# POSTDOC 12 MONTHS

*from october 1, 2022 – LMI – INSA Rouen*

## 1. General informations

This post-doc is part of the project DEFHY3GEO - - *DEFHY3GEO is co-financed by the* ***European Union*** *with the European regional development fund (ERDF) and by* ***the Normandie Regional Council***.

**Laboratories:**

- INSA Rouen (Institut National des Sciences Appliquées – National Institute of Applied Science), LMI (*Laboratoire de Mathématiques* de l'INSA – INSA Mathematics Laboratory), EA 3226, FR CNRS 3335
- Cerema, ENDSUM (Evaluation Non-Destructive des Structures et des Matériaux – Non-Destructive Evaluation of Structures and Materials), Laboratoire Régional de Rouen (Rouen Regional Laboratory), Unit of Applied Electromagnetism

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**Post-doc: « Study of the porosity of a porous media by inverse methods. Application on the cliff study. »**

**Duration:** 12 Months

**Salary:** 2 293 € (nets) **/month**

**Keywords:** Modeling of the porous media equation, inverses problems, numerical simulation

**Required skills:** We are looking for a candidate with experience in mathematical modeling of physics problems and having an interest in Earth Sciences. Digital implementation and simulation skills are a plus.

**How to apply :** Please send a cover letter and a CV by email before july 20, 2022 to the following addresses: ioana.ciotir@insa-rouen.fr, antoine.tonnoir@insa-rouen.fr et raphael.antoine@cerema.fr .

## 2. Project description

**Context:** Coastline erosion is a natural phenomenon accelerated by climate change and whose societal impact requires re-invented monitoring. The construction of a more faithful model and its study from a theoretical and numerical point of view must allow a better auscultation and understanding of the physical phenomena at stake.

In this post-doc, we will seek to establish a mathematical model to describe water infiltration into a stratified and cracked porous medium. Environmental heterogeneities and cracks will have to be taken into account in the construction of the model (based on Richards' classic equations and Darcy's law). Once the mathematical model is established, the focus will be on developing numerical tools to simulate water infiltration into the environment. Using these tools, it will be possible to compare the experimental data (surface humidity measurements, crack position and size, thermal measurements) with the simulation results and calibrate the model.

The model developed will allow a better understanding of water transfers in the study environment and will support the work of another post-doc of the project DEFHY3GEO.

**Main missions:** The first objective of this work will be to repeat the mathematical modelling of porous media while keeping explicit the dependence on the porosity of the media. The goal will be to obtain a form of the equation giving a more accurate description of the porous media. (See [3]).
Then we will focus on the well-posed nature of the problem (check that the model obtained is covered by the classic results). (See [1], [6]).
The known numerical methods for the porous media equation will then be studied and adapted to the new model. (See [4], [5]).
To conclude, we want to build and solve an inverse problem to determine the porosity of porous environments based on measurements of the surface humidity of cliffs. (See [2]).

**Bibliography:**

[1] D. G. Aronson, « The porous medium equation » *Nonlinear diffusion problems* (1986): 1-46

[2] D. Constales, D. J. Kačur, J. « On the solution of some inverse problems in infiltration ». Mathematica Bohemica, vol. 126 (2001), issue 2, pp. 307-322

[3] G. Marinoschi « Functional approach to nonlinear models of water flow in soils », Springer, 2006.

[4] M. Rose « Numerical Methods for Flows Through Porous Media. II » Mathematics of Computation Vol. 40, No. 162 (Apr., 1983)

[5] M. Rose « Numerical Methods for Flows Through Porous Media. I » Computers & Mathematics with Applications Volume 6, Issue 1, 1980, Pages 99-122

[6] J.l. Vázquez, « The porous medium equation: mathematical theory ». Oxford University Press on Demand, 2007