Editor comments

Thanks for the corrections. Sorry, but we're still not ready for publication.
In response to your response
" ... that 10−4 W/kg is a large value. Rather than using standard theoretical values, we chose to use actual in-situ observational ϵ data. ... Consequently, this value represents the maximum dissipation recorded in the upper layer (inside h1) during a windy period, rather than an average, serving to illustrate the upper-bound limits of mixing under strong wind forcing."
I note two critical issues:

1) I checked the preprint link you provided (thanks!). In that paper, all dissipation figures (colormaps) were cut at 10-6. Histograms show very few data points with larger values (appendix). Section 4.5 provides values (see below) which are not consistent with what you use. It is difficult to support the value you cite from that manuscript.

2) Use of a single data point with maximum dissipation in this energetics context is simply wrong. To explain dPhi/dt, the average energy dissipation rate should be representative of the dt period and h1 layer. Because you are stating "...,first-order approximations indicate that the wind power is comparable to the estuarine stratification power during episodic and intense winds" you can use a more representative value (10-7 to 10-6) and could still report "comparable" first-order approximation.

That paper, in section 4.5, reports turbulence values from two regions: Northern and Southern Patagonian fjords. [For your study, the relevant observation is from the southern region.] I quote: "the northern Patagonian fjords... During the winter 2024 campaign; extreme values occasionally reach –6 (<5%). ...PN-3 displays the highest turbulence intensities, with winter 2024 ...occasional high epsi values up to –6"....In the southern basins, PS-1 shows lower occurrence of high epsi values (>–7) ..."
Based on this, I cannot accept the value you quote and suggest you consider using an order of magnitude for average, representative dissipation during windy periods [perhaps max O(10-6)].

Ilker

Re:

We thank the Editor for this highly constructive observation. We fully agree that using a single maximum dissipation data point (10^{-4} W/kg) to represent the average energy dissipation rate over the dt period and the h_1 layer was methodologically incorrect.

Following your suggestion, we have adjusted our energetics calculations. We now use a more representative average dissipation rate of $\epsilon \sim O(10^{-6})$ W/kg during windy periods, which is entirely consistent with the turbulence intensities observed in the southern basins according to the cited reference. In the new estimations we changed the ϵ order and N2 based on Rojas-Celis (2025) observations.

However, by adopting this more representative (and lower) value of ϵ, the calculated eddy diffusivity (K_z) is proportionally reduced. To accurately evaluate whether the wind power can still compete with the estuarine stratification power under these new parameters, we had to address a fundamental physical assumption regarding the vertical mixing coefficients.

A common simplification is to assume that vertical eddy viscosity equals vertical eddy diffusivity ($A_z = K_z$, i.e., a turbulent Prandtl number $Pr_t = 1$). Yet, as extensively documented in the literature, this assumption breaks down in strongly stratified environments because buoyancy forces suppress scalar mixing much more efficiently than downward momentum transfer. Under highly stable conditions, classical parameterizations and observational data show that Pr_t increases significantly, reaching values of $\mathcal{O}(10)$.

By incorporating this physically constrained scaling ($Pr_t = 10$) alongside the revised $\epsilon \sim \mathcal{O}(10^{-6})$ W kg-1, we obtained an effective eddy viscosity of $A_z = 7.14 \times 10^{-4}$ m2 s-1. This value is highly consistent with background viscosities used in numerical models for Patagonian fjords under strong stratification (e.g., Castillo et al., 2012). More importantly, it yields an estuarine stratification power ($d\phi_E/dt = 2.1 \times 10^{-3}$ W m-2) that remains fully comparable to the wind power during intense episodic events (1.2×10^{-3} W m-2).

Thanks to your observation, we have significantly strengthened the physical rigor of our first-order approximation, confirming our original conclusion through a much more robust and defensible methodology.

We have extensively rewritten the paragraph discussing this energetics in the manuscript to reflect the revised representative ϵ value and to explicitly introduce the Pr_t scaling. The revised text now reads as follows : see Lines 751 – 772

"To determine if this wind power is sufficient for mixing, it must be compared to the power required to maintain stratification $d\phi_E/dt$ by the estuarine circulation (Simpson et al., 1990). This stratification power is given by: $d\phi_E/dt = (1/320)(g^2 h_1^5/A_z \rho)(\partial\rho/\partial x)^2$. Following Osborn (1980), the vertical eddy diffusivity is parameterized as $K_z = 0.2(\varepsilon/N^2)$. Based on microstructure measurements from winter 2024 (Rojas-Celis et al., 2025), we assume a representative dissipation rate of $\varepsilon \sim O(10^{-6})$ W kg^{-1} and typical buoyancy frequency of $N^2 = 0.0028$ s^{-2} which yields $K_z = 7.14\text{x}10^{-5}$ m^2 s^{-1}.

The relationship between the vertical mixing of momentum and scalars is governed by the turbulent Prandtl number ($Pr_t = A_z/K_z$; Thorpe, 2005). Assuming the standard Reynolds analogy for neutral or weakly stratified flows ($Pr_t = 1$; Mellor and Yamada, 1982; Rodi, 1987), the resulting eddy viscosity ($A_z = K_z$) yields a stratification power of $d\phi_E/dt = 21\text{ x}10^{-3}$ W m^{-2}. This value is an order of magnitude higher than wind power ($d\phi_W/dt$), which would imply that wind forcing is insufficient for mixing. However, the $Pr_t = 1$ assumption breaks down under stratified environments where buoyancy forces supress scalar mixing more efficiently than downward momentum transport (e.g. Munk and Anderson, 1948; Venayagamoorthy and Stretch, 2010). Consequently, in highly stable flows, Pr_t increases significantly, often reaching values $O(10)$ (e.g. Pacanowski and Philander, 1981; Peters et al., 1988). Applying a scaling of $Pr_t = 10$ to the summer conditions in the Almirantazgo fjord yields an effective eddy viscosity $A_z = 7.14\text{ x}10^{-4}$ m^2 s^{-1}. This reduces the estuarine stratification power to $d\phi_E/dt = 2.1\text{ x}10^{-3}$ W m^{-2}.

Under these physically constrained parameterizations, first-order approximations indicate that estuarine stratification power becomes comparable to the wind power during intense episodic winds events of up to 9 m s^{-1} ($d\phi_W/dt = 1.2\text{ x}10^{-3}$ W m^{-2}). This scaling suggests that despite the high static stability of the water column, wind momentum can be sufficiently transferred downward to overcome stratification and induce mixing. Nonetheless, these steady-state assumptions warrant further validation through future observational and numerical studies to better constrain the spatiotemporal variability of mixing in the fjord. "

Additionally, to maintain the focus of the Conclusions section on the most direct and robust empirical evidence (e.g., the Wedderburn number and the elephant seal data), we have removed the first-order energetic comparisons from the Conclusions, keeping them strictly within the Discussion section where such scaling arguments belong.

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