PhD position: Uncertainties and projections of relative sea level for decision-making

Location: BRGM, Orléans (France). The PhD will be co-directed by Stéphane Costa (Univ. Caen) and Rémi Thiéblemont (BRGM), and supervised by Jérémy Rohmer (BRGM).

Starting date: Autumn 2026.

Keywords: Sea-level rise, Uncertainty, Climate Change, Projections, Decision-Making.

PhD Topic Description: Sea-level rise (SLR) and its acceleration will lead to profound changes in coastal dynamics, coastal risks, and consequently in coastal societies over the coming decades and centuries. To face these challenges, coastal communities and socio-economic sectors must design adaptation strategies based on the best available sea-level projections. However, SLR projections and their consequences are characterized by a very wide range of uncertainties, which can result in inaction even though anticipation is essential. The objective of this PhD is to leverage new observational and modeling data on the one hand, and to explore advanced statistical methods on the other, in order to improve local-scale sea-level projections in support of coastal adaptation.

The PhD work will explore different datasets from observations or numerical modeling that make it possible to integrate local, fine-scale processes such as vertical land motion using InSAR and/or GNSS products [1,2], as well as high-resolution ocean modeling of the continental shelf [3] and the Mediterranean Sea [4]. These new data will be combined with results from historical climate simulations and compared with tide-gauge and altimetry observations to assess the ability of models and methods to reproduce the observed local sea level.

The results obtained from historical reconstructions will serve as a starting point for producing projections and representing the uncertainties of each sea-level component [5]. Several assumptions regarding the representation of uncertainty and their combination will be tested, and sensitivity analyses will help assess their impact on the total uncertainty of local sea-level projections. These assumptions include, for example, whether vertical land motion is linear or not [6], correlations between certain sea-level components [7], selection of specific climate models [8], or assuming physical processes that could drive an acceleration of ice-sheet mass loss [9].

Various projection methods may be explored:

- Probabilistic sea-level projections [10], widely used but potentially underestimating the uncertainty range [11];
- Storyline approaches, proposed to describe plausible scenarios of future climate change without necessarily relying on probability analysis [12], aiming to improve communication with decision-makers and the planning of adaptation strategies [13]. This approach allows exploration of low-probability, high-impact scenarios—so-called *high-end* scenarios [14];
- Extra-probabilistic approaches, enabling a more exhaustive exploration of the range of uncertainties [15], though their interpretation is more complex.

This PhD is part of the transdisciplinary CERISE project within the PEPR TRACCS program. The work will be presented and discussed with CERISE stakeholders and will support the co-development of sea-level projections intended for coastal actors. Within CERISE, stakeholders are engaged through two use cases:

- The first concerns coastal communities in a broad sense and involves elected officials, BRGM regional engineers, inter-municipal technical staff, citizens, etc., across the three selected study sites: Dunkirk, Le Havre, and Hyères.
- The second focuses on close collaboration with EDF to develop SLR projections supporting the adaptation of their coastal infrastructures.

Profile: Master's degree or Engineering degree in Climate/Ocean/Atmospheric Science or Coastal Geosciences

Professional experience: Some experience in managing climate datasets is recommended.

Technical skills :

- Solid experience in environmental data and time series processing (signal processing, statistical analysis, machine learning, applied mathematics)
- Knowledge of climate physics and oceanography
- Proficiency in programming languages (Python or R)
- French and English (ideally B1 level or equivalent)

Other skills:

- Scientific rigor and curiosity
- Autonomy, sense of initiative
- Ease of writing (scientific documents and articles)
- Ability to work in a group in a multidisciplinary approach

Would be a plus:

- Knowledge in physical geography
- Knowledge in uncertainty quantification

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