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# **The regionalisation of maritime networks: evidence from a comparative analysis of maritime basins**

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Throughout the maritime literature, most studies of port systems are focused on the national level or on a single port through a case study. This classic approach should be revisited in the context of international trade reorganisation, given the evolution of shipping and cargo handling technologies (the spread of containerization) and changes in the economic environment itself (role of multinational firms, declining role of states, consolidation of transnational custom unions, etc.). The regional perspective is increasingly being questioned by geographers, economists, and political scientists alike. The role of transport (by sea, land or air) remains little explored in this context.

One crucial question explored in this paper is the relevance of the “region” in port and maritime geography. Does the concept of “maritime region” provide a valid framework for the analysis of ports and maritime networks? How is it or should it be defined? How can a better understanding of the regional dimension contribute to existing port and maritime studies? In the vast related literature (see Ng and Ducruet, 2014), port regionalisation is better defined from a continental perspective (Notteboom and Rodrigue, 2005) of multimodal corridor development (Monios and Wilsmeier, 2012) and traffic concentration (Notteboom, 1997). Many case studies, too numerous to be cited, have contributed to the understanding of maritime regions at various scales, such as on deltas, straits, corridors, ranges, seaboard, basins, seas, and oceans, but often without a clear definition of the concept of maritime region itself. Monios and Wilsmeier (2012) recognise that regionalisation in maritime geography has not been defined adequately and that the question remains open-ended, and they insist on the role of “collective action” in reaching a better understanding of port regionalisation in an “inland” perspective.

Notteboom (2012) underlined the development of transshipment relay and interlining activities at ports along the “equatorial round-the-world route”, thereby forming dedicated regions based on intermediary hubs (see also Rodrigue and Notteboom, 2010). Several seas are required passages on that road: the Mediterranean, the Caribbean, and the China Seas. These basins have all been strongly affected by the spread of containerization that caused a new “maritime order” (Vigarié, 1990) or a new “spatial cycle” (Rodrigue et al., 1997) and modified over the long-run the spatial design of regional networks. Yet, regional evolutions that are influenced by global

strategies differ from one region to the other due to specific development pathways (Jacobs and Notteboom, 2011), so that these basins remain heterogeneous in their organisation (maritime range, isolated or integrated *hub and spokes* system, dispersed or polarized networks). Similar trends can, however, be observed and analysed in this “global-regional” context and encourage us to think about the internal dimension of flows in each region.

Other conceptual advances, never really linked with the aforementioned works, came from the field of area studies where the analysis of maritime basins was presented as a useful complement to the more dominant continental approaches in world history and “metageography” (Bentley, 1999; Lewis et Wigen, 1999; Grataloup, 1997). The maritime region was thus seen as a contact zone between different coastal societies through various linkages made possible mostly via sea transport. One main idea is that the actual contours and internal configurations of maritime regions are not necessarily determined by the physical layout of coastlines; they may fluctuate over time and have, in turn, strong influence over future developments.

The rest of the chapter is organised as follows. Next section goes through classical and recent definitions of the concept of “region” in geography and social sciences in general, before embarking on more empirical studies of regions in transport and mobility studies as well as in the specific area of port and maritime studies. Based on such a background, we propose an analysis of the evolution of maritime links within the Mediterranean basin and two other regions, namely the Caribbean basin and East Asia, based on container flows over the last 30 years (1996-2011). The last section discusses the results in light of current territorial factors underlying the observed evolutions.

## **Regions, flows, and maritime areas**

We first propose going back to the concept of region as one major spatial entity or category to describe the shift from a purely physical approach to a more functional, or relational, approach. In such a context, the region and its construction processes (regionalisation and regional integration) are more and more seen as multiple and multiscalar. It is perhaps where port and maritime studies have the most to learn, although regional forms of organisation have long been identified but in more implicit ways.

### *From physical/administrative regions to functional/relational regions*

One classic approach to the concept of region has been limited to the administrative criterion, i.e. the sub-national entity designed for territorial management, such as the 22 French régions, the 17 Spanish comunidades autónomas, or the 16 German Länders. Another classic approach can be found in the works of Vidal de la Blache (1903) where the region is categorised as urban, agricultural, nodal, or in decline, also

at the subnational level. Later, and for other geographers, the region owed its existence to perception and cognition based on the daily practice of space (Frémont, 1976). French researchers also developed the idea of polarised and peripheral regions depending on the ability of urban centres and industrial activities to facilitate the emergence of growth poles (Perroux, 1991), a view that has become essential in the development of the new economic geography (NEG) in recent decades. This long tradition of seeing the region as a subnational entity (see also Claval, 1968) through numerous monographs tended to decline in the late 20th century, notably with the renewed approaches of Veltz (1996) and Sassen (1991) about the dematerialisation of the world economy. Yet, some recent works have proposed adapting the classic framework to larger spatial scales somewhere between local and global (Beckouche, 2008; Girault, 2009; Richard, 2010), while early geographers such as Vidal de la Blache were recently revisited in their ability to define a global economic structure (Arrault, 2008).

The macro-regional level is thus clearly part of the “new regionalism” (Hettne and Söderbaum, 1998) where the region is extroverted and whose limits remain fuzzy. Some authors even insisted on the “rescaling” of the region (Jones and Paasi, 2013) and its necessary geographical connectedness (Amin, 2004). The most comprehensive view of the region was proposed by Hettne and Söderbaum (2000) for whom the region is a dynamic regionalisation process “in the making” made of both top-down and bottom-up factors. They proposed the notion of “regionness” to describe the emergence of the region as an evolutionary process.

### *Regions and flows*

The material dimension of the more relational region has been the focus of numerous works, both theoretical and in the more empirical field of transport and mobility studies. For instance, the Ford Foundation (1997) study entitled “Area Studies: Regional Worlds” and quoted by Lewis and Wigen (1999) recalled earlier studies of the “world system” whereby different regions of the world economy are linked with each other through certain dominant nodes (Wallerstein, 1979; Braudel, 1985) and/or through complex, multiscale relations (Dollfus et al., 1999; Dicken et al., 2001).

Indeed, economic globalisation that is supposed to transgress nation-states and allow the emergence of “winner regions” (Benko and Lipietz, 1992), “global cities” (Sassen, 1991), and “global city-regions” (Scott, 2001) greatly influenced territorial structures. Through accelerated mobility, territories are more and more hierarchically organised, internally and externally, as regions become, according to Ohmae (1996), “natural operational units of the contemporary world economy”, modelled by capital flows, comparative advantage, and the productivity of territories. The relational analysis of territories based on pioneering works on nodal regions (Rochefort, 1960; Nystuen and Dacey, 1961) and telecommunication flows among cities found fertile ground in transport and mobility studies such as on airline flows (see Ducruet and Lugo, 2013).

Analyses at the world level did not omit the importance of proximity in the design and regionalisation of flows. However, the link between world regionalisation and flows remains little studied, except from the point of view of monetary unions or trade agreements (Balassa, 1962; Snyder and Kick, 1979; Beauguitte, 2013) or simply based on country data (Didelon et al., 2008). Other studies have focussed on trade or migration flows to seek regional and hierarchical tendencies (Massey et al., 1993; Tarrius, 2007; Richard and Zanin, 2009), often arguing that regionalisation processes are strong components underlying world patterns.

### *Maritime regions*

Throughout port and maritime geography, Vigarié (1964) and Charlier (1996) have pioneered the analysis of transnational maritime ranges (Northern Range, Benelux port system) based on the idea of similar development paths caused by shared hinterlands, shipping services, and regional integration. But, as mentioned above, most studies of port systems remained bound to the national level. A look at the 399 papers listed by Ng and Ducruet (2014) in their review of port geography confirms that 48 percent of this corpus focussed upon a single port through a case study, 22 percent on country-level studies, 10.3 percent were subnational studies, 13.5 percent were transnational studies, and less than 1 percent concerned the level of entire basins, while the world level only occupied 5.5 percent of all papers. Such a state of affairs clearly explains the lack of consensus upon the appropriate concepts used in port and maritime studies, such as range, system, region, *etc.* (Ducruet, 2009). Empirical studies should be classified according to four types of approaches, without are not exhaustive:

- ***port development within a given region***: mostly reviews of port development projects, this approach offers useful evidence about the homogeneity or heterogeneity of certain areas of the world in terms of the pace, scale, and governance of such developments, notably at the level of large regions such as the Mediterranean (Ridolfi, 1999; Marcadon, 2002; Mareï, 2012), the Caribbean (McCalla et al., 2005; Vergé-Dépré, 2006), and the Baltic (Serry, 2006);
- ***port traffic concentration studies***: based on statistical measures such as the Gini coefficient or the HHI index, these studies quantitatively test the applicability of port system evolutionary models on certain areas such as Europe as a whole (Notteboom, 1997);
- ***geographical distribution of maritime linkages***: since Rimmer (1967)'s critique of port system evolutionary models for their ignorance of maritime linkages among ports, a number of scholars have analysed the pattern of such linkages in various contexts and under different methodologies, from simple cartography to graph theory and complex network research. They particularly highlighted the hierarchical structure of flows and the role of certain hubs in ensuring connectivity, as seen in the Caribbean (Veenstra et al., 2001;

Wilmsmeier and Hoffmann, 2008), the Mediterranean (Cisic et al., 2007), East Asia (Ducruet et al., 2011 ; Lam, 2011), the Atlantic (Ducruet et al., 2010) and at world level (Ducruet, 2013); or Wilmsmeier and Notteboom (2011) for a comparison between the west coast of South America and Northern Europe;

- ***emergence and resilience of regional trends in global flows***: this approach looks not only at the hierarchical structure of global flows but also at the existence of tightly connected groups of ports as well as the geographic dimension of this connectivity (Kaluza et al., 2010; Ducruet and Notteboom, 2012; Laxe et al., 2012). For instance, while proximity or short-distance links carry the biggest proportion of inter-port traffic at the world level, Ducruet and Notteboom (2012) also identified a large nodal region expanding from East Asia across Africa, the Mediterranean basin, and the Pacific Ocean. The cohesiveness of “Europe” as a functional entity in global maritime flows was also examined through a multivariate analysis of global maritime flows (Ducruet et al., 2014).

Overall, the concept of region remains little explored in port and maritime geography, despite the strategic role of basins, deltas, and straits in global shipping, as delineations are often taken for granted based on physical geography (e.g. Yangtze River Delta, Gulf of Guinea). Yet, basins are made of several coasts that are not necessarily continuous (unlike the closed sea, e.g. Black Sea), thereby implying a neighbourhood relationship between distinct subsystems. The concept of "maritime region" thus appears as a useful one for the study of how connected and integrated such heterogeneous areas are (cf. Lewis and Wigen, 1999). So it is necessary to differentiate the port region, group of ports in proximity within a given geographical area (Ducruet, 2009), and the maritime region, which we define as a functional area in which the mutual interactions and links between the mosaic of territories and scales are analysed.

In this context, we undertake an empirical analysis of maritime flows in distinct areas in order to elucidate how network structures are being shaped in various contexts and how they can be compared. This would contribute to both maritime studies and regionalisation studies.

### **The comparative analysis of maritime regions**

Interestingly, the “Mediterranean” concept has been applied already to the Caribbean basin and to East Asia to highlight certain similarities in terms of coastal and maritime organisation (Gipouloux, 2009; Allix, 1933) and in terms of logistics patterns, such as their concentration of transshipment activities at intermediate hubs (Notteboom, 2012) despite differences in absolute traffic volumes (Figure 19.1). It is thus a challenge to compare these three maritime regions and how their respective connectivity has evolved in 1996-2011, a period characterised by a boom in container trade. The method has been to compute vessel movement data into three origin-destination

matrices where local and transit flows of containers are mixed, from one major source *Lloyd's List*, a world leader in shipping intelligence. We wish to verify whether the three regions have gone through similar development paths in terms of network topology and flow patterns, and if there is convergence or divergence. Recent qualitative analyses described the Caribbean basin as a dispersed system (Mc Calla et al., 2005; Vergé Dépré, 2006) whereas East Asia was becoming an integrated range with the de-concentration of the port system and the reinforcement of local economies. The Mediterranean case would appear as an intermediate situation, between dispersion/fragmentation and integration.

[Figure 19.1 here]

The Mediterranean basin remains a very heterogeneous area that is not yet structured as a coherent maritime range; there is scattered development of southern and eastern subparts and concentration of flows in northwestern ports (Gouvernal et al., 2005). As such, the Mediterranean basin is currently designed by one major east-west axis and secondary north-south linkages (Figure 19.2). The so-called “MED rule” refers to the strong relationship between transshipment volumes and distance to main trunk routes (Zohil and Prijon, 1999).

[Figure 19.2 here]

#### *Graph properties of regional maritime networks*

A series of network indices has been calculated for each regional graph: network size (number of ports and links among them), density (or beta index: average number of links per port), completeness (or gamma index: proportion of observed links in the maximum possible number of links), clustering (or average clustering coefficient: proportion of closed triangles in the maximum possible number of closed triangles around ports), eccentricity (average number of stops between all pairs of ports), diameter (length of the longest of the shortest paths), and path length (average length of the shortest paths). These are complementary classic measures used in graph theory and complex networks to reveal how (transport) networks are internally structured (Ducruet and Lugo, 2013).

The study of the three specific basins shows that density (links per port) is growing, and the Mediterranean basin records the higher values (Table 19.1). Completeness is often the highest for the Mediterranean except in 2011, when it decreased in the Mediterranean and East Asia but increased in the Caribbean. This may suggest that although the growth rate of links always surpasses that of ports, many of the latter remain poorly connected or connected via larger ones such as hub ports (cf. growing density). However, such a trend is visible only in East Asia, where decreasing clustering underlines a stronger hub position of certain ports, whereas it has increased in the Mediterranean but from lower levels. The Mediterranean was more centralised

around major ports (cf. highest densities) but this tendency has diminished, probably because of growing intra-regional linkages (motorways of the sea, Marco Polo European programme) especially between Spain, Italy, Turkey, and Greece, and to the modernisation and emergence of new container ports along the southern coasts (e.g. Tangier-Med in Morocco, Port-Saïd in Egypt), which in the end counterbalance the network effects of increased transshipment via container hubs. Another explanation is that the multiplication of hub ports lowers the hierarchical configuration of the network by offering more alternatives to shipping lines instead of concentrating their calls at one main hub. Whatever the main cause, transshipment via hub ports or coastal trade, the growing eccentricity of the Mediterranean and East Asian networks confirms that on average, the internal connectivity of these basins is improving.

[Table 19.1 here]

Two other topological measures allow us to discuss the efficiency of the network: diameter and average path length (APL). The Caribbean basin is the only one to witness a lowering APL over the period, while it has continuously increased in East Asia and stabilized in the Mediterranean. Yet the latter region remains easier to circulate through, given its comparatively lower diameter and APL.

Interestingly, these changes occur despite the implementation of hub-and-spokes systems, which by definition make the network more efficient. The establishment of a hub-and-spokes system (around a few hubs) replacing port-to-port organisation allows for easier access across the network via the main hubs, as seen in the Caribbean case. On the contrary, the proliferation of such systems may also complicate circulation from the perspective of the spokes, which become less connected (and sometimes simply disconnected) except indirectly through hubs. In that sense, parts of the networks may have become less connected than in the past because of the hub-and-spokes strategy. The efficiency brought by hub-and-spokes systems, in fact, mostly benefits the carrier and the hub but implies a drastic reorganisation of the way other ports are connected in the network. The idea of a phased development of the role of hubs in the network is found in the work of Ducruet (2008) and Wilsmeier and Notteboom (2011) on the evolutionary patterns of liner shipping network configuration. The latter study even proposes that “the hub sees its functional position undermined” in the final phase characterised by the maturity of overseas markets and the development of secondary networks.

#### *Nodal hierarchies of regional maritime networks*

The analysis of the three (container) networks by the graph simplification method of single linkage analysis allows us to go deeper into the internal organisation of maritime regions. Removing all links of each port except the largest one with another port reveals which ports dominate others and whether regional networks are split into subgroups or "connected components". The size of links among ports is defined by



the sum of all vessel capacities having circulated during one month of navigation. In Figures 19.3 and 19.4, ports are differentiated by circle size, which expresses the number of remaining links after simplification (see also Table 19.3 for a ranking), and by colour, which provides an indication about the belonged connected component. For instance, the Caribbean is strongly defined by the shrinking influence of Houston, the emergence of local dynamics in 2006, and centralisation around major hub ports in 2011 (e.g. Colon, Port Everglades, Kingston, Freeport). In the Mediterranean, one can observe that the hubs along the east-west trunk line (i.e. Algeciras, Marsaxlokk, Port-Saïd) function apart from the rest of the basin. This state of affairs disappears in subsequent years, which would mean that such hub ports have been better integrated into the local and regional maritime system. Subregional interdependencies appear as well in parallel, such as local clusters of ports in the Adriatic, as well as around Turkish ports and the Strait of Gibraltar in 2011. The emergence of local port clusters is by no means revelatory of how host countries have improved their economic development and maritime connectivity in recent years. The growing position of Gioia Tauro is also clearly visible, at the expense of formerly well positioned ports such as Piraeus and Limassol, which do not play a crucial role in the later period.

The multiplication of Asian hubs is visible as the region goes through a growing north-south differentiation based on proximity linkages and optimal location factors (Figure 19.4). Japanese ports have much declined over time in terms of centrality, thereby favouring the South Korean hub of Busan, while in the southeastern part of the network, Surabaya and, later on, Jakarta gain grounds on the transshipment market to connect secondary ports of Indonesia (domestic hubs). While Singapore managed to maintain its position in the network, largely due to rather aggressive port development policies reinforcing transit trade in competition with Malaysia, Hong Kong has gradually lost ground with regard to its integration into mainland China's Pearl River Delta and the more relaxed policy towards Taiwan: since 2008, vessels are allowed to connect directly between Taiwanese and main Chinese ports without transshipping through Hong Kong. Mainland Chinese ports, however, have not yet become more central in the East Asian network despite their absolute growth in container throughputs, mostly due to their domestic role for shipping.

[Figure 19.3 here]

[Figure 19.4 here]

### *The intermingling of multiple scales and functions*

One last crucial step in the analysis of maritime regions is the distinction between two scales of circulation: intra- versus extra-regional. Each vessel has been coded according to the geographical scope of its movements, i.e. within the region exclusively, or connecting the region with other regions. Such an approach allowed measuring four main types of traffic by region, by year, over links, and among ports (Table 19.2): extra-regional, intra-regional, exclusive, and mixed. Exclusive traffic

refers to the presence of only intra- or extra-regional traffic at one link or port, while mixed traffic is the opposite, i.e. certain links and ports handled both intra- and extra-regional. This approach to maritime networks is fruitful because it provides essential evidences about the intermingling of different scales of flows within maritime regions.

In terms of links among ports, one striking difference between the three regions is that although East Asia exhibits a much higher share of intra-regional links in total traffic, most of its extra-regional traffic is mixed with intra-regional traffic, i.e. occurring on the same links. The same applies to its intra-regional links, which also have a higher proportion of mixed traffic. Such evidence suggest that East Asia is much more integrated than the two other regions because the different scales of maritime circulation are overlapped in space, whereas for the Mediterranean and the Caribbean, intra-regional and extra-regional flows tend to follow different tracks. Yet the two latter regions have in common a growing proportion of mixed traffic over time, as seen with the 20 percent increase of the share of mixed traffics in total extra-regional traffic. However, their intra-regional traffic remains balanced between exclusive and mixed in a somewhat stable way. Another important difference between East Asia and the other regions is the high share of intra-regional traffic in total exclusive traffic, as well as the high share of mixed traffic in total traffic: this tendency is the inverse in the Mediterranean and the Caribbean.

In terms of traffic distribution among ports, the three regions have in common a very high proportion of extra-regional traffic that is mixed. This means that extra-regional traffic everywhere is performed by ports that also handle intra-regional traffic, and this tendency has increased over time. This share remains the highest for East Asia, where only a handful of ports perform exclusively extra-regional traffic. In parallel, the share of port traffic being exclusively intra- or extra-regional has diminished over time. But East Asia remains strikingly different by the very high share of intra-regional traffics in total exclusive port traffic, which is the opposite for the Mediterranean (except in 2006) and the Caribbean. Even though the share of exclusive traffic remains low everywhere, it is more the outcome of intra-regional traffic in East Asia. Another sign of change that is specific to certain regions is the growing share of intra-regional traffic in total mixed traffic, especially in East Asia.

[Table 19.2 here]

Overall, the Mediterranean basin is the most extroverted region, because extra-regional flows dominate not only total flows but also exclusive and mixed flows. It means that this region is well inserted into global maritime circulation, but this occurs at the expense of internal linkages, which remain secondary. Such a situation and evolution is produced by the combination of two factors: the increasing importance of intermediate hubs, and the limited trade and logistical integration between the different Mediterranean economies. In comparison, the Caribbean basin appears to have a more balanced profile between global and local integration, while East Asia

has the most advanced character, with intra-regional traffic having a high share in general and an increasing connexion with extra-regional traffic over the same links and ports. One important explanation is that Mediterranean hubs greatly differ from their Asian and Caribbean counterparts because they are spatially and functionally disconnected from their hinterland. Ports such as Gioia Tauro, Algeciras, Taranto, Marsaxlokk, and Cagliari mostly serve the interests of shipping lines and port operators, located relatively far from the main regional markets but close to the liner trunk route. One difficulty, however, is the inability to untangle “hub-feeder effects” and “short-sea effects” in the distribution and evolution of intra-regional flows. Yet, the fact that in all three regions, the share of mixed versus exclusive traffic has increased is in itself a good indicator of a growing convergence between local and global scales of maritime circulation. The fact that intra-regional and extra-regional linkages and traffic have increasingly occurred over same links and ports confirms that the different scales have gradually been adjusted to each other across space. In that perspective, maritime networks can be analysed through their level of “branching” between different levels of activity.

This difficulty can be tackled by looking at the share of intra-regional traffic at the dominant ports for each region (Table 19.3). Some ports specialised in transshipment activities have a higher share of intra-regional traffic due to the high frequency of vessel calls induced by the hub-feeder system, such as Busan and Gioia Tauro. Yet, the trajectory of those two ports is opposed, as Gioia Tauro is increasingly extra-regional while Busan reinforces its local traffic. This can be explained by the reinforcement of interlining versus hub-and-spokes transshipment at Gioia Tauro, while Busan maintained its position as a hub for western Japan and northern China. Traditional gateways tend to have a rather limited share of intra-regional traffic (e.g. Barcelona, Valencia), but some of them witnessed a continuous increase due to their growing dependence upon transshipment hubs through which long-distance trades are getting rerouted (e.g. Genoa, Houston). High shares of intra-regional traffic also occur at ports trading mostly within the region without being hubs (e.g. Mersin) or developing hub functions while being at the same time under the dominance of a larger hub, such as Surabaya and Jakarta being national hubs polarized by Singapore. Many factors thus influence port evolution, such as the scale and scope of trading flows and the nature of competition.

[Table 19.3 here]

## **Discussion and conclusion**

This paper has provided an original comparative analysis of three major maritime regions, namely the Mediterranean basin, the Caribbean basin, and East Asia. The focus on vessel movements as a way of verifying the topological and functional consistency of maritime regions had various outcomes at different levels. One main result is that major hub ports are not disconnected from more local dynamics of trade

exchanges within each region. Thus, it helps us to rethink what exactly is the role of these intermediate hubs and their integration into regional flows. In addition, the growth of transshipment hubs is only partly visible due to the parallel multiplication of links that do not use these hubs, either through local trade linkages or more long-distance ones, but deeper verification of the underlying logics of flows would necessitate further research and scrutiny of the original data. Another factor to take into account when comparing different maritime regions is their overall throughput volume of containers, which in some way influences the emergence or not of intermediate hubs. In the Mediterranean basin, which was at centre stage in this study, new centralities appear over time, with the growth of Turkish ports and the steady role of Gibraltar (including Tangier-Med) sometimes replacing former ones such as those of Greece or Cyprus.

The new Moroccan port of Tangier-Med is emblematic of such a local-global tension within the basin. Competing with Algeciras to capture new transshipment flows the new port has attracted major terminal operators (e.g. APM Terminal, Maersk, CMA-CGM, and PSA) and looks forward to expanding its capacity to 8 million TEUs when Tangier-Med II is completed. As suggested in the various analyses, such a project goes beyond sole transshipments as it also consists in developing many economic zones while promoting new regional planning in the Tangier-Tetouan region of Morocco. The main objective is thus to attract foreign investment (e.g. Renault in 2012 in the Meloussa free-trade zone) and to support regional economic development as well as transport system modernisation (Mareï, 2013). Other examples include the modernisation of other ports in the region, such as in the Maghreb (Algeria) but also Egypt and Turkey, often through ambitious port reforms and foreign intervention (e.g. DP World in Algeria). Other shipping markets are also represented besides containers, such as ro-ro and oil products, in a context where the regional economy should grow by 18 percent in future years (AGAM 2013; LMIU, 2008). Yet, the regional integration process remains limited, since only 2.3 percent of Europe's foreign direct investments focus on the southern Mediterranean economies, compared with about 20 percent when it comes to US or Japan investments towards their southern counterparts (Telle, 2009). The extent to which maritime flows and networks constitute a component, a constraint, or an engine for further regional integration in the Mediterranean basin and elsewhere remains to be seen. However, the approach proposed by the analysis of two scales of circulation (intra versus extra-regional) is particularly significant because it shows how the different scales of maritime circulation overlap in space. This information is useful for assessing regional integration: the share of mixed traffic is thus a good indicator of the convergence between local and global dynamics.

By revealing how scales overlap through regionalization and maritimisation, our study reviewed theoretical research on scales that opens up new possibilities for regional analysis. The macro-regional scale, that of the maritime basins, enables us to identify processes of local, global, and regional origins and thus to grasp the

multiscalar complexity of our study object. The approach in terms of flows and networks is very useful in this regard. It allows to focus on interactions among places and to support the idea of the new regionalism that helps us to understand the transformation of the global space.

In this context, the analysis of a maritime basin as a singular geographical object in the sense that it is maritime and terrestrial, transnational and transcontinental, and that it forms at the same time a junction point and a limit, has a dual contribution. For port and maritime geography, network analysis of a maritime region contributes to the revival of a discipline where the port is primarily studied in its terrestrial environment (regional or national hinterland) but less from the perspective of the maritime links connecting regional neighbours or the rest of the world. For regional geography, the study of these basins provides an interesting example of heterogeneous regions, outside institutional territories and driven by internal and external exchange. The network approach allows us to highlight the internal dynamics likely to contribute to a process of regional economic integration.

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| Region              | Year | No. Links | No. Ports | Density | Completeness | Clustering | Eccentricity | Diameter | APL   |
|---------------------|------|-----------|-----------|---------|--------------|------------|--------------|----------|-------|
| Mediterranean basin | 1996 | 221       | 51        | 4.333   | 0.173        | 0.401      | 0.593        | 5        | 2.189 |
|                     | 2006 | 373       | 73        | 5.110   | 0.142        | 0.506      | 0.623        | 5        | 2.347 |
|                     | 2011 | 640       | 100       | 6.400   | 0.129        | 0.532      | 0.696        | 5        | 2.284 |
| Caribbean basin     | 1996 | 158       | 52        | 3.038   | 0.119        | 0.462      | 0.745        | 7        | 2.624 |
|                     | 2006 | 193       | 55        | 3.509   | 0.130        | 0.531      | 0.597        | 5        | 2.368 |
|                     | 2011 | 263       | 63        | 4.175   | 0.135        | 0.432      | 0.681        | 6        | 2.348 |
| East Asia           | 1996 | 416       | 109       | 3.817   | 0.071        | 0.617      | 0.528        | 5        | 2.413 |
|                     | 2006 | 861       | 182       | 4.731   | 0.052        | 0.541      | 0.635        | 6        | 2.560 |
|                     | 2011 | 1234      | 216       | 5.713   | 0.053        | 0.554      | 0.686        | 6        | 2.597 |

**Table 19.1: Graph properties of regional maritime networks, 1996-2011**

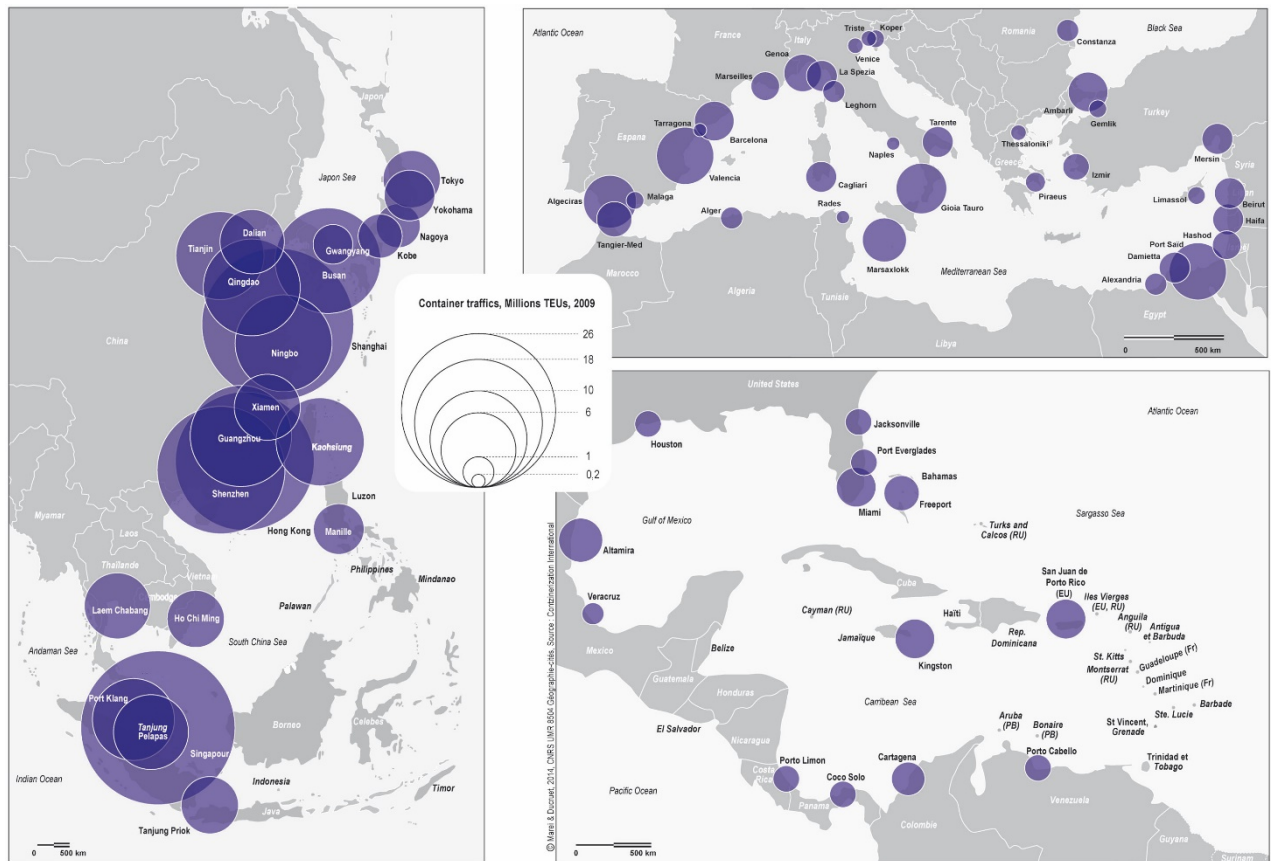
Source: own elaboration based on data from Lloyd's List Intelligence

|  | Region<br>Year                           | Mediterranean |      |      | Caribbean |      |      | East Asia |      |       |
|--|--|---------------|------|------|-----------|------|------|-----------|------|-------|
|  |  | 1996          | 2006 | 2011 | 1996      | 2006 | 2011 | 1996      | 2006 | 2011  |
| Traffic<br>shares on<br>links (%<br>DWT) | Extra, of which<br>exclusive<br>mixed    | 89.6          | 75.7 | 78.9 | 67.4      | 77.1 | 60.0 | 59.2      | 59.9 | 50.6  |
|  |  | 71.7          | 54.8 | 49.4 | 73.4      | 52.6 | 52.7 | 6.5       | 10.4 | 7.4   |
|  |  | 28.3          | 45.2 | 50.6 | 26.6      | 47.4 | 47.3 | 93.5      | 89.6 | 92.6  |
|  | Intra, of which<br>exclusive<br>mixed    | 10.4          | 24.3 | 21.1 | 32.6      | 22.9 | 40.0 | 40.8      | 40.1 | 49.4  |
|  |  | 48.8          | 51.5 | 47.4 | 58.7      | 52.2 | 55.2 | 41.7      | 41.9 | 37.3  |
|  |  | 51.2          | 48.5 | 52.6 | 41.3      | 47.8 | 44.8 | 58.3      | 58.1 | 62.7  |
|  | Exclusive, of<br>which<br>extra<br>intra | 69.3          | 54.0 | 49.0 | 68.6      | 52.5 | 53.7 | 20.8      | 23.0 | 22.2  |
|  |  | 92.7          | 76.8 | 79.5 | 72.2      | 77.3 | 58.9 | 18.3      | 26.9 | 17.0  |
|  |  | 7.3           | 23.2 | 20.5 | 27.8      | 22.7 | 41.1 | 81.7      | 73.1 | 83.0  |
|  | Mixed, of<br>which<br>extra<br>intra     | 30.7          | 46.0 | 51.0 | 31.4      | 47.5 | 46.3 | 79.2      | 77.0 | 77.8  |
|  |  | 82.6          | 74.3 | 78.2 | 57.1      | 77.0 | 61.3 | 70.0      | 69.7 | 60.2  |
|  |  | 17.4          | 25.7 | 21.8 | 42.9      | 23.0 | 38.7 | 30.0      | 30.3 | 39.8  |
| Traffic<br>shares on<br>ports (%<br>DWT) | Extra, of which<br>exclusive<br>mixed    | 89.6          | 75.7 | 78.9 | 67.4      | 77.1 | 59.5 | 59.2      | 59.9 | 50.6  |
|  |  | 13.9          | 0.2  | 1.3  | 14.5      | 5.0  | 1.4  | 0.3       | 0.1  | 0.0   |
|  |  | 86.1          | 99.8 | 98.7 | 85.5      | 95.0 | 98.6 | 99.7      | 99.9 | 100.0 |
|  | Intra, of which<br>exclusive<br>mixed    | 10.4          | 24.3 | 21.1 | 32.6      | 22.9 | 40.5 | 40.8      | 40.1 | 49.4  |
|  |  | 2.8           | 3.9  | 2.3  | 14.3      | 12.7 | 4.4  | 14.1      | 10.3 | 8.2   |
|  |  | 97.2          | 96.1 | 97.7 | 85.7      | 87.3 | 95.6 | 85.9      | 89.7 | 91.8  |
|  | Exclusive, of<br>which<br>extra<br>intra | 12.8          | 1.1  | 1.5  | 14.4      | 6.7  | 2.6  | 5.9       | 4.2  | 4.1   |
|  |  | 97.7          | 14.7 | 67.9 | 67.8      | 57.1 | 31.6 | 3.0       | 0.8  | 0.3   |
|  |  | 2.3           | 85.3 | 32.1 | 32.2      | 42.9 | 68.4 | 97.0      | 99.2 | 99.7  |
|  | Mixed, of<br>which<br>extra<br>intra     | 87.2          | 98.9 | 98.5 | 85.6      | 93.3 | 97.4 | 94.1      | 95.8 | 95.9  |
|  |  | 88.4          | 76.3 | 79.0 | 67.4      | 78.6 | 60.2 | 62.8      | 62.4 | 52.7  |
|  |  | 11.6          | 23.7 | 21.0 | 32.6      | 21.4 | 39.8 | 37.2      | 37.6 | 47.3  |

**Table 19.2: Traffic distribution by region and type of circulation, 1996-2011**

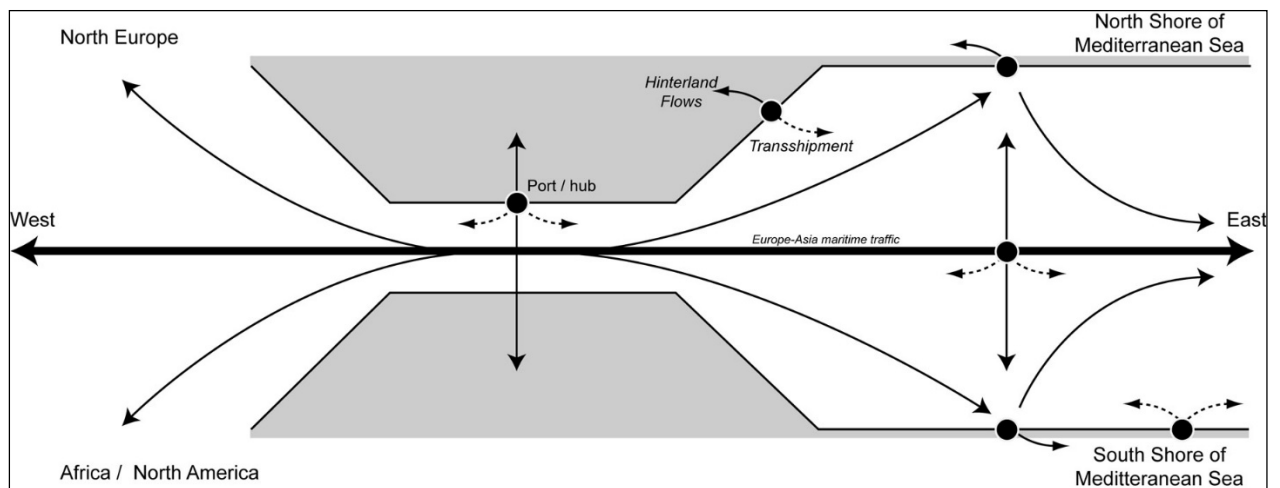
Source: own elaboration based on data from Lloyd's List Intelligence

N.B. Deadweight tonnage (DWT)



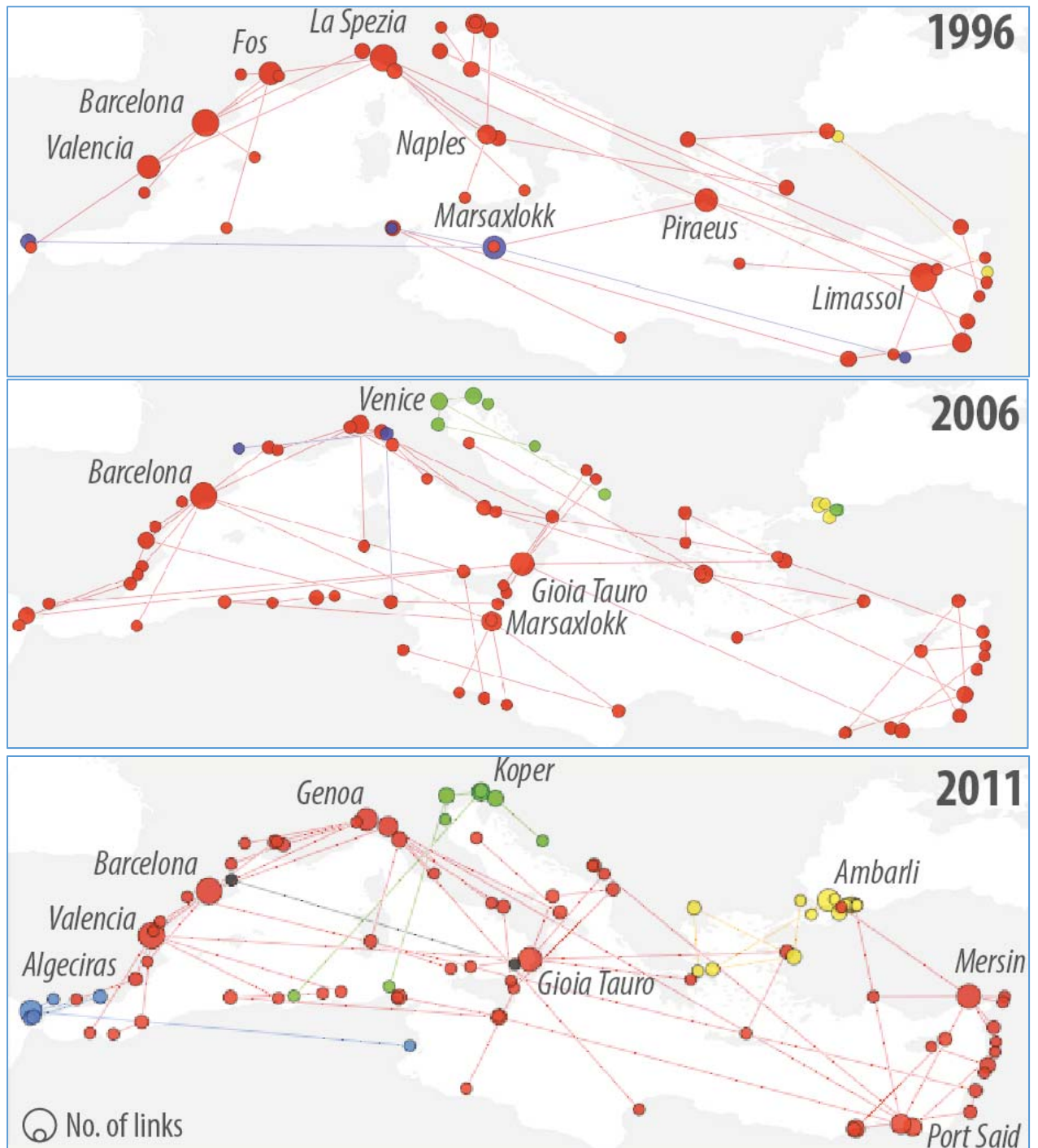
**Figure 19.1: Container port throughput in 2009**

Source: own elaboration based on Containerisation International



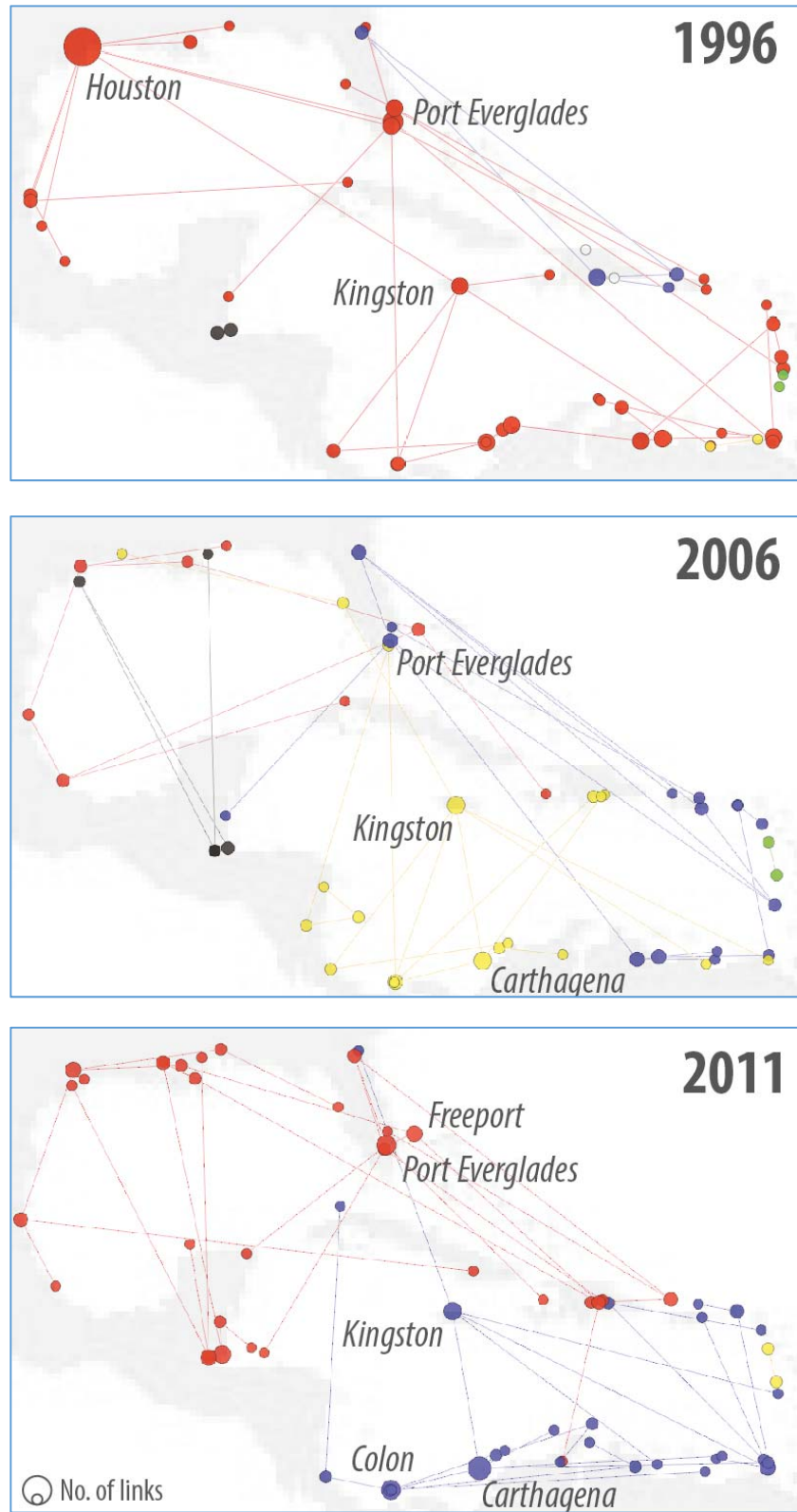
**Figure 19.2: A spatial model of the Mediterranean basin**

Source: Mareï (2012)



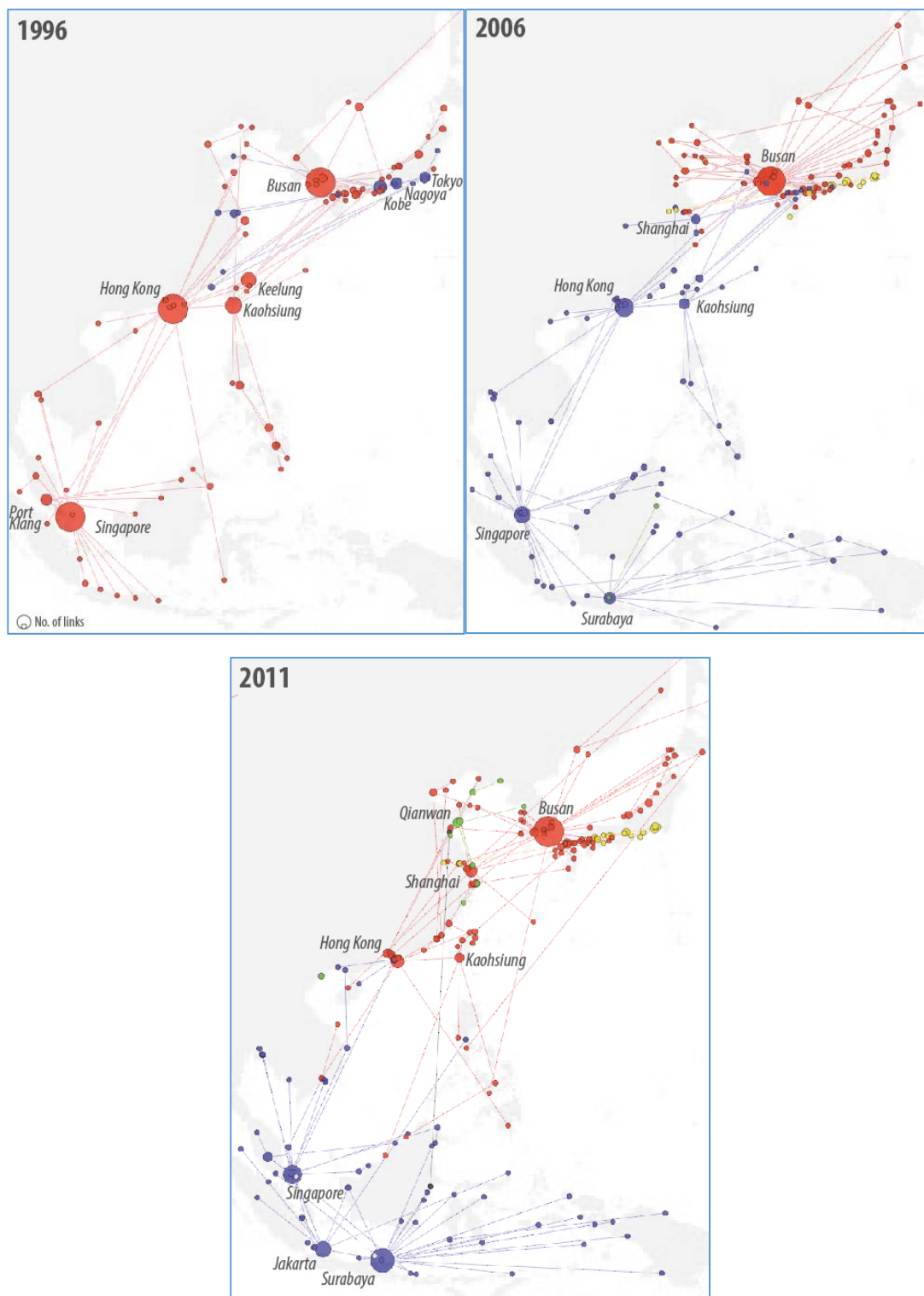
**Figure 19.3: Nodal hierarchies in the Mediterranean basin, 1996-2011**

Source: own elaboration based on Lloyd's List



**Figure 19.4: Nodal hierarchies in the Caribbean basin, 1996-2011**

Source: own elaboration based on Lloyd's List



**Figure 19.5: Nodal hierarchies in East Asia, 1996-2011**

Source: own elaboration based on Lloyd's List