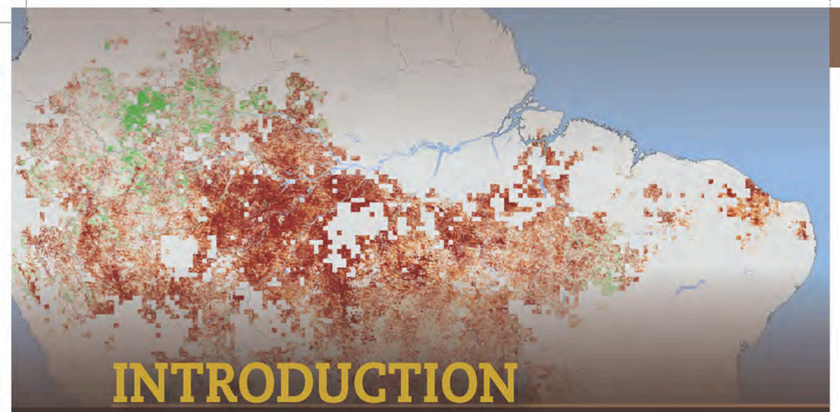

INTRODUCTION

The occurrence of drought hazards has seen a significant increase in the Region of Latin America and the Caribbean, affecting over 60 million people over the last decades (EM-DATA, 2015). Mitigating the impacts of drought is a top priority of many governments in the LAC region, in order to move away from reactive crisis management and work towards pro-active climate risk management. This requires insight into the causes and characteristics of drought events and its processes, in order to identify the vulnerability of livelihoods to drought hazards.

The Drought Atlas for Latin America and the Caribbean contributes to this effort, by providing an effective tool to raise awareness on their exposure to drought. The Atlas identifies the variability of rainfall deficits in countries in Latin America and the Caribbean, and allows visualizing how this climatic variability differs spatially within the countries, even at short distances. This is achieved by identifying the drought frequency, which is the probability of drought occurrence with a certain magnitude and duration at any given place in the area of interest.

Additionally, the atlas can be used to support decisions for drought risk management, answering the following questions:

- **How rare is the current drought?**
- **How large a drought should we plan for?**
- **How rare is the drought of record?**

The drought atlas is prepared within the framework of the International Hydrological Programme (IHP VIII, 2014-2021 'Water security: responses to local, regional and global challenges' and is a contribution to the Global Network on Water and Development Information for Arid Lands (G-WADI) and International Drought Initiative (IDI) of IHP.

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ACCESS THE DROUGHT ATLAS

http://www.climatedatalibrary.cl/CAZALAC/maproom/

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

Latin American and Caribbean DROUGHT ATLAS

Development through International Cooperation

The development of the Latin American Drought Atlas was started in 2008 as a collaboration between UNESCO's International Hydrological Programme (IHP), The Water Centre for Arid Zones (CAZALAC) and the Institute for Water Resources at the US Army Corps of Engineers, and received strong support from the Flanders UNESCO Science Trust Fund (FUST). These first efforts resulted in a set of manuals, regional workshops and the first published case study in the region, The Chilean Drought Atlas (Nuñez et al., 2010). During the period 2010-2014, more than ten regional workshops were held as part of the EUROCLIMA and RALCEA projects, funded by the DG DEVCO-EuropeAid division of the European Commission, and allowed training of the majority of the countries of Latin America, leading to a generally applicable, consolidated methodology. In addition to the work in Latin America, IHP and the UNESCO Category 2 Centers CAZALAC and ICIWaRM developed a workshop to focus on the Caribbean countries.

The project greatly contributed to the development of open-source software for the calculation of the Regional Frequency Analysis using L-moments, and resulted in a set of different, accessible software programmes: a version in the scripting language R and an open source programme with a user-friendly interface based on the R-scripts, REFRAN-CV, developed by the Joint Research Centre in charge of the EUROCLIMA and RALCEA programme implementation. The complementary software ICI-RAFT was developed by ICIWaRM to analyze various climate indices that help to identify modes of climate variability that affect a particular region of interest.

A New Methodology

The methodology of the Drought Atlas is based upon a statistical approach called 'Regional Frequency Analysis using L-moments', and has two distinct components: it applies a regional analysis using an L-moment approach.

The use of L-moments provides a solution to a common problem observed when fitting a distribution to a series of observed data, as extremely large or small values have a large influence on the final result. The L-moment approach was developed to better estimate the distribution from a limited number of observations, especially in the presence of outliers.

One of the first applications of the methodology was the **US Drought Atlas** in 1993. In this pioneering study, the L-moment approach was enhanced with a regionalization approach. This regionalization allows combining sets of observations from different stations, to determine a common distribution over a larger area. This is very useful when most stations have short record lengths, which is typical for dryland areas. Significant improvements were made over the original methodology to allow its application in regions of Latin America and the Caribbean that show high climatic variability combined with limited available measurement data.

Therefore, this method proved especially relevant in drylands where:

- The number of meteorological stations is limited;
- The data sets are short and incomplete;
- There is high variability in annual rainfall;
- Climate is frequently influenced by large scale extreme events, such as ENSO.

For each country, three different maps have been created:

- **The frequency of droughts** is presented as a set of maps with return periods associated to drought intensities, which are expressed as precipitation deficits. In Figure 1, the return period is presented for a 60% deficit of normal rainfall for Chile, indicating such drought occurs every 15 years or longer in the southern part and more frequently (every 6-8 years) in the northern part of the country.
- The **minimum expected rainfall amount** associated to a certain return period is presented in a second set of maps. In Figure 2, the minimum amount of rainfall that is expected each 5 years is mapped for Bolivia, indicating great differences throughout the country.
- The **maximum expected rainfall amount** associated to a certain return period is presented in the third set of maps.

The Online Drought Atlas

In order to allow the exposure to drought to be explored interactively, the Drought Atlas was integrated into a Regional Maproom with support from the International Research Institute for Climate and Society (IRI).

The online platform provides different menu options. Any of the three types of maps can be selected from the drop-down box. For each type of drought map, either the deficit level (the drought intensity) or the return period (the drought frequency) can be selected.

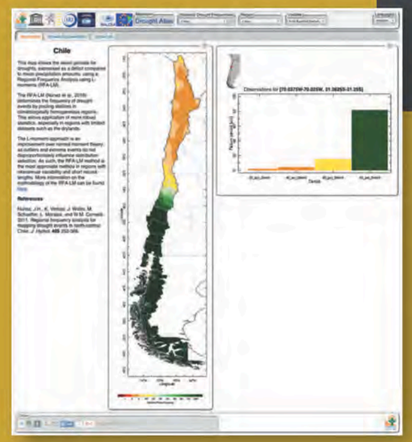


Figure 1.

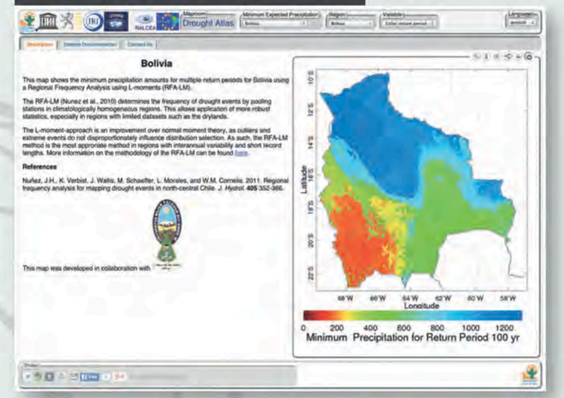
Return periods associated with different drought intensities for a selected location in Chile

Specific countries can be selected and within a country, regions can be selected to zoom-in directly to the area of interest.

By clicking on any location on the map, a local graph is presented with the corresponding return periods associated with different drought intensities, or the minimum and maximum precipitation amounts associated with different return periods.

Figure 2.

Minimum precipitation expected each 5 years in Bolivia



Maps can also be exported to Google Earth and to Geographical Information Systems. The online platform is designed to be accessible through smartphones and tablets, and maintains its full functionality on these smaller screens.

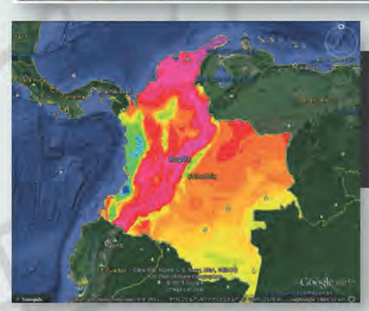


Figure 3.

Map of Colombia in Google Earth

A Matter of Impact

Since its launch in 2012, the Chilean Drought Atlas was selected as the most important drought information available to decision makers, following a stakeholder survey performed by the Chilean Ministry of Agriculture in 2014.

Figure 4.

Survey results figure