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Mediterranean capital pollution has far-reaching effects on air quality

New research has modelled the impacts of Athens and Istanbul in the eastern Mediterranean, on local and regional air quality. Results indicate that the impacts of megacity pollution vary significantly according to the time of year and that air quality improvements will require coordinated efforts within the eastern Mediterranean region and beyond.

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Source: Im, U. & Kanakidou, M. (2012) Impacts of East Mediterranean megacity emissions on air quality. *Atmospheric Chemistry and Physics*. 12: 6335-6355. Doi:10.5194/acp-12-6335-2012. This study is free to view at: www.atmos-chem-phys.net/12/6335/2012/acp-12-6335-2012.html

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Theme(s): Air pollution

Megacities (cities with more than 10 million inhabitants) and large urban agglomerations are concentrated sources of pollution and the impacts of emissions on local and regional air quality are attracting increasing attention. Air pollution is a concerning environmental issue in the eastern Mediterranean region, which experiences high levels of surface ozone and particulate matter, potentially damaging to both human health and the environment. The region is also sensitive to the effects of climate change, which could exacerbate problems of pollution and poor air quality.

Modelling the impacts of emissions from the megacity of Istanbul and from the Athens urban region on air quality has not been possible until recently. However, recent developments in emission inventories from these cities have enabled this study to model air quality in the region.

The researchers, working as part of the EU CityZen project[1], coupled the Weather Research and Forecasting Model (WRF-ARW)[2] with the US EPA Community Multiscale Air Quality model (CMAQ)[3] to quantify the impacts of human-generated emissions from each of the megacities on local and regional air quality. A range of pollutants were considered, including surface ozone, carbon monoxide and fine particulate matter ($PM_{2.5}$).

In both the Greater Istanbul Area and Greater Athens Area areas, $PM_{2.5}$ decreased by a factor of about 2 to 3 from the urban area to the rural suburbs. The results demonstrated that contributions from both areas to surface ozone and $PM_{2.5}$ are generally higher in the winter than in the summer. For example, emissions contribute to $PM_{2.5}$ levels inside the city by up to 75% in winter in both cities, but in the summer contribute only 50% to $PM_{2.5}$ for Istanbul and about 40% for Athens. This is mainly because urban emissions increase in winter by a larger proportion than regional background emissions.

In winter, both cities have a larger impact northwards owing to prevailing winds from the south. Istanbul's winter pollution affects the Black Sea and Athens's, the North Aegean Sea. In summer, the impact is more southwards, with Istanbul's emissions flowing over the Marmara Sea, towards the Aegean Sea, and Athens's emissions having a clear effect on the South Aegean.

The study also explored the effects of country-based mitigation policy using a policy scenario for 2030 from the EU CityZen project that mitigated the impacts of several pollutants on climate, health and the environment. This indicated that mitigation of emissions at a country-level could not suppress ozone levels, due to ozone's complex chemical response to reductions in NOx. However, levels of other primary pollutants may fall. For example, in winter the model predicted that carbon monoxide levels would be reduced by 2% for the entire eastern Mediterranean region and $PM_{2.5}$ would fall by 10% regionally, due to combined efforts by the countries inside the region.

This significant impact of national mitigation at the regional level and evidence for the long-range transport of pollutants highlights the importance of coordinated mitigation efforts across the region and beyond.

1. CityZen was supported by the European Commission under the Seventh Framework Programme. See: www.cityzen-project.eu
2. See: www.wrf-model.org/index.php
3. See: www.epa.gov/AMD/Research/RIA/cmaq.html