

Identification of Caribbean basin hurricanes from Spanish documentary sources

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Abstract This paper analyses five hurricanes that occurred in the period 1600 to 1800. These examples were identified during a systematic search in the General Archive of the Indies (AGI) in Seville. The research combined the expertise of climatologists and historians in order to optimise the search and analysis strategies. Results demonstrate the potential of this archive for the assessment of hurricanes in this period and show some of the difficulties involved in the collection of evidence of hurricane activity. The documents provide detailed descriptions of a hurricane's impacts and allow us to identify previously unreported hurricanes, obtain more precise dates for hurricanes previously identified, better define the area affected by a given hurricane and, finally, better assess a hurricane's intensity.

1 Introduction

Early Spanish documents provide interesting evidence regarding the occurrence of hurricanes in the Atlantic. As reported by Millás (1968), the first reported hurricane in the Caribbean basin occurred on June 25th 1494 at Isabella, Santo Domingo. The Spanish were soon familiar with these phenomena. In fact, according to the outstanding Cuban anthropologist, R. Ortiz (1984), Columbus arrived in Hispaniola on June 29th 1502 but was not allowed to dock by the Governor although he claimed that he was in danger from an approaching storm. He also advised the authorities that the fleet, ready to depart for Spain, should not leave port.

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Nevertheless, the fleet left and was destroyed by a hurricane, whereas Columbus weathered the storm and survived. Ortiz suggests that Columbus learned about hurricane signs from the native seamen. One of the first detailed descriptions of a hurricane is provided by Fernández Oviedo (1535). He wrote two pages describing a hurricane that struck Hispaniola on August 3rd 1508, which are transcribed by Millás (1968):

‘... Nearly at noon, that suddenly so much wind and water together commenced, and such an excessive amount of both of these things, that in this city of Santo Domingo all buhios or straw houses were demolished and even some (houses) of stone were greatly damaged. And in the same way, in many villages of this island the same thing happened, and on account of this cause, the country suffered very much, and all estates were destroyed. And the village called Buena Ventura (Good Luck), the hurricane demolished it to the level of the ground, and left her in such a way that it would be better to say Mala or Triste Ventura, or Derribada Ventura (Bad or Sad Luck or Destroyed Luck) for many that were destroyed in it. And what was more sorrowful was that in the harbour of this city more than twenty ships and caravels and other vessels were lost. . .’

The document continues by providing a description and the impacts of the hurricane. Oviedo provides more first hand descriptions in chapter III of book VI, [see case 6 of the 16th century in Millás (1968)] while in book L, chapter XXVII, yet more descriptions are included, but from indirect testimonies. Interestingly, in addition to the descriptions of single hurricanes, we also find references to extended periods of relative activity and inactivity on the part of hurricanes that may be considered evidence for the existence of multi-decadal variability in the 16th century similar to that observed in the modern hurricane records. Thus, according to B. de las Casas (1560) and Fernández Oviedo (1535), the hurricanes had ceased in Hispaniola once it had been Christianised (the island was conquered by the Spanish in 1495). Oviedo describes the situation as follows:

‘it is thought by the devout Christians and is demonstrated by the experience that the hurricanes have ceased since the Holy Sacrament has been offered in all the churches and monasteries of this city and island. . .’

According to Ortiz, when the previously described intense hurricane of 1508 struck the islands, it was thought that it was due to God’s rage, because the Indians said that hurricanes were very scarce before the Spanish had arrived. The latter, in turn, believed that it was due to their sins with the result that they started to build churches across the island. According to de las Casas (1560), the hurricanes were infrequent at the beginning of the conquest, but later they occurred:

‘within recent times, every year and make ravages and destructions over sea and land . . . and the causes are our new and abundant sins. . .’

Another proof of interdecadal variability is provided by the French Jesuit Du Tetre (1667) when describing the history of the French West Indies:

‘... before, they occurred, I will say, every seven, or five years, but, since the West Indies were inhabited by Europeans they occur more frequently and usually after the end of July until mid-September’.

Some differences in the hurricanes seasonal cycle were also noted by Jesuit B. Viñes (1895), one of the outstanding names in the analysis and forecast of hurricanes in the Belen observatory of Havana, the ritual prayer *Ad repellendas tempestates* had been offered since ‘*immemorial times*’ in Puerto Rico to deter storms during August and September, while in

Cuba it was offered only in September and October, coinciding with the periods when the hurricanes were more likely to occur.

These few cases provide a small sample of the abundant information available on Atlantic hurricanes and contained in Spanish documents. Unfortunately, these documents have not been extensively used to reconstruct hurricane occurrence. In fact, most of the reference works (Poey 1862; Millás 1968; Fernández-Partagás and Díaz 1996) were developed using documents kept in the various American archives, without exploiting Spanish sources.

The Spanish government of the American territories was highly bureaucratic, producing an extraordinary number of documents. In fact, the main Spanish depository, the *Archivo General de Indias*, General Archive of the Indies (AGI), keeps more than 8 linear km of shelves with these documents. Over the past years we have started to recover hurricane information from different Spanish archives, including the AGI, *Archivo del Museo Naval* (AMN, Archive of the Naval Museum) and the *Archivo General de la Armada* (AGA, General Navy Archive). To date, the results of this search have allowed us to identify 70 previously unreported hurricanes and produce a database freely available on the web (www.ucm.es/info/tropical), which can help to refine our long-term view of hurricane behaviour (García-Herrera et al. 2004, 2005a). The information in these documents dates the occurrence of individual hurricanes and also provides information on their impacts and the prevailing meteorological conditions during the hurricane season.

The aim of this paper is to show how documents kept in Spanish archives are relevant for the search for hurricane evidence, problems involved in gathering this evidence, and the types of additional information they contain.

2 Material and methods

This paper draws on the results of two years of systematic studies in the AGI, the documents of which contain evidence of hurricanes and their impacts. Details on the organization and content of the AGI have been described in García et al. (2001). In summary, the AGI is administered in 16 sections, each of which contains a variable number of ‘bundles’, ranging between 48 and 18760. We have examined 424 such bundles and found a variety of document types from different locations. Table 1 lists the sections that have been searched. The research team embraced expertise from two areas: two historians with previous experience in the searching and analysing documents in the AGI, and four climatologists/meteorologists. A pilot study produced an opportunity for greater mutual understanding between the two groups; the historians could understand what climatologists demanded and these, in turn, could better interpret the documents’ contents. Additionally, it provided guidelines on the type of information to be searched and the documents and sections most likely to contain hurricane evidence. As a consequence, the search was mainly focused in the following sections: *Gobierno* (Government), *Contratación* (Contracts) and *Papeles de Cuba* or *Cuba* (Cuban Papers).

The Government section is by far the largest in the AGI. It covers the period 1492–1898 and contains 18760 bundles with information on the government of the *Consejo de Indias* (Council of the Indies). It is divided in two large groups; the documents from the *Audiencias* (Courts), which are organised geographically, and those in the subsection *Indiferente General* (General Miscellaneous), which contain documents that are not related to any specific territory. Each *Audiencia* corresponds also to an AGI subsection. For this paper the most relevant are Santo Domingo and Mexico. The first one has papers from Santo Domingo itself, Cuba, Puerto Rico, Jamaica, Florida and Louisiana, all dated between 1518 and 1852. The Mexico section

Table 1 Distribution of the bundles examined according to the AGI sections/subsections

AGI section	Existing bundles	Examined bundles
Gobierno (Government), Subsection Santo Domingo	2720	132
Gobierno (Government), Subsection México	3196	100
Gobierno (Government), Subsection Indiferente General (General Miscellaneous)	3297	49
Contratación (Contracts)	6335	41
Papeles de Cuba (Cuban Papers)	2967	38
Others: Patronato (Patronage), Justicia (Justice), Correos (Mail), Escribanía (Notary), Government subsections of Guatemala, Santa Fe and Panama	8000	64

contains information on Mexico and Central America for the period 1519–1856, and here is to be found most of the correspondence of the colonial authorities in the form of letters and documents from Viceroy, Royal officers and individuals. These papers contain information on claims and compensations after natural disasters and incidents that had an affect on maritime trade.

The Contracts section is the second largest in the AGI and contains documents from the *Casa de Contratación* (House of Trade) for the period 1492–1794. In this section, the emphasis was placed on the documentation relating to trade between the Americas and mainland Spain, particularly from the fleets that sailed annually between them as well as the reports from admirals and fleet commanders.

The section Cuban Papers contains the volumes from the *Capitanía General de Cuba* (Captain General of Cuba) for the period 1712–1872. They consist mostly of papers from the Governors and include documents from Cuba, Louisiana and Florida and they complement the coverage provided by Contracts section. In this section, the official correspondence between governors and the captains general was selected for study, as it should contain most of the information on the impacts of natural hazards.

Following the pilot study the work was organised as follows: the historians searched documents in the AGI and produced literal transcriptions of those items that potentially contained evidence of hurricanes. These transcriptions were added to a working database. Two meteorologists then independently examined the transcriptions and decided if the report included information on a hurricane, a storm, or any other type of phenomena. When discrepancies occurred, a joint analysis was made including a third member of the team. After this, all the reports containing information on hurricanes and storms were included in the final database. The content of the database and the criteria used the analysis of the transcriptions can be found in García-Herrera et al. (2005a). As a result of these eyewitness accounts, we identified 134 hurricanes, 70 of which were previously unreported.

3 Hurricane evidence

In order to show the complexity of the search made in the AGI and the diversity of the documentary material that was used we present the following case studies:

1. The hurricane that occurred on November 6th 1605, in the Caribbean Sea (Bajos de las Víboras and Serrana-Serranilla).
2. The hurricane that occurred on November 1, 1774 in Havana.

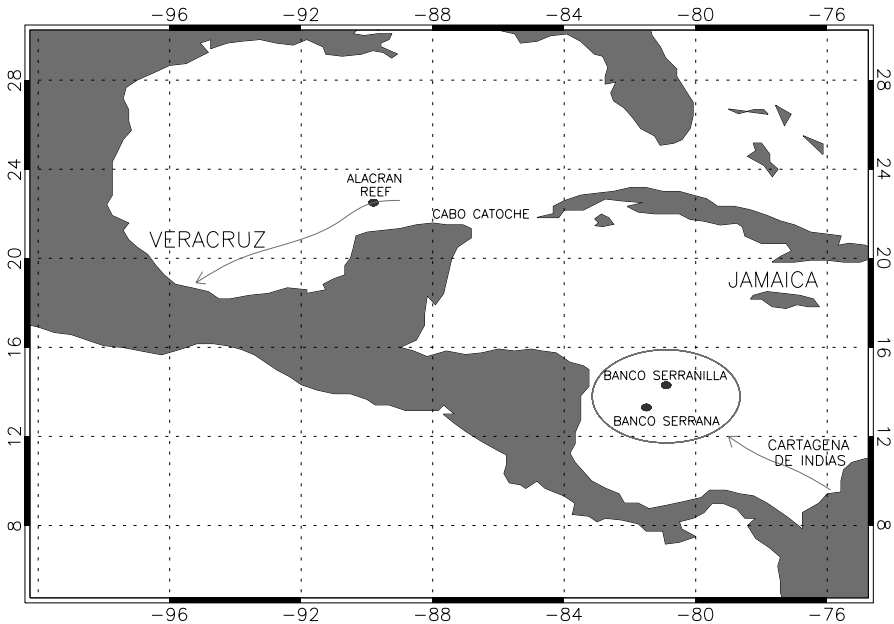


Fig. 1 Location of the storms reported in cases 1 and 3

3. The hurricane that struck the Spanish fleet in the Caribbean Sea on September 20, 1600
4. The hurricanes that occurred in Louisiana on 10 and 31 August 1794.
5. The hurricane that struck Havana on August 27–28, 1794.

Cases 1 and 2 are reported in numerous documents kept in different sections of the AGI. They illustrate the difficulty of identifying all the evidence for a hurricane when it is spread across a range of sources. Case 3 provides an account of the occurrence of a hurricane embedded within an episode of a polar outbreak, a not infrequent meteorological event in the area. Cases 3 and 4 identify two entirely new storms. Case 5 is one of the earliest descriptions of a hurricane that includes twice-hourly instrumental observations. In all cases, we present the documentary evidence and discuss them alongside other chronologies.

3.1 Case 1: November 6th 1600, Vívoras-Serranilla

On November the 6th 1605, at the shallows of Las Viboras, a storm surprised General Luis de Córdoba's *Armada* and Fleet arriving from *Tierra Firme*.¹ on a journey from Cartagena de Indias to Havana. The fleet had left Cartagena on November 1st 1605 and traveled without problems until the night of November the 6th when, at fifteen and a half degrees of latitude, between the shallows of la Serrana and la Serranilla, a hundred leagues² from the port of Cartagena, the fleet was struck by the storm. Figure 1 shows the Vívoras–Serranilla area. Table 2 presents the transcriptions of all the documents that we have identified as containing reports on this event.

¹ Tierra Firme was the name given to present day Colombia and Venezuela.

² The league was defined as the distance that a man or a horse could walk in an hour. The marine league was approximately equal to 5.55 km.

Table 2 Report on the hurricane that occurred during November 1605 in the Gulf. The columns provide: the document signature within the AGI, the author, date and purpose of the document and a transcription of the relevant content

Document	Author	Date (M/D/Y)	Purpose	Transcription
Contratación 4419, R. 2	Gerónimo de Torres and Portugal, General of the Fleet.	1606	Report of incidents along the journey.	"... and a gale in the Víboras and Serranilla area dispersed the fleet and such galleons arrived to the city of Cartagena almost ruined..."
Contratación 4419, R. 3	Diego Ramírez, damages received by the ships of the fleet.	1606	Report on the wealth arrived in the Tierra Firme fleet.	"... with a gale that struck the said fleet in the shallows of Víboras and Serranilla, the flagship and admiralship were lost together with two other galleons..."
Contratación 4803, N. 34.	Felipe Manríquez, infantry captain	9-22-1606	Report of incidents along the journey.	Statements of the crew: "... and coming from the city of Cartagena to Havana with the royal fleet commanded by general Luis de Córdoba y Sotomayor, in the Víboras and Serranilla area, on Sunday night, November the 6th of the past year of 1605, a storm and gale of sea and heavy wind struck them... and in the gale and hurricane four galleons were lost, including the flagship and the admiral's ship. I worked the whole night, encouraging the people with all the work required in such a cruel gale..."
Indiferente 111, N.37.	Juan de Haro, infantry captain	1622	Relationship of services and request of benefit.	"In the year 1605 being embarked in the galleon San Gregorio... where I was Captain and commander, a gale struck in the shallows of Serrana and Serranilla, and the flagship and admiralship were lost together with three other galleons and two pataches..."
Indiferente 428, L.32, IM.265-266	Governor of Cartagena	8-12-1606	Communication to the King.	"The fleet left this port of Cartagena commanded by general Luis Fernández de Córdoba on November the first of the past year. On the 6th he experienced such a great storm that two galleons and a ship arrived in Jamaica, and a galleon to this port, because the flagship and admiral's ship and two more galleons are missing..."

(Continued on next page)

Table 2 (*Continued*)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Indiferente 749	Indies Council	3-2-1606	Report of the incidents along the journey.	<p>“That on the 6th of this month, in the area known as Viboras and Serranilla, around 100 leagues from this port, going to Havana, they had such a violent south wind that they were in a bad condition and were forced to arrive to this port . . . and the cited witnesses said that on Sunday November the 6th, at night, being in the Viboras shallows, and the weather so bad, they ran the risk of sinking in the shallows. The fleet veered towards east. . . and along the route we had such a heavy wind that it broke the foremast and the mizzen was also damaged. . . and it was a miracle that the galleon did not sink. . . it had 17 feet and a half of water over the cockpit. . .”</p> <p>“That the said galleon left the port of Cartagena towards this city of Havana together with the others on All Saints Day, Tuesday, November the first of the past year and the 6th of this month, Monday night . . . the wind blew so strong that we were forced to cut the mainmast and we had 17 feet of water on the cockpit. . .”</p> <p>“At midnight the southeast wind increased and jumped to the north with much more fury. And, at dawn, they lost track of the rest of the fleet and decided to return to Cartagena, where they arrived on the 18th, with the galleon almost destroyed. . .”</p> <p>“Tuesday, All Saints Day, we left port with fair weather and on Sunday, at 15 degrees and a half, between the shallows of Serrana and Serranilla, the southeast wind blew so strong that it destroyed the foremast sail. At eleven in the night, it was very furious and threatening, and we asked for axes to cut the mainmast, but it was broken by the wind. . .” At two in the night the wind suddenly jumped to the north, with great rigor and strength.”</p>
Indiferente 749	Several crewmen	12-30-1606	Report of the incidents along the journey.	

(Continued on next page)

Table 2 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Indiferente 1859	Francisco de Tejada y Mendoza, president of the House of Contract	10-10-1617	Rescue inquiries.	“It has been said by certain people that one of the galleons lost in the year 1605 has been found in the coast of Honduras, and this galleon is the flagship that, due to the great gale, had run aground and was broken into pieces...” “...I have been informed that any of the lost galleons could have reached this area from the Serrana and Serranilla, where they were hit by the storm, within two days...”
Indiferente 1868, Fol. 494 – 495.	War Board.	2-15-1616	Commendation	“And the same year (1605) the storm struck the fleet commanded by Luis de Córdoba, in the shallows of Serrana, VÍboras and Serranilla, where four galleons were lost, he (the admiral Tomás de Larráspuru) worked very hard and due to his diligence the galleon in which he sailed could survive...” “... the past year of 1605, the fleet leaving the port of Cartagena towards Havana, in the VÍboras area, the fleet had such a great storm and hurricane that it almost destroyed them and the galleon San Martín y San Gregorio were left without rigging nor masts...we arrived in Jamaica, after 17 days.”
Indiferente 2682	Captain Juan Rodríguez de Reinoso, silver master	2-5-1609	Report of incidents along the journey.	“And in the year five (1605) when the four galleons and the general Luis de Córdoba and the admiral were lost with the gale, the galleon in which he travelled was saved because of the great diligence, work and care that he used to cut the main mast and help in other important matters...”
Lima 148	Captain Sebastián Barba Guerrero	1618	Relationship of services and request of benefit.	“And when we were hit by the storm of November the 6th in the VÍboras area, that night he behaved bravely...”
Lima 148	Juan de Haro, infantry captain	11-1-1606	Commendation	“... and in the storm that we had on November the 6th of the year 1605 in the VÍboras area... and after being dispersed, we reached Jamaica...”
Santa Fe 110, N.51.	Juan de Haro, infantry captain	11-23-1634	Relationship of services and request of benefit.	

(Continued on next page)

Table 2 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
SANTA FE 110, N.51.	Francisco de Corral y Toledo, Captain General of the fleet	11-23-1634	Relationship of services and request of benefit.	"...and in the year 1605 he embarked in the galleon San Martín, that arrived in Jamaica after the hurricane that struck the fleet commanded by general don Luis de Córdoba ..."
SANTO DOMINGO 129.	D. Francisco de Corral y Toledo, General of the Fleet	7-27-1606	Report of incidents along the journey.	"... I reported to His Majesty of the shipwreck that occurred to Luis Fernández de Córdoba and the four missing galleons as a result of the gale that occurred on November the 6th in the Vboras area, between Serrana and Serranilla."
SANTO DOMINGO 129.	Pedro de Valdés, Governor and Captain General of the Island of Cuba.	12-14-1606	Rescue inquiries.	"... he sent two frigates to search the area where the storm occurred and to look for them or for traces of them."

Its effects are reflected in the abundant documentation that circulated between the colonial authorities and Spain. Sixteen documents have been located in various sections and subsections of the AGI, which is an indication of the magnitude of this storm. These letters, mostly sent to the Council of Indies as the main office in charge of the administration of the American territories and the *Casa de Contratación* (House of Trade), which was responsible for commerce and travel to the colonies, include: reports from witnesses present during the storm, such as captains, pilots, masters and the crew of the galleons that experienced the hurricane; descriptions of the voyage made by the authorities shortly after the ships docked in port, and requests in recognition of distinction and service made some years later with the object of receiving some sort of Royal benefit.

These documents allow us to infer the intensity of the storm, especially useful are those of the declarations of the ships' crews, for example A.G.I. Indiferente 749:³

'the southeast wind blew so strong that it destroyed the foremast sail. At eleven in the night, it was very furious and rigorous, and we asked for axes to cut the mainmast, but it was broken by the wind (. . .). At two in the night the wind suddenly jumped to the north, with such a rigor and strength that it also broke the foremast'

The storm's intensity can be gauged to be a hurricane by the sinking of four galleons, including the flagship and the Admiral's ship and two other boats. The remains of the sunken vessels could be found on the coast of Honduras for a long time. The rest of the ships had their sails torn and masts broken. All were close to being shipwrecked and without leadership and tried to change the route of their voyage towards a closer port. Some of the ships separated from the main fleet and managed to reach the coasts of Jamaica and Cartagena of the Indies, attributing their survival to divine intervention.

It is interesting to note that the collection of this information required searches in five sections/subsections, namely Santo Domingo, corresponding to the main islands, Santa Fe to *Tierra Firme*, Lima, General Miscellaneous and Contracts. To date no other hurricane that we have identified in the Spanish archives is reported in so many units of the AGI.

Discussion

This hurricane is included by Millás in his chronology (Millás 1968) as case 4, '1605 Serranilla Bank, Western Caribbean Sea', but he could not identify its date of occurrence. The information that we recovered allowed us to date the hurricane with precision and supplied also a very detailed description of its impact. We suggest the main reason that we could better characterize this storm results from the fact that Millás used secondary sources only, while we employed primary information that provides a richer and more precise description of the hurricane.

3.2 Case 2: November 1st 1774 Havana, Cuba

Twenty-five documents related to the occurrence of this hurricane have been located among the bundles of the Government Section of the AGI (*Audiencia de Santo Domingo and Papeles de Cuba*). Their content and characteristics are described in Table 3. Most accounts come from captains of different *partidos* (counties), each of whom produced reports on the damage

³ References to manuscript sources in the *Archivo General de Indias* are denoted by the initials AGI, followed by the name of the section of the Archive where the manuscript is located, and a number identifying the *legajo*, or bundle, to which the manuscript belongs.

Table 3 As in Table 2, but for the hurricane that occurred on November 1st 1774 in Cuba

Document	Author	Date (M/D/Y)	Purpose	Transcription
Cuba 1164, N.64	Marquis de la Torre, Captain General of Cuba.	11-06-1774	Instruction to obtain information on damages.	“Being required to have individual reports of the ravages and damages produced in this district by the gale of the day first of the present month, I ask you to inform me as soon as possible of all the damages that occurred in the county under your command, including all the definite news relative to houses, fruits and livestock.”
Cuba 1165, N.82.	Nicolás de Cárdenas, captain of the San Juan de Jaruco county	11-18-1774	Information and report on damages.	“Evaluate the ravages caused by the hurricane in the church of San Juan de Jaruco...”
Cuba 1166, N.74	Marquis de la Torre, Captain General of Cuba	11-07-1774	Acknowledge receipt of the report on damages and commission for the repairs	“Your letter dated the second of this month reports on the damages that occurred to the bridges of Cojímar and Bacuranao due to the gale suffered on the day first and I will give the corresponding orders for their repair.”
Cuba 1166, N.96	Marquis de la Torre, Captain General of Cuba	12-01-1774	Instruction to obtain information on damages	“Being needed to repair the damages in the barracks of the cavalry volunteers regiment in different counties close to this city due to the gale of the first day of the past month, I give commission to take the required procedures (?). . .”
Cuba 1166, N.97	Marquis de la Torre, Captain General of Cuba	11-07-1774	Acknowledge receipt of the report on damages.	“... of the ruins caused by the gale of the first day of this month in the barrack built on the beach of Bacuranao”.
Cuba 1189.	Captain General of Cuba, Marquis of Torre Tagle	11-15-1774	Acknowledge receipt of the report on damages.	“... and after visiting this county following the hurricane which started on the 31st of the past month and ended at ten in the next morning, I am very satisfied with your report on the damages which occurred to factories and farms, with no remarkable disasters...”

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Table 3 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Cuba 1189.	Francisco José de Rojas Sotolongo, captain of the Arroyo de los Naranjos county.	12-07-1774	Efforts made to repair damages.	“Your letter on the reconstruction of the barrack ruined by the hurricane of October 30th...”
Cuba 1190, Fol.35–37	Dionisio Joseph Arango, captain of the La Prensa county	11-13-1774	Report and description of damages.	“... and the damage extends to the loss of a third of the rice which was ready to harvest and the banana plantations which were totally destroyed. Yuccas and yams, according to the farmers, will be harvested almost rotten. The vegetable gardens have lost all their seedbeds and vegetables. Some of the houses were damaged... and in the ranch of Don Nicolás Gómez de Castro, a guano house collapsed and killed a slave...”
Cuba 1190, Fol.111	Miguel Díaz, captain of the Luyano county.	11-14-1774	Report and description of damages.	“Relating to the damages caused by the gale of the first day of November... In the ranch of doctor Don José Palomino... the kitchen was completely knocked down. In others... the houses were destroyed except for the walls. In the barracks the damage was very severe due to the wind. In the ranch of Don Pedro Morales it knocked down the houses. In that of Don Francisco Puebla a bower was destroyed. In that of Don Lucas Yntenian the mill house and a kitchen were destroyed. In the tile factory of Don Gregorio Ravelo most of the houses and buildings were unroofed. The house of Francisco de la Rosa was completely ruined. A kitchen was destroyed in the ranch of Don Juan de Genes. The bridge on the Río Hondo was destroyed by the river, the royal road being impassable... the rice was almost harvested, and a third was lost. The yuccas have not been badly damaged because the rain stopped. For the same reason, the corn has survived. The fruit trees, including coconut palms, have fallen down”.

(Continued on next page)

Table 3 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Cuba 1190, Fol.228	Gabriel Alberto, captain of the Arroyo de Arenas county	11-20-1774	Report and description of damages.	"... we only find the total destruction of banana plantations. The yuccas had some damages. The livestock was harmless. In the factories, only ... a kitchen was completely ruined. The corn and rice have been poorly damaged..."
Cuba 1190, Fol.322	Antonio José Barreto, captain of the Guanaja county	11-13-1774	Report and description of damages.	"... that the gale occurred on the first did not ravage other parts of my county but did cause the complete destruction of the banana plantations. The other fruits, livestock and houses have received some damage. And I am informed that the hurricane struck only my county; those located to the leeward only recorded rains."
Cuba 1190, Fol.411	José Leandro Ramírez, captain of the Tubajay county	11-16-1774	Report and description of damages.	"... and the houses have not been damaged, but the fruits were damaged because in the ranches the bananas, corns and rice were ruined as they had not been harvested and most of it has been lost. The sugar factories have also been damaged because the canes had been torn down. After the hurricane had passed, I cleaned the road which had collapsed because of many fallen trunks"
Cuba 1191, Fol.45	José Antonio Bimelo, captain of the Guatao county	11-14-1774	Report and description of damages.	"... most of the ridges of the houses were destroyed and in the farms the bananas were completely destroyed and the sugar cane knocked down and the other fruits, root crops such as the yucca had some damage due to the excesses caused by wind strength. Happily no individuals have died and there is no news of damage to the livestock."
Cuba 1191, Fols. 45r-v	Francisco Javier Estévez, captain of the Bauta county.	11-21-1774	Report and description of damages.	"... and the guano houses were damaged in the ridges, which were blown down by the wind. The tile houses were very slightly damaged, with only some tiles being lost. In the farms the bananas were completely torn down only some located in places sheltered by high mountains survived. The canes in the sugar factories have been badly damaged by wind and water; the rice was ruined... the yuccas have suffered severe damage... the lands have few hopes of growing fruits. Rivers and lagoons have suffered excessive flooding, and the Ariguababo ranch was inundated, with its plains covered by water, preventing use of the royal road, where seven hogs drowned..."

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Table 3 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Cuba 1191, Fols. 207r – 208r.	Hilario José de Aranda, captain of the Jaruco county	11-03-1774	Report and description of damages.	“My lord, after the storm that occurred on the 1st of this month, I went to see the ravages caused in this county and give the orders to open the roads to the traffic of people and animals. I also saw 11 houses knocked down, with universal damage to bananas, rice, corn and other vegetables that was such that I have to consider the plight of the poor residents afflicted. In addition, I inform you of the regrettable ravages which occurred in the church of this city. The sacristy fell down completely with its timber roof. More than half of the body of the church main building also fall down, with additional damage to walls, windows and the main doors... Two of the houses were partly destroyed, but are now repaired.”
Cuba 1191, Fols. 358r-v.	Francisco Blandino, captain of the Regla county	11-01-1774	Report and description of damages.	“... there have been neither disasters nor injuries in the navy. The schooner in which the Indians arrived went onshore in the beach due to the fierce winds and it hit and destroyed another schooner and the boats have been damaged... In the house of Mayorazgo (...) one of the walls of the room used by the secretary has fallen and may ruin the whole building...”
Cuba 1192, Fol.288–289.	Vicente del Castillo, captain of the Cano county.	11-12-1774	Report and description of damages.	“... the canes in the ranches of the sugar factory have been badly damaged, all of them flattened. Most of the bohios of the black people were destroyed. The corn, mostly harvested, get soaked in the houses, because the ridge tiles were blown away. Half of the rice has been lost, the fruit devastated, most of the trees uprooted, and others have lost their branches. I have never seen the banana plantations so badly damaged. The well built factories were not damaged, nor the animals...”
Cuba 1192, Fol.44.	Army quartermaster-general Nicolás José Rapún.	11-13-1774	Report and description of damages.	“... it knocked some houses or bohios, those poorly built and previously damaged; among the fruits it crushed corn, rice and cane... the trees lost all their fruit, but the livestock was unharmed.”

(Continued on next page)

Table 3 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Cuba 1193, Fol. 113r-v.	Vicente de Meza, captain of the Managua county.	11-13-1774	Report and description of damages.	“... In the parochial church a window blew in and the S. Joseph altar was partly damaged. In the village a house was completely blown down, the rest partly damaged, and all but two of the tobacco houses were destroyed. The fruits were ruined except in some lowland areas, where the corn had been harvested, the yuccas deteriorated, the bananas and rice lost. The mountain areas suffered badly, with fallen palms. The factories were badly damaged and some buildings destroyed and the comes lost. In the San Nicolás de Managua factory, seven oxen drowned. The wind stayed violent for 5 hours.”
Cuba 1193, Fol. 314r.	Miguel de Almenteros y Saldívar, captain of the Alta Gracia county.	11-23-1774	Report and description of damages	“... there was wind and flood waters, but the heavy wind seemed to blow very high [sic], because no building was knocked the only damage being to some banana trees...”
Cuba 1194, Fols. 417r-418r.	José Morejón, captain of the Buenaventura county	11-03-1774	Report and description of damages.	“... and having experienced in this territory a strong gale the night of the past 31st, I visited the county to report to you any news... and I have found out that some buildings only were ruined and others damaged, but without casualties, nor any major disasters... The roads connecting these ranches have been fully closed...”
Cuba 1195, Fols. 252r-253r/261r.	Sebastián de la Cruz, captain of the Güines county.	11-03-1774	Report and description of damages.	“... the 1st day of the present month this county experienced a strong hurricane... The tobacco, which had been sown, according to knowledgeable people, has been lost and the seedbeds, rice and part of the corn have suffered heavy damage. Similar ruin has occurred in 266 plantations of this county. Around 20 tobacco houses remain in operation... Most of the other buildings were knocked down, but only one of the slaves of the senior priest died” Damage caused by the gale: “ Houses: 41, tobacco buildings: 240, kitchens: 46, passages: 24, pigsties: 36, tobacco bushes: 273.300, corn fanegas: 1.200, rice: 9.000.”

(Continued on next page)

Table 3 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Cuba 1201, Exp.43, N.70, Fol.388–389.	Esteban de Arostegui, captain of the Calvary volunteers regiment of Havana	11-18-1774	Report and description of damages.	News of the damage caused by the storm on the 1st of November 1774 in the barracks of this regiment: "Quemado barrack: part of the fence. Tubaxas barrack: . . . such storm has ruined part the factory. . . Guatao barrack: part of the fence. San Miguel barrack: the kitchen partly damaged. Luyano barrack: part of the roof. Santiago barrack: nothing. La Prensa barrack: part of the fences. Santa María del Rosario barrack: the partition walls destroyed, some keys unlocked (keystones shifted?), several supports moved, some bars broken, kitchen and stable destroyed. Río Hondo barrack: before the storm it was almost ruined, and we had a project to build a new one of rubblework, today it is uninhabitable. Jesús del Monte barrack: the back of the barrack broken, shelves torn off, and bedsteads broken."
Cuba 1201, Exp.43, N.92, Fol.344–345.	Marquis de la Torre, captain general of Cuba.	12-07-1774	Acknowledge receipt of the damages report.	" . . . The ravages made in the barracks of the regiment by the gale that occurred in the 1st day of this month are currently under repair."

(Continued on next page)

Table 3 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Santo Domingo 1211, N.770.	Marquis de la Torre, Captain General of Cuba.	11-08-1774	Description of damages and claim for compensations	<p>“... the first day of November, at 1.30 am the wind, that had been running from the northeast since the previous afternoon, grew stronger. It seemed the start of one of these dreadful gales that usually occur in these windward islands. At two there was furious wind accompanied by continuous and heavy rain. It blew from the northeast, passed to the north, then north-northwest and run the whole morning towards northwest, becoming more violent, until 8.30, when it started to calm down. The ravages which have been identified in this city until now have not been very great, because the buildings have not suffered, but the houses covered by guano have been mostly unroofed. . . The damages have been greater in the Bay: two schooners and a yacht were driven onshore against the San Francisco wall. The packet boat Rey San Carlos drove against the Machina pier, but has been freed without damage, only her boat and a schooner caught between her side and the pier were destroyed. Close to the Luz wall, a canoe sank and a schooner was stranded. Two schooners were stranded against the Paula bastion, one of them sunk. Another one stranded in Cayo de Cruz. The frigate Rey Caíman and the merchant ships Amazonas and Misericordia, the packet boat Cortés, the brig El Brillante and two schooners anchored in Tallapiedra were stranded in the coast of Atares, and the frigate La Perfecta, a yacht, a guayro and a schooner sunk in the same place. In the <i>Contaduría vieja</i> pier, three schooners were stranded. In Regla a schooner and a canoe were stranded. It is known that the merchant brig San Juan Nepomuceno was destroyed in the Batavano anchorage, and 5 men of the 15 of the crew drowned. A schooner and a boat sunk in Bayamo. A schooner coming from Cuba with tobacco cargo was lost in Cayo de Mono. These are the disasters occurred in the navy. They are much less than initially believed, because all the stranded ships could be floated again. The arrival of the mail ship from Veracruz and a ship from New Orleans, reporting that the storm had not been so strong at 7 or 8 leagues from the port have reduced our concerns for the situation of the king frigates Dorada and Volante, which had left for Cumaná and Cartagena and were close to the Morro on the 30th afternoon. The Cartagena mail has brought complete relief, because it met both of them when following the route for the Bahama Channel. We received fatal news from the countryside. The buildings have been badly damaged, especially in the leeward counties. The sugar cane has suffered heavy damage, as well as tobacco, rice, bananas and other fruits. This information needs to be confirmed, because in these events people are usually ready to believe all disastrous news. The weather continues fair and peaceful since the 2nd, which helps in the repair of the ruins.”</p>

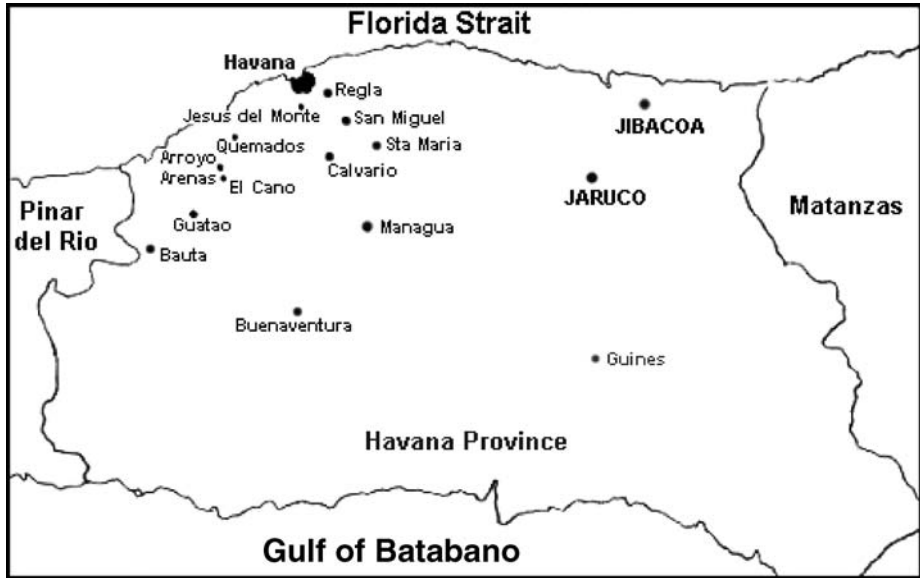


Fig. 2 Counties affected by the hurricane of November 1st, 1774

in their districts and following orders from the Marquis de la Torre, Captain General of Cuba, who needed to report to the Indies Council to receive economic help for the reconstruction of the island. Consequently, this case mostly has information on the impacts on farming and on damage to military installations, roads and bridges.

The documents allow us to reconstruct the chronological sequence of the passing of the hurricane through the city of Havana using the witnesses' testimonies, such as:

'the first day of November, at 1.30 am the wind, that had been running from the northeast since the previous afternoon, grew stronger. It seemed the start of one of these horrible gales that usually occur in these windward islands. At two it was furious wind accompanied by continuous and heavy rain. It blew from the northeast, passed to the north, then north-northwest and run the whole morning towards northwest, getting more and more violent, until 8.30, when it started to calm down.'

By November the 2nd the weather had become fair and pleasant (AGI Santo Domingo 1211, N.770). The other reports, made by independent authors, show two main facts:

- The storm affected only the western part of Cuba, described as the windward side in most of the reports. Districts considered to be on the leeward side (Alta Gracia and Guanaja) seem to have suffered only minor damage, mostly in the banana plantations, and the damage was mainly from rain and not wind. Figure 2 shows the location of the affected counties.
- Even when abundant damages are reported, they are not considered to be very heavy by the reporting individuals. The impacts are mostly focused on farming, especially in the banana plantations, and in the poor buildings (guano houses). Only two casualties are reported, both of them due to fallen buildings (AGI Cuba 1190 and Cuba 1195). Livestock seem to have been unharmed and no claims of severe or irrecoverable damage are found. Thus, we can assume that it was a low intensity hurricane when striking Cuba.

Discussion

For the year 1774, Millás (1968) reports a hurricane in Cuba, but he is not able to date it, or to identify the affected area. Millás bases his assessment in Fernández de Castro's (1871) book on the hurricanes that occurred in Cuba. In this book there is a reference to a report of the Marquis de la Torre on the *strong hurricanes suffered in the years of 72 and 74*, but no more information is reported. In a recent revision of Poey's chronology, Chenoweth (2006) identifies this hurricane as number 121, (see his Table 4), affecting *Cuba to north of Bahamas to 30N 67W*. This assessment is based (Chenoweth personal communication) on a variety of logbooks, newspaper items and the Thistlewood record of Jamaica (Chenoweth 2003). In fact, the records contained in Table 3 are the only ones available for land areas of Cuba, since only a newspaper account of a ship that encountered the hurricane at sea between Havana and Matanzas was previously available.

In this case the AGI documents allow us for the first time to identify the land area affected by this hurricane and to make an initial assessment of its intensity.

3.3 Case 3: September 1600

During the month of September, the Mexican coast of the Gulf of Mexico, between Cabo Catoche and Veracruz, registered various windstorms that disrupted the arrival of the ships of the New Spain fleet, sailing from Spain to Veracruz. Throughout the month of September and the Channel of the Bahamas. We have identified eight documents from the AGI, containing information, related to these incidents (they are summarized in Table 4). Most were written by personnel of the fleet from General Pedro de Escobar Melgarejo to clerks, and they include direct testimonies from masters, sailors and pilots.

On the 4th of September, General Pedro de Escobar Melgarejo, on board the Flagship of the Spanish fleet, wrote from the *Sonda de los Alacranes* (Alacran reef, see Fig. 1) announcing that he had remained with his fleet awaiting an auspicious time to arrive at port. On the 12th a strong west by northwest wind surprised the fleet, and boats were obliged by the fierce weather to separate from formation. The next day, a strong north wind blew and continued until the 17th. On this day, winds changed and a great west-by-southwest wind began twenty leagues from Veracruz, which quickly became a violent hurricane. On the morning of the 18th witnesses refer to having survived a terrifying storm, "*never thought nor imagined before*" that was caused by the hurricane's north wind. On the 21st of the same month another very strong storm from the north and continued until the following evening. The 26th of September the north wind began again, blowing over La Cabeza, a shoal two leagues from the port of San Juan de Ulúa.⁴ This wind, which lasted the entire following day, greatly complicated the entry of the ships into port. Witnesses say that it lasted until the first days of October. Because of these storms and hurricanes, only twenty-nine of the forty-three ships that composed the fleet of General Melgarejo, reached the port of San Juan de Ulúa. Two of them arrived at Campeche, forced by the winds, ten were beached on the coast and two sank. The human and material losses were considerable. Due to the violent weather the crews had to throw much of the cargo overboard, leaving half the holdings in the sea. The lists of the dead are not precise, but we know that from the ship the Catalina, which "*the sea swallowed,*" that only the master and two or three seaman were saved.

⁴ San Juan de Ulúa was the port of Veracruz.

Table 4 As in Table 2, but for the storm and *Nortes* episode that occurred in 1600

Document	Author	Date (M/D/Y)	Purpose	Transcription
Contratación 5732, N. 1, R. 1.	Alonso de Lerma, master	2-02-1601	Litigation, damage claims	<p>“... in the Villarrica spot, a violent storm occurred, never thought nor imagined possible, caused by a <i>Norte</i> wind and violent hurricane, on September 17 of the past year of 1600. And the cited Manuel Díaz departed this world when the said ship suffered damage in many parts, so that she foundered, with 5 feet of water over the cockpit, asking God’s mercy, and the passengers and children, and even the seamen crying, and screaming enough to move stones to compassion. . . .”</p> <p>“In the Villarrica area, 20 leagues from land, in the past September month, a great <i>Norte</i> wind storm occurred and lasted more than 20 days. . . being of the highest winds and seas.”</p>
Escribania 167 A.	Pedro de Escobar Melgarejo, Army General	10-03-1600	Report of incidents along the journey	<p>“... on the 27th of the past month, I entered the port of San Juan de Ulúa with 28 ships, 6 of them with great difficulty because of the strong north wind that the could not have been greater. And having continued until now, they could not reach the port. . . and thanks to God’s mercy, we have not lost all the fleet because of these great storms. On the 18th, going towards Villarrica, I met another <i>Norte</i> that lasted 6 days and afterwards I met a hurricane that lasted for two days and, after it, I met yet another <i>Norte</i> and the ships of Juan de Morales of 400 tons and of Andrés Jiménez were lost. . . .”</p>
Escribania 167 A.	Clerk of army and fleet	10-03-1600	Report of incidents along the journey	<p>“... being at sea, Monday morning, September 18th 1600, . . . the said ship named Santa María del Juncal, has fired three guns, which is signal of distress, being in very heavy weather and great storminess, after having passed 6 days of gale with <i>Norte</i> . . .”</p>
Indiferente 1866.	Pedro de Escobar Melgarejo, general of New Spain fleet	12-29-1600	Report of incidents along the journey.	<p>“And on September 12th, heading towards Veracruz, I met a strong West, Northwest wind. . . A lot of ships were separated from the flagship, and the weather being so heavy, some of them were in extreme danger. This storm did not allow me to set sail until the next Monday. The previous Sunday the wind blew from west to west-southwest. The hurricane blew until dawn. And the next day, the ships of Juan de Morales and Andrés Jimenez sank. . . This day the flagship and the ships close to her stayed close to the port until Thursday 21st, when a new and very strong <i>Norte</i> gale blew until Friday night. . . I could finally enter this port of S Juan de Ulúa on Wednesday 27th at dawn, with north violent wind. . . when I was secure in the channel. . . .”</p>

(Continued on next page)

Table 4 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
México 72, R-4, N.55.	Audiencia de Mexico	12-22-1600	Report of incidents along the journey	“Since September 4th, the fleet has been close to this port of S. Juan de Ulúa, in the Sonda or Alacranes area. However, they could not enter until the 27th, when, after escaping from a very dense fog and darkness, 28 ships arrived, 6 of them heavily damaged and could not follow the flagship due to a very strong <i>Norte</i> . Two ships arrived in Campeche and two others sunk. Most of the people from one survived, while in the other most of them died... The rest of the fleet was lost on the coast...”
México 120, Doc. 7	Pedro de Escobar Melgarejo, general of the fleet	03-09-1601	Report of incidents along the journey	“... On August the 21st I was close to the Negrillos point. That day the ships coming from Havana separated, and from the next day I had 9 days of calm, and on September the 4th I sounded in cape Catoche, and on the 8th, I lost the soundings and on the 12th the wind blew very strong from the northwest, and I had to move to open sea. Some ships separated from the flagship. The weather being so heavy, some were in great difficulty. This storm did not allow me to set sail until the next Monday. Having the previous Sunday night blown from west-southwest, as a hurricane until dawn. And the next day two ships sunk... until Thursday 21st, when I met another very heavy <i>Norte</i> storm, which blew until Friday night...”
México 351	Royal officers from Veraacruz	12-19-1600	Report on the arrival of the fleet and description of the damages to ships and merchandise.	“... General Pedro de Escobar Melgarejo, (...) entered in this port of San Juan de Ulúa on September 27th with other ships, with a <i>Norte</i> of violent wind, that it was due to Our Lord's mercy that we did not lose the whole fleet. It blew 6 days with such strength that it was not possible to moor, and they were at great risk of being lost due to the heavy storm... And with the two storms, <i>Norte</i> and hurricane... The fleet arrived so late because it encountered violent weather... and the ship Santa María del Juncal was lost in the Gavias islands because the <i>Nortes</i> storm did not allow us to give them any help...”
México 351	Luis de la Cruz, pilot	10-03-1600	Report of incidents along the journey	“... and on arriving close to Villa Rica, the fleet met a very great <i>Norte</i> , which blew for 6 days, and, after that, a very great hurricane occurred that lasted from Sunday until the next Monday at 10 in the morning...”

Discussion

During northern winter, cold air surges of polar origin may penetrate deep into the Gulf of Mexico and Caribbean region. They are caused by a build-up of cold air in the higher latitudes of the North American continent and a concomitant steepening of meridional pressure gradients. These sudden outbreaks of cold air penetrating deep into Mesoamerica are accompanied by very strong winds that may blow at gale force for several days. They are known regionally as *Nortes*. Modification of the cold continental air over the relatively warm waters of the region often brings abundant cloudiness and rainfall to the windward sides of the region. These polar outbreaks sometimes lead to frost occurring in low-lying areas, with damage to crops, such as coffee, being not an uncommon occurrence.

The Spanish were well aware of this phenomenon since the early times of the conquest. The relevance to navigation within the Gulf of Mexico, specially the organization of the fleets which sailed annually between the colonies with the Spanish mainland, required that meteorological conditions were carefully scrutinized from the very early times of the conquest, particularly the wind and storm conditions.

A.G.I. Indiferente 2661 provides a description of the level of understanding around 1575 for Santo Domingo (Dominican Republic):

“The winds running in this Hispaniola Island are the east winds all the year, except in August and September, which is the season of hurricanes, which are big storms. . . The Nortes winds blow in November, December, January and February. They are very strong in this island and in New Spain (Mexico) and Honduras, and to shelter from them we have very good and safe ports”.

The transition between the hurricanes season (July to November) to the start of the *Nortes* in November was a limit to navigation and it motivated abundant documentation on the best departure date, or on the problems for unloading the ships in Veracruz because of such outbreaks. Some examples can be found in: A.G.I. Mexico 2984, Letter of the Marquis Casa Tilly to Julián de Arriaga, Indies Secretary: Cádiz, October 7th de 1768, A.G.I. México 2489.

In this case the documents indicate that there were several *Nortes* spells during the second half of September, namely 13th–17th, 21st–22nd and 26th to the first days of October. Embedded within them, a hurricane struck the fleet in the Gulf on the 17th, between the Alacran reef and Veracruz. This hurricane has not been found in any previous chronology. For this year and month, Millás (1968) reports a hurricane on the 26th–27th in the Seas north or northeast of Havana but this hurricane struck a different fleet that commanded by General Marcos de Aramburu, when returning to Spain from Havana. Two documents in the AGI report on this hurricane: Patronato 255, N.2, G.5, R.1 and Indiferente 746.

3.4 Case 4: the hurricanes of August the 10th and the 31st of 1794 in Louisiana

On August the 10th of 1794 a hurricane devastated the territory comprising Baton Rouge and La Baliza, the mouth of the Mississippi, at a distance of 60 leagues (Fig. 3). Testimonies regarding this hurricane are summarized in Table 5. They come mostly from the governor and mayor of Louisiana, who were very concerned about the heavy damages and asked for support from the king. The greatest damage was suffered by the inhabitants of the mouth

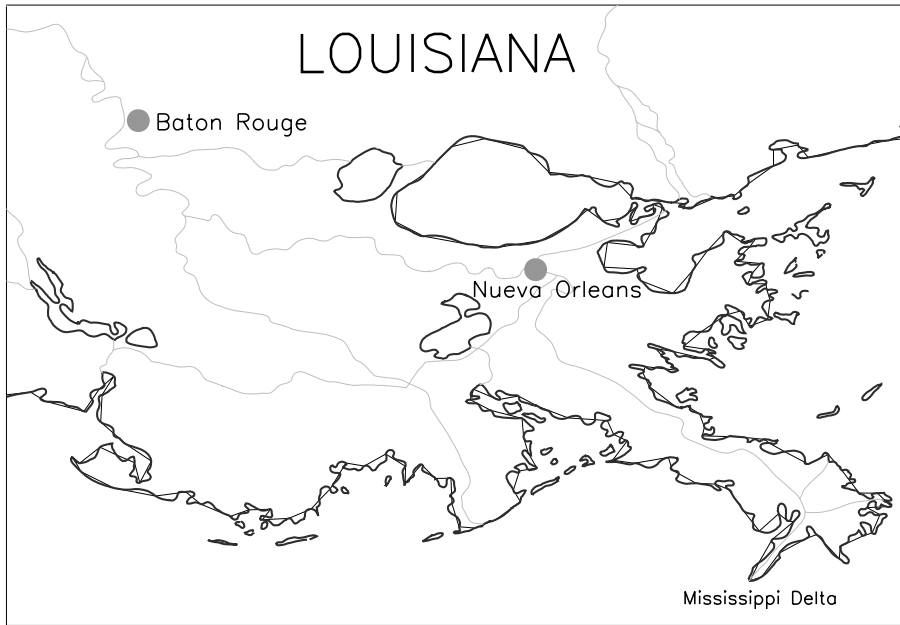


Fig. 3 Zone affected by the hurricanes of August the 10th and 31st of 1794

of the Mississippi and particularly those of the lower coast in an extension of nine leagues between New Orleans and Placaminas.⁵ These inhabitants

“scared due to the dreadful ravages caused by the sea waters, which reached more than six feet high, covering all the land and came with a terrible force to mix with the Mississippi waters, dragging trees, houses, livestock and everything that they found. So, everything is ruined to the last misery, the coast has been abandoned, and is now a desert extending eighteen leagues which previously were used to harvest rice.”

In New Orleans the force of the hurricane began to be felt at ten o'clock at night. The storm maintained its intensity until seven o'clock the next morning, when it began to weaken. According to an attachment included in A.G.I. Cuba 1443 A, the ships in the port did not escape the fury of the hurricane, ten of them grounded on the beach and were heavily damaged, six were stripped of their masts, and all of the canoes, launches and smaller ships in the port were shipwrecked. They included two warships, three merchant frigates, two packet boats, four brigs and three schooners. The countryside suffered the ruin of almost all the rice, corn and indigo.

Discussion

The hurricane of the 10th has not been identified in any of the previously published chronologies (Chenoweth 2005) and the documents in the AGI are the only source of information available on this event.

⁵ A.G.I. Cuba 479, N.33. Placaminas was a territory situated south of New Orleans, formed by a low and humid peninsula bathed by the Mississippi where this river meets the Gulf of Mexico. Its capital was Pointe a la Hache. Currently it is named Plaquemines.

Table 5 As Table 2, but for the hurricane occurred on August the 10th in Louisiana

Document	Author	Date (M/D/Y)	Purpose	Transcription
Cuba 479, N.33.	D. Francisco Rendón, mayor of Luisiana	6-01-1795	Claim of compensation	“The damages and delays caused in this province by the hurricane of August the 10th of the past year to many of the inhabitants of the Mississippi banks, and particularly to those of the lower coasts, moved this government to apply from His Majesty’s mercy some help for these people who will not abandon those lands...”
Cuba 479, N.49	D. Francisco Rendón, mayor of Luisiana	7-16-1795	Claim of compensation	“The hurricanes suffered lately in this province ensured that His Majesty’s galley La Luisana, one of the best of the fleet which defends this river, was in need of urgent repairs...”
Cuba 638 A, fol.58r-v.	D. Francisco Rendón, mayor of Luisiana	9-16-1794	Report and description of damages and claim of compensation	“Two violent hurricanes, occurred on the 10th and 31st of the past August, not only have they almost completely destroyed the crops of indigo, rice and corn, leading to misery to most of these farmers and depriving to the general neighbourhood of the subsistence means, but they have also destroyed all the ships which were in the river. So, the merchants cannot make voyages to bring in essential supplies that due to their scarcity are very expensive. This calamity adds to a similar one that occurred the previous year, its repetition increasing the pain and unhappiness of the unlucky inhabitants, victims of these disasters...”
Cuba 1443 A, Fols. 634r-637r.	Baron of Carondelet, governor of Louisiana.	8-31-1794	Report and description of damages and claim of compensation	“On the 10th of the present August, this capital suffered a furious hurricane much greater than that that occurred last year. It started at 10 in the night and kept up with much violence until seven in the morning, when it started to weaken. Its revenges extended from the Baliza or mouth of the Mississippi up to Baton Rouge, i.e., an extension of more than 60 leagues. (...) [the prisoners] will have to repair the damage caused by the said hurricanes. In Placaminas, the road was destroyed by the waters, reaching six feet above the land surface, leaving around the fort a great portion of trees mixed with animal bodies and dead fish which infected the atmosphere. In this capital they will have to repair the king’s ships and the damage to the batteries and other royal works. (...) All the people from the downstream coasts, from nine leagues of this capital to Placaminas have left the coast, scared by the dreadful revenges caused by the sea waters, which reached more than six feet high, covering all the land”

(Continued on next page)

Table 5 (Continued)

Document	Author	Date (M/D/Y)	Purpose	Transcription
Santo Domingo 2606, N.122	Baron of Carondelet, governor of Louisiana.	8-20-1794	Report and description of damages and claim of compensation	“Report on the ravages made by the hurricane on August the 10th in that province [Louisiana] over an area of 60 leagues. There will be great losses if part of the downstream coast is not populated again. Three thousand pesos will be required to help all the inhabitants who are now left without any help and can only abandon their lands.”
Santo Domingo 2612, N.6	D. Francisco Rendón, mayor of Louisiana.	9-16-1794	Claim of compensation	“The sum asked by the Barón of Carondelet to repair the pier in the fort of Placaminas, . . . I have eye witnesses to the ravages caused in this country by the hurricanes of the past August 10th and 31st (. . .)”
Santo Domingo 2612, N.8	Baron of Carondelet, governor of Louisiana.	9-16-1794	Report and description of damages	“The Louisiana galley has suffered in the hurricane of August 31st, after having being subjected to heavy damage on the 10th of the same month, being damaged also by the hurricane of the previous year and the many journeys it has made. . .”
Santo Domingo 2612, N.16	D. Francisco Rendón, mayor of Louisiana	11-5-1794	Claim of compensation.	“(. . .) a representation of the people of the Bonet Caré county ask His Majesty the Royal Grace, don Antonio Peytavin can obtain a two years deferment to pay the 16.000 pesos prepaid by the King to build a pier to avoid the flood caused by the high river waters in that area, because the three hurricanes of this and the previous year have delayed the end of this work. . .”
Santo Domingo 2612, N.41	D. Francisco Rendón, mayor of Louisiana.	4-25-1795	Report and description of damages and claim of compensation	“So general was the damage caused in these provinces by the two hurricanes of August 10th and 31st, that indigo, rice and tobacco crops were almost completely lost. . .”
Santo Domingo 2612, N.52	D. Francisco Rendón, mayor of Louisiana	6-01-1795	Claim of compensation	“ . . . I informed by this Governor that His Majesty has agreed to provide the 3.000 pesos asked for by the families of the downstream coast who suffered as a result of the hurricane of the past August the 10th. . .”

We do not find a description so detailed or exhaustive for the hurricane that occurred in this same region on the 31st of August. The testimonies recovered only mention the calamitous state of the region after the passage of both hurricanes (10th and 31st of August). The countryside and farms were totally destroyed, there were no ships to maintain commerce, and the inhabitants were in absolute despair. However, this second hurricane has been previously reported (see Chenoweth (2005), his storm 188, dated 25 August–1 Sept affecting Cuba to Louisiana) and should be connected with the next case that describes the consequences of this hurricane in Cuba

3.5 Case 5: Hurricane of the 27th–28th of August 1794, Cuba

On the 27th and 28th of August of 1794 a “*fierce storm of water and wind*” devastated the western part of the island of Cuba. The information found in the AGI (Indiferente 1559, N.152 and N. 155, and Santo Domingo 1254, N. 122) was sent to the metropolis by local authorities describing the damage to urban buildings, ranches and livestock in the rural areas, and to the ships docked in the ports. The intense rains associated with the storm caused rivers to rise and flood the fields. Table 6 shows the distribution of the damages in the different counties, while Fig. 4 shows the affected provinces.

Discussion

This storm is reported in Chenoweth (2005) as number 179, dated August 25 to September 1, 1794 and affecting the area between Cuba and Louisiana. The information available for this assessment comes mainly from newspaper accounts (Chenoweth personal communication). This storm attracted a lot of attention in the English-American press. One account mentions 64 ships driven ashore at Havana. The *Boston Centinel* has an account that is essentially the same as that provided by Millás (1968), who includes it as case 163. The *Jamaica Royal Gazette* mentions the storm in Louisiana on the 31st. According to Chenoweth, however, the newspaper sources can be misleadingly repetitive as they often drew on the same original accounts. Millás provides an incomplete set of observations made by the captain of the Spanish Navy, Tomás de Ugarte, and abstracted from the Havana newspaper *Diario de la Marina*.

This material is fully reproduced as Fig. 5. The observations have been transcribed without applying any corrections, since metadata are not available. Wind terms, on the other hand, have been translated according to the CLIWOC multilingual meteorological dictionary (García-Herrera et al. 2005b). Millás concludes that, if the minimum observed pressure of 29.5 inches is correct, the hurricane was rather weak. However, we have tried to reassess the intensity of the hurricane by applying the Saffir-Simpson (SS) hurricane scale and information about wind direction, surface pressure and damages. Although the SS scale evaluates the intensity based on the peak wind speed, it is possible to estimate the intensity from four different factors associated to the hurricane destructive power: maximum wind speed, minimum pressure, storm-surge and damage level. For this hurricane we have also wind direction and force. The wind was estimated at Beaufort 8 according to the CLIWOC dictionary during most of the 28th, its direction veering from NE, to E and then to SE. As surface winds rotate counter-clockwise in a Northern Hemisphere tropical cyclone, this change in the wind direction reported in the Havana province suggests that the hurricane eye should have been to the south of Cuba and moving from East to West. As a result, the eye was moving from a position to the southeast of Havana (NE winds reported in this observatory) to a position to the south (E winds in the observatory) and finally to the southwest (SE winds

Table 6 Relation of the damages caused by the hurricane in various districts of the island of Cuba, August 27 and 28, 1794. The first column provides the province and counties affected by the hurricane. The second one includes the signature of the document while the rest specify the type of reported damage

	Documentary Sources	Buildings	Ships and Boats	Rivers and Lakes	Fields and Harvests
Province of Pinar del Rio					
Filipina	Indiferente 1559, N.152	Damage to houses		Rivers rose	Tobacco cultivation damaged
Santa Cruz de los Pinos	Indiferente 1559, N.152	Destruction of housing		Flooding	Losses in tobacco production
San Lázaro	Indiferente 1559, N.152	Buildings damaged			Crops and trees damaged
Province of Havana					
Batavano	Indiferente 1559, N.152	Batteries and defences destroyed and houses in country damaged	Ships run aground	Flooding	Fields and trees damaged
Givacoa	Indiferente 1559, N.152	Church and houses ruined	Two schooners sunk		Fields and trees devastated
La Havana	Santo Domingo 1254, N.122	Rural houses damaged	76 ships and boats in terrible shape		Fields and trees damaged
Gabriel, Jesús del Monte, Luyano, Managua, Seiva, Province Matanzas	Indiferente 1559, N.152	Buildings damaged			Crops and trees damaged
Matanzas	Indiferente 1559, N.152, Indiferente 1559, N.155.	125 homes blown down, 89 in terrible shape, battery and fort badly damaged, buildings in the countryside destroyed.	Various ships and boats sunk and destroyed.		Crops and trees damaged
San Miguel Quemada	Indiferente 1559, N.152 Indiferente 1559, N.152	Buildings damaged Bridges and habitations ruined			Crops and trees damaged Fields and crops damaged

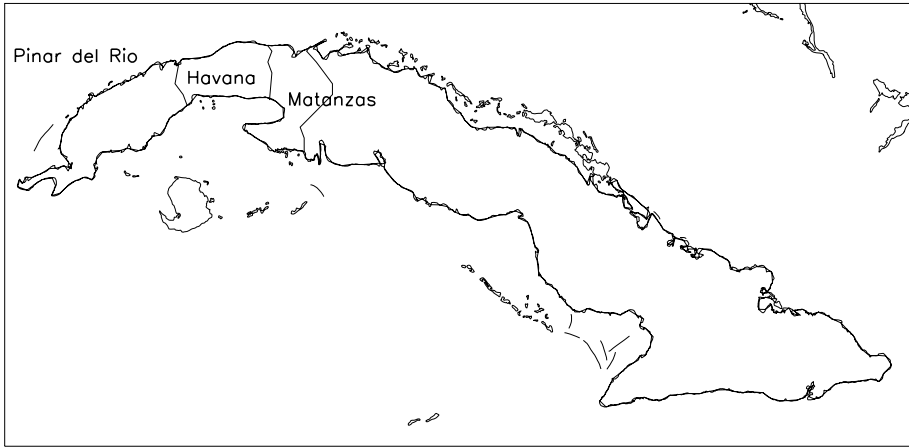


Fig. 4 Cuban Provinces affected by the hurricane of the 27th and 28th of August 1794. *Pinar del Río* counties: Filipina, Santa Cruz de los Pinos, and San Lázaro. *Havana* counties: Batavano, Givacoa, Gabriel, Jesús del Monte, Luyano, Managua, and Seiva. *Matanzas* county: San Miguel

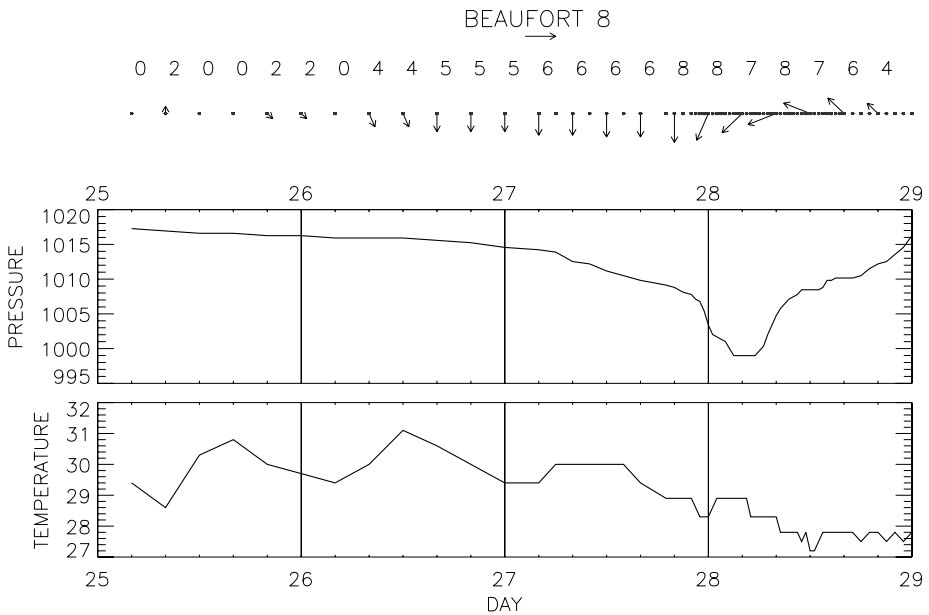


Fig. 5 Meteorological observations made by captain Tomás de Ugarte in Havana during the hurricane of August 27th–28th, 1794. Wind strength values are in Beaufort scale. The arrows show the reported direction. Pressure is in hPa and temperature in Celsius

in the observatory). Although rainfall is not a parameter used in Saffir-Simpson scale, the description of “heavy rain” until 10:30 of the 28th confirms that the three Cuban provinces with description of the hurricane were probably inside the eyewall (where the most intense precipitation occurs), or inside the outer (feeder) bands where convective precipitation occurs. Minimum pressure: surface pressure data are available only from the Havana observatory. The lowest pressure measured (Fig. 5) was 29.5 inches Hg (999 hPa) recorded between 3:00

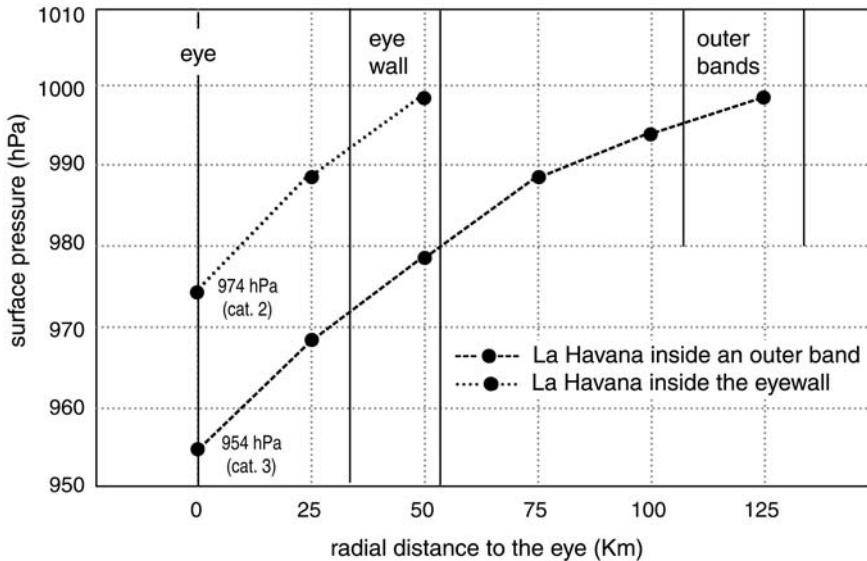


Fig. 6 Estimation of the surface pressure in the eye of the storm for two possible locations in Havana according to the Zu et al. model. See the text for details

to 5:30 on 28th August. If the pressure value of 29.50 inches is correct, then this equates to tropical storm force using the new wind-pressure relationship developed by Landsea et al. (2004). However, the area of minimum pressure (close to the hurricane eye) could have been placed more distant from Havana observatory. It is difficult to estimate the minimum pressure of a hurricane with pressure observations in a single place, but this can be done using typical values of radial pressure gradients based on modelling studies. In a numerical simulation of the hurricane Bonnie (1998), Zhu et al. (2004) calculated a radial gradient of pressure of 60 ba/km from the eye until 25 km, 40 ba/km from 25 to 75 km and 20ba/km from 75 to 125 km. Using these values we have estimated surface pressure in the eye for two possible locations in Havana (inside the eyewall or inside the feeder bands), as suggested in wind and precipitation observations. Figure 6 displays this estimation. If Havana had been placed in the eyewall, the minimum pressure would have been of 974 hPa (category 2 in SS scale), while if it had been in the outer bands the minimum pressure would have been of 954 hPa (category 3 in SS scale). The degree of damage can be used as a parameter with which to check the two possible locations and to estimate the cyclone's intensity. The Saffir-Simpson scale describes the damage associated to modern hurricanes, mainly describing damage to buildings and vegetation. It is not easy, however, to extrapolate the scale to 18th century buildings. Nevertheless, there are descriptions in Table 6 that could indicate strong intensity: destruction of houses in Santa Cruz de los Pinos and, especially, church and houses ruined in Givacoa, now Jibacoa. Although we have not found a particular reference to Givacoa church in Spanish archives, it must have been a stone building. According to Weiss (1985) "the basic building material in Cuba during the eighteenth century was stone", so the wind in the Jibacoa area must have been very strong, (possibly due to the proximity to the eyewall). Havana only had "rural houses" and some tree damage, which is more consistent with a location in the feeder bands than in the eyewall.

In conclusion, although there are significant uncertainties in the assessment of damage in historical times, the hurricane that occurred in August 27–28, 1794 was probably a major

event (category 3 or higher) with the highest intensity in the Jibacoa area, located nearer to the storm center.

4 Conclusions

The cases in this paper show that the documents kept in the Spanish archives are extremely useful for analyzing the behaviour of past hurricanes. In particular, they can:

- Identify previously unreported hurricanes, such as cases 3 and 4.
- Provide precise dating for hurricanes previously identified, such as in case 1.
- Help to define better the area affected by a given hurricane, such as in cases 2 and 5. This is especially interesting when trying to provide accurate hurricane trajectories.
- Contribute to a better assessment of the hurricane intensity, by providing detailed descriptions of the impacts, such as in cases 1, 3, 4 and 5.
- Help to evaluate other meteorological circumstances, as in case 2 with the *Nortes* spells.

They also show some of the difficulties associated with searching the archives. Thus, case 1 illustrates how reports of the same hurricane can be in different sections, the major division in the archive, and in several documents. Even more problematic, reports of storm effects may appear many years after the storm, as is the case for the 1605 hurricane, with reports dating between 1606 and 1634 (Table 3).

Finally, it is evident that primary sources provide more detailed and reliable results than secondary sources. This can be seen in cases 1 and 2, through a comparison between direct and indirect testimonies.

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