Geophysical Research Abstracts
Vol. 15, EGU2013-5879, 2013
EGU General Assembly 2013

A novel dual soil sensor for simultaneous water content and water potential determination in irrigation scheduling and environmental monitoring

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Due to the climate change and decreasing water availability in many parts of the world, water efficient irrigation becomes more and more important to stabilize or even increase agricultural productivity. An efficient irrigation scheduling relies on soil water potential information in order to define the optimal irrigation start as well as on soil water content data to quantify the amount of soil water and thus to properly define irrigation depth. Furthermore, nutrient leaching and groundwater contamination will be reduced by controlled irrigation.
Therefore, a novel dual soil sensor was developed which allows for simultaneous determination of water content and water potential at low costs suitable for distributed sensing. The soil water content measurement is realized with a dielectric measurement approach. Sensor elements are arranged on a printed circuit board, which can easily be inserted into the soil. Soil water potential data is deduced from water content measurements in porous matrices with known retention characteristics. The matrices are placed on the printed circuit board above a water content sensitive dielectric measuring area. In contrast to common granular matrix sensors, the matrices are characterized by a narrow pore size ranges by which the accuracy of soil water potential determination can be improved and a threshold characteristic suitable for irrigation is achieved. Sensor principle and laboratory experiments will be presented.

For application in irrigation scheduling, the dual sensor is connected to off-the-shelf irrigation controllers by an additional interface controller. The interface controller activates moisture measurements of the sensor and compares the actual measurements with set-points of water content or water potential. The running time-based programme of the irrigation controller will be interrupted if measured soil water contents are above a predefined water content threshold or soil water potential measurements are below a predefined water potential threshold. This way irrigation can either be interrupted during the ongoing irrigation or disabled before irrigation starts. Results of large area and long term field tests will be presented.