

Anthropogenic influence on climate through changes in aerosol emissions from air pollution and land use change

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Abstract

Particulate matter suspended in air (i.e. aerosol particles) exerts a substantial influence on the climate of our planet and is responsible for causing severe public health problems in many regions across the globe. Human activities have altered the natural and anthropogenic emissions of aerosol particles through direct emissions or indirectly by modifying natural sources. The climate effects of the latter have been largely overlooked. Humans have dramatically altered the land surface of the planet causing changes in natural aerosol emissions from vegetated areas. Regulation on anthropogenic and natural aerosol emissions have the potential to affect the climate on regional to global scales. Furthermore, the regional climate effects of aerosol particles could potentially be very different than the ones caused by other climate forcings (e.g. well mixed greenhouse gases). The main objective of this work was to investigate the climatic effects of land use and air pollution via aerosol changes.

Using numerical model simulations it was found that land use changes in the past millennium have likely caused a positive radiative forcing via aerosol climate interactions. The forcing is an order of magnitude smaller and has an opposite sign than the radiative forcing caused by direct aerosol emissions changes from other human activities. The results also indicate that future reductions of fossil fuel aerosols via air quality regulations may lead to an additional warming of the planet by mid-21st century and could also cause an important Arctic amplification of the warming. In addition, the mean position of the intertropical convergence zone and the Asian monsoon appear to be sensitive to aerosol emission reductions from air quality regulations. For these reasons, climate mitigation policies should take into consideration aerosol air pollution, which has not received sufficient attention in the past.

Keywords: *Climate change, Air quality, Land use, General circulation, Atmosphere-Ocean interactions, Aerosol climate effects, Earth system modelling.*

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