The Urgent Need for Updated Climate Metrics to Reduce Global and Arctic Climate Changes

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Today’s Discussion

The world is on track to pass irreversible thresholds of climate change within 20-40 years. The Arctic is closer to its tipping point, having warmed 3x as fast as the rest of the world.

The most commonly used climate metric today (GWP-100) is out of date. A separate accounting metric for Arctic climate change is needed.

A draft US standard for LCA (LEO-SCS-002) has updated climate metrics, including a separate metric for the Arctic.

The new Arctic metric has been used to examine the contribution of ten countries to Arctic climate change.

In order to meet the maximum temperature target of the 2009 Copenhagen Accord, climate metrics must be updated.
Business as Usual is Leading Us Towards Thresholds of Irreversible Global Climate Change

Thresholds of increasing irreversibility
Significance of Global Temperature Thresholds

+1.5°C C Threshold (2035)
Possible point of Arctic destabilization, and projected loss of small island states into the oceans.

+2.0°C C Threshold (2050)
Point beyond which dangerous climate interference will occur, according to 2009 Copenhagen Accord (UNFCCC).

+4.0°C C Threshold (2100)
This threshold is considered by many scientists to be “potentially catastrophic”.

Even with global mitigation of all emissions, the +1.5°C GMT anomaly will be exceeded.

Up to 1 meter of sea level rise

Source: UNEP and WMO report, 2011.
Significance of Global Temperature Thresholds

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+4.0°C Threshold (2100)  
This threshold is considered by many scientists to be "potentially catastrophic".

Projected impacts when GMT anomaly reaches +2.0°C:

- Up to 1 meter of sea level rise
- Coral reefs decimated by bleaching.
- Effects to water supplies, including a 40% reduction in surface water supplies in the Mississippi River Basin.
Significance of Global Temperature Thresholds

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+4.0° C Threshold (2100)
This threshold is considered by many scientists to be “potentially catastrophic”.

Projected impacts when GMT anomaly reaches +4.0° C.

Unprecedented heat extremes: July in the central U.S. will be 9° C (20° F) warmer

As much as an 80% reduction in surface water in the Mississippi River Basin.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Without adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring wheat</td>
<td>-14 to -25%</td>
</tr>
<tr>
<td>Maize</td>
<td>-19 to -34%</td>
</tr>
<tr>
<td>Soybean</td>
<td>-15 to -30%</td>
</tr>
</tbody>
</table>

Significant declines in food production in all world regions.
Climate Change is More Severe in the Arctic

Increase in temperatures since 1900

Source: NASA GISS Surface Temperature Analysis
Consequences of Arctic Climate Change

Loss of Sea Ice

The Arctic sea ice extent has been in decline since measurements began.

It is predicted that the Arctic could be nearly free of sea-ice in the summer by 2035 (US NOAA).

This will add 25% to global radiative forcing, equivalent to over 340 billion tons of CO₂ emissions.

Source: National Oceanic and Atmospheric Administration (NOAA).
NASA Warning: Methane releases rose sharply in 2013 and were described as “amazing.”

Major sources include:
A thawing permafrost (30% will thaw by 2050)
Melting methane hydrates in Arctic Ocean
Risks from Catastrophic Methane Releases

**Without methane:**
- +1.5°C limit exceeded in 2035
- +2.0°C limit exceeded in 2050

Risks from Catastrophic Methane Releases

The Critical Need for
Updated Climate Metrics
Current Climate Metrics Need to be Updated

The most commonly use climate metric, the GWP-100, is used almost universally in LCA software and calculations, and is embedded in government policies and international agreements.

The GWP-100 is based on the framework of the 1997 Kyoto Protocol, based on the best consensus climate science of the time.

Since that time, climate science has progressed significantly, with improved understanding of:

- The importance of short-lived climate forcers
- Projections of global temperature changes
- Pace and global ramifications of rapid Arctic warming

There is a need to update the GWP-100 with current science to understand and react to global and regional warming.
GWP-100 Omits 60% of Contributors to Radiative Forcing

(Total Net Forcing: 2.5 W/m²)

<table>
<thead>
<tr>
<th>Greenhouse Gases</th>
<th>Radiative Forcing (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td>1.8 W/m²</td>
</tr>
<tr>
<td>Methane</td>
<td></td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>0.2 W/m²</td>
</tr>
<tr>
<td>Other GHGs</td>
<td>0.3 W/m²</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.8 W/m² (40%)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Short-Lived Climate Forcers</th>
<th>Radiative Forcing (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black carbon</td>
<td>1.1 W/m²</td>
</tr>
<tr>
<td>Brown carbon</td>
<td></td>
</tr>
<tr>
<td>Tropospheric Ozone</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.8 W/m² (30%)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cooling Climate Forcers</th>
<th>Radiative Forcing (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling aerosols (sulfate, nitrate, and organics)</td>
<td>-2.1 W/m²</td>
</tr>
</tbody>
</table>

-2.1 W/m² (30%)
GWP-100 Omits 65% of Contributors to Arctic Climate Change

*(Total Arctic Warming: 2.5 °C)*

<table>
<thead>
<tr>
<th>Greenhouse Gases (CO₂, CH₄, N₂O, CFCs, HFCs)</th>
<th>Arctic Temperature Change</th>
</tr>
</thead>
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<tr>
<td>Short-Lived Climate Forcers</td>
<td>Arctic Temperature Change</td>
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<tr>
<td>Black carbon</td>
<td>Cooling Climate Forcers</td>
</tr>
<tr>
<td>Ozone</td>
<td>Cooling aerosols</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

The Climate Crisis is Today, Not in 100 Years

The GWP-100 uses a 100-year time horizon, assuming impacts from climate change are 100 years in the future.

Global and Arctic climate impacts are occurring today, and will rapidly intensify in the next few years.

Changes within 20 years could become irreversible.

Tanana Flats in Alaska, over last 20 years

(photo by Torre Jorgenson, downloaded September 22, 2014) http://www.arctic.noaa.gov/detect/land-tundra.shtm
### New Metrics Integrate Consensus Climate Science

*Part of draft LEO-SCS-002 standard for LCA (ANSI process)*

- Updated metrics integrate current consensus climate science
- Time horizon used in the **global warming potential (GWP)** equation is tied to global temperature thresholds
- Accounts for all climate forcers, including short-lived climate forcers (SCLFs) such as black carbon
- Accounts for climate forcers causing negative radiative forcing (i.e., coolants)
- Arctic Climate Change is accounted for separately
Accounting for Arctic Climate Change

Radiative forcing traps heat in the Earth-atmosphere system, increasing the global temperature.

Arctic warming occurs because of:

- Direct radiative forcing in the Arctic, warming the atmosphere and surface
- Radiative forcing elsewhere, which warms the Arctic indirectly through heat transport

These direct and indirect effects add heat to the Arctic system, increasing its temperature.

Effects are characterized using a model established by scientists from US NASA. Used to establish Arctic Temperature Potentials, evaluated over 20 years.
### LCA Arctic Temperature Potentials (CO₂e)

*Using a 20 year time horizon*

<table>
<thead>
<tr>
<th>Climate Forcer</th>
<th>India</th>
<th>United States</th>
<th>Russia</th>
<th>Arctic Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black carbon</td>
<td>kg CO₂e kg⁻¹</td>
<td>kg CO₂e kg⁻¹</td>
<td>kg CO₂e kg⁻¹</td>
<td>kg CO₂e kg⁻¹</td>
</tr>
<tr>
<td><em>From energy generation</em></td>
<td>872</td>
<td>1,580</td>
<td>3,086</td>
<td>7,500</td>
</tr>
<tr>
<td>Black carbon</td>
<td>kg CO₂e kg⁻¹</td>
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</tr>
<tr>
<td><em>From forest &amp; grass fires</em></td>
<td>617</td>
<td>4,542</td>
<td>5,380</td>
<td>23,961</td>
</tr>
<tr>
<td>CO₂</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>N₂O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH₄</td>
<td>68</td>
<td>68</td>
<td>68</td>
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</tr>
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</table>

**For short lived forcers, significance increases closer to the Arctic**

**ATP of methane is corrected to account for all radiative effects, including ozone formation**
Arctic Application of Metrics

ATP-20s were evaluated and used to assess annual contributions from emissions from member countries in the Arctic Council:

- Canada
- Denmark
- Finland
- Iceland
- Norway
- Russia
- Sweden
- United States

Two largest observer states also included:

- China
- India

Sources Included:

Emissions far from Arctic
- Industrial sources
- Forest fires

Emissions in or near Arctic
- Forest fires
- Industrial sources make a very small contribution (<1%) to Arctic temperature effects
- Insufficient data to establish methane emissions from permafrost or hydrates
New Metric Contributors to Arctic Climate Change (2012 Emissions)

Total: 45 billion tons

Billion tons CO2e (ATP-20) per year

- Nordic Countries
- Canada
- India
- Russia
- United States
- China

- Emissions far from Arctic
- Forest fires in the Arctic
New Metric Contributors to Arctic Climate Change (2012 Emissions)

Total: 45 billion tons

Black carbon from cookstoves in India: 2 billion tons

Emissions far from Arctic

Forest fires in the Arctic

Emissions from various sources:
- Black carbon from Siberian fires: 5 billion tons
- US Methane emissions: 2 billion tons
- Black carbon from cookstoves in India: 2 billion tons

Total: 45 billion tons

Gases and their contributions:
- Carbon dioxide: 38%
- Black carbon: 27%
- Methane: 17%
- Nitrous oxide: 9%
- Black carbon: 27%
- Brown carbon: 5%
- HFCs: 1%
- Nitrogen oxides: 9%
- Carbon dioxide: 38%
- Nitrous oxide: 3%

Nordic Countries
Canada
India
Russia
United States
China
New Metric Contributors to Arctic Climate Change (2012 Emissions)

Total: 45 billion tons

- Black carbon from Siberian fires: 5 billion tons
- US Methane Emissions: 2 billion tons
- Black carbon from cookstoves in India: 2 billion tons
- Emissions far from Arctic: Orange bars
- Forest fires in the Arctic: Purple bars

Contributors:
- Black carbon from Siberian fires:
  - 5 billion tons

- US Methane Emissions:
  - 2 billion tons

- Black carbon from cookstoves in India:
  - 2 billion tons

- Total:
  - 45 billion tons
Conventional GWP-100 Metrics vs. New Metrics (2012 Emissions)

- Total: 23 billion tons (+96%)
- Black carbon from India cookstoves: Not included (+17%)
- Carbon dioxide 81%
- Nitrous Oxide 5%
- Methane 13%
- HFCs 1%

- Black carbon from Siberian fires: Not included (+175%)
- Carbon dioxide: +96%
- Nitrous Oxide: 5%
- Methane: 13%
- HFCs: 1%

- US Methane Impacts Underestimated by 65% (1.2 billion tons) (+54%)
- Total: 23 billion tons (+51%)

- Emissions far from Arctic
- Forest fires in the Arctic
Conventional GWP-100 Metrics vs. New Metrics (2012 Emissions)

- **Total:** 23 billion tons
- **US Methane Impacts**
  - Underestimated by 65%
  - (1.2 billion tons)
- **Black carbon from Siberian fires:** Not included
- **Black carbon from India cookstoves:** Not included
- **US Methane Impacts**
  - +54%
- **India**
  - +175%
- **Russia**
  - +280%
- **United States**
  - +51%
- **China**
  - +270%
- **Emissions far from Arctic**: Orange bars
- **Forest fires in the Arctic**: Purple bars

- **Nordic Countries**
  - +17%

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Takeaways

All countries have an Arctic Climate Footprint. Even mitigation projects far away can benefit the Arctic.

The Nordic Countries have a relatively small contribution.

Conventional GWP-100 metric emphasizes climatic effects of CO₂ over all other climate forcers.

Updated metrics reveal that short-lived climate forcers, especially black carbon, play a significant role in Arctic warming.

Using Arctic climate metrics provides a way to identify projects which should be prioritized, such as:

- Forest management aimed at minimizing black carbon emitted from boreal forest fires.
- Reducing methane emissions.
The Need for Corrected Accounting

Conventional GWP-100 metric hides potential of mitigation projects tied to black carbon emissions reductions.

Underestimates the benefit of projects to reduce methane emissions.

These types of projects are necessary to avoid exceeding +2° C.

Current climate metrics will make it impossible to meet the +2° C temperature target.

Updated metrics, which can account for all pollutants affecting the globe and the Arctic, are needed to meet this target.
The Path Forward

Climate metrics used in LCA and other applications need to be updated and standardized, incorporating the latest climate science.

Standardization is the most direct way to have these metrics implemented in carbon registries, national policies, and international treaty negotiations.

- The metrics are standardized under a draft ANSI standard in the US (LEO-SCS-002).

- At the US Technical Advisory Group to ISO TC 207, the updated metrics have been put forward for incorporation into ISO 14044.

The ISO process is the only way to have these metrics be considered at both national and international levels, including the 2015 Paris COP meeting.

International support is needed to ensure widespread adoption of these metrics.

Updating climate metrics are only the first step.

- A carbon registry has established a pilot offset registry based on the Arctic climate metrics; pilot projects are needed.
Questions? Please Contact: Tobias Schultz, SCS Global Services
tschultz@scsglobalservices.com

For more information on...

...the update climate metrics:
https://www.scsglobalservices.com/lca-climate-metrics-white-paper-0

...the draft ANSI standard:
http://www.leonardoacademy.org/programs/standards/life-cycle.html

...the Arctic Climate Action Registry:
http://www.climate.org/programs/acar/

Webinar tonight! Hosted by Security & Sustainability Forum
The Case for New Climate Change Metrics, 17:15-18:45
https://www1.gotomeeting.com/register/428407153