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Prospective upscaling of quantification of non-rainfall water inputs to regional scale

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In drylands, the annual amount of non-rainfall water inputs (NRWIs), i.e., a gain of water to the surface soil layer that is not caused by rainfall, can exceed that of rainfall. They thus significantly contribute to the water cycle and to biogeochemical dynamics. However, the small magnitude of the fluxes involved in the formation and evaporation of NRWIs challenges their measurement. Various methods were applied in attempting to quantify NRWIs amount and duration, all being point/local measurements. Given the large heterogeneity of soils, both at local and at regional scale, upscaling from the small point measurement methods to larger scales is necessary in order to fully understand the environmental factors controlling NRWIs and the role of NRWIs in dryland ecosystems. Numerous remote sensing-based models have been developed to assess spatially distributed latent heat fluxes, greatly varying in complexity. Unfortunately, the magnitude of diurnal fluxes due to NRWIs is too small to be detected by any of the existing models. Hypothesizing that soil surface emissivity is sensitive to very small changes in water content at the top soil layer, our objective was to quantify NRWIs by analyzing the temporal changes in land surface emissivity over bare loess soil in the Negev desert, Israel. Proven successful, this can be utilized over large areas.

Intensive measurements using a longwave infrared radiometer (CLIMAT 312-2n ASTER, Cimel Electronique, Paris, France) were conducted in summer 2019 at the Wadi Mashash Experimental Farm (31^{o}08'N, 34^{o}53'E). Radiance and temperature measurements were obtained for a broad band (8.01-13.34 μm) and 5 subsections of this bandwidth. The radiometer was mounted at 0.5 m directly above one of four microlysimeters (undisturbed soil samples installed flash with the soil surface and weighed continuously). Radiometer readings were automatically taken every 15 min for 24-h cycles.

Initial results indicate an agreement between the diurnal cycle of NRWIs detected by the microlysimeters and between the diurnal cycle of an index derived from the radiometer bands: ($e_{11.3}$-$e_{8.3}$)/ $e_{10.6}$ (the numbers are the center of the band in μm). These preliminary results show the potential to upscale quantifying NRWIs to regional scale.