Where Does the Irrigation Water Go? An Estimate of the Contribution of Irrigation to Precipitation Using MERRA

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Irrigation is an important human activity that may impact the local and regional climate, but current data assimilation systems do not include irrigation over agricultural land. Two reanalysis products, MERRA and ERA-Interim, show different patterns of surface evapotranspiration (ET) over irrigated areas. ERA-Interim is closer to observational based estimate because it indirectly considers the effects of irrigation by adjusting soil moisture according to the observations of surface temperature and humidity.

We estimate the potential ET increase due to irrigation based on the energy constraint in MERRA and data for irrigation area, and compare with another dataset of ET increase from a water balance and transport model that considers irrigation and reservoir operations. The two methods produce ET increases with different seasonal cycles and amplitudes, and the latter is considered to be more realistic because of its more detailed considerations of irrigation dependence on crop types, growing seasons, crop production, etc. A back-trajectory method is used to estimate the impact of increased ET from irrigation (from the second method) on precipitation over local and nonlocal regions, using MERRA data for the atmosphere, MERRA-Land data for ET, and CPC unified precipitation data. Results show substantial contributions of irrigation to precipitation over certain parts of the global, especially over heavily irrigated Asian regions.

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