, RMSE are below 0.2 ºC, which shows a good agreement between both datasets, and supports the reliability of using this reanalysis product in our study to assess the temporal variability of dense water transports.

Moreover, as previously commented, we have recently submitted a paper to the same journal (Fos et al., 2025) in which we conduct a thorough statistical analysis and validate this reanalysis product against long-term mooring observations in the Cap de Creus and Lacaze-Duthiers canyons. In that paper, we demonstrate that reanalysis accurately reproduces DSWC events, matching 84% of IDSWC events within the same week and 56% on the exact date. This validation further reinforces the robustness and applicability of the reanalysis data that we use in our paper.

L.546. “relatively weak wind forcing”.

Reply: Noted.

L.560-562. How was this percentage estimated? I’m a bit confused. When we say export, I think about the water transport down-canyon to reach deeper depths, if water doesn’t get to leave the shelf I wouldn’t call it export. Throughout the manuscript the authors state (and the transport numbers suggest) that the actual export is very weak. I would like to know how these percentage were computed and, as asked before, what are the reference values in Sv (for instance a climatological mean, or the typical values in strong winters) for transport.

Reply: We have removed the reference to percentages, as we did not explicitly calculate the portion of dense waters that flowed along the coast versus the portion that was actually transported through the canyon. We agree that including these percentages without a clear reference is misleading.

On the other hand, we have decided to retain the term “export” when referring to the downslope transport of dense shelf waters into the canyon. We think it is an appropriate term since there was indeed a net downslope transport of dense shelf water, although with a much lower magnitude than in extreme winters.

Finally, to better contextualize the weak export in winter 2021-2022, we have added a reference to Fos et al. (2025), which reports a peak in dense water transport of 1.29 Sv in the Cap de Creus Canyon for the IDSWC event of winter 2004-2005. Additionally, we now include comparisons between the estimated exported volumes (in km^3) with those reported for other mild and extreme winters, in order to provide a clearer view of the interannual variability of dense water export through the canyon (lines 631-639). In this context, we have also incorporated a new figure (Figure 10) with a long time series (from 1997 to 2022) better contextualize and compare our cascading event (2021-2022) with previously reported events.

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