The geography of maritime ranges: interfacing global maritime shipping networks with Hinterlands

Jean-Paul Rodrigue

Abstract The paper looks at an intermediate scale of analysis for maritime transportation; the maritime range. Maritime ranges are bounded regions where a set of ports are either in competition, complementary, sharing a common regulatory regime, or having some fundamental geographical commonality. This scale is mostly missing from the research about the structure and organization of maritime transportation focusing on either the port or on the shipping network. The paper proposes a methodology defining maritime ranges bounded by maritime, inter-range, and hinterland boundaries. This methodology is applied to define 28 global maritime ranges representing functional commercial entities generating and attracting maritime traffic.

Keywords Port geography · Port hinterland · Maritime ranges

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Maritime ranges: defining a unit of analysis

A matter of scale

The importance of maritime transportation as a linchpin of global trade requires new analytical frameworks, particularly as they relate to the scale of analysis, which can vary from a single terminal to the global maritime shipping system (Lloyd 2014). Each of these scales contributes to the understanding of the geography of maritime transportation by offering a unit of analysis framing transport demand, networks, and flows. Global maritime shipping networks have been the object of substantial attention since they help explain the drivers and network structure of maritime transportation (e.g. Ducruet 2013; Ducruet et al. 2018). It is, however, challenging to infer global processes to local geographical units since each of these units is connected differently into the global mesh. On the opposite side of the spectrum, the port and its terminals represent a highly relevant multidimensional unit of analysis (Ng et al. 2014). Still, it is hazardous to infer local dynamics reflective of one port to other ports. Even port authorities show an impressive diversity of involvement in local port and stakeholder management (Van der Lugt et al. 2015). In such a context, the port remains a case study that can be used comparatively to find some common economic and functional factors (e.g. Lee et al. 2016).

What appears to be missing is an intermediate scale of analysis investigating the interactions between global and local maritime transport systems. As noted in reviews of the port geography literature, only 1% of the papers focused on a regional consideration beyond the nation, while about half focused on a single port (Marei and Ducruet 2015). An issue worth considering in the geography of ports and maritime shipping is what could be the largest possible regional unit of analysis that can be constructed from a series of relatively coherent port groups? The concept of the port region or a system of ports constituting a region has been considered as a unit of analysis (Ducruet et al. 2018). Still, there have been limited attempts to define it functionally across multiple regions.

Kaluza et al. (2010) used the concept of *port communities* defined as groups of ports (nodes) that have a high number of links within the groups and with much fewer links between groups. This nodal definition is inherently unstable and varies according to the type of cargo being carried (such as containers or dry bulk) and how maritime shipping lines elect to configure their networks. Thus, a change in shipping services could lead to a change in port communities since their connectivity shifts. This approach has been further expanded with complex temporal analyses of port networks, allowing to underline dynamic changes in port communities (e.g. Ducruet 2013).

Alternatively, port hinterlands have been considered as a relevant intermediate scale unit for the analysis of maritime transportation. They underline the commercial geography of ports and their relationships with the markets they service (Vigarié 1964). In recent decades, port hinterlands have been subject to remarkable changes with containerization and the setting of global supply chains (Bernhofen et al. 2016; Rodrigue and Notteboom 2015). While port hinterlands offer a relevant regional scale of analysis, it usually concerns a single port or a cluster of ports in a well-defined area subject to contestability (de Langen 2015; Haezendonck and Langenus 2019).

Lemarchand and Joly (2009), following Vigarié (1979), see ranges as groups of port cities with competing hinterlands. The approach underlines a hierarchy starting with the *maritime front*, which is a group of ports with limited interdependencies, to the *maritime range*, which is fully integrated with shipping networks and hinterland corridors. A shortcoming is the lack of a distinction between what could formally be defined as a maritime front as opposed to a maritime range. Xu et al. (2015) further expanded the concept of *maritime regions* as buffers acting as maritime ranges, but with no particular rationale justifying their extent. A clear definition of the extent and boundaries of maritime ranges remains partial and elusive, in part because maritime shipping lines set their shipping services from a market access perspective. This service network is de facto considered to be a maritime range.

The regionalism of maritime shipping and ports

A review of the literature underlines that the research covering the regionalism of maritime transportation can be articulated from three perspectives (Fig. 1).

- *Connectivity* Consider ports as nodes and groups of ports as communities (G). The groups, or communities, are measured based on the centrality and connectivity of each port (node) within a maritime network consisting of shipping services. The focus is on the foreland and benefits from readily available data about shipping networks, allowing quantitative classification methods. This perspective captures well the dynamics of shipping networks, but connectivity does not define regionalism well due to potential rapid changes in shipping network configurations.
- *Accessibility* Consider ports as gateways granting access to a regional hinterland (H). It is fundamentally a market area analysis, often represented as a probability that a location will attract or generate cargo from a given port. The hinterland can be classified as fundamental where a port has a large market share and as competitive where two or more ports may compete to secure customers and traffic.
- *Proximity* Consider ports as part of coherent bounded ranges, mainly based on a commonality such as a coastline (R). Ports in proximity are assumed to have a low criteria variance, such as a similar regulatory regime or inland market characteristics. Maritime ranges provide a formal and stable unit of analysis, but the level of commonality cannot be similar across ranges. Therefore, some ranges are more coherent and well-defined than others.
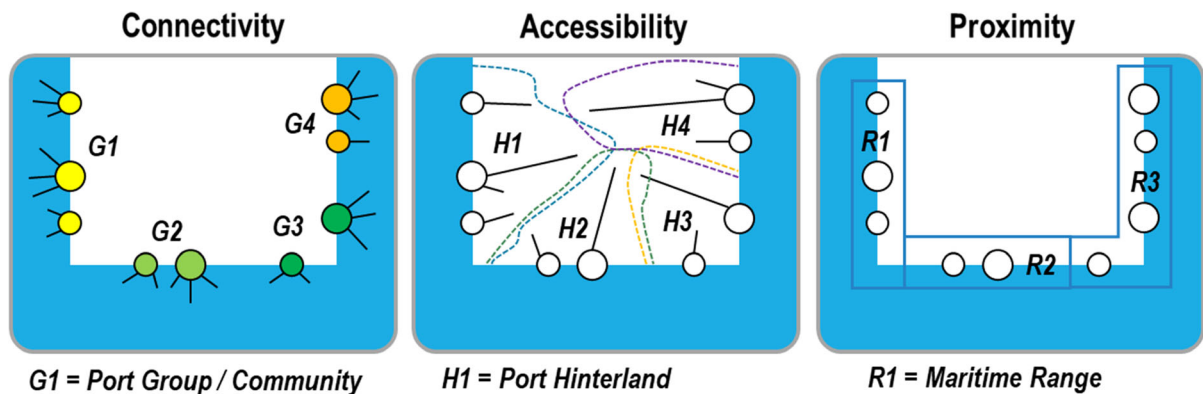
**Fig. 1** The regionalism of maritime transportation

Each approach has its merits and flaws but offers a complementary perspective on the regionalism of maritime shipping. Contemporary research has focused on the connectivity and accessibility effects of maritime shipping and ports, which the maritime range relegated as a historical oddity. Still, approaches using connectivity measures are dynamic, but unstable and changing with the configuration of shipping services. Accessibility approaches require comprehensive information about the market area of each port, often not available due to their commercial sensitivity. The development of complex maritime shipping networks and increasingly efficient port hinterlands because of intermodalism have led to extensive analysis of freight regionalism as connected and accessible spaces. It is worth revisiting the maritime range as an element of freight regionalism.

The maritime range

A maritime range is a bounded region where a set of ports are either in competition, complementary, sharing a common regulatory regime, or having some basic geographical proximity, such as contiguity, or being part of an archipelago. Ports within a range have a higher level of internal commonality than with their adjacent ranges. They may compete over similar hinterlands or may be part of similar feeder services, connecting them to deepsea services. Maritime ranges can extend over several countries if a common regulatory regime applies. Implicitly, maritime shipping lines have range-based commercial strategies since their services either link maritime ranges (deepsea services) or connect the range itself with regional

feeder or cabotage services. Maritime shipping lines thus have inter-range and multi-range services as fundamental elements of their network configuration, and yet, the range itself remains ill-defined. Changing commercial conditions within a maritime range are expected to impact the structure of shipping networks, but little attempts have been made to look at maritime ranges as a unit of analysis. Conventionally, they were simply defined by regional geography constructs, which means that ranges usually corresponded to standard world regions such as Southeast Asia or Western Europe, or even single countries.

A maritime range represents a functional region that includes three major components; the coast (maritime/land interface), a hinterland, and a maritime boundary. The hinterland is the land market area potentially serviced by the range, as services outside this hinterland are possible but represent a marginal share of the hinterland activity. Maritime ranges are complex to define formally. In many parts of the world, the hinterland is well serviced, clearly defined, and competitive (e.g. North America and Europe), while in other parts of the world, hinterlands are exclusive, disjointed, and constrained by complex regulatory regimes (e.g. Sub-Saharan Africa). Many maritime ranges have been formally acknowledged for decades, such as the Northern European range or the American East Coast, but there is no explicit attempt to define them comprehensively. Analysis at the maritime range level do exist (e.g. Merkel 2017; NEA 2011; Notteboom 2007), but they focus on a single range, often without questioning its nature; it is a unit of analysis taken for granted. Further, only a few ranges have been formally used as a geographical
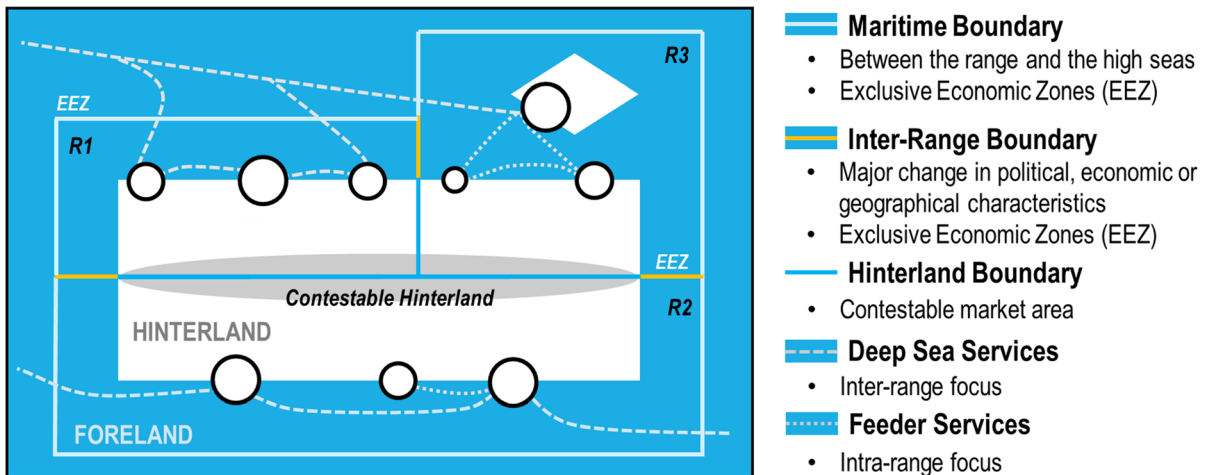
Fig. 2 Defining maritime range boundaries

framework, with the Hamburg-Le Havre range the most common.

Defining boundaries

Regional sciences have divided the world into formal regions that have become part of the lexicon. Maritime ranges can be used as regional units to monitor changes in commercial activity since they reflect a functional unit of economic activity. As any geographical unit, their boundaries require a clear definition that involves a set of heuristic rules involving three boundaries types (Fig. 2):

- *Maritime boundaries* The boundary between the range and the high seas. Although the range boundary could, in theory, be the coastline, using Exclusive Economic Zones (EEZ) to mark the extent of a maritime range has a higher relevance. It corresponds to the geopolitical and economic reality since it includes an area of sovereign maritime jurisdiction.[1] For boundaries between oceanic masses, such as the Atlantic and the Indian oceans, the official inter-oceanic boundaries provided by the International Hydrologic Organization (2002) are used.

- *Inter-range boundaries* The most important boundaries as they represent a major change in political, economic, or geographical characteristics, which requires considering the ranges on both

sides of the boundary as separate entities. For instance, being part of a trade agreement or having a similar level of economic development would characterize the common elements of a maritime range. From a geographical standpoint, seas are common inter-range boundaries, such as for the Mediterranean or the Red Sea. Like maritime boundaries, inter-range boundaries are using EEZ as the demarcation line.

- *Hinterland boundaries* These boundaries are complex to establish since, at times, the boundary between hinterlands are market areas that can be measured. Hinterland boundaries are contestable (De Langen 2007). In highly competitive hinterland markets such as Europe, the hinterland is relatively straightforward but subject to variations on a port basis. On other occasions, they cannot be readily assessed and correspond either to national boundaries or to a geographical feature of high impedance such as a mountain range. The international border remains an important element in the delimitation of hinterlands, particularly in areas having a low level of economic integration.

The purpose of the paper is to develop and test maritime ranges as geographical constructs for the analysis of ports and maritime transport systems. It expands the conventional perspective over two dimensions. First, instead of applying maritime ranges only to high density and well-defined areas, it applies the concept to the world. Second, it provides formal

[1] 1982 United Nations Convention on the Law of the Sea.

boundaries, allowing to define explicit ranges that can be used as units of analysis. The introduction defined the concept of maritime ranges as a functional scale of analysis. In the second part, the concept of maritime ranges is applied to the analysis of global maritime transport and its regionalism. In the third part, a more detailed analysis of the maritime ranges of the Americas is undertaken in light of recent commercial changes and the expansion of the Panama Canal.

Global maritime ranges

Applying the heuristic rules developed in the prior section leads to 28 proposed maritime ranges, which are depicted in Fig. 3. The maritime extent of a range is in direct relation with the density of port activity and competitive pressures at the hinterland margins. Extensive ranges such as the North American East Coast (5) of the West African Coast (17) have relatively evenly distributed ports that agglomerate in clusters. Much less extensive ranges, such as Northern Europe (13) or the Yellow Sea (23), have a high concentration of container ports handling large volumes.

Oceanic ranges

Oceans are systems of maritime circulation and account for a marginal share of global port activity. They can be considered as maritime ranges, but since they are not empty entities, they are a separate class delimitated on one side by the EEZ of the maritime ranges and the other by oceanic boundaries, such as between the Atlantic (1) and the Indian (3) oceans. Similarly, the Pacific range (2) is composed of a large number of unintegrated entities with Hawaii, the largest cluster of activity. The hinterlands serviced are negligible, fragmented, and independent.

The Arctic (4) is an emerging maritime range with some port activities (e.g. Murmansk, Narvik, Churchill), but minimal container traffic. There is also minimal hinterland accessibility from the Arctic range, so the hinterland boundary is ill-defined. For instance, during the summer, communities along the Canadian Arctic are serviced by supply vessels mainly calling from Montreal. Climate change and the lengthening of the Arctic navigation season has involved additional traffic in the range and the potential of the new sea routes to link the Pacific and

Atlantic oceans (Pruyn 2016). The Antarctic is not a maritime range since it has no level of port activity and virtually no maritime traffic; it is merely the end of oceanic boundaries.

The Americas

The maritime ranges of the Americas are oriented along the North American East (5) and the North American West (6) coasts. The hinterland boundary between the two main coasts is approximate of the market areas of the major class I railways. Because of North American economic integration (NAFTA), both the West Coast (6) and the East Coast (7) include Canada, the United States, and Mexico as a single functional entity. Alaska and its full EEZ are also included, implying that the two concerned maritime ranges account for the regional definition of North America. However, the northern boundary with the Arctic range remains ill-defined since there are little economic activity and transportation infrastructures.

The Caribbean Basin range (7), which includes Central America, represents a duality between the archipelago component and the continental hinterlands of Colombia, Venezuela, and most Central American countries (to a lesser extent). The Guyanas are included in this range because of their political (CARICOM) and commercial (mostly serviced by feeder services from Caribbean hubs) associations with the Caribbean. The inter-oceanic relations are intensive in Panama due to the presence of the canal, a little bit less extensive in Central America due to the short interoceanic distances, and also to a lesser extent in Colombia due to its exposure to two maritime ranges.

Like North America, South America is divided into two ranges, the South American West Coast (8) and the South American East Coast (9). The South American West Coast (8) is a series of independent hinterlands with the South American hinterland boundary being mostly physical (Andean mountain range).

Europe and the Mediterranean

European maritime ranges are organized along two main regions. The first is linked to the Atlantic with the British Isles (10), Europe Atlantic (11), the Baltic (12), and Northern Europe ranges (13). The second region
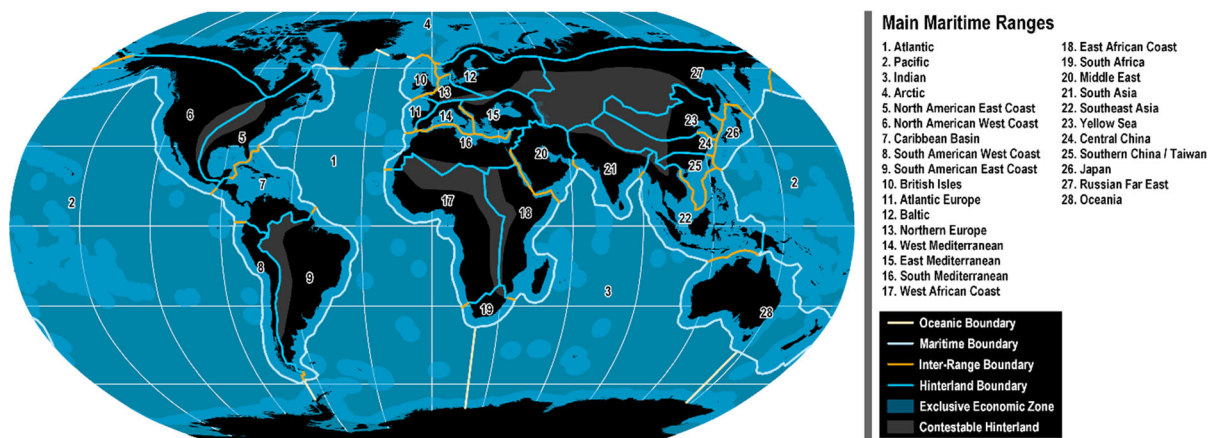
Fig. 3 World's main maritime ranges (The boundary of many ranges is based on Exclusive Economic Zones (EEZ) and subject to contention. The boundaries depicted on this map are functional representations and should not be as sovereignty claims)

involves the Mediterranean with the Western Mediterranean (14), and the Eastern Mediterranean (15). Due to relatively short hinterland distances, these ranges are extensively competing with one another, with the Northern European range (13) assuming dominance (NEA, 2011). The Southern Mediterranean range (16), extending from Morocco to Syria, represents ports servicing their national markets and with limited competition. Mediterranean ranges are also subject to significant transshipment activity interfacing between range-specific port activity and deep-sea shipping services.

Africa, the middle east and south Asia

For the West African (17) and East African (18) ranges, ports are servicing poorly connected national markets with the setting of inland corridors in an early stage (Gekara and Chhetri 2013). The hinterland between the East and West African coasts is subject to much contestability and ill-defined. South Africa (19) represents a specific range because of its higher level of economic development and being at the interface between two oceans with growing levels of transshipment as a connector between Sub-Saharan Africa, South America, and East Asia (Fraser and Notteboom 2012).

The Middle East (20) and South Asia (21) ranges are impacted by dual functions of accessing regional economies, but also as growing transshipment

platforms. Their extent remains closely similar to their corresponding regional geography constructs.

Pacific Asia

Southeast Asia (22) is an archipelago range with a series of ports servicing their respective insular or national markets with the system articulated by a major hub; Singapore. Conventionally, East Asia was considered as a single range corresponding to its standard regional geography definition, including China, the Korean peninsula, and Japan. The substantial level of growth in port activity, particularly in China, has rendered this region unsuitable as a unit of analysis, which necessitated its fragmentation in four maritime ranges. Mainland China is divided into three ranges, each corresponding to the natural hinterland of its three main river systems and centers of economic activity; the Yellow Sea range (23), the Central China range (24), and the Southern China range (25), which includes Taiwan. Due to the excessive level of container port activity, China is the only nation that has been subdivided into ranges. Conventionally, the Korean peninsula was functionally part of the Japan range (26), but the trade reorientation of South Korea towards China supports its inclusion in the Yellow Sea range (23) (e.g. Lee and Rodrigue 2006).

Japan (26) is a specific range due to its archipelago nature with its ports oriented at servicing the national economy and supporting cabotage. The Russian Far East range (27) is marginal and does not see significant

maritime volumes. It also includes former Soviet republics in a hinterland that is not clearly defined and highly contestable. The setting of the Eurasian land-bridge is improving its relevance and may likely impact the relationships with the Chinese hinterlands, such as those being expanded by the One Road One Belt initiative. Last, Oceania (28) covers the range of Australia and New Zealand, active resources and agricultural goods exporters.

Shifts in global maritime ranges

Range concentration and clustering

Maritime ranges are associated with the commercial dynamics of their forelands and hinterlands. Looking at the distribution of container port activity across ranges is revealing in terms of their concentration and clustering (Fig. 4). The propensity for cluster formation varies substantially by maritime range, mainly for the following reasons:

- *Availability of port sites* Relates to the physical characteristics of the range with its coastal geography impacting the number of suitable port sites with factors such as protected bays and tidal range, which are related to the distribution of cities. The growing average size of containerships tends to restrict port choice because of draft limitations. Further, container terminals require a substantial amount of real estate for piers and yards, which can be challenging to find.

- *Administrative divisions* Nations states commonly have their own cabotage rules and restrictions, which can impact how hinterlands are serviced. In a context of limited economic integration, adjacent nation-states, or even administrative divisions, can be serviced by a dedicated container port with their level of activity constrained by the size of the administrative unit. This can also incite the over-supply and duplication of port infrastructure.

- *Hinterland accessibility and density* Economic development, urbanization, and the distribution of resources imply an uneven hinterland density. As major economic regions are structured along corridors, this concentration favors specific container ports and port groups servicing these areas.

- *Economies of scale and infrastructure* The growing average size of containerships and the push towards terminal efficiency underline the capital intensiveness of containerization. In turn, this incites a concentration of investments in a specific number of efficient container ports able to generate enough traffic and economic returns.

The case of sub-Saharan Africa is revealing because of its high level of political and cultural fragmentation, undermining the setting of scale economies in freight distribution. The differences in the distribution of ports along the Eastern and Western African coast ranges can, in part, be attributed to a very different distribution of coastal nation-states. While 23 nation-states are along the West African Coast range, only 12 (including Madagascar) nation-states are along the East African Coast range.
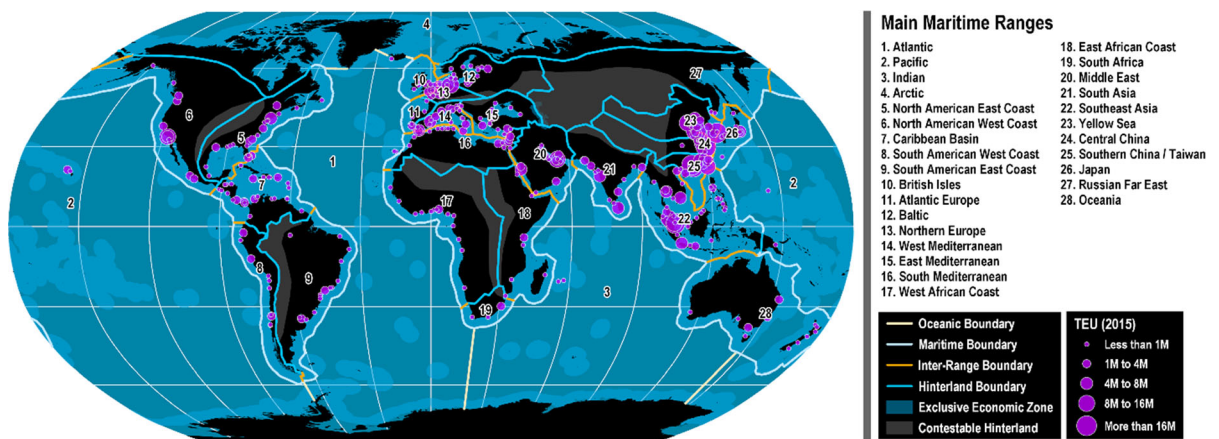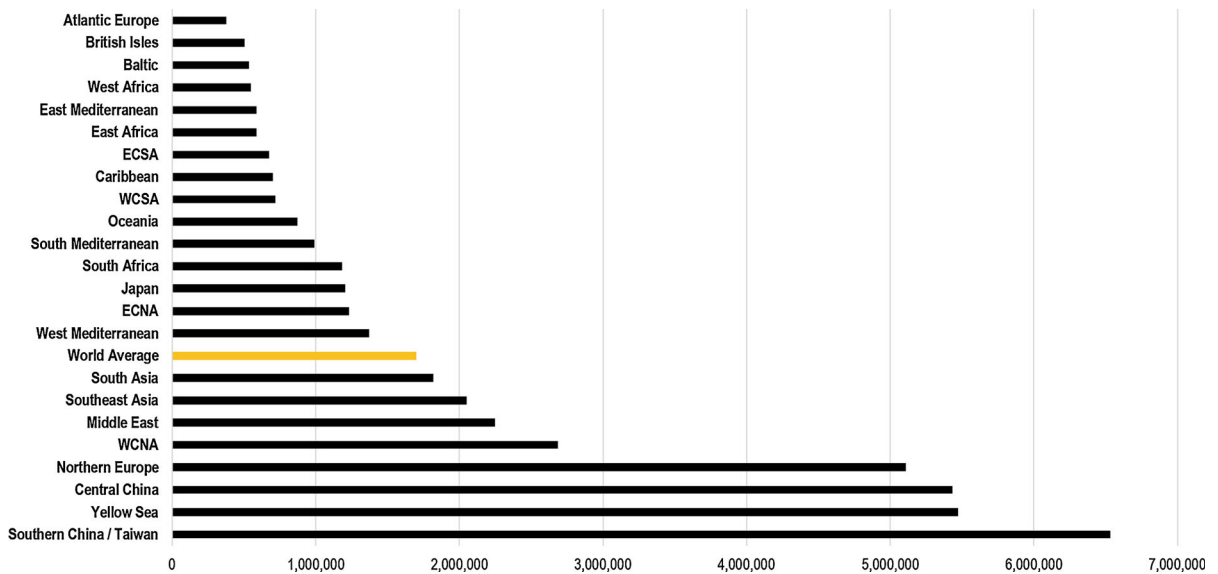

Fig. 4 Port container traffic per maritime range, 2015

Fig. 5 Average port traffic by maritime range, 2015 (in TEU) (Only ports having a traffic of more than 100,000 TEU are considered)

Paradoxically, the higher population concentration and density along the West African Coast range would incite a higher level of traffic concentration, but this is counterbalanced by twice as many nation-states. This is also reflected in the average traffic by port within the ranges (Fig. 5), where the East African range has an average of 588,000 TEU per port compared with 549,000 for the West African range. Technically, higher levels of traffic would be expected in the West African range.

Figure 5 reveals significant port scale differences across ranges with a global average of 1.7 million TEU per port, irrespective of the number of container terminals (larger ports usually have more terminals than smaller ports). There is less traffic size variation at the terminal level than at the port level since the container terminal is bound by operational constraints while the port is simply bound by its jurisdictional definition. The concentration of the largest ports in the world in just a few ranges is apparent with Southern China (26), Central China (25), the Yellow Sea (24), and Northern Europe (14) having 3 to 5 times the global average. At the opposite end of the spectrum, the Gulf Coast (7), the Caribbean (8), Atlantic Europe (12), and the Baltic (13) are 3 to 4 times below the global average. The scale differences are partially attributable to the nature and density of the hinterland serviced by each range. The higher the density, the higher the level of contestability.

Differences at the range level are further nuanced by the level of concentration of port activity, which can be observed geographically and in terms of traffic. Figure 6 depicts the linear distribution of ports along the seven maritime ranges having the most traffic with their respective Gini Coefficient[2] and Nearest Neighbor Index.[3] All ranges show a level of container traffic concentration, a characteristic which is well documented (Notteboom 2007). The two North American ranges indicate a level of dispersion (NNI around 1.3), which is associated with low Gini coefficients. The ranges of China all show a level of traffic concentration, but a more uniform spatial distribution (NNI around 1). Both European ranges have concentrated spatial distribution (NNI below 1) and traffic concentration (Gini around 5).

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[2] The Gini coefficient (G) measures the degree of concentration (inequality) of a variable in a distribution of its elements. It ranges between 0, where there is no concentration (perfect equality), and 1 where there is the total concentration (perfect inequality).

[3] The Nearest Neighbor Index (NNI) is expressed as the ratio of the observed mean distance to the expected mean distance. The expected distance is the average distance between neighbors in a random distribution. If the index is less than 1, the pattern exhibits clustering. If the index is greater than 1, the trend is toward dispersion. The area used to calculate the NNI is derived from a 200 km band (100 km on the foreland and 100 km on the hinterland) that follows the coastline of each range.
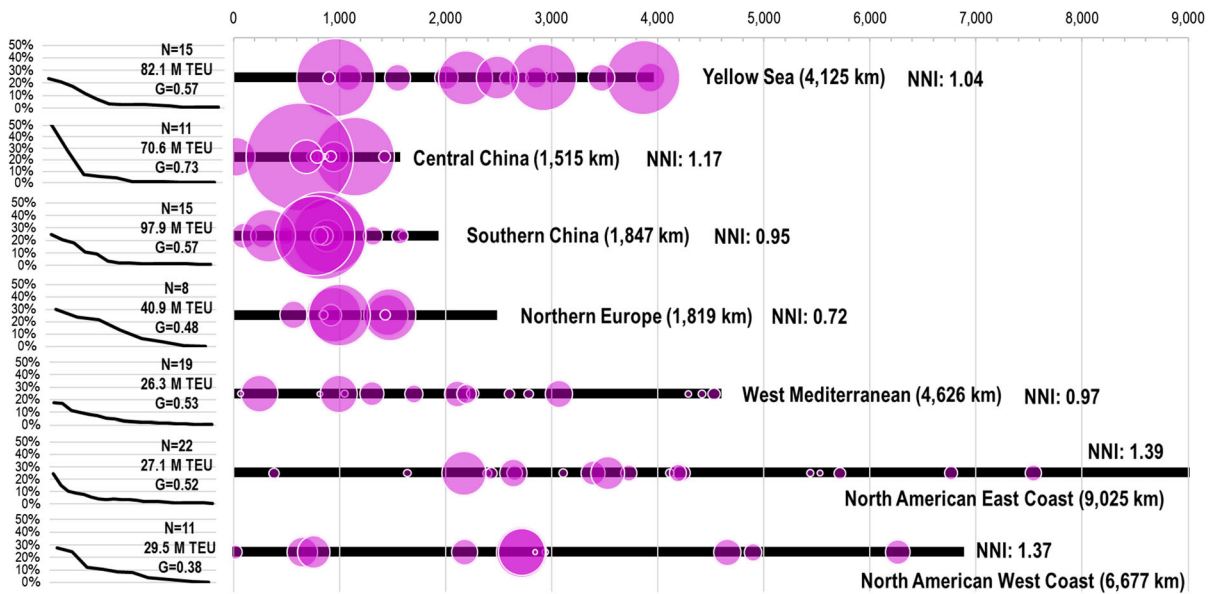
Fig. 6 Rank/size distribution, linear distribution and nearest neighbor index of ports along main coastal maritime ranges
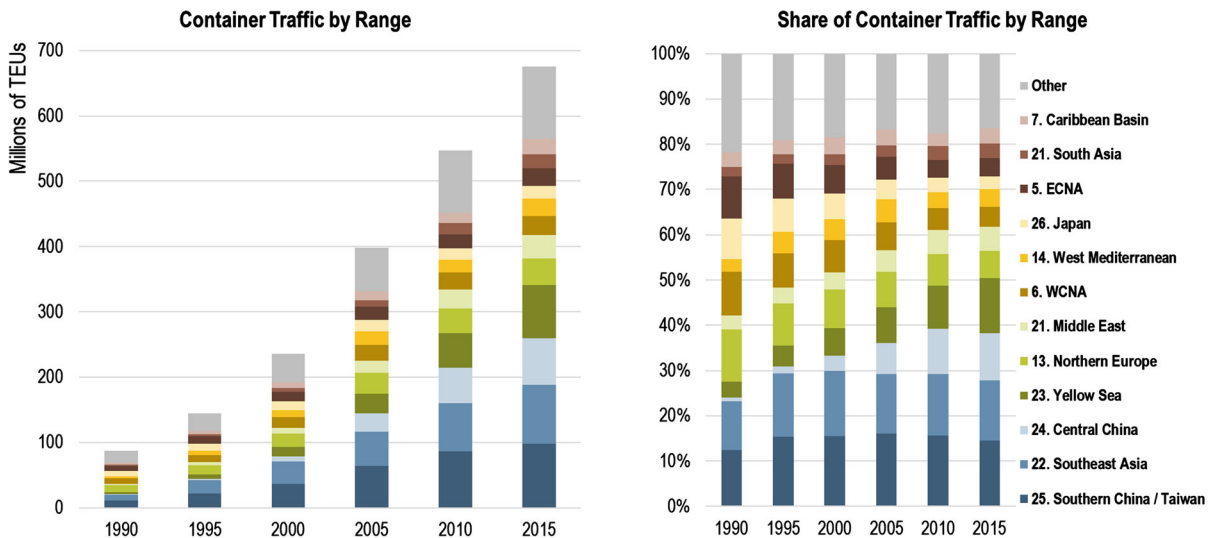
Fig. 7 Container traffic per maritime range, 1980–2015

Range growth dynamics

The scale and change of container traffic are illustrative of significant regional shifts. While container traffic by range has seen nonlinear growth between 1990 and 2015, looking at the share of major ranges in the total traffic shows a shift in their relative importance (Fig. 7). The level of range concentration is increasing with the share of East Asia (Yellow Sea, Central China, and Southern Chin/Taiwan ranges).

Including Southeast Asia, these four ranges accounted for 50.4% of the total container traffic in 2015, while this share was 27.5% in 1990. Still, share assumed by the ranges of Southeast Asia and Southern China/Taiwan has remained stable since the 1990s. In contrast, the share assumed by the ranges of Central China and the Yellow Sea has increased, which underlines a shifting regional dynamic. While most of the growth of the Southeast Asia range is derived

from transshipment activities, the growth of the share of Central China and the Yellow Sea ranges is the outcome of massive industrialization beyond the initial cluster of the Pearl River Delta (Southern China/Taiwan range).

Inversely, the share of the Japanese range declined, from about 9% of the global traffic in 1990 to than 2.8% in 2015, a process in part attributable to the offshoring of its manufacturing base in China. A similar observation can be made for the West Coast of North America (WCNA) as well as for the East Coast of North America (ECNA) that have accounted for the decline of their share. Yet, the traffic handled by the ten most active ranges has remained in the 75–80% range during that period. The above observations are well documented and are illustrative of the main macroeconomic changes affecting the global economy. These include trade liberalization and the diffusion of containerization involving a shift in growth according to different cycles (Guerrero and Rodrigue 2014).

Maritime ranges of the Americas

The five core ranges

The maritime system of the Americas has been impacted by several ongoing shifts in recent years, namely the comparative growth of transpacific trade as opposed to transatlantic trade, a trend that is being counterbalanced by the expansion of the Panama Canal. Further, Central and South America experienced ongoing deconcentration of port activity and the liberalization of port governance, which led to many new terminals being constructed (Wilmsmeier and Monios 2016). Five major maritime ranges can be identified, each with its distinct level of activity and logistics (Fig. 8):
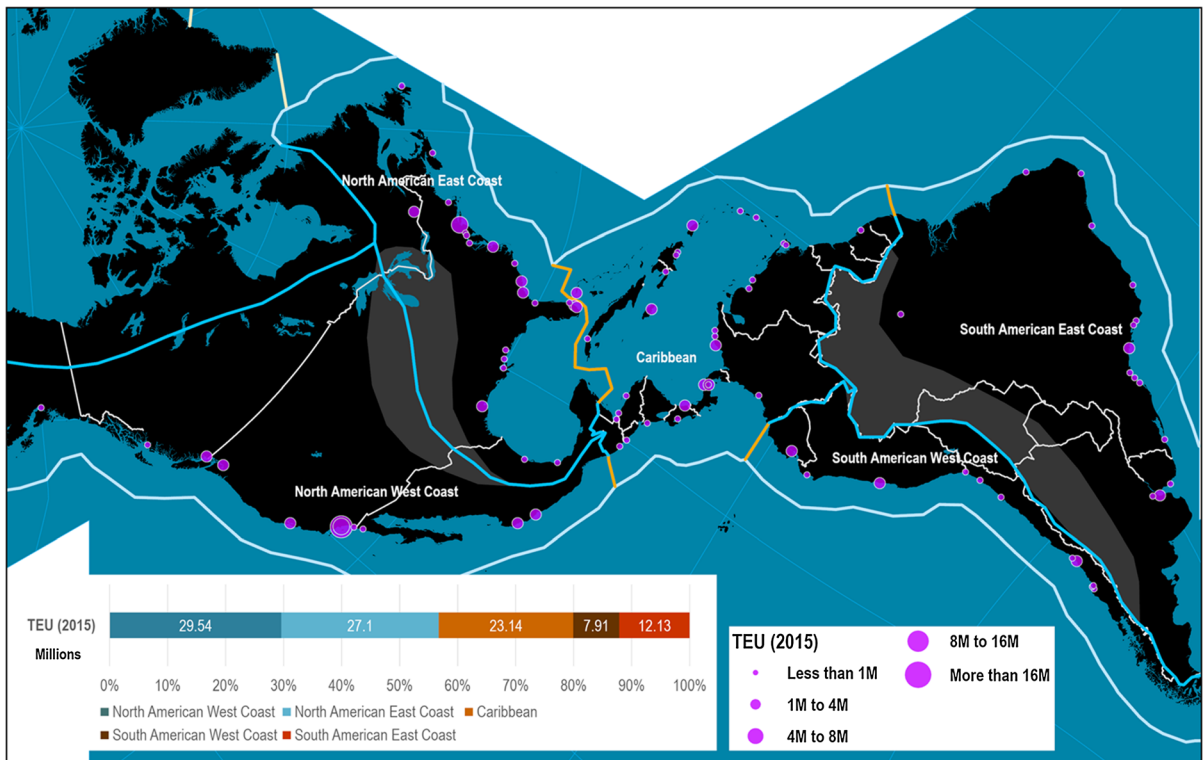
- *East and West Coasts of North America* This sub-system has two coasts (Pacific and Atlantic) that are integrated through long-distance rail corridors (landbridges), leading to a high level of contestability. They jointly account for about 57% of the TEUs handled by the Americas. Most of the gateways are within regional port clusters such as Los Angeles/Long Beach, Vancouver/Seattle—Tacoma, Charleston/Savannah, or New York/

Hampton Roads. These clusters provide importers and exporters with options and act as logistics platforms for continental freight distribution. While hinterland access is dependent on port proximity, the efficiency and capacity of rail transportation (e.g. double-stacking) provide higher levels of hinterland accessibility. With the setting of NAFTA and the integration of its rail system (e.g. the acquisition by KCS of a rail corridor between Kansas City and Lazaro Cardenas), Mexico is increasingly considered as integrated with North American West and Gulf Coasts.

- *Caribbean* This sub-system has small hinterlands, implying limited growth potential, with a few exceptions (e.g. Cuba, Venezuela, and Columbia), with about 21% of the TEUs handled by the Americas. The nature and extent of the traffic are related to the economic activities of each island. The main growth driver is transshipment, a trend that emerged in the late 1990s, accelerated in the 2000s, and cumulated with the expansion of the Panama Canal in 2016 (McCalla 2004; Rodrigue and Ashar 2016). The Caribbean has a pronounced duality between the commercial ports focusing on transshipment and hinterland access and the social ports with limited hinterlands and growth potential.

- *East and West Coasts of South America* This sub-system has two coasts that are not integrated because of the difficulties of servicing the hinterland, which is not well connected beyond coastal areas. It accounts for about 22% of the TEUs handled by the Americas. Inland rail connections tend to be poor or non-existent, and when they are present, they are simply penetration lines linking a gateway and a few inland load centers. Each coast is an entirely different market, and more than often, each port can assert dominance over its hinterland since competition tends to be limited. Most ports are not directly connected to deepsea shipping lines but through coastal services to main transshipment hubs such as Santos, Buenos Aires, or Callao.

Port and range dynamics

A look at the net growth of containerized traffic at the maritime range and port levels reveals significant changes in port dynamics in recent years (Figs. 8 and

Fig. 8 Container traffic and share by maritime range in the Americas, 2015

9). While the North American East and West Coasts remain the most salient ranges, their share dropped from 80% of the total traffic in 1990 to 57% in 2015. Until 2010, the East Coast has experienced a gradual decline of its share, which is mainly attributable to the growth of the transpacific trade. After 2010, the growth of all-water routes using the Panama Canal as well as the Suez Canal option resulted shifted the


Fig. 9 Share of the maritime ranges of the Americas in total container volumes, 1990–2015 (TEU)

equilibrium between the East and the West coasts (Bhadury 2016; Rodrigue and Ashar 2016). Latin American and Caribbean ports accounted for 88% of the net container growth of the Americas during that period. This growth is putting pressure on freight distribution systems and the need to develop better logistical capabilities. It also supports the development of economies of scale in maritime shipping since a growth in traffic handled by Latin American ports can attract services by bigger, and thus more cost-effective, ships. The outcome would be a reduction in transportation costs and better trade facilitation. However, growth is far from uniform and has mostly benefited the largest ports in Latin America (Fig. 10).

Changes in North American gateways have influenced freight distribution and ports of entry on the respective maritime ranges. The development of the Savannah gateway has been a notable driver of traffic growth through the all-water route. Two new port gateways are also emerging, both with the support of major rail operators. In Canada, Prince Rupert capitalizes on shorter transpacific distances and a dedicated and uncongested CN (Canadian National railway) rail corridor to Chicago. In Mexico, Lazaro Cardenas, with a rail corridor operated by KCS (Kansas City Southern railway) up to Kansas City (and through the major market of Mexico City), offers a new corridor in tune with the NAFTA trade. Thus, the role of gateways in coordinating freight distribution influence the routes selected to access markets.

Another factor impacting North America maritime ranges is changes in global routing options. The usage of the Suez Canal as a routing option to service East Coast ports has increased in the last decade, particularly with the growth of transshipment activities around the Mediterranean basin as well as a shift in sourcing towards South and Southeast Asia. Mediterranean transshipment hubs offer additional opportunities to consolidate Asian and European cargo and employ larger ships. This option is increasingly competing with the Panama Canal option.
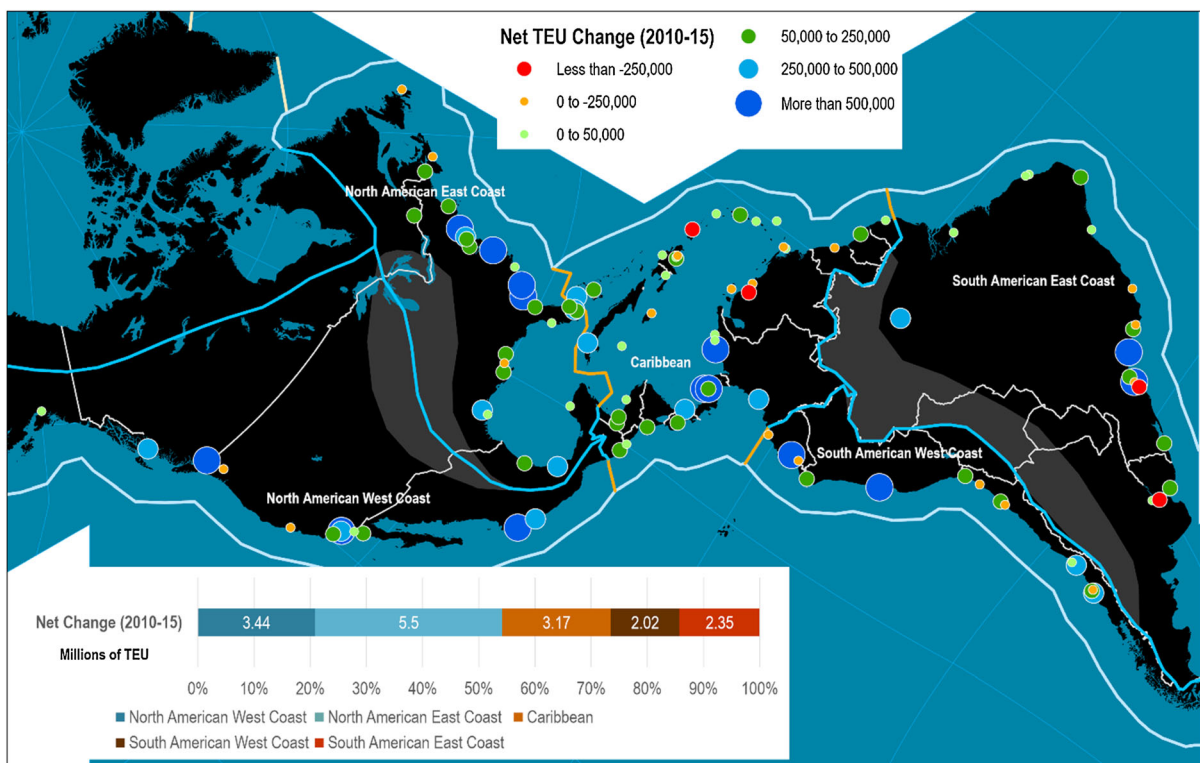
Fig. 10 Container traffic evolution by port and maritime range in the Americas, 2010–2015

Conclusion

The paper proposed an intermediate scale of analysis for the geography of maritime transportation, relying on the concept of maritime ranges. Maritime ranges are bounded regions where a set of ports are either in competition, complementary, sharing a common regulatory regime, or having some fundamental geographical commonality. This scale is mostly missing from research in the structure and organization of maritime transportation that either looks at the port level or the shipping network level. Maritime ranges investigate the proximity effect in the regionalism of maritime shipping, which has also been investigated from the connectivity (networks) and accessibility (hinterlands) approaches.

The paper proposed a methodology defining maritime ranges bounded by maritime, inter-range, and hinterland boundaries. This methodology was applied to define 28 global maritime ranges representing functional entities generating and attracting maritime traffic. The question remains about how effectively ranges can act as representative units of maritime commercial activity, and how consistent is this representativeness.

Several hinterland boundaries are not well defined either because of the lack of traffic and the lack of available data. Within each range, a propensity to cluster was observed with the level of clustering and concentration linked with the level of hinterland development. Ranges with a higher level of hinterland development tend to have a lower level of concentration, mainly because of higher contestability levels. Further research could focus on how consistent are intra-range and inter-range clustering and concentration in space and time and what are the main factors behind the propensity to cluster at the range level.

A fundamental issue is related to the coherence of the approach, namely, in light of the dynamics of the shipping industry, which the connectivity approach captures. Further analysis would help expand the definition of the maritime range as a combination of connectivity and accessibility measures. A long term analysis of port systems require a stable unit of reference, such as a range, against which the connectivity approach can explore the gaps, and if these gaps are only temporary or long term. For instance, the decision of shipping lines reflects underlying macroeconomic factors impacting a range. If a connectivity analysis reveals enduring stability in a port group, then the maritime range should be redefined accordingly. The level of synchronism between the network, accessibility, and proximity definitions could therefore be further tested to understand better in which way they converge or diverge. Convergence would be expected in periods of stability, while divergence reflects a shift brought by economic, technological, and political factors.

Defining the hinterland ranges remains a challenge, and further research is needed to understand in more detail the dynamics involved. Looking at the Americas revealed a shift in the relative importance of maritime ranges following shifts in global trade orientation, with transpacific trade being an important driver. The role of transshipment as a range defining activity also remains to be clarified since the volumes handled can be for intra-range traffic. In light of global processes and local impacts, the regionalism of maritime shipping remains an underinvestigated field linking geographical attributes and commercial drivers.

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