The Global Adaptation Atlas

Linking Science, Policy, and Practice to Build Resilience to Climate Change

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A new issue—adaptation—has recently begun to penetrate policy discussions on how to manage climate change, perhaps the most complex environmental problem of our time. 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.

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.

Until recently, projects like these were seen as either poverty alleviation development activities or solely as backstop measures in the event that mitigation efforts failed. Now there is growing recognition that reducing emissions and building resilience to climate impacts are complementary–not competing–objectives. Despite this shift in awareness, 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 community is now slowly converging around international and national policy options for mitigation, and in parallel, a variety of large and smaller-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 applied to adaptation policy development and investment. The primary reason for this disconnect is a single fundamental difference between the problems of mitigation and adaptation: location, location, location.

Policy Context

Mitigation is a global problem, where emissions reductions anywhere provide benefits everywhere. In sharp contrast, adaptation is an inherently local problem, where responses must be targeted and site-specific 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, where there are large gaps in monitoring and baseline research. Nonetheless, decision-makers at all levels of government have already begun to establish funding mechanisms for adaptation. The largest and most recent of these is the UNFCCC Adaptation Fund. It already holds approximately $50 million dollars (USD), a figure that is expected to grow into the billions over the coming decades. Yet significant disagreement exists about how to set allocation priorities and identify target areas for new investment.

This conflict is not unique: governments, donors, and development practitioners at all levels around the world are making similar decisions about how to address and prioritize climate change within ongoing projects and programs. To date, all of these efforts have largely been driven by current political concerns in the absence of a clear picture of future impacts. 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. Successfully supporting adaptation will demand extraordinary new approaches to:

- synthesizing data on projected climate impacts,
- integrating this information with data on adaptation responses on-the-ground,
- disseminating data widely and supporting outreach at multiple scales,
- and monitoring and evaluating interventions to help set priorities for the future.

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 both these kinds of data.

The Project

Dialogues at the recent United Nations Conference of the Parties (COP 14) in Poland, underscored that adaptation policy design is a fundamentally spatial problem. Geography is one of the few common threads connecting climate impact science to programs designed to promote adaptation. Therefore, mapping can play a central role in building and maintaining the essential linkages among science, policy, and on-the-ground practice. Because adaptation is both a global and a local problem affecting populations and ecosystems around the world, it is natural that responses

will be sector-, site-, and population-specific. Therefore, success depends on real-time coordination of impacts and actions.

We propose to create a web-based digital "atlas" on global adaptation, with maps of the best-available science on impacts and up-to-date information on adaptation projects. Our aim is to use existing mapping software to create a platform on which to layer relevant demographic and natural resource data, just as it is now possible to cue up an existing map and add satellite terrain imagery and street-level information. The real-time adaptation data displayed online would allow scientists, policymakers, and global citizens to visualize what impacts are likely to affect their region(s), what activities are already underway, what gaps exist, and where to act.

For example, a foundation program officer in Mali working on supporting innovative 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. Similarly, local agriculture extension agents funded by government ministries could be provided with health information in tandem with education materials on water and irrigation to distribute to individual farmers. 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, foundation program officers at the Gates Foundation, international agency staff at the WHO, and Adaptation Fund staff at the Global Environment Facility (GEF) could search and sort projects to view their own and other current grants in a sector or geographic area to identify opportunities for coordination, anticipate unintended intersections of existing projects, and set priorities for new programs and investments.

Atlas Objectives and Architecture

To meet this coordination challenge, the Atlas will consist of four key building blocks aligned with the following objectives:

- Compile the best-available natural and social science data on climate impacts
- Integrate these data with up-to-date information and maps of on-the-ground adaptation projects to highlight "confluences of impact and (in)action"
- Build a virtual global community of practice centered on climate change adaptation to support outreach and share best practices
- Support long-term monitoring and evaluation through the development of a spatial data archive and help set priorities for future adaptation investment

Our aim is to use Geographic Information Systems (GIS) software to create an integrative platform on which multiple communities of users can contribute, layer, and view adaptation science and project information in a quality-controlled "wiki" format.

Building Block 1: Compiling and Organizing Climate Impact Science

Scientists around the world are making great strides in creating fine-grained regional and local assessments of climate impacts; however, these data remain largely fragmented across research disciplines and fundamentally disconnected from the scales at which adaptation policies and decision are made. To consolidate the enormous amount of natural and social science data on climate change impacts in a format relevant for decisionmaking, we plan to focus on five main themes: food, water, land, health, and livelihood. These themes serve as an organizing framework for research on the natural and human systems effects of climate change and for planned adaptation strategies to manage impacts.

The first phase of developing the Atlas will involve compiling data on human impacts for various climate scenarios and layering this impact data using GIS. We have already established a partnership with the Center for International Earth Science Information Network (CIESIN) at the Earth Institute at Columbia University to use their database of climate impact data and streamline conversion of the data into compatible map layers. The aim is to create the outline for a mosaic of the best-available climate model projections, which can evolve as impact science and local observations improve.

The focus of this building block will be on establishing a structure to help users make robust and transparent decisions about overlaying various climate impacts at different scales and for different parts of the world in order to avoid missing or double-counting specific impacts across sectors. The prototype developed using existing data will then serve as the basis for an upload feature for input of new impact data from the wider science community and a mechanism for coordination of new research.

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

In addition to mapping climate impacts, it is essential to gather data on adaptation activities intended to manage and reduce impacts at various scales. The second building block centers on automating the process of mapping adaptation projects and activities around the world using an online survey mechanism. Project information will be identified using an automated search and filtering application, paired with carefully designed and deployed online survey inviting development practitioners, donors, and program managers to enter, update, and/or validate descriptive information about adaptation projects in the Atlas (sector, size, location, population served, funding source, timeline, etc.). The resulting entries, which form a searchable database of adaptation activities over time, can then be overlaid on climate impacts maps to identify “hotspots of impact and (in)action.”

We plan to begin by building on data gathered by the interdisciplinary Project-Level Aid (PLAID) research team at the College of William and Mary in a comprehensive database of over 400,000 development and environmental aid projects funded in the past three decades around the world. Using these data as a proxy and baseline for future adaptation funding and project data, we envision creating a framework for automating the collection of thousands of adaptation projects. The resulting dynamic online map(s) of points and areas plotted alongside one another across the

world will allow users to see gaps and overlaps in the types, sizes, and locations of adaptation projects relative to key climate impacts.

As adaptation activities proliferate and cover ever-wider sets of activities–including basic research, capacity building, development planning, retrofitting infrastructure, and designing new insurance mechanisms–tracking and updating adaptation records will become increasingly challenging. Through an automated approach, we hope to overcome the hurdle of conducting repeated and fragmented paper surveys and assessments. The power of the Atlas will derive from the spatial integration of existing and emerging repositories of adaptation projects around the globe. The resulting data can be filtered and sorted to analyze patterns of adaptation investment over time and evaluate the relationships of these patterns to corresponding climate impacts. In the future, we plan to incorporate the project databases of major institutions, such as the UN Adaptation Fund, the World Bank Development Marketplace, and the Global Environment Facility.

Building Block 3: Creating a Tailored Outreach Vehicle

The process of conducting online searches and surveys to collect information about adaptation activities opens the door to the third component of the Atlas: outreach and dissemination. A major feature of the Atlas will be tailored user feedback. By tracking Atlas entries and user searches, we plan to develop a third "recommendation engine" style application to manage user profiles and provide tailored feedback on local, regional, and global best-practices for types and sizes of projects corresponding to user interests. 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 and/or coverage area in Mali, projects in different sectors (water, health, etc.) across West Africa, and projects of similar type and size across the world. This structured and tailored approach will also include a rating feature, where practitioners and users can rate projects already in the Atlas to create a record of best practices and lessons offered. Because adaptation is both a process and an outcome, capacity building is an essential component of successful adaptation over time. This approach to outreach and education can help build awareness and shape and motivate additional adaptation measures. Further, this type of knowledge is an essential element of scaling-up best practices under different contexts, governance structures, and institutions.

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 new research and analysis on where around the world data 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 this tool (and all user-released data) will be 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 donor alignment and track large-scale adaptation funds controlled by international agencies, national governments, and philanthropic

organizations in concert with one another. Monitoring, assessment, and evaluation are critical challenges when it comes to adaptation. The eventual goal of any adaptation effort 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 progress and delays.

Data Partners and Sources

At its core, the Atlas is an innovative spatial data management and visualization tool. Building a framework for effectively locating, consolidating, and coordinating new climate impact and emerging adaptation project data requires close collaboration with a wide variety of data partners. As described under Building Blocks 1 and 2, we have already initiated data partnerships with two key groups–CIESIN and PLAID–and we expect to work closely with additional data partners as the Atlas grows.

For nearly 20 years, CIESIN has served as a major clearinghouse of socioeconomic and earth science information to help scientists and members of the general public understand critical interactions between humans and the natural environment. Spatial data available through CIESIN's servers comes from several different projects and sources, including the Socio-economic Data and Applications Center (SEDAC) and the Intergovernmental Panel on Climate Change-Data Distribution Center (IPCC-DDC). The IPCC-DDC, in particular, distributes numerous datasets and maps derived from climate general circulation models (GCMs) that illustrate projected global climate changes based on key impact assessment scenarios. As part of the Atlas project, our core team has engaged in detailed discussions with CIESIN staff about establishing a long-term data partnership, and we expect to build on CIESIN's repositories to centralize up-to-date natural and social science map layers on adaptation for visualization through the Atlas. Because the IPCC-DDC partners with CIESEN to distribute data, this data source also provides us with a direct pipeline to the data underlying many of the latest and most widely cited peer-reviewed climate impact studies and global assessment reports.

Just as climate impact science is rapidly evolving, adaptation funding mechanisms are now emerging within a complex landscape of existing environmental grants and loans. Understanding if new activities are being effectively targeted requires clear baseline information on past environmental aid activities. To establish a baseline for mapping adaptation funding patterns, we have initiated a partnership with scholars at the College of William and Mary who have developed a comprehensive project level aid database (PLAID), encompassing over 400,000 development and environmental aid projects granted over the past three decades from around the world. The database currently has over 64 specialized coding variables that include characteristics of aid projects, including environmental impact and health impact. Analyses based on these data were recently published in a book titled, *Greening Aid: Understanding the Environmental Impact of Development Assistance* (Hicks et al., 2008). The PLAID database is currently being updated to include funding information from all major bilateral and multilateral donors through 2009, and we anticipate working closely with the team over the coming year to geo-code and incorporate relevant environmental aid data from the past three decades into the Atlas.

In addition to the data partnerships already underway, the Atlas will aim to bring together new data sources, including upcoming World Bank Development Marketplace grants on "Innovations in Climate Change Adaptation." The Development Marketplace (DM) is a global grants

program administered by the World Bank. With competitive grants awarded since 2000, the DM provides funds to local social entrepreneurs to find creative solutions to local poverty reduction and development challenges on key topics, such as health, water, and agriculture. Problem-solving entrepreneurs with innovative poverty-fighting ideas compete in annual country, regional, and global competitions for early-stage seed money to promote small-scale development projects intended to bring concrete benefits to their communities. In past years, global DM competitions have distributed between $4-$7 million USD in grants to 20-50 winning projects. In 2009, the DM plans to offer funding for proposals focused on climate change adaptation. Funded projects from this competition will represent some of the earliest adaptation efforts, and provide us a new source of data on emerging adaptation projects that will help lay the groundwork for incorporating similar projects and ensuring the accuracy and relevance of the Atlas application moving forward.

Implementation Plan

The first phase of the Atlas consists of a one-year effort beginning in December 2008 focused on Building Blocks 1 and 2. Early research in support of the Atlas is well underway (Vajjhala and Nackoney, in prep), and we anticipate expanding our data partnerships with CIESIN and the PLAID project group, as described above. We plan to work closely with these groups and others over the coming year to use existing climate impact and adaptation project databases as the basis for the Atlas prototype design, development, and testing.

We further plan to create a science and policy advisory board that will consist of 12-15 independent experts from an array of disciplines. Board positions will be three-year rotating positions, and the responsibility of board members will be to periodically (quarterly) visit, use, and assess the Atlas; to participate in an annual meeting to review major Atlas developments; to contribute one commentary (blog posting) on the Atlas per year; and provide support for outreach to scientists, decisionmakers, and policymakers associated with international and national adaptation programs and planning processes.

Currently, we have confirmed the participation of three advisory board members: Mohamed El-Ashry, Senior Fellow at the United Nations Foundation and the former Chairman of the Global Environment Facility (the primary body coordinating the UN Adaptation Fund); Bo Kjellén, Ambassador and former chief climate negotiator of Sweden; and Raymond Kopp, Senior Fellow and Director of the Climate and Technology Policy Program at RFF. Phase One will conclude with the launch of a beta-version of the Atlas at the 15th Conference of the Parties in Copenhagen in December 2009.

We expect to engage our data partners and advisory board members over the course of this year to user test the Atlas and to build relationships with key communities of natural scientists, social scientists, and policy makers. We also plan to solicit feedback from major climate groups, such as the readership of the Climate-L distribution list (a news and announcement list service on climate change issues), prior to launching the tool for wider use. We anticipate beginning work on Building Blocks 3 and 4, following the December 2009 launch of the tool.

Measurable Objectives and Outcomes

Several key outcomes will be tracked immediately following the launch of the Atlas, including:

- Counts of total number of climate impacts and projects mapped by theme and region
- Count of total number of Atlas entries and users by sector and region
- Total number of website "hits" and downloads of archival data over time
- Counts and citations of research and policy papers using Atlas impact and action databases, including studies on the type, sizes, and locations of impacts and adaptations
- Reports on meeting(s) of advisory boards and external meetings and conferences
- Written feedback by advisory board members on Atlas design, outcomes, and outreach
- Surveys and interviews with foundations and donors to evaluate effectiveness of Atlas at providing information to support funding decisions and adaptation planning efforts
- Surveys and discussions with policy audiences to evaluate effectiveness of Atlas at providing information to support local, national, and international policy processes

The information collection, integration, dissemination, and decision-support objectives of the project will be carefully tracked using these and other measures throughout the development of the Atlas. We anticipate that advisory board members and Atlas users will also contribute feedback on possible measures of success as the tool evolves to respond to diverse user needs.

Timeline and Benchmarks: Phase One - Prototype Design and Development

December 2008 – Science Data Compilation
Early and ongoing work has focused on data compilation and coding within our five themes – food, water, land, health, and livelihoods; developing decision rules for data compatibility; harmonizing formats for upload and overlay in Google Earth; and developing the structure for a wiki to elicit basic "meta-data" for future Atlas climate impact entries.

January 2009 – Hiring of Application Development and Web Design Consultants
We have begun work with Blue Raster, LLC (see description in staffing section) on the Atlas schematic design, geodatabase architecture, and application features.

**February 2009 – Provisional patent application submitted for the Atlas design, patent pending*

February 2009 – Adaptation Project Database Evaluation
We have initiated collaboration with the PLAID group at the College of William and Mary to use their existing database, and will explore and geo-code the data to support the design and testing of the Atlas adaptation project search and input survey mechanism.

March 2009 - May 2009 – Rapid Prototype Development
Using CIESIN's and PLAID's existing repositories of climate data and baseline adaptation project data, the core team and consultants will spend several months creating, testing, and evaluating the science layer upload application (Building Block 1) and the adaptation project mapping application (Building Block 2).

April 2009 - June 2009 – User Interface Design
Work with consultants to design and develop the website and interface for the Atlas map/data explorer with a focus on specific design features, such as the development of user profile options.

July 2009 - September 2009 – Atlas Prototype Testing
Collaborate with partner organizations and advisory board members to coordinate an extended period of user and collaborator testing of the Atlas prototype and interface.

August 2009 - November 2009 – Refining Prototype with Feedback from Advisory Board
The final months of Phase One will be dedicated to meetings and presentations to gather feedback on Atlas and solicit participation of science and policy advisors from around the world.

December 2009 - Launch of Prototype at COP 15 event in Copenhagen, Denmark
Phase One will conclude with the first convening of the science/ policy advisory board and the launch of the Atlas prototype at the 2009 UN Framework Convention on Climate Change negotiations in Denmark.

Budget

The total budget for Phase One is $400,000 (plus in-kind contributions) to cover the development of a prototype tool based on Building Blocks 1 and 2. To date we have already received funding and support from the Mistra Foundation Climate Policy Research Forum (Clipore) ($60,000); Resources for the Future ($120,000); the Doris Duke Foundation ($20,000); Goldman Sachs (one full-time technology staff resource, in-kind contribution); ESRI (map server and GIS software, in-kind contributions). We have also applied for other grants and technical resources, including a Google.org GeoChallenge grant ($100,000), which would be directed primarily toward the staffing, consulting, and development costs outlined below.

- Hiring application development firm (Blue Raster) to develop Atlas prototype ($100,000)
- Core team salaries and support through December 2009 (Vajjhala, $75,000; Spadaro,
- $25,000; Nackoney, $20,000; Krishnan, $10,000)
- Hiring of research assistants (2) and GIS interns (2) for spatial data management ($100,000)
- Travel and other expenses for Atlas launch event at COP 15 in Copenhagen ($20,000)
- CIESIN data partner honorarium for data processing and design collaboration ($25,000)
- PLAID data partner honorarium for data provision and geo-coding support ($25,000)

We anticipate seeking funds for a second phase of the project over the course of 2009. Phase Two (from December 2009 - December 2010) will be dedicated to the expansion and refinement of the applications created under Building Blocks 1 and 2 of the prototype and the addition of new features to support Building Blocks 3 and 4. A Phase Two budget of $600,000 will cover the hiring of additional research and technology support staff, and will also support a series of high-level workshops for scientists, policy-makers, and target Atlas user groups. Because outreach and dissemination are core components of all of the building blocks of the Atlas, this second phase encompasses research, technology development, and outreach in equal measure.

Core Team and Staff

In addition to the interdisciplinary RFF core team of Vajjhala (Project Leader), Spadaro (Strategic Leader of Technology), Nackoney (GIS Specialist), and Krishnan (Research Assistant), we have been working closely with the GIS software development firm Blue Raster, LLC since mid-January 2009. The key skills and contributions of each member of the Atlas team are described briefly below.

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, joins the RFF team through the Goldman Sachs Public Service Program, for one year beginning December 1, 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 financial application systems technology infrastructure 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.

Janet Nackoney is an environmental conservation professional with 10 years of experience in natural resources research and GIS. As part of her own consulting company, Summit Geographics LLC, she has been working on adaptation research and the Atlas project as a part-time GIS Specialist at Resources for the Future for over one year. She specializes in spatial data analysis and mapping for a diverse array of natural resources, conservation, humanitarian, and international development applications. Janet holds an M.A. in Geography from the University of Maryland.

Nisha Krishnan is a research and technology assistant on the Atlas project and a former IT/web intern at RFF. She was instrumental in the development of RFF's new website, and has been near full-time on the Atlas team since September 2008. Nisha holds a B.A. in Economics and Political Science from Macalester College and is currently completing her M.A. in Applied Economics from the Johns Hopkins University.

Michael Lippmann, Blue Raster, LLC, has more than 10 years of experience in environmental policy and web application development. Since 2002, Michael has managed information technology projects at Blue Raster. He currently provides web application development, web geographic information system (GIS) development, policy analysis and project management support. He has broad experience with environmental research and has worked with numerous federal agencies in his management of the design, development, and deployment of many award winning interactive mapping/GIS and database-driven web applications.