

DIVA & DIVAnd interpolation tools

All you need to know about them

 gher-ulg

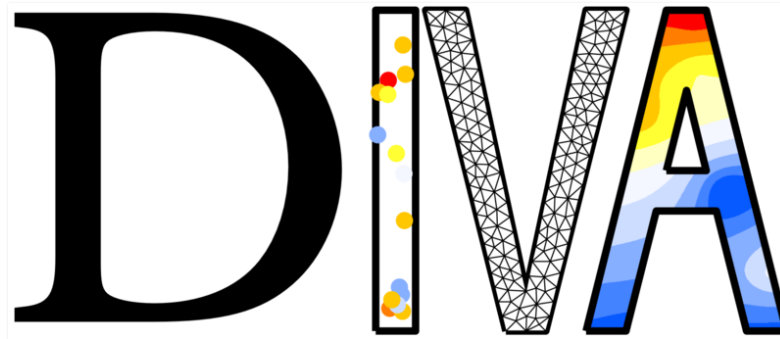
 @GHER_ULiege

 0000-0002-0265-1021



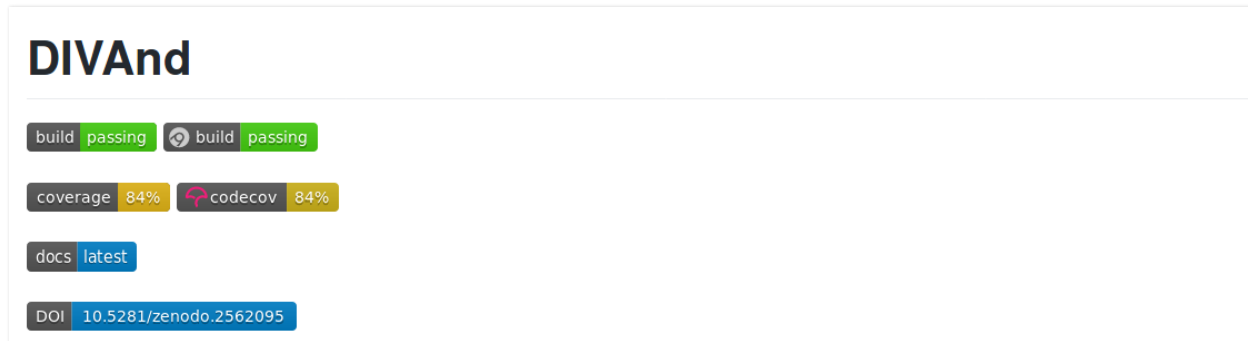
What (who?) is DIVA?

Data
Interpolating
Variational
Analysis



Software tool to interpolate in situ observations

What is [not] DIVAnd?

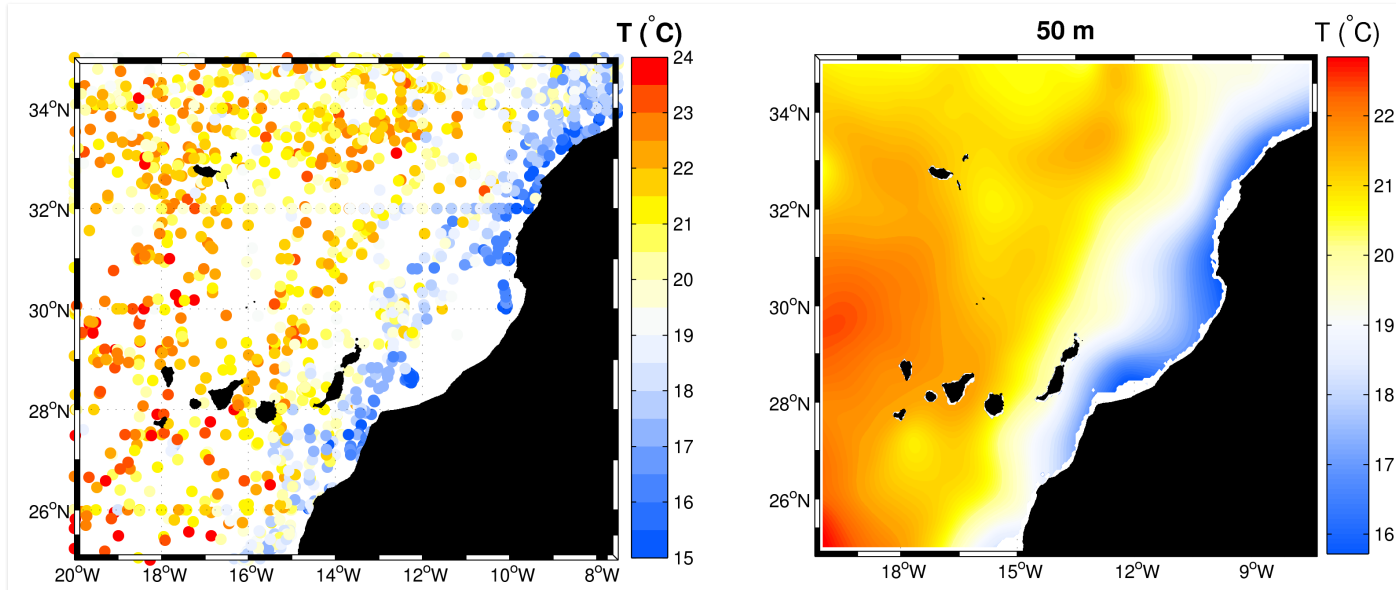


The screenshot shows the top section of a GitHub repository page for 'DIVAnd'. It features several status badges: two 'build passing' badges (one with a refresh icon), two 'coverage 84%' badges (one with the Codecov logo), a 'docs latest' badge, and a 'DOI 10.5281/zenodo.2562095' badge.

= n dimensional version of DIVA

≠ not a new release of DIVA,
but a brand new code

What's the goal of DIVA{nd}?



Get gridded field from in situ data

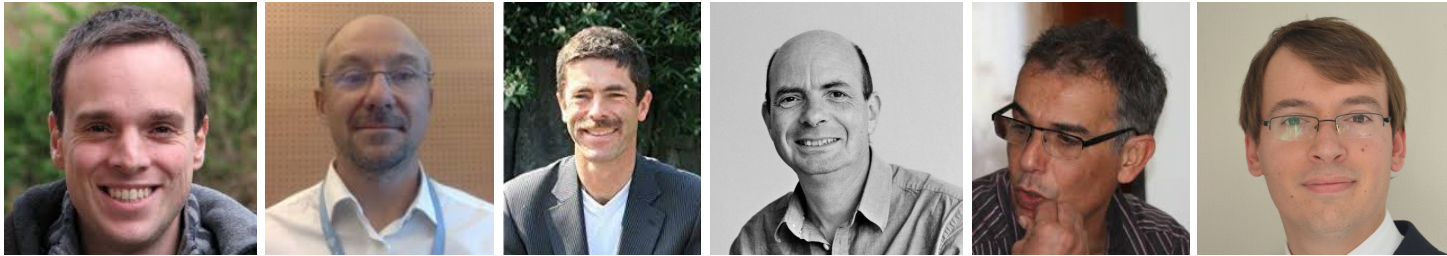
What are the differences between them?

 Mathematical formulation

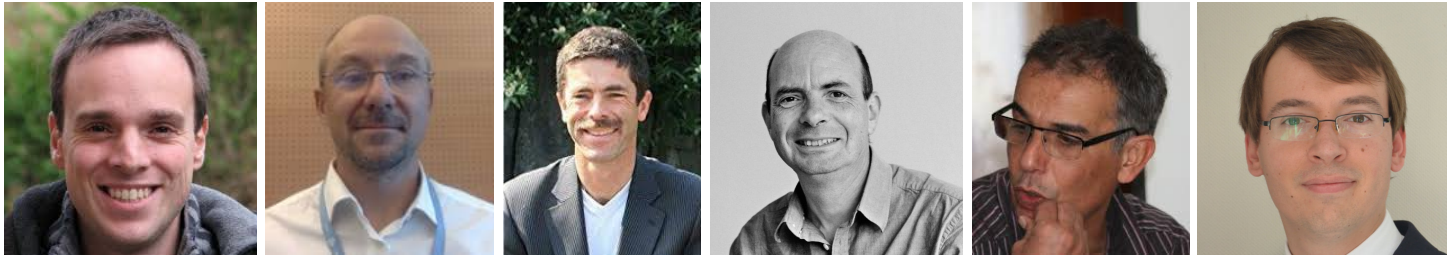
 Programming language

 User interface


Who wrote the code?



Who wrote the code?



and a few others since 1991

Why  julia,

why not  or  python™ ?



Source: <http://daftpunk.wikia.com>, No copyright infringement is intended

Better...

Multiple dispatch

Math-friendly syntax

Unicode support: π , η , $\int \epsilon \alpha$

```
julia>  $\zeta$  = 1./3.  
julia> cos( $\zeta$ * $\pi$ )  
0.5000000000000001
```

Faster

Just-in-time (JIT) compiled Parallelism

```
function fib(n::Int)
f=Vector{Int}(undef, n+1)
f[1]=f[2]=1;
for i=3:n+1
f[i]=f[i-1]+f[i-2]
end
return f
end
ff = @time fib(400000000);
1.158971 seconds (18.52 k allocations: 2.981 GiB, 0.84% gc time)
```

Stronger

Metaprogramming:

Julia programs can read, analyse, generate other Julia programs

"Easy" interfacing: R, Python, ...

```
@pyimport numpy.random as nr  
nr.rand(3,4)
```

Harder

Learning a new and evolving language
Transition from 0.6 to 1.0

Here is the latest from Julia Computing



Julia 1.0 Released

10 Aug 2018 | Andrew Claster

London, UK – Julia 1.0 was [released](#) today during [JuliaCon 2018](#).

Today's Julia 1.0 release is the most important Julia milestone since Julia was introduced in February 2012.

Julia 1.0 is the first complete, reliable, stable and forward-compatible Julia release. More information about Julia 1.0 is available [here](#).

RECENT POSTS

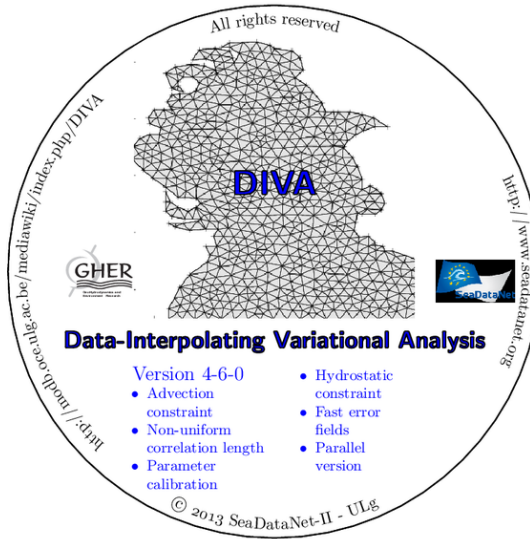
[Call for Proposals to Increase Diversity and Inclusion Within the Julia Community](#)

31 Oct 2018 | Jane E. Herriman

[The New JuliaPro](#)

16 Oct 2018 | Julia Computing

How can I get the code?



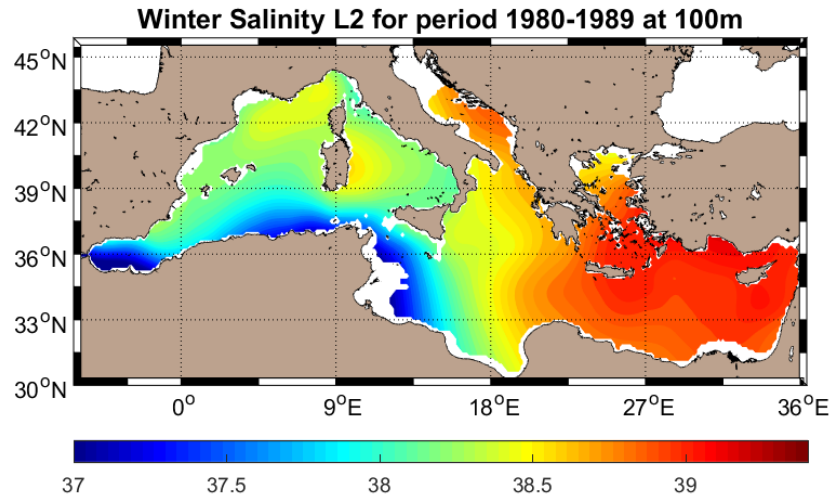
 <https://github.com/gher-ulg/DIVA> DOI 10.5281/zenodo.1407062

 <https://github.com/gher-ulg/DIVAnd.jl> DOI 10.5281/zenodo.2562095

Who's using it?

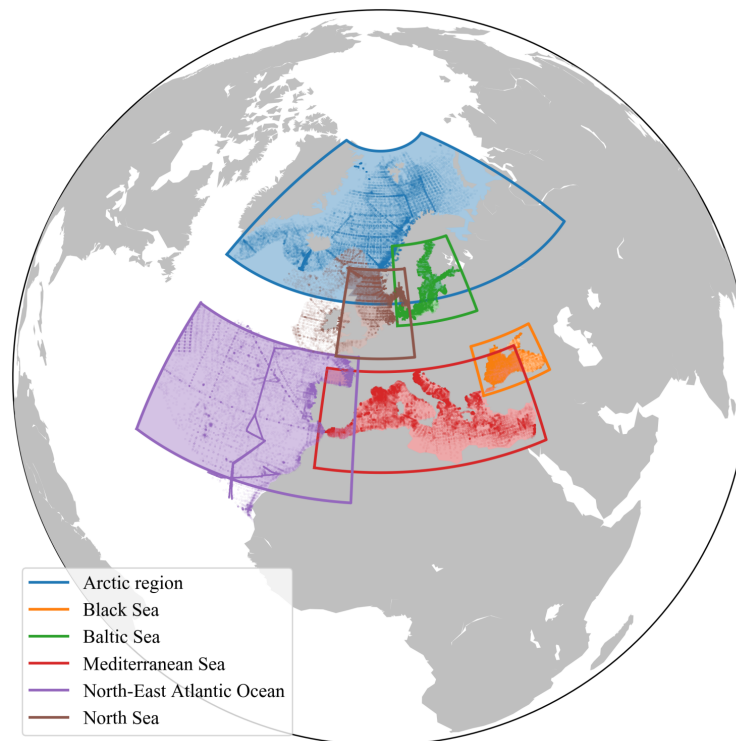
SeaDataCloud regional leaders, creating climatologies

<https://www.seadatanet.org/Products/Climatologies>



EMODnet Chemistry regional leaders

<http://www.emodnet-chemistry.eu/products>



EMODnet Biology (specific products)

<http://www.emodnet-biology.eu/data-products>

The screenshot shows the EMODnet Biology website interface. At the top left is the EMODnet logo and the word "BIOLOGY" with the tagline "Dive into data on Europe's marine life". On the top right, there is a search bar and links for "CONTACT US" and "SUBMIT DATA". A dark blue navigation bar contains the following menu items: Home, Data Catalog, Data Download, Map Viewer, Data Products, Project, Contribute, and Help-desk.

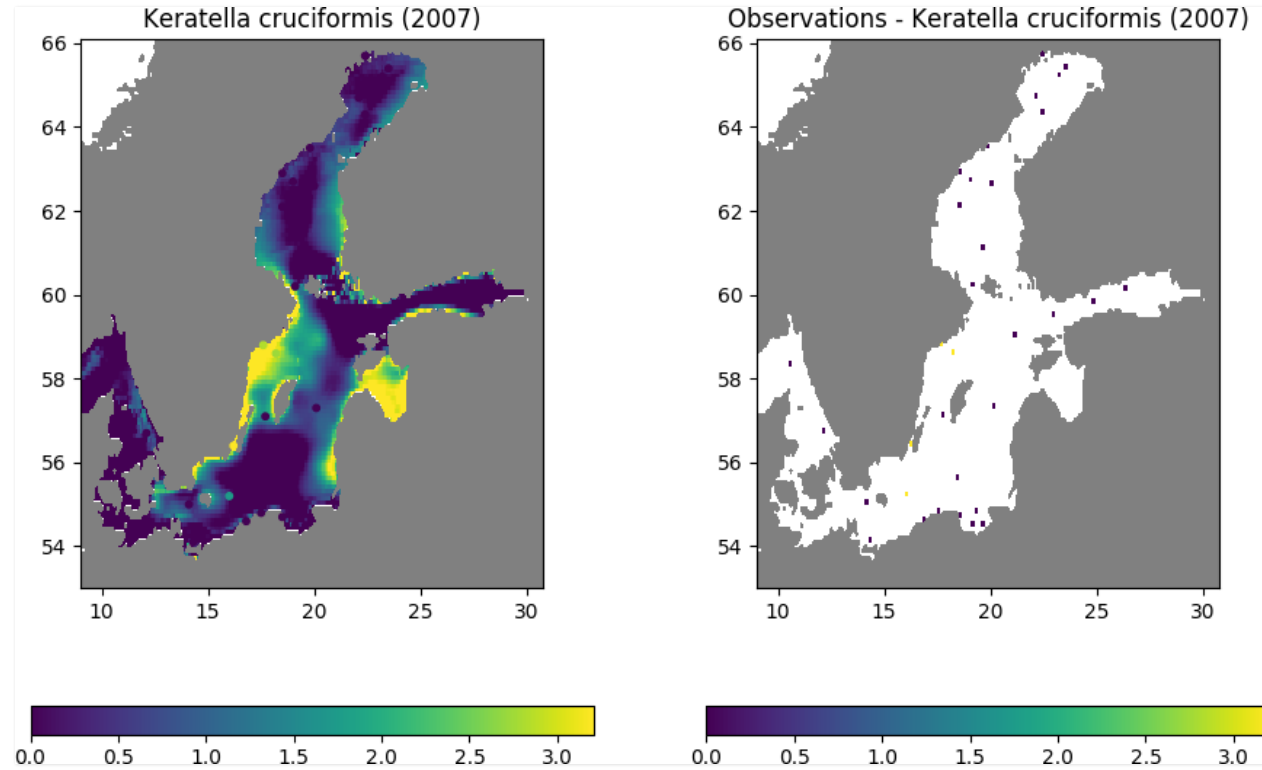
Below the navigation bar, the page title "Data products" is visible on the left, and social media icons (Facebook, Twitter, YouTube, RSS) and another search bar are on the right.

The main content area displays eight data product categories, each with a thumbnail image and a play button icon, indicating video content. The categories and their counts are:

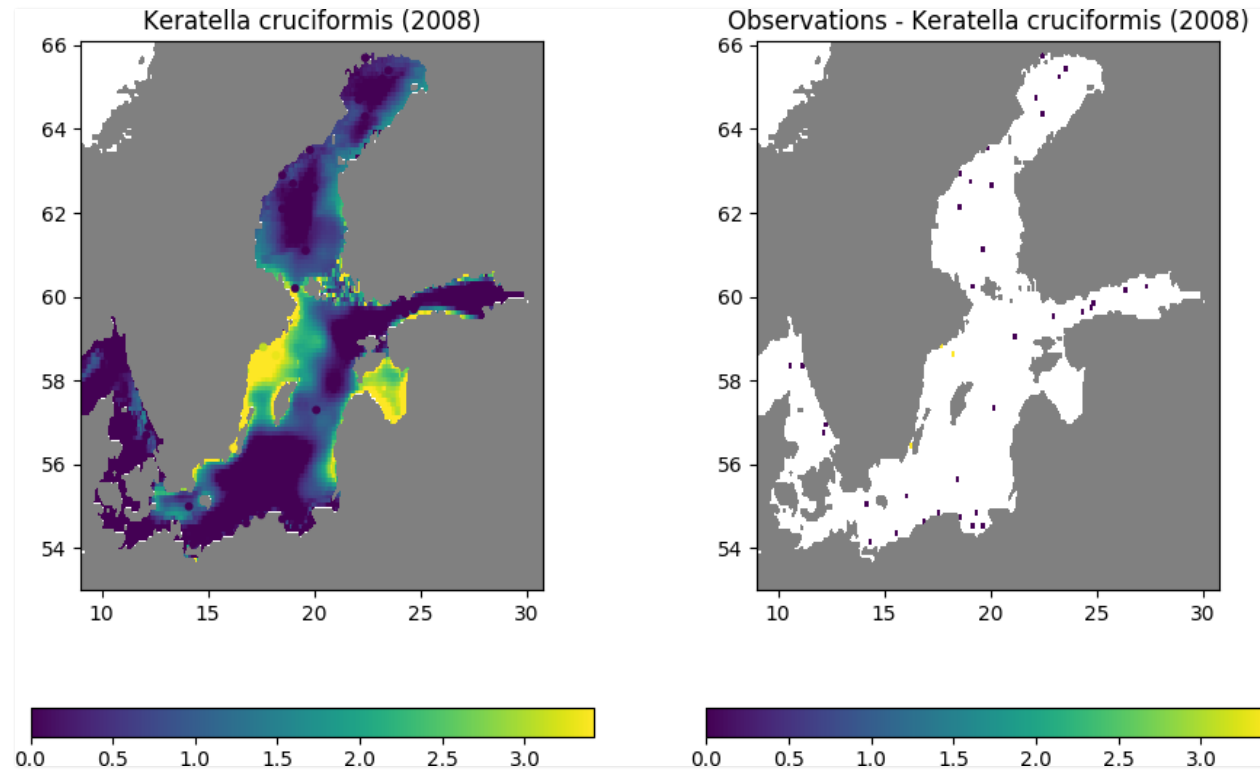
- Benthos (19)
- Birds (10)
- EMODnet Biology use cases (8)
- Fish (6)
- Mammals (8)
- Microorganisms (5)
- Phytoplankton (24)
- Reptiles (1)

Example: zooplankton count in the Baltic Sea

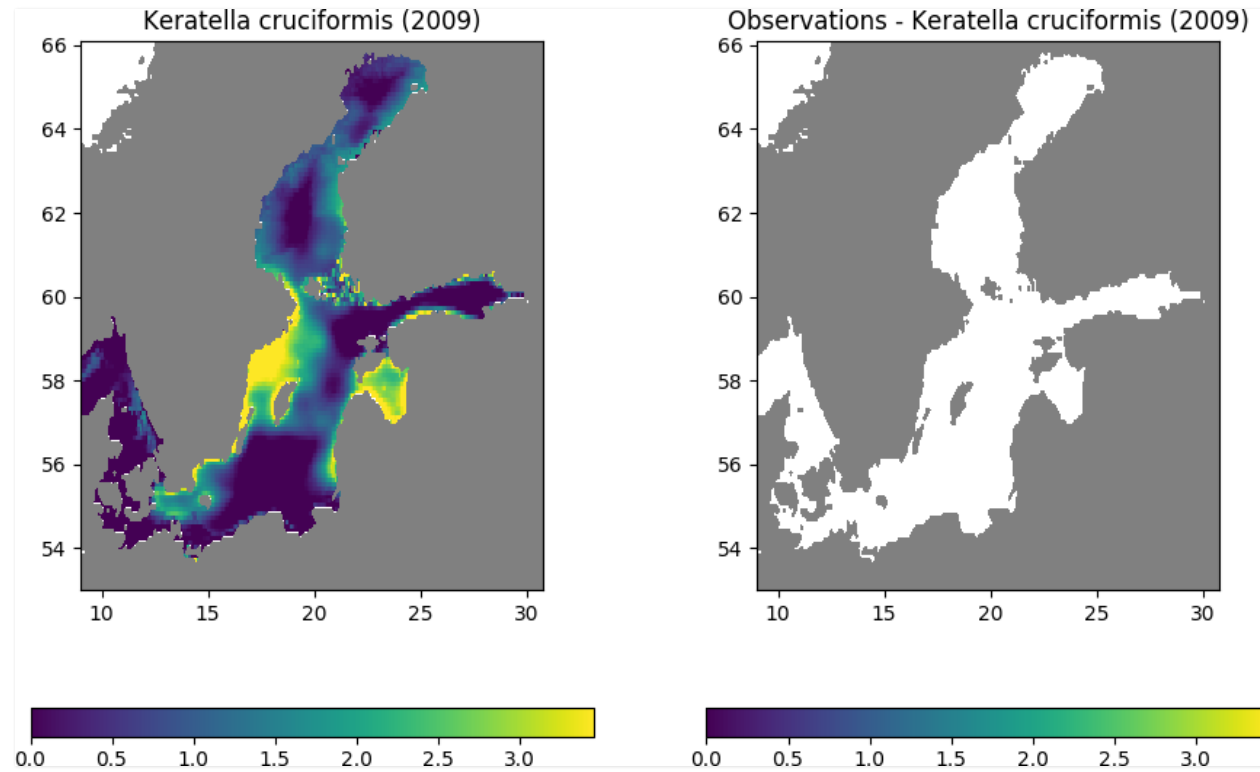
Example: zooplankton count in the Baltic Sea



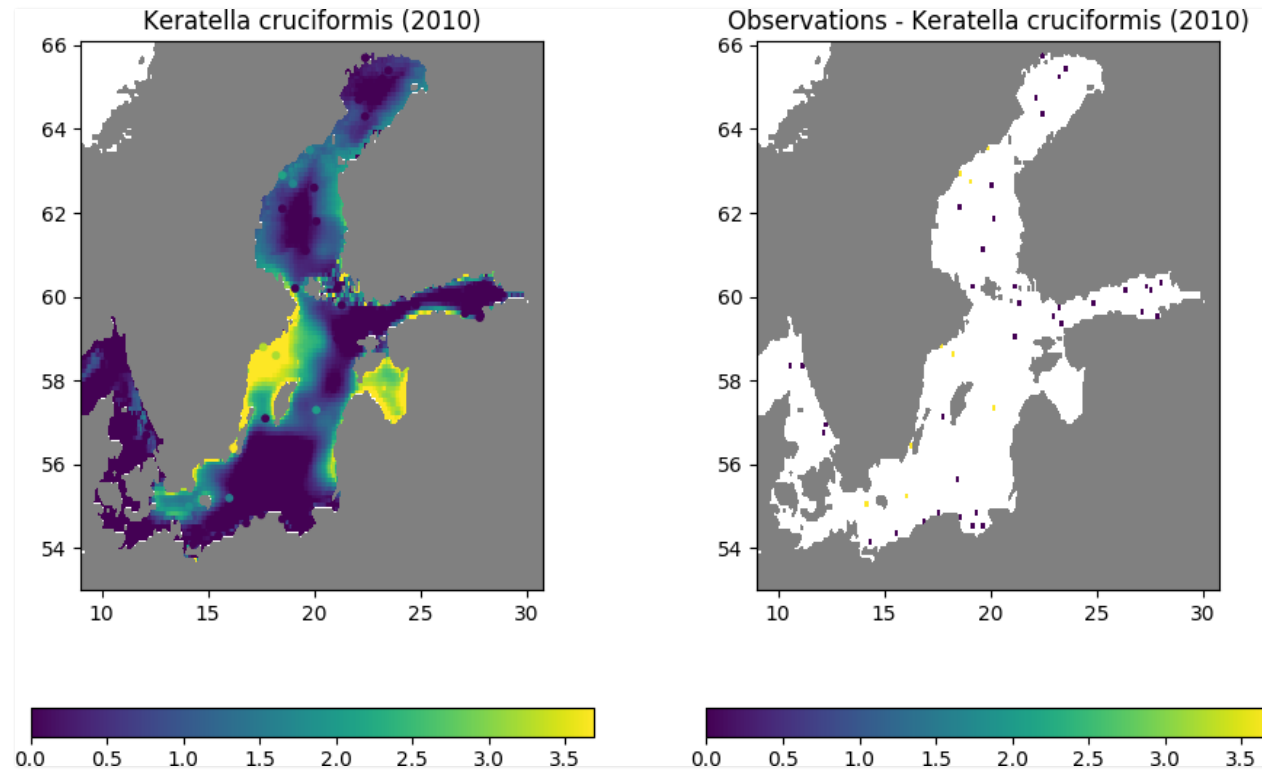
Example: zooplankton count in the Baltic Sea



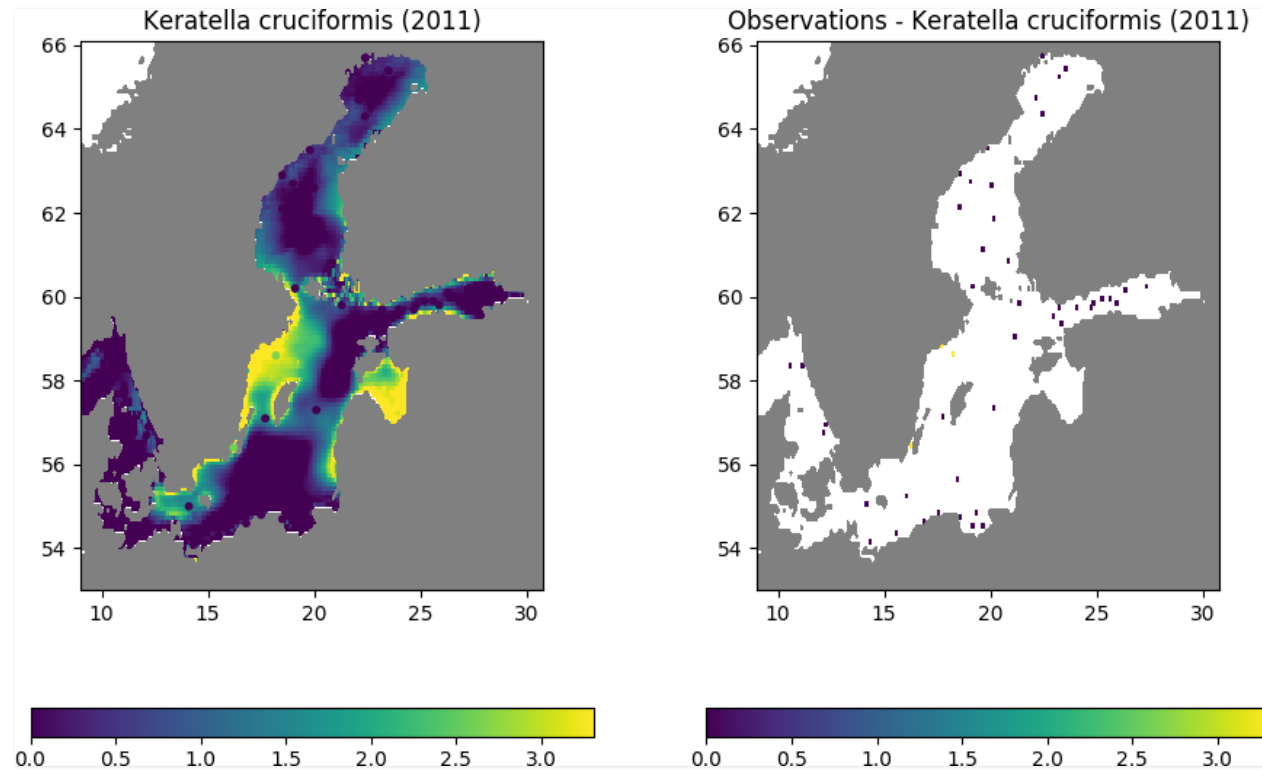
Example: zooplankton count in the Baltic Sea



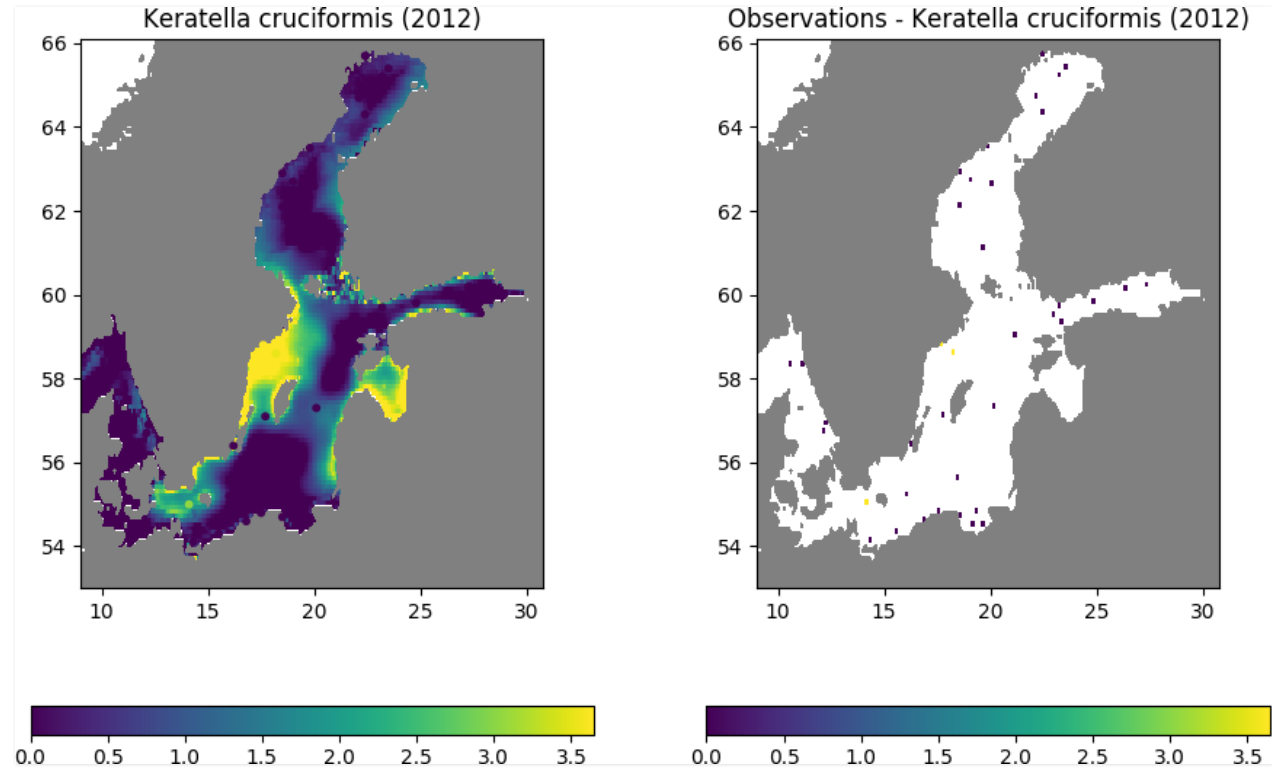
Example: zooplankton count in the Baltic Sea



Example: zooplankton count in the Baltic Sea



Example: zooplankton count in the Baltic Sea



BioOracle: <http://www.bio-oracle.org/index.php>



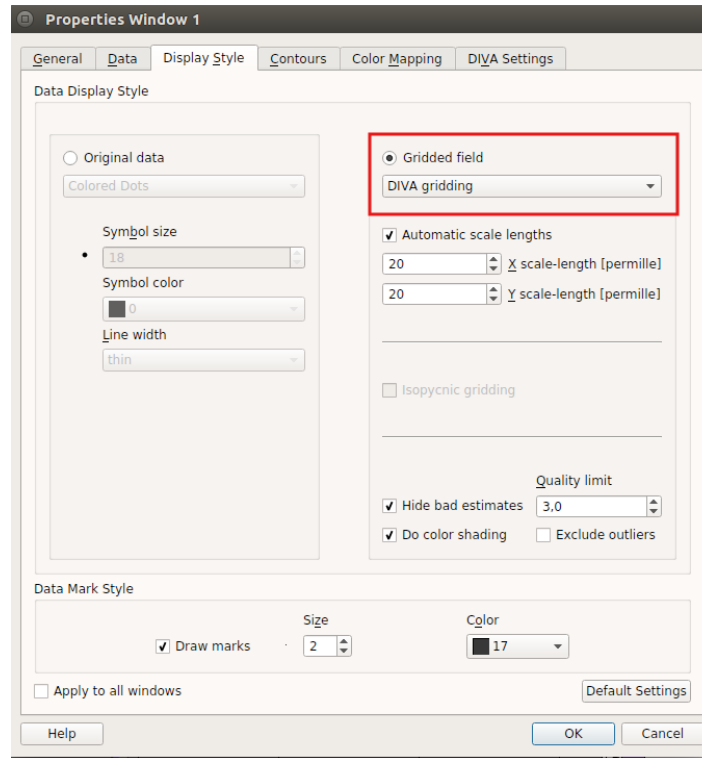
**Can I test it without installing
it?**

DIVA (2D) within Ocean Data View

<http://odv.awi.de/>

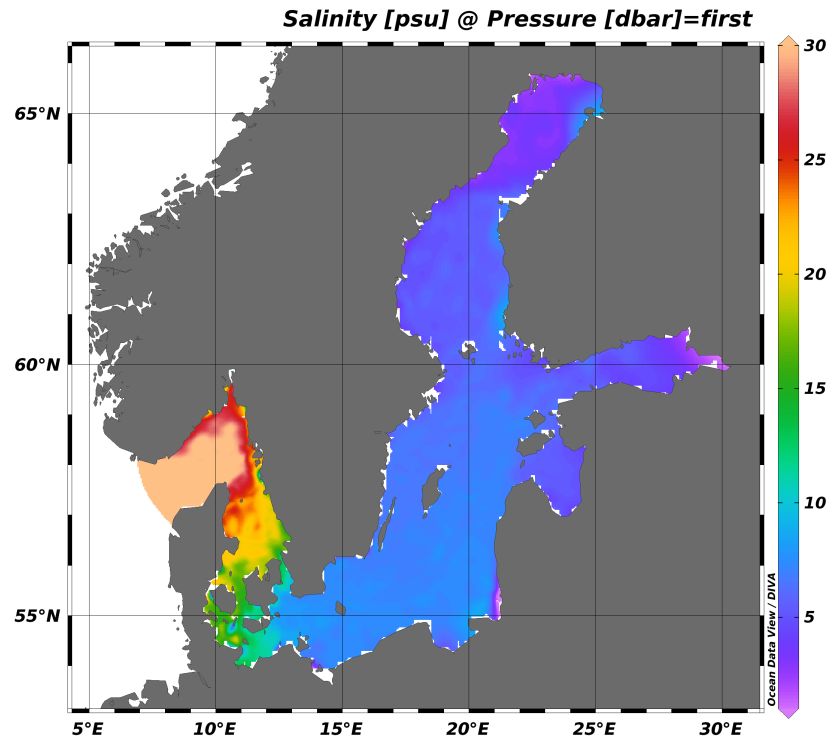
DIVA (2D) within Ocean Data View

<http://odv.awi.de/>



DIVA (2D) within Ocean Data View

<http://odv.awi.de/>



DIVA-on-Web (2D)

<http://ec.oceanbrowser.net/emodnet/diva.html>

Upload Grid Analysis

Statistics Download Link or embed Report a problem Help

Upload observations

Text file ODV4

File:
 No file selected.

Column separator:

Decimal separator:

Format

The file must be an ASCII text file with three columns. The columns represent longitude, latitude and value of the observation respectively. For example:

```
29.7667 45.15 16.146
29.7667 45.15 16.346
...
```

[Sample global temperature data from ARGO](#)

-51.32813, 82.96875

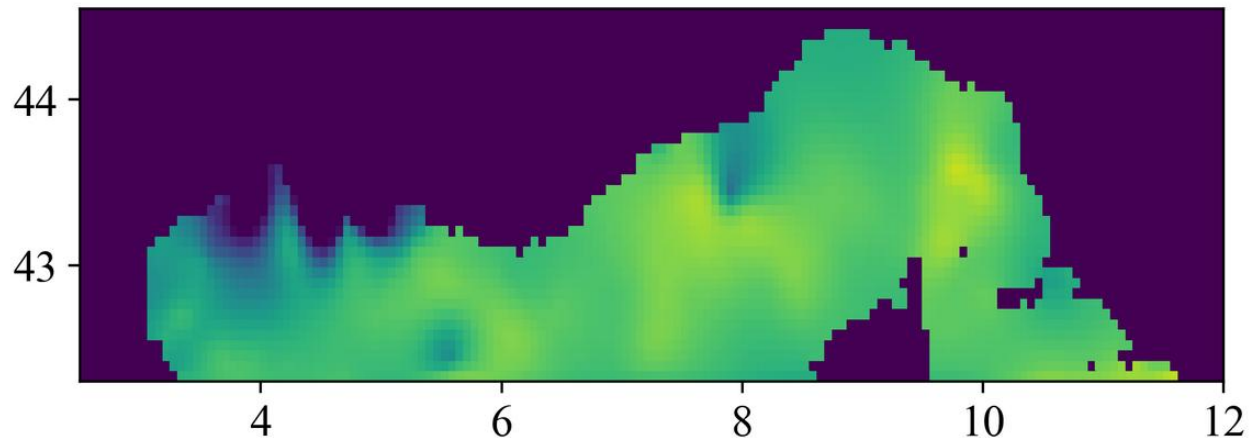
Jupyter notebooks inside the Virtual Research Environment

Analysis f_i using mean data as background.
Structure s is stored for later use in error calculation.

```
In [10]: fi,s = DIVAndrun(mask,(pm,pn),(xi,yi),(obslon,obslat),obsval,-mean(obsval),len,epsilon2);
```

Create a simple plot of the analysis

```
In [11]: pcolor(xi,yi,fi+mean(obsval),vmin=37,vmax=38.5);  
colorbar(orientation="horizontal")  
gca()[ :set_aspect](1/cos(mean([ylim()...]) * pi/180))
```



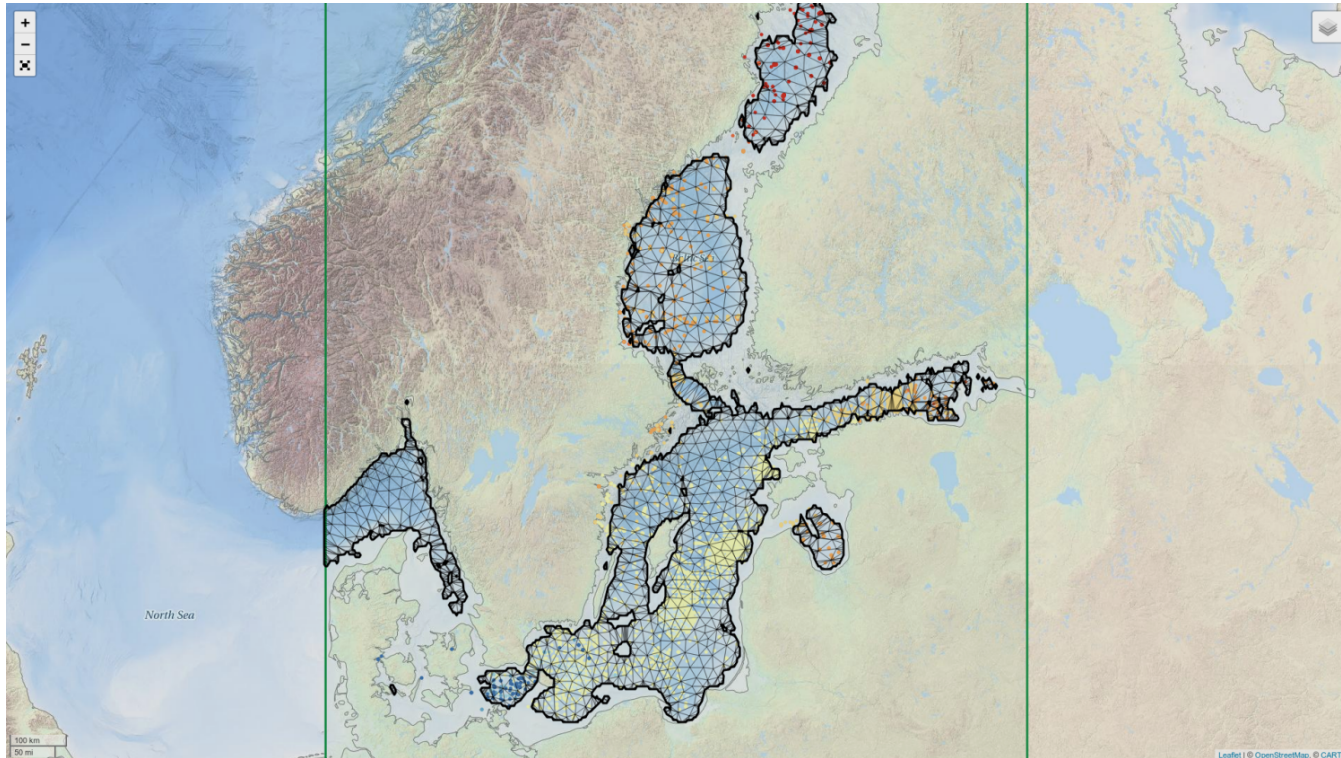
DIVAnd REST API (2D)

DIVAnd REST API

observations	<input type="text" value="sampledata:WOD-Salinity"/>			
varname	<input type="text" value="Salinity"/>			
bbox	<input type="text" value="-3,42,12,44"/>			
depth	<input type="text" value="0,20"/>			
len	<input type="text" value="100000,100000"/>			
epsilon2	<input type="text" value="1"/>			
resolution	<input type="text" value="0.5,0.5"/>			
years	<input type="text" value="1993,1993"/>			
monthlist	<input type="text" value="1,2,3"/>	<input type="text" value="4,5,6"/>	<input type="text" value="7,8,9"/>	<input type="text" value="10,11,12"/>
bathymetry	<input type="text" value="sampledata:gebco_30sec_16"/>			
metadata_project	<input type="text" value="SeaDataCloud"/>			

**Why (do we think) it is better
than any other method?**

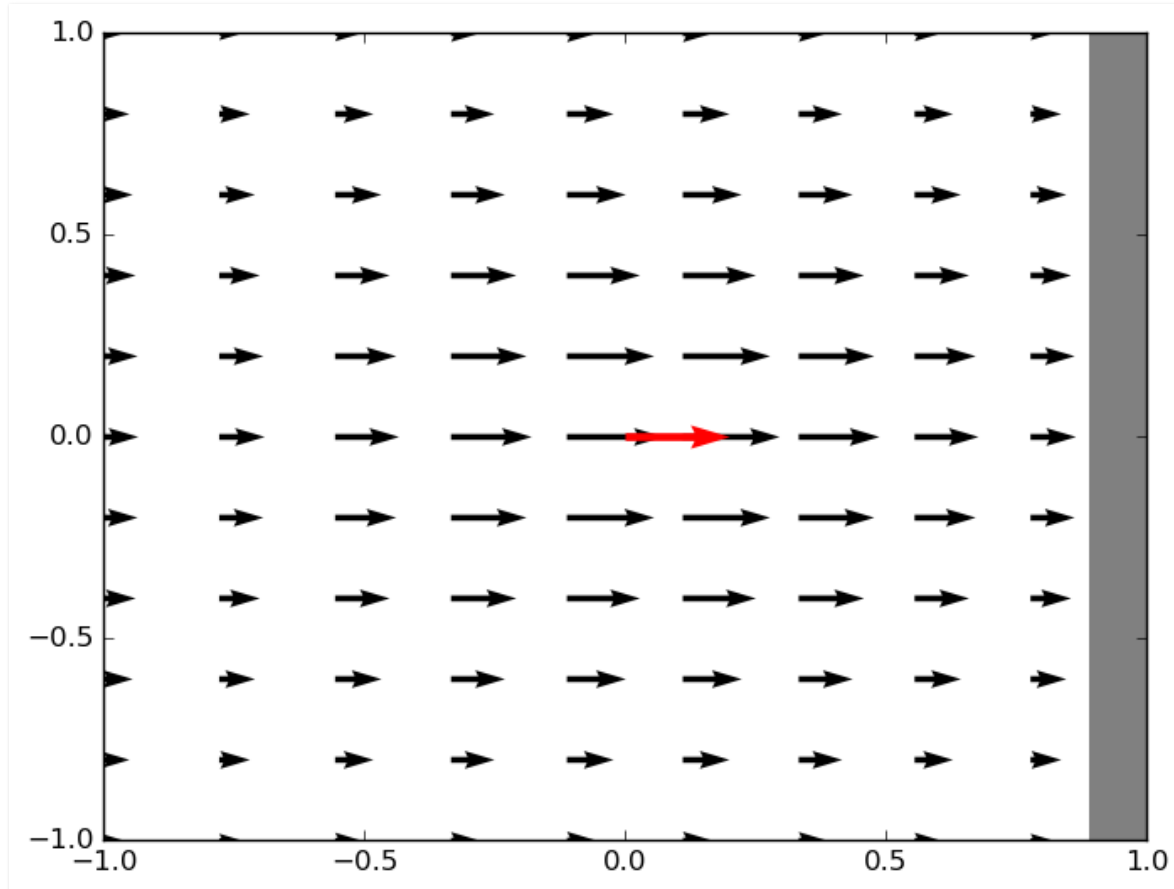
Fast, robust, specific to ocean
Separation of sub-domains
Associated error field



**Can I interpolate velocity
measurements?**

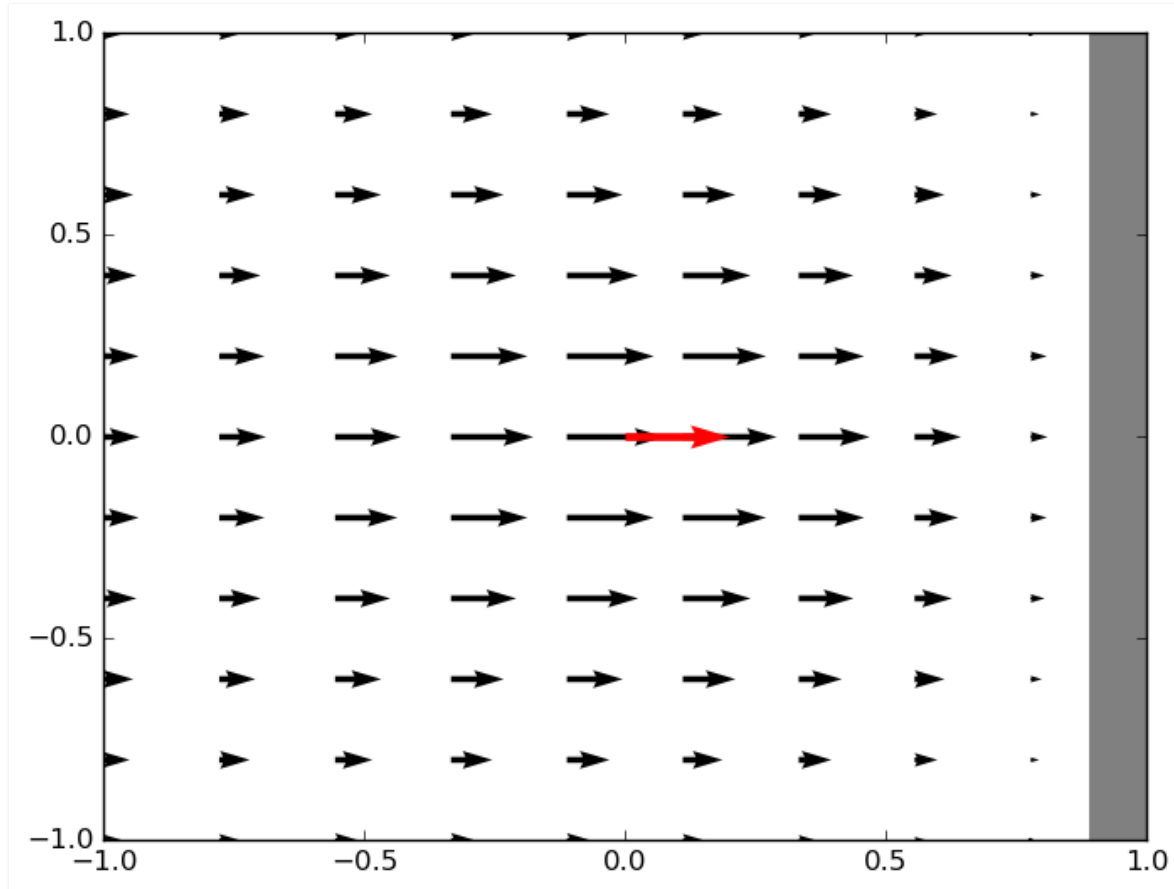
High-frequency radar interpolation

Synthetic velocity field, red arrow = measurement



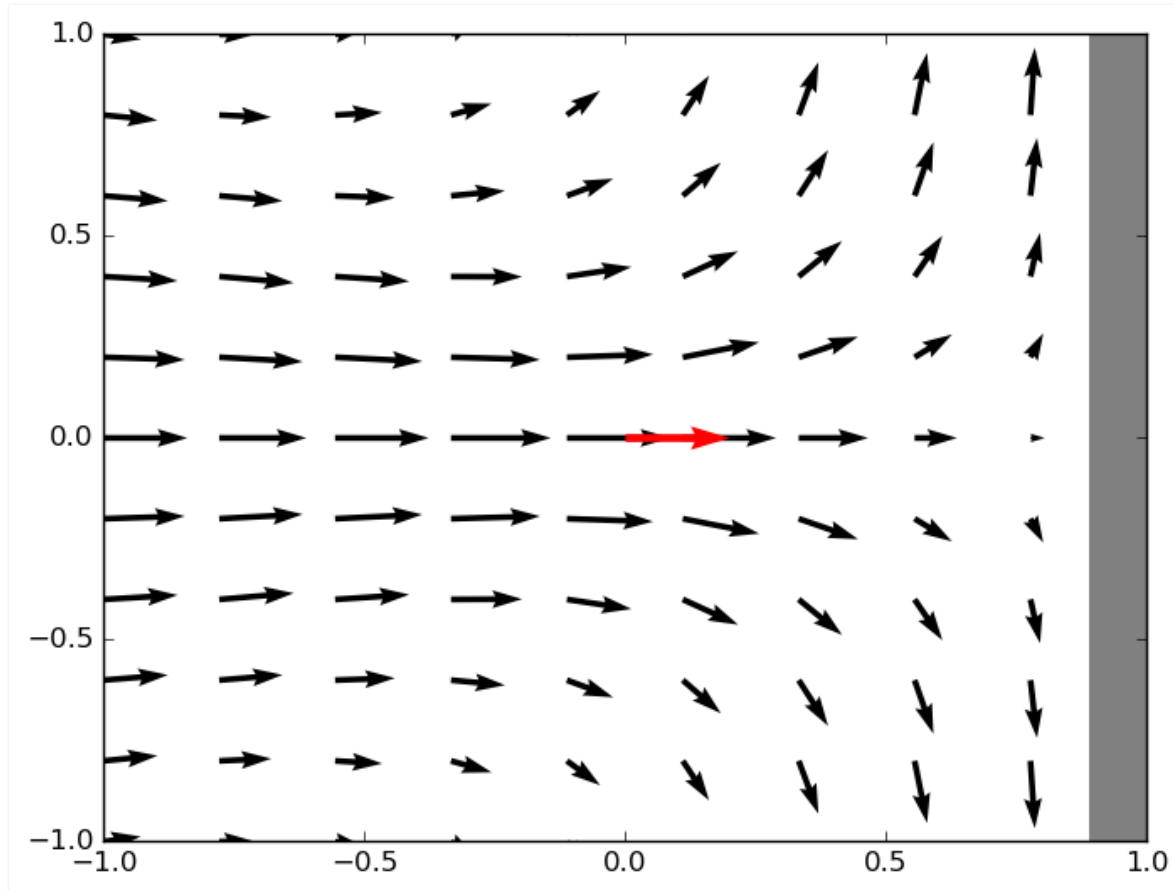
High-frequency radar interpolation

Adding the influence of the coast



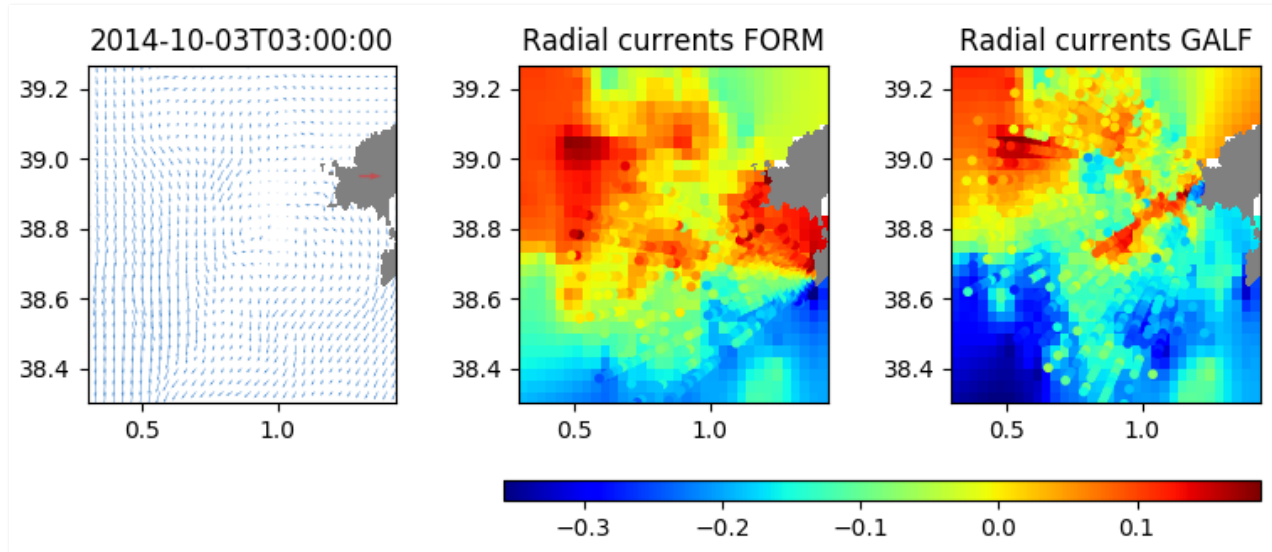
High-frequency radar interpolation

Low horizontal divergence of currents



High-frequency radar interpolation

Including Coriolis force and geostrophically balanced mean flow



Test areas: Ibiza Channel, Gulf of Trieste

Would you help me use it?

Why may I not be able to use it?



Why may I not be able to use it?



Hofstadter's Law:

It always takes longer than you expect,
even when you take into account Hofstadter's Law.

How to cite?

How to cite?

Barth, A., Beckers, J.-M., Troupin, C., Alvera-Azcárate, A., and Vandenbulcke, L.: DIVAnd-1.0: n-dimensional variational data analysis for ocean observations, *Geosci. Model Dev.*, 7, 225-241, doi:10.5194/gmd-7-225-2014, 2014.

One DOI per code release

2.3.1 → DOI 10.5281/zenodo.2562095

2.3.0 → DOI 10.5281/zenodo.2548856

...

Who is Julia?

Who is Julia?

Julia Child (1912-2004)



Who is Julia?

Julia Child (1912-2004)



By Lynn Gilbert - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=51678880>

Thanks for your attention