

Facts on sustainability



The MOSAIC expedition is one of the biggest and logistically most complex scientific expeditions of our time. Five icebreakers, several research planes and more than 600 researchers and crew members will be taking part in the major Arctic project; not least to conduct research that will allow us to better predict future changes in the Arctic sea ice and the global climate.

Naturally, the expedition itself, with its complex logistics should contribute as little as possible to the greenhouse effect and not interfere with Arctic habitats. To achieve this goal, the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research has prepared a set of regulations and precautions. In part, this catalogue of measures goes well beyond the international nature and environmental protection standards. Modern Arctic and climate research is not possible without the use of large vessels like Polarstern and the other icebreakers taking part. Minimising the environmental impact on this fragile region and respecting nature are absolute priorities.



Fuel consumption and CO₂ emissions

Passively traversing the Arctic propelled solely by the natural power of the ice is the most environmentally friendly method of conducting research with an icebreaker in the Arctic Ocean. The Polarstern is carried by the natural ice drift, pushed on by the wind. This does not cost anything and is CO₂ emission free. During the drift, the ship of course has to be heated and electricity has to be generated. In addition, the Polarstern must first travel to the start region and also cover the last leg under its own steam. The estimated CO₂ emissions resulting from this are listed below.

The research icebreaker Polarstern will be underway for the MOSAIC expedition for a total of 390 days. On the journey to the Arctic and back to Bremerhaven, the ship will use on average a maximum of 54 tonnes of diesel per day. During the time that the Polarstern is passively drifting with the ice, the consumption will be as low as 15 tonnes of diesel per day. This means that the Polarstern's total diesel consumption for the MOSAIC expedition is circa 7,100 tonnes.

The combustion of one tonne of diesel produces roughly 3.1 tonnes of carbon dioxide. This means that during the one-year MOSAIC expedition a total of circa 22,100 tonnes of carbon dioxide will be produced. That is roughly the amount that Germany's largest coal-fired power station produces on average in just six hours. The four other icebreakers will only be used intermittently during the expedition, and so their CO₂ emissions will be significantly lower.

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Marine diesel

Today, the majority of the circa 50,000 merchant ships worldwide use heavy fuel oil, a viscous black mass that is left behind in the oil refining process. Heavy oil contains sulphur and other toxic substances, which are in part released into the environment via the ship's exhaust gases. In contrast, the Polarstern runs strictly on low-sulphur marine diesel (DMA quality), which burns much more cleanly. The sulphur content is already significantly below the limits specified by the International Maritime Organization (IMO) from 2020.



Wastewater management

The Polarstern has a complex sewage treatment system. As a basic principle: no unfiltered wastewater leaves the ship. Sewage is fed into a biological purification plant, where solids are removed. The filtered water is then purified in a so-called ultra-filtration facility. Less contaminated wastewater flows directly into the ultra-filtration system. The ultra-filtered water is pumped into the sea.



Diesel consumption and CO₂ emissions

Journey Bremerhaven - Arctic:

19 days times 54 tonnes diesel per day: 1,026 t (travelling in water and ice)

Drift:

357 days times 15 tonnes diesel per day: 5,355 t

Return journey Arctic- Bremerhaven:

14 days times 54 tonnes diesel per day: 756 t (travelling in water and ice)

Polarstern's total consumption during MOSAIC:

7,137 t marine diesel

3.1 tonnes CO₂ per 1 tonne marine diesel yields emissions of 22,125 tonnes CO₂.

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Refuse management

On board a ship like the Polarstern, where people live, carry out research and work, a wide variety of waste is produced. Glass and metal are crushed and then stored for disposal on land. Paper, kitchen waste and solids from the purification system are incinerated at a temperature of 950 degrees. Although according to the International Convention for the Prevention of Pollution from Ships (MARPOL), it is permissible to throw biodegradable materials such as paper and wood into the sea, the Polarstern refrains from doing so: wood, cardboard and plastics are stored in a large container and disposed of at the next port. And of course, laboratory waste, like chemical waste, is collected in accordance with the respective regulations and later taken on land.



Offsetting flights

For some time, the Alfred Wegener Institute has offset its CO₂ emissions from all its business flights via the non-profitable climate protection organisation atmosfair. Accordingly, all flights taken by the Institute's employees as part of the MOSAIC expedition will be offset. For every air mile, the AWI provides funding for a biogas plant in Nepal, which means that the CO₂ emissions are offset by savings elsewhere. Further, in addition to the CO₂ emissions, other pollutants like nitrogen oxides and soot particles are also taken in account. Depending on the type of aeroplane and route, a return flight from Bremen to the Norwegian port of Tromsø causes roughly 0.9 tonnes of CO₂ emissions per person. The journey to the Central Arctic begins in Tromsø.



Bilge water

On motor vessels with large engines, like the Polarstern, it is impossible to prevent leftover oil, lubricating oil and condensation water from accumulating beneath the engine room. This oil-water mixture is known as bilge water. It is not permitted to simply pump bilge water into the ocean. On board Polarstern, therefore, the bilge water is processed in an oil separator. The separated oil is then collected in a special tank along with waste oil and disposed of according to regulations in the next port. The purified water is pumped into the sea.

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Avoiding accidental contamination

The ice can become contaminated with oil and fuel when the tanks of vehicles, drills, power saws and compressors are refilled, or due to broken pipes. To avoid this, every time a tank is filled, collecting pans must be put in place beforehand. These must be large enough to hold the entire contents of the tank. Furthermore, they must be chemically resistant. Tools such as drills and power saws must also be placed on trays during work breaks. For the event that a spillage occurs, all teams on the ice must carry shovels and large containers that can be filled with the contaminated snow. For the unlikely event that chemicals enter the sea or a meltwater pool, absorbent mats must be carried.



Refuse disposal on the ice

The sea ice must be kept completely free of refuse. Waste is collected in rigid containers that will not be blown away even by strong winds. In addition, they must be placed so that they cannot become covered with snow or fall into the water. Refuse must be taken to the ship daily so as not to attract polar bears, which can smell food from long distances. Disposal is also important because refuse in the ice can distort the measurements of certain parameters.

