INTERNSHIP PROPOSAL

INFORMATION ABOUT THE INTERNSHIP	
Project	This internship is part of a project entitled 'Probability and severity of space weather impacts on terrestrial infrastructures', which is the result of collaboration between the Grenoble University Space Centre (CSUG), the UGA foundation, AXA XL insurance and AXA Research Fund, as well as G2ELAB. This project is part of the 'Joint Research Initiatives' set up by the AXA Research Fund, the aim of which is to establish partnerships between AXA teams and university experts with the aim of joining forces to answer a common research question.
Financement	Funded by AXA Research Fund and AXA XL.
Responsibles	- Elisa Robert *(elisa.robert@univ-grenoble-alpes.fr)* – PhD in space weather - Mathieu Barthelemy (*mathieu.barthelemy@univ-grenoble-alpes.fr*) – University professor
Title	Economic study of a space weather event on ground infrastructures.
Period	February or March 2025 – July or August 2025 (~6 months)
Language	English or French
Level of knowledges	Master 1 or 2, engineering school Economy, maths, basic knowledge of space physics (if possible)
Remuneration	Legal rate (4.35 euros per hour - 35 hours per week or (~)140 hours per month)
Location	UFR PhITEM - Bâtiment C - Centre Spatial Universitaire de Grenoble (CSUG) -120 Rue de la Piscine, 38400 Saint-Martin-d'Hères

CONTEXT OF THE STUDY

The context of this project concerns the field of space weather which study the impact of the Sun on terrestrial ground and space infrastructures. We are focusing here on the ground component. The aim is to better understand and quantify the risks involved so that solutions can be put in place to mitigate them, and in the best case to avoid them. These risks include disruptions (up to and including blackouts) to electricity grids, pipelines, railways and telecommunications cables. There are also increased risks associated with radiation received by crews and passengers in aviation, as well as disruption to HF and GNSS communications leading to malfunction of the systems using them. As a result, terrestrial electronics (mobile phones, connected watches, autonomous cars, etc.) and space systems are also likely to be affected. The work of Hapgood et al, 2020 provides a good overview of these different risks.

As all these events are interconnected, the malfunction of one system can lead to cascading failures. As a result, a major space weather event could have far-reaching consequences for our infrastructures, like the widespread power cut in Quebec in 1989. In major cases, the damage is estimated to be in excess of 2000 billion euros.

Space weather events are frequent, but their severity varies. We are currently experiencing the solar maximum of solar cycle 25, so we are not immune to the possibility of an event having a major impact on our infrastructures. In this context, the need to understand and predict this type of event is crucial. Although this project is as much about quantifying and forecasting these events as it is about the technological damage and the solutions put in place to mitigate the risks. The economic and social aspects are also important to take into account in order to obtain a complete study, and this internship will focus on the economic component of the study.

Several studies have already estimated the global economic cost of space weather impacts on our infrastructures (e.g. Eastwood et al., 2018; Schulte in den Bäumen et al. (2014); Riley et al., (2018)). However, these studies focus on impacts related to electricity networks. Although this sector seems to be the most devastating, other sectors are important to take into account. In particular, new technologies (e.g. mobile phones, connected watches, autonomous cars, etc.) are increasingly used by our society and are vulnerable to space weather events. Another little-studied sector is finance (Krausmann et al., 2014), although it is known that GNSS disruptions caused by space weather have a direct impact on financial transactions. This internship will therefore focus on the economic impact of these sectors, which have not yet been the subject of concrete studies. An assessment of the level of vulnerability of these systems as a function of the severity of the events is also envisaged. The study will focus on space weather events of medium and high severity (which serve as benchmarks for insurers). The economic impact will be assessed on a national scale, with priority given to mid-latitude countries: France, UK, Quebec, Italy, Germany and Benelux.

DELIVRABLE

- Study report (English)
- Power point presentation containing the key points of the study (English)

REFERENCES

- Eastwood, J. P., Hapgood, M. A., Biffis, E., Benedetti, D., Bisi, M. M., Green, L., ... & Burnett, C. (2018). Quantifying the economic value of space weather forecasting for power grids: An exploratory study. Space Weather, 16(12), 2052-2067.
- Hapgood, M., Angling, M., Attrill, G., Bisi, M., Burnett, C., Cannon, P., ... & Willis, M. (2020). Summary of space weather worst-case environments.
- Riley, P., Baker, D., Liu, Y. D., Verronen, P., Singer, H., & Güdel, M. (2018). Extreme space weather events: From cradle to grave. Space Science Reviews, 214, 1-24.
- Schulte in den Bäumen, H., Moran, D., Lenzen, M., Cairns, I., & Steenge, A. (2014). How severe space weather can disrupt global supply chains. Natural Hazards and Earth System Sciences, 14(10), 2749-2759.