Wind Extreme Events in Uruguay

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1 INTRODUCTION

As Figure 1 shows, Uruguay is located in the southeastern part of South America, between 30 and 34.5º south latitude, having an area of approximately 175.000 km^2. Its population is around 3.5 million people, of whom 1.5 million live in the capital Montevideo, in the southern coast of the country. The rest of the urban population lives in about 20 towns and cities, and the agro-alimentary sector represents 24% of its gross domestic product and 70% of the total exportations.

Fig. 1. Location of Uruguay

In this region of the world, the events that produce extreme winds are extratropical cyclones that intensify during their passage, and severe convective storms [1], which form when warm humid air is driven upwards in an unstable atmosphere due to the fast entrance of a cold air mass [2], and produces downbursts and occasionally tornadoes. Fig. 1 to the right shows the area where severe convective storms occur more frequently in South America [3], which includes Uruguay.

In Uruguay, the wind is responsible for significant crop loss, interruptions and damage to the electric transmission system, damage to buildings and structures, as well as for pedestrian non-comfort and risk situations.

In particular, when specific wind events that caused great losses in crops [4] or important disruption on the electric transmission system [5] have been analysed, severe convective storms were found to occur more frequently than it was thought, being responsible for many events per year exceeding 100km/h in Uruguay.

The relevance of these findings has motivated the author to conduct research which aims to determine the statistical description of the wind speeds produced by severe convective storms in Uruguay, and also their frequency of occurrence. As a first stage, a search for sources of available occurrence information for these events, collection of data and its systematisation is currently being carried out, and this paper describes the main characteristics of the employed methodology and a summary of the principal results obtained to date.

2 SOURCES OF INFORMATION AND METHODOLOGY

The standard meteorological information from the National Meteorological Office (DNM) can be used, after performing some quality and statistical analysis, in order to characterise the developed wind speeds and frequency of occurrence of extratropical cyclones in Uruguay [6]. Due to the smaller spatial and temporal scales of the convective storms, their passage is not usually registered in these stations as they usually report the mean wind speed (and sometimes, maximum gusts) of the last 10min of each hour.

For this reason, other sources of information like newspapers, data from other types of meteorological stations, reports from several institutions, visits to the affected places after the occurrence of an event, pictures or films taken, descriptions by witnesses of the characteristics of the events and damage produced, etc. must be used for the characterisation of the intense winds caused by these storms. As these registers have different characteristics and are not systematic, the collection and analysis of the data and its quality becomes complex.

As sources of information for the research, the author has partially carried out search on one of the major newspapers of the country (El País) and in wind speed data measured by some meteorological stations related to the IMFIA. She has also resorted to papers ([2],[7]) and books [8] from last century describing extreme wind events that occurred in the country, as well as to a list of events compiled by Ramis and Schwarzkopf [9] (which Schwarzkopf kindly provided), and to some recent though fragmented reports ([10], [11]).

For this research, a wind event is considered extreme when its wind speed exceeds 80km/h, and classified as convective when it occurs suddenly and has relatively small temporal and spatial scales, as the passage of a convective storm lasts for just few minutes and affect areas generally smaller than 10km wide by 100km long. Other characteristics that are taken into account for this classification are the occurrence of hail, intense rain and/or violent gusts, typical of this type of storm. In a few of the analysed cases wind speeds were actually measured during the passage of a convective storm; in most of them the wind speeds were estimated from the description of the damage caused to trees, electric lines, poles, houses, buildings, etc.

3 SOME PRELIMINARY RESULTS

A fascinating registration of a downburst that passed over a meteorological station in Montevideo in July 8th, 1935 is shown in Fig. 2. The maximum gust wind speed measured was almost 200km/h, and winds exceeding 90km/h were measured for almost 4 minutes.

Not only the evolution of the wind speed is similar to that of downbursts registered elsewhere in the world, but also the description of the damage matches the damage usually caused by a succession of downbursts produced by severe storms: "in a park, populated with trees of the same species, tens of trees were damaged in different areas, while some hundreds meters from those places no damage was recorded. This pattern was repeated with intermittency in places located at a considerable distance from the previous damaged location, always in the same trajectory as the storm" [8]. Apart from blowing down and cutting down many trees, this storm twisted a crane located at the port, blew trucks off the road and moved others a distance of 30m, destroyed cement and iron poles, removed roofs, windows and gates, and was followed by very intense hail.

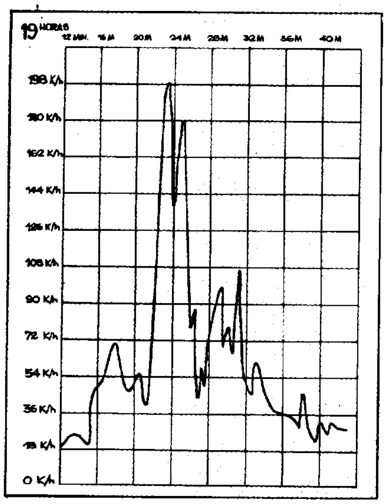

Fig. 2. Registration of a downburst in Montevideo, July 8th, 1935 [7]

Prior to this event, hail of diameter from 6 to 8cm had been reported as early as 1891, 1908 and 1929 [8], also indicating the passage of severe storms over Uruguay.

Recent research conducted for the State Insurance Bank (BSE), for the development of insurance to cover losses due to wind-driven fruits fall [4] showed that the wind events that had caused the highest fruit fall losses corresponded to severe convective storms. During one of them, which occurred in March, 2002, the agricultural industry lost about 8 million US dollars.

The same event also affected the electricity distribution system, twisting and damaging several high voltage transmission towers and cutting the main energy supply from the hydroelectric plants in Montevideo, with a cost of repair of 2 million US dollars, and an additional cost of 10 million US dollars for the production of energy from petroleum until the towers were repaired. This event was produced by a meso-cyclone that entered Uruguay from the River Plate and developed intense downbursts and at least one tornado during its passage over the country. Fig. 3 shows a picture of the meso-cyclone and of a damaged high voltage transmission tower.

Fig. 3. Meso-cyclone in River Plate & damaged high transmission tower, March 10th,2002

Fig. 4 Tornado in Florida, 2008

Fig. 5 Waterspout in the River Plate,1988

During the research outlined in [5], 23 failures in the 500kV transmission lines of the Uruguayan electric company were analysed, and it could be verified that at least 70% of the cases occurred during the passage of severe convective storms that produced downbursts which caused excessive sway angles, bringing the conductors too close to the towers, and thus producing an earth discharge. It was also noted that several events crossed the lines with wind speeds greater than 100km/h (at 10m height) every year.

From all the analysed information (155 cases), it can be concluded that at least between 5 to 10 severe convective storms occur every year in Uruguay, blowing down trees and power poles, removing roofs from houses and other buildings during their passage. Data indicate that wind speeds of 100km/h or more are likely on an annual basis, and gusts of 130 to 145km/h have been measured several times in the last 10 years. In addition, at least 15 tornadoes have been reported since 1968 (as shown in Fig. 4). At least 9 possible tornadoes, as well as 5 waterspouts have also been reported since 1968, similar to the one shown in Fig. 5 that formed over the River Plate in front of Colonia, Uruguay in 1988.

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