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The challenge of climate change in Spain: Water resources, agriculture and land

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SUMMARY

Climate change effects are becoming evident worldwide, but some water scarce regions present higher vulnerability. Spain, located in the Mediterranean region, is expected for instance to be highly vulnerable given its unbalanced distribution between water resources availability and existing demands. This article presents an introduction to the main threats of climate change mainly on water resources, but it also assesses effects in interlinked areas such as agriculture, soil and land management. Contents focus on measures and initiatives promoted by the central government and address efforts to establish multi-sectoral coordinating bodies, specific adaptation plans and measures for the different sectors. The article highlights some political aspects, such as the complexity of involved competent authorities in water and land management, the need to strengthen public participation and the conflicts arising from the defence of regional interests. It also makes a link to current EU policies; summarises foreseeable problems derived from climate change effects, and provides some recommendations in the different areas covered.

1. Introduction to climate change in Spain

The warming of the global climatic system is a reality, and the human influence has been a dominant cause (Intergovernmental Panel on Climate Change, 2013). It is global, with the most significant local impacts occurring in certain regions, among which the Mediterranean stands out. The Report from the European Environment Agency (2008), Impacts of Climate Change in Europe, noted the high vulnerability of mountain and coastal areas as well as the Arctic and the Mediterranean. This reality was introduced already at the fourth report of the Intergovernmental Panel on Climate Change (2007), considering that there is a high probability that many semi-arid regions such as the Mediterranean basin, will suffer a significant decline in water availability due to climate change.

Spain is considered one of the most vulnerable countries to climate change within the European Union, due to its geographic and socio-economic characteristics. Forecasts obtained from models place it as a region where a further increase in temperature and decrease in precipitation is expected (European Commission, 2009a,b; Agencia Estatal de Meteorología, 2009; Garrote, 2009; Somot et al., 2008; Estrela et al., 2012) (Fig. 1 shows average precipitation in the country).

Climate change, on the other hand, is a problem closely related to human development, growth and consumption patterns. One of the difficulties in addressing climate change lies precisely in its overarching and cross-sectoral characteristics. Territorial disconnection between emissions and impacts, systems vulnerability, the difficulty of achieving proper coordination among the various administrations, and the involvement of stakeholders in decision-making processes, are additional problems for the adaptive capacity to cope with its effects. Spain experienced, since 1995, an important economic development, higher than the European average, which the current economic recession is now seriously threatening (Pérez García et al., 2011). In addition, the country witnessed a social growth, with a significant increase in population, all of which translated into a growing contribution of greenhouse gases (GHGs) and climate change consequences. For instance, emissions of CO_2-equivalent increased steadily between years 1996 and 2005 (Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013a).

Another important element when addressing climate change in Spain is its political and jurisdiction organisation, since competences related to climate change (transport, industry, agriculture and environment, among others) are often shared between the Central Administration and the Regional Governments (Autonomous Regions) and, to a lesser extent, the municipalities.

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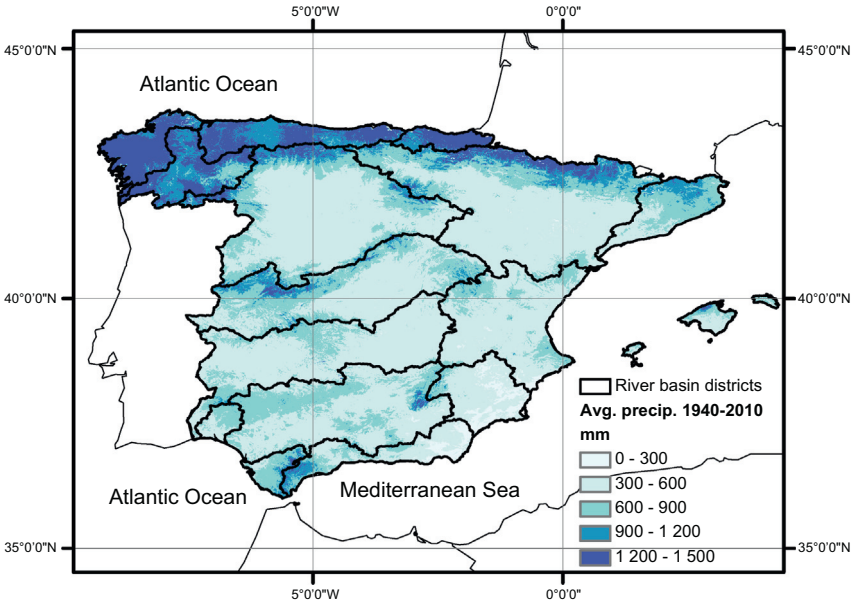

Fig. 1. Map of average precipitation for the period 1940–2010. River Basin Districts are shown inside of the boundaries of Spain. Northern Basins Districts (*Cantábrico Oriental y Occidental*, *Miño-Sil* and *Galicia-Costa*) have significantly more precipitation than the rest of Basin Districts. *Source*: Prepared with data from the *Sistema Integrado de Información del Agua* (Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013c). Precipitation data originated to be used by the SIMPA model of the Centro de Estudios Hidrográficos (Centro de Estudios y Experimentación de Obras Públicas).

Therefore, entities that promote coordination, collaboration and participative approaches are essential. Some current examples include the Climate Change Policy Coordination Commission, which includes the three administrative levels (national, regional and local), and the National Weather Council, adding to the former representatives, experts and the civil society. However, these structures and other advisory bodies do not always have the ability to promote the necessary consensus for complex project implementation. That would be the case for some urban[2] projects promoted by local interests, and dependent, among others, on water and energy resources availability. These often lack a regional approach or even national interest, and expected climate change impacts can strongly affect their viability.

It is important to remember that most problems and impacts linked to climate change are not new. In fact, Mediterranean societies, and in particular the Spanish one, have always faced floods, water scarcity, heat waves, prolonged droughts, flows variability, temperature rises, and decreased rainfall with related impacts on crops. Although it is difficult to attribute to global warming the occurrence of a particular phenomenon, there are different studies that suggest that climate change will cause a higher frequency and amplification of these problems (Bates et al., 2008), and their displacement to areas that do not always have sufficient experience to incorporate uncertainty into water planning (Arnell and Liu, 2001).

2. Climate change impacts

Given the uncertainty of climate change, the Spanish Administration launched the project *Climate change effects in Spain*, from which, in 2005, the report *General Preliminary Assessment in Spain of the Impacts by Climate Change Effects* (Ministerio de Medio Ambiente, 2005) was published. This report represented a solid basis for reviewing and gathering information on the state of the art of climate change impacts and possible initiatives for adaptation. It indicated that climate change impacts could have particularly serious consequences such as water resources decreases, coastal regression, loss of biodiversity and natural ecosystems, increased soil erosion processes and loss of lives and goods resulting from the intensification of extreme weather events like floods, wild fires and heat waves.

3. Water resources

The findings of the formerly mentioned *Preliminary Assessment* related to water resources highlighted that a general reduction of water resources and increased demand for irrigation systems was expected in Spain. The report also predicted a reduction in inputs

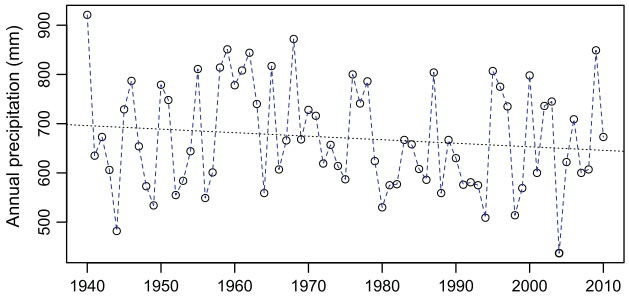

Fig. 2. Time evolution of annual precipitation (hydrological years 1940–1941 to 2010–2011). The hydrological year starts on October of year *i* ending on September of year *i*+1. The time axis shows the natural year when the hydrological year starts. The trend line shows a linear fit to the data. There has been a decrease of the average annual precipitation of approximately 1 mm per year (roughly 10%). The average annual precipitation over the time period for continental Spain and Mediterranean islands was 670 mm (standard deviation 110 mm). *Source*: Prepared with data from the *Sistema Integrado de Información del Agua* (Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013c). Precipitation data originated to be used by the SIMPA model of the Centro de Estudios Hidrográficos (Centro de Estudios y Experimentación de Obras Públicas).

[2] With regard to spatial planning there is certain degree of legal gap, and competences assigned to different administrations are complex and interlinked. Some urban plans promoted by municipalities, despite having completed the formalities required by law, may be approved and developed even though unfavorable opinions are emitted by consulted bodies, which express the lack of water supply guarantee or main road access (these responsibilities are assigned in some parts of the territory to the General Administration).