MARITIME STRATEGIC EVALUATION FOR ISRAEL 2020/21

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Impact of climate change and extreme weather events on maritime transport

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Climate change has a crucial impact on all areas of life, including water, public health, agriculture, energy, biodiversity, coastal infrastructure, economics, natural damage insurance, national security, and human health. In the oceans, the main climate changes are sea level rise and sea surface temperature rise, leading to an increase in the frequency of extreme weather events, all of which affect maritime transport. Emission control regulations will also increase operating costs for the maritime industry but may delay ocean acidification process. On the other hand, melting ice caused by climate change will seasonally turn the Arctic into a sea for navigation and create new shipping routes across the Arctic Sea. Ice melting will also enable the conditions for oil and gas production in the Arctic. Increased ship traffic and offshore oil drilling may lead to pollution of the Arctic ecosystem. Climate change-driven change in agricultural patterns probably will also affect the ship movements due to changes in the agricultural areas and the markets. Different stakeholders of the industry should take the necessary steps for adaptation to be better prepared to meet the new situation. In addition, the maritime sector should forcefully adopt minimum emission practices in order to try to mitigate the impact of the maritime industry on global warming.

Introduction

All people on Earth depend directly or indirectly on the ocean and cryosphere. The oceans cover 71% of the Earth's surface and contains about 97% of the Earth's water. The ocean and cryosphere support unique habitats and are interconnected with other components of the climate system through the global exchange of water, energy, and carbon. Human communities in close connection with coastal environments, small islands, polar areas are particularly exposed to ocean and cryosphere change, such as sea-level rise, extreme sea level, and shrinking cryosphere. Other communities further from the coast are also exposed to changes in the ocean, such as through extreme weather events (IPCC, 2019). There is no doubt that today we live in a period when significant climate changes are taking place, which, among other things, lead to more frequent and more extreme weather events. These changes greatly affect human health, stability at local and regional levels in a wide range (Cheung et al., 2009; Butchart, 2010). Also, the maritime sector, which accounts for 80% of all world trade, is highly dependent on climate change and extreme weather conditions. It follows that some of the most serious future challenges will be in the marine area, but it is unclear to what extent changes in the marine ecosystem will affect political and economic stability as a result of an increase in both extreme weather events and other manifestations of climate change (Marshall, Hsiang and

Edward, 2012). Some recent studies have shown that global ocean temperatures are steadily increasing (Jones et al., 1999; McMichael et al., 2006), extreme climatic events and related disease outbreaks are becoming more frequent, faunas are shifting (Hunter, 2003), and invasive species are spreading (Galil, 2007; Molnar et al., 2008) and this is only a small part of global changes with serious consequences. Moreover, the recent COVID-19 crisis has affected all aspects of everyday life and work, and heavily impacted the global economy (Manzanedo and Manning, 2020). These circumstances appear to have accelerated the implementation of the maritime sustainability agenda with increased awareness (UNCTAD, 2019). This article try to deal with two main question and dilemmas: How does climate change affect the maritime transport and how maritime transport contribute to the climate changes?Climate change and the shipping industry.

It looks like a new norm is being set in the maritime sector, reflecting the modest growth of the global economy and efforts to tackle the impact of the shipping sector on climate change and the opposite (Kontovas, 2020). This important step is the result of the realized understanding of decision-makers that climate change is a serious problem for the marine industries, and humans are making a great contribution to this change (Mitchell et al., 2006). As results of this new realm, the last decades of the maritime industry have been characterized by significant technological and legislation changes to improve ocean ecology condition and minimize human impact on the ocean (Becker et al., 2018; Joung et al., 2020; Zis and Cullinane, 2020). The introduction of new technologies in the maritime sector such as Automatic Identification System (AIS) made which was originally designed to prevent accidents at sea (Bye and Almklov, 2019) has found wide applications to solve environmental problems through the monitoring of shipping activities (Ferraro et al., 2007, 2009; Fiorini, Capata and Bloisi, 2016). Below presented some of the impacts of climate change on maritime transport, in particular on its efficiency and profitability.

By analyzing the relation loop presented in Fig. 1, we can see an overall picture of the impacts of climate change on shipping activities. It is interesting to notice that one climate change phenomenon – ice melting is conducive to a growing maritime industry. All other climatic events like sea surface temperature rise, sea-level rise, and climate change policy or emission control regulations will have negative impacts on shipping activities. Moreover, we can see, if shipping activities increases, offshore and onshore maritime industries also increase. The growth of maritime industries will be decreased with the reduction of shipping activities.

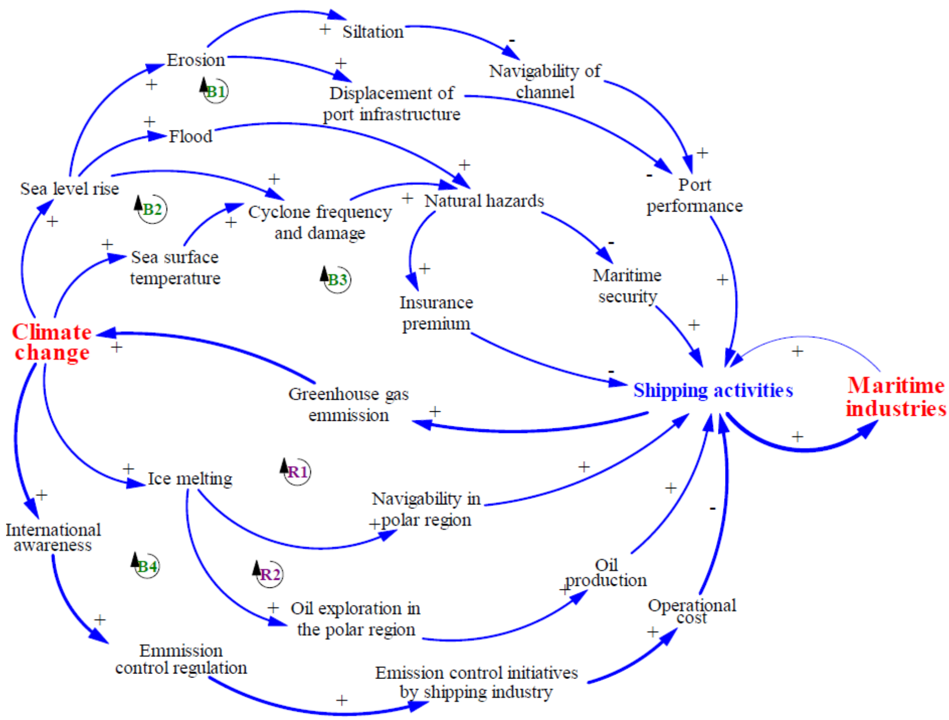

Figure 1: loop relationships among climate change, natural hazards, and shipping[1]

Shipping Decorbanization

All transportation sectors face decarbonization process in order avoid raising global average temperature (Bows-Larkin, 2015). Emissions from international shipping accounted for an average of 2.4% of global annual greenhouse gas (GHG) emissions between 2007–2012 and are expected to increase by 50–250% by 2050 in a 'Business as Usual' b scenario. However, in order to stay within the 1.5ºC global average temperature increase threshold, it is necessary that all sectors reach net-zero emissions by 2050. International shipping can significantly reduce GHG emissions using existing technical and operational measures, while a full decarbonization requires further research and development and rapid deployment of technology (Kachi, Mooldijk and Warnecke, 2019).

Globally there are around 52,000 merchant ships contributing to international shipping of goods and passengers (see Fig. 2 left). For a sense of scale, these ships produce engine capacity, more than Europe's entire fleet of fossil-fueled power stations.

1 https://commons.wmu.se/cgi/viewcontent.cgi?article=1275&context=all_dissertations

There is significant heterogeneity across the merchant fleet with different ships, fuels, emissions and regulations, thus there is no one-size-fits-all decarbonization solution. The greatest source of GHG emissions within shipping are from container ships, bulk carriers and oil tankers. This is due to these vessels conducting longer journeys to deliver their cargo – international and intercontinental, rather than domestic and coastline routes. The spatial distribution of these emissions is shown in Fig. 2 (right) and covers most of the oceans and seas in the northern hemisphere (Balcombe et al., 2019).

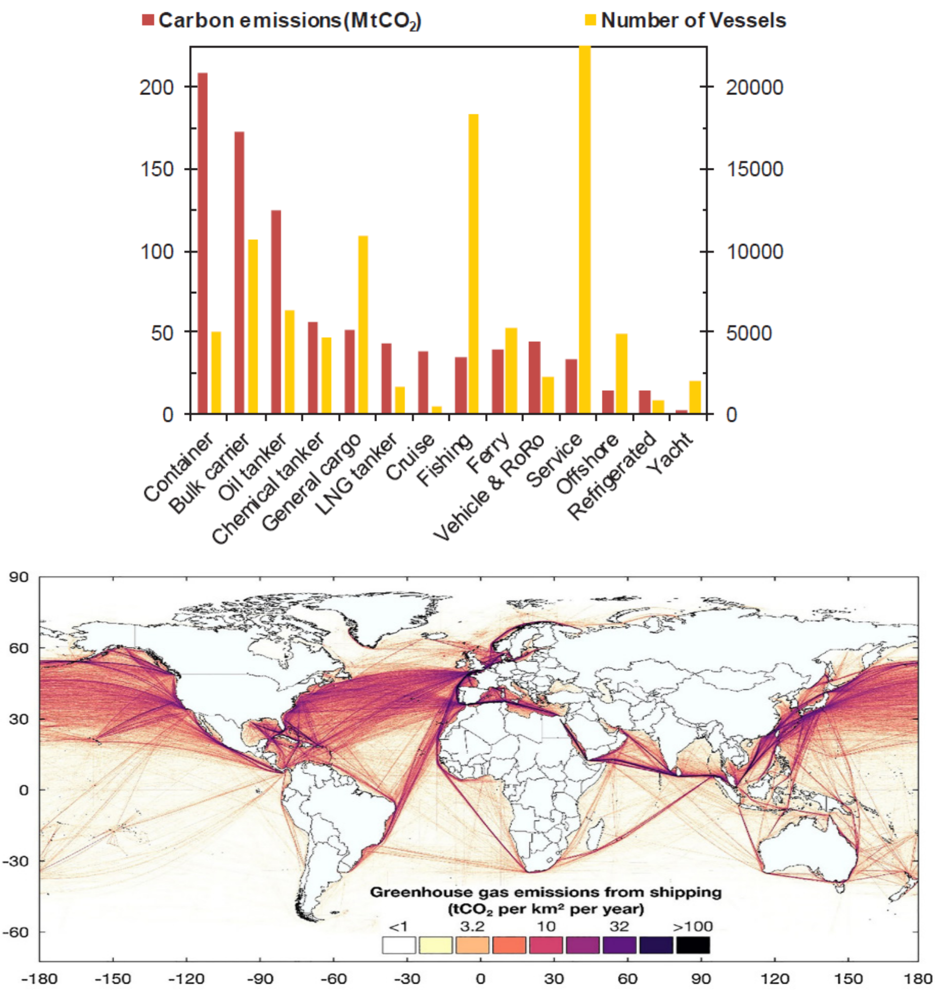

Figure 2: Number of merchant ships and their carbon emissions, by category (Upper image) and Map of the global distribution of greenhouse gas emissions from shipping (Lower image) in 2017 (from Balcombe et al., 2019)

Over the past several decades, significant legislative action has been taken through the International Maritime Organization (IMO) to decarbonize transport to avoid further temperature increases and lower GHGs emissions from shipping (Joung et al., 2020; Kontovas, 2020).

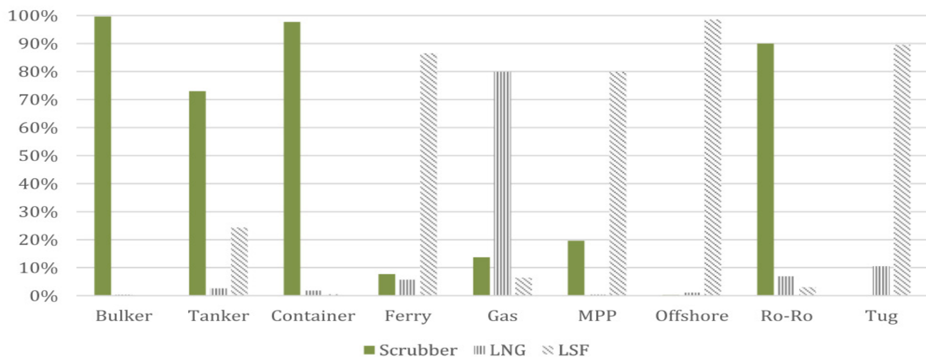

Figure 3: Share of vessels turning to three different compliance methods by fleet type (Li et al., 2020)

However, such policy and legislative measures to tackle the increase in CO2 and other GHGs remain grossly inadequate (Bows-Larkin, 2015). The second "However" it's the nature of the contribution of the various gases emitted from ships to climate change is complex (Kontovas, 2020). One of the major advances in minimizing the impact of shipping on climate change appears to have been the adoption of the 2020 IMO resolutions to reduce GHGs emissions from ships (especially SOx[2]). Although SOx gases are generally not considered greenhouse gases, they have a cooling effect that plays a role in climate change and negatively impacts human health and the environment (Zis and Cullinane, 2020). With the introduction of the sulfur limitation IMO 2020, shipowners have three main abatement options: (1) switching to low sulfur fuel (LSF); (2) installation of sulfur oxide scrubbers; (3) runs on liquefied natural gas (LNG). In fig. 2 clearly shows significant differences between fleet types depending on how ship operators respond to the new 2020 IMO sulfur limit. Almost all bulk carriers, containers, and Ro-Ros ships are equipped with SOx scrubbers, while the majority of tugs, and ferries have switched to LSF. Most of the gas vessels are LNG-powered; this is as expected, as are most LPG vehicles such as LNG and liquefied petroleum gas (LPG) (Li et al., 2020). The new IMO 2020 regulation, which should lower the sulfur limit from 3.50 percent to 0.50 percent, is expected to bring significant benefits to human health and minimize human impact on climate change.

2 https://ec.europa.eu/commission/presscorner/detail/en/IP_19_6837

Given the acceleration of climate change due to the elimination of the cooling effect of SOx emissions, more ambitious carbon reduction targets may be required (Kontovas, 2020).

Impact of extreme weather events on shipping

Various aspects of the maritime industries are becoming increasingly susceptible to extreme weather events, mainly as a result of climate change. Quite obviously that in the present we experience an increase in the numbers of natural disasters a year, resulting in devastating consequences (Knutson et al., 2010). Climate change primarily affects the frequency of extreme weather events such as storms, hurricanes, waves regime, as well as the vulnerability of coastal areas to sea-level rise (Huppert and Sparks, 2006). The catastrophic consequences can only intensify if more effective ways to mitigate the consequences are not found (Mitchell et al., 2006). Extreme weather events are particularly challenging, which can affect simultaneously multiple countries, while the largest events can have global implications (Huppert and Sparks, 2006). Continuous efforts are needed to identify areas at risk and to take action to apply scientific evidence before events occur.

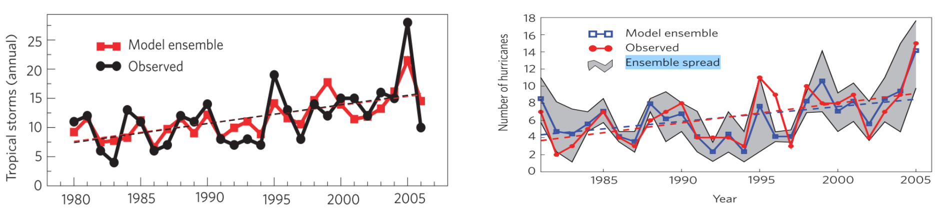

Figure 4: Simulated versus observed Tropical cyclone (left image) and Hurricanes between years 1980–2006 (based on Knutson et al., 2010)

In fig. 3 shows changes in the annual number of tropical cyclones and hurricanes with relatively conflicting results. A manifestation of the ambiguity of the results is fluctuations in the frequency and intensity of tropical cyclones with a large amplitude, which significantly complicates the identification of long-term trends, despite the general trend towards an increase in the number. Future projections based on different theories and models indicate that warming from anthropogenic greenhouse gases will increase the global average tropical cyclone intensity towards more severe storms, with an increase of 2–11% by 2100 (Knutson et al., 2010). Conclusion

As climate change risks have become increasingly recognized and understood by the scientific community, vulnerable sectors such as shipping, ports, and supply chains are now beginning to consider implications for both their long-lived infrastructure and the efficiency and resilience of their operations. Here are just some of the major changes and outputs expected to impact business as usual scenario:

1. Increased regulation on maritime transport, such GHSs emissions (Joung et al., 2020).
2. Increased operating costs and movement of freight (Curtis, 2009).
3. New shipping lanes, mainly Artic (Wright, 2013).
4. Higher risk of port infrastructure damage (Hanson et al., 2011; Messner et al., 2013)

Future trends and recommendations

- With climate change and its impacts, the marine industry will be affected to a certain extent and the environmental regulation requirements on the industry will grow.
- The maritime sector, which is highly dependent on various effects of climatic changes, must be very interested in minimizing climate impacts, as inaction now will be costly in the future.
- With the increased range, intensity and severity of climate change of impacts, existing shipping routes are no longer as safe and easy to navigate as they used to be, new routes need to be planned. Re-routing can be very inconvenient and reduce productivity for both the client and the shipping line because instead of continuing with their normal operations, shipping companies must devote time and financial resources to route planning. For the customer, an increase in delivery time will affect their delivery.
- Autonomous vessels will allow shipowners to more effectively control vessel traffic, reduce fuel consumption and emissions, thereby reducing the contribution of shipping to climate change.
- Work in partnership—climate impacts do not respect borders, working with relevant partners contributes to more effective outcomes; building "regional redundancy" capacity can help damaged ports bounce back from storm events more quickly by accessing resources (e.g., equipment and cargo rerouting) at nearby facilities.

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