



Hydrologic dynamics in a Urban Tropical Lagoon, San Juan Bay Estuary, Puerto Rico

Abstract

❖ The San Juan Bay Estuary (SJBE) is an important natural coastal resource which comprises several types of habitats, five lagoons, and the largest mangrove forest in Puerto Rico: the Piñones Commonwealth Forest. During the last one hundred years, humans have altered the SJBE extensively by dredging, filling, and by the discharge of domestic and industrial wastes. The hydraulic characteristic of the Laguna San José (LSJ), its dynamics and nitrogen loads are not completely understood. A preliminary simple box model (according to Land-Ocean Interaction in the Coastal Zone-LOICZ guidelines) is proposed to calculate the water budget for the LSJ. Our overall goal is to develop a N budget for the LSJ. This research is relevant to the management and restoration efforts of the SJBE.

Introduction

❖ The San Juan Bay Estuary (SJBE) in Northern Puerto Rico (Figures 1 and 2) is comprised of five lagoons interconnected by several canals. It represents a unique tropical estuarine ecosystem enclosed within the highly populated San Juan Metropolitan Area.

❖ Because nitrogen is considered a limiting nutrient in coastal waters (Howarth et al. 1996), hydrologic characterization and analysis of nitrogen fluxes to the SJBE should provide invaluable information to direct pollution control efforts. In addition, since the magnitude and fate of anthropogenic nitrogen inputs to the SJBE are unknown, it is, therefore, of both national and global interest to understand human-related nitrogen fluxes in the tropical SJBE.

❖ The LOICZ-(Gordon et al., 1994) study of the International Geosphere-Biosphere Programme includes guidelines to estimate water, salt and nitrogen budgets in semi-enclosed coastal areas.

❖ The objective of this work is to present the relative water contribution of the watersheds that drain into the LSJ, water budget and a conceptual nitrogen budget for the LSJ using a steady-state box model approach.

Materials & Methods

❖ Direct discharge measurements were made biweekly at permanent cross sections using at each watersheds (fig. 1).

❖ A preliminary water balance budget according to the LOICZ approach (Gordon et al., 1996) was applied to estimate the water residence time of the LSJ. The conceptual premise under the LOICZ approach is to establish a compensatory residual flow (V_R) to balance the fresh water volume entering the system, such as runoff (V_Q), precipitation (V_P), ground water (V_G), other flows (V_O), and the evaporative losses (V_E) (Sylaios 2003).

❖ The water balance for LSJ was calculated using the following equation:

$$V_R = V_P - V_Q - V_G + V_E$$

The data presented in this poster were summarized from the following reports: Ellis and Gómez-Gómez (1975), Ellis and Gómez-Gómez (1976), and Gómez-Gómez and Ellis (1983), Cerco et al., 2000, and Ortiz-Zayas et al. 2006 and preliminary data obtained from the present dissertation. Meteorological data were gathered based on observations made by the National Weather Service in San Juan, Puerto Rico.

Results, Discussion & Conclusions

❖ Figure 3 presents the annual water budget for the LSJ. The water exchange (residence time) of LSJ was calculated at 55.6 days.

❖ A water residual outflow (V_R) occurs as a result of the water discharge from the Quebradas Juan Méndez, San Antón, Baldorioty de Castro Pump Station, precipitation (V_P) and evaporation (V_E). Since the N budget for tropical estuarine ecosystems is not well understood, one of our overall goals is to develop a N budget for LSJ (Figure 4).

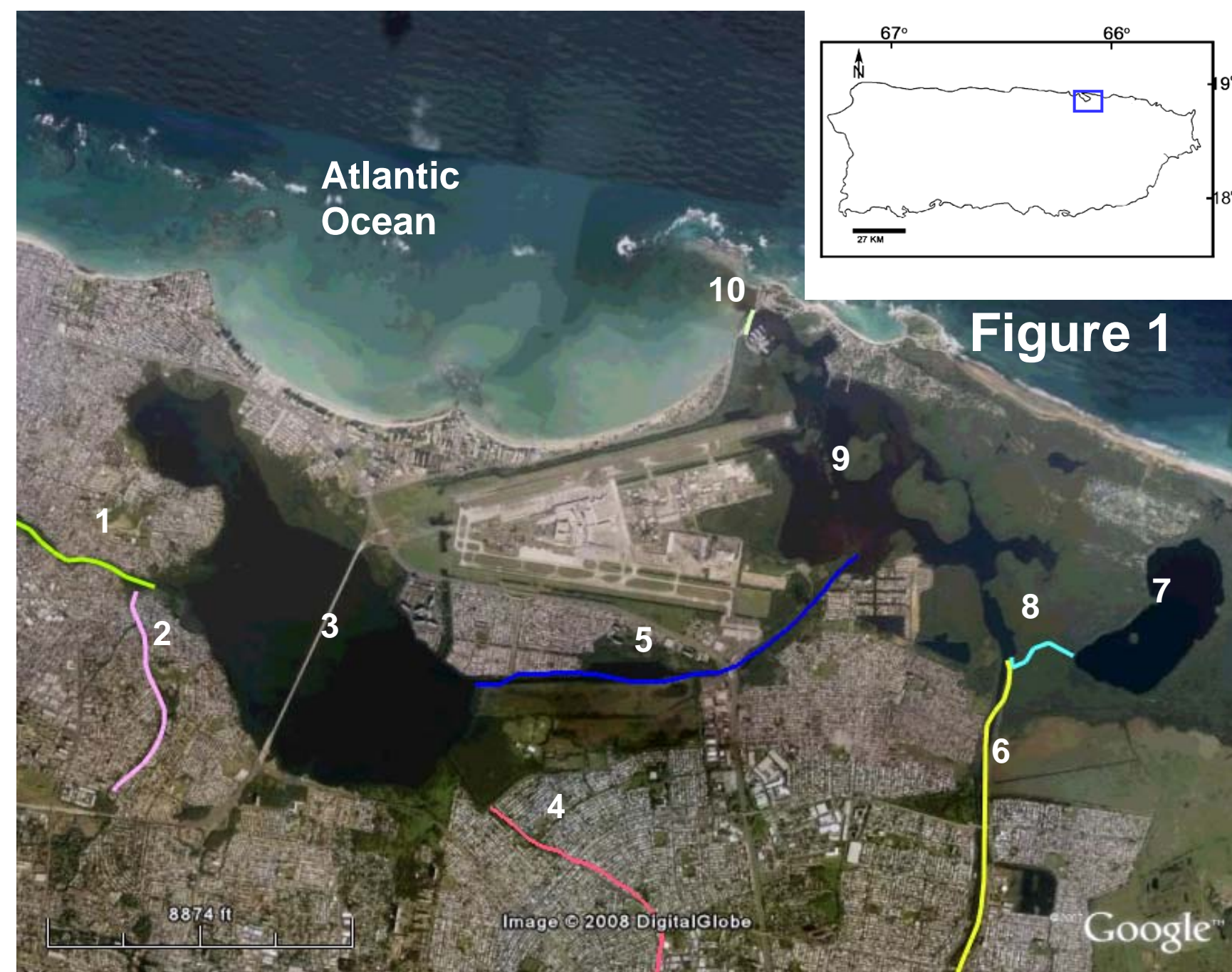


Figure 2

Figure 1. Location of the SJBE in Puerto Rico

Figure 2. Details of the in SJBE, Puerto Rico

1. Caño Martín Peña
2. Quebrada Juan Méndez
3. Laguna San José
4. Quebrada San Antón
5. Canal Suárez
6. Quebrada Blasina
7. Laguna De Piñones
8. Canal Piñones
9. Laguna La Torrecilla
10. Boca De cangrejos

❖ The preliminary water budget presented in this study require a more detailed description of the drainage area of the creeks associated to SJBE.

❖ The conceptual nitrogen budgets reveal the need to asses the role of the fringe mangrove forests on litterfall inputs to the lagoons, to measure denitrification, N fixation, fluvial and runoff from creeks and channels N-load in order to fully understand the N dynamics in LSJ.

Water fluxes ($m^3 yr^{-1}$) x 10^6

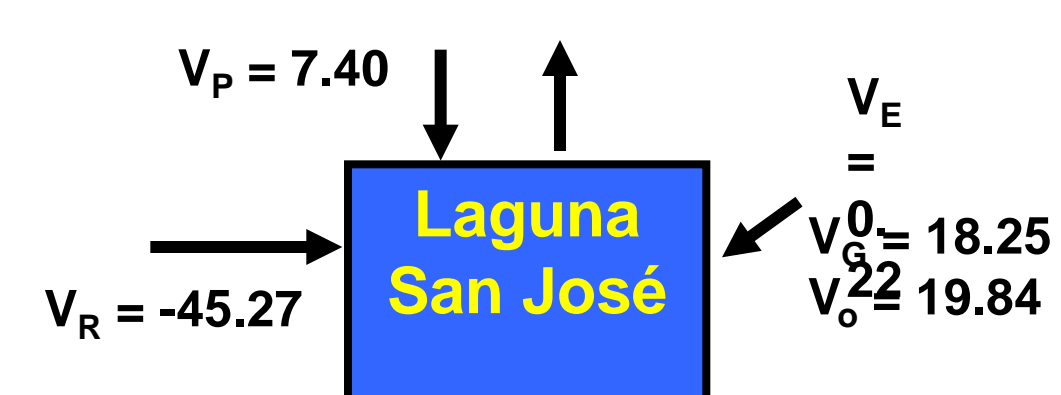


Figure 3

Conceptual nitrogen budget

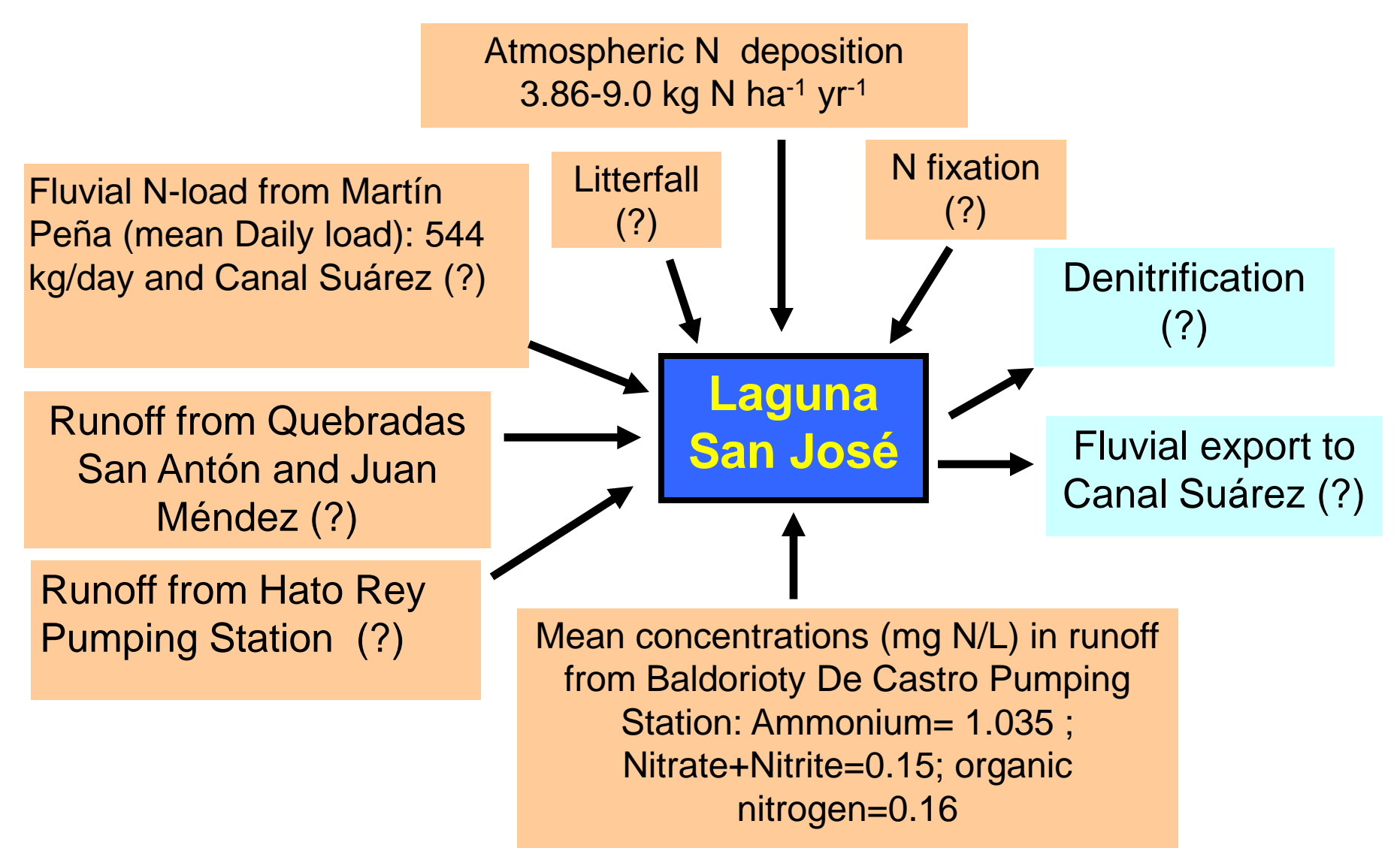


Figure 4

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Funded by National Science Foundation, HRD #0734826, University of Puerto Rico, Río Piedras Campus and Fondo Institucional para la Investigación, Decanato de Estudios Graduados y de Investigación, Universidad de Puerto Rico, Recinto de Río Piedras.

