This book explores new methods and techniques for research about merchant networks and maritime routes of trade during the First Global Age through the use of Geographic Information Systems (GIS) as a tool to visualize the formation of trading systems, database management, cartography and spatio-temporal analysis in Historical GIS.

In doing so, the book focuses on key issues in understanding the birth of the so-called First Global Age (16th to 18th centuries): the integration of spatial economies; the regionalization of markets; the organization of maritime trade routes; and the evolution of self-organizing networks of merchants, producers, communities, and other social agents during the age of expansion. The essays collected here deal with relevant information about historical problems including maritime connections, the organization of oceanic trade and the use of digital cartography and metric analysis of old maps, and social network analysis – commercial networks involved a high level of cooperation and served to move goods and people within a highly open system over an expanding geographic space.

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Cover image: *Planiglobii Terrestris Cum Utroque Hemisphaerio Caelesti Generalis Exhibitio*, Johann Hoffman, 1707

978-1-4438-5542-6
www.cambridgescholars.com

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CAMBRIDGE SCHOLARS PUBLISHING

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This book first published 2014

Cambridge Scholars Publishing

12 Back Chapman Street, Newcastle upon Tyne, NE6 2XX, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-4438-5542-1, ISBN (13): 978-1-4438-5542-6

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PREFACE

A Flemish scholar from Haarlem, Michael Van der Veen, disciple of Johan Huizinga, gave a precise account of the punctual appearances on several places on the planet since 1614, of "the Flying Dutchman" (Cunqueiro, 1998: 121–123). In 1731 the Dutchman enters the port of Genoa on his ship, and an old sailor from Liguria recognizes him because they had been drinking together in Lisbon in 1689. Forty-two years later, the Dutchman is still a young-looking, pitch-black haired fellow of an intriguingly melancholic sort. Rumours of witchcraft reach the Genoese authorities, and at dawn on a stormy morning the Dutchman flees. Then in 1718 he sets foot on Saint-Maló and wins the love of the young daughter of a member of the Chamber of Commerce. He runs off with her only to abandon her some months later on a beach near Boulogne. The girl will remain insane during her short life, ceaselessly shouting "the burning man is coming, the burning man!" In 1736 he is again to be found in Lisbon just arrived from New Spain, where he visits a woman and gives her news of her husband who is an innkeeper in Veracruz. But then, once again, the Dutchman is gone with the outward wind. Then in 1751 he is seen in Naples where an aristocratic lady dates him and then tells the story of a Dutch captain that cannot live on land for longer than nine days, and those nine days come at a price of nine months of ceaseless navigation; and he can be killed only by fire; and if you ask him for his name he will reply, "Call me *Foreigner!*"

The very last documented account of the stay of the Dutchman on land has him stay in London, then Marseille, in 1819; in the latter he met an envoy from Napoleon. Before that he had stayed in Lübeck some time during the blockade years in Europe; he had been seen as well in the Bermudas, Amsterdam, Java, and sailing around the Cape of Good Hope. This piece of sailors' imaginary describes the ceaseless wandering of Willem van der Decken from Holland, a Jewish captain, as he was sentenced to an eternity of aimless sailing that would see him join political or military causes, frequent taverns and make women fall for him, or engage in business of an uncertain kind. Almost every man who met him turned mad, and no-one ever knew how to put an end to such long and miserable peregrination. This story has been repeatedly depicted in art, music and literature, and its protagonist has been identified with a real

man by the name of Bernard Fokke (Falkenburg in Dutch literature). He was the captain of a vessel notorious for its cruise speed when travelling between Holland and Java; he was thought to have struck a deal with the Devil some time between 1641 and 1680. There are differences between the various versions of this famous example of the sailors' imaginary in which the sea plays the part of a frontier world across which seamen lead a life of constant wandering between port cities (Fitzball, 1826; Marryat, 1837; Irving, 1855; Neale, 1840).

This is a reference to changes in time although strongly linked to space since space is neither static nor immutable; what is more, this is a clear reference to travelling narratives. The Flying Dutchman seemed to have the gift of ubiquity, he was everywhere and nowhere. Time and movement are dialectic concepts in space and they are related to the dynamic systems and their evolution. Just as in sailors' tales, the spatial frontier where historical progression takes place is a dynamic, non-linear reality where consequences may not be proportional to their causes (Puu, 2003). Besides, it is deterministic and described in terms of three distinct elements: the configuration space, the agent making the change, and the whole of final states. Just as in any good narrative, the space where events take place acts as a category needed for the description of events. Space makes history immutable and ever-changing at the same time as can be seen in the materialization of the various forms of existence, in policy making, in socio-historic organizations and in theoretic paradigms. Every time we construct a narrative it manifests itself in space as space is essential to human action, especially when it comes to thinking historically as advised by Pierre Vilar, because every historical moment has its own way of thinking, and the evil of anachronism must be avoided as Lucien Febvre warned us (quoted in Vilar, 2004).

This book is a collective dream that has come true. It is the result of years of research conducted by the authors of this volume as part of a project that has meant a new turn of historical studies as a scientific discipline that is vital so we can understand the evolution of human behaviour, the interactions among individuals and groups, and the resulting societies shaped by this behaviour. That project was named "Dynamic Complexity of Cooperation-Based Self-Organizing Commercial Networks in the First Global Age" and it was funded by the European Science Foundation. This project ran between 2007 and 2011 as part of the EUROCORES "The Evolution of Cooperation and Trading" and under the DynCoopNet acronym (Owens, 2008: 23–35). Its object was the expansion of the available data on the evolution of cooperative relationships responsible for the self-organizing commercial networks that

created and sustained the first global economy (1400–1800) by integrating disciplinary methods such as Geographic Information Systems (GIS) and other information technologies. The perspective was multinational and multidisciplinary and it was innovative in its conceptual focus and the unusual disciplinary combination of history and other social science methods. As far as historical sciences are concerned, this project intended to refute the classic theory that greater human cooperation in trading became possible with the increased effectiveness of the state, which was accompanied by the rise, primarily in Europe after 1500, of capitalism and the individualism characteristic of modernity. This theory will not stand up to the scrutiny of the analyses of the processes of spatial economic integration, by using actual historical data, on agents, forms of network behaviour, and the mechanisms these agents and networks developed in order to communicate through trade the areas of production and markets along the intercontinental sea routes. These international routes greatly expanded from the 15th century onwards. And this era of so-called merchant capitalism was central to the understanding of the emergence of new economic/financial and social behaviours as determined by how the world was integrated and spatially linked. This dynamic complexity, as defined by Andre Gunder Frank, requires a wealth of historical data as well as powerful tools that are capable of handling massive amounts of information (Frank, 1998). The DynCoopNet project has gone a great length in revealing the mechanisms of cooperation that permitted merchants and others to establish the often long-distance trading networks of the first global age. This is particularly relevant when studying the expansion of the Iberian empires of Portugal and Spain; these were much more interconnected than would appear on first sight even when the dynastic union between the Kingdom of Portugal and the Spanish Monarchy between 1580 and 1640 was no longer in force. This interconnectedness has been proven in other works where the special features of these corporate and composite monarchies were discussed, and the impact of the activities conducted by social agents was heavier than that from the political and even the military powers. Between the 16th and the 18th centuries, the specificities of certain shadow empires (Winius, 1983: 83–101) made up of a multitude of different agents conditioned Spain and Portugal to became the first imperial powers on a worldwide scale, and although they lost their political primacy in the 17th century, both monarchies survived and were able to enjoy a relative success until the early 19th century. The networks in the empire did definitely condition this expansion as well as other "expansions" in England, France or the Low Countries since all these expansions had to adapt to how other

territories in Europe, Asia and America would socially and economically fit in these Iberian empires. Besides, the analysis of the social networks and their spatial links shows how important these networks and their links were on the circulation of ideas, cultures, religious confessions, identities and other forms of institutional organisation. These studies are being continued in various projects run by former DynCoopNet researchers[1]. Also, further works along similar lines point out those relations between networks and institutions or between networks and ways of commercial cooperation. Having said this, what is really characteristic of the post-DynCoopNet works conducted by these researchers is their increasing interest in spatial history (Fujita, Krugman & Venables, 1999; Hewings, Sonis & Boyce, 2001). This spatial history claims the need to tell narratives not only with text and language but also with images so history can be visualized (Shnayder, 2010), as well as analysed from the fashionable digital humanities perspective. Beyond technical meanings, the specialists in spatial history focus on the space – rather than on the time – aspect as a coordinate that is central to approaching how heavily spatial changes affected behaviours throughout history. It is worth mentioning that this approach is a long-standing aspiration for historians, as it was already present in Fernand Braudel's definition of geohistory as "the history that the environment imposes on men through its constants, what happens most often, or through slight variations in those constants, when they have consequences at human level" (Braudel, 2002: 78), and in the Annales school when the road to a new scientific quality in history was open through empirical-quantitative analyses and the intensive use of historical databases.

Consequently, a cartographical perception of landscape and the geographic framework where historical events take place are central to the spatial turn analysis. This is a new approach to the need to create "mental maps" by historians, but also a return to the *ever-so-important-in regional-*

[1] The projects are: "Understanding social networks within complex, nonlinear systems: geographically-integrated history and dynamics GIS" (SOCNET), which is administered by the NSF Office of Cyberinfrastructure (J. B. Owens and May Yuan); "Una ruta Global: análisis histórico con bases de datos y geovisualización espacio-temporal del comercio marítimo internacional (1717-1850)" (GlobalNet) Reference number: HAR2011-27694 (Ana Crespo Solana) and *Geografía Fiscal y Poder financiero en Castilla en un siglo de transición. Análisis mediante Sistemas de Información Geográfica* Ref. HAR2010-15168 (David Alonso García), both funded by the Spanish Ministry of Science and Innovation (MICINN); and Dynamic Complexity of Cooperation-Based Self-Organizing Networks in the First Global Age, FCT - TECH/0002/2007 (http://www.dyncoopnet-pt.org/) funded by the Portuguese government (Amélia Polonia Da Silva).

studies spatio-temporal analysis, now framed in ever wider contexts, whether national, transnational or, above all, global. This review of the spatial paradigm is very important when it comes to delimiting the social and economic spaces analysed in terms of their relationships, such as in Atlantic history (Pieper & Schmidt, 2005: 17). Although this review is in fact a revival of an approach previously seen in certain classic studies by thinkers and scientists such as Jules Michelet or Fernand Braudel, the notion of "space" allows us to pinpoint geographic areas that condition historic evolution. Certain specialists in Atlantic history take into consideration this relationship with "space" as a fundamental aspect in order to understand the dynamics between empires, or the formation of hierarchical structures around monopolies, or either the "peripheral" or the "leading" nature shown by certain regions. This has been described in studies of the various "expansions" observed from a large-scale treatments perspective that claims that the Atlantic must be regarded as a historical subject, and that analysing how far the influences of the spatial interchanges go is of great importance (Greene & Morgan, 2009). Space as a historic category allows us to highlight a specific event and attach to it further data that greatly add to this event's knowledge; hence the use of historic GISs means an IT-based added value as this technology is placed at the very frontier of knowledge (Middell, 2010: 149–170).

In fact, one of the main basic assumptions of the DynCoopNet project was that the history of any place, no matter how large (the Atlantic), is shaped by the way it is connected to other places and all places are connected to an ultimately global system that shapes the histories of all places (Owens, 2007: 2014–2040). This is why this book insists on a new turn for the studies on expansion and integration in the Modern era; these should be conducted with an interdisciplinary methodology in mind and the use of data-processing technologies that combine historical databases, tools for spatial visualisation and network analysis. The commercial networks to be studied involved a high level of cooperation among people of various ethnic, linguistic, and religious backgrounds. They served to move goods and people within a highly open system over an expanding geographic space. These self-organizing networks, and the strategies employed to achieve cooperation among a large number of widely-dispersed people which made them possible, served as the source of the creativity and innovation necessary to respond in a flexible manner to the endemic disruptions to transportation and capital flows occasioned by war, disease epidemics, arbitrary government actions, environmental changes, and the transportation problems associated with weather, distance, and the available technologies. Without the diffusion of authority and the

widespread cooperation among merchants and others, often overcoming apparently serious cultural and political barriers, the emergence and spatial intensification of the first global economy would have been impossible, but existing research on such trading activity has been too limited and fragmentary to grasp how such networks of cooperating individuals emerged and how they were sustained and evolved for hundreds of years. Therefore studies involve the gathering, organizing, and sharing of data on commercial relationships. In part, this will involve micro-studies identifying these networks and the people involved in them. The historians will find out how, within their social and cultural environments, individual merchants maintained the "creditworthiness" necessary for such a remarkable degree of cooperation over often great distances and with people they sometimes did not know. They will focus on the cultural environment of ways of understanding the world and on the types of cooperation at various scales: family, small firm, rural community, political and economic urban centre, and geographically extensive trade routes (Crespo Solana & Alonso García, 2012).

This book attempts to explore new methods and techniques for research about merchant networks and maritime routes of trade during the First Global Age by using Geographic Information Systems as a tool for visualizing the formation of trading systems, for database management, and for cartographic and spatio-temporal analysis in historical GIS. In order to achieve this goal we focus on key issues for understanding the birth of the so-called First Global Age (16th to 18th centuries): integration of spatial economies, regionalization of markets, the organization of maritime trade routes and the evolution of self-organizing networks of merchants, producers, communities, and other social agents during the age of expansion. The collections of essays will deal with relevant information about spatial and social network analysis, the use of digital cartography and the possibilities of digital humanities: sharing databases via the Internet, metadata and possibilities, problems and new design by using geographic information systems (GIS) for the organization and visualization of data and spatial analysis. This volume consists of twelve chapters dealing with various subjects devoted to the study of the mechanisms by which the socio-economic spaces integrated the Iberian monarchies; specific examples from the Spanish Atlantic colonial trade routes are studied (Crespo Solana); how transnational commercial networks operated, from the specific case of Castilian merchant Simón Ruiz and Portuguese networks (Polonia Da Silva, Pinto, Ribeiro, Morais Barros). These works highlight the process of integration between network and space. The authors intend to argue, with empirical evidence, how this

still innovative methodological approach to the field of history, combined with a renewed theoretical framework, enabled us to generate new historiographical perspectives with significant impact upon the historiography of the First Global Age.

Other papers are devoted to the detailed description, at scientific and technical levels, of the methodology used in a GIS; also the social network analysis and the use of cartography as a representation and visualization method are clearly detailed (Yuan). Three papers explain how spatio-temporal GISs can greatly add to historical studies. J. B. (Jack) Owens is the intellectual father of this research team; he has made a truly outstanding contribution to the theoretic configuration of historic studies of spatial integration, and has had a truly remarkable impact on the development of new methodological devices for spatio-temporal GISs (Owens and Wachowikz). Together with Kantabutra he has now produced an article in which they explain what an ILE (intentionally-linked entity) is: a database system for representing dynamic social networks, narrative geographic information, and general abstractions of reality. In their work, Guerrero Nieto and Saurí describe the development of tools for data transfer from a semantic web perspective. This is also a major innovation that will greatly contribute in the future to the processing of spatio-temporal information contained in historical sources. The paper written by Pérez Asensio, Salas Tovas, Del Bosque, Maestre and Crespo analyzes the application of Social Network Analysis software to Spatial Analysis. The authors study what these technologies offer in terms of understanding and visualizing the relationships between merchants and ships. Analysis is based on the data collected by the DynCoopNet project and made publicly available from the Digital Repository of the Spanish National Research Council (CSIC).[2]

Cartography has contributed from a twofold approach: cartography and networks (Picazo Muntaner), and cartography and GIS (Crespo Sanz). The elaboration of network cartography and the subsequent visualization greatly add to our ability to conduct in-depth network analyses and perceive the main systemic nodes, the network's geographic expanse and configuration as a "small world", and assess its fragility. Two characteristic examples of the global network can be visualized with this tool showing trans-Pacific commerce and its impact on continental America, the Caribbean area, and even the various metropolises. This type of study leads to a cartographic visualization of the port networks including the main connecting ports, and allows for a better observation of

[2] Available at http://digital.csic.es/handle/10261/28394 and http://hdl.handle.net/10261/23414.

the movements of the merchant networks at local level as well as in their connections with other geographic areas. In addition to this, the combined use of GIS and cartographic data offers cartographers new tools to examine the characteristics of historical maps, their distortions, and their functions, as well as making it possible to compare different historical maps through new overlapping technologies. Crespo Sanz uses GIS technologies to study the *Atlas de El Escorial* (c. 1538), a manuscript of the Iberian Peninsula consisting of an index map (1:2,600,000) and twenty detailed maps (1:400,000). The geographical and spatial details of this Renaissance manuscript allow scholars to use three distinct, yet complementary, methods of metric analysis. First, traditional mathematical and statistical analysis will be used to obtain the necessary data to appraise the map – determine its scale, accuracy, the degree length, geographical and hydrographical details, territorial limits, and so forth. Such analysis, however useful, generates many cumbersome tables and datasets, making it difficult for scholars to use. GIS with its analytical capabilities will allow scholars to manipulate such large datasets more easily, and thereby gain greater insights into early modern maps and their making. Second, GIS makes cartographical georeferencing possible. This allows us to compare geographical coordinates between various old maps as well as between old and modern maps. That is, we can overlay maps or points on maps to determine more accurately the distortions and other differences between maps. Although there are many georeferencing programs, this study uses Google Earth, which is free and readily available to scholars. Third, MapAnalyst is another tool for cartographical analysis that combines mathematical and visual analysis. This program is user-friendly for those with limited mathematical and computer programming skills; you can compare all kind of maps estimating the distortion between them, watching the values as vectors that express the direction and length of the deformation. By applying these three methods of analysis to the Atlas of the Escorial, this study will show how these approaches complement each other and define a general methodology for using GIS and metric analysis on any historical maps. Along this line Mukherjee discusses the construction of spaces in her work on Srihatta/Sylhet in the medieval Bay of Bengal world. Finally, as added assets to this book I wish to mention the works focusing on the analysis of the links between social networks and the spaces of interaction in which cooperation amongst agents takes place; how the latter take advantage of the strengths and weaknesses present in the systems (Alonso García), and the impact of these agents on the economic structure of ports and maritime routes (Scheltjens).

The authors of these papers have travelled to distant ports in their search for the spatio-temporal relations conducted by the protagonists in history. Technology has assisted us in trying to understand a teleological narrative which, in turn, we can attempt to make available to our readers.

I pass, like night, from land to land;
I have strange power of speech;
that moment that his face I see,
I know the man that must hear me:
to him my tale I teach.
(Samuel Taylor Coleridge, *The Rime of the Ancient Mariner*, 1799).

Ana Crespo Solana