

Metrics for Accounting for SLCPs Mitigation Benefits

Discussion Paper for the CCAC 2016 Science Policy Dialogue

Background

Metrics are needed to easily estimate the benefits of emission reductions associated with implementing SLCP measures, and for tracking the impact of the Climate and Clean Air Coalition (CCAC), including in the context of its new Demonstrating Impacts framework¹. Such metrics would allow for easy quantification of the main impacts and benefits associated with SLCP mitigation, including changes in warming and other aspects of climate change, as well as benefits related to human health, ecosystem structures and functions, and agricultural productivity.

Climate Benefit Metrics

- Climate metrics that compare the effect of emission changes to the effect of carbon dioxide are not well-suited to SLCPs because the impacts happen over very different temporal and spatial scales;
- The climate metric recommended by SAP for surface temperature, based also upon IPCC recommendations, is the AGTP (Absolute Global Temperature Potential) and the related ARTP (Absolute Regional Temperature Potential) as these will provide estimates of the temperature change for a given year for a given emission profile. These metrics incorporate the radiative efficiency and lifetime of emitted substances (or climate drivers produced from those substances) and the time-dependent response of the climate system to estimate the surface temperature response to a ton of emissions over time.
- SLCP emission reduction also provide other climate benefits including minimization of weather disruption (e.g. rainfall pattern and associated benefits for agriculture, ecosystems, and water provision to cities), reduction in biodiversity loss owing to provision of greater time for adaptation to climate change, and reduction in the risk of crossing thresholds activating strong climate feedbacks (e.g. large emissions associated with melting permafrost). However, there are no metrics for capturing these, and complex and multiple General Circulation Models (GCMs) will be needed for reliable analysis.

Health Benefit Metrics

- As health impacts are highly sensitive to the timing and location of emissions, simple metrics analogous to those developed for global climate change have seldom been used for health benefits (except in the case of methane). Metrics for health thus refers to quantification of impacts using sophisticated atmospheric modelling or atmospheric measurements for PM_{2.5} and ozone concentrations, linked with concentration-response functions, population data and baseline mortality rates..
- There are a number of different health metrics used to characterise the benefits of emission reductions, and these have different strengths and weaknesses related to the confidence in the estimated values and their transferability from one region to another.
- The most widely used metric, which is also recommended for use by the SAP, is premature mortality that measures the number of people dying earlier than they would have done with lower concentrations of PM_{2.5} and ozone. Uncertainty in this metric becomes large at high exposure levels as data for these conditions is limited. Nonetheless, the underlying exposure-response rests upon many peer-reviewed

¹ CCAC Demonstrating impacts indicators include: Changes in emissions; Energy efficiency benefits; Near term climate benefits; Health benefits; Agriculture and ecosystem benefits (cf. WG/DEC2015/02)

independent studies using a wide variety of methods, leading to high confidence in the qualitative impacts at all levels.

- Other metrics may also be used with some confidence including years of life lost (YLL) (which can also be expressed in terms of average reduced longevity), years of life lived with disability (YLD), disability adjusted life-years (DALYs) which combine YLL and YLD.
- Other health impacts include chronic, non-lethal illnesses, lost work and school days, and hospital admissions related to PM_{2.5} and ozone exposure. These are important, but the underlying data on exposure-response functions is generally less robust especially in terms of transferability from one region to another.

Agricultural Benefit Metrics

- As with health impacts, agricultural benefits associated with ozone reductions are sensitive to the timing and location of emissions, and hence simple metrics analogous to those developed for global climate change have not been used for benefits (except in the case of methane). Metrics for agriculture thus refers to quantification of impacts using sophisticated atmospheric modelling or atmospheric measurements hereafter. SLCP strategies will also lead to changes in temperature and rainfall which will in turn affect crop yields. These climate-related benefits are generally assumed to be encompassed within the climate metrics.
- Benefits from reduced ozone can be calculated for the yields of four crops – rice, wheat, soybean and maize (corn). Further fieldwork is required to characterize the impact of ozone on other crops, and on various cultivars for all crops.
- There have been studies of other impacts of ozone, such as reductions in net primary productivity of vegetation, but the underlying data on ozone's impact on the vast array of vegetation types is quite limited and hence we have low confidence in these results.

Economic Valuation of Impacts

- Metrics to estimate the monetary costs of the impacts of SLCP emissions to society have also been developed. Standard methods exist for deriving relevant direct cost estimates, for example, the direct cost of air pollution on the health sector, for different countries. It can be contentious to transfer estimates to countries and regions where costs have not been estimated, however.
- Indirect costs are more challenging to estimate and there are substantial differences between the methods and standards used in different parts of the world.
- For crop yields, only direct costs based on market value of the crops tend to be estimated, neglecting impacts on subsistence farmers or indirect health impacts.
- For climate change there is a large body of literature on valuation but it is almost entirely focused on carbon dioxide.
- Valuation of the impact of SLCPs has been presented in recent research, with greatest progress on incorporating the multiple effects of methane via climate and ozone.

Recommendations

We recommend that the CCAC emphasize the potential benefits from SLCP emission control measures for near-term climate, human health, agriculture and ecosystems rather than the contribution of historical SLCP emissions to current warming.

Recognizing that decision-makers around the world will have varying perspectives, the UNEP/WMO Integrated Assessment strove to include climate and air quality benefits on an equal footing rather than characterizing one as a co-benefit of the other. As evident in its very name, and reflected in its framework of impact indicators, the CCAC is likewise concerned with more than just climate impacts. Hence as multiple SLCP impacts are of interest, we also recommend that the CCAC continue to utilize multiple metrics, each suitable for characterizing various end-points of interest. Metrics for near-term climate, human health and agriculture could all be utilized.

Best practices, including for data collection under the CCAC impacts indicators, should include specifying emissions changes of all pollutants (not aggregating) whenever possible to facilitate the use of metrics related to whichever end-point is of greatest interest to the user. Hence within INDCs, for example, countries would ideally report both their estimated changes in CO₂ and in other Kyoto gases and individual SLCPs.

The use of multiple metrics will allow the achievements of the CCAC and SLCP reductions in general to be related to multiple goals, including very broad ones such as the SDGs in addition to the UNFCCC's twin goals of keeping warming below dangerous levels and the often overlooked goal of keeping the rate of change from becoming too fast for human and natural systems to adapt. The SDGs in particular address a much broader swath of issues affecting societal well-being, and hence impacts need to be assessed in multiple areas (beyond purely emission-based metrics in some cases). Economic analyses are also overly narrow if they focus on a single impact of SLCPs, and hence economic metrics will ideally include all impacts that can be readily characterized. Note that virtually all economic indicators include a time-weighting giving greater value to near-term impacts in line with basic economics principles, and hence a metric such as GWP is particularly unsuitable to relate to economics. Best practice for economic indicators, as with emissions, is reporting disaggregated as well as total values so that users can effectively analyse market vs non-market costs, health costs, agricultural costs, etc.