

From Carbon to Societal Footprint: Geoscience Research in the Face of the Socio-Environmental Emergency

Laurent Jeanneau ¹, , Cécile H. Albert ², Nicolas Champollion ³, Mathieu Chassé ⁴, Emilie Dassié ⁵, Laure Guerit ¹, Françoise Immel ⁶, , Emilie Jardé ¹, Sylvain Kuppel ⁷, Odin Marc ⁸, Christophe Peugeot ⁹, Irène Schimmelpfennig ¹⁰

1 : Univ Rennes, CNRS, Géosciences Rennes, UMR 6118, 35000 Rennes, France

2 : Institut méditerranéen de biodiversité et d'écologie marine et continentale

Aix Marseille Université, Institut de recherche pour le développement [IRD] : UMR237, Centre National de la Recherche Scientifique

3 : Institut des Géosciences de l'Environnement

Institut de Recherche pour le Développement, Centre National de la Recherche Scientifique, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement, Université Grenoble Alpes, Institut Polytechnique de Grenoble - Grenoble Institute of Technology

4 : Sorbonne Université, MNHN, CNRS, IRD, IMPMC

Sorbonne Universités, UPMC, CNRS, Muséum National d'Histoire Naturelle (MNHN), Centre national de la recherche scientifique - CNRS (France), Institut de recherche pour le développement [IRD]

5 : Environnements et Paléoenvironnements OCéaniques

Observatoire Aquitain des Sciences de l'Univers, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Ecole Pratique des Hautes Etudes, Université de Bordeaux

6 : Laboratoire Chrono-environnement (UMR 6249)

Centre National de la Recherche Scientifique, Université de Franche-Comté

7 : Géosciences Environnement Toulouse

Institut de Recherche pour le Développement, Université Toulouse III - Paul Sabatier, Institut National des Sciences de l'Univers, Observatoire Midi-Pyrénées, Centre National d'Études Spatiales [Toulouse], Centre National de la Recherche Scientifique, Institut National des Sciences de l'Univers : UMR5563, Centre National de la Recherche Scientifique : UMR5563, Institut de Recherche pour le Développement : UR254

8 : Géosciences Environnement Toulouse

Institut de Recherche pour le Développement, Université Toulouse III - Paul Sabatier, Institut National des Sciences de l'Univers, Observatoire Midi-Pyrénées, Centre National d'Études Spatiales [Toulouse], Centre National de la Recherche Scientifique, Institut National des Sciences de l'Univers : UMR5563, Centre National de la Recherche Scientifique : UMR5563, Institut de Recherche pour le Développement : UR254

9 : Hydrosociences Montpellier

Institut de Recherche pour le Développement, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Université de Montpellier

10 : Centre européen de recherche et d'enseignement des géosciences de l'environnement

Institut de Recherche pour le Développement, Aix Marseille Université, Collège de France, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement, Institut de Recherche pour le Développement : UMR_D161, Aix Marseille Université : UM34, Collège de France : UMR7330, Centre National de la Recherche Scientifique : UMR7330

In light of the major socio-environmental challenges of our time, ensuring a safe and just world for humans and non-humans calls for profound changes in our societies. According to the 6th IPCC WG3 report, the scale and speed of actions required to keep global warming below +2°C are unparalleled at both individual and institutional levels. Consequently, no sector nor activity -whether in the Global North or in countries moving toward similar economic trajectories – should be exempt from critical reflection on its suitability for sustainable practices. This also includes scientific research, particularly our Geosciences community at large, which not only brings to light the above challenges, but also increasingly calls for decisive action

Our research practices are often resource- and energy-intensive: air travel, field campaigns, laboratory instrumentation, and data infrastructures all contribute significantly to the environmental footprint of research, with estimated emissions of 9–21 tCO₂e per person annually—well above planetary boundaries. Geoscientist communities must therefore critically reflect on the societal impact of their findings and their research practices.

These considerations are being increasingly raised by ethics committees at universities and research institutes, as well as in a growing number of opinion pieces, publications, and other forms of expressions within our communities. This is the approach we have undertaken within the French SIC community, culminating in a dedicated chapter on environmental responsibility in the 2024–2028 SIC prospective report coordinated by CNRS. This represents a clear break from previous editions, where such concerns were largely absent.

Here, we address the environmental responsibilities, strategic actions, and systemic transformations required to align SIC research with sustainability goals while maintaining scientific relevance. Rewarding low-impact research designs, valuing open data and equipment sharing, and supporting local and low-tech research methods are among the actionable levers discussed. Tools such as those proposed by Labos 1point5 research group are promoted to raise awareness and guide emission reduction strategies.

Importantly, environmental responsibility should not be viewed as a constraint but as an opportunity to rethink what science entails. The community is invited to reflect on how scientific priorities—such as ever-growing demands for modeling, data collection, infrastructure and incentive to join remote study areas—might reinforce unsustainable trajectories. This demands deeper reflexivity about the broader impacts of research beyond knowledge production. We argue that the community must uphold transparency and ethical leadership to ensure a balance between the environmental benefits and impacts of research.

Despite this strong positioning, a transversal analysis of the entire SIC prospective reveals that environmental concerns remain compartmentalized. While climate and ecological challenges are widely recognized as research topics, they are rarely considered as drivers to transform research practices themselves. This highlights a persistent disconnect between diagnosing environmental risks and changing the systems—including scientific systems—that contribute to them. Ultimately, addressing this tension requires a cultural shift within research communities: moving from passive awareness to proactive transformation. By embedding environmental responsibility into its prospective planning, the SIC community has taken a pioneering step. Yet much work remains to scale these practices, institutionalize them, and make them the norm rather than the exception.