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A multi-scale approach to quantifying non-rainfall water inputs

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Non-rainfall water inputs (NRWIs) are a gain of water to the surface soil layer caused by sources other than rainfall, i.e., by fog deposition, dew formation, or water vapor adsorption. These water inputs usually evaporate the following morning, creating a diurnal cycle of water content in the uppermost soil layer, which involves exchange of latent-heat flux (LE) between the soil and the atmosphere. The significance of the formation and evaporation of NRWIs in drylands is largely acknowledged, yet understanding of the environmental conditions controlling its magnitude are still lacking, and its spatial extent was not studied before. A multi-scale approach to quantifying NWRIs and the corresponding diurnal water cycle in arid regions will be presented.
The research has been conducted over a bare loess soil in the Negev desert (30o51'35.30" N, 34o46'40.97" E) during the dry season (May-September 2014). During this dry period, gain in soil water content is only a result of NRWIs. A micro-lysimeter (ML) with a 20 cm diameter and 50 cm depth filled with an undisturbed soil sample was placed on a scale buried in the soil such that the top end of the sample was level with the soil surface and the sample's mass was continuously monitored. The ML served as a point measurement to which larger-scale micrometeorological methods, i.e., eddy covariance (EC) flux tower (field scale, 2X103 m2) and a surface layer scintillometer (field scale, 8X103 m2). The ability to obtain spatially distributed NWRIs at the regional scale through mapping changes in land surface emissivity was tested as well.
Preliminary results indicate that despite the acknowledged limitations in nighttime measurements, the EC LE followed closely the micro-lysimeter LE; and the sensible heat flux derived by the EC and the scintillometer were in good agreement; demonstrating the feasibility of measuring NRWIs with both methods. This innovative multi-scale approach sheds light on various aspects of the NRWI phenomenon and its magnitude. Evidences are lately accumulating indicating that greenhouse gas (GHG) emissions in arid areas are a result of microbial activity in desert soils, which is driven by NRWIs, despite the limited amounts of water and nutrients. Thus better understanding of NRWIs formation and evaporation will lead to improved understanding of GHG emissions in arid areas.