Editorial: Women in remote sensing: 2022

Jane Southworth[1]*, Erin Bunting[2], Hannah V. Herrero[3] and
Kelley Crews[4]

[1]Department of Geography, University of Florida, Gainesville, FL, United States, [2]Department of
Geography, Environment, and Spatial Sciences, Michigan State University, East Lansing, MI, United States,
[3]Department of Geography and Sustainability, University of Tennessee, Knoxville, TN, United States,
[4]Department of Geography and the Environment, University of Texas, Austin, TX, United States

Editorial on the Research Topic
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In a world where less than 30% of researchers are women, with similar proportions reflected in the remote sensing community, this Research Topic of Frontiers in Remote Sensing stands as a beacon of change and diversity. This collection of 15 papers led by women researchers offers a panoramic view of the remarkable contributions of women across the spectrum of remote sensing research. With over 28,000 views as of January 2024, these studies not only showcase scientific excellence but also serve as a testament to the crucial role of gender equality in driving sustainable development. This goal is underscored by the United Nations Educational, Scientific and Cultural Organization (UNESCO), a world leader dedicated to fostering global peace and security, sustainability, and gender equality through the encouragement of international collaboration in the fields of education, the arts, sciences, and cultural endeavors.

The scope of this issue spans from theoretical advancements to practical applications, addressing global challenges through a multifaceted lens. Together, these papers weave a rich tapestry of innovation, diversity, and scientific rigor. They not only demonstrate the invaluable contributions of women in remote sensing but also chart a course for future research in this dynamic field. As we stand at the intersection of technology, environmental science, and gender equality, this Research Topic marks a significant milestone in our collective journey toward a more inclusive and sustainable future. Highlighting the themes, synergies, and connections among the 15 works in this Research Topic on Women in Remote Sensing demonstrates the diversity and collaborative potential within the field. Broadly speaking, these manuscripts, together with the participants in and sponsors of the 6-part Women in Remote Sensing presentation sessions, the Remote Sensing Specialty Group Highlight Session, the mentoring reception, and the community-building dinner at the 2023 American Association of Geographers (AAG) illustrate the breadth and depth of foundational contributions that span: 1) data/data collection devices and protocols, 2) methodological and analytical approaches, 3) a variety of regions and units of analysis, and 4) many topical areas of study, while at the same time highlighting the community building, mentoring, and inclusivity inherent in this collaborative approach to science (Figure 1).
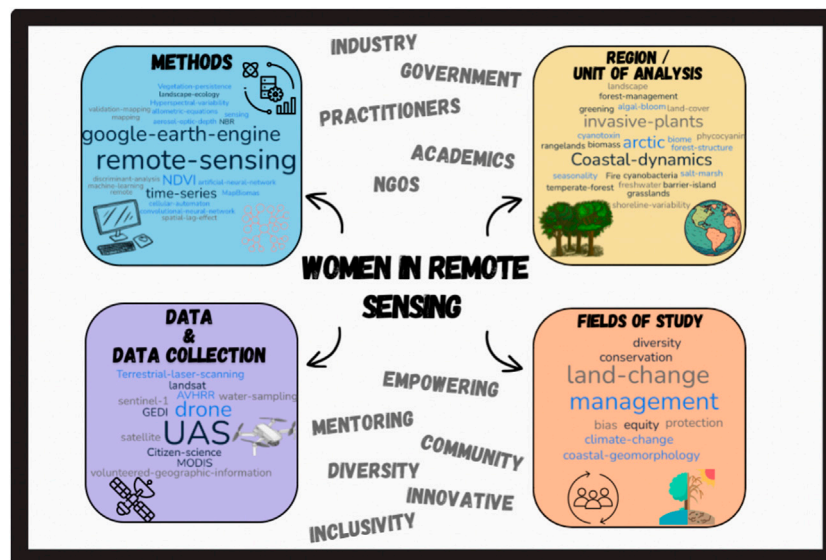
FIGURE 1
This thematic concept map represents the keywords for each of the articles in this special issue of Women in Remote Sensing. The keywords are grouped similarly to the list of key themes and include methods of analysis, data/data collection approaches, fields of study, region/unit of analysis in addition to the characteristics of the Women in Remote Sensing ethos, which is open to all remote sensing practitioners.

1. Technological Innovation and Methodological Advances: Several papers, like those by Mattilio et al., Herrmann et al., and Krause et al., demonstrate innovative applications of machine learning and terrestrial laser scanning (TLS). These technological advancements underscore the common theme of leveraging cutting-edge tools to address ecological and environmental challenges.

2. Environmental Monitoring and Conservation: Carvalho et al., Rivarola et al., and Digiacomo et al. focus on different aspects of environmental monitoring. While analyze coastal morphological changes, assess the effectiveness of protected areas, and evaluate coastal wetland habitats using Unoccupied Aircraft Systems (UAS). Collectively, these studies highlight the critical role of remote sensing in environmental conservation and management.

3. Climate Change and Ecosystem Dynamics: The contributions by Southworth et al., Parkinson, and Vogeler et al. share a common thread in studying the effects of climate change. Work on global biome shifts, Parkinson's research on Arctic Sea ice, and assessment of forest structure are all crucial to understanding and responding to climate change impacts.

4. Urbanization and Land Use Change: Fontana et al. and Yang et al. explore urban development and land use transitions. Urbanization predictions in Brazil and study of forest management strategies in the U.S. both address how land use changes impact the environment, offering insights for sustainable development.

5. Data Integration and Interdisciplinary Approaches: The works by Karale and Yuan. and Hanlon et al. represent the integration of various data sources, such as satellite data with ground measurements and drone-based water sampling, to improve environmental monitoring. This integration reflects a broader theme of interdisciplinary approaches to addressing complex environmental issues.

6. Policy Implications and Conservation Strategies: Several studies, including those by Herrmann et al., Rivarola et al., and Vogeler et al., have direct implications for policy and conservation strategies. Collectively, these papers contribute to a better understanding of how scientific research can inform and shape environmental policy and practice.

7. Diversity and Inclusivity in Science: The paper by Joyce et al. stands out for addressing the meta-theme of diversity in the scientific community, particularly within editorial boards. This paper connects to the broader issue of gender representation and inclusivity in science, technology, engineering, and mathematics (STEM) fields, which is a central theme of the Research Topic.

8. Synergies in Remote Sensing Applications: The works by Huelsman et al. and Digiacomo et al. both utilize unoccupied aerial vehicles (UAVs), showcasing the synergy in remote sensing applications across different environmental contexts. Their research highlights the versatility and potential of remote sensing technologies.

Each contribution in this Research Topic underscores the diversity of thought and high level of rigor in remote sensing, with Joyce et al. initiating the discourse by examining the composition of editorial boards in remote sensing journals. Their audit exposes a striking lack of diversity, shedding light on the implicit biases and citation disparities faced by underrepresented communities. They propose an action plan aimed at fostering inclusivity within the field, paving the way for a more diverse and equitable research environment.

In a blend of geospatial analysis and environmental science, Carvalho et al. delve into the morphological dynamics of a tropical

barrier island. Utilizing Landsat imagery and Google Earth Engine, they unravel the complex interplay of erosional trends and seasonal shifts, providing valuable insights into coastal processes along the southeastern coast of Brazil. This study not only contributes to our understanding of coastal morphology but also underscores the importance of long-term environmental monitoring.

Rivarola et al. shine a light on the effectiveness of protected area zoning, employing remote sensing to evaluate conservation strategies in Nahuel Huapi National Park, Argentina. Their work highlights the need for critical evaluation of conservation goals, and emphasizes the role of remote sensing in large-scale environmental management.

Taking a step into the realm of global ecology, Southworth et al. harness the power of the normalized difference vegetation index (NDVI) time series to decipher patterns of vegetation change over 3 decades. Their findings not only reveal the impact of climate and land-use change on global biomes but also underline the utility of statistical time series analysis in ecological research.

In a demonstration of precision agriculture, Mattilio et al. present a novel application of machine learning to map leafy spurge infestations. Their work, rooted in high-accuracy classification models, offers a glimpse into the potential of technology to manage invasive species—a critical aspect of sustainable land management. The theme of machine learning continues with Herrmann et al. who apply these techniques to the regulatory landscape of highland grassland fires in Brazil's Atlantic Forest Biome. Their findings reveal significant discrepancies between authorized and actual burned areas, offering evidence to inform policy revision and environmental governance.

Krause et al. bring a technological edge to forestry research by employing terrestrial laser scanning for biomass estimation. Their work challenges existing methodologies, offering more accurate assessments that have significant implications for carbon quantification and forest management. Vogeler et al. investigate the potential of satellite data, particularly the Global Ecosystem Dynamics Investigation (GEDI), in generating predictive models of forest structure. Their study evaluates the utility of GEDI data in biodiversity assessments and wildlife habitat modeling, contributing to our understanding of forest ecosystems. Yang et al. explore the intersection of forest management, land use transitions, and citizen science in the southeastern United States. Their integration of crowdsourced data underscores the value of public participation in scientific research, particularly in the context of regional land change dynamics.

Digiacomo et al. assess the utility of UAS for monitoring coastal wetland habitats. Their work not only addresses the need for methodological standardization but also demonstrates the potential of UAS in large-scale ecological assessments. In the field of water quality, Hanlon et al. introduce an innovative drone-based method for sampling harmful algal blooms. This approach, which overcomes the limitations of traditional sampling methods, offers a timely and precise tool for monitoring and managing aquatic ecosystems. Huelsman et al.

utilize drones for species identification, shedding light on the capabilities of UAV-based spectroscopy in differentiating between invasive plant species. Their findings contribute to the advancement of remote sensing techniques in biodiversity conservation.

Parkinson (2022) presents a comprehensive record of Arctic Sea ice changes over 43 years, utilizing satellite passive microwave data. Her work provides crucial evidence of long-term trends in sea ice coverage, and reinforces the role of satellite observations in climate change research. In urban studies, Fontana et al. examine land use and land cover changes in the Metropolitan Region of Porto Alegre, Brazil. Their integration of historical Landsat data and spatial modeling not only paints a picture of urban expansion but also provides a forecast of future developments, serving as a valuable tool for urban planning and policy formulation. Finally, Karale and Yuan improve the estimation of particulate matter (PM) concentrations in PM2.5 by integrating satellite data with ground measurements. Their approach, which uses a Convolutional Neural Network, not only improves air quality monitoring but also opens new avenues for environmental health research.

In summary, this Research Topic, diverse in approach, topical foci, and occupational roles of the authors, collectively emphasizes the importance of technological innovation, environmental stewardship, climate change research, urban and land use studies, data integration, policy impact, and the promotion of diversity in the field of remote sensing. This Research Topic not only contributes significantly to the scientific literature but also reinforces the vital role of women in advancing remote sensing research and its applications for an inclusive, collaborative, and sustainable future.

Author contributions

JS: Writing–review and editing, Writing–original draft, Conceptualization. EB: Writing–review and editing, Writing–original draft, Visualization. HH: Writing–review and editing, Writing–original draft. KC: Writing–review and editing, Writing–original draft.

Conflict of interest

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