

## NOTIFICATION OF PROPOSED RESEARCH CRUISE

### Part A: GENERAL

1. Name of research ship: **R.V. MARIA S. MERIAN** Cruise No. **MSM 130**
2. Dates of cruise **from Reykjavik, Iceland, July 9<sup>th</sup> 2024**  
**to Reykjavik, Iceland, August 14<sup>th</sup> 2024**
3. Operating Authority **Institute of Geology / Universität Hamburg**  
**Bundesstr. 55, D-20146 Hamburg, Germany**  
**Tel.: +49-40-42838-3640 - Fax: +49-40- 4273-10063**
4. Owner (if different from para 3) **Federal State Mecklenburg-Vorpommern, Germany**
5. Particulars of ship:
 

Name	<b>MARIA S. MERIAN</b>
Nationality	<b>German</b>
Overall length	<b>94,8 metres</b>
Maximum draught	<b>6,50 metres</b>
Net tonnage	<b>1.671 NT</b>
Propulsion	<b>Diesel Electric</b>
Call sign	<b>DBBT</b>
IMO No.	<b>9274197</b>
6. Crew
 

Name of master	<b>Björn Maaß</b>
No. of crew	<b><u>max. 24</u></b>
7. Scientific personnel:
 

Name and address of scientist in charge:	<b>Prof. Dr. Eric Achterberg</b> <b>GEOMAR Helmholtz Centre for Ocean Research Kiel</b> <b>Wischhofstraße 1-3</b> <b>24148 Kiel, Germany</b>
Phone:	<b>+49-431-600-1290</b>
Fax:	<b>+49-431-600-131290</b>
Email:	<b>eachterberg@geomar.de</b>
No. of scientists	<b><u>max. 22</u></b>

8. Geographical areas in which ship will operate (with reference in latitude and longitude):

**North Atlantic Ocean between 60°N – 44.5°W and 74.5°N-16°W**

9. Brief description of purpose of cruise:

The high latitude N Atlantic and Arctic Oceans are visibly affected by anthropogenic climate change through ocean warming, freshening, acidification, increased cryosphere and river discharge, and rapid acceleration of sea ice loss. The changing dynamics at polar ice-ocean-atmosphere interfaces have far-reaching implications for Earth's climate on diverse timescales through feedbacks on atmospheric circulation; oceanic mixing, circulation and carbon sequestration; and greenhouse gas sources and sinks. The overall goals of the POLAR BEAST cruise will be to conduct observations: (i) to investigate the role of Arctic sea ice loss as a driver of global change, (ii) to quantify chemical and physical processes at the ice-ocean-atmosphere interface that may constitute poorly-characterized climatic feedbacks in the Earth system. We will investigate on the cruise in the N Atlantic and Greenland Sea the key physical, chemical and biological factors determining salinity distribution, ocean productivity, sediment carbon and greenhouse gas exchange.

The cruise MSM130 will sail along the East Greenland coast to capture land-ocean exchange, gradients in salinity, primary production and historical carbon export (from cores), with observations of water column biogeochemistry, ocean physics in combination with satellite observations. Our improved understanding will be used to improve model projections of Arctic and low latitude systems under future climate scenarios.

10. Dates and names of intended ports of call:

Reykjavik (Iceland) for four days within the period of 3<sup>rd</sup> July 2024 and 12<sup>th</sup> July 2024

⇒ Planned so far from 06.07.2024 to 09.07.2024.

Reykjavik (Iceland) for five days within the period of 11<sup>th</sup> August 2024 and 21<sup>st</sup> August 2024

⇒ Planned so far from 14.08.2024 to 18.08.2024.

11. Any special logistic requirements at ports of call:

**Crew change, unloading/ loading of equipment, logistics, bunkering.**

**Part B: DETAIL**

1. Name of research ship: ***R.V. MARIA S. MERIAN*** Cruise No. **MSM 130**
2. Dates of cruise **from Reykjavik, Iceland, July 9<sup>th</sup> 2024**  
**to Reykjavik, Iceland, August 14<sup>th</sup> 2024**
3. Purpose of research and general operational methods:

The high latitude N Atlantic and Arctic Oceans are visibly affected by anthropogenic climate change through ocean warming, freshening, acidification, increased cryosphere and river discharge, and rapid acceleration of sea ice loss. The changing dynamics at polar ice-ocean-atmosphere interfaces have far-reaching implications for Earth's climate on diverse timescales through feedbacks on atmospheric circulation; oceanic mixing, circulation and carbon sequestration; and greenhouse gas sources and sinks. The overall goals of the POLAR BEAST cruise (MSM 130) will be to conduct observations: (i) to investigate the role of Arctic sea ice loss as a driver of global change, (ii) to quantify chemical and physical processes at the ice-ocean-atmosphere interface that may constitute poorly-characterized climatic feedbacks in the Earth system. We will investigate on the cruise in the N Atlantic and Greenland Sea the key physical, chemical and biological factors determining salinity distribution, ocean productivity, sediment carbon and greenhouse gas exchange. The cruise MSM130 will sail along the East Greenland coast to capture land-ocean exchange, gradients in salinity, primary production and historical carbon export (from cores), with observations of water column biogeochemistry, ocean physics in combination with satellite observations. Our improved understanding will be used to improve model projections of Arctic and low latitude systems under future climate scenarios.

The proposed work program in waters of the EEZ of Iceland involves the deployment of a towed fish (made from stainless steel) at ca. 2 m depth to collect trace metal clean surface water for trace metal and nutrient analysis, and the deployment of high-volume aerosol collectors for the collection of aerosol particles. In addition, we will measure in the surface waters from the ship's underway supply (using the Thermosalinograph) T, salinity, chlorophyll fluorescence, total alkalinity, pCO<sub>2</sub>, pH, dissolved oxygen.

The ship will also obtain multi-beam bathymetry data, and water column ADCP data which will contribute to observations of the seafloor, and mixed layer heat, freshwater balances and the supply of nutrients through turbulent mixing. The Thermosalinograph, ADCP and multi-beam data will be made available to all on Pangaea following the cruise.

We will not conduct water column sampling using CTD rosette frames in the waters of the EEZ of Iceland.

We will also not conduct any seafloor sampling in the EEZ of Iceland.

We will not collect biological samples in the EEZ of Iceland.

We will not deploy or collect moorings in the EEZ of Iceland.

Only aerosol sampling and surface water sampling, and ADCP and multibeam observations will be conducted in the EEZ of Iceland.

4. Attach chart (see Annex 1 and attached) showing (on an appropriate scale) the geographical area of the intended work, positions of intended stations, tracks of survey lines, positions of moored / seabed equipment:

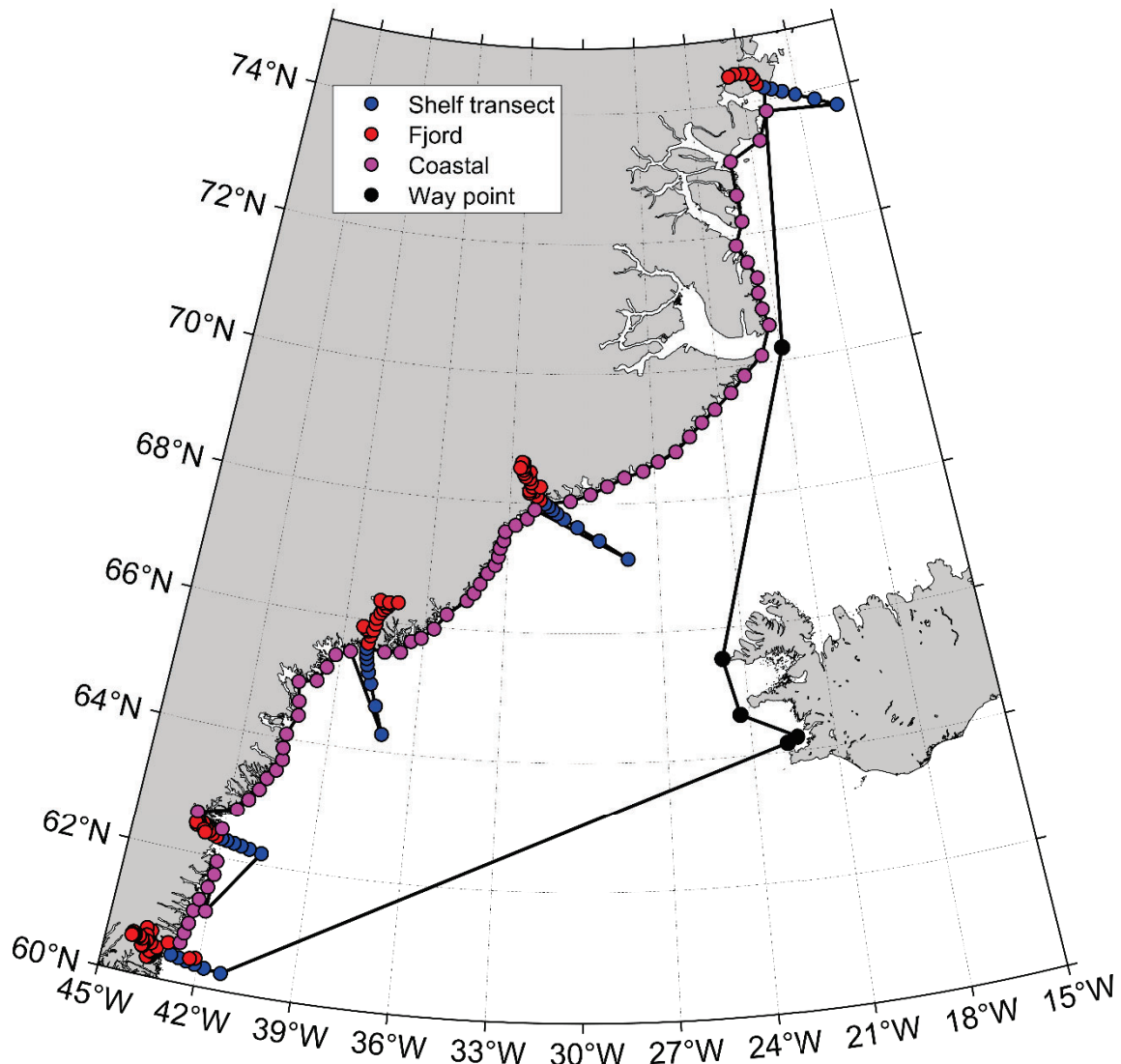


Figure 1: Map of working area in the high latitude N Atlantic Ocean.

Estimated date of first entry into EEZ of coastal state: July 9, 2024

Estimated last exit from EEZ of coastal state: August 14, 2024

Multiple EEZ entries/exits during the research cruise? YES

*We will exit the EEZ of Iceland on July 10, 2024, and then re-enter the EEZ of Iceland towards the end of the cruise (August 11) before returning the port of Reykjavik Iceland. We will sail in a clockwise manner from Reykjavik to Reykjavik.*

5. Types of samples required (e.g., Geological / Water / Plankton / Fish / Radioactivity / Isotope) and (b) methods by which samples will be obtained (including dredging / coring / drilling/ fishing etc.).

(a) Type of samples	(b) Method
Water (for analyses of nutrients, trace metals, carbonate chemistry)	Collection using tow fish with pump from 2 m depth below sea surface, and from the ship's seawater inflow at 3 m below sea surface.
Aerosols (for trace element and nutrient analyses)	Deployment of high-volume aerosol collector on vessel.

6. Details of moored equipment: **No equipment will be moored.**

7. Explosives: **No explosives.**

8. Detail and reference of

(a) Any relevant previous / future cruises:

- **German R/V POLARSTERN PS100 cruise in Fram Strait in 2016**
- **UK RRS Discovery cruise D354 in Iceland and Irminger Basin in 2010**

**These cruises investigated biogeochemical processes in the high latitude North Atlantic Ocean.**

(b) Any previous published research data relating to the proposed cruise. (Attach separate sheet if necessary.):

**Krisch, S., Hopwood, M. J., Roig, S., Gerringa, L. J., Middag, R., Rutgers van der Loeff, M. M., et al. (2022). Arctic – Atlantic exchange of the dissolved micronutrients Iron, Manganese, Cobalt, Nickel, Copper and Zinc with a focus on Fram Strait. *Global Biogeochemical Cycles*, 36, e2021GB007191. <https://doi.org/10.1029/2021GB007191>**

**Krisch, S., Browning, T.J., Graeve, M., Ludwichowski, K-U., Lodeiro, P., Hopwood, M.J., Roig, S., Yong, J-C., Kanzow, T., Achterberg, E.P. (2020). The influence of Arctic Fe and Atlantic fixed N on summertime primary production in Fram Strait, North Greenland Sea. *Scientific Reports* 10, 15230. <https://doi.org/10.1038/s41598-020-72100->**

**Krause, J., Hopwood M.J., Höfer, J., Krisch, S., Achterberg, E.P., Alarcón, E., Carroll, D., González, H.E., Juul-Pedersen, T., Liu, T, Lodeiro, P., Meire, L., Rosing, M.T. (2021). Trace Element (Fe, Co, Ni and Cu) Dynamics Across the Salinity Gradient in Arctic and Antarctic Glacier Fjords. *Frontiers in Earth Science*. DOI=10.3389/feart.2021.725279.**

**Krisch, S., Hopwood, M.J., Schaffer, J., Al-Hashem, A., Höfer, J., Rutgers van der Loeff, M.M., Conway, T.M., Summers, B.A, Lodeiro, P., Ardiningsih, I., Steffens, T., Achterberg, E.P. (2021). The 79°N Glacier cavity modulates subglacial iron export to the NE Greenland Shelf. *Nature Communications*, 12 (1), 1-13.**

- Clarke, J. S., Humphreys, M. P., Tynan, E., Kitidis, V., Brown, I., Mowlem, M. and Achterberg, E. P. (2017). Characterization of a Time-Domain Dual Lifetime Referencing pCO<sub>2</sub> Optode and Deployment as a High-Resolution Underway Sensor across the High Latitude North Atlantic Ocean. *Frontiers in Marine Science*, 4 (396). DOI 10.3389/fmars.2017.00396.
- Moigne, F.A.C. Le, Moore, C.M.M., Sanders, R., Villa, M., Steigenberger, S., Achterberg, E.P. (2014). Sequestration efficiency in the iron limited North Atlantic: Implications for iron supply mode to fertilized blooms. *Geophysical Research Letters*. 06/2014;
- Tynan, E., Tyrrell, T., Achterberg, E.P. (2014). Controls on the seasonal variability of the carbonate system in the Atlantic gateway to the Arctic Ocean. *Marine Chemistry*, 158, 1-9.
- Painter, S.C., Henson, S.A., Forryan, A., Steigenberger, S., Klar, J., Stinchcombe, M.C., Rogan, N., Baker, A.R., Achterberg, E.P. and Moore, C.M. (2014) An assessment of the vertical diffusive flux of iron and other nutrients to the surface waters of the subpolar North Atlantic Ocean. *Biogeosciences*, 11, 2113-2130.
- Achterberg, E.P., Steigenberger, S., Marsay, C.M., LeMoigne, F.A.C., Painter, S.C., Baker, A.R., Connelly, D.P., Moore, C.M., Tagliabue, A., Tanhua, T. (2018). Iron Biogeochemistry in the High Latitude North Atlantic Ocean. *Scientific Reports*, 8, Article number: 1283. doi:10.1038/s41598-018-19472-1.
- Achterberg, E. P., Steigenberger, S., Klar, J. K., Browning, T. J., Marsay, C. M., Painter, S. C., et al. (2020). Trace element biogeochemistry in the high latitude North Atlantic Ocean: seasonal variations and volcanic inputs. *Global Biogeochemical Cycles*, 34, e2020GB006674. <https://doi.org/10.1029/2020GB006674>.
- Ardiningsih, I, Krisch, S., Lodeiro, P., Reichart, G., Achterberg, E.P., Gledhill, M., Middag, R., Gerringa, L.J.A. (2020). Natural Fe-binding organic ligands in Fram Strait and over the Northeast Greenland shelf. *Marine Chemistry*, doi.org/10.1016/j.marchem.2020.103815
- Hopwood, M. J., D. Carroll, T. J. Browning, L. Meire, J. Mortensen, S. Krisch, E. P. Achterberg (2018): Non-linear response of summertime marine productivity to increased meltwater discharge around Greenland. *Nature Communications*, 9 (1), 3256, <https://doi.org/10.1038/s41467-018-05488-8>

9. Names and addresses of scientists of the coastal state in whose waters the proposed cruise takes place with whom previous contact has been made:

**N/A**

10. State:

- (a) Whether visits to the ship in port by scientists of the coastal state concerned will be acceptable:

**Yes, after discussion.**

- (b) Whether it will be acceptable to carry on board an observer from the coastal state for any part of the cruise and dates and ports of embarkation/ disembarkation:

**Yes, after discussion.**

**Embarkation: Reykjavik, 8<sup>th</sup> July 2024**

**Disembarkation: Reykjavik, 14<sup>th</sup> August 2024**

- (c) When research data from intended cruise is likely to be made available to the coastal state and if so by what means:

- ***Cruise Report three months after finishing the research cruise.***
- ***Scientific publications within the following three years.***
- ***Multibeam, ADCP and surface ocean T, salinity, fluorescence and oxygen data within 1 year after finishing the research cruise.***

**Part C: SCIENTIFIC EQUIPMENT**

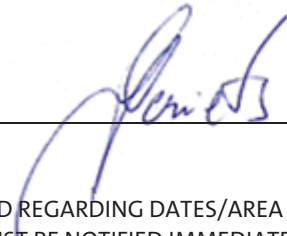
COASTAL STATE: Iceland

11. Complete the following table - (indicate 'YES' or 'NO'):  
**Please add in "b" the equipment you will bring to the vessel and complete the table with yes or no. Note that forgotten equipment can led to restrictions in research.**

List of all major marine scientific equipment it is proposed to use.	Fisheries research within fishing limits	Research concerning continental shelf out to State's margin	Waters in which equipment will be deployed			
			within 3 NM	between 3-12 NM	between 12-50 NM	between 50-200 NM
<b>a. vessel mounted systems</b>						
ADCP current profiler	No	Yes	Yes	Yes	Yes	Yes
USBL underwater positioning	No	Yes	Yes	Yes	Yes	Yes
Multibeam echosounder	No	Yes	Yes	Yes	Yes	Yes
Sub-bottom profiler Parasound P70	No	Yes	Yes	Yes	Yes	Yes
Permanent surface water sampling / analysis (incl. Thermosalinograph)	No	Yes	Yes	Yes	Yes	Yes
<b>b. mobile equipment</b>						
Meteorological Sensors	No	Yes	Yes	Yes	Yes	Yes
Aerosol collector	No	Yes	Yes	Yes	Yes	Yes
Tow fish for water sampling	No	Yes	Yes	Yes	Yes	Yes
Sound velocity probe AML SV PlusX	No	Yes	Yes	Yes	Yes	Yes

Hamburg, 05.12.2023

Date

  
 Universität Hamburg  
 CEH Centrum für Erdsystemforschung und Nachhaltigkeit  
 Leitstelle Deutsche Forschungsschiffe  
 Bundesstr. 55  
 D-20146 Hamburg  
 - Germany -

(On behalf of the principal scientist)

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