

## DIAB-HEAT PROJECT

### Climate and Health – Impact of heat waves on diabetes: from observation to pathological model analysis

**Type of contract:** 36 months doctoral contract (100% Rouen-University thesis allocation in the context of France 2030 Excellences TRANSITION program)

*As part of the Rouen-Normandie University (URN)'s commitment in the field of ecological transition for sustainable development, the "TRANSITION" project obtained within the framework of the France 2030 program "Excellence in all its forms" aims to develop innovative and transversal research to respond to the challenges of multi-risk in the context of environmental changes, and to inform the decision-making of local and national actors. This call for theses is part of this dynamic and aims to accelerate interdisciplinary research and therefore strengthen collaborations between the research units at the URN on multi-risk and territorial adaptation.*

<https://www.univ-rouen.fr/actualites/lancement-du-projet-transition/#:~:text=Le%2025%20juillet%202023%2C%20le,matière%20de%20transitions%20socio%20Décologiques>

**Localisation:** Rouen – **Beginning of the contract:** September-October -November 2024

**Institutes and teams for the co-direction in Rouen-Normandie University:**

- Laboratory of Neuroendocrine, Endocrine and Germinal Differentiation and Communication NorDiC, INSERM U1239 – Team: Regulatory Peptides
- Laboratory of Continental and Coastal Morphodynamics M2C, UMR CNRS 6143

**Doctoral School:** École Doctorale Normande de Biologie Intégrative, Santé, Environnement (ED497)

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**Application deadline:** until recruitment

#### Project overview

Climate change poses a growing threat to human health and one of its most dangerous consequences is extreme heat which caused, in 2019, an increase in mortality of more than 80% among people over 65 years old. . According to IPCC experts, the frequency of days of extreme heat will increase drastically before the end of the century. **These larger and more frequent heat waves can have many impacts on human health**, particularly if chronic diseases, such as type 2 diabetes, are already present. This context is particularly worrying given the evolution of diabetes, considered today by the World Health Organization as a global epidemic, both in France and around the world. Thus, **the major health risk represented by diabetes could be greatly aggravated by extreme climatic conditions**. The conjunction of these two proven risks, climatic and health, places society face to face with a real public health challenge. In this context, it is crucial **to precisely assess the impact of extreme heat episodes on the development of diabetes in order to meet the challenge that the prevention and treatment of diabetes will represent in the years to come**. To do this, we will seek to understand the impact of the meteorological parameters of a heat wave on the mechanisms of regulation of glucose homeostasis. Notably, it is now well established that the brain plays a crucial role in the regulation of blood sugar levels which is controlled, at least partially, by the neuroendocrine systems of the hypothalamus. Thus, an alteration of these systems by heat could contribute to the development of diabetes.

The conjunction of these observations led to the proposal of this project which aims **to study the impact of heat waves on the pathophysiology of diabetes, by combining analyzes of meteorological and air quality parameters, clinical parameters and development of murine models**. To achieve this objective, the thesis will explore:

- the links between the occurrence of extreme heat waves and the pathology of diabetes on a local, regional and then national scale. Weather conditions (temperature, duration of the episode, humidity, tropical nights) as well as air quality (particles, NO<sub>x</sub>, O<sub>3</sub>, etc.) will be taken into account.



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- the impact of heat waves on healthy and obese/diabetic animal models (neuroanatomical study, physiological study at the neuron and organism level).
- the consistency of meteorological/health parameters and *in vivo* modeling, in order to define the conditions of a representative animal model.
- the effects of real heat wave episodes on a cohort of diabetic patients and reproduced on an obese/diabetic mouse model.

To do this, the candidate will have to adopt a **transdisciplinary approach at the interface between physiology/neuroendocrinology and meteorology/climatology**. In particular, i/ **statistical approaches** will be implemented to explore the links that exist between meteorological and climatological parameters, health data specific to diabetes and data obtained *in vivo*, ii/ *in vivo* studies to measure the impact different parameters characterizing heat waves in **healthy mice or mice made obese/diabetic by a high-fat diet**, iii/ *in vitro* approaches to understand the **cellular and molecular mechanisms underlying the body's reaction to heat**.

#### ***Profile of the desired candidate***

Master's degree in cellular/molecular biology, neuroendocrinology, physiology, neurosciences.

Meteorology/climatology courses will be given to the candidate in order to upgrade. The candidate must acquire solid skills in this area during its thesis in order to acquire a transdisciplinary scientific profile.

#### ***Technological approaches***

Using mouse models

Cellular and molecular biology

2D, 3D, super-resolution imaging techniques

Advanced use of statistical analysis/programming tools (R, Matlab,...)

#### ***Skills sought or to be developed***

Statistical analyzes (including AI)

Interest in meteorology/climatology/climate change

Animal experimentation level 2, surgery

Functional tests of energy and carbohydrate metabolism

Cell culture, 2D immunohistochemistry

Writing skills in French and English

Relational skills and interest in transdisciplinary work (broad scientific curiosity)

Team work