Referee Report - Manuscript essd-2026-42

Manuscript Title: Climatology of the Sea Temperature from Long-Term In Situ Observations: Northern Chilean Patagonia.

Authors: Pujol et al. 2026

1. General assessment

This paper presents a four-dimensional temperature climatology for Northern Chilean Patagonia, covering the period 1948–2023 at approximately 900 m horizontal resolution and 32 depth levels between the surface and 400 m. The interpolation is performed with DIVAnd, a well-established variational tool that accounts for bathymetric constraints and data uncertainties. The work compiles roughly 3.3 million in situ observations drawn from several public repositories and regional monitoring programmes, merging them into coherent monthly and daily-derived gridded fields.

The topic is of genuine scientific relevance. Northern Chilean Patagonia is a poorly instrumented region where persistent cloud cover and complex fjord geometry limit the utility of satellite products, and where the expansion of aquaculture makes an accurate thermal baseline increasingly important. To my knowledge, no previous study has produced a spatially continuous, in situ-based climatology for this entire region at the resolution reported here, and the potential applications listed by the authors, from model validation to marine heatwave detection, are realistic and well motivated. The manuscript is clearly written, the figures are informative, and the discussion places the results appropriately within the existing literature on Patagonian oceanography.

I have a number of concerns that I believe should be addressed before publication. Most of them relate to documentation and transparency rather than to the scientific substance of the work, and I am confident they can be resolved without difficulty. I recommend minor revisions.

2. Main concerns

2.1 Undocumented difference in depth coverage between the two products

The monthly and daily-derived climatologies differ substantially in their vertical coverage: the monthly product spans 32 depth levels from 0 to 400 m, whereas the daily product covers only 14 levels from 0 to 100 m. This distinction is correctly reflected in the Zenodo repository metadata, but it is never stated in the manuscript. The abstract and conclusions describe the study as producing a product with “32 vertical levels” and coverage “from the surface to 400 m” without clarifying that these specifications apply only to the monthly file. A reader who downloads the

daily file expecting full-depth coverage will find it limited to the upper 100 m. The manuscript should clearly state, at the first description of the daily product (Section 2.3) and in the abstract, that the daily-derived climatology is restricted to 14 depth levels between 0 and 100 m, and should briefly explain the rationale for this choice.

2.2 Absence of subsurface validation

The validation presented in Table 4 is limited to the sea surface (0–1 m depth). While this is the layer with the most observations, the product extends to 400 m, and a user intending to employ the climatology as background for subsurface assimilation or model comparison has no quantitative basis for assessing its reliability at depth. The authors do show profile comparisons in Figure 8, which is helpful, but the comparison is qualitative. I would expect, at minimum, summary validation statistics (correlation, RMSE, bias) for a representative set of depth levels, or a reference to the validation procedure for depth. If a fully stratified validation is not feasible given the data sparsity at depth, the authors should be explicit about this limitation and note the depths below which the climatology should be used with caution.

2.3 Spatial sampling bias

Table 2 reveals that 76.8% of all observations come from Comau Fjord alone. The authors acknowledge this but do not assess its impact on the resulting climatology. The concern is whether DIVAnd's spatial smoothing adequately compensates for the extreme undersampling of other basins, particularly in the southern part of the domain (Elefantes Channel: 0.32%, Chonos Archipelago: 0.95%). The validation in Table 4 does not distinguish spatially between well-sampled and data-sparse regions, so it is not possible to tell whether the performance metrics are dominated by Comau Fjord. I would encourage the authors to provide at least a regional breakdown of the validation statistics, or to test the sensitivity of the climatology in data-sparse areas by, for instance, comparing the full climatology with one produced excluding Comau Fjord data.

2.4 Temporal representativeness

The data span 75 years in principle, but the authors note that 99% of observations post-date 1990 and 55% post-date 2010 (lines 130–131). The climatology is therefore predominantly a representation of recent thermal conditions rather than a true long-term mean, which has implications for its use as a baseline against which to measure trends or anomalies. This is not necessarily a fatal limitation, but the authors should discuss it more explicitly, for example, whether the product is better described as a climatology of the 1990–2023 period with historical anchor points, and how the underrepresentation of earlier decades might affect the mean state.

3. Minor concerns and technical corrections

3.1 Inconsistencies in the manuscript text

Line 199 contains the placeholder “see Table XX for details”,

Line 319: “4-dimentional” should read “4-dimensional”.

Line 373: “Chacao Channal” should read “Chacao Channel”.

Line 390: “associated wit harmful” should read “associated with harmful”.

3.2 Very high NaN fraction at depth

At 400 m, approximately 94% of the monthly grid cells contain NaN, meaning that fewer than 6% of the domain has valid interpolated values at maximum depth. This is not in itself a problem, it reflects the narrow geometry of the fjords and the rapid increase in land fraction with depth, but it is worth noting explicitly so that users are not surprised. A brief statement or a figure showing the spatial coverage as a function of depth would help.

3.3 File format and Zenodo deposit structure

The manuscript never explicitly states the format of the distributed files (NetCDF3-Classic, as confirmed by inspection). This should be stated in Section 2.3 and in the data availability statement, along with the coordinate reference system (WGS84, assumed). Users would also benefit from a note about recommended software for reading the files and, ideally, a short code snippet or Jupyter notebook in the Zenodo repository.

The Zenodo description also notes that the cited deposit (zenodo.18255999) is a subset of a larger deposit (zenodo.14845077) containing the full dataset, including the in situ observations used to construct the climatology. The manuscript does not mention this parent deposit, which seems relevant: readers who wish to access the underlying observational data should be directed to it. I recommend that the data availability statement reference both DOIs and clarify what each contains.

4. Recommendation

This is a solid piece of work that will be a useful resource for the oceanographic community working in Chilean Patagonia. The methodology is sound, the regional context is well described, and the presented results are consistent with previous knowledge of the area. The concerns raised above relate primarily to documentation and transparency rather than to the scientific substance, and I expect them to be resolved without difficulty. I recommend **minor revisions**.