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Keywords

- irrigation
- air pollution
- climate

Index Terms

- Atmospheric Processes: Climate change and variability
- Atmospheric Composition and Structure: Pollution: urban and regional
- Atmospheric Processes: Land/atmosphere interactions
- Atmospheric Composition and Structure: Aerosols and particles
- Global Change: Land cover change

Abstract

Short-term effects of agriculture on air pollution and climate in California

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This paper discusses the short-term effects of irrigation and albedo differences due to agriculture on California and Los Angeles air pollution and climate. High-resolution irrigation, land use, soil, albedo, and emission data were applied at the subgrid scale in the nested global-through-urban GATOR-GCMOM model to examine these issues following a comparison of baseline model results with data. In August, irrigation alone was found to increase soil moisture, thereby increasing nighttime but decreasing daytime ground temperatures more, causing a net ground cooling in California and Los Angeles. Agriculture was calculated to increase the albedo of the northern Central Valley but decrease that of the southern valley more relative to nonagricultural land today, offsetting part of the cooling due to irrigation alone. The spatial maximum day-night average August cooling in the Central Valley due to irrigation plus albedo differences from agriculture was 0.9 K at 30 m height and 2.3 K at the ground, in range of an historic 0.74–2.4 K cooling at 2 m attributed to heavily irrigated agriculture in an independent data study. When averaged over all model cells containing >0% irrigation, irrigation alone and irrigation plus albedo differences decreased day-night average 2-m temperatures by 0.44 K and 0.16 K, respectively, indicating greater local than regional effects of agriculture. In the Central Valley, irrigation increased the relative humidity, cloud water, and precipitation, shifting aerosol and soluble gas mass to clouds and rain. In the valley and Los Angeles, agriculture stabilized air, decreasing wind speeds and turbulence, increasing pollution in the absence of rain. Thus, when enhancing clouds and precipitation, agriculture decreased pollution; otherwise, agriculture increased pollution. Agriculture in parts of the polluted eastern Los Angeles basin increased fine particulate matter by ~2% and ozone by ~0.1%. All results were robust to a change in the simulation date, although further evaluation is needed to better quantify effects of agriculture on climate and air quality.

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