ECLIPSE project – WP5: Assessment Metrics

Objectives

The overall goal of this work package is to calculate climate metrics for the short-lived components addressed in WP 4, as function of region and season.
Based on the results from WP 4, and other values available in the literature, we will calculate aggregated indicators and metrics for climate impacts of various components as function of region and season. This will be done for both well-established concepts as well as for more novel concepts.

O5.1 – Improve the flexibility of the GTP to allow variable climate sensitivity/efficacy (D5.1)
O5.2 – Calculate GWPs and GTPs for O3 precursors, BC, OC and SO2 components as function of region and season, including impacts on clouds where applicable (D5.1, D5.2, D5.3, D5.4)
O5.3 – Compute CO2-equivalent emissions using different metrics for various sectors/countries (D5.3)
O5.4 – Calculate time dependent metrics for the short-lived components (D5.3)
O5.5 – Calculate source-specific metrics for the short-lived components (D5.3)
O5.6 – Calculate metrics for the short-lived components that go beyond global mean values of RF and temperature (D5.5, D5.6)
O5.7 – Quantify uncertainties in calculated metric values (D5.1, D5.2, D5.3, D5.4, D5.5, D5.6, D5.7)
O5.8 – Review of the interface between air quality indicators and health benefits (D5.7)

Description of work

T5.1 – Standard metrics for short-lived components (LEAD: UREAD. PARTICIPANTS: CICERO, IIASA, METOFFICE)
In this task we will first calculate the standard metrics GWP and GTP. We will first improve the flexibility of the GTP methodology to allow for easy incorporation of the variations in climate sensitivity and climate efficacy. In order to assess how the metrics will change with time we will also calculate metric values for future background atmospheric and climatic conditions.

For the O3 precursors, NOx, CO and VOC, we will calculate metrics that include effects on short-lived O3, the O3 response controlled by CH4 (primary mode O3), CH4, nitrate, sulphate and stratospheric H2O. In addition, we will also account for effects of O3 precursors on CO2. These metrics will reflect non-linear chemical effects and aerosol feedbacks on regional and seasonal scales as they are represented in the comprehensive models.
The validity of the simplifying assumptions for the policy-relevant range of emission reductions will be examined in WP7, T7.4.

For black carbon we will build on recent work and calculate metrics that include the direct effect and deposition on snow and cloud effects. Metrics for the cooling

components OC and SO2 will also be calculated and their uncertainties will be estimated. The effects of NH3, NOx or SO2 depend strongly on co-emissions. Since the RF of components are done one by one in T4.2 the calculated values will be interpreted as the marginal effect with current background levels. The source specific metrics in T5.2 below will be relevant for these components.
The uncertainty in the metric values will be quantified using results from both ECLIPSE models and from earlier studies, such as within HTAP. We will calculate the CO2-equivalent emissions for a range of countries and sectors to quantify how perceptions of the CO2-equivalent emissions vary between metrics and parameter choices within metrics. (Start: Month 1: End 24)
Deliverables: D5.1, D5.2, D5.3, D5.4, D5.5

T5.2 – New concepts (LEAD: CICERO. PARTICIPANTS: UREAD, IIASA, METOFFICE)
We will explore new metric concepts that may be more adequate for short-lived components. We will calculate time-dependent metrics; i.e. metrics as function of proximity to target year and explore the possibilities and applicability of source-specific metrics as an alternative to component specific metrics.

We will explore how a rate-based metric concept could be formulated, and then calculate values for both short-lived components and long-lived components. We will also explore whether rate-based metrics and metrics suitable for level of warming could be used together. Its potential application will be evaluated in WP 7.

Global mean values of RF or temperature are the most common indicators of climate change used in metrics and simple climate models. However, much important information about regional variation and changes in other aspects of climate change is lost by this standard approach. Thus, we will evaluate the application of global mean ΔT values versus other aspects of climate (precipitation and runoff as a proxy for freshwater availability, ecosystem productivity etc), and their regional variations. This will be based on the selected cases for which there will be GCM simulations available from WP 6. We will perform exploratory work on metrics beyond GWP and GTP as the short-lived species may have different effects on rainfall, plant productivity or runoff.

Negative radiative forcing does reduce global-mean warming, but it may also have detrimental effects on climate by changing atmospheric circulation and the hydrological cycle - aspects of climate change that are not visible when global mean temperature is used as the indicator. In this case, a focus that emphasizes disturbance of climate may be better. Such disturbances could initiate changes in climate that require adaptation due to the many aspects of climate change. How such a “disturbance” metric could be formulated, however, is not presently obvious and will be explored. We will calculate metrics for short-lived components that capture regional variations that may be hidden in global mean values due to cancelling effects.
(Start: Month 1: End Month 33)
Deliverables: D5.5, D5.6

T5.3 – Interface between air quality indicators and health benefits (LEAD: NILU)

For aerosols, air quality legislation is based on the concept of particulate matter (PM), in particular PM2.5 (the mass of PM smaller than 2.5 m). However, PM is a complex mixture of aerosol components and it is possible that differences in PM composition could have different impacts on human health, just as the climate effects of aerosols depend on the radiative properties and, thus, the chemical composition of the aerosol. This task will provide a review of existing air quality standards and guideline values from the National Ambient Air Quality Standards (NAAQS) of the U.S. Environmental Protection Agency (EPA), the new Directive 2008/50/EC of the European Parliament on ambient air quality and cleaner air for Europe and the 2005 WHO Air Quality Guidelines (AQGs) of the World Health Organization (WHO) as well as of the latest literature, in order to summarize the weight given to the individual SLCF components (e.g., BC, sulfate) with respect to acute and chronic human health effects, especially respiratory diseases, cardiovascular diseases and lung cancer. The output of this task will feed into WP 7, where potential sensitivities of abatement measure optimization to the definition of air quality standard definition will be considered.
(Start: Month 7: End Month 24)
Deliverables: D5.7