Proposal of Master 2 internship:

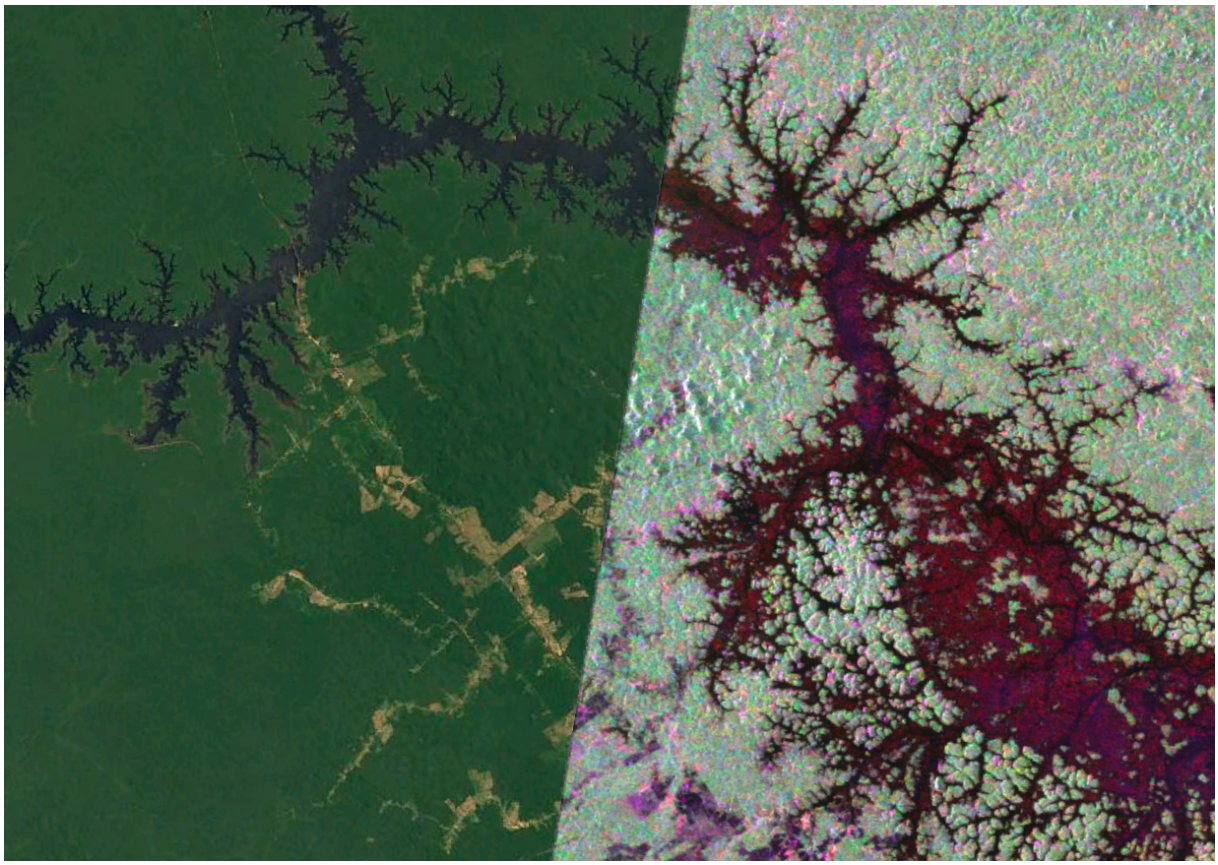
« Deep learning methods for the analysis of the images of the European satellite Biomass»

Context:

Last June, the European Space Agency (ESA) launched a satellite dedicated to studying forests. It is the first radar imaging satellite to use the P-band frequency, allowing the radar wave to penetrate vegetation effectively. By analyzing the radar echoes received under different polarizations and along slightly offset orbits, it is possible to separate the response from the ground from that of the canopy. These measurements can be used to estimate the biomass of tropical forests, which is essential for studying the carbon cycle on Earth.

The european satellite Biomass launched to study forests using radar imaging.

Crédit : ESA/ATG medialab



An area of the Amazon rainforest seen in visible light or radar imagery.

Left: optical image from the American Landsat satellite. Right: radar image from ESA's Biomass satellite (polarimetric information is represented in false colors). The radar image can be used to analyze forests.

Internship objectives:

The satellite is currently completing its calibration and validation phase. The data will be available for scientific use in early 2026. The first images acquired by the satellite confirm the great value of this data for studying vegetation. However, standard processing methods for estimating soil and canopy responses require spatial averaging, which significantly degrades image resolution.

The objective of this internship is to develop deep learning approaches that preserve spatial resolution and achieve better separation of soil and vegetation responses. The methods may be based on recent work carried out at Télécom Paris in self-supervised learning for radar image restoration [1,2] and on the reconstruction of tomographic profiles for forest studies [3]**.**

The algorithms developed will be made available to the scientific community to facilitate the use of images from the Biomass satellite.

Location of the internship:

The internship will take place within the IMAGES team of the Image, Data, Signal department at Télécom Paris (Palaiseau site). The team develops mathematical models and AI methods for image analysis, particularly in the field of satellite and medical imaging.

Supervision:

- Florence Tupin, Professor at Télécom Paris, Institut Polytechnique de Paris
- Loïc Denis, Professor at Télécom Saint-Etienne and Invited Professor at Télécom Paris
- Laurent Ferro-Famil, Professor at ISAE-Supaéro and Biomass team leader at Center for the Study of the Biosphere from Space .

Bibliography:

[1] Dalsasso, E., Denis, L., & Tupin, F. (2021). As if by magic: Self-supervised training of deep despeckling networks with MERLIN. IEEE Transactions on Geoscience and Remote Sensing, 60, 1-13.

[2] Denis, L., Dalsasso, E., & Tupin, F. (2025). Just Project! Multi-Channel Despeckling, the Easy Way. IEEE Transactions on Geoscience and Remote Sensing.

[3] Berenger, Z., Denis, L., Tupin, F., Ferro-Famil, L., & Huang, Y. (2023). A deep-learning approach for SAR tomographic imaging of forested areas. IEEE Geoscience and Remote Sensing Letters, 20, 1-5.