

## METHODOLOGICAL APPENDIX

Researching, analyzing, and then writing this book happened in three main phases spanning more than a decade. I describe these phases below in (mostly) plain language for those interested in what long-term ethnographic research and inductive analysis is like. I primarily relied on data collection methods of participant observation, interviewing, and archival research. I collected data, analyzed them, and then did it all over again. I visited and revisited field sites, key texts, and new publications. Throughout the process, I wrote.

I present my work toward the book like this because ethnographic research and inductive analysis—that is, qualitative research that illuminates how people live and make meaning—can be hard to explain to nonpractitioners. On the one hand, these methods are sometimes obfuscated or presented as quasi-mystical practices, which is misleading. Inductive research and analysis methods are as valid as deductive laboratory work, for all that we may use them to inquire into the nature of scientific validity. The precise engagements that lead to ethnographic findings cannot be recreated, but the findings themselves may be supported or undermined by other research. On the other hand, we do a tremendous disservice to the sophistication of this work when methods like interviewing or observation are considered a matter of simply asking a few questions or “hanging out.” Research and analysis methods like these, if they are to yield robust results, must be understood in the context of ongoing training, mentorship, analysis, reading, and writing. All the extra stuff—the preparation, thinking, reading, talking, and reconsideration—are what help a scholar steer research design and analysis to make a project meaningful. Good ethnography requires what some refer

Table A.1  
Research timeline.

2010–2012 Preparation	2013–2014 Fieldwork	2015–2021 Analysis, Reading, Follow-up, and Writing
<ul style="list-style-type: none"> <li>• Background research</li> <li>• Methods training</li> <li>• Theoretical reading</li> <li>• Discussion at conferences and workshops</li> <li>• Short fieldwork trips for preliminary observation and interviews</li> <li>• Refining research questions</li> <li>• Visits to pertinent archives in Mexico, the United States, and the United Kingdom</li> <li>• Language training</li> </ul>	<ul style="list-style-type: none"> <li>• On-site participant observation at CIRES offices in Mexico City</li> <li>• Archival research at Mexico City collections and libraries</li> <li>• Visits to Civil Protection officials in Mexico City, Oaxaca, and Guerrero</li> <li>• Preliminary data analysis</li> <li>• Theoretical reading</li> <li>• Discussion at conferences and workshops</li> <li>• Refining research questions</li> </ul>	<ul style="list-style-type: none"> <li>• Short fieldwork trips</li> <li>• Data analysis</li> <li>• Writing dissertation, articles, and book</li> <li>• Further background research related to pertinent themes</li> <li>• Research on US earthquake early warning project</li> <li>• Theoretical reading</li> <li>• Discussion at conferences and workshops</li> </ul>

*Source:* Author (2021).

to as a “theory-data-method triangle,” in which all elements align to support each other. As anthropologist Diana Forsythe argues, poorly considered engagements with ethnographic methods can easily produce shallow or wholly inaccurate findings.<sup>1</sup> I will remind readers: there are whole libraries of careful thought on the historical, theoretical, and political forms into which this book fits. There is so much to inspire and trouble you out there. What follows are a few practical notes. If you read this, please read more.

## RESEARCH TIMELINE

### PHASE 1: PREPARATION, 2010–2012

My preparation for this research began with my enrollment in the University of California Irvine’s PhD program in anthropology in 2010. Although I benefited from anthropological training as a student at Reed College and the University of Chicago and as a researcher at Northwestern Memorial Hospital beforehand, where I first encountered and practiced qualitative research, it was at UC Irvine where I learned more about a few research methods

that have been particularly useful for this work: participant observation, in which a researcher engages in the activities that they are investigating to better understand them; unstructured ethnographic interviewing, in which a researcher guides a conversation with research participants to learn about their perceptions and experiences; and various forms of qualitative and quantitative data analysis. I also enrolled in seminars on anthropological approaches to science and technology, environment, and other key topics related to this research. These helped me understand the state of the field and introduced their important histories, supporting my ability to make wise choices in relation to methods, research questions, analysis, and representing my findings. Thinking with other students and with guidance from mentors gave me insights into my discipline and my work that I would never have developed on my own.

I came to this project with a theoretical interest, but had no pre-existing relationships to people involved in Mexican earthquake risk mitigation communities with whom I could build a project. I had to make practical connections in order to take on this project responsibly and make sure its outcomes could be useful. During my first years working on this project, I took advantage of research funding through UC Irvine to spend several months in Mexico. While I had studied Spanish for many years, an intensive summer language course and immersion were necessary to bring my language skills up to the level where they needed to be to ask questions, listen, and read widely. In this time, I also began to develop contacts, explore archives, and consider what kinds of research would be truly feasible for someone like me to perform in this place. These months of preparatory visits allowed me to develop a network in Mexico City who helped me learn about the city and the field of seismic risk mitigation. My contacts and mentors pointed me toward essential texts, concepts, people, and issues that would become crucial for my next steps. They helped me refine research questions, learning about Mexico City and the many communities involved in seismic risk mitigation work.

I used what I learned to produce short papers for academic conferences and workshops. This was an opportunity to think through new ideas and materials with colleagues and to listen to what more established scholars in related fields and working in the area were saying. This, too, gave me the chance to refine my approaches in ways that might allow me to make my findings meaningful in conversation with that of other anthropologists and science and technology studies (STS) scholars.

## PHASE 2: FIELDWORK, 2013–2014

This preliminary research and training, as well as guidance from mentors, allowed me to write persuasive grants for my research. I spent twelve full months in Mexico with funding from the American Institute of Physics, the Society for the History of Technology, the University of California Institute for Mexico and the United States, and the National Science Foundation. During this time, I was invited to join a seminar on the history of science led by Gisela Mateos González and Edna Suárez-Díaz at the National Autonomous University of Mexico (UNAM). I was also guided by Sandra Gonzáles-Santos, then working at Iberoamerican University in reading and thinking about STS. Studying with these scholars helped me shape and refine my work.

During the first three months of my long-term fieldwork, my priority was to identify, collect, and review archival materials, including historical documents, journal articles, policy, and media documents regarding SASMEX and seismic risk mitigation in Mexico, especially those published since the upwelling of support for earthquake science after the 1985 earthquakes. I spent a substantial amount of time at physical archives at earthquake research institutes and state agencies including the National Center for Prevention of Disasters (CENAPRED), and the libraries of the Center for Research and Higher Studies in Social Anthropology (CIESAS) in Mexico City, and combing over online archives maintained by print media outlets. Collecting and considering these documents allowed me to analyze the historical situation out of which SASMEX was developed and consider technoscientific, popular, and policy discourses mobilized to develop it.

After I settled in, I secured permission from Center for Seismic Instrumentation and Registry (CIRES) director Juan Manuel Espinosa Aranda to spend extended time at CIRES headquarters. I observed ordinary office work and meetings. I conducted a survey of CIRES employees to better understand their backgrounds and thoughts on SASMEX. I did extensive interviews with the people who worked there and the scientists, engineers, entrepreneurs, scholars, and officials that they collaborated with, which I recorded and transcribed. I sampled carefully, primarily using chain referrals by which one interviewee might recommend others, but also seeking out those who might offer counternarratives. I sought “saturation,” a point at which people were no longer sharing truly new perspectives even as they recounted their views regarding new events.

Over ten months, I spent three days each week at CIRES. During this time, I wrote fieldnotes detailing what I saw and heard; exploring how it aligned, or failed to, with what I learned elsewhere. I reviewed this material for trends and performed preliminary thematic analysis on these notes and the archival documents I had collected after I had been in Mexico for approximately eight months and visiting CIRES for around five. It was at this point that I began to note and then trace how, for example, risk mitigation was being treated, or how engineering identities were discussed and deployed in the interactions I observed.

During the last three months of my yearlong stay in Mexico, I focused on investigating the broader social and political context of CIRES's risk mitigation work. I supplemented my visits to CIRES with visits to the offices of officials and emergency managers in Mexico City. I traveled to Guerrero and Oaxaca states to learn about SASMEX and risk mitigation and gain a sense of how Mexico City compared with other places that are subject to frequent and dangerous seismicity.

### PHASE 3: ANALYSIS, READING, FOLLOW-UP, AND WRITING, 2015–2021

Analysis, reading, follow-up, and writing are deeply entangled. Anthropologists choose to write material that expresses things we find in our data that are meaningful in scholarly conversations. This phase requires searching out and evaluating studies and pertinent material after research in much the same way as when we begin crafting our research questions in the first place.

To do this work, I returned to the United States: first to Long Beach, then to central Pennsylvania, back west to San Diego, and finally to Denver, Colorado. I had support during this time from UC Irvine's Newkirk Center for Science and Society and teaching positions at UC Irvine, California State University-Long Beach, and Bucknell University. I secured a post-doctoral position in engineering education at the University of San Diego and then took a faculty role at the Colorado School of Mines. These challenged me to read and think bigger even as I used thematic analysis techniques to trace relevant concepts through my fieldnotes, interviews, and the many documents I collected and wrote. I completed a dissertation and began to publish.

Meanwhile, I continued making follow-up visits to Mexico. A visit to Mexico in 2015 gave me firsthand experience with an earthquake early warning event. In 2017, tragic earthquakes gave this research a new and worrisome

context to consider, and I made another visit. I began, further, to work with the US-based earthquake early warning community and to teach engineers and applied scientists just starting in their careers. Ongoing conversations with members of the ShakeAlert community and the ShakeAlert Social Science Working Group have helped sharpen my understanding of earthquake early warning practitioners' concerns and how social scientific insights might be useful to projects in this area. This fieldwork and experiences in my professional life drove me to write this book in ways that emphasized insights for application.

## RESEARCH METHODS

I have built up my research with ethnographic questions in ways informed by the places and materials I have been allowed access to. My fieldwork for this book fell into four broad types: observation, interviews, archival work, and survey research. I collected data and then visited and revisited it, analyzing in light of the themes that I came to understand as crucial. I considered my notes, transcripts, documents, and survey data together to help me understand events and their context.

### OBSERVATION AND PARTICIPANT OBSERVATION

Observation and participant observation are key tools of ethnographic research, giving researchers the opportunity to systematically observe how people go about their lives. I chose this method of research because it could help me learn about life with earthquakes and earthquake early warning in ways that reports highlighting specific events or incidents never could. I was interested in learning about ordinary life as well as remarkable events that may or may not be scheduled. Some of this I could investigate about by taking part myself. Some things I could not—for example, participating meaningfully in fast-paced CIRES director's meetings or fixing equipment were not within my skillset. Nevertheless, I could be an observer.

### UNSTRUCTURED AND SEMI-STRUCTURED INTERVIEWS

Unstructured or semi-structured interviews are excellent ways to elicit reflection and explore themes of mutual interest in collaboration with interviewees. The fifty-one formal interviews that I conducted for this project took place in Spanish or, occasionally, English, and were largely focused

on issues that the people kind enough to talk to me were professionally involved in. They were experts, well versed and often very passionate. Asking them about their work, and the events and relations entailed, allowed me to learn more about the parts of earthquake risk mitigation that they might leave out of narratives that they published themselves but that they nevertheless found essential. Further, I could both enlist them in inquiries into puzzles that I had identified and follow them into key issues that they wanted to tell me about. This meant that an interview that I began with questions about an earthquake event or the development of SASMEX could jump to other themes, as an interviewee made offhand mention of a concept or theme I had heard elsewhere. At a reference to “engineers’ work” or a “culture of prevention,” I could shift gears and ask: “Wait a minute, can we talk a little about *that* before we move on? I want to know more!”

#### ARCHIVES AND LIBRARIES

Spending time at archives and libraries was incredibly useful for this project. Of course, the utility of archives depends on the data that are generated and collected in the first place. I found that my investigations into earthquake risk mitigation were well served by diving into materials others had assembled. CIESAS and CENAPRED collections held reports, dissertations, public outreach materials, conference proceedings, and peer-reviewed publications. Accessing scholarly books and popular press articles also proved essential to my project. I visited each repeatedly, sometimes for periods of months, to work my way through their collections. Throughout my entire year of fieldwork, I made weekly sojourns to the Iberoamericana University library to read through books while carefully sipping coffee. My visit to the Royal Geological Society in London was far too short in comparison—only one day!—but still allowed me to track down key materials to corroborate details and better understand stories that had been told to me in interviews.

#### SURVEY

Surveys can be very useful complements to the other methods mentioned here. They can provide a means of situating qualitative findings in context. In this case, I administered a short, anonymous questionnaire designed with the help of collaborators at CIRES. While CIRES had kindly allowed me to spend time at their offices, they were not able to share employee information with me; employees themselves had to choose to do that. A

survey was an excellent tool for investigating demographic trends at the NGO: where people were born, where they studied, how long they had worked at CIRES, and so on. I used this opportunity to ask people when they had learned about earthquake early warning and what they thought of it, too. Only thirty-two people participated—that is, less than 50 percent of CIRES employees. People in some departments were more likely to do so than others, so it was not a representative sample by any means. I could nonetheless learn a great deal from those who did respond. I used simple descriptive statistical analyses to identify trends among respondents rather than search for correlations between their answers to my questions. This approach to survey analysis trends bolstered my understanding of CIRES and the people who work there. In this book, I do not report these findings in great detail, but instead use survey data to support qualitative analysis when appropriate.

## ETHICAL RESEARCH

In this research, ethics begin with the guidelines that I established with the Internal Review Board (IRB) at UC Irvine, but do not end there. Typically, IRB guidelines stress the importance of making sure the appropriate people are invited to participate in research like this, that those who do are not made unnecessarily uncomfortable or put at risk, that they have freely consented to participate after having been informed about what their participation entails, and that they feel able to opt out of participation at any time without penalty. Addressing these considerations is not the same thing as engaging ethically in research, but doing so can be a place to begin and a way to remember commitments. Ethical work is whole-project work; it is involved in research design, research practice, and communication of findings. There are topics that it is more and less appropriate for me to ask questions about and then describe here. My status as a white woman from the United States, my lack of pre-research relationships with the people whose experiences I describe here, and my disciplinary identity as an anthropologist rather than an engineer, policy maker, emergency manager, or physical scientist inform my ethical responsibilities and accountabilities.<sup>2</sup>

When I write about responsibilities, I mean to signal a wide variety that exist between myself as researcher, research participants, and readers—not to mention all of those whose lives are affected by the choices that research



participants participants and readers may make. The technoscientific work I describe here, after all, is not just any work. It has potentially broad consequences for public safety. We have responsibilities to each other and have power to influence each other's lives. We may choose to explicitly consider them or not, but they are very real. When I write about accountabilities, I consider a smaller set of relations: primarily those I have within my field, to my colleagues and collaborators, and to those whose experiences I study. Through accountability, my responsibilities can begin to be more than choices—they can be obligations, and failing to meet them can have meaningful repercussions.

I want to talk about this last group, people who have chosen to share their work and lives with me, in more detail here. Being accountable to them does not mean that I agree with them on all points, nor they with me. It does mean that I do my best to take their opinions seriously. In this, I understand them the same way that I understand any of my colleagues and collaborators. However, they are different in important ways. I write about them. I expose what they share with me to my analysis and then the scrutiny of my readers. That is no small thing, and I find that mechanisms for accountability that exist in my academic institutions are often clumsy for navigating these relationships. For example, it is standard practice that those who do not like a researcher's behavior can stop engaging with her. They can contact her IRB to complain. Ideally, however, accountability means something more subtle and ongoing: a researcher should be sensitive to signals from the people she is working with and use those to inform her behavior and the questions she asks long before they have to cut her out or lodge complaints. She should allow her questions and behavior to change in light of what she perceives in the field and ask the people in her field site and her scholarly community for guidance. She should be sensitive to their discomfort and refusals.

The people represented in this book have stakes in these issues, and I have relied on their help. In the early stages of my research, preliminary meetings with potential research participants and others concerned with earthquake risk mitigation allowed me to ask them questions regarding the things I was curious about. From these conversations, I refined my understanding of what research questions it might be appropriate for me to pursue. They helped me see what I might investigate and where I could go (or should not go) to do it. My primary methods of participant observation,

open-ended interview, and archival research all lend themselves to refining areas of inquiry during the research process, allowing me to shift tracks when necessary.

Finally, writing and communicating findings can happen with help. Every time I have prepared anything for publication in journal articles, blog posts, or indeed for this book, I have sent preliminary copies of the texts to those who take center stage in them. They have generously guided me to clarify key issues or fix details. This way, there are built-in opportunities to gather more information, to change things when I go wrong, or to move forward with information about the implications of my research choices—at least, as long as people are able to read and comment, which may not always be the case.

The work of the people who informed this research is cited throughout this book. They themselves are described and quoted, sometimes by their real names and sometimes by pseudonyms. I developed an acceptable procedure with my patient IRB officers: generally, I attribute quotes to real people when they are on record for these statements or others like them in academic documents or in the popular press, while concealing their identity in relation to reflections that they offered to me in private and have not discussed publicly. I cannot claim that I have always done a good job at ethical research, or that I have made everyone happy in any of the choices I make in the book. My attempts at ethical research entail, if nothing else, a commitment to keep on interrogating the available methods.

## THE FORM OF THE BOOK

I write in light of my own research findings, movements in anthropology and STS, concerns of professionals in fields related to disaster response and recovery, and the insights of my many readers and editors. These audiences have influenced how I have framed this book in several ways. First, they have informed my analysis. They prompt me to describe the spaces in which I did much of this research, the thoughtful reflections that people shared, and the isolated events that I experienced in ways that fit within larger trends documented by other scholars. I have been particularly interested in environments, society, and technology, and how technoscientists actively consider and attempt to remake the relationships between these not-so-separate domains. Considering how people make meaning related

to environments, society, and technology are strengths of my training. I am particularly well positioned to study and write about these topics. Not only do they stand out to me but my reading and observation of practitioners in risk mitigation and the particular challenges they grapple with suggest that insights from such an approach may be of use to them. If these insights do not solve problems, they at least explain certain headaches and, I hope, let the people who have them know they are not alone.

Environment, society, and technology are what I chose to write about. However, the data I collected would make many different arguments and forms of writing possible. In this book, I choose to emphasize the ideas and histories that people there helped me learn. I refer to plenty of texts. A significant part of the social life of this topic unfolds in the popular press, peer-reviewed journal articles, conferences, and reports, and I have sought to showcase this while keeping the text as readable as an academic like me can manage. This book is a balancing act, reflecting all this as well as my embodied experiences in offices and field sites. Choosing to present all of this together means offering less of what anthropologist Clifford Geertz has famously called “thick description” here than I might.<sup>3</sup> For all its popularity among anthropologists, rich discussion of physical observations is just one mode of communicating anthropological research. There are a number of reasons to choose not to use it, or not to use it exclusively, within a book. My reasons for representing my findings as I do in this book have to do with accounting for various forms of practice and thought that are relevant to earthquake early warning. Meanwhile, I have also cast my engagements with a great deal of rich anthropological and STS thought into the endnotes of this book. I hope that both moves make the text legible, and even inviting, to readers not trained as anthropologists or STS scholars. Whether and how it all works remains to be seen.

In sum, this book is a product of many decisions and compromises. Things could have gone differently in big ways and little ones. It has been a joy, vexation, and honor to have the opportunity to make those decisions and develop this work.



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# **¡Alerta!**

## **Engineering on Shaky Ground**

**By: Elizabeth Reddy**

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