Underwater sound speed Netcdf calculator

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SCOPE

One of the fundamental aspects of providing Military Oceanography (MILOC) related products, is the underwater acoustical description of each area of operations. Therefore, a tool for the calculation of the underwater sound speed and the production of the relevant thematic maps is needed, to support all levels of command. In order to achieve this, a Sound Speed Calculator is created with the aim to produce Netcdf format files containing sound speed values for the selected region. The input files are Netcdf data, from CMEMS MFS model MEDSEA_REANALYSIS_PHYS_006_004, as made available by CMEMS online catalogue[1-2] set. The output of the calculator is a new Netcdf file, containing sound velocity values with the exact same space-time dimensions as the initial source files. A secondary input option for the calculator is the use of a single source Netcdf data file, as available from the global reanalysis model of CMEMS [3] (not included in the current poster). The full analysis of the input data used goes beyond the scope of this poster, but for a more detailed description and analysis, the reader is encouraged to visit references 1 to 4.

METHODOLOGY (CALCULATOR DOCUMENTATION)

The NetcdfSoundVelocityTransfomer.jar is a Java Application which uses the *netcdfAll-4.5* and *javax.swing* java libraries to read, construct and manipulate .nc files, through a user friendly desktop graphic interface. This client side application is customizable to utilize .nc files, with salinity and temperature data of the common chronological period, with the purpose of creating a new .nc file, at the same timestamps, containing sound velocity data.

The input files for the program to process are netCDF (network common data form) files, containing array-oriented scientific data, which pertain to Unidata' s Common Data Model (CDM). Their exact file type is *NetCDF-3/CDM.* The calculator supports 2 modes of input data.

This poster presents only the primary mode, by designating the input data as two distinct .nc files[4] . One file contains salinity data (variable name: *vosaline*) while the second file contains temperature data (variable name: *votemper* or *thetao*).

The algorithm for calculation of the new variable is based on the Mackenzie formula for underwater sound speed [5]. The use of this polynomial formula, allows the calculator to be used on low end machines, usually carried *at sea*, by avoiding complex calculations which are resourceful demanding.

DATA INPUT

Input Netcdf files are downloaded from CMEMS interactive catalogue.

The monthly mean, hind casted averaged data of salinity and temperature, with covering region bounded by 36N to 42N and Prime Meridian to 009E is selected.

The region chosen, represents an area with distinct halo clinic variations, as the surface water masses originating from the Atlantic Ocean, after entering the Mediterranean Sea through the Gibraltar strait, meet with the saltier water masses of the Mediterranean Sea. As an indicative representation of the input data, two thematic maps are created using NASA's Netcdf data viewer software Panoply [6].

RESULTS

The output file is a new .nc file containing a new float value variable which is defined as sv (unit: m/s). The thematic map in jpeg format show the area where the combination of temperature and salinity values, produce mid and large scale acoustic fronts at various depths.

The calculator combines all temperature and salinity values, correlating them both spatially and timely with the Mackenzie sound speed equation, thus producing a new Netcdf file, containing sound velocity results per each point.

As depicted at fig.3, the production of a Sound Speed thematic map, validates the effect of temperature gradients to the underwater sound speed. Additionally, the effects of salinity spatial distribution are also accounted for, allowing for a more robust soundscape / acoustic environmental analysis of the area of operations.

CONCLUSIONS – NEW FEATURES

The current project is utilized as a calculation tool for marine researchers and specialists, thus for future reference, message queue mechanisms could be used in order to process larger files and support a larger software ecosystem.

As graphically presented, a robust analysis of the soundscape for a selected Area of Operations, is produced by creating sound velocity thematic maps. The use of these maps by all levels of command, allows the commander / researcher to have a detailed description of the subsurface acoustic environment.

Therefore, the thorough knowledge of the environment, procures the Environmental Knowledge and Operational Effectiveness (EKOE) principle, allowing the optimal use of the assets involved.

For further information/queries and details, the reader is kindly requested to contact the authors.

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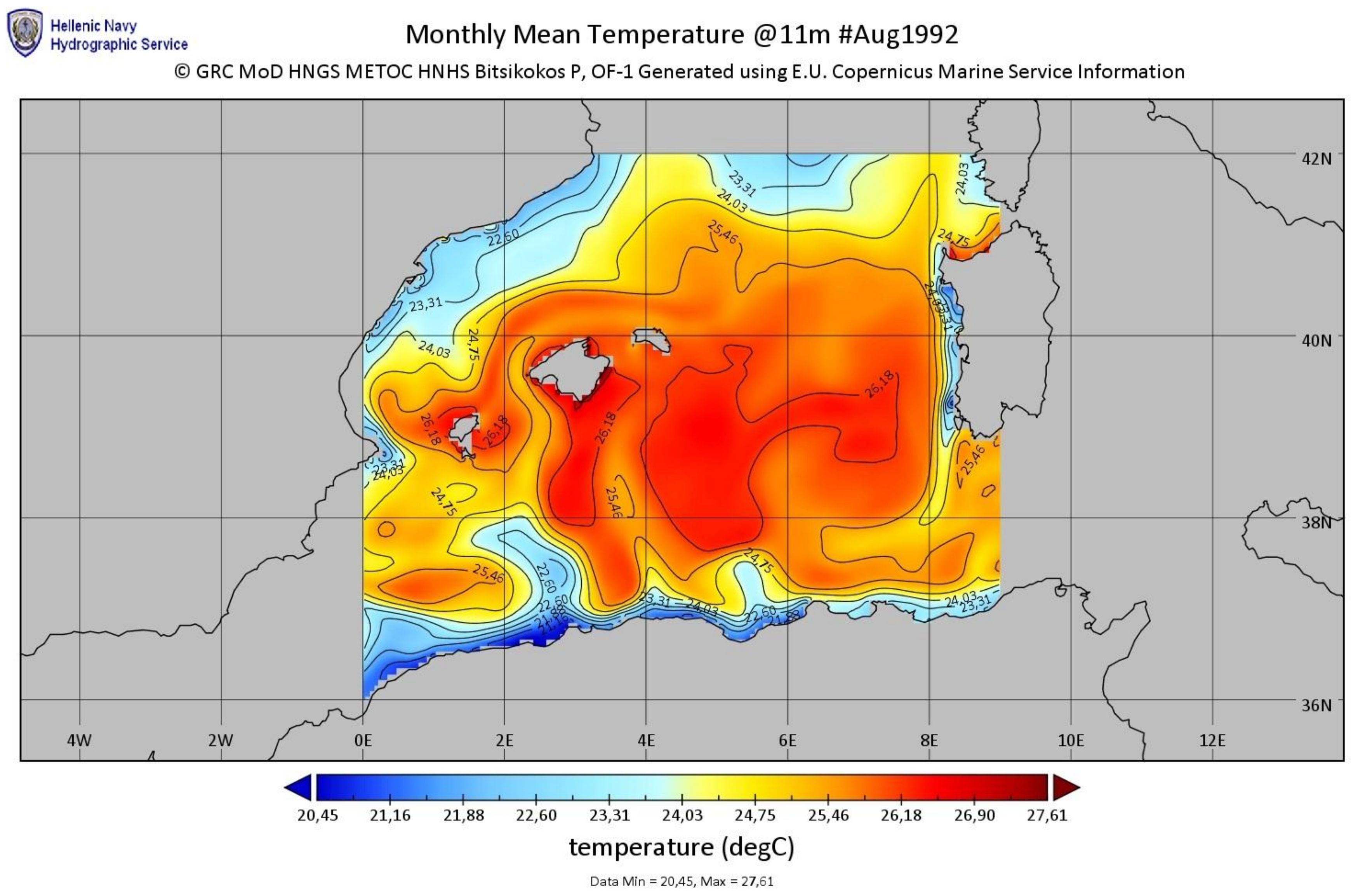

Figure 1: Input Netcdf file plotted. It presents the monthly average Sea Temperature at a depth of 11m for Aug 1992.

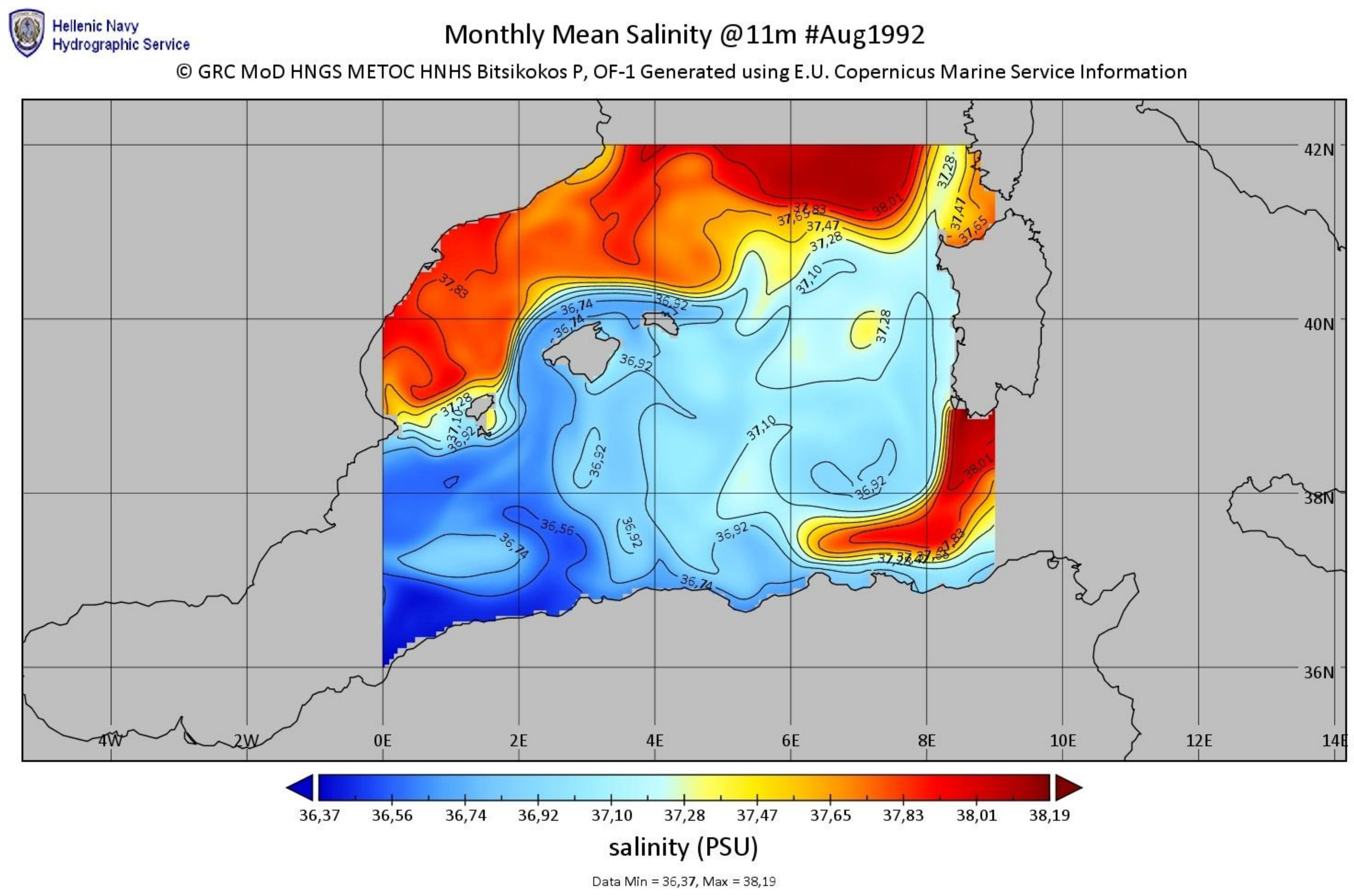

Figure 2: Input Netcdf file plotted. It presents the monthly average Salinity at a depth of 11m for Aug 1992.

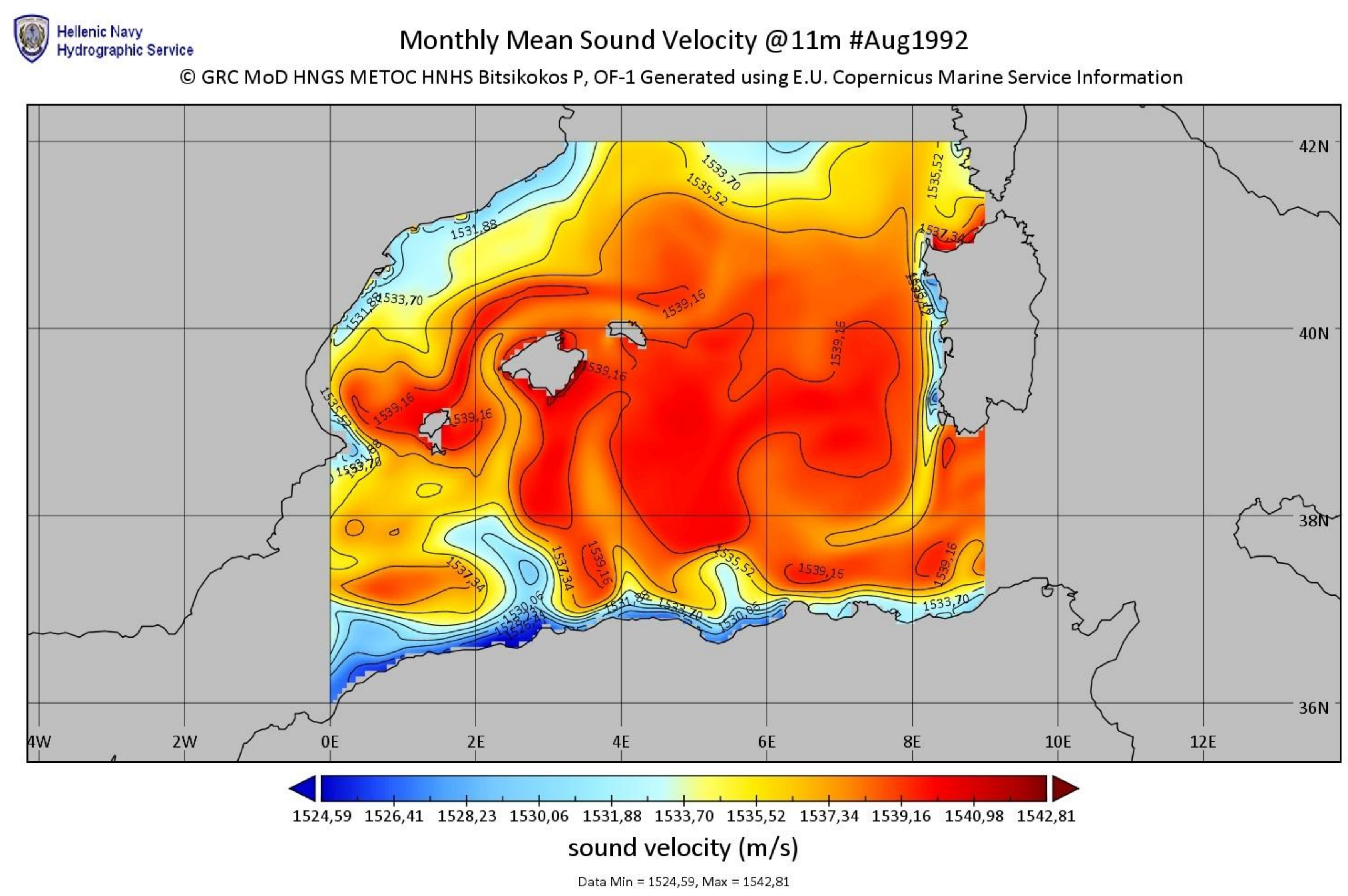

Figure 3: Output Netcdf file plotted. It presents the monthly average Sound Speed at a depth of 11m for Aug 1992.

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