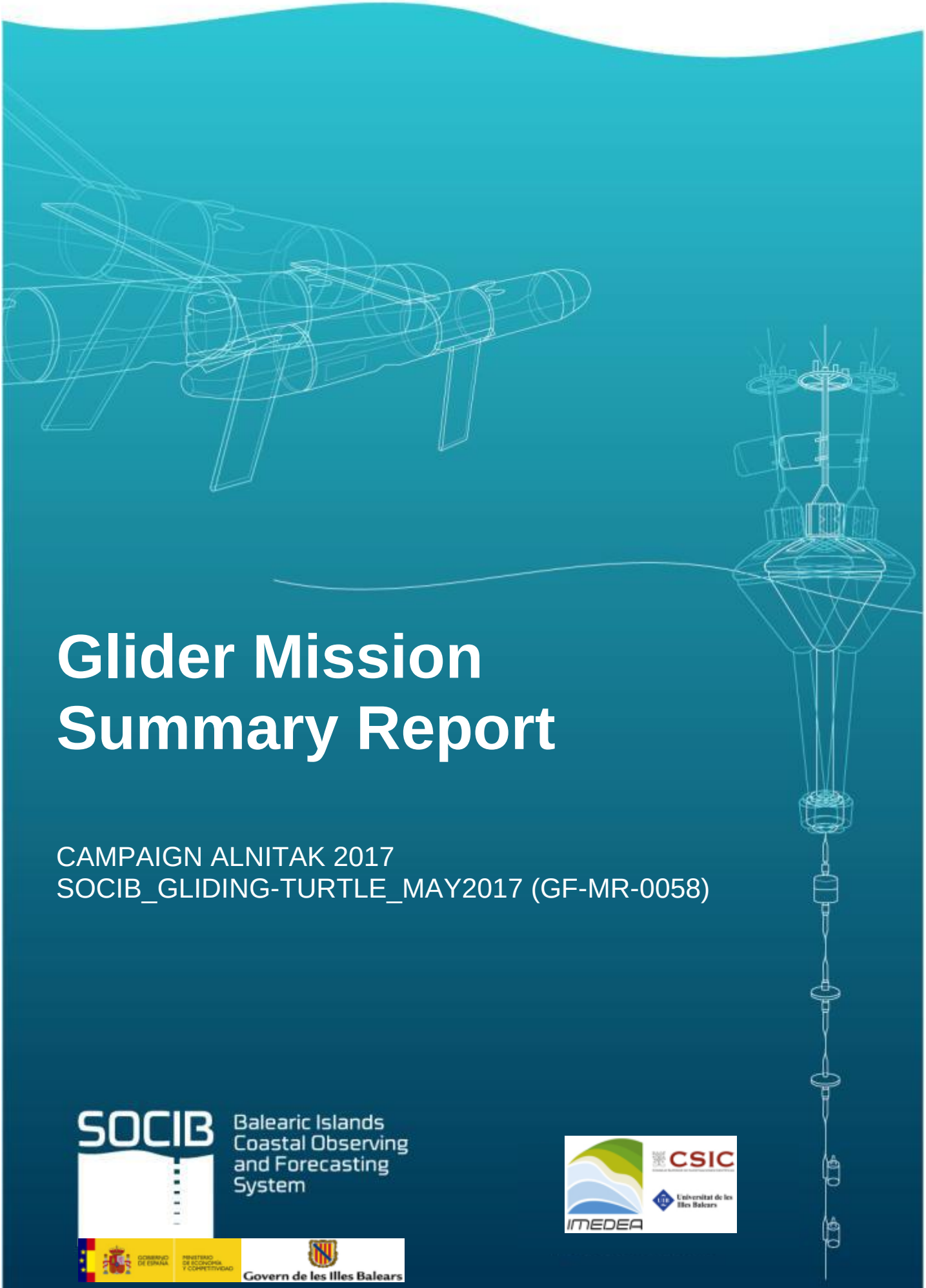

Glider Mission Summary Report

CAMPAIGN ALNITAK 2017
SOCIB_GLIDING-TURTLE_MAY2017 (GF-MR-0058)

SOCIB Balearic Islands Coastal Observing and Forecasting System

Govern de les Illes Balears

IMEDEA CSIC Universitat de les Illes Balears

Mission Name	*SOCIB_GLIDING-TURTLE_MAY2017 (GF-MR-0058)*		
Platform Model	*Slocum 200m G1*		
Platform ID / Name / WMO Code	*U050 / ICOAST00 / 68968*		
Related Platforms / Missions	*SDEEP01 (CanalesAPR2017, GF-MR-0057)*		
Start Date	*2017-06-26*		
End Date	*2017-07-11*		
Total Days	*15*	**Total distance (Km / Nm)**	*348 / 188*
Survey Area (NODC or SDN region)	*West coast of Mallorca (between Palma's Bay and Cabrera island [Western Mediterranean Sea]*		
Objective(s)	• *Gliding Turtles is a research experiment aimed to analyse the fine-scale patterns of sea turtles (Caretta caretta) in relation to oceanographic features and human activities through a multi-platform approach to support the conservation of marine pelagic ecosystems [David March, dmarch@socib.es,MAY2017]*		

Scientific Sensors (name & model / serial_number / calibration date)	• *CTD -SBE- / sn 0041 / 08-Feb-2011* • *FLNTU -WetLabs- / sn696 / 02-Feb-2011* • *OPTODE -Aandera- / sn 429 / 20-Jan-2011* *(calibration sheets available upon request to glidertech@socib.es)*
Number of Profiles	*NA (CTD), NA (FLNTU), NA (OXY)*

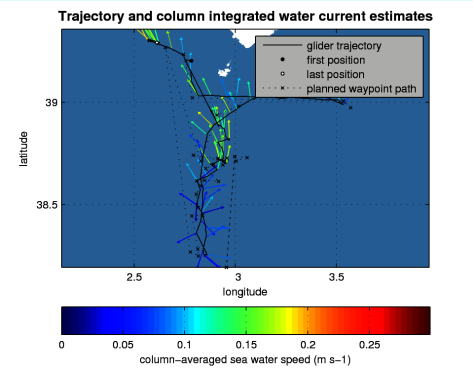

Figure 1. Current map

Significant Events	• *1st ICOAST00 mission in 2017 (and first one since ALNITAK-2016)* • *Dual launching operation (ICOAST00 and tagged-turtle)* • *Launching one day after IDEEP00 launch on-board Canales-SUMMER SOCIB-RV cruise* • *2nd "adaptive sampling" mission (driven by a living and wild animal)* • *Very intense route commanding (daily reload of GOTO file)*
Mission Summary	*Introduction* *This mission, the 1st one by ICOAST00 in 2017, stands for the second GLIDING-TURTLE mission in 2017 (contact dmarch@socib.es for further details on the background and project filiations of this mission). Internal code is GF-MR-0058. After initial operational and logistical challenges (especially with regard to the synchronization with the turtle release) a solid and intense mission monitoring and piloting was executed.*

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Pre-mission Report

Created prior to the start of the preparations, compiling the key preliminary aspects of this GF-MR-0058, derived from planning sessions.

Preparation

Phases were executed between 16/May/2017 to 22/June/2017. All checks and configurations were undertaken according to the pre-mission-report and applicable protocols. There were neither relevant issues nor problems worth to be mentioned here. Compass error was measured in a EMI-free forest location (max. error greater than 37º). This glider remained in stand-by (between this phase and the next) longer than usual due to the indetermination introduced by the capture of the turtle and the management of the tagging and posterior release. ICOAST00 was stored at Calanova's hangar during all this waiting period.

Launching

This field operation (26/June) were performed by 1 G-F and 1 ETD using SOCIB I at the south of Cabrera island. The turtle was released 3 days earlier to prevent stress nor damage to the turtle.

Additionally, ICOAST00 pilot was remotely acting from IMEDEA. These three teams were in permanent contact by GSM-phones and messaging applications (when possible).

The deployment was an operative and tactical success. Glider executed successful test dives prior to the initial survey dive (regardless the extraordinary elements, the launching protocol was strictly fulfilled). Note: very nice pictures were taken of the simultaneous glider-turtle release.

Survey

Two turtle was followed during this glider deployment. The first followed turtle went out of defined safety boundary (2/July). By that time, a second turtle was released, and PI team decided follow it until glider battery capacity allows it. This event occurred on 07/July.

Again, this part of the mission was different to the standard surveys SOCIB-GF is usually devoted to. It was in fact the first adaptive sampling/navigation attempted in many years. The fact that the driving-factor (determining the attack-heading) was a living animal freely moving in its natural environment introduced an indetermination that forced both the PI, and piloting-team, to evaluate the situation (and the necessity to re-adjust the commanded route) every 3 to 5 hours (no changes made at night to assure the rest of the team). Another significant novelty was the configuration applied to implement that commanded track. The standard linear waypoint list (with no repetition) was replaced by a circular scheme with infinite looping (so the glider never ran out of waypoints to pursue) and, very importantly, without surfacing due to hit-a-waypoint. Thanks to this, in the case that the turtle maintained its position the glider would stand-by navigating around a central point describing a triangle; whereas, if the animal was far away enough, this central point was moved to an estimated location (over turtle's ahead-path) so the glider would resume the turtle tracking. The results of this new strategy were very positive. Important: a security perimeter was established depending on three variables that were water-depth (bathymetry), distance-to-shore (cartography) and ship-traffic (AIS). The assumed risk-level, with respect to these factors, could be catalogued as Medium following a rather conservative approach considering the summer season and proximity to coast-line (the turtle moved very close to show in two different stages of the mission and the glider had to remain waiting for the specimen to return to deeper and safer waters.

- ***Navigation**: it was very satisfactory. The glider responded well to the commanded target waypoints. Due to the adaptive character of the mission, an average of 2 different waypoint lists were configured per day. This resulted in an irregular and non continuous advancement, especially when the glider had to wait for the turtle to return to more favorable waters. For the rest of the mission, ICOAST00 followed the turtle very well considering its own technical limitations. With respect to surface periods, NRT transmission was avoided to reduce the exposition time to ship collision. Configuration interventions were executed as fastest as possible to also contribute to minimize that risk. A security policy was applied avoiding bathymetries shallower than 60 meters and areas closer to the coast-line than 7Km. The fact of not surfacing after every waypoint hit incremented the error in heading modification. Nevertheless, position was hold successfully during waiting loops.*

- ***Underwater Maneuvering**: a single configuration was applied during the whole deployment (See Chart 1 for details) and was modified only once to lower the gliding angle to +-22deg so to fly more efficiently in very shallow waters. ICOAST00 to fly between -5 and -190 meters of depth using an 85% of the buoyancy drive. Bottom distance was set to 20 meters. Mission telemetry (obtained during Conclusion phase) revealed that the resulting 'flight' was pretty much adapted to these commands. No sea-floor collisions were observed. Due to trimming imprecision, the vertical velocities were very asymmetrical (ICOAST00 dove much slower than ascended) with 0,06 m/s on diving and -0,22 m/s on climbing. Surface events were triggered as expected due to the No-comms-for-a-while timmer as expected.*

- ***Engineering***
  - *Power Source: (Lithium Eltec Roll battery pack). Dummy Pitch battery. It performed very well.*
  - *Electro-Mechanical: actuators and sensors exhibited an acceptable performance. Besides*

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normal Oddities raised by Digifin, numerous (but known) oddities raised by the Buoyancy-Pump. This 'out of deadband' are due to the imprecision of the micro-positioning of the pump which is probably a cause of fatigue and age of the device.

- *Communication Systems: were reliable and fluent.*
- *Electronic Modules: (processors, memory cards, control boards,...) revealed no evidences of problems but the mentioned "Ring Buffer Overflow" problem occurred in Science-Super.*
- *Contextual/Awareness Sensors: pressure transducer, internal vacuum and internal temperature seemed to have worked correctly. Compass also reported coherent values. Altimeter detected the bottom correctly.*
- *Hull/Hydrodynamics: no signs of problems.*
- *Device Error-Statistics: 0 Errors ; 1 Warnings (GPS) 949 Oddities (243 buoyancy pump the most worrying ones).*
- *Mission Runs: 2 missions runs due to 1 same_depth_abort. No significant event*

Recovery

In this case, a new goto was loaded in order to simplify recovery operation. A closer waypoint was set.

Administration/Notification

Although multiple administrative and notification procedures took place during the different stages described above, these have not been reported because are considered out of the scope of this report. Same applies for multimedia and public-diffusion (special and more intense actions taken in that aspect. Contact dmarch@socib.es and outreach@socib.es for specific information); and also for accounting.

HHRR

Once more, the novelties and exigencies of this mission required of an extraordinary team coordination (with more people involved and number of intra-communications) .Nevertheless, coordination amongst multiple participants (glider-techs, field-techs, scientists & outreachers) was fluent and efficient. There were no personal damages and the availability of each member, for all the tasks assigned at each moment, was correct (including on-alert shifts for field intervention and 24/7 glider monitoring during survey -which was more intense than usual-). Interaction with external partners (Alnitak, Palma-Aquarium,...) was also very fruitful. The most relevant outcome on this aspect was the proved capability of executing a near-real-time adaptive sampling and navigation.

Detailed Charts:

	05	190	14400	20	∞	04	disabled	50

(1): This strategy ruled during the whole deployment. Only diving angles were modified on July-15th (to +-22deg) to improve very shallow navigation

(M.S.): Mission Start	N_{DIV}: *Surface upon completion of this # of dives*
D_{UTI}: *Underwater Top Inflection Depth (m)*	N_{COM}: *Surface if this amount of hours without stable communications (hrs)*
D_{UBI}: *Underwater Bottom Inflection Depth (m)*	
T_{UND}: *Average Period of Underwater Navigation (secs)*	t_{UTC}: *Surface at this particular UTC times*
d_{BOT}: *Minimum Distance to Sea-floor to be kept (m)*	H_{WPT}: *Surface if a waypoint is hit within that distance (m)*

Chart 1 Summary of Underwater Strategies (Navigation)

Date (utc)	SEN	fSMP	DRNG	MDIV	MCLI
(from Mission Start to Mission End)	CTD	0,5000	[-5, 2000]	yes	yes
	OXY	0,5000	[-5, 2000]	yes	yes
	FLNTU	0,5000	[-5, 250]	yes	yes

SEN: Sensor type
fSMP: Frequency of sampling (Hz)
DRNG: Depth range this configuration applies (m)
MDIV: Sampling during Diving maneuver
MCLI: Sampling during Climbing maneuver

Chart 2 Summary of Commanded Sampling Strategies

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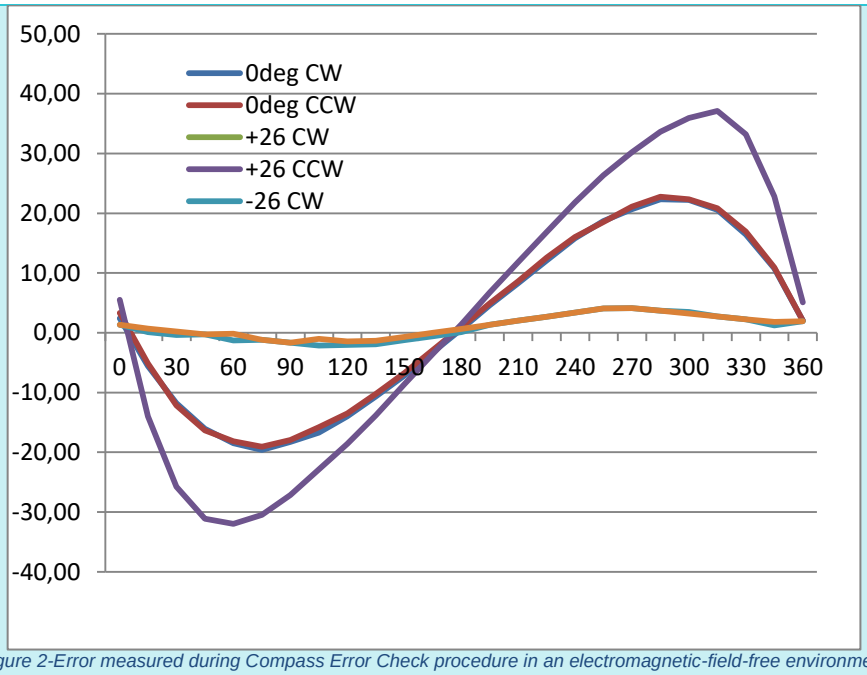

Figure 2-Error measured during Compass Error Check procedure in an electromagnetic-field-free environment located in a forest close to IMEDEA (in Esporles)

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Principal Investigator (e-mail or contact phone/address)	• *PhD. David March Morlà* *dmarch@socib.es (+34 971439764)*
Institute	*SOCIB in collaboration with IMEDEA*
Project Affiliation (web-site)	*http://www.socib.eu*
Partnership / Participation	• *SOCIB (www.socib.eu)* • *IMEDEA (www.imedea.uib-csic.es)* • *Alnitak (http://www.alnitak.info/es/)*
Glider Software Version	*Nav : v7.13 Acomms, Payload: 3.17*
Data Retrieval (real-time [RT] / delayed-mode [DM])	• *RT: not implemented to minimize surface-risk* • *DM: full/direct memory card backup after glider disassembly during Conclusion mission-phase*
Compass Calibration (specify procedure)	*Compass error was measured. Observed error followed a well-known sinusoid-shape although the glider followed traced-route very well(See Figure 2).* *Re-calibration is needed.*
Battery Type	*Eltec lithium Battery Pack (170Ah-nominal capacity) (Brand new)*
Battery Consumption (Ah)	*74.3Ah (reading from 3.7Ah to 78.0Ah)*
Data Available From	*http://thredds.socib.es/thredds/catalog/auv/glider/icoast00-ime_slcost000/catalog.html*
Further Details	*glidertech@socib.es*

General Map

Figure 3 - Map providing general overview of the Survey Area

On-line Track

http://apps.socib.es/dapp/?deployments=732-17-0-000033&layers=none&units=scientific

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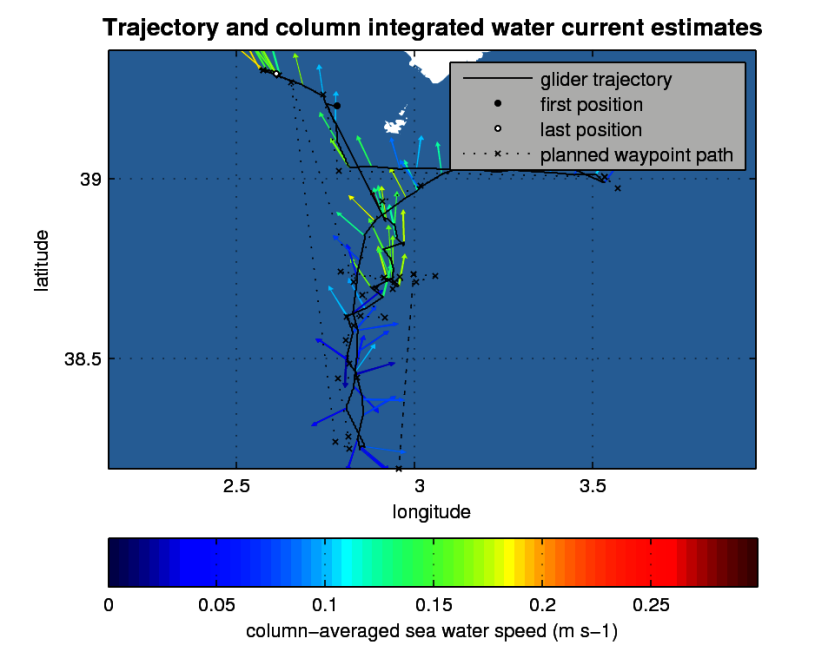
Detailed Maps



Scientific Preliminary Review

CTD

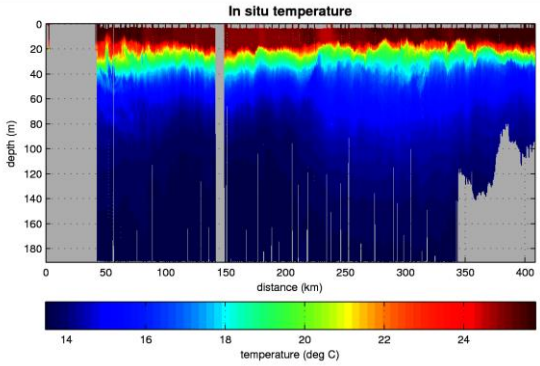


Figure 4 - In-situ temperature (full depth range)

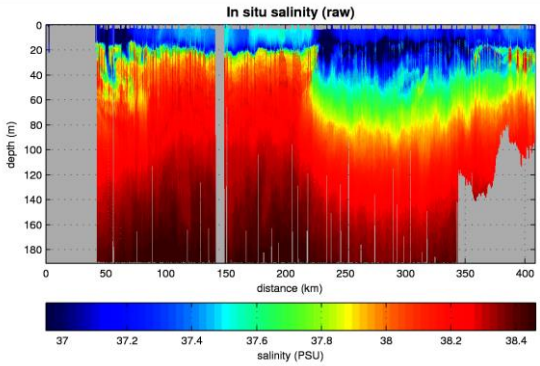


Figure 5 - Corrected salinity (full depth range)

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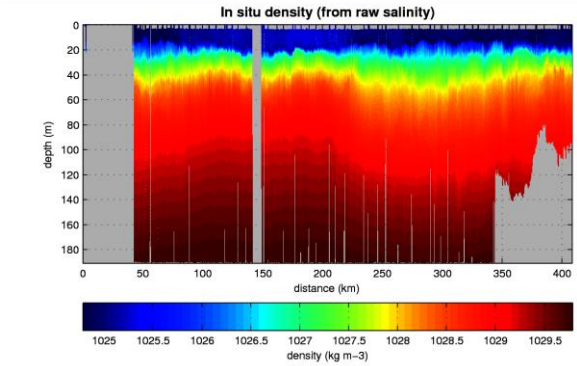
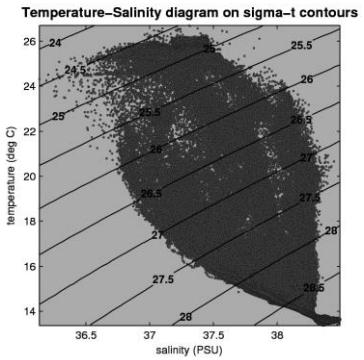


Figure 6 - Density derived from corrected salinity and temperature (full depth range)

(Plot4 shown here is the result of a Quality-Control method applied by SOCIB's Data-Center to filter suspicious horizontally-aligned outliners -see a miniaturization of the original-plot below-.

Contact data.center@socib.es for further info.)



Plot 4 – T-S diagram (thermal-lag corrected)

OXYGEN

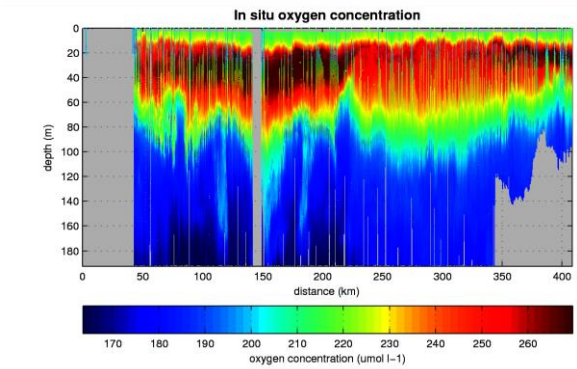


Figure 7 - In-situ oxygen concentration

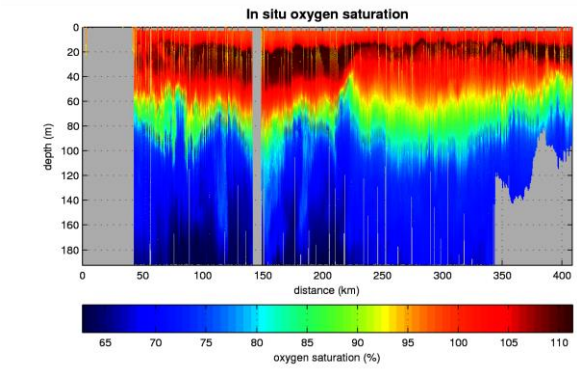


Figure 8 - In-situ oxygen saturation

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TURBIDITY & CHLOROPHYLL

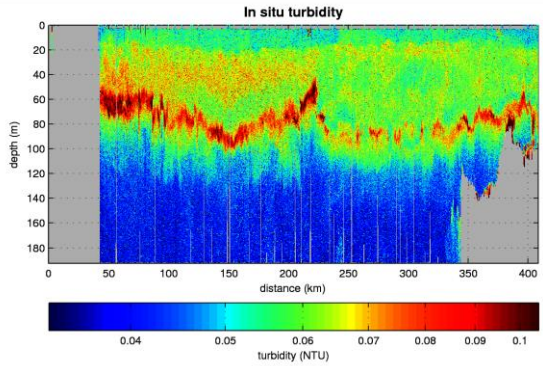

Figure 9 - Blank turbidity measurements due to the mistake of having deployed the glider with a sun-protective tape used during storage

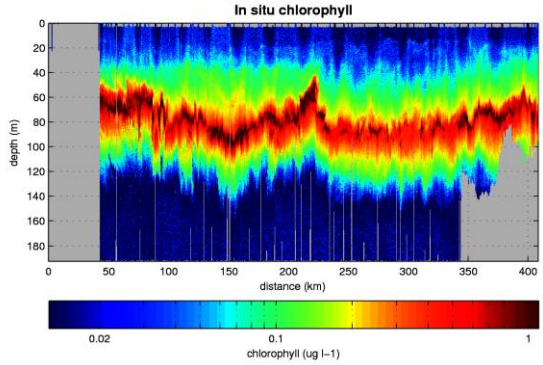

Figure 10 - Blank chlorophyll measurements (same reason as Turbidity)

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