

NARRATIVE QUARTERLY REPORT

(JULY–SEPTEMBER) 2025

Project — In situ monitoring of water quality in Cuban bays: creating and promoting the use of scientific tools

Participating institutions

- University of Havana (UH)
- Université Libre de Bruxelles (Belgium)

Cooperating institutions

- Center for Environmental Research and Transport Management (CIMAB)
- ESPOLETA Tecnologías (SME)

Other collaborating institutions

- José Antonio Echeverría Technological University of Havana (Cujae)
- Havana Bay State Management Group
- Université Catholique de Louvain

Project coordinators

Cuban side: Dr. C. Ernesto Altshuler Álvarez

Foreign side: Dr. Denis Terwagne

Participants — Dr. Geydis Fundora Nevot, Dr. Florence Degavre, Dr. Stamatios Nicolis, Dr. Alexandre Campo, MSc. Lázaro Martínez Ortiz, Eng. Alex Rivera Rivera, MSc. Luis Abel Rodríguez de Torner, Dr. Aramis Rivera Denis, Eng. Orestes Chávez Linares.

Duration — Five years

General objective — To provide the Cuban scientific-social ecosystem with a set of tools that enables in situ monitoring of water-quality parameters in Cuban bays, in a sustainable way and connected to local communities.

Specific objectives

- Design and build a wave channel at the Faculty of Physics, UH
- Design and build a buoy prototype
- Set up a server with a website to receive data from the buoys and from the community
- Establish a methodology for using the buoys
- Train the corresponding human resources

Fulfillment of the quarterly objectives

Objective 1. Drafting the second-year purchase list and customs procedures

After multiple procedures (including contracting an alarm-installation service), the alarm box was successfully cleared from Customs in early September 2025. Its installation began, carried out by the project's own members with the help of students. As a key milestone, and after extensive contact with the importing company, import authorization was obtained for the first container from the Université Libre de Bruxelles; we expect it to depart for Cuba before the end of the year. The first shipment from Panama, meanwhile, is ready to be cleared from warehouses in Guanabacoa, which

is planned for the coming days, using both University of Havana transport and project resources. During the last quarter, constant negotiation continued with suppliers of specialized equipment for the second container from Belgium and the second shipment from Panama.

Objective 2. Continued instrumentation of the buoys, and wave-channel design

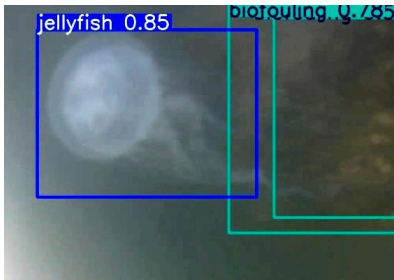


Figure 1. For the first time: detecting sub-aquatic life in Havana Bay through artificial intelligence.

Throughout the period, multiple tests were run on the buoys' LoRa-based communication system, involving PhD candidates Alex Rivera, Daniela Martínez, and Luis Abel Rodríguez. In particular, the resilience of the communication system with 12-volt batteries was tested on land to minimize the effect of the country's systematic blackouts. Tests were also carried out to build a submersible camera capable of filming sub-aquatic life and contaminants, aided by artificial intelligence, which appears to hold potential for assessing water quality in the bay. Figure 1 shows how a moderately trained AI is able to identify a jellyfish and biological wall fouling (bio-fouling) from a video shot with an inexpensive camera in very turbid waters. The video was taken by E. Altshuler and P. Altshuler; processing was done by Daniela Martínez, Stamatios Nicolis, Milton García, and Alex Rivera. Luis A. Rodríguez continued working on image processing for measuring parameters in wave channels.

Objective 3. First steps in developing a wireless sensor for seawater conductivity

Physics graduate Marlon Mederos continued tests, both in the lab and in Havana Bay waters, on the possibility of using LoRa signal-reception strength as a wireless measure of water conductivity/salinity. The tests continue to advance.

Objective 4. Academic exercises carried out by the PhD candidates involved in the Project

PhD candidates Luis Abel Rodríguez, Alex Rivera, and Daniela Martínez were successfully enrolled in doctoral programs at the Université Libre de Bruxelles. In addition, the first draft was completed of a review article on the use of artificial intelligence for detecting biological marine contaminants, whose lead author is Lic. Daniela Martínez. In terms of university outreach, an ARES-associated summer school was held within the Faculty of Physics' Summer School, between July 14 and 19, 2025. In it, pre-university students carried out experiments on topics such as measuring water contamination, measuring parameters in a wave channel, and identifying microplastics using polarized light.

Objective 6. Continued research in the social sciences

During the period under review, progress was made on the doctoral thesis objective of identifying the needs and expectations of social actors in terms of knowledge, communication, and participation, related to water quality in Havana Bay. Coordination was carried out with local authorities to begin activities with social actors of the Casablanca geographic community,

specifically with the President of the local Popular Council. The 2024 environmental and cultural diagnostics of Casablanca, produced by the community's Popular Council and projecting activities through 2026, were studied. Key informants and experts to be interviewed were identified and selected. Two focus groups were defined: one with officially accredited recreational fishers residing in the community, and the other made up of students from the local "Aracelio Iglesias Díaz" secondary school. The content of the survey to be used in the community diagnosis was validated, regarding residents' knowledge of the various practices carried out in terms of education, communication, management, and environmental monitoring in the area, and relevant adjustments were made. Sample size was defined using the formula for representative samples of finite populations, with a 95% reliability coefficient and a 5% sampling error; given the community's population (6,024 residents), the resulting sample size is 375, to be applied by electoral district.

A meeting was held with members of the Popular Council, discussing the importance of the topic and the community's need to develop practices contributing to the sanitation and monitoring of the bay's water quality; notably, they showed interest in the citizen-science approach to be used in the research. The project took part in the PReCISE Summer School on citizen science, to design citizen-science actions in Casablanca that promote social participation in water-quality monitoring (<https://pattern.projects.directory/>), to prepare a course for local people interested in citizen science based on <https://www.circle-u.eu/resources/>, and to apply for inclusion in the RICAP network (<https://cienciaparticipativa.net/>). An article on these experiences of working with different types of actors is being prepared for CLACSO's "Diálogos en Desarrollo" bulletin. Regarding objective 2, the research, monitoring, and environmental-sanitation practices carried out in Havana Bay by CIMAB, CFV, and GTEBH over the last three decades were systematized in the previous quarter; these results were used to present the paper "Environmental Monitoring and Management in Community Transformation: Experiences from Casablanca," to be presented at the 5th UCLV International Scientific Convention 2025.

Finally, it should be noted that on September 25, 2025, CIMAB organized the workshop "Climate change and women: more vulnerable?", organized by PhD candidate Mayelín García with the participation of PhD candidate Luis Abel Rodríguez, who presented the seminar "ARES Project: In situ monitoring of water quality in Cuban bays: creating and promoting the use of scientific tools" (see Figure 2).

Sincerely,

Dr. C. Ernesto Altshuler

Head of the Complex Systems Laboratory, Center for Complex Systems, Faculty of Physics
University of Havana.



Figure 2. When the social sciences meet the natural and technical sciences. Luis Abel Rodríguez presents at the

event organized by CIMAB, "Climate change and women: more vulnerable?" (September 25, 2025).

English translation of the original Spanish narrative report submitted to ARES, prepared for the CubanWaterLab website.