

# A Peculiar Interaction: Extreme Temperature Rise in the North Atlantic and the International Maritime Organization's Sulphur Regulation

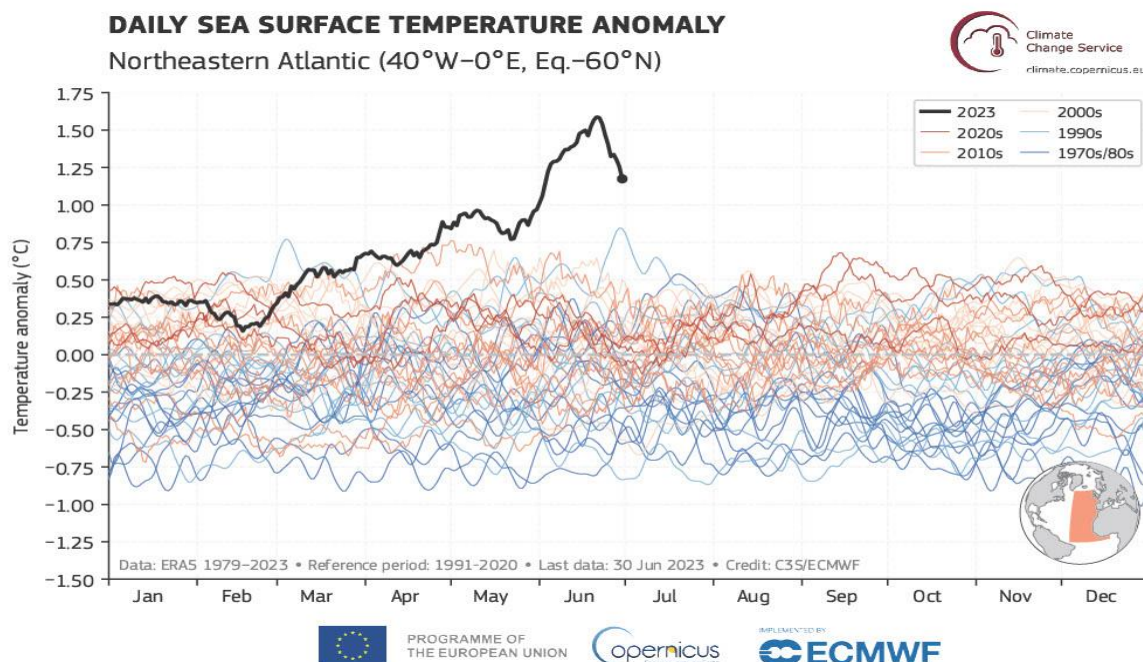
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**Matters Commented on:** North Atlantic Ocean surface temperature rise, IMO 2020 Sulphur Regulation, IMO GHG Strategy, Climate Change

## 1. Introduction

In the summer of 2023 exceptional sea surface temperatures were recorded on the North Atlantic Ocean, as a climax of a period of rapid warming that began in spring 2023 ([Copernicus Programme, 2023](#)). According to the '[Copernicus Programme](#)' (the European Union's Earth observation programme):

Temperatures in the northeastern Atlantic climbed steadily from the end of May, peaking on 21 June at around 1.6°C above average [...]. While absolute temperatures do reach higher values in the region during the summer, the average temperatures observed last month are more typical of later in the summer ([Copernicus Programme, 2023](#)).



*Graph: Daily sea surface temperature anomaly (°C) averaged over the northeastern Atlantic region during 2023 (black line) and for previous years from 1979 to 2022 (red and blue lines). Data source: ERA5. Credit: [Copernicus Climate Change Service/ECMWF](#).*

Of course, human-caused climate change is the main cause of increased temperatures around the globe, including the North Atlantic Ocean surface. However, the extraordinary and rapid increase in temperature observed in 2023 was likely facilitated by a number of other factors that amplified the effects of climate change.

These likely factors include unusual atmospheric circulation patterns, broader tropical warming involving the transition to El Niño conditions, the presence of Saharan Dust, wild fire smoke from Canada, and the effects of the Hunga-Tonga volcano eruption, as well as one likely factor that stands out as of particular importance in the context of the law of the sea ([Hausfather and Forster, 2023](#)). This is a relevant regulation of shipping, specifically the reduction of sulphur emissions from ships, following the implementation of the relevant International Maritime Organization (IMO) Regulation on sulphur emissions ([Voosen, 2023](#), [Hausfather and Forster, 2023](#)).

## **2. The IMO 2020 Sulphur Regulation and unintended consequences of the temperature of the North Atlantic Ocean**

Sulphur Oxides (SO<sub>x</sub>) emitted by ships have adverse impacts on human health, causing respiratory symptoms, lung disease and asthma, while they are also causing acid rain, and are contributing to the acidification of the oceans. ([Fanø, 2019](#), p. 13-15, [IMO Media Center](#)). In response to the harmful impacts of sulphur emissions from ships, the IMO adopted the [MARPOL Annex VI, Chapter 3, Regulation 14 \(IMO 2020 Sulphur Regulation\)](#). According to the IMO 2020 Sulphur Regulation, the sulphur content of any fuel oil used on board shall not exceed the limit of 0,50% m/m (from 3.5% m/m that was before), while on Sulphur [Emission Control Areas](#) this limit is 0,1% m/m since 2015.

However, sulphur emissions also have a cooling effect on the climate. According to [Fuglestad et al.](#), sulphur dioxide (SO<sub>2</sub>) directly reflects incoming sunlight and forms “cloud condensation nuclei”, an activity that increases droplet number densities and changes the reflectance and lifetimes of clouds, thus reflecting more sunlight to the atmosphere. ([Fuglestad et al., 2009](#)) These highly reflecting clouds, also called ship tracks, have been a matter of research since the 1960s ([Diamond, 2023](#)). The cooling effects of SO<sub>x</sub> and ship tracks on the climate and sea surface temperatures were thus well researched (e.g. [Fuglestad et al., 2009](#), [Gryspeerd et al., 2019](#), [Lorenz-Meyer, 2021](#), [Quaas et al., 2022](#)) even though certain studies claim that they have been overestimated (e.g. [Glassmeier et al., 2021](#)).

After the rapid increase of the North Atlantic Ocean surface temperature, as it was already mentioned, studies pointed towards the diminishing of reflective ship tracks as a likely factor causing the phenomenon ([Voosen, 2023](#), [Hausfather and Forster, 2023](#), [Diamond, 2023](#)). Due to the studies on ship tracks and sulphur emissions, the effects of the IMO 2020 Sulphur Regulation on this cooling effect were not totally unforeseen. At least since 2016, studies have raised the concern that the then-discussed IMO 2020 Sulphur Regulation would create disturbances in the climate since it would diminish the cooling effect of ship tracks ([Antturi et al., 2016](#), [Singh and Shanthakumar, 2022](#)).

## **3. Relationship of the IMO 2020 Sulphur Regulation with the IMO GHG Strategy and the Climate Change Regime**

The extraordinary temperature rise in the North Atlantic represents a unique interaction between two distinct legislation pieces established by the same international body. Specifically, the interaction between the IMO 2020 Sulphur Regulation and the [IMO Strategy on reduction of greenhouse gases emissions from ships \(IMO GHG Strategy\)](#), and its subsequent measures.

The IMO adopted the “Strategy on Reduction of GHG emissions from ships” on 7 July 2023, aligning with global initiatives combating climate change, as emphasized in the preamble. IMO’s Maritime Environment Protection Committee recalls that

the Paris Agreement adopted at the UN Climate Change Conference (COP 21), which identifies the long-term goal to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change, as was also reaffirmed in the Glasgow Climate Pact at COP 26 and in the Sharm el-Sheikh Implementation Plan at COP 27 ([IMO GHG Strategy, Preamble](#)).

The IMO GHG Strategy is a framework for member-States and includes a range of proposed mid- and long-term measures that are to be assessed in the various comprehensive impact assessments and adopted by the States ([IMO Media Centre](#)). Its goals include “to reduce CO<sub>2</sub> emissions per transport work, as an average across international shipping, by at least 40% by 2030, compared to 2008” and “to peak GHG emissions from international shipping as soon as possible and to reach net-zero GHG emissions by or around, *i.e.* close to, 2050 [...] consistent with the long-term temperature goal set out in Article 2 of the Paris Agreement.” ([IMO GHG Strategy, 3.3.](#)) IMO has since then adopted a plethora of measures and interrelated projects ([IMO Media Centre](#)).

The likely effects of the IMO 2020 Sulphur Regulation provide for ambivalent consequences of the two sets of rules. The diminishing reflective ship tracks seem to contribute to rising temperatures on the sea surface, coming in direct opposition to the stated goals of the IMO GHG Strategy. This apparent conflict between the IMO 2020 Sulphur Regulation and the IMO GHG Strategy poses a significant challenge within the maritime regulatory framework. These sets of rules, which address different aspects of environmental impact in the shipping sector, are evidently creating a complex intersection that demands careful consideration.

Due to the international character of the shipping sector, there is a need for harmonized standards and clear horizontal rules, a fact that is reflected in IMO practice and negotiations. However, this becomes challenging as regulations evolve to encompass more complicated issues. The evolving nature of these regulations introduces additional strains and scientific uncertainty, leading to a higher risk of mistakes and unintended consequences. In cases of scientific uncertainty, the precautionary principle is applied. The precautionary principle sets out that “where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” ([Rio Declaration, Principle 15](#)). In this particular case, one kind of environmental degradation (*i.e.* anthropogenic climate change) is likely accelerated by a regulation that wishes to combat a different kind of environmental degradation (the effects of sulphur emissions). Thus, a question arises: should the IMO 2020 Sulphur Regulation have been adopted in the first place and then continue to be implemented in order to combat the impacts of sulphur emissions or should it be scaled back in order to halt the environmental degradation caused by diminishing ship tracks? Which kind of environmental degradation would be deemed more important to be prevented?

#### **4. Addressing the highlighted issues**

The rising temperatures of the North Atlantic Ocean due to the diminishing ship track underscore the intricate nature of maritime regulations and their potential interconnectedness in terms of opposing environmental impacts. Given this complexity, there is an increased risk of ambiguous outcomes arising from the interplay between regulations. However, it is crucial to recognise that these two regulations are not inherently incompatible. They were implemented

with specific goals in mind, reflecting the continuous efforts to address environmental concerns and improve the sector's practices. The IMO 2020 Sulphur Regulation focuses on limiting sulphur emissions, while the IMO GHG Strategy aims at reducing overall greenhouse gas emissions.

As a result, the IMO 2020 Sulphur Regulation does not provide for opposing obligations to the IMO GHG Strategy on the member-States, but it rather has unwanted consequences. The situation in the North Atlantic Ocean in the summer of 2023 highlighted the interconnectedness of regulations, revealing consequences that were not taken into account before their implementation, rather than a legal conflict of norms where one regulation should take precedence over the other. A different example of a similar issue has also emerged concerning the IMO Sulphur Regulation and the use of Exhaust Gas Cleaning Systems (EGCS, also known as scrubbers). Discharge water used by the scrubber systems has been found to be polluting. Use of scrubbers ([either open loop or closed loop](#)) involves discharging highly acidic water with elevated levels of pollutants. ([Hassellöv et al., 2020](#), [Teuchies et al., 2020](#)). As a result, it can be argued that the use of scrubbers is in breach of Art 195 of the [UN Convention on the Law of the Sea](#) (LOSC) which sets the duty of States to “act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another” ([Hassellöv, 2022](#), p. 355). The two phenomena are relatively different: on the one hand, scrubber use is only one of the possible measures that can be implemented in order to fulfil the obligations under the IMO 2020 Sulphur Regulation (another possible measure would be the use of low sulphur fuel). On the other hand, the likelihood of rising temperatures due to the desulphurization process is present whatever measure the flag State and the shipowner adopts since it is a result of the process itself. As a result, while it can be argued that scrubber use should be discouraged in favour of different solutions that could be implemented by the shipowner, it cannot be argued that the desulphurization process itself should be scaled back in order to not cause rising temperatures, since it would be in contradiction to the general obligation to protect and preserve the marine environment (Art 192 LOSC) and human health from the effects of sulphur emissions. Furthermore, from a policymaking and governance point of view, the proposal that ships should continue to emit detrimental gasses such as SO<sub>x</sub> in order to combat climate change appears, at the very least, counterintuitive.

As the case of the use of scrubber technology indicates, the problem is not new. Consequently, there is a growing imperative for comprehensive environmental impact assessments by regulatory bodies, such as the IMO. In the case of the IMO 2020 Sulphur Regulation, the majority of impact assessments primarily focused on the economic implications of transitioning to low sulphur fuels or installing EGCS (MEPC 78/INF.4, 24 February 2022). Impact assessments carried out by the IMO aim, in general, to assess the impacts of possible restrictions on shipping rather than the impacts of the activities on the marine environment ([Henriksen, 2023, p. 228](#)). As it was noted, the issue of diminishing ship tracks had been raised by scientific papers since at least 2016 (see [Antturi et al., 2016](#)). This further underscores the importance of ongoing evaluation and adaptability to uphold the efficacy of these regulations after their implementation while minimizing any adverse impacts. Furthermore, continuous evaluation and re-examination of set rules is an obligation set out by Art 211 (1) LOSC and regularly undertaken by the IMO committees following the [tacit amendment procedures of its conventions](#).

Nevertheless, it is crucial not to prioritize one regulation at the expense of the other. In this context, the re-evaluation of the regulation should not focus on the IMO 2020 Sulphur Regulation which caused the temperature rise on the first place. A potential scaling back of the desulphurization process is not the recommended course of action since the effects of sulphur emissions on the marine environment and human health need to be addressed as well. Instead, the focus should be put more on the IMO GHG Strategy. Especially in light of the recent findings and decisions of the [COP 28](#), the IMO GHG Strategy should acknowledge the impact of diminishing ship tracks on rising temperatures. In response, there should be an amplification of efforts towards achieving a zero-net carbon shipping industry in order to take into account and counterbalance the loss of the sulphur cooling effect. Here, the relevance of the precautionary principle is reinstated. First, the IMO 2020 Sulphur Regulation was and is necessary to combat the effects of sulphur emissions. Furthermore, lack of scientific certainty regarding whether the temperature rise in the North Atlantic Ocean during the summer of 2023 was genuinely attributable to diminishing ship tracks and not to other likely factors, should not serve as grounds to disregard the potential effects of desulphurization in the implementation of the IMO GHG Strategy.

Finally, this instance highlights the intricate landscape of maritime regulations and the potential environmental ramifications they entail. The recognition that these regulatory frameworks were deemed necessary at their inception highlights the dynamic nature of international maritime standards and the ongoing commitment to addressing environmental sustainability in the shipping industry. This dynamic nature of the regulations emphasizes the need for holistic governance approaches in order to encompass broader environmental considerations. Such structural adjustments are necessary for the overarching legal framework that governs the sector of shipping as a whole.

## **5. Conclusion:**

The extraordinary high temperatures noticed in the North Atlantic Ocean surface in the summer of 2023 created an interesting legal situation by highlighting a possible strenuous relationship between the IMO 2020 Sulphur Regulation and the IMO GHG Strategy. This phenomenon further underlines the complexity of contemporary regulatory processes in the sector of shipping but also between generally environmental measures and measures combating climate change. This complexity is also a result of the competing interests that are ever-present in the negotiations in the competent organizations (coastal/flag States, environmental organizations/shipping industry, etc.). Such an intricate problem highlights the need for a holistic approach to governance that will take into consideration the broad landscape of shipping regulations and their potential interconnectedness.

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