THE EFFECT OF DIURNAL SEA SURFACE TEMPERATURE WARMING ON THE MEDITERRANEAN SEA HEAT AND WATER BUDGET

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ABSTRACT

The diurnal cycle in sea-surface temperature is reconstructed by combining numerical model analyses and satellite measurements in the context of the Optimal Interpolation theory. The method (Marullo et al., 2014) is applied to reconstruct hourly Mediterranean SST fields during 2013 using data from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) and Mediterranean Forecasting System analyses provided by the Copernicus Marine environment monitoring service. The Diurnal OI SST (DOISST) fields reproduce well the diurnal cycles including extreme diurnal warming events as measured by drifting buoys. The evaluation of DOISST products against drifter measurements results in a mean bias of −0.1°C and a RMS of 0.4°C. We evaluate the impact of resolving the SST diurnal cycle on the heat budget of the Mediterranean Sea over an entire annual cycle. The mean annual difference in the heat budget derived using SST's with and without diurnal variations being -4 Wm^{-2} with a peak monthly difference of -9 Wm^{-2} in July-August.

Data and Methods

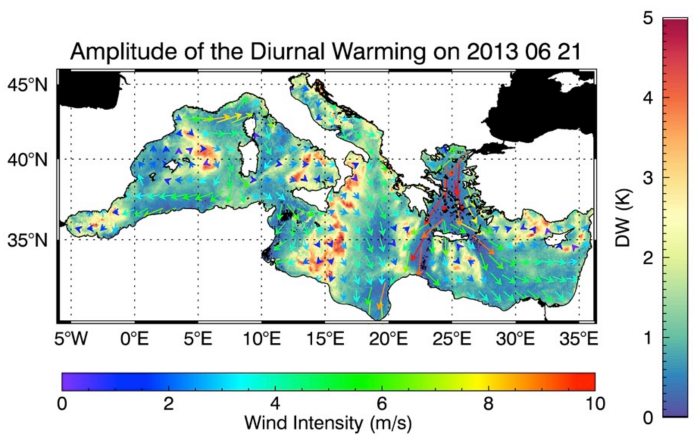
Input data:

- ✓ Satellite data: hourly SEVIRI SST fields, distributed by **OSI-SAF** (Ocean and Sea Ice - Satellite Application Facility)
- ✓ **CMEMS** (Copernicus Marine Environmental Monitoring Service) Mediterranean Forecasting SST Analysis

Method:
Diurnal Optimal Interpolation SST method which combines numerical model analyses and geostationary satellite data (Marullo et al. RSE, 2014).

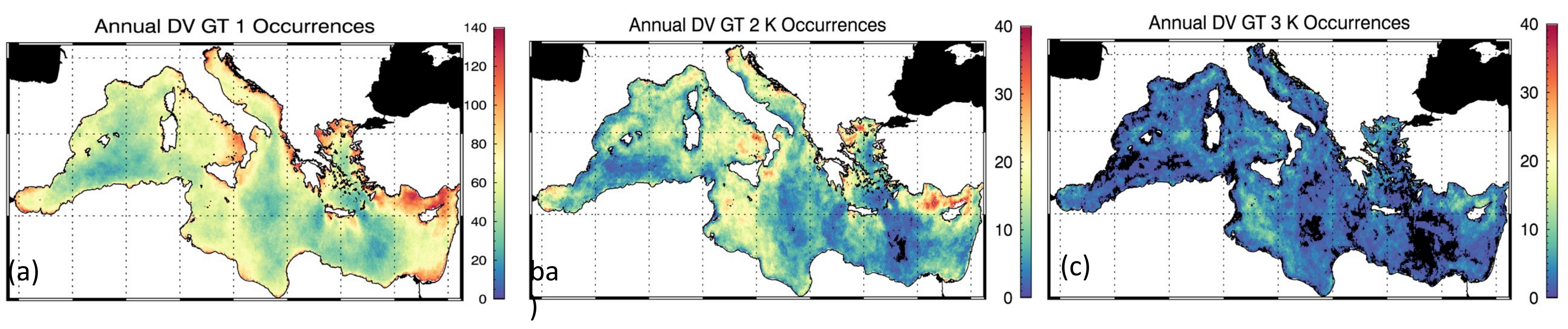
Output:
L4 Hourly reconstructed SST maps

Diurnal Warming in the Mediterranean Sea

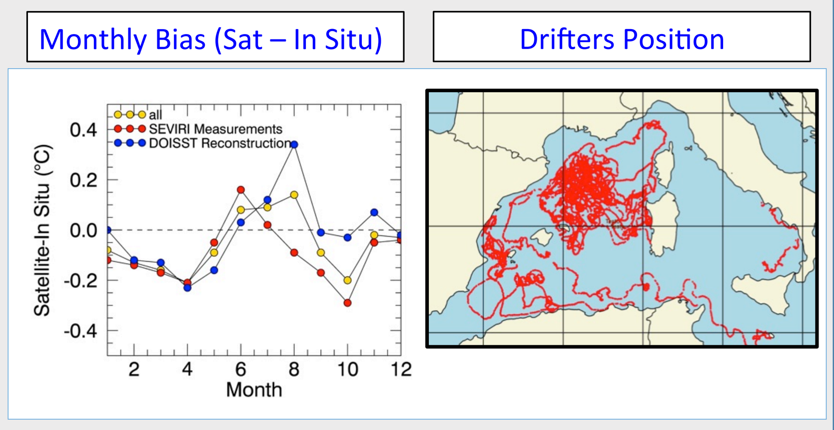


A Diurnal Warming (DW) Event in The Mediterranean Sea on June 18° 2013. Figure (a) shows the maximum day – night temperature excursion during this day. DW events require sustained low winds under favorable insolation conditions. The DW pattern in fig (a) highlights this effect downwind of the Crete Island and on its east and west side.

Diurnal Warming Event are very frequent in The Mediterranean Sea. Figures below (a), (b) and (c) show the number of occurrence of Diurnal Warming Event with day-night difference above 1, 2 and 3 K respectively during 2013

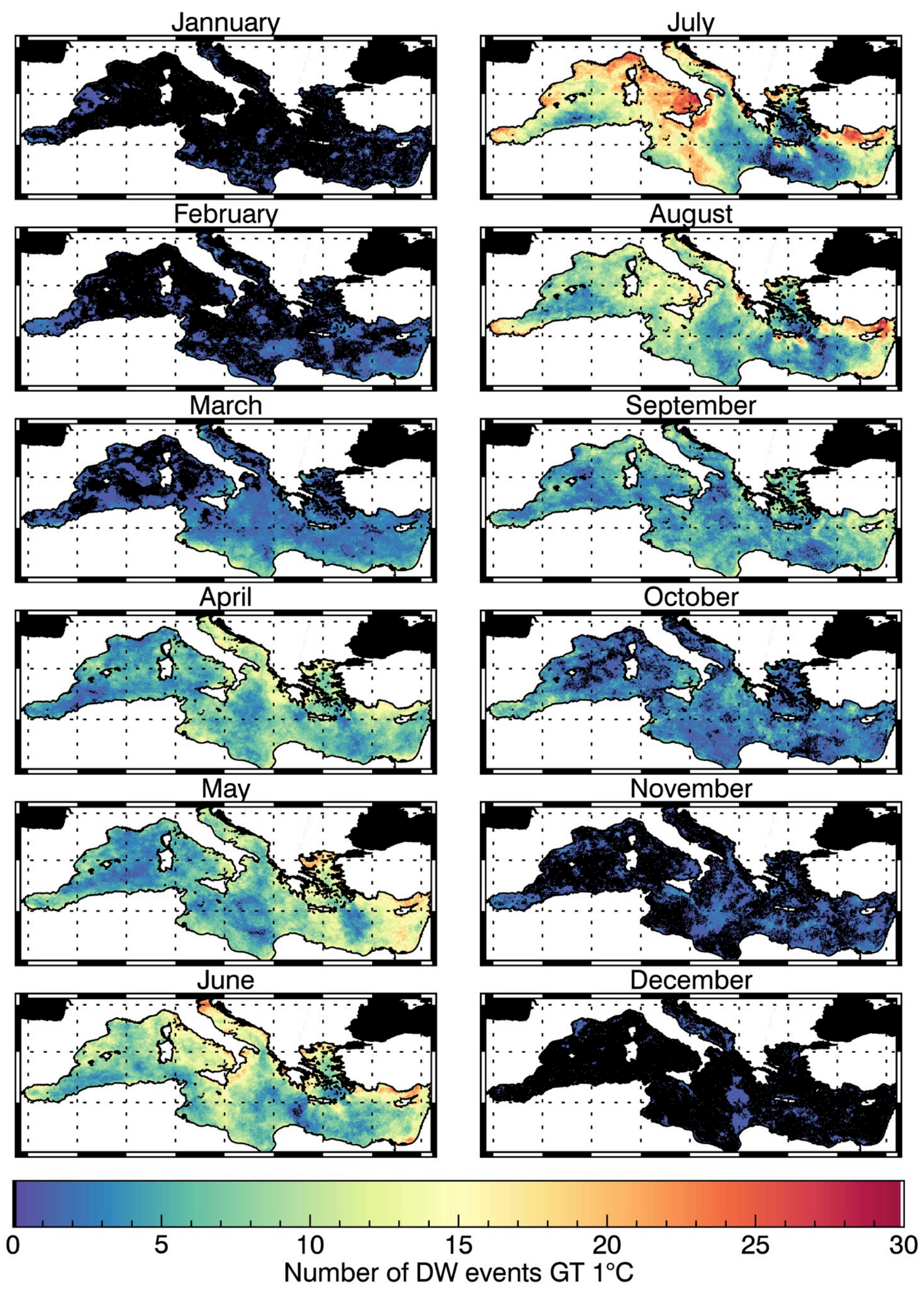


Validation



(2013 Data)	SEVIRI (Measured)	SST Reconstruction
(sat-buoy)	-0.03 °C	-0.13 °C
STD	0.47 °C	0.39 °C
Corr. Coef.	0.9957	0.9953
N. of matchups	26149	13846

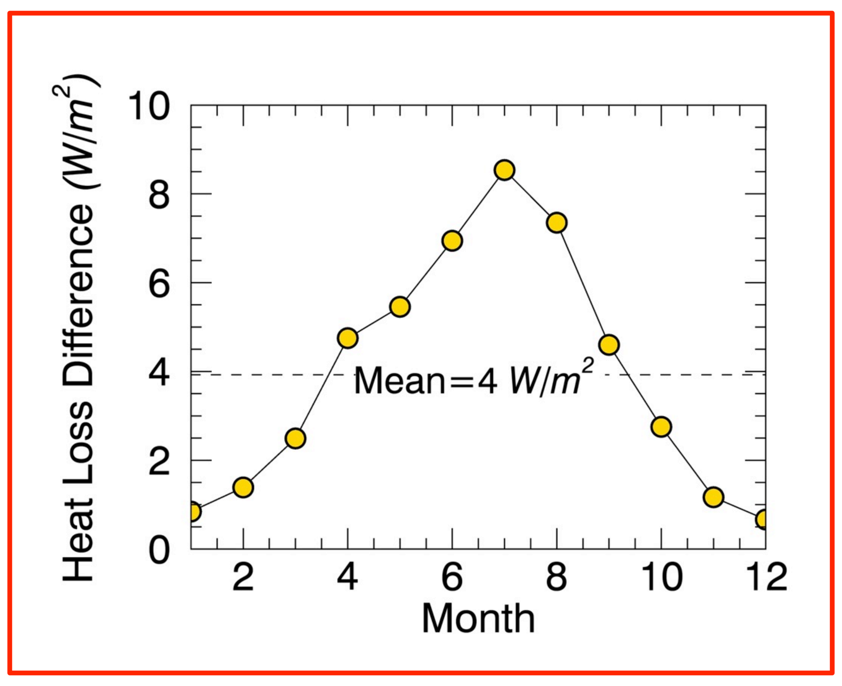
Diurnal Warming and Mediterranean Heat Budget

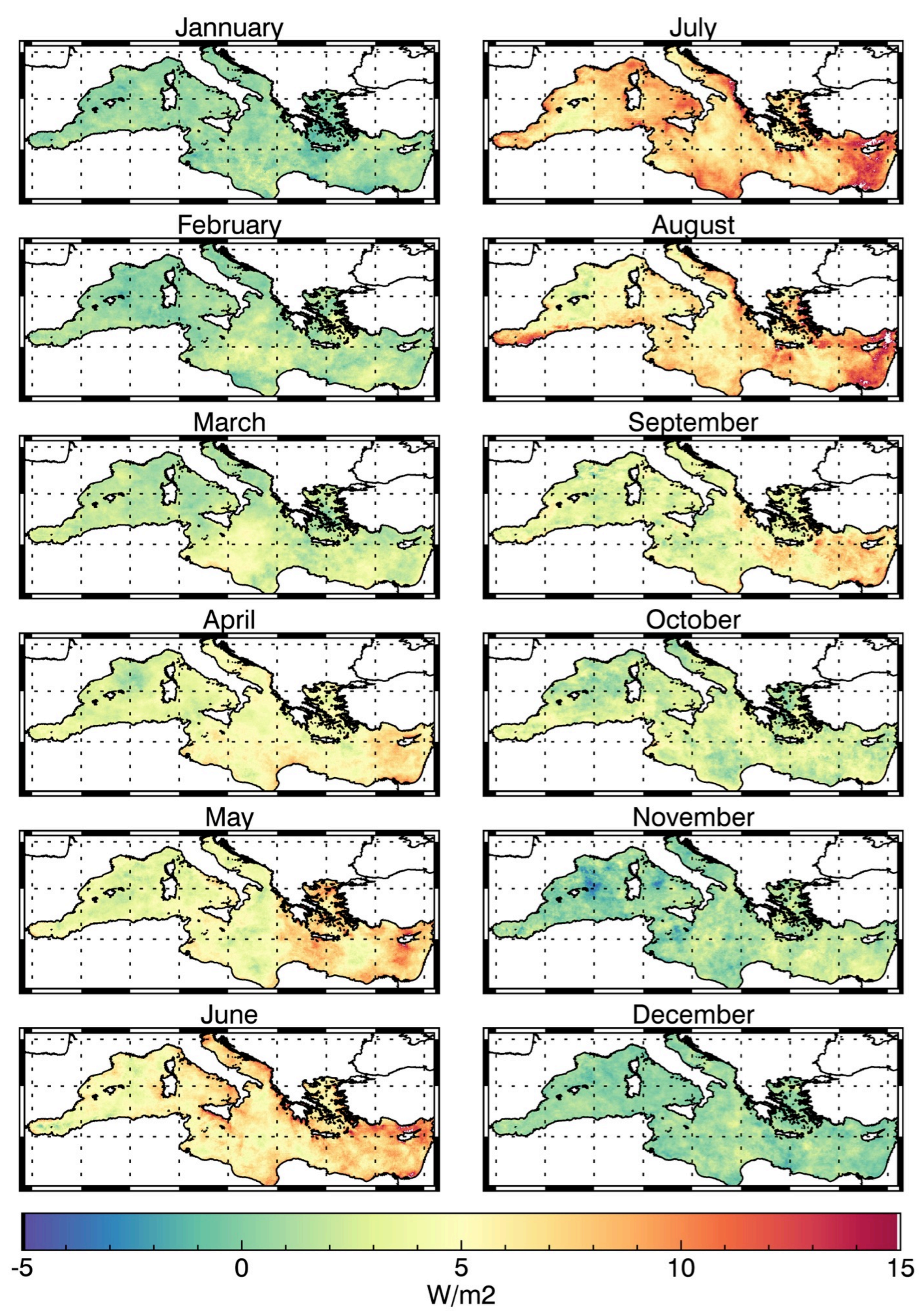


Spatial distribution of the number of DW events with amplitude greater than 1°C for each month of the year 2013.

The impact of the SST Diurnal Warming on air-sea Heat Fluxes.

Difference between ocean heat loss estimated using foundation SST or hourly DOISST Radiative and Turbulent Heat Flux formulae: monthly spatial distribution (to the right) and monthly mean (below)

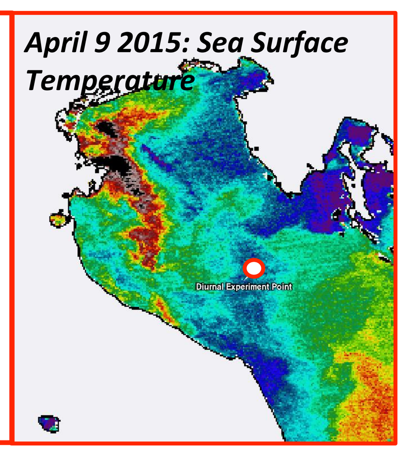




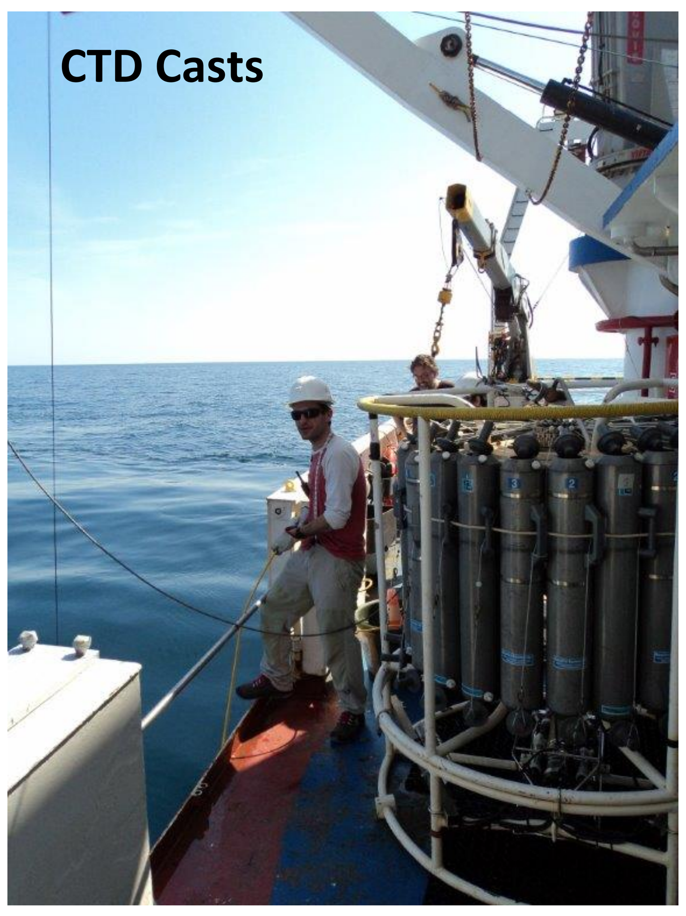
The COSIMO 2015 Experiment

1. CTD Casts
2. Near surface Thermistor Measurements
3. Meteo data
4. M-AERI continuous skin SST Measurements (SST retrieval uncertainty <<0.1 K)

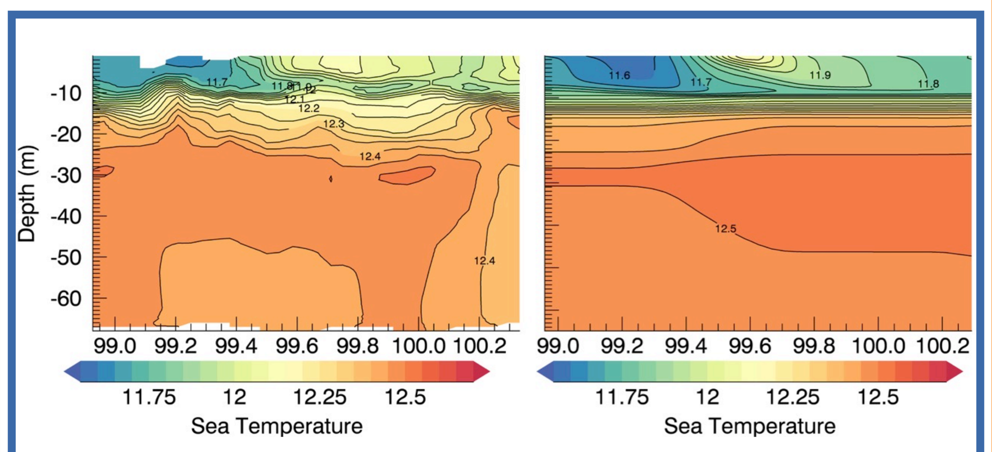
The COSIMO Diurnal Experiment was conducted in the north Adriatic Sea from 2015/04/08 22:14:00 to 2015/04/10 07:59:00



CTD Casts



The M-AERI Mounted on Italian R/V Minerva Uno



Hourly CTD Casts During the COSIMO Experiment (from 2015/04/08 22:14:00 to 2015/04/10 07:59:00)

GOTM Run (25 cm vertical resolution) using in situ initial condition and Meteo data acquired on board (no SST assimilation)

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