

**APPLICATION FOR CONSENT TO CONDUCT MARINE SCIENTIFIC RESEARCH
IN AREAS UNDER NATIONAL JURISDICTION OF
ICELAND**

Date: 05/03/2024

1 - GENERAL INFORMATION

1. Cruise name and/or number:

1.2. Sponsoring institutions:

Funding agency: Ministerio de Ciencia e Innovación de España

Funding programme: Programas Estatales de Generación de Conocimiento y Fortalecimiento Científico y Tecnológico del Sistema de I+D+i y de I+D+i Orientada a los Retos de la Sociedad

Name and reference of the project: Far-reaching impacts of dense water overflows in the North Atlantic Ocean and the Mediterranean Sea (FAR-DWO)

Reference: PID2020-114322RB-I00

Country: Spain

1.3. Scientist in charge of the projects and legs:

Dr. Anna Sanchez-Vidal

Dr. David Amblas

1.4. Scientist from Iceland involved in the planning of the project:

Three scientists from the University of Iceland will be involved in the cruise:

1. Dr. Angel Ruiz Angulo (University of Iceland, Iceland)
2. Postdoc (University of Iceland, Iceland)
3. Student (University of Iceland, Iceland)

Also, the following two scientists from HAFRO have been involved in the design of the research plan:

1. Dr. Sólveig Rósa Ólafsdóttir
2. Dr. Andreas Macrander

1.5. Submitting officer:

Name: Dr. David Amblas

Address: Facultat de Ciències de la Terra, Universitat de Barcelona
C. Martí i Franquès, sn, 08028 Barcelona (Spain)

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2 - DESCRIPTION OF THE PROJECT

2.1. Nature and objectives of the project:

The cruise FARDWO-DS2 primary aim is the retrieval of two moorings deployed during the previous expedition, FARDWO-DS1, conducted aboard the Spanish RV Sarmiento de Gamboa in the summer of 2023. Additionally, the expedition seeks to deepen our understanding of the DSO through a series of CTD casts, enabling a comprehensive examination of its structure and biogeochemical characteristics throughout the duration of the cruise. During the navigation we will acquire simultaneously multibeam bathymetry data and very shallow seismic data to study the physical imprint of DSO on the seafloor and sedimentary record. We will also foresee maintenance operations of a third mooring from the University of Hamburg (Germany) placed at Denmark Strait sill.

Both cruises FARDWO-DS1 and -DS2 are part of the project FAR-DWO, which is investigating the the physical processes involved in the propagation of the DSO, its capacity to erode, transport and deposit sediment and, through the use of high-frequency proxy reconstructions in sediment cores, to unveil its variability through time.

DS1's preliminary findings have unveiled a predominantly clear overflow, with sporadic episodes of high turbidity near the seabed. These observations suggest the active transport of fine sediment and the existence of a turbid plume within the DSO waters. FAR-DWO's primary focus lies in examining the sediment dynamics within the water column and revealing broader trends in seabed erosion and deposition, to bring our comprehension of DSO, a principal driver of the Atlantic Meridional Overturning Circulation, a step further.

2.2. Relevant previous or future research cruises:

Previous. FARDWO-DS1 research cruise. Reykjavik 19/07/2023 – 12/08/2023. RV Sarmiento de Gamboa. Co-PIs: Dr. David Amblas, Dr. Anna Sanchez-Vidal (University of Barcelona, Spain).

Upcoming: FARDWO-DS2 research cruise. Reykjavik 17/09/2024 – 25/09/2024. RV Sarmiento de Gamboa. Co-PIs: Dr. Anna Sanchez-Vidal and Dr. David Amblas (University of Barcelona, Spain).

2.3. Previously published research data relating to the project:

The following are the SCI papers published in the framework of the FAR-DWO project (started in September 2021):

Amblas, D., Sanchez-Vidal, A. and FARDWO-DS1 shipboard party (2023). Oceanographic Cruise FARDWO-DS1 Report. Universitat de Barcelona. 78 pp. <https://doi.org/10.5281/zenodo.10581882>.

Estournel, C.; Mikolajczak, G.; Ulses, C.; Bourrin, F.; Canals, M.; Charmasson, S.; Doxaran, D.; Duhaut, T.; Durrieu de Madron, X.; Marsaleix, P.; Palanques, A.; Puig, P.; Radakovitch, O.; Sanchez-Vidal, A.; Verney, R. (2023). Sediment dynamics in the Gulf of Lion (NW Mediterranean Sea) during two autumn–winter periods with contrasting meteorological conditions. *Progress in Oceanography*, Volume 210, 2023, 102942. <https://doi.org/10.1016/j.pocan.2022.102942>

Martí, A.; Portell, J.; Amblas, D.; de Cabrera, F.; Vilà, M.; Riba, J.; Mitchell, G. (2022). Compression of Multibeam Echosounders Bathymetry and Water Column Data. *Remote Sens.* 14, 2063. <https://doi.org/10.3390/rs14092063>

PhD Theses (running):

Luisa Freitas, thesis from University of Barcelona (supervisors: A. Sanchez-Vidal, D. Amblas), started in January 2023. Physical imprints of dense water overflows in the Northern Atlantic Ocean and the North-western Mediterranean Sea.

Irene Llamas, thesis from University of Barcelona (supervisors: A. Sanchez-Vidal), started in November 2022. Impact of dense water formation in biogeochemistry and diatom floristics in the Northern Atlantic Ocean and the North-western Mediterranean Sea.

Mara Navarro Buigues, thesis from University of Las Palmas de Gran Canaria (supervisors: Dolores Hernández-Perez, Anna Sanchez Vidal), started in 2023. Deep Water of the Denmark Strait; physical characteristics and interaction with geomorphology. Universidad de las Palmas de Gran Canaria, 2023-2027.

Helena Fos Serdà, thesis from University of Barcelona (supervisors: David Amblas, Anna Sanchez-Vidal), started in March 2024. Atmospheric and oceanographic conditioning factors involved in the formation of dense waters in the Mediterranean and the North Atlantic, 2024-2027.

3 - METHODS AND MEANS TO BE USED

3.1. Particular of vessel:

MAIN RESEARCH VESSEL

Name: SARMIENTO DE GAMBOA
Nationality: Spanish
Owner: CSIC
Operator: CSIC, UTM
Type of vessel: **Oceanographic Research Vessel**
Year built and country: **2007 by CNP Freire, Spain**
Length / width **70,5 m**
Length p.p.: **62,0 m**
Design Draught: **4,60 m**
Scantling Draught: **4,90 m**
Depth to main deck: **5,00 m**
Tonnage: Gross = **2630 GT**
Dead weight: **850 tpm**
Maximum Speed: **14,5 knots**
Prop. Power: **2400 kW**
Fuel: **528 m3**
Endurance: **40 days**
Accommodation (crew + research) **16+26**

Classification society: **Bureau Veritas, +HULL Special Service Oceanographic and Fishing Research/Unrestricted Navigation/+MACH+AUT-UMS, AUT-CCS, ALM SDS COMF-1, SYS-NEQ 1 DYNAPOS AM/AT**

Register port: **Vigo**

Call code: **E A K F**

Phone:

INMARSAT: +870.761.143.975 / INMARSAT: +870.761.143.979

VSAT: +34.911.930.357 (Captain)

VSAT: +34.911.930.359 (Bridge)

Cellular: +34.679.510.317

Email: capitan.sdg@utm.csic.es

Name of master :

Miguel Angel Menéndez

David Arenas

Number of crew: 16

Number of scientists on board: 26

3.2. Aircraft or other craft to be used in the project: None

3.3. Particulars of methods and scientific instruments:

<i>Provide a list of the main scientific equipment that is going to be used, saying the waters where it will be used / installed</i>	<i>Fisheries research within the established fishing limits</i>	<i>Research related to the continental shelf beyond the limits of the coastal state</i>	Distance to shore		
			<i>Within 12 nautical miles</i>	<i>Within 12 and 50 nautical miles</i>	<i>Within 50 and 200 nautical miles</i>
CTD rosette equipped with: - 24 sampling bottles (12 liters) - SeaBird SBE911 (Conductivity Depth Temperature Oxygen), - 2 LADCP (Acoustic Doppler Current Profiler) - Turbidimeter				x	x

Geophysical equipment for the watercolumn, seafloor and sub-seafloor characterization: - Multibeam echosounder Atlas Hydrosweep DS-3 - Sound velocity profiler Applied Microsystems SV Plus V2 - Doppler Teledyne RD Instruments ADCP Ocean Surveyor 75 y 150 kHz (hull mounted) - Parametric echosounder Parasound P-35				x	x
Instrumented mooring lines: - ADCP Teledyne RD Instruments 300 kHz (2) - Sediment trap Technicap PPS3 (3) - Current meter Nortek Aquadopp (3) - Buoys Nautilus (20) - Seabird SBE37 (3)					x

3.4. Indicate whether harmful substances will be used:

No

3.5. Indicate whether drilling will be carried out:

No

3.6. Indicate whether explosives will be used:

No

4 - INSTALLATIONS AND EQUIPMENTS

Equipment to be used from the vessel:

- CTD rosette equipped with 24 sampling bottles (12 liters, a SeaBird SBE911 (Conductivity Depth Temperature Oxygen), a LADCP (Acoustic Doppler Current Profiler), and a Turbidimeter. This equipment will be used to monitor the physic-chemical characteristics of water masses with depth (red dots in the chart in section 5.2).

- Geophysical equipment hull mounted on the vessel including a multibeam echosounder Atlas Hydrosweep DS-3, a Doppler Teledyne RD Instruments ADCP Ocean Surveyor (75 and 150 kHz), and a parametric echosounder Parasound P-35 will be used to characterize water column and seafloor and sub-seafloor:

Equipment to be recovered, after 13 months of deep-sea monitoring:

2 mooring lines will be recovered at m water depth in the slope off Greenland (see chart in section 5.2).

FD-DS-A: 1370 m water depth (65°14.637'N, 31°19.060'W)

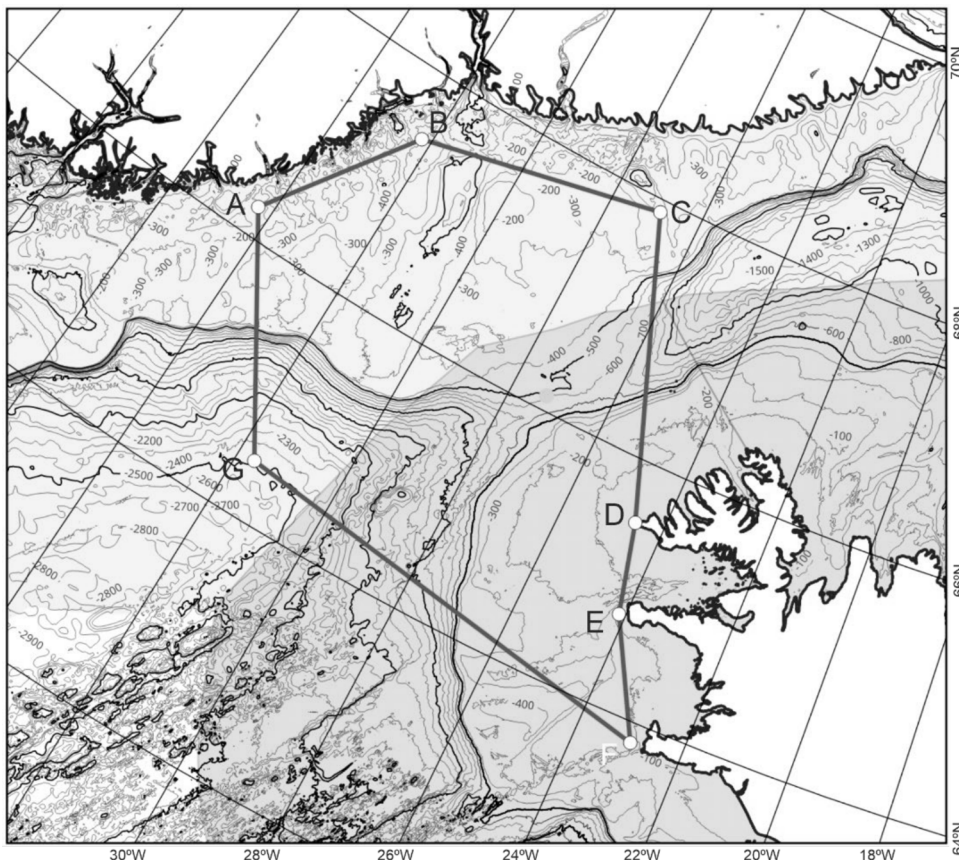
FD-DS-B: 1870 m water depth (65°01.610'N, 31°22.209'W)

The moorings include ADCP, currentmeters and sediment traps to monitor water column physico-chemical and sediment transport characteristics.

We will also anticipate maintenance tasks for a third mooring stationed at the Denmark Strait sill, which is operated by the University of Hamburg (Germany).

5 - GEOGRAPHICAL AREAS

5.1. Indicate geographical areas in which the project is to be conducted (with reference in latitude and longitude):



Latitude and longitude (in Degrees, Minutes, Seconds) of the bounding box corners:

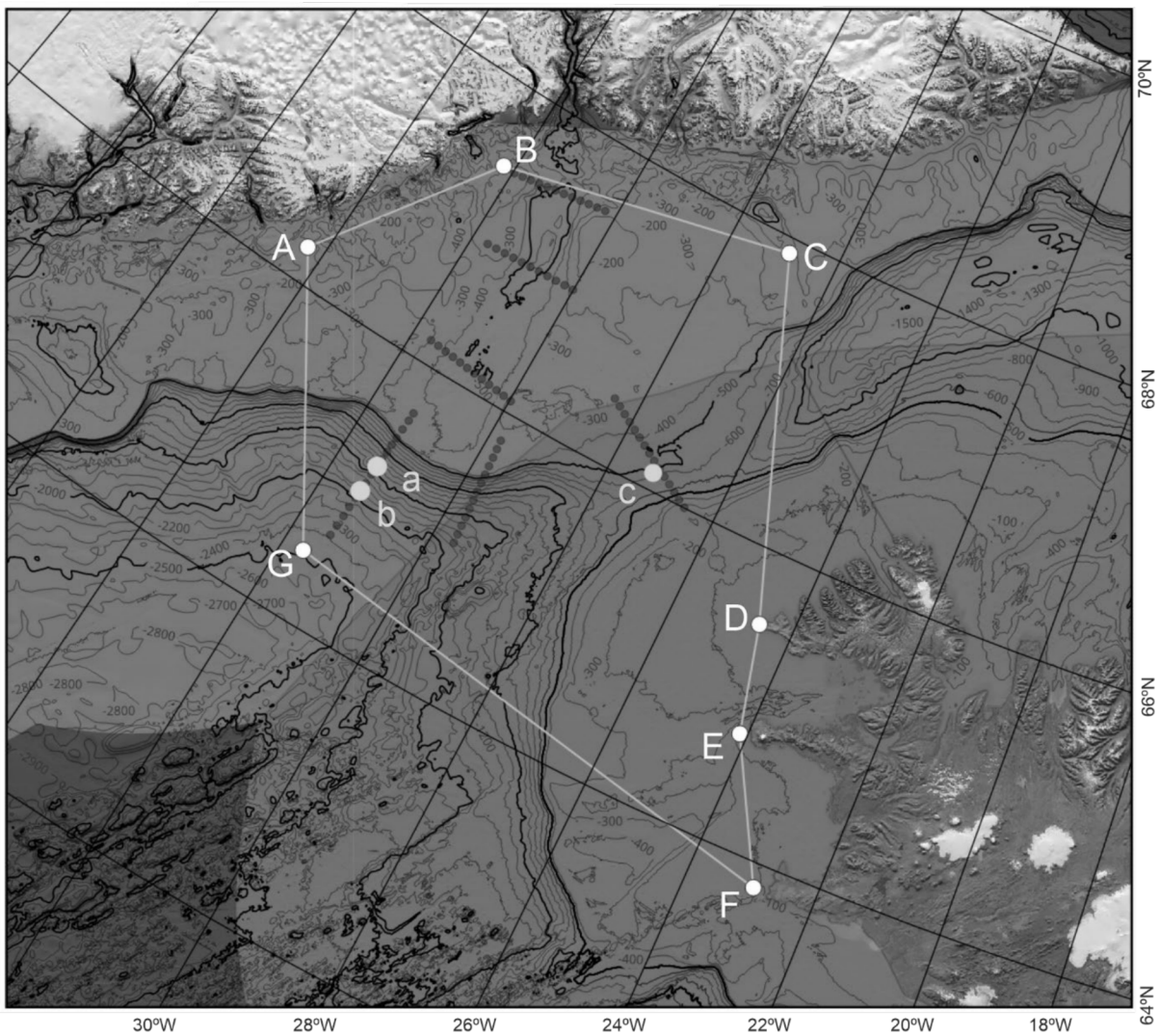
(A) 66°14'23"N, 34°18'03"W;

(B) 67°26'54"N, 32°12'30"W;

(C) 67°53'52"N, 26°54'07"W;

- (D) 65°30'14"N, 24°34'09"W;
 (E) 64°45'56"N, 24°07'28"W;
 (F) 63°50'18"N, 22°57'43"W; and
 (G) 64°28'37"N, 31°39'14"W

5.2. Attach chart(s) at an appropriate scale showing the geographical areas of the intended work and, as far as practicable, the positions of intended stations, the tracks of survey lines, and the locations of specific equipments or facilities:



The red dots indicate CTD stations, and the yellow dots mark the positions of the three moorings set for maintenance during the cruise. Moorings labeled 'a' and 'b' will be recovered and removed from the sea, while mooring 'c' will undergo only maintenance procedures.

6 - DATES

6.1 Expected dates of first entry into and final departure from the research area of the research vessel:

- | | |
|-------------------------------|-------------------|
| 1. Entry in Iceland EEZ | date : 17/09/2024 |
| 2. Departure from Iceland EEZ | date : 25/09/2024 |

6.2 Indicate if multiple entry is expected:

We will enter and leave Iceland's EEZ waters multiple times during the research cruise, as the study area is situated between Danish and Icelandic waters, in the Denmark Strait.

7 - PORTS CALLS

7.1. Dates and names of intended ports of call in Reykjavik:

17/09/2024 Reykjavík – 25/09/2024 Reykjavík

7.2. Any special logistical requirements at ports of call :

None

7.3. Name/Address/Telephone of shipping agent (if available):

Not designated yet

8 - PARTICIPATION

8.1. Proposed dates and ports for embarkation/disembarkation:

Start: Reykjavik (Iceland) date: 17/09/2024

End: Reykjavik (Iceland) date: 25/09/2024

9 - ACCESS TO DATA, SAMPLES AND RESEARCH RESULTS

9.1. Expected dates of submission of preliminary reports which should include the expected dates of submission of the final results:

A preliminary cruise report will be sent to Iceland authorities within one month after the end of the cruise. The final cruise report will be sent within six months after the end of the cruise.

9.2. Proposed means for access by the Icelandic scientific and public entities, to data and samples:

The final processed data will be made available through the means mentioned in section 9.3. Preliminary data will be distributed to Iceland scientists and authorities on request.

9.3. Proposed means of making research internationally available:

All FAR-DWO data will be findable, accessible, interoperable and reusable (FAIR), following the principles of the EC-programmes H2020 and Horizon Europe to ensure it is soundly managed. The cruise report, and the processed and metadata will be uploaded in international open-access data repositories (e.g. Zenodo). The seawater and suspended particulate data generated during this project will be submitted to the BCO-DMO (<http://bco-dmo.org/data/>), which serves as a data management office for different oceanographic programs. The high-resolution bathymetric data obtained in DS will be uploaded to the Arctic and North Pacific Ocean Regional Center of the SEABED2030 project for the updating of the IBCAO map.

Oral or Poster presentations in international conferences and symposia (e.g. Ocean Sciences, AGU Fall Meeting, EGU General Assembly, Goldschmidt ...).

The scientific results of FARDWO-DS2 will be published in specialized, high impact, peer-review scientific journals and specialised books.

ANNEX

List of the scientific team

1. Anna Sanchez-Vidal (University of Barcelona, Spain)
2. David Amblas (University of Barcelona, Spain)
3. Marc Cerdà-Domènech (University of Barcelona, Spain)
4. Galderic Lastras (University of Barcelona, Spain)
5. Antoni Calafat (University of Barcelona, Spain)
6. Luisa Freitas (University of Barcelona, Spain)
7. Helena Fos (University of Barcelona, Spain)
8. Ricardo Silva-Jacinto (IFREMER, France)
9. Anthony Ferrant (IFREMER, France)
10. María Dolores Pérez-Hernández (University Las Palmas de Gran Canaria, Spain)
11. Mara Navarro (University Las Palmas de Gran Canaria, Spain)
12. Angel Ruiz Angulo (University of Iceland, Iceland)
13. Postdoc (University of Iceland, Iceland)
14. Student (University of Iceland, Iceland)
15. Andreas Welsch (University of Hamburg, Germany)

16. Núria Casacuberta (ETH Zurich, Switzerland)
17. Scientist TBC (University of Barcelona, Spain)
18. Scientist TBC (University of Barcelona, Spain)
19. Technician (Marine Technology Unit, UTM, CSIC, Spain)
20. Technician (Marine Technology Unit, UTM, CSIC, Spain)
21. Technician (Marine Technology Unit, UTM, CSIC, Spain)
22. Technician (Marine Technology Unit, UTM, CSIC, Spain)
23. Technician (Marine Technology Unit, UTM, CSIC, Spain)