Geophysical Research Abstracts
Vol. 19, EGU2017-7931, 2017
EGU General Assembly 2017

Within-field advection enhances evaporation and transpiration in a vineyard in an arid environment

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Advection of hot air from a warmer to a cooler surface is known to enhance evaporation through additional supply of energy, provided that water is readily available. This study investigated advection in an isolated irrigated vineyard in the Negev desert, over a period of several months under changing plant cover and environmental conditions, and for different degrees of water availability. Field, canopy, and soil energy balance fluxes were assessed, as well as likely indicators of advection such as wind speed, VPD, vertical temperature gradients between the soil, the canopy air space, and the air, and lateral temperature gradients between the vineyard and the surrounding desert. It was found that for a period from May to July, advection enhanced transpiration by 8%, of which an estimated 80% was soil-to-canopy advection and 20% was local advection. At times, soil-to-canopy advection was responsible for as much as 30-40% of transpiration. Wet irrigated strips likewise experienced soil-to-soil advection from drier soil, but to a much lesser degree. A surprisingly large difference was observed in the contribution of advection to transpiration between June (2%) and July (11%), which had almost identical environmental conditions. This indicates that small changes in the agro-system could have a large impact on within-field advection, and that systems could potentially be managed to reduce or enhance advection.