DIVA & DIVAnd interpolation tools

All you need to know about them

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[Logos of GHER, LIÈGE université, SeaDataCloud, and EMODnet]

GHER: Geodynamics and Environment Research
LIÈGE université: University of Liège
SeaDataCloud: European Marine Observation and Data Network
EMODnet: European Marine Observation and Data Network
What (who?) is DIVA?

Data Interpolating Variational Analysis

Software tool to interpolate in situ observations
What is [not] DIVAnd?

DIVAnd

= 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 R or Python?
Multiple dispatch
Math-friendly syntax
Unicode support: \( \pi, \eta, \int \in \alpha \)

```julia
julia> 🌊 = 1./3.
julia> cos(🌊*π)
0.5000000000000001
```
Just-in-time (JIT) compiled Parallelism

```plaintext
function fib(n::Int)
    f=Vector(Int)(undef, n+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)
```
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

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.
How can I get the code?

https://github.com/gher-ulg/DIVA

https://github.com/gher-ulg/DIVAnd.jl
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)

Example: zooplankton count in the Baltic Sea
Example: zooplankton count in the Baltic Sea

Keratella cruciformis (2007)

Observations - Keratella cruciformis (2007)
Example: zooplankton count in the Baltic Sea

Keratella cruciformis (2008)

Observations - Keratella cruciformis (2008)
Example: zooplankton count in the Baltic Sea

Keratella cruciformis (2009)

Observations - Keratella cruciformis (2009)
Example: zooplankton count in the Baltic Sea
Example: zooplankton count in the Baltic Sea

Keratella cruciformis (2011)

Observations - Keratella cruciformis (2011)
Example: zooplankton count in the Baltic Sea

Keratella cruciformis (2012)

Observations - Keratella cruciformis (2012)
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
Jupyter notebooks inside the Virtual Research Environment

Analysis fi 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)

<table>
<thead>
<tr>
<th>DIVAnd REST API</th>
<th></th>
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<tbody>
<tr>
<td>observations</td>
<td>sampledata:WOD-Salinity</td>
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<td>Salinity</td>
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<tr>
<td>metadata_project</td>
<td>SeaDataCloud</td>
</tr>
</tbody>
</table>
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?

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)

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Thanks for your attention