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Group of Experts on Climate Change Impacts and Adaptation to International Transport Networks

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Note by the secretariat

I. Mandate

1. At the seventy-fifth session of the Inland Transport Committee (ITC) in February 2013, the secretariat informed the Committee about the status of the work of the Group of Experts on Climate Change Impacts and Adaptation to International Transport Networks (ITC Informal document No. 7).

2. The Group of Experts had been established by the Executive Committee (EXCOM) in May 2011. The group met twice in 2011 (September and November), three times in 2012 (April, October and December) and once, and completed its work, in 2013 (March).

3. The Group submits the full report – publication of its accomplishments (ECE/TRANS/WP.5/2013/2, UNECE publication) for consideration by the Working Party.

4. The structure of the report – publication is:

(a) Introduction;

(b) Chapter 1: Climate Change: The Physical Basis;

(c) Chapter 2: Climate Change Implications for Transport;

(d) Chapter 3: Survey Analysis;

(e) Chapter 4: Specific Country experiences and Practices;

(f) Chapter 5: Conclusions and Policy Recommendations;

(g) Annexes:

(i) Annex I: Information on Selected Studies on Climate Change Impacts in Transport;

(ii) Annex II: International Conference on Adaptation of Transport Networks to Climate Change and Expert Opinion;

(iii) Annex III: Questionnaire;

(iv) Annex IV: Detailed Survey Analysis;

(v) Annex V: Select Literature of Relevance for the Further Study of Climate Change Impacts on International Transport Networks.

5. More specifically, the report of the Group of Experts:

(a) Analyses all existing forecasts and surveys on climate change;

(b) Identifies potential climatic impacts on transport infrastructure, including ports and their hinterland connections;

(c) Identifies existing best practices in national policies and risk management as well as formulation of relevant strategies to enhance the resilience of transport networks;

(d) Takes stock of the available data and analysis of climate change impacts on transport networks in the ECE region and beyond;

(e) Collects and analyses information on all relevant planning, management, organizational and other initiatives for adaptation of transport networks to climate change;

(f) Suggests recommendations and proposals to member Governments, with a view to improving the adaptability of transport networks to climate change.

II. Conclusions and Recommendations of the report

A. Introduction

6. Although climate change (CC) impacts on various human activities have been considered by both Governments and international organizations for some time now, relatively little attention has been paid to the assessment of CC impacts on the international transport networks and operations as well as on potential adaptation measures. However, on the basis of the recent work undertaken at national and, in few instances, at supra-national level as well as by the transport industry, it has been shown that CC–induced weather conditions may have significant implications for the infrastructure of international transport networks and, thus, the functioning of the global and regional economy and livelihood. In response to these considerations, integrated strategies at national and supra-national levels have recently started to emerge as, for example, the recent (April 2013) European Union (EU) Climate Change Adaptation Strategy, which sought to make the EU more climate-resilient; for the transport sector, the strategy focused on the assessment of costs, benefits and impacts of adaptation, the enhancement of knowledge, the fostering of standards and guidelines, and the collection and sharing of best practices.

7. Recognizing the need for concerted action, experts from various countries, international organizations and the academia, under the auspices of the United Nations Economic Commission for Europe established the Group of Experts on Climate Change Impacts and Adaptation for International Transport Networks. The Group (a) discussed relevant information for the UNECE region (and beyond) and analysed and identified

potential CC impacts on transport infrastructure and transport services across the broader supply-chain; (b) collected and analysed information about the current level of awareness and preparedness, the availability of relevant information and tools, the existing and planned transport adaptation policies, measures and initiatives, and on the research needs, financing requirements and the collaboration mechanisms at national, regional and international levels; (c) reviewed relevant national initiatives, case studies and research projects; (d) exchanged experiences on mode-specific adaptation measures that may mitigate transport network vulnerability; (e) identified existing (best) practices in national policies for risk management and the enhancement of transport network resilience; (f) recognized the need for an increased awareness about the assessment of the CC impacts and adaptation measures; and (g) assessed the contribution of the CC adaptation to the development of broader guidelines and best practices in the transport sector.

B. Climate Change Trends and Impacts

8. A long-term increasing trend in the mean air temperature is already clear in the current climate trends and future projections. Precipitation has also changed, but in a more complex manner, with some regions becoming wetter and others dryer; such trends are predicted to continue or even pick up pace in the future. A decreasing (but non-uniform) trend in the snow cover can be discerned. A damaging side-effect of the temperature increases concerns a substantial rise in the mean sea level, due to ocean thermal expansion, the melting of the Greenland and Antarctic ice sheets and the glacier and ice caps as well as changes in the terrestrial water storage. Since the 1860s, sea levels have increased by about 0.2 m, with satellite information showing a progressive increase in the rates since the 1990s.

9. Changes in the average climate conditions can also lead to fluctuations in the frequency, intensity, spatial coverage, duration, and timing of weather and climate extremes, which can, in turn, modify the distributions of the future climatic conditions. Extreme events (e.g. storms, storm surges, floods/droughts and heat waves), as well as changes in the patterns of particular climatic systems (e.g. monsoons) can have at smaller spatio-temporal scales, more severe impacts on the transportation networks than changes in the mean variables. One of the clearest trends appears to be the increasing frequency and intensity of heavy downpours. Climate models project the continuation of this trend, with heavy downpours that presently occur once about every 20 years being projected to occur every 4–15 years by 2100 (depending on location). River floods appear to present a very significant hazard, particularly for central and eastern Europe and for central Asia; however, their trends are better assessed at a regional and local scale. Evidence also suggests increases in the frequency and intensity of heat waves, i.e. of extended periods of abnormally hot weather. Heat waves are often associated with severe droughts, which are generally becoming more severe in some regions.

1. Main Climate Change Trends

10. One of the major causes of the observed temperature increases is considered to be the increasing atmospheric concentrations of greenhouse gases (GHGs) (i.e. water vapour, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O)). GHGs absorb heat reflected back from the Earth's surface and, thus, increase the heat storage of the Earth system. Since the industrial revolution, atmospheric concentrations of GHGs have been steadily increasing — higher now than they have been for some million years; for example, the CO_2 concentration surpassed the 400 ppm (parts per million) milestone for the first time in (at least) the last million years in early May 2013. Global warming can be amplified by reinforcing feedbacks, i.e. climate change-driven processes that can induce further warming. For example, previously inert carbon reservoirs (e.g. the tropical peatlands and

the vast CH_4 stores of the Arctic permafrost) can be mobilised by increasing temperatures and release more CO_2 and/or CH_4 to the atmosphere. The rapid reduction in the spatial coverage of Arctic Ocean ice, particularly during summer may also affect climate, as sea ice reflects most of the incoming radiation from the sun back into the atmosphere in contrast to the sea water; an ice-free Arctic Ocean may accumulate sun radiation that will reinforce global warming.

11. Climate change (e.g. mean sea level rise, warmer water temperatures, higher intensity of storms and storm surges and potential changes in the wave regime) may severely impact coastal infrastructure and services, such as ports and other coastal transport hubs and networks. Daily port operations can be directly influenced by storm surges and backwater, resulting in port closures. Recent studies have assessed the population and assets exposure of 136 port cities with more than one million inhabitants, finding that tens of millions of people and assets with a value in excess of United States dollars 25 billion may be exposed to coastal flooding by 2050. Coastal inundation will have significant impacts on coastal transportation infrastructure by rendering it unusable for the flood duration and significantly damaging terminals, intermodal facilities, freight villages, storage areas and cargo and, thus, disrupting intermodal supply chains and transport connectivity for longer periods. Ports, which form key-nodes in international transport networks and link international supply-chains, will be particularly impacted, due mostly to the long life-time of their key infrastructure, their exposed coastal and/or estuarine location, and their dependence on trade, shipping and inland transport that are also vulnerable to climate change.

12. Precipitation changes may result in stream flow changes that are likely to affect roadways, railways, rail and coach terminals, port facilities, and airports. There can be direct damages during the event, necessitating emergency responses; there can also be effects on the structural integrity and maintenance of roads, rail lines, bridges, tunnels, drainage systems, telecommunication and traffic management systems necessitating more frequent maintenance and repairs. Increases in heavy precipitation events and floods will cause more weather-related accidents due to vehicle /road/rail tracks damages and poor visibility, delays, and traffic disruptions in the already congested networks. Ports will also be vulnerable to short-term rain-induced flooding, whereas extreme precipitation-induced silting could reduce navigation channel depths and considerably increasing dredging costs. Inland waterways can suffer navigation suspension, silting, changes in river morphology and damage of banks and flood protection schemes, whereas increased delays and cancellations of flight operations due to airport flooding are also likely, together with effects on the structural integrity of runways and other specialized airport infrastructure.

13. Extreme winds can damage coastal and estuarine railways, damage port facilities (e.g. cranes and loading terminals), destroy agricultural crops (and, thus, indirectly affect the transportation industry), induce more frequent interruptions in air services and damage airport facilities (equipment, perimeter fencing and signs), damage road/railway infrastructure (through e.g. wind-generated debris) and stress road and rail operations. In addition, changes in the wind (and wind-wave) directional patterns may also have important implications on e.g. seaport operations and safety.

14. Heat waves may also have substantial impacts on transport services and infrastructure. The hot and dry conditions may lead to wildfires and crop failures, stress water supplies, food storage and energy systems and increase refrigeration requirements. Heat waves can also damage roads, deform rail tracks and desiccate track earthworks and cause lengthy delays through speed restrictions. Airport facilities, runways and operations will be also affected as will inland waterway transport. The decline in the Arctic Ocean ice cap may allow the openings of new shipping routes, but also alter supply and demand of regional transport services and considerably increase the costs of linking Arctic ports to

major national and international inland transport networks. Arctic warming may also lead to changes in the permafrost distribution and the freezing/thawing cycles that can damage building foundations, cause frost heaves at roadways/rail lines, and affect the integrity of bridges and other transport structures and their load-carrying capacity.

2. Impacts on Transport modes

15. Demand for transport services grows in line with the global economy, trade and world population. As transport is a demand-driven industry, CC-induced changes in e.g. population distribution, commodity production (and its spatial distribution), tourism patterns the trade and consumption patterns can also have significant implications for transport. Therefore, climate change presents significant challenges, for both freight and passenger transport. Some of these challenges are summarized below for the different transport modes.

(a) Road Transport

16. The projected climate change will certainly impact the infrastructure, operations, safety and maintenance of the road systems, affecting all network managers and users. Main impacts include both direct (e.g. pavement deterioration and deformation, damages and subsidence in permafrost areas, general structural damage, traffic disruption and accessibility problems for tunnels and bridges caused by floods and bank erosion) and indirect (economic, environmental, demographic, and spatial planning). Road infrastructure will also suffer from asphalt rutting and/or melting, thermal expansion of bridge joints, landslides and bridge scouring or undermining and it is, thus, crucial to prepare; a move towards the so-called 5th Generation Road/Forever Open Road that is CC-adaptable (see World Road Association (PIARC) (2012) and Annex II) should be considered.

(b) Rail Transport

17. The rail sector has already been affected by climate change with hotter summers, wetter winters, stronger winds and sudden season changes causing increased traffic disruption and higher costs of network maintenance and traffic as well as higher energy consumption. Main impacts include rail buckling, rolling stock overheating and failure, signalling problems, increased construction and maintenance costs, embankment and earthwork failures, bridge scouring, overwhelming of the drainage systems and speed restrictions, delays and operation disruptions. As such impacts are likely to increase in the next decades, effective CC adaptation strategies are required that will include vulnerability assessment and mapping, maintenance and emergency planning, dedicated research and development actions and the introduction of effective design guidelines and protocols for line construction using improved new technologies and for the rolling stock.

(c) Inland Waterways

18. As relatively small changes are projected for the mean water levels of inland waterways until 2050, climate change impacts are not expected to be significant until then. However, the foreseen greater temporal (and spatial) variability in water levels can certainly create problems (particularly after 2050) that would require integrated waterway planning, investments, maintenance and management. Main impacts include restrictions and cost increases due to very low and high water levels, land infrastructure inundation, and sedimentation issues in navigation channels as well as building new water reservoirs.

(d) Seaports

19. Seaports, key nodes of the international transport networks, will bear some of the worst impacts of climate change due to its nature — placement at the edge of lands and seas

— and a possible mean sea level rise and higher and more frequent storm surges. The majority of seaport locations are currently vulnerable to coastal flooding, a situation that is foreseen to deteriorate in the future; at the same time, estuarine ports will be also vulnerable to fluvial floods (and droughts). Main CC impacts include infrastructure, equipment and cargo damages from inundation and wave energy changes, increases in the energy consumption for cooling cargo, changes in transportation patterns due to the potential development of new shipping routes (e.g. Arctic Ocean lanes), higher port construction and maintenance costs, changes in flow and sedimentation patterns in ports and navigation channels and insurance issues. A recent questionnaire survey to the International Association of Ports and Harbors/American Association of Port Authorities (IAPH/AAPA) members showed that (a) respondents were highly concerned about CC impacts, but not well informed; (b) port design standards do not sufficiently take account of CC considerations although seaports contain very substantial and expensive infrastructure with a long service life; and (c) the great majority (97 per cent) of the respondents believed that they will face significant problems with a sea level rise of 0.5 m, or greater.

C. Recommendations

20. In the transport sector, CC adaptation has so far not been given appropriate attention. However, as most of the respondents (> 75 per cent) to the questionnaire survey, undertaken as a part of the present study, foresee that climate change may likely have considerable impacts on transport in the next 30 years, avoiding significant future expenditures would require policymakers and stakeholders to address this issue as a matter of urgency. A clear understanding of the CC potential impacts, risks and vulnerabilities appears to be both a first step and a prerequisite for the design and construction of resilient transport infrastructure and their management systems in future. It must be noted that the transport sector of the developing and poorly-diversified economies will be particularly vulnerable not only to catastrophic, large-scale extreme events but also to 'slow-burning' stresses due to the projected higher average temperatures and mean sea levels and more frequent flooding and/or droughts.

21. Adaptation action aims to reduce vulnerabilities and increase the resilience of systems to climatic impacts. In the transport sector, resilience refers not only to the physical strength and durability of the infrastructure that allows it to withstand adverse impacts without losing its basic functions, but also to its ability to recover quickly and at a minimal cost. It follows that potential CC impacts should be factored into the planning, design, construction and operations, as well as in the broader economic and development policies involving the transport sector. Developing effective adaptation strategies for climate change impacts on international transport requires policy action, investments efforts and collaborative research. Well targeted vulnerability studies, empirical studies and assessments of projected risks and related costs are deemed as a necessary first step towards bridging the current knowledge gap and identifying / defining priority areas.

22. Efforts to assess risks and potential impacts on the transport sector may result in the development of practices and recommendations for adapting to current and projected CC impacts.

23. The following general recommendations are based on experiences gained so far and on scientifically confirmed and potential manifestations of climate change impacts. Government action is considered as a necessary prerequisite for the development and formulation of effective CC adaptation strategies requiring a clear understanding and systematic mapping of the transport sector vulnerabilities to climate change that are determined by 3 main factors: the nature and the extent of climate change, the transport system sensitivity and the required capacity to adapt to changes. It is recommended that:

(a) Governments, in collaboration with owners and operators of transport infrastructure (e.g. port authorities, private rail companies) and international organizations should establish inventories of critical and sensitive nodes of transport infrastructure to assess whether, where and when projected climate changes might have significant consequences.

(b) Climate change should be incorporated into the long-term capital improvement plans, facility designs, investment works, maintenance practices, operations, engineering practices and emergency response plans.

(c) Transport infrastructure and services are subject to many regulations; therefore, in order to accommodate CC adaptation measures, institutional and regulatory adaptation may also be necessary. In this respect, the 2007 European Commission Directive on the assessment and management of flood risks presents a good example. According to the Directive EU member States are required to bring into force relevant laws, regulations and administrative procedures in order to prepare flood hazard and risk maps, management plans and implementation measures for coastal areas and river basins in their territory.

(d) Transport infrastructure planners and designers together with transport infrastructure managers, vehicle and rolling stock manufacturers should take into account (from the planning stage) climate change projections and their potential impacts at both global and regional scales. It is also important that effects of potential diverse goals should be assessed when designing adaptation responses, in order to avoid conflicting measures.

With regard to **adaptation** strategies, the following are general recommendations:

(a) Without effective adaptation strategies and actions, the present resilience of transport networks may prove to be insufficient in the near-medium future. Therefore, pro-active adaptation strategies must be adopted urgently in order to systematically build up adaptive capacity. Such strategies should include short and long-term objectives and measures, take into account economic constraints and have ‘Readiness’, ‘Resilience’ and ‘Recovery’ (RRR) as guiding principles.

(b) It is strongly recommended for adaptation actions to take place within integrated natural hazard management frameworks. Such frameworks should be able not only to pro-actively address the present weather-related challenges and disruptions, but also to design and build mid- to long-term CC adaptation measures. Moreover, it appears that building upon current management systems that already deal with the present weather and climate related adverse impacts is more likely to create a working adaptation framework; CC adaptation programmes that are not connected to present business operations are likely to face significant adoption and implementation problems.

(c) A well-structured and nationally as well as internationally integrated database of digitized network data, disruption hotspots and incidents, management and maintenance plans and asset management practices should form the core of an efficient natural hazard management system for the transport sector. This database should be well maintained and updated and supplied with necessary and innovative (software) tools that can project future risks in order to form an integrated tool to assist CC adaptation in the transport sector.

(d) Possible climate change impacts should be considered at the early stages of planning and included in risk and vulnerability assessments. In assessing future conditions with the aim of prioritizing adaptation measures, current practices and methodologies should be complemented with more innovative and future-orientated approaches. Future projects should integrate CC considerations into their asset design and maintenance planning.

24. Although the present report deals with the adaptation of the transport sector to climate change, issues relevant to **CC mitigation** should always be kept in mind.

(a) Adaptation is not an alternative to reducing GHG emissions. Global emission monitoring is considered necessary to constrain the rate and magnitude of climate change and, consequently, reduce costs and increase the effectiveness of the CC adaptation measures.

(b) Many fundamental decisions regarding both CC adaptation and mitigation will be influenced by cost-benefit assessments. Presently, such assessments are constrained by uncertainties in the quantification of significant environmental, social and economic impacts; therefore, reducing such uncertainties (where possible) should become an urgent integrated research priority.

(c) The possibility of developing synergies with GHG emission mitigation and other environmental objectives should be investigated further. Consideration might be also given to addressing, for instance, how modal transportation planning might assist in the CC mitigation objectives.

25. The present study has shown that there are significant information and knowledge gaps that must be filled by appropriate research. The recommendations are:

(a) The study of CC impacts and adaptation requires integration of a wide range of disciplines, including those of law, natural and social science, engineering and economics. Although integration in the context of an uncertain future is challenging, it is also necessary in order to obtain results that could assist individuals, communities, governments, international organizations and the industry to deal with the adverse impacts of climate change.

(b) Focused research should be undertaken for different climate change impacts. These studies could be complemented by case studies on the potential economic, social and environmental consequences and the cost/benefits of adaptation options. For example, the riverine flood risk on road and rail networks could be assessed by detailed studies that will model the potential extreme flood hazard in the ECE region under different scenarios of climate change and transpose it on the ECE road and rail networks in order to identify flood ‘hot spots’.

(c) Initial assessments of the transport sector vulnerabilities are possible without a detailed knowledge of future climatic changes; these assessments can be based upon the analysis of the sensitivity to past climatic variability and the current capacity of the systems to absorb disruption and adapt to changing conditions. Therefore, it is possible to define coping ranges and critical thresholds. Scenarios of climate and socio-economic changes present a range of plausible futures that provide a basis for the assessment and management of future risks. Uncertainties in the nature and the extent of future climatic changes should serve to focus on adaptation measures that address current vulnerabilities through expanding coping ranges and increasing adaptive capacity.

(d) It is worth highlighting that in view of the interconnectedness and interdependence of economies in a globalised trading system, the special needs of developing counties, and particularly Small Island Developing States, should also be taken into consideration.

(e) Cooperation of UNECE with other relevant international organizations and agencies to institute a process for better communication among transportation professionals, climate scientists, and other relevant scientific experts, and establish a clearing house for transportation-relevant CC information appears to be a way forward. UNECE could take a leading role in the development of a mechanism and a process that encourages sharing of best practices for addressing potential impacts of climate change in the transportation sector.

26. With regard to the different **transport modes**, the following recommendations concern:

1. Road Transport

(a) Road owners should implement a systematic approach to define risks and assess consequences at network level (e.g. by identifying flood-prone hotspots and temperature sensitive network sections), and initiate the development of strategies to mitigate such risks in a cost-effective manner, using costing models that incorporate CC scenarios.

(b) Need to incorporate CC considerations into the road design, construction and operation should include (i) risk assessments that evaluate the exposure, sensitivity, vulnerability, resilience and adaptation responses of the road systems, (ii) planning of timeframes that consider longer-term CC effects, and (iii) adaptation (including implementation procedures) strategies.

(c) National policies for road transport should include awareness raising and good practice sharing schemes, as well as more strategic and long-term approaches to spatial planning.

2. Rail transport

(a) In the longer term, there may be ways in which the railway industry might assist in the mitigation of the projected climatic changes through addressing sustainability issues. The results could, for example, help railways managers in determining how existing assets could be most effectively managed, whether revised design standards for new assets could be beneficial, and how current operational measures might be best adapted.

(b) A constructive way forward is to begin quantifying changes related to safety risk and traffic delays that are likely to be induced by unforeseen weather events. This should take into account:

- different types of sensitive infrastructure and their spatial distribution (e.g. track, drainage, overhead electrification equipment);
- historical quantitative information on e.g. delays caused by weather-related incidents;
- current values used in risk models for weather-related precursors to hazardous events and predicted harm to people;
- available quantitative estimates of likely changes in the occurrence of extreme events, based on current industry intervention levels (temperature, flood levels, wind gust speeds, etc.);
- common education and awareness improvements, starting within the railway industry staff.

(c) Railway infrastructure and rolling stock are generally robust, but train operations can be still severely affected by extreme weather (e.g. delays due to safety requirements and limits). Although currently such risks are generally modest, they are also likely to increase under a changing climate that may affect the frequency and intensity of extreme weather events.

(d) The impacts of more frequent extreme storms and, in particular, of intense downpours, heat waves, floods and extreme winds on the rail network might be considered as escalations of the present situation. Such effects have already been studied to varying degrees but mostly for the purposes of assessing accident risks in the design process, rather than for assessing CC impacts and for the precautionary measurements.

(e) Rail infrastructure is designed to be used over long periods of time (often > 100 years). Therefore, it seems reasonable that CC adaptation needs should be considered well in advance. A good example of relevant practices is the engineering innovation related to adaptation to the effects of thawing permafrost (which will be exacerbated by the projected increases in global temperature), such as sinkholes causing railway crack and heave. The world’s longest high-elevation railroad (the Qinghai-Tibet railway- ‘The Permafrost Express’- in China) involves engineering and design innovations adapted particularly for permafrost environments, that can be considered applicable in other regions.

3. Inland Waterways

27. Inland waterway transport will not be significantly affected by CC until 2050, there appears to be a sufficient time window to assess adaptation options in ports design, fleet design, integrated waterway planning and management and logistics. The following activities appear to be beneficial:

(a) Improvement and integration of the future waterway infrastructure development.

(b) Definition of integrated planning principles that involves experts from different disciplines (e.g. navigation, hydrology, engineering, freshwater ecology and economics).

(c) Development of concrete guidelines for activities that can assist in the implementation of integrated planning principles with regard to inland waterway infrastructure projects.

(d) Information on existing (and ongoing) practices and innovations concerning vessel design and waterway engineering.

4. Seaports

28. In order to identify priority areas for adaptation response, a classification of the facilities that are harder to protect that takes into account the IMO regulations is needed. Seaports should be at the top of the priority list for CC adaptation responses, as they face increased CC-induced risks (e.g. sea level rise), are almost impossible to relocate and are indispensable links in the international supply chain.

(a) Facilities that face manageable risks might require mostly risk management and emergency response planning. Termination of port facilities should be the last resort and only if vulnerabilities are deemed to be too high and complex to deal with, or if port relocation costs could be managed.

(b) To understand the significance of climate change-induced risks for a given port, it is necessary to analyse the factors affecting the port performance and evaluate CC impacts taking into account existing vulnerabilities, critical thresholds and climate change assessments / forecasts.

(c) The extent of CC impacts on ports will vary greatly, though there are some key risk areas that all ports should consider. There will be considerable differences in the nature and level of climate change risks and opportunities among ports depending on their location (e.g. ports affected by long waves, ports prone to tropical or extra-tropical cyclones, or ports in permafrost areas).

(d) Ports also vary considerably in terms of functionality. Climate change might have different implications for ports with cargo handling and warehousing functions compared to those providing exclusively pilotage, navigation and dredging services, or for cruise and passenger ports or for leisure marinas.