

We thank both reviewers for the time devoted to evaluating the manuscript and for their constructive comments, which helped us improve its clarity and overall quality. Reviewer comments are shown in regular type; **bold text** identifies our responses. Line numbers cited below refer to the clean revised manuscript.

The Results, Discussion, and Conclusions sections and their subsections were incorrectly numbered in the preprint. Their correct section numbers are 4, 5, and 6, respectively. The section numbers used below have been updated accordingly.

In addition to the changes made in response to the reviewers, we corrected minor grammatical errors, standardized terminology and section numbering, and rephrased a small number of sentences for clarity. We also made minor stylistic adjustments to the figures, including refinements to panel dimensions and spacing and the addition or adjustment of labels. We also made minor stylistic adjustments to the figures, including changes to panel dimensions, spacing, and labels; reformatted the reference list; and renumbered the supplementary figures according to their order of citation. These changes affect presentation only and do not alter the data, analyses, results, or scientific conclusions.

Reviewer 1

This manuscript presents a comprehensive and well-structured analysis of the impact of wind variability on surface ocean properties over the Patagonian continental shelves. The study addresses a relevant and timely topic, combining satellite observations and reanalysis data with a coherent methodological framework based on EOF analysis, spectral decomposition, and composite techniques. The results are internally consistent and provide a physically plausible interpretation of the link between wind variability and ocean surface response. In particular, the identification of the dominant role of meridional wind variability and its connection to large-scale patterns across both the Pacific and Atlantic shelves is an interesting and valuable contribution.

The figures are clear, well organized, and effectively support the results presented in the manuscript. The captions are detailed and informative.

Overall, the manuscript is clearly written and well organized, and it makes a solid contribution to the understanding of regional ocean dynamics. The following comments are intended to further improve clarity, consistency, and the physical interpretation of some aspects of the analysis.

Response: Thank you for the positive assessment of the manuscript. We have addressed each suggestion as detailed below.

Introduction

The introduction is well structured and the progression from the general context to the regional description and study objectives is clear. However, the use of subheadings within the introduction feels somewhat inconsistent. The subheadings ("The Pacific Patagonian Shelf" and "The Atlantic Patagonian Shelf") appear mid-introduction without corresponding subheadings for the opening paragraphs or the closing section on objectives, which may interrupt the overall flow.

This is also slightly inconsistent with the structure adopted in later sections of the manuscript (e.g., Methods and Results), where a clear hierarchical organization with numbered subsections is used. A simple way to improve this would be to introduce a third subheading (e.g., "Aims of this study") to clearly mark the transition to the objectives and maintain structural consistency throughout the manuscript. In this context, it may also be helpful to move lines 115-119 (where the proposed mechanism is introduced) to the beginning of this subsection, as they would provide a more natural motivation for the objectives.

Response: As suggested, we numbered the Introduction subsections as 1.1-1.3, added Sect. 1.3, "Aims of this study," and reorganized the proposed mechanism and objectives within that subsection (lines 113-125).

Additionally, the first two paragraphs (L28-37) would benefit from the inclusion of references. In particular, a general reference supporting the role of wind forcing on continental shelf dynamics (L31), as well as citations supporting the statements regarding previous studies and remaining knowledge gaps (L34 and L36-37), would strengthen the context and better position the study within the existing literature.

Response: We added references supporting the role of wind forcing on continental shelf dynamics (line 31) and the interocean exchanges around southern South America (line 33).

Results

Section 4.1

This section provides a useful and clear overview of the mean fields and variability patterns, effectively preparing the reader for the EOF analysis.

SSS variability (around line 263): The discussion of nearshore SSS variability could benefit from a clearer distinction between physically meaningful variability and potential artefacts or uncertainties associated with satellite-derived salinity products in coastal regions. In this context, it may also be useful to explicitly acknowledge that satellite-derived salinity products can present systematic uncertainties near the coast and in regions with strong gradients, which could influence the interpretation of the spatial variability patterns.

Response: We have added a cautionary note in Sect. 2.2 on reduced sensitivity in cold waters and land contamination near the coast (lines 146-148). Section 4.1.2 also discusses coastal data limitations and freshwater inputs, with additional references (lines 285-291).

SLA variability (around line 293): The persistence of the spatial structure of SLA variability after removing the seasonal cycle is an interesting result. Since this is later explained in terms of intraseasonal wind forcing and geostrophic adjustment (Sections 4.3 and 5), a brief forward reference here, for example, noting that non-seasonal wind variability is explored in subsequent sections, would help the reader anticipate the physical interpretation and improve the flow of the manuscript.

Response: We added a forward reference at the end of Sect. 4.1.3 indicating that the possible influence of non-seasonal wind variability on SLA is examined in Sect. 4.3 (lines 315-316).

Wind (around line 295): The relatively large variability of the meridional wind component compared to its mean-implicating frequent reversals-is an important result. Since meridional wind variability is later identified as a key driver of ocean variability, it would be helpful to more explicitly highlight its physical implications here and briefly anticipate its role in modulating cross-shelf transport and surface properties.

Response: We added a sentence highlighting the potential role of frequent meridional wind reversals in modulating along-shelf circulation on both margins (lines 343-346).

Section 4.2.1 (EOF analysis)

The EOF analysis is well implemented and provides a useful framework to describe the dominant patterns of variability. Some aspects of the interpretation could be further refined. In particular, it would be useful to acknowledge that EOF modes represent statistical modes and are not necessarily associated with independent dynamical processes, especially when assigning physical meaning to them.

Response: We clarified in Sect. 3.3.1 that the PCs are uncorrelated at zero lag, but that this property does not imply statistical independence or a one-to-one correspondence between EOF modes and independent dynamical processes (lines 206-208).

Additionally, some modes (e.g., SSSa) explain a relatively small fraction of the total variance, their robustness and physical relevance could be further discussed.

Response: We revised Sects. 4.2.1 and 5.2 to emphasize the low variance explained by the SSSa modes (14% and 7%), their spatially heterogeneous patterns, the shorter SSS record, and the limited magnitude and spatial extent of their correlations. We also clarified the regional relevance of EOF2-SSSa, which captures energetic intraseasonal variability in the southern Pacific (lines 369-380 and 624-643).

Also, a clearer connection between the spatial patterns and the dominant temporal scales identified in the spectral analysis would strengthen the interpretation.

Response: We revised the descriptions of the spectra in Sects. 4.2.1 and 4.2.2 and added a comparison of the dominant ocean and wind timescales. The strongest wind–ocean spectral overlap occurs at intraseasonal periods (lines 416-426). We also added a caveat concerning the limited resolution of interannual periods (lines 574–578). Section 5.2 discusses the temporal resolution of the SSS product and the increase in SSSa–wind correlations after filtering wind variability shorter than 40 days (lines 639–643).

In addition, it may be helpful to briefly discuss the sensitivity of the identified modes to the preprocessing choices (e.g., filtering and detrending), as these steps can influence the variance distribution and spatial patterns. Clarifying this would help assess the robustness of the EOF-based interpretation.

Response: We repeated the EOF analysis using alternative low-pass filters and seasonal-cycle removal methods. The tested configurations and their robustness are described in Sect. 3.2.2 (lines 194-198) and shown in Figs. S1-S5. Linear detrending was retained in all tests and is described in Sect. 3.2.1 (lines 176-178).

It may also be useful to briefly discuss the sensitivity of the results to the temporal filtering applied, as this could influence the variability patterns identified.

Response: This is addressed by the sensitivity tests described above, which include low-pass cutoff periods of 10, 20, and 30 days, Butterworth and Lanczos filters, and alternative methods for removing the seasonal cycle (lines 194-198; Figs. S1-S5). We also explicitly examined the sensitivity of the SSSa–wind relationships to a 40-day wind cutoff in Sect. 5.2 (lines 639-643).

Section 4.3.2 (Composites)

This section provides a coherent and well-structured analysis linking wind variability to ocean surface properties through composite patterns. The results are internally consistent and physically plausible. However, some aspects of the interpretation could be slightly tempered. In particular, it would be helpful to more clearly distinguish between statistical consistency and physical causality when attributing changes to wind forcing.

Response: We added an explicit statement at the beginning of Sect. 4.3.2 that the composites describe statistical associations consistent with the proposed mechanisms but do not establish causality on their own (lines 476-478). We also adopted more cautious wording in the interpretation and Conclusions, and numbered the composite subsections consistently.

Discussion (Section 5)

For consistency with the structure used in previous sections, it may be helpful to introduce subsection numbering in Section 5 (e.g., 5.1, 5.2, etc.), rather than using only informal subheadings.

Response: The Discussion subheadings are now numbered as Sects. 5.1, 5.2, and 5.3.

SSSa: The discussion of SSSa variability is generally cautious but could be further refined. In particular, the leading EOF modes explain a relatively small fraction of the total variance, and the correlations with wind are relatively weak, suggesting a more complex and possibly multi-factorial control. Additional processes such as mixing, advection, and freshwater inputs may also play a role and could be more explicitly considered. Furthermore, the known limitations of satellite-derived salinity products, especially in coastal regions, should be more clearly taken into account when interpreting these patterns.

Response: Section 5.2 discusses the low explained variance, shorter observational record, and limitations of the SSSa analysis (lines 624-626), and notes the weak correlations with wind (line 629). It discusses the role of freshwater inputs and states that the separate contributions of advection, mixing, and freshwater inputs were not quantified (lines 655-658). We also emphasize that SSSa signals near the Strait of Magellan require cautious interpretation and confirmation with in-situ observations (lines 669-672).

Reviewer 2

This article presents an analysis of the impact of wind variability on anomalies of the sea surface temperature, salinity and height over the Patagonian shelves in South America. The authors find a strong modulation of the circulation by the meridional winds with southerly winds promoting upwelling and offshore flow of fresher waters over the Pacific shelf and strong flow of cold-salty water over the Atlantic shelf with northerly winds reversing this pattern. The study shows the interconnection of the regions by the winds filling an observational gap and addressing the PCS system as a whole.

The article is well written, and I only have minor corrections and suggestions. Also, I would like the authors to clarify on potential uncertainties in the use of satellite altimetry over shallow waters. Subject to the authors adequately addressing the concerns raised in this review, I recommend the manuscript for publication.

Response: Thank you for the positive assessment. We agree that uncertainties in satellite altimetry over coastal and shallow shelf waters required more explicit treatment. We revised the manuscript accordingly and addressed each suggestion below.

Important remarks

Comment on SLA in coastal regions and its uncertainty? See Birol et al. (2025), "Understanding uncertainties in the satellite altimeter measurement of coastal sea level: insights from a round-robin analysis."

You mentioned the unreliability of the data in line 267 when referring to SSS within 40-100 km from land and in line 498 mentioning "near-shore altimetric limitations associated to the geophysical corrections". While the manuscript does discuss the SLAa results in depth and compares results with reanalysis data, there is only brief mention of potential uncertainties associated with altimetry measurements in waters shallower than 200 m, which are typically found over continental shelves. It would be beneficial to highlight this limitation early in the discussion to make readers aware of potential data caveats and to provide appropriate context for the interpretation of the results.

Response: We added a cautionary note in Sect. 2.2 stating that satellite-derived SLA has increased uncertainty in coastal and shallow shelf waters (lines 155-156). We also added a limitations paragraph at the beginning of Sect. 5 identifying uncertainties associated with land-contaminated waveforms, retracking, tidal corrections, mean sea surface estimates, and the effective resolution of gridded altimetry products, citing Birol et al. (2025) and Ballarotta et al. (2019) (lines 564-568). Finally, we rewrote the sentence quoted by the reviewer (line 498 of the preprint, now in Sect. 4.3.2.2) to identify the specific sources of uncertainty in the narrow, shallow and macrotidal region of Grande Bay, replacing a personal communication with Birol et al. (2025) (lines 540-543).

Minor suggestions and fixes

Introduction

Line 84. Replace "characterize" by "characterized".

Response: Corrected (Sect. 1.2, line 85).

Line 107. Remove brackets from reference in narrative citation, i.e., Juhl et al. (2024) demonstrate ...

Response: Corrected (lines 107-109).

Data

Line 146. Remove "," after "2025".

Response: Corrected (Sect. 2.2, line 146).

Methods

Line 215. Identify all terms in Eq. (1).

Response: All terms in Eq. (1) are now defined immediately after the equation (lines 225-228). We also defined the upper limit K of the summation in Eq. (2), which was the only term in that equation that remained undefined (lines 236-237).

Line 222. Fix "revision mode" after "functions of the ..."

Response: Corrected in the description following Eq. (2) (lines 235-236).

Results

Line 233. This section starts with a figure and no description or introduction to lead result. Perhaps move the figure to section 4.1.1 or break the composites for each of the sections 4.1.X as done in section 4.2.1.

Response: We added an introductory paragraph at the beginning of Sect. 4.1 describing the organization and purpose of the mean and standard-deviation fields before presenting Fig. 2 (lines 247-251).

Line 303. I do not see a "white" dashed line, just a black one. Similarly, in line 333 I do not see a "Gray" line. Check other similar figures.

Response: We corrected the colour descriptions in the captions of Figs. 3-5 (lines 320-325, 355-360, and 398-404) and checked that the remaining captions match the plotted isobaths.

Discussion

Line 530. Fig. 5?

Response: We have added the reference to Fig. 5d: "This mode is weakly but significantly correlated with the first mode of meridional wind variability (Fig. 5d, Table 1) and emerges prominently in the EOF1-Va composites (Fig. 6a and b)." (lines 584-585).