# Model-Based Approaches for Preserving Coastal Lagoon Ecosystems: A Case Study in Southeastern Spain

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Coastal lagoons are key ecosystems for human purposes, but their proximity to densely populated areas, water resource consumption, and limited water exchange make them highly vulnerable. An example of this vulnerability can be found at the Campo de Cartagena aquifer in south-eastern Spain, located along the shores of the Mar Menor, the largest saltwater lagoon in Europe, which faces significant challenges to achieve good quantitative or chemical status.

Many factors contribute to the contamination, including the groundwater over-exploitation of deep aquifers. The severity of this contamination has been underlined by concentrations of salinity, nitrates, and pesticides exceeding established thresholds. In particular, average nitrate concentrations persistently exceeded 50 mg/L between 2015 to 2019, confirming the extent of the problem.

In addition, the growth of the tourism industry has led to increased nutrient inputs and rising algal blooms that involve toxicity risks to wildlife. Eutrophication has caused a significant reduction in water transparency and episodes of anoxia.

The NINFA EU project (grant 101081865) aims to develop conceptual and numerical models of groundwater flow and transport to predict the transport, evolution, and chemical-physical reactions of pollutants on a basin scale. The new model, supported by a previously realized flow model at the regional scale, will focus on the urban coastal area of Los Alcázares, integrating data from innovative monitoring strategies to improve the representation of groundwater flow and reactive transport, reducing uncertainties in future scenarios. Advanced numerical methods will be used for porous media to identify and classify primary pollution fate processes for different contaminants. By increasing the understanding of water flows and developing predictive models, the project aims to promote the treatment, and improvement of water quality, protecting coastal lagoons and their ecosystems.