Megacity Radiative Forcing: A Mexico City Case Study

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We assess the radiative forcing budget of the largest megacity in North America, Mexico City. While particular aspects of the regional environmental impacts of cities on their surroundings have been thoroughly investigated, e.g., air quality and acid rain, relatively little effort has been focused on the net radiative impact of a megacity on global climate. The range of radiative impacts from a megacity covers many spatial and temporal scales from short-term regional-scale effects due to aerosols and relatively short-lived gases (O3) to long-term global-scale impacts due to long-lived trace gases (e.g., CH4, CO2). In this study we use both bottom-up and top-down approaches to evaluate these radiative forcings. From the bottom up we utilize emission inventories and the Model for Ozone And Related Chemical Tracers (MOZART-2) chemistry-aerosol model. From the top down we use observations from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument, the Aerosol Robotic Network (AERONET), and in situ aerosol single scattering albedo measurements collected during the Megacity Initiative-Local and Global Research Observations (MILAGRO) campaign. We also explore the radiative impact of various emission control strategies that focus on improving urban air quality. We show that the warming by greenhouse gases like CO2 and ozone can be moderated or exacerbated by aerosols depending on their optical properties. As the size and number of megacities increase and clean air regulations are implemented, metrics such as the net radiative forcing may become increasingly important in comparing the impact of urban centers and assessing pollution abatement policies.