Quantifying unaccounted greenhouse gas emissions due to the war in Ukraine – driver analysis, emission estimation, and implications for emissions reporting

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1 Introduction

- Emissions reporting is important for understanding the global carbon cycle and for addressing global climate change.
- In a period of open conflict or war, military emissions increase significantly, and the international accounting system is not currently designed to account adequately for this source.

2 Materials and Methods

The major war-related emission processes from the territory of Ukraine not covered by current GHG inventory guidelines are:

- a) the use of bombs, missiles, barrel artillery, mines, grenades, and small arms;
- b) the consumption of oil products for military operations;
- c) fires at petroleum storage depots and refineries;
- d) fires in buildings and infrastructure facilities;
- e) fires on forests and agricultural lands;
- f) the decomposition of war-related garbage/waste.

3 Results and Discussion

3.1 Emission sources

<table>
<thead>
<tr>
<th>Emission sources</th>
<th>CO2, Mt</th>
<th>CH4, kt</th>
<th>N2O, kt</th>
<th>Total, Mt-CO2-eq</th>
<th>Relative uncertainty, 95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of bombs, missiles, barrel artillery, mines, etc.</td>
<td>0.28</td>
<td>–</td>
<td>–</td>
<td>0.28</td>
<td>+/- 54.2</td>
</tr>
<tr>
<td>Use of petroleum products for military actions</td>
<td>28.5</td>
<td>0.25</td>
<td>0.68</td>
<td>28.7</td>
<td>+/- 39.7</td>
</tr>
<tr>
<td>Fires of petroleum products at petroleum storage depots</td>
<td>5.4</td>
<td>0.21</td>
<td>0.04</td>
<td>5.43</td>
<td>+/- 20.3</td>
</tr>
<tr>
<td>Fires of buildings and infrastructure objects</td>
<td>17.8</td>
<td>5.0</td>
<td>0.73</td>
<td>18.1</td>
<td>+/- 49.8</td>
</tr>
<tr>
<td>Forest fires and fires of agricultural fields</td>
<td>21.1</td>
<td>63.3</td>
<td>3.5</td>
<td>23.8</td>
<td>+/- 38.2</td>
</tr>
<tr>
<td>Emissions from garbage/waste</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1.03</td>
<td>+/- 69.4</td>
</tr>
<tr>
<td>Total emissions</td>
<td>73.1</td>
<td>105.6</td>
<td>4.96</td>
<td>77.2</td>
<td>+/- 22.3</td>
</tr>
</tbody>
</table>

*“Peace Time” vs “War time”*

First 18 months of the 2022/2023 war in Ukraine

4 Conclusions

- During a war, GHG emissions due to military actions can increase significantly.
- The impact of conflict on GHG emissions extends well beyond the time and place of the physical conflict.
- The IPCC guidelines do not explicitly consider wartime GHG emission reporting.
- War-related GHG emissions for the first 18 months of the war in Ukraine were 77 Mt CO2-eq.
- The relative uncertainty of war-related emissions in Ukraine is estimated to be 22% (95% CI).

References