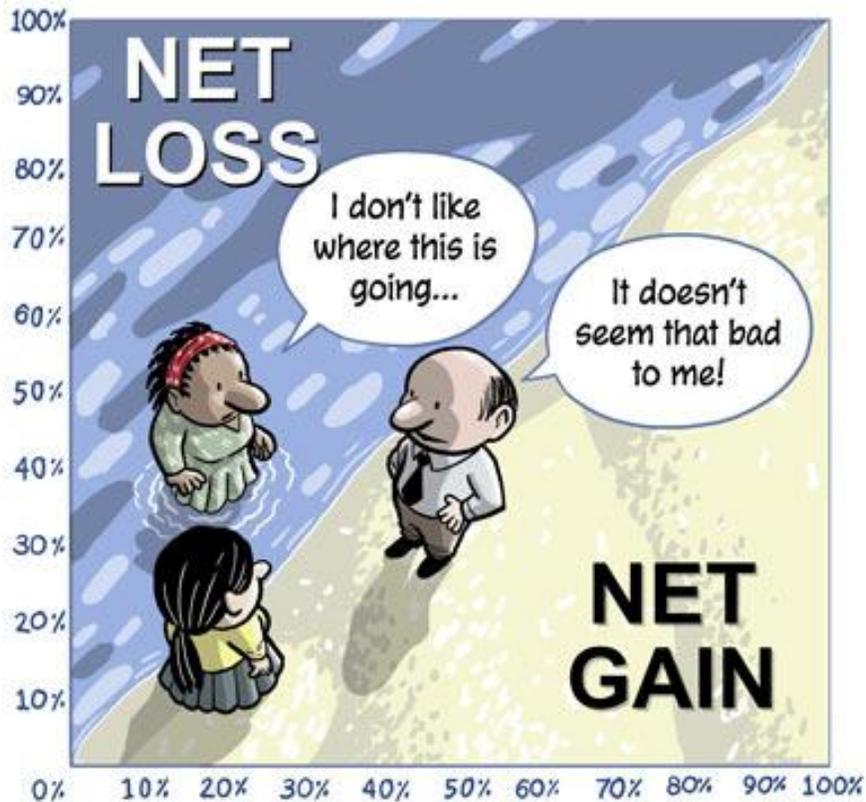


Real People, Real Impacts: The Climate Impact Equity Lens

CIEL: Climate Losses and Gains in 2050



Elizabeth A. Stanton

Ramón Bueno

Marion Davis

Stockholm Environment Institute-U.S. Center

November 2011

Copyright © 2011 by the Stockholm Environment Institute

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes, without special permission from the copyright holder(s) provided acknowledgement of the source is made. No use of this publication may be made for resale or other commercial purpose, without the written permission of the copyright holder(s).

For more information about this document,
contact Elizabeth A. Stanton at liz.stanton@sei-us.org
Stockholm Environment Institute – US Center
11 Curtis Avenue
Somerville, MA 02144-1224, USA
www.sei-us.org and www.sei-international.org

Cover art: CIEL cartoon by Barry Deutsch.

Acknowledgments

Funding for this study was provided by the Stockholm Environment Institute. The authors are particularly grateful to the people who helped us find individuals around the world to profile for our study, and who in several cases interviewed and photographed them for us as well: our SEI colleagues Marisa Escobar, Amanda Fencl, Takeshi Takama, Aaron Atteridge and Ian Caldwell, as well as Judi Clarke, Owen Day, Celina García, Christophe Grigri, Jaspreet Kindra, Ricardo Laureano, Rafael Méndez Tejada, Divine Ntiokam, Steven Percival, Babita Sinha, Ana Simendic, and Sara Farias Teneppe. We are also deeply grateful to the individuals who agreed to be profiled in this report and on the CIEL website, whose rich and diverse personal stories exemplify the message of CIEL.

Learn more about CIEL on our website: <http://www.SEI-CIEL.org>.

Contents

Executive Summary	4
Introduction.....	6
What is CIEL?.....	8
CIEL across the world	12
CIEL in the Caribbean	18
Climate change gets personal.....	25
References.....	26
Appendix Table.....	27

Executive Summary

The Climate Impact Equity Lens (CIEL) is a new tool for calculating net impacts from climate change in a way that highlights important differences in the distribution of costs and benefits. The CIEL Excel tool, which allows users to graph their own net impact, is available for download at <http://www.sei-ciel.org>.

CIEL looks at climate impacts for real people, not regional averages.

Policymakers rely on economic analysis of impacts to the “average” person in each large world region. CIEL makes it possible to compare individual impacts among the diverse global population, and to compare impacts for a single individual as they change from 2025 until 2200.

Different people will experience different impacts from climate change. In every world region, the average person is not a good representative of the diversity of climate vulnerability and emission reduction savings. CIEL takes account of these important differences by characterizing people by their income, economic vulnerability, coastal exposure, water availability and region of origin.

Even in a small region, like the Caribbean, there will be a wide diversity of impacts. With less than 1 percent of global population, all living on small islands, the Caribbean still possesses a wide diversity of individuals, each with a different vulnerability to climate change and different emission-cost savings. The most vulnerable people in the Caribbean will see net losses by 2050. By 2100, only the small minority with the least vulnerability to climate change will still have net gains.

There are both damages and savings from allowing climate change to continue.

Climate damages come from higher temperatures, more acidic oceans, and changing weather patterns. Climate savings come from not having to pay to reduce greenhouse gas emissions; there are real costs to investing in green technology and alternative energy, costs that could be avoided by allowing greenhouse gas emissions to continue growing.

Today, there are both net winners and net losers from climate change. And throughout most of the 21st century, there will still be a large group of net winners, even as the number of net losers grows, and the losses that they experience get larger and larger. Balancing these interests is a central challenge for global climate negotiations.

Climate damages, net of savings, will increase over time.

Today, for the majority of people around the world, savings from not reducing emissions are greater than damage costs. But with each passing year more and more of these “net winners” will become “net losers”, with large damage costs that dwarf much smaller savings.

By 2100, almost everyone will be a net loser from climate change. For our best hope of a successful climate policy – a policy that by 2100 will benefit the majority of people around the world – it is imperative that the net losers from climate change are represented at the negotiating table. The voices of the most vulnerable must be heard. Without their perspective there is a danger that the least vulnerable among us may lead the world, disastrously, into a climate policy that will be too little, too late.

REAL PEOPLE IN CIEL



Jovan Simendic

Age: 55
Sombor, Serbia

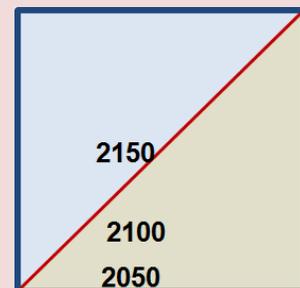
Jovan Simendic is a merchant and a farmer. He works for a company that runs a chain of stores in Slovenia, Serbia and Croatia. To better support himself, his wife and two daughters, he supplements his income by selling crops from his farm, although this income depends on how good the growing season has been. Jovan’s household income per person is a little lower than the Serbian national average.

Sombor is over 300 km from the Adriatic Sea, and more than 80 meters above sea level. Living in an urbanized area, Jovan has electricity and municipal water, and air conditioning and central heating. For the latter, he uses organic waste from a local silo – from soybeans, sunflowers and other seeds – as fuel.

As a farmer, he says, he is very concerned about climate change. He has noticed changes already in the last several years: There are droughts that affect his crops, reducing yields. Temperatures have been getting higher and higher, and sometimes when there is rain, it is too heavy, also bad for the crops.

It is getting very hard to predict the climate for the growing season, he says, and more and more people are worried.

The Profile Graph: Each of the profiles in this report is accompanied by a small CIEL graph. Markers above and the left of the red line indicate net losses from a global failure to prevent dangerous climate change in a given year, while markers below and to the right show net gains. On the red line, damages equal savings. Here, estimates of Jovan’s projected climate damages and savings are displayed for 2050, 2100 and 2150. A “net winner” this century, Jovan becomes a “net loser” in the next one. For a more complete explanation of the CIEL graph see the *What is CIEL?* section below.



Introduction

Very often research and reporting on climate change sounds impersonal, like something that might happen in a far-away future or a far-away place. Something that we wish were different; something we wish that somebody, somewhere would do something about.

Climate scientists, however, tell us the problem is urgent, and that there is a risk of enormous potential damages from climate change; this means that our decision today to reduce global greenhouse gas emissions, drastically and immediately, will likely be among our greatest legacies to future generations. The urgency of the climate problem cannot be overstated (Ackerman and Stanton 2011). Once temperatures rise, they will not fall again for many centuries, so overshoot scenarios where we allow temperatures to rise and then bring them back down with later emission reductions are simply not viable. Serious, stringent emissions reduction must be well underway in this decade in order to avoid dangerous climate change.

In 50 or 100 years, it will be easy to see that climate damages are affecting the majority of the global population; today, those damages are less obvious and are not yet universal. That's one reason why many economic analyses of climate change suggest that we still have plenty of time to reduce emissions. Those assessments, however, are based on the impacts felt by one "average individual" for each of several world regions. If you don't happen to be that average person, then this method should raise a few questions: Are you and the people that you care about more or less vulnerable to climate damages than the average person for your region? Do you and the people that you care about emit more or less greenhouse gases than the average person?

The Climate Impact Equity Lens (CIEL) is a tool for looking at climate impacts for real people instead of regional averages. CIEL compares an individual's climate damages in a given year to her savings from not reducing emissions. These estimates of damages and savings from climate change are illustrative, using the best information at our disposal. CIEL does not predict exact dollar impacts in the future; instead it gives a sense of just how big the climate problem is and of the surprising diversity of climate impacts that will be experienced by people around the world.

Using CIEL can help us think about whether we are net winners (savings greater than costs) or net losers (costs greater than savings) today, and how that is likely to change over time. CIEL also lends itself to thinking about the answer to one more question: Who are the people you care about? Your family? Your friends? Your community? Your nation? All humanity? A small share of global population is already suffering net losses from climate change. By 2050, this will grow to a much larger share, and – if nothing is done to prevent dangerous climate change – by 2150 most people around the world will experience net losses. Many of these current and future net losers from climate change live in the poorest countries in the world, which have contributed next to nothing to past emissions, and will need significant international assistance in keeping emissions down as their economies grow (Stanton 2011).

As policymakers negotiate the future of our climate, it is absolutely vital that they have in mind not just the potential impacts on a few "average" people, but the wide diversity of effects that will be felt by every person around the world. Today, some are net winners and some net losers. But in the not-too-distant future, almost everyone will be a net loser. A climate policy that focuses on real impacts to real people calls for immediate, steep emission reductions, and the international financing to make those reductions possible in the developing world.

REAL PEOPLE IN CIEL



William Msimango

Age: 57

Johannesburg, South Africa

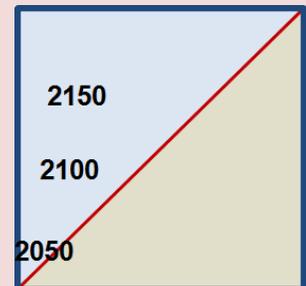
William Msimango is from the outskirts of Mtubatuba, about 200 km north of Durban. His family has always done small-scale farming, but erratic rainfall has hurt agriculture, forcing him and his two sons to find work in Johannesburg. For the past six years, he has done odd jobs in Johannesburg, more than 800 km from home, to support himself, his wife, his mother and three school-age daughters.

He works as a gardener for someone who lets him live behind his house, and also as a laborer with a transport company, earning about \$2 per hour; altogether, his family's per person income is well below the South African average. He rarely sees his family, who stayed back home and have no electricity or running water. Their water supply is a nearby stream, and the water isn't clean – they add bleach to make it safe.

In recent years, however, the stream has been drying up, so now his wife and mother have to get together with neighbors and hire a car to take them to a part of the stream that hasn't dried, at a cost of at least \$15 per week. The local municipality used to help with tankers of water, but it doesn't anymore.

"Water is the biggest problem in our area," he says. Some members of the community are considering relocating to another area, and some already have, but his family doesn't want to move.

William has never heard of climate change, but he does describe visible signs of it: Something is wrong with the rains. When he was younger, they were a lot more reliable, he says – now they hardly ever get any rain.

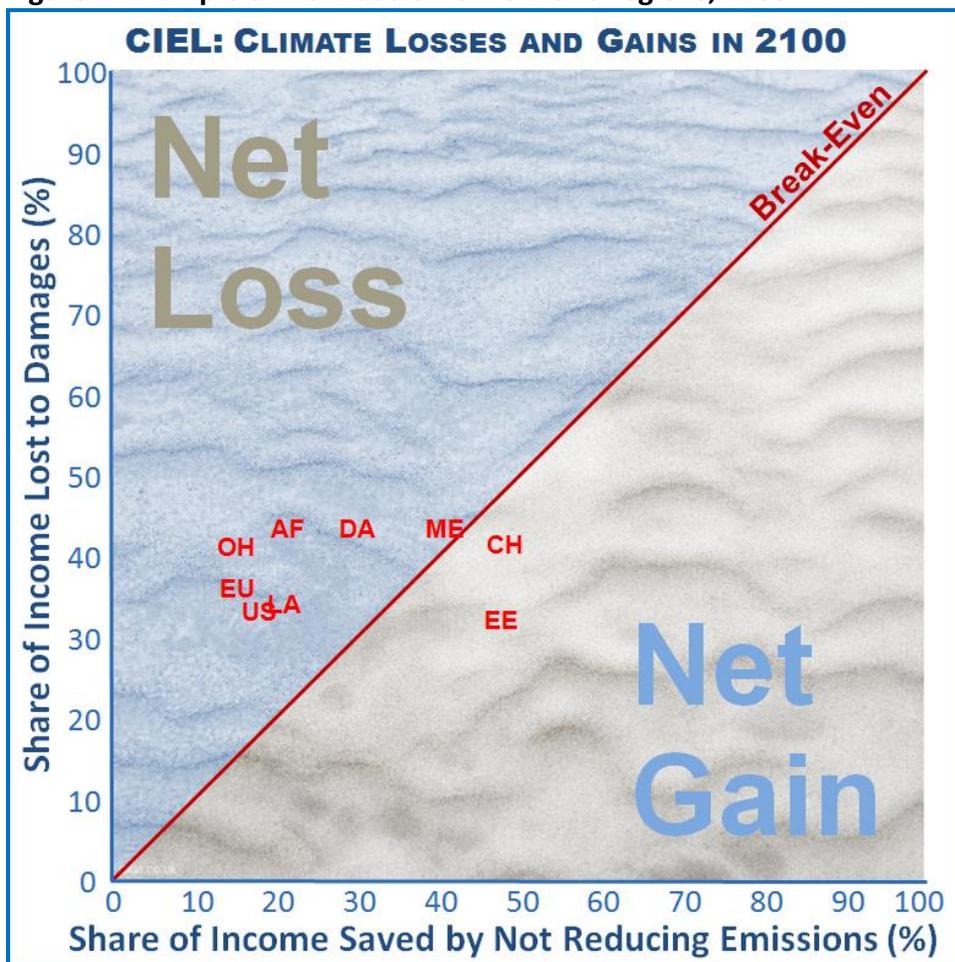


What is CIEL?

The Climate Impact Equity Lens (CIEL) examines individual costs and benefits from climate change. The costs of climate change are estimates of damages – flooding, storm damages, lost income – expected to result from higher average temperatures, ocean acidification, and changes to historical weather patterns; these damages are averaged over the 10-year period surrounding a given year. The benefits of climate change are our savings from not spending money to reduce emissions. If instead we were to take vigorous action to permit the best possible chance of avoiding dangerous climate change, we would have to pay non-trivial costs for new technologies and alternative energy sources. (The CIEL model is explained in greater detail in Stanton and Bueno 2011.)

For each individual, climate damages and savings from not reducing emissions are compared on the CIEL graph. (See Figure 1, which displays sample individuals for nine world regions in 2100; these nine individuals are discussed in more detail in the next section.) Each marker (here, a two-letter abbreviation) maps an individual’s losses from climate damages as a share of income against her savings from avoided emission reduction costs as a share of income. Individuals above and to the left of the break-even line suffer net losses in a given year; individuals below and to the right of the red line reap net gains.

Figure 1: Example of individuals from 9 world regions, 2100



Note: AF=Africa; CH=China; DA=Developing Asia/Pacific; EE=Eastern Europe; EU=Europe; LA=Latin America/Caribbean; OH=Other High Income; ME=Middle East; and US=United States.

REAL PEOPLE IN CIEL



Rebecca Sharpless

Age: 43

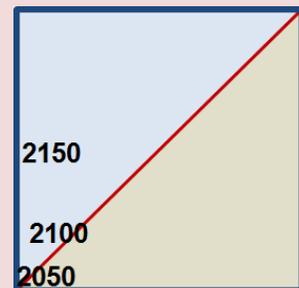
North Bay Village, Florida, USA

Rebecca Sharpless is a law professor in South Florida. She and her husband, who live with their two children, earn well above the U.S. average income. They have two cars: a minivan and a hybrid that she uses to drive to work. Her husband rides his bike to work.

They have electricity and air conditioning at home, and – like most residents of Florida – electric heat for the rare times when it gets cold in the winter. They also have municipal water service, with a steady supply – though they worry about salt-water intrusion.

Being on the coast, they're exposed to sea-level rise and storms; they lost their seawall and part of their backyard to Hurricane Wilma, in 2005. Asked if she's experienced climate impacts, she says yes: "South Florida has hotter and longer summers, and we are concerned about the increase in hurricanes and heavy rainfalls." She also worries about sea-level rise, because her family's house is just about 1.5 meters above sea level.

"I am concerned about what the future will hold for our children and their children," she says. "I am also worried about the global effects, especially those that will be experienced by people of low income and those who cannot migrate away from places where the effects of global warming will be experienced the most."



REAL PEOPLE, REAL IMPACTS: THE CLIMATE IMPACT EQUITY LENS

The data used in CIEL comes from two scenarios from the CRED (Ackerman et al. 2011) model: a no climate policy, business-as-usual scenario, where nothing is done to prevent dangerous climate change; and a very-low-emission scenario, where everything that can be done to slow emissions is done. The ideas behind the CIEL model come from the body of literature analyzing the political economy of the environment, which has a strong focus on questions of equity (see Boyce 2002). For a recent overview of the most up-to-date science and economics of climate change see Ackerman and Stanton (2011).

In CIEL, vulnerability to climate damages is estimated using four factors:

- **Income per capita** – household income divided by the number of people in the household;
- **Economic vulnerability** – share of household income derived from industries that are especially vulnerable to climate change, such as agriculture, fishing and tourism;
- **Sea-level rise vulnerability** – vulnerability of home to sea-level rise;
- **Water shortage vulnerability** – adequacy of local water supply.

Emission-reduction costs are determined by income per capita (the poorer you are, the greater your savings from not paying emission-reduction costs are as a share of your income) and region of origin (each region has a different pattern of energy use). The nine world regions used in CIEL are:

- **Africa (AF)** includes Sub-Saharan and North Africa;
- **China (CH)** includes Hong Kong but not Taiwan or Macau;
- **Eastern Europe (EE)** includes Russia and non-EU Eastern Europe, i.e., European ex-USSR, ex-Yugoslavia, and Albania;
- **Europe (EU)** includes EU-27, Norway, Switzerland, Iceland, and Turkey;
- **Latin America and the Caribbean (LA)** includes Puerto Rico and all Virgin Islands;
- **Middle East (ME)** excludes North Africa;
- **Other High Income (OH)** includes Canada, Japan, South Korea, Australia, and New Zealand;
- **Developing Asia/Pacific (DA)** includes South and Southeast Asia, Taiwan, Asian ex-USSR and Pacific;
- **United States (US)** excludes Puerto Rico and smaller island territories such as Guam and American Samoa.

Economic models used to develop policies for emissions reductions, often base their recommendations not on individuals, but on regional averages. But what's best for the person with the average income, average climate vulnerability, and average energy use in your region is not necessarily what's best for you or for people that you care about. Climate policy created with the goal of protecting the most vulnerable would be a lot more stringent than policy based on the mythical average person. CIEL's unique vantage point on individual climate impacts shows that in this century, some people are net losers from climate change and others are net winners; after 2100 it becomes increasingly difficult to identify individuals with net gains. (In other words, after 2100, the vast majority of the global population will be net losers from failing to implement a deliberate, far-reaching climate policy to control greenhouse gas emissions.)

CIEL is an illustrative tool, designed to open a new window into climate damages on a personal level; it is not a crystal ball predicting exact future outcomes. CIEL offers a sense of the scale of the climate problem and the scope of the variation in climate impacts among individuals.

REAL PEOPLE IN CIEL



Gloria Mendoza Miranda

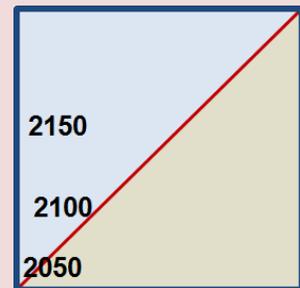
Age: 35
La Paz, Bolivia

Gloria Mendoza Miranda is an engineer and graduate student in the Bolivian capital, La Paz, working as a college instructor and consultant. She lives alone, supporting herself on a little more than the Bolivian average per capita income. Being in the city, she has electricity and municipal water; she has neither heat nor air conditioning. She doesn't own a car and is too far from downtown to have regular bus service, so she rides "trufis" – mini-buses that serve the area.

She's writing her thesis on the La Paz water supply, so she's quite aware of climate issues, which she said are, "without a doubt, very troubling" for people in the region.

Global warming is thawing the Andean glaciers and snow pack that the cities of La Paz and El Alto rely on for water, she notes, and with population growth in the region, water shortages are imminent. At the same time, temperature fluctuations in the tropical Pacific – affecting rainfall in many parts of the world – continue to hit the region periodically, leading to heavy rains and landslides. And the weather is increasingly erratic.

"Years ago, this area had well-defined seasons – rainy season, dry season – and you knew what temperatures to expect, so you could plan crops and other activities," she says. "Now there's a lot of uncertainty around climate. Sometimes it rains heavily; sometimes temperatures drop a lot, or rise a lot. We've had warm seasons that were intensely cold, even with snow, which affects people's health and the food supply."



REAL PEOPLE IN CIEL



Yuji Baba

Age: 36
Iki Island (Iki-shi), Nagasaki Prefecture, Japan

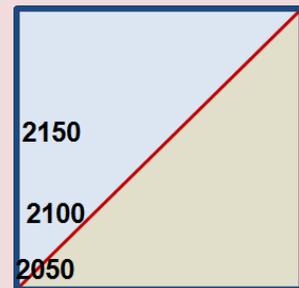
Yuji Baba lives on a small island in the Sea of Genkai, with his wife, three small sons, his parents and his grandmother. They're on a quiet, unspoiled peninsula, but have electricity, running water, and kerosene heaters, and cars for transportation. Their per person household income is above the Japanese average.

After high school, he worked in hotels and at a Toyota automobile plant, but now he supports his family primarily by raising calves for Iki-gyu (top-end Japanese beef). He also works at a boutique hotel, does some fishing, and plays music on the radio and at events.

Though he's close to the coast, his home is at least 20 meters above sea-level, so he's not concerned about direct impacts from sea-level rise or storms. He has no water-supply concerns, and climate change, so far, has been benign: December temperatures seem milder, and there is less chance of frost in January and February. But he does worry about the cattle – warming could ruin the pasture, and it might be hard to find suitable new varieties. If they can't find good pasture, the animals' health – and the quality of the beef – would suffer.

He also worries about ecological damages and endangered plants and animals, "which I would like to keep and show to our children in the future."

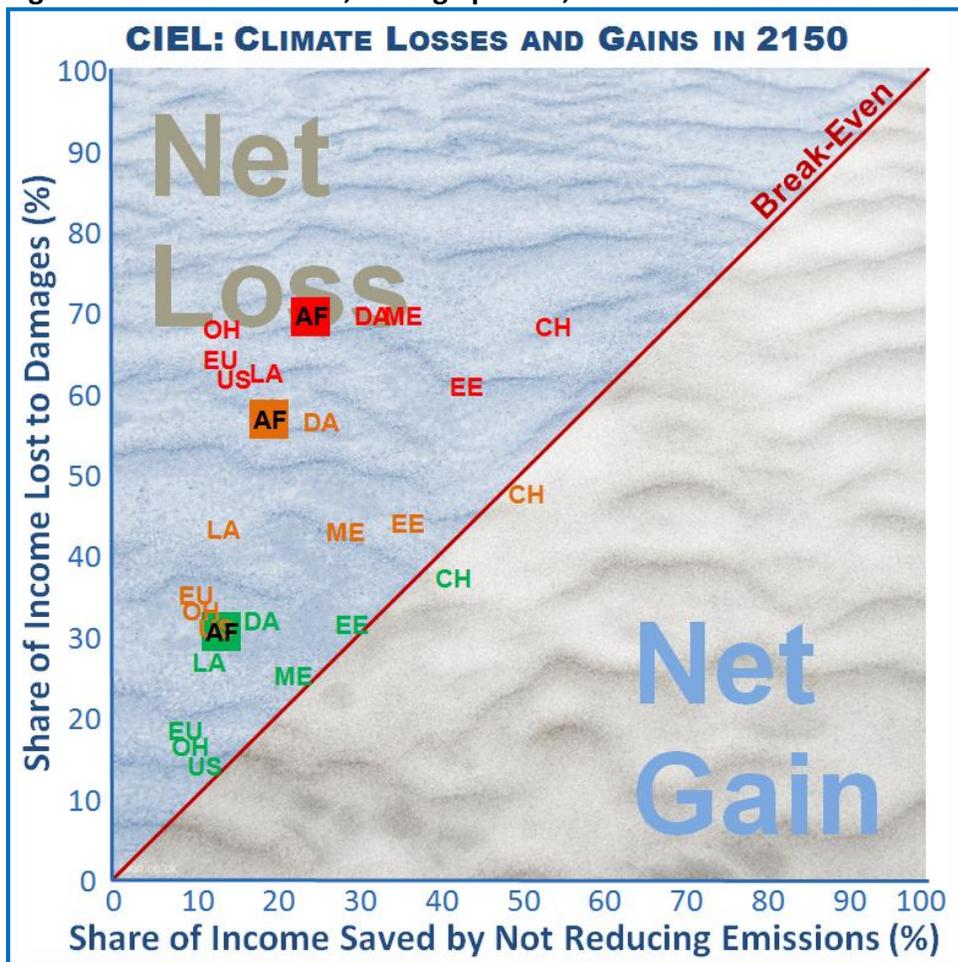
He's not "100-percent convinced" that climate change is real, he says, and "it is hard to live ecologically by lowering the standard of our living." But he adds: "I think it is absolutely necessary to be aware of the 'little' things we can do now."



REAL PEOPLE, REAL IMPACTS: THE CLIMATE IMPACT EQUITY LENS

In Figure 3, the orange markers show these same people (or, more accurately, people with the same characteristics) in 2150. Now, the average persons in every region except China lose more from climate damages than they gain in savings from not reducing emissions, and even China is very close to the break-even line. As time passes, climate damages become worse for the average person in every region around the world; emission reduction costs may grow too, especially during the 21st century, but rising savings from not reducing emissions cannot keep up with rising damages.

Figure 3: Most vulnerable, average person, and least vulnerable in 9 world regions, 2150



Note: **RED**=most vulnerable; **ORANGE**=average person; and **GREEN**=least vulnerable. AF=Africa; CH=China; DA=Developing Asia/Pacific; EE=Eastern Europe; EU=Europe; LA=Latin America/Caribbean; OH=Other High Income; ME=Middle East; and US=United States.

Figures 2 and 3 show two additional people for each region: someone with high vulnerability to climate change (in red) and someone with low vulnerability (in green). Characteristics for each of these example persons (described in detail in the Appendix Table) were chosen based on the range of real vulnerability in each region.

For example, the high-vulnerability person from Africa is from Comoros, a nation composed of several islands in the Indian Ocean. This sample person supports four children on \$500 a year (or \$100 per household member), all of which comes from fishing – an economic sector that is, because of warming waters and ocean acidification, particularly vulnerable to climate change. She lives very close to the ocean at less than 1 meter of elevation, and fresh water is abundant in her local area.

REAL PEOPLE IN CIEL



Maheshwar Mahto

Age: 53

Deoghar District, Jharkhand, India

Maheshwar Mahto is a farmer in India. He grows rice, maize, potatoes, tomatoes and chilies, mostly for his own family's consumption, and sells his surplus produce and milk from his cow to earn cash – for an income per capita, for his household of five adults and one child, that is well below the Indian average.

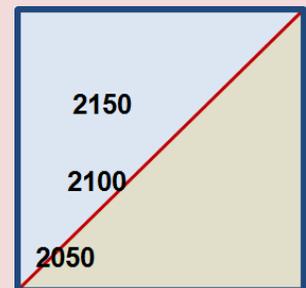
His village gets “some” electricity, he says, but it's not regular. For water, people rely on a hand pump in the village; for heat in the winter, they use firewood they collect from a nearby forest, and cow dung cakes. They get around on bicycles, or for longer trips, use public transportation.

His region is prone to drought, he says, which is troubling because people's livelihoods depend on good rain. “During summer, we face a water crisis, and it even becomes difficult to get drinking water.” This year's rains have been good, but the previous three were very dry.

“The rainfall has become quite irregular, which is very harmful for our farming.”

The climate has been visibly changing since the 1990s; he adds: the fish that used to come in monsoon season (a source of food for his family) don't come anymore, there are many harmful insects and fewer birds, the storms seem more severe and damaging, and people's health is suffering.

Looking ahead, he says, he worries “very much” about climate change and its impacts on agriculture. Last year, when the drought ruined the growing season, many young men migrated to the city in search of jobs. But life there, he says, is not good either.



REAL PEOPLE, REAL IMPACTS: THE CLIMATE IMPACT EQUITY LENS

The low-vulnerability person from Africa has very different characteristics. She too lives in a coastal area, in Gabon, but her home is in very little danger of sea-level rise or storm-surge flooding. Her household of three makes \$38,000 (\$13,000 per person) a year, all of which derives from the oil industry. She faces no risk of water shortage.

In 2100, the low-, average-, and high-vulnerability people from Africa have very different experiences: from net gains for the person in Gabon, to small net losses for the average African, to much larger net losses for the person in Comoros (see Figure 2). By 2150, all three sample Africans are experiencing damages greater than savings, although net losses for the most vulnerable would be especially devastating (see Figure 3).

All nine world regions have a similarly wide spread of climate impacts among individuals in CIEL:

- Damages increase over time; avoided emissions reductions costs do too, but nowhere near as quickly.
- There is a very wide diversity of costs and benefits within each region that is not well-represented by the average person's experience.
- In 2100, the low-vulnerability person in all regions sees net gains from climate change; whereas the high-vulnerability person sees net losses everywhere except in Eastern Europe and China,.
- By 2150, even the low-vulnerability person sees net losses in every region except for China.

Why do the sample people from Eastern Europe and China have a more optimistic outlook? In Eastern Europe, less than 3 percent of the population lives near the coast and at elevations lower than 5 meters above sea-level, and no country (as a whole) experiences water scarcity. While incomes are low compared to Europe, Other High Income, and the United States, they are still fairly high in comparison to Africa, China, and Developing Asia/Pacific. In both Eastern Europe and China, high savings from not reducing emissions have a big impact on net losses and gains. China's damage costs are relatively high for all three sample people, but their savings from not reducing emissions are also high (as a share of their incomes) compared to savings in other regions.

Failing to stop climate change is a bad deal for many people by 2050 and an even worse deal for most people by 2100. Acting to greatly reduce emissions down to levels consistent with avoiding dangerous climate change (which in CIEL means a good chance of keeping global temperature increases below 2°C) will carry significant costs, but it's a lot cheaper than the alternative.

REAL PEOPLE IN CIEL



Ala'ifatu Tasi

Age: 66
Letogo Village, Samoa

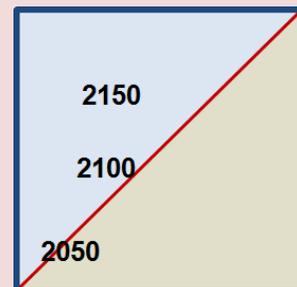
Ala'ifatu Tasi used to be a fisherman, but his outrigger canoe is no longer seaworthy, so he doesn't fish anymore. His family – two adults, three youths and six children – lives on significantly less per capita income than the Samoan average. They have no car, but they do have electricity at home, and also running water.

Yet the water is not clean, he says, and when there is a drought, as there was earlier this year, the water is rationed and only available for a few hours a day, usually at night. Drought is always a concern, he says, as his family then has to look for water when the taps run dry.

Their house is in a coastal area, but it is slightly elevated, not quite at sea level like more vulnerable houses in the area. He also has not noticed any significant climate-change impacts, he says – at least not in terms of sea level, rainfall or air temperature.

He has, however, seen an increase in the frequency and severity of tropical cyclones. "When I was young we never experienced cyclones," he says, "but there have been a few in the last 15 years. And not only have there been cyclones, but they seem to be getting stronger."

Thinking about the future, he says, he worries about his children and their homes, and whether with climate change they'll be at greater risk from tropical cyclones and storm surges.



CIEL in the Caribbean

In two dozen island nations of the Caribbean, most people are far more vulnerable than the average person for the Latin America and Caribbean region. While the average income for the Caribbean is a little bit higher than the rest of Latin America (\$5,600 versus \$5,000), the distribution of income is very wide: Haiti has the lowest income per capita in the larger region (\$440); Cayman Islands has the highest (\$52,000). The Caribbean also has a high share of income from vulnerable industries. Tourism contributes about half of the GDP of Aruba, Netherlands Antilles, Saint Lucia, and Turks and Caicos Islands, and significant shares elsewhere; agriculture makes up 28 percent of GDP in Haiti, and 18 percent in Dominica; and fisheries are important both to Caribbean income and for subsistence. On most of the islands, a significant share of the population is vulnerable to sea-level rise and storm surge damages from climate change; in Bermuda (sometimes included as part of the Caribbean) more than 80 percent of the population lives below 5 meters elevation above sea level, on the Cayman Islands, 60 percent, and several other islands are not far behind. On almost every island, fresh water is extremely scarce.

Still, in the Caribbean, just like in every region of the world, there is a great diversity of climate vulnerability. The nine markers shown in Figures 4, 5 and 6 display this diversity, represented by choosing plausible characteristics for individuals living in nine different Caribbean nations. Table 1 displays the characteristics of these nine sample Caribbeans. Their household incomes range from \$300 per person in Haiti to \$80,000 in Cayman Islands; the share of income from economic sectors vulnerable to climate change ranges from 100 percent in Anguilla and Dominica, to 0 percent in Cayman Islands, Puerto Rico, Trinidad and Tobago, and the British Virgin Islands. In Anguilla and Dominica, the sample person lives below 1 meter of elevation above sea level; in Cayman Islands, Dominican Republic, Haiti, Trinidad and Tobago, and the British Virgin Islands, at more than 5 meters above sea level. Water is abundant in the local area of the sample persons from Anguilla and the British Virgin Islands, stressed in Cayman Islands, and scarce (less than 1,000 m³ per person per year) for the other six individuals.

Table 1: Characteristics of 9 sample persons from the Caribbean

Caribbean	Income per Capita	Share of Income from Vulnerable Sectors	Elevation of Home	Water Availability
Anguilla	\$15,000	100%	<1m	Abundant
Cayman Islands	\$80,000	0%	>5m	Stressed
Cuba	\$4,000	50%	<4m, >3m	Scarce
Dominica	\$2,000	100%	<1m	Scarce
Dominican Rep.	\$5,000	50%	>5m	Scarce
Haiti	\$300	90%	>5m	Scarce
Puerto Rico	\$35,000	0%	<3m, >2m	Scarce
Trinidad & Tobago	\$20,000	0%	>5m	Scarce
Br. Virgin Islands	\$40,000	0%	>5m	Abundant

In the CIEL climate vulnerability index (described in detail in Stanton and Bueno 2011), which estimates individual vulnerability on a scale from 1 (most vulnerable) to 0 least vulnerable, the nine Caribbean sample people range from 1.00 in Dominica to 0.07 in the British Virgin Islands.

REAL PEOPLE IN CIEL



Lourdes Ayala Santos

Age: 51

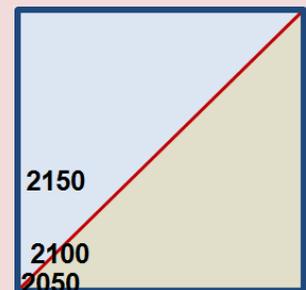
Vega Baja, Puerto Rico

Lourdes Ayala Santos works for an engineering firm, and because her husband lost his job, her income now supports both of them and their two teenage children; their per capita household income is less than the Puerto Rican average. Like most Puerto Ricans, they have running water and electricity at home; they also have two cars.

Their home is near the coast, close to Playa Puerto Nuevo, at about 13 meters above sea level. Conscious about the environment, they use no air-conditioning and have “energy-saver” appliances, plus a solar water heater. She’s also aware of the problems that drought or contamination could cause to the water supply, and worries about how poorly water is treated.

She says she has seen climate-change impacts already: erosion, dried-out land, and changes in the sea and in the flora and fauna. Yet children and youth are not getting educated about climate change in the schools, she notes – because of government ignorance.

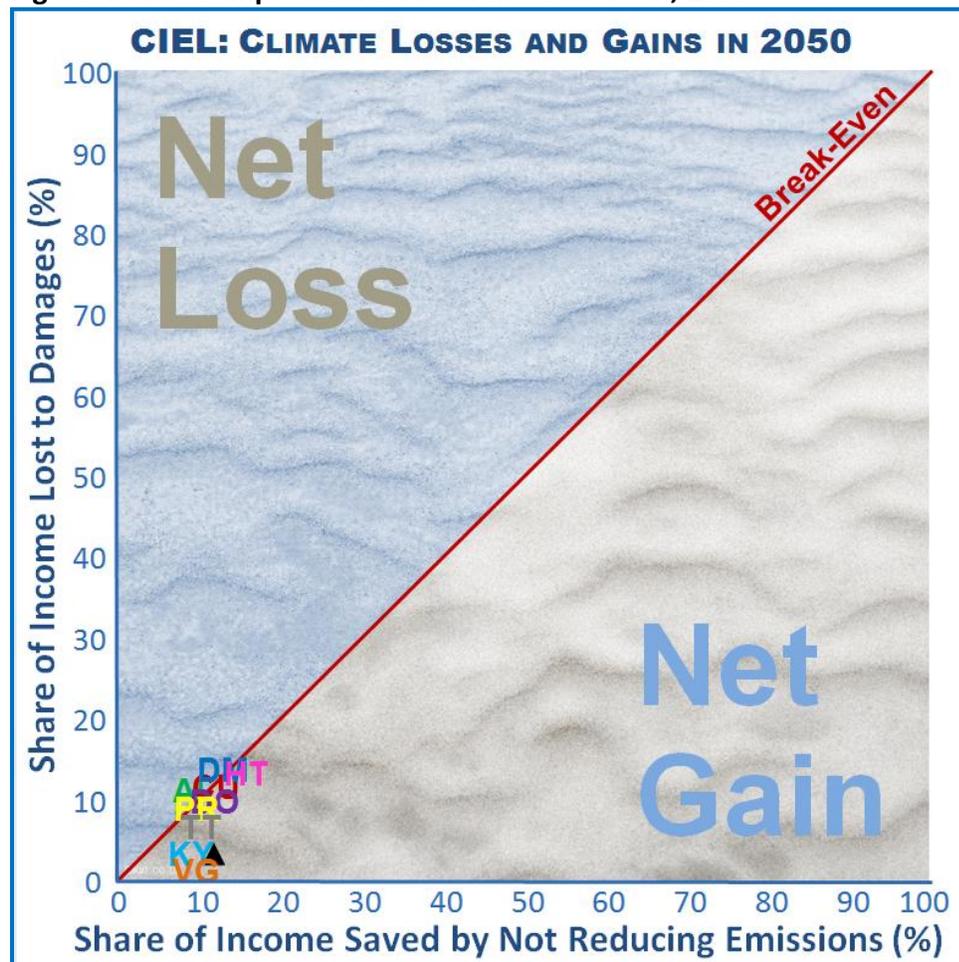
“The future is theirs,” she says. “There are no intensive campaigns, no legislation, because they figure we’re far from the poles and will have time to regenerate our ecosystems. But they’re wrong – if we keep going like this, we won’t just have drought; we’ll have no water at all. We won’t have to worry about species going extinct, because they’ll be gone already. We won’t have to worry about our health, because we won’t be alive. I worry about my children, because although I have educated them about what could come in the future, they alone can’t change things. We need to work as a team to save our planet.”



REAL PEOPLE, REAL IMPACTS: THE CLIMATE IMPACT EQUITY LENS

In 2050, all nine people have fairly similar net impacts: from about a 1 percent net loss (climate damages are greater than savings from not reducing emissions) in Anguilla, Cuba and Dominica down to a 8 percent net gain in the British Virgin Islands (see Figure 4). In the Caribbean, climate damages are important, even in the next forty years – damages as are as high as 14 percent of income (for the Dominican) in 2050, no small impact – but savings from avoided emissions reductions are about the same size, or a little larger.

Figure 4: Nine sample individuals in the Caribbean, 2050



KY=Cayman Islands; CU=Cuba; DM=Dominica; DO=Dominican Republic; HT=Haiti; PR=Puerto Rico; TT=Trinidad & Tobago; and VG=British Virgin Islands. Black triangle=Latin America/Caribbean average.

In *The Caribbean and Climate Change: The Costs of Inaction*, Bueno et al. (2008) found that preventable climate damages could reach 5 percent of Caribbean GDP by 2025 and 10 percent by 2050 – and noticeably more in certain islands. The main sources of the damages are destruction to property from more intense hurricanes; loss of tourism income as a result of the changing climate; and infrastructure damage due to rising sea levels and more-destructive storm surges. According to Bueno and coauthors, the highest climate damages as a share of GDP are expected in Haiti, Grenada, Turks and Caicos, Saint Kitts and Nevis, and Dominica; the smallest damages, in Puerto Rico, Martinique, and Guadeloupe.

By 2100, the CIEL graph for the Caribbean looks very different (see Figure 5). Only the person from the British Virgin Islands is still experiencing net gains from climate change. For the average person for the Latin American and Caribbean region (shown as a black triangle), 2100 climate damages and savings from not reducing emissions are almost exactly equal: 16 percent damages, and 15 percent savings.

REAL PEOPLE IN CIEL



Wolde Kristos

Age: 40

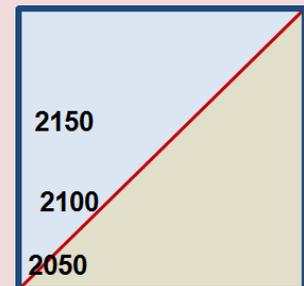
Bluefields, Westmoreland, Jamaica

Wolde Kristos (in the middle, standing between the former Minister of Agricultural and Fisheries and the former CEO of the Fisheries Division) works in tourism in Jamaica, running birding excursions and eco-tours, and also does some work in community development. With three adults and three children, his household's per capita income is well below the Jamaican average. They have a car, and also electricity and municipal water, but no air conditioning.

The water supply is steady and clean, he says, but he worries about pollution – human and animal waste getting into the water supply. Sea-level rise also worries him; though his home is about 30 meters above sea level, he is still exposed to storms, and the hurricanes seem to be getting more intense.

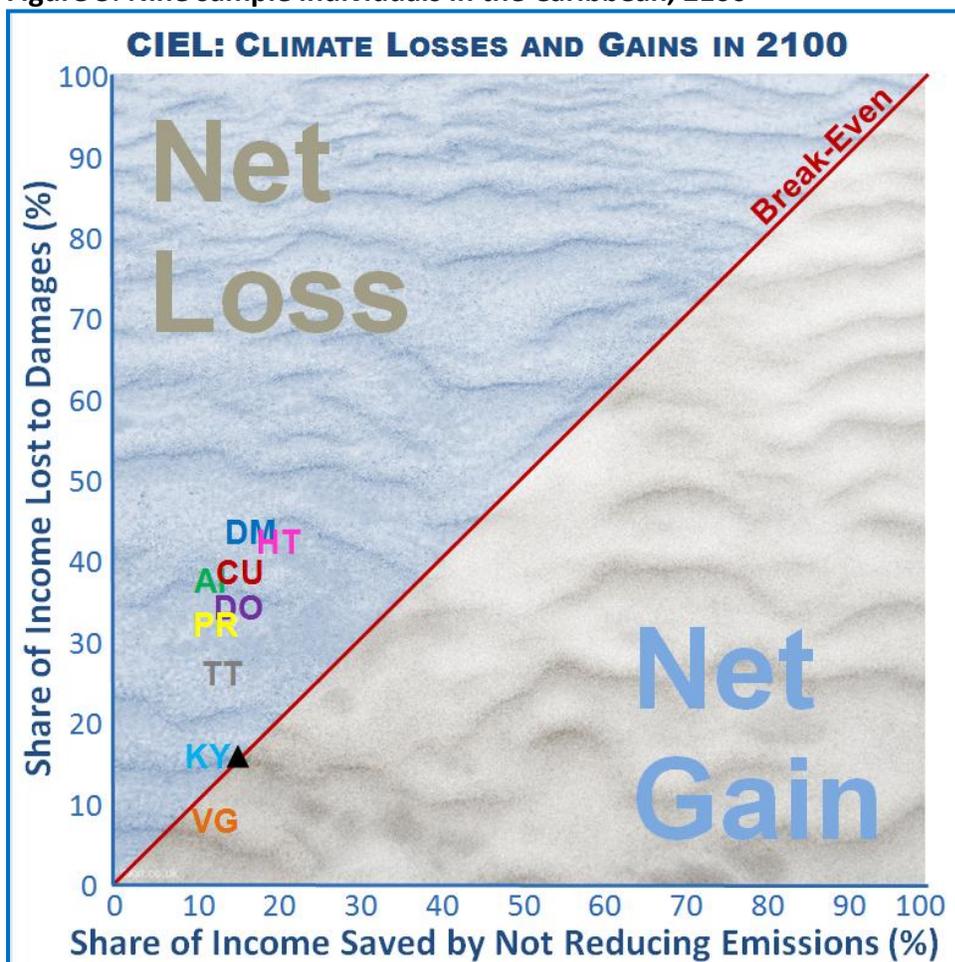
"If we keep all our mangroves," he says, "we don't have to worry about flooding affecting us." But this is also a fishing community, he notes, and people's livelihoods could be affected by sea-level rise.

Asked about the most visible climate impacts, he says the coral reefs are bleaching, and the weather has become unpredictable. And he says he's worried about the future: "I'm concerned that life as we know it will change, and we will see the loss of coastal communities like ours."



Among the sample persons shown, the person from Cayman Islands falls closest to the regional average, with 16 percent damages and 12 percent savings. The other seven individuals have significantly more costs than benefits (net losses of 13 to 27 percent) from failing to stop climate change.

Figure 5: Nine sample individuals in the Caribbean, 2100



Note: AI=Anguilla; KY=Cayman Islands; CU=Cuba; DM=Dominica; DO=Dominican Republic; HT=Haiti; PR=Puerto Rico; TT=Trinidad & Tobago; and VG=British Virgin Islands. Black triangle=Latin America/Caribbean average.

The Cuban, Dominican and Haitian in this sample have the highest 2100 climate damages – all upwards of 40 percent losses in income – and the highest net losses from climate change. All three suffer water scarcity and receive the majority of their income from economic sectors that are particularly vulnerable to climate change. The person from Dominica is the most vulnerable of the nine sample Caribbeans. She lives at less than 1 meter of elevation above sea level, and her household makes just \$2,000 per person per year.

By 2150, all nine sample Caribbeans suffer net losses from climate change, and none have damages that amount to less than 30 percent of their income (see Figure 6). Savings from not lowering emissions range from 10 to 18 percent of income, but these benefits are not sufficient compensation for the costs of failing to stop climate change. As is the case for 2100, most of these sample individuals are worse off than the average person for the Latin American and Caribbean region (note the black triangle).

REAL PEOPLE IN CIEL



Fiordaliza Mateo de Arcena

Age: 54

Santo Domingo, Dominican Republic

Fiordaliza Mateo de Arcena lives with her husband and two grown sons – one of them disabled – on a household per capita income below the Dominican average. Fiordaliza is a college graduate, but she is currently unemployed. Her family has no car; they all get around on public transportation, or take taxis.

They have electricity at home, and running water – though she worries about water contamination. Their home is well above sea level, above 25 meters, but they've had short-term flooding due to poor drainage systems and overflowing rivers. Still, they're much better off than Haitians who've come into the country and live with no municipal services, sanitation or health care, she says.

Climate change, she says, has manifested itself in precipitation changes: The rainy seasons are different, and the rains are erratic, with dry periods followed by torrential rains. When it's not raining, there can be serious enough droughts that rivers run dry. It has also gotten hotter, and some produce, such as grapefruits, will hardly grow in the region anymore.

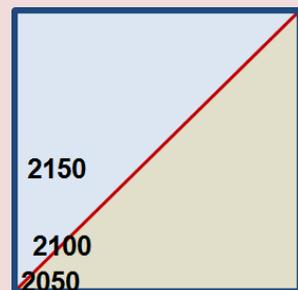
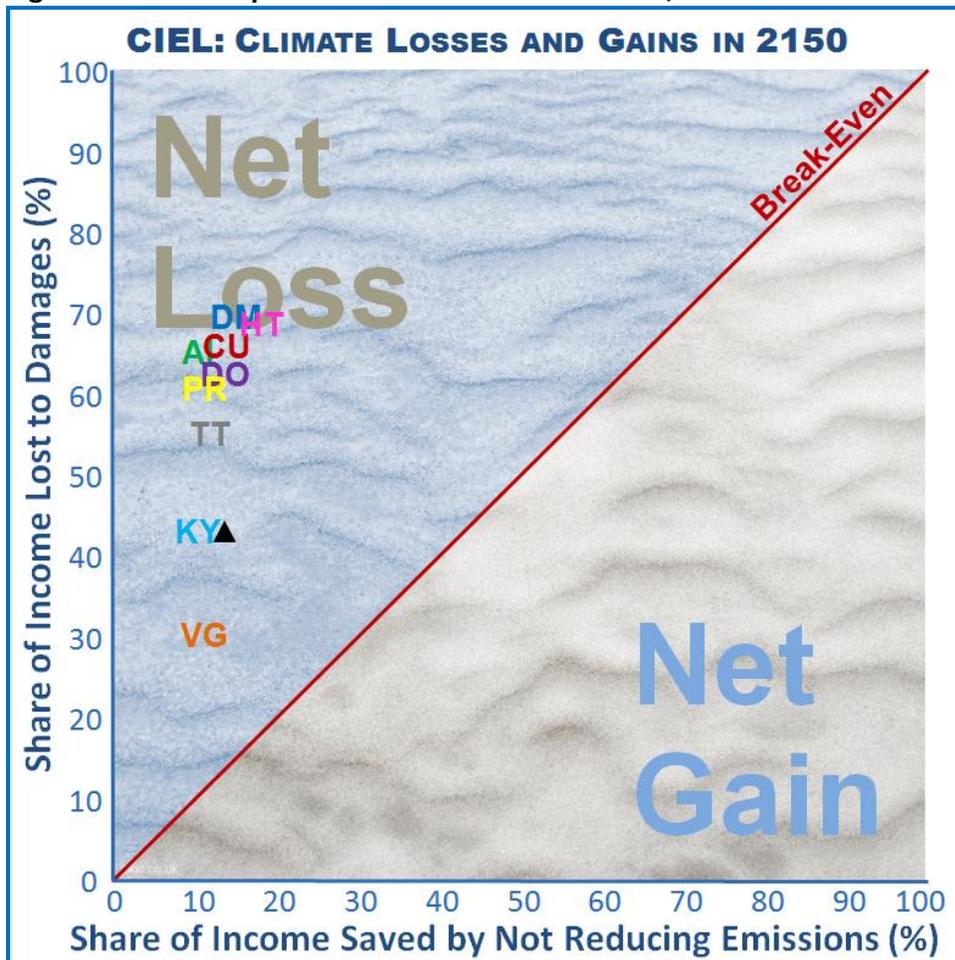


Figure 6: Nine sample individuals in the Caribbean, 2150



Note: AI=Anguilla; KY=Cayman Islands; CU=Cuba; DM=Dominica; DO=Dominican Republic; HT=Haiti; PR=Puerto Rico; TT=Trinidad & Tobago; and VG=British Virgin Islands. Black triangle=Latin America/Caribbean average.

Even in the Caribbean islands, one of the areas of the world with the greatest vulnerability to climate change, different people will experience climate change differently. Income, economic vulnerability, coastal exposure, and water availability all differ greatly: no one should expect to have the average impact from climate change. The diversity of experiences in such a small area – 40 million people, less than 1 percent of global population – illustrates the importance of considering the distribution of impacts in forming climate policy. Around the world, the diversity of climate vulnerability and patterns of energy use is even greater. Climate policy based on what’s best for regional “average” people would permit a great deal of suffering by the most vulnerable.

Climate change gets personal

Climate change is already having big effects on the most vulnerable people worldwide; by 2050, these impacts will be devastating. Even those that are less vulnerable are likely to suffer net losses from climate change by 2100. CIEL does not offer a detailed policy recommendation on the best pace of emissions reductions; it leaves that up to the reader. Instead of policy advice aimed at achieving the best outcome for the average person in each world region we offer this insight: climate change affects real people and climate policy should be based on our best understanding of the likely impacts on real people, not on regional or global averages.

Climate policymakers have a big task ahead of them. There are winners and losers from climate change, and will be for many decades to come. How will these competing interests be balanced in global negotiations? For our best hope of a successful climate policy – a policy that by 2100 will benefit the majority of people around the world – it is imperative that the net losers from climate change are represented at the negotiating table. The voices of the most vulnerable must be heard. Without their perspectives, there is a danger that the least vulnerable among us may lead the world, disastrously, into a climate policy that will be too little, too late.

What's your climate vulnerability?

Does the average person in your region do a good job of representing your personal vulnerability to climate change? How about in other regions where you may have friends and family that you care about? Chances are that if any of the following applies to you or your loved ones, then your expected climate damages are more severe than those of that average person:

- Your household makes less money, per person, than the regional average.
- A large share of your household's income comes from economic sectors that are especially vulnerable to climate change, such as agriculture, fisheries, forestry, or tourism.
- You live very close to the coast or a river delta, or at a low elevation above sea level.
- Fresh water resources in your local are already scarce.

To try out characteristics in CIEL for yourself or people that you know, download the CIEL Excel tool at www.sei-ciel.org. You can also use this url to send us your characteristics and a photo, to have your profile appear on the CIEL website.

References

- Ackerman, F. and Stanton, E.A. (2011). *Climate Economics: The State of the Art*. SEI Report. Somerville, MA: Stockholm Environment Institute-U.S. Center. Available at <http://sei-us.org/publications/id/417>.
- Ackerman, F., Stanton, E.A. and Bueno, R. (2011). *CRED v.1.3 Technical Report*. Somerville, MA: Stockholm Environment Institute-U.S. Center. Available at <http://sei-us.org/publications/id/411>.
- Boyce, J.K. (2002). *Political Economy of the Environment*. Northampton, MA: Edward Elgar.
- Bueno, R., Herzfeld, C., Stanton, E.A. and Ackerman, F. (2008). *The Caribbean and Climate Change: The Costs of Inaction*. Report commissioned by the Environmental Defense Fund. Somerville, MA: Stockholm Environment Institute-U.S. Center. Available at <http://sei-us.org/publications/id/86>.
- Stanton, E.A. (2011). *Development without Carbon: Climate and the Global Economy through the 21st Century*. Somerville, MA: Stockholm Environment Institute - U.S. Center. Available at <http://sei-us.org/publications/id/419>.
- Stanton, E.A. and Bueno, R. (2011). *The CIEL Backgrounder: Understanding the Climate Impact Equity Lens*. Somerville, MA: Stockholm Environment Institute - U.S. Center. Available at <http://sei-us.org/publications/id/421>.

Appendix Table

Most Vulnerable	Region	Income per Capita	Share of Income from Vulnerable Sectors	Elevation of Home	Water Availability
Comoros	Africa	\$100	100%	<1m	Abundant
China	China	\$1,000	100%	>5m	Scarce
Moldova	Eastern Europe	\$700	100%	>5m	Abundant
Turkey	Europe	\$2,100	100%	<2m, >1m	Abundant
Bolivia	Latin America/Caribbean	\$200	100%	>5m	Abundant
Yemen	Middle East	\$600	100%	<5m, >4m	Scarce
Korea, Rep.	Other High Income	\$4,000	100%	<2m, >1m	Stressed
Micronesia	Developing Asia/Pacific	\$130	100%	<1m	Scarce
United States	United States	\$8,000	100%	<2m, >1m	Abundant
Regional Average	Region	Income per Capita	Share of Income from Vulnerable Sectors	Elevation of Home	Water Availability
average person	Africa	\$1,100	18%	>5m	Stressed
average person	China	\$1,800	13%	>5m	Abundant
average person	Eastern Europe	\$4,300	8%	>5m	Abundant
average person	Europe	\$26,100	5%	>5m	Abundant
average person	Latin America/Caribbean	\$5,000	7%	>5m	Abundant
average person	Middle East	\$5,500	7%	>5m	Abundant
average person	Other High Income	\$31,700	3%	>5m	Abundant
average person	Developing Asia/Pacific	\$1,100	16%	>5m	Stressed
average person	United States	\$41,600	2%	>5m	Abundant
Least Vulnerable	Region	Income per Capita	Share of Income from Vulnerable Sectors	Elevation of Home	Water Availability
Gabon	Africa	\$38,000	0%	>5m	Abundant
China	China	\$13,000	0%	>5m	Abundant
Croatia	Eastern Europe	\$34,000	0%	>5m	Abundant
Norway	Europe	\$110,000	0%	>5m	Abundant
Chile	Latin America/Caribbean	\$50,000	0%	>5m	Abundant
Israel	Middle East	\$69,000	0%	>5m	Abundant
Japan	Other High Income	\$120,000	0%	>5m	Abundant
Malaysia	Developing Asia/Pacific	\$32,000	0%	>5m	Abundant
United States	United States	\$130,000	0%	>5m	Abundant
Caribbean	Region	Income per Capita	Share of Income from Vulnerable Sectors	Elevation of Home	Water Availability
Anguilla	Latin America/Caribbean	\$15,000	100%	<1m	Abundant
Cayman Islands	Latin America/Caribbean	\$80,000	0%	>5m	Stressed
Cuba	Latin America/Caribbean	\$4,000	50%	<4m, >3m	Scarce
Dominica	Latin America/Caribbean	\$2,000	100%	<1m	Scarce
Dominican Rep.	Latin America/Caribbean	\$5,000	50%	>5m	Scarce
Haiti	Latin America/Caribbean	\$300	90%	>5m	Scarce
Puerto Rico	Latin America/Caribbean	\$35,000	0%	<3m, >2m	Scarce
Trinidad & Tobago	Latin America/Caribbean	\$20,000	0%	>5m	Scarce
Br. Virgin Islands	Latin America/Caribbean	\$40,000	0%	>5m	Abundant