



tion of spatial methods and models in public health care practice. Without local expertise and local ownership, it is unlikely that public health authorities will prioritize healthcare interventions based on geospatial technology. Future education in this area should not only include general data visualization courses but also embrace immersive and augmented reality as this can help public health professionals to better understand geospatial models and their outcomes. AI-based data augmentation techniques can help in the creation of realistic synthetic data (tailored to specific use cases without compromising privacy) to train better models. Federated learning, a decentralized approach to training machine learning models, could be another way to create more robust and generalizable models without compromising data privacy and ownership issues.

Finally, to increase the impact of our scientific achievements, communication is key. To date, geospatial health research is mostly published in dedicated scientific journals with a relatively narrow audience. To increase impact, we also need to actively reach out to health practitioners, policy makers and other stakeholders, and inform funding organizations of the contribution that geospatial tools offer. One promising way towards achieving this, for example, is geo-journalism, a novel communication approach that combines (online) interactive visualizations, StoryMaps, and infographics with easy-to-understand, evidence-based narratives tailored to various audiences.

Conclusions

The past few decades have seen major progress in global health. People are living longer than ever before, maternal and child mortality rates are declining, the development of new vaccines continues to save countless lives, and some neglected tropical diseases have been eliminated in several previously endemic countries. At the same time, urbanization, rural poverty, emerging infectious diseases, lack of access to essential and affordable health services, large numbers of people on the move, and climate change effects all impact global health negatively. Work on current and future health challenges need geographic perspectives and impact-driven research approaches to achieve the relevant Sustainable Development Goals (SDGs), many of which are interlinked through space and time and across different geographic scales. We conclude that geospatial health can substantially contribute towards achieving the SDGs locally both globally and temporally with short-, medium- and longer-term goals in sight.

Recommended reading

- Abdulkareem SA, Augustijn E-W, Mustafa YT, Filatova T, 2018. Intelligent judgements over health risks in a spatial agent-based model. *Int J Health Geogr* 17:8.
- Alcayna T, Fletcher I, Gibb R, Tremblay L, Funk S, Rao B, Lowe R, 2022. Climate-sensitive disease outbreaks in the aftermath

of extreme climatic events: A scoping review. *One Earth* 5:336-50.

- Anthoj C, Stanglow SN, Leinen A, Flacke J, Manga M, Schmiege D, Grunwald N, 2024. A question of human dignity. Identifying solutions to improve WASH for people experiencing homelessness. A case study from Germany. *Water Security* 22:100176.
- Bergquist R, Zheng JX, Zhou XN, 2024. Synergistic integration of climate change and zoonotic diseases by artificial intelligence: a holistic approach for sustainable solutions. *Sci One Health* 3:100070.
- Blanford JI 2024. *Geographic Information, Geospatial Technologies and Spatial Data Science for Health*. CRC Press. Available from: <https://books.google.nl/books?id=vDMWEQAAQBAJ>
- Coetzee S, Gould M, McCormack B, Mohamed Ghouse Z, Scott G, Kmoch A, Alameh N, Strobl J, Wytzisk A, Devarajan T, 2021. Towards a sustainable geospatial ecosystem beyond SDIs. EUROGI). Available from: <https://doi.org/10.13140/RG.2.2.22555.39203>
- Desjardins R, Murray ET, Banyoni G, Hobbs M, Curtis S, 2023. Improving longitudinal research in geospatial health: An agenda. *Health & Place* 80:102994.
- Gevaert CM, Pauwels T, Homberg MJC vd, 2024. Auditing Geospatial Datasets for Biases: Using Global Building Datasets for Disaster Risk Management. *IEEE J Selected Topics Appl Earth Observations Remote Sensing* 17:12579-90.
- Jelokhani N, Araki M, 2021. Collaborative spatial multicriteria evaluation: a review and directions for future research. *Internat J Geograph Informat Sci* 35:9-42.
- Malone JB, Bergquist R, Martins M, Luvall JC, 2019. Use of geospatial surveillance and response systems for vector-borne diseases in the elimination phase. *Trop Med Infect Dis* 4:15.
- United Nations, 2015. *Transforming our World: The 2030 Agenda for Sustainable Development*. Resolution Adopted by the General Assembly on 25 September 2015. 42809:1-13.
- World Health Organization, 2024. *WHO Integrated Data Platform (WIDP)*. Accessed 1 October 2024. Available from: <https://www.who.int/tools/who-integrated-data-platform>
- Park Y-S, McMorris BJ, Pruinelli L, Song Y, Kaas MJ, Wyman JF, 2021. Use of geographic information systems to explore associations between neighborhood attributes and mental health outcomes in adults: a systematic review. *Internat J Environ Res Public Health* 18:8597.
- van den Homberg M, Susha I, 2018. Characterizing data ecosystems to support official statistics with open mapping data for reporting on sustainable development goals. *ISPRS Internat J Geo-Informat* 7:456.
- Vardell E, 2020. Global health observatory data repository. *Med Ref Services Qrtly* 39:67-74.
- Wang Y, Khodadadzadeh M, Zurita-Milla R, 2023. Spatial+: A new cross-validation method to evaluate geospatial machine learning models. *Internat J Appl Earth Observat Geoinform* 121:103364.