

HYDRODYNAMIC MODELLING OF THE HUAVE LAGOON SYSTEM, OAXACA

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INTRODUCTION

Coastal lagoons are regions of confluence of water coming from the continent, with water entering from the ocean to the coast (de la Lanza Espino & Cacéres Martínez, 2000). Their hydrodynamics are governed by forces with different origins such as: the ocean, with the tides and currents; the continent, with the discharge of fresh water mainly by rivers; and the atmosphere with the wind (Chavez A. E. A., 1977). These generate movement at different scales of time and space, translating into a complex dynamic. Understanding hydrodynamically these ecosystems becomes relevant for their conservation and sustainable management and, reliable information on the movement of water can be obtained from validated hydrodynamic models (Hodges, 2009).

This investigation presents numerical experiments of the hydrodynamic model implemented for the Huave Lagoon System using the software DELFT3D (Figure 1). The Huave System is part of the Istmo of Tehuantepec in Oaxaca, Mexico and has an intermittent connection with the Pacific Ocean, more specifically in the Gulf of Tehuantepec. The region is known by its eolic dynamism which is influenced by macro-scale atmospheric phenomena and modulated at different time-scales, including long term events such as the ENSO (de la Lanza Espino & Cacéres Martínez, 2000). The numerical experiments aim to determine the importance of: 1) the different forcers, 2) the connection with the ocean and 3) the effect of the ENSO; for the spatiotemporal changes of the hydrological characteristics of the lagoon system.

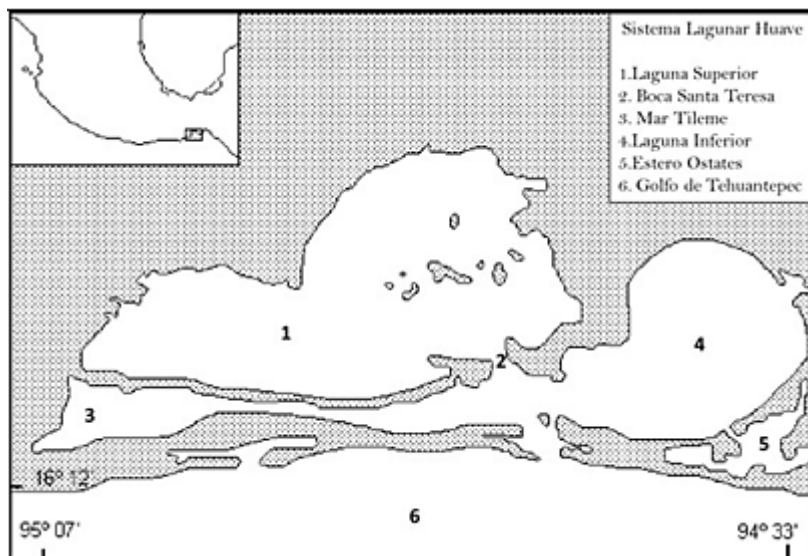


Figure 1. Location of the Huave Lagoon System (SLH) in the Gulf of Tehuantepec, Pacific Ocean.

AVAILABLE BACKGROUND INFORMATION & DATA

This is the most extended lagoon system in the Mexican Pacific (Gluyas M., 1982 and, it hosts the largest white shrimp fishery in Mexico. It is also characterized by the influence of the Tehuano winds, because the Istmo of Tehuantepec is the region where the mountain ridge Sierra Madre del Sur decreases its height, generating a valley where the northerly winds are accelerated in the form of very intense jet. These winds are generated mainly in winter and are modulated by the coupled ocean-atmosphere phenomenon of El Niño or Southern Oscillation (ENSO) (Romero, Zavala, & Gallegos, 2003). Additionally, the system's environmental complexity generates high biodiversity indexes (Chavez AE, 1979), and has therefore been evaluated as a priority site for its conservation (CONABIO-CONANP- TNC-PRONATURA, 2007). This biodiversity is composed of different groups such as: migratory birds, jellyfish, crustaceans, phytoplankton, mammals, marine turtles, mangroves, etc.; which present both endemic and in any degree endangered species (Arroyo H., 1981, Baez V., 1987, Chavez A. E., 1979, Lopez., 2009). In addition to biological, its richness is cultural too because it is inhabited by Huaves and Zapotec indigenous

communities, whose social, economic and spiritual development depends completely on their natural resources (Villagómez, Amoroz, & Gómez, 2013). Currently the SLH, goes through a series of environmental problems among which stand out: prolonged droughts (decrease in precipitation and temperature increase), substantial decrease in the water table, silting of the lagoon system; as a result, since 2016 La Boca San Francisco is closed impeding the daily exchange with the sea (López-Yllescas, 2014, Ramirez, 1993, Villagómez, Amoroz, & Gómez, 2013) which in turn is creating eutrophication problems.

BRIEF STATE OF THE ART

Due to its thermohaline characteristics, the Huave Lagoon System (SLH), located in the coasts of Oaxaca in the Mexican Pacific, was one of the chosen systems to be studied within the strategic line of salinity gradient energy from the Mexican Centre for Innovation in Ocean Energy (CEMIE-Ocean); which aims to explore the energy resource derived from salinity gradients that are naturally generated in different sites of Mexico.

SUMMARY

The hydrodynamic modeling of the SLH consists of:

i) Collection and analysis of in situ measurements: meteorological variables (temperature, and atmospheric pressure, solar radiation, rain and wind), as well as CTD data (temperature, salinity, water level) were collected from October 08 to 13 of 2018.



Figure 2. Measurements in situ.

ii) Compilation and analysis of forcers: a) Hydrodynamic scenario considering that the lagoon system does not present a connection with the sea since 2016, hence driven by only the wind stress and the continental water discharges (rivers and estuaries) to intervene directly, and b) hydrodynamic scenario for the case where Boca de San Francisco is open and allows connection with the sea (tide and currents). At the same time, two types of temporal analysis are carried out with each of the constrainers: a) the one that allows the validation of the model, forcing with data that coincide with the field dates (October 2018) or in equivalent environmental conditions (October of a year without effect ENSO), and b) those related to the creation of scenarios, using historical data grouped according to their different phases of the ENSO.

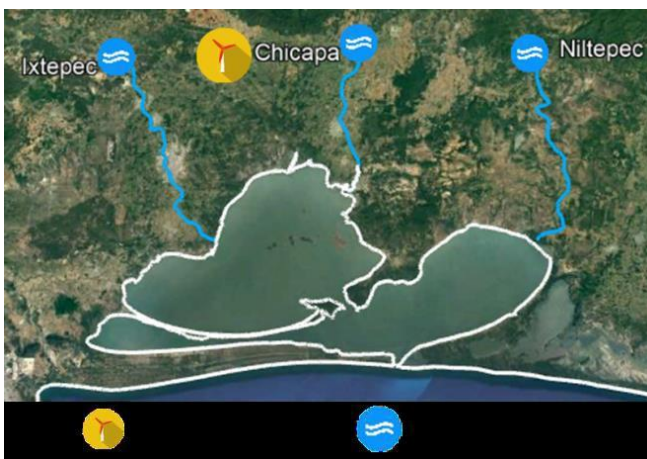


Figure 3. Compilation of forcers.

iii) Preliminary numerical results include the implementation and validation of the model, a series of numerical experiments carried out for sensitivity tests to the mesh resolution and to the time step, as well as the establishment of current processes through initial and open boundary conditions.



Figure 4. Model implementation

iv) Calculation of residence times: for the present state of the lagoon system and the different numerical scenarios of connection with the sea and ENSO events the spatially variable residence times are approximated.

REFERENCES

CONABIO, CONANP, The Nature Conservancy, ProNatura (2007): Ficha técnica para la evaluación de sitios prioritarios para la conservación de ambientes costeros y oceánicos de México: Sistema Lagunar del Golfo de Tehuantepec.

de la Lanza Espino, Cacéres Martínez (2000): Lagunas Costeras y el Litoral Mexicano. Baja California Sur: UABCS.

Gluyas (1982): Distribución de algunas variables fisico-químicas durante primavera, verano, otoño e invierno en laguna Inferior, Oax., Tesis de licenciatura. UABC, pp. 71.

Hodges (2009): Hydrodynamical Modeling. Hydrodynamics and Mixing.

López-Yllescas. (2014): Batimetría del Sistema Lagunar Huave, Istmo de Tehuantepec, México, mediante Percepción Remota. Tesis de Maestría: Instituto Politécnico Nacional.

Romero, Zavala, Gallegos (2003): Isthmus of Tehuantepec Wind Climatology and ENSO Signal. Journal of Climate, pp. 2628-2639.

EXCEED - SWINDON Conference 2019

THE FUTURE OF WATER RESOURCES

October 13th - 16th, Mérida, Mexico



Programme and Book of Abstracts

PROGRAMME

Sunday, 13 th		Arrival
19:00	- 21:00	Welcome cocktail

Monday, 14 th		Conference Day 1
08:30	- 09:00	Registration
09:00	- 09:30	Opening Ceremony <ul style="list-style-type: none"> • Norbert Dichtl • Andreas Haarstrick • Rodolfo Silva • Local authority
09:30	- 10:00	Keynote speech <ul style="list-style-type: none"> • Norbert Dichtl
10:00	- 10:10	Break
Session 1: The impact/performance/role of SDGs Chairman: Valeria Chávez		
10:10	- 10:30	Exploring some ocean energy possibilities in Latin America (Jassiel Hernández)
10:30	- 10:50	Water energy nexus in the MENA region (Abbas Al-Omari)
10:50	- 11:10	Ocean energy and marine biodiversity affectations: a life cycle assessment review (Dora Ruiz-Méndez)
11:10	- 11:40	Coffee Break
Session 2: Water-Energy-Nexus (I) Chairman: Dwi Andreas Santosa		
11:40	- 12:00	Wastewater/waste to energy in MENA region: A review for opportunities (Zeinab Abou Elnaga)
12:00	- 12:20	Water-energy nexus in a wastewater treatment plant: Energy efficiency and recovery (Wang Hongtao)
12:20	- 12:40	From wastewater treatment plants to a resources recovery facility (Marcelo Nolasco)
12:40	- 13:00	Seasonal assessment of the energetic potential associated with salinity gradient: Champoton River, Mexico (Gregorio Posada Vanegas)
13:00	- 14:30	Lunch
Session 3: Water, ecosystem and socio-economic integrating aspects (I) Chairman: Germán Rivillas		
14:30	- 14:50	Decolourization and mineralization of acid green 25 dye through single and catalytic ozonation (Liliana Amaral Féris)

14:50	-	15:10	Adsorption of naphtholate-as dye in wastewater of batik industry using green synthesized zn layered hydroxyl salts (Sri Juari Santosa)
15:10	-	15:30	Adsorption of hexavalent chromium in coal beneficiation tailing in fixed bed column (Liliana Amaral Féris)
15:30	-	15:50	Kinetics of the adsorption of anionic and cationic dyes in aqueous solution by low-cost activated carbons prepared from sea cake and cotton cake (Ibrahim Tchakala)
15:50	-	16:10	Distribution of microplastics in water and sediment in a Biosphere Reserve (Cecilia Enriquez)
16:10	-	16:30	Evaluation of microplastics contamination in the margins of the Patos Lagoon in south of Brazil (Eduardo Saldanha Vogelmann)
16:30	-	17:00	Coffee Break
Session 4: Water, ecosystem and socio-economic integrating aspects (II) Chairman: Rodolfo Silva			
17:00	-	17:20	Hydrodynamic modelling of the Huave Lagoon System, Oaxaca (María Fernanda González Amador)
17:20	-	17:40	Impact effects of hard infrastructure in Salamanca Natural Park (Juan Carlos Caez-Perez)
17:40	-	18:00	The decision-making in face to coastal squeeze, analysis between social and economic impacts: Case study of Campeche, Mexico (Debora L. Ramírez-Vargas)
18:00	-	18:30	Keynote speech • Elvis Carissimi
20:00			Dinner

Tuesday, 15th		Conference Day 2	
Session 5: Water, ecosystem and socio-economic integrating aspects (III) Chairman: Arwa Naser Damen Hamaideh			
09:00	-	09:20	Dispersion of submarine groundwater discharges in reef lagoons and associated environmental effects (Arlett Rosado Torres)
09:20	-	09:40	Salt intrusions into a freshwater spring in a tropical coastal lagoon, Yucatán, Mexico (Xaní Malagón)
09:40	-	10:00	Variability of the saline gradient in a hypersaline coastal lagoon (Brenda Natalia Fitch Geymonat)
10:00	-	10:20	Sedimentation and water quality status of lake Tana, the headwaters of the Blue Nile, Ethiopia (Seifu A Tilahun)
10:20	-	10:40	An innovative approach to mitigate risks on the existing iron tailings dams in Brazil (Jose Araruna)

10:40	-	11:00	Urban sustainable water management and water efficiency improvement for buildings – a case study for Istanbul (Ahmet Baban)
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11:00	-	11:30	Coffee Break
Session 6: Water-Energy-Nexus (II) Chairman: Eduardo Saldanha Vogelmann			
11:30	-	11:50	Reverse electrodialysis for energy and water: coupled systems based in salinity gradients (Mateo Roldan-Carvajal)
11:50	-	12:10	Development of graphene oxide membranes for its use in reverse electrodialysis systems (Eddie López Honorato)
12:10	-	12:30	Development of graphene oxide based materials for water treatment (Ana Cecilia Reynosa Martinez)
12:30	-	12:50	Laboratory experiences on marine energy conversion devices for supplying electricity demand of remote coastal communities (Jassiel Hernández)
12:50	-	13:10	Plate type obstacles used for coastal protection and power generation (Luis Eduardo Pérez Paez)
13:10	-	14:40	Lunch
Session 7: Water, ecosystem and socio-economic integrating aspects (IV) Chairman: Thi Thanh Van Ngo			
14:40	-	15:00	Evaluating combinatorial water treatment by locally available materials (Chrispin Kowenje)
15:00	-	15:20	Desalination by capacitive deionization as a tool to provide drinkable water to small communities in the Brazilian semiarid (Luis Augusto Martins Ruotolo)
15:20	-	15:40	Fluoride ions removal from groundwater by alumina adsorption (Elvis Carissimi)
15:40	-	16:00	Bio-refineries: A new concept towards green energy production from agroindustrial wastewater (Víctor Alcaraz)
16:00	-	16:20	The importance of water and nutrients management in paddy fields as an effort to increase crop yields and producing an electrical energy through microbial fuel cells (Dwi Andreas Santosa)
16:20	-	16:50	Coffee Break
16:50	-	17:20	Keynote speech • Klaus Fricke
16:50	-	18:00	Panel discussion Moderators: Edmilson Santos de Lima and Norbert Dichtl
20:00			Gala dinner