

Running MOHID Water in Linux and HPC computers



MOHID

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UAç
UNIVERSIDADE
DOS AÇORES

MOHIDing 2025
25th, 26th and 27th June 2025, Lisbon

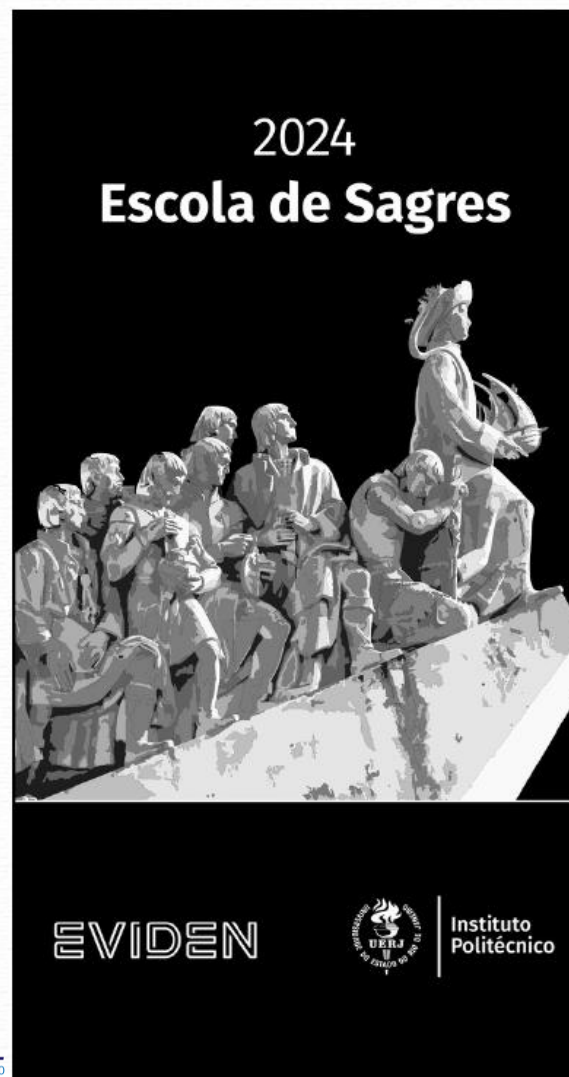




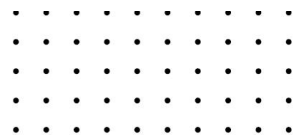
Escola de Sagres

Computador de Alto Desempenho

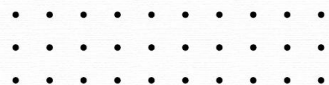
- Equivalente a 112 notebooks com Intel i5;
- 4,6 TFLOPS de Rpeak;
- 72 TFLOPS de computação paralela;
- 128 núcleos;
- 256 threads;
- 2560 núcleos CUDA;
- 1024 GB de RAM;
- 5280 GB de SSD; e
- 112 TB de HDD.



Nós do Escola de Sagres



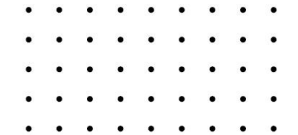
Infante D. Henrique de Avis
(Nó de Gerência)



Pedro Álvares Cabral
(Nó de GPU)



Nós do Escola de Sagres



Vasco da Gama
(Nó de CPU #1)



Bartolomeu Dias
(Nó de CPU #2)



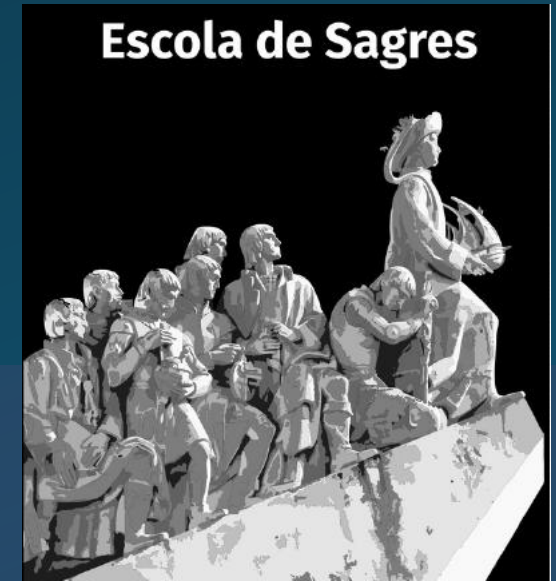
MOHID at “Escola de Sagres”:

- Installation of required libraries
- Environment Setup
- Mohid compilation:

Mohid Water
Mohid Land
Mohid Tools
Mohid Langrangean

- Software compilation (Fortran and Python)
- Testing
- Running Mohid:

Azores
Cabo Verde



/opt/MohidModel/Mohid/	
▼ Name	Size (KB)
..	
bin	
lib	
MohidMaster	
scripts	
software	
mohid.env	1
mohid_run_mpi.env	1
run_mpi.sh	1
run_mpi_2nodes.sh	1
run_openmp.sh	1

→ from mohid *github*

scripts

compile

- MohidCompile_Readme.md
- mohid_land_compile.sh
- mohid_tools_compile.sh
- mohid_water_compile.sh

install

- HPC_Sagres
 - externalSoftware
 - hdf5-1.8.17.tar.gz
 - mpich-3.2.tar.gz
 - netcdf-4.4.1.1.tar.gz
 - netcdf-fortran-4.4.4.tar.gz
 - proj-4.9.3.tar.gz
 - proj4-fortran
 - proj-5.0.0.tar.gz
 - zlib-1.2.11.tar.gz
 - install_externallibs.sh
 - install_hdf5.sh
 - install_mpi.sh
 - install_nc.sh
 - install_proj4-fortran.sh
 - install_zlib.sh

software

ART_tools

- ART_py
- CopyFiles2ART
- MPI_Consolidate

FES2014

Gfs2Me

MyOcean2Me

WRF2Me

scripts/compile/ ➡

/opt/MohidModel/Mohid/	
▼ Name	Size (KB)
..	
bin	
lib	
MohidMaster	
scripts	
software	
mohid.env	1
mohid_run_mpi.env	1
run_mpi.sh	1
run_mpi_2nodes.sh	1
run_openmp.sh	1

scripts/install/ ➡

scripts/install/ ➡

bin	mohidland	MohidLand_debug.exe
		MohidLand.exe
		MohidLand_openmp.exe
	mohidwater	MohidWater_debug.exe
		MohidWater.exe
		MohidWater_lagrangianglobal.exe
		MohidWater_mpi.exe
		MohidWater_openmp.exe
	tools	Convert2netcdf.exe
		ConvertToHDF5.exe
		HDF5Exporter.exe
		HDF5Extractor.exe
		MohidDDC.exe
lib	hdf5-1.8.17	
	intel	
	libfproj4	
	netcdf-4.4.1.1	
	proj-4.9.2	
	proj4-fortran	
	zlib-1.2.11	
	mohid.env	
	mohid_run_mpi.env	

Scripts/Compile/Mohid_water_compile.sh

```
mohid_water_com... x
1 #!/bin/bash
2
3 ### Make the changes to fit your setup ###
4
5
6 #####      choose the OPTION of compilation by the number at left and mohid path location (mohid_root) #####
7
8         # 1 - RELEASE
9         # 2 - RELEASE with Lagrangian_global
10        # 3 - RELEASE MPI
11        # 4 - DEBUG
12        # 5 - DEBUG with Lagrangian_global
13        # 6 - RELEASE OpenMP
14
15 OPTION=3
16
17 mohid_root=$HOME/Mohid
18
19
20 #####
21 #
22 ##### Don't touch anything below this line #####
23 #
24 #####
25
26 MOHIDMASTER=$mohid_root/MohidMaster
27 output_path=$mohid_root/bin/mohidwater
28
29 pathlib=/opt/MohidModel/Mohid/lib
30 pathsource=/opt/MohidModel/Mohid
31
32 mkdir -p $output_path
33
34 #----- Loading compiler and setting the enviremont -----
35
36 spack load intel-oneapi-compilers@2023.2.1
37
38 source $pathsource/mohid.env
39
40
41 #----- External Libs -----
42
```

Thanks João Rodrigues and Paulo Chambel!

Scripts/Compile/Mohid_water_compile.sh

```
#----- External Libs -----  
DIRLIBS=$HOME/Mohid/lib  
  
ZLIB=$DIRLIBS/zlib-1.2.11  
HDF5=$DIRLIBS/hdf5-1.8.17  
NETCDF=$DIRLIBS/netcdf-4.4.1.1  
  
MPI=/opt/software/spack/opt/spack/linux-rocky8-zen/gcc-8.5.0/intel-oneapi-mpi-2021.14.0-ioo4zz44fei7shh7cvtrgpze6gc4gegc/mpi/2021.14  
  
#----- Software -----  
MOHIDPATH=$MOHIDMASTER/Solutions/mohid-in-linux  
SRCPATH=$MOHIDPATH/src  
  
MohidBase1=$SRCPATH/Mohid_Base_1/src  
MohidBase2=$SRCPATH/Mohid_Base_2/src  
MohidWater=$SRCPATH/MohidWater/src  
  
#----- working directory -----  
  
cd $MOHIDPATH  
  
#----- Setting text colors -----  
  
set -e  
  
# echo colors ##  
RED='\033[0;31m'  
GREEN='\033[0;32m'  
NC='\033[0m' # No Color  
OK=${GREEN}OK${NC}  
NOK=${RED}NOK${NC}  
ERROR=${RED}ERROR${NC}  
WARNING=${RED}warning${NC}  
Orange='\033[93m'  
Cyan='\033[96m'
```

Scripts/Compile/Mohid_water_compile.sh

```
#----- compiler flags -----

flag_option_release="-O3 -w -cpp -real-size 64 -convert little_endian -fPIC -heap-arrays 64 -mcmodel=large -xHost -ip -fpe3 -fpp"
flag_option_debug="-O3 -w -cpp -real-size 64 -g -traceback -convert little_endian -fPIC -heap-arrays 64 -mcmodel=large -xHost -ip -fpe3 -fpp"
flag_option_openmp="-O3 -qopenmp -w -cpp -real-size 64 -convert little_endian -fPIC -heap-arrays 64 -mcmodel=large -xHost -ip -fpe3 -fpp"

#----- COMPILATION -----

find . -name \*.mod -type f -delete

START_OF_COMPILE=`date`

case $OPTION in

  1) # RELEASE_X64

      NAMEEXE=MohidWater.exe
      find . -name \${NAMEEXE} -type f -delete

      echo -e " ${Orange} "
      echo '-----'
      echo '                Compiling ' ${NAMEEXE}
      echo '-----'
      echo -e " ${NC} "

      cd src && \

      ifort $flag_option_release -D_NO_NETCDF -D_INCREASE_MAXINSTANCES_EXTRA -D_LAGRANGIAN_ -D_USE_NIX -D_STACK_LIMITS_ -D_BIG_LINE_LENGTH -
-D_INCREASE_MAXINSTANCES $MohidBase1/ModuleGlobalData.F90 $MohidBase1/ModuleLUD.F90 $MohidBase1/ModuleTriangulation.F90 $MohidBase1/
/ModuleTime.F90 $MohidBase1/ModuleEnterData.F90 $MohidBase1/ModuleWWTPQ.F90 $MohidBase1/ModuleStopWatch.F90 $MohidBase1/ModuleFunctions.F90
$MohidBase1/ModuleMacroAlgae.F90 $MohidBase1/ModuleWaterQuality.F90 $MohidBase1/ModuleSedimentQuality.F90 $MohidBase1/
/ModuleHydroIntegration.F90 $MohidBase1/ModuleSeagrassWaterInteraction.F90 $MohidBase1/ModuleHDF5.F90 $MohidBase1/ModuleHDF5_00.F90
$MohidBase1/ModuleSeagrassSedimInteraction.F90 $MohidBase1/ModuleLife.F90 $MohidBase1/ModuleCEQUALW2.F90 $MohidBase1/ModuleBenthos.F90
$MohidBase1/ModuleDrawing.F90 $MohidBase1/ModuleProfile.F90 $MohidBase1/ModuleBivalve.F90 $MohidBase1/ModuleBenthicEcology.F90 $MohidBase1/
/ModuleInterface.F90 $MohidBase1/ModuleTimeSerie.F90 $MohidBase1/ModuleDischarges.F90 $MohidBase1/ModuleLightExtinction.F90 $MohidBase1/
/ModuleDrainageNetwork.F90 $MohidBase1/ModuleMPImanagement.F90 $MohidBase1/ModuleTask2000.F90 $MohidBase2/ModuleHorizontalGrid.F90 $MohidBase2
/ModuleStatistic.F90 $MohidBase2/ModuleGridData.F90 $MohidBase2/ModuleBasinGeometry.F90 $MohidBase2/ModuleHorizontalMap.F90 $MohidBase2/
/ModuleBoxDif.F90 $MohidBase2/ModuleGeometry.F90 $MohidBase2/ModuleMap.F90 $MohidBase2/ModuleAdvectionDiffusion.F90 $MohidBase2/
/ModuleInterpolation.F90 $MohidBase2/ModuleTwoWay.F90 $MohidBase2/ModuleField4D.F90 $MohidBase2/ModuleFillMatrix.F90 $MohidBase2/
/ModuleChainReactions.F90 $MohidBase2/ModuleAtmosphere.F90 $MohidWater/ModuleTurbine.F90 $MohidWater/ModuleGOTM.F90 $MohidWater/
/ModuleTurbGOTM.F90 $MohidWater/ModuleFreeVerticalMovement.F90 $MohidWater/ModuleToga.F90 $MohidWater/ModuleGauge.F90 $MohidWater/ModuleOil
.F90 $MohidWater/ModuleOil_0D.F90 $MohidWater/ModuleHNS.F90 $MohidWater/ModuleOpenBoundary.F90 $MohidWater/ModuleTurbulence.F90
$MohidWater/ModuleHydrodynamicFile.F90 $MohidWater/ModuleAssimilation.F90 $MohidWater/ModuleWaves.F90 $MohidWater/ModuleJet.F90 $MohidWater
/ModuleSand.F90 $MohidWater/ModuleConsolidation.F90 $MohidWater/ModuleHydrodynamic.F90 $MohidWater/ModuleWaterProperties.F90 $MohidWater/
/ModuleSedimentProperties.F90 $MohidWater/ModuleSediment.F90 $MohidWater/ModuleInterfaceSedimentWater.F90 $MohidWater/
/ModuleInterfaceWaterAir.F90 $MohidWater/ModuleModel.F90 $MohidWater/Main.F90 -I$HDF5/include -L$HDF5/lib -lhdf5hl_fortran -lhdf5_hl -
-lhdf5_fortran -lhdf5 -ldl -I$ZLIB/include -L$ZLIB/lib -lz -lm -o $output_path/${NAMEEXE}
```

Running Mohid...

MOHID at “Escola de Sagres”:

- Installation of required libraries
- Environment Setup
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 - Mohid Water
 - Mohid Land
 - Mohid Tools
 - Mohid Langrangean
- Software compilation (Fortran and Python)
- Testing

Running Mohid...

```
#!/bin/bash

#SBATCH --job-name=AzoresZee
#SBATCH --time=6-23:00:00

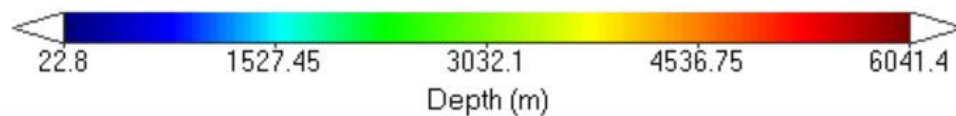
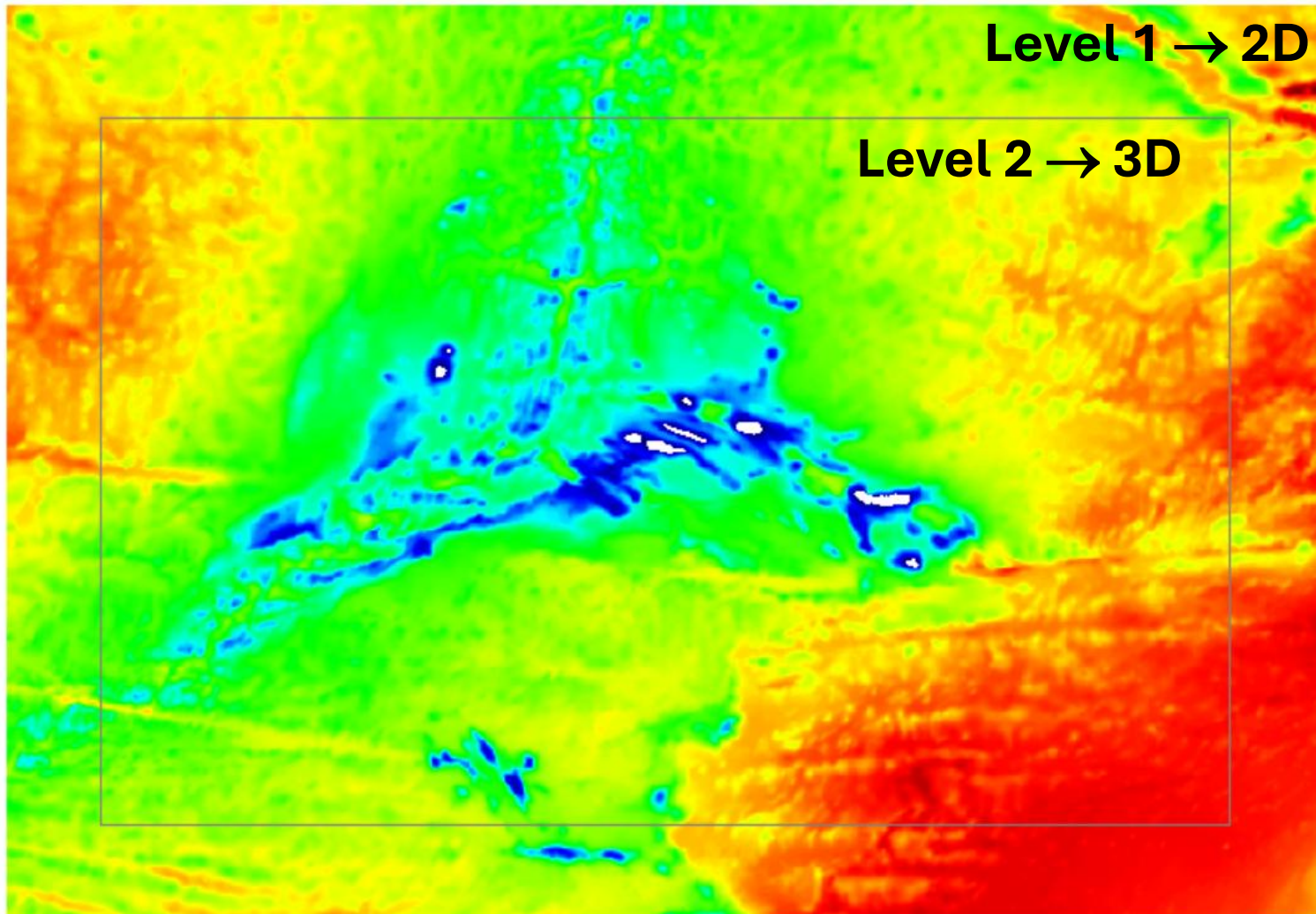
#SBATCH --nodes=2
#SBATCH --ntasks=40
#SBATCH --ntasks-per-node=20
#SBATCH --cpus-per-task=1
#SBATCH --hint=multithread
#SBATCH --threads-per-core=2

#SBATCH --mem=180GB

source $HOME/Mohid/mohid_run_mpi.env

./art.exe art_Level2.yaml
```

```
[maria.fraga@mgt1 ~]$ squeue
      JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
      2481      cpu AzoresZe maria.fr  R      8:43:31       2 bartolomeu-dias,vasco-da-gama
[maria.fraga@mgt1 ~]$
```



AzoresZee
2 km

“OPERA”

In collaboration with

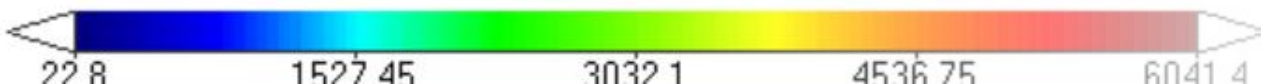


Level 1 → 2D

Horizontal: 855 x 588 cells

GLOBAL TIDE - FES2014 DESCRIPTION

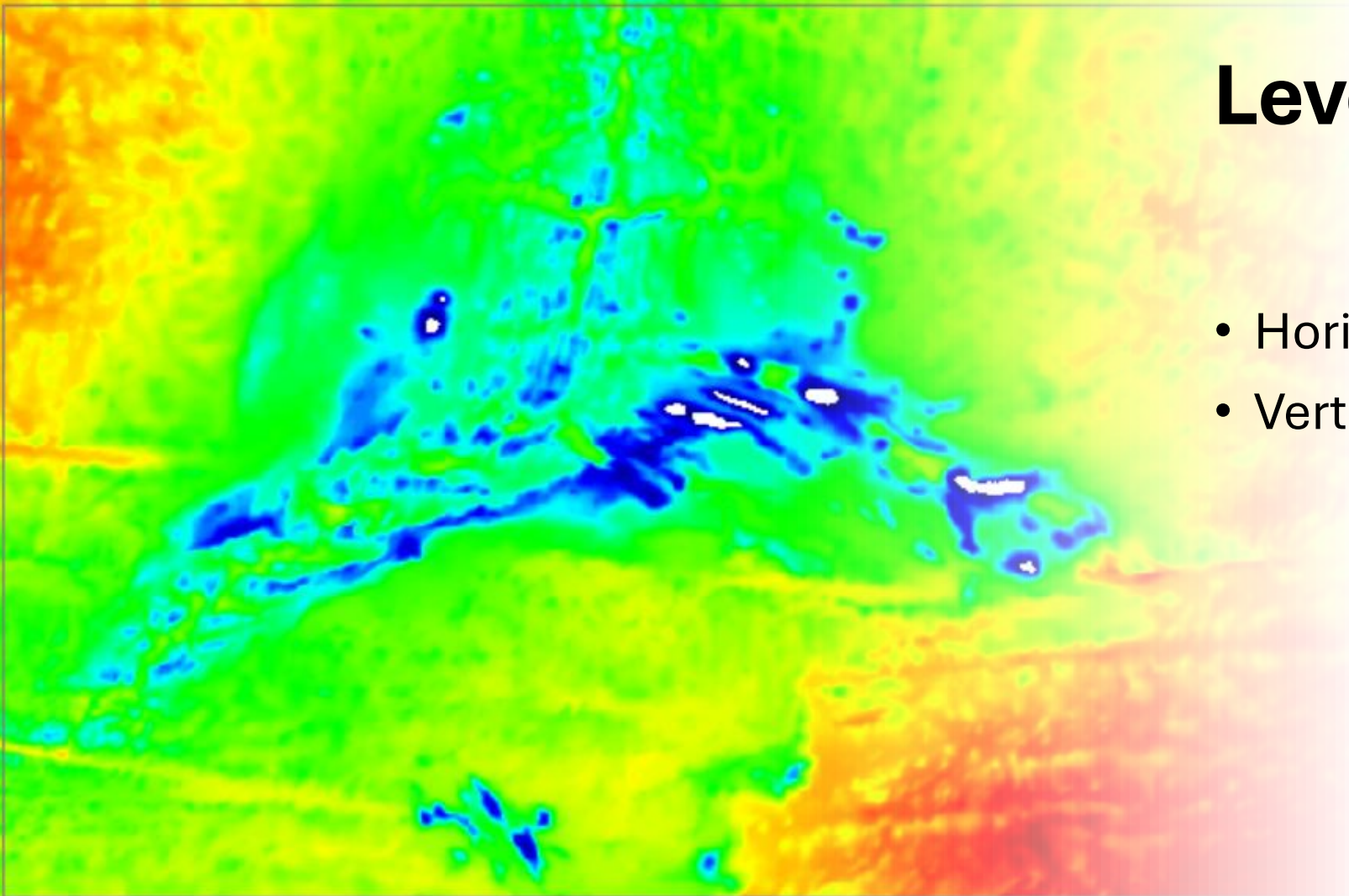
FES2014 is the last version of the FES (Finite Element Solution) tide model developed in 2014-2016. It is an improved version of the FES2012 model. This new FES2014 model has been developed, implemented and validated by the LEGOS, NOVELTIS and CLS, within a CNES funded project.

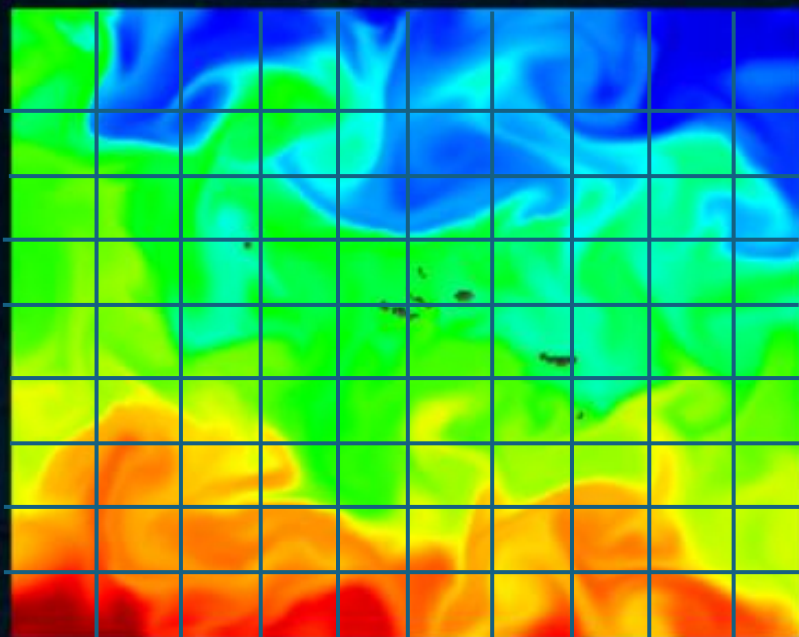


Level 2 → 3D

- Horizontal: 730 x 456 cells
- Vertical: 67 levels

22 302 960 cells





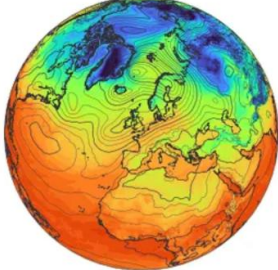
chess.dat	
1	AUTOMATIC_DD : 3
2	CHESSE_LINES : 8
3	CHESSE_COLUMNS : 10

ERA5 hourly data on single levels from 1940 to present

[Overview](#)[Download](#)[Documentation](#)

ERA5 is the fifth generation ECMWF reanalysis for the global climate and weather for the past 8 decades. Data is available from 1940 onwards. ERA5 replaces the ERA-Interim reanalysis.

ERA5 2 metre temperature and Mean sea level pressure
1 January 2023 at 00:00 UTC



References

[Citation and attribution](#)

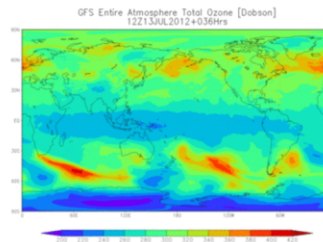
DOI: [10.24381/cds.adbb2d47](#)

Licence

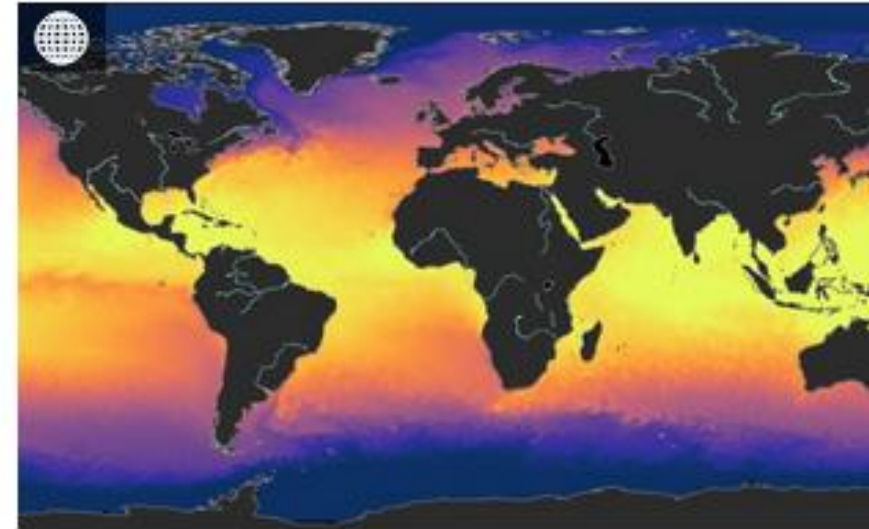
[Licence to use Copernicus Products](#)

Global Forecast System (GFS)

The Global Forecast System (GFS) is a National Centers for Environmental Prediction (NCEP) weather forecast model that generates data for dozens of atmospheric and land-soil variables, including temperatures, winds, precipitation, soil moisture, and atmospheric ozone concentration. The system couples four separate models (atmosphere, ocean model, land/soil model, and sea ice) that work together to accurately depict weather conditions.



Copernicus Marine Data Store



Global Ocean Physics Analysis and Forecast

GLOBAL_ANALYSISFORECAST_P... 001_024

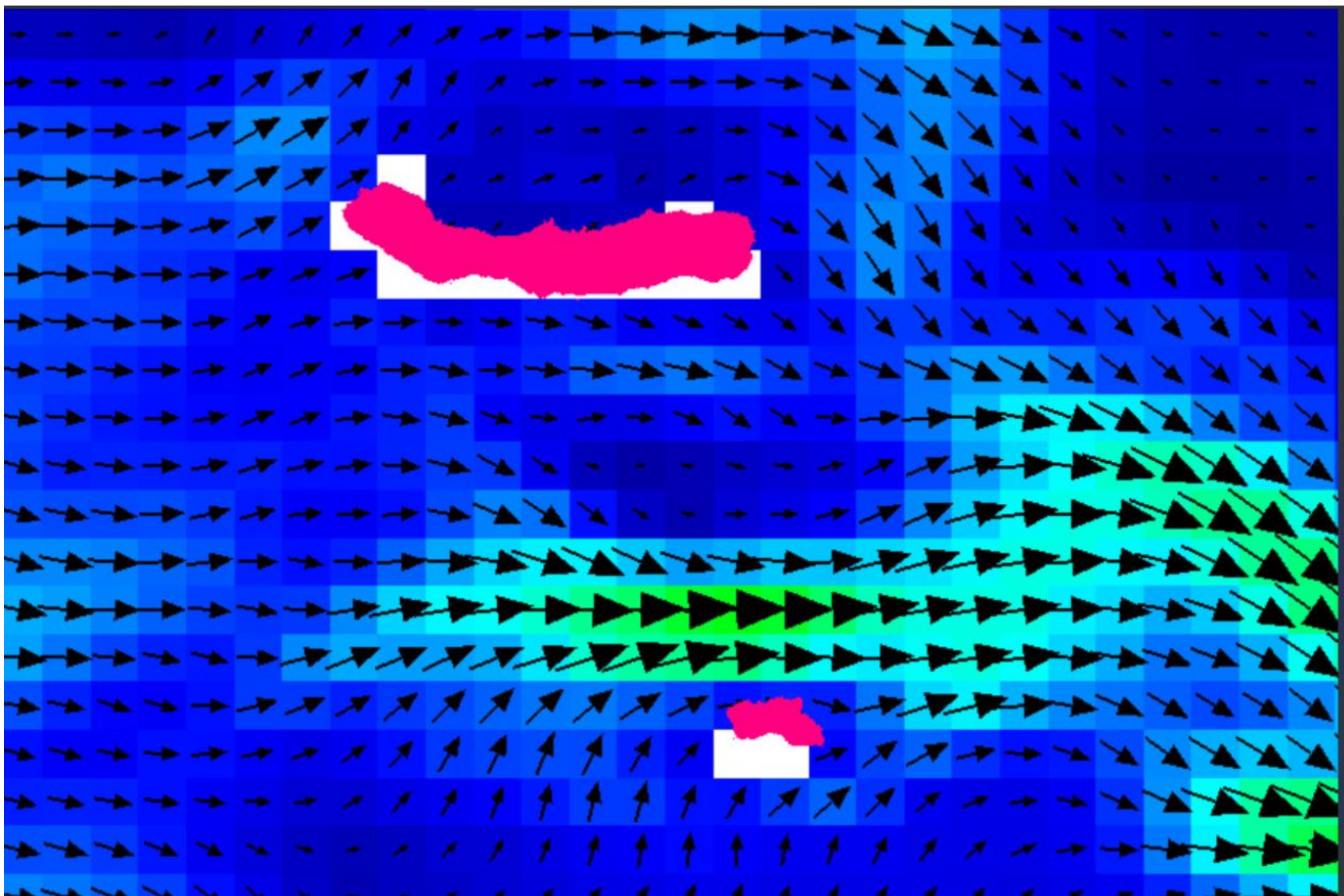
Models

Global, $0.083^\circ \times 0.083^\circ \times 50$ levels

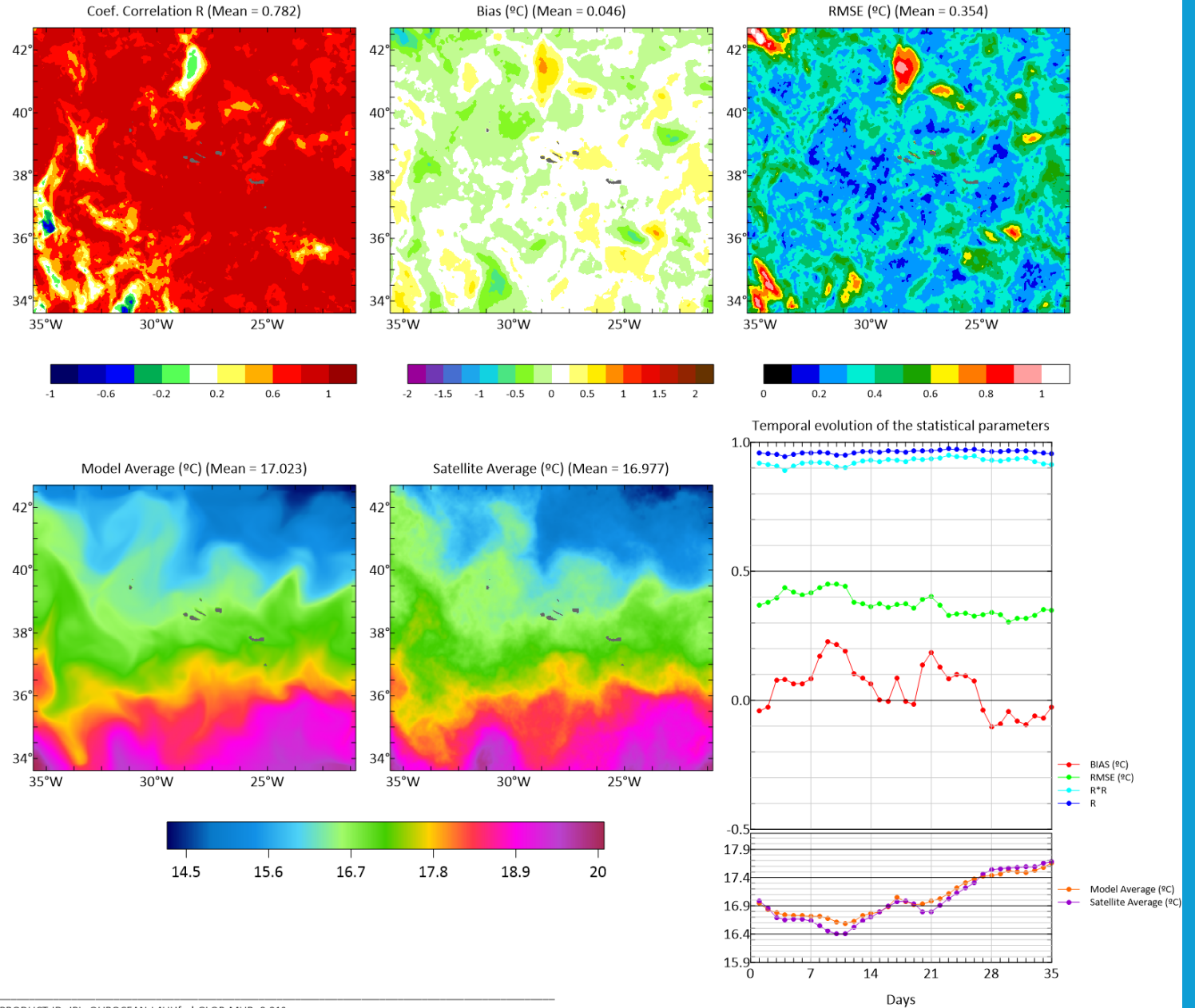
31 Oct 2020 to 27 Jun 2025, hourly, daily,...

Temperature, salinity, sea surface height, velocity, mixed layer thickness, wave, sea ice...

6 hourly 3D Global

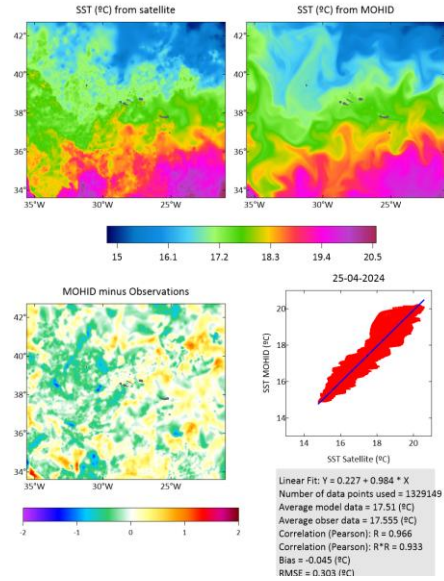


Validation



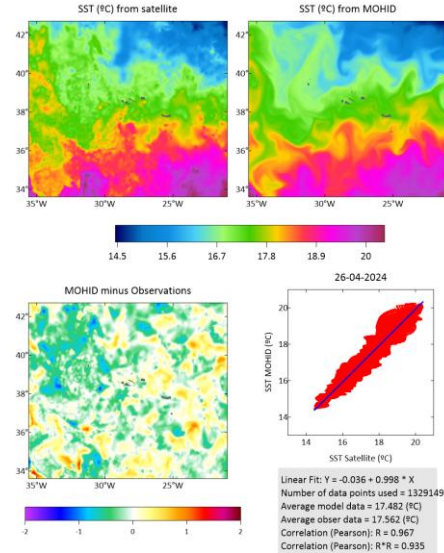
MOHID SST vs Satellite SST (Microwave + Infra-red + In Situ)(*)

25-04-2024



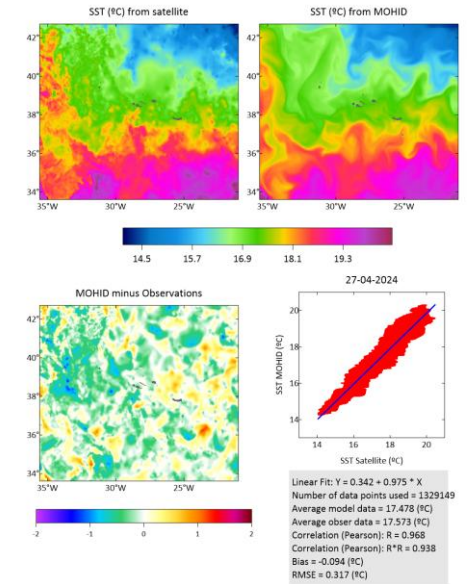
MOHID SST vs Satellite SST (Microwave + Infra-red + In Situ)(*)

26-04-2024

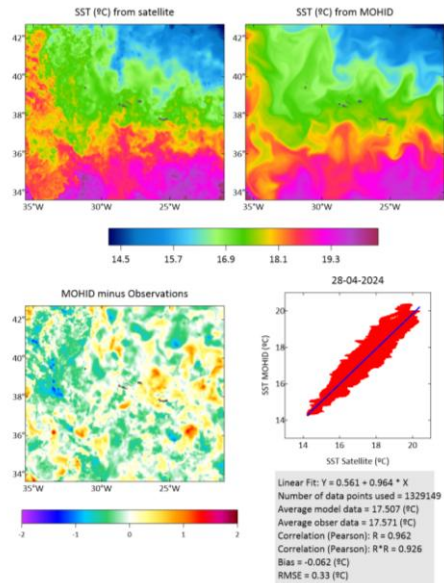


MOHID SST vs Satellite SST (Microwave + Infra-red + In Situ)(*)

27-04-2024

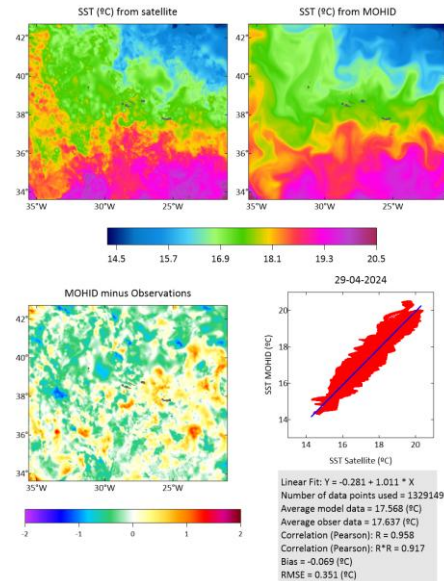


28-04-2024



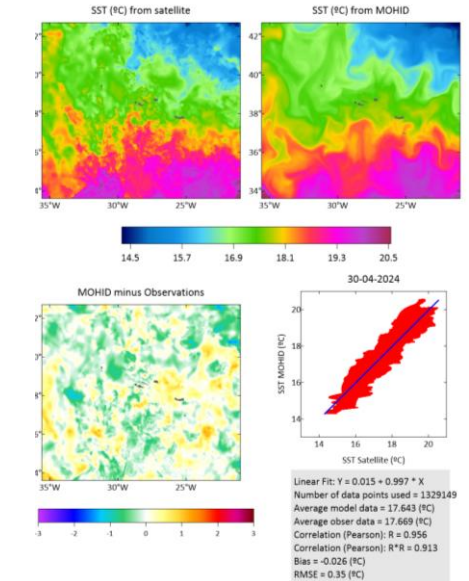
MOHID SST vs Satellite SST (Microwave + Infra-red + In Situ)(*)

29-04-2024



MOHID SST vs Satellite SST (Microwave + Infra-red + In Situ)(*)

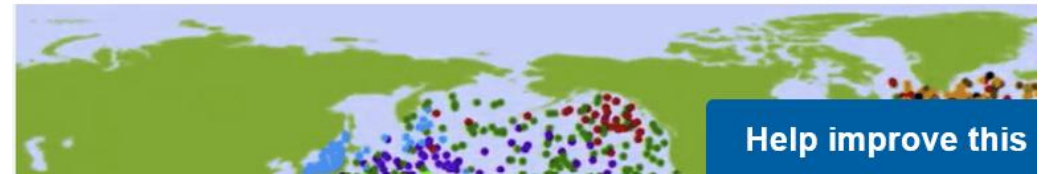
30-04-2024



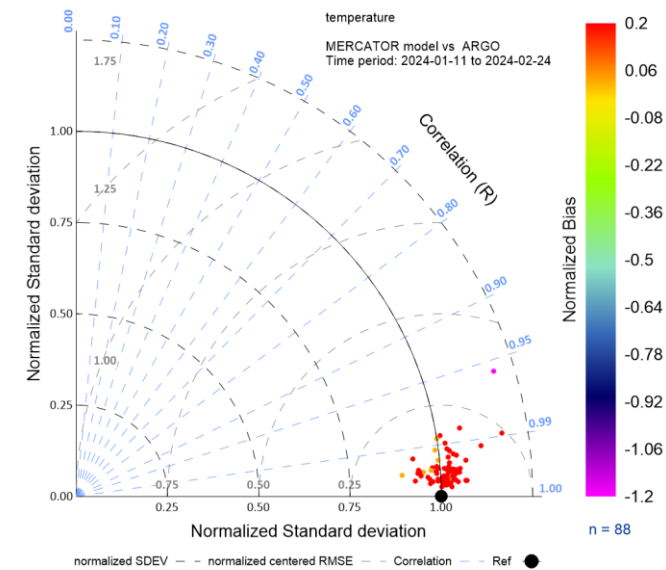
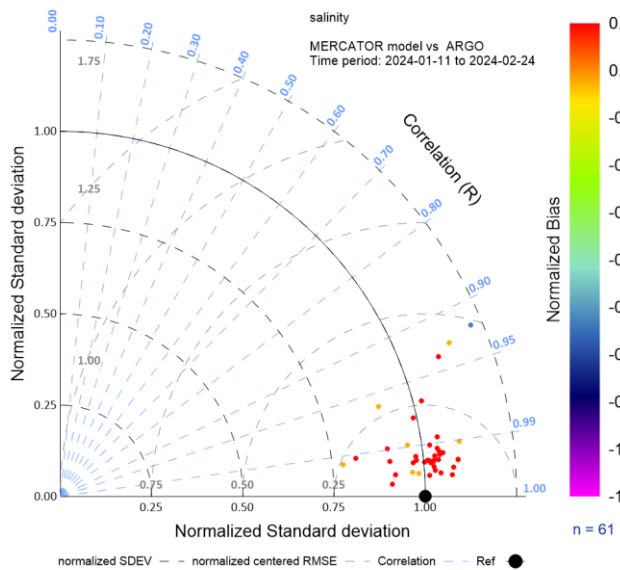
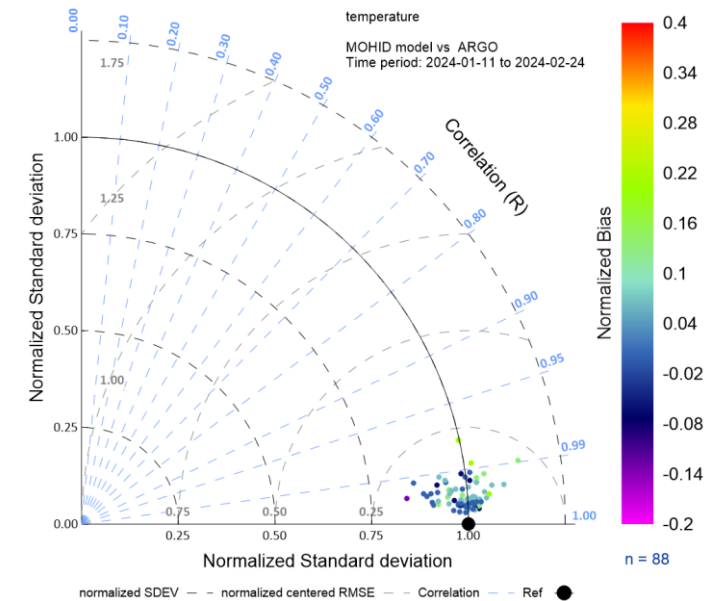
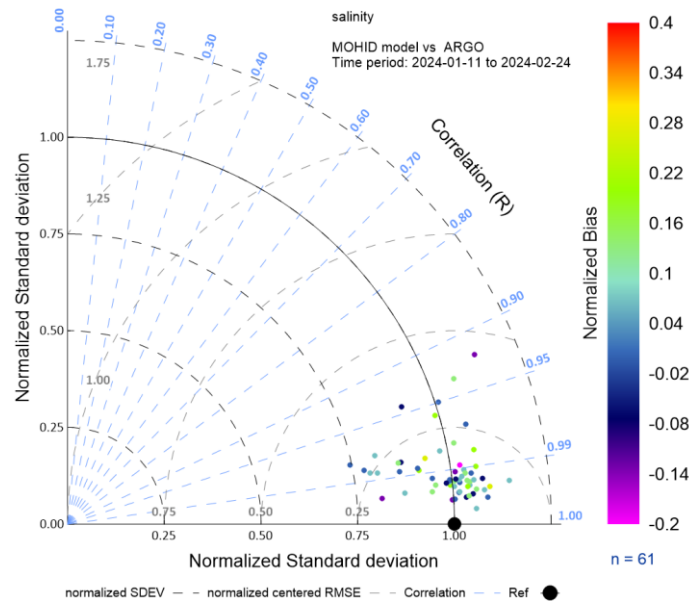


The Argo Program at AOML

AOML is the data processing center for all US Argo data. Argo floats are deployed in the US, the data are collected via satellite, processed and quality controlled by AOML, and then sent to the US Global Data Assembly Center (GDAC) for distribution to the user community. AOML is a full

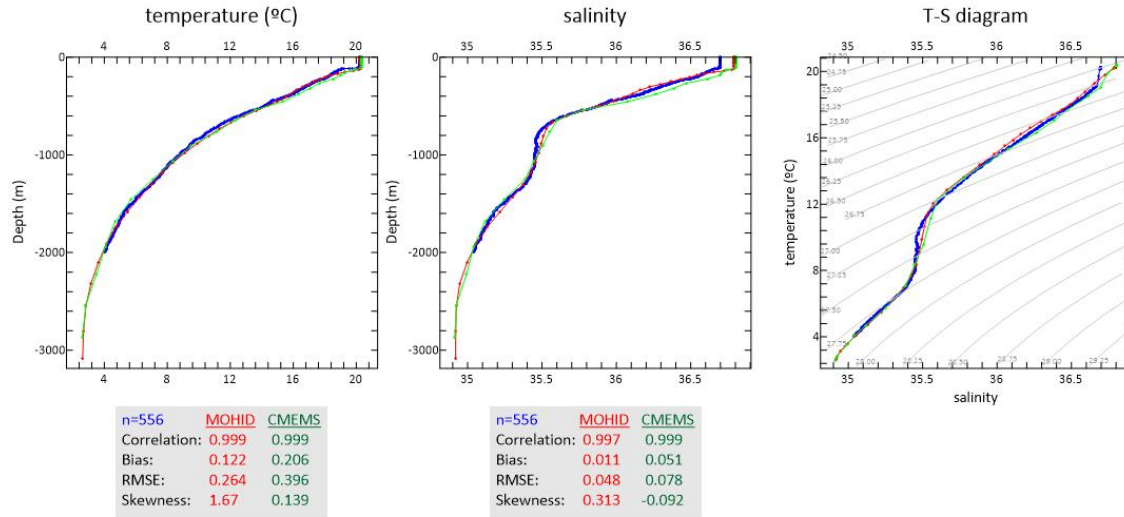


Validation

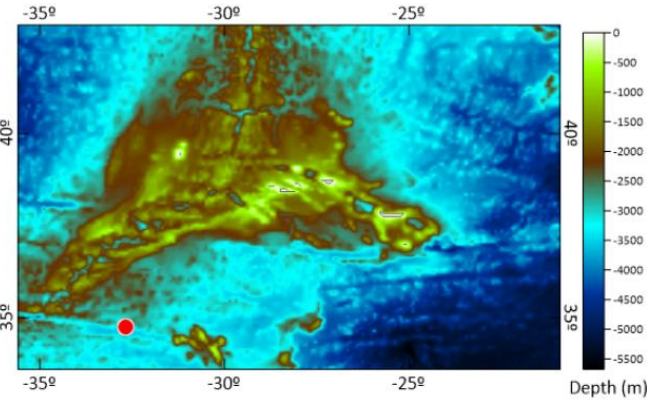


ARGO ●
 MOHID ●
 CMEMS ●

Time: 12-Jan-2024 1:50
 Location: 34.748°N, 32.69°W
 Id: 3902000 Cycle No. 77(A)



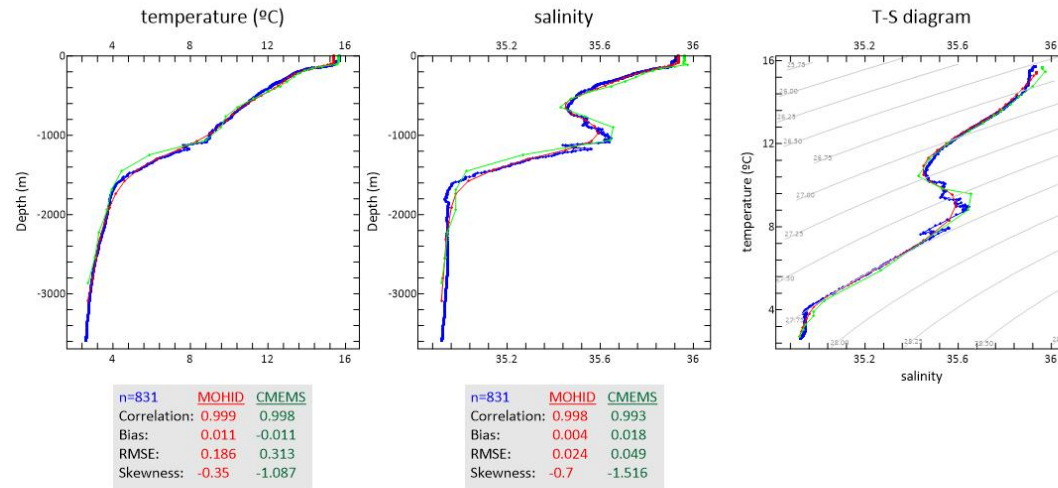
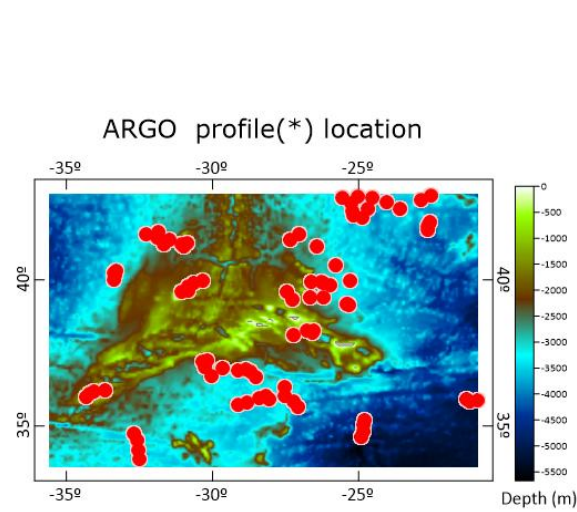
ARGO profile(*) location



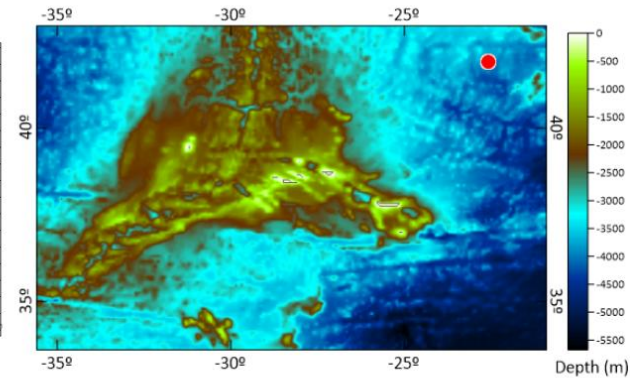
(*)These data were collected And made freely available by the International Argo Project And the national programs tha (http://www.argo.ucsd.edu, http://argo.jcommops.org). Argo is a pilot program of the Global Ocean Observing System.

ARGO ●
 MOHID ●
 CMEMS ●

Time: 25-Jan-2024 22:58
 Location: 41.909°N, 22.592°W
 Id: 6903081 Cycle No. 97(A)



ARGO profile(*) location



(*)These data were collected And made freely available by the International Argo Project And the national programs that contribute To it. (http://www.argo.ucsd.edu, http://argo.jcommops.org). Argo is a pilot program of the Global Ocean Observing System.

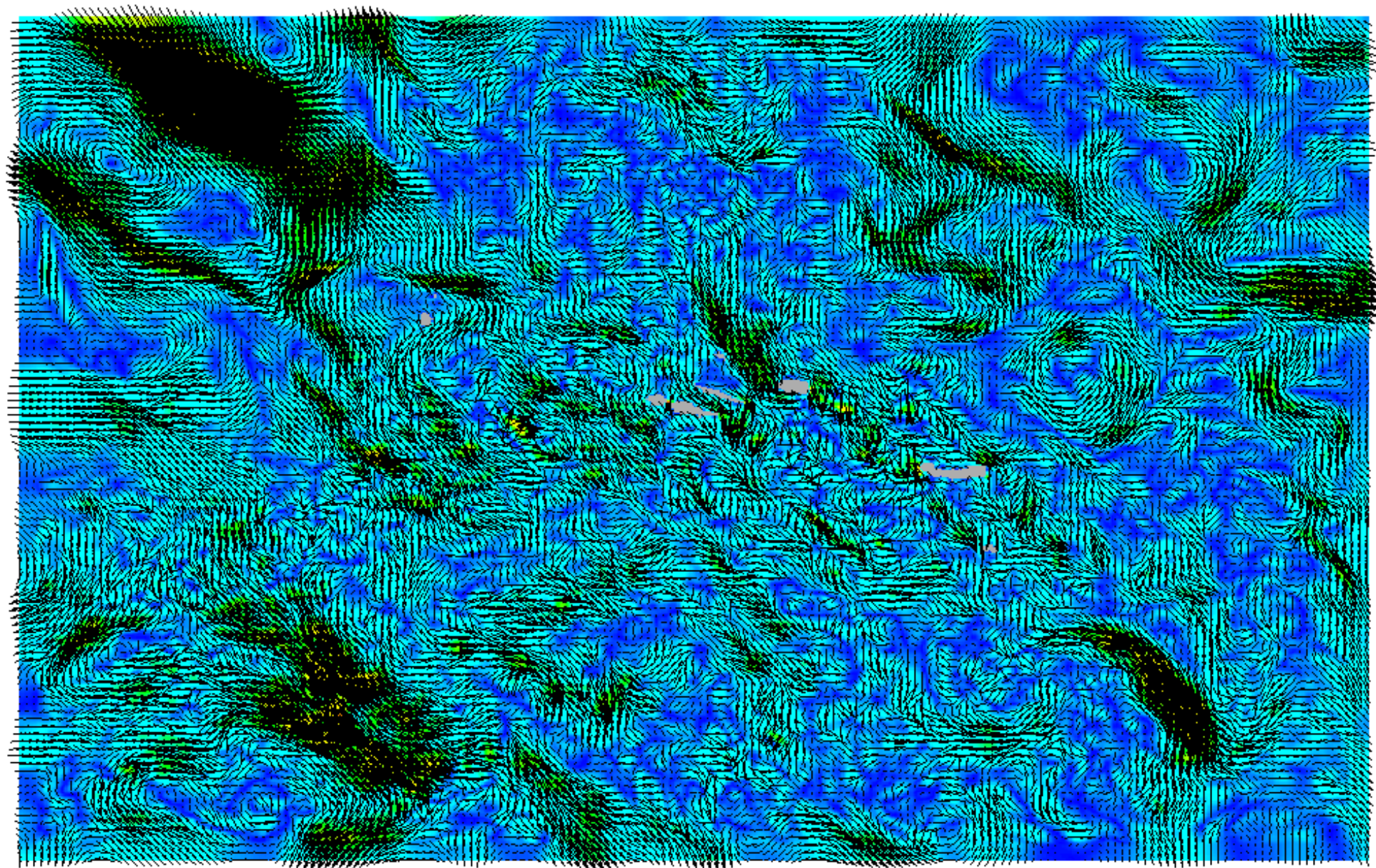
0.700

0.525

0.350

0.175

0.000



Velocity (m/s) at surface

MOHID

Water Modeling System

2024/1/30

8h 0min

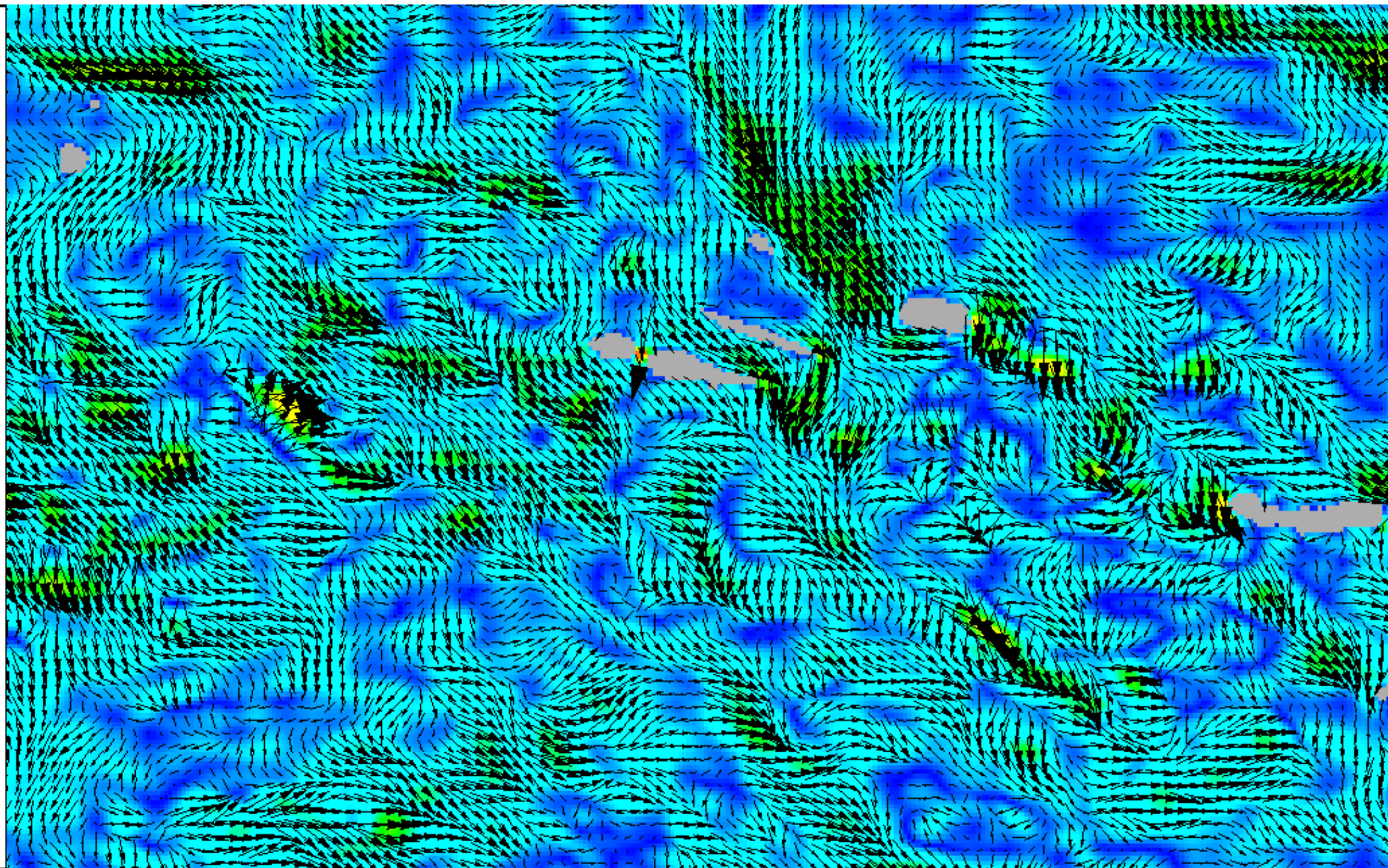
0.700

0.525

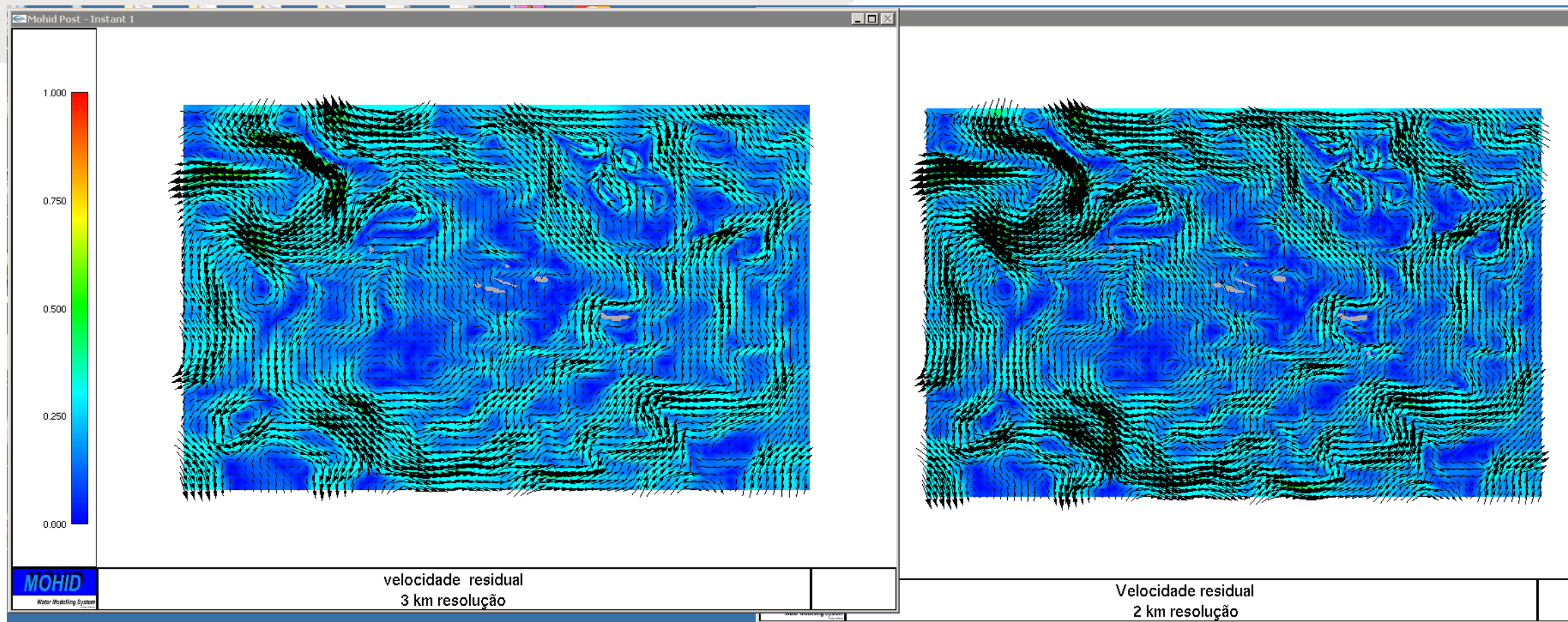
0.350

0.175

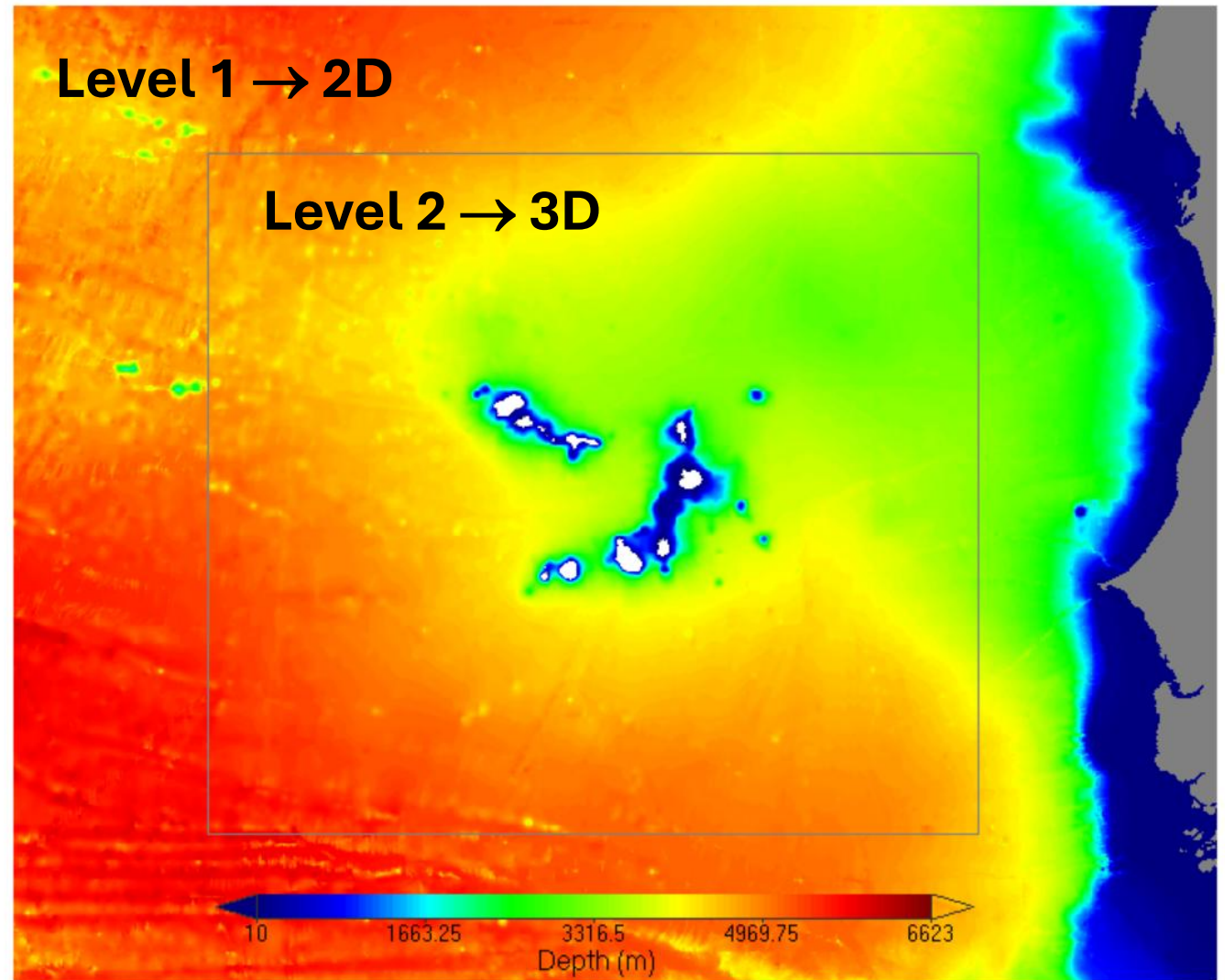
0.000



Residual velocity (m/s) 3km vs 2km

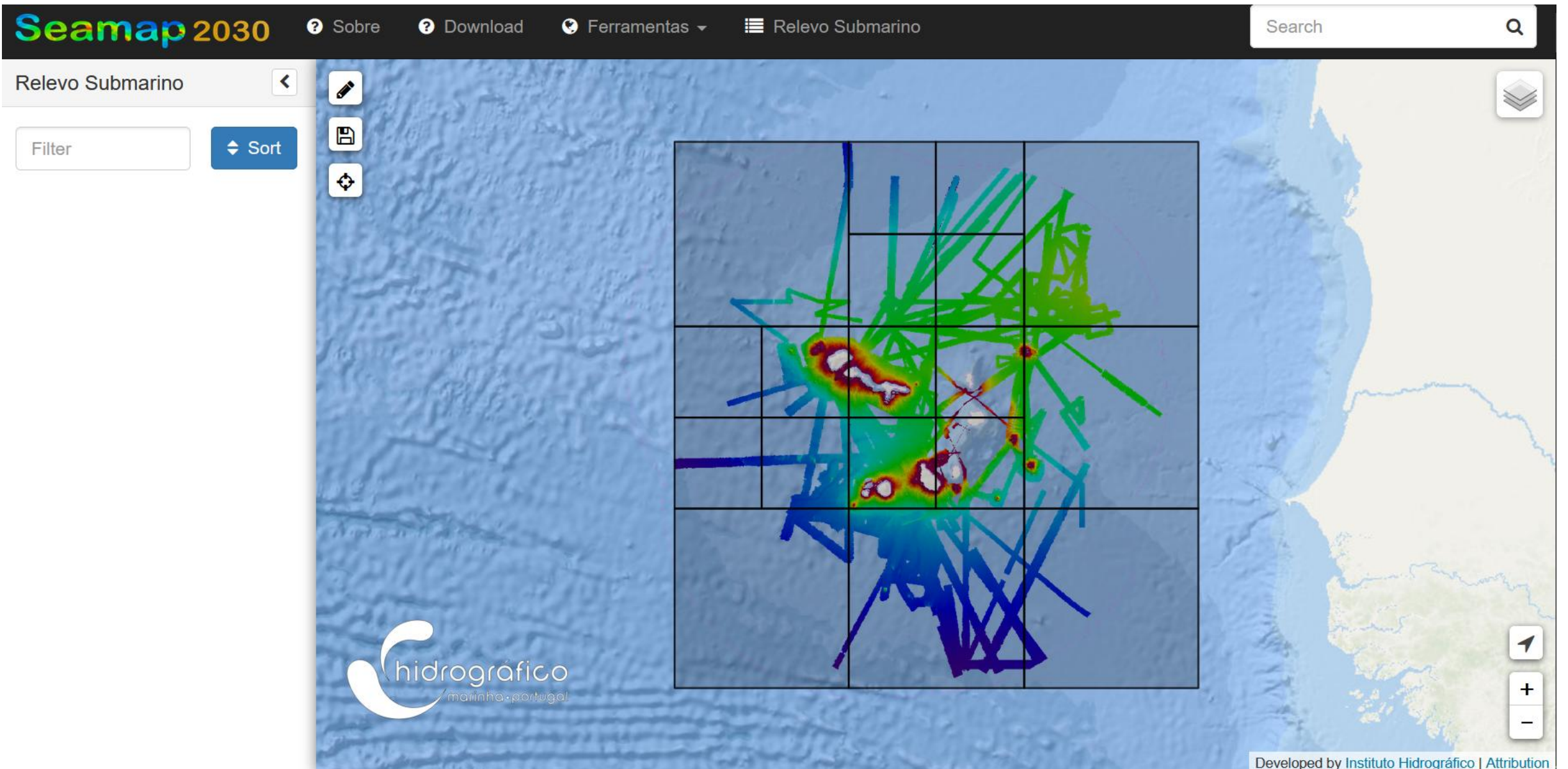


Cabo Verde 2 km



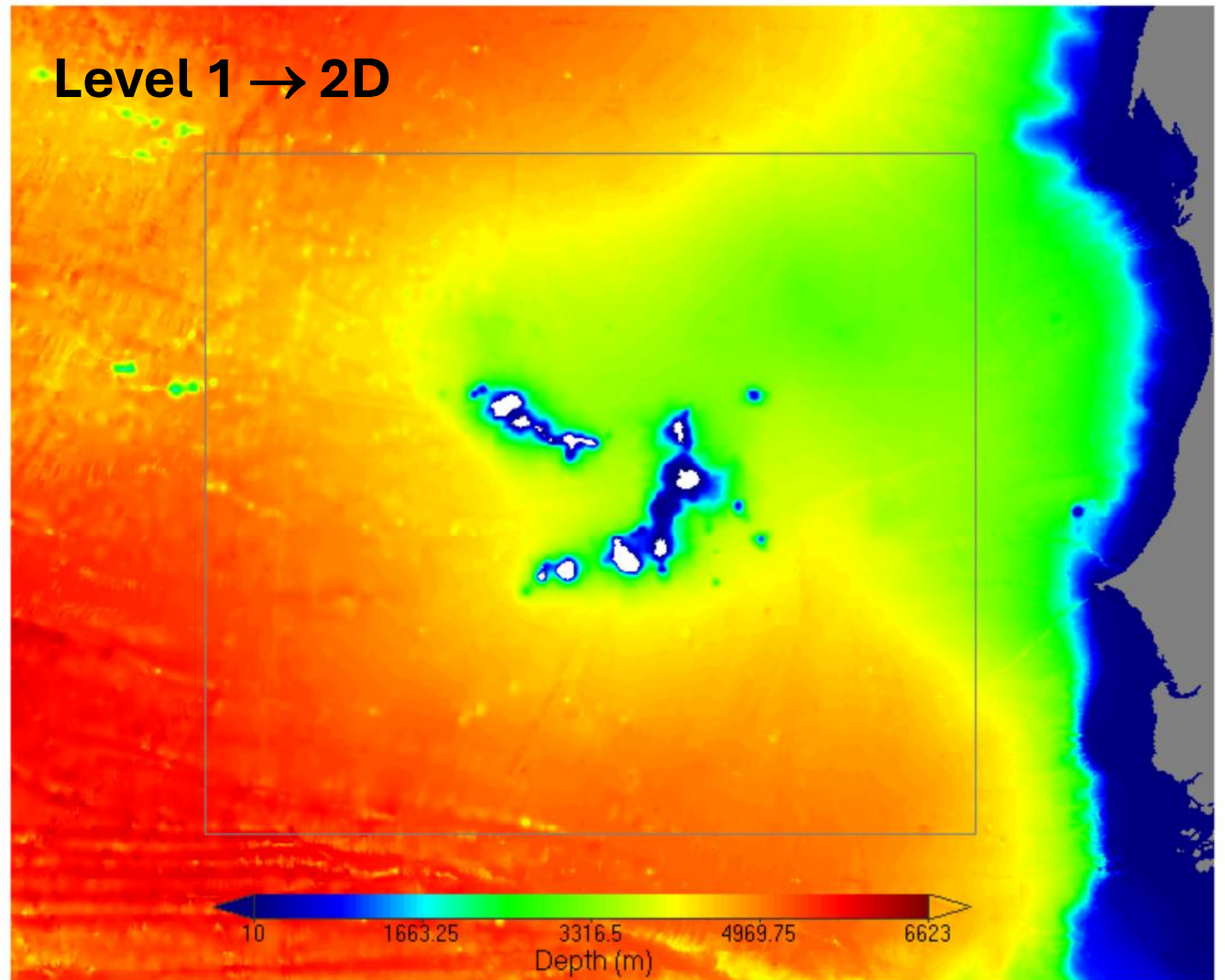
In collaboration with

O INSTITUTO DO MAR DE CABO VERDE DISPONIBILIZA DADOS DO RELEVO DO FUNDO MARINHO



Level 1 → 2D

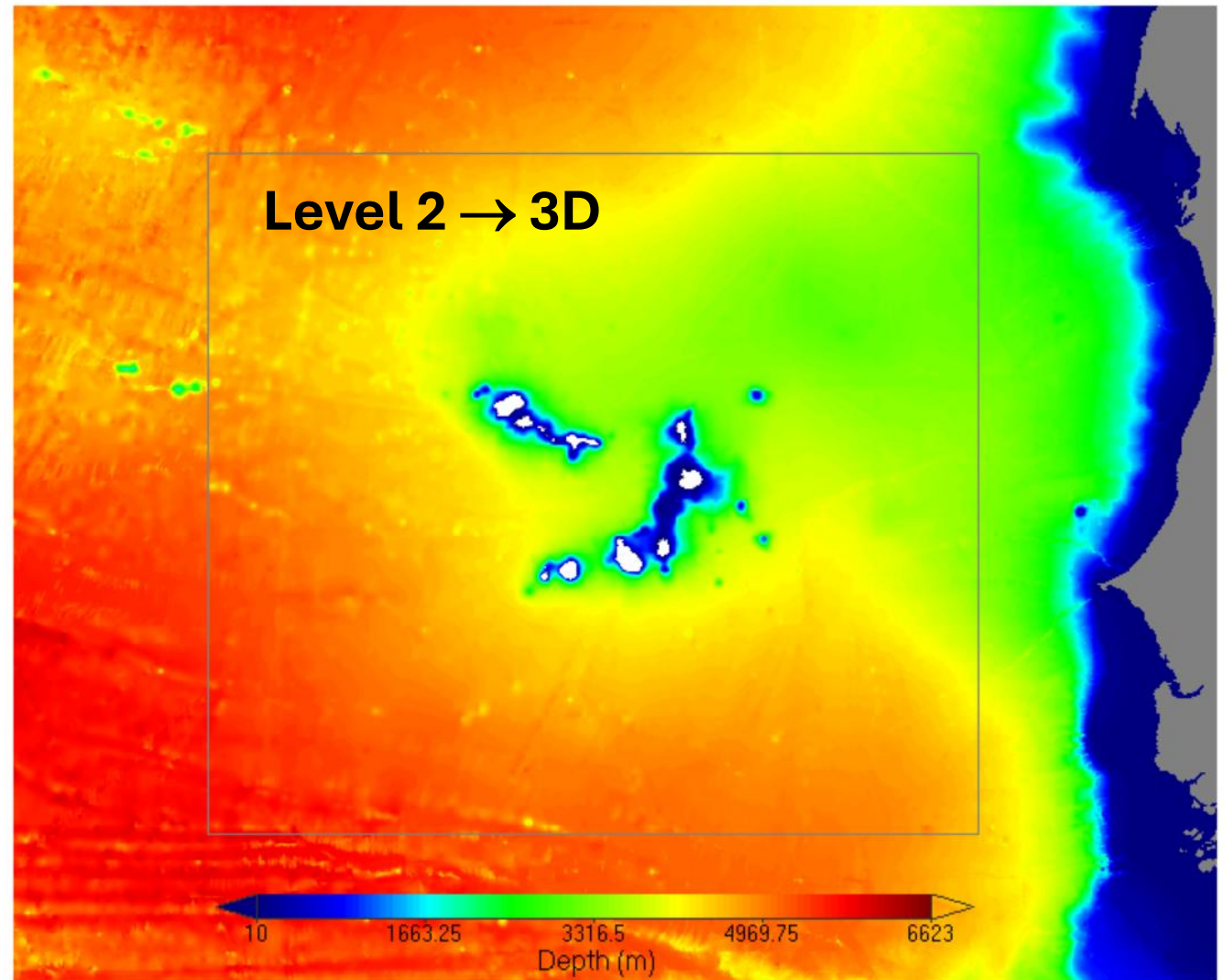
Horizontal: 780 x 632 cells



Level 2 → 3D

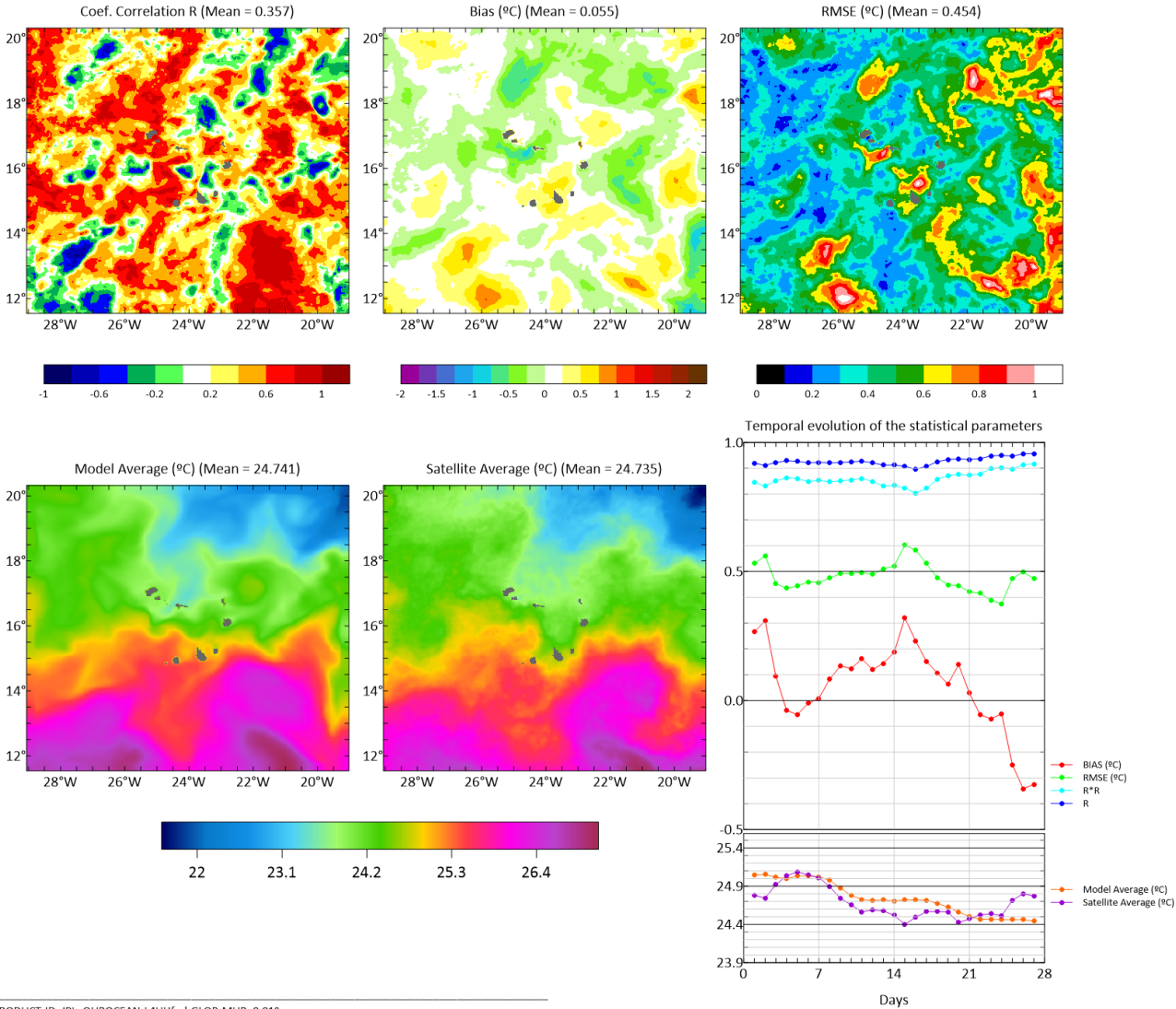
Horizontal: 500 x 440 cells

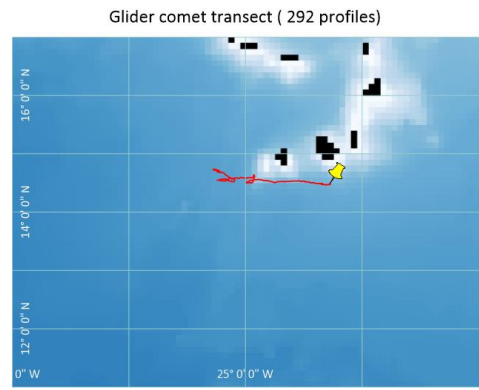
Vertical: 68 levels



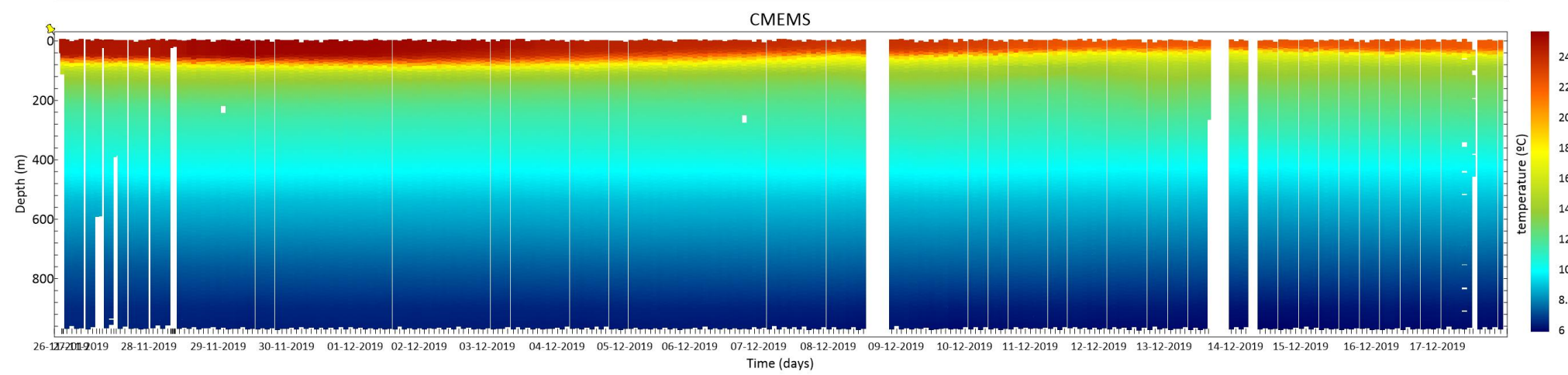
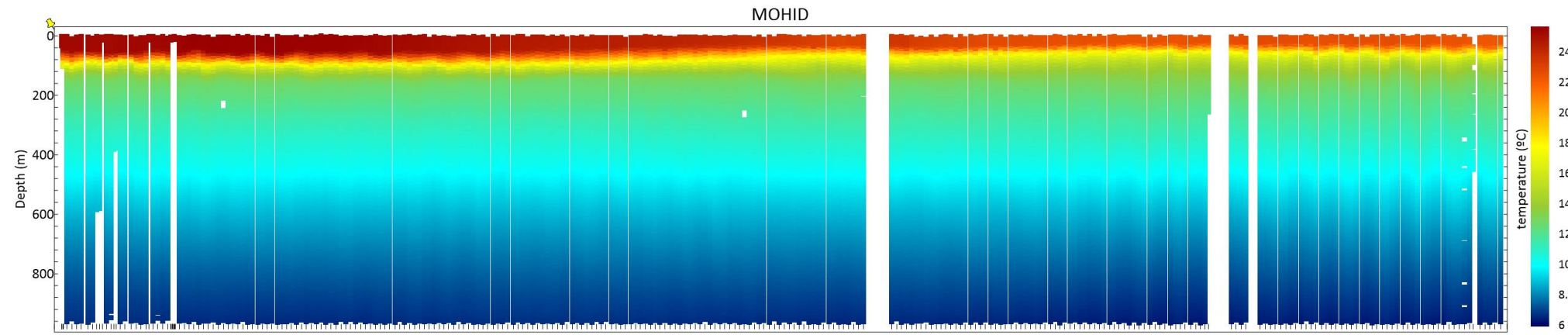
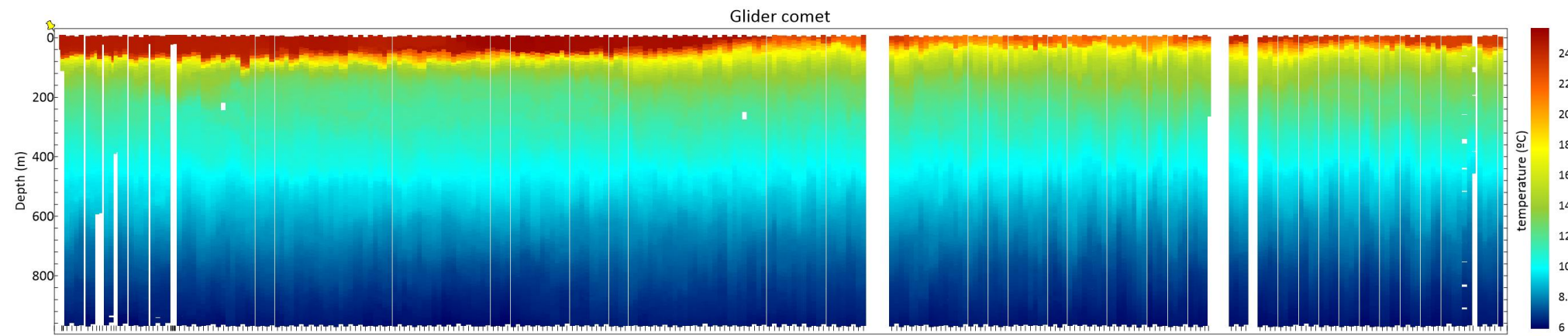


Validation

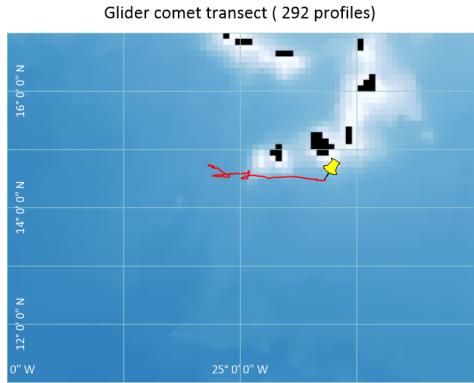




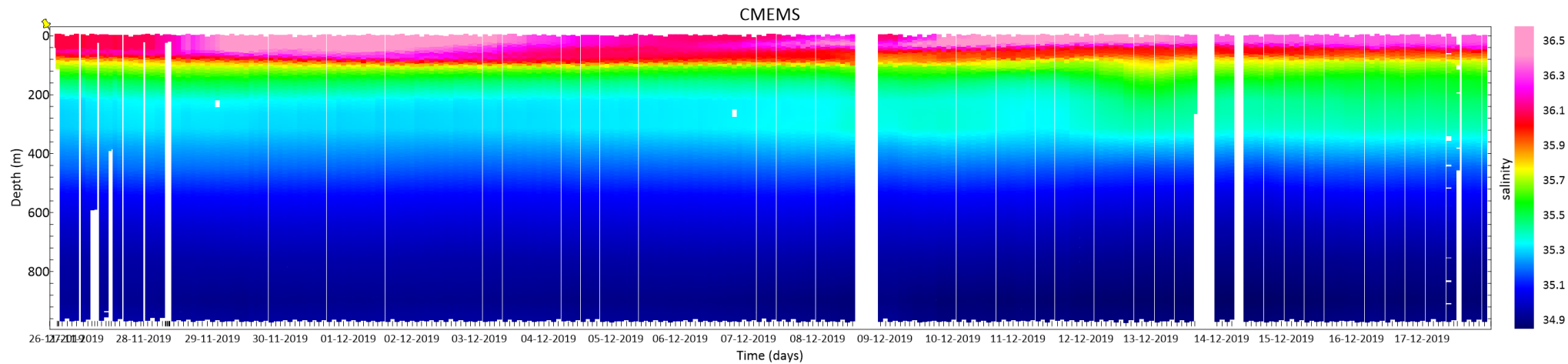
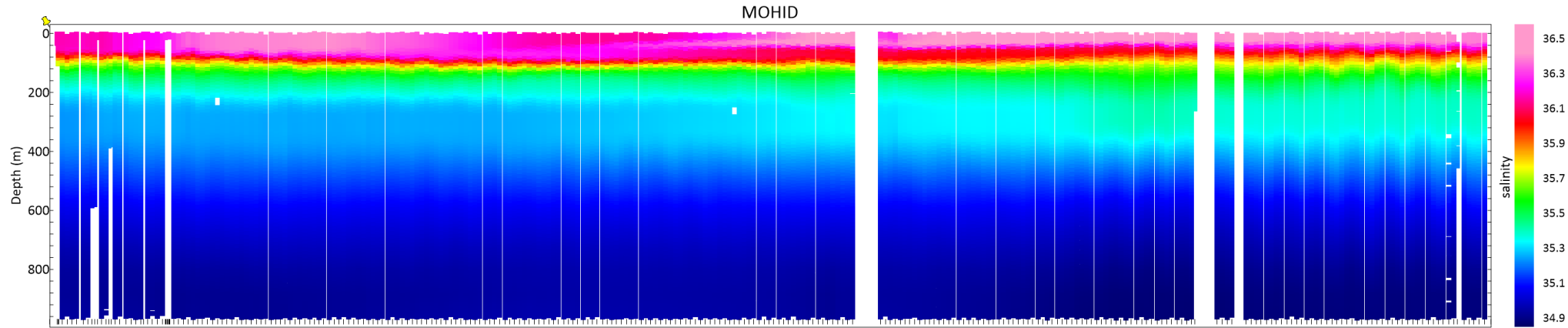
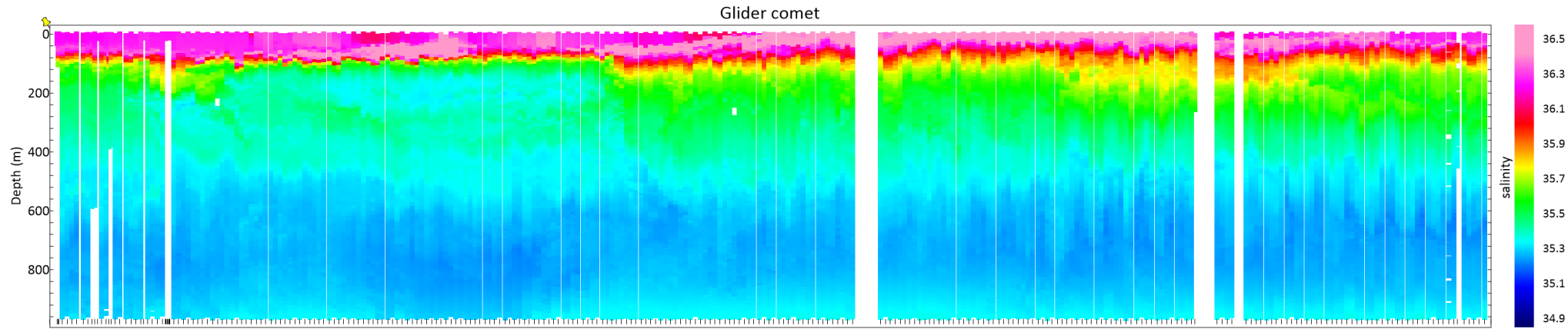
Time: 26-Nov-2019 to 17-Dec-2019



CMEMS product:
GLOBAL_ANALYSISFORECAST_PHY_001_024



Time: 26-Nov-2019 to 17-Dec-2019



CMEMS product:
GLOBAL_ANALYSISFORECAST_PHY_001_024



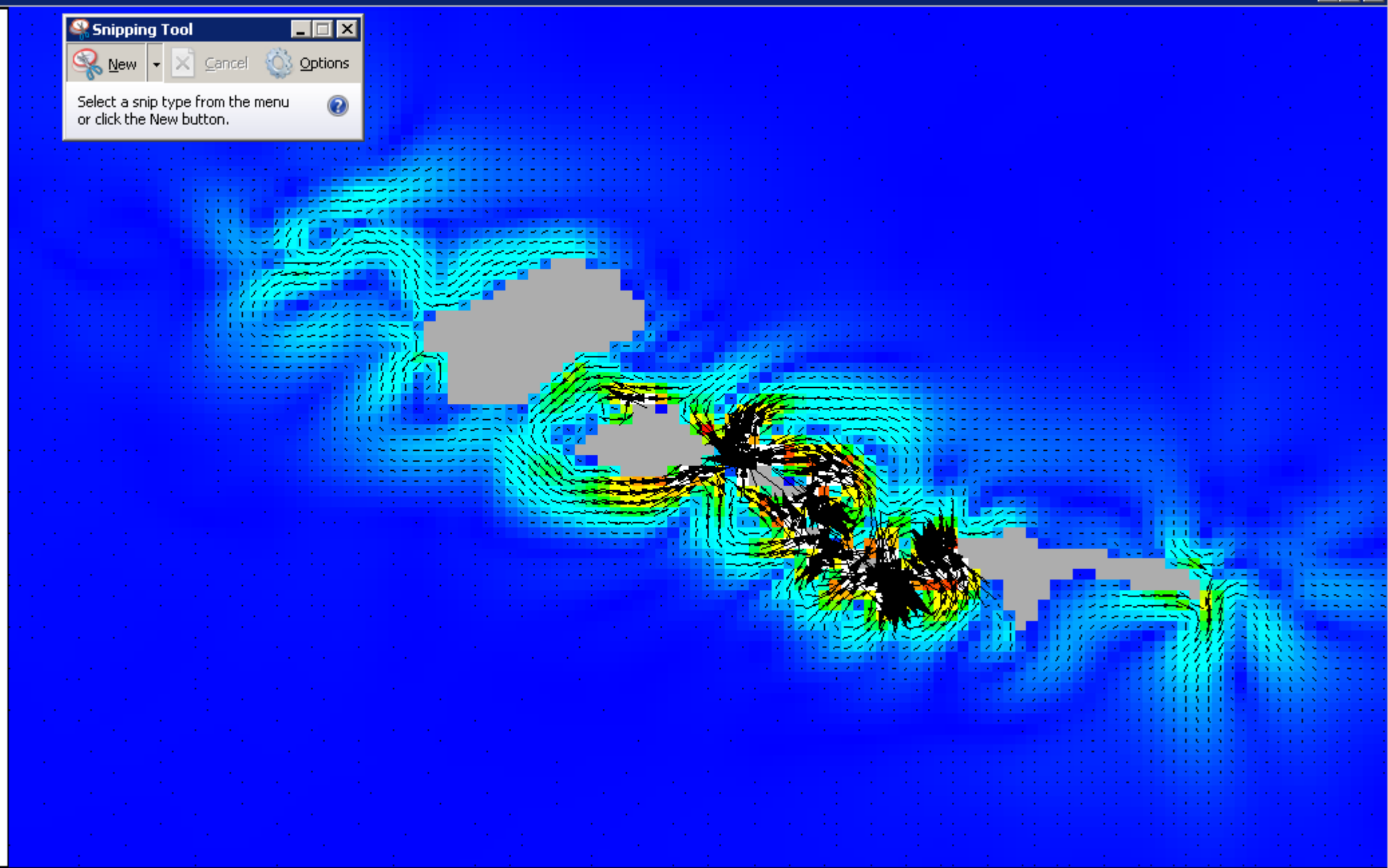
0.050

0.038

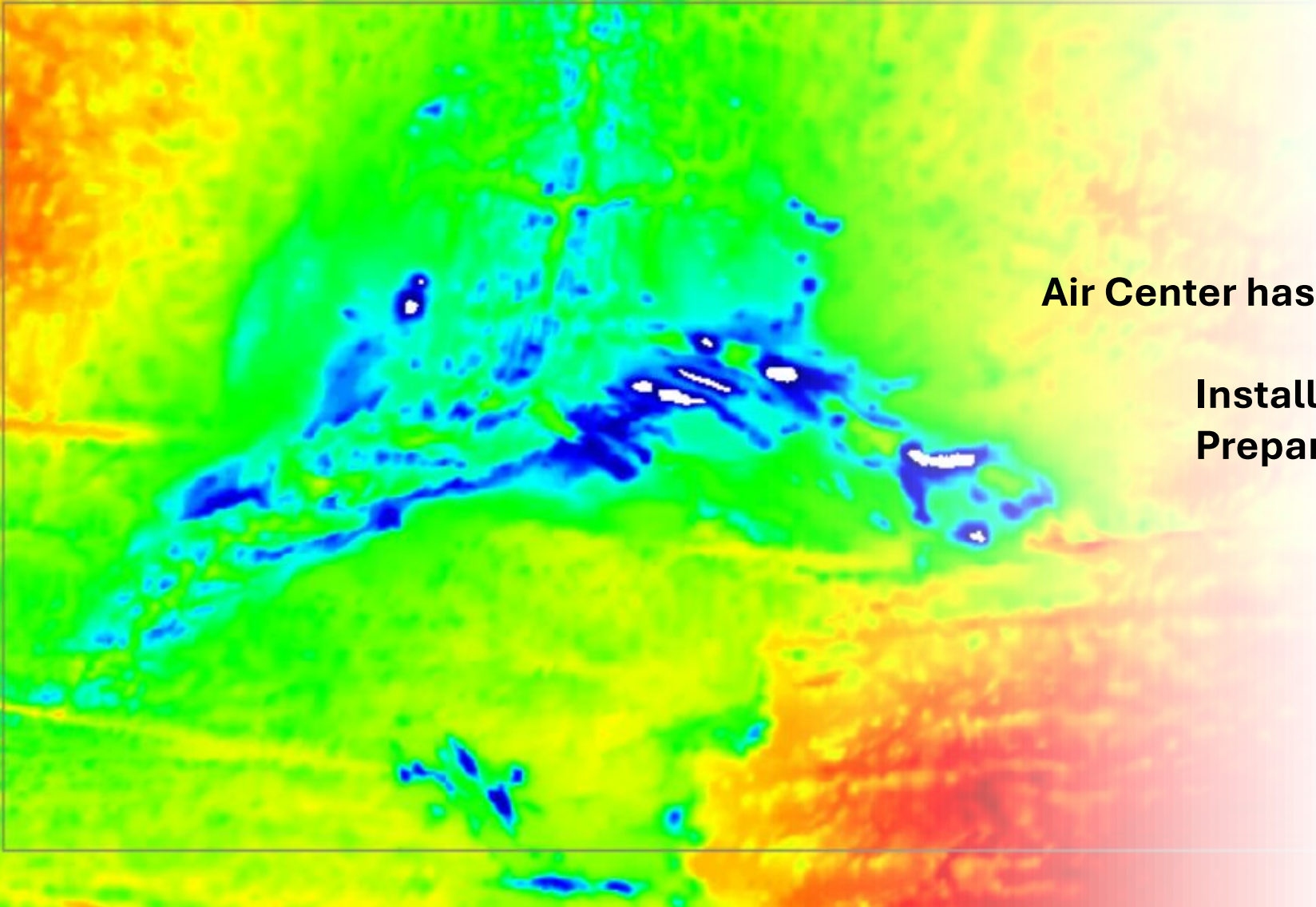
0.025

0.013

0.000



Running Azores model in operational way (10 days of forecast / day)



Air Center has contacted Inductiva:

Install MOHID

Preparing ART_py to run docker



MOHID

MOHIDing 2025

25th, 26th and 27th June 2025, Lisbon

Obrigada!

Manuela Juliano



UAç
UNIVERSIDADE
DOS AÇORES