



axis **5**

“Dynamics & vulnerability of coastal zones”

SCIENTIFIC CONTEXT

The rationale of axis 5 is to observe and understand coastal vulnerability arising from the combination of natural and complex social dynamics, so as to devise coherent and long-term strategies for a sustainable management of the coastal zone. Coastal vulnerability, in particular to erosion and flooding, is related to the response of coastal environments (beaches, dunes, cliffs, estuaries) to physical forcing such as marine and meteorological hazards and the subsequent storm impacts on the coast (sediment transport processes, geomorphological evolution), or also longer-term forcing due to climate change (sea-level rise, storminess increase). Coastal vulnerability is also related to human forcing accompanying the increase of social and economic activities, urbanization, coastal defense and changes in land use as well as governance strategies, nature conservation and public policies, etc. The analysis of physical and human forcing following spatial, temporal and social multi-scale and multi-disciplinary approaches will yield a knowledge base of coastal dynamics and vulnerability.

Keywords

- Coastal risks
- Systemic vulnerability
- Coastal geomorphology
- Hydro-sedimentary dynamics
- Multi-source
- and multi-proxy observation
- Erosion and flooding

Coordinators

- Alain Hénaff (LETG-GEOMER)
- Nicolas Le Dantec (LGO et CEREMA)

Participating laboratories

- **LETG**
Littoral Environnement Télédétection Géomatique
[UMR 6554, CNRS, UBO, Univ. Nantes](#)
- **LGO**
Laboratoire de Géosciences Ocean
[UMR 6538, CNRS, UBO, UBS](#)
- **LOPS**
Laboratoire d'océanographie physique et spatiale
[UMR 6523, CNRS, UBO, IRD, Ifremer](#)
- **AMURE**
Laboratoire d'Aménagement des Usages des Ressources et des Espaces marins et littoraux
[UMR 6308, CNRS, UBO, Ifremer](#)



ROADMAP

The objective of the axis is to gain insight on hydrodynamic and morpho-sedimentary processes involved in erosion and flooding hazards, and to better understand the associated risks with a systemic approach to vulnerability.

Research actions focus on:

- **Coastal hydrodynamics:** energy dissipation (in particular in the swash zone) ; hydro-sedimentary processes at the sediment-water interface ; role of infragravity waves and their consequences for flooding and erosion, wave-beach-cliff interactions and processes involved in cliff-top storm deposits,
- **Coastal morphodynamics:** kinematics of the shoreline; beach/dune profile evolution ; cliff erosion, sediment fluxes ; foreshore dynamics and sediment budgets, dynamics of underwater bedforms.
- **Modeling:** coupled hydro-morpho-sedimentary modeling (Xbeach, etc.) on beach morphodynamics ; wave-to-wave modeling approach (Swash, Mystic and Bosz models) to examine the effect of transient hydrodynamic processes on sea level changes (setup, runup) and on sediment fluxes in the swash zone.
- **Methodological developments:** measurement of forcing factors and dynamics, multi-proxy approach for bathymetry, water-column sensing (acoustic methods) and surface water analysis (passive and active optical measures ; high-resolution imagery for topographic surveys and high-resolution acoustic imaging for autonomous submersibles.
- **Implications of the occupation and uses of the coastal strip by human activities:** impact of anthropogenic forcing on the natural environment.



Vougot beach (Guissény) during the Christine Storm in March 2014.

© S. Suarez / UBO

Following upon the Cocorisco ANR project dedicated to knowledge, understanding and management of coastal risks, multidisciplinary studies on systemic approach to coastal vulnerability will be continued. Going beyond the sole observation of physical processes, all four components of coastal vulnerability are considered: hazards, social and economic stakes, coastal zone management, and the perception of coastal risks. Research actions consist in:

- **Defining and implementing indicators to monitor and analyze the four components of vulnerability.** The dynamic dimension of monitoring risk management is essential because coastal zones and their regulations are in constant evolution.
- **Developing relevant methodologies and assessment tools to build an interdisciplinary observatory of coastal erosion and flooding hazards,** combining humanities, social, economic, legal and natural sciences. Insights on the relevant timescale of responses will guide the definition of data collection protocols. Risk, as a social construct, refers to very diverse forms of knowledge according to the people involved and their relationship to the considered risk and the concerned areas. Co-development will be applied to design such an observatory, based on real-life experimentation and interactions between researchers and public stakeholders.
- Axis 5 participants will be encouraged to build upon the expertise of the Indigeo (www.indigeo.fr) and Dynalit (www.dynalit.fr) data portals to ensure data management (storage, metadata library building, geographic visualization), in relation to the implementation of the INSPIRE Directive (2007/2/CE).

EXPECTED RESULTS

Studies on coastal hydro-sedimentary processes will improve our understanding of the coastal zone response towards present and future forcing scenarios. The challenges consist in discriminating the contributions of multiple forcing factors playing a role in coastal erosion and submersion. Innovative observation methodologies aim at unraveling the processes acting at different spatial and temporal scales. The combination of modeling and observation networks will contribute to risk assessment at regional and global scales. The pioneering research on systemic vulnerability will set the scene for the development of new paradigm to support comprehensive and effective coastal risk management.

Expected outcomes include guidelines for the implementation of methodologies and practical tools for coastal management and protection policies. Scientific results may be transferred via training courses dedicated to coastal managers or filing for innovative techniques or software at the INPI (National Institute of Industrial Property) or the APP (Software Protection Agency).