Legal Approaches to Dry Cargo Liquefaction: An Arctic Perspective on a Global Problem

Stefan Kirchner

Structured Abstract

Article Type: Research Paper

Purpose—The liquefaction of dry cargoes poses a serious threat to maritime safety. Dry cargo liquefaction is frequently the cause of loss of life at sea. This text aims at raising awareness of the utility of existing international law norms to contribute to disaster risk reduction (DRR) at sea in this particular context.

Design, Methodology, Approach—The topic is approached from a particular Arctic perspective as the Arctic Ocean is opening up for maritime traffic in ways never seen before.

Findings—By bringing together technical and legal aspects, the text provides the reader with insights into a challenging problem with high practical relevance for seafarers around the world, emphasizing the human dimension of the regulation of the use of maritime spaces.

Practical Implications—This approach highlights the practical importance of insurance providers and other actors for enhancing shipping safety. This role can be seen also in other aspects of shipping safety, for example with regard to oil pollution or passenger rights.

Originality, Value—At this time, it appears that Arctic-related seafarer training regimes are not yet taking the increased risk of Dry Cargo Liquefaction into account as a matter of course—nor is there a corresponding legal requirement *de lege lata*.

University of Lapland, Arctic Centre, P.O. Box 122, 96100 Rovaniemi, Finland; email: stefan.kirchner@ulapland.fi; Tel: +358 40 48 44 001

Journal of Territorial and Maritime Studies / Volume 6, Number 1 / Winter/Spring 2019 / pp. 85–95 / ISSN 2288-6834 (Print) / © 2018 Yonsei University

Nevertheless, awareness of Arctic conditions and risks can help increase awareness of specific Arctic risks among crew members. There are not specific DCL-related rules in the Polar Code but it learning about Arctic-specific risks can complement existing rules, such as those of the IMSBC Code, to enhance seafarer safety.

Keywords: Arctic, law, risk, safety, shipping

Introduction

The Problem

Dry Cargo Liquefaction (DCL) causes the deaths about seafarers every year and over the course of two decades more than 800 lives of seafarers were lost due to DCL.[1] Even though the problem has been known for more than a century,[2] it is still not completely researched, let alone solved. This text is intended to provide an Arctic perspective on the problem, which is particularly relevant in the context of the transport of raw materials which are also found in the Arctic, such as iron or nickel[3] ore.

As global warming continues, shipping in the Arctic Ocean is predicted to increase. This has consequences not only for the Arctic environment,[4] but also for seafarers.[5] Already today, shipping routes which were long thought impenetrable, such as the Northwest Passage,[6] are used on a regular basis. Especially the Northern Sea Route along the Russian Arctic coast is already today used for regular cargo transport as well as for the transport of natural gas and other resources. Compared to traditional shipping routes, e.g., from East Asia to Europe through the Suez Canal, let alone around Africa, Arctic shipping routes offer significant financial savings.[7] Although shipping in the Arctic region is undergoing rapid changes,[8] it must not be ignored that fundamental dangers associated with shipping continue to remain relevant even in times of increasing reliance on technology.[9] Although it can be assumed that fully automatic vessels will cause a revolution in shipping similar to that which followed the introduction of standardized containers,[10] for the time being the human factor in shipping is not to be underestimated.

The transport of potentially dangerous goods, such as nickel, by sea is likely to increase in the Arctic as the Arctic Ocean is becoming more accessible. In particular, the nickel mine operating by Nornickel (formerly Norilsk Nickel) in the Russian city of Nickel as well as other mines on the Kola peninsula are likely candidates for nickel transports by ship. Increasing interest by the international shipping industry in the Barents region increases the likelihood of ship-based nickel transports in the Arctic. This in turn increases the likelihood of DCL events which can endanger the lives of seafarers.

That transport by ship remains dangerous is often forgotten by consumers. Every day, seafarers risk their health and their lives to ensure the continued functioning of the global economy. By entering the Arctic region, this risk is only increasing. In this text, the particular threat posed by dry cargo liquefaction will be used as a starting point for an investigation into the possibilities provided by what can

be referred to as the "The Human Dimension of the Polar Code,"[11] i.e., the training requirements created by the Polar Code and amendments to the STCW Convention, including the STCW Code, including both the 2010 Manila Amendments and new changes due to the entry into force of the Polar Code. It is the aim of this text to raise awareness among those working in the Arctic of this particular risk to human life, the natural environment and property in the Arctic.

Physics

While containers dominate the public perception of international shipping, raw materials are still often transported in bulk. As of 2010, 38 percent of the tonnage of the global merchant fleet (532 dwt) was devoted to such dry bulk shipping.[12] Ideally, assuming correct documentation by everybody concerned, the master and crew of a container vessel will know the weight and content of containers. While this is often not the case (as has been highlighted, e.g., by the fire on the *BBC Arizona* in the port of Valdez, Alaska, in 2013[13]), under ideal circumstances the crew will know the weight distribution on board their vessel. When transporting granular bulk cargo, there is no such certainty because the cargo can shift when it gets wet: "A combination of the water content, dynamic energy produced by the waves and the vessels [*sic*] engine along with the material itself would cause the granular bulk cargo to liquefy."[14] As a result, cargo which was loaded in a dry form "behaves like a fluid,"[15] sloshing around in the cargo hold and causing instability of the vessel.[16] Stability is a key safety issue in shipping.[17] This is a problem not only but especially in geographical areas which experience extreme weather events because "the movement of the cargo in a carrier's hold would dramatically weaken the stability of the carrier, even cause it to capsize under some rough seas."[18]

Technical Approaches

Among the technical approaches suggested to limit the risk of destabilization of ships are the idea that "a longitudinal baffle is recommended to be mounted in the cargo hold"[19] or that "Ultralight Honeycomb Cargo Hold Separators"[20] are used to limit the destabilizing effects of liquefied granular cargo on a vessel. In recent years, there have been a number of studies on this problem,[21] in particular regarding non–Newtonian fluids of an "incompressible and inelastic"[22] nature and which a "flow [which is] laminar and isothermal,"[23] as is the case, e.g., with a mix (or "slurry"[24]) of nickel ore and water.[25]

An alternative approach is to keep the cargo dry to begin with as "reducing the degree of saturation of cargos will enormously improve the stability of the cargo ship during transportation."[26] Humidity can enter dry cargo, e.g., during loading,[27] prior to loading during storage in ports or transport to ports, or during the voyage, e.g., if cargo hold hatches or doors are not closed properly. It is noteworthy that Dry Cargo Liquefaction is a particularly serious problem in some South South-East Asian countries known for humid climates, which export iron (India) or nickel or (such

as the Philippines, Indonesia but also New Caledonia).[28] Given that relevant materials, such as nickel, are also found in the Arctic, it appears necessary to raise awareness also in this geographical context. In order to prevent liquefaction, it is essential "that the transportable moisture limit (TML) and moisture content of cargoes must be accurately detected before shipment, and the moisture content should be under the TML."[29]

Regulatory Approaches

The IMSBC Code

One attempt to achieve this is through the International Maritime Solid Bulk Cargoes Code (IMSBC Code). The IMSBC Code has been included in Chapter VI and Chapter VII Part A1 of the International Convention for the Safety of Life at Sea[30] (SOLAS) and is legally binding since 1 January 2011.[31] The idea behind the IMSBC Code and its predecessor, the Code of Safe Practice for Solid Bulk Cargoes (BC Code), is to reduce risk through regulation. While insurance providers may impose their own standards and provide information,[32] the IMSBC Code is the closest to true international legal regulation regarding the problem of Dry Cargo Liquefaction. That said, "[i]t should be noted that other international and national regulations exist and that those regulations may recognize all or part of the provisions of this Code [and that] port authorities and other bodies and organizations should recognize the Code and may use it as a basis for their storage and handling bye-laws within loading and discharge areas."[33]

The IMSBC Code includes rules for the transport of "solid bulk cargoes, which are considered to be potentially liquefiable,"[34] including tests of the moisture content of the cargo in order to determine if there is a risk of liquefaction[35]: "The IMSBC Code infers the TML is the maximum Gross water content (GWC) that a cargo may contain without being at risk of liquefying,"[36] i.e., "a percentage of the moisture divided by the wet mass instead of the moisture divided by the dry mass."[37] This is an important piece of information for those who are handling cargoes such as nickel or iron ore[38] prior to or during loading it on a vessel because "the GWC of a material is not as commonly used in geotechnical engineering as the Net Water Content (NWC)."[39] It is not necessary for the cargo to be fully saturated in order to cause liquefaction.[40] Raising awareness of potential risks for seafarers at a later stage of the process from mining to customer already at an early stage can therefore contribute to reducing risks down the line, e.g., by ensuring that ores are protected against rainfall during storage or transport to a vessel.

The Polar Code

In recent years, more regulatory work has been done to address this significant threat to human life,[41] although it has been noted that this development is based

"almost entirely [on] empirical considerations, a fact implying the lack of a fundamental theoretical framework of the problem."[42] In the last few years, this number of new publications have delved deeper into the scientific questions underlying the problem of Dry Cargo Liquefaction. This increase in scientific knowledge also allows the international legal community to no longer simply react to problems but to look at potentials for the utilization of other (existing) legal tools for the improvement of seafarer safety in this particular context. In the following it will be argued that, although not directly aimed at the problem at hand, both the Polar Code and seafarer training can contribute in this regard.

General Remarks

The Polar Code entered into force on 1 January 2017. It is a legally binding instrument which has been created under the auspices of the International Maritime Organization (IMO) and which operates in the frameworks of both the International Convention for the Prevention of Pollution from Ships[43] (MARPOL) and SOLAS.[44] It is designed "to enhance maritime safety, training and environmental protection in the polar regions. It consists of two parts, each of which includes both mandatory and recommendatory sections,"[45] regulating both vessels and seafarers. While international shipping law is predominantly technical in nature, the human aspects of shipping are not to be underestimated. Even though its geographical scope does not include significant maritime areas which are located in the wider Arctic, e.g., the waters off Iceland, Norway and the Aleutian Islands,[46] it is quickly becoming an important tool for the improvement of shipping safety.

The idea behind the Polar Code "is to provide for safe ship operation and the protection of the polar environment by addressing risks present in polar waters and not adequately mitigated by other instruments of the [International Maritime Organization]."[47] While Dry Cargo Liquefaction is no specific polar problem, the Polar Code can be utilized to combat the risk of Dry Cargo Liquefaction.

The Polar Code addresses different kinds of dangers, such as the environment,[48] "rapidly changing and severe weather conditions, with the potential for escalation of incidents,"[49] "[i]ce, as it may affect hull structure, stability characteristics, machinery systems, navigation"[50] and aspects of vessel operations,[51] frozen ship surfaces,[52] cold temperatures,[53] long periods of light or darkness,[54] effects of high latitudes[55] and remoteness[56] and the lack of polar shipping experience among crew members[57] and of emergency equipment and services (Polar Code, Introduction, para. 3.8), by "includ[ing] improvements to charting, ice and weather forecasting, communications and maritime domain awareness."[58] Obviously, ice features prominently in discussions concerning polar shipping risks.[59] This also leads to a focus on charting[60] and, because it "is limited in polar waters[, the Polar Code] requires additional navigation equipment so that ships can know where the ice is."[61] Such situational awareness is also relevant for other features of the Arctic shipping environment, for example extreme weather phenomena, such as storms, which can accelerate the effects of liquefaction on the stability of vessels.[62]

Situational awareness can be created through training[63] as well as through the Polar Water Operational Manual (PWOM).[64] While the Polar Code does not address the problem of Dry Cargo Liquefaction *expressis verbis*, it contributes to the understanding of seafarers, especially seafarers without prior Arctic experience, of the conditions of shipping the polar regions. Overall, shipping in the Arctic requires more information about the Arctic and its particular dangers.[65] This includes the training requirements envisaged in the Polar Code.

Seafarer Training and the Polar Code

Among the human elements of the Polar Code is the requirement for adequate training,[66] which will require amendments to the STCW Convention.[67] According to para. 12.1 of the Polar Code it is the goal of the Polar Code's training and manning requirements "to ensure that ships operating in polar waters are appropriately manned by adequately qualified, trained and experience personnel."[68] Specifically, "companies shall ensure that masters, chief mates and officers in charge of a navigational watch on board ships operating in polar waters shall have completed training to attain the abilities that are appropriate to the capacity to be filled and duties and responsibilities to be taken up, taking into account the provision of the STCW Convention and the STCW Code, as amended."[69] Because of scheduling problems at the IMO, the training requirements will only enter into force on 1 January 2018.[70]

While the new training requirements do not include a liquefaction-prevention element, polar navigation training is meant to provide seafarers with some of the skills necessary to deal with common issues in Arctic and Antarctic waters. The training leads to the Basic Polar Waters Certificate of Proficiency and the Advanced Polar Waters Certificate of Proficiency. The requirements for such certifications, however, might not so as far as one could expect: while "no sea service is required"[71] for the Basic Polar Waters Certificate of Proficiency, the Advanced Polar Waters Certificate of Proficiency requires two months of service at sea.[72] Interestingly, this practical experience may be gained outside polar waters in "approved equivalent waters."[73] As a result it will be possible to obtain at least the Basic Polar Waters Certificate of Proficiency without having spent a single moment in an Arctic or Antarctic environment. This is rightly seen as a grave problem or, in the words of David (Duke) Snider, "the most flagrant gap in Polar Code/STCW training and certification."[74] Given the particular dangers of shipping in the Arctic, such as cold temperatures, the presence of ice in the water, long periods of light or darkness[75] and in light of the likely lack of local experience among many seafarers, this training regime falls short of the practical needs associated with shipping in polar regions. This can be dangerous in particular as Arctic shipping is becoming more normal: with an increasing number of trips in the Arctic, seafarers operating in the Arctic for the first time might be given a false sense of security.

Today, first courses are offered, e.g., in Finland.[76] Prior experiences in areas which have sea ice for part of the year, for example in the Baltic Sea region, can also be utilized for the effective implementation of the Polar Code.[77]

Polar Seafarer Training and Dry Cargo Liquefaction

The polar navigation training is not meant to address issues concerning Dry Cargo Liquefaction—but it can be utilized to raise awareness among seafarers of the enhanced dangers they are likely to encounter in the Arctic Ocean.

Given that the training requirements of the Polar Code and the future STCW amendments appear to be far from complete, "[s]ome operators, insurers and other agencies are looking for standards above the present Polar Code requirements. In particular, the Nautical Institute is continuing to pursue implementation of its Ice Navigator Training Accreditation and Ice Navigator Certification schemes. These schemes are intended to complement the requirements of the Polar Code and fill the gap, putting in place a recognized level of certification that ensures officers meet basic and advanced levels of skill in handling ships in ice, whether inside or outside polar waters."[78]

A Role for Non-State Actors

This approach highlights the practical importance of insurance providers and other actors for enhancing shipping safety. This role can be seen also in other aspects of shipping safety, for example with regard to oil pollution[79] or passenger rights.[80] While flag states and international bodies such as the IMO play an important role in regulating international shipping, the fundamental international legal principle of the freedom of navigation on the high seas continues to have a restraining effect when it comes to the direct regulation of shipping. Indirect regulation through technical and other requirements which are imposed by insurance providers on the other hand have significant effects on improving shipping safety.

Such effects can also be seen in the field of bulk cargo transport safety because insurance companies do not limit themselves to imposing technical standards on their customers. As they have an obvious economic interest in preventing disasters, insurance providers often conduct their own research and make information on ways to reduce the likelihood of DCL events available to their customers (and often online through the public at large). By raising awareness of DCL risks and ways to prevent their realization, insurance providers therefore contribute to reducing the likelihood of future losses of life and vessels. In the case of navigating in polar waters, these industry standards go a step further: "Once in place, the schemes will accredit training institutions that meet the Polar Code/STCW requirements and address additional needs to ensure competence and proficiency in operating vessels in ice-infested waters. The accompanying certification scheme will measure individuals against a known and common standard of proficiency and competence."[81]

Concluding Remarks

The international law of the sea is cognizant of the interests of states as well as of non-state entities.[82] In particular the Law of the Sea Convention is universal in its approach.[83] The interests of seafarers have only gained more attention in recent years, most notably with the Maritime Labor Convention (MLC). International shipping law tends to be reactive, with the international community responding to lessons learned as a result of accidents, etc.,[84] be it through "best practices"[85] or binding legal norms, although disproportionate attention appears to be given to event affecting developed countries. The human side of shipping has been given more attention in the wake of the *Costa Concordia* disaster while valuable lessons on marine contamination in the Arctic have been learned after the *Exxon Valdez* oil spill.

When it comes to increasing the safety of seafarers, though, international legal standards alone are not sufficient to provide optimal results. Both navigation in polar waters and the problem of Dry Cargo Liquefaction illustrate the shortcomings of the *lex lata*. Limited functional regulation means that there is an increased need for practical solutions. This is particularly the case in the Arctic Ocean. The low number of vessels traveling in the area (and the likelihood that natural gas or finished products rather than bulk cargo are being transported) means that very little attention has been paid has been paid to the problem. Arctic weather patterns, storms and waves, increase the risk of vessels capsizing as a result of liquefaction. At this time, it appears that Arctic-related seafarer training regimes are not yet taking the increased risk of Dry Cargo Liquefaction into account as a matter of course—nor is there a corresponding legal requirement *de lege lata*. Nevertheless, awareness of Arctic conditions and risks can help increase awareness of specific Arctic risks among crew members. There are not specific DCL-related rules in the Polar Code but learning about Arctic-specific risks can complement existing rules, such as those of the IMSBC Code, to enhance seafarer safety in an often-overlooked part of international shipping which is also bound to remain relevant in the Arctic Ocean for the foreseeable future.

Notes

1. Christos C. Spandonidis/Kostas J. Spyrou, "Micro-Scale Modeling of Excited Granular Ship Cargos: A Numerical Approach," *Ocean Engineering* 74 (2013), pp. 22–36, at p. 22.

2. Michael C. Munro/Abbas Mohajerani, "Variation of the Geotechnical Properties of Iron Ore Fines Under Cyclic Loading," *Ocean Engineering* 126 (2016), pp. 411–431, at p. 411; see also Lei Ju/Dracos Vassalos, "Potential Assessment of Cargo Fluidization Based on an UBC3D-PLM Model," 12th International Conference on the Stability of Ships and Ocean Vehicles, 14–19 June 2015, Glasgow, UK, http://strathprints.strath.ac.uk/57207/, p. 1.

3. See Hiok Hiang Lee, "Nickel Ore Bulk Liquefaction: A Handymax Incident and Response," *Ocean Engineering* 139 (2017). pp. 65–73, at p. 65.

4. Stefan Kirchner, "The Future of the Central Arctic Ocean: Protection Through International Law," *Journal of Territorial and Maritime Studies* 4 (2017), pp. 135–139.

5. Stefan Kirchner/Susanna Pääkkölä, "Polar Health Risks, Seafarers' Rights and Training in International Law," *University of San Francisco Maritime Law Journal* 28 (2016), pp. 225–235.

6. Vanessa Escobar, "Monitoring Ice from Space Reduces Risks," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), pp. 16–17, at p. 16.

7. See *ibid.*

8. Stefan Kirchner, "The Human Dimension of the Polar Code," *Australian Journal of Maritime & Ocean Affairs* 9 (2017), doi: 10.1080/18366503.2017.1333191, accessed November 2, 2018.

9. Cf. *ibid.*

10. Cf. Marc Levinson, *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger* (Princeton: Princeton University Press, 2008).

11. Kirchner (2017), accessed November 2, 2018, doi: 10.1080/18366503.2017.1333191.

12. Stephen E. Roberts/Stephen J. Pettit/Peter B. Marlow, "Casualties and Loss of Life in Bulk Carriers from 1980 to 2010," *Marine Policy* 42 (2013), pp. 223–235, at p. 223.

13. See Dom Yanchunas, "Oil Spill Leads to Fire, Environmental Cleanup Aboard Ship at Valdez," *Professional Mariner*, 28 August 2013, accessed November 2, 2018, http://www.professionalmariner.com/September-2013/Oil-spill-fire-Valdez/.

14. Jianwei Zhang/Wanqing Wu/Junquan Hu, "A Numerical Study of the Effects of the Longitudinal Baffle on Nickel Ore Slurry Sloshing in a Prismatic Cargo Hold," *Marine Structures* 46 (2016), pp. 149–166, at p. 150, referring to Michael C. Munro/Abbas Mohajerani, "Determination of the Transportable Moisture Limit of Iron Ore Fines for the Prevention of Liquefaction in Bulk Carriers," *Marine Structures* 40 (2015), pp. 193–224.

15. Zhang et al., 2016, p. 150

16. *Ibid.*; Ju et al., 2015, p. 1; Spandonidis et al., 2013, p. 22.

17. Igor Bačkalov/Gabriele Bulian/Jakub Cichowicz/Eleftheria Eliopoulou/Dimitris Konovessis/Jean-François Leguen/Anders Rosén/Nikolaos Themelis, "Ship Stability, Dynamics and Safety: Status and Perspectives from a Review of Recent STB Conferences and ISSW Events," *Ocean Engineering* 116 (2016), pp. 312–349, at p. 313.

18. Zhang et al., 2016, p. 150.

19. *Ibid.*

20. Stefan Kirchner, "Limiting the Effects of Dry Cargo Liquefaction: Ultralight Honeycomb Cargo Hold Separators," in *Journal of Brief Ideas*, 24 February 2015, doi:10.5281/zenodo.15634, http://beta.briefideas.org/ideas/c3f020721b4cbd8aa0383a66adb3b108, accessed November 2, 2018; cf. also Zhang et al., 2016, p. 153.

21. See *ibid.*, pp. 149 et seq. and the references there in notes 4–17.

22. *Ibid.*, p. 151.

23. *Ibid.*

24. *Ibid.*, p. 152.

25. *Ibid.*

26. Ju et al., 2015, p. 8.

27. Lei Ju/Dracos Vassalos/Evangelos Boulougouris, "Numerical Assessment of Cargo Liquefaction Potential," *Ocean Engineering* 120 (2016), pp. 383–388, at p. 383.

28. For an overview over different risk-cargoes see Cheng Xiaonan/Liu Minyan/He Longjun, "Shipwreck Statistical Analysis and Suggestions for Ships Carrying Liquefiable Solid Bulk Cargoes in China," *Procedia Engineering* 84 (2014), pp. 188–194, at p. 190.

29. *Ibid.*, p. 189.

30. International Convention for the Safety of Life at Sea (SOLAS), https://treaties.un.org/doc/Publication/UNTS/Volume%201184/volume-1184-I-18961-English.pdf, accessed November 2, 2018.

31. Federal Ministry of Transport and Digital Infrastructure, "Bulk Cargoes (IMSBC)," *Deutsche Flagge*, no date given, https://www.deutsche-flagge.de/en/safety-and-security/cargo/imsbc, accessed November 2, 2018.

32. See, e.g., Lloyd's Register/UK P & I Club/Intercargo, "Carrying Solid Bulk Cargoes Safely: Guidance for Crews on the International Maritime Solid Bulk Cargoes Code," UK P & I, London (2013), https://www.ukpandi.com/fileadmin/uploads/uk-pi/LP%20Documents/IMSBC%20Code%20pocket%20guide.pdf, accessed November 2, 2018

33. International Maritime Solid Bulk Cargoes (IMSBC) Code, Annex to MSC.268(85) (IMSBC Code), section 1.1.1.

34. Munro et al., 2016, p. 411.

35. *Ibid.*

36. *Ibid.*

37. *Ibid.*; see also Spandonidis et al., 2013, p. 22; Michael C. Munro/Abbas Mohajerani, "Determination of the Transportable Moisture Limit of Iron Ore Fines for the Prevention of Liquefaction in Bulk Carriers," *Marine Structures* 40 (2015), pp. 193–224.

38. Cf. Munro et al., 2016.

39. *Ibid.*, p. 411.

40. *Ibid.*, p. 417, note that there appears to be a need for more research, *ibid.*, p. 430.

41. Christos C. Spandonidis/Kostas J. Spyrou, "Coupled Vessel-Dry-Granular-Cargo Roll Dynamics in Regular Beam Seas," *Ocean Engineering* 120 (2016), pp. 238–245, at p. 238.

42. *Ibid.*

43. International Convention for the Prevention of Pollution from Ships (MARPOL), https://treaties.un.org/doc/Publication/UNTS/Volume%201340/volume-1340-A-22484-English.pdf, accessed November 2, 2018.

44. John Mauger, "Everything You Need to Know About the Polar Code," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), pp. 4–6, at p. 4.

45. *Ibid.*

46. Polar Code, Introduction, Figure 2; see also Mauger, 2017, p. 6.

47. Polar Code, Introduction, para. 1.

48. Polar Code, Introduction, para. 3.10.

49. Polar Code, Introduction, para. 3.9.

50. Polar Code, Introduction, para. 3.1.

51. *Ibid.*

52. Polar Code, Introduction, para. 3.2.

53. Polar Code, Introduction, para. 3.3.

54. Polar Code, Introduction, para. 3.4.

55. Polar Code, Introduction, para. 3.5.

56. Polar Code, Introduction, para. 3.6.

57. Polar Code, Introduction, para. 3.7.

58. Mauger, 2017 p. 4.

59. See Rob Hindley/James Bond/Andrew Kendrick, "Polaris: Operational Risk Management Guidance Under the Polar Code," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), pp. 8–9, at p. 8; Escobar, 2017, p. 16; John Falkingham, "Ice Charting Provides Vital Safety Support," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), pp. 18–19.

60. Falkingham, 2017, p. 18.

61. Mauger, 2017, p. 5.

62. Cf. Stephen E. Roberts and Peter B. Marlow, "Casualties in Dry Bulk Shipping (1963–1996)," *Marine Policy* 26 (2002), pp. 437–450, at p. 440.

63. Polar Code, Part I-A, Chapter 12.

64. Polar Code, Part I-A, Chapter 2.

65. See Mauger, 2017, p. 6.

66. Polar Code, Chapter 12, Part I-A.

67. See also Stefan Kirchner, "Protecting Human Rights in the Arctic Through Amendments to the STCW Convention," *Current Developments in Arctic Law* 2 (2014), pp. 17–19; Stefan Kirchner/Susanna Pääkkölä, "Polar Health Risks, Seafarers' Rights and Training in International Law," *University of San Francisco Maritime Law Journal* 28 (2016), pp. 225–235.

68. Polar Code, Chapter 12, para. 12.1.

69. Polar Code, Chapter 12, para. 12.2; note that the STCW Convention is not concerned with manning issues, STCW/CONF.2/32, Res. 6, para. 1, which is why this text concentrates on matters concerning training.

70. David Snider, "Training Lags a Year Behind the Code," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), pp. 22–23.

71. *Ibid.*, p. 22.

72. *Ibid.*

73. *Ibid.*

74. *Ibid.*, p. 23.

75. See also Kirchner et al., 2016.

76. Aboa Mare, Ice Navigation Courses (Polar Code), 2017, http://training.aboamare.fi/en/events/pd/ice-navigation-courses-polar-code, accessed November 2, 2018; no author named, "New Course Meets Code's Training Requirement," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), p. 25.

77. Cf. Jarkko Toivola, "Baltic Experience Can Benefit the Polar Code," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), p. 44.

78. Snider, 2017.

79. Stefan Kirchner, "Multiple Risks and Limited Law: Compensation for Oil Spills in the Context of Long-Term Damages to Arctic Coastal Communities," *Ocean Yearbook* 30 (2016), pp. 267–281.

80. Cf. Stefan Kirchner/Grit Tüngler/Jan Martin Hoffmann, "Carrier Liability for Damages Incurred by Ship Passengers: The European Union as a Trailblazer Towards a Global Liability Regime?," *University of Miami International and Comparative Law Review* 23 (2015), pp. 193–214; Kim Crosbie and Frigg Jorgensen, "Code Brings New Focus for Passenger Operators," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), pp. 38–39.

81. Snider, 2017.

82. Pirjo Kleemola-Juntunen, *Passage Rights in International Law: A Case Study of the Territorial Waters of the Åland Islands* (Rovaniemi: Lapland University Press, 2014), p. 61.

83. Wolfgang Graf Vizthum, "Begriff, Geschichte und Rechtsquellen des Seerechts," in Wolfgang Graf Vizthum (ed.), *Handbuch des Seerechts* (Munich: Verlag C. H. Beck, 2006), pp. 1–61, at p. 42.

84. Michael Kingston, "IMO Deserves Credit for Polar Code's Timely Arrival," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), pp. 36–37, at p. 36.

85. Michael Kingston, "Arctic Council Backs 'Best Practice' Forum," in Edwin Lampert (ed.), *Decoding the Polar Code* (Enfield: Riviera Maritime Media, 2017), p. 43.

Biographical Information

Stefan Kirchner is an associate professor of Arctic Law at the University of Lapland in Rovaniemi. He is an adjunct professor of Fundamental and Human Rights at the same university and regularly teaches law of the sea as an associate professor at Vytautas Magnus University in Kaunas. In the current academic year, he is a visiting professor for EU Oceans and Arctic Law and Policy and for EU Environmental Policy at V.N. Karazin University in Kharkiv.