

The post-Paris approach to mitigating Arctic warming— perspectives from shipping emissions reduction

BAI Jiayu* & MA Yuan

Law & Politics School, Ocean University of China, Qingdao 266100, China

Received 18 February 2018; accepted 30 March 2018

Abstract The availability of increased Arctic shipping as a consequence of sea ice decline is a regional issue that is closely linked with international climate governance and global governance of the maritime industry. Sea ice decline creates favorable circumstances for the development of merchant shipping, but is accompanied by increases in greenhouse gas emissions. Reduction of greenhouse gas emissions from the shipping industry is of utmost importance to prevent the destruction of the fragile Arctic ecosystem. This paper focuses on the core content of the Paris Agreement and suggests that the International Maritime Organization could guide the shipping industry to reach a fair agreement with states that includes market-based measures, capacity building, and voluntary actions of shipping companies as non-state actors.

Keywords climate change, Arctic, shipping emissions, the Paris Agreement, non-state actor, International Maritime Organization

Citation: Bai J Y, Ma Y. The post-Paris approach to mitigating Arctic warming—perspectives from shipping emissions reduction. *Adv Polar Sci*, 2018, 29 (1): 40-50, doi:10.13679/j.advps.2018.1.00040

1 Introduction

The Arctic is warming at almost twice the rate of the rest of the world (Jeffries et al., 2014). Arctic average temperature has increased by 2.3°C since the 1970s (Richter-Menge et al., 2017). By the middle of the 21st century, the Arctic Ocean could become ice-free in the summer (IPCC, 2013).

Earlier studies have attributed Arctic warming to the combined effects of greenhouse gas (GHG) emissions and other anthropogenic influences, such as stratospheric ozone depletion and black carbon (BC) emissions (Cavazos-Guerra et al., 2016). The main cause of climate change is the emission of GHGs (IPCC, 2013), and thus national authorities have been increasingly concerned about the effective reduction of GHG emissions on a global scale. Black carbon is emitted as a result of incomplete combustion of fossil fuel, biofuels and biomass (Ramanathan and Carmichael, 2008). Once deposited on

snow and ice, it is very effective at enhancing the absorption of solar radiation of the surrounding ice and snow particles, contributing to the rapid warming of the Arctic. Therefore, it is necessary to take into account the effects of BC in the mitigation of Arctic warming.

Shipping is an important contributor to global climate change through emissions of carbon dioxide (CO₂), methane (CH₄), nitrogen oxides, sulfur oxides, carbon monoxide (CO) and diverse species of particulate matter including organic carbon and BC. Global shipping is currently responsible for approximately 2.6% of global CO₂ emissions from 2007 to 2012 (IMO, 2015). The shipping industry was the sixth largest emitter of GHG in 2015 (Olmer et al., 2017). Furthermore, GHG emissions from shipping could increase 50%–250% by 2050 from 2012 to 2050 because of increases in economic development and global volume of goods transported (IMO, 2015).

In addition, shipping contributed approximately 8% to 13% of global diesel BC emissions in 2010 (Azzara et al., 2015). However, diesel BC emissions from international

* Corresponding author, E-mail:gracefulgl@hotmail.com

shipping are not yet subject to international regulation under the International Maritime Organization (IMO) which works as an agency of the United Nations, and specializes in setting global standards for the safety and security of maritime navigation and prevention of pollution from international shipping.

The contribution of Arctic shipping to the BC emissions in the Arctic is expected to double by 2030 if increases in ship traffic continues to be unregulated (AMAP, 2015). Increases in shipping outside the Arctic is expected to increase ambient BC concentration by 10% or 20% (Dalsøren et al., 2013).

Given that Arctic sea ice extent is declining, international ship traffic through the Arctic is expected to increase, as shipping routes between northern Europe and northern Asia are much shorter through the Arctic than through the Suez or Panama Canal. With rapidly melting ice and thinning permafrost, climate change impacts are already more severe in the Arctic than in most of the rest of the world. Increased shipping activities in the Arctic may create additional challenges for the region. In addition, global shipping activities are expected to grow in the coming years, with global seaborne trade volumes projected to expand at an annual growth rate of 3.2% between 2017 and 2022 (UNCTAD, 2017).

With the increase of shipping activities in and outside of the Arctic, concerns are growing about the impacts of shipping emissions on the Arctic environment.

This paper begins with a summary of the IMO's endeavors to regulate Arctic shipping, including the International Code for Ships Operating in Polar Waters (the Polar Code), energy efficiency measures, and other ongoing proceedings. It then proceeds to analyze the governance approach of the Paris Agreement. Subsequently, the paper focuses on the implications of the Paris Agreement for the regulation of shipping and shipping emissions. The final section concludes by revisiting the context of the study and synthesizing the main points of the paper.

2 Polar Code governing Arctic shipping

Considering the threats to navigation safety under the severe Arctic conditions and pressure on the environment from increasing shipping activities in the Arctic, the IMO has been working on polar navigation safety and preventing vessel-source pollution since the inception of the Polar Code at the beginning of this century (Bai, 2015). Part II-A of the Polar Code lays out mandatory requirements to prevent vessel-source pollution. Other parts of the Code focus on navigation safety but some of them also have indirect effects on the protection of the marine environment. For example, technical requirements for ship structure, stability and integrity ensure navigation safety, thereby reducing the likelihood of accidents and marine pollution incidents.

Of the eight states that possess territory within the

Arctic Circle (Arctic states), including Canada, Finland, Iceland, Russia, Norway, Denmark, Sweden and the USA, Canada and Russia, driven by special geographical advantages and political demands, have attempted to regulate Arctic shipping via domestic legislations (Zou and Huang, 2014). In 1991, Russia issued the Rules of Navigation in the Water Area of the Northern Sea Route, which were updated into a comprehensive legal system of navigation management measures in 2013 following the development of the Northern Sea Route. It covers various aspects such as navigation safety, environmental protection, rescue, and pilotage service charges. Canada, as an important stakeholder in the Northwest Passage, has placed great importance on the protection of the environment around the shipping routes. It has established a relatively comprehensive system of environmental protection in the Arctic, including the Arctic Waters Pollution Prevention Act, which prevents pollution of the Arctic waters by ships. A tension exists between national and international standards, which can be solved by ensuring that domestic rules conform to the Polar Code. In other words, coastal States should not impose rules that are stricter than those in the Polar Code.

3 Efforts of the IMO to reduce shipping emissions outside the Arctic

Polar shipping is regulated under the IMO via two sets of mechanisms. The Polar Code specifies special guidelines and mandatory rules to protect the unique and sensitive environment in the Arctic and the Antarctic. Moreover, the international maritime conventions pertaining to global seas are also applicable to polar waters because of their universality and extensive field of application.

3.1 Adoption of energy and operational efficiency measures

Regulation of shipping GHG emissions was first discussed in the 1980s, when it was formally considered under the resolutions related to the International Convention for the Prevention of Pollution of the Sea (MARPOL) (IMO, 1998). Under these resolutions, the IMO began to cooperate with the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) whose ultimate objective is to achieve stabilization of GHG concentrations that would prevent dangerous anthropogenic interference with the climate system. The Marine Environment Protection Committee (MEPC) as a particular organization responding to environmental issue under IMO's remit was also invited to develop strategies concerning the evaluation and reduction of GHG emissions from international shipping.

In 2000, IMO issued a research report on the GHG emissions of international shipping. In 2003, the 23rd session of the IMO Assembly approved Resolution A.963

(23) IMO Policies and Practices Related to the Reduction of Greenhouse Gas Emissions from Ships (Assembly, 2003), which urged the MEPC to establish the necessary mechanisms for realizing GHG emissions reduction from international shipping.

Over the following years, the MEPC worked on and developed a set of technical documents on technology, operation, and market mechanisms targeted towards international shipping emissions reduction. In 2011, the 62nd session of the MEPC adopted amendments to MARPOL Annex VI, adding a new chapter 4 to make the Energy Efficiency Design Index (EEDI) mandatory for new ships and the Ship Energy Efficiency Management Plan (SEEMP) mandatory for all ships, becoming the first legally binding climate change treaty to be adopted since the Kyoto Protocol (IMO, 2011).

In contrast to calculations of energy efficiency taken into account during the design phase, calculations of energy efficiency during operation contain high levels of randomness and uncertainty, and some basic questions, such as the definition of Energy Efficiency Operation Indicator, metering method and actual levels of energy efficiency remain to be resolved. Therefore, mandatory standards of operational energy efficiency are inadequate to meet the objectives of emissions reduction.

3.2 Progress in reduction of shipping emissions

Reduction of shipping emissions has been fueled by the recent efforts made by the IMO. The Paris Agreement plays an undeniable role in accelerating this process despite the absence of any reference to shipping emissions in its text. After the signing of the Paris Agreement, the 69th session of the MEPC, which took place in April 2016, agreed on a three-step approach of data collection, data analysis and decision-making, to develop further measures to address emissions reduction of the maritime industry. In October 2016, the 70th session of the MEPC adopted mandatory MARPOL Annex VI requirements for ships of 5000 gross tonnages and above to record and report fuel consumption (MEPC, 2016).

On 13 April 2018, at the 72th session of the MEPC held in London, an initial strategy on the reduction of GHG emissions from ships as a response to the Paris Agreement temperature goals was accepted. This strategy sets out the IMO's vision of its continuing commitment to shipping emissions reduction and its aim of phasing out GHGs as soon as possible in this century. The EEDI is emphasized as a major tool for emissions reduction and will be reviewed and strengthened. Furthermore, the strategy sets out the ambitious goals of achieving at least 40% reduction of CO₂ emissions by 2030, and pursuing efforts towards 70% reduction by 2050 relative to 2008 level (IMO, 2018). It aims to make GHG emissions from international shipping peak and decline as soon as possible and to diminish total annual GHG emissions by at least 50% by 2050 relative to 2008 levels (IMO, 2018). This initial strategy attempts to be

in accordance with the temperature goals set out in the Paris Agreement.

However, global responses to “limit warming to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels” as set forth in Article 2 of the Paris Agreement need to include BC emissions reduction (Amann et al., 2011). More significantly, shipping outside the Arctic contributes a far greater share of the BC emissions than shipping in the Arctic. Therefore, efforts to reduce emissions from shipping outside the Arctic may need to occupy a more important position in the governance of Arctic shipping activities.

4 The governance approach of the Paris Agreement

Global climate change and Arctic warming are closely linked. Melting ice in the Arctic has caused global sea level to rise and is expected to impact populations worldwide. Arctic warming influences global climate and precipitation patterns, and is considered as a global, rather than merely a local, problem. Obviously, because of the global impacts of Arctic warming, the responsibility to protect the Arctic environment rests not only on the Arctic states, but on the entire international community. It is therefore necessary to investigate the reactions and responses from global society with respect to the mitigation of climate change.

The progresses of high-level climate negotiations have been slow due to the long-standing political stalemate (Stuenkel, 2013). However, the Paris Agreement signifies an innovative method to address this issue. It offers a catalytic and facilitative model that allows actors to undertake GHG emissions reduction voluntarily and progressively (Hale, 2016).

At the intergovernmental level, internationally negotiated emissions reduction targets have been transformed into nationally determined contributions, and has succeeded in diminishing the hesitation of every large emitter and bringing them into the mitigation regime. Meanwhile, the contributions will need to be enhanced substantially to achieve the long-term 2°C goal. Five-yearly reviews allow states to adapt to climate change and ratchet up their contributions progressively. The Paris Agreement also acknowledges that the involvement of non-state actors will be imperative to avert catastrophic changes in the climate.

4.1 Platform building through intended nationally determined contributions

In accordance with Article 4.4 of the Paris Agreement, developed countries should continue their leading role in making economy-wide absolute emissions reduction, while developing countries should continue to strengthen their mitigation efforts and achieve absolute reductions or targets

in line with their national circumstances. Effectively, with the Paris Agreement, the climate regime has shifted from a top-down model to a hybrid system that combines bottom-up with top-down elements (Falkner, 2016), whereby all states reduce their emissions differentially according to their Intended Nationally Determined Contributions (INDCs). Parties to the UNFCCC were asked to outline their post-2020 climate actions well in advance of COP 21. These INDCs lay out the emissions reduction targets that each state is committed to, and they become legally binding when the Paris Agreement was ratified. To date, 175 parties have ratified the agreement (UNFCCC, 2018).

The INDCs communicate each country's ambition for taking actions to limit the increase in global average temperature to below 1.5–2°C. The word “intended” was applied because states had communicated their proposed climate actions before the Paris Agreement was finalized. However, as states formally joined the Paris Agreement and looked forward to the implementation of these climate actions, the intended contribution was confirmed and an INDC was converted into a Nationally Determined Contribution (NDC) (Höhne et al., 2014). The expression “nationally determined” means that global mitigation actions are not determined collectively, but determined by individual states taking into account their domestic circumstances and capabilities. The ratification of the Paris Agreement requires Party states to submit their NDCs as a binding obligation. Under Article 4.2 of the Paris Agreement, Party states undertake a legal commitment to achieve their NDCs through domestic policies.

The NDCs could be viewed as states' willingness to achieve sustainable development. More importantly, the non-binding feature of the NDCs' content (Macey, 2018) offers a wide margin of discretion that motivates Parties to take actions to mitigate climate change (Savaresi, 2016). Such discretion is highly desired, because each state is confronted with different domestic realities, including social, economic and technological conditions. Through their NDCs, states are able to make sensible contributions that cater to their own national priorities, capabilities, and responsibilities. These individual measures can be the foundation for collective action, and, if these measures are sufficiently ambitious, can set a path toward a low-carbon, climate-resilient future.

The independent, non-binding and voluntary nature of NDCs is distinctly different from the approach taken by the predecessors of the Paris Agreement—the UNFCCC and the Kyoto Protocol. Parties to the UNFCCC were classified into Annex I and Non-Annex I. Annex I Parties include developed countries and countries with economies in transition, and had the obligation to take the lead in emissions reduction under Article 4 of the UNFCCC. Developing countries (Non-Annex I Parties) could receive financial support from developed countries to build their mitigation capacity. This classification is based on the principle of common but differentiated responsibilities

(CBDR). The CBDR principle, formalized in the UNFCCC establishes that all states have a shared responsibility in protecting the environment, but they assume different responsibilities in accordance with their social, economic and ecological conditions. The principle reflects two antagonistic trends in international environmental law, namely, the need for universalism, and the need for sensitivity to the special needs of developing countries. If the “common sense of all obligations” emphasizes the commonality of human responsibility, then the “common but differentiated responsibilities” principle clearly emphasizes the difference in human responsibility. The foundation of this principle rests on the historical differences in states' contributions to global environmental problems and the varied abilities that different states have to solve these problems. The CBDR forms the backbone of international climate agreements and continues to be a persistent and crucial element underlying subsequent actions related to climate change.

The Kyoto Protocol made further efforts based on this principle and set mandatory targets for developed countries, including all Arctic states except the United States (US). However, compliance was below expectation. Some Parties were unwilling to participate. The US, for example, never ratified. Canada withdrew entirely in 2011. Japan, as an Arctic stakeholder, did not follow the examples of the US or Canada, but ended up failing to achieve its targets.

Although the Kyoto Protocol demonstrates the CBDR principle by classifying Parties into Annex I and non-Annex I, it remains relatively rigid, making it difficult for all Parties to reach consensus, thereby blocking the progress of collective action to reduce emissions. This inability to galvanize global action could be explained from the perspective of equity. The emphasis of equity is crucial to achieving compromises that can take into account the interests of all stakeholders. Stakeholders engage in the political process on account of its fairness, thereby ensuring the longevity of the agreement (Biermann et al., 2012). International law represents the volition of sovereign states. Negotiation mandates and standpoints are dominated by governments' insights about what is fair enough, which are central to states' commitments and willingness to collaborate with other states (Winkler and Beaumont, 2010). Cooperation among actors may not be a win-win situation if the outcome is unjustified (Ostrom and Walker, 2003).

The concept of NDCs under the Paris Agreement has weakened the asymmetry created by the Kyoto Protocol. Climate negotiations between developed and developing countries have revolved around the issue of emissions reduction obligations under international law. Under the Paris Agreement, developed countries still take the lead in meeting economy-wide absolute emissions reduction targets, while developing countries are tasked with continuing to increase their own reductions in accordance with their individual national circumstances. While CBDR is still the main principle driving the Paris Agreement, NDCs seem to

achieve a balance between the interests of developed and developing countries.

From a scientific point of view, the NDCs are insufficient to meet the global mitigation requirements as set out in the Intergovernmental Panel on Climate Change (IPCC)'s latest reports. Nonetheless, the adoption of NDCs is critically meaningful for neutralizing political stalemates because it shifts the focus from a global deal to an aggregation of polycentric policies. Contributions are based on comprehensive considerations of states' responsibilities, capabilities, and circumstances. Such differentiation accords with the intention of the agreement and its long-term goals at the same time (Voigt and Ferreira, 2016). Under such reinterpretation of differentiation, the CBDR principle is strengthened, thus attracting the broad and equal participation of states around the world.

4.2 Transparency framework and global stocktake

By establishing the NDCs, the Paris Agreement has created a more diverse climate regime. Furthermore, it created a facilitative platform by establishing a transparency framework and the global stocktake. In contrast to regulation through negotiated emission targets and timetables, facilitative climate governance creates conditions under which actors progressively reduce their emissions through coordinated policy shifts (Hale, 2016). The Paris Agreement enables such facilitation through a legally binding transparency framework, regular global stocktakes and the provision of finance. It recognizes the need to assess progress towards the goals of the agreement periodically. Such assessments serve as opportunities for Parties to reflect upon how impetus for climate action can be increased.

The purpose of the transparency framework is to ensure clarity and to track Parties' progress towards their NDCs and adaptation actions (UNFCCC, 2015). For any mature international mechanism, a convincing transparency system greatly assists in building political trust and maintaining the mechanism. Since Parties' achievement of their NDCs is voluntary, the transparency framework should closely follow Parties' progress towards their NDCs, because it is only when Parties' progress towards NDCs is publicized that states could compare and determine whether the burden-sharing is fair. In addition, since NDCs differ among Parties, the transparency framework facilitates data collection. The collected data can be used to confirm each state's contribution, which is of utmost importance in evaluating collective progress towards global mitigation targets.

The transparency framework is complemented by a global stocktake to assess collective progress towards long-term goals (UNFCCC, 2015). The Paris Agreement envisions the stocktake as a comprehensive and facilitative exercise (UNFCCC, 2015), thus reinforcing the notion that the agreement addresses not just mitigation but also adaptation and support, and that it is a facilitative rather

than a prescriptive instrument.

The stocktake is the long-term measure proposed by the Paris Agreement to assess the Parties' fulfillment of their obligations through periodic global assessments. Regular stocktake will start in 2023 (UNFCCC, 2015), and will take place every five years. It will improve the transparency of national actions and can be used to forecast future trends. In particular, the stocktake will first assess whether national contributions are sufficient to meet the long-term goals of the Paris Agreement. Each national contribution is designed for five years, with the stocktake completing each cycle of national contribution, allowing the progress of global climate action to be assessed. To ensure a more comprehensive reach, stocktakes will include information provided by states as set out in the transparency framework, and also from other sources, such as the IPCC. Stocktakes will guide future action in the renewal and enhancement of national contributions, and strengthen international cooperation in climate action.

Furthermore, Parties agreed to convene a facilitative dialogue in 2018 (COP, 2017) to take stock of the collective efforts of Parties in relation to the long-term mitigation goal identified in the agreement, and for this initial stocktake to inform the preparation of their next NDCs. The global stocktake is tactfully designed to ensure that the national determination is subtly constrained in service of long-term goals, and that the results are palatable to all. Global stocktake is a facilitative process that assesses collective but not individual progress. In evaluating collective progress on mitigation and support, it will take into consideration science as well as equity. Lastly, ratcheting of contributions as a result of stocktake, if any, will be determined nationally.

4.3 Alliance with non-state actors

The NDCs, significant finance for developing states, regular five-yearly stocktaking and enhanced transparency, and a facilitative approach to compliance form the pillars of the Paris Agreement (Klein et al., 2017). They reflect a state-centric climate governance framework, but non-state actors are also engaged in global climate governance. Decision 1/CP.21 of the UNFCCC Adoption of the Paris Agreement recognized climate action undertaken by non-Party stakeholders. Non-state actors involved in the UNFCCC system include environmental non-governmental organizations (NGOs) featuring as being non-profit and independent of governments, activist groups, inter-governmental organizations, city networks, oil companies, consultancy and legal firms, carbon brokers, indigenous communities, and trade unions.

The advent of non-state actors in global climate governance may have stemmed from the inability of foreign policies and international negotiations to achieve effective multilateral cooperation in addressing climate change (Hoffmann, 2011). Because of the complex international political landscape, cities, businesses and NGOs decided to

promote their own initiatives. As a result, guidance for climate action is not exclusively provided by the international treaty signed by states and implemented through national policies. They can also be supplemented by private rules and standards (Bäckstrand et al., 2017). However, decisions and actions of non-state actors would not impair the ability and authority of states. Instead, the Paris Agreement establishes a hybrid governance regime combining mitigation efforts from states and non-state actors. This could be further interpreted as a fragmented multilateralism. Correspondingly, the UNFCCC is required to perform as a platform, which integrates non-state actors and multinational projects with states' actions to fit the complex regime (Bäckstrand and Kuyper, 2017). As a coordinator, the UNFCCC could organize international meetings and timetables to facilitate the deliberation processes of policy-making. Furthermore, it could assist its state members and non-state constituents in navigating through the financial and administrative landscape. As a consequence, shared goals could potentially be pursued in the absence of hierarchical governance (Abbott et al., 2015).

The Paris Agreement acknowledges that states' NDCs form the foundations of mitigation, adaptation, and financial actions, but also accepts that non-state actors are essential in governance, implementation and knowledge gathering. The post-Paris climate regime regards sub- or non-state actors as helpful supplements that can also catalyze climate actions of all actors.

5 Implications of the Paris Agreement for the reduction of international shipping emissions

Interactions of professional knowledge from different disciplines with new governance instruments might produce specific insights that can enable the effective governance of emissions reduction from international shipping (Gehring and Oberthür, 2008; Underdahl, 2002). The Paris Agreement, as the newest agreement under the UNFCCC, succeeds in addressing the political deadlock of climate negotiations, promoting global actions for GHG emissions reduction. The facilitative mechanisms will help the effective implementation of NDCs, and the enhancement of mutual trust and confidence among Parties. It also takes into account the efforts of non-state actors in the GHG mitigation process. Efforts to reduce international shipping emissions are also currently trapped in political debate. As outlined in Section 3, the IMO has been pushing forward the GHG emissions reduction trajectory by establishing a data collection system, and adopting an initial strategy of great ambition. However, political stalemate among member states may be unavoidable, and, hence, the Paris Agreement may be a useful example that can guide the IMO and its state members towards a compromise. Moreover,

there is a possibility for the IMO to function as a facilitator in boosting mutual trust and confidence among states and in engaging shipping companies to make voluntary emissions reduction.

5.1 Facilitating agreement over market-based measures with the spirit of fairness of the Paris Agreement

Persistent differences between the interests of developed and developing countries could potentially harm future progress of IMO rule-making on emissions reduction (Zhang, 2016). Global regulations mandating improvements in energy efficiency has become the regime through which shipping emissions reduction is addressed. However, the development of this regime has been accompanied by many challenges, not least of which is the need to reconcile the principle of fair burden-sharing as integrated in CBDR with the principle of No More Favorable Treatment (NMFT).

5.1.1 Conflicts between guiding principles

The NMFT principle requires port states to enforce applicable standards in a uniform manner to all ships in their ports, regardless of the ships' flag states. It has been included in the MARPOL convention and applies to all of the annexes of the convention, underlying the IMO's regulatory regimes. In other words, this principle requires that all ships, regardless of ownership and state of registration, comply with the same rules. The World Shipping Council and other industry organizations strongly support the NMFT principle. Furthermore, a carbon emissions reduction regime would have little effect if it could be avoided by changing the ship's registration.

The current regime that addresses GHG emissions reduction from international shipping mirrors that in global climate negotiations. A number of industrialized states are in favor of an approach that includes all major emitters, while a number of developing countries insist that developed countries should take the lead in emissions reduction.

The Paris Agreement establishes an alternative approach by taking into consideration the equitable sharing of responsibilities, and taking the interests of developing countries fully into account. It corrected the CBDR by retaining differentiation, and stressing the need to build a common response framework accommodating emerging economies.

The IMO has established the Inter-sessional Working Group on Reduction of GHG Emissions from Ships, which had made progress in formulating an initial strategy in 2017. Group members include IMO member states and top shipping organizations, such as the International Chamber of Shipping and the Clean Shipping Coalition, and they proposed ambitious emissions reduction targets and conservation actions. Preference for concrete emissions targets was demonstrated by Denmark, Germany, northern European states, and several Pacific states. In contrast, India,

Brazil, Argentina, and Saudi Arabia were reluctant to commit to concrete emissions targets. Ultimately, the meeting ended with massive divergence, and it seems that a compromise will be unavoidable. The issue of fair burden-sharing underlies the deadlock. Therefore, governments should seek a compromise solution that incorporates the views of a broad range of stakeholders, reflects differentiation between developing and developed countries, takes into account possible socio-economic consequences, and is environmentally effective. It would certainly require high levels of trust, confidence, and mutual understanding among states, and much work before such a solution can be found.

5.1.2 Market-based measures

Economic development lies at the heart of environmental problems. Market mechanisms are effective in addressing environmental problems while promoting sustainable development. To this end, carbon markets internalize the negative externalities of emissions while administering and transferring climate risks.

Eleven proposals of market-based measures (MBMs) to address shipping emissions reduction were presented at the 60th session of the MEPC in March 2010. These proposals can be divided into two categories except for the one submitted by Bahamas (IMO, 2010a) which advocated a penalty on trade and development. The first type proposed a tax-based pattern. This pattern could be subdivided into fuel and efficiency tax respectively. Proposals pertaining to fuel tax consisted of an international GHG fund submitted by Cyprus, Denmark, the Marshall Island, Nigeria and International Parcel Tankers Association (IPTA) (IMO, 2010b), a Port State Levy submitted by Jamaica (IMO, 2010c) and a rebate mechanism submitted by the International Union for Conservation of Nature (IUCN) (IMO, 2010d). Proposals related to efficiency tax with the aim of improving ships' energy efficiency embodied the Leveraged Incentive Scheme submitted by Japan (IMO, 2010e) and the Vessel Efficiency System submitted by the World Shipping Council (WSC) (IMO, 2010f). The second type of proposals put forward a trading mechanism, which could be further divided into emission and efficiency trading model respectively. Emission trading pattern was introduced by Norway (IMO, 2010g), the United Kingdom (IMO, 2010h) France (IMO, 2010i), and Germany (IMO, 2010j). Efficiency trading proposal is exemplified by the Ship Efficiency and Credit Trading program proposed by the USA (IMO, 2010k).

Some developing countries strongly opposed MBMs, because MBMs are incapable of implementing CBDR even though they are compatible with NMFT (Karim, 2015). Nevertheless, among the different proposals, the rebate mechanism may have the chance to be adopted if a rebate that is sufficiently high is offered to developing countries to

offset the adverse effects of market mechanisms. Similarly, a Port State Levy can be effective in implementing CBDR if it establishes a self-governing fund or includes international financial support. Therefore, these types of MBMs can be consistent with CBDR, and have the potential to ensure fair burden-sharing in shipping emissions reduction (Shi, 2016; Psaraftis, 2012). Application of MBM proposals tailored to individual national circumstances are also in accordance with the flexible arrangements established under the Paris Agreement.

5.2 Capacity building

The Paris Agreement contains no reference to shipping emissions, indicating that the negotiators sought to avoid the complexities and disagreements of the maritime industry. However, for diverse reasons, the agreement has empowered the IMO to take the global action to reduce emissions. The IMO, as a specialized agency of the United Nations and the highest regulatory body of the international maritime industry, has been entrusted with the development of regulations and standards relating to international maritime safety and environmental impact since 1948. As such, the promotion of an environmentally sustainable maritime industry has been a priority for the IMO in recent years, and the IMO assumes a significant role in inspiring, conducting, directing and governing shipping activities.

The IMO has no enforcement power, as the enforcement of its rules lies in the hands of national authorities. However, it is still making every effort to promote environmental protection. One example is the establishment of the mandatory data collection mechanism, which aims to provide data and an objective, transparent and comprehensive basis for policy discussions in the MEPC.

An international environmental regime can only be successful if there is widespread willingness among stakeholders to engage. Nonetheless, regime effectiveness critically depends on stakeholders' consensus on the interpretation of the matter to be addressed and the appropriate measures to resolve the problem (Young, 2008, 1999). For this reason, a prospective regime needs to take a cooperative approach to build trust and confidence among its stakeholders, and create consensus in all aspects of the matter. The emerging knowledge in a specific domain could alter stakeholders' behaviors, which in turn, could change the political focus within a regime (Siebenhüner and Suplie, 2005).

Therefore, a regime to regulate emissions from international shipping should be a forum for its member states and other stakeholders, such as academia, the shipping industry, and NGOs, to share and transfer relevant knowledge and technology across disciplines and fields of practice. Consequently, the regime helps states build capacity to address maritime energy efficiency by helping them mainstream the issue in their own development policies, programs and dialogues.

5.3 Inclusion of ship companies' contributions to emissions reduction into the IMO's strategy to reduce shipping emissions

The IMO's activities are more inclined towards regulation of member states (Rahim et al., 2016), and have not focused on shipping companies' responsibility for GHG emissions reduction. Fortunately, many shipping companies are investigating into measures to improve the environmental sustainability of their operations (Skovgaard, 2014). As demonstrated by the Paris Agreement, private sectors' engagement in emissions reduction reflects the diversity of the legal, physical, and social responses to climate change. Similarly, shipping companies' engagement in emissions reduction reflects the diversity of the actors and the types of global governance. From this perspective, inclusion of shipping companies' contributions to emissions reduction into the IMO's strategy to reduce shipping emissions can be regarded as a promotion of the anti-formalization of the shipping industry, and also as a way of recognizing the increasingly blurred division between the responsibilities of the public and private sectors in climate action. Instead of passively accepting emissions reduction targets, or complying with the requirements of the EEDI, the requirement to declare their contributions to emission reduction will actively mobilize shipping companies to undertake emissions reduction, thereby rectifying the democratic deficiencies in the maritime industry's engagement in emissions reduction and extending the range of stakeholders involved in global climate governance.

6 Conclusion

The Paris Agreement was designed to address issues related to climate change, and profoundly affected future opportunities concerning global investment, technological innovation, and changes in business models. It also had a far-reaching impact on the maritime industry, especially with regard to its governance model involving nationally determined contributions and participation of non-state actors. Within the global framework of GHG emissions reduction, the maritime industry has insisted that negotiations adhere to the common but differentiated principle, and refused absolute emissions reduction targets. The maritime industry, with its unique characteristics, is complex and, ultimately, the Paris Agreement contains no reference pertaining to this industry's emissions reductions.

However, the Paris Agreement provides a new way of thinking, and the application of its governance approach to the shipping industry could arguably promote a new global governance regime. The NDCs emphasize states' self-determined contributions, which take into account the needs of individual states and the global demand for emissions reduction. It mobilizes states to participate actively in climate governance and, essentially, emphasizes

the commonality of governance. In addition, the transparency and stocktake mechanisms proposed in the agreement are potentially effective approaches for achieving the NDCs. Although a state can contribute according to its national circumstances, the contribution is mandatory and transparent to enhance mutual trust between states. If a state violates its obligation, it will have to assume international responsibility, be condemned by other states and be subject to various forms of sanctions. After all, it is assumed that states will act cautiously in the international community for the interests of preserving national reputation. If a state does not comply with its own commitments, its international image will be affected directly. Furthermore, the UNFCCC has developed a new role as a facilitator in including non-state actors in their call for worldwide efforts to address climate change, signifying that global climate governance is becoming fair and facilitative though fragmented.

The commonality of governance and bottom-up model of NDCs could function as a good example for shipping emissions reduction. Given that the interests of the shipping industry in different states vary, the principle of common but differentiated responsibility makes it intractable for the international community to comply with binding targets. The principle of non-discrimination is capable of inserting the transnational nature of international shipping, but it fails to draw attention to the special need for fair burden-sharing in climate policies. The important function of the NDCs lies in its new articulation of the common but differentiated responsibility principle, avoiding the sharing of responsibility, and combining it with the consideration of national circumstances and the ability to make nationally determined contributions. Since the maritime industry also emphasizes this principle, the IMO should steer member states towards concluding a fair agreement using MBMs, similar to what the Paris Agreement has achieved with the NDCs.

In addition to promoting equity, the IMO could be valuable as a facilitative forum, following the example of the Paris Agreement, which has consolidated political trust and confidence through establishing facilitative dialogues, and transparency and stocktake mechanisms. The IMO, as an intergovernmental organization, may follow the example and bring together common interests and avoid the possible development of distrust by putting in place capacity building programs.

The Paris Agreement recognized that non-state actors are a force to be reckoned with. Similarly, many shipping companies attend meetings organized by the IMO, and the efforts of these private actors could be acknowledged and shared. Another element of the Paris Agreement that can be transferred to the shipping sector is the inclusion of emissions reduction contributions from shipping companies into the IMO's strategy to reduce shipping emissions. Contributions of shipping companies may be ineffective, and inclusion of the private sector into international

shipping governance may lead to fragmentation of the governance regime, but the integration of non-state actors may also mobilize shipping companies to actively explore and adopt diverse mitigation measures. Ultimately, the post-Paris trajectory for reducing the carbon footprint of international shipping will be fragmented but also more facilitative and cooperative.

Climate change in the Arctic is addressed by initiatives conducted in the Arctic, but also by efforts made in the rest of the world. While Arctic shipping directly impacts the Arctic environment, Arctic warming will accelerate because of increased shipping activities outside of the Arctic as well. Therefore, the environmental challenges faced by the Arctic are closely linked with global governance as discussed in this paper.

Furthermore, the Paris Agreement may inspire the development of governance regimes that can be applied to the regulation of shipping emissions reduction and Arctic shipping. Sea ice decline may lead to increases in shipping-related operations. Shipping activities in the Arctic have been regulated under the IMO and domestic regulations of Arctic states to protect the fragile Arctic environment. However, these regulations discriminate against other states especially when Arctic states use the regulations to pursue their own environmental benefits. The post-Paris approach for Arctic shipping is expected to follow the spirit of fairness of the Paris Agreement. Therefore, the IMO can uphold its leadership in defense of a fair and rational instrument that supports business development and protects the Arctic environment. Market-based measures could also be utilized in attaining such a balance. In addition, both Arctic and non-Arctic states are provided with opportunities to take part in knowledge-sharing fora and cooperate through technology transfer and capacity building. Emissions reduction contributions at the state level will contribute towards alleviating the adverse impacts of Arctic shipping. In addition, Arctic shipping companies, as significant Arctic stakeholders, could also be motivated to assume their corporate social responsibility and reduce pollution in the Arctic.

Acknowledgments This article was supported by the National Science Foundation of China (Grant no. 16BFX188, Research on the Construction of a Cooperative Legal Regime for China's Participation in Arctic Governance), and the Polar Research Institute of China Project (Grant no. 2018001, Research on China's Standpoints about the Development of the Northern Sea Route).

References

- ABBOTT K W, GENSCHEL P, SNIDAL, et al. 2015. *International organizations as orchestrators*. Oxford: Cambridge University Press.
- AMANN M, KLIMONT Z, KUPIAINEN K. 2011. *Integrated assessment of black carbon and tropospheric ozone*. Nairobi: UNEP.
- ANDERSON K, BOWS A. 2012. *Executing a Scharnow turn: reconciling shipping emissions with international commitments on climate change*. *Carbon Manag*, 3(6): 615-628, doi: 10.4155/cmt.12.63.
- Arctic Monitoring and Assessment Programme (AMAP). 2015. *Summary for Policy-makers: Arctic Climate Issues 2015*. <https://www.amap.no/documents/doc/summary-for-policy-makers-arctic-climate-issues-2015/1196>.
- ASSEMBLY. 2003. *IMO policies and practices related to the reduction of greenhouse gas emission from ships*. [http://www.imo.org/blast/blast-DataHelper.asp?data_id=26597&filename=A963\(23\).pdf](http://www.imo.org/blast/blast-DataHelper.asp?data_id=26597&filename=A963(23).pdf).
- AZZARA A, MINJARES R, RUTHERFORD D. 2015. *Needs and opportunities to reduce black carbon emissions from maritime shipping*. https://www.theicct.org/sites/default/files/publications/ICCT_black-carbon-maritime-shipping_20150324.pdf.
- BÄCKSTRAND K, KUYPER J W. 2017. *The Democratic legitimacy of Orchestration: the UNFCCC, non-state actors, and transnational climate governance*. *Environmental Politics*, 26(4): 764-788, doi: 10.1080/09644016.2017.1323579.
- BÄCKSTRAND K, KUYPER JW, LINNÉR B-O, et al. 2017. *Non-state actors in global climate governance: from Copenhagen to Paris and beyond*. *Environmental Politics*, 26(4): 561-579, doi:10.1080/09644016.2017.1327485.
- BAI J Y. 2015. *The IMO polar code: the emerging rules of Arctic shipping governance*. *International Journal of Marine and Coastal Law*, 30(4): 674-699, doi: 10.1163/15718085-12341376.
- BIERMANN F, ABBOTT K, ANDRESEN S, et al. 2012. *Navigating the Anthropocene: improving earth system governance*. *Science*, 335(6074): 1306-1307, doi: 10.1126/science.1217255.
- CAVAZOS-GUERRA C, LAUER A, ROSENTHAL E. 2016. *Clean air and white ice: governing black carbon emissions affecting the Arctic*// KEIL K, KNECHT S. *Governing Arctic change*. London: Palgrave Macmillan, 231-256.
- Conference of Parties. 2017. *Draft decision 1/CP.23 Fiji Momentum for implementation*. <https://unfccc.int/resource/docs/2017/cop23/eng/113.pdf>.
- DALSØREN S B, SAMSET B H, MYHRE G, et al. 2013. *Environmental impacts of shipping in 2030 with a particular focus on the Arctic region*. *Atmospheric Chemistry and Physics*, 12(10): 26647-26684, doi: 10.5194/acpd-12-26647-2012.
- FRANKER R. 2016. *The Paris Agreement and the new logic of international climate politics*. *International Affairs*, 92(5): 1107-1125, doi: 10.1111/1468-2346.12708.
- GEHRING T, OBERTHÜR S. 2008. *Interplay: Exploring institutional interaction*// YOUNG O R, KING L A, SCHROEDER H. *Institutions and environmental change: principal findings, applications, and research frontiers*. Cambridge: MIT Press, 187-223.
- GILLET N P, STONE D A, STOTT P A, et al. 2008. *Attribution of polar warming to human influence*. *Nature Geoscience*, 1(11): 750-754, doi: 10.1038/ngeo338.
- HALE T. 2016. "All hands on deck": The Paris Agreement and nonstate climate action. *Global Environmental Politics*, 16(3): 12-22, doi: org/10.1162/glep_a_00362.
- HOFFMANN M J. 2011. *Climate governance at the crossroads*. Oxford: Oxford University Press.
- HÖHNE N, ELLERMANN C, LI L. 2014. *Intended nationally determined contributions under the UNFCCC*. <https://www.ecofys.com/files/files/ecofys-giz-2014-intended-nationally-determined-contributions-under-unfccc.pdf>.

- IMO. 2018. UN body adopts climate change strategy for shipping. <http://www.imo.org/en/mediacentre/pressbriefings/pages/06ghginitialsstrategy.aspx>.
- IMO. 2015. Key findings from the Third IMO GHG Study 2014//SMITH T, JALKANEN J, ANDERSON B, et al. Third IMO GHG Study 2014. London: IMO, 1-4.
- IMO. 2011. Main events in IMO's work on limitation and reduction of greenhouse gas emissions from international shipping. <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Main%20events%20IMO%20GHG%20work%20-%20October%202011%20final.pdf>.
- IMO. 2010a. Summary of the proposal submitted by Bahamas to MEPC 60 on Market-Based Instruments: a penalty on trade and development (MEPC 60/4/10). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010b. Summary of the proposal submitted by Cyprus, Denmark, the Marshall Islands, Nigeria and the International Parcel Tankers Association (IPTA) to MEPC 60 on an International Fund for Greenhouse Gas Emissions from ships (MEPC 60/4/8). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010c. Summary of the proposal submitted by Jamaica to MEPC 60 on achieving reduction in GHG emissions from ships through Port State arrangements (MEPC 60/4/40). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010d. Summary of the proposal submitted by IUCN to MEPC 60 on a Rebate mechanism for a market-based instrument for international shipping (MEPC 60/4/55). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010e. Summary of the proposal submitted by Japan to MEPC 60 on Consideration of a market-based mechanism: Leveraged Incentive Scheme to improve the energy efficiency of ships based on the International GHG Fund (MEPC 60/4/37). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010f. Summary of the submission by World Shipping Council (WSC) to MEPC 60 on a Proposal to Establish a Vessel Efficiency System (VES) (MEPC 60/4/39). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010g. Summary of the proposal submitted by Norway to MEPC 60 on a Further outline of a Global Emission Trading System (ETS) for international shipping (MEPC 60/4/22). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010h. Summary of the proposal submitted by United Kingdom to MEPC 60 on a global emissions trading system for GHG emissions from international shipping (MEPC 60/4/26). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010i. Summary of the proposal submitted by France to MEPC 60 on further elements for the development of an Emissions Trading System for international shipping (MEPC 60/4/41).
- IMO. 2010j. Summary of the proposal submitted by Germany to MEPC 60 on Impact Assessment of an Emissions Trading Scheme with a particular view on developing countries (MEPC 60/4/54). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 2010k. Summary of the proposal submitted by the United States to MEPC 60 on further details on the United States proposal to reduce greenhouse gas emissions from international shipping (MEPC 60/4/12). <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf>.
- IMO. 1998. Focus on IMO: MARPOL-25 years. [http://www.imo.org/en/KnowledgeCentre/ReferencesAndArchives/FocusOnIMO\(Archives\)/Documents/Focus%20on%20IMO%20-%20MARPOL%20-%202025%20years%20\(October%201998\).pdf](http://www.imo.org/en/KnowledgeCentre/ReferencesAndArchives/FocusOnIMO(Archives)/Documents/Focus%20on%20IMO%20-%20MARPOL%20-%202025%20years%20(October%201998).pdf).
- IPCC. 2013. Summary for Policymakers// STOCKER T F, QIN D, PLATTNER G K, et al. Climate change: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom, New York, NY, USA: Cambridge University Press, 1-30.
- JEFFRIES M O, RICHTER-MENGE J, OVERLAND J E. 2014. Executive Summary in Arctic Report Card 2014. ftp://ftp.oar.noaa.gov/arctic/documents/ArcticReportCard_full_report2015.pdf.
- KARIM M S. 2015. Reduction of emissions of Greenhouse Gas (GHG) from Ships// KARIM M S. Prevention of pollution of the marine environment from vessels. Switzerland: Springer International Publishing, 107-126, doi: 10.1007/978-3-319-10608-3_4.
- KLEIN D, CARAZO M P, DOELLE M, et al. 2017. The Paris Agreement on climate change: analysis and commentary. Oxford: Oxford University Press.
- MACEY A. 2018. The atmosphere, the Paris Agreement and global governance. <https://ojs.victoria.ac.nz/pq/article/view/4640>.
- MEPC. 2016. Amendments to the annex of the protocol of 1997 to amend the international convention for the prevention of pollution from ships, 1973, as modified by the protocol of 1978 relating thereto amendments to MARPOL Annex VI. <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/278%2870%29.pdf>.
- MILES E L, ANDRESEN STEINAR, CARLIN E M. 2002. Patterns of regime effectiveness//MILES E L, et al. Environmental regime effectiveness: confronting theory with evidence. Cambridge: MIT Press, 433-465.
- NEJAT P, JOMEHZADEH F, TAHERI M M, et al. 2015. A global review of energy consumption, CO₂ emissions and policy in the residential sector (with an overview of the top ten CO₂ emitting countries). Renewable and Sustainable Energy Reviews, 43: 843-862, doi: 10.1016/j.rser.2014.11.066.
- OSTROM E, WALKER J. 2003. Trust and reciprocity interdisciplinary lessons from experimental research. New York: Russell Sage Foundation.
- OLMER N, COMER B, ROY B, et al. 2017. Greenhouse gas emissions from global shipping 2013-2015. https://www.theicct.org/sites/default/files/publications/Global-shipping-GHG-emissions-2013-2015_ICCT-Report_17102017_vF.pdf.
- PSARAFTIS H N. 2012. Market-based measures for greenhouse gas

- emissions from ships: a review. *WMU Journal of Maritime Affairs*, 11(2): 211-232, doi: 10.1007/s13437-012-0030-5.
- RAHIM M M, ISLAM M T, KURUPPU S. 2016. Regulating global shipping corporations' accountability for reducing greenhouse gas emissions in the seas. *Mar Policy*, 69: 159-170, doi: 10.1016/j.marpol.2016.04.018.
- RAMANATHAN V, CARMICHAEL G. 2008. Global and regional climate changes due to black carbon. *Nature Geoscience*, 1(4): 221-227, doi: 10.1038/ngeo156.
- RICHTER-MENGE J, OVERLAND J E, MATHIS J T, et al. 2017. Arctic Report Card 2017. <http://www.artic.noaa.gov/Report-Card>.
- SAVARESI A. 2016. The Paris Agreement: a new beginning? <http://dx.doi.org/10.2139/ssrn.2747629>.
- SHI Y B. 2016. Reducing greenhouse gas emissions from international shipping: Is it time to consider market-based measures? *Marine Policy*, 64: 123-134, doi: 10.1016/j.marpol.2015.11.013.
- SIEBENHÜNER B, SUPLIE J. 2005. Implementing the access and benefit-sharing provisions of the CBD: A case for institutional learning. *Ecological Economy*, 53(4): 507-522, doi: 10.1016/j.ecolecon.2004.10.012.
- SKOVGAARD J. 2014. European Union's policy on corporate social responsibility and opportunities for the maritime industry. *International Journal of Shipping Transport Logistics*, 6(5): 513-530, doi: 10.1504/ijstl.2014.064572.
- STUENKEL O. 2013. Gridlock: why global cooperation is failing when we need it most. *Brazilian Journal of International Relations*, 4(3): 694-699, doi: 10.20424/2237-7743/bjir.v4n3p694-699.
- UNDERDAHL A. 2002. Patterns of regime effectiveness// MILES E L, et al. *Environmental regime effectiveness*. Cambridge: MIT Press, 433-465.
- UNFCCC. 2015. Decision 1/CP.21 Adoption of the Paris Agreement Annex article 14(2). <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>.
- UNFCCC.2018. Paris Agreement–Status of ratification. <https://unfccc.int/process/the-paris-agreement/status-of-ratification>.
- United Nations Conference on Trade and Development (UNCTAD). 2017. Development in international seaborne trade//BARKI D, DÉLÈZE-BLACK L. *Review of Maritime Transport 2017*. Switzerland: United Nations, 1-2.
- VOIGT C, FERREIRA F. 2016. Differentiation in the Paris Agreement. <http://dx.doi.org/10.2139/ssrn.2827633>.
- WINKLER H, BEAUMONT J. 2010. Fair and effective multilateralism in the post-Copenhagen climate negotiations. *Climate Policy*, 10(6): 638-654, doi: 10.3763/cpol.2010.0130.
- YOUNG O R. 2008. Institutions and environmental change: The scientific legacy of a decade of IDGEC research//YOUNG O R, KING L A, SCHROEDER H K. *Institutions and environmental change: principal findings, applications, and research frontiers*. Cambridge: MIT Press, 3-46.
- YOUNG O R.1999. Regime effectiveness: taking stock//Young O R, Gasser Les. *The effectiveness of international environmental regimes: causal connections and behavioral mechanisms*. Cambridge: MIT Press, 249-280.
- ZHANG H. 2014. Towards global green shipping: the development of international regulations on reduction of GHG emissions from ships. *International Environmental Agreements: Politics, Law and Economics*, 16(4): 561-577, doi: 10.1007/s10784-014-9270-5.
- ZOU L, HUANG S L, Fu Y. 2014. A comparative study of the administration of the Northwest Passage and the Russian Northern Sea Route. *Chin J of Polar Res*, 26(4): 515-521, doi: 10.13679/j.jdyj.2014.4.515.