Thunderstorm warning in Argentina

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Abstract— **Since 2005 it was developed in Argentina the lightning study with several papers, presentations and a PhD Thesis. In the last year, the Minister of Defense and Cordoba University started a project in Lightning Protection that include GeoRayos Project. The aim of this work is to present the GeoRayos project and it's different topics: The Nowcasting algorithm for the National Weather Service (SMN), the work with National Fire Management Service, the Ginkgo Field Mill network progress, and the community work services together with La Plata University, to promote Lightning Protection behaviors in the population.**

Argentina, Thunderstorm, Warning

I. INTRODUCTION

The information about lightning activity is fundamental item for atmospheric surveillance due its relevant applications on different aspects like security, defense, early warning system and generation of statistical data for planning infrastructure projects, for instance.

This paper and Nicora et al, 2015 [1] arises as an operative response to the PhD Geophysics Thesis Nicora "Actividad Electrica Atmosférica en Sudamerica" (Nicora, 2014) [2] and associated papers (Bürgesser et al 2012, [3], Nicora et al, 2011 [4], Nicora et al, 2014 [5], Nicora et al, 2013 [6], Garreaud et al 2014 [7] Avila et al, 2015 [8]) , which explore lightning activity in S. America. The understanding of atmospheric electrical activity has been progressing in recent times due to several works in Lightning Warning in different countries in South America (e.g., Cardozo et al, 2014 [9]; Lopez et al, 2012 [10]). But nevertheless in Argentina there are a few studies of lightning activity, and there is a serious lack of valid scientific data in Argentina. For this, our compromise is to characterize the lightning activity in Argentina, its global implications and development tools in lightning protection

The expanded body of knowledge on lightning activity in the region, allowed us to study its relevance on Nowcasting and the need for a tool to forecast high impact weather was clear: thus GeoRayos was developed. The National Meteorological Office (SNM) and the Scientific and Technical Research Institute for Defense (CITEDEF) collaborate in the undertaking. [1]

GeoRayos is a project to anticipate the development of severe weather. It consists on the electrical activity detection process during the storms and the use of the Nowcasting algorithm (http://georayos.citedef.gob.ar) to determine the Severe Weather Warning and finally a Community Service Programme, to reach out with alert information in vulnerable rural and urban areas. Measurements are based on lightning with World Wide Lightning Location Network (WWLLN) and atmospheric electric field measuring instruments named Ginkgos.

GeoRayos Project, since its very origin, is thought of as a tool for developing countries since it is low cost and its design and implementation is not excessively complex. It relies on IT tools easily available since it runs on personal computers and the Ginkgos can be built with accessible parts. It is particularly relevant to the observing systems in developing countries since it can easily become a lighting network. More sophisticated forecasting techniques and tools are beyond these countries means. In fact, at present GeoRayos is operative and being tested in the National Meteorological Office (SMN) and together with CITEDEF, the project continues to grow by developing a Network in Argentina.

GeoRayos is a project that could be adapted to be used in any developing country to anticipate severe weather and promote lightning protection behavior in the population.

The aim of this work is to present the GeoRayos project and it's different topics: The Nowcasting algorithm for the National Weather Service, the work with National Fire Management Service (SNMF), the Ginkgo Field Mill network progress, and the community work services together with La Plata University, to promote Lightning Protect behaviors in the population..

II. SUMMARY OF ACTIVITIES

A. GeoRayos algorithm and National Meteorological Office

In Nicora et al, 2015 [1] we present a lightning jump algorithm (LJA): "GeoRayos" to detect severe weather. It is based on the algorithm presented by Schultz et al. (2011) [9]. The lightning data used in this study came from the World Wide Lightning Location Network (WWLLN) which is a real-time, world-wide ground network.

The conclusion of this study shows that GeoRayos could be used as warning systems of severe weathers events. The best Storm Threshold found for central Argentina is five lightning every two minutes, threshold that allows GeoRayos to identify more than 60% of the reported severe weathers over central Argentina, combined with a LJA detection procedure. The study case showed that warnings could be send well in advance, which allows to send the alert of the severe event to the population. The current study suggests that the WWLLN lightning data are suitable to anticipate the development of severe weather before it reach the population.

Since August 2015 GeoRayos is operative and being tested in SMN and CITEDEF. The project continues to grow by developing a Network for entire Argentina

GeoRayos also has a public web page http://georayos.citedef.gob.ar in which the general population can see in real time the lightning activity.(Figure 1)
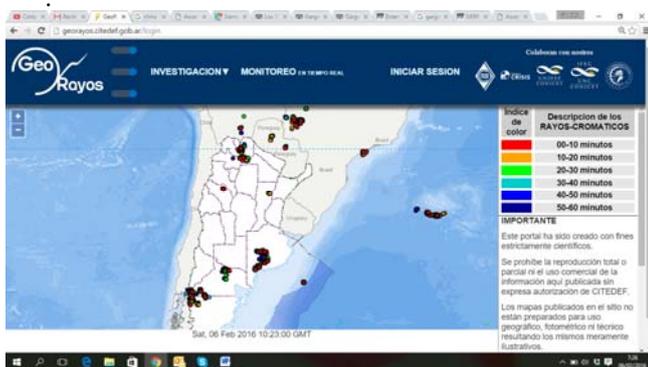

Figure 1. GeoRayos page

B. National Fire Management Service

Lightning can cause outbreaks of fire or endanger personnel working in a fire in progress, so that knowing the real-time location of electrical activity produced by storms will be important for the management of fire handling strategy.

The National Fire Management, in partnership with the National Weather Service, attends special fire weather forecasts. These forecasts serve to define firefighting strategies and thus increase safety.

On February 16 th, 2015, the National Fire Management (SNMF) detected a plume of smoke near the town of Cholila, northwest of Chubut Province (Patagonia), for unknown reasons yet. We analyzed the lightning activity observed with WWLLN and found that the activity was on February 3rd. This information matched with National Meteorological Office data.

This was the first time in Argentina where a lightning network was used to detect lightning activity that could be associated to the origin of a fire.

Since October 2015 the SNMF is using GeoRayos to help to prevent fire hazards associated with lightning. Here we present a example.

On 19 January, in the province of Rio Negro (Argentina), two focus fires were detected. Since noon, electrical activity produced by thunderstorms that developed between the two fires are detected with GeoRayos using WWLLN network (Figure 2). This resulted in the issuance of a new forecast for this zone led to send fire patrols to the area to be alert to the begining of a new focus.
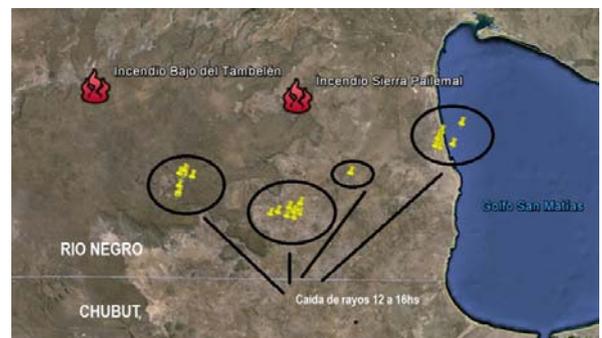

Figure 2. Lightning activity and fires

Our country is lacking studies on the number of fires which are actually caused by lightning. These studies can be found for example in Canada, where 45% of forest fires on an overall average of 8,000 per year are due to this phenomenon (https://www.ec.gc.ca).

For these reasons, determining the location of lightning is a valuable tool that will be use to increase the knowledge about fires caused by this phenomenon.

C. Lightning Protect behaviors

This project came up after the flood occurred in La Plata (Bs. As. province capital city) in April 2, 2013, which resulted

in countless human loss [12], and the death of 3 young people in a beach because of a lightning stroke in January 10, 2013 [11]. This problem caused a constant demand for different social actors in the society.

Severe weather events not only come with flooding. It is known [5] that the rural population is extremely vulnerable to death by lightning. In this context we consider it vital to disseminate the results obtained by this thesis, because with this many possible deaths can be avoided.

For this, the FCAG (UNLP) impulse a University extension Project : "Concientización y prevención ante tormentas severas"[14], This project began in 2015 and continue throughout 2016. There have been more than 10 lectures in rural schools (Figure 3), and have delivered various protection brochures, we also made a facebook page "Protección contra rayos" [15] (Figure 4)

Figure 3. Lectures in a rural school

Figure 4. Facebook Page

D. Field Mill Ginkgo

The technique used in the sensors is called "Field Mill". Our was named GINKGO (Figure 5)

These are devices designed for measuring the ambient electrostatic field formed mainly by moving parts. By varying the area of a measuring electrode exposed to electric field induced voltage signal which is proportional to the magnitude of the field. Electric Field Mill sensors detect changes in the electric field produced by lightning or by charged clouds in the previous moments.

All parts were made in CITEDEF and is important to emphasize that Ginkgos can be built with accessible parts.

It is particularly relevant for the observing systems in developing countries since it can easily become a lighting network.

Figure 5 Fill Mill Ginkgo

III. FUTURE ACTIONS AND CONCLUSIONS

The GeoRayos Project, since its very beginning, is thought of as a tool for developing countries since it is low cost and its design and implementation is not excessively complex. It relies on IT tools easily available since it runs on personal computers and the Ginkgos can be built with accessible parts. It is particularly relevant to the observing systems in developing countries since it can easily become a lightning network. More sophisticated forecasting techniques and tools are beyond these countries. In fact, at the present GeoRayos is operative and being tested in SMN together with CITEDEF, and the project continues to grow and deploying a Network in Argentina.

GeoRayos is a project that could be adapted to be used in any country to anticipate severe weather and promote lightning protection behavior in the population.

We like to remark, for those countries like Argentina that do not have a national network of lightning activity, to have data base from a global network like WWLLN is really powerful because it can use an inexpensive data base, can cover all the region and can use this information not only for applications on different aspects such as security and defense, but also in early warning system and nowcasting for severe weather.

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