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Editorial: Democratizing Earth Observations-Based Science to Improve Agriculture, Food Security and Resilience, From Village to Globe: Volume I

Kiersten B. Johnson[1,2]*, *Molly E. Brown*[3] *and Inbal Becker-Reshef*[3]

[1] *Bureau for Food Security, United States Agency for International Development, Washington, DC, United States,* [2] *United States Department of Agriculture, Foreign Agricultural Service, Washington, DC, United States,* [3] *Department of Geographical Sciences, University of Maryland, College Park, MD, United States*

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Editorial on the Research Topic

Democratizing Earth Observations-Based Science to Improve Agriculture, Food Security and Resilience, From Village to Globe: Volume I

Understanding and solving the most urgent problems facing humanity today—food and water insecurity, climate variability and change, massive biodiversity loss—depends on the ability to access and use critical information captured by Earth-observing satellites. Increasing numbers of satellites gathering more data at higher spatial and temporal resolution, data policies allowing public access to Earth Observation (EO) data, and advances in cloud and high-performance computing constitute key enabling conditions for expanded use of these data. Yet challenges to efficient uptake and application of EO data persist at every level, from farmer's plots to ministries of agriculture and international fora. This Research Topic addresses these challenges from a range of perspectives.

One challenge limiting uptake of these data is the extent to which access to and use of EO data and derived products are democratized: do people and organizations have access to the EO data they need, and do they possess the capacities to use them? Shukla et al. describe how the SERVIR Eastern and Southern Africa Hub enhances use of EO through capacity building: transferring technology to the East African Regional Center for the Mapping of Resources for Development to allow easy processing and visualization of EO, and training representatives from regional and national agencies in EO applications using targeted case studies. The authors provide usable recommendations for increasing EO uptake in the region and beyond.

Another critical challenge includes lack of high-quality ground-truthing and validation data for developing high-quality machine learning models, a critical obstacle to leveraging EO data to understand agricultural production, particularly among smallholder farmers. Kehs et al. describe their approach to both capacity building and increasing availability of ground-referenced data by working with Kenyan youth to collect and analyze these data. Their solution to a data availability problem also contributes to important development results, including employing young people, building capacities in future-looking skills, and sharing data as a public good to improve understanding of crop stress in the context of climate change. Yadav and Congalton develop an alternative solution to the need for ground-referenced data to generate crop type maps: using a phenology-based approach to generate additional reference data within similar agriculture ecological zones, they spatially extend appropriate, existing reference data to other regions where

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Ole Mertz,
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***Correspondence:**
Kiersten B. Johnson
kiersten.b.johnson@gmail.com

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ground-referenced data are sparse. Paliwal and Jain address the same issue by examining the validity of existing ground-referenced data, specifically farmer-reported crop yield estimates. They find that farmers' self-reported crop yields are not accurate, and consequently produced inaccurate results when used to calibrate yield estimation models using remote sensing data. These papers demonstrate important progress in gathering and using the ground-referenced data that are foundational to advancing the use of EO data for agriculture, while underscoring the need to validate the data we collect both from satellites and surveys.

Use of EO-derived information also depends on the extent to which people trust that it is valid and reliable for food security-related decision-making. To this end, Alkhalil et al. from the AGRHYMET Regional Center in Niger, evaluate how well the 20-meter European Space Agency Climate Change Initiative version 2 prototype land cover product represents cropland in the Sahelian and Sudanian zones of West Africa. They find it mistakes the sand dunes and degraded land that constitute a significant part of the cropland in the region, and therefore should not be used as a crop mask. Their findings remind us that remotely sensed data products take years to develop and produce, and user-community evaluations to find and report weaknesses are the only way for these products to improve to meet user needs.

A final challenge to widespread use of EO-derived information relates to communication inefficiencies between the technical experts who work with these data and the decision-makers—from farmers to politicians—who could benefit from them. As a case in point, Sazib et al. generate actionable insights by assessing the impact of the El Niño–Southern Oscillation (ENSO) on agriculture in Southern and Eastern Africa. Connecting their technical findings to the central policy issue of food production, they underscore the policy implications of ENSO impacts on yield, and provide user-friendly, map-based guidance for identifying vulnerable areas affected by the extreme climate conditions. Although ENSO drivers of food security in the region have been known for decades (e.g., Anyamba and Eastman, 1996), the community has yet to use this knowledge to drive market response, insurance, or social protection strategies for the millions of farmers in the region. Indeed, Bégué et al. point out that although satellite remote sensing is a powerful tool to support decision-making, the path from satellite images to policy decisions is not straightforward. Grounded in a comprehensive analysis of the current landscape of EO use in Africa, the authors argue that to benefit from these technical advances, gaps between analysts and policy makers must be bridged, particularly through amplifying capacity building efforts and cultivating political will and institutional commitment to using EO-derived information. They advocate for engaging in public-private partnerships and leveraging proofs of concept associated with economic valuations as key pathways for catalyzing engagement between technical experts and those charged with policy-making responsibilities.

As the field makes revolutionary strides in leveraging EO data to grapple with the world's most pressing problems, building the capacity of all stakeholders to collect, analyze, understand, and use these data appropriately remains an outstanding priority. At the same time that earlier innovations have demonstrated value and are moving from research to operations, contemporary innovations are emerging that hold promise for future applications, but are yet to be validated. Ensuring that data inputs into EO-based models are of the highest quality and are validated is central to assuring the quality of information that is intended for decision making, and for establishing decisionmaker trust in EO-derived models and applications. Recognizing the field's current position at the junction of the technical, the ethical, and the political is essential for cultivating widespread engagement with these data, which in turn underpins the world's ability to make evidence-based decisions on the most critical issues of our time.

AUTHOR CONTRIBUTIONS

MEB, IB-R, and KBJ contributed concepts and text to this editorial. KBJ assembled the final draft, which was reviewed, edited, and approved by each author. All authors contributed to the article and approved the submitted version.

REFERENCES

Anyamba, A., and Eastman, J. R. (1996). Interannual variability of NDVI over Africa and its relation to El Niño/Southern Oscillation. *Int. J. Remote Sens.* 17, 2533–2548. doi: 10.1080/01431169608949091

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