

## NOTIFICATION OF PROPOSED RESEARCH CRUISE

### PART A: GENERAL

1. NAME OF RESEARCH SHIP CRUISE NO.  
Autonomous Observations in the Nordic Seas
2. DATES OF CRUISE From 2022-06-15 To 2025-06-14
3. OPERATING AUTHORITY: University of Washington, Seattle, U.S.A.  
TELEPHONE: +1-206-543-1300  
TELEFAX: +1-206-543-6785  
TELEX: NA
4. OWNER (if different from no. 3) Office of Naval Research, U.S.A.
5. PARTICULARS OF SHIP:

Name:	Autonomous underwater gliders
Nationality:	U.S.A.
Overall length: (in metres)	1.5 m
Maximum draught: (in metres)	NA
Net tonnage:	50 kg
Propulsion e.g. diesel/steam:	Buoyancy driven
Call sign:	Seaglidern, Slocum gliders
Registration port and number (if registered fishing vessel)	NA
6. CREW

Name of master:	NA. Autonomous platform, piloted remotely
Number of crew:	0
7. SCIENTIFIC PERSONNEL

Name and address of scientist in charge:	Dr. Luc Rainville, Applied Physics Lab, Univ. of Washington lucrain@uw.edu
Tel/telex/fax no.:	+1-206-685-4058 (voice); +1-206-543-6785 (fax)
No. of scientists:	0
8. GEOGRAPHICAL AREA IN WHICH SHIP WILL OPERATE (with reference to latitude and longitude) The area of operations is north of 60°N and south of 73°N, between 28°W and 10°E, excluding territorial waters and the EEZs of the U.K. and near Greenland. Most operations will take place west of Jan Mayen (near 71°N 6°W), in the Lofoten Basin eddy (near 70°N 3°E), and along the Faroe-Iceland Ridge (63°N 10°W).
9. BRIEF DESCRIPTION OF PURPOSE OF CRUISE

Autonomous underwater gliders, profiling floats, autonomous surface vehicles (Wave Gliders), and surface drifters will measure environmental conditions in the Nordic Seas. Ocean properties (temperature, salinity, currents, etc.) and surface atmospheric conditions (wind, air temperature, etc.) will be measured to better understand the response of the ocean to strong atmospheric forcing, on timescales of days to seasons.
10. DATES AND NAMES OF INTENDED PORTS OF CALL

Local research vessels and charters will be used to deploy and recover the autonomous instruments. For example, gliders and Wave gliders could be deployed from G.O. Sars and K. Bonneville from Norway, and R/V Árni Friðriksson from Iceland.
11. ANY SPECIAL REQUIREMENTS AT PORTS OF CALL

These sustained measurements will be collected in collaboration with partners in Norway (Dr. Ilker Fer, Ilker.Fer@uib.no), in Iceland (Dr. Angel Ruis-Angulo, angel@hi.is), and in the Faroes (Dr. Hjalmar Hatun, Hjalmarh@hav.fo). Local logistics (charters, research vessels, etc.) will be coordinated with our partners.



## NOTIFICATION OF PROPOSED RESEARCH CRUISE

### 1. PART B: DETAILS

1. NAME OF RESEARCH SHIP CRUISE NO.  
Autonomous Observations in the Nordic Seas
2. DATES OF CRUISE                      From    2022-06-15                      To    2025-06-14
3. a) PURPOSE OF RESEARCH    Measure oceanic and surface atmospheric conditions over long periods of time (months to years) to better understand the response of the ocean to strong atmospheric forcing.
- b) GENERAL OPERATIONAL METHODS (including full description of any fish gear, trawl type, mesh size, etc.)  
Autonomous underwater gliders, profiling floats, autonomous surface vehicles (Wave Gliders), and surface drifters. These instruments will measure ocean properties (temperature, salinity, currents, etc.) and surface atmospheric conditions (wind, air temperature, etc.) in places and time difficult to access with ships (e.g., winter)
4. ATTACH CHART showing (on an appropriate scale) the geographical area of intended work, positions of intended stations, tracks of survey lines, positions of moored/seabed equipment, areas to be fished  
Please see attached chart at the end of the document.
5. a) TYPES OF SAMPLES REQUIRED (e.g., geological/water/plankton/fish/radionuclide)  
No sample will be collected
- b) METHODS OF OBTAINING SAMPLES (e.g., dredging/coring/drilling/fishing, etc. When using fishing gear, indicate fish stocks being worked, quantity of each species required, and quantity of fish to be retained on board).  
NA
6. DETAILS OF MOORED EQUIPMENT                      No moorings will be deployed

<u>Dates Laying</u>	<u>Recovery</u>	<u>Description</u>	<u>Depth</u>	<u>Latitude</u>	<u>Longitude</u>
---------------------	-----------------	--------------------	--------------	-----------------	------------------

7. ANY HAZARDOUS MATERIALS (chemicals/explosives/gases/radioactives, etc.)  
(Use separate sheet if necessary)                      No explosives or harmful materials.
- a) Type and trade name
- b) Chemical content (and formula)
- c) IMO IMDG code (reference and UN no.)
- d) Quantity and method of storage on board
- e) If explosives give dates of detonation
- Method of detonation
  - Position of detonation
  - Position of detonation
  - Frequency of detonation
  - Depth of detonation
  - Size of explosive charge in kg.
8. DETAIL AND REFERENCE OF
- a) Any relevant previous/future cruises  
This work is related on ship-based project NORSE: cruise in Sept. 2021 on R/V Neil Armstrong, USA, and cruise in Sept. 2022 on NRV Alliance, USA. The scope of the work described here is broader (longer time scales, larger region).
- b) Any previously published research data relating to the proposed cruise  
None



9. NAMES AND ADDRESSES OF SCIENTISTS OF THE COASTAL STATE(S) IN WHOSE WATERS THE PROPOSED CRUISE TAKES PLACE WITH WHOM PREVIOUS CONTACT HAS BEEN

MADE

Norway: Dr. Ilker Fer, Ilker.Fer@uib.no  
Iceland: Dr. Angel Ruis-Angulo, angel@hi.is  
Faroes: Dr. Hjalmar Hatun, Hjalmarh@hav.fo

10. STATE

a) Whether visits to the ship in port by scientists of the coastal state concerned will be acceptable  
(Yes/No) Yes

b) Participation of an observer from the coastal state for any part of the cruise together with the dates and the ports for embarkation and disembarkation

Yes. Deployments and recoveries will be from vessels based in the concerned coastal states. Schedule will be shared as operations are planned (with our international scientific partners)

c) When research data from the intended cruise are likely to be made available to the coastal state and by what means

Data will be provided through official channels at no cost to the coastal states. A preliminary report must be submitted no more than 30 days from the end of the project, or upon request as instruments are recovered. Samples and assistance with data interpretation will be provided upon request.





**PART C. SCIENTIFIC EQUIPMENT**

Complete the following table using a separate page for each coastal state

Coastal state NORWAY  
Port of call none  
Dates NA

Indicate "YES" or "NO"

<u>List scientific work by function</u> e.g.	Water column including sediment sampling of the seabed	Fisheries research within fishing limits	Research concerning the natural resources of the continental shelf or its physical characteristics	DISTANCE FROM COAST		
				Within 4 nm	Between 4-12 nm	Between 12-200 nm
Profiles of temperature, salinity, turbulence, oxygen, optical backscatter, chlorophyll fluorescence, acoustics from long-endurance underwater gliders	No samples - all measurements are sensor-based	no	no	no	no	yes
Profiles of temperature, salinity, turbulence, oxygen, optical backscatter, chlorophyll fluorescence, acoustics from long-endurance underwater floats	No samples - all measurements are sensor-based	no	no	no	no	yes
Near surface ocean turbulence, directional wave spectra, surface winds, salinity, water temperature, air temperature, and surface images from surface autonomous vehicles (Wave Glider)	No samples - all measurements are sensor-based	no	no	no	no	yes
Surface currents, ocean temperature, ocean conductivity (salinity), wind velocity, atmospheric pressure, surface waves and underwater sound from surface drifters	No samples - all measurements are sensor-based	no	no	no	no	yes

\_\_\_\_\_  
 (On behalf of the Principal Scientist) Dated \_\_\_\_\_

NB IF ANY DETAILS ARE MATERIALLY CHANGED REGARDING DATES/AREA OF OPERATION AFTER THIS FORM HAS BEEN SUBMITTED, THE COASTAL STATE AUTHORITIES MUST BE NOTIFIED IMMEDIATELY





**PART C. SCIENTIFIC EQUIPMENT**

Complete the following table using a separate page for each coastal state

Coastal state ICELAND  
Port of call none  
Dates NA

Indicate "YES" or "NO"

<u>List scientific work by function</u> e.g.	Water column including sediment sampling of the seabed	Fisheries research within fishing limits	Research concerning the natural resources of the continental shelf or its physical characteristics	DISTANCE FROM COAST		
				Within 4 nm	Between 4-12 nm	Between 12-200 nm
Profiles of temperature, salinity, turbulence, oxygen, optical backscatter, chlorophyll fluorescence, acoustics from long-endurance underwater gliders	No samples - all measurements are sensor-based	no	no	no	no	yes
Profiles of temperature, salinity, turbulence, oxygen, optical backscatter, chlorophyll fluorescence, acoustics from long-endurance underwater floats	No samples - all measurements are sensor-based	no	no	no	no	yes
Near surface ocean turbulence, directional wave spectra, surface winds, salinity, water temperature, air temperature, and surface images from surface autonomous vehicles (Wave Glider)	No samples - all measurements are sensor-based	no	no	no	no	yes
Surface currents, ocean temperature, ocean conductivity (salinity), wind velocity, atmospheric pressure, surface waves and underwater sound from surface drifters	No samples - all measurements are sensor-based	no	no	no	no	yes

\_\_\_\_\_  
 (On behalf of the Principal Scientist) Dated \_\_\_\_\_

NB IF ANY DETAILS ARE MATERIALLY CHANGED REGARDING DATES/AREA OF OPERATION AFTER THIS FORM HAS BEEN SUBMITTED, THE COASTAL STATE AUTHORITIES MUST BE NOTIFIED IMMEDIATELY



**PART C. SCIENTIFIC EQUIPMENT**

Complete the following table using a separate page for each coastal state

Coastal state DENMARK (Faroe Islands)  
Port of call none  
Dates NA

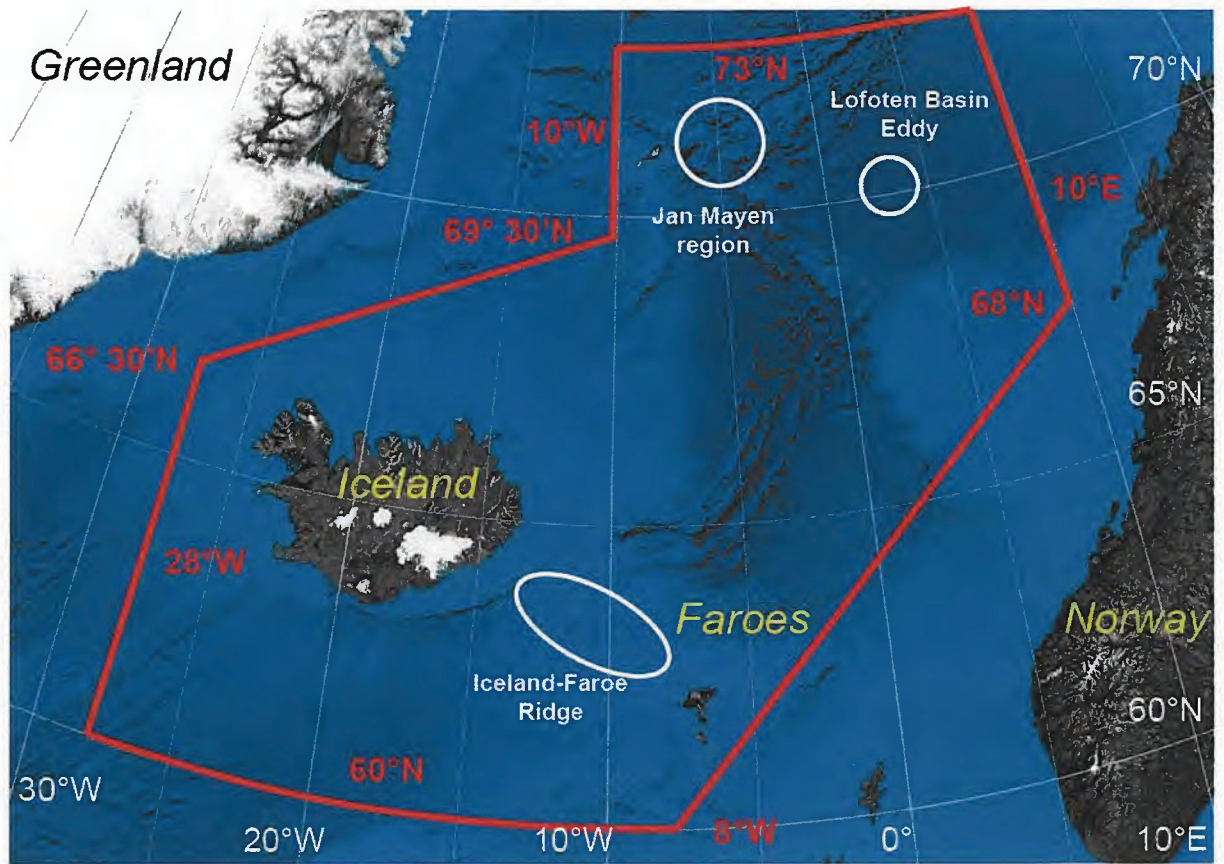
Indicate "YES" or "NO"

<u>List scientific work by function</u> e.g.	Water column including sediment sampling of the seabed	Fisheries research within fishing limits	Research concerning the natural resources of the continental shelf or its physical characteristics	DISTANCE FROM COAST		
				Within 4 nm	Between 4-12 nm	Between 12-200 nm
Profiles of temperature, salinity, turbulence, oxygen, optical backscatter, chlorophyll fluorescence, acoustics from long-endurance underwater gliders	No samples - all measurements are sensor-based	no	no	no	no	yes
Profiles of temperature, salinity, turbulence, oxygen, optical backscatter, chlorophyll fluorescence, acoustics from long-endurance underwater floats	No samples - all measurements are sensor-based	no	no	no	no	yes
Near surface ocean turbulence, directional wave spectra, surface winds, salinity, water temperature, air temperature, and surface images from surface autonomous vehicles (Wave Glider)	No samples - all measurements are sensor-based	no	no	no	no	yes
Surface currents, ocean temperature, ocean conductivity (salinity), wind velocity, atmospheric pressure, surface waves and underwater sound from surface drifters	No samples - all measurements are sensor-based	no	no	no	no	yes

\_\_\_\_\_  
 (On behalf of the Principal Scientist) Dated \_\_\_\_\_

NB IF ANY DETAILS ARE MATERIALLY CHANGED REGARDING DATES/AREA OF OPERATION AFTER THIS FORM HAS BEEN SUBMITTED, THE COASTAL STATE AUTHORITIES MUST BE NOTIFIED IMMEDIATELY





The red box delineates the region where all scientific operations will take place. Science goals require observations focused on specific oceanographic phenomenon, including fronts and eddies. Deployment locations and sampling for autonomous instruments thus depend on the locations and evolution of such features, and will this be determined in real time, in response to environmental variability. Focus areas for sustained glider operations are indicated in white: west of the island of Jan Mayen (near 71°N 6°W), in the Lofoten Basin eddy (near 70°N 3°E), and along the Faroe-Iceland Ridge (63°N 10°W)







## APPLICATION FOR CONSENT TO CONDUCT MARINE SCIENTIFIC RESEARCH

### 1. General Information

1.1 Cruise name and/or number:	F2022-042 - Autonomous Observations in the Nordic Seas
--------------------------------	--

1.2 Sponsoring institution(s):		
Name	Address	Name Of Director
Applied Physics Laboratory, University of Washington	Applied Physics Laboratory University of Washington 1013 NE 40th Street Box 355640 Seattle, WA 98105 phone : 206-543-1300 email: webadmin@apl.uw.edu Director email address: williams@apl.uw.edu	Kevin Williams

1.3 Scientist in charge of the project:	
Name:	Luc Rainville
Country:	United States
Affiliation:	Applied Physics Laboratory, University of Washington
Address:	US
Telephone:	+1-206-685-4058
Email:	lucrain@uw.edu

1.4 Entity(ies) /Participant(s) from coastal State involved in the planning of the project:	
Name:	See Section 6.2
Country:	
Affiliation:	
Address:	
Telephone:	
Fax:	
Email:	
Website (for CV and photo):	

1.5 Submitting officer:	
Name:	Emily Shroyer
Affiliation:	Office of Naval Research
Address:	One Liberty Center, 875 N. Randolph Street, Suite Arlington, VA 22203-1995 United States
Telephone:	703-501-7134
Fax:	
Email:	emily.l.shroyer.civ@us.navy.mil

### 2. Description of Project

2.1 Nature and objectives of the project:
The objective is to conduct scientific oceanographic research from autonomous platforms in the Nordic Seas. Gliders, wave gliders, floats, and drifters will be deployed and recovered from primarily Norwegian and Icelandic research vessels. Instruments will measure environmental parameters (temperature, salinity, velocity, passive acoustics, turbulence, wind, atmospheric pressure).

2.2 Relevant previous or future research projects:
This project is related to previous NISKINe (2018, 2019; south of Iceland) and NORSE (2021, Fall 2022; near Jan Mayen, Norway) ship-based studies, although broader in scope and with a more direct involvement of International partners.



2.3 Previous publications relating to the project:
None at the moment

### 3. Geographical Areas

3.1 Indicate geographical areas in which the project is to be conducted (with reference in latitude and longitude, including coordinates of cruise track/ way points):
The general area of operations is north of 60°N and south of 73°N, between 28°W and 10°E, excluding all territorial waters and the EEZs of the U.K. and near Greenland (map is attached). Most sustained glider operations will take place west of the island of Jan Mayen (near 71°N 6°W), in the Lofoten Basin eddy (near 70°N 3°E), and along the Faroe-Iceland Ridge (63°N 10°W)

3.2 Attach chart(s) at an appropriate scale (1 page, high-resolution) showing the geographical areas of the intended work and, as far as practicable, the location and depth of sampling stations, the tracks of survey lines, and the locations of installations and equipment.
Chart provided - see Section 10.1.

### 4. Methods and Means to be Used

4.1 Particulars of AUV:	
Name:	Underwater glider (Seaglider, Spray glider, SLOCUM glider)
Nationality (Flag state):	United States
Owner:	PI-owned (chief scientist)
Operator:	PI-owned (chief scientist)
Manufacturer:	** attach details in description **
Make/Model:	** attach details in description **
Range/Endurance:	1000 km+
Overall length:	1.5 m
Weight:	50 kg
Cruising:	20 km per day (0.25 m/s)
Additional Information:	

4.2 Other craft in the project, including its use:
Three classes of autonomous underwater glider will be used for our 2022-2025 studies: Seagliders operated by APL-UW (Rainville, Lee, and Johnson), Teledyne-Webb Slocum gliders operated by APL-UW (Shapiro and Simmons), and ALSEAMAR SeaExplorer gliders operated by VIMS (Gong). Profiling floats, e.g. ALTO floats ( <a href="https://www.mrvsys.com/products/mrvalto">https://www.mrvsys.com/products/mrvalto</a> ). Wave Glider (SV3), from Liquid Robotics ( <a href="https://www.liquid-robotics.com/wave-glider">https://www.liquid-robotics.com/wave-glider</a> ); Surface drifters ( <a href="https://gdp.ucsd.edu/ldl/svp/">https://gdp.ucsd.edu/ldl/svp/</a> )
Glider and Wave gliders will be deployed and recovered from research vessels (for example: G.O. Sars and K. Bonneville from Norway, and R/V Árni Friðriksson from Iceland) and local charters.

4.3 Particulars of methods and scientific instruments:		
Types of samples and measurements	Methods to be used	Instruments to be used
Ocean environmental data	Underwater gliders and profiling floats equipped with sensors to measure temperature, salinity, pressure, and (optionally) ocean currents with an Acoustic Doppler Current Profiler [1000 kHz Nortek current profiler], dissolved oxygen, Chlorophyll and optical backscatter [WETLabs ECO puck], and turbulence microstructure [Rockland Scientific's MicroRider or equivalent].	Three classes of autonomous underwater glider will be used for our 2022-2025 studies: Seagliders operated by APL-UW (Rainville, Lee, and Johnson), Teledyne-Webb Slocum gliders operated by APL-UW (Shapiro and Simmons), and ALSEAMAR SeaExplorer gliders operated by VIMS (Gong). Profiling floats, e.g. ALTO floats ( <a href="https://www.mrvsys.com/products/mrvalto">https://www.mrvsys.com/products/mrvalto</a> )
Surface environmental data	Sensors mounted on autonomous surface vehicles (Wave Gliders) to measure ocean surface temperature and salinity, surface ocean currents, surface air temperature, pressure, humidity, surface waves, wind stress. Surface drifters, to measure ocean current (from their positions), along with sea surface temperature, salinity, and atmospheric pressure.	Wave Glider (SV3), from Liquid Robotics ( <a href="https://www.liquid-robotics.com/wave-glider">https://www.liquid-robotics.com/wave-glider</a> ); Surface drifters ( <a href="https://gdp.ucsd.edu/ldl/svp/">https://gdp.ucsd.edu/ldl/svp/</a> )

4.4 Indicate nature and quantity of substances to be released into the marine environment:
--





No
----

4.5 Indicate whether drilling will be carried out. If yes, please specify:
--

No
----

4.6 Indicate whether explosives will be used. If yes, please specify type and trade name, chemical content, depth of trade class and stowage, size, depth of detonation, frequency of detonation, and position in latitude and longitude:
---

No
----

4.7 Indicate whether protected species be studied. If yes, please specify:
--

No
----

5. Installations and Equipment

5.1 Details of installations and equipment (including dates of laying, servicing, method and anticipated timeframe for recovery, locations and depth, and measurements):
--

No
----

6. Dates

6.1 Expected dates of first entry into and final departure from the research area by the research vessel and/or other platforms:
--

Project Start Date: 6/15/2022
-------------------------------

Project End Date: 6/15/2025
-----------------------------





6.2 Coastal State-specific details:	
<b>Coastal Area</b>	Iceland
Estimated Entry Date:	6/15/2022
Estimated Departure Date:	6/14/2025
Explanation of multiple entries:	Autonomous underwater gliders and autonomous surface Wave Gliders can be piloted to waypoints for sampling specific features or rendezvous for recoveries. Several deployments are planned for the next 3 years, mostly using local charters, and details of the operations will be shared with the appropriate coastal states and collaborators.
Research will be performed:	Between 12-200 nm, Beyond 200 nm
Extent to which Iceland will be enabled to participate or to be represented in the research project:	Instrument deployments, missions, and recoveries near Iceland will be conducted in collaboration with Angel Ruiz-Angulo, from the University of Iceland (angel@hi.is). Operations will be reported as requested, and instrument positions are available in real time. Data and reports will be shared with appropriate coastal States and collaborators
Name, affiliation and contact information for all participants from Iceland :	Angel Ruiz-Angulo, from the University of Iceland (angel@hi.is)
<b>Coastal Area</b>	Norway
Estimated Entry Date:	6/15/2022
Estimated Departure Date:	6/14/2025
Explanation of multiple entries:	Autonomous underwater gliders and autonomous surface Wave Gliders can be piloted to waypoints for sampling specific features or rendezvous for recoveries. Several deployments are planned for the next 3 years, mostly using local charters, and details of the operations will be shared with the appropriate coastal states and collaborators.
Research will be performed:	Between 12-200 nm, Beyond 200 nm
Extent to which Norway will be enabled to participate or to be represented in the research project:	Instrument deployments, missions, and recoveries near Iceland will be conducted in collaboration with Ilker Fer, from University of Bergen (Ilker.Fer@uib.no). Operations will be reported as requested, and instrument positions are available in real time. Data and reports will be shared with appropriate coastal States and collaborators
Name, affiliation and contact information for all participants from Norway :	Ilker Fer, from University of Bergen (Ilker.Fer@uib.no)
<b>Coastal Area</b>	Faroe Islands
Estimated Entry Date:	6/15/2022
Estimated Departure Date:	6/14/2025
Explanation of multiple entries:	Autonomous underwater gliders and autonomous surface Wave Gliders can be piloted to waypoints for sampling specific features or rendezvous for recoveries. Several deployments are planned for the next 3 years, mostly using local charters, and details of the operations will be shared with the appropriate coastal states and collaborators.
Research will be performed:	Between 12-200 nm, Beyond 200 nm
Extent to which Denmark will be enabled to participate or to be represented in the research project:	Instrument deployments, missions, and recoveries near Iceland will be conducted in collaboration with Hjalmar Hátún, from the Havstovan Faroe Marine Research Institute (Hjalmarh@hav.fo). Operations will be reported as requested, and instrument positions are available in real time. Data and reports will be shared with appropriate coastal States and collaborators
Name, affiliation and contact information for all participants from Denmark :	Hjalmar Hátún, from the Havstovan Faroe Marine Research Institute (Hjalmarh@hav.fo)

## 7. Port Calls

7.1 List of Port Calls
No Port Calls

## 8. Participation of the representative of the coastal State

8.1 Modalities of the participation of the representative of the coastal State in the research project:
See Section 6.2



8.2 Proposed dates and ports for embarkation/disembarkation:
See Section 6.2

9. Access to Data, Samples and Research Results

9.1 Expected dates of submission to coastal State of preliminary report, which should include the expected dates of submission of the data and research results:
No more than 60 days from the end date of the research as provided in Section 6.1.

9.2 Anticipated dates of submission to the coastal State of the final report:
No more than 2 years from the end date of the research as provided in Section 6.1.

9.3 Proposed means for access by coastal State to data (including format) and samples:
Data will be provided through official channels at no cost to the coastal State(s). Samples will be provided upon request.

9.4 Proposed means to provide coastal State with assessment of data, samples and research results:
Assessment of data, samples and research results will be provided at no cost to the coastal State(s).

9.5 Proposed means to provide assistance in assessment or interpretation of data, samples and research results:
Assistance in further assessment or interpretation will be provided upon request.

9.6 Proposed means of making results internationally available:
We will notify the coastal states as instruments are deployed and recovered. Reports and data will be shared with appropriate coastal States and collaborators in Norway, Faroes, and Iceland. Primary academic partners are Dr. Ilker Fer in Norway (Ilker.Fer@uib.no), Dr. Angel Ruis-Angulo (angel@hi.is) in Iceland, and Dr. Hjalmar Hatun (Hjalmarh@hav.fo) in the Faroes.

10. List of Supporting Documentation

10.1 List of attachments, such as additional forms required by the coastal State, etc.:			
Attachment Type	Description	Attachment	Submission Date
Proposed Cruise Track	Map of the region of operations of autonomous platforms	map_NordicSeas_Autonomous.png	3/28/2022 7:25 PM

Executed: 3/31/2022 9:13:58 PM (Coordinated Universal Time)





