

## Detection and Study of Fracturing by HYdrological, GEOMorphodynamic, GEOlogical and GEOphysics approach DEFHY3GEO

203

203.5



204

20.6

20.4



Normandie Université



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# Le Project

The erosion of the coastline in Normandy originates from three main phenomena: marine meteorology, withdrawal of sediments, and the anthropization of the coastline.

The evolution of these phenomena also seems to be taking shape unfavorably. In this project, we propose to study the fracturing of coastal cliffs under the influence of marine and plateau hydrology. We are particularly interested in the vertical-walled cliffs of Normandy composed of chalk (Seine-Maritime, Pays de Caux) and limestone (Calvados, Bessin), where cracking can be particularly significant.

Understanding this phenomenon contributes to the explanation and identification of the factors accelerating the erosion of cliffs and the triggering of mass movements (sudden collapses, landslides, falling blocks, etc.), and consequently, the retreat of the Normandy coastline.

Our scientific problem is that, although the major control of structural processes on cliff erosion is widely recognized and the exogenous factors (marine, continental, and anthropogenic) are well identified, the question of their respective contributions in triggering the movements remains open. We therefore propose to deploy, on the one hand, a methodology for measuring the surface of the plateau, the vertical walls, and the plateau and, on the other hand, deeper within the massif. The resources deployed require aerial techniques, surface monitoring in clay fracturing, and geophysical imaging within the massif. The implementation of these techniques and an adapted methodology should allow a better understanding of the transit of water in this system.

Our methodology was applied to different research sites selected and representative of environments with contrasting lithologies. The DEFHY3GEO project offers an open and structured framework for the development of a strategy for the detection and study of fracturing for a better definition of the mapping of the coastline recession hazard. The leverage effect of the project materialized via a planned submission of a European project (drafting in progress), and on the LMI side, a new PEPS project from the AMIES national Labex was validated at the end of 2023.

Naturally, publications and communications, the organization of conferences, and invitations of international researchers to Normandy contribute to the influence of the members of the DEFHY3GEO project.

## DEFHY3GEO



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### GOALS of the PROJET

The project objectives are linked to advances in both fundamental and technological research. The concrete applications are clearly identified, as well as the expected consequences of this project

- for: companies,
- for the academic entities,
- in Normandy and beyond. :

### ARTICLES & CONFERENCES

Three different options are considered:

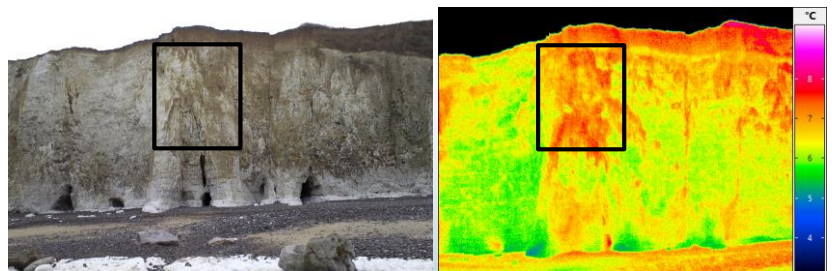
- Research articles in international journal (MCA 2022, J. of Imaging 2024...),
- Oral and postal communications in conferences (SIAM 2024...),
- National communications (MSN Rouen 2023...).

### CONFERENCES

Every year, scientific workshops are organized linked to DEFHY3GEO topics, with international researchers participating

- 2023 : Workshop « Modelling and numerical simulation FR CNRS3335, Normandie Mathématiques »

### Earth-Ocean continuum



*Sainte-Marguerite-sur-Mer dataset (Normandie),  
and corresponding infrared image  
(Equipments : IR camera – data processing  
using imaging station and laptop)*

# THE PROJECT DEFHY3GEO

- **Project reference** : 21 E 05300
- **Signature date of the convention** : 2021 (from 01/01/2022 to 30/06/2025)
- **Funding partners** : Région Normandie and European Union
- **Leader** : CEREMA Normandie [R. Antoine (CEREMA). INSA Rouen Normandie : C. Gout (INSA)]
- **Scientific chairs** : R. Antoine (ENDSUM, CEREMA) and C. Le Guyader (LMI, INSA) for WP2

Recrutments on DEFHY3GEO topics

Recrutments Temporary contracts DEFHY3GEO	Researchers/Engineers linked to the project
<b>Rim FAYAD</b> (12m, postdoc LMI) <b>Zoé LAMBERT</b> (24m, postdoc CEREMA) <b>Georges SADAKA</b> (12m CEREMA) ...	<b>Guzel KHAYRETDINOVA</b> (PhD LMI) <b>Nathan ROUXELIN</b> (Asst Prof. LMI INSA, 2023)

## DEFHY3GEO

An ambitious research program

At the service of the scientific community and society

### Four different work packages

- **WP1: Characterization of hydrology and fracturing** by combining remote sensing, geophysical, geotechnical and geomorphological methods. This will involve studying the triggering processes at the scale on one or more particular site(s) ;
- **WP2 : Detection/characterization of this large-scale fracturing** using multi-spectral methods;
- **WP3 : Assesment, modelling and mapping of the hazard** in order to define the sectors of high susceptibility and the location of the hazard ;
- **WP4 : Results dissemination and exploitation.**

## DEFHY3GEO

### ➤ High level research activities...

- Codes, softwares...
- Articles
- Communications
- Posters
- Workshops

### DEFHY3GEO : high level equipments

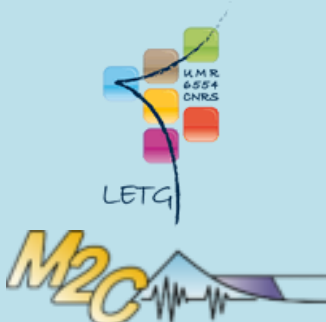


IR camera



Workstations and computers...

## Involved entities to the project...

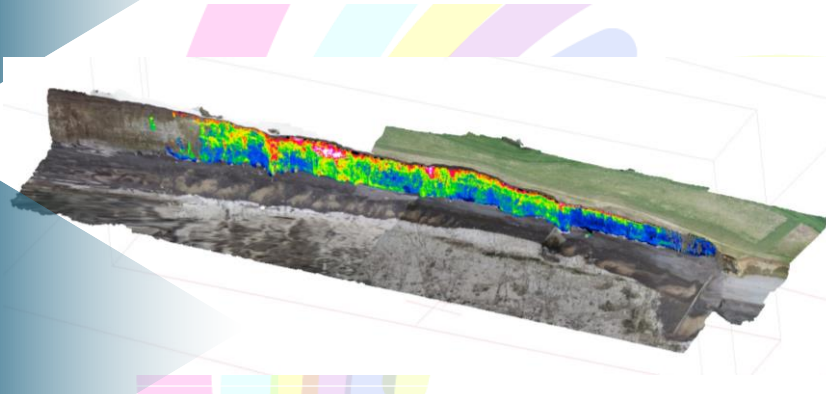




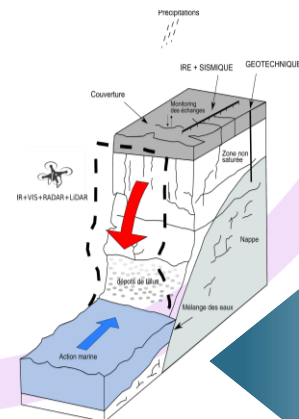
## Researchers involved in DEFHY3GEO :

Full and assistant professors :

- LMI (5) : C. Le Guyader (Resp. de WP), C. Gout (porteur INSA), I. Ciotir, A. Tonnoir et N. Rouxelin.
  - ENDSUM CEREMA (2) : C. Fauchard, R. Antoine.
  - LETG Caen (2): S. Costa, O. Maquaire.
  - UMR M2C Rouen (1) : F. Rejiba
- as well as doctoral students, interns, research engineers, postdocs, end-of-study projects from the INSA Mathematical Engineering department and collaborators external to the project.



**Zoé Lambert**  
Faults detection  
on geological dataset



### Informations :

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Raphael Antoine (CEREMA, project leader)  
Project managing at INSA (INSA) :  
Brigitte Diarra-Vincent Arnoux et Estelle Deilhau.

Co-financeurs :



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