Preface: Embracing Interdisciplinary Earth Science: Advancing through Open Science, Collaboration, and Innovation

Vasco Mantas\textsuperscript{1*}, Jennifer Wei\textsuperscript{2}, Zhong Liu\textsuperscript{3}, Menglin Jin\textsuperscript{4}

\* vasco.mantas@uc.pt

1. University of Coimbra, Department of Earth Sciences, and CITEUC
2. NASA Goddard Earth Sciences Data and Information Services Center (GES DISC)
3. NASA Goddard Earth Sciences Data and Information Services Center (GES DISC); George Mason University
4. Earth System Science Interdisciplinary Center, University of Maryland

This special issue is dedicated to the exploration of interdisciplinary data and services, where the convergence of diverse expertise and datasets fosters cutting-edge research and advances our understanding of Earth’s complex systems. In a world where traditional disciplinary boundaries often fall short of addressing intricate Earth Science challenges, interdisciplinary approaches have emerged as powerful tools for unraveling the mysteries of our planet.

At the heart of the new, more inclusive scientific paradigm lies the principle of Open Science. By promoting transparency, collaboration, and innovation, Open Science has become the bedrock of current scientific advancement. As we embark on this journey of interdisciplinary Earth Sciences, it is essential that we embrace rigorous standards and new collaborative approaches. Our increasingly diverse scientific landscape demands nothing less if we are to fully realize the potential of interdisciplinary research.

The integration of diverse Earth Science data within a unified platform, offering seamless online visualization and analysis services, represents a pivotal step towards expanding our geoscience community while encouraging and facilitating interdisciplinary research and applications. By breaking down the barriers of data accessibility, this approach empowers researchers from diverse backgrounds, fostering collaboration and driving innovation within the interdisciplinary geosciences community.

As we traverse the era of Artificial Intelligence, adherence to transparent and rigorous practices becomes paramount to ensure scientific integrity and uphold the highest standards. Stable data services and repositories, equipped with persistent access methods, play a central role in enhancing findability and enabling downstream solution development. Sustainable and open data management plans are essential for supporting interdisciplinary research projects, overcoming obstacles such as poorly documented datasets, and dispelling the shadow of "black-box" processors that hinder data utilization across various fields.

Interdisciplinary geosciences present unique complexities stemming from scientific, technical, and cultural challenges. In this rapidly changing world, cross-discipline collaborations have emerged as a
driving force, enabling us to define and address complex problems while effectively disseminating results to diverse audiences. Embracing the FAIR principles (Findable, Accessible, Interoperable, Reusable) is not only a crucial step towards sustainable and relevant solutions but also a way to tackle the persistent challenge of accessing diverse datasets. Additionally, the development of CARE (Collective Benefit, Authority to Control, Responsibility, and Ethics) concepts emphasizes the need for greater diversity, equity, inclusion, and justice within the interdisciplinary geosciences community, underlining the significance of ethical and open research collaborations.

Within the pages of this special issue, we proudly present a collection of studies that exemplify the importance of open data policies, integrated platforms, and innovative methodologies in advancing interdisciplinary geosciences. The contributions featured here shed light on the potential of FAIR and CARE principles, new collaborative approaches for Open Science, and cutting-edge technologies like Generative Adversarial Networks (GANs) and AI methods. These transformative insights have the power to break down barriers, foster transparency, and drive sustainable and ethical solutions within the interdisciplinary geosciences landscape.

The work of Wagemann et al. (2021) delves into the dissemination of open data policies for Big Earth data and its impact on user diversification in interdisciplinary geosciences. Their findings highlight distinct user needs and requirements, paving the way for more effective utilization of Big Earth data and advancements in this burgeoning field.

Graff et al. (2022) introduce a novel Python library designed to facilitate event mining on Twitter for research purposes in interdisciplinary geosciences. By bridging traditional research methods with the rapidly evolving social media landscape, this work empowers researchers to analyze geoscience-related events across diverse domains.

Varadharajan et al. (2022) present BASIN-3D, an ingenious data integration framework aimed at overcoming environmental science barriers arising from the diversity of observational and simulation datasets. This transformative framework offers a valuable solution for data integration across various fields and modeling studies.

Finally, Hu et al. (2023) highlight the significance of dependable sedimentary facies models in geology and present an innovative solution leveraging Generative Adversarial Networks to enhance geological modeling capabilities. Their pioneering approach showcases the potential of emerging technologies in addressing long-standing geological limitations.

This special issue, which represents but a subset of the intricate web of interdisciplinary science, celebrates the vital role of open data policies, integrated platforms, and innovative methodologies in advancing interdisciplinary geosciences. By promoting FAIR and CARE principles, embracing new collaborative approaches for Open Science, and harnessing cutting-edge technologies, the interdisciplinary geosciences community can overcome barriers, foster transparency, and drive sustainable and ethical solutions. As we embark on this exciting journey, let us wholeheartedly embrace the opportunities that interdisciplinary research offers, bridging the gap between traditional and contemporary approaches to propel scientific progress, explore new frontiers, and cultivate a thriving innovation ecosystem for the benefit of all.