

This investigation was designed to evaluate a methodology for zoning susceptible to being affected by mass movements in the area of Merida. The method was based on the use of appropriate digital map data processing geotechnology, overlapping and crossing of thematic maps using the tools of the Information Processing System Georeferenced (SPRING). As such, zoning susceptibility to the occurrence of mass movements was performed from the evaluation maps conditioning factors: geology, slope ranges, geomorphic positions and land use - vegetation cover, applying the method of the Analytical Hierarchy Process (AHP). The digital cartographic processing yielded a map at 1: 40,000 representing the levels of susceptibility to mass movements and analysis of communities that are vulnerable to this type of geomorphological processes. The study area was classified into five levels of susceptibility: very low, low, moderate, high and very high. The results showed that 57 % of the area of the study area susceptibility remains high to very high, so that these areas should be restricted to the use of human settlements. Moderate susceptibility areas occupy 33,4 % and levels of low and very low susceptibility account for 9,6 % of the area under analysis. All results obtained allow comparisons between levels of susceptibility map and inventory of existing mass movements, being able to check good correlation between the two. Field observations helped to validate the results of this study, which will serve as a basis for proposing risk management plans, to threats by mass movements in the city Mérida. They could also become the Institute of Civil Protection and Disaster Management Mérida State (INPRADEM), a tool orientation action in these processes.

*Key words:* Geomatics, AHP, Susceptibility, Mass Movements.

## **INFLUENCIA DEL CAMBIO CLIMÁTICO SOBRE EL RÉGIMEN HIDROLÓGICO DE LA CUENCA DEL RÍO MACHANGO ESTADO ZULIA**

### ***INFLUENCE OF CLIMATE CHANGE ON THE HYDROLOGICAL REGIME IN THE MACHANGO RIVER BASIN ZULIA STATE***

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#### **RESUMEN**

Con el propósito de evaluar el impacto del cambio climático en la producción de agua del río Machango, fuente importante de suministro de agua potable en la Costa Oriental del Lago de Maracaibo, estado Zulia, se aplicaron las proyecciones de precipitación y temperatura período 2015-2044 de 3 Modelos Generales de Circulación Atmosférica (MGCA): HADGEM1, CGCM3T63 y MIROC3.2. Mediante la técnica de reducción de escala estadística las proyecciones climáticas de los MGCA se transformaron en datos locales para las dos estaciones climáticas de la cuenca (El Venado y El Cruce).

Como resultado de la reducción de escala se tiene que el cambio climático disminuye la

precipitación anual de la cuenca con cualquier MGCA, y con un amplio rango de variación: desde -4% con el modelo MIROC3.2 hasta -26% con el modelo HADGEM1 para un futuro cercano (2015-2044). De manera similar, la evaporación aumentó para el mismo período entre 26% con el modelo CGCM3T63 y 38% con HADGEM1.

Aplicando el modelo de simulación hidrológica de cuenca SIHIM, previamente calibrado con datos locales de precipitación, evaporación y escorrentía, período 1977-1982, se calcularon los caudales a la salida de la cuenca para los distintos escenarios de precipitación y evaporación (2015-2044) según los MGCA seleccionados, y los resultados se compararon con caudales calculados para una línea base de referencia (1961-1990).

Comparando el caudal de la línea base, 4,86 m<sup>3</sup>/s, se obtuvieron como consecuencia del cambio climático reducciones en términos porcentuales iguales a -21% con el modelo MIROC3.2, -45% con CGCM3T63 y -53% con HADGEM1.

Se concluyó que, independientemente de la precisión de los cálculos, hay una significativa reducción del caudal en la cuenca del río Machango para un futuro cercano a consecuencia del cambio climático.

*Palabras claves:* Modelo general de circulación atmosférica; modelo de simulación hidrológica; reducción de escala estadística; cambio climático.

## ABSTRACT

In order to assess the impact of climate change on water production Machango River, a major source of drinking water in the eastern shore of lake Maracaibo, Zulia state, the projections of precipitation and temperature period 2015-2044, 3 were applied Atmospheric General Circulation Models (MGCA): HADGEM1, CGCM3T63 and MIROC3.2. By the technique of statistical downscaling climate projections of MGCA became local data for the two seasons of the basin (El Venado and El Cruce).

As a result of reduced scale that climate change has decreased the annual precipitation in the basin with any MGCA, and a wide range of variation: from -4% to -26% MIROC3.2 model until the model HADGEM1 for the near future (2015-2044). Similarly, increased evaporation for the same period with 26% and 38% CGCM3T63 model with HADGEM1.

Applying the model basin hydrological simulation SIHIM, previously calibrated with local precipitation data, evaporation and runoff period 1977-1982, the flow rates were calculated at the outlet of the basin for the different scenarios of precipitation and evaporation (2015-2044) according to MGCA selected, and the results were compared with flows calculated for a baseline (1961-1990) online.

Comparing the flow of the baseline, 4,86 m<sup>3</sup>/s were obtained as a result of climate change reductions in percentage terms equal to -21% with MIROC3.2 model, -45% and -53% with CGCM3T63 with HADGEM1.

It was concluded that regardless of the accuracy of the calculations, there is a significant reduction of flow in the river basin Machango for the near future due to climate change.