

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

**DOCTOR OF ENGINEERING SCIENCES**

of **Analy Baltodano Martinez**

The public defense will take place on **Wednesday 8<sup>th</sup> October 2025 at 4 pm** in room **I.0.02** (Building I, VUB Main Campus)

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**BRIDGING THE DATA GAP: REVEALING WATER QUALITY THROUGH  
REMOTE SENSING AND CITIZEN SCIENCE**

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## Abstract of the PhD research

Water quality degradation is emerging as one of the most critical environmental and social challenges of the 21st century, especially in the Global South where data scarcity and institutional capacity gaps persist. The uneven availability of monitoring infrastructure, compounded by the high cost and labour-intensive demands of in-situ measurements, continues to impede progress toward Sustainable Development Goal 6.3.2. This thesis addresses these challenges by exploring the synergistic potential of satellite remote sensing and citizen science as complementary strategies to generate actionable water quality data. It advances a transdisciplinary research that integrates technological innovation with social engagement to bridge critical knowledge gaps and enhance environmental governance.

Adopting a multi-scalar, multi-methodological approach, this research centres on two emblematic freshwater systems in Latin America: Lake Nicaragua and Lake Titicaca. First, it explores the performance and limitations of global remote sensing products for deriving key water quality parameters (chlorophyll-a, turbidity, and lake surface temperature). The findings highlight the potential of these products to characterize long-term variability and identify pollution hotspots, while underscoring the need for region-specific calibration to improve accuracy. In Lake Titicaca, the optimization of atmospheric correction and bio-optical algorithms was shown to significantly improve the retrieval of optically active water quality parameters.

Beyond the technical dimension, the research foregrounds the importance of contextualization, both in how data are produced and how they are understood by those most affected. A citizen science initiative in Chojasivi, Bolivia, exemplifies how participatory monitoring can enhance environmental literacy, cultivate community ownership, and catalyse social and institutional change. The project not only produced valuable datasets, but also catalysed a platform for dialogue, advocacy, and capacity building by engaging indigenous youth and local stakeholders in water quality monitoring and the collaborative interpretation of results.

The final synthesis demonstrates that remote sensing and citizen science are not only technically compatible but epistemologically complementary. When strategically integrated, they can enhance the robustness, legitimacy, and inclusiveness of water quality monitoring systems. The thesis concludes with practical recommendations for aligning scientific innovation with local needs, advocating for hybrid monitoring models that balance global technologies with community-based knowledge systems. This research contributes to a growing body of work aimed at rethinking environmental monitoring as a participatory, context-oriented, and multi-scalar endeavour.