'The climate of the Mediterranean Sea during the Maunder Minimum from old Royal Navy logbooks'

Report

ESF MedCLIVAR Exchange Grant

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One of the specific objectives of MedClivar is “to reconstruct the past climate variability by using a multiproxy approach of available instrumental observations (whose dense network includes some among the longest existing time series worldwide), documentary evidence and natural archives; to explore the physical mechanisms and address the importance of different forcing factors of past variability at different time and space scales using coupled-paleoclimate model runs”.

Taking into account the proven quality of the logbook data and the large volume of such information from the Mediterranean region over the climatically critical period from 1680 to 1750, which included the closing years of the Little Ice Age/Maunder Minimum and the rapid recovery from its extremities, we made a careful examination of the logbooks for this period as an innovative exercise to benefit the scientific community.

1. INTRODUCTION:

An increasing interest in the reconstruction of the European and Atlantic climate during the last few centuries with as much detail as possible is evident from recently published scientific papers. These reconstructions are based on early instrumental data or, more frequently and as a result of the relatively short length of good quality instrumental data series, on the analysis and application of climatic proxies. Consequently, long term climate reconstructions have tended to call upon information from natural proxies or land based documentary sources. These usually represent composite atmospheric circulation variability more than the evolution of individual climate variables. Such proxy data allowed, for example, the extension of the temporal and spatial coverage of climate reconstructions back to 1500 for most of Eurasia (Luterbacher et al.

2002) and back over two millennia for mean Northern Hemisphere and global temperatures.

The spatial and temporal detail provided by those reconstructions is however variable. While over European continental regions a fairly good provision of data exists, many other continental regions of the world and most of the oceanic areas do not enjoy such any correspondingly helpful spatial and temporal coverage.

The CLIWOC project, which ran from 2001 to 2004, was one of the first internationally coordinated efforts to provide a near-global database and meta-database of such largely non-instrumental logbook data using French, English, Dutch and Spanish sources and covering the period 1750-1850 (Garcia-Herrera et al., 2005). It also improved the methods of data treatment developed in the 1980s and 90s and produced a nautical dictionary with which to transform the old narrative descriptions of the weather in the various native tongues to their Beaufort Scale equivalents (Garcia-Herrera et al., 2003). The database produced by CLIWOC was used, amongst other applications, to analyze and reconstruct the climate over the Atlantic sector during pre-instrumental periods (Jones and Salmon, 2005; Gallego et al., 2005).

A further example of the different directions and time scale at which logbook studies can be pursued is offered by Wheeler and Suarez-Dominguez (2006). They use Royal Navy logbooks of ships in English waters for the period 1685 to 1700 to provide a daily series of wind force, wind direction and weather observations. The resulting series of gale days and wind direction provided important information on the nature of the climate of this period – the coldest of the Little Ice Age – confirming it to have been notably more stormy around the British Isles than is currently the case and confirming thereby a long-held but unproven view of the climate of this key period. In this, as with so many other examples, this information, with this degree of temporal resolution, can only be secured from logbooks.

1.1. MAUNDER MINIMUM (LITTLE ICE AGE):

The Maunder minimum is the name given to a period of extreme solar inactivity that occurred between 1645 and 1710 (Figure 1). Of particular interest is that this period of inactivity corresponds closely to one of the coldest periods of the so-called "Little Ice Age" in Europe, a time of long, cold winters that caused severe hardships in the pre-industrial revolution world. This, among other uses, has led scientists to extensively study the possible influences of solar activity on terrestrial climate.

In 1991, a pair of Danish meteorologists published a paper in which they pointed out a remarkably strong correlation between the length of the solar activity cycle and the global mean temperature in the northern hemisphere. It is very difficult to assess the effect of even recent solar cycles on global climate, let alone those from the Maunder minimum period, because of the relatively short time span for which detailed observations exist, and because climate records become sparse to nonexistent as one looks back more than a century or so. It is why we used these records, logbooks, because in them we can find detailed information for such studies.

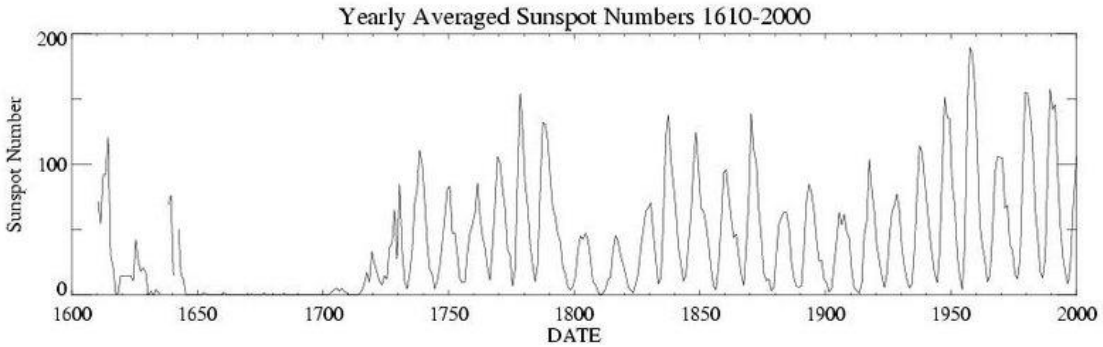

Figure 1: The Maunder minimum in a 400 year history of sunspot numbers. We can se the minimum between 1650-1700.

1.2. LOGBOOKS IN CLIMATIC RESEARCH

Ship's logbooks have proved to be one of the most effective sources in our endeavours to reconstruct the maritime climate back, at least, to the 17th century and to fill some of the spatial voids in our observational networks. thus the logbooks yield a near-global coverage with a high temporal resolution, i.e. daily, view of the weather of the great oceanic basins (D. Wheeler, 2005).

These Logbooks were prepared by captains, masters and lieutenants and one of the factors that a ship's officer needed to take into account for reliable navigation was the weather. Navigation became a precise science only in the nineteenth century. (García-Herrera et al, 2005). Before that time, approximate methods were used to determine the true direction of the vessel's course and the distance covered each day (Woodruff, 2005). These all required that wind force and wind direction were carefully recorded, the information being then used to determine the 'leeway', made by the ship (Wilkinson, 2005). Mariners also kept a careful note of other weather phenomena such as rain, thunder, fog and snow. Because some observations were made several times each day during the voyage, logbooks contain huge amounts of such detailed information.

Many logbooks failed to survive the rigours of life at sea but several thousand have come to the present day (Wilkinson, 2005). Some logbooks are dated from as long ago as the seventeenth century. Most frequent amongst the survivors are the logbooks of vessels in state service. Most are to be found in the UK repositories such as the National Archives (Kew) and the National Maritime Museum (Greenwich) (Wheeler and Garcia-Herrera, 2008).

1.3. THE ARCHIVES

The United Kingdom, France, Spain and the Netherlands all possess notable collections. The CLIWOC project was the first comprehensive study of this rich source of climatic data. In our project we'll use only the resources of United Kingdom. (García-Herrera et al, 2005).

The british archives contain the most extensive collections of ships' logbooks and journals in the world. The various collections fully represent the wide range of maritime activities engaged in by british mariners from the 17th century onwards. There are large numbers of royal navy logbooks written by captains, lieutenants and navigating officers and a small number kept by midshipmen. All officers on board a royal navy vessel kept their own logbook correctly termed a journal.

The information about these logbooks is available in different places of London:

- National maritime museum at Greenwich in southeast London.
- British library, located in central London.
- The National Archives (TNA) at Kew, southwest London (figure 2).

Our project is focalised in the third one, The National Archives (Kew, SW London). The National Archives have one of the largest archival collections in the world. It spans 1000 years of British history from the Domesday Book of 1086 to government papers recently released to the public.

The National Archives (TNA) formerly know as the Public Record Office is located at Kew in southwest London. It is the largest and most important archive in Britain containing official records of government from the earliest times. It holds an extensive collection of logbooks and journals written by admirals, captains and masters. The admirals's journals are generally less useful than the logbooks of more junior officers since they do not usually contain regular entries for the ship's position or records of wind force and

direction. Many are purely narrative and are devoid of the ordered structure of formal logbooks.

Lists of documents from the National Archives used in this project for the search of the logbooks we need:

- ADM 8: Monthly general list of vessels that sailed in each year from 1670 to 1850.
- ADM 51: list of captain's logs sorted by boats and years between 1670 to 1850.
- ADM 52: Overview of master's ships and logs sorted by years, from 1670 to 1850.

Figure 2: Image of The National Archives (TNA) at Kew, SW London.

2. PURPOSE OF THE VISIT

The principal objective this project is to anlyzethe scientific potential of logbook climatic data and to produce a database of daily weather observations for the Mediterranean between 1673 and 1750. This database will be made freely available to the scientific community. Other objectives are:

1. Provide a comprehensive understanding of the nature of climatic change over the Mediterranean for the 1673-1750 period, when logbooks aren't abundant.

2. Prepare future analysis of extreme weather events like storms focalised in exact points.

3. Make a study about reconstructing of climate for the past weather with pressure data, actually we don't have any data about pressure in the logbooks examined, but we can get it with some analyses of the winds in medclivar's database

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The benefits of the proposed work include:

- The generation of a freely available database of daily wind and weather records for the Mediterranean area for the study period.

- A significant advance in the knowledge of the circulation variability in the Mediterranean during the Maunder Minimum and immediately following decades.

- The possibility of comparing the past wind variability with that of an instrumental climatology.

3. DESCRIPTION OF THE WORK CARRIED OUT DURING THE VISIT

First it was necessary to make lists of all ships that sailed along the Mediterranean in the period 1680-1750. It was sought in the collections of captain's logs of the National Archives at Kew encoded as ADM 8, where we can find lists of all the ships that sailed in each month, separated by years and places of navigation (Mediterranean, pacific, India,…). In this way it is possible to know how many ships were sailing (monthly) along the Mediterranean each year of our study period. Since most of the time the ships sailed in squadrons, it was enough to get information about one or two of the ships in the squadrons. In this way, we didn't duplicate information. All these monthly lists of ships that sailed in the Mediterranean from 1680 to 1750 have also been photographed (figure 3). Additionally, an Excel document has been produced qhich contains a little database of all ships that sailed the Mediterranean in the period of interest..

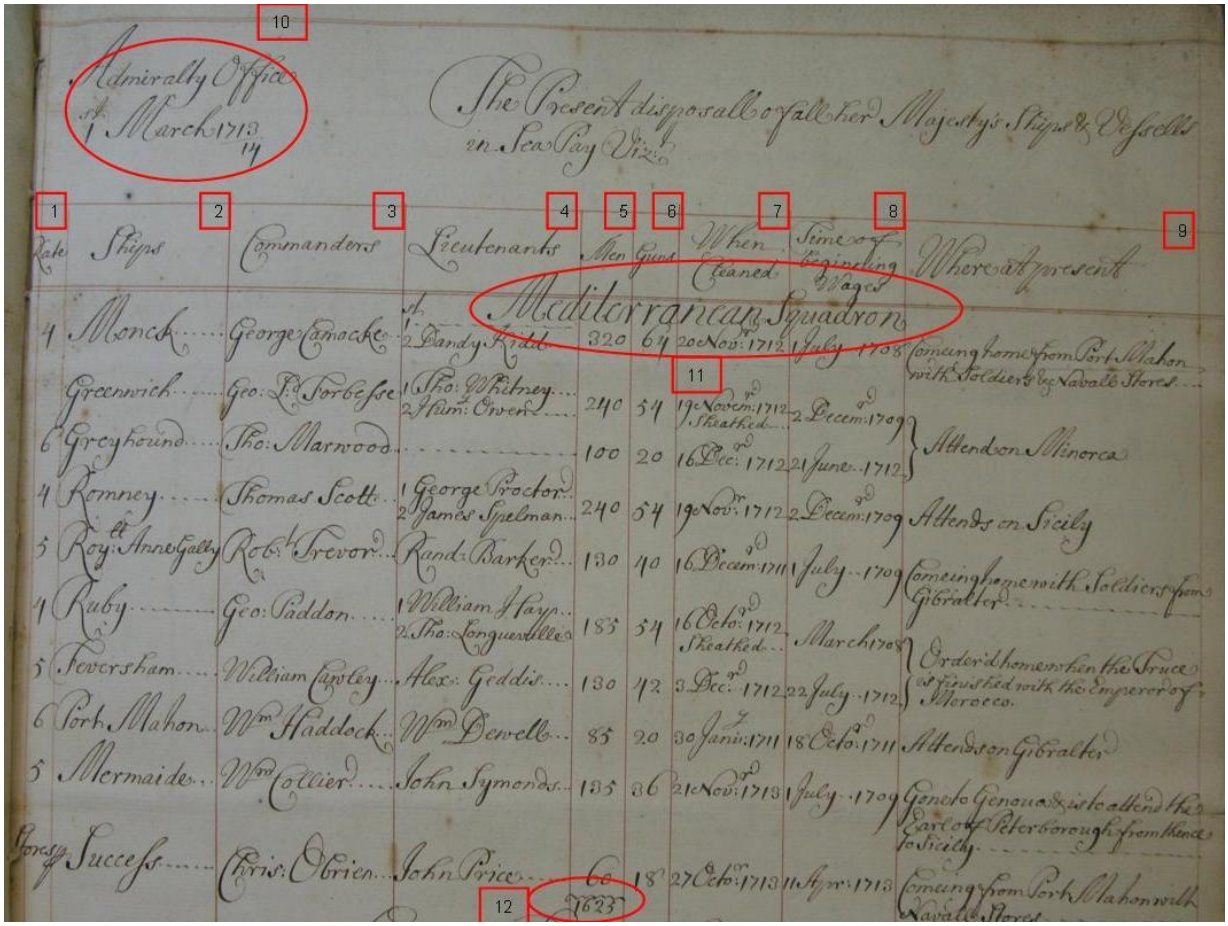


Figure 3: Image of one Logbook from ADM 8 documents in TNA where appear the complete list of vessels that sailed along the Mediterranean sea in March 1714. The numbers in red will be explained in the figure 4.

1	Rate
2	Ships
3	Commanders
4	Lieutenants
5	Men
6	Guns
7	When was Cleaned
8	Time of beginning wages
9	Where at present
10	Month and Year
11	Place: Mediterranean Squadron
12	Total mens

Figure 4: Explanation of the red numbers in the last figure. (1) Rate of the ships due to their guns, (2) List of Ships in the Mediterranean (3) Commanders aboard of each ship, (4) Lieutenants aboard of each ship, (5) Men aboard of each ship, (6) Number of Guns aboard the ship, (7) When each ship was cleaned, (8) time of beginning wages (9) Where at present each ship, (10) month and year, (11) Place where the squadron of ships stay in this month, in our case always would be Mediterranean, (12) Total mens in total ships that sailed for a complete month.

Once the ships were selected, under the criterion of one or two ships per month, their logbooks were searched in the ADM 51 documents in the archives, where the information about the logs interesting for this study is included. Once we had the reference of the documents, we ordered the documents necessary to the national archives and started taking pictures of each one of these logbooks, so that we digitized the daily logbooks to make medclivar's database for the years 1673 -1750.

In the figure 5 we show all the ships used for this project and the years digitized in Medclivar database for each ship (ships that sailed in the Mediterranean sea between 1680-1750). As well, for each ship, it is included the code of the document where we found the logbook (with daily register for each year) in the National Archives at Kew.

	CAPTAIN'S LOGS	
Ship's name	**Years digitized in database**	**Code of Logbooks in TNA**
Looe	1714,1719,1720,1721,1722	ADM 51/553 (1707-1737)
	1696,1697,1698,1699	ADM 51/4246 (1696-1746)
Lyme	1722,1723,1724,1725	ADM 51/560 (1708-1737)
	1696,1699,1700,1701,1704,1705,1706	ADM 51/4250 (1695-1731)
Winchelsea	1720,1721,1722	ADM 51/1069 (1695-1735)
	1710,1711,1712,1713	ADM 51/1081 (1694-1728)
Newcastle	1713,1714,1717,1718	ADM 51/634 (1708-1741)
	1677,1678,1690,1691,1692,1694,1695,1719,1720,1721	ADM 51/4271 (1677-1759)
Dragon	1686,1687,1688,1689,1694,1695,1696,1697,1719,1720,1721,1722,1723	ADM 51/269 (1686-1739)
	1682,1683,1684,1694,1695,1701	ADM 51/4167 (1681-1706)
	1682	ADM 51/4168 (1717-1783)
Dover	1718,1719,1720,1723,1724	ADM 51/266 (1707-1741)
	1698,1699,1720,1721	ADM 51/4166(1679-1721)

Colchester	1695,1696,1711,1712,1713,1714,1722,1724,1725,1726	ADM 51/205 (1694-1741)
	1708,1709	ADM 51/4148 (1698-1740)
	1724,1725,1726,1727	ADM 51/3813 (1721-1727)
Dunkirk	1693, 1706,1707,1708,1709,1710	ADM 51/4175 (1677-1710)
	1712,1713	ADM 51/4176 (1712-1737)
	1718,1719,1720	ADM 51/285 (1718-1719)
Hampshire	1712,1720,1721	ADM 51/444 (1707-1721)
	1678,1679,1680,1681,1687,1688	ADM 51/3857 (1677-1689)
	1699,1700,1703,1704,1706	ADM 51/4212 (1692-1743)
Nonsuch	1707,1708	ADM 51/4273 (1698-1707)
	1678,1679,1680,1681	ADM 51/3923 (1677-1693)
Greenwich	1678,1679,1680,1694	ADM 51/414 (1678-1741)
	1690,1691,1693,1695,1704,1705	ADM 51/4204 (1687-1706)
	1713,1714,1715,1716	ADM 51/4205 (1708-1780)
Gloucester	1695,1696,1697,1704,1705,1715,1716	ADM 51/401 (1695-1740)
Nassau	1703,1704,1708,1709,1710,1711	ADM 51/4269 (1702-1763)
Speedwell	1716,1717,1718	ADM 51/837 (1705-1720)

Cambridge	1695,1696,1697,1698,1699,1702,1703,1704,1705,1706,1707,1708 1706,1707,1708	ADM 51/151 (1690-1740) ADM 51/4135 (1678-1772)
Centurion	1678,1679,1680,1681,1699,1706,1707,1708,1709,1710 1704,1705,1708,1709,1710 1673,1674	ADM 51/4140 (1677-1747) ADM 51/174 (1695-1739) ADM 51/134 (1672-1674)
Tilbury	1700,1701,1702,1704,1706,1707	ADM 51/4372 (1699-1709)
Yarmouth	1695,1696,1697,1698,1704,1705 1711,1712	ADM 51/ 4401 (1694-1705) ADM 51/ 1087 (1709-1736)
Quaker Ketch	1672,1673,1674,1675 1673,1674,1675	ADM 51/ 751 (1671-1675) ADM 51/3947 (1671-1696)
Canterbury	1695,1696,1697,1706,1712,1718,1719,1720,1726,1727,1728,1729,1730,1731,1738,1739,1740	ADM 51/160 (1695-1740)
Poole	1707,1708,1727,1728	ADM 51/704 (1706-1737)
Drake	1729,1730,1731,1732,1733,1734	ADM 51/272 (1709-1740)
Superb	1740,1747,1748,1749	ADM 51/933 (1739-1749)

Phoenix	1745,1746,1747,1748	ADM 51/729 (1743-1748)
Seahorse	1749,1750,	ADM 51/903 (1741-1751)
Salisbury	1734,1735,1736,1738,1739	ADM 51/842 (1699-1740)
	1741,1742,1743,1744	ADM 51/936 (1740-1749)
Dursley Gally	1726,1727,1735,1736,1737,1739,1740	ADM 51/289 (1717-1740)
	1736,1737,1739,1740,1741,1742,1743,1744	ADM 51/290 (1740-1744)
	1728,1740,1741,1742,1743,1744	ADM 51/4176 (1727-1744)
Assistance	1675,1676,1678,1679	ADM 51/68 (1675-1703)
	1727,1728,1738,1740	ADM 51/69 (1694-1750)
	1702,1716,1717	ADM 51/4118 (1694-1750)

Figure 5: complete list of ships all the ships used for this project and the years digitized in Medclivar database for each ship with the respective code for find in the national archives .

3.1. DESCRIPTION OF MEDCLIVAR DATABASE:

All meteorologically relevant data of the midday (noon) observation were extracted, i.e. the date, geographical position, wind direction, wind force, present weather, sea state and meteors observed (figure 6). Some logbooks contain more than one observation per day. Other information registered in the database is the information about the document that contains the logbook, including the place where the logbook is stored, the logbook identification, the ship's name and type, the names of the original logbook keepers (the actual writers), reports of encounters at sea with others vessels and, outside the climatological fields, notable events on board were all inserted into the database.

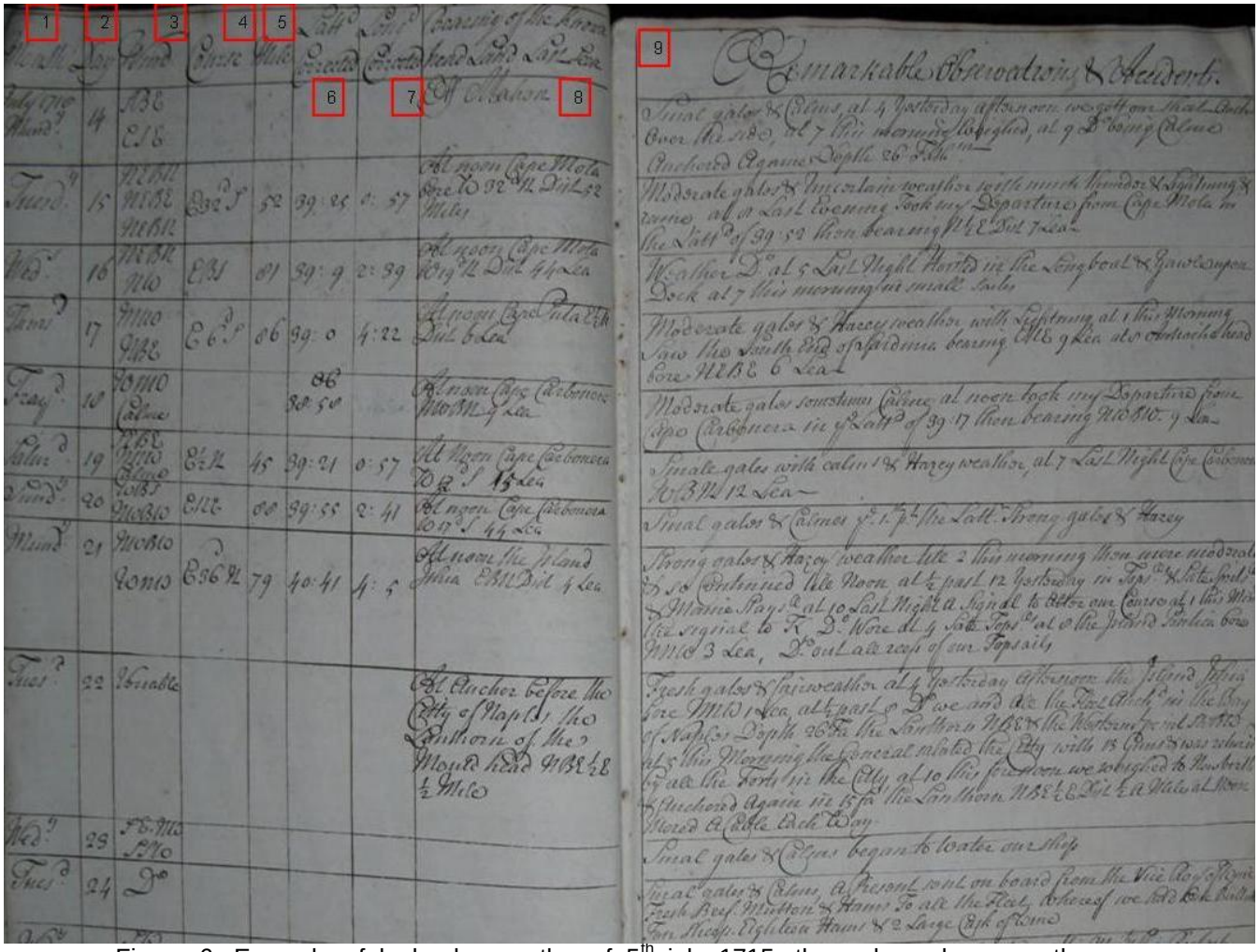


Figure 6: Example of logbook, exactly of 5th july 1715. the red numbers are the explanation for each column. (1 &2) date, (3) wind direction, (4) Course, (5&6) latitude and longitude, (7) place where they stayed at noon, this point was used like reference for latitude and longitude correction.

1 & 2. Month and Day:

In the first and second column, the date (day, month and year)is registered in the logbook.

3. Winds:

The main information about winds in that period was directed towards the wind direction and wind force records (Prieto, 2005). Their estimation without modern instruments must admit a degree of inconsistency. This is not, however, to suggest that the data are inherently unreliable, and it is worth recalling that it remains today normal practice on many ships to record wind force without instruments and by reference to the state of the sea, very much as was done in the age of sail (Wheeler, 2005).

It is evident that winds were recorded in terms of the direction from which, and not to which, they were blowing. Wind directions are the most frequently observed in the registers of all weather phenomena in logbooks of our period.

4. Course:

Course is the distance navigated of a vessel over the sea. The reference can be true north or magnetic north. Course corrections could be applied only if the variation were known and regularly observed. Actually, mariners could not have estimated wind direction in any other fashion. The compass provided their only consistently available means of determining direction, as cloud cover might obscure the astronomical reference points (for true north) of the midday sun and the pole star (polaris) for periods of several days (Wheeler, 2005).

5. Miles sailed:

In this column appears the distance from the last place of navigation registered. That means the distance since the last day at noon, because most registers were written at noon.

6 & 7. Latitude y longitude:

Before the adoption of Greenwich as the prime meridian in the late 19th century, London was frequently used as the “zero” meridian by British ships. In this way the line that passed through St. Paul’s Cathedral, about 30’’ west of the present Greenwich meridian (Können and Koek, 2005). More commonly before the 1790s, and particularly before the widespread use of the marine chronometer, the longitude was noted with reference to the last major sighting of land. Therefore when sailing by dead reckoning (estimating position by observed latitude, course, speed and leeway alone) the meridian used would change several times and the ship’s position, especially longitude, being corrected by sighting a known landmark such as “Port Mahon”. When reading a logbook it is essential to know which meridian is being used. In those British logbooks that use chronometers or lunar observations to determine longitude, the meridian is Greenwich. In all other instances it is usually the last major landmark sighted.

For example, in the CLIWOC project, the team assembled a list of over 600 meridians that were used in logbooks during the study period (Garcia-Herrera et al., 2005). Yet, we need to study about the meridians of reference in our project.

The latitude of the break in the ship’s longitude usually provides enough information to deduce the offset of the new zero meridian with respect to Greenwich.

8. Places at noon:

Is the place where they stayed in that day, sometimes is the reference for the register of longitude.

9. Observations and accidents:

In this page of the logbook was registered something remarkable for this day; such the meteorological information or information about navigation, about the sailors of the vessels, etc.

3.2. EXAMPLES OF MEDCLIVAR DATABASE:

a) The code of this document is ‘ADM 51/401’, the vessel is ‘H.M.S. Gloucester’. The first day of navigation in this logbook is ‘5 February 1715’ under the command of Captain ‘William Passenger’. The port of departed was ‘Woolwich’ the port of arrival was ‘Sheerness’. The meridian used in this logbook was Greenwich Meridian, longitude geographic unknown (*), the units of measure were ‘leagues’ and the annotations were made ‘at noon’.

The information of this main part (figure 7) is common for this complete document unless important changes occur (changes in the captain of the vessel, the units of measurements or the reference’s meridian. When any f those things happened we had to modify the main sheet of the database).

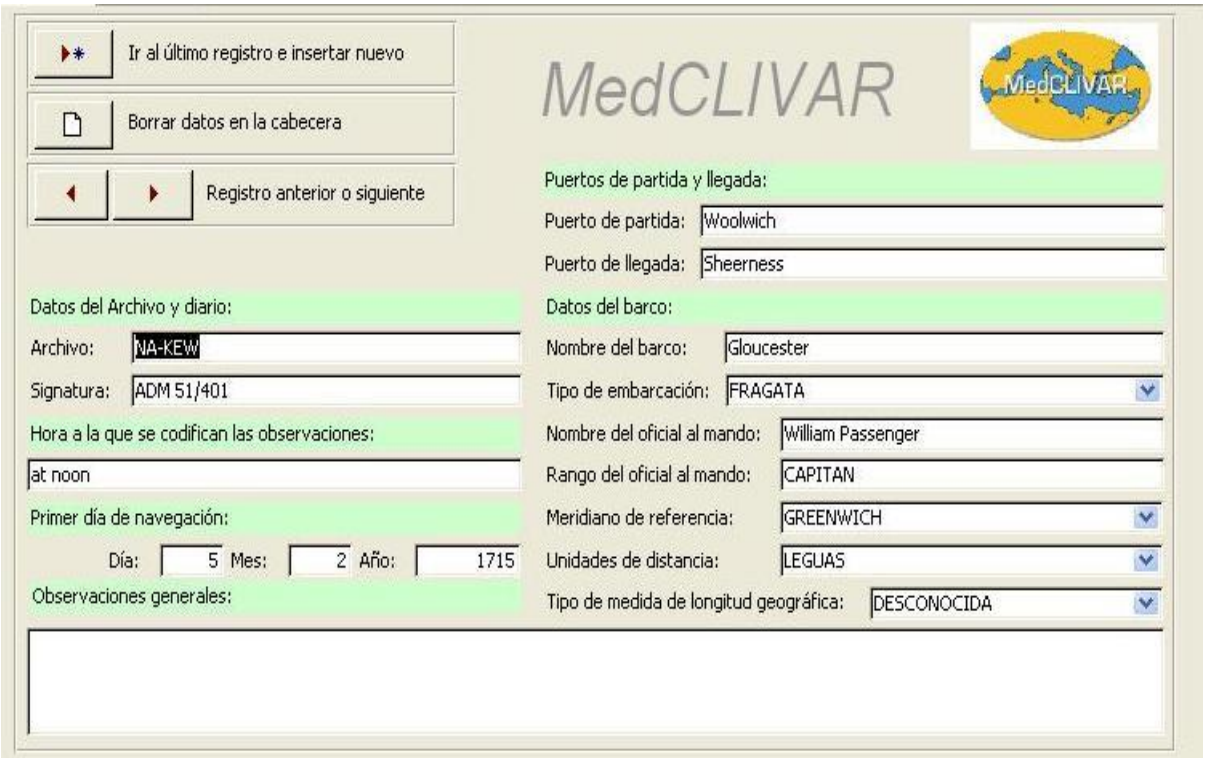


Figure 7: main sheet of the medclivar database

b) When the main sheet of the database is ready, we can start to enter registers. The first register is the 'date', then continue with the 'observed and estimated position of the ship'. In the example below it appears as 'latitude

38º35'N and longitude 2º49'E observed'. In the movement of the ship appears 'course E 27 S 'with a 'distance of 188 miles'.

As for weather information, with respect to the 'wind direction is ENE, NW and N 'by the 'wind force' was encoded to the Beaufort scale with the CLIWOC dictionary, which in this case would be 'BF 7'. With regard to the 'sea state' this logbook does not give us any information about this but 'the general description of the weather is Moderate gales and fair weather'.

In the right side of the database, figure 8, there are some boxes where we are asked about the occurrence or not of meteors such ‘snow, fog, lightning, thunder, hail, ice at sea, rain’ in the case of our example there is no occurrence of any of those meteors in that day, we haven't information on the ‘direction’ and ‘intensity of currents’ or ‘encounters with other vessels’. The ‘reference point’ of the ship is "cape mola" and is located in the ‘direction W’ from the ship at a ‘distance of 188 miles’.

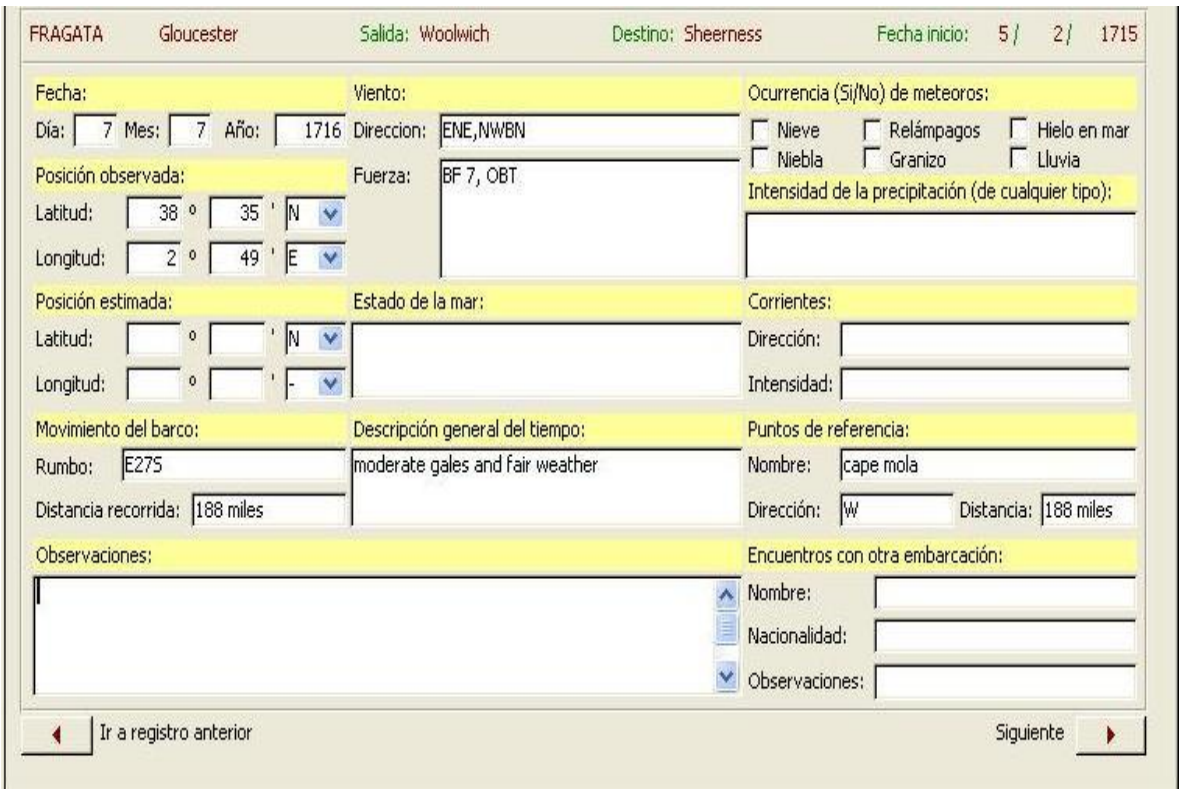


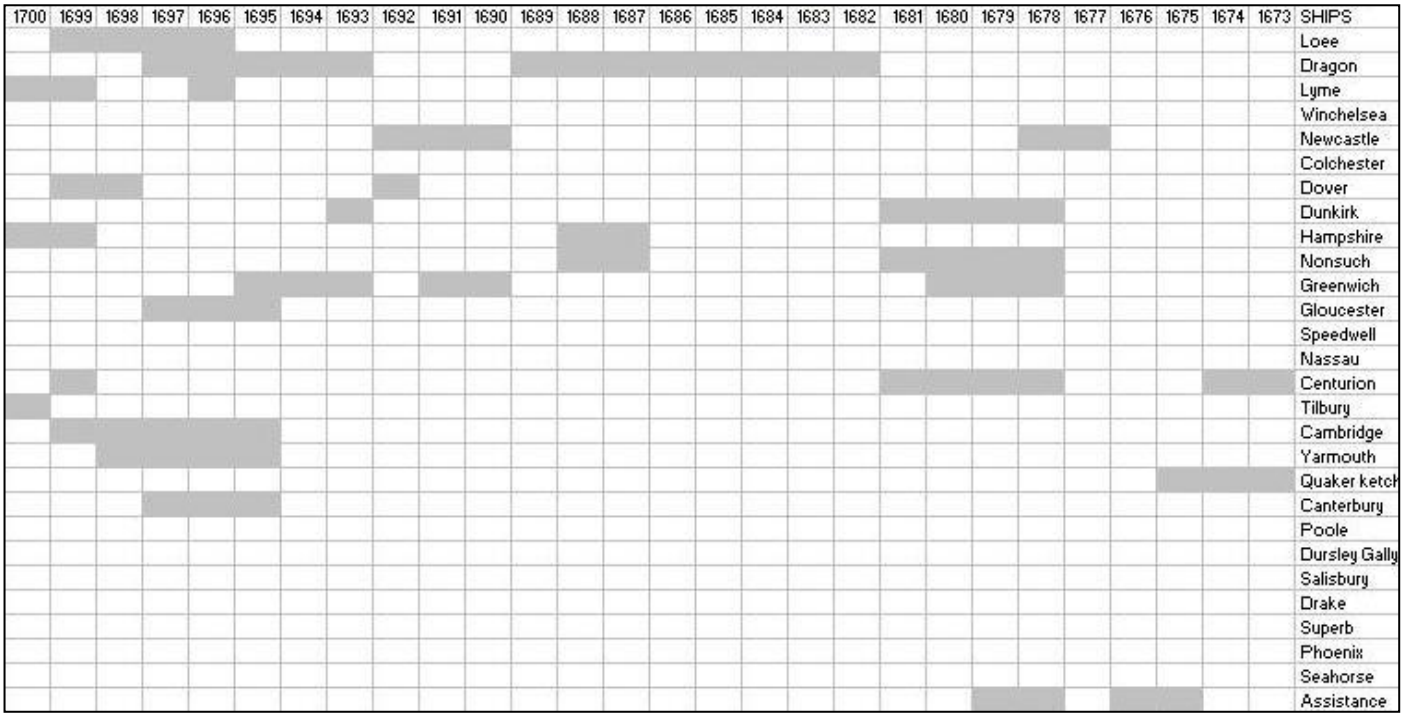
Figure 8: metadata sheet of the medclivar database

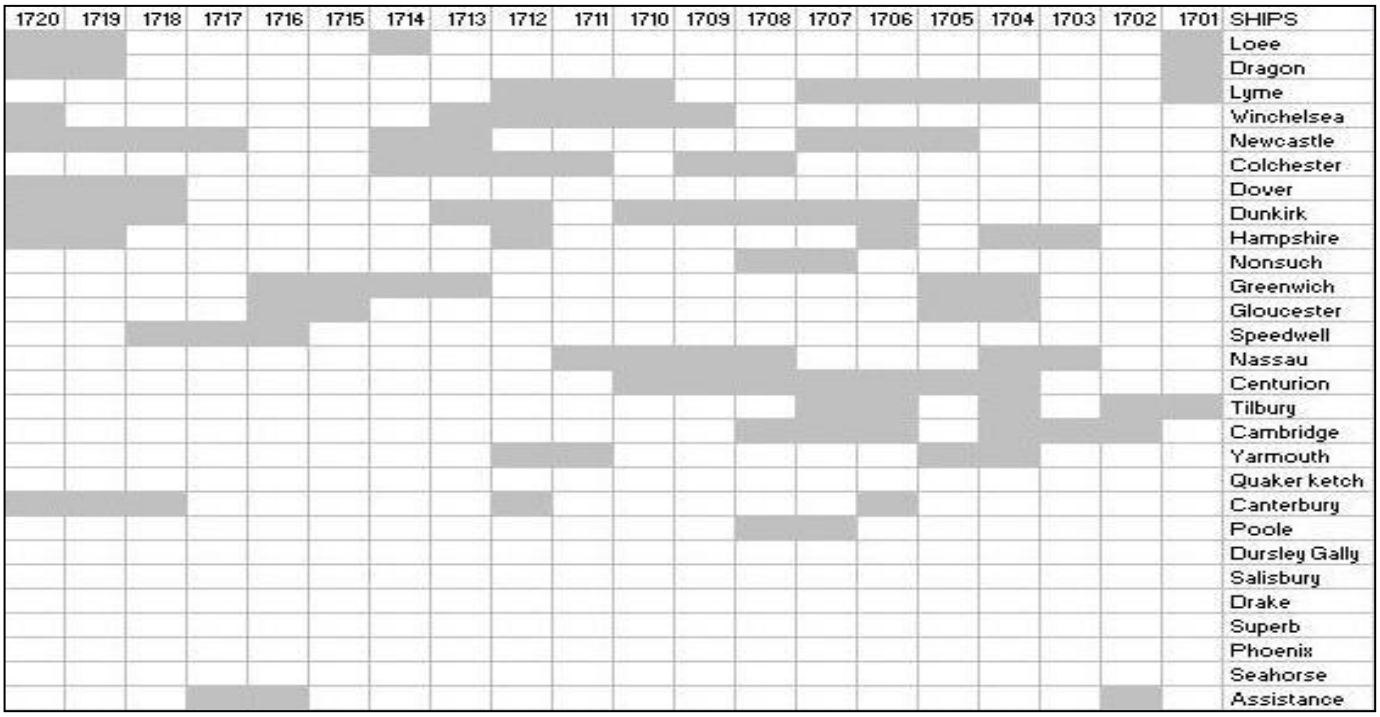
4. DESCRIPTION OF THE MAIN RESULTS OBTAINED

The information digitized for this project includes information about 28 ships from 54 documents with the logbooks covering the period 1680-1750. All these logbooks are digitized for the complete period, we have 7173 images about this logbooks saved in 2 computer and 6 DVDs. Today, the database includes already around 10000 registers and we continue working to transcribe the rest of data digitized (All these information is available for Medclivar).

The database is not yet completed for the whole 1673 to 1750 period, and this report will include only partial analysis. An example of this would be the database of the image 7 and 8.

The following tables show all the ships that were digitized from 1680-1750. We can see in this figure throughout the period for the database, sorted by year and ships. So we can visually see what ship sailed in each year.





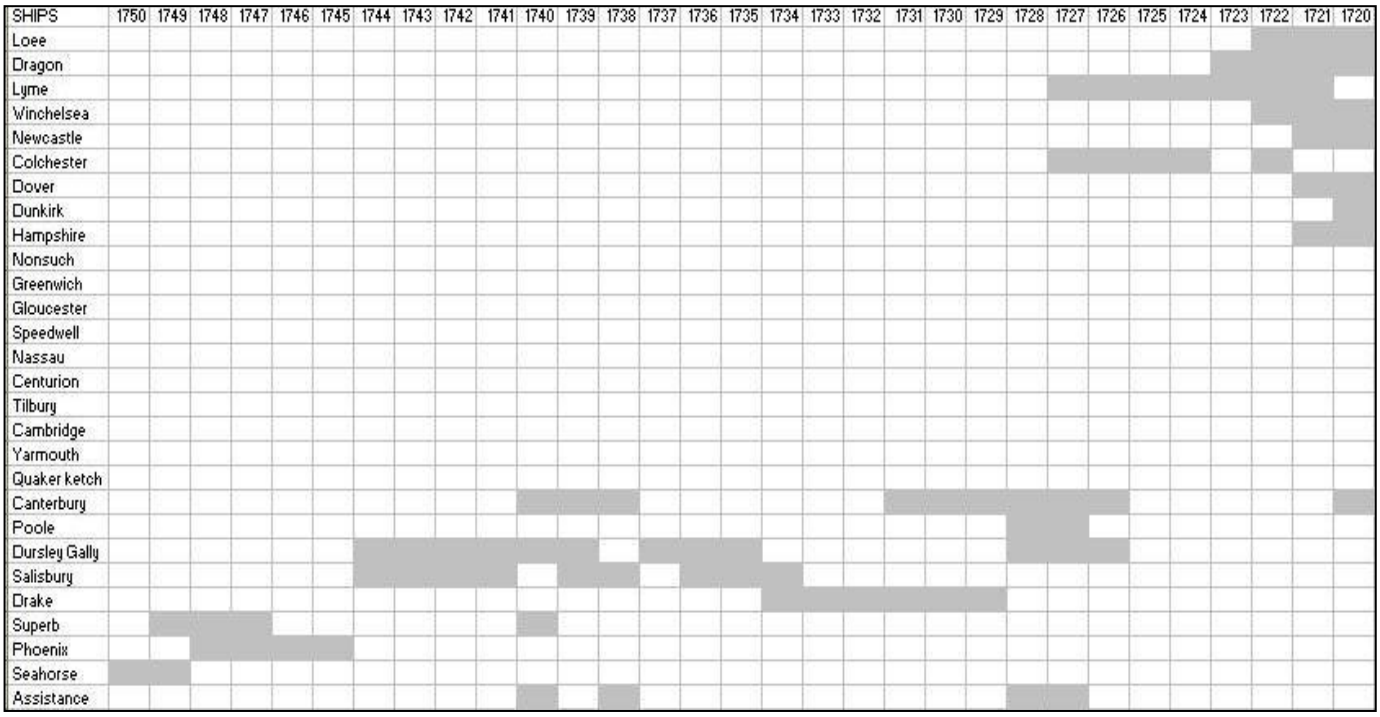


Figure 9: These tables show all the ships that were digitized from 1680-1750. We can see in this figure throughout the period for the database, sorted by year and ships. So we can visually see what ship sailed in each year.

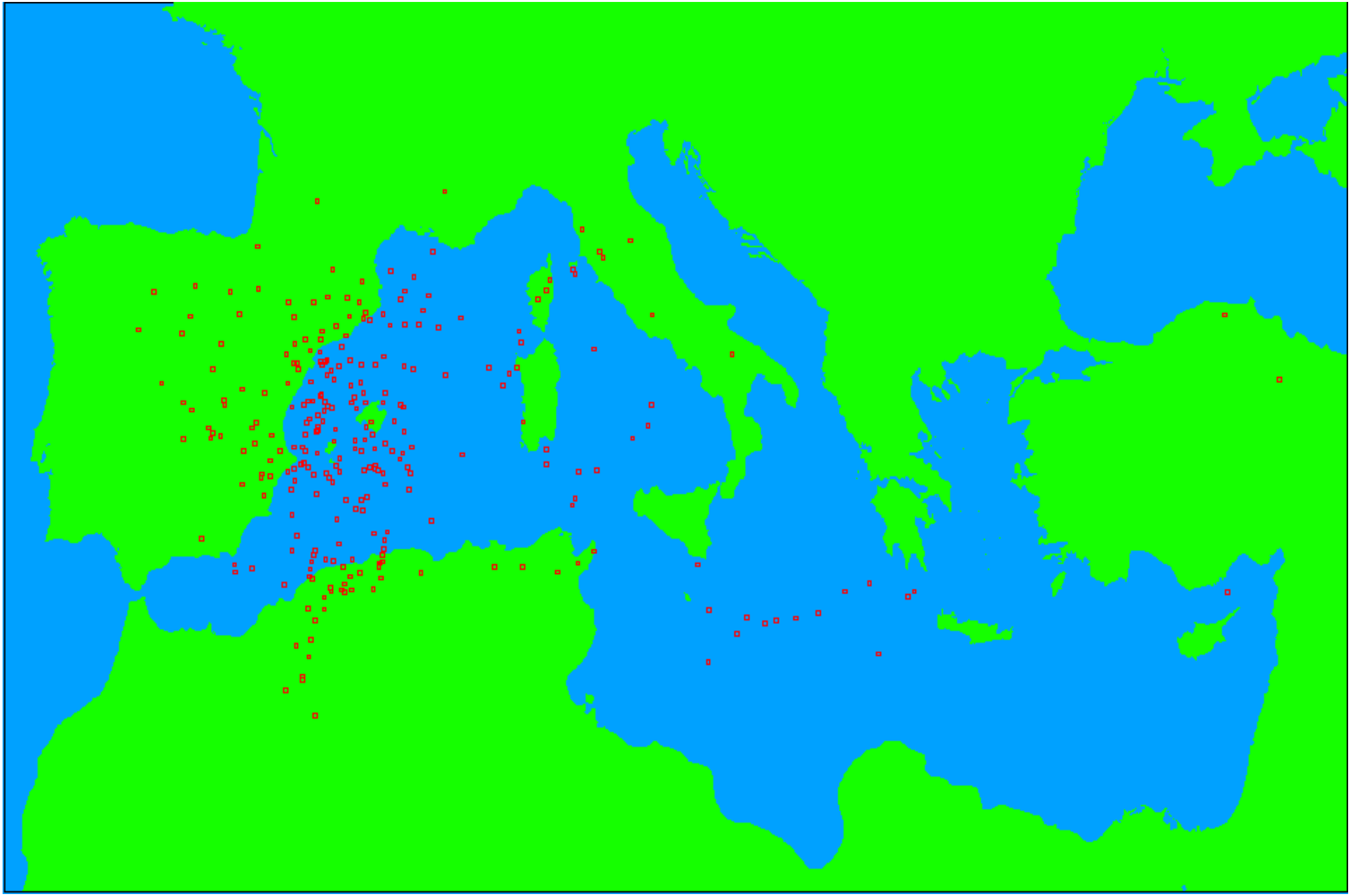


Figure 10: distribution spacial of our data, for a extract of the data in our database (1705-1715)

4.1. SPATIAL DISTRIBUTION OF DATA:

We can see in the figure 10 that several points appears on continental areas, the explanation for this is linked with the different references to meridians chosen by different captains in each ships. Checking records in the database, we noticed that in several occasions, when detailing the latitude and longitude, the longitude does not correspond to the actual meridian of reference (Greenwich Meridian). They could have used any other meridian of reference but it is relatively easy, but time consuming, to find the exact longitude and latitude because in the most occasions we have the reference point of where they were. With this information from this reference point and the trajectory followed by the vessel, it will be possible to identify the real longitude and the meridian of reference used. To do this we need a correction of these parameters in our database to ensure the exact shape of the defeat of the ship.

For example, the image 11 show us the data from the '18-27 April 1704' for 'Lyme' ship under the command of 'Captain George Dolman'. In this image appears in the first column the latitude, longitude in the second and the third column is the point of reference in which they stay. For instance, for the first day we look the Lyme in Malaga at latitude 36 º 00 'and longitude 34 º 06', however the next day we can see the Lyme in Granada Hill with longitude 86 º 00. That is impossible because Malaga and Granada are very near, and if the reference meridian was Greenwich, it would be impossible.

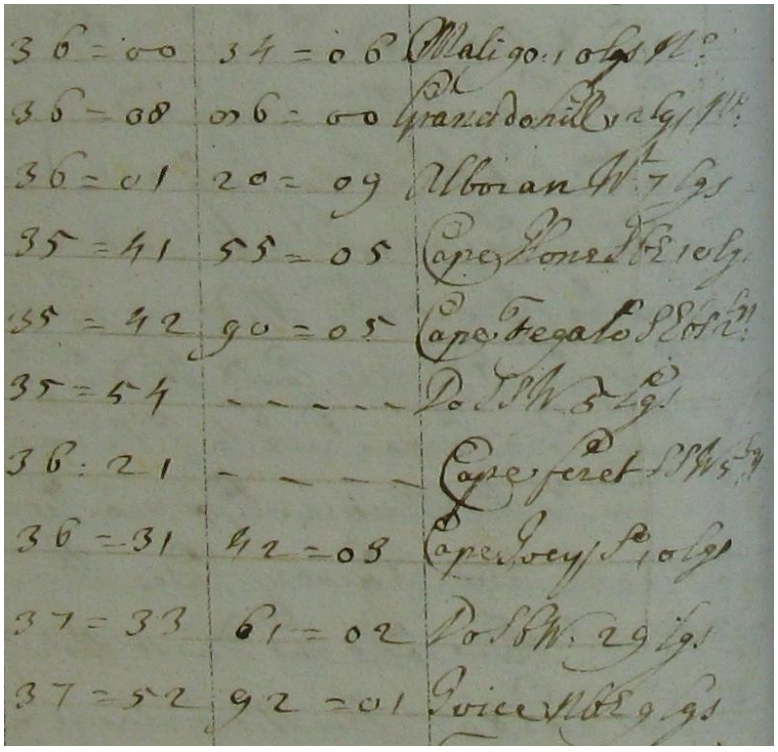


Figure 11: example of logbook with a different reference meridian for each place.

4.2. WINDS RESULTS:

Logbooks were examined and the original text was converted into Beaufort Scale equivalent terms (figure 12) with the help of the CLIWOC dictionary, providing thereby the opportunity of undertaking scientific analyses of these important historical data.

Koek and können (2005) describe how the words used to describe wind speed by the mariners were translated to estimates equivalent to beaufort wind force values. Wheeler (2005) describes how consistent this was between ships sailing together, but with masters independently filling in their own logbooks. Wind direction measures were taken directly from the compass onboard ship.

English wind force terms were brief and often specialised. Wind force descriptions were commonly one of the following forms (this system was very used in the early 17 th century):

a) single adjective + noun, e. g. strong gale

b) double qualification + noun, e. g. very fresh gale

c) unqualified noun, e.g. storm

d) verb (usually the gerund) + adjective, e.g. blowing fresh.

These constructions had been popular before 1700. (Wheeler and Wilkinson, 2005)

In medclivar database the common noun used to describe the general weather is ‘moderate and fair weather’ and the wind force is BF 4. We can see in the following table the common terms found in the logbooks that we have used for this project.

BEAUFORT FORCE	WIND FORCE	FREQUENTLY USE IN LOGBOOKS	
BF 0	Calm		
BF 1	Light Airs	Small Airs	
BF 2	Light Breeze	Little Winds	Light Breeze
BF 3	Gentle Breeze		
BF 4	Moderate Breeze	Moderate	Small Gale
BF 5	Fresh Breeze	Fine Gale	
BF 6	Strong Breeze	Fresh Wind	Blows Fresh
BF 7	Near Gale	Moderate Gale	
BF 8	Gale	Fresh Gale	Strong Wind
BF 9	Strong Gale	Strong Gale	Blows Strong
BF 10	Storm	Blows Hard	Hard Gale
BF 11	Violent Storm	Storm	
BF 12	Hurricane		
NDA	No Definition Available (*)		
IU	Infrequently Used		

Figure 12: Table about Beaufort Scale, this is a scale for study the wind force, we can find in the last table two columns with the frequently use of the terms in our logbooks (1680-1750) (*) This may be because the term refers to wind direction, e.g. “fair wind”, rather than force, or because of uncertainly or imprecision regarding its point on the beaufort wind force scale, e.g. “baffing winds”. Descriptions such as “variable winds” etc. fall into this same category.

Pre-analysis with an extract of database (1705-1715): we have accumulated one part of data to see which is the dominant wind force in those years using the Beaufort scale and CLIWOC multilingual dictionary. We have used 5637 data records for the period 1705-1715 and the results were as follows:

BF0	BF1	BF2	BF3	BF4	BF5	BF6	BF7	BF8	BF9	BF10	BF11	BF12	IU	NDA

296	150	677	0	1126	0	191	732	756	25	126	6	0	44	1508

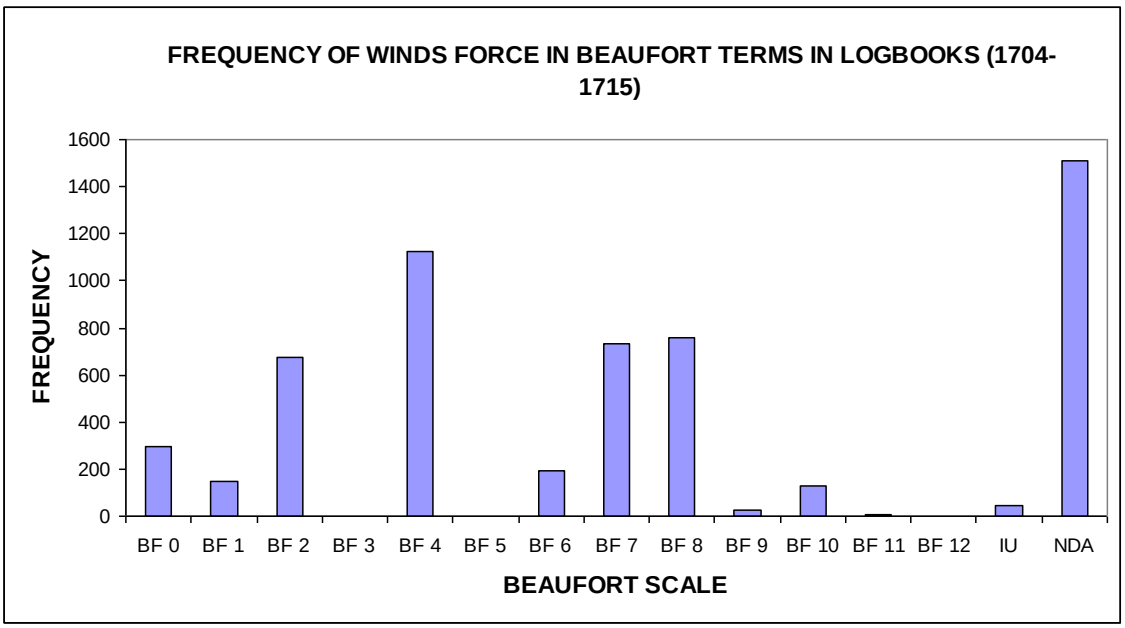


Figure 13: events transformed to the beaufort scale. for one extract of database (1705-1715), in both tables the events with more registers were BF4 and NDA.

The higher values for 1705-1715 were BF 4, BF 7, BF 8, BF 2, (figure 13) and the highest value was NDA, where we can find terms without noun in the CLIWOC dictionary. Further analysis is needed to convert these terms into the beaufort scale. The list of terms not found in CLIWOC dictionary is the following:

uncertain weather
close weather
foggy weather
cloudy weather
several winds
good weather
fresh weather
squally weather
hazy weather
small breeze
rainy weather

All these terms has been called NDA in the MedClivar database.

Other meteorological events for that period (1705-1715) were:

Rain	snow	fog	hail	Thunder
314	4	20	7	66

The predominant meteor was the rain, followed of the thunder and lightning in storms.

4.3. OTHER RESULTS AND CURIOSITIES:

As a curiosity we found some of the battles in which the fleet of the Royal Navy during this period of time, as an example, we can highlight some as:

• Battle of Passaro: in which the Royal Navy against the Spanish army in August 1718 following the signature of the quadruple alliance with France, the United Provinces and Holy Roman Empire. The British Army was deployed to snatch messina in Corsica and Sardinia to the Spaniards, some of the vessels that we scanned in this project were involved in this attack as the Canterbury and Dunkirk under the command of Commander Sir George Byng. These logbooks from this battle are digitized for this project.

• Papers on geometry: papers about geometry were found in some logbooks, this papers contain the most important methods in that time for study some points of interest for navigation. An example of one of them is the following image: In the figure 14 we can see some formulas used by 1600 for estimate longitude and latitude, or position of the sun at sunrise and sunset.

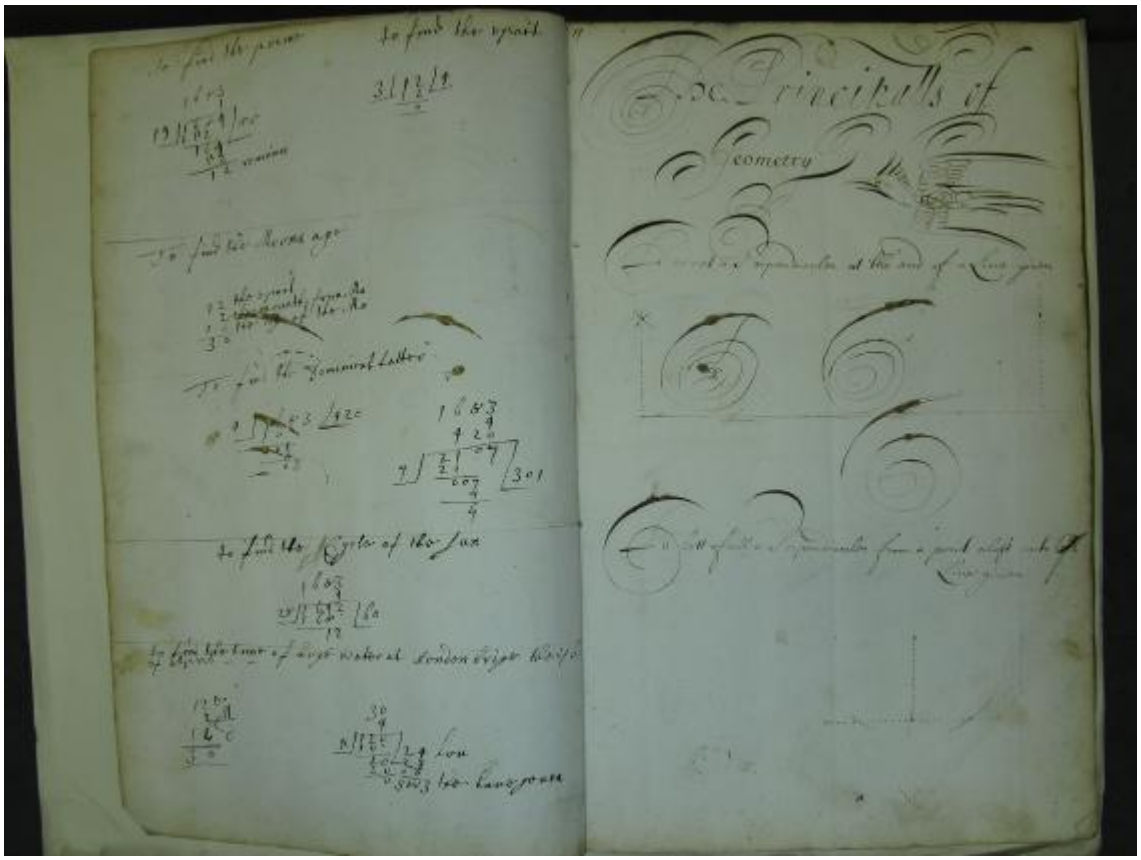


Figure 14: example of logbook with registers of geometry.

4.4. CONCLUSIONS OF MEDCLIVAR DATABASE:

- Covers the period 1673-1750, most of the gaps are in the early years, between 1682 and 1689, when information in the database is less detailed than during the later years.

- The weather reflected in the database is usually the general weather and the wind direction and strength. The general state of the weather is expressed with phrases like "fresh gale and fair weather “and”strong”.

- Sometimes the logbooks have no information on the latitude and longitude, but they always include information about some site where they have been. This enable us to determine those parameters.

5. FUTURE COLLABORATION WITH HOST INSTITUTION

A new project in the UPO group has just started and it aims to continue with a similar data collection and later analysis for period between 1750 and 1850. It will be necessary to stay in the national archives again to extract the new registers; digitize the logbooks for that period and transcribe them in a similar database.

6. PROJECTED PUBLICATIONS/ARTICLES RESULTING OR TO RESULT FROM YOUR GRANT

In this moment, there isn't any publication or articles resulting of this grant but when this happens we will let MedClivar know. Before projected any publication we need to do some additional work and to complete MedClivar database in order to cover some gaps of data and longitude references in our registers. We keep working on this completion of the database in Seville.

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