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Latest Advances in Distributed Soil Water Content and Fluxes Monitoring Using Heated Fiber Optics

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Every drop counts, so count every drop! Achieving and maintaining sustainability in irrigated agriculture production in the era of rapidly increasing stress on our natural resources require, between other essential actions, a significant upgrade of the currently available soil water monitoring technologies to allow optimum control and management of the applied water. Here we present lab and field test results of an emerging technology, the Actively Heated Fiber Optic (AHFO), which has the potential to measure soil water content and fluxes many times per hour at many thousands locations simultaneously.

AHFO observes the heating and cooling of a buried fiber optic (FO) cable through the course of a pulse application of energy as monitored by a distributed temperature sensing (DTS) system to reveal soil water content simultaneously every 0.25 m along the FO cable that can exceeds 10,000 m in length. The methodology of data collection and interpretation is detailed in WRR doi:10.1029/2009WR007846.

We present the theoretical basis for the active method, as well as validation of the method for both soil water content and soil water flux determination based on large-column laboratory. We also present field validation results based on 750 m of FO cables buried at 30, 60, and 90 cm depths in agricultural field under center pivot irrigation. The results demonstrate the validity of such method by mapping with high spatial and temporal resolution the spatial variability of soil water content induced by the non-uniformity of water application.

The instrumentation employed was made available by the NSF-EAR funded Facility CTEMPs.org, which is open to the entire US research community to advance and make use of these techniques.