GeoHealth

COMMENTARY
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Special Section:
Community Engaged Research to Action: Examples from GeoHealth

Key Points:

- The GeoHealth research community often engages actively with civil society in the research enterprise, but often uses various models
- The models of engagement, from researcher-heavy to community-heavy, have very different outcomes
- A new model of training and support is required for the GeoHealth community to more productively engage with civil society

Supporting Information:

Supporting Information may be found in the online version of this article.

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Addressing the Need for Just GeoHealth Engagement: Evolving Models for Actionable Research That Transform Communities

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Abstract GeoHealth as a research paradigm offers the opportunity to re-evaluate common research engagement models and science training practices. GeoHealth challenges are often wicked problems that require both transdisciplinary approaches and the establishment of intimate and long-term partnerships with a range of community members. We examine four common modes of community engagement and explore how research projects are launched, who has the power in these relationships, and how projects evolve to become truly transformative for everyone involved.

Plain Language Summary GeoHealth research is often partnership focused. We describe four common models for community-engaged GeoHealth research and highlight the central characteristics of each, while daylighting the lived experiences of LEAD Agency activists. We note a range of outcomes emerge which can foster science-based environmental health policy making and lead to justice focused actions.

1. Introduction

GeoHealth is an emerging research paradigm that seeks to blend earth, environmental, and health sciences while simultaneously informing policy and community action. Increasingly, this research often involves close work with community partners to identify actionable scientific questions that matter. In this setting researchers and community members collaborate and co-produce an expanded range of just and sustainable outcomes. Yet how do researchers learn to daylight the needs of their communities they partner with? What is expertise, and how do we value different kinds of expertise? Who has the power in these relationships? These questions require that GeoHealth researchers revisit traditional methodologies and training to assure that their work is ethical, transdisciplinary, and centers the needs and goals of the communities most impacted by their research. This article is focused on the GeoHealth community, which has largely arisen from the geoscience community and for whom concepts like community-engaged research, epidemiology, exposure science, and health policy are generally not within the scope of the standard training for emerging scholars.

GeoHealth research must be framed with environmental justice as a central principle while simultaneously working through ethical models for engagement. Current and forward looking framing of GeoHealth must be: community-centered and partnership-focused, valued and sufficiently funded, and sustainable. GeoHealth research should aim to reorient power back to communities through the redistribution of researchers' resources. While previous definitions of GeoHealth focus on the intersection of natural sciences and public health, we propose that there is no GeoHealth without community (Figure 1).

In this context, it is important to define what we mean by community. GeoHealth researchers often default to the coded word "community" in reference to the people who live and work in areas where research takes place. However, another community evolves through the relationships made between GeoHealth researchers and all other stakeholders aimed at addressing the environmental challenges (researchers, advocacy groups, and local administrators). It is important to note that advocacy leaders might not see themselves as representative of all members of the community while the researchers often equate them in this way. While it might not always be possible for the researcher to become a member of either of these communities, it is on the GeoHealth researcher to foster non-hierarchical collaborations where community voices and knowledge are heard, valued, and acted upon.

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What research models exist for GeoHealth researchers? In this paper, we aim to (a) provide a snapshot of four modes of research inquiry, (b) share essential components of successful community-researcher partnerships while highlighting ways to overcome obstacles to building lasting and transformative partnerships, and (c) forefront community partnerships' experience of these collaboration models.

2. Modes of GeoHealth Inquiry

Table 1 summarizes four modes of GeoHealth inquiry that community research partners experience. They range from models that do research on communities to approaches that forefront research for and with community partners. Table S1 we offer references that highlight case studies and best practices of these research models. We use descriptive terminology borrowed from Bacon et al. (2005) to broadly characterize each framework.

2.1. Parachute Science

Parachute Science in the GeoHealth context is often "big science." It comes with large price tags, networks of research university collaborators, and is often triggered by a very public and urgent GeoHealth crisis (e.g., arsenic contamination of groundwater in Bangladesh; Harvey et al., 2002). Parachute science in a GeoHealth context is often defined by wealthy western nation scientists "parachuting" themselves into low-income foreign communities to collect data while addressing an urgent crisis, then publishing their findings without local scientists as meaningful collaborators. Recently, Stefanoudis et al. (2021) found that after 50 years of coral reef research in Indonesia and the Philippines by western researchers, 40% of the publications had no host nation scientist as a co-author.

We contend that many environmental advocacy groups in wealthy nations can also experience parachute science. Similar to international examples of colonial science, in the U.S. when an urgent GeoHealth crisis is identified (e.g., large percentage of children having elevated BLLs in Ottawa County, OK) research university sciences with federal funding "drop" themselves into communities to address acute health challenges. In both cases, this kind of research can easily become extractive, using the needs of a community as a career launching-point, rather than developing research questions and projects together (Smith, 1999).

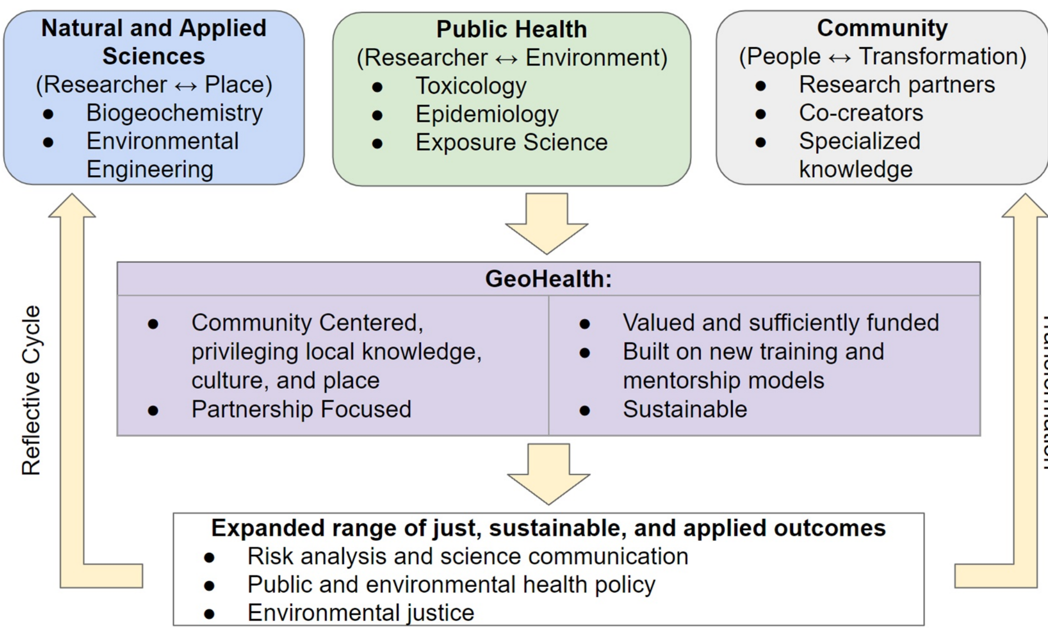
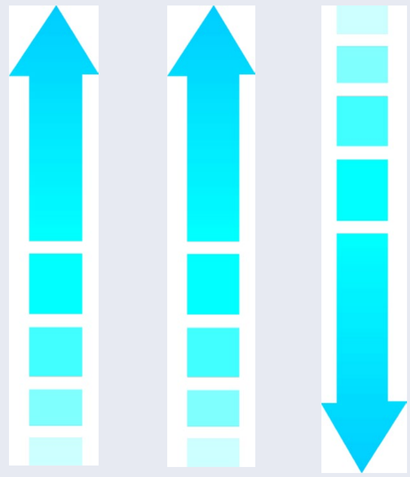


Figure 1. Conceptual framework for GeoHealth research. Goals, stakeholders, and a broader array of research outcomes. Note there is no GeoHealth without community.

Table 1
Modes of GeoHealth Inquiry and Community Engagement Along With Typical Characteristics and Outcomes

Mode of engagement	Characteristics	Outcomes	Power of investigator	Funding dollars	Community led
Parachute Science (Extractive to contractual)	Large funding levels create transdisciplinary teams of researchers that "parachute" into an affected area.	Immediate increases in public environmental health safety and publishing in high profile journals to create new mechanistic knowledge.			
Citizen Science (Consultative)	Researcher provides data and research questions while contextualizing information in exchange for samples distributed over a large geographic area.	Focus on community education and individual behavior change to reduce risk.			
Brokered Science (Collaborative)	Scientific "brokers," such as Thriving Earth Exchange, connect scientists with communities in need of technical expertise to address a particular environmental health concern or question.	Clear community deliverables (ex. Maps, reports) and short-term partnerships (8-12 months).			
Participatory Action Science (Co-produced)	Community members and researchers co-discover research questions and work with an explicit focus on how science outcomes can address inequities and create new community networks.	Can lead to serendipitous science and long-term relationships (years) with the aim of creating positive community level transformation			

Note. These research models are porous and often a community group experiences these in blended ways.

Parachute Science places an emphasis on understanding biogeochemical processes operating in the system, generating new knowledge that then can be transferred to understand fate and transport of a contaminant in other regions. However, the challenge we pose to our GeoHealth community is this—is it not possible to entertain technologically appropriate interventions *with* local community partners from the start to make an impact on reducing exposure? Often figuring out the "science" at a processes level takes a long time because the systems we study are open, complex, and several competing ideas often need to be adjudicated. We need to value the creative efforts centered on education, low-cost sustainable interventions as much, and changing the root causes that allowed the problem to develop as much as (if not more than) the understanding of biogeochemical mechanisms and importantly we need to be accountable for the long-term sustainability of these interventions that are informed by the science we conducted.

2.2. Citizen Science

The term "citizen science," was coined in 1989, in relation to efforts by the Audubon Society to enlist members in a nation-wide program to document acid deposition (Haklay et al., 2021). Since then, many flavors of citizen science have emerged, all of which center on public engagement in the research process, but vary in purpose, motivation, and outcomes, with even the term "citizen" being contentious as it is exclusionary (Kasperowski & Kullenberg, 2019). Citizen science offers the opportunity to crowd-source painstaking measurements and sampling, however these partnerships are typically one-sided. Namely researchers can tap into an interest group's skills to document natural variability, with little of substance returning back to the individual participant beyond the good will of participating. GeoHealth researchers must engage in holistic approaches with communities.

A collaborative approach provides local expertize, helping researchers pair environmental equitability with resiliency solutions. Engaging communities in the science of their own environmental conditions builds agency among community members to co-design, effective, appropriate, and sustainable local solutions.

2.3. Brokered Science Model

Many examples of brokered science exist, but perhaps the most relevant one to the GeoHealth community, and to the American Geophysical Union membership, is the Thriving Earth Exchange (TEX), which serves as a broker to tackle local challenges related to natural hazards, natural resources, and climate change. In the TEX model

"Community Science" forefronts community voices and knowledge as the foundational member of a partnership with consulting scientists. This model of GeoHealth inquiry is in stark contrast with PI-driven citizen science. A defining characteristic of programs like TEX is that the research question or environmental challenge is inspired by community members. TEX projects have three principal actors: (a) Community Leaders that launch projects with TEX, (b) Volunteer Community Scientists that help refine projects and bring scientific and technical skills to the team, and (c) paid Community Science Fellows that serve as project manager and facilitators. TEX projects focus on short-term (6–18 months) actionable science projects that build environmentally just futures.

2.4. Participatory Action Research (PAR)

Participatory Action Research (PAR) breaks away from the traditional researcher-researched dichotomy, seeking to build power with community members, through collective empowerment and meaningful action toward community member's goals (Baum et al., 2006). Rather than assuming that scientific research (or knowledge) is objective, PAR "affirms that experience can be a basis of knowing." Sharp (2016) notes three core principles that support PAR's goals of being "useful and non-oppressive":

1. Community-Based: Community members identify useful actions and visions for their neighborhoods
2. Applied: Research creates local scale solutions that can also be applied at a systems level
3. Interdisciplinary: Involving all stakeholders to define, investigate, and craft sustainable policy driven solutions

One emerging model for PAR inspired GeoHealth research is the "Flashlight Model" (Gallagher et al., 2020). This approach blends PAR with community science and promotes shared ownership of the research process. Non-profit organizations partner with academic labs to generate actionable scientific questions that matter, designing studies to address the public health concerns identified by the community. This process allows for "serendipitous science," or science that unfolds in ways the PI could not have anticipated or even articulated without deep community engagement. However, while the aim of PAR research should be horizontal relationships between researcher and community partners, without intentional redistribution of power and resources, these relationships privilege the already privileged (Ransby, 2015; Sandwick et al., 2018). The Flashlight Model also asserts that "rigorous science should also be accessible science, [...] ideally using a 'just right' analytical approach rather than using exclusive highest precision techniques" (Gallagher et al., 2020). As the GeoHealth discipline evolves scientists must acknowledge the complexity (scientifically, but also socially and politically) of the system being researched, using new research paradigms to generate serendipitous scientific questions and inquiries that lead to just, sustainable, and transformative outcomes.

3. "They Only Cared Because We Made This Personal"

The LEAD agency is a grassroots organization that has worked for over 20 years to address the issues of the Tar Creek Superfund Site in Ottawa County, OK. There, large mine waste (chat) piles and acid mine seepage contaminate surrounding communities with zinc, lead, and cadmium. This chat continues to be stored in piles that leach toxic metals, but were also used in the foundations of schools and homes, in paint, and in sandboxes and even now is used in road construction. Neuberger et al. (2009) found that over 60% of children under six in Picher, OK had lead poisoning (using the twice outdated national guideline of 10 μg/dL).

Collaborations with academics at Tar Creek began after a phone call. In the car ride home from an EPA meeting, a student asked one of the authors (Rebecca Jim, Executive Director, LEAD Agency) if she thought the student might be lead poisoned. She replied she didn't know, but after finding out the student's father had filled her backyard sandbox with fine chat, thought it was likely. Rebecca called a researcher at the Harvard School of Public Health because she read in a newsletter that he had studied the effects of lead on children past the age of six. After an initial citizen science project focused on mineralized lead in children's teeth, researchers at Harvard Chan School of Public Health submitted a multi-million dollar NIEHS-Superfund proposal, launching six years of intensive research. In subsequent years, a few participating researchers have remained in relationship with Rebecca and LEAD. LEAD's experience here highlights the way in which relationships are functionally more important than research models when assessing long-term community benefits. Further research is needed to determine what, if any, correlation exists between particular engagement models and longer-term community benefits.

Three key themes emerge from LEAD's long history with academic collaborators: (a) researchers' motivations for engagement, and assumptions about community members are crucial, (b) pathways to community-engaged research are dependent on individuals because research models can be porous, and (c) outcomes of community-engaged research have the potential to be impactful for both individuals and communities.

1. Motivations for engagement are key when working with community partners. Community science should be driven by empathy rather than pity or charity. Community-engaged researchers should empower local organizers as the experts about their own communities and who should take the lead on how best to make change.
2. While we have presented four research models of engagement, the boundaries between them are relatively porous. Within any model, researchers and community members may build relationships that lead to PAR research. The variety of pathways to PAR research at Tar Creek demonstrates the importance of personal relationships and leveling the traditional, hierarchical "researcher-researched" model to one of collaborators. Community transformation is built on trust.
3. Community-engaged research has the potential to do "good science" while also having significant impacts on individuals and communities. Additionally, because community members are personally vested in the outcome, they, working with researchers, ensure that each step of the research is done with care.

4. What Will Community-Engaged Research Look Like in 20 Years?

For too often, and for too long have environmental justice communities been the ladder that launched scientists' careers. But what does an "ideal" future look like from the perspective of university researchers and community activists?

First, we must enhance incentives for researchers to engage with communities. This must start with increased recognition of the effort that is involved in building impactful and sustained community-engaged research programs. For example, a laboratory-based scientist might spend much of her pre-tenure time developing a new analytical tool or technique that is utilized by a small subset of other experts, and is rewarded within the "comfort zone" of promotion and tenure committees. But that pre-tenure scientist is not likely to be rewarded for spending that same amount of time building an engagement program that ultimately might have tremendous impact. We must value (culturally and institutionally) community-based participatory research and participatory action research.

Second, funding agencies must recognize and value university-community partnerships financially. Currently, obtaining sustained and consistent funding to support a community-engaged program is challenging. University partners typically seek research funding from federal sources that might not have community support as a key priority, and funding is typically of limited duration. Scientific funding sources must develop funding specifically aimed for CBPR projects.

Finally, we need to rethink how we train our graduate students. The gold standard around which most science graduate students are trained focuses on analytical training in the laboratory and/or in the field. Anything outside of this type of training is typically considered "not relevant to the student's academic plan." This model persists because it increases the academic output and publication records of principal investigators, which is necessary to obtain funding for the next set of graduate students. But it is a model is increasingly disconnected from the needs of society. There is no questioning the value of many products of this model, but the space should be open to newer approaches that mentor and train young scientists to develop curiosity and questions that matter about a system. This is certainly done in many undergraduate programs, but not so frequently in graduate programs in the basic sciences.

GeoHealth as a research paradigm is fast evolving, adopting new models for applied research that privileges community outcomes as much as scientific "advances." This will allow us to deliver science that is actionable, environmental justice focused, and sustainable.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Data Availability Statement

No new data were involved in this study.

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