

TITLE

Environmental Health Governance in Six Cities: How Scientific Cultures, Practices and Infrastructure Shape Governance Styles

OVERVIEW

The aim of this project is to advance understanding of different ways scientific capacity is developed and used in governance, examining how environmental health research and governance has developed in six cities (four in the United States and two in Asia). Extending on-going work since 2008 through The Asthma Files project, this project will focus on efforts to understand and address the health effects of long term exposure to transportation-related air pollution. In each city studied, we will examine the operation and use of science in four arenas of governance (environment, health, transportation, and education), and how these different arenas interrelate. We will map the sources of scientific evidence used in governance, assess how these sources are evaluated and translated into policy and programming. We will also document and analyze the scientific infrastructures that produced the findings used in governance, the diverse stakeholders involved in interpreting scientific findings, and diverse cultural logics that shape the creation and use of science knowledge in different settings.

Ethnographic interviews will be our primary means of data collection, supplemented by analyses of scientific publications, policy debates, and media coverage. The cities we will study are Albany, New York City, Houston, Philadelphia, Beijing, and Bengaluru. In each city, we have a collaborator with deep experience and prior research in the city. The digital platform built for The Asthma Files project will support collaboration among project researchers, and the involvement of student researchers. In each city, we will run a field school to teach the project's methods to students, and to enroll them in our effort to advance effective development and use of science in governance. Methodologically, the project models and advances understanding of collaborative research in the social studies of science.

The project will result in a theoretically robust, empirically grounded understanding of environmental health research and governance styles, detailing and categorizing different ways of developing environmental health data, advancing the sciences of environment and health, and directing these toward governance of complex problems. The project builds on work in the history and anthropology of science on how "thought styles" shape scientific research, and extends it to sociocultural analysis of "governance styles." The project will extend theorization of governance by addressing how scientific cultures, practices, and infrastructure shape governance processes and outcomes.

Project results will have wide implications for efforts to improve collaboration between governance regimes (across scale, and between nations); such collaboration is particularly important in addressing complex, often transboundary problems like air pollution, which call for new levels of cooperation and sharing of technology, data, and effective policy design. In the final project stage, recommendations resulting from the project will be disseminated among policy makers, journalists, and other stakeholders in all cities studied in the project. Project results will also be translated into curriculum for K-12 students, using the techniques and infrastructure developed by RPI's EcoEd Research Group, which for the past four years has successfully translated social sciences research findings on the dynamics of environmental problems into programs for young students (delivered both at RPI and at local K-12 schools).

RESEARCH AIMS, QUESTIONS, AND SPECIAL CONTRIBUTIONS

The proposed project will build comparative analysis of environmental health research and governance in six cities, as grounds for robust, empirically grounded theorization of *scientific research and governance styles* (akin to Ludwik Fleck's theorization of the dynamics of thought styles within scientific communities). By examining scientific research and governance styles in different settings, we will ethnographically capture dynamics *between* different scientific communities, *between* spheres of government, and *between* scientists and other governing actors to advance understanding of how science is developed and used to govern complex societal problems. Special contributions of the research will partly result from its grounding in the ethnography of scientific practice and culture, extending from this to ethnographic analysis of science in governance. A special contribution will also result from the comparative

methodology and scope of the project, demonstrating how shared analytic structures can facilitate comparison across sites and cases while allowing for ethnographic differentiation and specificity.

The first aim of the project is to collect empirical data to map environmental health research and governance in different cities. The main question and sub-questions supporting this aim are:

1. What scientific practices, infrastructure, and organizations shape environmental health governance in different locales?
 - a. What scientific infrastructures have been built that support environmental health governance?
 - b. What types of data are collected, and how do scientific data, models, and theories travel to environmental health policy arenas?
 - c. What social actors and organizations have supported scientific research, and shaped public discourse about environmental health and related policy processes?

The second aim is to develop a theoretical framework to characterize styles of scientific research and governance in different settings. The main question and sub-questions supporting this aim are:

2. What historical, social, and cultural factors shape the development and use of scientific research in governance, contributing to particular *research and governance styles*?
 - a. What hierarchies have emerged between different research communities and the modes of evidence they produce, what accounts for these hierarchies, and how does it impact the use of science in governance?
 - b. How have global concerns about environmental equity and health disparities shaped local research, and the use of research in governance?
 - c. What diverse cultural logics have shaped the making and use of scientific data and theory to address environmental health?

PROJECT BACKGROUND

The proposed project extends work done over the last five years with The Asthma Files (TAF), a collaborative ethnographic research project designed to advance understanding of, and efforts to address, environmental public health challenges around the world. Focusing on global incidence of asthma and other respiratory illnesses as a starting point, the project spirals out to address growing concern about the health impact of air pollution and the need to build scientific, clinical, and public health capacity to address environmental determinants of human health. Through ethnographic interviews and analysis of scientific publications, policy debates, and media coverage, the project draws together different ways of approaching environmental public health, aiming to enhance comparative perspective.

The Asthma Files project has two primary streams of work, one focused on the sciences of asthma and air quality (from genetics to pediatric pulmonology, to air chemistry and atmospheric modeling), the other focused on different spaces (neighborhoods, cities, countries) in which air pollution occurs and must be managed (by patients, school nurses, and people in diverse government agencies and environmental advocacy organizations, among others). Through these, we have built considerable ethnographic understanding of the sciences relevant to the proposed project, and to the ways these sciences interact—and sometimes don't. A notable finding of our work thus far is that there often continues to be considerable distance between air quality sciences and health sciences, and between government agencies responsible for environment, health, transportation, education, and other elements of the air pollution calculus. There certainly are exceptions, and some impressive interventions have been made, but they often emerge from one "stove-pipe" or "silo," rather than multidisciplinary collaborations. The proposed project will examine such phenomena directly.

Through The Asthma Files we have also built a robust comparative methodology and supporting digital platform. We have learned how to develop "analytic structures" that can be shared among researchers without overly delimiting the methodological, analytic, and interpretive freedom of individual researchers. We have also learned to use these structures to effectively involve students in research at all stages, as

the analytic structures developed for collaboration can provide scaffolding to young researchers just learning to turn high-level research questions into questions that can be answered empirically. Over fifty undergraduates have participated in The Asthma Files thus far, for stints of one semester or more. Two PhD dissertations have also stemmed from the project, one by Alison Kenner (now Assistant Professor at Drexel), who will serve as a consultant for the proposed project (for Philadelphia). Learning to effectively involve students in The Asthma Files has been an especially rewarding dimension of the project.

The Asthma Files runs on an open-source (Drupal-based) digital platform designed for the project, that has now grown into the Platform for Experimental and Collaborative Ethnography (PECE), which will eventually support an array of projects, both collaborative and individual. There are now four instances of PECE, supporting different kinds of projects; we plan to release PECE on Github in December 2015, supporting its adoption by other researchers.

PECE is designed to support collaborative and distributed interpretive analysis of qualitative data. A critical aspect of PECE is its built-in data management functionality. Artifacts archived on the PECE platform are provided with Extended Dublin Core metadata. We are now working to attach metadata to the analytic structures used in the project, capturing our work flows and the conceptual process leading to arguments. In the coming nine months, the data management functionality of PECE will be substantially refined, with the support of a financial award from the (NSF-funded) Research Data Alliance (RDA). In January 2015, PECE was selected by RDA to become a test adopter of recommendations for data management produced by an RDA working group. The data management policy and practices developed through this effort can also be implemented on other platforms used by social science and humanities researchers; PECE itself (with its embedded data management policies) may also become widely adopted, partly to enable compliance with data management expectations of funders like NSF.

The Asthma Files' instance of PECE includes an archive, spaces for online collaboration, and tools for various forms of publication (photo essays, timelines, working papers). The Asthma Files archive includes bibliographies, photographs, found documents, field notes, recorded interviews, and other material collected by associated researchers— with options to share in delimited or fully open ways, and with metadata that provides contextual information and guidelines for attribution. The Asthma Files also provides space where groups – large or small, private or public -- can collaborate, drawing on various analytic structures developed to facilitate collaboration within the project. There are structures for annotating texts and interviews, for example, and structures for addressing shared questions about diverse asthmatic spaces and sciences. The project is designed to support many differently focused projects within a larger project structure. The project proposed here can thus build on work already done through The Asthma Files, while making a unique contribution.

The proposed project will also build on the work of the RPI EcoEd research group run by Kim Fortun. Since fall 2011, RPI EcoEd has run over fifty 1-2 hours programs for K-12 students, with curriculum developed and delivered by RPI students. The curriculum is designed to share the results of social science research on environmental problems – through hands-on experiments and role plays, and exercises that link STEM to critical analysis and writing. RPI EcoEd programs are a means to disseminate research findings, while providing transformative educational experiences to both K-12 and university students.

SOCIETAL SIGNIFICANCE

Environmental health research is remarkably complex and almost always controversial – because of tension between economic and environmental priorities, because the science at issue is multi-dimensional and produces findings that are far from straightforward to translate into policy, because environmental health stressors can be difficult to apportion to sources and mitigate. (Brown et al. 2004) Air pollution research and governance is exemplary and thus centers this project.

Understanding and addressing air pollution requires remarkable coordination among different scientific fields, different government agencies and scales of government, and between scientific arenas and government. The proposed research aims to understand the challenge of coordinating knowledge

production as a key governance challenge. The significance of this is evident in the disjunctive history of efforts to deal with air pollution in the United States. (Dupuis 2004, Eisinger 2010)

In the United States, environmental health regulation has developed in parallel with overall environmental protection policy since the early 1900s. While these early efforts included statutes governing the quality of food, drinking water, and sewage systems, most notably left out were concerns of air quality (EPA 1988; Davis 2003; Gonzalez 2012). It wasn't until the 1950s that an awareness surrounding the dangers of industrial pollution was fostered, triggering a realization that regulation must attend to more than the acute, communicable diseases such as typhoid, but also to the chronic, long-term disease burdens caused by the very visible particulate air pollution of the industrial age. In comparison to the immediate and quite tangible health outcomes of polluted drinking water, efforts to understand the health effects of air pollution have been riddled with difficulty on the scientific, industrial, and political fronts. (Thorsheim 2006; Sze 2007) Spurred by the deadly smog episodes of the 1940s in Pennsylvania and London, Congress passed the Air Pollution Act in 1955, providing the US Public Health Service \$5 million annually to study the effects of pollution on human health (Klinger 2014).

The 1970s brought about stronger federal air control regulations in acknowledgement that state and local standards were insufficient for dealing with a matter that crosses political borders; further indication of the importance of studying cities as both unique, insular microcosms of pollution, as well as contributors to overall air pollution. The regulations established National Ambient Air Quality Standards, New Source Performance Standards, establishment of the Environmental Protection Agency, and limited emissions from motor vehicles. Expectedly, this strengthening of standards did not come without backlash from industry, with numerous cases of litigation ensuing over the next decades, further calling for the establishment of irrefutable scientific evidence to support the regulatory measures (Melnick 1983).

This research takes as its more immediate backdrop the extended controversy about the Harvard Six Cities Study. Beginning in the mid-1970s, the Six Cities Study examined the effects of air pollution on more than 8,000 adults and 14,000 children in six US cities over a 14 year span (Dockery 1993). Although one of the most influential public health studies, the study has been subject to intense scientific scrutiny since its publication in 1993. Following a 1979 epidemiological study concluding "there was no evidence for negative health effects from particulate pollution at levels seen in the United States," the Six Cities study reached a radically different conclusion. In response to the widespread controversy, the Six Cities researchers, along with the authors of a similarly controversial American Cancer Society study linking emergency room visits to air pollution, released their data to the Health Effects Institute, a corporation jointly funded by the EPA and the automobile industry, in an attempt to validate their results to the public. The Health Effects Institute's objective validation of the study's methodology proved a significant juncture in the scientific and political acceptance of such studies (Dockery, 2009; Upton 2015). The Clean Air Act, established in 1963, mandates that the standards be reviewed every five years to reflect the latest scientific knowledge, forcing the EPA to review the latest standards in light of the recent epidemiological evidence (McClellan 1997).

Despite the controversy surrounding air control regulations, the potential positive health impacts of governing air pollution are quite evident. A 2014 World Health Organization report attributed one out of every eight global deaths to air pollution exposure, a staggering 7 million premature deaths in 2012 (WHO 2015). This data also points to the necessity of addressing air pollution in a global context, as the disease risk is particularly high among vulnerable groups.

INTELLECTUAL SIGNIFICANCE

The proposed project will build on and extend a number of overlapping literatures, promising new understanding of environmental health governance, and a theoretical framework for understanding *governance styles*: the way particular forms of evidence and technoscientific knowledge are developed and used to address complex societal problems in different contexts. The project will build on and contribute to the extensive bibliography developed for The Asthma Files project, now containing more than 1,400 references.

Extending from Ludwik Fleck's conceptualization of the way thought styles characterize different scientific

communities, the project will bring core ideas from social studies of science into conceptualizations of governance. The project will examine how different forms of knowledge about air pollution are created, used and shared between different domains of governance (environment, health, transportation, education), in different urban settings. The project will thus also contribute to work in the social studies of science on “trading zones” and the challenges of interdisciplinarity. Studies of asthma in the social studies of science will also be drawn on. (Fortun et al. 2008; Fortun et al. 2014; Mayer 2012; Juhn et al. 2005)

The proposed project also builds on important STS work on different formations of science and engineering across cultural and national contexts. Gary Downey’s work on engineering across cultural contexts is exemplary (Downey 1998), as is Sharon Traweek’s work on physics in Japan and the United States (Traweek 1988, 2000), and Sheila Jasanoff’s work on civic epistemologies (that direct the kind of evidence used in policy making in different contexts) (1986, 2007). A related stream of work examines environmentalism across cultural and natural contexts, also providing grounds for the proposed project.

Important STS texts such as *Changing the Atmosphere: Expert Knowledge and Environmental Governance* (Miller and Edwards 2001) also lay ground for this project and its focus on how different communities build, legitimate, and begin to act on particular understandings of nature. Like the proposed project, *Changing the Atmosphere* gives special attention to where knowledge is composed and how it travels. Also like the proposed project, the book works with a conception of “governance” that extends beyond “government” to “the full range of knowledge, technique, power and practice constituting the manner in which something is governed or regulated” (Miller and Edwards 2001, 5). As briefly described below, the literature on governance is now vast, and largely focused on the topics of concern here: governance of the urban spaces, the environment, and public health.

A fourth stream focuses on air pollution: its social shaping, the scientific challenges and controversies associated with it, and the difficulties of integrating different domains (transportation, environment, health, education) into coherent policy and action.

Below we provide further detail on each of these bodies of literature, and how we will build on them.

Literature on Thought Styles and Trading Zones

A key aim of the proposed project is to chart the environmental health governance style of six different cities, building on Ludwik Fleck’s (1981 [1935]) conception of the “thought-styles” that characterize different scientific communities. “Thought styles” in Fleck’s analysis are far from monolithic or homogeneous; indeed, their ability to generate shared perceptions as well as new thinking and creative solutions depends on the different members of the scientific “thought collective” belonging to multiple thought collectives, and on the mixing of the different abilities, insights, and interests of a more “esoteric” circle of experts and professionals, and those of a more “exoteric” circle of people with more “generalized” knowledge, including lay persons. Similarly, with “governance styles” we hope to capture an overall quality reflective of how environmental problems are conceptualized and addressed by place-specific mixtures of diverse scientists, engineers, state and local government workers, and involved citizens.

A key focus of our work will thus be on what historian of science Peter Galison (1996) has called “trading zones,” where people with different skills and perceptions come together for collaborative work. Despite “vast global differences,” Galison demonstrates, trading partners can “hammer out a local coordination” in a way similar to the way groups that speak different natural languages establish contact languages to enable interaction. Galison’s concept of “trading zones” has been taken up in multiple areas, to orient both scholarly analysis and practical work (Fincher and Petre 2004; Gorman 2002; Gorman, Werhane, and Swami 2009) The May 2006 NSF-sponsored conference on “Trading Zones, Interactional Expertise and Interdisciplinary Collaboration” emphasized the importance of trading zones in many areas of scientific research (Gorman 2010). The empirical cases and theoretical framework developed here to characterize environmental governance styles can thus help extend important work in the social studies of science on trading zones, by demonstrating how particular governance styles can be characterized and compared as “trading zones.”

Literature on Technoscience and Environmentalism Across Cultural Contexts

In characterizing environmental health governance styles in six cities (in three countries), this project builds on and extends an important, emergent thread of work in the social studies of science that examines differences in the way science and engineering knowledge is developed and used in different natural contexts. (Downey and Beddoes 2011; Han and Downey 2014) Yaron Ezrahi's early work on the changing role of science within state structures, and governments' utilization of science to produce facts and justify action (Ezrahi 1990, 2004) has been extended by Sheila Jasanoff in her analysis of the "boundary-defining language" used in the process of translating science into regulation of stem cells, nuclear power, and nanotechnology (Jasanoff 2011; see also Jasanoff 2004). A decade ago, Jasanoff and Martello argued that with increased levels of connectedness between cities, nations, and societies brought on by globalization, it is particularly important for environmental governance to evolve and develop flexible frameworks for cutting across differences (Jasanoff and Martello 2004). The challenge remains today. This project is designed to help clarify such cultural differences, hoping to provide grounds for collaborative work across them.

Literature on Urban and Environmental Governance

This project has origins in ethnographic studies of the sciences and we will leverage this in our effort to build on the now vast literature on "governance," developed to describe the increasing role in recent decades of non-state actors in activities that have de facto governing effects. The environment, cities and humanitarianism have been key foci in the governance literature (O'Neill, Weinthal, Suiseeya, Bernstein, Cohn, Stone & Cashore 2013; Newell, Pattberg & Schroeder 2012; Banister, Anderton, Bonilla, Givoni & Schwanen 2011; Bulkeley 2010; Lemos & Agrawal 2006; Hooghe and Marks 2001) Recently, there has been a call for research on disaster governance (Tierney 2012), which can be read to address both acute disaster and chronic disaster (such as air pollution in many locales). The literature emphasizes NGOs and businesses as important non-state actors, while the role of scientific communities in governance is very minimally addressed. The proposed project will thus contribute to the urban environmental governance literature in a much-needed way, describing and analyzing the involvement of scientific communities and organizations in governance processes..

Literature on Air Pollution Politics and Policy

Competing interests between infrastructure and transportation policy, and environmental policy makes environmental policy integration (EPI) "easier said than done" (Busscher, Tillema & Arts (2012). Even if "doing" EPI in our six cities is a struggle or a promised future, we will be able to document how EPI is "said" in these different cultural and political contexts. Campbell (1996) argues that environmentally conscious planning entails resolving three interconnected conflicts: between equity and economic growth, between environmental protection and economic growth, and between equity and environmental protection. The weight of environmental considerations is consistently measured against the weight of other sectoral objectives and trade-offs are inevitable (Jordan and Lenschow 2010; Lafferty and Hovden, 2003). Often times, environmental considerations are given "principled priority" and in other cases it is given mere consideration (Lafferty and Hovden, 2003: 9; Schout and Jordan, 2007)..Persson (2004) identifies three factors that influence EPI; (a) normative factors including political commitment; societal backing; and changes in political paradigms; (b) organizational factors including the architecture of government and non-government institutions; and (c) procedural factors including decision making tools such as environmental impact analysis (EIA) and strategic environmental analysis (SEA) (Nilsson and Dalkmann, 2009; Sheate and Partidario, 2010); action plans and consultation procedures. This project aims to provide rich documentation of these kinds of negotiations, including analysis of successful strategies

To understand the factors that propel EPI forward, studies suggest using a multi-level governance perspective; in other words, it is critical to consider the nature of interaction between multiple tiers of government and how they influence EPI at the local level. Hooghe and Marks (2001) point out that EPI is affected by how authority is shared among different, state and non-state, actors and institutions. Others suggested that EPI at the local levels can be hindered or helped significantly by governing institutions at different levels of the state. (Alahuhta et al., 2010; Bulkeley and Betsill, 2005). The character of multi-level governance of EPI can partly explain the 'implementation gap' (Nilsson et al., 2009). This project is designed to advance understanding of multi-level, multi-actor governance, and thus has potential to help address this implementation gap.

PROJECT SITES

Houston is in the largest petrochemical manufacturing region of the United States, has no zoning laws, and has a notorious amount of vehicle traffic (and supporting infrastructure). (Harper 2004) For these reasons and others, Houston became the focus of air quality studies led by the National Oceanic and Atmospheric Administration in 2000 and 2006. The 2006 study (Parrish et al. 2009) emphasized that “the current Houston area emission inventories still underestimate HRVOC [highly reactive volatile organic compounds] emissions by approximately 1 order of magnitude,” and that “the background ozone in eastern Texas...can approach or exceed the current National Ambient Air Quality Standard of 75 ppb for an 8-h average. These findings have broad implications for air quality control strategies in eastern Texas.”

A group of scientists convened by Houston Mayor Bill White developed the Benzene Action Plan of 2007, which led to a targeted campaign to reduce emissions at one particular facility (partly because this facility was inside city limits, unlike many other that also pollute Houston’s air – from just outside the city limits). This initiative provoked considerable wrangling over jurisdiction, involving the US EPA, Texas state agencies, and city agencies in both Houston and adjacent cities like Pasadena. Today, similar political and scientific wrangling is playing out around ozone: the Texas Council on Environmental Quality (TCEQ) “is now marshaling...arguments to fight tougher federal standards on ozone levels—even as the overwhelming majority of the scientific community heads in the other direction” (Satija 2014).

In November 2009, Dan Price hosted Mike Fortun, Kim Fortun, and Alison Kenner at the University of Houston, where they recorded interviews with diverse actors in air pollution governance in Houston to document the successful benzene campaign, and convened a public roundtable that brought numerous stakeholders together for further discussion about air quality governance. Interviews will trace the impacts of the NOAA studies and the benzene campaign on the contemporary science and politics of ozone; another public roundtable with stakeholders from multiple arenas (air quality science, public health, environmental groups, and city officials) will be convened and recorded for archiving and analysis.

Philadelphia is a city challenged by industrial legacies, high poverty rates and health disparities, and spatial fragmentation. The city is also increasingly described as a “living laboratory,” with an active and growing technology community, a multitude of neighborhood and city-wide sustainability initiatives, and robust professional networks that allow for innovative, transdisciplinary projects. A key question for scientists, civic professionals, and urban communities is how sustainable development can be advanced amid outdated material and civic infrastructures (including multiple transportation systems), a limited air monitoring network, and a public education system in crisis. Energy industries hoping to leverage Philadelphia’s existing infrastructure (ports and industrial sites in particular) have sparked difficult discussions about how to invigorate the city without perpetuating unequal distributions of environmental risk and benefits, particularly as green infrastructure research (exemplified in the *Philadelphia 2035* program) begins to draw communities into urban planning. (Moskowitz 2014, Philadelphia City Planning Commission 2011) Although Philadelphia is also a recognized hub for climate change/sustainability work, being one of four cities in the Climate and Urban Systems Partnership (CUSP 2013), there is far less air research on Philadelphia than on many other cities in our set.

Partnering with Drexel University’s Alison Kenner, our group will focus its interviewing around a collaboration led by the University of Pittsburgh’s Graduate School of Public Health to model and characterize the time and space sequence of events that predict asthma exacerbations. We will document and analyze the efforts made by an interdisciplinary group of bioinformaticians, air quality modelers, and public health researcher to develop an exploratory model that includes analyses of past weather, air pollution data (particulate matter and ozone), and asthma emergency department visits, to produce a prediction model map. We will also study efforts to encourage members of the public to learn about the prediction map, and to monitor the possibility of air pollution-induced asthma for their location.

New York City represents an excellent and unique case study in environmental governance: the complex air quality challenges of the most densely populated city in the U.S. combine with a complex set of monitoring and data analysis initiatives that link actors in the domains of special interest to the proposed project (health, environment, transportation). (Patel et al. 2010, 2011) The city released PlaNYC in 2007, for example, as “the city’s unified strategy to bolster economic development, improve the environment,

and better the quality of life for all New Yorkers;” the plan sets the ambitious goal to “achieve the cleanest air quality of any big U.S. city” by the year 2030.” (PlaNYC 2015) New York has also been an active site of collective governance action, where stakeholders’ and agency engagement and coalition building have been credited with the effective implementation of environmental sustainability strategies.

Interviewing and fieldwork here will begin with the numerous local agencies involved, such as the city’s Department of Environmental Protection (DEP), responsible for updating and enforcing the Air Pollution Control Code (Air Code) and air quality monitoring in all five boroughs, and the New York City Department of Health and Mental Hygiene (DOHMH) which also monitors air pollution. DOHMH, in partnership with Queens College, also runs the New York City Community Air Survey operating at 150 locations in NYC; they model the health impacts of air pollution, indicating, for example that “fine particle pollution alone caused an average of more than 2000 deaths, approximately 1500 hospital admissions for lung and heart conditions, and 5000 emergency department admissions for asthma based on levels in 2009-11.” (NYCCAS 2015) New York City’s participation in the U.S. Center for Disease Control’s Environmental Public Health Tracking Program offers an opportunity to examine how different domains and scales of governance interrelate. Interviews collected for this project will also explore how the legacy of 9-11 and other formative events continues to shape air pollution governance in New York City.

Albany, a medium-size city and the capital of New York State, has received a failing scorecard from the Environmental Defense Fund for failing to meet the national ambient air quality standard. Although the average number of days for which the ozone Air Quality Index exceeded 100 has declined from its peak in 2002, the Mayor’s Office of Energy and Sustainability has projected that this will once again increase due to climate change. Even now, the average emergency department visits for asthma in all the zip codes in City of Albany are currently higher than any in New York State, and even surpasses the average rate for all zip codes in New York City. (Albany Climate Change 2013) Albany is now also a major oil hub, with daily trains carrying Bakken crude oil from North Dakota to its Hudson River port, increasing both diesel emissions and the risk of disaster with serious environmental and health impacts.

We are partnered here with Scott Kellogg, Director of the Radix Center, an urban ecology resource and education center, and a student in our graduate program. A member of the Mayor of Albany’s Community Advisory Committee on Sustainability, Kellogg will facilitate interviews and fieldwork within an extensive network of community environmental groups, the New York State Department of Environmental Conservation, researchers at area colleges and universities in the area, and the New York State Department of Health.

Beijing now provides the iconic image of a city immersed in and practically paralyzed by air pollution, despite China’s reputation for having one of the most rationalistic, science-informed air quality governance regimes—laws, monitoring programs, standards, indices, and public policies—of all the “emerging” nations. China’s earliest air quality plans of the 1980s were guided by World Health Organization (WHO) and U.S. EPA science and standards, and China portrayed its air quality program as one defined and managed solely by technocratic expertise. But although monitoring programs increased (from 5 cities in the 1980s to 86 in 2006) and new legislation and standards were written (the Prevention and Control of Atmospheric Pollution Law of 2000, and the National Ambient Air Quality Standard GB3095, updated most recently in 2012), scientific advice was in reality being used strategically to legitimate policy decisions based on political calculations. Thus when Beijing’s air quality dramatically improved for the 2008 Summer Olympics due to government-industry coordination, only to quickly degenerate again to even worse levels (as initially revealed by U.S. Embassy releases of AQI reports on its official Twitter account), Chinese citizens adopted much more critical stances toward both technical expertise and government management of air quality.

Working with PhD candidate Rodolfo Hernandez at Tsinghua University, our project will document the development of China’s air quality governance regimes, incorporating reviews of the scientific literature and interviews with air quality scientists and officials (Chen, B. et al. 2011; Chen, R., et al. 2013; Wang and Burnell 2013). Interviews with members of NGOs such as the Clean Air Alliance of China and more broadly with citizens actively concerned with air quality, will provide rich ethnographic material for understanding new relationships between citizens, local and national government officials, and diverse

experts as they narrate, evaluate, and contest emergent agreements and disagreements about air quality, policy, and its effects on health.

Bengaluru (Bangalore), the main hub of India's IT industry (Nair 2005, Pani 2010, Benjamin 2000) has grown dramatically in the last decade into a city of over 10 million people and 5 million vehicles, many of them personal cars. Transport is thus the major focus in air quality research and governance, as both vehicle emissions and particles kicked up from roads make for extraordinarily high levels of particulate matter (PM10 and PM 2.5) in a dense and sprawling urban area constantly being constructed and demolished. Numerous researchers at various levels are engaged in ongoing efforts to apportion sources (bakeries and restaurants, construction projects, open burning, and domestic cooking all add significantly to the transportation mix), map pollutant patterns and "hot spots," and model possible scenarios of control, all toward developing an air quality action plan. (TERI 2010) Interviews and other research here will focus on the intersections of this technical expertise with the multiple levels of governance that shape urban infrastructure and planning, from the Central Pollution Control Board and the Jawaharlal Nehru National Urban Renewal Mission (JJNURM) at the national level, to the Karnataka State Pollution Control Board and, at the local level, the new Urban Local Bodies (ULB) to which responsibility for economic and infrastructure development has been devolved, including "para-statal" bodies (Benjamin and Bhuvaneshwari 2006) such as the Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC), Bangalore Metropolitan Transport Corporation (BMTCL), Bangalore Development Authority (BDA), and the Bangalore Metropolitan Land Transport Authority (BMLTA). (Gopakumar 2013a, 2013b, 2014a, 2014b)

PROJECT METHODOLOGY AND COMPONENTS

Project Methodology

The proposed project is a comparative, ethnographic study focused on six cities (four in the United States, and two in Asia). The aim is to understand how science relevant to air pollution governance is developed, accessed and used in different contexts. Toward this, we will collect approximately twenty-five open-ended interviews in each city in our study, with people actively involved (through their roles in government agencies, NGOs, and universities) in efforts to address air pollution. Our interviews will include people in four domains: environment, health, transportation, and education. Interviews will be supplemented with participation observation, and with intensive review of relevant policy documents, news reports and scientific publications. One line of inquiry will explore how these domains interact (or fail to interact). Another line of inquiry will explore how science moves across scale -- from federal initiatives into local governance, for example. A third line of inquiry will explore the ways different forms of science and evidence accrue cultural authority and become the basis of governance; we will inquire about the process and organizational structures through which science is brought to bear on governance, and about the ways different styles of thinking -- about "good science," the public good, and possibilities for infrastructural, political, behavioral and cultural change -- come together and interactively produce a style of environmental health governance that is particular to the city in which it operates.

We will build on the methods for comparative ethnography developed in The Asthma Files project. These include "analytic structures" that direct work at different sites that are sufficiently flexible to accommodate the way ethnographic research inevitably (and productively) leads beyond questions defined in advance. On the digital platform supporting The Asthma Files, these analytic structures provide researchers working at different sites with a set of shared questions to start with, but encourage continual elaboration of the questions themselves as ethnographic material is collected. A finding about the importance of jurisdiction over air emissions in Houston (where many pollution industries are just outside city limits) can lead to a question for all other researchers about the significance of jurisdiction in air pollution governance in the cities they are working in. Further, the field for answering a project's shared questions are open and unstructured, allowing for the interpretive flexibility so important in ethnographic work. The "light structure" of tools in The Asthma Files platform thus facilitates comparability without undercutting deeply particular, close readings of a particular site by a particular researcher. (An abbreviated excerpt of how this data is handled is provided in the data management plan.)

This project, and the broader Asthma Files project it builds on, engages long-standing effort – with renewed contemporary relevance – to design and carry out collaborative ethnography (Stull and Schensuhl 1987; Lassiter 2005, Konrad 2012). The project’s contribution will thus be methodological as well as empirical and theoretical.

PLAN OF WORK AND PROJECT COMPONENTS

The proposed project will extend over two years, involving PI Kim Fortun and Co-PI Mike Fortun, their undergraduate and PhD students, and five consultants with special expertise on one of the cities in the study. The work will include fieldwork and field schools in six cities, on-going online collaboration between project researchers, and a workshop at Rensselaer that will bring all researchers on the project together. In the field schools in each city, we will train local researchers and build capacity for continued development of the project in the future. Year-by-year phases and components of the project are described below.

Year 1 will primarily involve data collection through ethnographic field work in each of the cities in the project. Consultants associated with each city will collect a first round of interviews, then will be joined by researchers from Rensselaer for a second round of interviews and to lead a field school to train local researchers who can contribute to the project the following year and in the future.

Initial Comparative Analysis of Six Cities

Our first stage of work will be in development of an initial, comparative analysis of the six cities in our study, using an analytic structure used in The Asthma Files project to characterize “asthmatic spaces.” This structure guides researchers through a set of questions about each city that draw out its environmental health history, current demographics and prevalence of air quality related disease, natural and industrial landscapes, political actors, health care availability, and the way the city has (or has not) been the focus of scientific studies focused on air pollution or on asthma and other diseases associated with air pollution. Each consultant will complete a portrait of their city as an “asthmatic spaces;” share it with the research group, then extend their descriptions to include material responsive to descriptions of other cities. Kim Fortun and Mike Fortun will moderate this process, which will occur and be archived on The Asthma Files digital platform. Each consultant will come to this exercise with extensive prior experience in and expertise on the city they are associated with.

Further Review of Published Literature on Air Pollution, Related Health Impacts, and Governance

Once initial comparative portraits of each city in our study are complete, we will return to the published literature to update and extend the city portraits, and to begin addressing the research questions that center this project. Kim Fortun, Mike Fortun and their students will do this work, then share with consultants for feedback.

Development of Interview and Observation Protocols

Based on the city portraits developed and the project’s core research questions, Kim Fortun and Mike Fortun will lead development of interview and observational protocols to be used in field research for this project. Students will be actively involved, learning how research design is put into practice. Consultants will be asked to comment on and extend the interview and observational protocols, encouraged to put forward questions they know to be relevant in the city they know well, which could potentially shed light on environmental health governance processes and styles in other cities. The interview and observation protocols for the project will be archived in The Asthma Files platform (with metadata that will make them discoverable by other researchers), in a manner that allows them to be iterated and elaborated as the project progressing – using the “light structures” functionality built into The Asthma Files platform. This process and functionality facilitates collaborative research while allowing research questions to iterate in the manner essential to ethnographic research.

Ethnographic Interviews and Participant Observation in Six Cities

Approximately 150 ethnographic interviews, approximately one hour in length, will be conducted for this project. Consultants for each city will collect approximately ten interviews that address the themes of this project before being joined by Kim Fortun or Mike Fortun, and one of their students. Together, the consultants and a team from Rensselaer will collect an additional fifteen interviews, and attend as many

air pollution related events in the city as scheduling allows. Interviewees will be based in universities, government agencies, or NGOs, where they have observed or been part of the development and use of science for air pollution governance.

Our standard interview preparation process is to prepare a file for each interviewee that includes biographical information available online, publications, and news reports of their work, the work of the organizations they work in or interact with, and about the air-pollution related issues they have engaged. Close review of these material prior to an interview allows the interview to go beyond information retrieval to focus on the interviewees' own perspectives on social, political and scientific processes they have observed or been involved in. One goal of each interview is to learn about the ways science has traveled from lab or monitoring station to policy arenas, and was debated and possibly discounted in the process. Another goal is to learn how interviewees themselves evaluated available science, investments in scientific research, and the ways science has been used (or not) in air pollution governance. The interviews will thus produce data about events and processes that have constituted air pollution governance in a particular city, and about the interactive dynamic through which involved actors have participated in and contribute to these events and processes.

Interview recordings will be uploaded to The Asthma Files' digital platform, with metadata, including IRB approved consent forms signed by interviewees. If interviewees have granted permission, interviews will be made publicly available immediately. Access to interview recordings can also be restricted to our group of project researchers, archived with metadata that will enable later sharing to the extent permitted. The IRB approved consent form for interviews associated with this project will give interviewees the option to be recorded or not, to be identified or not, and to make their interview widely available for public accessibly or restricted to researchers formally associated with this project.

Field Research Schools in Six Cities

We will run field research schools in each city in the study, training approximately ten students over six days. Students will learn short histories of the social studies of science and collaborative ethnography, then will be introduced to the research design and supporting digital platform for this project. They will identify relevant interviews, develop interview questions, and conduct practice interviews, then move out into the city to collect interviews. We have budgeted to provide required transportation. Students will be able to use recording equipment owned by The Asthma Files. Each student will participate in at least three interviews, accompanied by the city consultant or a member of the Rensselaer team. Once interviews are collected, students will learn to upload recordings into the project digital platform, attaching metadata and documentation of informed consent. They will then learn to annotate the interviews to address project questions, participating in group deliberation about the meaning and implications of interview excerpts. Participating students will be invited to stay involved with the project as it progresses, and will begin receiving newsletters reporting on project progress and findings.

Year 2 will primarily involve data analysis (for each city then across cities). Mid-way through the year, all researchers associated with the project will come together for a workshop at Rensselaer.

Data Analysis, Interpretation and Theorization

Once interviews are collected and archived in the Asthma Files digital platform, we will begin annotating them using a "light structure" that allows questions to be added to (or retired from) an analytic structure as researchers work through empirical material – allowing for the iterative analytic process so important in ethnographic research while keeping the analytic structure visible to all participants in the collaborative project, and archived as part of the project's data. Our data analysis will be directed toward articulation of different environmental health research and governance styles for each city in our study, bringing together understanding of the way scientific practices develop and acquire legitimacy within scientific arenas with understanding of science moves beyond the lab and is evaluated, changed and turned into public knowledge and a resource for governance.

Collaborative Workshop

During the second year of the project, we will host a workshop at Rensselaer that will bring all consultant-researchers to our campus for collaborative data analysis, and for analysis of the collaborative

methodology and supporting digital structure that sustained the project. One goal of the workshop is to advance comparative analysis of the six cities in our study, specifying the particular environmental health research and governance style of each city. Another goal is to advance articulation of a theoretical framework for analysis and description of the environmental health governance styles of different cities, nations and transnational organizations. A third goal is to assess and advance the collaborative methodology and digital infrastructure used in this project. We hope to come away from the workshop with a robust, well-vetted methodology, a set of empirical cases, and a theoretical framework.

Research Writing and Publication

Our research products will include journal articles and a book, presenting both our analyses of particular cities and our comparative analysis.

Education and outreach

The proposed project will produce materials for education and outreach designed to enhance understanding of how science is developed and used in governance of complex societal problems (such as air pollution). At the outset of the project, we will start a monthly newsletter for reporting on project progress and findings; newsletters will be archived on The Asthma Files digital platform. We will send the newsletter to people interviewed for the project (150 total, in six locations), and to others who indicate interest; we will actively cultivate interest in the newsletter by sending it to recommended individuals and to organizations with a role in air pollution governance. We will also develop educational modules for sharing project findings to K-12 and undergraduate students, building on the substantial prior experience of the RPI EcoEd Research Group (led by Kim Fortun).

PROJECT RESEARCHERS

PI Kim Fortun is a cultural anthropologist and Professor of Science & Technology Studies at Rensselaer Polytechnic Institute. Her research and teaching focus on environmental risk and disaster, and on experimental ethnographic methods and research design. Her research has examined how people in different geographic and organizational contexts understand environmental problems, uneven distributions of environmental health risks, developments in the environmental health sciences, and factors that contribute to disaster vulnerability. Fortun's book *Advocacy After Bhopal Environmentalism, Disaster, New World Orders* was awarded the 2003 Sharon Stephens Prize by the American Ethnological Society. Currently, Fortun is working on a book titled *Late Industrialism: Making Environmental Sense*; on *The Asthma Files*, a collaborative project to understand how air pollution and environmental public health are dealt with in different contexts; and on design of the Platform for Experimental and Collaborative Ethnography (PECE), an open source/access digital platform for anthropological and historical research. Fortun also runs the EcoEd Research Group, which turns ethnographic findings about environmental problems into curriculum delivered to young students (kindergarten-grade 12), and is helping organize both the Disaster-STS Research Network, and the Research Data Alliance's Digital Practices in History and Ethnography Interest Group.

Co-PI Mike Fortun is a historian and ethnographer of science and Associate Professor of Science & Technology Studies at Rensselaer Polytechnic Institute. His research and teaching focus on the practices and politics of the life sciences. He has written about the early years of the U.S. Human Genome Project, about the infamous Icelandic company DeCode Genetics, and about relationships between scientific and other forms of knowledge. Currently, Fortun is completing a book on the data practices, culture, and politics of what many have termed "post-genomics," arguing that it is largely through care for their data that contemporary genomic scientists think through and enact concerns about genomics, science, and society writ large. Tentatively titled *Minding Genomics*, the book is about the interweaving of knowledge and ethical practices, extending theoretical perspective on care, ethics and the politics of science. Since 2008, Fortun has played a lead role in *The Asthma Files*, and in the design and development of PECE. Fortun is co-chair of the Digital Practices in History and Ethnography Interest Group in the Research Data Alliance, an international effort to build data infrastructure that supports and links diverse research communities.

Dr. Sam Elrahman is our lead collaborator for New York City. Elrahman has 35 years of experience in the area of transportation research, environmental policy analysis and transportation planning. He served in numerous capacities at different divisions within New York State Department of Transportation since 1983, including Policy and Environmental Analysis Divisions. He coordinated and evaluated large-scale projects that analyzed air quality policies to reduce transportation emissions in New York State, including congestion pricing and conformity to federal and state air quality standards and regulations. His work translated scientific data on air pollution in New York State into state-level policies. Recommendations of his single-authored study on night-time construction were adopted and translated into policies in New York State to curtail construction-related congestion and curb adverse impacts on air quality. As a Senior Researcher at the Transportation Research & Development Bureau, he worked on mainstreaming climate change adaptation strategies within transportation planning and promoting system sustainability and resiliency. He published extensively on different issue areas related to transportation sustainability. Dr. Elrahman is currently a Senior Research Scholar at the Center for Infrastructure, Transportation, and Environment at Rensselaer Polytechnic Institute.

Govind Gopakumar is our lead collaborator for Bengaluru (Bangalore), India. Gopakumar is Associate Professor at the Centre for Engineering in Society, Concordia University, Montreal. He received a PhD in STS from Rensselaer Polytechnic Institute; Kim Fortun was on his dissertation committee. Dr. Gopakumar's research centers on the socio-political aspects of urban infrastructure and the governance of infrastructure change in Bengaluru. In addition to a book *Transforming Urban Water Supplies in India* published by Routledge, he has published articles in the *International Journal of Urban and Regional Research*, *Water Policy*, *Water Alternatives*, and *Mobilities*.

Scott Kellogg is our lead collaborator for Albany. Kellogg is a STS PhD candidate at Rensselaer and Educational Director at the Radix Ecological Sustainability Center, a non-profit environmental education organization in Albany, NY that teaches youth and adults about sustainable city living, urban agriculture, and ecological literacy. Kim Fortun is Kellogg's dissertation advisor; Mike Fortun is on his dissertation committee. Kellogg has a Master's degree in Environmental Science and Policy from Johns Hopkins University. He is presently serving as an appointed member of Albany's Common Council Sustainability Advisory Committee (SAC), and as the Chair of the SAC's Urban Agriculture Subcommittee.

Alison Kenner is our lead collaborator for Philadelphia. Kenner is an Assistant Professor of History and Politics, and a core faculty member in the Center for Science, Technology, and Society at Drexel University. Kenner's research and teaching activities focus on how environmental health risks are experienced, understood, and addressed through sustainability projects in the city of Philadelphia. Her research builds relationships with community organizations, nonprofits, and civic employees in city and state offices, and draws in student and faculty collaborators at Drexel University. Kenner works with the Clean Air Council and National Nursing Consortium to design and host workshops on climate change and home health, "Be Air Aware," a project supported by the NSF-funded Climate and Urban Systems Partnership. The Be Air Aware project is part of broader efforts to bolster citizen engagement with climate change issues in Philadelphia and the surrounding region.

Dan Price is our lead collaborator in Houston, Texas. He is a philosopher and a faculty member in the Honors College at the University of Houston, the director of Data Analytics in Student Hands (DASH) at UH, and the director of The Houston Clean Air Network (HCAN). HCAN includes groups at the University of Houston Medical Center, the City of Houston, and with non-profits working on air quality and the environment. HCAN is currently developing a warning system for asthmatic kids in Houston Independent School Districts that would represent a vast improvement on the warnings issued by the Texas Council on Environmental Quality.

Rodolfo Hernandez is our lead collaborator for Beijing, China. Hernandez is a PhD candidate in the Institute of Science, Technology, and Society at Tsinghua University (China). His research focuses on the managing of evidence, the efforts to forge scientific consensus, and the increasing adversarial role of the public in the construction of China's air pollution standards and regulations.

CONCLUSION: INTELLECTUAL MERIT AND BROADER IMPACTS

Intellectual Merit

The proposed project will produce original data (including 150 qualitative interviews) and analyses of the practices, roles, and contributions of scientific research communities in air pollution governance in six diverse cities. It brings scholarship in science and technology studies together with scholarship in environmental governance in a novel, empirically-driven way that will add to our understanding of cross-cultural differences in the practices of both scientific research and governance. The project will also produce a theoretical framework for characterizing particular “styles” of scientific research and governance in different settings, expanding social scientific understanding of cross-cultural differences in the sciences into understanding of cross-cultural differences in governance styles.

BROADER IMPACTS OF THE PROPOSED WORK

The proposed project will have considerable broad impact, through the following:

- Because it will be carried out on the digital platform developed for The Asthma Files project, the proposed project will serve as proof-of-concept for data management *throughout the research process*, with both primary data and analytic structures archived as the research is done – with metadata that can later be exposed, making these data widely discoverable by other researchers. The project will also demonstrate use of an IRB-approved informed consent from that allows interviewees to grant permission to make their recorded interviews publically accessible.
- The proposed project will train students in the social studies of science in the methods and use of digital infrastructure to support data sharing and re-use, collaborative research, and the translation of research findings into materials for education and public outreach.
- The proposed project will produce materials for education and outreach to k-12 students, undergraduates, and professionals (scientists, policy makers, NGO actors, journalists) that enhance understanding of how science is developed and used in governance of complex societal problems (such as air pollution).
- Drawing on the interviews and other empirical data generated by the project, the project will and develop recommendations concerning effective strategies for better integration of scientific research as a crucial component of environmental governance.

RESULTS OF PRIOR NSF SUPPORT

NSF Research Award #0724684: Strategizing Transdisciplinarity: From Exposure Assessment to Exposure Analysis. 9/01/2007-07/31/2012. \$160,000

Results: This award supported travel and time for participation observation and ethnographic interviewing at the EPA’s Office of Research and Development, and at the annual meetings of the International Society for Exposure Science.

Intellectual merit: This research advanced understanding of the interdisciplinary organization and challenges of the environmental health sciences, drawing on ethnographic interviews with environmental health scientists and science managers.

Broad Impact: This NSF award led to the development of *The Asthma Files*, a collaborative ethnographic project to understand efforts to develop science and policy to effectively govern air quality and related health impacts. Findings from this NSF funded research on the exposure science community – pointing to the many challenges of connecting health and pollution research -- motivated the design of The Asthma Files. The project is designed to involve researchers at different sites, and at different career stages, allowing for the development of new models for linking teaching and research.

This NSF award led to the development of the Rensselaer’s EcoEd Research Group, which involves undergraduate and graduate students in the translation of STS research findings on environmental problems into curriculum for K-12 students. The group is now in its fourth year, and has run over 40 programs. Working as teachers, university students grow into roles as stewards of both educational and ecological systems. Extending from this work, Fortun has also coordinated the Capital District Working Group on Sustainability Education, which connects regional k-12, community and university educators to each other, and to a broader, state-wide initiative.

Publications: See in references: (Fortun, Kim, Erik Bigras, Brandon Costello-Kuehn, Tahereh Saheb,

Jerome Crowder, Dan Price, Alison Kenner, Mike Fortun, 2014); (Fortun, Kim, Erik Bigras, Brandon Costelloe-Kuehn, Allison Kenner, Tahereh Saheb, Jerome Crowder, Dan Price, Mike Fortun, 2013); (Fortun 2012a); (Fortun 2012b); (Fortun 2011a); (Fortun, Kim. 2011b); (Fortun 2010); (Fortun 2008).
Availability of research products: Interviews collected for this project are archived at The Asthma Files, where they are accessible to members of Kim Fortun's research group (including undergraduate and PhD students). Select interviews (as indicated on IRB approved consent forms) are publicly accessible.

Doctoral Dissertation Research Award (for Aalok Khandekar) #0848540: "Understanding (Indian) Technomigration." 3/01/2009-2/28/2011. \$16,000.

Results: This award resulted in a dissertation granted in the Department of Science and Technology Studies, Rensselaer Polytechnic Institute.

Intellectual merit: This research advanced understanding of the character and dynamics of migration by Indian scientists and engineers to the United States.

Broad Impact: Khandekar's dissertation led to his playing a leadership role in a series of workshops and broader effort to build a network of STS researchers in India, titled Public, Politics and Technoscience in Contemporary India (<http://fasos-research.nl/indiatechnoscience/>)

Publications: See proposal references: (Khandekar 2013); (Khandekar 2010).

Availability of research products: See above publications.

Workshop Award #1230611: "Disaster Science and Technology Studies (DSTS): Advancing an Emerging Subfield." 8/15/2012-7/31/2014. \$25,000

Results: The workshop was held at the National Science Foundation in Arlington, VA in September 2013, bringing together researchers at many career stages, working on different types of disaster, interested in helping build an analytically and empirically rich, comparative body of STS research focused on disaster.

The workshop at NSF led to a follow up "Disaster-STS Workshop" hosted by Drexel University in April 2014, and to participation of STS researchers (Kim Fortun and Scott Knowles) in the 50th Anniversary Conference of the Disaster Research Center, University of Delaware, May 1-2, 2014.

Intellectual merit: The workshop advanced understanding of empirical cases, analytic themes and theoretical frameworks that will be important to the development of Disaster-STS research. The workshop also advanced understanding of the kinds of digital infrastructure needed to support Disaster-STS research going forward.

Broad Impact: The workshop resulted in the launching of a new book series to be published by University of Pennsylvania Press titled "Critical Studies in Risk and Disaster," which Kim Fortun will co-edit with historian of technology Scott Knowles (Drexel). The workshop also led to the development of a web platform to support an international research network focused on disaster (<http://disaster-sts-network.org/>).

Publications: See proposal references: (Fortun 2014)

Availability of research products: <http://disaster-sts-network.org/> will provide a place to archive and collaboratively analyze research data produced by disaster-STS researchers. The platform has built-in metadata functionality through which the data will be widely discoverable.

Workshop Award #1230627: "An STS Forum on Fukushima: Building a Transnational Research Agenda" 8/01/2012-7/31/2014. \$25,000

Results: The workshop, held in May 2013 at the University of California, Berkeley, brought together scholars from the United States, Europe and Japan, with many different specialists (from the history of earthquakes to the ethnography of citizen scientists).

Intellectual merit: The workshop advanced understanding of the entwined system failures (technological, political, social, geophysical) that resulted in the Fukushima disaster, and shaped disaster response. The workshop also began the work of putting the Fukushima disaster in comparative perspective.

Broad Impact: The workshop led to Kim Fortun's role as a representative of the United States in a series of meetings convened by the Division of Human Health, International Atomic Energy Agency (IAEA) to bring STS perspectives into the medical school curriculum at Fukushima Medical University, and into the curriculum of a new PhD program at Hiroshima University, the Phoenix Leader Education Program for Renaissance from Radiation Disaster – designed to train a new generation of interdisciplinary, international radiation health leaders.

Publications: See in proposal references: (Fortun, in press); (Fortun 2014 (March)).

Availability of research products: Workshop papers and associated dialogue are archived <https://fukushimaforum.wordpress.com/>.