ODYSSEA

Creating products and knowledge for the Mediterranean

ALSEAMAR ALCEN

PROCESSING AND ANALYZING UNDERWATER GLIDER DATA

Platform user validation and operational oceanography training workshop

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727277

Objectives of the presentation

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- **What are glider data ?**
  - Require scientific and technical skills
- **What to do once you get your data ?**
  - Processing / adjustment / QC
- **How to interpret glider data?**
  - Basic principles and example of the ODYSSEA first glider mission
- **How to be connected with the international community?**
  - OceanGlider
  - GDAC glider toolchain

What are glider data?

ODYSSEA

What are glider data and their specificities?

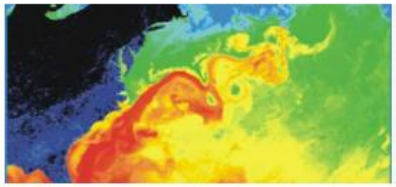
ODYSSEA

- A unique sampling strategy
  - High-resolution
  - Long-term
  - Resolve a wide-range of spatio-temporal scales

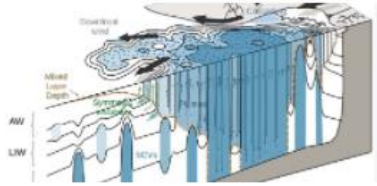
→ An efficient tool to monitor the ocean that "fill the gap"

Storms

Ocean Health and Ecosystems



Boundary Currents

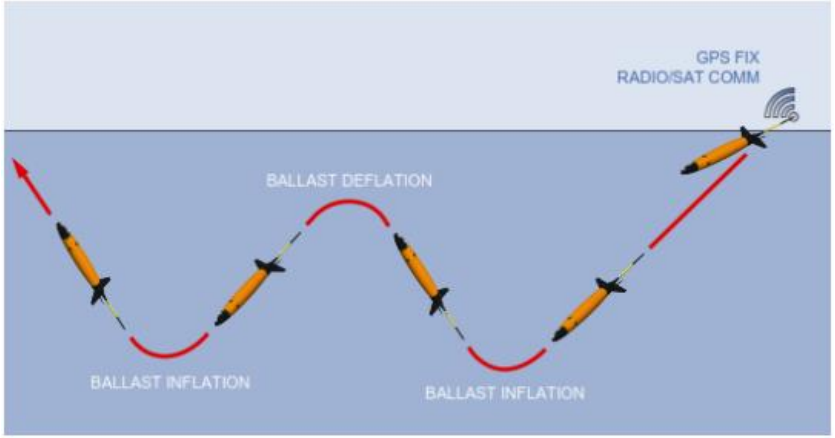


Water Transformation

What are glider data and their specificities?

ODYSSEA

- Specificities related to the platform
  - A glider is a float that move horizontally
  - Neither Eulerian nor Lagrangian
  - Hard to decorrelate between spatial/temporal variability
  - Sawtooth trajectory
  - Profiling platform



→ Require analytical tools and adapted survey

- Specificities related to the sensors
  - Significant constraints (size, power, P,T, response time, stability, Robustness, Biofouling

→ Require tool for processing, QC/QF and data adjustment

What are glider data and their specificities?

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- Glider data acquisition and recovery
  - Spatio-temporal resolution
    - → Depends on the sampling rate (typically 4s for a GPCTD-DO and 1s for a FLBBCD)
    - → Depends on the glider vertical and horizontal speed
    - → Can be depth and sensor-specific
  - RT dataset
    - → Each time the glider surface (if need)
    - → Through IRRIDIM telecommunication
    - → Subsampled dataset (30s-1min)
  - DM dataset
    - → At the end of the mission
    - → Full resolution dataset

What are glider data and their specificities?

ODYSSEA

- Structure of glider's files
  - 1 *.csv file per yo
  - Each measurement is associated to a time and a geographical position (P,T,S)
  - Navigation files (*.gli)
    → Contain the technical information of the glider
  - Payload files (*.pld)
    → Contain the scientific data

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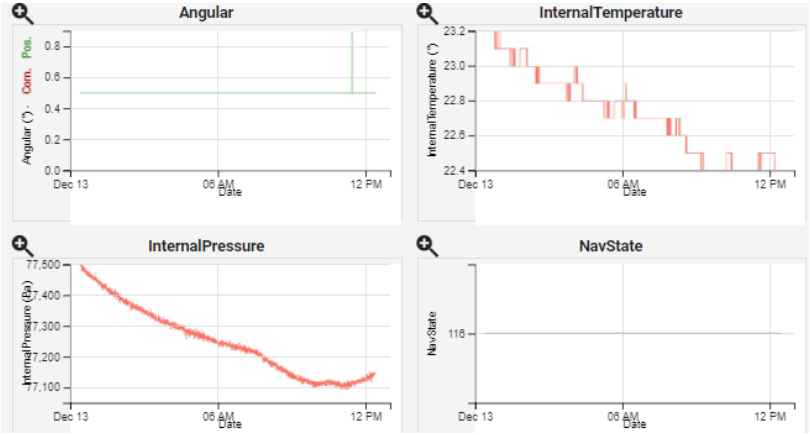
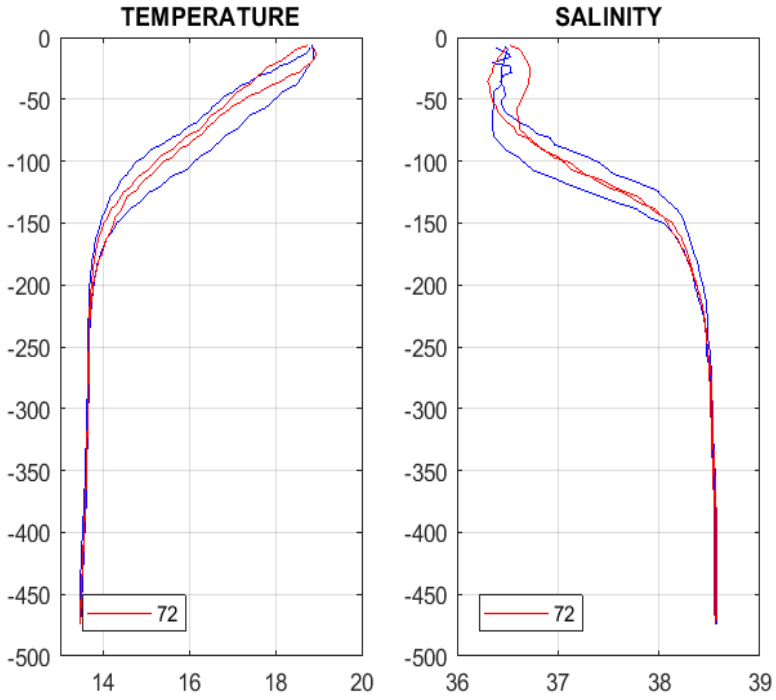


What to do once you get your data?

What to do once you get your data?

- Convert data in physical units
  - PSAL from raw conductivity measurements
  - RHO from the 48-term function of TEMP, SAL and PRES
  - DO from Hz to µmol/kg (use calibration sheet and formulae)
  - http://www.teos-10.org/pubs/IOC-XXV-3_e.pdf
- Adjust data (according to published methods)
  - Thermal lag effect
  - Time lag



Example from ODYSSEA mission

What to do once you get your data?

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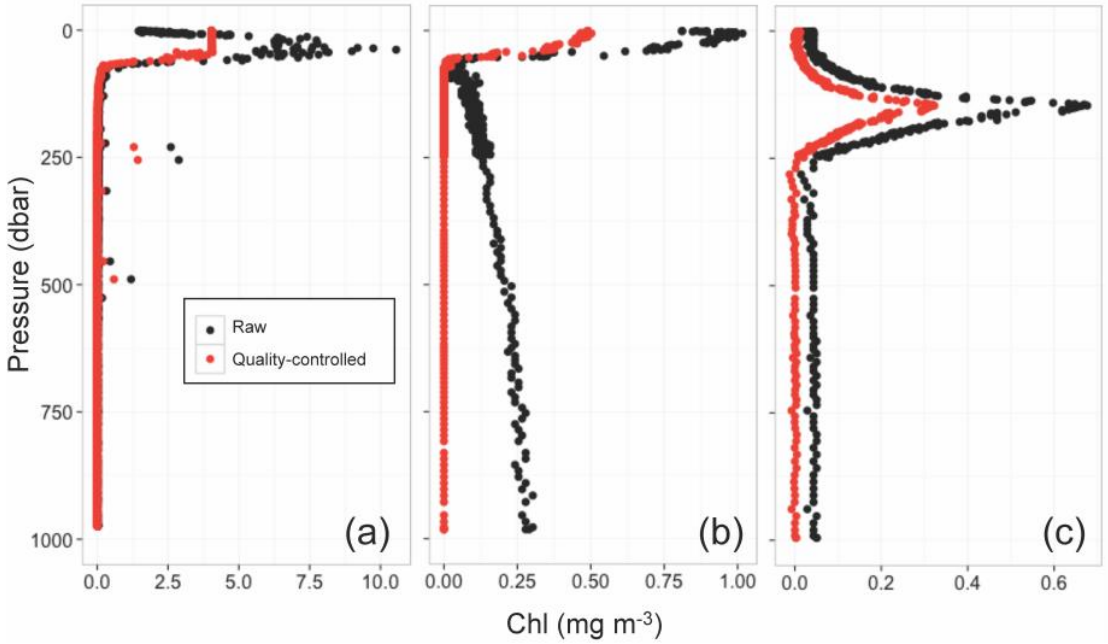
- Convert data in physical units using calibration factor
  - Using calibration factor
- Adjust data
  - Dark offset
  - Quenching
  - …

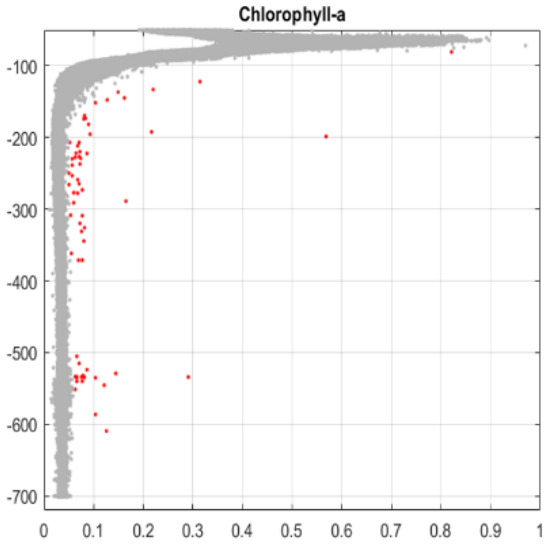


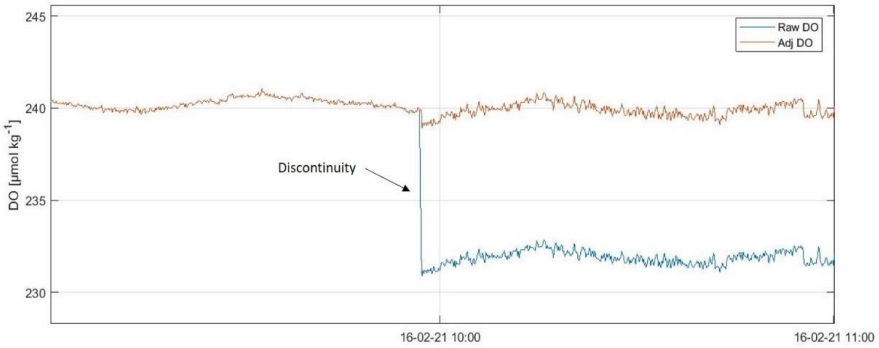
From Organelli et al., (2020)

What to do once you get your data?

- RT
  - Regional range tests
  - Spikes
  - Offset
  - …
- DM
  - Sensor drift
  - Discontinuities
  - Expert (Stat., NN, Database)
  - ….

→ Best practice recommend the acquisition of reference data





What to do once you get your data?

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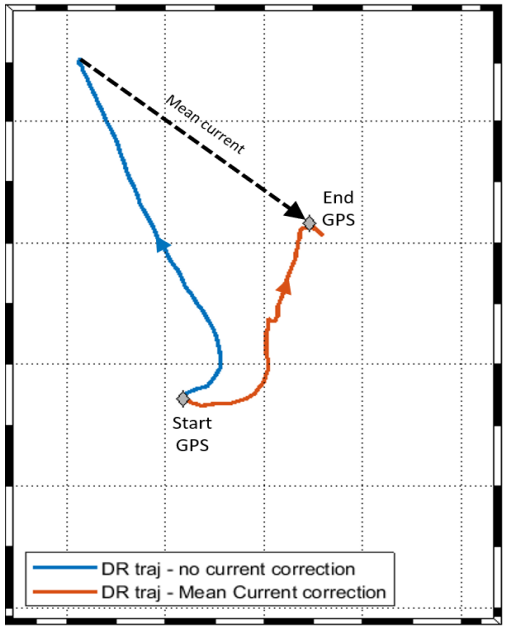
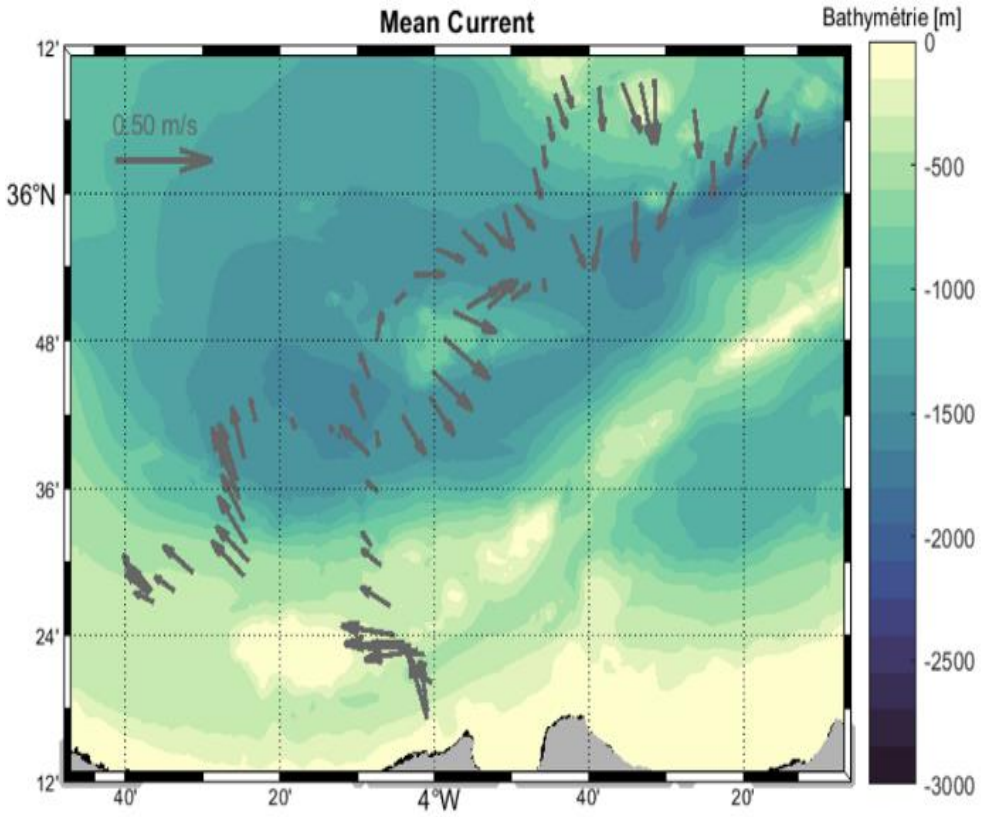
- Glider position known in surface (GPS)
- Within the water-column the position is estimated through the flight model
- The glider is subject to currents and its predicted trajectory rarely coincides with the true position at the end of a dive



- → Difference between predicted (flight model) and measured (GPS) position = Depth average current

What to do once you get your data?

- Example in ODYSSEA mission



How to interpret glider data?

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How to interpret glider data?

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- Basic recommendations
  - Principle / Anti-principle of (glider) data analysis (http://jmlilly.net/)

    → First examine the data with the simplest possible methods and gradually add complexity as needed

    → Find a way to look at the data in such a way that it simplifies

    → Synergy with other dataset

- Additional recommendations relative to BGC data : you measure proxy !
  - PHYTO = Chlorophyll-a fluorescence (NPQ etc.)
  - CDOM = fluorescent dissolved organic matter
  - Turbidity = backscatter index at 700nm

How to interpret glider data?

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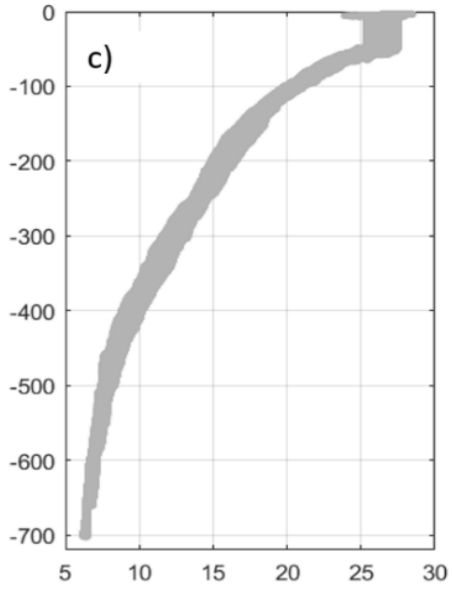
- Graphical representation of glider data

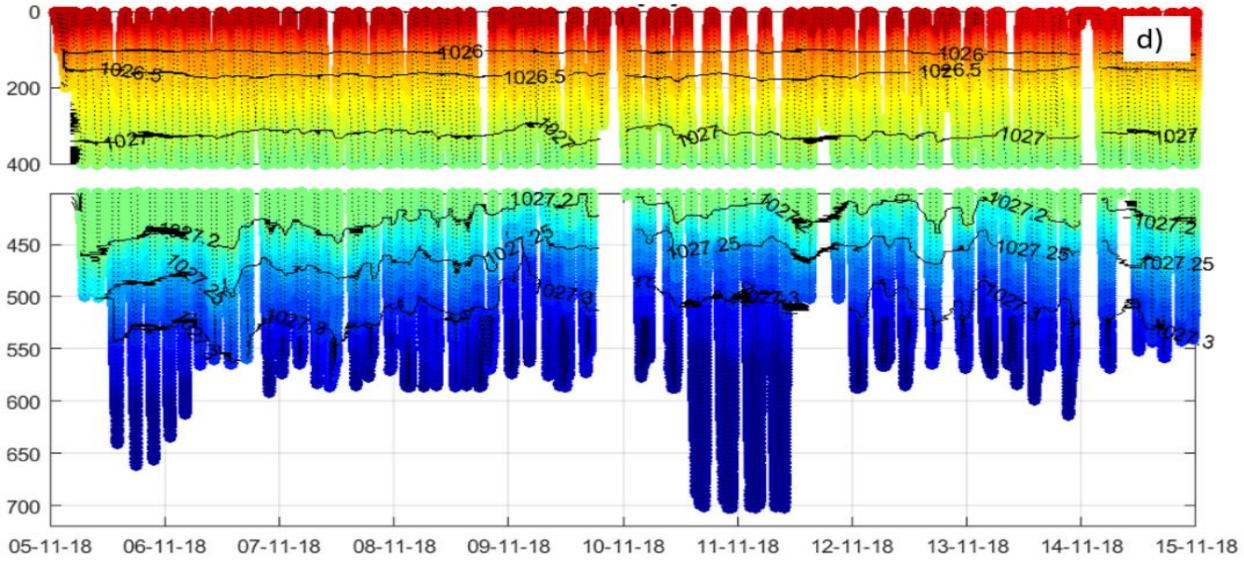
- Vertical profiles

→ Classical view of oceanographic data
→ 2D (time and space fixed)
→ Focus on the vertical distribution

- Hovmoller diagram

→ Add a third dimension
→ Highlight temporal variability





How to interpret glider data?

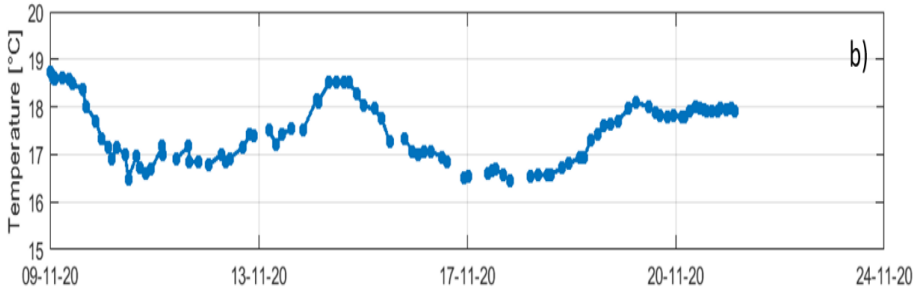
- Graphical representation of glider data

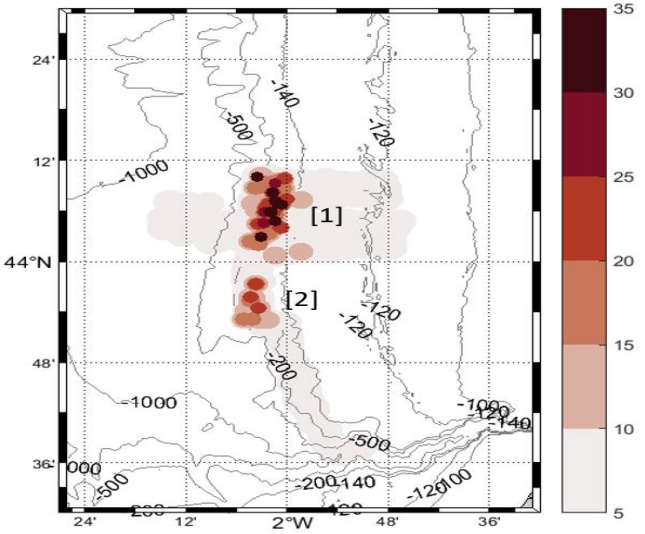
  - Time-series

  → 2D
  → Focus on the temporal variability

  - Map

  → 2D
  → Focus on the spatial dimension



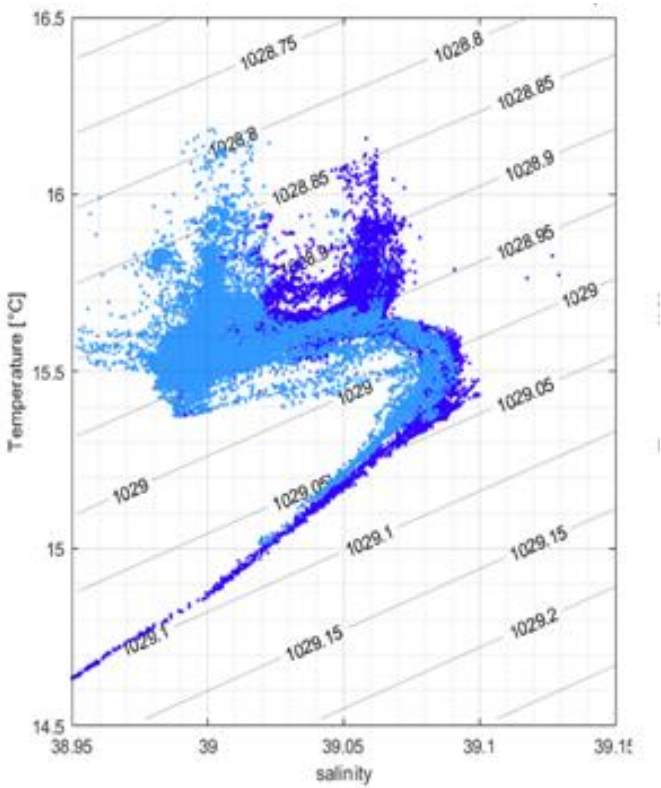


How to interpret glider data?

- Graphical representation of glider data

  - Diagram T-S

  → Focus on water-masses
  → Focus on mixing

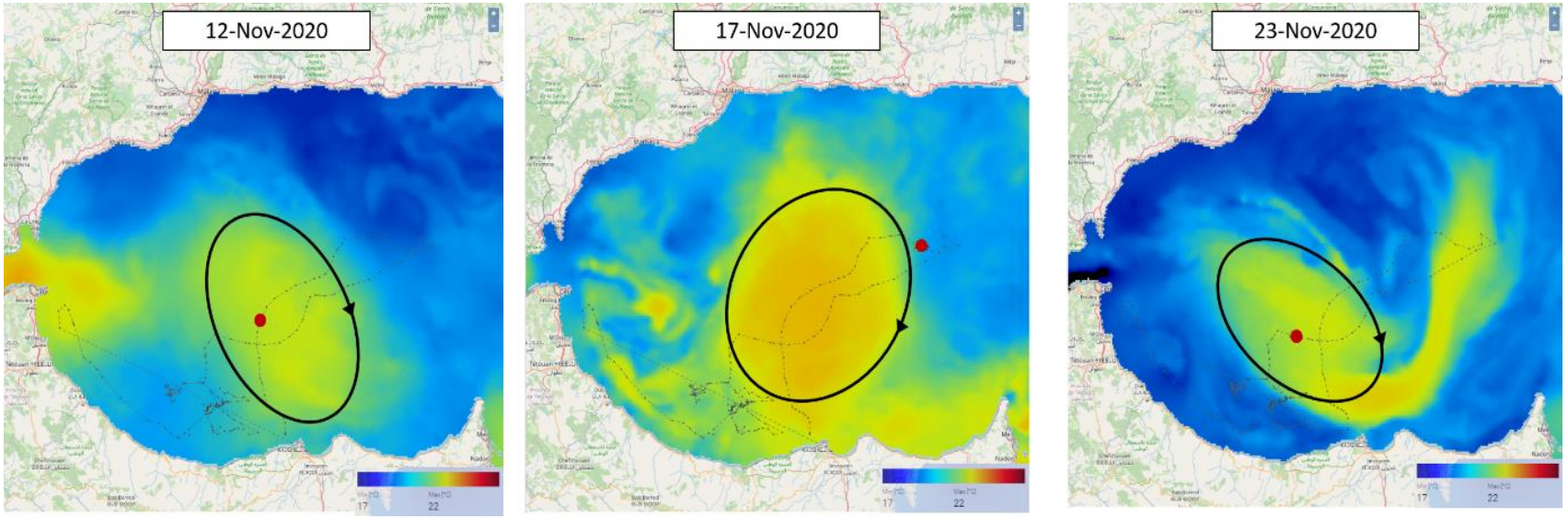


Example of the first ODYSSEA glider mission

- 3-D context (synergy with other platforms)
  - e.g. complementarity with satellite data
  - Help interpreting glider profiles
  - https://marine.copernicus.eu/

WAG

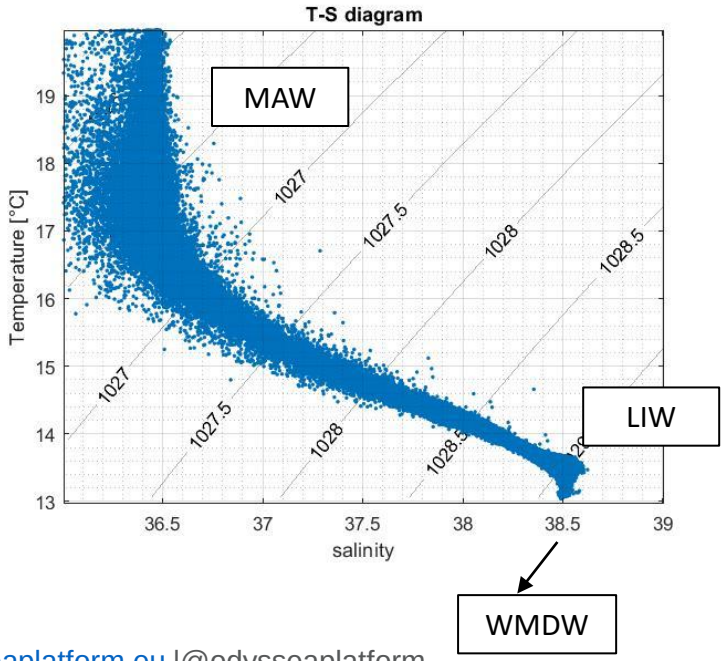
- anticyclonic gyre
- warm core
- Size/location variable

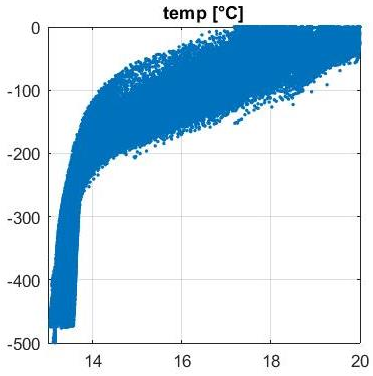


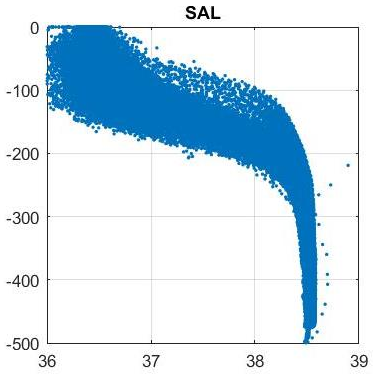
Nibani et al., (EUROGOOS - 2021)

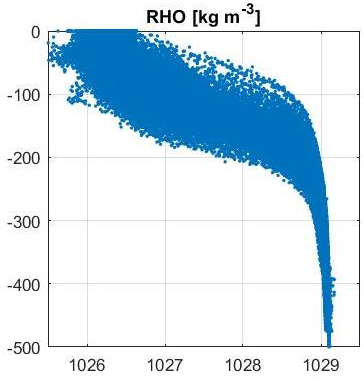
Example of the first ODYSSEA glider mission

- Vertical structure
  - T (resp. S) decrease (resp.) increase with depth
  - Important variability above the thermocline





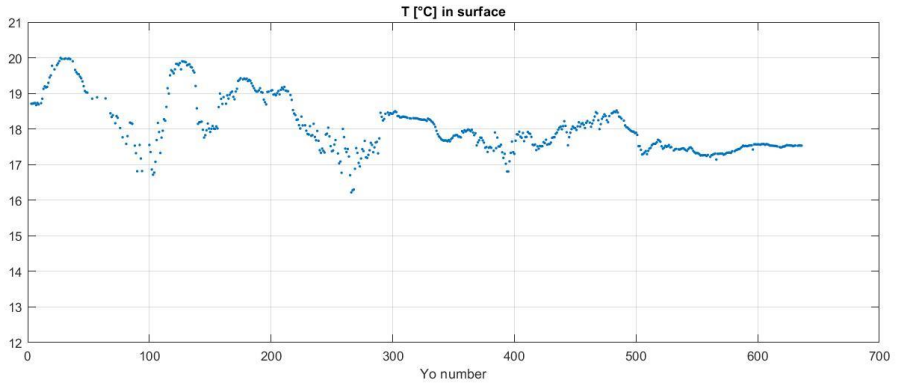


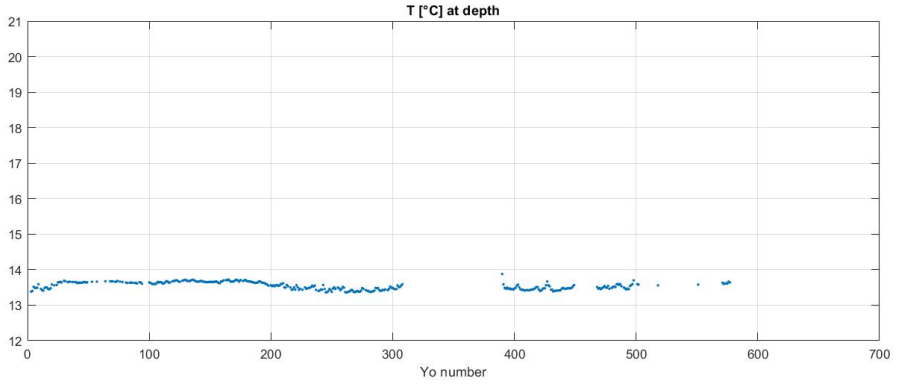


Nibani et al., (EUROGOOS - 2021)

Example of the first ODYSSEA glider mission

- Temporal variability
  - In surface from 16 to 20°C
  - Almost no variability at depth





- Decorrelation between the surface and the deep layer
- What can explain the observed variability?

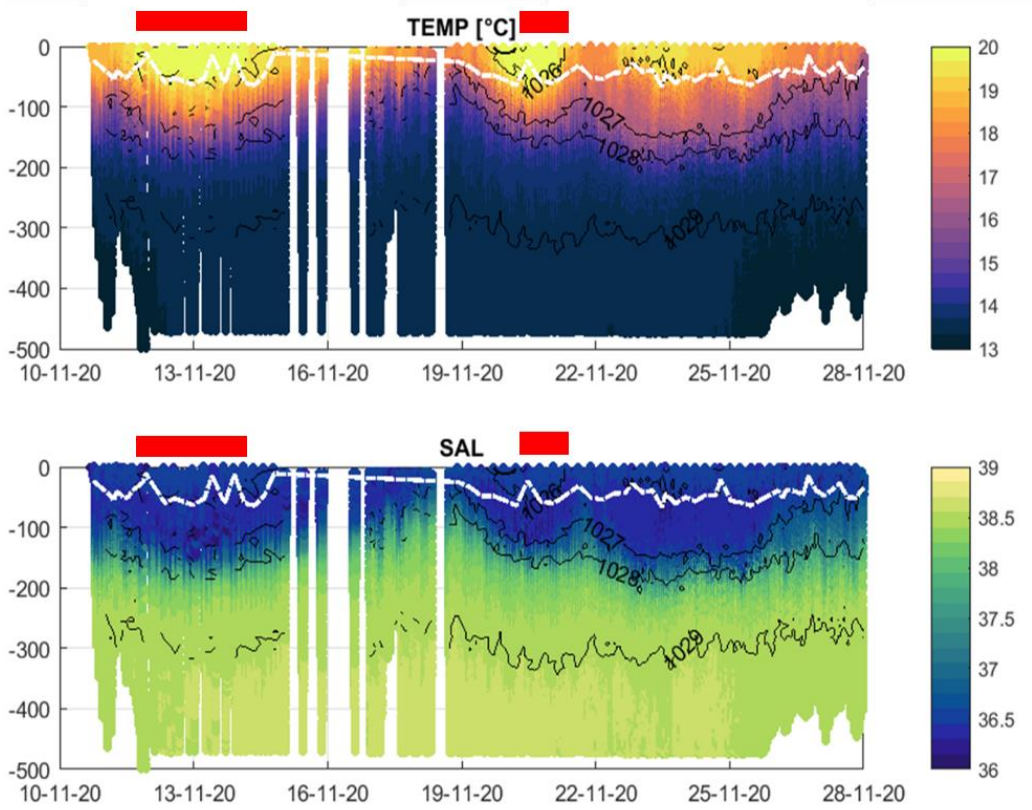
Nibani et al., (EUROGOOS - 2021)

Example of the first ODYSSEA glider mission

ODYSSEA

- Glider Hovmoller diagram
  - Clear signature of the WAG
  - Uplift of isopycnal levels

- Glider data allows to describe the WAG structure in the whole water-column
- Open questions : impact on the ecosystem, mixing of Atlantic waters? …..



Nibani et al., (EUROGOOS - 2021)

How to be connected with the international community ?

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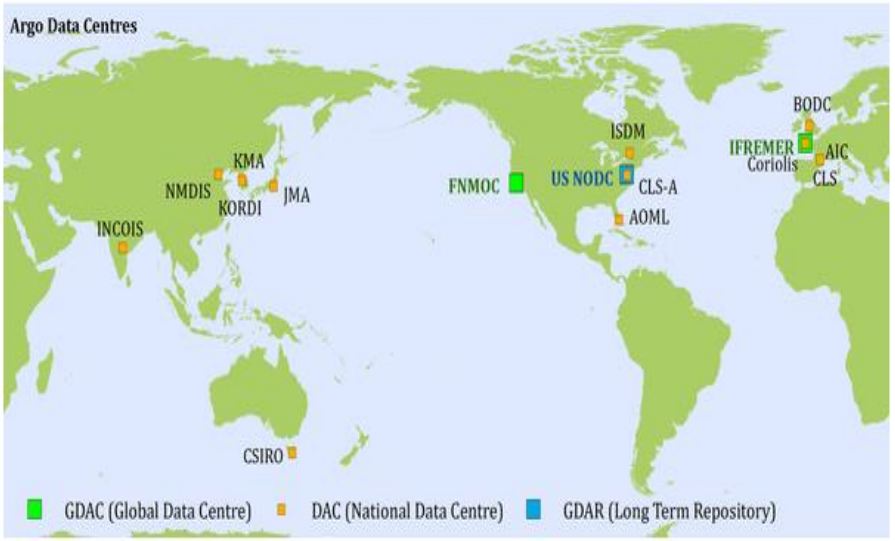
The international community

- OceanGliders
  - support coordination of the worldwide glider activity
  - www.oceangliders.org

- Best practice and recommendations documentation
  - Standard operating practice (SOP)
  - Processing and CQ

- Send your data to the GDAC
  - Gain visibility
  - Obtain a WMO
  - Get your data processed according to international standard



Available tools

ODYSSEA

- Coriolis processing chain
  - Decode and format the glider data and metadata
  - Apply Real Time Quality Control (RT QC) tests
  - Generate NetCDF files
  - https://www.seanoe.org/data/00343/45402/

- SOCIB toolbox
  - https://github.com/socib/glider_toolbox

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THANK-YOU

Orens de Fommervault

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727277