Diva workshop 2014

New developments

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Charles Troupin, Sylvain Watelet & Jean-Marie Beckers

Acknowledgements: SeaDataNet, EMODnet Chemistry,
EMODnet Biology, STARESO

GHER
GeoHydrodynamics and Environment Research

Université de Liège

SeaDataNet

EMODnet
European Marine Observation and Data Network

STARESO
Station de Recherches Sous-Marines et Océanographiques

Diva developments: summary

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- Modernisation of the code structure. — OK
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- Multivariate approach — OK
- Non-Gaussian distributed variables — OK
- 4-dimensional generalisation — OK: `divand`
- Spatially correlated observations errors — In progress

Past releases: 4.5.1 – March 2013

New features: from user feedback during Diva workshop 2012 (*Roumaillac*)

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- Advection constraint with linear decay rate and local sources
- `divadetrend`: change in the detrending order
- Two new error calculations
  - `divacpme`: quick & better than original poor man's error
  - `divaexerr`: almost exact error calculation, much faster than the exact calculation

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- Advection constraint with linear decay rate and local sources
- `divadetrend`: change in the detrending order
- Two new error calculations
- Simplified procedure for installation/compilation + tests
- Housekeeping of the code
  (simplifications, error messages, cleaning up of code, further optimisations, elimination of depreciated tools)

Past releases: 4.5.1 – March 2013

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- `divadetrend`: change in the detrending order
- Two new error calculations
- Simplified procedure for installation/compilation + tests
- Housekeeping of the code
- Updated user guide
  (augmented with examples and new tool descriptions)

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- Possibilities to call Diva from other software via system calls
- `divadoxml` adapted to new specifications from IFREMER

Past releases: 4.6.1 – June 2013

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- Two additional solvers
  - parallel version
  - iterative version

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- Optimisations of file exchanges for use with ODV

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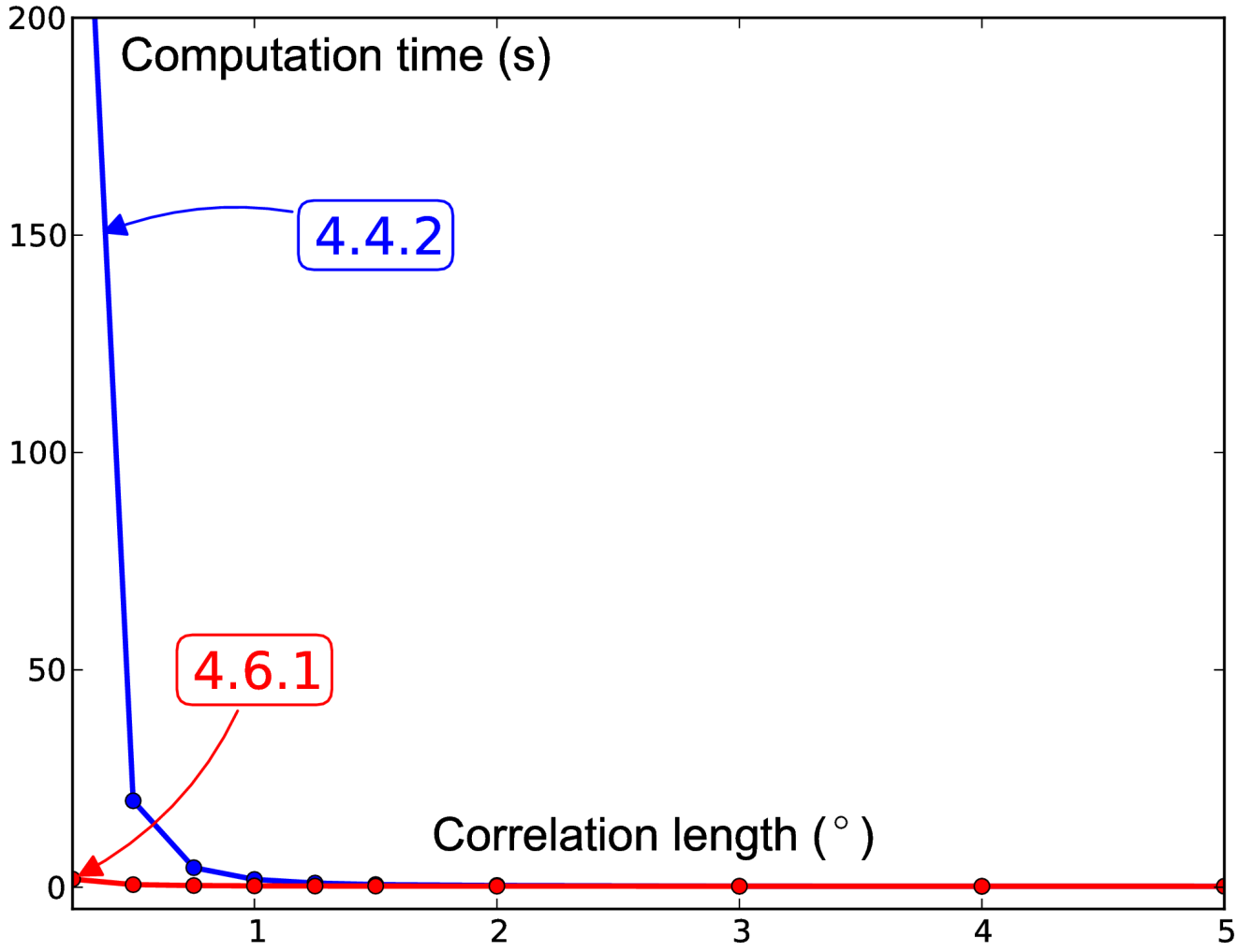
- Two additional solvers
  - parallel version
  - iterative version
- Optimisations for large data sets
- Optimisations of file exchanges for use with ODV
- Highly optimised new version of the grid generator

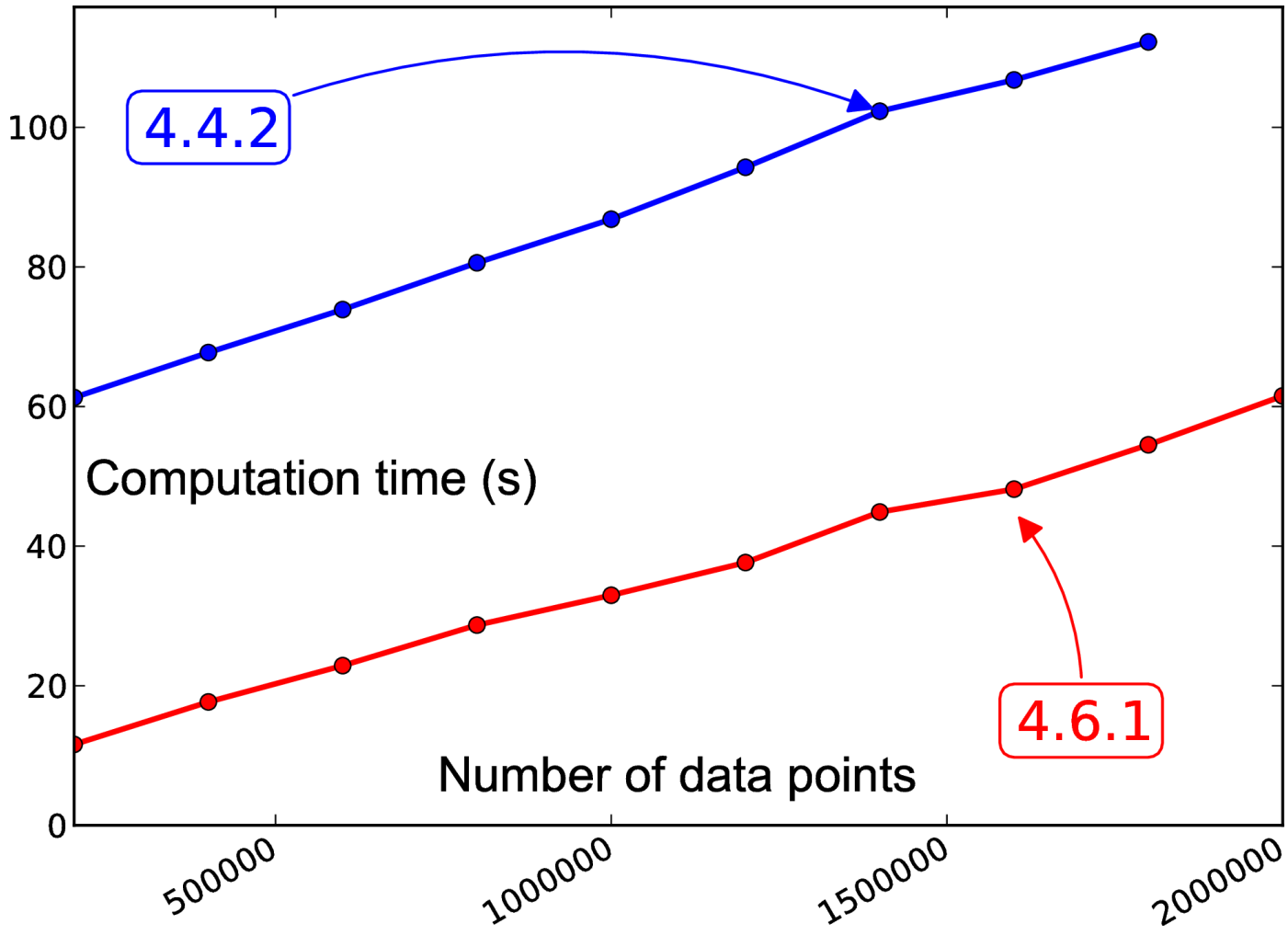
Better, faster, stronger …

Mesh:
very fine
meshes in a
few seconds



Better, faster, stronger …

Analysis:
2 million data
≈ 1 minute



Better, faster, stronger . . .

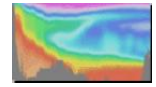
Solvers:

- Direct
- Parallel
- Iterative

Better, faster, stronger . . .

Mesh: $\approx 100 \times$ faster

Analysis: $\approx$ 5-10 $\times$ faster

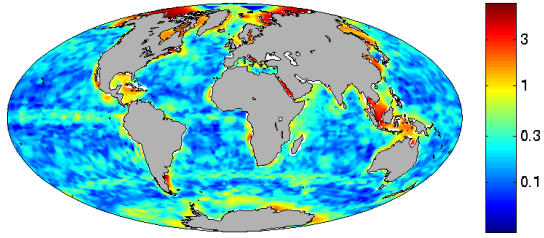
$\rightarrow$ also quicker in ODV 

Scientific developments – innovations

4-dimensional generalisation: `divand`

- Derivation of the kernel for n dimensions
- Additional constraint
- Algorithms (primal and dual formulations)

RMS 3D analysis



Released code version available at:
`http://modb.oce.ulg.ac.be/mediawiki/index.php/Divand`

Scientific developments – innovations

Spatially correlated observations

Ideally:	observation errors not correlated
Reality:	clusters of observations (cruises, . . .)
Consequence:	observations error covariance matrix is not diagonal

Scientific developments – innovations

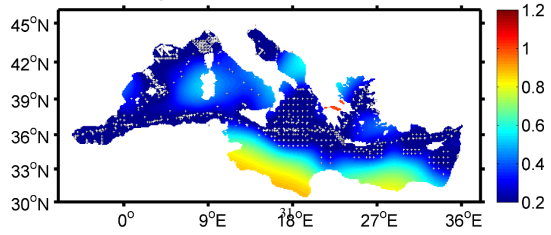
New error computation

Poor man's error: quick, but error underestimation

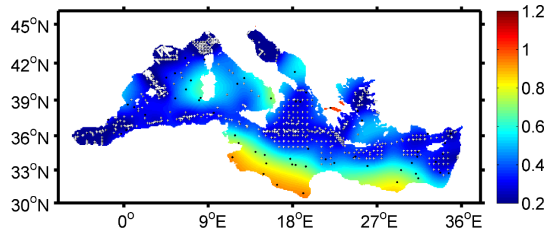
Real covariance: correct error estimation but very slow

Now: two quicker/more accurate methods

Clever poor man's estimate



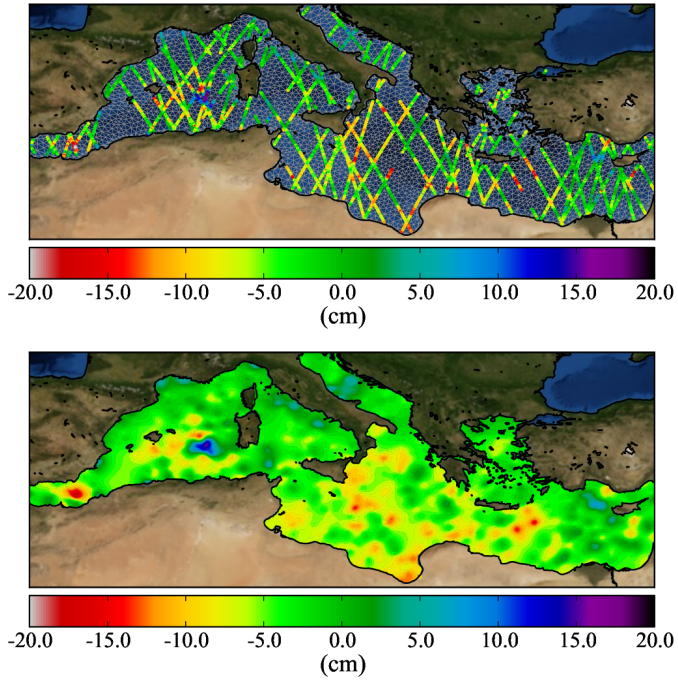
Almost exact error



Scientific developments – innovations

Adaptation to altimetry data

- Particular temporal/spatial coverage
- Input files: NetCDF
- Modified data weights according to time of measurement



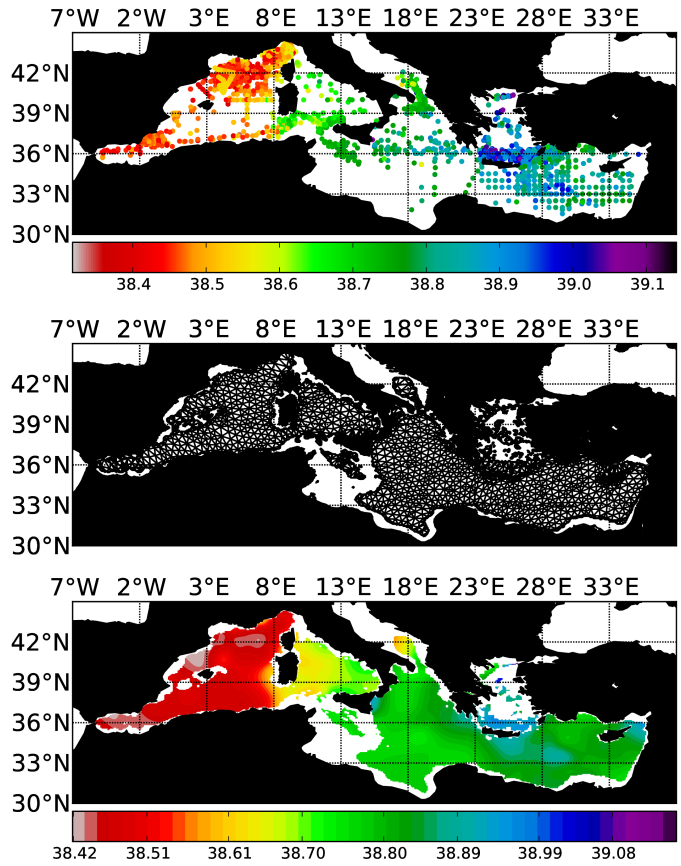
Scientific developments – innovations

Python plotting tools

→ python™

- Free alternative to matlab/octave
- Easily deals with NetCDF
- Publication quality figures with Matplotlib

http://modb.oce.ulg.ac.be/mediawiki/index.php/Diva_python



GHER SeaDataNet

Publications

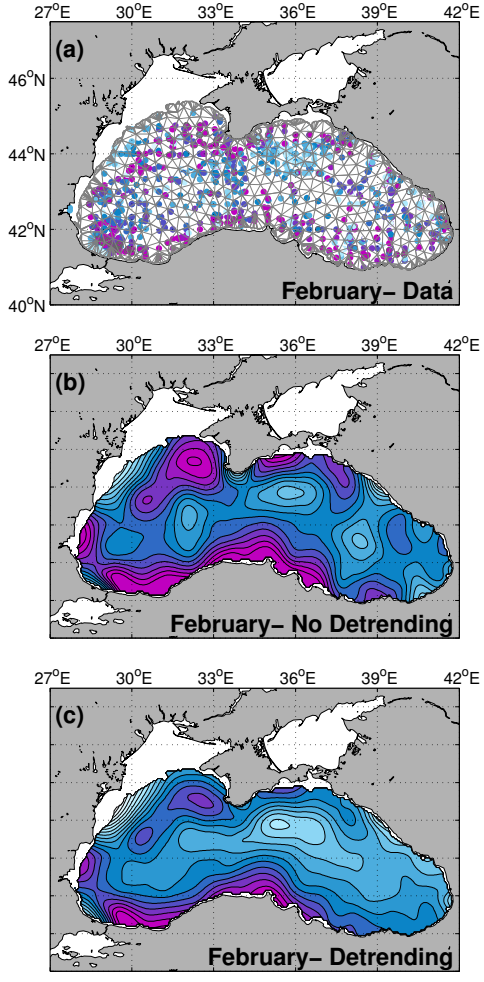
Detrending:

Recognizing temporal trends in spatial interpolation : an application to the Black Sea Cold Intermediate Layer and mixed layer depth

A. Capet, C. Troupin, J. Carstensen, M. Grégoire & J.-M. Beckers

Ocean Dynamics

Under revision



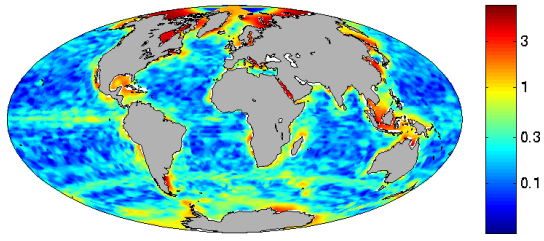
Publications

Diva-nd:

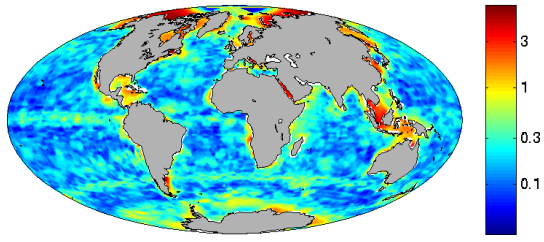
divand-1.0: n-dimensional variational data analysis for ocean observations

A. Barth, J.-M. Beckers, C. Troupin,
A. Alvera-Azcárate & L. Vandenbulcke
Geoscientific Model Development
Under revision

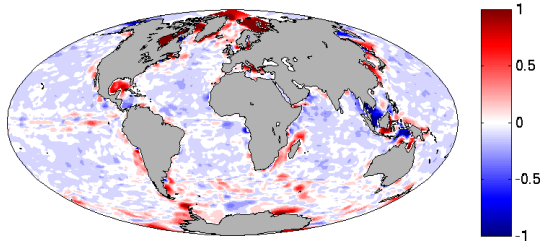
RMS 2D analysis



RMS 3D analysis



RMS(2D) – RMS(3D)



GHER SeaDataNet

Publications

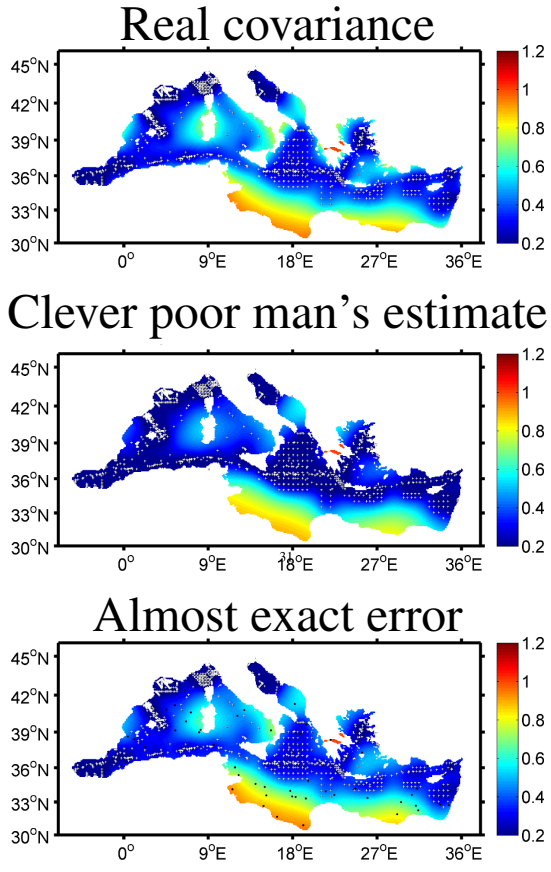
Error field:

Approximate and efficient methods to assess error fields in spatial gridding with Diva (Data Interpolating Variational Analysis)

J.-M. Beckers, A. Barth, C. Troupin &
A. Alvera-Azcárate

Journal of Atmospheric and Oceanic Technology

Under revision



DivaonedepthODV4

Introduction

Purpose : **Handling of files with no vertical axis**

DivaonedepthODV4

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Purpose : **Handling of files with no vertical axis**

- For instance, a BODC file :

```
//Data documentation at http://www.bodc.ac.uk/data/documents/series/7011/
//SDN_parameter_mapping
//<subject>SDN:LOCAL:Chronological Julian Date</subject><object>
SDN:P011::CJDY1101</object><units>SDN:P061::UTAA</units>
//<subject>SDN:LOCAL:CurrDir</subject><object>SDN:P011::
LCDAEL01</object><units>SDN:P061::UABB</units>
//<subject>SDN:LOCAL:CurrSpd</subject><object>SDN:P011::
LCSAEL01</object><units>SDN:P061::UVBB</units>
//

Cruise Station Type yyyy-mm-ddThh:mm:ss.sss Longitude [degrees_east] Latitude [degrees_north]
LOCAL_CDI_ID EDMO_code Bot.Depth [m] Chronological Julian Date [days] QV:SEADATANET CurrDir [deg T]
QV:SEADATANET   CurrSpd [cm/s]  QV:SEADATANET
PBISOP/SB1 B1/328/MB * 1971-08-30T10:31:00.000 -5.6166 54.9833 7011 43 148 2441194.438194 1 280.60
1 4.90 1
        2441194.445139 1 266.90 1  5.50 1
        2441194.452083 1 193.00 1  6.70 1
        2441194.459027 1 185.40 1  9.50 1
        2441194.465972 1 176.60 1 13.50 1
        2441194.472916 1 174.00 1 15.30 1
        2441194.479861 1 170.50 1 18.10 1
               .       .    .   .   .   .
               .       .    .   .   .   .
               .       .    .   .   .   .
               .       .    .   .   .   .
```

DivaonedepthODV4

Step 1 - Recognition

The script performs several preliminary tests :

1. pressure axis ? $\Rightarrow$ exit
2. depth axis ? $\Rightarrow$ exit
3. no metadata file ? $\Rightarrow$ exit + warning
4. **else ?** $\Rightarrow$ file with **no vertical axis**

- CurrDir, CurrSpd and a vertical axis ? $\Rightarrow$ special case (see later)

DivaonedepthODV4

Step 2 - Variables averaging

Scalar variables

- simple arithmetic average

Vectorial variable

- only for current speed (currdir & currspd) ($\rightarrow$ future upgrade)
- polar coordinate system $\Rightarrow$ Cartesian coordinate system (u_star & v_star)
- simple arithmetic average

DivaonedepthODV4

Step 3 - Writing a new data file

A new file…

- The new file has the extension "**_bis**.txt" instead of ".txt"
- There are only two data line left, containing the mean values of the variables
- Currspd and Currdir become u_star and v_star
- A column "Depth [m]" is added

DivaonedepthODV4

Step 3 - Writing a new data file

A new file...

- The new file has the extension "**_bis**.txt" instead of ".txt"
- There are only two data line left, containing the mean values of the variables
- Currspd and Currdir become u_star and v_star
- A column "Depth [m]" is added

...with a new depth axis

1. the average of "minimum instrument depth" and "maximum instrument depth" is computed
2. the file "contour.depth" is read and the two nearest depths are written in the new file

DivaonedepthODV4

Step 3 - Writing a new data file

A new file :

```
//Data documentation at http://www.bodc.ac.uk/data/documents/series/7011/
//SDN_parameter_mapping
//<subject>SDN:LOCAL:Chronological Julian Date</subject><object>
SDN:P011::CJDY1101</object><units>SDN:P061::UTAA</units>
//<subject>SDN:LOCAL:CurrDir</subject><object>SDN:P011::
LCDAEL01</object><units>SDN:P061::UABB</units>
//<subject>SDN:LOCAL:CurrSpd</subject><object>SDN:P011::
LCSAEL01</object><units>SDN:P061::UVBB</units>
//

Cruise Station Type yyyy-mm-ddThh:mm:ss.sss Longitude [degrees_east] Latitude [degrees_north]
LOCAL_CDI_ID EDMO_code Bot.Depth [m] Chronological Julian Date [days] QV:SEADATANET u_star [cm/s]
QV:SEADATANET v_star [cm/s] QV:SEADATANET   Depth [m]
PBISOP/SB1 B1/328/MB * 1971-08-30T10:31:00.000  5.6166 54.9833 7011 43 148 2441194.438194 1
-10.023330879292929292 1 3.469439742424242424  1 150
        2441194.445139 1 -10.023330879292929292 1 3.469439742424242424 1 100
```

The following files are also modified :

varlist u_star and v_star are added to the list

datasource the old files are replaced by the new ones (“_bis”)

DivaonedepthODV4

Other features

Tests and warnings

- no depth in the metadata file $\Rightarrow$ exit + warning
- more than one scalar variable $\Rightarrow$ exit + warning ($\rightarrow$ future upgrade)
- time series exceeds the user-defined period $\Rightarrow$ warning

Speed and vertical axis

- Same procedure than "speed without vertical axis"...
- ...except that there is no averaging in this case

$\rightarrow$ also included in the divaonedepthODV4 script

DivaonedepthODV4

How to use it ?

- DivaonedepthODV4 is called by divadoall (4D analysis) for every data file
- The script is called only if the extraction flag is set to 1 (driver file)

How to disable it ?

2 options :

1. set the extraction flag to 0 in the driver file
2. set the variable “onedepth” to “no” in divadoall ($\sim$ line 222)

What is new since Stareso 2013 ?

New features: from user feedback during Diva workshop 2013 (*Calvi*)

What is new since Stareso 2013 ?

Website informations

- The website is often upgraded (Diva last version, updated documentation,...)
- History of new features and bug fixes is now available at : http://modb.oce.ulg.ac.be/mediawiki/index.php/New_Diva_Features
- Diva (4.6.5) on VirtualBox is now available here : http://modb.oce.ulg.ac.be/mediawiki/index.php/New_Diva_Features

What is new since Stareso 2013 ?

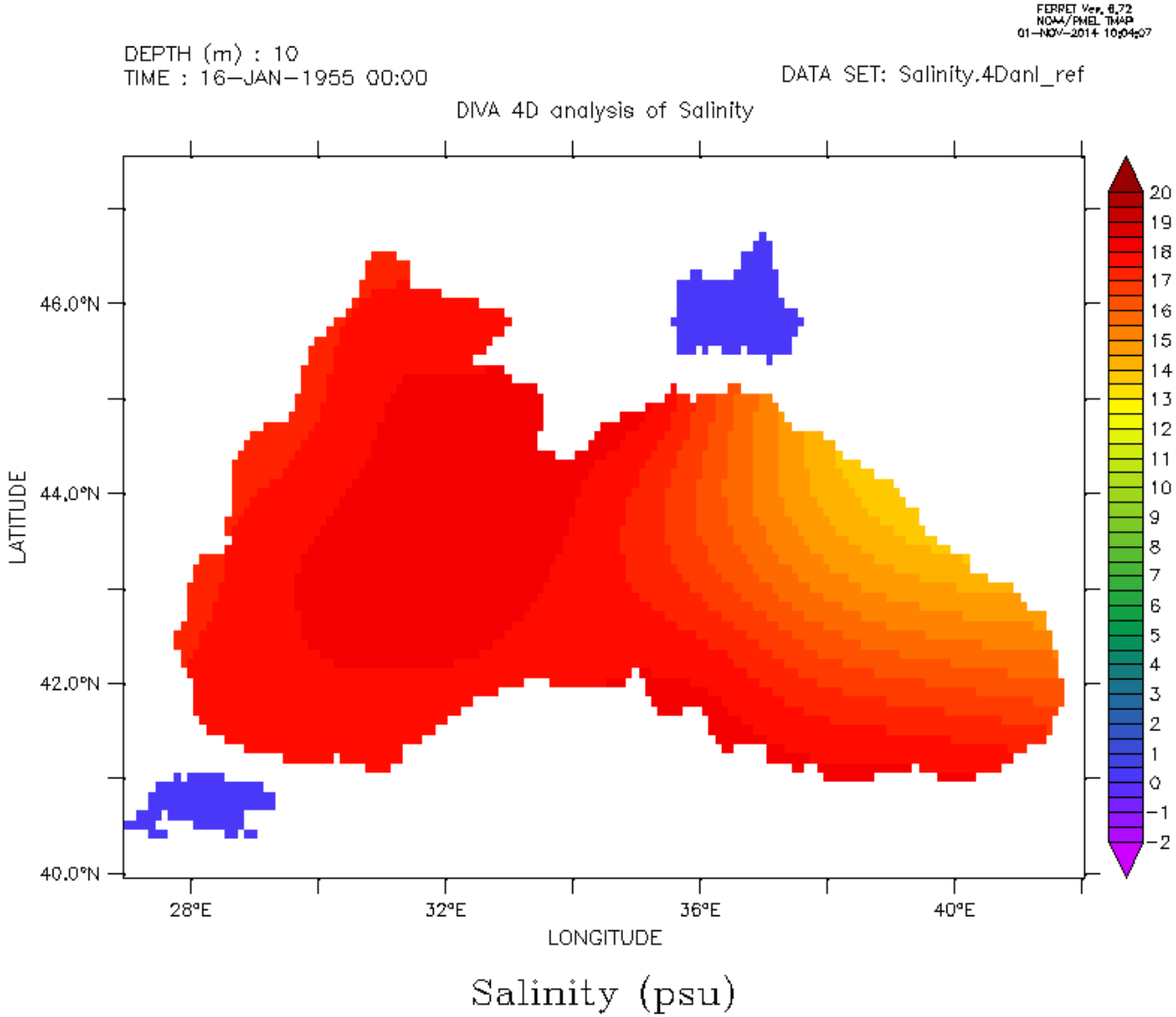
Diva-4.6.4

- Released in February 2014
- New features
  - Introduction of logit transformation
  - Use of a mask file to introduce a relative correlation length field in Diva2D
- Bug fixes
  - Minor bug corrections following the Diva workshop

What is new since Stareso 2013 ?

Details about log and logit transformations

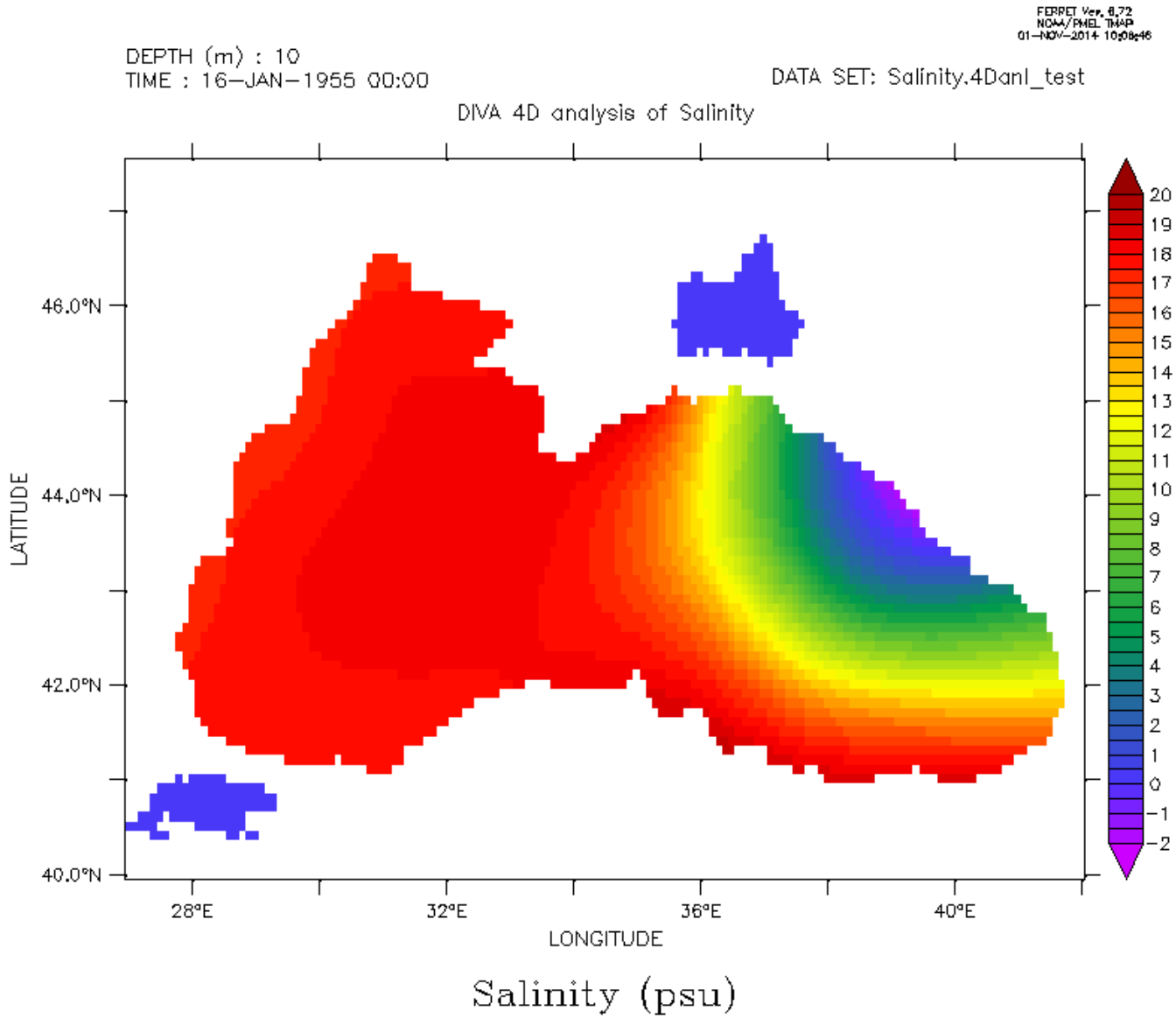
Figure 1 : Salinity analysis from Example4D data



What is new since Stareso 2013 ?

Details about log and logit transformations

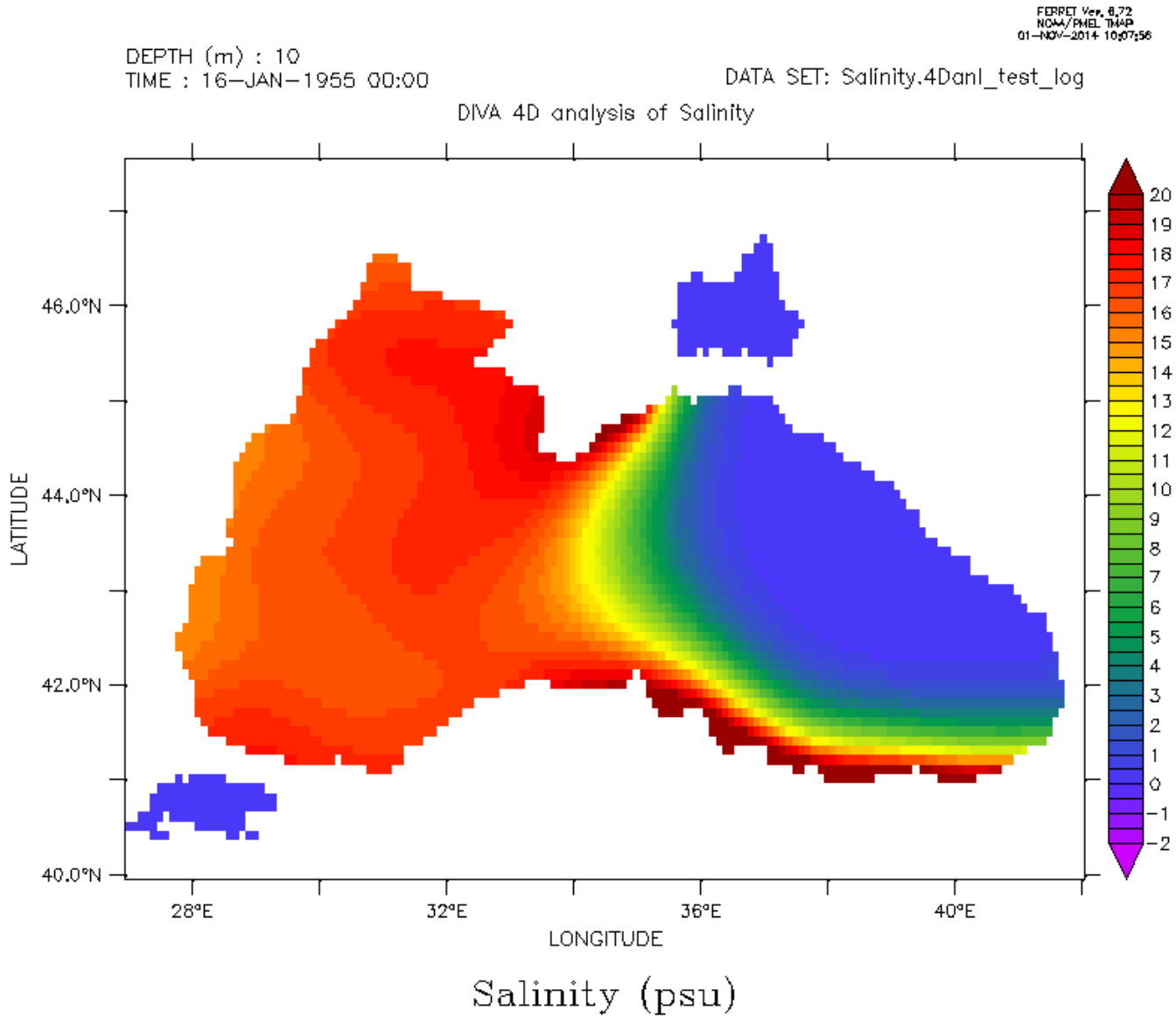
Figure 2 : Salinity analysis modified with zeros : test



What is new since Stareso 2013 ?

Details about log and logit transformations

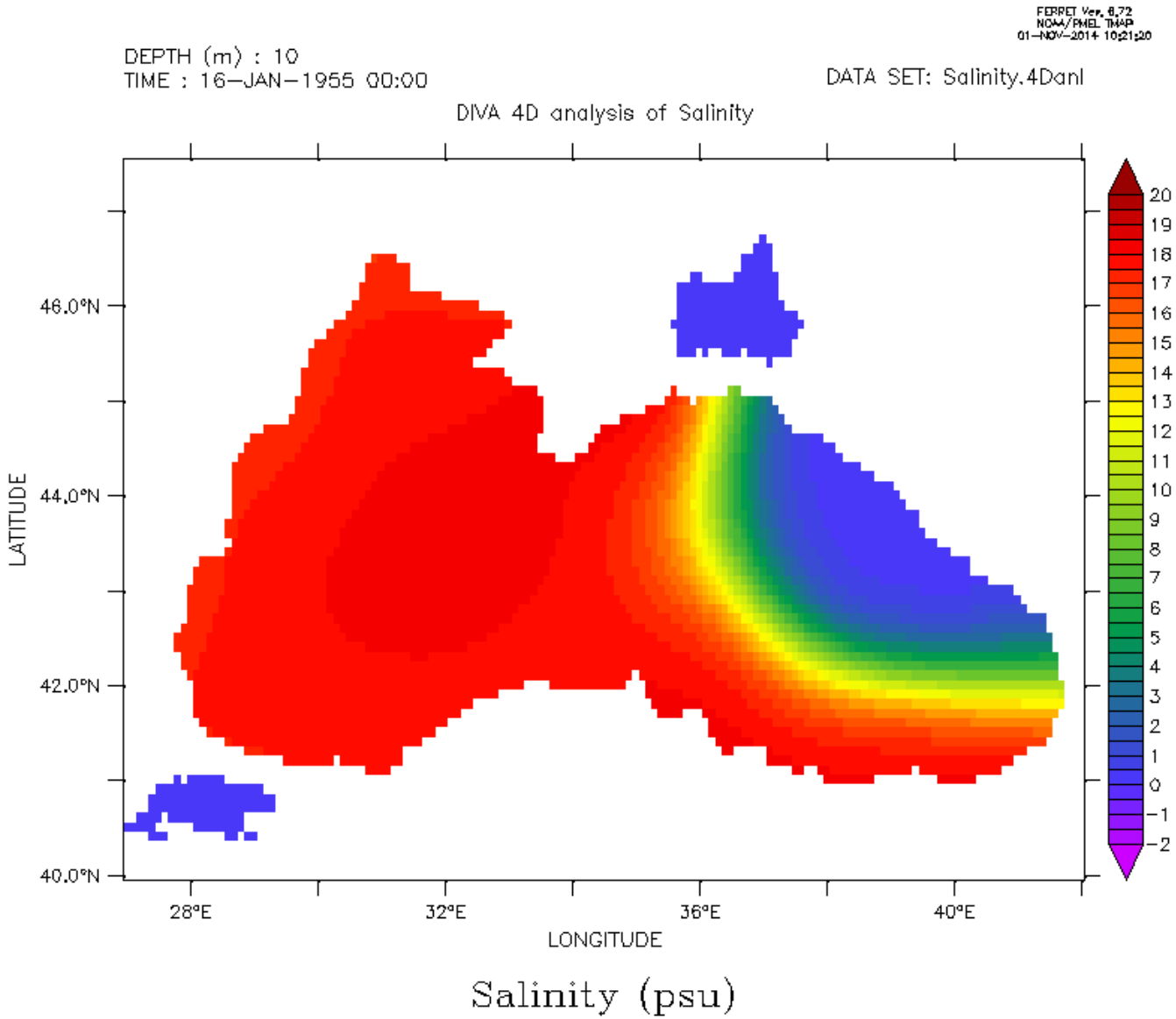
Figure 3 : Test with log transformation



What is new since Stareso 2013 ?

Details about log and logit transformations

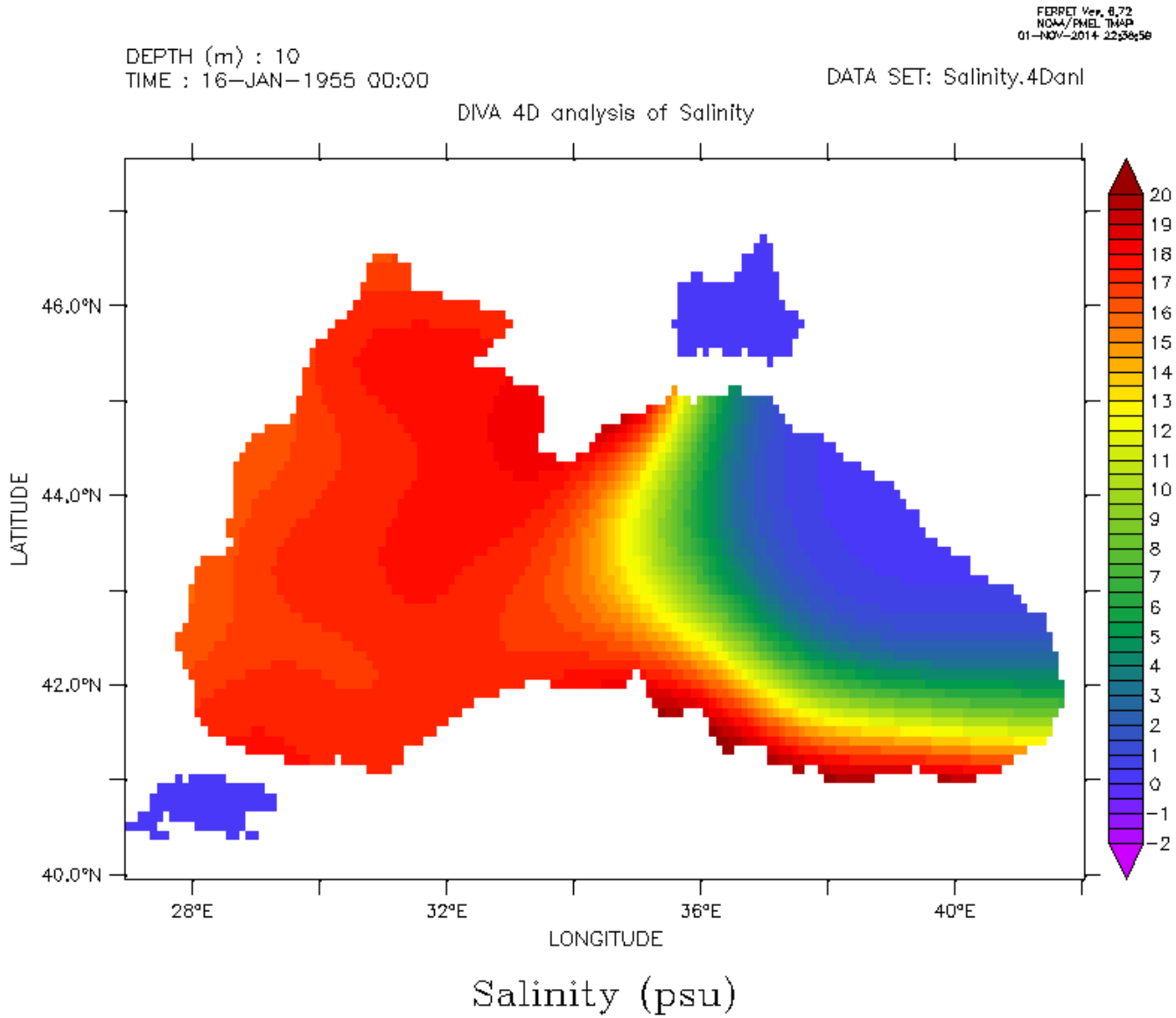
Figure 4 : Test with logit transformation



What is new since Stareso 2013 ?

Details about log and logit transformations

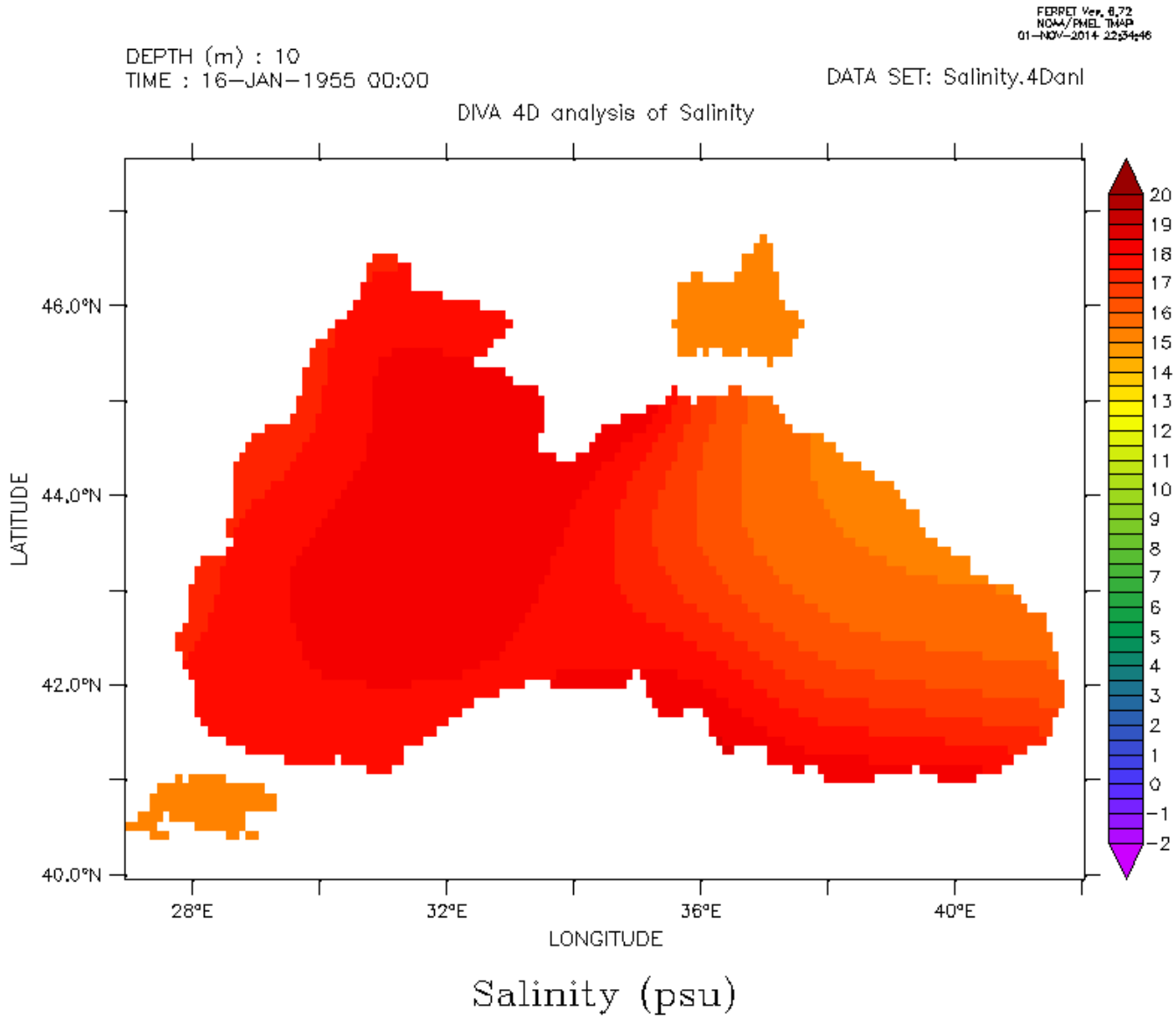
Figure 5 : Test with logit transformation + logitrange (0-35)



What is new since Stareso 2013 ?

Details about log and logit transformations

Figure 6 : Test with logit transformation + logitrange (15-35)



What is new since Stareso 2013 ?

Diva-4.6.5

- Released in April 2014
- Bug fixes
  - "end of line" problems under Windows (file "datasource")
  - Portability of scripts using the "sort" command
  - Vertical filtering of correlation length : case of 1 and 2 layer(s)
  - Wrong min and max values in the netcdf output file (error and analyzed field) when using some values of ispec
  - Error field not written in the netcdf output file under some values of ispec
  - Other small fixes

What is new since Stareso 2013 ?

Diva-4.6.6

- Released in September 2014
- New features
  - Check for severe errors in DIVA 3D/4D (script "godiva") + simple errors and warnings
  - Possibility of binning the data before the parameters estimation (script "divabin" + program "binning_lines.f90")
  - Variable correlation length, depending on depth (script "divarlvardepth" + program "rlvardepth.f90")
- Bug fixes
  - Correction of the example in 4D (datasource)
  - Correction of the script divaguessformODV4
  - Exact match needed between variable name in "varlist" and its real name in the data file.

What is new since Stareso 2013 ?

Diva on VirtualBox

- Released in September 2014
- Advantages
  - Diva “ready to run” !
  - Works on every host system
  - Very easy to install
  - PATH is already ok, as well as netcdf libraries,...
- Disadvantages
  - Can be very slow with certain host systems / virtualbox parameters
  - Constraints linked to use of VirtualBox (shared folders, disk space,...)

Installation in 5 easy steps ? $\Rightarrow$ `modb.oce.ulg.ac.be/mediawiki/upload/DIVA/notes/virtualbox.pdf`

What is new since Stareso 2013 ?

Diva-4.6.7

- Released in October 2014
- New features
  - Transformation of user relative length or advection fields files (ascii format) into the gher binary format, via a run of Diva (new script "asctobin")
- Bug fixes
  - Correction of time axis and climatology bounds in Netcdf output files
  - Correction of some attributes in 4D netcdf (databins, snr, cl, varbak)
  - Update of driver files (also in Example4D)

The Diva team supports its users, everywhere in the world...

The Diva team supports its users, everywhere in the world...

... with chocolates.

Releases: 4.7.1 – expected December 2014

Beta testers …

Releases: 4.7.1 – expected December 2014

Developed features

- Correlated observational errors

Releases: 4.7.1 – expected December 2014

Developed features

- Correlated observational errors
- Better file structures
  (input and driver better separated from command) in 4D loops

Releases: 4.7.1 – expected December 2014

Developed features

- Correlated observational errors
- Better file structures
- Automatic selection of solver (parallel, serial, iterative)
  depending on the problem type and size

Releases: 4.7.1 – expected December 2014

Developed features

- Correlated observational errors
- Better file structures
- Automatic selection of solver (parallel, serial, iterative)
- Retrieval of topographies from Diva-on-web

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- Improved version of the almost exact error calculation with boundary effects

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Developed features

- Correlated observational errors
- Better file structures
- Automatic selection of solver (parallel, serial, iterative)
- Retrieval of topographies from Diva-on-web
- Improved version of the almost exact error calculation with boundary effects
- Incorporation of metadata
  (EDMO-CDI identifier, space-time location)
  into 4D NetCDF files of climatologies

Releases: 4.7.1 – expected December 2014

Developed features

- Correlated observational errors
- Better file structures
- Automatic selection of solver (parallel, serial, iterative)
- Retrieval of topographies from Diva-on-web
- Improved version of the almost exact error calculation with boundary effects
- Incorporation of metadata
- Update of divadoxml with new template and graphic user interface (see other presentation)