

Preface

Climate change studies have a long tradition in México, particularly at the Centro de Ciencias de la Atmósfera, UNAM (CCA-UNAM). For more than 20 years, the research that has been conducted by this institution has focused on climate variability and change, and on the consequent environmental implications of these changes.

The initial studies related to climate change were developed in the Centro de Ciencias de la Atmósfera, mostly based on simulated atmospheric responses to the increases of CO₂ and other greenhouse gases (i.e. Adem and Garduño, 1984). Other studies focused on historical trends of climatic variables and extreme events (i.e. Jáuregui 1995; Gay *et al.*, 2007) and the impacts of strong El Niño events (i.e. Magaña, 1999).

Soon after, the research concentrated on generating climate change scenarios and on estimating the possible potential impacts on relevant sectors or regions in México. A clear example of this stage of research is the *Country Study: México* (Gay, 2000). The results of this project were included in the First National Communication of México to the United Nations Framework Convention on Climate Change (UNFCCC¹). The *Country Study: México* had a similar structure to that of the IPCC's, which allowed creating a research core for future investigations in climate change.

During 2008, the Instituto Nacional de Ecología of the Environmental Ministry of México (INE-SEMARNAT) supported the project "Generación de Escenarios de Cambio Climático a Escala Regional, al 2030 y 2050; Evaluación de la Vulnerabilidad y Opciones de Adaptación de los Asentamientos Humanos, la Biodiversidad y Los Sectores Ganadero, Forestal y Pesquero, ante los Impactos de la Variabilidad y el Cambio Climáticos; y Fomento de Capacidades y Asistencia Técnica a Especialistas Estatales que Elaborarán Programas Estatales de Cambio Climático". Dr. Carlos Gay, from the CCA-UNAM, coordinated this project and the results were delivered to INE-SEMARNAT as a contribution to the Fourth National Communication of México to the UNFCCC.

In this issue of *Atmósfera*, the main results of this project are presented, particularly the regional climate change scenarios that were generated for México and for Central America with a resolution of 5' x 5' ($\approx 10 \times 10$ km). A guide for their use for impact assessments can also be found at the web page of CCA-UNAM². These scenarios were applied for the assessment of the potential impacts of climate change on forestry, livestock, agriculture, fisheries, hydrological sectors, and on biodiversity and human settlements. This special issue of *Atmósfera*, synthesizes the studies of at least 20 researchers from different academic institutions and their students. The methods applied for assessing the potential impacts of climate change are innovative and address sectors that were not included in the previous National Communications, such as livestock, fisheries and forestry. The methods applied in the biodiversity and human settlement studies were also original.

One of the most vulnerable sectors in México is agriculture. Rainfed maize production in the country might reduce under climate change conditions, since most of the suitable areas will be highly affected. Even under irrigated conditions, such as in the Guayalejo-Tamesí River Basin in Tamaulipas, México, agricultural activities could receive the most negative impacts.

¹ <http://www2.ine.gob.mx/cclimatico/comnal1.html>.

² http://www.atmosfera.unam.mx/cclimat/documentos/reportes_cuarta_comunicacion/Escenarios/Guia_escenarios.pdf.

The potential impacts of climate change for 16 species that have economical importance were considered for the forestry sector. Soil humidity and the environmental requirements for those species had a key role in the methodology that was applied. In general, the results showed that the species from temperate regions will be the most affected.

For the livestock sector two independent studies were developed. The first one has a national scope, and showed that, based on the net primary productivity (NPP) and the rangeland coefficients, livestock production could be affected by the decrease in forage availability. The second study analyzed the possible impacts of climate change in this sector for the state of Veracruz, based on an “animal comfort” index. Considering that the animal comfort is already low, the projected increases in temperature and the changes in relative humidity will make future conditions more adverse for this sector in Veracruz.

For the fisheries sector, several marine environments were studied, such as coral reefs, sea grasses, coastal lagoons, wetlands, sea currents, frontal systems and upwelling. Sixteen fisheries that constitute 70% of the production volume and that have commercial importance for the country were analyzed. The results show that negative potential impacts are to be expected, considering the increases in marine temperatures and sea level rise, as well as the changes in river flows that reach coastal zones.

The human settlements study, which was based on the heat island effect and human comfort indices, indicates that cities will suffer severe impacts including important increases in their electric energy consumptions.

The biodiversity study shows that, under the regional climate change scenarios, the current distribution areas of the species that were considered might be reduced in almost 50%.

The results presented here show that México is highly vulnerable to climate change, and that it is clear that changes in policies, practices and processes must occur if México wants to increase its adaptive capacity, ameliorating the potential impacts of climate change in different regions and sectors. Also, these results show that climate change studies must be carried out under an interdisciplinary perspective, and that climate change scenarios must be tailored to be useful for climate change assessments.

Adem J. and R. Garduño, 1984. Sensitivity studies on climatic effect of an increase on atmospheric CO₂. *Geof. Int.* **23**, 17-35.

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Jáuregui, E., 1995. Rainfall fluctuations and tropical storm activity in Mexico. *Erdkunde. Archiv für Wissenschaftliche Geographie* **49**, 39-48.

Gay C., F. Estrada and C. Conde, 2007. Some implications of time series analysis for describing climatologic conditions and for forecasting. An illustrative case: Veracruz, Mexico. *Atmosfera*, **20**, 147-170.

Magaña V. (Ed.), 1999. *Los Impactos de El Niño en México.* México. UNAM, IAI; SG. (http://www.atmosfera.unam.mx/editorial/libros/el_nino/index.html).