CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

SOCIB Balearic Islands Coastal Observing and Forecasting System

GLIDER MISSION DEFINITION

Reference: *GF-MD-0013*

Platform:	*GLIDER SEAGLIDER*
Platform ID:	*sdeep03 (Unit541)*
Mission:	*JERICO TNA SARDINIA JAN13*
Date:	*January, the 23st, 2013*

Issue:	Glider Pre-mission Report
Description:	This document summarizes the mission definition, preparation, and logistics for the scientific mission *JERICO TNA SARDINIA JAN13* responding to JERICO TNA Call_1_8, and SOCIB glider facility monitoring operations.
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Involved Personnel:	Simó Cusí, Marc Torner, David Roque, Miguel Martínez, Benjamín Casas, Carlos Castilla, Irene Lizarán, Guillermo Vizoso, Joan Pau Beltran, Sebastián Lora, David March, Emma Heslop, Simón Ruiz, Ananda Pascual, Jose Luís Lopez Jurado, Rosa Balbín Chamorro, Joaquin Tintoré, Alberto Ribotti

DOCUMENT

VERIFICATION AND DISTRIBUTION LIST

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Distribution	Benjamín Casas, Joan Pau Beltran, Joaquín Tintoré		
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Approved and Accepted by	***J.P. Beltran***	***DC***	
Approved and Accepted by	***J. Tintoré***	***OD***	

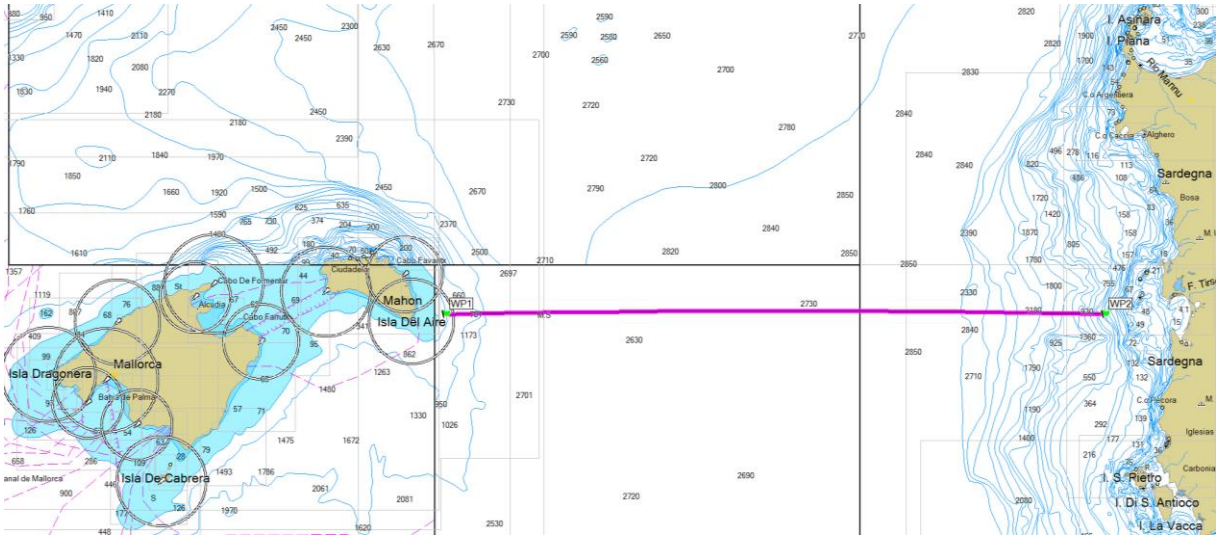
I MISSION DEFINITION

Mission Area: Western Mediterranean Sea - Menorca to Sardinia
Mission Objective: JERICO TNA Agreement CSIC-CNR
Deployment date: 31 January 2013
Recovery date: 17 March 2013 -tentative-
Mission Duration: 45 days
Glider: sdeep03 (Unit 541)
Glider backup: None
Route Distance: 333nm (617km)
Profiles: 392 approx.

Mission Waypoints

Latitude	Longitude	Name
39º 49.457' N	4º 28.855' E	***WP1***
39º 49.457' N	8º 05.486' E	***WP2***
39º 49.457' N	4º 28.855' E	***WP1***

Minimum Distance to Shore: 8.4nm (at WP1)



Mission route

II ENVIRONMENTAL PROPERTIES

Expected water properties

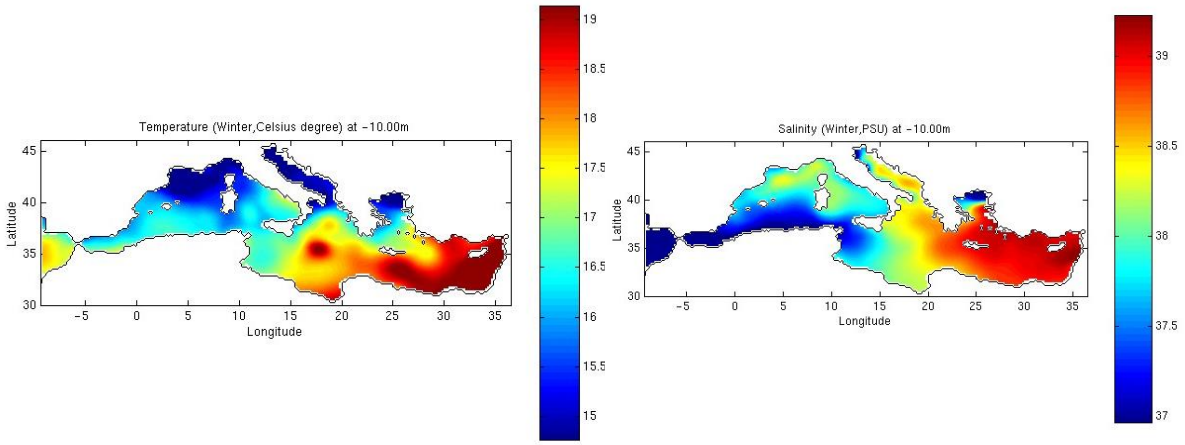
Source	Surface Temperature	Surface Salinity	Surface Density	Bottom Temperature	Bottom Salinity	Bottom Density	Average Density
CNR	15,1 ºC	37,5 PSU	1027,9 kg/m^3	13,1 ºC	38,5 PSU	1029,1 kg/m^3	**1028,5 kg/m^3**
MEDAR	15,0 ºC	37,2 PSU	1027,7 kg/m^3	13,0 ºC	38,5 PSU	1029,1 kg/m^3	**1028,4 kg/m^3**
APEX	14,0 ºC	38,3 PSU	1028,7 kg/m^3	13,0 ºC	38,5 PSU	1029,1 kg/m^3	**1028,9 kg/m^3**

CNR 17-Jan-2012 transect

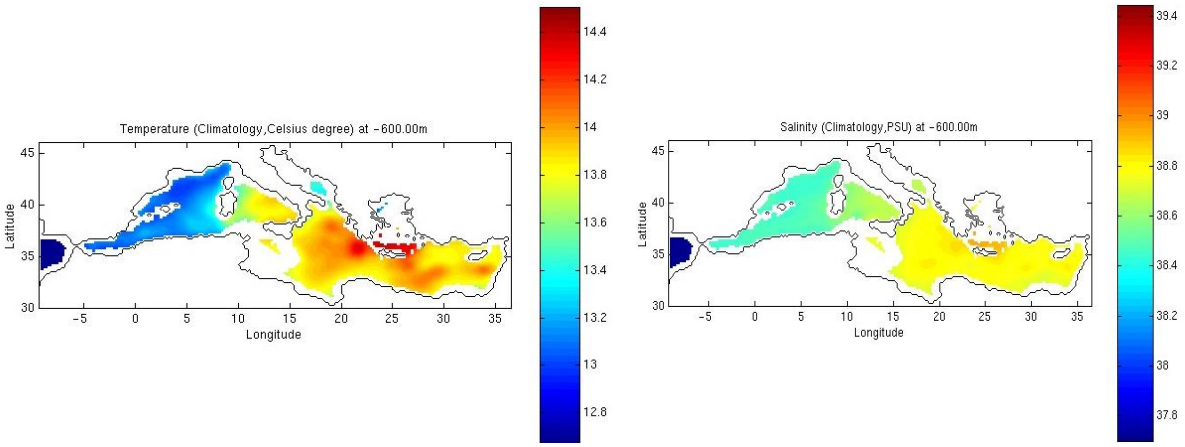
0 m T/Theta: from 14.5 to 15.1 °C
Salinity: from 37.48 to 38.07 psu

1000 m T: from 13.09 to 13.28 °C
Theta: from 12.94 to 13.13 °C
Salinity: from 38.49 to 38.53 psu

Medar Winter Season

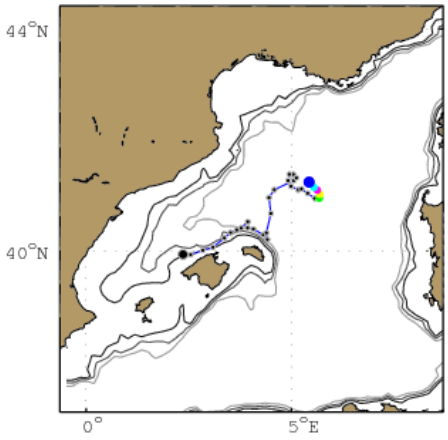


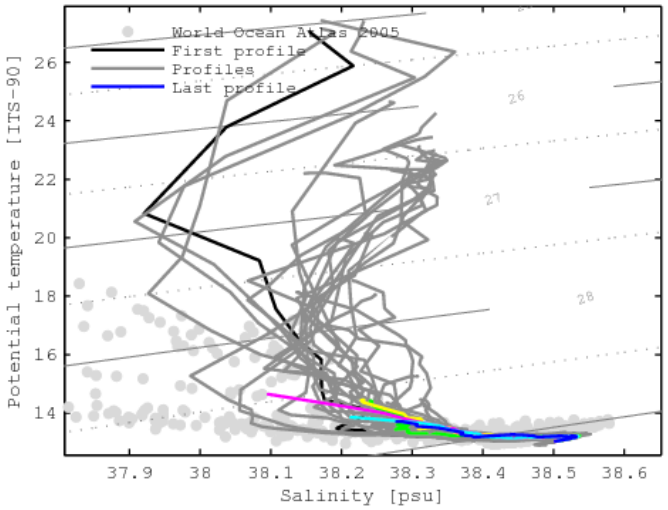
Seasonal (Winter) Temperature and Salinity MEDAR Climatology at ~10m depth

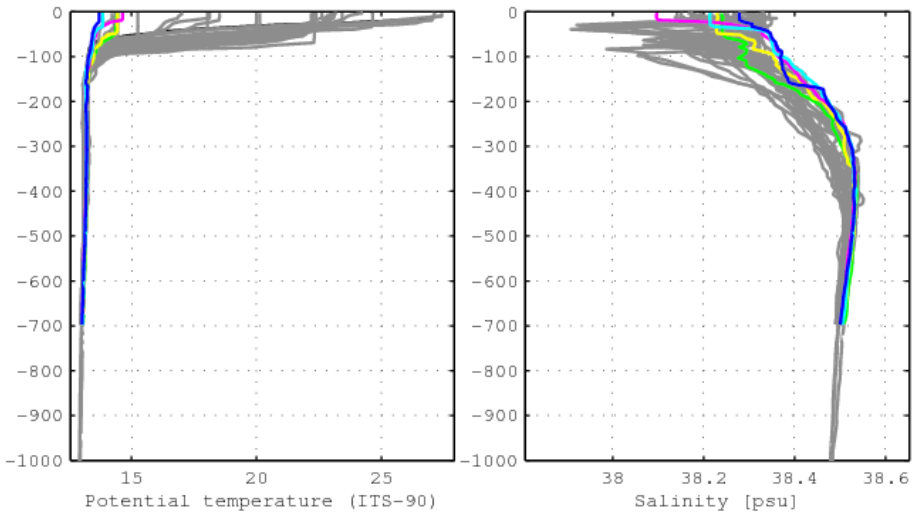


Temperature and Salinity MEDAR Climatology at ~600m depth

SOCIB APEX at N 41.26 E 5.43 in January 2013







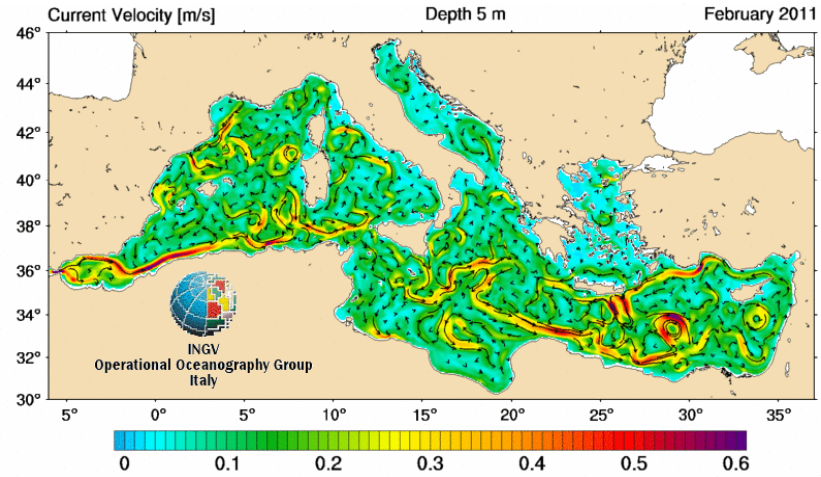
Glider Ballasting

- Glider Average Density: 1029,35 Kg/m3
- Glider Density Range: [1024,35 1034,35] Kg/m3

Note:

Seaglider densities must be computed with in-situ temperature and salinity at surface (0 dbar) because of its isopicnal hull (σ_t calculus).

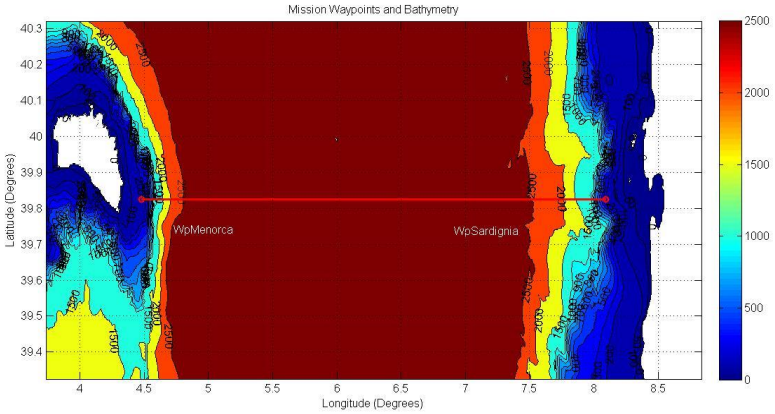
Currents



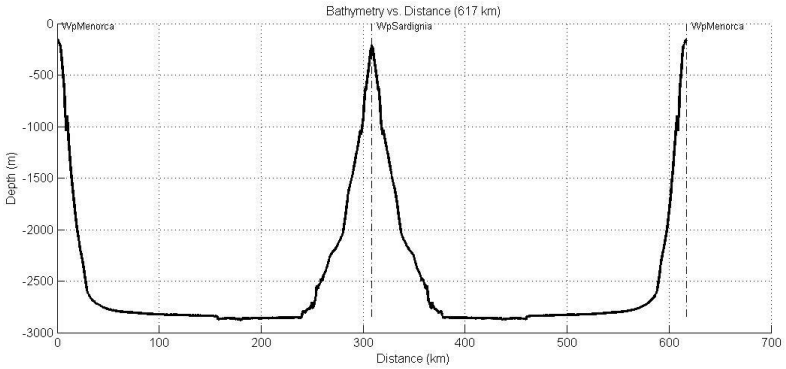
Currents February 2011 from http://gnoo.bo.ingv.it/mfs/analysis_archive.htm

Mission Depth

- Depths: min 150.0 [m], max 2874.4 [m]



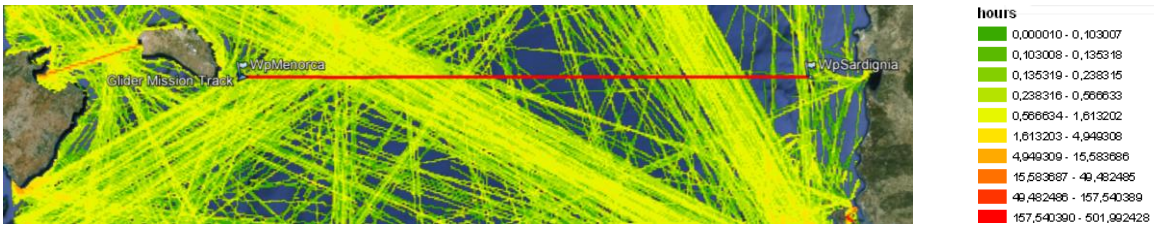
Mission bathymetry map



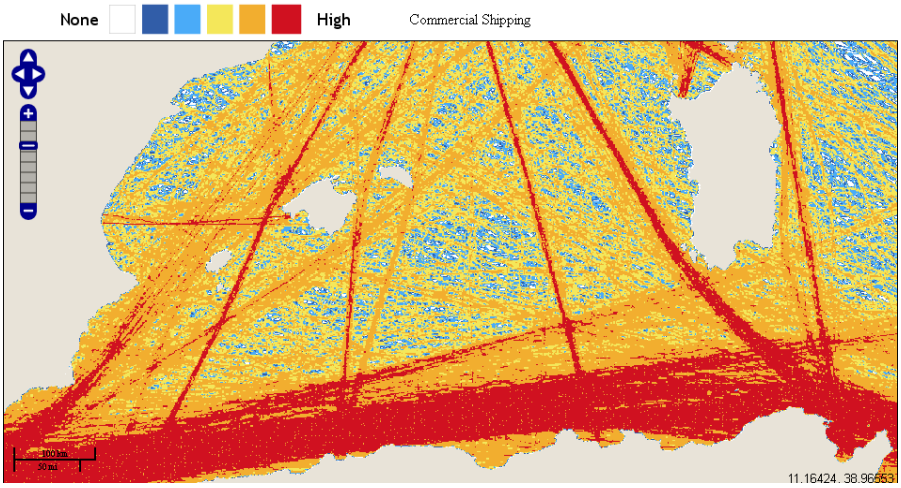
Distance vs Depth plot

III MARITIME ROUTES AND NAVIGATION SAFETY

Maritime Routes



Marine traffic density (number of hours occupied by ships in every cell of 1km x 1km) between Mallorca and Sardinia (one month of AIS data, August 2012)



Commercial shipping routes (available at: http://globalmarine.nceas.ucsb.edu/)

Navigation Safety

Warnings of glider mission:

- Spanish Navy (NATO Member)
- SASEMAR (Spanish Search and Rescue)
- Oristano Coast Guard

Glider insurance

- Company
  - Willis, S&C
- Coverage
  - Glider loss
  - Emergency recovery costs
  - Third party damage

IV INSTRUMENTAL SETTINGS

Navigation Behaviour

Surfacing events

-Every inflection
-Mission aborted

Movement

-Distance to seabed: 30.0 m
-Maximum depth: 975.0 m (see Note 1)
-Angle of inclination: 20º (see Note 2)
-Approx. vertical speed: 0.1 m/s (see Note 2)
-Approx. horizontal speed: 0.17 m/s (see Note 2)

Scientific Data Sampling and Transmission

Sensors Sampling (see Note 3)

CTD (conductivity, temperature and pressure)
-Sampling state: diving and climbing
-Sampling frequency: 1/4 Hz (approx. 1 sample/0.4m)
-Sampling depths: [0, 1000]m

Oxygen
-Sampling state: diving and climbing
-Sampling frequency: 1/4 Hz (approx. 1 sample/0.4m)
-Sampling depths: [0, 300]m (see Note 4)
-Sampling frequency: 1/8 Hz (approx. 1 sample/0.8m)
-Sampling depths: [300, 1000]m (see Note 5)

FLNTU (fluorescence and turbidity sensor)
-Sampling state: diving and climbing
-Sampling frequency: 1/8 Hz (approx. 1 sample/0.8m)
-Sampling depths: [0, 300]m (see Note 5)

Sensors Transmission (Real-Time mode)

Data measured will be transmitted through Iridium to verify sensors, sampling and navigation behaviour of the glider. Real time data transmission will be done at least every day (approximately 1 dive transmitted every 4 dives performed) to minimize costs and surface time. All data will be downloaded by cable once mission finishes (delay mode).

Notes

1. During deployment the navigation depth will be increased in consecutive changes (increases of 200m approx.) to ensure correct glider behaviour and navigation minimizing the probability of damage of the glider in case of error.

2. The piston buoyancy and pitch angle will be changed during mission to optimize glider flight, reduce consumption and to adapt the glider velocity to the currents of the mission zone. Those changes will vary the vertical and horizontal velocities.

3. To verify correct sensor measurement and behaviour all sensors will be measured up to 1000m (at least during one dive). The configuration of the sensors sampling will be changed during mission to verify glider and sensors integrity and behaviour.

4. The Oxygen sensor will be measured at a frequency of 1/4Hz up to 300m and at 1/8Hz from 300m to 1000m to reduce power consumption. FLNTU (Wetlabs) sensor will be measuring up to 300m to minimize the power consumption.

5. The Oxygen and FLNTU sensor sampling frequency and depth might have to be changed during mission to reduce power consumption depending on battery capacity.

V LOGISTICS

Deployment: 31 January 2013
Recovery: 17 March 2013 –tentative-
Mission Duration: 45 days
Glider: sdeep03 (Unit 541)
Glider backup: None

Tasks and Calendar

Mission preparation

Task	Personnel	Date
Glider ballasting verification	Simó Cusi, Joaquin Tintoré	20-25 January
Glider verification	Simó Cusi, Miguel Martinez	23-30 January
Navigational Warning	David Roque, Guillermo Vizoso	29 January
Deployment material load	Simó Cusi, David Roque, Benjamin Casas, Miguel Martínez	29 January

Deployment (Menorca)

Task	Personnel	Date
Glider deployment	Carlos Castilla, David Roque, Benjamin Casas, Guillermo Vizoso, Miguel Martínez	31 January
Glider remote control	Simó Cusí, Simón Ruiz, Ananda Pascual	31 January
Vessel	IEO Vessel	31 January
Vessel pilot	David Roque, Benjamín Casas	31 January
Vehicle	SOCIB Mercedes Sprinter	30 January

Mission tracking

Task	Personnel	Date
Glider following, control and mission updates responsible	Simó Cusi, Miguel Martínez, Benjamín Casas, Guillermo Vizoso, Joaquin Tintore	31 January - 17 March
Glider pilot backup	Marc Torner, Simón Ruiz, Ananda Pascual	31 January – 17 March

Data Management

Task	Personnel	Date
Real Time Data retrieval	Simó Cusi, Guillermo Vizoso, Miguel Martínez	31 January – 17 March
Real Time Data verification	Marc Torner, Emma Heslop, Simon Ruiz, Ananda Pascual, Joaquin Tintoré	31 January – 17 March
Delay Mode Data retrieval	Simó Cusi, Benjamín Casas, Guillermo Vizoso, Miguel Martínez	18-22 March
Delay Mode Data verification and export	Marc Torner, Emma Heslop, Simon Ruiz, Ananda Pascual, Joaquin Tintoré	18-22 March

Recovery (Menorca)

Task	Personnel	Date
Glider recovery	Marc Torner, David Roque, Benjamin Casas, Guillermo Vizoso, Miguel Martínez	17 March
Glider remote control	Simó Cusí, Simón Ruiz, Ananda Pascual	17 March
Vessel	TMOOS Valiant	17 March
Vessel pilot	David Roque, Benjamín Casas	17 March

Vehicle	SOCIB Mercedes Sprinter	17 March
Calibration CTD Cast - SBE 25	David Roque, Guillermo Vizoso	17 March

Emergency plan

Task	**Personnel**	**Date**
Emergency Decision	Miguel Martínez, Benjamin Casas, Joaquin Tintoré, Guillermo Vizoso	31 January – 17 March
Emergency recovery glider pilot	Marc Torner, David Roque, Benjamín Casas, Miguel Martínez	31 January – 17 March
Emergency recovery glider remote control	Simó Cusí, Simón Ruiz	31 January – 17 March
Emergency Vessel and Vehicle	-Depending on availability-	31 January – 17 March

Notes

1) Deployment:

The deployment will be carried out by Benjamín Casas, Miguel Martínez, Guillermo Vizoso, David Roque and Carlos Castilla at East Menorca to reduce the consumption of the glider and minimize the scientific mission start-up time. This deployment will be done using the vessel IEO on date 31 January. The glider (541) is already in the Menorca facility. The material to carry from IMEDEA is: argos tag, communication cable, magnets, tool box, Benthos pinger, spare wings, rudder, weights, foams and laptop.

2) Recovery:

The recovery will be done at Menorca (WP1) approximately on the 17th of March. The vessel TMOOS Valiant must be available for recovery during these dates and also SOCIB's Mercedes Sprinter.
Vehicles and vessels needed for an emergency recovery will be available. A CTD cast will be done during recovery for calibration and verification purposes.

VI DATA MANAGEMENT

Communications

Basestation Primary:	67.207.130.126
Basestation Secondary:	67.207.130.126
Primary Iridium Phone:	881600005201 (Rudics)
Secondary Iridium Phone:	881600005201 (Rudics)

The data from this mission will be available in Real Time and Delay Mode.

Real Time

The data will be received at the iRobot Basestation through Iridium satellite communications every glider surface. The log and binary data obtained will be then transferred to SOCIB Data Center for mission tracking. Pre-processing of log files will be carried out creating NetCDF files and images that will be available for public download at SOCIB thredds data discovery portal. The scientific sensors data will be processed by glider technicians that will represent the scientific variables and generate images for verification.

All files from basestation will be synchronized according to the following properties:

-Origin: ftp://67.207.130.126/../sg541
-Target:
/home/glider_public/deployments/sg541/20130131/basestation_01
-Download frequency: every 60 minutes.

The data will be accessible for the general public at the following location with read only access:

-Host: ftp://ftp.socib.es
-User: glider_public
-Password: **** (hidden)

The data files will be transmitted in the future to EGO server, Coriolis, and MyOcean2 portal (when available). Attention will be given for all theses data to be available to the GTS (Global Telecomunication System, WMO).

Delay Mode

Once the mission is finished, the data will be downloaded to the SOCIB Data Center where pre-processing and Quality Control and Validation will be carried out and NetCDF files and images will be created.

The data files will be finally included in JERICO portal.

VII GLIDER SETUP

Batteries

Battery endurance is calculated with the Excel Spreadsheet provided by iRobot (SG Endurance).

Glider navigation and behaviour parameters are set as follows:

	Inputs			Units	Description
Dive Profile	vertical velocity	=	0,1	m/sec	Desired vertical velocity during ascent and descent. This and $MAX_BUOY determine $T_MISSION for respective $D_TGT
	$MAX_BUOY	=	200	CCs	Multiply MAX_BUOY*2 for total number of CCs pumped at Apogee due to error in calculations used later
	$SM_CC	=	400	CCs	Surface Maneuver minimum buoyancy
	$N_NOSURFACE	=	0	int	0 to disable; must be > 1 (-1 and 1 illegal values)
	Roll retries	=		float	Average number of retries per roll event.
	Pitch retries	=		float	Average number of retries per pitch event.
Pump Config	$T_BOOST	=	5	sec	Time (seconds) to run boost pump. (must be 0 if SBE)
	$D_BOOST	=	120	m	The depth (meters) above which only the boost pump will run.
	VBD retries apogee	=		float	Average number of retries per pump event.
	VBD retries surface	=		float	Average number of retries per pump event.
	EBE or SBE	=	1		0=SBE 1=EBE
Navigation Config	$NAV_MODE	=	2	int	select navigation method (values 0 - 3)
	$KALMAN_USE	=	2	int	Kalman filter use 0 - 2 (2 to disable)
Comms	$CALL_NDIVES	=	1	int	The number of profiles (dive/climb cycles) to perform before attempting communications. (range 1 - 10)
	$CAPUPLOAD	=	0	int	upload capfile for current dive (0 = no, 1 = yes)
Battery Config	24V Starting Capacity	=	133	Amp/hrs	Standard (new battery) = 145
	10V Starting Capacity	=	87	Amp/hrs	Standard (new battery) = 95

Glider science parameters are set as follows:

Science File (all cells need to be defined)			
Depth	Sample Interval	Sample Multiplier	GC Interval
50	5	1 2 1 0 0 0	60
100	5	1 2 1 0 0 0	60
150	5	1 2 1 0 0 0	60
300	5	1 2 1 0 0 0	60
500	5	1 0 2 0 0 0	300
1000	5	1 0 2 0 0 0	300

The resulting consumption estimated for both batteries is:

Depth in meters	50	100	150	300	500	1000	
24V Amp-hr /dive	0,036717	0,048664	0,072644	0,088447	0,109457	0,161981	
10V Amp-hr/dive	0,025062	0,045587	0,067424	0,130997	0,185789	0,244455	
Mission Dives	12	4	8	16	12	144	**TOTAL Ahr**
Consumption 24V	0,440602	0,194655	0,581149	1,41515	1,31348	23,32527	**27,270309**
Consumption 10V	0,300743	0,182346	0,539389	2,095957	2,229462	35,20158	**40,549476**

The current and post-mission expected battery state are:

	24V Energy	**10V Energy**	**24V Voltage**	**10V Voltage**
Current	133,4 Ahr (92%)	87,1 Ahr (92%)	24,8 V	10,8 V
Post-mission	106,1 Ahr (73%)	46,6 Ahr (49%)	-	-

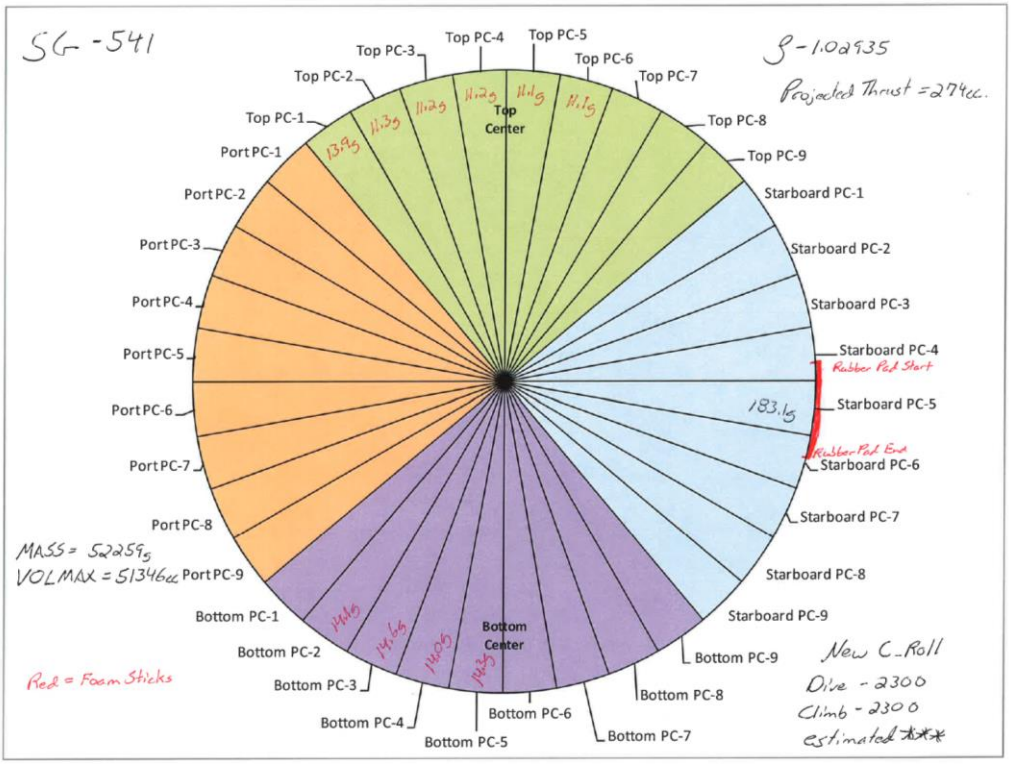
Previous missions (GF-MR-0005, GF-MR-0006, GF-MR-0012) performed with sdeep02 (sg538) showed that this sensor configuration was consuming the 10V battery pack at the same rate as the 24V battery pack so that the 40,5 Ahr hour estimation seems too conservative. For the mentioned missions the glider was just estimating the consumption as it is not equipped with a coulomb counter. Therefore, there is a conflict between the glider estimations and those of the endurance model spreadsheet provided by iRobot (19% vs 43%). The current battery capacity allows for both estimations so that the mission can be safely performed.

The mission allows flexibility in sampling frequencies and depths for both WetLabs and Aanderaa sensors (the most consuming ones). This gives a margin to correct excessive 10V battery consumption during the mission.

Ballasting

The expected average density for the waters the glider will dive in is 1028,55 kg/m^3 and current glider's density is 1029,35 kg/m^3. Therefore, there is no need to reballast the glider. The minimum expected surface density is 1027,7 kg/m3 so that glider will have no problems to surface and communicate.

In the next figure it can be seen the pinwheel diagram done by iRobot showing where the weights and foams are placed on the pupa. Also it shows the glider's total mass (52259 g) and the glider's maximum volume, with oil bladder inflated (51,346 l), that gives a minimum density for the glider equal to 1017,78 kg/m^3. The final glider density range having into account its 10σ capability is from 1024,35 kg/m^3 to 1033,3 kg/m^3. All glider weights and their distribution are shown in sdeep03's trimsheet.



Pinwheel diagram of ballasting for determining the weights and foams and their location

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