Call for Applications: Doctoral Contract on the Multifractality of Urban Networks (2026–2029)

Title: Multifractal and AI Approaches for Coherent and Resilient Urban Energy Networks

Keywords
Urban energy networks, territorial planning, urban forms, multifractality, multi-criteria analysis, renewable energies

Context
Urban areas face the challenge of integrating renewable energy sources and managing high population density, efficient land use, and resilience to increasingly irregular climate events. Traditional urban planning methods struggle to capture the impact of the multi-scale complexity of urban systems on these challenges. This doctoral project proposes an innovative multi-scale framework using multifractal analysis coupled with open science mapping tools and artificial intelligence (AI) to address these issues. It is part of the Fracnet-City project, funded by the French National Research Agency (ANR) and the Swiss National Science Foundation (SNSF).

Objective
The goal is to develop an urban energy network planning approach inspired by a multifractal geospatial analysis. By applying multifractal analysis, the project will examine and propose urban layouts and networks to reduce land artificialization, promote renewable energy integration, and increase resilience to extreme climate events. The project will also produce adaptive tools capable of responding to urban dynamics, such as changes in energy demand, demographic growth, and climate evolution.

French-Swiss Partnership
This project is the result of a collaboration between teams in France and Switzerland, bringing together expertise in multifractals, energy networks, photovoltaic integration, geography, urban planning, and AI. Five research laboratories are involved:

- G2ELab – Université Grenoble Alpes (France) – nicolas.retiere@univ-grenoble-alpes.fr
- LOCIE – Université Savoie Mont-Blanc (France) – julien.ramousse@univ-smb.fr
- ThéMA - Université Bourgogne Europe (France) – jean-philippe.antoni@u-bourgogne.fr
- Lucerne University of Applied Sciences and Arts (Suisse) – yousra.sidqi@hslu.ch
- Empa, Swiss Federal Laboratories for Materials Science and Technology (Suisse) – georgios.mavromatidis@empa.ch

Expected Outcomes
Through case studies in urban areas (France and Switzerland), the project aims to demonstrate the relevance of its approaches for more coherent and efficient land use, enhanced integration of renewable energies, and increased resilience to climate change. Expected results include an adaptive planning model for networks based on multifractal coupled with open science tools and AI principles, and concrete recommendations for urban territory development.

FRACNET-CITY

PhD Topics
In this scientific context, four complementary PhD topics are proposed:

1. Electric Network and Territory: Mapping links through multifractal analysis
   (nicolas.retiere@univ-grenoble-alpes.fr)
2. Heat Network and Urban Form: Mapping links through multifractal analysis
   (julien.ramousse@univ-smb.fr)
3. Multifractal Urban and Energy Planning Assisted by Artificial Intelligence
   (yousra.sidqi@hslu.ch) – to be published.
4. Operationality and Robustness of Multifractal Urban Networks
   (georgios.mavromatidis@empa.ch)

More detailed descriptions of each thesis are available via the provided links.

Research Environment and Candidate Profile
The PhD candidates will be primarily based in one of the partner laboratories in France or Switzerland. The successful candidate must hold a Master's degree in electrical engineering, energetics, geography, urban planning, or ecology. Skills in geomatics are a plus, with a particular interest in spatial modeling, statistical analysis, fractal approaches, and Python programming. A strong interest in energy issues is also essential. Proficiency in spoken and written English is mandatory. The doctoral contract is for 36 months, with remuneration in accordance with French and Swiss regulations.

Applications
Applicants should send the following documents by email to the address specified for each thesis by **June 15, 2026**:

- Detailed CV
- Cover letter (max 1 page)
- M1 and M2 academic transcripts
- Master's thesis or internship report (if available)
- Letters of recommendation (if available)

Empa Materials Science and Technology
G2Elab
HSLU
LOCIE
ThéMA UMR 6049 Théoriser & Modéliser pour Aménager