Projecting Civil Conflict Along Climate Change and Socioeconomic Scenarios

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This material is based upon work supported by, or in part by, the U.S. Army Research Laboratory and the U.S. Army Research Office via the Minerva Initiative under grant number W911NF-13-1-0307 and the Research Council of Norway, project 217995/V10. The opinions expressed in this work are those of the authors.
Project Overview

**OBJECTIVE:** Generate projections of global and regional conflict burdens from present to 2100 along a plausible range of socioeconomic and climate change futures.

1. Empirical models of relationships of armed civil conflict, climate change and socioeconomic variables

2. Scenarios for future socioeconomic conditions and climate change
   - Representative concentration pathways (RCP)
   - Shared socioeconomic pathways (SSP)
   - Shared policy assumptions (SPA)

3. Simulation of future conflict burdens
Projecting conflict along socioeconomic scenarios

**PROOF OF CONCEPT:** Project armed civil conflict under the shared socioeconomic pathways (SSPs)

1. **Multinomial logit model for armed civil conflict:**
   - Dependent variable: Whether a country experienced peace, a minor (25-999 deaths/year) or a major (1000+ deaths) conflict in any given year, taken from the UDCP/PRIO Armed Conflicts dataset.
   - Explanatory variables: GDP/capita, population, educational attainment, state of dependent variable at \( t-1 \), time in peace, time since independence, decade dummies, region dummies, lagged and interaction terms

2. Annual time series of the explanatory variables along the SSPs

3. Simulations along the SSPs to estimate of conflict burdens

Proof of concept
## Five Shared Socioeconomic Pathways (SSPs)

### Summary of the SSPs in 2100

<table>
<thead>
<tr>
<th>SSP</th>
<th>Total world population</th>
<th>Average GDP/capita (in 2005 USD PPP)</th>
<th>Average % of males (20-24) with secondary education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base (2010)</td>
<td>6 867 000</td>
<td>$ 12 370</td>
<td>69 %</td>
</tr>
<tr>
<td>SSP1:</td>
<td>6 887 000</td>
<td>$ 82 460</td>
<td>95 %</td>
</tr>
<tr>
<td>Sustainability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSP2:</td>
<td>9 000 000</td>
<td>$ 68 140</td>
<td>92 %</td>
</tr>
<tr>
<td>Middle of the Road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSP3:</td>
<td>12 612 000</td>
<td>$ 35 490</td>
<td>65 %</td>
</tr>
<tr>
<td>Fragmentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSP4:</td>
<td>9 268 000</td>
<td>$ 56 730</td>
<td>63 %</td>
</tr>
<tr>
<td>Inequality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSP5:</td>
<td>7 376 000</td>
<td>$ 135 360</td>
<td>95 %</td>
</tr>
<tr>
<td>Conventional Development</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Simulation approach

- Simulation approach developed by Håvard Hegre (PRIO/Uppsala) and described in detail at http://havardhegre.net/forecasting/

1. Estimate multinomial logit model
2. Draw model parameters randomly from the estimated average effects and the variance-covariance matrix.
4. Repeat steps 3 – 4 multiple times
Projections along the SSPs

Global conflict projections using population and GDP/capita

Preliminary Results
Projections along the SSPs

Global conflict projections adding educational attainment

Preliminary Results
Regional distribution of conflict

Conflict model includes population, GDP/capita and education
Conclusion and challenges

• Our forecast model that includes GDP/capita and educational attainment shows meaningful differences in the conflict propensity along the shared socioeconomic pathways (SSPs)

• Challenges:
  – Development of consistent variables for model building and for the scenarios
  – Feedback of conflict onto the scenarios, for example the feedback of armed conflict on economic growth
Next step: Armed conflict and climate change

- Direct causal pathways between climate change variables, such as temperature, and civil conflict may not exist.
- We are investigating plausible indirect pathways for both climate change and climate policies:

  Climate change \rightarrow \text{Changes in agricultural yields} \rightarrow \text{Changes in food prices} \rightarrow \text{Low-level violent conflict} \rightarrow \text{Armed civil conflict}

- Empirical modeling of different measures of food security and conflict
- Modeling of food prices as a function of climate change and socioeconomic conditions using the Global Change Assessment Model (GCAM)

- Other pathways of potential interest include oil exports and international monetary transfers due to climate policies
- Other suggestions?
Website

http://faculty.publicpolicy.umd.edu/climateandconflict

Projecting Civil Unrest and Conflict Under Climate Change and Socioeconomic Scenarios

A three year project funded by the Minerva Initiative of the US Department of Defense

The anticipated effects of climatic changes will have serious implications for human wellbeing and security. Quantitative efforts, however, to assess how the impacts will influence the future probability of armed conflict and unrest are relatively limited. Improving the understanding of these dynamics as well as projecting how conflicts may emerge over the next few decades is critical for developing interventions and adaptations to mitigate these risks.

In this three-year project, we aim to develop a consistent and integrated model that projects climate damages and future global and regional conflict burdens under a range of future climate change and socioeconomic trajectories. We will examine the implications of existing literature as well as test new hypotheses of how the impacts of climate change may influence conflict, specifically through changes in economic growth, human health, agricultural productivity, institutional capacity and other known conflict predictors.

We have brought together a highly interdisciplinary team for this effort.
Backup Slides
GDP/capita, country mean
Percentage of males (20-24) with secondary schooling
Total world population
Conflict map in 2013
Statistical Model

• Estimate a multinomial logit model with lagged dependent variables and interaction terms between explanatory variables and the lagged dependent variables.
  – GDP/capita, population, educational attainment, past conflict, time in peace, time since independence, decade dummies, region dummies, interaction terms

• Dependent variable is the annual transition probability matrix between peace, minor (25-999 deaths/year) and major (1000+ deaths) conflict from the UCDP dataset.

### Annual transition probability matrix (1960 – 2012)

<table>
<thead>
<tr>
<th>Conflict at t-1</th>
<th>No Conflict</th>
<th>Minor Conflict</th>
<th>Major Conflict</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Conflict</td>
<td>5078 (0.965)</td>
<td>155 (0.029)</td>
<td>21 (0.004)</td>
</tr>
<tr>
<td>Minor Conflict</td>
<td>145 (0.207)</td>
<td>481 (0.689)</td>
<td>72 (0.103)</td>
</tr>
<tr>
<td>Major Conflict</td>
<td>24 (0.077)</td>
<td>70 (0.205)</td>
<td>247 (0.724)</td>
</tr>
<tr>
<td>Total Obs</td>
<td>5247</td>
<td>706</td>
<td>340</td>
</tr>
</tbody>
</table>
**Shared Socioeconomic Pathways**

**SSP1: Sustainability**
- Good progress towards sustainable development
- Stabilizing population
- Decreasing income inequality
- Early MDG achievement
- Low resource intensity and fossil fuel dependency
- Strong int’l governance and local institutions
- Well managed urbanization
- Environmentalism

**SSP2: Middle of the Road**
- Current trends continue
- Moderate population growth
- Slowly converging incomes between industrialized and developing countries
- Delayed MDG achievement
- Reductions in resource and energy intensity at historic rates
- Environmental degradation

**SSP3: Fragmentation**
- Rapid population growth
- Slow economic growth
- Failing to achieve MDG
- High resource intensity and fossil fuel dependency
- Low investments in technology development and education
- Unplanned settlements
- Weak int’l governance and local institutions

**SSP4: Inequality**
- Increasing inequality within and across countries
- Effective governance controlled by a small number of rich global elites
- Most of populations with limited access to higher education and basic services
- Energy tech R&D made by global energy corporations
- Low social cohesion

**SSP5: Conventional Development**
- Rapid economic development
- Stabilizing population
- Consumerism
- High fossil fuel dependency
- Eradication of extreme poverty and universal access to education and basic services
- Highly engineered infrastructure and ecosystems

Adapted from the meeting report of the *Workshop on The Nature and Use of New Socioeconomic Pathways for Climate Change Research* [https://www.isp.ucar.edu/sites/default/files/Boulder%20Workshop%20Report_0_0.pdf](https://www.isp.ucar.edu/sites/default/files/Boulder%20Workshop%20Report_0_0.pdf)
Simulation approach

• Statistical relationships are tested and projected along the future scenarios using a simulation (forecasting) technique.

• Simulation approach developed by Håvard Hegre (PRIO/Uppsala) and described in detail at http://havardhegre.net/forecasting/