Summary
for Decision Makers

Integrated Assessment of Short-Lived Climate Pollutants in Latin America and the Caribbean

Improving air quality while contributing to climate change mitigation

UNEP

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

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In 2011, two scientific global assessments[1] coordinated by the United Nations Environment Programme (UNEP) identified a number of win-win measures for near-term climate change and clean air benefits. Implementation of these cost-effective and readily available measures, which target reducing emissions of short-lived climate pollutants (SLCPs) in key sectors, can bring rapid and multiple benefits for human well-being and support countries achieve their development objectives, while simultaneously increasing their ambition for climate mitigation in the near term. The reduction in SLCP emissions should, however, be done in parallel with the reduction in carbon dioxide (CO_2) emissions.

While the two global assessments were very comprehensive, some specific emission characteristics and estimates of the benefits of emission reductions in different regions could not be explored in detail. This provided the motivation for more in-depth regional assessments, of which the Latin American and the Caribbean (LAC) assessment is the first.

The LAC region is one of the most urbanized in the world, with almost 80 per cent of its population living in cities, including several megacities. Urban air pollution has been a concern in the region's cities for many years, and while steps have been taken to improve it, much still remains to be done, especially in mid-size cities that are continuing to grow rapidly. As the climate changes, urban environments, which are already experiencing urban heat-island effects, face particular challenges that policy-makers need to consider, such as further increases in temperature, scarcity of water and the complexity of transport systems in cities that have grown without adequate planning. Increasing temperatures will also lead to the more widespread use of air conditioning, which is not as prevalent in LAC as in other parts of the world, in buildings and cars.

The region is also characterized by significant socio-economic inequality, both in urban and rural areas, particularly those that are difficult to access, such as in certain parts of the Andes and Amazonia. The lack of opportunities in rural areas is one of the reasons for the steady flow of people to the cities. Both outdoor and indoor air pollution strongly affect people's health.

The region has a large variety of climates due to both, its latitudinal extent and the presence of mountain ranges, the most prominent being the Andes. From the biodiversity-rich tropical areas, through the highest peaks with vulnerable tropical glaciers, to the vast continental ice fields in Patagonia, all regions are susceptible to significant change in the coming decades if climate change continues at its current rate.

Some of the glaciers in the tropical Andes have receded rapidly in the last decades, endangering the water supply at high altitudes for people and agriculture. In the sub-tropical regions of the Andes, winter precipitation builds the snowpack that supplies water for agricultural, industrial and human consumption in Chile and Argentina. Additionally, because of its many island states and the growth of coastal region development in several countries, the LAC region is particularly vulnerable to sea-level rise.

Urban pollution can be transported beyond cities, affecting agricultural areas that are vital for local food security and income generation through exports. Ozone (O_3) damage to crops can lead to substantial yield losses including maize, an important staple in many LAC countries. Rising temperatures and shifts in precipitation patterns due to climate change can also affect other important crops including coffee and sugar cane. These impacts could potentially be reduced in the near term by implementing a strategy to reduce SLCPs in the region.

The *Integrated Assessment of Short-Lived Climate Pollutants in Latin America and the Caribbean* convened more than 90 authors, under the leadership of renowned experts and institutions from the region and supported by international experts, to assess current knowledge of emissions, ambient measurements and impacts of SLCPs on the climate, and air quality in the region. A survey of national emission inventories collected the best available data and was used to develop a detailed, complete and consistent emission inventory in 13 regions within LAC[2]. Examples of mitigation measures already being considered at different levels of government in LAC have been evaluated in terms of their benefits and the barriers to their more widespread implementation. This assessment investigates the potential benefits that could be achieved if the identified measures for reducing SLCPs were to be widely implemented. It focuses on the four main SLCPs (Boxes 1 to 4): methane (CH_4), black carbon (BC), ozone (O_3), and hydrofluorocarbons (HFCs).

Through this assessment, policy makers and implementers will be able to better quantify and understand the relevant emissions in the region; identify which measures are most important for delivering near-term climate and air pollution benefits; and estimate the reductions in regional air pollutants that could be achieved by implementing these measures, with associated health and crop-yield benefits for the LAC region.

Decision makers would also find that the measures identified in this report are crucial to the regional implementation of the 2015 United Nations Framework Convention of Climate Change (UNFCC) Paris Agreement. Reductions in SLCPs could contribute significantly to an emissions pathway consistent with holding the increase in the global average temperature below 2^0 C above pre-industrial levels, aiming at 1.5^0 C, while also helping countries achieve the Sustainable Development Goals (SDGs) including those for human health, hunger, energy, cities and human settlements, and sustainable consumption and production. The Nationally Determined Contributions (NDCs) for several countries already include significant efforts to reduce SLCPs, focusing on BC and CH_4, and some of the measures identified in this assessment can complement them.

The results presented in the *Summary for Decision Makers* (SDM) are based upon the findings of the much more extensive *Integrated Assessment of Short-Lived Climate Pollutants in Latin America and the Caribbean*.

1. UNEP and WMO (2011) Integrated Assessment of Black Carbon and Tropospheric Ozone; and UNEP (2011) Near-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers.
2. The regions are: Argentina, Bolivia, Brazil, The Caribbean, Central America, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela. They were selected by balancing economic importance; population size; the availability of data on energy use, production, transport and contributions to total SLCP emissions in LAC; and available information on emission inventories.

Box 1
Methane

Methane (CH_4) is a powerful greenhouse gas with a lifetime in the atmosphere of approximately 12 years. Its increase in the atmosphere has caused the most significant radiative forcing of any greenhouse gas after carbon dioxide. Atmospheric CH_4 concentrations have grown as a result of human activities related to agriculture, including rice cultivation and ruminant livestock; coal mining; oil and gas production and distribution; biomass burning; and municipal waste landfilling.

Methane has a direct influence on climate, but also has a number of indirect effects including its role as an important precursor to the formation of tropospheric O_3, which in turn affects human health, crop yields and the quality and productivity of vegetation.

For some CH_4 sources, emission control measures also reduce other co-emitted substances such as the more reactive volatile organic compounds (VOCs) that contribute to the local formation of O_3, as well as air toxins such as benzene (C_6H_6), carbon tetrachloride (CCl_4) and chloroform ($CHCl_3$).

Box 2
Black Carbon

Black carbon (BC) is a potent climate-warming particle that remains in the atmosphere for a few days or weeks. It is formed by the incomplete combustion of fossils fuels, wood and other fuels. Complete combustion would turn all carbon in the fuel into carbon dioxide (CO_2), but combustion is never complete and CO_2, carbon monoxide (CO), VOCs, and organic carbon (OC) and BC particles are all formed in the process. Black carbon is always co-emitted with other particles and gases, some of which have a cooling effect on the climate. The complex mixture of particulate matter resulting from incomplete combustion is often referred to as soot.

The type and quantity of co-pollutants differs according to the source, and a high ratio of warming to cooling pollutants indicates the most promising sources to target for achieving climate benefits in the near term. Black carbon and co-emitted particles also reduce surface albedo (the ability to reflect sunlight) when deposited on snow and ice.

Black carbon and co-emitted pollutants also contribute to the formation of fine air polluting particulate matter ($PM_{2.5}$), which are strongly linked to observed short- and long-term health impacts. Specifically, $PM_{2.5}$ has been linked to a number of health impacts including premature death in adults with heart and lung disease, strokes, heart attacks, chronic respiratory disease such as bronchitis, aggravated asthma and other cardio-respiratory symptoms. It is also responsible for premature deaths of children from acute lower respiratory infections such as pneumonia. In general BC co-emitted with polycyclic aromatic hydrocarbons (PAHs) that are carcinogenic.

Box 3
Ozone

Ozone (O_3) is a reactive gas that exists in two layers of the atmosphere: the stratosphere (the upper layer) and the troposphere (ground level to ~15 km). In the stratosphere, O_3 protects life on Earth from the sun's harmful ultraviolet (UV) radiation. In contrast, at ground level, it is an air pollutant, which is harmful to human and ecosystem health, and is a major component of urban smog. Tropospheric O_3 is also an important greenhouse gas. The threefold increase of O_3 concentrations in the northern hemisphere in the past 100 years has made it the third most important contributor to the human enhancement of the global greenhouse effect, after CO_2 and CH_4. Ozone has a lifetime of a few hours to days in the atmosphere.

Tropospheric O_3 is a highly reactive oxidant that harms human health and significantly reduces crop productivity as well as the uptake of atmospheric carbon by vegetation. Ozone is known as a secondary pollutant because it is not emitted directly, but is formed when precursor gases such as CH_4, CO, oxides of nitrogen (NOx) and non-methane volatile organic compounds (NMVOC) react in the presence of sunlight. Ozone is particularly dangerous for children, the elderly and people with lung or cardiovascular disease – it can worsen bronchitis, emphysema, asthma, and may permanently scar lung tissue. Recent studies have also linked both short- and long-term ozone exposure to premature death, heart attacks, strokes, heart disease, congestive heart failure, and possible reproductive and developmental harm.

Box 4
Hydrofluoro-carbons

Hydrofluorocarbons (HFCs) are a group of industrial chemicals primarily produced for use in refrigeration, air-conditioning, insulating foams and aerosol propellants, with minor uses as solvents and for fire protection. HFCs were developed to replace stratospheric ozone-depleting substances (ODS) that are currently being phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer. Many HFCs are very powerful greenhouse gases and a substantial number have a lifetime of between 15 and 29 years in the atmosphere.

Hydrofluorocarbons have only been commercialized since the early 1990s, and their abundance in the atmosphere is currently small. They are, however, among the fastest growing greenhouse gases, largely as a result of increasing demand for refrigeration and air-conditioning, particularly in developing countries. If left unchecked, HFC consumption is projected to double by 2020, and their emissions could contribute substantially to radiative forcing in the atmosphere by the middle of the century.

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Key messages

1

Poor air quality and global warming have already affected vulnerable populations and ecosystems in LAC, resulting in premature deaths, crop yield losses and damage to ecosystems.

Premature deaths from exposure to $PM_{2.5}$ and O_3 in 2010 are estimated to be around 64 000, with a possi-

2

Agriculture, mobile and commercial refrigeration, and transport are the sectors that produce the largest emissions of CH_4, HFCs and BC.

Another large source of methane in several countries is the fossil fuel production sector. Consistent estimates from the reference scenario allow the identification of mitigation opportunities in relevant sectors