



New

Scientific Research

Period of operation: from 0001-01-01 to 0001-01-01

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$\gamma_b \Delta^c \dot{\gamma} \Pi \sigma^b$ $\Lambda_{\tau} \kappa \nabla^{\gamma} b^{\gamma} \sigma \nabla \kappa \nabla^{\alpha} L^{\alpha} \sigma^b$

The research cruise we are proposing is part of a UK Natural Environment Research Council funded project – “Shipping Emissions in the Arctic and North Atlantic Atmosphere: SEANA”. The project is hosted by the University of Birmingham and led by Professor Zongbo Shi. Ship emissions have a marked influence on the concentrations of aerosol particles in the marine atmosphere. These tiny particles affect the climate by scattering light back to space and by forming clouds. Melting sea ice in the Arctic in the future will lead to increased shipping in the region, which could significantly affect the atmospheric composition and climate. Quantifying these influences is challenging, however, due to a lack of understanding of marine aerosol sources (a dynamic baseline from which predictions are made) as well as uncertainty in current / future shipping emissions. This is particularly true at high-latitudes. SEANA aims to better understand the impact of increasing future ship traffic upon atmospheric aerosol particles and the climate in western Arctic. To this aim, we first have to better understand where are the aerosol particles coming from and how they are formed or change in the Arctic atmosphere. These data are essential to improve global models, which are poor at modelling Arctic aerosol particles. For this reason, SEANA project will organize a research cruise to the David Strait, Labrador Sea and potentially South Baffin Bay (if sea ice melted during the cruise). We will use the UK’s Royal Research Ship Discovery for this cruise. She will sail from Iceland on 19 May and back to the UK on 27 June 2022. The research will involve 19 scientists onboard and supported by 29 crew and technicians. During the research cruise, we will make a comprehensive observation of physical and chemical properties of aerosol particles, as well as on cloud condensation and ice nuclei (which form clouds). After the cruise, we will analyse the new data to quantify the sources of aerosol particles in the region (e.g., from biomass burning, mineral dust, or shipping) and understand the chemical processes affecting the ability of the particles to form clouds. The new datasets and process understanding will be used to evaluate and improve a state-of-the-art global aerosol model to represent key aerosol sources and processes, including shipping emissions. SEANA will apply the improved model to provide robust predictions on both the impact of future ship traffic on aerosol and the climate in the western Arctic. This will inform future policies to limit shipping emissions to protect the Arctic environment, which may be highly sensitive to shipping emissions. This research cruise will primarily focus on the areas where the ice is melting. We also plan to sail to eastern coast of Canada, if sea ice conditions permitting, in order to measure the aerosol particles (including for example, biomass burning and mineral dust) from the North American continent.

▷ΔΛΠΔ: La croisière de recherche que nous proposons fait partie d'un projet financé par le Conseil de recherche sur l'environnement naturel du Royaume-Uni - Émissions maritimes dans l'atmosphère arctique et nord-atlantique : SEANA. Le projet est hébergé par l'Université de Birmingham et dirigé par le professeur Zongbo Shi. Les émissions des navires ont une influence marquée sur les concentrations de particules d'aérosols dans l'atmosphère marine. Ces minuscules particules affectent le climat en diffusant la lumière vers l'espace et en formant des nuages. La fonte des glaces de mer dans l'Arctique à l'avenir entraînera une augmentation de la navigation dans la région, ce qui pourrait affecter considérablement la composition atmosphérique et le climat. La quantification de ces influences est difficile, cependant, en raison d'un manque de compréhension des sources d'aérosols marins (une base dynamique à partir de laquelle les prévisions sont faites) ainsi que de l'incertitude des émissions actuelles / futures du transport maritime. Cela est particulièrement vrai aux hautes latitudes. SEANA vise à mieux comprendre l'impact de l'augmentation future du trafic maritime sur les particules d'aérosols atmosphériques et le climat dans l'ouest de l'Arctique. Pour cela, nous devons d'abord mieux comprendre d'où viennent les particules d'aérosols et comment elles se forment ou se modifient dans l'atmosphère arctique. Ces données sont essentielles pour améliorer les modèles globaux, qui sont peu capables de modéliser les particules d'aérosols arctiques. Pour cette raison, le projet SEANA organisera

Operations Phase: from 2022-05-20 to 2022-06-25

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South Baffin / David Strait	Scientific/International Polar Year Research	Marine	Not being studied before	Not relevant	Far away from the protected areas / communities
David Strait	Scientific/International Polar Year Research	Marine	None	None	Far away from the communities and protected area; considering the thick sea ice and RRS Discovery can only work in 1/10 sea ice and open water, the research area will be much limited and will likely to be very far away from the land
Proposed ship track - David Strait, South Baffin and Labrador Sea	Scientific/International Polar Year Research	Marine	None	None	Considering the thick sea ice and RRS Discovery can only work in 1/10 sea ice and open water, the research area will be much limited and will likely to be very far away from the land

[illegible][illegible]

$\epsilon \Delta^{\alpha} j^{\beta} \wedge J^{\alpha} e^{\beta} \dot{N} \quad \nabla^{\alpha} r^{\beta} C D P L \dot{r}^{\gamma}$

[illegible]

Transboundary

South Baffin

$\epsilon \Delta^{\alpha} j^c$ $\wedge J^{\flat} e_D n$ $\nabla^{\flat} r^{\flat} C D P L \downarrow^c$

[illegible]

Project transportation types

Transportation Type	Transportation Name	Length of Use
Water	Royal Research Ship Discovery	

Project accomodation types

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Λ⁹δ^c Δ⁹ρ²ζ⁵ Δ⁵CDσD⁴γ⁵ Δ^cζ⁵ρDΠ^cρ^c Δ^dCDΔ^c, Γ^cΔP⁰ζ^c, ζ⁵ζ⁵CD²ζ⁵, ρ^cρD^c Δ²ρ^cρ^cΔ

[illegible]

ΔL^{9b} ΔC^{9b} CΔJL^{9b} C^{9b}

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0	Directly pumping seawater	Water samples will be taken

through an underway pump to the laboratory. The amount of water we will use is minimal - we will take a very small amount of water to measure water chemistry.

along the research cruise track (which is shown in the project map).

$\triangleleft^b C d^c$
$$\Delta^b C d \leq \rho \sigma \Delta^a \sigma^b$$

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Scientific/International Polar Year Research	ᐳᖃᑕᐳᑦ ᐃᐳᐳᑦᑕᐅᐯᓇᖃᐅᑦ	500 kg	incinerated at sea	N/A
Scientific/International Polar Year Research	ᐃᒪᐃᑦ ᐳᐅᖃᑕᐅᔭᓗᓗᓴᓶᓵᒫᒻᐳᑦ	3000kg	Stored and disposed when back to the UK (Southampton port)	N/A
Scientific/International Polar Year Research	ᐳᑦᑕᓇᖃᐅᖃᑕᓈᑦ	50 kg	Safely stored on the ship and disposed appropriately when returned to the UK (Southampton port)	N/A
Scientific/International Polar Year Research	ᐳᖃᑕᐳᑦ ᐃᐳᐳᑦᑕᐅᐯᓇᖃᐆᑦᐅᑦ	5000kg	Stored and disposed of unpon arrival in Southampton port in the UK	N/A
Scientific/International Polar Year Research	ᖃᐳᖃᑕᑦᓗᓄᖃ	1500kg	Stored safely onboard and disposed when back to the UK (Southampton port)	N/A

$\Delta^{\epsilon} \Gamma \Delta C^{\circ} D^{\circ}$ $\Delta^b D^{fb} CD^f L^f$

The ship will release air pollutants from the fuel burning. The impact is negligible due to the huge air volume in the study area. Chemicals: All chemicals will have accompanying COSHH and risk assessments. They will be stored, handled and disposed of appropriately as per standard NMF procedure. Ship's waste: All cardboard and paper products are incinerated at sea on the Discovery. Recyclable items are stored for appropriate recycling upon arrival into port. Any non-burnable or non-recyclable waste (e.g. batteries) is stored appropriately and disposed of upon arrival into port. Incidental waste: It is intended that all equipment will be recovered. Acoustic-based data collection The potential impacts associated with acoustic data collection relate to marine mammals. The primary concerns to marine mammals as a result of acoustic systems are considered to be masking effects, behavioural changes, and physiological effects such as temporary threshold shift (TTS) and permanent threshold shift (PTS). While it is difficult to be certain of the potential for physiological damage as a result of various acoustic activities, localised behavioural disturbance is considered a possibility. These concerns are considered below. Deep-water multibeam echosounder: The effects of multibeam echosounders on marine mammals has not been widely studied, such that it is unclear what impacts these may have on them. While Lurton and DeRuiter (2011) suggested that the risk of the sounds causing physiological auditory damage to marine mammals is likely to be low, a few studies have observed potential behavioural changes as an apparent result of

the operation of multibeam echosounders (Quick et al 2016; Cholewiak et al 2017). Due to this uncertainty, the JNCC have created a set of best-practice guidelines to follow in the case of deep-water multibeam echosounder surveys (see MEMP). With the proposed mitigation recommendations outlined in the MEMP, the effects of the multibeam echoso

Additional Information

SECTION A1: Project Info

SECTION A2: Allweather Road

SECTION A3: Winter Road

SECTION B1: Project Info

SECTION B2: Exploration Activity

SECTION B3: Geosciences

SECTION B4: Drilling

SECTION B5: Stripping

SECTION B6: Underground Activity

SECTION B7: Waste Rock

SECTION B8: Stockpiles

SECTION B9: Mine Development

SECTION B10: Geology

SECTION B11: Mine

SECTION B12: Mill

SECTION C1: Pits

SECTION D1: Facility

SECTION D2: Facility Construction

SECTION D3: Facility Operation

SECTION D4: Vessel Use

SECTION E1: Offshore Survey

SECTION E2: Nearshore Survey

SECTION E3: Vessel Use

SECTION F1: Site Cleanup

SECTION G1: Well Authorization

SECTION G2: Onland Exploration

SECTION G3: Offshore Exploration

SECTION G4: Rig

SECTION H1: Vessel Use

SECTION H2: Disposal At Sea

SECTION 11: Municipal Development

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This research will primarily be on air composition. The ship will sail in open water with no sea ice or less 1/10 of sea ice. Air quality in the area is usually predicted to be extremely clean and that is the reason we are studying it. We expect that in the future when there are more ships, the emissions from the ships could significantly affect the sensitive Arctic environment and climate. It is predicted that sea ice will be completely melted in the summer long the Northwestern Passage. This makes Arctic shipping possible. The single ship we will use will have minimum impact on the noise level in the study area.

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The research cruise will sail in the David Strait and will be far away from wildlife species

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Not applicable - no direct engagement identified

Miscellaneous Project Information

$\Delta^{\text{fb}}CD\sigma^{\text{fc}}$ $\Delta^{\text{fb}}CDPL\text{LC}$ $\Delta^{\text{fb}}CD\dot{\sigma}^{\text{fc}}$ $\langle CD\Gamma' \rangle PL^{\text{fb}}CD\sigma^{\text{fd}}\sigma^{\text{fc}}$

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Cumulative Effects

Impacts on the environment and wildlife is minimal.

Impacts

$\mathcal{L}(\mathcal{A}) \subseteq \mathcal{L}(\mathcal{B})$

[illegible]
$$(P = \langle b \rangle \Delta_P \cap \langle a \rangle \Delta_Q)^C, N = \langle b \rangle \Delta_P' \cup \langle D \rangle \Delta_Q'^C \langle \langle D \rangle \Gamma' \cup \Gamma'^b \rangle^b \langle D \rangle \Delta_Q'^C, M = \langle b \rangle \Delta_P' \cup \langle D \rangle \Delta_Q'^C \langle \langle D \rangle \Gamma' \cup \Gamma'^b \rangle^b \langle D \rangle \Delta_Q'^C, U = \langle b \rangle \Delta_P \cup \langle a \rangle \Delta_Q)^b)$$

1	polygon	South Baffin / David Strait
2	polygon	David Strait
3	polyline	Proposed ship track - David Strait, South Baffin and Labrador Sea

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|---|----------|---|
| 1 | polygon | South Baffin / David Strait |
| 2 | polygon | David Strait |
| 3 | polyline | Proposed ship track - David Strait, South Baffin and Labrador Sea |