A one-page account of manmade global warming

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The purpose of this note is to arm those in outreach with just enough data to answer some of the more common objections to the connections between industrial emissions of CO2, atmospheric greenhouse gases, and global mean land temperatures.

Table 1 lists cumulative industrial CO2 emissions since 1751 (CumEm, row 1), greenhouse gases (GHGs, row 2, mainly water vapor and CO2), and land temperatures (row 3), for the three years 1851, 1977, and 2019 (columns 1, 4, and 7), along with their intermediate increases and corresponding rates per century (columns 2, 3 and 5, 6; 1851-1977 is 1.26 centuries). Units are exagrams¹ for rows 1 and 2 and °F for row 3. Figure 1 gives a more detailed picture of rows 2 and 3 (GHGs and temperature).

<table>
<thead>
<tr>
<th>Year(s):</th>
<th>1851</th>
<th>Δ</th>
<th>Δ/1.26</th>
<th>1977</th>
<th>Δ</th>
<th>Δ/0.42</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>CumEm (Eg):</td>
<td>0.54</td>
<td>0.43 Eg/cy</td>
<td>0.54</td>
<td>1.12</td>
<td>2.67 Eg/cy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GHGs (Eg):</td>
<td>15.14</td>
<td>0.35</td>
<td>0.28 Eg/cy</td>
<td>15.5</td>
<td>0.60</td>
<td>1.42 Eg/cy</td>
<td></td>
</tr>
<tr>
<td>Temp (°F):</td>
<td>-0.01</td>
<td>0.15</td>
<td>0.12 °F/cy</td>
<td>0.15</td>
<td>1.94</td>
<td>4.61 °F/cy</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Cumulative emissions, GHGs, land temperatures: 1851-1977-2019

In each of the two green columns, for respectively 1851-1977 and 1977-2019, emissions during those periods are considerably higher than increases in GHGs. This is to be expected in light of drawdown by ocean, plants, etc. Some say that these rising GHGs are not coming from industrial emissions, but then where are those emissions going, and where are these additional GHGs coming from?

In each of the three red rows, for respectively cumulative emissions, GHGs, and temperature, the rate of increase during 1977-2019 is some 5 to 7 times greater than during 1851-1977. Evidently all three have been increasing much faster lately. Furthermore Figure 1 shows no sign of any abatement in temperature, contrary to what some have argued based on the hiatus of 2001-2012 (black trend line).

Preindustrial GHGs consisted mainly of 12.9 Eg of H2O and 2.2 Eg of CO2. Their combined 15.1 Eg is what has kept Earth’s surface about 60 °F above what it would be with no GHGs, or 4 °F per Eg. The recent 0.60 Eg increase from 15.50 to 16.09 Eg could therefore be expected to raise the temperature by about 2.4 °F. That it only rose 2.04 °F reflects that any such warming may take centuries to reach equilibrium, though a lower global warming potential for CO2 than H2O may also be a factor.

Supplementary material is at http://clim8.stanford.edu/agw/suppl/

¹1 Eg (exagram) = 10¹⁸ grams or a thousand gigatonnes.