Editorial

Sea Surface Temperature: From Observation to Applications

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Sea surface temperature (SST) has been defined by World Meteorological Organization (WMO) as one of the essential climate variables (ECVs) contributing to the characterization of Earth's climate. As one of the ECVs, SST study and analysis have been receiving growing interest in the last two decades, especially as new databases from satellites have become increasingly available with higher spatial and temporal resolution. In a global and accelerated climate change environment, SST can be understood as a proxy of the ocean's role as an energy storage facility. This role is especially important to derive future trends in climate change and their impacts on climate, weather extremes, marine ecosystems, and on human societies.

The main mechanism by which the ocean interacts with the atmosphere is through heat and moisture exchanges. Those processes exert a major influence on the development of extreme weather events, such as hurricanes or torrential rains, which are projected to increase in frequency and intensity in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) [1]. Hence, good knowledge of SST patterns and trends is crucial to investigate interactions/feedback with the atmosphere, climate drivers such as El Niño, and marine biodiversity, but especially to understand predicted future climate scenarios. Some of these issues have been addressed in this Special Issue, such as marine heat waves (MHW), SST, and hurricanes interaction or SST trends and projections. This assessment has been mainly done by analyzing data measured from satellites, but proper validation with in-situ data is necessary to test and validate satellite sensors. This has also been addressed in this Special Issue in one of the most biologically diverse and under menace ecosystems on Earth, the coral reefs.

Satellites measure skin and subskin temperature at the very surface of the sea in a thin layer at 10 μm and 1 mm depth. Other science branches, such as marine biology, may need to know temperature at different depths, so the feasibility of using SST in those studies needs to be investigated. In [2], Gómez et al. investigate the correlation between different satellite SST databases and in-situ data at the coral reef depth. They found a good correlation between satellite and in-situ measurements, expected as coral reefs lie under shallow waters in coastal subtidal areas, but with some seasonal bias that can be used to correct satellite data for its use in coral reef surveillance. In a somewhat similar work [3], Colin et al. look for a correlation between a temporally long and spatially extensive temperature monitoring network, at different sea depths and going deeper than the previous reference, and satellite SST and sea surface height (SSH) data. The authors were able to create a regression model with SST and SSH capable of predicting depth-varying thermal stress from satellite measurements. These two studies highlight the need for and complementarity of both types of SST measurement, in situ and satellite. This highlights the importance of promoting both technological development of measurement methodologies and calibration and validation studies.

Regarding extreme weather events, [4] investigates the relationship between a highly active hurricane season in the Pacific and the SST and upper ocean heat content (UOHC). They found good relationship between both SST and UOHC anomalies and intensity of three major hurricanes, and with the spatial extent of hurricane tracks. These results reinforce the interest of the deepening of knowledge in such ocean–atmosphere energy

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exchanges that trigger extreme weather phenomena that are expected to increase in the coming decades.

In addition, it is important to analyze SST actual trends and projected scenarios in the framework of climate change. For the Adriatic Sea, [5] detect a positive trend for both SST and air temperature, but with a lag between them. The authors also point to the impact that the long-term SST warming trend in the Adriatic has already had in marine fauna and the implications of climate change in the Adriatic islands population and development. At a greater scale, climate shaping phenomena like El Niño events can also be studied through SST analysis, among other variables, as shown in [6]. Once actual and past phenomena and trends are increasingly well known, the focus should be on analysing future climate scenarios, among which the evolution of the SST is of particular interest in this Special Issue. Indeed, [7] studied decadal and seasonal SST variation in the East China Shelf seas using Couple Model Intercomparison Project (CMIP) models under RCP4.5, demonstrating an expected 1.5 °C increase by 2100. This SST increase, especially the seasonal one, can play an important role in future climate and marine ecology changes in the area.

In recent years, a poorly studied phenomenon has been gaining insight in ocean science literature—marine heat waves (MHWs). MHWs are defined as a prolonged discrete anomalously warm water event that can be described by its duration, intensity, rate of evolution, and spatial coverage. MHWs impact on marine biodiversity is and will be a major topic of study in the coming years. Refs. [8,9] study the recent evolution of MHWs in the Mediterranean and Red Seas, where their frequency and intensity have clearly increased in the last four decades. Finally, [10] analyzes the main characteristics of MHWs in the Red Sea.

As is evident from the variety of topics covered in the articles of this Special Issue, sea surface temperature is involved in a wide range of fields and topics of great relevance to marine and climate science. SST can be used as a tool for analysis in many fields, from extreme weather events to marine biology, so it is of great interest both to deepen our understanding of it, and to improve the way we approach it and how we measure it. Although a high level of excellence has been achieved in the measurement of SST, especially in its measurement from satellites, there is undoubtedly much progress to be made in this field.

Advancing knowledge about SST will certainly be of great help in analysing, understanding, and trying to cope with the already observed and expected future climate change on Earth, and we encourage and request all researchers in this field to maintain and redouble their efforts, in the interest of science and humankind.

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