MARINE ENVIRONMENT PROTECTION COMMITTEE
77th session
Agenda item 7

MEPC 77/7/18
17 September 2021
Original: ENGLISH
Pre-session public release: ☒

REDUCTION OF GHG EMISSIONS FROM SHIPS

Climate Change 2021: The Physical Science Basis, IPCC 2021

Submitted by WWF, Pacific Environment and CSC

SUMMARY

Executive summary:	This document draws attention to the UN Intergovernmental Panel on Climate Change's publication of the first part of three working group reports published as part of the Sixth Assessment Cycle. The Working Group I report focuses on the physical science basis of climate change. The Committee is invited to note the findings from the report, together with the views of the co-sponsors, and is urged to support the urgent action outlined.
Strategic direction, if applicable:	3
Output:	3.2, 3.3
Action to be taken:	Paragraph 16
Related documents:	MEPC 77/7/3, MEPC 77/7/15 and MEPC 75/7/15

Introduction

1 The UN body for assessing the science related to climate change – the Intergovernmental Panel on Climate Change's (IPCC) – Sixth Assessment Cycle started with three special reports, including *The Special Report on Global Warming of 1.5°C* (known as *SR1.5*) published in 2018, which focused on emission pathways and system transitions consistent with 1.5°C global warming over the twenty-first century. *SR1.5* had previously concluded that "all emission pathways with no or limited overshoot of 1.5°C imply that global net anthropogenic CO_2 emissions would need to decline by about 45% from 2010 levels by 2030, reaching net zero around 2050, together with deep reductions in other anthropogenic emissions, such as methane and Black Carbon." (For a summary of the three special reports see box 1.2 in the *Full Report (FR)*).

2 This document draws attention to the first part of three IPCC working group reports that will be published as part of the Sixth Assessment Cycle. The report of Working Group I which focuses on the physical science basis of climate change, published in August 2021,

is the most up-to-date physical understanding of the climate system and climate change. The report consists of a *Summary for policymakers* (SPM) (39 pages) [1], a *Technical summary* (TS) (150 pages)[2] and a *Full report* (FR) (1800 pages)[3]. Further reports from Working Groups II and III, focused on climate change impacts, adaptation and vulnerability and on mitigation of climate change, are due in 2022.

3 In brief, the report conveys a stark message. "Unless there are immediate, rapid and large-scale reductions in greenhouse gas emissions, limited warming to 1.5°C will be beyond reach", and "To limit global warming, strong, rapid, and sustained reductions in CO_2, methane and other greenhouse gases are necessary. This would not only reduce the consequences of climate change but also improve air quality[4]." It is acutely apparent that "transformational change is needed at all levels – individuals, communities, business, institutions and governments.[5]"

***Climate Change 2021: The Physical Science Basis* key findings**

4 *Climate Change 2021: The Physical Science Basis* concludes that scientists are observing climate changes in every inhabited region of the planet and across the whole climate system. Furthermore, it is agreed that these changes are rapid, intensifying and unprecedented in thousands of years. Some of the immediate findings are set out below for the consideration of the Committee:

.1 human influence has warmed the climate at a pace that is unprecedented in at least the last 2000 years (*SPM A*), and at the core of these impacts is the increase in concentrations of greenhouse gas emissions in our atmosphere and its reflection in temperature;

.2 global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the twenty-first century unless deep reductions in carbon dioxide (CO_2) and other greenhouse gas emissions occur in the coming decades (*SPM B.1*);

.3 with regard to shifts in temperature, in 2019 atmospheric CO_2 concentrations were higher than at any time in at least 2 million years (*SPM A.2.1);*

.4 human-induced climate change is already affecting many weather and climate extremes in every region across the globe (*SPM A.3*);

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1 IPCC, 2021: Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press. Available at: https://www.ipcc.ch/report/ar6/wg1/#SPM

2 Id. at: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_TS.pdf

3 Id. at: https://www.ipcc.ch/report/ar6/wg1/#FullReport

4. https://www.ipcc.ch/report/ar6/wg1/downloads/outreach/IPCC_AR6_WGI_SPM_Basic_Slide_Deck_Figures.pdf

5 Rowell, A. (2021). Climate Crisis: Scientists warn that the worst is yet to come if we don't act now. *Price of Oil.* Available at: http://priceofoil.org/2021/06/24/climate-crisis-scientists-warn-worst-is-yet-to-come-if-we-dont-act-now/

.5 human influence has likely increased the chance of compound extreme events since the 1950s. This includes increases in the frequency of concurrent heatwaves and droughts on a global scale; fire in some regions of all inhabited continents; and compound flooding in some locations (*SPM A.3.5*);

.6 global mean sea level (GMSL) has risen faster since 1900 than over any preceding century in at least the last 3000 years (*SPM A.2.4*);

.7 together, ice sheet and glacier mass loss were the dominant contributors to global mean sea level rise during the period 2006 to 2018 (*SPM A.4.3*); and

.8 some recent hot extremes observed over the past decade would have been *extremely unlikely* to occur without human influence on the climate system. Marine heatwaves[6] have approximately doubled in frequency since the 1980s, and human influence has very likely contributed to most of them since at least 2006 (*SPM A.3.1*).

The Arctic continues to warm at twice the global rate

5 The present state of many aspects of the climate system is unprecedented over many centuries to many thousands of years and this will continue. The IPCC report recognizes that the changes happening across the globe are magnified in the Arctic and that vital aspects of many traditional Arctic indigenous communities are under threat:

.1 it is *virtually certain* that the Arctic will continue to warm more than global surface temperature, with high confidence above two times the rate of global warming. *(SPM B.2.1*). The Arctic is projected to experience the highest increase in the temperature of the coldest days, at about three times the rate of global warming. (*SPM B.2.3*);

.2 in the period 2011 to 2020, the annual average Arctic sea ice area reached its lowest level since at least 1850. The late summer Arctic sea ice area was smaller than at any time in at least the past 1,000 years. The global nature of glacier retreat, with almost all of the world's glaciers retreating synchronously since the 1950s, is unprecedented in at least the last 2,000 years (*SPM A.2.3*);

.3 the Arctic is likely to be practically sea ice free during the seasonal sea ice minimum (in September) for the first time before 2050 in all considered scenarios. This "practically ice-free state is projected to occur more often with higher greenhouse gas concentrations (SPM B.2.5) and will become the new normal for high-emission scenarios by the end of this century" (*FR Chapter 9 Executive Summary*);

.4 mountain and polar glaciers are committed to continue melting for decades or centuries. Loss of permafrost carbon following permafrost thaw is irreversible at centennial timescales. Continued ice loss over the twenty-first century is virtually certain for the Greenland ice sheet and likely for the Antarctic ice sheet. There is high confidence that total ice loss from the Greenland ice sheet will increase with cumulative emissions (SPM B.5.2); and

[6] Sustained periods of anomalously high near-surface temperatures that can lead to severe and persistent impacts on marine ecosystems.

.5 it is *virtually certain* that global mean sea level rise will continue to rise over the twenty-first century. Relative to the period 1995 to 2014, the likely global mean sea level rise by 2100 is from between 0.28 to 0.55 m under the very low GHG emissions scenario to 0.63 to 1.01 m under the very high GHG emissions scenario (*SPM B.5.3*). Global mean sea level rise above the likely range – approaching 2 m by 2100 and 5 m by 2150 under a very high GHG emissions scenario – cannot be ruled out due to uncertainty in ice sheet processes *(SPM B.5.3*). In the longer-term sea level is committed to rise for centuries to millennia due to continuing deep ocean warming and ice sheet melt and will remain elevated for thousands of years. Over the next 2,000 years, global mean sea level will rise by about 2 m to 3 m if warming is limited to 1.5°C, 2 m to 6 m if limited to 2°C and 19 m to 22 m with 5°C of warming, and it will continue to rise over subsequent millennia (*SPM B.5.4*).

6 Black Carbon (BC) is a significant short-lived climate forcer (SLCF) of particular relevance to warming in the Arctic. Indeed, the Arctic Council has adopted a target of reducing black carbon emissions by between 25% to 33% by 2025 (based on 2013 levels). The report clarifies that warming SLCFs are either greenhouse gases (e.g., ozone or methane) or particles like Black Carbon (also known as soot), which warm the climate by absorbing energy and are sometimes referred to as short-lived climate pollutants. Cooling SLCFs, on the other hand, are mostly made of aerosol particles, (e.g. sulphates, nitrates and organic aerosols) that cool down the climate by reflecting away more incoming sunlight (*FR 6.8*). While most of the radiative forcing which causes climate change comes from CO_2 emissions, many short-lived species themselves exert a warming effect, including Black Carbon and CH_4, while aerosol species, especially SO_4, tend to cool the climate and their reduction leads to a masking of greenhouse gas induced warming (*FR 1.2.2*).

7 Some findings from the report are set out below:

.1 the Arctic region is warming considerably faster than the rest of the globe and, generally, studies indicate that this amplification of the temperature response toward the Arctic has important contributions from local and remote aerosol forcing. Several studies indicate that changes in long-range transport of sulphate and BC from northern midlatitudes can potentially explain a significant fraction of Arctic warming since the 1980s (*FR 6.4.3*);

.2 global emissions of carbonaceous aerosols (BC, organic carbon, (OC)) almost doubled since 1950 with North America and Europe contributing about half of the global total, but successful introduction of diesel particulate filters on road vehicles and declining reliance on solid fuels for heating, brought in large reductions. (*FR 6.2.1*);

.3 there is high confidence that darkening of snow through the deposition of Black Carbon and other light absorbing particles enhances snow melt (*SROCC Chapter 3*, also *FR 7.3.4.3*) and the darkened surface subsequently absorbs more solar energy, leading to more melting and more warming;

.4 the efficacy of Black Carbon on snow forcing was estimated to be 2 to 4 times as large as for an equivalent CO_2 forcing as the effects are concentrated at high latitudes in the cryosphere (*FR 7.3.4.3*); and

.5 studies show relatively large responses in the Arctic to BC perturbations and reveal the importance of remote BC forcing by rapid adjustments (*FR 6.4.3*).

International shipping's role in the climate crisis

8 Shipping's primary source of climate warming impacts remains its substantial CO_2 emissions. According to the *Fourth IMO Greenhouse Gas Study 2020*, shipping emitted an estimated 1,056 million tonnes of CO_2 emissions in 2018, an increase of 9.3% in just the six years since 2012. The climate warming impact of short-lived climate forcing from Black Carbon emitted by ships, addressed by the Organization for the first time, was also found to be significant, representing some 7% of shipping's CO_2 equivalent emissions on a 100-year timescale and 21% on a 20-year timescale, i.e. within the time remaining to fully decarbonize by 2050[7].

9 The IPCC report notes that shipping's recourse to burning heavy fuel oil (HFO) resulted in the sector being responsible for 10% or more of the controllable fine particulate matter ($PM_{2.5}$) concentrations and depositions of oxidized nitrogen and sulphur for many coastal countries, generating adverse health impacts especially over India, East China and coastal areas of Africa and the Middle East (Sofiev et. al., 2018) (*FR 6.6.2.3.2*). The IMO decision to limit the sulphur content of marine fuel globally to 0.5% in 2020 has thus been rightly lauded as leading to improved air quality and reduction in premature mortality and morbidity.

10 The IPCC report also recognises the past climate cooling effect of sulphate emissions from shipping – spanning a range -47 mW m-2 to -8 mW m-2 (direct radiative effect) and – 600 mW m-2 to -38 mW m-2 (indirect radiative effects) *(FR 6.6.2.3.2*) – and that the introduction of the global 0.5% limit on ship fuel sulphur content in 2020 resulted in a 77% reduction – or about 8 Tg of SO_2 – but which in turn decreased ship sulphur's cooling effect by some 80% (FR 6.6.3.2). This considerably increased shipping's global warming potential by at least 30% and significantly shortens the timescale of the transition from shipping's role as net cooler to a new source of increased warming potential.[8]

11 Factoring in this regulatory development makes a critical case for urgent action on all sources of shipping's climate warming impacts, principally CO_2 and especially short-lived climate pollutants Black Carbon and methane.

12 The IPCC report notes that specific reductions of the warming SLCFs (CH_4 and BC) would, in the short term, contribute significantly to the efforts of limiting warming to 1.5°C. Reductions of BC and CH_4 would have substantial co-benefits improving air quality and therefore limit effects on human health and agricultural yields. This would, in turn, enhance the institutional and sociocultural feasibility of such actions in line with the United Nations' Sustainable Development Goals (*FR 6.1.2*).

Co-sponsors commentary

13 The IPCC's latest findings are the strongest confirmation yet that dramatic and transformative change is urgently required in all sectors if the worst of the climate crisis is to be averted. The timescales necessary to remain within a 1.5°C or 2°C warming scenario will require very substantial reductions in emissions from all sources this decade and total decarbonization including by the maritime industry by 2050 at the latest.

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[7] Olmer N, et al, 2017. *Greenhouse gas emissions from global shipping, 2013-2015*. The ICCT also found that BC emissions from the entire Arctic fleet increased by 85% between 2015 and 2019. https://theicct.org/sites/default/files/publications/Arctic-HFO-ban-sept2020.pdf

[8] Zisi, V., Psaraftis, H. N., & Zis, T. (2021). The impact of the 2020 global sulfur cap on maritime CO_2 emissions. *Maritime Business Review*.

14 The recent statements by some nations including the United States, the United Kingdom, and in document MEPC 77/7/3 (Kiribati et al.) have reiterated this call for full decarbonization. It is clear that the commitment by Member States in 2018 to reduce ship emissions globally by at least 50% by 2050 now needs to be revised to ensure full decarbonization by 2050 at the absolute latest. Follow-up action by Member States to date has been entirely inadequate and ambition needs to be urgently stepped up. Even straightforward and readily implementable action to reduce shipping's short-term warming impacts in the Arctic, the most climate vulnerable of regions, has yet to be taken.

15 The co-sponsors urge the Organization and its members to:

.1 make immediate cuts to Black Carbon emissions from shipping in and near the Arctic, and urgently develop measures to reduce black carbon emissions from shipping globally;

.2 revise the levels of ambition in the recently agreed short-term carbon intensity reduction measures to include a 1.5°C-compatible 7% annual improvement in the carbon intensity of ships; and

.3 revise its climate targets to ensure full decarbonization of international shipping *well before* 2050,[9] with intermediate absolute emission reduction targets that provide a clear trajectory for the industry.

Action requested of the Committee

16 The Committee is invited to note the findings listed in paragraphs 4 to 12 from the first part of the Intergovernmental Panel on Climate Change's Sixth Assessment report, *Climate Change 2021: The Physical Science Basis*, together with the views expressed in paragraphs 13 to 14 and is urged to support the urgent action outlined in paragraph 15 and to implement without delay the immediate measures recommended.

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9 According to the International Council on Clean Transportation (ITCC), to have a high likelihood (67% chance) of remaining below 1.5°C, shipping's carbon budget must not exceed 10 GT, and must fully decarbonize by 2040 at the latest. See most recently: Comer, B. (2021). *Zero-emission shipping and the Paris Agreement: Why the IMO needs to pick a zero date and set interim targets in its revised GHG strategy.* International Council on Clean Transportation. Available at: https://theicct.org/blog/staff/marine-shipping-imo-ghg-targets-global-sept21