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ENERGY EFFICIENCY OF SHIPS

Proposal for the CII adverse weather voyage adjustment

Submitted by Argentina, Chile, Cook Islands, Panama, Samoa, Türkiye, ICS, IPTA and Nautical Institute

SUMMARY

Executive summary:	The co-sponsors' previous document MEPC 84/6/5 (Cook Islands et al.) provided detailed justifications for an adverse weather voyage adjustment within the carbon intensity indicator (CII). This document builds on the earlier submission by proposing a methodology similar to that which has been successfully adopted by IMO for the existing ice voyage adjustment. This proposal would allow fuel consumption and distance travelled during defined adverse weather periods to be excluded from CII calculations. Thresholds are based on existing IMO minimum power standards, i.e. significant wave heights above 4.5 m for smaller ships and 6.0 m for larger ships, with corresponding wind limits. The document contends that the methodology is practical, verifiable using AIS and weather data, consistent with MARPOL's safety provisions, and would ensure accuracy and fairness without affecting IMO's overall GHG reduction targets.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 27
Related documents:	Resolution MEPC.355(78); MEPC 84/WP7, MEPC 84/6/2; MEPC 76/7/23 and MEPC.1/Circ.850/Rev.3

Background

1 Within the Correspondence Group (CG) on Carbon Intensity Reduction that prepared the *2022 Interim Guidelines on correction factors and voyage adjustments for CII calculations (CII Guidelines, G5)* (resolution MEPC.355(78)), proposals for including adverse weather as a reason for applying the FC_{voyage} adjustment were previously considered.

2 Despite a majority of the CG agreeing that voyage adjustment for adverse weather should be given further consideration, it is not currently included within the CII Guidelines, G5.

3 More recently, it has become clear that a number of operational factors which are outside of the control of the ship are influencing CII ratings. These factors were discussed at the first session of the Intersessional Working Group on Air Pollution and Energy Efficiency (ISWG-APEE 1), and with respect to the impact of adverse weather, it was agreed to keep its consideration in abeyance until further concrete proposals were submitted to a future session of the Committee.

4 Document MEPC 84/6/5 (Cook Islands et al.) built on earlier submissions and provided further robust justifications for an adverse weather voyage adjustment. Following an initial discussion of this document, the Working Group on Air Pollution and Energy Efficiency at MEPC 84 agreed to keep its further consideration in abeyance (MEPC 84/WP.7), pending submission of a proposal to a future session.

5 Accordingly, this document sets out a detailed proposal for the adverse weather voyage adjustment.

Adaptation of the ice voyage adjustment methodology

6 Within the CII Guidelines, G5, a voyage adjustment has already been adopted for periods when sailing in sea ice. Due to the excessive fuel consumption, both the distance travelled and fuel consumed may be omitted from the annual assessment of a ship's CII rating. As this has been successfully implemented since January 2023, the co-sponsors considered that the methodology could be a good basis for the adverse weather voyage adjustment.

7 Therefore, a shipowner that utilizes the ice voyage adjustment and the recognized organization (RO) validating the supporting data were consulted. The key elements were identified as follows:

.1 by reference to satellite data and the EU Copernicus ice maps, a specialist consultant assesses the boundary location of the ice edge. By comparison with the ship's AIS data, the time periods within which a ship is within the sea ice are then established;

.2 the shipowner maintains an hour-by-hour record of the ship's fuel consumption and, by comparison with the data from the consultant, can determine the periods for which to delete the fuel consumption and distance travelled from the record;

.3 annually, the shipowner submits all of the data to the class society acting as the RO; and

.4 both the shipowner and the RO have confirmed this methodology is working well and the administrative burden is manageable.

8 Considering how this approach could be adapted for an adverse weather voyage adjustment, similar historic records of global wave height and wind speed are also available, for example within the EU's Copernicus[1] database or the National Oceanic and Atmospheric Administration (NOAA)[2] database. If a weather limit can be agreed, then in a very similar way, the AIS data can be cross-referenced to determine the points in time when a ship is within a

[1] Further information on the EU's Copernicus may be found at: https://marine.copernicus.eu/

[2] Further information on the NOAA database may be found at: https://www.nco.ncep.noaa.gov/pmb/products/

locality that exceeds those weather limits. Therefore, the critical thing to determine is a rationally based weather limit, above which the adverse weather voyage adjustment becomes applicable.

Discussion of an appropriate limit for the adverse weather voyage adjustment

MEPC's requirements for a ship to maintain its ability to manoeuvre in adverse conditions

9 The *Guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions* (MEPC.1/Circ.850/Rev.3) define the minimum power requirements for a ship to maintain its manoeuvrability in adverse conditions, which are defined as follows:

.1 for a ship length less than 200 metres, the adverse condition corresponds to a significant wave height of 4.5 metres and a mean wind speed of 19.0 m/s, i.e. Beaufort force 8;

.2 for a ship length greater than 250 metres, the adverse condition corresponds to a significant wave height of 6.0 metres and a mean wind speed of 22.6 m/s, i.e. Beaufort force 9; and

.3 for ship lengths of between 200 and 250 metres, the adverse condition should be interpolated.

10 Once the adverse conditions are exceeded, it is likely that the ability to manoeuvre will be compromised and alternative strategies will be employed to maintain safety, e.g. resorting to a power reserve, altering course, or seeking shelter. Such strategies will increase the fuel consumption as compared to a similar ship undertaking the same voyage that has not encountered adverse conditions.

11 Indeed, regulation 3.1 of MARPOL Annex VI exempts emissions necessary for securing the safety of a ship:

"Regulations of this Annex shall not apply to:

.1 any emission necessary for the purpose of securing the safety of a ship or saving life at sea".

12 Therefore, in principle, a ship experiencing conditions in excess of the aforementioned limits could request exemption of its emissions from its annual CII calculation, due to the excess fuel consumption necessary to maintain safety.

Increased fuel consumption attributable to sea states in adverse conditions

13 Regardless of the increased fuel consumption attributable to the aforementioned mitigation tactics, a ship will also incur additional fuel consumption due to the sea state encountered.

14 For example, figure 1 below, taken from Rawson and Tupper, 2005,[3] summarizes power requirement versus speed for a 150-metre ship in predominantly head seas. As may be seen, when comparing with a still water speed of 15 knots and to maintain constant power, Beaufort 7 would require about a 1.5 knot decrease in speed. Assuming the same distance travelled, this speed reduction would amount to about a 10% increase in fuel consumption.

[3] K.J. Rawson and E.C. Tupper. (2005). *Basic Ship Theory*

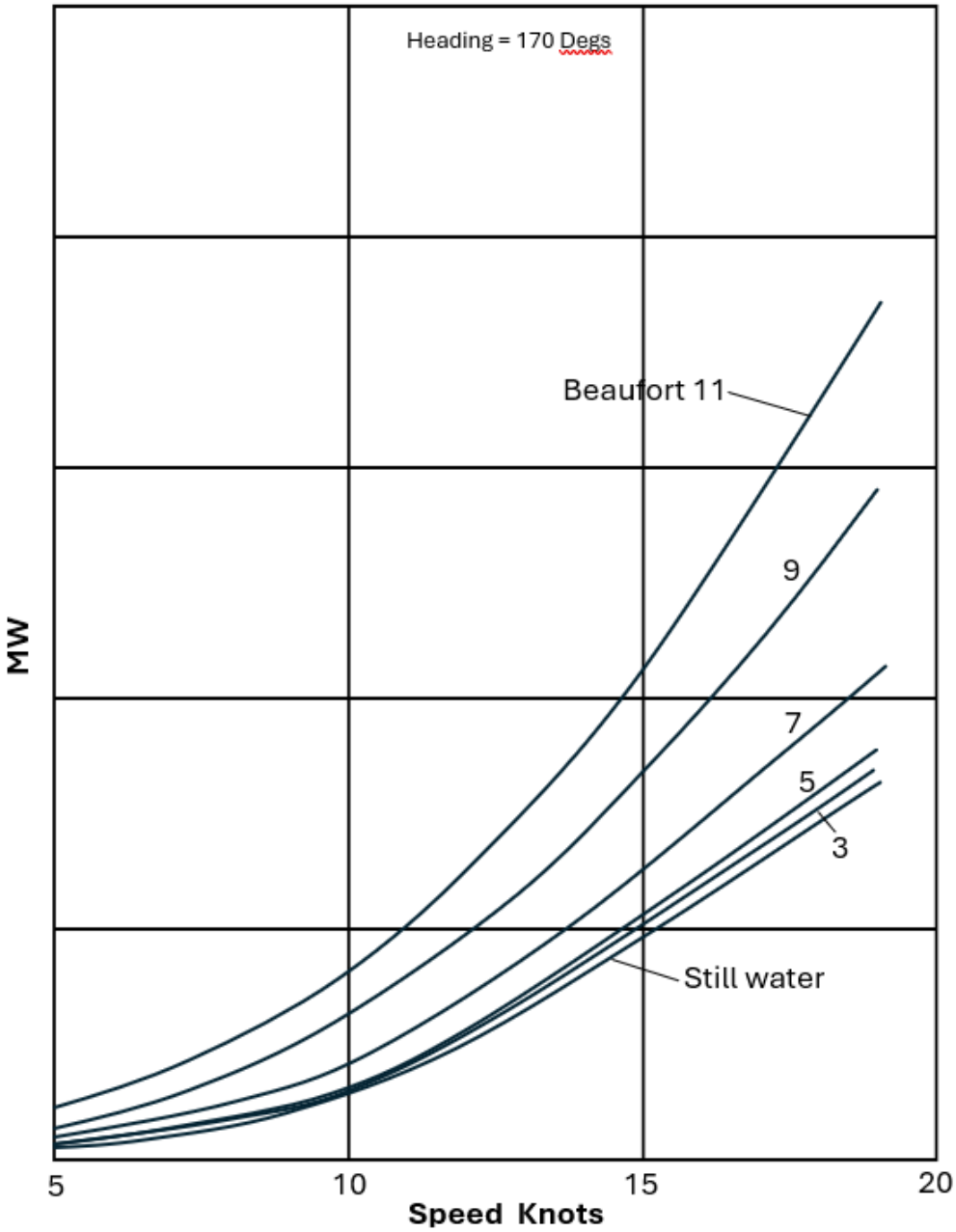

Figure 1: Power versus speed for varying sea state
(K.J. Rawson and E.C. Tupper, 2005)

Prevalence of the adverse conditions

15 For global conditions, Veritas (2017)[4] includes the table 1 wave scatter diagram for worldwide trade, and from this it can be determined that approximately 9% of waves encountered are in excess of 4 metres in significant wave height and 1.7% are in excess of 6 metres, with the prevalence of 4.5 metre waves lying between the two.

[4] Veritas, D. N. (2017). *Environmental Conditions and Environmental Loads*

Table 1: Wave height scatter diagram for worldwide trade
(Veritas, 2017)

T_Z(s)	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	Sum
Hs (m)																
1.0	311	2734	6402	7132	5071	2711	1202	470	169	57	19	6	2	1	0	26287
2.0	20	764	4453	8841	9045	6020	3000	1225	435	140	42	12	3	1	0	34001
3.0	0	57	902	3474	5549	4973	3004	1377	518	169	50	14	4	1	0	20092
4.0	0	4	150	1007	2401	2881	2156	1154	485	171	53	15	4	1	0	10482
5.0	0	0	25	258	859	1338	1230	776	372	146	49	15	4	1	0	5073
6.0	0	0	4	63	277	540	597	440	240	105	39	13	4	1	0	2323
7.0	0	0	1	15	84	198	258	219	136	66	27	10	3	1	0	1018
8.0	0	0	0	4	25	69	103	99	69	37	17	6	2	1	0	432
9.0	0	0	0	1	7	23	39	42	32	19	9	4	1	1	0	178
10.0	0	0	0	0	2	7	14	16	14	9	5	2	1	0	0	70
11.0	0	0	0	0	1	2	5	6	6	4	2	1	1	0	0	28
12.0	0	0	0	0	0	1	2	2	2	2	1	1	0	0	0	11
13.0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	4
14.0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Sum	331	3559	11937	20795	23321	18763	11611	5827	2489	926	313	99	29	9	0	100000

Average sea state

16 The CII reference lines are based upon fuel consumption data for a large number of ships operating in numerous locations around the world. Therefore, the reference lines represent the fuel consumption under average weather conditions. However, because the IMO DCS data does not include the latitude/longitude positions of the ships or the weather conditions experienced, it is impossible to ascertain precisely what the reference line average weather conditions are.

17 Nevertheless, there have been various studies published that assess the average conditions for each ocean. For example, Young (1999) provides a global climatology summary of wind and wave conditions.[5] Based upon satellite data, these give a monthly summary of the significant wave height for all sea areas. From this it can be determined that the global average predominantly lies in the range of 2 to 4 metres in significant wave height.

Previous weather limit proposed within the Correspondence Group on Carbon Intensity Reduction

18 Within the CG that prepared the CII Guidelines, G5, proposals for including adverse weather as a reason for applying the FC_{voyage} adjustment were previously considered. At that time, the threshold sea state was proposed as:

.1 mean significant wave height – 4.0 m; and

.2 mean wind speed – 28 knots,

i.e. a sea state consistent with a sustained wind speed of Beaufort force 7.

[5] Young, I. (1999). *Seasonal variability of the global ocean wind and wave climate.* Royal Meteorological Society.

Selection of an appropriate limit for the adverse weather voyage adjustment

19 Based upon the preceding discussion, for the adverse weather voyage adjustment, it is proposed to adopt the same limits as for the adverse conditions within the *Guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions* (MEPC.1/Circ.850/Rev.3), i.e.:

.1 for a ship length less than 200 metres, a significant wave height of 4.5 metres and a mean wind speed of 19 m/s, i.e. Beaufort force 8;

.2 for a ship length greater than 250 metres, a significant wave height of 6.0 metres and a mean wind speed of 22.6 m/s, i.e. Beaufort force 9; and

.3 for ship lengths of between 200 and 250 metres, the conditions should be interpolated.

20 The rationale underpinning this is as follows:

.1 Beyond these weather limits, and for the purposes of preserving safety, navigational strategies are likely to be deployed by crews that will themselves increase fuel consumption;

.2 When exceeding these limits, regulation 3.1 of MARPOL Annex VI provides justification for an adverse weather voyage adjustment, as this regulation exempts emissions necessary for securing the safety of a ship;

.3 Globally, the prevalence of such sea states lies within the range of 1.7% to 9%. Hence, whilst the number of ships experiencing these conditions is substantial, the percentage of the world fleet potentially claiming the adverse weather voyage adjustment will be small and therefore manageable in terms of overall administrative burden; and

.4 The CII reference lines are based on average global sea states, which lie in the range of 2 to 4 metres in significant wave height. The proposed limits for the adverse weather voyage adjustment are above this average, i.e. greater than 4 metres in significant wave height. Therefore, ships claiming the adverse weather voyage adjustment will be those that experience more extreme weather than the average, i.e. those unfairly treated under the existing CII rating system.

Alignment with the 2023 IMO GHG Strategy

21 The 2023 IMO GHG Strategy includes the following milestone target for the carbon intensity of the world fleet:

"To reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, compared to 2008".

22 IMO assesses progress towards this and publishes the results within its annual reports on carbon intensity. For example, most recently within document MEPC 84/6/2 (Secretariat), for the reporting year 2024. It should be noted that IMO's assessment is based upon total fuel consumed and total distance travelled for the entire world fleet. It takes no account of any correction factors or voyage adjustments within the CII rating mechanism. Therefore, regardless of the adoption of the adverse weather voyage adjustment, the basis for IMO's assessment of the carbon intensity of the world fleet will remain the same.

23 Progress towards the carbon intensity milestone is currently well on track. Nevertheless, if in subsequent years the industry's progress were to diverge, other actions could be considered, for example by revisiting the Z reduction factors. Therefore, the adoption of the adverse weather voyage adjustment does not undermine the co-sponsors' progress towards the 2023 IMO GHG Strategy's carbon intensity milestone.

Document MEPC 76/7/23 – Guidance on the assessment of proposed CII correction factors and voyage adjustments

24 Document MEPC 76/7/23 (France) included guidance on the assessment of proposed correction factors and voyage adjustments. The document proposes four criteria, and table 3 below assesses the proposed adverse weather voyage adjustment against them.

Table 3 – Assessment of the proposed adverse weather voyage adjustment against the document MEPC 76/7/23 guidance

Document MEPC 76/7/23 criteria	**Assessment of the proposed adverse weather voyage adjustment**
Policy justification	Detailed justification is included in the co-sponsors' previous document MEPC 84/6/5. The impact of adverse weather on a ship's fuel consumption has been extensively researched and the effects have been quantified for over 100 years. Most textbooks on naval architecture include relevant information. The impact is irrefutable; naval architects, marine engineers, mariners and test tank scientists are conversant with these effects. The question should not be why an adverse weather adjustment should be included, but rather why it should not be included.
Accuracy	As detailed within the co-sponsors' previous document, MEPC 84/6/5, the impact of adverse weather on fuel consumption is well understood and well documented. The means to accurately assess this impact are well established.
Applicability	The proposal within this document is based on the existing methodology for the ice voyage adjustment, which has been adopted since the coming into effect of CII in January 2023. A shipowner utilizing this methodology has confirmed that the administrative burden is manageable, and the RO's opinion is that appropriate documentary evidence is being provided, and a satisfactory level of verification is being achieved.
Assessment of effects	Document MEPC 76/7/23 clarifies that the objective of this criterion is to ensure that the 2023 IMO GHG Strategy target of a 40% reduction in carbon intensity of the world fleet is achieved by 2030. However, as explained earlier in this document, IMO's annual assessment of carbon intensity does not take into account correction factors or voyage adjustments. It uses the total fuel consumed and distances travelled, i.e. as reported by the world fleet through the IMO DCS. Regardless of the scope of adopted correction factors and voyage adjustments, IMO's methodology for assessing the carbon intensity of the world fleet will remain the same. Progress towards this target is very good, and as per IMO's latest annual report (i.e. for the 2024 DCS data) a 31.5% reduction has been achieved under AER and a 38.6% reduction under EEOI. Nevertheless, if in subsequent years the industry's progress were to falter, other actions could be considered, for example by revisiting the Z reduction factors. The objective of the CII rating mechanism should remain the accurate assessment of a ship's efficiency. Any aspect that unfairly impacts that assessment should either be corrected or the associated fuel consumption and distance travelled should be omitted from the calculation. Clearly, adverse weather is such a factor.

Regulatory text

25 The annex to this document details the proposed changes to the regulatory text.

26 The impact of adverse weather on fuel consumption and CII ratings is substantial and irrefutable. If left unaddressed, this inaccuracy will limit ongoing efforts to improve the fairness of the rating system. Without redress, affected services will be unfairly and inaccurately rated. Routes serving remote communities and islands within high latitudes will be particularly impacted due to their exposure to adverse weather.

Actions requested of the Committee

27 The Committee is invited to:

.1 consider the information provided in this document;

.2 note the detailed justifications provided by the co-sponsors in document MEPC 84/6/5;

.3 note the arguments provided in paragraphs 6 to 24 of this document; and

.4 adopt the amendments to the CII Guidelines, G5, as proposed in the annex to this document.

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ANNEX

PROPOSED AMENDMENTS TO THE 2022 INTERIM GUIDELINES ON CORRECTION FACTORS AND VOYAGE ADJUSTMENTS FOR CII CALCULATIONS (CII GUIDELINES, G5) (RESOLUTION MEPC.355(78))

The proposed additions are grey shaded and deletions ~~strike through and grey shaded~~:

2 Definitions

1 A new paragraph 2.3 is added as follows:

"For the purpose of these Guidelines, the definitions in regulation 2 of MARPOL Annex VI, as amended, apply. In addition, and for the scope of these guidelines, the following definitions apply.

2.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.2 *IMO DCS* means the IMO Ship Fuel Oil Consumption Database referred to in regulation 27 and related provisions of MARPOL Annex VI.

2.3 *Adverse weather* is defined as conditions that exceed either the wave height or wind speed defined as:

.1 for a ship length of less than 200 metres, a significant wave height of 4.5 metres and a mean wind speed of 19.0 m/s, i.e. Beaufort force 8;

.2 for a ship length of greater than 250 metres, a significant wave height of 6.0 metres and a mean wind speed of 22.6 m/s, i.e. Beaufort force 9; and

.3 for ship lengths of between 200 and 250 metres, the conditions should be interpolated."

2 Existing paragraphs 2.3 to 2.10 are renumbered as 2.4 to 2.11.

4 Attained annual operational CII (CII_{Ship}) formula for voyage adjustments and correction factors

4.1 $FC_{voyage,j}$ for voyage adjustment

3 Section 4.1 is replaced as follows:

"The parameter $FC_{voyage,j}$ is the total mass (in grams) of fuel of type j, consumed in voyage periods during the calendar year which may be deducted from the calculation of the attained CII in case the ship encounters one of the following situations:

.1 scenarios specified in regulation 3.1 of MARPOL Annex VI, which may endanger safe navigation of a ship; ~~and~~

.2 sailing in ice conditions, which means sailing of an ice-classed ship in a sea area within the ice edge; and

.3 the weather conditions listed under the definition of adverse weather within section 2.3 of these guidelines.

In cases where $FC_{voyage,j}$ is used:

- any associated distance travelled must also be deducted using D_x otherwise ships will benefit from distance travelled without any associated CO_2 emission.

- the ship should report data for the deductions associated with voyage adjustments to the Administration in accordance with appendix 2 of these guidelines."

APPENDIX 2

GUIDANCE ON REPORTING OF FUEL OIL CONSUMPTION AND DISTANCE TRAVELLED FOR VOYAGE PERIODS WHERE THE SHIP MEETS THE CRITERIA TO APPLY ANY VOYAGE ADJUSTMENT

4 Appendix 2 is replaced as a whole, as follows:

"In this appendix guidance is given for reporting and verification of fuel oil consumption and distance travelled concerning voyage adjustments when a scenario specified in regulation 3.1 of MARPOL Annex VI applies, which may endanger safe navigation of a ship, or when sailing in ice conditions, or in adverse weather.

1 Fuel oil consumption for voyage periods should include all the fuel oil consumed on board including but not limited to the fuel oil consumed by the main engines, auxiliary engines, gas turbines, boilers and inert gas generator, for each type of fuel oil consumed, regardless of whether a ship is under way or not. Methods for collecting data on fuel oil consumption in metric tonnes include the method using flow meters or the method using bunker fuel oil tank monitoring on board as described in paragraphs 7.1.2 and 7.1.3 of the *2022 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP Guidelines)* (resolution MEPC.346(78)) respectively.

2 The distance travelled over ground in nautical miles for voyage periods should be recorded in the logbook in accordance with SOLAS regulation V/28.1 and submitted to the Administration.

3 At the end of the voyage, if the ship has encountered ice conditions during its voyage, when the ship is under way sailing between the ice edges or between the ice edge and the port, or when a scenario specified in regulation 3.1 of MARPOL Annex VI applies, or the ship has encountered adverse weather:

.1 the fuel oil consumed, measured in accordance with 7.1.2 or 7.1.3 of the SEEMP Guidelines, for the voyage period should not be included in the calculations for the annual average attained CII index value;

.2 if the voyage period is excluded from calculations of the attained CII index value when a scenario specified in regulation 3.1 of MARPOL Annex VI applies, the distance travelled should be clearly marked in the SEEMP monitoring plan, the ship's logbook should include data entries for the voyage period with date, time and position of the ship when a scenario specified in regulation 3.1 of MARPOL Annex VI started to apply and ceased to apply, and the data should be added to the data reporting format;

.3 if the voyage period is excluded from calculations of the attained CII index value due to sailing in ice conditions or adverse weather, the distance travelled should be clearly marked in the SEEMP monitoring plan, the ship's logbook should include data entries for the voyage period with date, time and position of the ship when the ship encountered ice conditions or adverse weather and left ice conditions or adverse weather, and the data should be added to the data reporting format.

4 The summary of monitoring data containing records of measured fuel oil consumption and distance travelled for voyage periods should be available on board. Ice charts related to the voyage periods should also be available if the ship has sailed in ice conditions. For adverse weather, the cross correlation of time-stamped AIS records with the wave height and wind speed conditions from an appropriate metocean database* should be available to the verifier.

Figure 1: An example of an ice chart of the Baltic Sea area

(Omitted)

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* Examples of an appropriate metocean database are the European Union's Copernicus website https://marine.copernicus.eu/ or the NOAA database https://www.nco.ncep.noaa.gov/pmb/products/