Examples of Climate Informing Decisions in Chile: Advances and Challenges at the National and Water Basin Level

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Introduction

Climate variability can have serious social impacts inthe Chilean drylands, affecting farmers who depend onrain-fed agriculture, as well as irrigated agriculture that depends on the annual accumulation of snow and ice in the Andes. During the most recent drought in 2007, more than 30 million US Dollars were spent to support affectedfamilies and farmers in the country(MINAGRI 2008). Although thesemeasures reduced the immediate negative impacts of the 2007drought, they did not address all affected families becauseof budget limitations, nor did they increase preparednessand resilience to future droughts.

In order to move away from this type of crisis management, the Chilean Government entrusted the Unit for Agricultural Emergencies (UNEA) with the development of a Climate Risk Management (CRM) strategy. One of the decisions adopted was the creation of a National Agroclimatic Observatory to allow informed decision making related to droughts, as well as other climatic hazards (heat waves, frostand extreme rainfall events). In collaboration with UNESCO-IHP, the International Research Institute for Climate and Society (IRI), the FAO and The Water Centre for Arid Zones (CAZALAC), a framework for CRM has been implemented, establishing a decision support system for climate informing decisions in the agricultural sector.

The Chilean Agroclimatic Observatory

A key elementin the development of this Agroclimatic Observatory consistedin the establishment of a local Chilean climate data repository, using the Climate Data Library technology developed at the IRI (del Corral et al., 2012). This open-source environment provides enhanced climate data management tools, allowingto store data sets in a multitude of formats, to visualize these in maps and figures, as well as exporting the data sets in a range of formats. The integrated scripting language 'InGrid' enhances these data base capabilities with advanced statistical algorithms and GIS operations that can be applied to any data set as well as automated in time, creating a powerful environment for the development of tailored climate information in near-real time.Additionally, the Data Library supports OPeNDAP data transfer protocol (Cornillon, 2003) assuring full access to the IRI-DataLibrary, that holds over 300 global data sets, as well as to other data repositories worldwide.

In order to provide effective decision support tools, a user-friendly interface was built on top of the Climate Data Library, constituting the portal of the Agroclimatic Observatory, in order to service final stakeholders with tailored information for decision making. An important challenge when designing such a system consists in providing all necessary information needed to evaluate the drought riskin an easy-to-understand format, while hiding all the complexities for providing that data in real time.

Following the framework for Climate Risk Management (Baethgen, 2010), the Observatory was built to reduce climatic uncertainties aroundthree pillars: (i) understanding the past behavior of climatic variability at different timescales; (ii) monitoring the present conditions of relevant environmental factors;and (iii) providing the best possibleclimate information of the future.

To provide relevant historical information, the Chilean Drought Atlas(Núñez et al., 2011)was developed, which indicates expected drought frequencies for different drought intensities and durationsbased on a modified Regional Frequency Analysis using L-moments (Hosking and Wallis, 1997). This allows visualizing drought exposure throughout the region, creating awareness on drought risk for those communities with a high vulnerability to climatic variability. At the same time it serves as a reference to put current droughts into perspective, and allows bringing drought relief support in balance with the exceptional character of the drought.

An important part of the effort was focused on developing effective drought monitoring indicators, using both national and remote sensing data sources. Four variables were marked as essential: climatic variables (precipitation/temperature), streamflow, soil moisture and vegetation. Maps and graphs reflecting different aspects of these variables were grouped to indicate conditions regarding meteorological, hydrological and agricultural droughts. Finally, a Combined Drought Index(Sepulcre-Canto et al., 2012)was incorporated to provide an integrated view on current drought conditions.

In the third component, uncertainty on future drought events is reduced by providing a seasonal drought forecast, with up to four months of lead time (Verbist et al., 2010). As such, the drought risk can be visualized in a spatially distributed manner, and allows advanced drought planning and early response to specifically affected sectors.

Towards a decision support tool for Climate Risk Management in Chile

Although CRM capacities in Chile have been drastically enhanced with the development of the Agroclimatic Observatory, this has also triggered new demands by its stakeholders that need to be addressed. Therefore, the objective of the upcoming phase is to optimally connect the Observatory with climate informed decision making.

The focus of the Observatory has been to identify drought risk, butso far it has only been able to support information on drought exposure. The vulnerability component has not yet been developed, making targeted drought risk management to vulnerable communities more difficult. Different methods need to be explored, including comprehensive indicators already available at a global resolution, such as the Climate Vulnerability Index(Sullivan and Meigh, 2005).

During the initial phase, 11 monitoring maps were developed showing both national data sets and remote sensing products as complementary data sets, where local data is scarce. In a subsequent phase, merging techniques need to be applied to optimally benefit from spatial cover of satellite imagery, while assuring adequate ground truthing to remove typical biases in remote sensing products (Dinku et al., 2010). As different techniques have been developed in recent years, a critical assessment to define the most appropriate methods for the specific climatic conditions of Chile is currently ongoing.

Although the Observatory was designed as a tool for national drought risk management, the impact of drought on water resources is dealt with at the watershed level, through a participatory process of integrated water resource management. The challenge remaining is to expand current capabilities of the Observatory to support decision making on water allocation at the watershed level. This requires a new set of conditions to be fulfilled, before this can be implemented. First, local datasets on available water resources (surface, subsurface) as well as current water demand (extraction wells, irrigation channels) need to be available in near-real time. A second condition is the establishment of a water resources management model for the watershed that can effectively represent the water balance of the region, and inform on the demandssupplied.Although many hydrological models could fulfill that role, the Water Evaluation And Planning (WEAP) model (Johnson et al., 1995) has gained worldwide support as an effective tool for this purpose, and is currently considered to be coupled to the Chilean Observatory for watershed level decision making. Finally, the whole water balance information process needs to be coupled to the decision making process that has already been established by the local water managers and water users of the watershed. As such, a crucial step is to understand every component of this process, and provide relevant, timely and adequate information that can be directly linked to the decision making tools already in place.

Water managers have also expressed their need to evaluate scenarios on longer timescales, such as the upcoming decades, in order to implement adaptive water management strategies under scenarios of global change (including building infrastructure). A very relevant timescale for this decision making is the Near Term Climate Change (NTCC) horizon, focusing on the period 2020-2035. While long-term climate change is expected to continue impacting during that period, decadal and interannual variation have shown to be the critical components to be considered (Greene et al., 2011). An upcoming challenge is to translate this new source of climate information into watershed management options that can trigger investments to reduce climate vulnerability on the long term,following a no-regret approach.

Improvements at the seasonal forecast timescale can still contribute to make better plans and decisions. Although seasonal forecasts have been available for more than a decade, they may not provide actionable information, reducing its usefulness for final stakeholders.Therefore, a task still remaining is the coupling of seasonal forecasts to agricultural and water management tools in order to provide a seasonal outlook with relevant information.

While the development of climate informing tools has been prioritized, a crucial step will be to institutionalize these newly available CRM management tools.Therefore, an interactive dialogue with decision makers and other stakeholders needs to be established to reassure that the information provided is covering the effective needs. For this purpose, it is foreseen that a national working group for CRM will be put in place under the coordination of UNEA, involving governmental agencies and local decision makers, but also other representatives of the agricultural sector, farming communities and the academic sector. This should further enhance the development of tailored climate information required for decision making, as well as providing an official structure to steer this process.

Finally, there is a need to frame the Chilean CRM efforts in a regional and global framework, which is currently under active development (Pozzi et al., 2013). Global interaction will further enrich the Chilean Agroclimatic Observatory, as it will benefit from new developments and global data sets. At the same time, a global user community on drought risk management is emerging, supported by the UNESCO G-WADI Programme, as well as the Global Framework for Climate Services and other programmes. Exchange, outreach and training on this global level is expected to further drive the innovation and development of the required tools to strengthen informed climate decisions at the local and national level.

The Agroclimatic Observatory is accessible at http://www.climatedatalibrary.cl/UNEA/maproom/

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