

Sophie Giffard-Roisin

CHARGÉE DE RECHERCHE IRD

02-04-1991 (33 YEARS OLD)

ISTerre, Grenoble Universités, France

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Employment

ISTerre, Université Grenoble Alpes

CHARGÉE DE RECHERCHE IRD (INSTITUT DE RECHERCHE POUR LE DÉVELOPPEMENT)

Grenoble, France

oct. 2019 - current

Colorado University and CNRS Paris Saclay

POSTDOCTORAL POSITION IN CLIMATE INFORMATICS WITH CLAIRE MONTELEONI

Boulder, USA and Paris, France

mar. 2018 - aug. 2019

Inria Sophia Antipolis (Asclepios Group)

PHD IN MACHINE LEARNING FOR MEDICAL APPLICATIONS

Sophia Antipolis, France

apr. 2014 - dec. 2017

Education

PhD in Computer Science

ASCLEPIOS RESEARCH PROJECT, INRIA SOPHIA (ADVISORS: M. SERMESANT, N. AYACHE, H. DELINGETTE)

- Title: Non-invasive personalisation of cardiac electrophysiological models from surface electrograms
- [Manuscript link](#).

Sophia-Antipolis, France

2014-2017

MVA research master (Math, Vision and Learning)

ÉCOLE NORMALE SUPÉRIEURE (ENS) CACHAN

Paris, France

2013-14

Master of Science in Engineering

ÉCOLE NATIONALE SUPÉRIEURE DES MINES DE SAINT ETIENNE

Saint-Etienne, France

2010-13

Responsibilities

Teacher

- Teacher of the master course *Introduction to machine learning*, Phitem, Université Grenoble Alpes (24h, since 2023)
- Online free course MOOC (2023) [ORISAT: remote sensing of natural hazards](#), Member of the educational team.
- Training sessions on *Introduction to machine learning for earth science* (2 to 3 days), in spanish (at Instituto Gefisico del Peru and Ingemmet, Peru) - 2022 and 2023

Reviewer

Nature Communications, NeurIPS, ICLR, IEEE TIP, IEEE TGRS, AGU Geophysical Res. Solid Earth, MDPI Remote Sensing, JSTARS, Cold Regions Science and Technology, MDPI Entropy, Coastal Eng. Journal, CVPR EarthVision, NSF Grant

Convener

- Organizing committee of the 2019 and the 2018 Climate Informatics Workshops (including hackathon organization)
- EGU: Member of the convener team of the session *Challenges and Opportunities for Machine Learning in Solid Earth Geophysics*, EGU 2024, Vienna.

Committees

- Examiner for 4 PhD juries: A. Karas, MétéoFrance, Mar 2023; R. Bailly, CEA/UGA, Dec 2023; A. Bralet, LISTIC/UGA, 1er Oct 2024; I. Rocamora, 3 Oct 2024.
- Member of professor hiring committee (maître de conférence), LISTIC laboratory, Annecy, 2023.
- Member of the Scientific Council of the Multi-disciplinary Institute of Artificial Intelligence (MIAI) of Grenoble, 2024-28 - Elected as personal representative of the *Conseil du Laboratoire* of ISTerre (2022-24).
- Organizing the Grand Séminaires of ISTerre Laboratory (since 2023)

Associate Editor

[Environmental Data Science](#) open-access journal, Cambridge University Press.

Board Member

[GdR Théorie et Climat](#) CNRS groupement de recherche (GdR), leader: F. Bouchet.

Supervision

- PhDs**
- * Giuseppe Costantino 2020-23 (defended in Oct. 2023, co-supervision with A. Socquet and M. Dalla Mura, 36 months)
3 journal papers, post-doc in sept. 2024 at ENS Paris with R. Jolivet
 - * Tristan Montagnon 2021-24 (co-supervision with J. Hollingsworth and E. Pathier), defense in Dec. 24
1 journal paper + 1 in prep., and 2 conferences with peer-reviewed proceedings.
 - * Audrey Chouli 2021-24 (co-supervision with A. Socquet and D. Marsan), defense planned Jan. 24
1 journal paper submitted + 2 in prep.
 - * François Faure 2024-27 (main PhD director)

- Internships**
- 2021: M2 Salah-Eddine Boudaour (*one journal paper, went to industry*), M2 Tristan Montagnon (*one conference proceedings, continued in PhD*), M2 Lorena Rosell-Guevara (*went back to Ingemmet institute in Peru*)
- 2022: M1 Ada Abboud (*poster presented at G2*), M1 Theo Lallemand (*co-author of 1 paper, continued as M2 and PhD at ISTERre*)
- 2023: M2 Alicja Matulewicz in 2023 (*went to industry*)
- 2024: M2 François Faure in 2024 (*continuing with me on a PhD*)

- Post-docs**
- * Vera Shalaeva 2020-21 - *hired in industry as data scientist since 2021*
 - * Lea Pousse 2021-22 - *IRD Chargée de recherche since 2022*
 - * Sarah Visage apr. 2023- apr. 24 - *post-doc in Roma Univ. in sept. 2024 with Fabio Corbi*
 - * Diego Cusicanqui 2023-25
 - * Bryan Raimbault dec. 2023 - dec. 24

Planned HDR HRD Planned for 2026. Derogation and HDR registration authorised by ED STEP HDR comity.

Awards & Grants

- Grants/ Projects**
- *Principal investigator* ANR JCJC 2024 grant (350k€), 'EDAM': Earth Deformation from Automatic Mapping
 - *Principal investigator* of a MIAI 2023 grant (50k€) on landslide detection from InSAR (Co-PI P. Lacroix, ISTERre)
 - *Co-PI* of a 2022 CNES 'Projet télédétection innovant' (50k€) on Deep learning for strike-slip fault characterization (with Léa Pousse, ISTERre)
 - *Co-PI* of a 2021 MIAI Projet IA émergent (50k €) on Deep Learning for characterizing active faults (with Laurence Audin, ISTERre)
 - *Co-PI* of a 2021 UGA Projet exploratoire et émergent 100k €) on Deep Learning in optical image correlation (with James Hollingsworth, ISTERre)
 - *Collaborator* of ERC consolidator project DeepTRIGGER 2020-25 (Anne Socquet, ISTERre)
 - *Collaborator* of ERC starting MoniFAULT 2019-23 (Piero Poli, ISTERre)
 - *Collaborator* of CNES APR 2021-24 (SHARE project, F. Karbou MétéoFrance)
 - *Collaborator* of ANR project REPED-SARX 2022-26 (Yajing Yan LISTIC laboratory)

- Awards/Fellowships**
- 1-year Fulbright fellowship 2024 (Columbia University visit in 2025)
 - Prix d'Excellence PhD of Université Côte d'Azur, 2017
 - Best Paper Award, FIMH Conference, *Sparse Bayesian Non-linear Regression for Multiple Onsets Estimation in Non-invasive Cardiac Electrophysiology*, Toronto, Canada, 2017

- Invited talks**
- *Keynote speaker* at 2023 EGU conference (Machine learning for understanding Earthquakes Physics session).
 - *Invited talks*: INSU journée PNTS (2024), EOSC lab. Strasbourg (2024), ERC TECTONIC / FEAR Seminars (2023), Inria Thoth team (2023), GDR MADICS MacLean (2022), GDR ISIS (2021), Resif conference (2021), GeoAzur lab. Sophia A. (2021).

Main Research Achievements

What defines my work is the construction of machine learning frameworks able to solve new geoscientific tasks: which problems to tackle, how to correctly formulate it, how to create a database, what model architecture and how to identify its limits. For this, it always involves close collaborations in interdisciplinary projects, for which the best way to start has been to share a student supervision.

Learning Optical Correlation (*partnership with J. Hollingsworth 2021-24*) We have developed, during the co-supervision of T. Montagnon's PhD, a convolutional neural network method which estimates the dense displacement field between 2 images (before and after an earthquake). We have then trained a U-net type network, which can estimate a 2D dense displacement map in one pass: this helps the model to learn and therefore minimize the errors. For both, the key step was the creation of realistic synthetic datasets. This project has two current follow-ups: 1) the improvement of the U-net algorithm with a multi-step optical flow model, 2) the development of a similar method for radar amplitude images (SAR).

Automatic Fault Scarps (*partnership with L. Pousse 2021-24*) In this project, we want to assist geomorphologists by automatically estimating the amount of deformation of a fault scarp over thousands of years. We worked on an algorithm to calculate the scarp height of an eroded fault from a digital terrain model profile. To do this, we first generated a realistic synthetic database. We then extended the method to include strike-slip faults, requiring the processing of 2-dimensional data. This extension provided the opportunity to co-supervise the post-doc. Sarah Visage, and will continue in 2025.

SSE detection from GNSS (*partnership with A. Socquet 2020-23*) GPS time series measure the absolute displacement of the ground over time, but the signal is very noisy because the movement is small (a few cm maximum). Nevertheless, a network of hundreds of GNSS stations is able to perceive slow slip events ('no-shake' seismic events), which are not detectable by seismic stations. During the co-supervision of G. Costantino's PhD, we developed space-time and graphical convolutional neural networks for detecting and then characterizing slow slip events. For this, a realistic synthetic database was created as the number of known events are too small for machine learning.

Tropical Cyclone Forecasting (*2019-2020, post-doc*) The aim of this work was to predict tropical cyclone tracks by fusing convolutional neural networks (CNN). A large number of past hurricane tracks are available online. In addition, current meteorological measurements (temperature, pressure) are compiled in near-real time to generate reanalysis data (global gridded measurements). In project I extracted reanalysis data (pressure and velocity fields) as cropped images centered on the storm locations to generate a large database from both hemispheres. To predict hurricane tracks, I designed a CNN fusing past track data and atmospheric reanalysis images. This study paved the way for data-driven forecasting methods (+100 citations).

Outreach/ Transfer to Peru As IRD researcher, I have dedicated part of my time in establishing collaborations with Southern countries and in particular Peru. During my 2 stays of 2 months each, I have given training sessions in universities and observatories, participated in shared student supervision, and started joint projects (such as the new ANR JCJC EDAM). I participated in the Orisat MOOC who gathered 3000 participants of 90 nationalities, among which many South Americans thanks to Spanish subtitles. I also want to promote women in science, so participated in an article in *Le Monde* in 2023.

Selected Publications after PhD (see Scholar account)

- Journal of Geophysical Research-Machine learning**, Sub-Pixel Displacement Estimation with
2024 **Deep Learning: Application to Optical Satellite Images Containing Sharp Displacements** T. Montagnon, S. Giffard-Roisin, M. Dalla Mura, M. Marchandon, E. Pathier, J. Hollingsworth. *in press.*
- IEEE Journal of Selected Topics in Applied Earth Obs. and Remote Sensing**, Denoising of
2024 **Geodetic Time Series Using Spatiotemporal Graph Neural Networks: Application to Slow Slip Event Extraction.** G. Costantino, S. Giffard-Roisin, M. Dalla Mura, A. Socquet *in press.*
- Seismica (under minor rev.)**, Automatic characterization of normal fault scarps using
2024 **convolutional neural networks.** L. Pousse-Beltran, T. Lallemand, L. Audin, P. Lacan, A. David Nuñez-Meneses, S. Giffard-Roisin. *under revision*

2024	<p>Seismica, Deep learning detects uncataloged low-frequency earthquakes across regions. J. Münchmeyer, S. Giffard-Roisin, M. Malfante, W. Frank, P. Poli, D. Marsan, A. Socquet.</p>	<i>Journal</i>
2023	<p>Nature Comm. Earth & Env., Multi-station deep learning on geodetic time series detects slow slip events in Cascadia G. Costantino, S. Giffard-Roisin, M. Radiguet, M. Dalla Mura, D. Marsan, A. Socquet.</p>	<i>Journal</i>
2023	<p>Scientific Reports, Classification of red cell dynamics with convolutional and recurrent neural networks: a sickle cell disease case study M. Darrin, A. Samudre, M. Sahun, S. Atwell, C. Badens, A. Charrier, E. Helfer, A. Viallat, V. Cohen-Addad, S. Giffard-Roisin.</p>	<i>Journal</i>
2023	<p>Journal of Geophysical Research, Seismic source characterization from GNSS data using deep learning G. Costantino, S. Giffard-Roisin, D. Marsan, M. Radiguet, M. Dalla Mura, A. Socquet.</p>	<i>Journal</i>
2022	<p>Geophysical Journal International, Interpreting convolutional neural network decision for earthquake detection with feature map visualisation, backward optimisation and layer-wise relevance propagation methods. J. Majstorović, S. Giffard-Roisin, & P. Poli.</p>	<i>Journal</i>
2022	<p>Earthquake Spectra, Testing machine learning models for seismic damage prediction at a regional scale using building-damage dataset compiled after the 2015 Gorkha Nepal earthquake. S. Ghimire, P. Guéguen, S. Giffard-Roisin, and D. Schorlemmer</p>	<i>Journal</i>
2022	<p>Frontiers in Remote Sensing, Land cover classification of the Alps from InSAR temporal coherence matrices. Giffard-Roisin, S., Boudaour, S., Doin, M. P., Yan, Y., & Atto, A.</p>	<i>Journal</i>
2021	<p>Journal of Geophysical Research, Designing conv. NN pipeline for near-fault earthquake catalog extension using single-station waveforms. J. Majstorović, S. Giffard-Roisin, P. Poli</p>	<i>Journal</i>
2020	<p>Frontiers in Big Data - Data-driven Climate Sciences, Tropical Cyclone Track Forecasting using Fused Deep Learning from Aligned Reanalysis Data. S. Giffard-Roisin et al.</p>	<i>Journal</i>