Galileo's dilemma. The climate pattern of a South European city. Saint Sebastian (1570-2000).

I. History as an applied science. How many data does past climate reconstruction require?.

Some years ago, the U. N. raised the alarm on a new global scale problem: Climate Change. The Earth government has fueled some initiatives to face that trouble, among them, the nowadays well known Intergovernmental Pannel on Climate Change, (IPCC)[1].

As main result of its efforts, periodical rapports have been written; they warn, globally and nation by nation, about the consequences of so called Climate Change. The last one, for instance, published in 2007, claimed that Spain might face increasing temperatures and rougher droughts. To say nothing about changes in its coastal territories…

Former Spanish Ministry of Enviroment accepted these conclusions but, naturally, they prepared their own agenda to fight that defy. Among other projects started before the last legislative election (March 2008), the Ministry sketched some initiatives to prevent the consequences of Climate Change in Spain. One of them was to encourage historical research on Spanish past climate[2].

A completely logical decission considering that, if we do not know what extent our weather changed during the last centuries, in fact, we know nothing on this matter.

This is obvious but, as it seems, frequently cast in oblivion when considering Climate Change problems.

A really strange result given that, as we have pointed out, research on past climate should be an unavoidable exercise in order to fight the threat described in the IPCC's rapports, in Spain or everywhere around the World.

So it happens, strange or not, although History of climate is not exactly a novelty. Specially in Spain, as professor Mariano Barriendos's works prove, particularly, the article entitled "La climatología histórica en el marco de la antigua

[1] See, for example, www.grida.no/climate/ipcc_tr/wg1/index.htm.
[2] See www.mma.es, "Subprograma nacional del Sistema Nacional de Observación y Análisis del clima". These plans, focused on that kind of problems, started, as it seems, during the year 1986. See ALONSO, Sergio. "La investigación del clima y el Plan Nacional de I+D". El Campo De las Ciencias y las Artes. El cambio climático. Servicio de Estudios BBVA, 2000, nº 137, p. 355.

Monarquía Hispánica", published nine years ago and which has provided an interesting basis to other research works on Spanish History of Climate; some of them had been published, for example, in the RECLIDO net[3].

What follows here is just a little essay, another drop in that increasingly vaste ocean of this not so new historical research subject frequently put aside by both some supporters of Climate Change theories and their antagonists, who, as it seems, prefer to defend their faced up positions by using political arguments instead of a rough, but serious, reliable and detailed research work[4].

Thus, this article, gathering new evidences and methodological reflections coming directly from the field of History, will try to answer some simple but, at the same time, difficult and sensitive questions.

Questions like these: could historical research help us to know exactly where and how that uneasy phenomenon known as "Climate Change" will hit us?. Do we need further historical research on Climate?. Does History -not Geography or Physics-, as an applied science, have something intelligent and useful to add to solve that problem?.

Answering these questions involves accepting what could be called Galileo's dilemma, which poses some other questions. For example, how many measurements do we need to do?. How many experiments do we need to perform to get a solid scientific pattern of past climate that could explain where we came from, where we are and which

[3] See, for example, the most ancient, perhaps, LE ROY LADURIE, Emmanuel. *Histoire du climat depuis l'an mil*. Flamarion. Paris, 1967, and WORSTER, D. (ed.). *The Ends of the Earth. Perspectives on Modern Environmental History*. Cambridge University Press. Cambridge, 1988, DELÉAGE, J. P. *Une Histoire de l´Ecologie*. Paris, 1991 and GONZÁLEZ DE MOLINA, M.-MARTÍNEZ ALIER, J. (eds.). *Historia y Ecología*. Marcial Pons. Madrid, 1993. More recent and, perhaps, more focused on Climate Change, BRADLEY, R. S.-JONES, P. D. (eds.). *Climate since A. D. 1500*. Routledge. London, 1995. BARRIENDOS, Mariano. "La climatología histórica en el marco de la antigua Monarquía Hispánica". *Scripta Nova*, nº 53, 1999, weblink www.ub.es/geocrit/sn-53.htm. See also www.reclido.net and www.euroclimat.com. More recently MARTÍN VIDE, Javier-BARRIENDOS VALLVÉ, Mariano. "El clima del pasado: la perspectiva histórica". El Campo De las Ciencias y las Artes. El cambio climático. Servicio de Estudios BBVA, 2000, nº 137, pp. 49-67.

[4] On criticism against the current theories of Climate Change mainly based upon political arguments, see, for example, HORNER, Christopher C. *Politically incorrect Guide to Global Warming and Enviromentalism*. Regnery Publishing Inc., 2007. Some contents of this book are really hard to believe, for instance, this author's assertion on Nuclear power plants as a clean source of energy because the only waste material they produce is *just* water vapour! See also, of course, GORE, Al. *An Inconvenient Truth*. Al Gore, 2006. There are more serious objections based upon solid scientific arguments; see, for example, some spanish works: TOHARIA, Manuel. "Cambio climático: percepción social" and FERNÁNDEZ, Joaquín. "La estrategia de la catástrofe", both articles in El Campo De las Ciencias y las Artes. El cambio climático. Servicio de Estudios BBVA, nº 137, 2000, pp. 367-371 and pp. 373-377, and, specially, URIARTE, Antón. *Historia del clima de la Tierra*. Eusko Jaurlaritza-Gobierno Vasco. Vitoria-Gasteiz, Bilbao, 2003. Further information on this subject could be got in professor Uriarte's blog. See http://antonuriarte.blogspot.com.

are our options? Or, in other words, how many "cannonballs" must we "drop" -just as Galileo did- to reconstruct past climate?.

I dare to answer to this last question, that, if we really want to know what we can expect during the next years concerning that matter -that is to say, Climate Change-, and we want to prevent, even to avoid these problems, as far as we can, we must drop from our particular tower of Pisa as many "cannonballs" as we can find. Wherever[5].

II. The boundaries of historical knowledge. The weather of a sixteenth century South European city. Saint Sebastian climate from 1570 to 1600.

What can be got about Spanish past climate from documentary ancient sources, such as town council's records? The answer to that question has been granted, partially, at least, by some works as the aforementioned article signed by professor Barriendos -"La climatología histórica en el marco de la antigua Monarquía Hispánica"-, as well as by other researchers devoted to study the past climate in Badajoz or in the Canary Islands and who have also published on RECLIDO net[6].

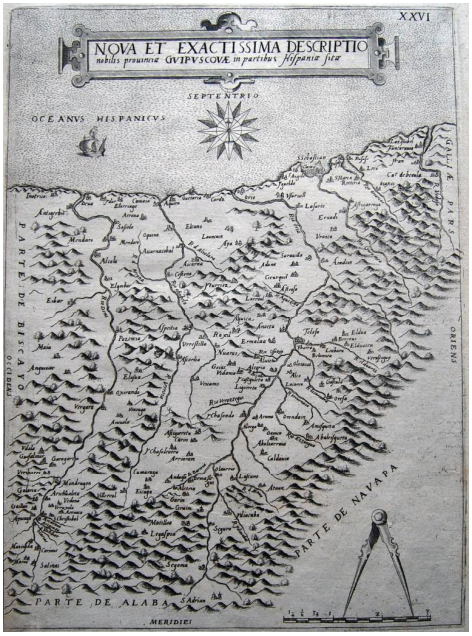

Image 1: Archivo Municipal de Hondarribia. G. de Joole´s map of Gipuzkoa. 1560.

[5] A troublesome problem, indeed; according to the opinions of Julian Morris, chairman of the "International Policy Network", on some mistakes about future expectatives on Climate Change. See, for example, "Sunday Telegraph.co.uk" 10 february 2007. A controversial article, but that has pointed out some interesting problems on Climate Change researching, its means and its aims.

[6] See www.reclido.es. See also PFISTER, C.-BRADZIL, R-GLASER, R. (eds.). *Climatic variability in sixteenth century Europe and its social dimension*. Climate Change 43. Specially PFISTER, C. "Documentary evidence on climate in sixteenth-century Europe", pp. 55-110. See also, of course, MARTÍN VIDE, J.-BARRIENDOS VALLVÉ, M. "The use of rogation ceremony records in climatic reconstruction: a case study from Catalonia (Spain)". Climatic Change, 30, pp. 201-221.

But, which are the limits of that kind of sources? Professor Barriendos points out in his work that documents used in past climate research must be "continuous and homogeneous". If that is true, and there is no reason to suppose that he is wrong, an interesting problem appears when trying to reconstruct the past climate pattern of Saint Sebastian.

There is an homogeneous source to do that work, indeed, but it is not exactly continuous. Napoleonic Wars -or rather, sir Arthur Wellesley- have destroyed most of the City Archives, in August 1813. As a result, only three town council's books have survived to the ravenous fire lighted by Portuguese and British troops when the city was stormed.

Can any profitable research be done by using only the pages of one of these valuable books, sole survivors of that great fire?. Or, according to the boundaries marked by professor Barriendos, must we abandon that effort, which looks really futile, and wait, defenceless, for the local troubles associated to the Global Climate Change, since we would have no instrument to know what extent our climate changed before and after the Industrialization?

I will dare to answer that, after having read the 277 pages of Saint Sebastian town council's book dated from 1570 to 1599, it is really difficult to deny that, though our source is not continuous, we can reconstruct, at least, an important part of the local History of Climate, since four hundred -almost five hundred- years ago. That new knowledge could help us to make the most correct decissions on specific and local Climate Change troubles, which, that is quite sure, we can only face by using models based, on local sources and not on general rapports such as those offered by IPCC's last paper.

That town council's book, written from 1570 to 1599, had kept the description of the weather the inhabitants of a South European city, Saint Sebastian, enjoyed or sometimes suffered during thirty years of XVIth century. In those days, just a little fortress and a merchant town placed before the Gulf of Biscay, next to the Spanish-french border.

The data offered by this really rare book are sometimes quite nebulous. For example, we will find there no exact measurement on rains or temperature. This source,

as many others, includes just what professor Barriendos calls "proxy-data" in his aforementioned indispensable work[7].

In fact, that kind of information -exact measurements on rains or temperature- is partially veiled in that source because the aims of the people who wrote these town council records were completely different from those which we consider to be interesting or significant nowadays.

Our ancestors did not want to know, for instance, how much temperature changed from 1570 to 1571. The main purpose of our source, just as many others of its kind, was to reflect the "health" of town council's bussiness. Both political and financial.

Then, if we can guess amidst these ancient pages something about the past climate of that city during these years, it is often due just to a coincidence.

Let's consider some examples. In October 1570 the town council's bailiffs were sent to check the property of some cunning neighbours of Saint Sebastian: bachelor Zandategui and Juan Cardel.

The visit was really successful. Town council's bailiffs destroyed some illegal boundaries raised by bachelor Zandategui to close some lot lands that, in fact, belonged to the town. But this fair punishement was put to an end by metereological hazards. As the town's bailiffs pointed before the council, on 3 November 1570 weather "got worse", and that, joined to sunset, stopped their efforts. Anyway, that fact pleased greatly to both the mayor and the aldermen[8].

The book reveals us that the weather was much better just one month before these events took place. Winds from south-southeast warmed the north of Spain during the beginning of that autumn of 1570. Domingo de Yraeta, a messenger (and probably an experienced sailor) sent by the town council to the port of Laredo to honour the new wife of king Philip the second, predicted that these favourable winds could take the queen's fleet right to that harbour just in a couple of days[9].

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[7] See BARRIENDOS. "La climatología histórica en el marco de la antigua Monarquía Hispánica".

[8] See Archivo Municipal de San Sebastián (Saint Sebastian City Archives, hereafter AMSS) Actas A 01 01 299 L, actas de pleno, folio 8 recto.

[9] AMSS Actas A 01 01 299 L, actas de pleno, folio 6 recto. On this subject, the sailors, or their environment as a source on Climate data, it would be interesting to see, for example, GARCÍA HERRERA, R.-GIMENO, L.-HERNÁNDEZ, E.-PRIETO, M. R.-RIBERA, P. "Reconstructing the North Atlantic Atmospheric Circulation in the 16th, 17th and 18th centuries from Historical Sources". Climate Research, 14, pp. 147-151, or, specially, GARCÍA, R. R.-DÍAZ, H. F.-GARCÍA HERRERA, R.-EISCHEID, J.-PRIETO, M. R.-HERNÁNDEZ JIMENO, E. L.-RUBIO, F.-BASCARY, A. M. "Atmospheric Circulation Changes in the Tropical Pacific Inferred from the Voyages of the Manila Galleon in the 16th-18th Centuries". Bulletin of the American Metereological Society 82, pp. 2435-2455

Laredo was certainly quite far from Saint Sebastian -around one hundred and fifty kilometres westward- but the decission made on these news by the town council shows that Saint Sebastian enjoyed warm and dry weather too. Thus, the mayor and the aldermen decided to celebrate the Queen's arrival firing Artillery and launching a good bundle of rockets. Besides, they ordered to light bonfires, as usual in Old Regime Europe. This kind of operations -firing cannons, specially- should be done only in the absence of rains, which otherwise could ruin the gunpowder and, obviously, these rejoicing shots…[10]

We can gather more data of this kind by reading the deliberation entertained by the mayor and the aldermen on 8 July 1583. That day they decided to apply firmly the decree signed on 13 June 1583. It ordered that the town's militia (this is, as usual, all the male neighbours of Saint Sebastian from 18 to 60 years old, except disabled people or clergy) should do their tactical exercises. This meant mainly learning to handle and to fire their arquebuses against an aim (to be exact a little round shield specially brought for these ocassions). As this kind of weapons, arquebuses, could be fired properly only during fine weather days, we must infer that, from 13th June to 8th July 1583, the town council and its militia did not enjoyed exactly dry weather. For the same reason, we can guess that year July the 8th was probably a good weather day[11].

We can read another data like this on 10 February 1579. That day two sailors, masters of *La concepción de Nuestra Señora*, went to the town hall to explain why their ship was anchored in the seaport of Saint Sebastian, called "Pasajes".

The two captains said that they had had no other choice, since *La Concepción de Nuestra Señora* had set sail from Bermeo, in Biscay, to Ribadeo, in Galicia. From this point, around five hundred kilometres westward from the seaport of Pasajes, they tried to reach the coast of Andalucia, but a tempest forced them back to the Basque coast. It seems that the storm was quite furious and hit the main part of the Spanish north coast, because the ship stopped not in Bermeo, her native port, but in Pasajes, one hundred kilometres eastward from this point[12].

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and, obviously, WHEELER, D. A. "Sailing ships logs as weather records: a test case". Journal of Methereology, 13, pp. 122-126.

[10] AMSS Actas A 01 01 299 L, actas de pleno, folio 6 recto. That is not an axiom. As it seems Modern Age Artillery officers and soldiers had some tricks to fire cannons and mortars even under heavy rains, see for example Biblioteca Foral de Bizkaia (BFB) VR 783 ANÓNIMO. *RELACION DIARIA DEL MEMORABLE CERCO, Y FELIZ VITORIA (sic) de la muy noble, y muy leal ciudad de FVENTERRABIA*, folio 17 verso.

[11] AMSS Actas A 01 01 299 L, actas de pleno, folio 149 verso.

[12] AMSS Actas A 01 01 299 L, actas de pleno, folio, 98 verso.

On 23 May 1582, another tempest is mentioned in that book. A French ship arrived to the pier of Saint Sebastian compelled by a strong sea storm which pushed her to the bay on 22 May 1582[13].

There are some other curious news of this kind inside this town council's book. For instance, we can guess, reading again its pages, that, in Saint Sebastian during those years, rains were heavy and continuous enough to rotten the wooden door that opened the main entrance to the town citadel, placed upon the sidewalk of the pier. This is what the military officer on charge told to the town council on 13 July 1579, at least[14].

This seemed to be an almost continuous problem. Thus, the town council's book told eleven years later, on 31 August 1590, that another door, the one that closed the walls of Saint Sebastian, was changed for the same reason: it was rotten. Humidity had even destroyed even its iron pieces [15].

As it seems, rain was a constant phenomenon in sixteenth century Saint Sebastian, as we can learn by reading the town by-laws on salaries published during 1581.

They pointed that the servants who carried wares from the pier to the town had to do this work quickly. Otherwise, among other dangers, "merchandises" could be damaged if they got wet.[16].

Do these scattered informations mean that this kind of sources, sometimes unique, as the one we have been analyzing in this study, are a complete fiasco and that it is impossible to reconstruct the past climate of Saint Sebastian before the 1860's, and that at best?

Not at all. As I have pointed, there is more, much more, inside these old leather covers which gather and preserve wide abstracts of the Saint Sebastian town council's sessions held during the last three decades of the XVIth century. Then, these valuable but scattered news are *not* the boundaries of what we can reconstruct about past climate in that South European city.

In fact, if we keep on asking questions to that document -in other words, if we continue doing what it is commonly called "historical research"- we will soon find a certainly proxy but useful and almost systematic image of the past climate of Saint

[13] AMSS Actas A 01 01 299 L, actas de pleno, folio 139 recto.
[14] AMSS Actas A 01 01 299 L, actas de pleno, folio 102 recto.
[15] AMSS Actas A 01 01 299 L, actas de pleno, folio 223 recto.
[16] AMSS Actas A 01 01 299 L, actas de pleno, folio 117 recto.

Sebastian. The one that town enjoyed or, I insist, suffered during the last half of the XVIth century.

III. The town's Forests

Lots of data about weather in Saint Sebastian during the XVIth century can be got from these old pages, indeed.

For example, the town council refers regularly to the forests which belonged to the community. They were mainly oakwoods, but the deliberations also concerned thicket, vineyards, apple orchards and, more rarely, chestnut plantations[17].

Obviously, that lets us learn which kind of climate allowed the city to raise such plantations. In fact, the mayor and the aldermen explained where and when the oaks, chesnuts, vines and applewoods were raised up.

Thus, we can got some systematical facts about XVIth century weather in a South European city. The following ones, as we will see, can illustrate us about what this climate allowed cultivating, as well as when, where and how much:

On 27 December 1571, Miguel de Arreche raised a harvest of millet and had some applewoods and chestnuts planted, as the millet, upon lands seized to the town council[18].

On 24 March 1572, the town council pursued some other trespassers from the suburb of Alza who had seized the thicket between the houses of Pelegrin de Arbide and Martín Arano de Valencegui, both placed in the ground called "Donaztegui"[19].

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[17] The History of the basque forests, specially the Guipuzcoan ones, has been deeply studied, as professor Alvaro Aragón Ruano has pointed out recently. There are several studies on this subject, indeed. The most important of them are two classics of this Historiography DE YARZA ADÁN, M. *La Repoblación Forestal en el País Vasco*. Imprenta de la Provincia. San Sebastián, 1913 and FERNÁNDEZ DE PINEDO, Emiliano. *Crecimiento económico y transformaciones sociales en el País Vasco (1100-1850)*. Siglo XXI. Madrid, 1974. More recently, but following the path opened by these essays, GARAYO URRUELA, J. M. *Aprovechamientos agropecuarios forestales en común en Álava*. Sancho el Sabio. Vitoria-Gasteiz, 1984, URIARTE AYO, R. *Estructura, desarrollo y crisis de la siderurgia tradicional vizcaína (1700-1810)*.UPV-EHU. Bilbao, 1988, URZAINQUI MIQUELEIZ, A. *Comunidades de montes en Guipúzcoa: las parzonerias*. Universidad de Deusto. Donostia, 1990, GOGEASCOECHEA, A. *Los montes comunales en la Merindad de Busturia. Análisis económico*. UPV-EHU. Bilbao, 1993, and, last but not least, the aforementioned professor Aragón Ruano's work, ARAGÓN RUANO, A. *El bosque guipuzcoano en la Edad Moderna: aprovechamiento, ordenamiento legal y conflictividad*. Aranzadi. Donostia-San Sebastián, 2001, specially, pp. 22-23.
It would be interesting to compare the data I will to put on show in that section of the work and the conclusions of ORTUBAI, Amelia. "Repercusión de la hipótesis de cambio climático en la vegetación del País Vasco". El Campo De las Ciencias y las Artes. El cambio climático. Servicio de estudios BBVA, 2000, nº 37, pp. 261-276.

[18] See AMSS Actas A 01 01 299 L, actas de pleno, folio 18 verso.

[19] AMSS Actas A 01 01 299 L, actas de pleno, folio 21 recto-21 verso.

The town's bailiffs went again to this suburb, Alza, on 18 August 1572. Another tresspasser had seized a huge apple orchard that belonged to the town: about 15.000 feets of good ground suitable to raise apple tree plantations[20].

Reading the record dated on 8 October 1572 will let us learn something not only about the proper conditions -water sources, rains, temperature…- which the town enjoyed that year, but also about the strenght of the winds that periodically fell upon the XVIth century Saint Sebastian.

In fact, that day, a widow, Mari Anton de Trencher, wife of the late Guillen de Lendres, asked for the town council's permission to plant and raise some trees to defend the apple orchard she has "in the mountain of el Pasaje" from constant winds. This place, nowadays known as mount Ulia, was not far from the suburb of Alza, before the seaport controlled by the town council. The mayor and the aldermen graciously granted Mari Anton to plant some trees to protect her apple orchard, but they had to be oaks, as His Majesty the King of Spain have ordered, so as to provide wood to his Navy if necessary[21].

Near this mount the town had another oakwood, planted between the fence of Ana de Arcae's house and the road which led from the town to that side of the seaport of Pasajes placed eastward, not far from the house called "Algarbe". The town council deliberated about this common property the same month and year, in December 1572[22].

On 8 June 1575, the council planted a new oakwood. This one was completely devoted to serving King's Navy. It was really ample and scattered all around the town's commons.

The first lot of these trees was planted in a little valley placed southwestward from Saint Sebastian, upon the town called Urnieta. The second was raised not far from there, in a field named Besabeguy, upon the grounds that belonged to the farm of "Oyarvide", near the mountain called "Adarra"[23].

The third one was planted in a big valley not far from Urnieta, placed on the frontier between the towns of Saint Sebastian and Hernani. There was a wide thicket

[20] AMSS Actas A 01 01 299 L, actas de pleno, folio 22 recto.
[21] AMSS Actas A 01 01 299 L, actas de pleno, folio 24 recto.
[22] AMSS Actas A 01 01 299 L, actas de pleno, folio 26 recto.
[23] AMSS Actas A 01 01 299 L, actas de pleno, folio 64 recto. About the forests of Urnieta see, for example, OTAEGUI ARIZMENDI, Arantxa. "Los montes francos de Urnieta: precedentes históricos y principales aprovechamientos durante el Antiguo Régimen". BEHSS, 20, 1986, pp. 263-282 and BANUS Y AGUIRRE, José Luis. "El limite meridional de San Sebastián. La villa de Hernani y los montes francos de Urnieta". BRSBAP, 1971, pp. 47-60.

where the town council expected to raise a gallant oakwood to serve His Majesty's Navy[24].

There was a fourth place: a field close to a hermitage devoted to Saint Mary Magdalen, between the houses called "Chipres", "Alamalia" and the hut of Arzac's family called "Atañoa"[25].

The fifth and last lot of oaks was planted southwestward from Saint Sebastian, near the little village of Usurbil. The deliberation about this place is really interesting because it points that this was a really proper place to raise oaks and, besides, which degree of humidity and winds these trees must endure there. According to the town council, this little valley, placed before the left side of the road which led from Saint Sebastian to Usurbil, next to the farms called "Unanue", "Bidarte" and "Zuazu", was a really nice place to plant oaks which could serve as masts for His Majesty's Navy, because there was no wind which could twist the trees and, moreover, necessary humidity was completely granted[26].

The town council expected to plant a surface of 10.000 feet in that area and 10.000 more every year in the other places chosen for serving that purpose. The mayor and the aldermen hoped to plant around 30.000 to 40.000 feet the following years[27].

In fact the raising of new oakwoods, as well as other plantations, went on in Saint Sebastian and its dominions for many years up to 1599.

On 7 December 1579, for instance, the town council deliberated on 1.000 feet of new oaks that had to be planted by Miguel de Aguirre at Basanoaga, just as it had been done the previous year[28].

On 29 November 1582, the town council deliberated on the new seizure of its lands that some neighbours of the Igueldo suburb had done. As usual, they have dedicated these lands to plant oaks and chestnuts[29].

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[24] AMSS Actas A 01 01 299 L, actas de pleno, folio 64 recto-64 verso. On this subject, the deal of this forest between the two towns, see, again, the aforementioned article of BANUS Y AGUIRRE. "El limite meridional de San Sebastián. La villa de Hernani y los montes francos de Urnieta", pp. 47-60 and SORÍA SESÉ, Lourdes. *Los hombres y los bienes de la villa de Hernani entre 1585 y 1650*. CAP. San Sebastián, 1982.

[25] AMSS Actas A 01 01 299 L, actas de pleno, folio 64 verso. On this subject, the oakwoods raised in that province to serve King's Navy, see GÓMEZ RIVERO, R. "La Superintendencia de Construcción naval y fomento forestal en Guipúzcoa (1598-1611)". AHDE, 1986, pp. 591-636.

[26] AMSS Actas A 01 01 299 L, actas de pleno, folio 65 recto.

[27] AMSS Actas A 01 01 299 L, actas de pleno, folio 65 verso-66 recto.

[28] AMSS Actas A 01 01 299 L, actas de pleno, folio 104 recto.

[29] AMSS Actas A 01 01 299 L, actas de pleno, folio 146 recto.

Then, oaks continued to be planted during the last decade of that century. On 21 December 1588, the town council deliberated about the most proper places to raise new oakwoods. The suburb of Alza was the first choice to grow up one thousand to one thousand and five hundred oaks. The experts chose also Ibaeta. That place was southwestward from the town and they considered it was a nice ground to create a new oakwood of one thousand to one thousand and five hundred trees, not far from the farm called "Mugica". Anyway, some neighbours from Alza, considered that to be a bad idea because, as Sanjuan de Oyarçaual, their chairman, pointed out before the mayor and the aldermen, if the council followed on these plans, they would have to lose their cattle and apple orchards, from Molinao to the farm of the aforementioned chairman. That would have meant an unecessary damage because, as the cunning San Juan de Oyarçaual remarked, the town had enough fit places to raise these new oakwoods quite afar off from Alza[30].

Despite these conciliatory words, the following year, on 16 December 1589, the town council discovered that some neighbours from this suburb had planted their own oakwoods. For instance, the farmer of "Our Lady of Acorda"[31].

On 5 March 1592, the town raised new oak trees -five hundred- and chestnuts. This new oakwood had to be planted not far from the sea, in the place called "Pertache" and as soon as possible, because the mayor and the aldermen thought this was the most proper season to do that operation. The chestnuts, of an excellent quality, had been raised in Bonacategui. The man the town council sent there to check that work, Miguel de Cardel, considered them to be very proper to become nice planks[32].

On 24 October 1594, the town council deliberated about another oakwood. That one had been planted in Igueldo upon a quite wide area between the church of this ham, the local inn and the farms of Gamboa, Zuhaztieder, Barrenechea and Durandegui. The man on charge was Nicolás de Aldalagorri, a neighbour from Usurbil, who, as it was pointed out, did not fill his task satisfactorily: he planted 2.619 oaks instead of the 3.000 stipulated…[33]

Apple orchards were also common in Saint Sebastian during the second half of the XVIth century, as the town's records clearly show. On 18 February 1583, the council discovered a new point where a neighbour, named Diego de Arrizurriaga, had

[30] AMSS Actas A 01 01 299 L, actas de pleno, folio 196 recto-197 verso.
[31] AMSS Actas A 01 01 299 L, actas de pleno, folio 214 verso.
[32] AMSS Actas A 01 01 299 L, actas de pleno, folio 234 recto-235 recto.
[33] AMSS Actas A 01 01 299 L, actas de pleno, folio 246 recto.

raised an apple orchard upon town's commons. The lot was placed just in the middle of the new road that the council was constructing to communicate the town with its suburb built up around the church of Saint Sebastian called "el Antiguo" (this is: the ancient), opposite the harbour[34].

This illegal apple orchard was not the only one, of course. In fact, the 1570-1599 town council book is filled up with many references related to this question. Particularly about the apple harvest.

As it seems, the apple orchards of Saint Sebastian were quite rich during the second half of the XVIth century. Both those that were property of particular neighbours and those which belonged to the town council, granted enough cider to feed that community.

During these years, the successive mayor and their aldermen discussed almost continuosly about foreign cider cargoes. These, coming from France, from Biscay, even from towns in the neighbourhood of Saint Sebastian were stopped, destroyed or seized, because there was still enough native cider to supply the town's market.

On 21 December 1583, for instance, Ochoa de Goyaga, a neighbour from Saint Sebastian, lost sixteen cider casks he has bought in France. The council men discovered that merchandise blatantly unloaded upon the pier of the town[35].

That revenue operation was, in fact, completely unecessary if considering that in the outskirts of Saint Sebastian, on 26 May 1589, there was huge apple orchards that could provide enough cider to keep out of the local market the content of these smuggling casks. Pedro de Olloqui had one raised with the kind permission of Saint Sebastian and Hernani town councils. There were two hundred and forty apple trees[36].

Anyway the punishement against cider smuggling went on. On 14 July 1589, the town council seized 48 casks of this beverage captured at the seaport of Pasajes[37].

In fact, the mayor and aldermen of Saint Sebastian rejected also the cider poured with water which came from Biscay on 6 October 1589. This was an usual export from that province to this seaport, by the way[38].

They could even go without some apple orchards raised in the suburb of Loyola, as it was proclaimed on 24 November 1589. That day, the town council decided to

[34] AMSS Actas A 01 01 299 L, actas de pleno, folio 148 recto-148 verso.
[35] AMSS Actas A 01 01 299 L, actas de pleno, folio 155 recto-155 verso.
[36] AMSS Actas A 01 01 299 L, actas de pleno, folio 201 recto-201 verso.
[37] AMSS Actas A 01 01 299 L, actas de pleno, folio 205 verso.
[38] AMSS Actas A 01 01 299 L, actas de pleno, folio 210 recto.

expropriate some lands there to construct a new road that should join that isolated lands to Saint Sebastian crossing over the river that divided that neighbourhood from the town centre. We will talk about this matter later, in the Vth point of this work, when referring to other aspects to reconstruct past climate allowed by this town council's book of records[39].

On 15 June 1590, the victim of that sharp policy against cider smuggling was the harvest of a farm called "Zarategui", owned by Miguel de Azparren. His cider was stopped by an alderman of Saint Sebastian named Arnaobidau, who considered the quantity sent to the town's market until this day to be enough[40].

One year later, on 11 November 1591, Martín de Nauejas lost eight casks of cider that he had taken from the East side of the seaport of Pasajes. This was an illegal cargo because it came from a place out of the town boundaries[41].

Even military officers as Captain Martín de Esquibel were victims of these decrees which show us that the town had wondrous harvests of cider provided by its different apple orchards. In fact, on January 1592, that brave warrior lost four casks of Biscaian cider he had imported, not to sell but to feed his family and servants[42].

Vineyards, as well as the apple orchards, enjoyed the same prosperous prospect during these years in the neighbourhood of Saint Sebastian. The town's wine harvests were copious enough to be severely controlled by both the mayor and the aldermen. For example, on 17 December 1584, the town council ordered to seize a vineyard planted southwestward, in the middle of the way that led from the town to the bridge of Arribisqueta and to the village of Usurbil, where they wanted to construct a new road[43].

The lands devoted to raising thicket around Saint Sebastian also looked prosperous. On 29 December 1581, the mayor and the aldermen told that they could get, shared with the town council of Hernani, about 12.200 "cargas" -"loads"- of coal made of the thicket raised in the Urumea river valley, in the place named "Landarbaso"[44].

On 4 January 1585, the town council estimated that they had 4.000 to 6.000 loads of coal in the land called Beotegui, placed in the suburb of Igueldo. That was the result of the last pruning, done eleven years before[45].

[39] AMSS Actas A 01 01 299 L, actas de pleno, folio 211 recto.
[40] AMSS Actas A 01 01 299 L, actas de pleno, folio 222 verso.
[41] AMSS Actas A 01 01 299 L, actas de pleno, folio 230 verso.
[42] AMSS Actas A 01 01 299 L, actas de pleno, folio 233 verso.
[43] AMSS Actas A 01 01 299 L, actas de pleno, folio 161 verso.
[44] AMSS Actas A 01 01 299 L, actas de pleno, folio 135 recto.
[45] AMSS Actas A 01 01 299 L, actas de pleno, folio 162 recto.

They had also another thicket between the suburb of Saint Martin and Saint Cahterine's bridge. It was rich enough to be hired in a public auction, as they decided to do on 26 May 1589…[46]

Obviously, during these decades of the XVIth century, from 1570 to 1599, the climate pattern enjoyed in Saint Sebastian allowed raising huge plantations of vines, apple trees, oaks and chesnuts. That means, of course, a proper temperature and periodical rains. The data we have gathered from the town council's book support that aset, evidently. In few words, it seems that this South European city enjoyed a quite pleasant temperate weather during the three last decades of the XVIth century. That is the first solid fact we can extract from our discontinuous source.

But, as we will inmediatly see, there is much more information inside documents like this, which could show us which the climate of that little part of the World was four hundred years ago.

IV. The water sources of the town

The first water source mentioned in the town council's book is a well. As it was pointed out during the deliberation held on 26 December 1571, it was placed in the middle of the town, in the street then known as "Tripería" and nowadays as "San Jerónimo". The town council argued that it was really necessary to raise works to detour out of the walls the remaining water that this well could not contain. Ten years later, in 1581, a new town council's deliberation placed another well in the Main street, not far from that other one[47].

There was another brook, strong enough to raise six huge oaks, westward from the town, in the suburb of Igueldo. On 24 December 1572, the town council said that this rich booty had been planted upon its commons, near the houses called Eraunseta, Balda and Murguil[48].

On 8 February 1574, the council had discovered another source of water. It was placed eastward from the town, in the lands of a powerful neighbour of Saint Sebastian: milady Lorença de Ysturriçaga. That was a manor not far from the road which led from

[46] AMSS Actas A 01 01 299 L, actas de pleno, folio 201 recto-201 verso.
[47] AMSS Actas A 01 01 299 L, actas de pleno, folio 18 verso and 117 verso. See also folio 276 verso-277 recto, where the town council explains the change of name when referring to a little orchard that existed near to this point in 1599.
[48] AMSS Actas A 01 01 299 L, actas de pleno, folio 25 verso.

the town to its seaport, in Pasajes. The landlady would allow the town council to build a fountain, if the mayor and the aldermen gave her a part of this water to raise her vineyards, planted upon that humid, rich ground[49].

Anyway, there was another water source in the outskirts of Saint Sebastian which might be most significant to this work. The first mention of this brook appears in the town council's book on September 1573, when the mayor and the aldermen decided to detour to a proper recipient the water that used to fall down from Saint Bartholomew's hill, placed southward from the town, in a suburb which, nowadays, is part of the C. B. D. of Saint Sebastian[50].

That brook had been a continous problem: the road that led from this point to the town was often cut by these waters. As it seems, the deliberation on September 1573 was useless, because four years after, on 12 March 1577, the town council decided to do something again to eliminate the little lagoon of water and mud periodically created by this Saint Bartholomew's brook. Around three years later, on 28 November 1580, the town council still had not found a solution to these overflowing waters[51].

There were some other mountain brooks that run free from their sources in the outskirts of the town. That was the case of one which fell down from the aforementioned mount Ulia to the Pasajes seaport waters. The town council decided on 2 August 1574 that these waters did not need a fountain. Thus, they should run from Ulia to the sea passing before the stairs of Saint Peter's church. The town council thought that this was the best solution for both the ships and people who walked through this path riding horses or just walking[52].

Obviously, these deliberations on brooks and fountains are some good keys to know the periodical rainy weather enjoyed in Saint Sebastian during the last three decades of the XVIth century but they are not the last ones...

V. The sea level and the flood areas

Among the problems attached to the so called "Global Warming" changes in the sea level and catastrophic floods appear to be the most grievous. Could a document like the Saint Sebastian town council's records provide any useful knowledege on that troublesome matter? I dare to answer in the affirmative again.

[49] AMSS Actas A 01 01 299 L, actas de pleno, folio 46 recto.
[50] AMSS Actas A 01 01 299 L, actas de pleno, folio 39 verso.
[51] AMSS Actas A 01 01 299 L, actas de pleno, folio 79 verso-80 recto and 108 verso.
[52] AMSS Actas A 01 01 299 L, actas de pleno, folio 53 verso-54 recto.

If we search, we will find there some interesting notes about the level of waters around Saint Sebastian during the XVIth century, indeed.

First news on this subject appeared on 18 April 1573. That day the sea waters destroyed the wall and the corridor of Saint Catherine's door, the east entrance to the town, placed not far from the only bridge -also named Saint Catherine- which connected the town to the road that led to the seaport of Pasajes and to France[53].

As it seems, that part of Saint Sebastian waterfront was under the siege of the sea, as fierce as it is still nowadays. On December 1579, the town council punished Yñigo Hortiz de Quejo Salaçar. This neighbour had taken ten huge stones placed in that part of the town without asking permission, obviously as a defense against this furious sea[54].

Anyway, during the summer months, the strenght of the sea in that point looked weaker. In fact, the town had there a promenade at seaside, on the round rampart which defended that part of the Walls -the so called "revellin"-, that was improved on 20-27 February 1584. This place was usually visited by the neighbours mainly "in summertime", as the town's council book itself points out[55].

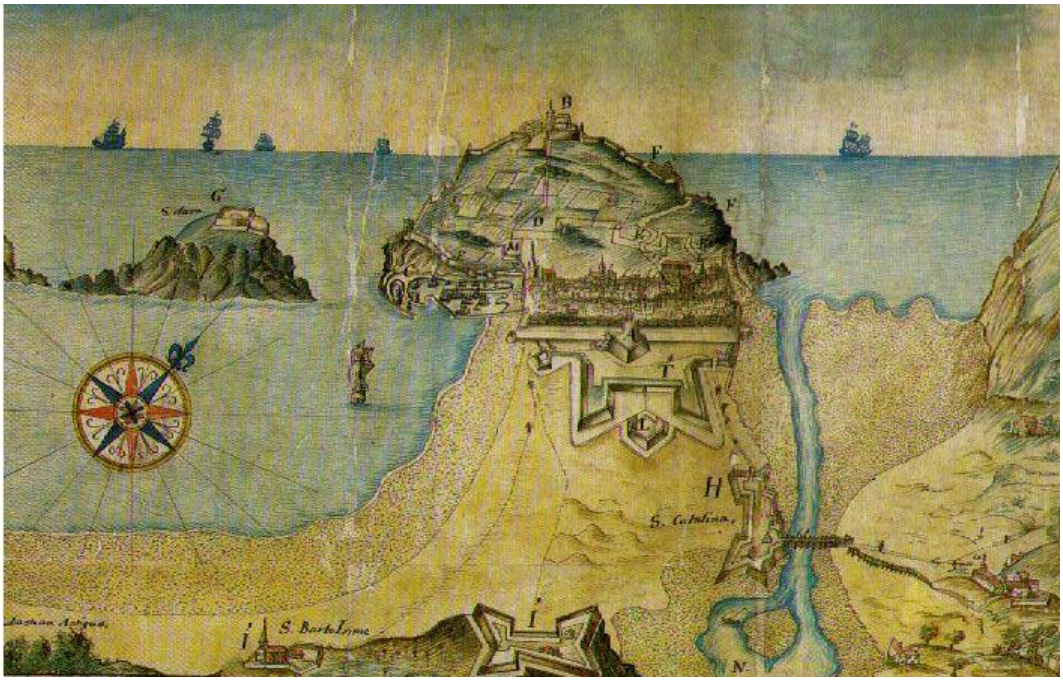

Image 2: GOMEZ PIÑEIRO, J.: *Documentos Cartográficos Históricos de Gipuzkoa. II. Servicio Histórico Militar. San Sebastián: Diputación Foral de Gipuzkoa, 1999, p.121. Engraving of Saint Sebastian, 1641*

[53] AMSS Actas A 01 01 299 L, actas de pleno, folio 32 verso.
[54] AMSS Actas A 01 01 299 L, actas de pleno, folio 109 recto.
[55] AMSS Actas A 01 01 299 L, actas de pleno, folio 157 recto.

As it seems, there was no real trouble until 1592. On 31 January the town's council secretary wrote in the margin of the book of records that the sea had completely destroyed Saint Catherine's bridge and, thus, it was necessary to raise a temporary gangway upon boats[56].

That was the last serious problem related to the sea level there, during this century at least. In fact, there is no other reference to extraordinary tides like this on this book, whose records stop in 1599. But there were some other places in Saint Sebastian more or less threatened by floods during the three last decades of the XVIth century.

That was the case of the suburb of Loyola. That place was raised upon the shores of the Urumea river, five to six kilometres far from the walls of the town. Some of its denizens complained to the town council on 20 September 1589. That day, they explained to the mayor and his aldermen that the road they used to take to go to Sebastian was "flooded and consumed" by the river and also by the sea tides that invaded the mouth of the Urumea[57].

Morlans, a couple of kilometres westward from the city walls, was another potentially troublesome place, as it was a periodical flood area. There was a mill and the women who went there carrying grain loads needed a bridge to cross over urgently, as it was pointed on 4 December 1595[58].

Anchume was, more or less, in the same situation. This place needed a new bridge to connect Saint Sebastian to Astigarraga, because the one which was there had been completely wasted on 4 July 1596[59].

Things seemed to get better in the seaport of Pasajes. There, the problem was not exactly the increase but the decrease of the depth of that wide bay which granted to Saint Sebastian a prosperous maritime trade.

The town council was really troubled on this subject. As it seems, the ships that anchored there released their ballast by throwing these big stones to the water. That was filling up the seaport bottom. The town council decree proclaimed on 26 August 1585 specified where and when the ships should leave their ballast and explained clearly the trouble they were causing until that date. The mayor and the aldermen said that the

[56] AMSS Actas A 01 01 299 L, actas de pleno, folio 233 recto. On 20th April the local parliament that ruled the province, that means also Saint Sebastian town council, warned that this way should be tax-free, which the mayor and the aldermen found quite disgusting. See AYERBE IRIBAR, María Rosa-DÍEZ DE SALAZAR, Luis Miguel. *Juntas y Diputaciones de Gipuzkoa (1590-1592 Documentos)*. Juntas Generales de Gipuzkoa-Diputación Foral de Gipuzkoa. San Sebastián, 1990, p. 527, vol. XI.
[57] AMSS Actas A 01 01 299 L, actas de pleno, folio 211 verso-212 recto.
[58] AMSS Actas A 01 01 299 L, actas de pleno, folio 252 recto.

sailors who throwed their ballast were "loosing and destroying the aforementioned seaport of the aforementioned Pasaje". Experience had already demonstrated that some places which, "in ancient times", granted a safe harbour to "big carracks and very big shippes", in those days could not allow even very little boats to anchor. In few words: the town council had noticed that, due to this indiscriminate ballast releasing -joined to tongues of mud, increased by these abandoned stones-, "the sea is not as deep as it used to be"…[60]

On 7 August 1587, the town council warned the seafarers once more about the ballast. They could take stones to this purpose just in the narrow mouth of the bay, and if they did not need to take ballast but to leave it, they must gather the stones and take them back on board, because they "Can ruin the seaport and they have ruined the seaport". The town council needed to proclaim such warnings again on 2 November 1587[61].

VI. Conclusions. The boundaries of historical knowledge. Weather in Saint Sebastian from 1599 to 2070.

Which was the climate, the weather enjoyed in Saint Sebastian during the last decades of the XXth century? What extent did it change from the XVIth century onwards?

This is a matter that this article refuses to answer. Mainly because it has been answered -partially, at least - by other works devoted to that question[62].

But there are some other reasons to shut up. In fact, our research has reached its own boundaries, its "nec plus ultra".

Thus, we can not go on, because there is no way of making further research on this subject, indeed.

Firstly, we have no more documents. Obviously, the city has other documentary sources which continue this first book, but they are just a couple of town council's records which reach only the mid seventeenth century and the beginning of the XVIIIth. After that, there is nothing but silence until 1814.

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[59] AMSS Actas A 01 01 299 L, actas de pleno, folio 254 recto.
[60] AMSS Actas A 01 01 299 L, actas de pleno, folio 165 verso-166 recto.
[61] AMSS Actas A 01 01 299 L, actas de pleno, folio 180 recto and 181 verso.
[62] See, for instance, the aforementioned professor Uriarte's blog, http://antonuriarte.blogspot.com.

If we wanted to continue our research on Saint Sebastian climate pattern, this would involve quite a big amount of time -and money, which in our World is almost the same- so as to crown that effort[63].

We should dedicate hours, days, weeks, months and even a complete year to that work, in order to get more information on this subject, re-create this local past climate and, which it is more important, its evolution during the last five hundred years.

This is the only kind of work that might allow us to know exactly where we are, or, in other words, which kind of climatological troubles affect that South European city nowadays and, specially, during the next years...

I started this paper talking about Galileo. Perhaps it would be a good idea to end it talking about another pioneer of modern Science: Sir Francis Bacon.

The Lord Verulam said that one of the best ways to know the truth -the main aim of any "natural philosopher", or scientist, if we prefer - was to separate the part from the whole keenly.

Our research has given us a "part" of knowledge on past climate. This allows us to get some conclusions on which the climate pattern of Saint Sebastian was during the three last decades of the sixteenth century, but there is still a "whole" to identify, to measure off, to face the real shape of that problem known as "Climate Change".

In other words, our work should be regarded just as a little step towards the correct direction. I must insist on the fact that there is still a great deal of work to do in using the History as an applied Science. First of all, in Saint Sebastian, but also in the Basque Country, in Spain and around the whole World, of course.

This is a task we need to fill if we really want to know what we can expect and where exactly we can fear the worst consequences -if any- of the Climate Change. That is certainly something we ignore, due to the present state of the research on this matter in Saint Sebastian, as well as in many other parts of Europe, America, Asia, Africa…

Let's consider just a last example on this subject that, I hope so, could enlight us about how much we need to do to know the History of our climate and, subsequently, to face the so called Climate Change and its associated troubles correctly.

[63] Curiously, many enterprises or institutions involved in the discussion against or, *prima facie*, in favour of Climate Change theories, refuse to invest such quantities of money to support that kind of research. As it seems, some people consider propaganda to be a tool better than science to face and manage that still not well known trouble. A worriying discovery? This is a question that every one should answer after a deep and careful reflection upon that curious research policies.

Then, let's talk about XVIth century catastrophic sea storms and floods. Barcelona, around six hundred kilometres southward from Saint Sebastian, was roughly punished by these phenomenons in 1578 and 1595. Were the flood of June 1578 and the storm at sea of April 1595 part of a "global" sixteenth century Climate Change? [64].

The answer to this question should be a resounding "no". If we consider again Saint Sebastian town council's records, we will soon discover that this South European city and its entourage enjoyed, as it seems and the town council's book points out, a rather good weather on 10 June 1578 or on 8 April 1595, just when Barcelona was swamped and lashed by a severe sea storm. In fact, from 1570 to 1599, the town of Saint Sebastian suffered only a remarcable storm at sea in 1592, three years before Barcelona experienced something like that, in 1595… [65]

As far as floods are concerned, we find the same result. Saint Sebastian did not suffer such an uneasy phenomenon on 10 June 1578, indeed. In fact, the town did not suffer floods even when its hinterland was affected by one on 21 September 1593. A nefarious event that different documents consider to be "extraordinary".

Even more, as it was pointed out by a mayor, victim of that phenomenon, this flood was something that nobody had seen "during centuries" in that part of the World… He was probably right; that day, 21 September 1593, some parts of the province that surrounded Saint Sebastian were surprised by a flood that destroyed bridges and inundated meadows and a number of houses. The places that suffered that unpleasant phenomenon were the towns of Urrechua, Oñate, Legazpia, Vergara and Segura, all of them around forty kilometres far from Saint Sebastian, southward, and some other, by the coast, westward from Saint Sebastian, such as Orio, Zumaya and Guetaria, and, last but not least, Usurbil, placed around ten kilometres southward from Saint Sebastian… [66]

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[64] See BARRIENDOS, Mariano-MARTIN-VIDE, Javier. "Los riesgos metereológicos en Barcelona a través de los registros históricos (SS. XIV-XIX). Primeros resultados sobre su comportamiento climático plurisecular", in MARTIN-VIDE, Javier (ed.). *Avances en Climatología histórica en España / Advances in Historical Climatology in Spain*. Oikos-Tau. Barcelona, 1997, pp. 33, 35 and 41. There are an english translation of this work in that same book, see pp. 133-156.

[65] See note 13 on another storm that took place in 1582, not so furious, as it seems, as this other one, and note 56.

[66] In fact, floods became periodical from that day onwards. In November 1594 another mayor, from Motrico, also a coastal village, pointed out that they could not construct a longlasting bridge to Saint Sebastian -around twenty kilometres eastward far from this town- due to that reason. See Archivo General de Gipuzkoa-Gipuzkoako Artxibo Orokorra (AGG-GAO) JD IM 1 / 2 / 22, page five and AYERBE IRIBAR-DÍEZ DE SALAZAR. *Juntas y Diputaciones de Gipuzkoa (1590-1592 Documentos)*, pp. 239, 257, 295, 303, 317, 338 and 403.

According to data like the aforementioned, it seems obvious that we have much more work to do, indeed, if we want to know the real shape of the problem, of the so called "Climate Change".

Will somebody dare to say that this task must remain undone or that we know everything we need to know to face that troublesome phenomenon? If "yes", perhaps we should meditate -deeply- upon her or his reasons to give such an answer and specially on the final consequences of that reply[67].

[67] On this subject, please, consider again the contents of note 63.