

#MarineData4SouthAmerica

Physical oceanographer actively working with data from Copernicus Marine Environment Monitoring Service (CMEMS)

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Climate change impacts on fisheries and conservation of marine species

Subsurface Ocean Warming Hotspots and Potential Impacts on Marine Species: The Southwest South Atlantic Ocean Case Study

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Main question: In the southwest South Atlantic Ocean (SWAO) strong ocean surface warming (or “hotspots regions”) have been observed. However, there was no knowledge about the signature of ocean hotspots below the surface and the potential effects of ocean warming on marine biota.



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Objectives:

In this work, we provide initial evidence of how deep the hotspots of the SWAO extend in the water column, in particular at mid-water and bottom layers where two marine species - the green turtle (*Chelonia mydas*) and the Patagonian scallop (*Zygochlamys patagonica*) - inhabit.

Dataset:

We compare 15 years (2003–2017) of **Copernicus Marine Environment Monitoring Service (CMEMS) ARMOR3D** high-resolution ($1/4^\circ$) 3-D temperatures reprocessed from combined satellite and in situ observations with **high-resolution ($1/12^\circ$) Mercator ocean reanalysis**. We also use location data of *C. mydas* and *Z. patagonica* to discuss the potential impacts of warming on these species in terms of geographic distribution, phenological shifts and thermal tolerance.



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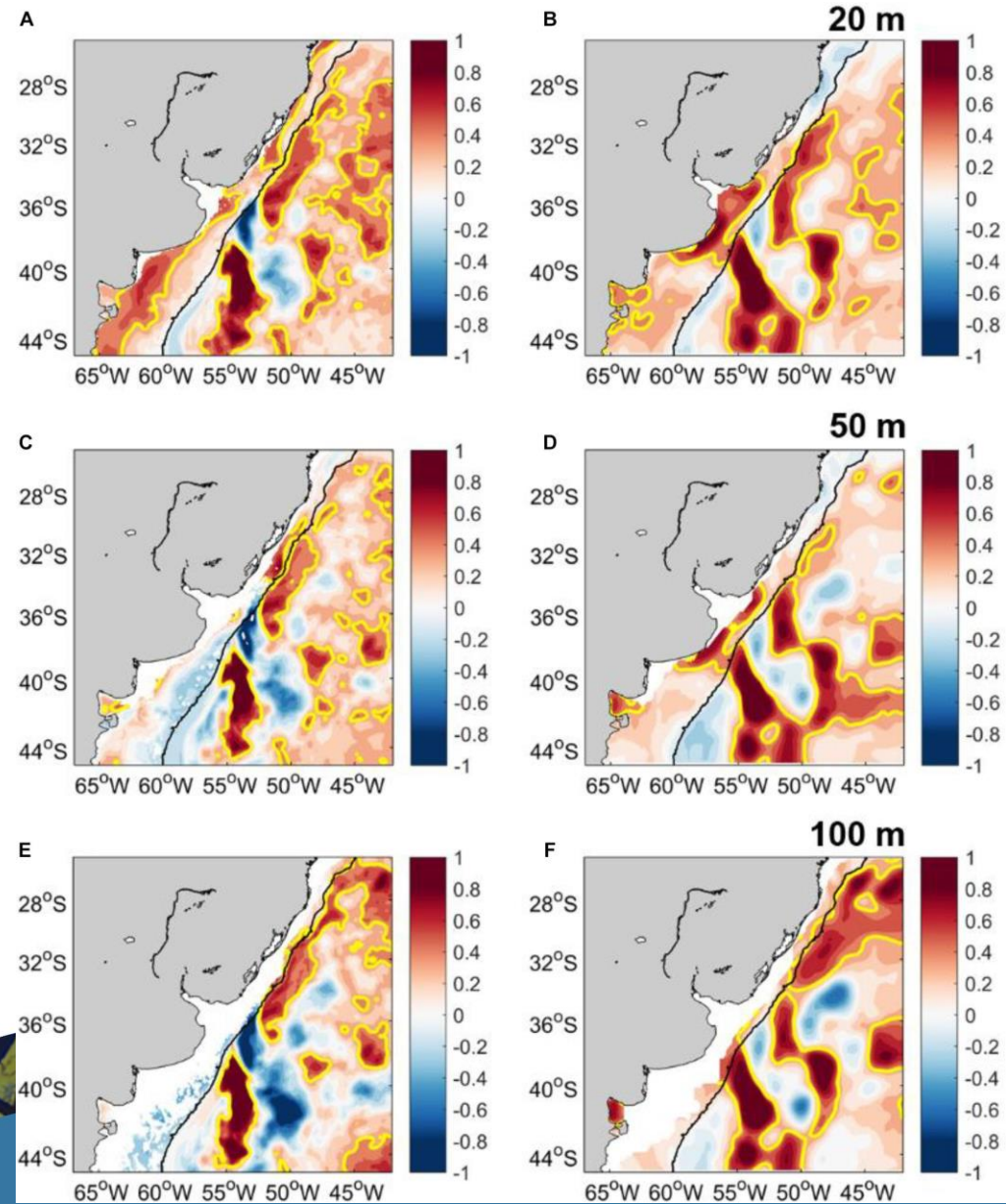


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Main results from CMEMS dataset:

FIGURE 2

GLORYS12 temperature trend ($^{\circ}\text{C}/\text{decade}$) during 2003–2017 at (A) 18 m, (C) 47 m, and (E) 92 m. ARMOR3D trend ($^{\circ}\text{C}/\text{decade}$) at (B) 20 m, (D) 50 m, and (F) 100 m. The yellow contour corresponds to the $0.4^{\circ}\text{C}/\text{decade}$ isoline. The 200 m isobath is shown in black.



Green Turtle Data and Distribution Modeling:

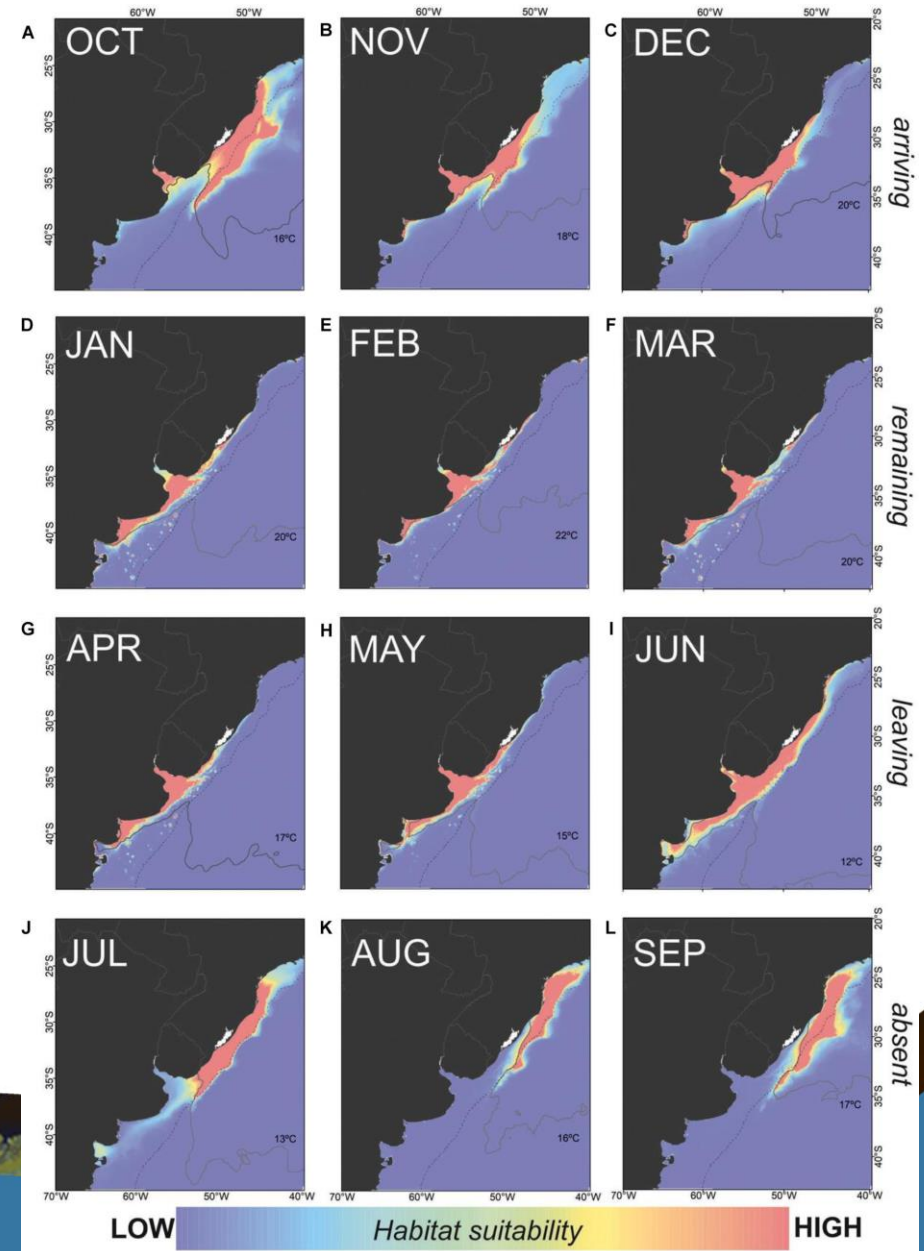
To explore potential changes in *C. mydas* austral distribution likely driven by the warming of inner shelf waters, we used satellite tracking of nine juveniles during the period (2008–2011). Then, we developed maximum entropy (MaxEnt) species distribution modeling to identify the potential distribution of *C. mydas* in relation to two predictor variables: SST and bathymetry. **SST is derived from GLORYS12 data for the period 2008–2011.**

Our modeling exercise shows that the potential distribution of the species in the SWAO is driven by **SST** and bathymetry, though the contribution of **SST changes** during different seasons.

Main results from CMEMS dataset:

FIGURE 3

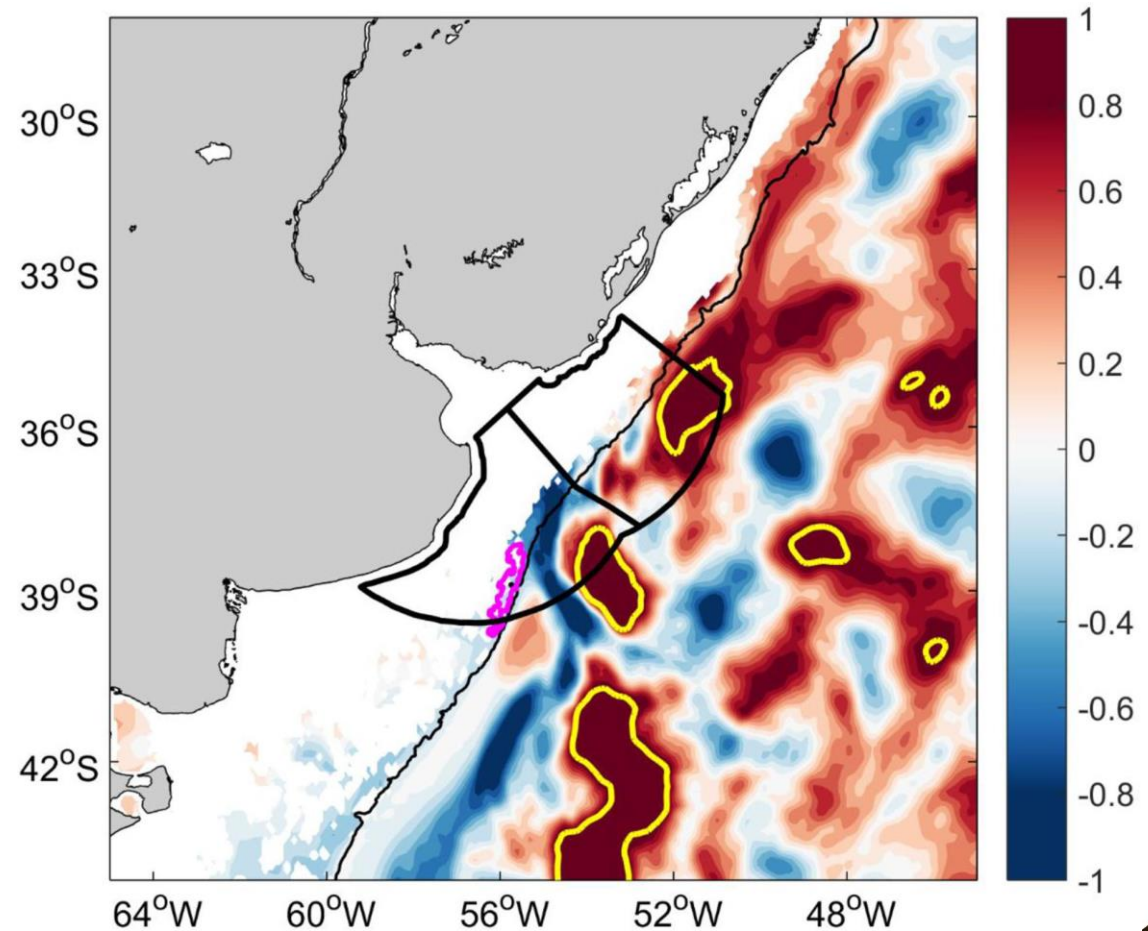
Green sea turtle (*Chelonia mydas*) monthly habitat suitability throughout the year in its boundary range of the SWAO. *C. mydas* behavior is divided in periods as: (A–C) arriving, (D–F) remaining, (G–I) leaving, and (J–L) absent. Dashed black line indicates 200 m isobath.



Main results from CMEMS dataset:

FIGURE 4

GLORYS12 temperature trend ($^{\circ}\text{C}/\text{decade}$) during spring of 2003–2017 at 92 m. The Argentina-Uruguay Common Fishing Zone (AUCFZ) is shown by two heavy-black polygons. The northernmost and largest Patagonian scallop bed is shown by a magenta polygon. Trends higher than $1^{\circ}\text{C}/\text{decade}$ are depicted by a heavy yellow line. The 200 m isobath is shown in black.



Main contribution from Copernicus Marine Environment Monitoring Service (CMEMS)

→ The high-resolution (1/12°) Mercator ocean model:

Given the **lack of long-term monitoring programs** to address the impacts of climate change on marine biota in the SWAO, our results could provide the first effort to call the attention of stakeholders and decision makers on marine conservation and fishery management to work toward better management strategies in the context of **climate change**.

Data Availability Statement

Publicly available datasets were analyzed in this study. This data can be found here: Copernicus Marine Environment Monitoring Service (CMEMS) (<https://marine.copernicus.eu/>).

Figure 1

Schematic circulation in the **Southwest South Atlantic Ocean (SWAO)**. Concentration of surface chlorophyll-a (mg m^{-3}) from the SeaWiFS radiometer (austral summer average) is shown in the background colors. The magenta lines indicate the schematic shelf circulation. The Brazil-Malvinas confluence (BMC) region is shown.

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