

IFM-GEOMAR glider operations in the Tropical Atlantic Ocean

J. Karstensen, G. Krahmann, P. Brandt

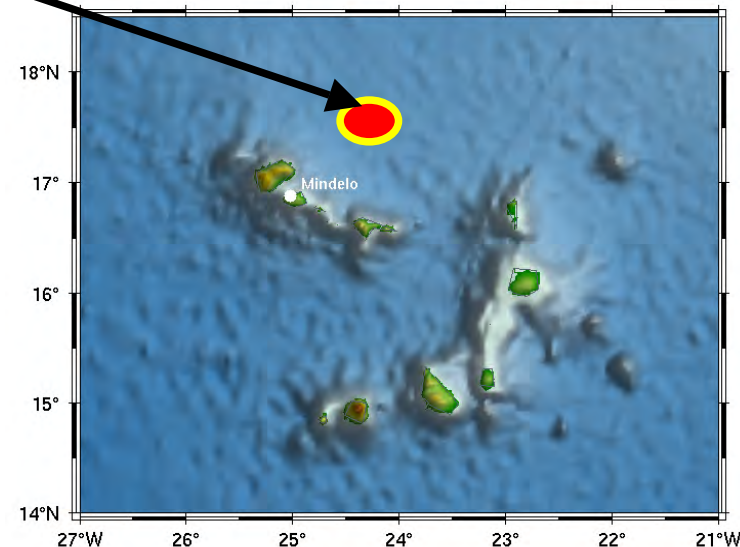
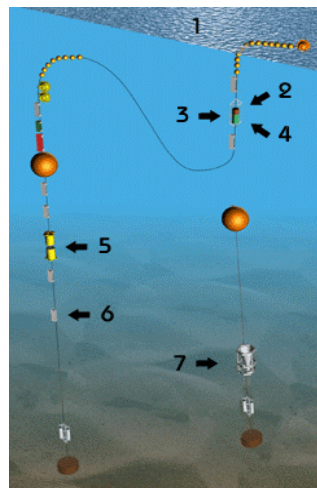
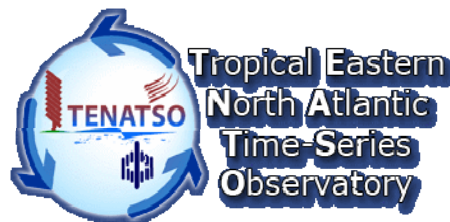


SLOCUM Glider deployment during NO I'Atalante cruise March 2008

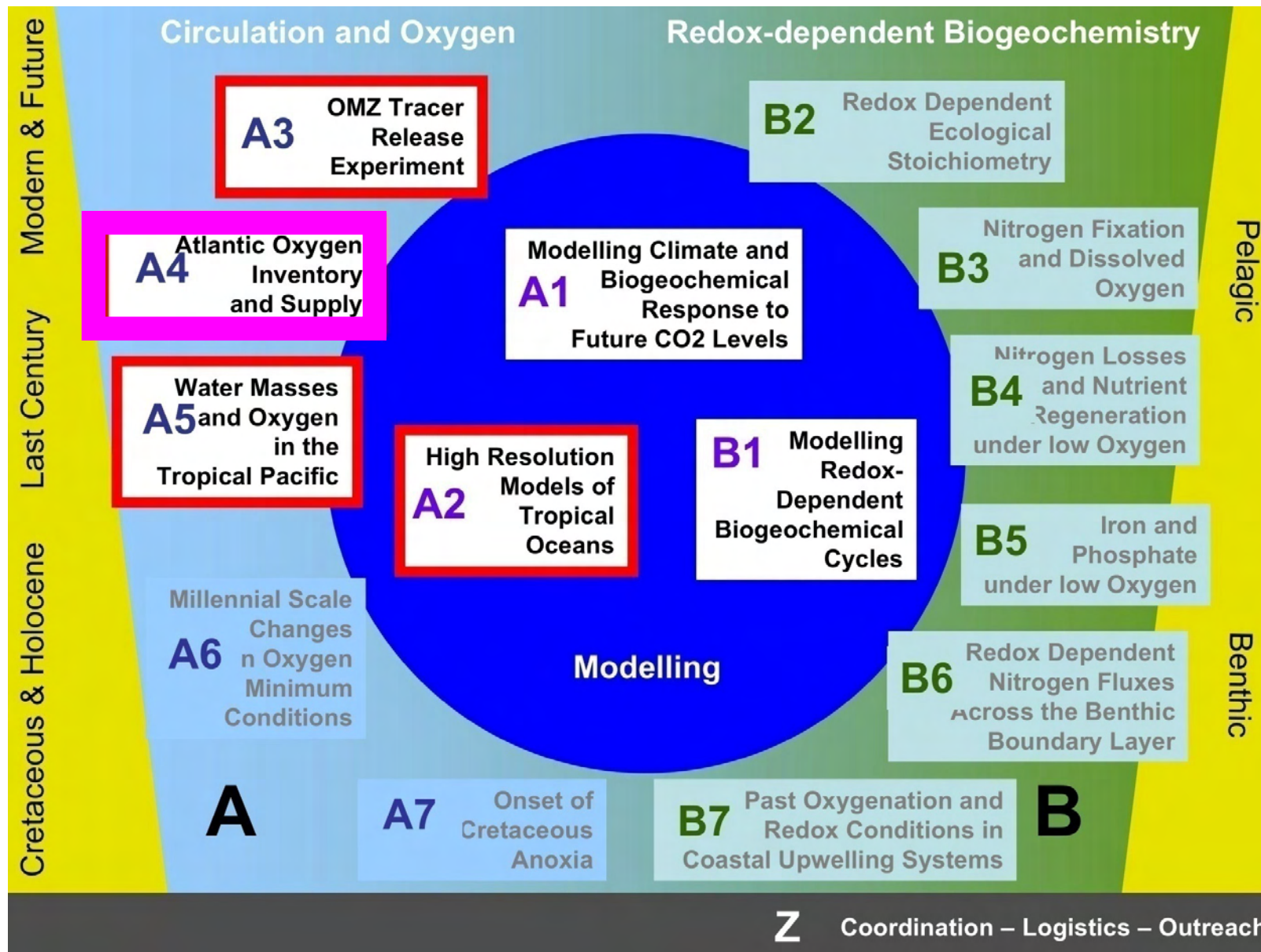
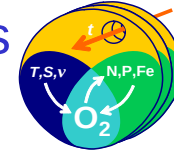
- The projects
- The gliders
- The missions
- The future

- The operations are embedded in the following projects:
 - **MERSEA:**
(Financed: EU FP6, Coordinator: IFREMER, Brest)
 - **SFB 754:**
University of Kiel
(Financed: DFG – German Research foundation)
 - **BMBF Project:**
(Financed: German Government)

- MERSEA was (ended in Sept. 2008) an operational oceanography project “ocean weather forecast” - lot of modeling but some observations (Glider task leader: J. Tintore/A. Alvarez IMEDEA)
- The MERSEA glider missions in the tropical Atlantic concentrated on mapping the mesoscale around the **TENATSO time series station** (north of Cape Verde)

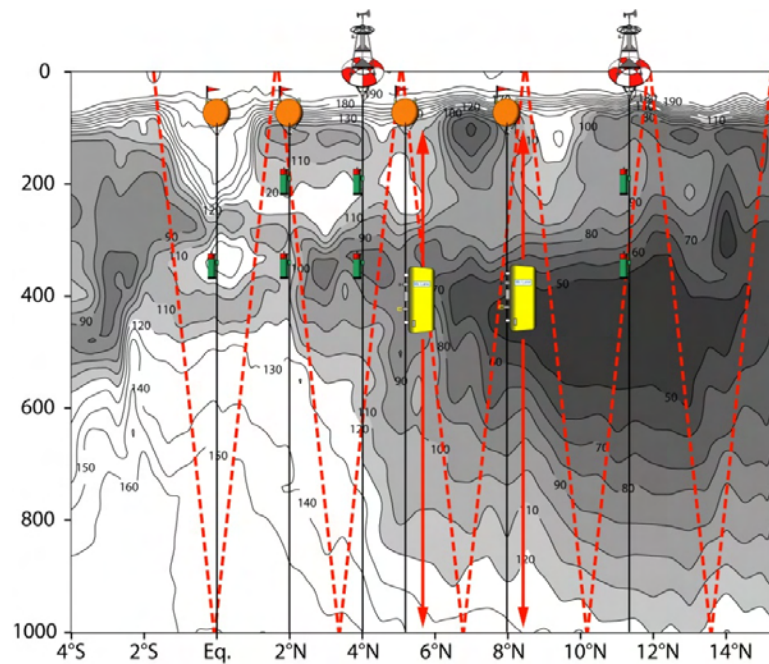


SFB 754: Climate –Biogeochemistry Interactions in the Tropical Ocean (1st phase: 2008-2011)

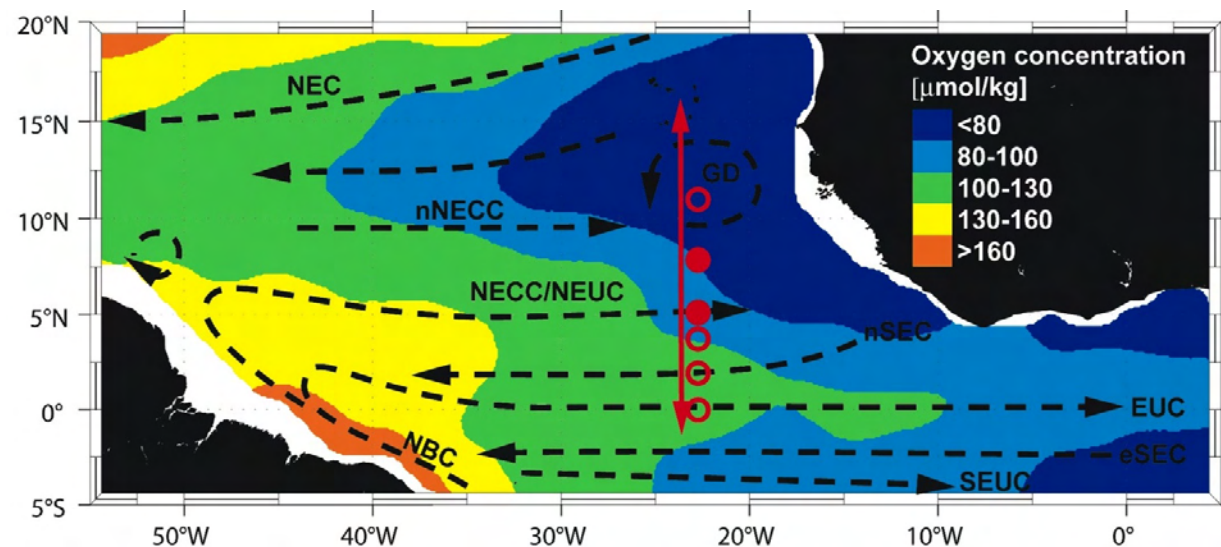


SFB 754: Teilprojekt A4 (Brandt & Körtzinger)

Atlantic oxygen inventory and supply

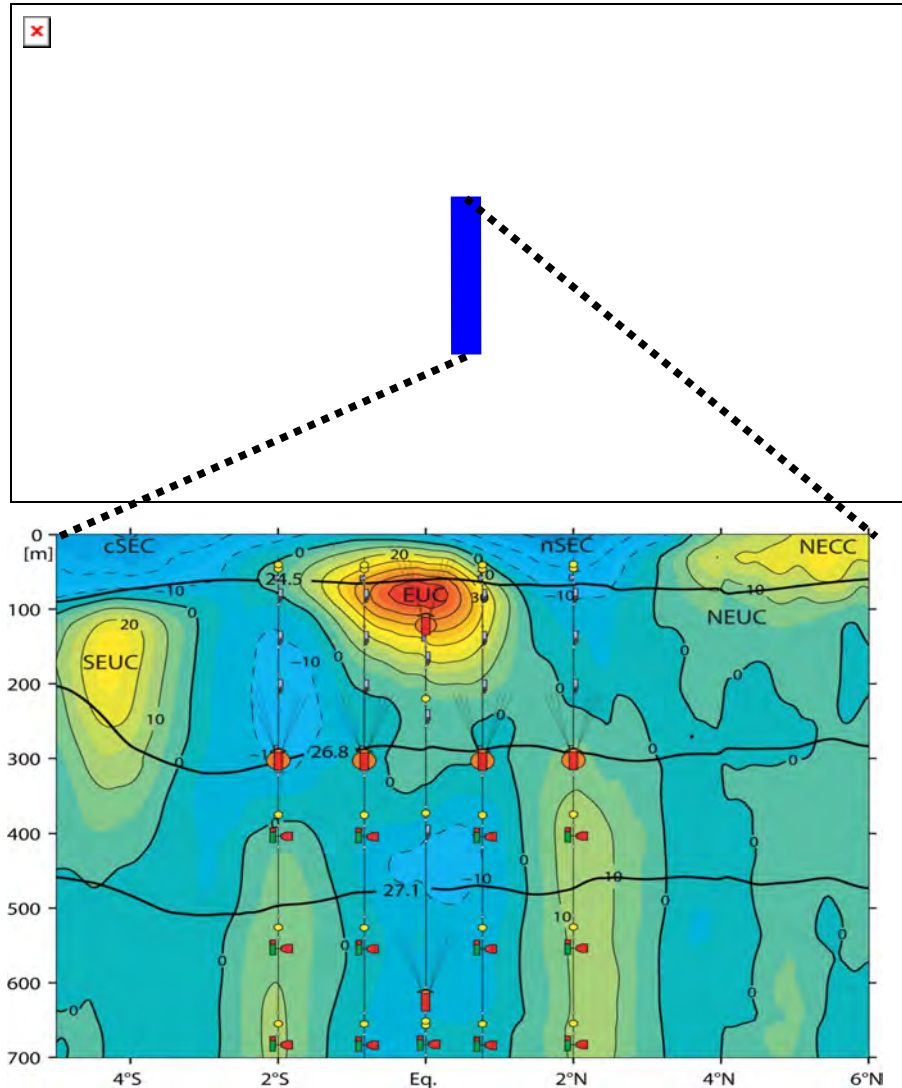


- Multiyear moored observation of oxygen concentration variability and supply
- Glider sections along 23°W



BMBF Project: “North Atlantic” (AP 1.2)

Brandt et al.



- Main objective: Understanding variability of equatorial current system (and relation to cold tongue e.g. control rainfall over Africa)

- Array of subsurface mooring at 23°W
 - part of TACE/PIRATA

- Glider and ship sections along 23°W

The Gliders

- Model: Webb SLOCUM 1000m
- Sea-Bird SBE 41 Temp, Conduc., Press. (unpumped)
 - calibration:
 - manufacturer, comparison with recent ship survey data (if available), “home made” time lag correction
- Wetlabs FLNTUSLK Fluorescence/Turbidity
 - calibration:
 - manufacturer, comparison with recent ship survey data (if available)
- Aanderaa Optode oxygen
 - calibration:
 - manufacturer, 0/100% saturation (lab), comparison with recent ship survey data (**Gerd's talk**)
- Energy: “Home-made” Lithium battery pack (based on SAFT LS 26500, *Batterieladen*, Kiel) and Alkaline

The Missions

- From October 2007 to October 2008 we started 7 missions
 - Overall 150 days at sea
 - Mainly two gliders involved:
 - ifm02 (“Deepy”)
 - 86 days at sea
 - ifm03
 - 64 days at sea
 - ifm05 only one day
 - About 730 surfacing
 - More than 1000 profiles
(maybe half of them to 1000m depth)
- Missions started typically some miles south of Sao Vicente (Cape Verde, CV), ~900m waterdepth

The Missions: Cape Verde Glider Port

- Ships
 - INDP: 22m long RV Islandia (1994), crane, CTD, TENATSO project, ~2000-3000€/day
 - Game Fishing boats, boat and crew well suited for glider deployment (similarities with Blue Marlin), typically 10m length, ~600€/day



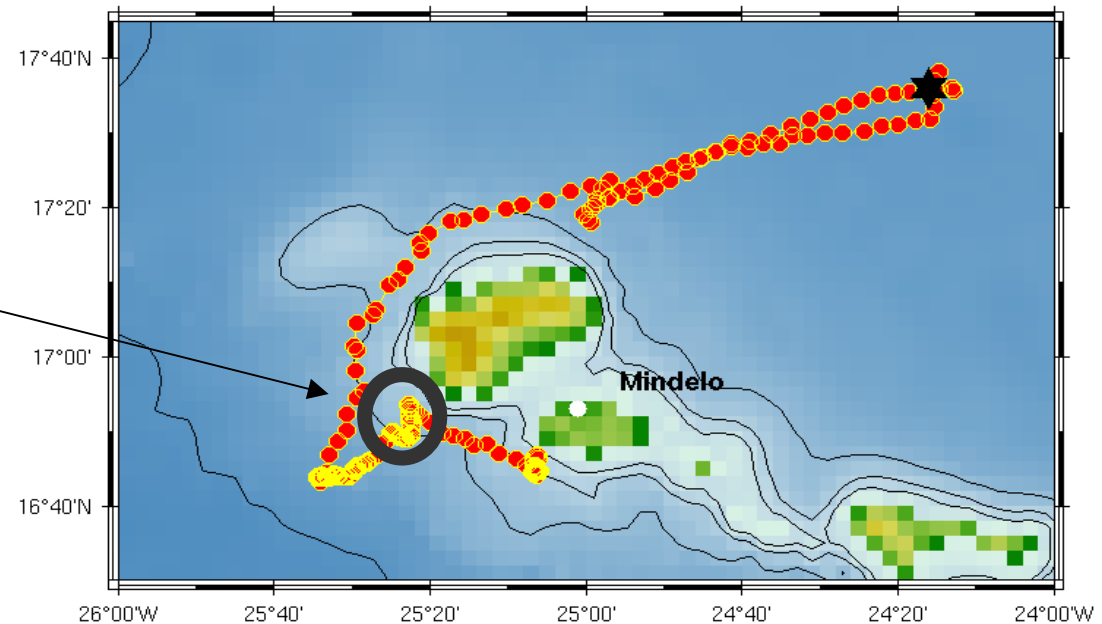
The Missions: Cape Verde Glider Port

- Access to Infrastructure at INDP
(Instituto Nacional de Desenvolvimento das Pescas) in Mindelo, Sao Vicente –
TENATSO Project
 - Costumes/Agent
 - Local expertise
 - Room, Tank, Cars, Internet access, ...
 - Great People and great cooperation!!



The Missions: Mesoscale at TENATSO station

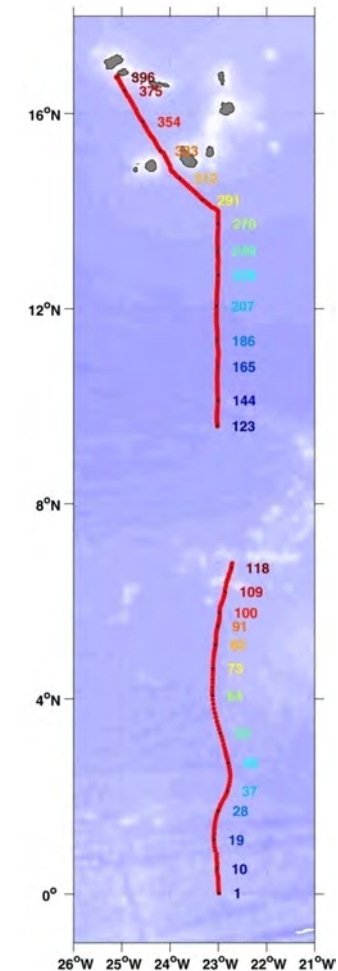
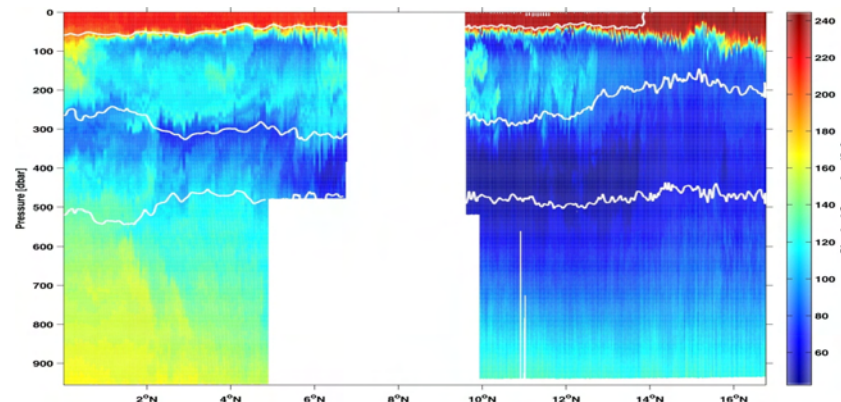
Lost wing



- IFM02 at TENATSO time series
 - Deployment Jan. 2007 (Clayton on CV)
 - 35 days in water
 - Lost one wing after 1 week (4 days “out of control”)
 - Local institute (INDP) added wing at sea, mission continued
 - Data quality: No oxygen (Optode defect), CTD defect

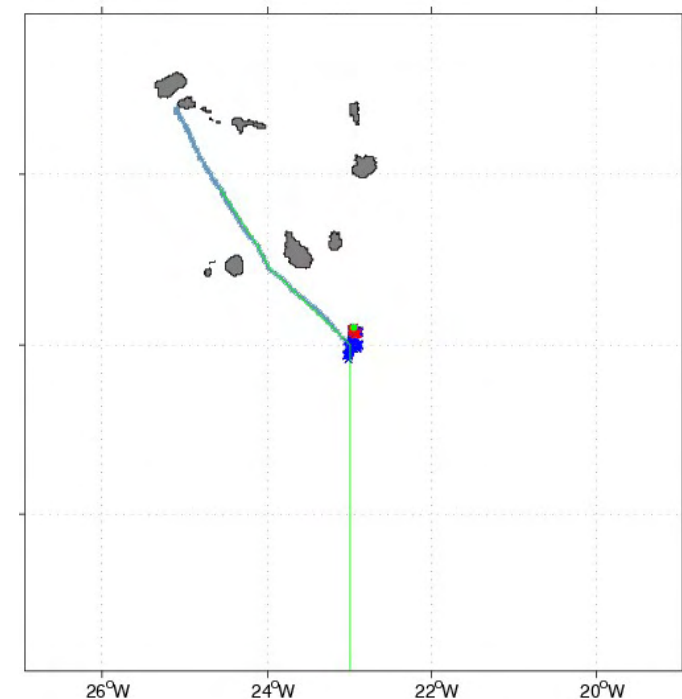
The Missions: 23°W section (I)

- Deployment IFM03 in January 2008, start occupation from north
- Recovery IFM03 after 44 days (February 08) during NO l'Atalante cruise
- Deployment IFM02 March 2008 during NO l'Atalante cruise, start occupation from south
- Recovery IFM02 after 42 days (April 08) during FS Maria S. Merian cruise
- First successful glider missions in the tropical Atlantic: high-quality data (**Gerd's talk**)



The Missions: 23°W section (II)

- Deployment IFM03 in mid September 2008 from Cape Verde
- Planned recovery:
FS Maria S. Merian cruise Nov. 2008
- Failure of engineering pressure sensor after 19 days of operation –
Emergency weight released -
Drift at surface -
Rescue operation required
(personal and ship from INDP/Sao Vicente + person from Kiel)
- High quality T, S, O₂,
Fluorescence/turbidity data



The Missions: Summary

Vehicle name	Deployment period	Deployment duration	Acquired profiles	Comment
ifm02	24.10.-30.10.07	6 days	~30	Leak detect (science bay?)
ifm03	24.10.07	1 day	1	Air oil pump
ifm05	24.10.07	1 day	3	Air bladder defect
ifm02	11.01.08-15.02.08	35 days	120	Lost wing & sensor problem
ifm03	11.01.08-24.02.08	44 days	350	Mission normal
ifm02	03.03.08-14.04.08	42 days	300	Mission normal
ifm03	15.09.08-04.10.08	19 days	150	failure Press. sensor

- About 1000 profiles in 150 days overall mission length
- Effort?

The Missions:

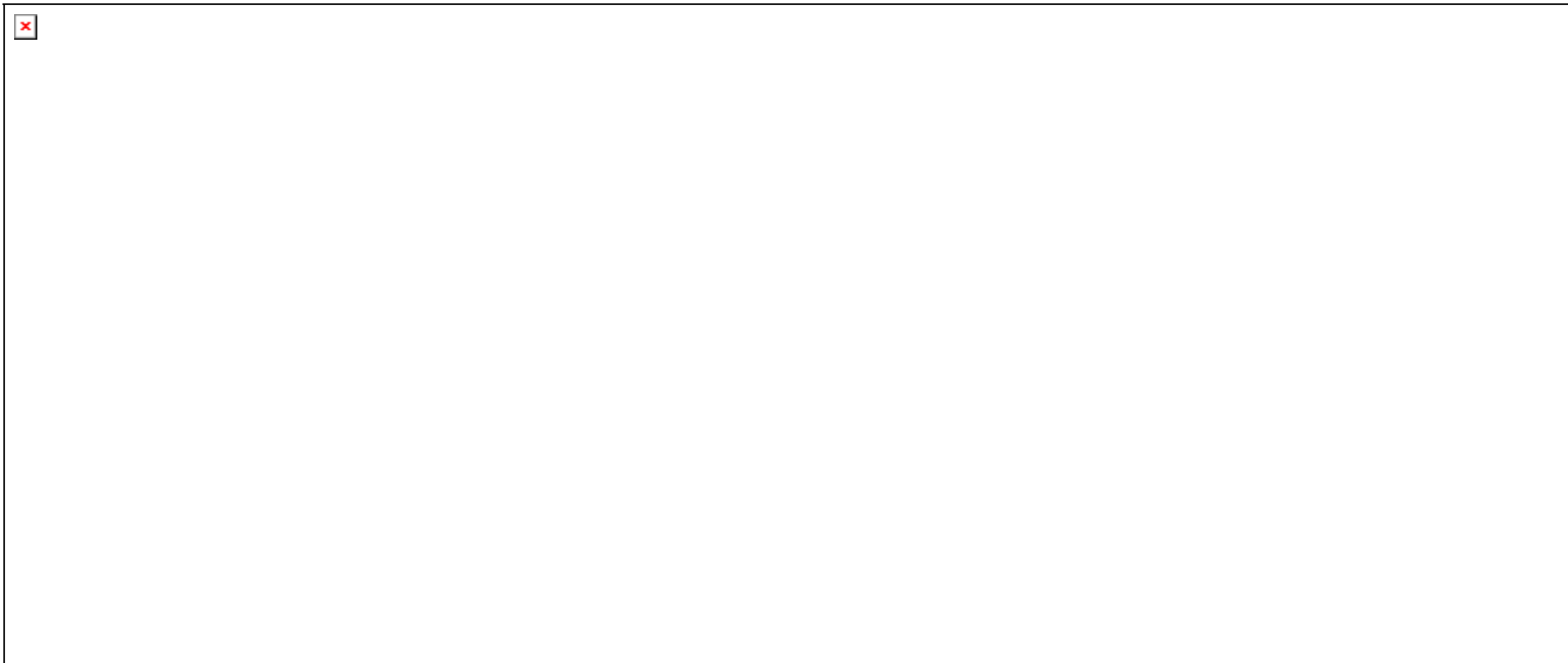
Effort versus „Outcome“ a cost estimate

- Do a rough cost estimate – very difficult ...
 - Travel: 5 return trips of 1 to 3 people to Cape Verde (order 10.000€)
 - Hotel: about 80 night (order 4.000€)
 - Batteries: 15.000€
 - Local ship time: 5.000€
 - Iridium Communication cost: 10.000€
- Overall (plus daily expenses etc.): 50.000€ ->
50€/Profile

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- In comparison: Argo Float (15.000€/130 profiles)
115€/Profile (but to 2000m and ...)

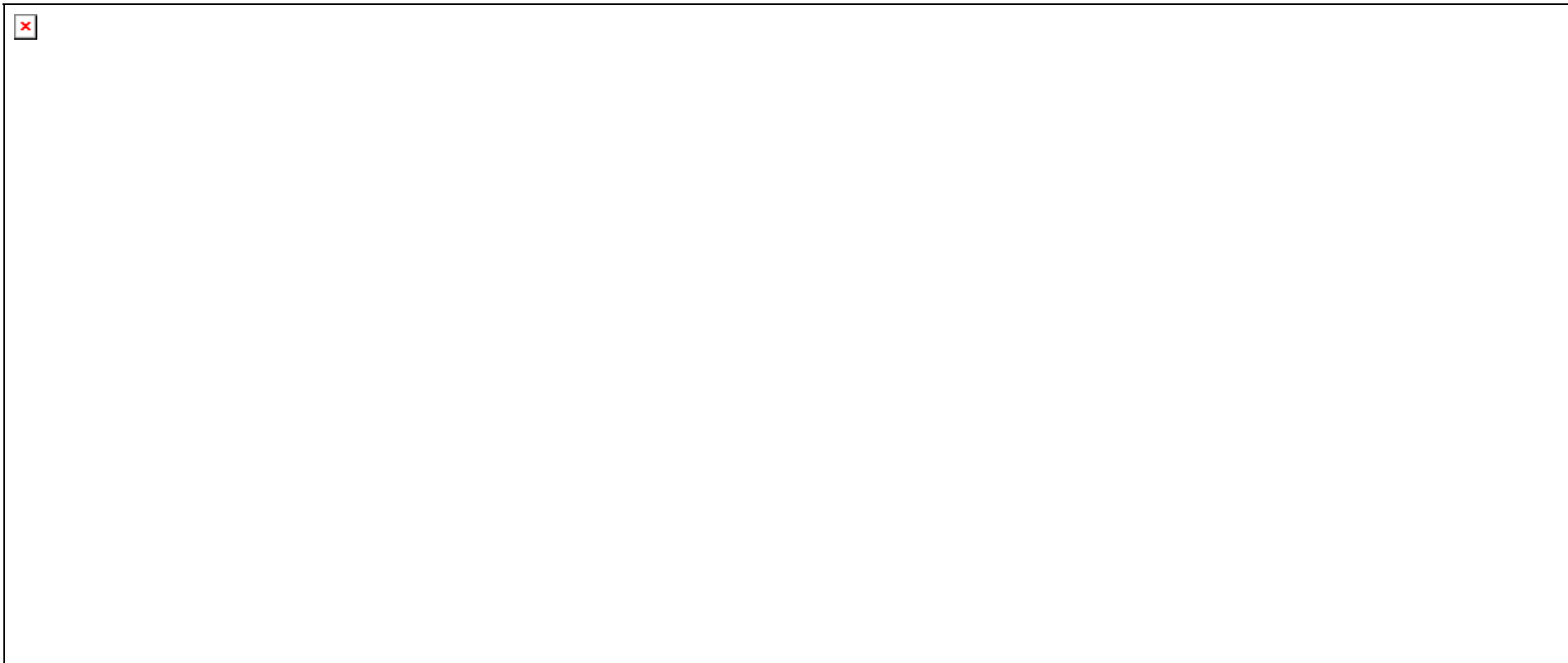
Comparison with WOCE Global Hydrographic Climatology



AOU (Apparent oxygen utilization) = Saturated oxygen (Temp./Sal.) – observed oxygen

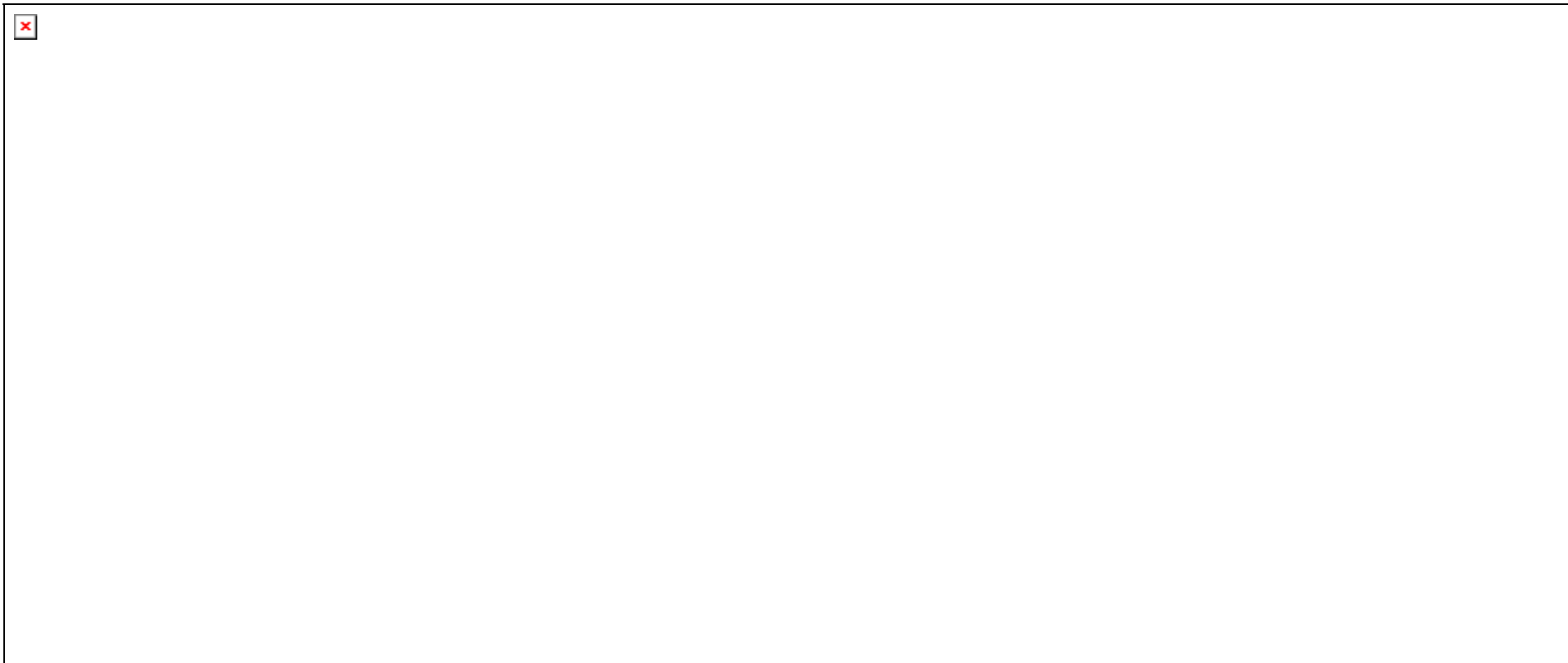
Distribution from climatology - No signatures resulting from mean zonal current bands

Comparison with WOCE Global Hydrographic Climatology



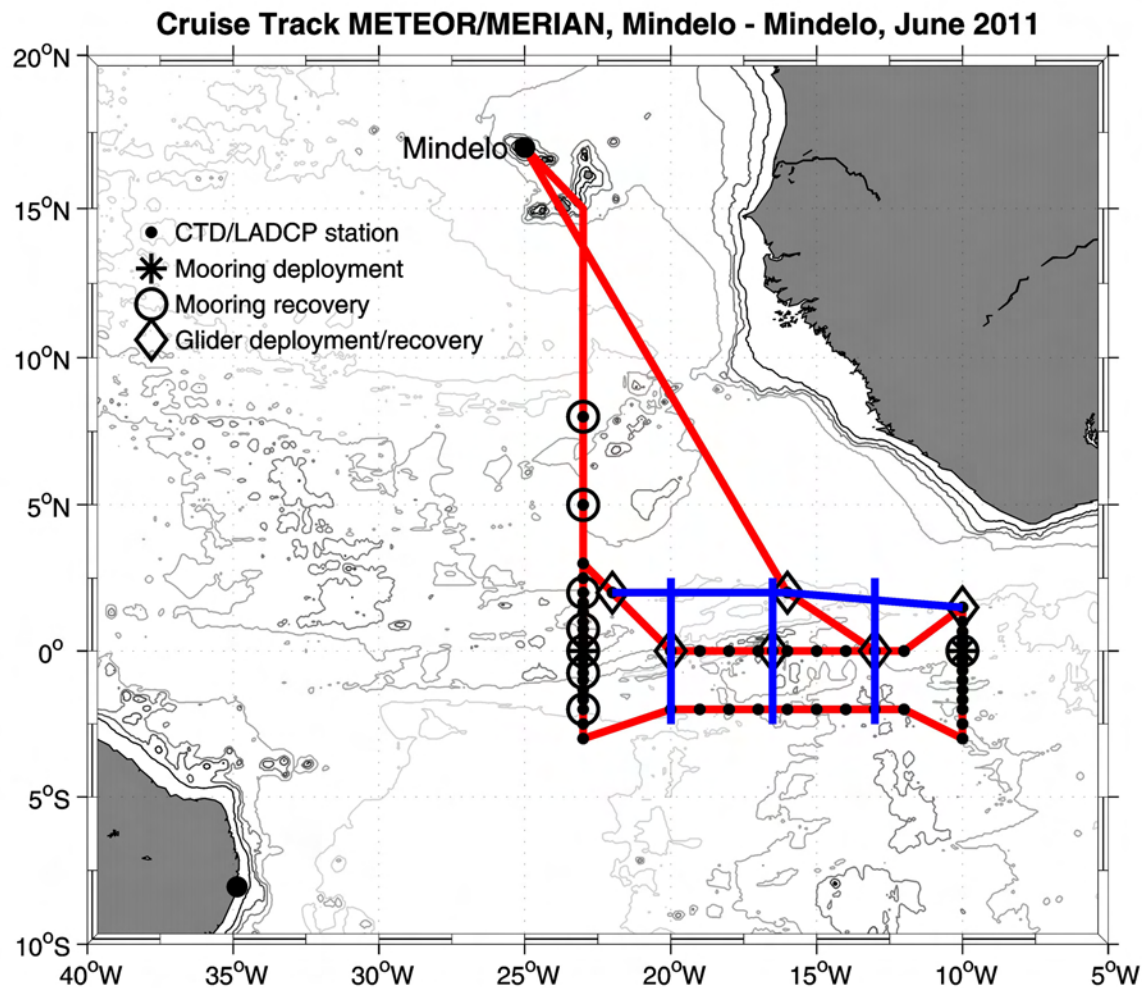
L'Atalante cruise in Feb./Mar. 2008 shows an increase in AOU compared to climatology – this is a reduction of oxygen!

Comparison with WOCE Global Hydrographic Climatology



Glider measurements are much more capable resolving high spatial variability associated with eddies and filaments

Future Missions



- Detailed mapping of evolution of the Equatorial cold tongue (blue: planned glider tracks)
- Deployment/Recovery of 8 gliders in June 2011 (during cruise)
- Cooperating partners are most welcomed!

Thanks – the EGO Cafe on Sao Vicente
awaits t be opened...





IFM-GEOMAR

Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

