The Global Adaptation Atlas

Shalini P. Vajjhala and Daniel G. Spadaro

Abstract

Climate change is a global problem that will likely contribute to a wide range of local environmental changes. Even if society averts the most severe projected impacts of climate change through long term reductions in CO_2 emissions, climate changes already underway will present challenges for sustaining livelihoods of communities around the world. Accordingly, adaptation will play a major role in addressing these human sustainability challenges. Decision makers need to understand which climate impacts are important in their region and what their options are for adapting well, to decide how money and resources should be allocated. The *Global Adaptation Atlas* is intended to enable this type of knowledge creation, sharing, and learning. As a web-based mapping application (in development), the *Atlas* will integrate interactive maps of the best-available science on climate impacts and the latest information on adaptation activities, provided free to the public.

Introduction

What Is Adaptation?

A new issue—adaptation—has recently begun to penetrate policy discussions on how to manage climate change. Even if mitigation successfully stabilizes global greenhouse gas emissions and averts the most severe predicted ecosystem effects of climate change, there will still be significant local and regional impacts on humans in many parts of the world. Impacts are expected to be especially severe in developing countries where populations rely on local natural resources, like the crops they grow and the fish they catch for their livelihoods, and may lack the capacity to respond to and recover from sudden or severe events (IPCC WG2 AR4, 2007)

Adaptation, the process of adjusting to changing environmental conditions, encompasses a broad set of activities designed to reduce human and ecosystem vulnerability to climate change and its potential long-term impacts. Interventions can range in scale and scope from small installations of rain water collection and drip irrigation systems to help farmers weather more severe droughts to national investments in dikes and levees to respond to sea-level rise (McGray et al. 2007). Adaptation remains a daunting challenge, requiring coordination at unprecedented scales from the local to global level across nearly all sectors of the economy and all types of ecosystems. In many cases, the countries and regions in greatest need of adaptation measures are the least equipped to develop, manage, and coordinate large-scale programs.

The global communities is slowly converging around international and national policy options for mitigation, and in parallel, large and small-scale funding mechanisms have emerged to spur investment in adaptation. However, the allocation of adaptation funding remains highly controversial, and limited lessons can be drawn from the decades of experience with mitigation policy design that can be adapted for adaptation policy and investment. The primary reason for this disconnect is a single fundamental difference between the problems of mitigation and adaptation: location, location, location.

Adaptation Is A Spatial Problem

Mitigation is a global problem, where emissions reductions anywhere provide benefits everywhere (Pacala and Socolow 2004). In sharp contrast, adaptation is a location specific problem, where responses must be targeted and relevant to the local context to be effective. As a result, the geographic location of key impacts, populations, and resources – where, whom, and how hard droughts, storms, or floods will hit – really matters. Current climate models are not well-suited to evaluate highly localized impacts or adaptation needs. Global assessments have typically been focused on macro-scale trends in natural systems, making it extremely challenging to assess local climate impacts, especially in developing nations. Nonetheless, decision-makers at all levels of government have begun to establish funding mechanisms for adaptation. The largest and most recent of these is the UNFCCC Adaptation Fund. It holds approximately $50 million dollars (USD), a figure that is expected to grow into the hundreds of millions over the coming decades. Yet significant disagreement exists about how to set allocation priorities and identify target areas for new investment. Given the risk of climate change to impacted communities, it is critical, starting now; to use the data we have to inform priorities for adaptation funding and early capacity building efforts, and strengthen the links between science, policy, and practice.

Why Is Coordination of Climate Adaptation Efforts Important?

Without careful coordination, we run the risk of investing in adaptation measures in one sector that could duplicate or negate investments in another sector both in the short-term and the long-term. For example, new rainwater collection reservoirs in areas affected by climate change could create large pools of standing water in areas more susceptible to breeding of mosquitoes, which in turn could undercut public health interventions targeting outbreaks of malaria or dengue fever, by changing local exposure to mosquito-borne diseases. As a result, stakeholders not only require information on how the local climate is anticipated to change, but also information on what others in the region and around the world are doing in response. Right now, no central clearinghouse exists for these kinds of data.

How Can Mapping and Visualization Help Address The Problem?

Adaptation policy design is a fundamentally spatial problem. The geographic locations of populations, resources, and impacts are central to the decisions being made. Geography is one of the few common threads connecting the science on climate impacts to programs and policies designed to promote adaptation. Therefore, mapping can play a central role in building and maintaining the essential linkages between science, policy, and on-the-ground practice.

The Atlas: A visualization Solution

We are in the process of developing a web-based digital “atlas” on global adaptation, with maps of the best-available science on climate change impacts and up-to-date information on adaptation activities. Our aim is to use existing GIS (Geographic Information System) software on a web based application platform to layer relevant demographic and natural resource data, just as it is now possible to cue up an existing map and add terrain and satellite information. The real-time information displayed online would allow decision-makers ranging from the leader of a small farming cooperative to the international donor to visualize what impacts are likely to affect their region, what activities are already underway, and what gaps need to be filled with new adaptation activities and measures.

For example, a foundation program officer in Mali working on supporting irrigation systems for agriculture and a local health official concerned about the spread of dengue in the same area would both be able to view the potential impacts of climate change on agricultural productivity and disease spread in the country and across a wider region of West Africa. The public health specialist could address risks of mosquito breeding created by new irrigation ponds or channels and compare locations of new disease vectors against the existing. All would receive tailored feedback from the Atlas on local, regional and global best practices for similar types of projects and relevant parallel efforts.

At a larger scale, for example, program officers at the Gates Foundation, staff at the WHO, and Adaptation Fund staff at the Global Environment Facility (GEF) could search projects to view their own and other current grants in a sector or geographic area to identify opportunities for coordination, anticipate unintended consequences of existing projects, and set priorities for new programs and investments.

Atlas Design, Structure, and Visualization Principles

To meet the multiple coordination challenges associated with adaptation, the Atlas will consist of four key building blocks aligned with the following objectives:

1. Synthesize peer-reviewed science on climate impacts
2. Support rigorous data collection and mapping of adaptation projects on the ground
3. Create a tailored outreach vehicle displaying gaps and overlaps (hotspots) of impact and inaction and facilitate dissemination of local and global best practices
4. Sustain long-term monitoring, evaluation, and priority-setting through the development of a spatial data archive

Building Block 1: Synthesizing Science on Impacts

The existing body of climate science on human system impacts is very coarse and limited; however, scientists around the world are making strides in creating finer-grained regional and local assessments of impacts and integrating these data across multiple sectors ranging from health to water. To organize the enormous amount of natural and social science information available on climate change impacts, we are compiling climate impact data under five major themes: food, water, land, health, and livelihood. These themes are intended to serve as an organizing framework for evaluating the effects of climate change on natural and human systems and identifying strategies to manage impacts.

The first phase of developing the Atlas involves collecting peer-reviewed data on various climate impacts for specific climate scenarios and layering this data in the online mapping software. The challenge in this phase has been to establish a structure for making robust and transparent decisions about which impacts should be included, at what scales, and for which parts of the world. Other issues include how to avoid missing or double-counting specific impacts across sectors, how to consider multiple-stressors, and how to address model uncertainty associated with system feedbacks.

Building Block 2: Mapping On-the-Ground Adaptation Projects

In addition to layering maps of climate impacts, it is essential to gather information on adaptation activities intended to manage and reduce these impacts at various scales – from the community level to the multi-national level. The second building block centers on facilitating the process of collecting data on adaptation activities around the world using an online survey mechanism. Projects to be entered into the Atlas will first be solicited drawn from existing

databases of relevant adaptation programs and funds (Hicks et al, 2008) to form a broad, searchable database of adaptation activities over time. The resulting entries can then be overlaid onto maps of climate impacts to illustrate hotspots of impact and inaction (See figures 1, 2, 3 and 4).

This very simple description illustrates how one can begin to visually survey and map adaptation activities on the ground. Our goal is to aggregate and display, at a high level of detail, the locations of specific adaptation projects and the areas they are intended to serve. Envision a collection of thousands of points and areas plotted alongside one another across the world, allowing users to see gaps and overlaps in the types, sizes, and locations of projects relative to key climate impacts. Atlas entries would be regularly updated and solicited using a carefully designed and deployed online survey inviting development practitioners, donors, and program managers to enter descriptive information (sector, size, location, population served, funding source, project timeline, etc.) about their past projects and ongoing programs. With this online system, we aim to overcome the hurdle of conducting repeated and fragmented paper surveys and assessments. As the Atlas database of adaptation projects around the globe grows, it can be filtered and sorted in order to analyze patterns of adaptation investment over time and evaluate their relationships to expected local climate impacts.

Building Block 3: Creating a Tailored Outreach Vehicle

The process of conducting online surveys to collect information about adaptation activities opens the door to the third component of the Atlas: outreach and dissemination. A major feature will be real-time outputs tailored to each entry/user on related local and regional efforts and relevant global best-practices for similar types and sizes of projects. A user who enters information (or searches for projects) on micro-insurance programs for small farmers in Mali would be able to view collections of information on projects in the same sector within the same local coverage area in Mali, projects in different sectors (water, health, etc.) in Mali or across West Africa, and projects of similar type and size across the world.

This structured and tailored approach will allow practitioners to rate projects in a large, searchable database for best practices and lessons offered. Because adaptation is both a process and an outcome, capacity building is a fundamental component of promoting successful adaptation. This approach to outreach and education can help build awareness and shape early adaptation measures.

Building Block 4: Sustaining Long-term Monitoring and Evaluation

The goal of the final component of the Atlas is to establish a robust platform for monitoring and evaluation. By creating a spatial data archive, the Atlas will support visualization and analysis of areas around the world where data (science) on climate impacts is inadequate, policy action is lacking across regions and sectors, and adaptation-related decisions and activities have the potential to duplicate or negate one another in the absence of coordination.

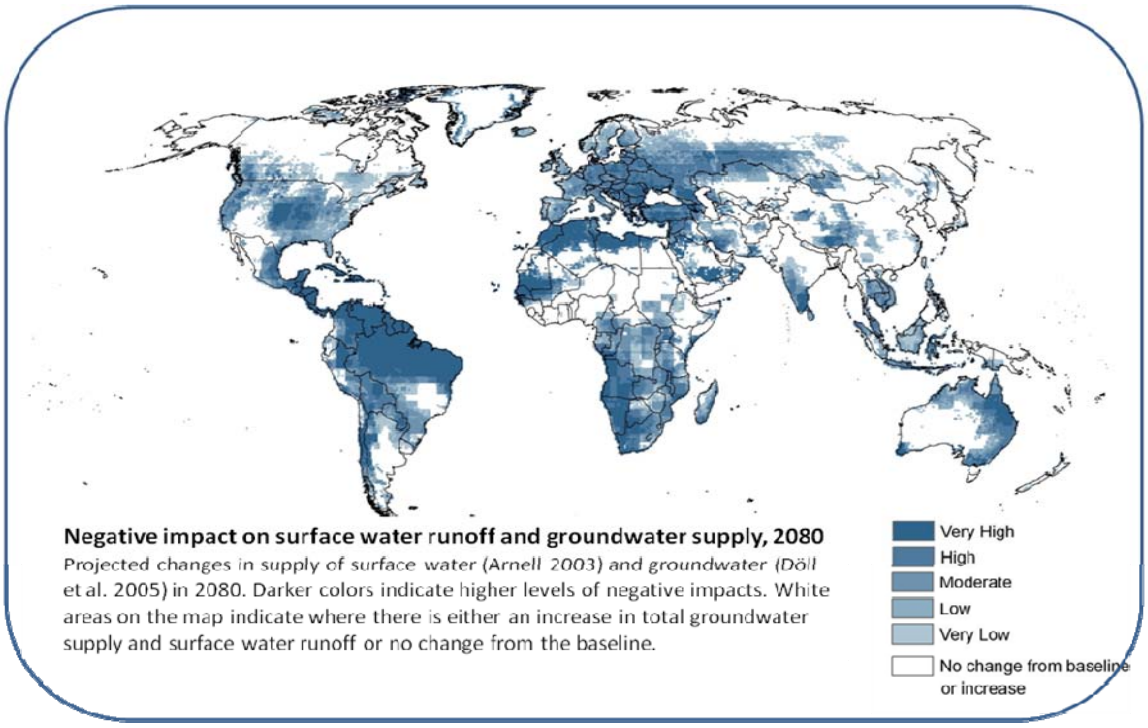
Because it will be made publicly available, this archive also has the potential to support monitoring and assessment activities for local adaptation projects and policies. In addition, the database can be used to help monitor large-scale adaptation funds controlled by international bodies, national governments, the philanthropic community, and the private sector in concert with one another. Monitoring, assessment, and evaluation are critical challenges when it comes to adaptation. The eventual goal of any adaptation measure is to prevent adverse impacts from climate change. As a result, defining and measuring success will depend on having a clear baseline to be able to effectively evaluate both progress and delays.

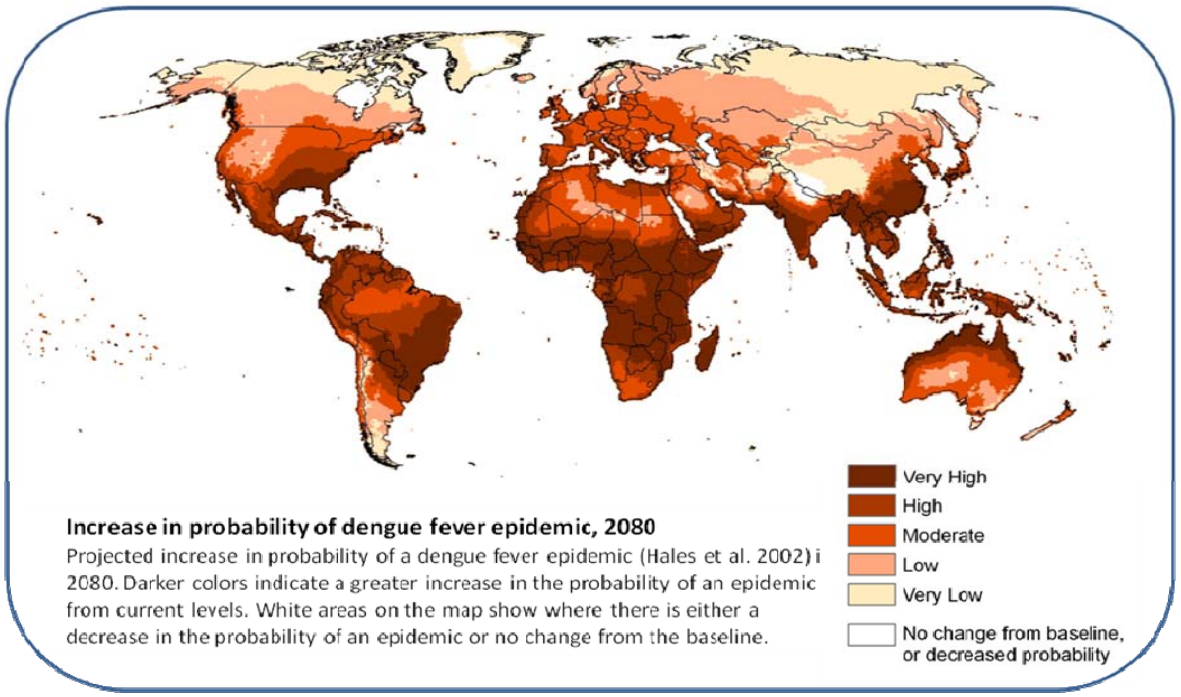
Summary

The first phase of the Atlas consists of a one-year application development effort targeted for completion in December 2009. During this year, data and program partners have been established to guide the development of the Atlas and help secure its adoption. In parallel, compilation of climate impact data and adaptation activities are being integrated into the initial application prototype. Phase one will conclude with the launch of a beta-version of the Atlas at the UN Climate negotiations in the 15th Conference of the Parties in Copenhagen in December 2009.

As climate change impacts become evident around the globe, coordinating adaptation activities will become increasingly challenging. The *Atlas* and its map based design for collecting and visualizing projected climate impacts and current adaptation data, is targeted to enable centralized access to diverse data, presented in a visual, easy to understand format, to assist decision makers in allocating climate funds and resources where needed.

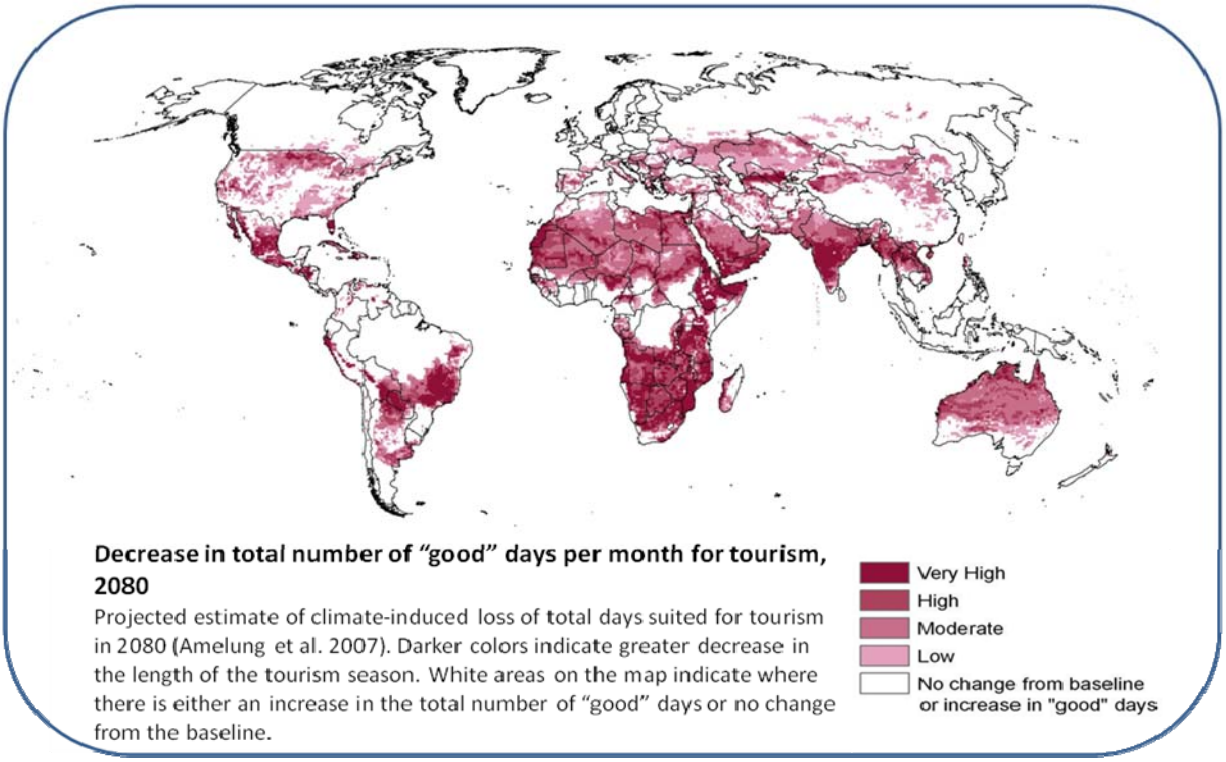
Figures: Three individual climate impact layer maps generated with the Atlas system and a fourth composite map showing the overlay of the 3 individual layers and the "hot spots" or regions of converging climate impacts that result.





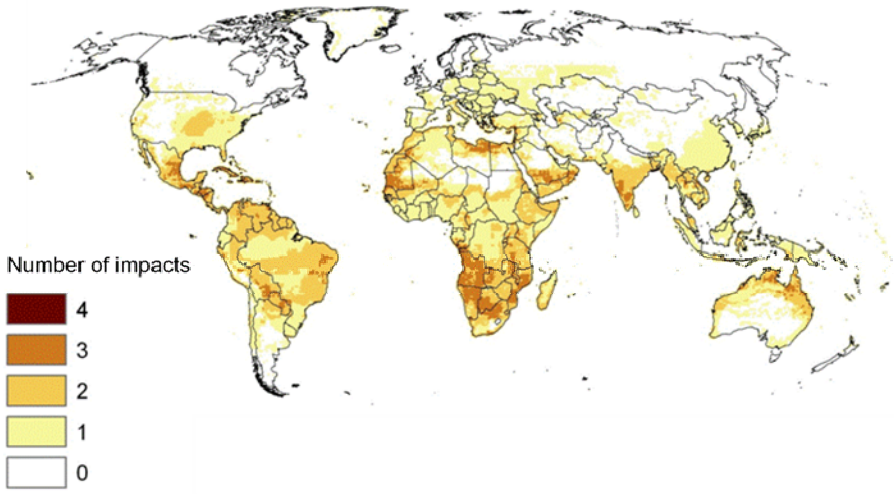
Increase in probability of dengue fever epidemic, 2080

Projected increase in probability of a dengue fever epidemic (Hales et al. 2002) i 2080. Darker colors indicate a greater increase in the probability of an epidemic from current levels. White areas on the map show where there is either a decrease in the probability of an epidemic or no change from the baseline.



Decrease in total number of "good" days per month for tourism, 2080

Projected estimate of climate-induced loss of total days suited for tourism in 2080 (Amelung et al. 2007). Darker colors indicate greater decrease in the length of the tourism season. White areas on the map indicate where there is either an increase in the total number of "good" days or no change from the baseline.



Sample overlay map of selected negative climate impact "hotpots," 2080
Number of impacts in the "high" and "very high" categories in each 1-km grid cell for four major climate impacts: 1) Water: decrease in surface water runoff and groundwater supply, 2) Land: loss due to a 1-meter sea level rise (CRESIS Database), 3) Health: increased probability of dengue fever epidemic, and 4) Livelihood: decrease in number of days suitable for tourism (Vajjhala and Nackoney, in prep).

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Biography

Shalini Vajjhala is a Fellow at Resources for the Future and the leader of the Atlas project. Her research focuses on the social impacts of large-scale development and environmental policies with critical public participation components. She has worked extensively on integrating and applying participatory mapping methods and Geographic Information Systems (GIS) technology to diverse issues including climate change adaptation, environmental justice regulation, renewable energy siting, and carbon sequestration risk management. Shalini holds a Ph.D. in Engineering and Public Policy from Carnegie Mellon University. Prior to joining RFF, she worked as an architect, community organizer, and design instructor in Pittsburgh**.**

Dan Spadaro, a Vice President in the Technology Division at Goldman Sachs, joined the RFF team through the Goldman Sachs Public Service Program, for one year beginning December 2008, as the full-time Strategic Leader of Technology on the Atlas project. He is a technology professional with over 20 years experience supporting various industries and technologies, with the last 12 years primarily focused on the design, implementation, and support of systems technology infrastructure for financial applications at firms including Morgan Stanley, Deutsche Bank, and Goldman Sachs. Dan holds a B.S. in Engineering Science with concentration in Electrical Engineering/ Computer Science and is currently completing an M.S. in Environmental Science focusing on climate change.