# SIMULATION OF THE BEHAVIOR IN TABASCO MEXICO SALT-MARSHES AND THE IMPACT ON THE VEGETATION

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## ABSTRACT

In this paper we propose a computational method to simulate the evolution of a coastal region included its aquifer in the Tabasco, Mexico, salt marshes.

As the evolution due to intense deforestation is well known and documented our model extrapolates the future evolution taking in consideration several scenarios, the first one is the actual use of the land with the natural rise of the level of Gulf of Mexico other is introducing comercial species of trees with a high water consumption ratio, the third scenario is restoring, following a very well designed strategies the original environment.

Our model takes in consideration the surface and subsurface hydrology and has been calibrated with the historical data.

## 1. INTRODUCTION

The state of Tabasco is the region of the country where the hydrological network is more complex; as well as is the one that registers major precipitations. Here, in contrast to other entities of Mexico, it is the surplus and not lack of water what causes problems, but this plenty it might be object of studio and to give a draft problematic wing in particular in zones where the continental water is consolidated by that of the sea and to see its behavior with the vegetation since it is having changes the zones of salt marshes.

The plenty of superficial escurrimientos with a seemingly untid distribution, has given place to the formation of water bodies of varied dimensions, the same that to marshes and flatness of flood populated by hydrophilous vegetation, like mangrove, popal and tule.

One of the aspects that characterizes the rivers of the territory tabasqueño considered a coastal flatness of raising is the formation of meanders, due to the flat area and the abundant transport of materials. This peculiarity is intimately tied by the floods provoked by the continuity of the rains throughout more than eight months. By virtue of the previous features, a considerable extension of the state gives the appearance of being composed by a series of lakes with islands.

## 2. HYDROLOGY IN TABASCO

### 1.1 Surface Water

The state of Tabasco deserves special attention from the hydrological point of view, since in there develops a system of complex runoff, which links between them a series of geologic, climatic and biological phenomena, which have response in a complicated geomorphological process.

The coastal flatness of the southeast of the Gulf of Mexico counts with saturated network of runoffs, deltoid flatness, lagoons systems, estuaries, salt marshes, etc., that spread along the coast in a distance of more than 160 km between the Tonalá, San Pedro and San Pablo rivers. In this area there remain included three of the most important rivers of the country, the Mezcalapa, the Grijalva and the Usumacinta; as well as the lagoon systems of Carmen, Pajonal, Machona and Mecoacán.

The different formations in the coastal flatness are a consequence of others, since there is the case of the meanders of the Usumacinta, Grijalva and Mezcalapa rivers that have formed extensive zones of salt marshes and simultaneously the type of deltoid mouth, which is related to the lagoon systems.

## 1.2 Grijalva river

The basin River Grijalva-Villahermosa is the biggest 10 586.60 $km^2$ and it is the most important in Tabasco, since in there where end big part of the rivers that cross the flatness of the state, sucha as the Usumacinta river.

The main current originates in the Saw of Cuchumatanes, in Guatemalan territory. San Gregorio and San Miguel forms for the union of the rivers, which cross separately the border between Mexico and Guatemala, and on having joined in our country, constitute the Big river of Chiapas or High place Grijalva

The Grijalva covers approximately 600 km in chiapanecas grounds before entering Tabasco. Streamwise from the Netzahualcóyotl dam, in the place where it serves as limit between Chiapas and Tabasco, where for the first time it receives the name of Grijalva (although also it is known in this zone as Mezcalapa) denomination that it preserves up to his mouth to the sea in the bar of Border.

## 1.3 Deltas and Salt-Marshes formed in the Mezcalapa and Usumacinta Rivers

The rivers Mezcalapa and Usumacinta form mouths of deltoid character, which consist of the fork of runoffs of several channels before coming to the sea. This has given place to the formation of salt marshes. In this area there is a big number of marshes and lagoons of shallow funds, which are interconnected by a considerable quantity of channels and drain towards the above mentioned formations or towards the active arms of the river Mezcalapa, according to the epoch of the year.

## 1.4 Wetlands

The wetlands are features of the surface of the Earth because they answer to some of the following conditions: a) Areas with stagnant water or flows very slowly that are not lakes, or, with a plate of shallow water. For some authors this is what allows that the waterfowls could feed in them; b) Areas with a slightly deep freatic surface so that the capillary stripe is obtainable to the roots of permanent plants (freatofitcs), which can include trees of average and big freightage; c) Areas in which the evapotranspiración is major than the precipitation, and which therefore receive water contributions of other areas, superficially or subsuperficial.

Freatofits are plants that exist in zones where the freatic level is very little depth with regard to the surface of the soil, possess very deep roots that go so far as to reach the freatic level. Some freatofits possess a low level of tolerance front wing saltness of the water, being this a problem for the same ones due to the high existing levels of saltness in zones of salt marshes.

In Tabasco the zone of salt marshes has plenty of popal and mangrove forest including some freatofits, the wetlands at some level of saltness it is named salt marshes, these do that the existing vegetation has changes across the time and that due to the water consumption for the vegetation the zone of wetlands suffer changes, this is well-known in the evolution of the salt marshes, although in some cases when the levels of underground water lowers the levels of saltness increase, achieving that some freatofits die.

This equation is used in the consumption of water in vegetation , and also can represent the water amount inside the salt marsh system.

$$Vtp = \frac{\Delta s_1}{\Delta t_1} \pm \frac{\Delta s_2}{\Delta t_2}$$

$Vtp$ = Raicing water velocity

$$q = Ne\left(\frac{\Delta s_1}{\Delta t_1} \pm \frac{\Delta s_2}{\Delta t_2}\right)$$

*q = Amount water displace per surface unit*

$$Q = \left(Ne\left(\frac{\Delta s_1}{\Delta t_1} \pm \frac{\Delta s_2}{\Delta t_2}\right)\right) \times A$$

$Q$ = Water consumption due to vegetation

The water consumption due to vegetation , among others, is a cause of the descent in the freatic groundwater level, beginning to modify the zones of salt-marshes.

The acuifer located on the coast of Tabasco next to the city of Villahermosa that is connected hydraulically to the sea and doing without the effect of the differences of thickness and supposing that the sea ranges of form sinusiodal, it is fulfilled that:

$$\Delta h = \Delta H_0 \times \exp\left(-\sqrt{\frac{\pi \times x^2 \times S}{t_0 \times T}}\right) \bullet sen\left(\sqrt{\frac{\pi \times x^2 \times S}{t_0 \times T}}\right)$$

in wich:

$\Delta h$ = change of the level of the water in the acuifer with regard to the average position
$\Delta H$ = semilargeness of oscillation of tide
x = distance to the connection between the acuifer and the sea ( it can or not coincide with the coast )
$t_0$ = period of tide=12h 25 min
S = coefficient of storage
T = transmisivity of the acuifer t = time

Next it presents some stages of the zone of salt marshes, where are observed the elevations of the static level having connection of the rivers Grijalva and Usumacinta with the wetland zone.

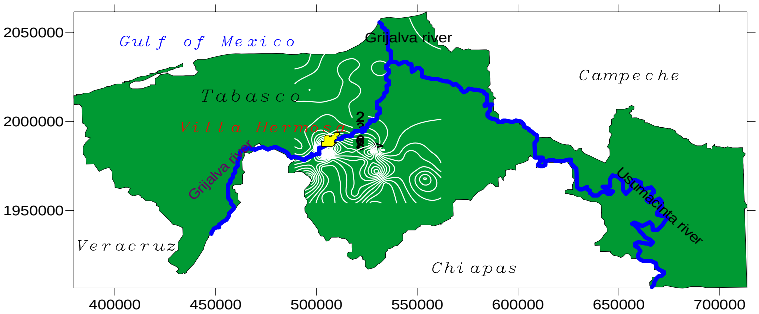


FIGURE 1. First stage . The salt-marshes area is high because of the high piezometric levels.

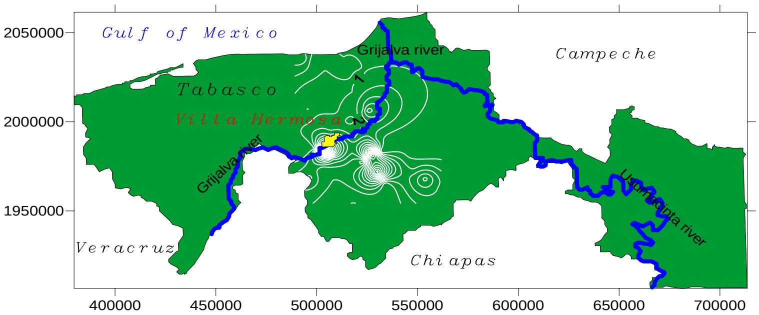


FIGURE 2. Second stage . The salt-marshes area is medium because of the medium piezometric levels.

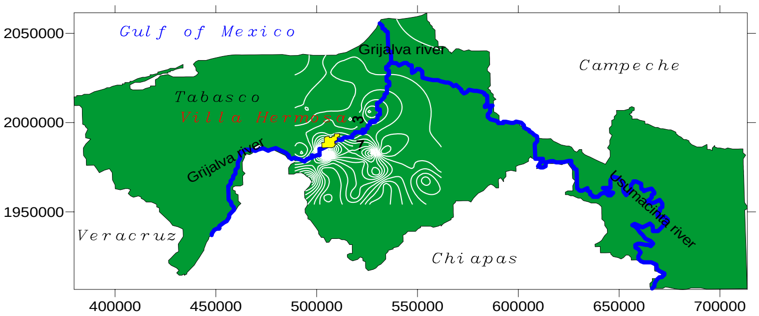


FIGURE 3. Third stage . The salt-marshes area is low because of the low piezometric levels.

These stages perfomed themselves in a simulated way for a model using finite elements in this one I show the simulating evolution of salt marshes used.

## REFERENCES


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