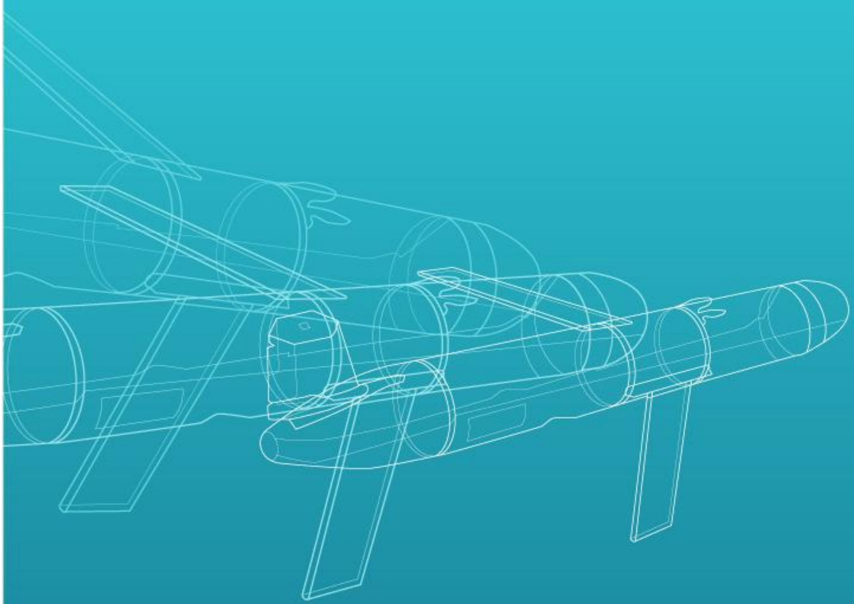

# Mediterranean Surface Exploration Tool

# Product User Manual (PUM)


SOCIB
Balearic Islands
Coastal Observing
and Forecasting
System

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3-Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO), France.

4-Instituto Mediterráneo de Estudios Avanzados (IMEDEA), Baleares, Spain.

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The initial development of the MSET beta version was carried out at SOCIB during 2019 to enhance end-user access to ocean data exploration, visualization and analysis. More recent developments carried out since 2020 respond to end-user requirements and have been carried out in the frame of WP6 from the EuroSea project (H2020, Grant Agreement 862626), and the PANDORA project (H2020, grant Agreement 773713), whose support is gratefully acknowledged.

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## SUMMARY

The Mediterranean Surface Exploration tool (MSET) tool allows exploring various ocean variables providing information on the sea surface of the Western Mediterranean Sea. These variables include five key Essential Ocean Variables (EOVs, Tanhua et al., 2019): temperature, salinity, sea level, chlorophyll-a and currents, and two additional variables, temperature and salinity fronts, derived from the EOVs. The information is obtained from the SOCIB Western Mediterranean Operational system (WMOP, Juza et al., 2016; Mourre et al., 2018) and from satellite data provided by Copernicus Marine Service (CMEMS). Oceanographic features can be explored as layers or time series at specific points defined by the user when double-clicking the layer on display. This tool is aimed for a wide range of end users in the field fisheries sustainability, conservation and education. The implementation fully relies on Web Map Services (WMS). All data handled by the tool is publically available from the SOCIB and CMEMS data servers.

## APPLICATIONS, SECTORS AND USERS

The Mediterranean Surface Exploration Tool is a planning and analysis application that was initially designed to respond to drivers and gaps identified for the sustainable management of marine resources. Relevant gaps linking operational oceanography and fisheries sustainability are associated with the limitations of the end users to access, explore and quickly analyze ad-hoc operational oceanographic products, informing on the ocean variability affecting fish ecology (Alvarez-Berastegui et al., 2016, 2018; Berx et al., 2011; Reglero et al., 2017).

In order to ensure an adequate design of the MSET that really addressed these gaps, SOCIB used 'Agile development' methodologies, new market development methods and innovative approaches, combining business best practice, innovation and science. Agile development methodologies are used for early delivery, adaptive planning and continuous improvement, they develop through cross-disciplinary teams and iterative face-to-face communications (Fig. 1). Accordingly, for the MSET development, a cross-disciplinary team was established harnessing knowledge across the modelling experts, Data Centre, Observing Facilities, Outreach and key external experts. Details on the application of these methodologies for the product development at SOCIB are described in Heslop et al. (2019).

The resulting web based application has been successfully applied for conducting field work campaigns where sampling design depended on oceanographic conditions, being a valuable improvement on adaptive capabilities for scientific teams. Specific examples are the field surveys of the Bluefin tuna project conducted in the Balearic Sea to provide indices of abundances to the International Commission for the Conservation of Atlantic Tuna (ICCAT).


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The recent improvements of the MSET, focused on the usability of the web interface, expands the end-user community beyond the fisheries scientists. The latest version of the tool has been designed to be applied also by other sectors interested in exploring real time, forecast and time series of sea surface features in the western Mediterranean Sea. This includes a wide range of end users in the field of fisheries, non-governmental organizations (NGOs) conducting sampling activities for conservation, and the education community in oceanography, marine ecology and nautical studies.


**Figure 1**: Typical development loops of the Agile methodology (Singh, 2018). See Heslop et al. (2019) for details on the application of this scheme within the SOCIB strategy.

## DESCRIPTION OF EOVs AND SURFACE OCEAN VARIABLES

The tool provides five Essential Ocean Variables (EOVs, Tanhua et al., 2019) and two derived ocean surface variables for exploration: 1) **temperature**, 2) **salinity**, 3) **sea level**, 4) **chlorophyll,** 5) **currents** and 6-7) **oceanic fronts** (surface ocean variables derived from EOVs). Buttons on the "VARIABLE PANEL" (see Fig. 2) enable the display of any of these features. The EOV **"currents"** is provided as vector data and can be visualized on the top of the other variables which are provided as raster (or grid) data. Details about data sources are provided in table 1, together with links to data product descriptions.


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**Table 1:** Data type and source for each variable (**Note:** this information can be consulted also through the Visualization & info panel together with the direct links to data specifications and servers)

| Variable | | Type of data | Source | Availability |
|---|---|---|---|---|
| **Temperature** (EOV) | | Model Forecast | WMOP*[1] | since 2013/08/27 |
| **Salinity** (EOV) | | Model Forecast | WMOP*[1] | since 2013/08/27 |
| **Sea level** (EOV) | | Satellite | CMEMS*[2] | *uncertain* |
| **Chlorophyll** (EOV) | | Satellite | CMEMS*[3] | *uncertain* |
| **Oceanic fronts** (Derived variable) | **Salinity fronts** | Model Forecast | WMOP*[1] | since 2016/08/14 |
| | **Temperature fronts** | | | |
| **Currents** (EOV) | **Total surface current** | Model Forecast | WMOP*[1] | since 2013/08/27 |
| | **Geostrophic surface current** | Satellite | CMEMS*[2] | *uncertain* |

-*[1] The system description of the Western Mediterranean OPerational forecasting system (WMOP, Juza et al., 2016; Mourre et al., 2018) that provides the sea surface temperature, salinity and currents can be found at SOCIB Modelling and Forecasting facility. An operational validation system has been developed to systematically assess the model outputs at daily, monthly and seasonal time scales. Multi-platform observations including satellite-derived products (sea surface temperature and surface geostrophic currents) and in situ measurements (profiling floats and fixed moorings) are used for this systematic validation.

Sea surface temperature and salinity fronts are computed as the spatial gradient of the surface fields of the respective EOV from WMOP, using the "gradient" function of Matlab.

-*[2] The CMEMS sea level and derived geostrophic current data are obtained from the MEDITERRANEAN SEA GRIDDED L4 SEA SURFACE HEIGHTS AND DERIVED VARIABLES NRT. Product identifier: SEALEVEL_MED_PHY_L4_NRT_OBSERVATIONS_008_050. Its availability can change over time and therefore it is recommended to better visit the previous link of the source portal (CMEMS) for up-to-date information.

-*[3] The CMEMS chlorophyll-a concentration data is obtained from the Mediterranean Sea Monthly and Daily Interpolated Surface Chlorophyll Concentration from Multi Satellite and Sentinel-3 OLCI observations. Product identifier: OCEANCOLOUR_MED_CHL_L4_NRT_OBSERVATIONS_009_041. Its availability can change over time and therefore it is recommended to better visit the previous link of the source portal (CMEMS) for up-to-date information.


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## GRAPHICAL DISPLAY AND MAIN FUNCTIONALITIES

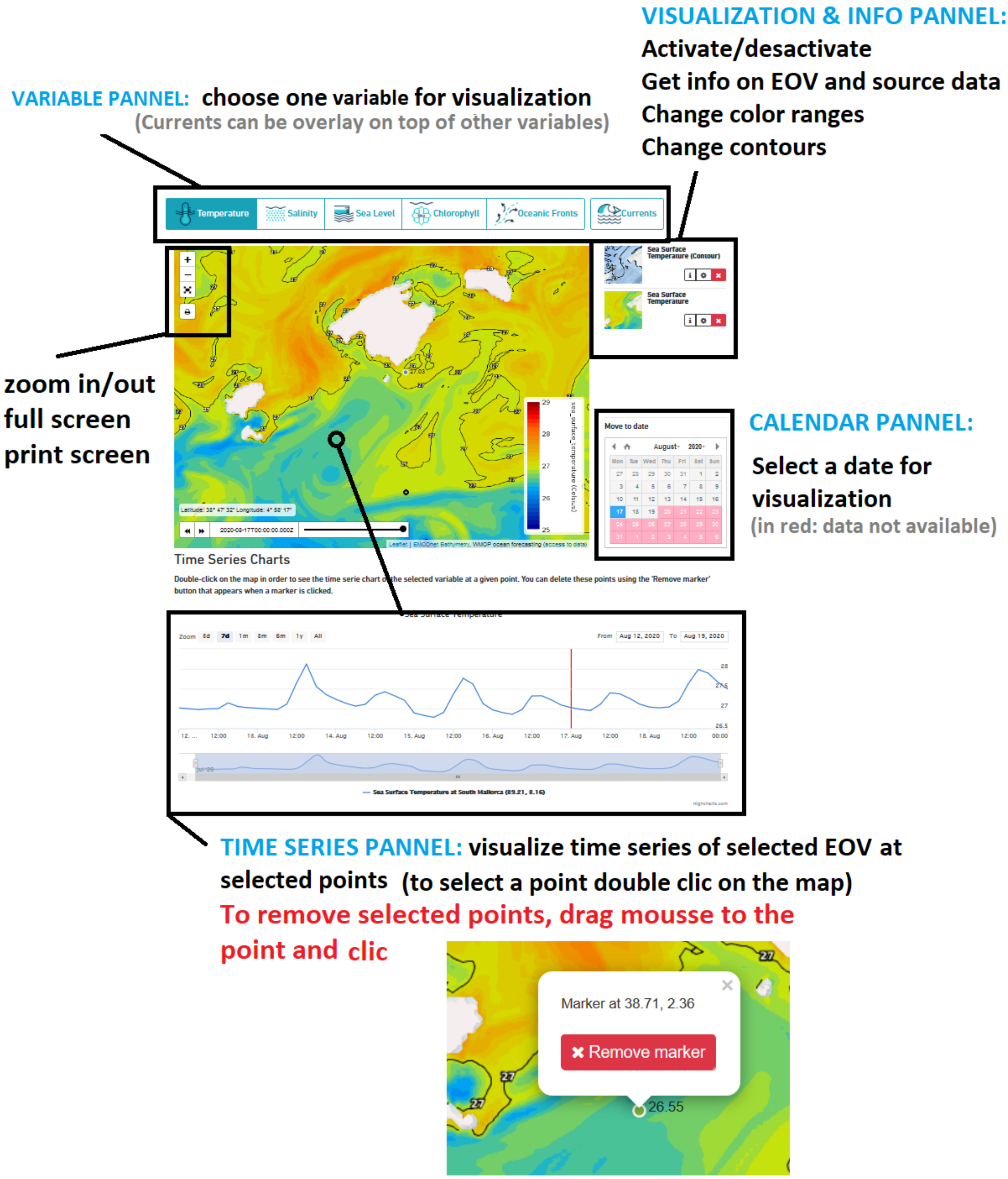


**Figure 2.** Tool screen, panel distribution and functionalities


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## HANDLING THE MAP

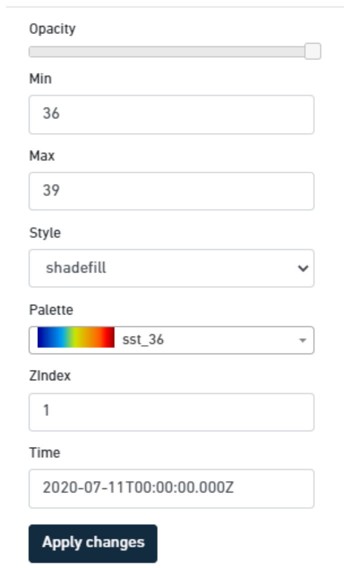
The visualization of **oceanographic** features is available in two graphical formats:

(1) **Maps (grids and contours)**
(2) **Time series**

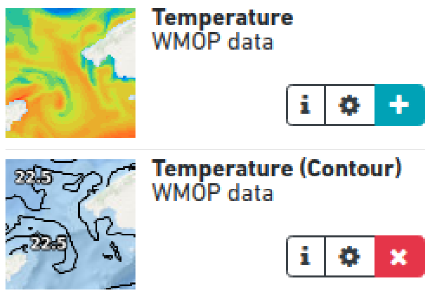
### Maps (grids and contours)

The map representation shows the spatial distribution of the active variable as two layers, i.e. gridded and contoured data. The map can be zoomed in and out, using the buttons on the top-left corner of the map (Fig. 2, top-left corner buttons). On the right-hand side, small panels provide information about the layer on display, enable layer customization (modifying layer settings at the user's convenience) and on/off switching.

- **Layer Information**: provides the user information regarding the layer on display


- **Layer settings**: enables the user to modify the default layer settings (opacity, range of values to be displayed -minimum and maximum-, style, color palette…).
- **Switch on/off**: enables the user to turn on/off either the grid or the contour layer.




These layers (grid and contour) can be visualized at specific times by using the time-slider available on the map or the available calendar (see Fig. 2). The selected date appears in blue while not-available dates are colored in pink.

## EXPLORING TIME SERIES

A Time Series Chart is provided below the map (Fig. 2). The oceanic feature displayed corresponds to the active layer on the map . The chart is provided, by default, for a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particular point located in the south of Mallorca (geographical coordinates 39.21ºN, 3.16º E) but further time series can be generated by clicking elsewhere on the map. To remove points, just click it and select “Remove marker” on popup open (detail on Fig.2). Chart-line tooltip informs about the feature values when hovering, referencing location and time for each one.

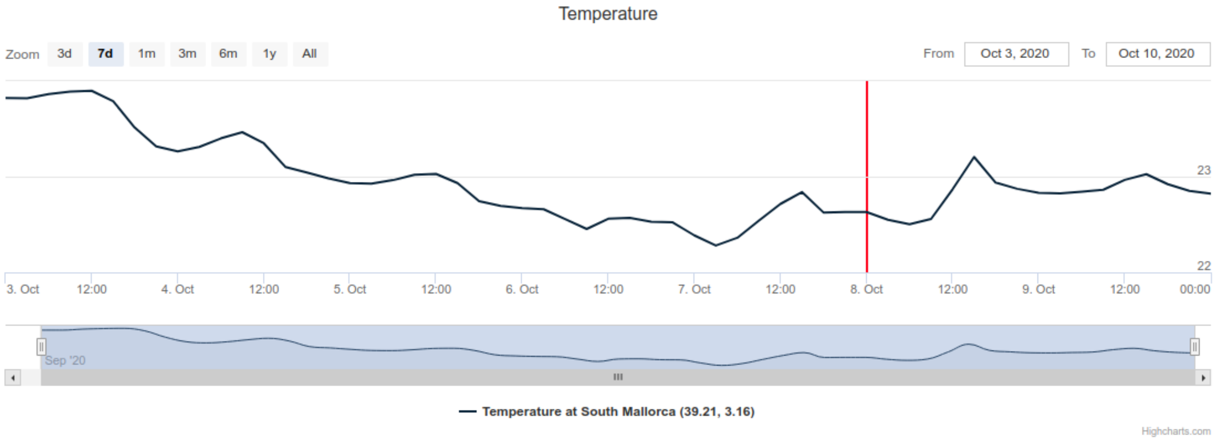


**Figure 3.** Sample time series chart for sea surface temperature.

By default, the Time series Chart shows the latest 7-days. It can be switched to 3 days, 1 month, 3 months, 1 year or all the available dates using the buttons at the top-left side of the time series chart. Time lapse can be also changed using the inputs available at the top right corner of the Time Series Chart as well as using the below range selector (see at the bottom of the chart on Fig. 3).

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