Building socioeconomic scenarios for the analysis of climate impact vulnerability

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Why do socioeconomic scenarios matter?

Vulnerability to climate impacts depends on both climate exposure and underlying social and economic conditions. A rich country at peace will be able to cope better with a climate disaster than a poor country at war. In the analysis of climate impact vulnerability, there is a great need to look at climate scenarios in conjunction with socioeconomic scenarios.

Water shortage in Darfur, Associated Press 2008

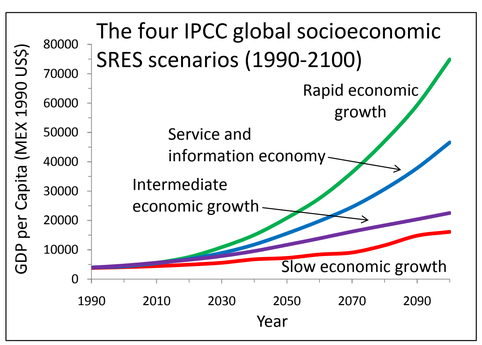
vs.

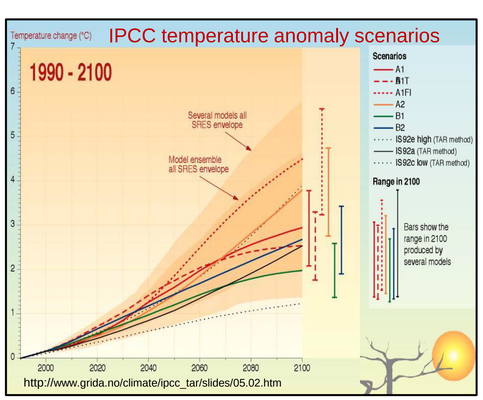
Drought in Arizona, New York Times 2008

What is the current state of socioeconomic scenarios?

Although there are many sophisticated and rigorous climate exposure scenarios, socioeconomic scenarios are limited and inadequate. The IPCC (Intergovernmental Panel on Climate Change) has created four income scenarios under the SRES (Special Report on Emissions Scenarios), as well as temperature projections. The two figures below show the discrepancy in quality between the temperature projections and the income scenarios. The temperature projections number more than twice the income scenarios, and they cover a wider range and have more variation. The income scenarios cover a small range, are deterministic, and have low variation.

In general, socioeconomic scenarios reflect a world that exhibits normal and predictive behavior, a far cry from reality. Some common themes are steadily increasing incomes without the occurrence of a recession, and a consistent trend towards peace. Furthermore, most socioeconomic scenarios lack a probability distribution, suggesting that all are equally likely.





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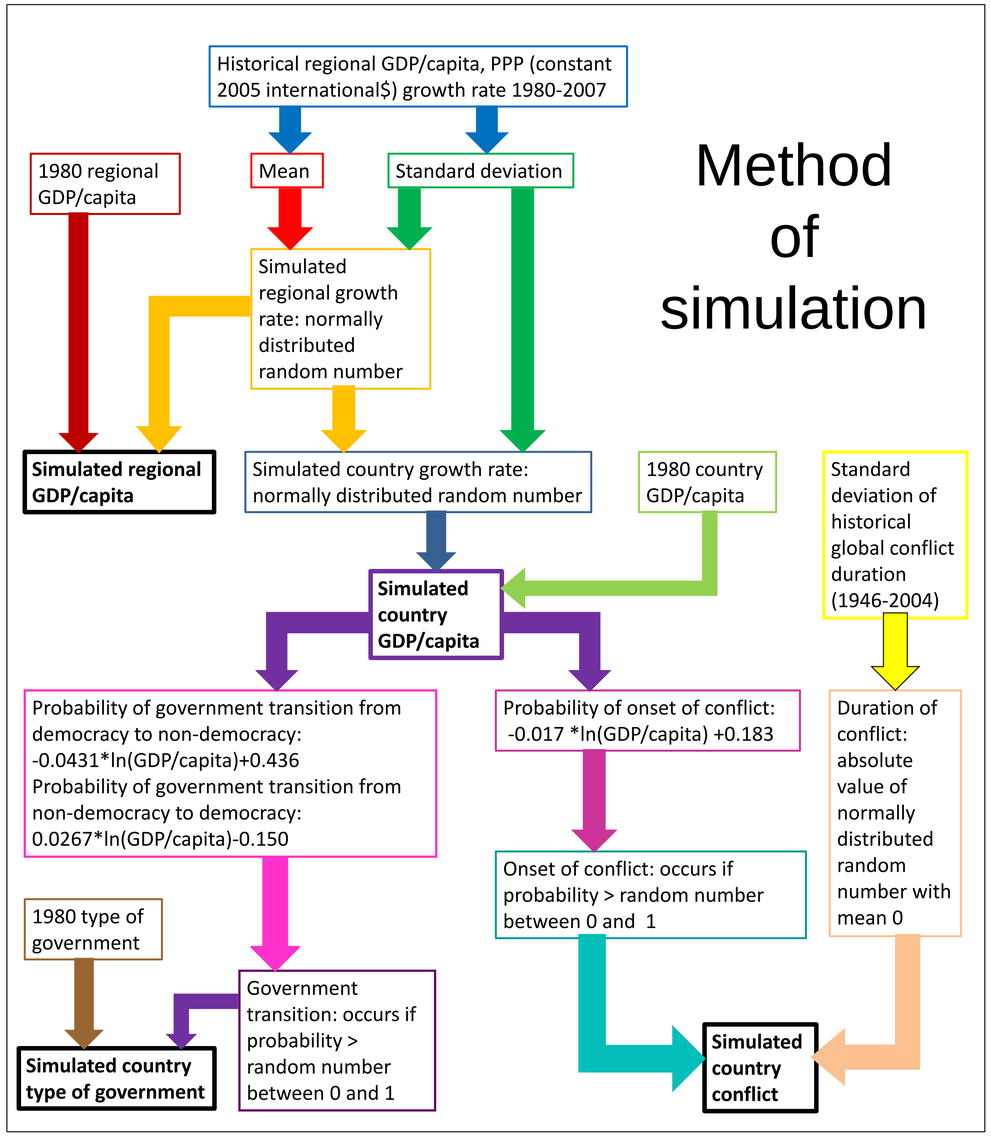
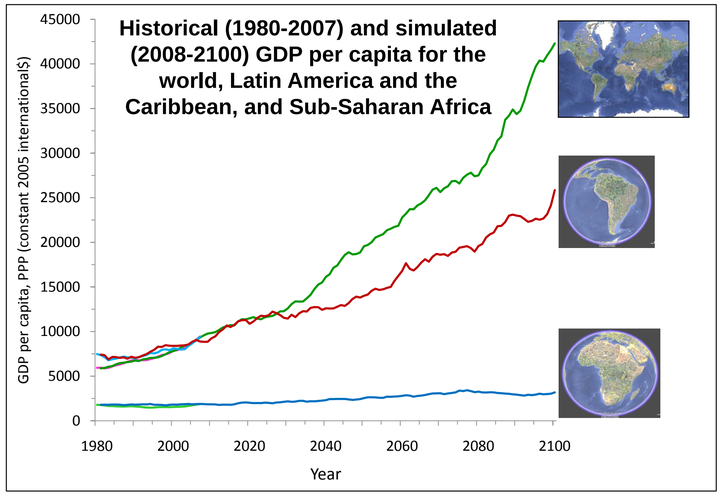
Political Instability Task Force "Internal Wars and Failures of Governance, 1955-2007" http://globalpolicy.gmu.edu/pitf/pitfdata.htm (2009)

Building more useful socioeconomic scenarios

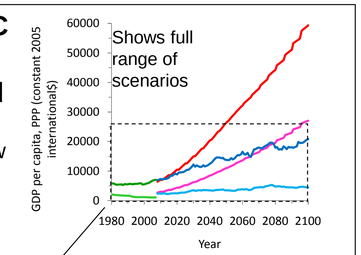
We explored a method of simulating plausible socioeconomic scenarios that are likely to affect a country's ability to cope with climate change impacts, and the well being of its citizens. Using Microsoft Office Excel 2007, we simulated regional income scenarios, and country level income, government type (democratic or not), and instance of internal armed conflict scenarios. We have the ability to run these simulations thousands of times. Our simulations include random number effects, which result in scenarios with more spatial and temporal variation, and allow them to be non-deterministic. At the same time, our scenarios are based in history, and reflect historical relationships established by the literature between income, type of government, and conflict. The figure below shows the method of simulation, including relationships between variables and the basis in history.

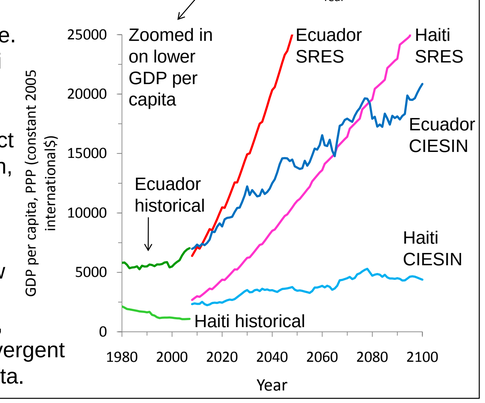




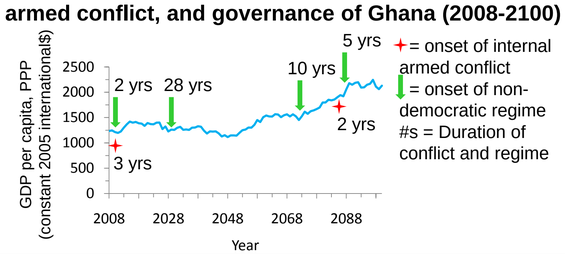
Comparison between IPCC SRES B1 and CIESIN scenarios for Ecuador and Haiti 2008-2100

The IPCC SRES scenarios show a future trend of GDP per capita for both Ecuador and Haiti that is completely void of recession, and has very few discontinuities over time. Both Ecuador and Haiti experience a smooth upwards trend. The CIESIN scenarios depict more temporal variation, including negative discontinuities. Furthermore, the CIESIN scenarios allow Ecuador and Haiti to follow dissimilar trends, consistent with their divergent historical GDP per capita.





Simulation of GDP per capita, instance of internal armed conflict, and governance of Ghana (2008-2100)



Social determinants of vulnerability

Not included in these simulations	Included in these simulations
Population	PPP per capita
Migration	Governance
Education	Conflict
Health	

Conclusions and next steps

Our multidimensional, nondeterministic, and variable scenarios permit more effective climate change vulnerability assessment, especially in their ability to account for historical differences between countries and to allow for negative growth. Looking forward, we would like to impose random income growth shocks, vary the random number distribution by region and/or country, apply consistency checks between the world, the regions, and the countries, allow the country income trends to be more independent of the regional trends, and add additional constraints on all variables. Furthermore, we wish to explore different options of characterizing regions, such as by income group or by risk of drought. Finally, we hope to graph the CIESIN socioeconomic scenarios next to climate exposure scenarios, in order to simulate different combinations of climatic and socioeconomic conditions, and to research which combinations of conditions historically produced the greatest human impacts.