

Reviewer's comments for Drivers of the spatiotemporal distribution of dissolved nitrous oxide and air-sea exchange in a coastal Mediterranean area

This study investigates the spatiotemporal distribution of dissolved N₂O and air-sea exchange in the coastal waters of the Balearic Islands. The authors identify temperature, salinity, and chlorophyll a as key drivers influencing N₂O variability, using machine learning approaches to analyze their relationships. Their findings contribute valuable data on N₂O fluxes in a Mediterranean coastal system, an area where such measurements remain limited. However, several aspects of the study warrant further clarification and discussion. Below are my comments and suggestions for this manuscript.

The title suggests that the study identifies drivers of the spatiotemporal distribution of dissolved N₂O and air-sea exchange. However, the manuscript does not clearly demonstrate how the measured parameters (drivers) directly influence these variations over time and space. Additionally, why were these specific parameters chosen as drivers? For instance, why was NH₄⁺ not included.

In addition, the study area appears to be relatively shallow. Were sediment N₂O fluxes considered? If not, could the lack of sediment contribution explain the weak relationships observed in the study?

Line 21: Consider providing the average air-sea flux with standard deviation for clarity and comparison.

Line 36: Briefly introduce nitrification and denitrification, including the conditions under which these processes occur.

Line 86: Time sampling timeline is unclear. Please specify when the samples were collected.

Line 136 - 143: Please specify the bottle type, volume, and collection frequency for DO, Chl a, nutrient, DOC and N₂O samples.

Line 202: This section lacks descriptions of basic environmental parameters, such as surrounding nutrient and oxygen variations. While these results are presented in Section 3.2, that section mainly focuses on their impact on N₂O rather than describing the environmental parameters themselves. To improve clarity and provide a better understanding of local environmental conditions, consider including these descriptions here

Line 205: Is it BP or PB? The abbreviation appears inconsistent. Please check for consistency, including in the Methods section.

Line 226-234: The table is unclear. It states significant seasonal, yearly, monthly, or station differences for some parameters, but these are not evident in Table 1. Please clarify or update the table accordingly.

Line 254: Unit?

Line 265: The not shown results could be included in the supplementary material.

Line 285: The study found low NO_3^- and NO_2^- concentrations, weak nitrification signals, and no correlation between AOU and N_2O . Based on these findings, the authors propose that photosynthetic organisms-driven NO reduction could be a source of N_2O in their system. This presents an interesting alternative pathway to nitrification and denitrification. However, based on these data, this hypothesis remains uncertain. Please provide a more detailed explanation of how this mechanism works.

Line 296: The explanation in Section 3.2 is largely based on the GBM and CVB results; however, it lacks a deeper discussion on the relationships between parameters and N_2O , as well as a literature review for comparison. Expanding on these aspects would strengthen the section.

Line 312: I agree that coastal air-sea N_2O exchange is an important parameter in the context of GHG emissions. However, this section lacks comparisons with similar studies or coastal systems, making the discussion somewhat limited.

Lines 329-339: The description of the study sites is insufficient. It is unclear which areas are open regions and which have seagrass. This lack of detail in the study location section makes their sudden appearance in the discussion feel abrupt. In addition, please explain the mechanism and process by which vegetation acts as a sink for N_2O .

Line 340: Please provide references for European seagrass constitute.

Line 344: The Methods section does not describe the presence, extent, or coverage of seagrass meadows at the study sites. Since seagrass is later discussed as a factor influencing N_2O dynamics, please provide details on seagrass distribution and area to support these claims.

Line 353: The estimation of N_2O GWP is based on a 1 km offshore distance and 1,428 km of coastal length. What is the basis for this area calculation? Additionally, uncertainty should be provided for this conversion. Does this area calculation include both seagrass meadows and bare sediments?

Line 361: Line 361: Ensure unit consistency—sometimes 'nM' is used, while other times ' nmol L^{-1} ' appears. Please standardize throughout the text

There seems to be inconsistent use of r and R^2 . Please ensure consistent notation throughout the text.