



Monolithic field Lysimeter – a precise tool to close the gap between laboratory and field scaled investigations

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The evaluation of lysimeter data allows a much more reliable calculation of the solute load carried towards the groundwater than any other method. If the lysimeters are weighable, precipitation and actual evapotranspiration can be deduced from changes of their weight. As previous research has shown precise measurement of dew, fog, and frost is possible using a high-precision weighable lysimeter. If drainage is measured separately all the parameters of the water balance equation are measured using one specific instrument. The main arguments against the use of lysimeters for monitoring water balance parameters and measuring solute transport parameters in the soil and unsaturated zone has been the discussion of some sources of error existing potentially in lysimeter measurements, such as the well known oasis effects, preferential flow paths at the walls of the lysimeter cylinders due to an insufficient fit of soil monoliths inside the lysimeters or the influence of the lower boundary conditions on the outflow rates.

In 2004 monolithic lysimeters have been implemented in the Wagna agricultural test field in southern Austria. The two scientific field lysimeters have a depth of 2 m and a surface of 1 m². In the different horizons of the loamy to sandy soil and the underlying gravel and sand water content using TDR-probes, the hydraulic potential using tensiometers and SIS-sensors and soil temperature are recorded in a time interval of 10 Minutes. The same data acquisition is done in the soil hydrologic measuring profile (SHMP). The precision load cells on the concrete fundament measure the lysimeters weight with a resolution of 50 g (0.05 mm water equivalent). The lower boundary condition of the lysimeter is realized as a suction cup rake. The soil water tension mea-

sured in 1.8 m below surface in the SHMP is transferred via an automatic controlled vacuum pump to the suction cups. For tillage purposes the load cells are lowered to the fundament and the upper ring of the Lysimeter is removed. The field and the Lysimeter may be cultivated by machines. Afterwards the ring is remounted and the lysimeter is lifted on to the load cells. In April 2005, a tracer experiment was performed to test the solute transport regime for possible fringe effects due to the excavation technique. Data analysis shows a conservative behaviour of the bromide. Mass uptake by plants was proportional to the water uptake, and the total mass recovery of bromide was >95 %.

Due to the implementation of the lysimeter directly in the agricultural field there is no oasis effect cognizable. The lysimeter is cultivated in the same manner as the field. Based on the evaluation of the tracing experiments no fringe effects have been found; that indicates that the excavation technique causes no significant disturbance. The transfer of measured hydraulic potential in the SHMP onto the lower boundary of the lysimeter guaranties the same flow rates in the lysimeter as in the undisturbed soil. The comparison of measured soil water parameters between SHMP and the lysimeters monolith have shown that the difference are very small and reflect natural heterogeneity.

Based on this new type of field-lysimeters - high precision weighable monolithic lysimeters directly built in at the arable land - we get exactly measured water balance and solute transport parameters. Due to these characteristics, lysimeters are an excellent tool to validate the transferability of water and solute transport models which are mostly derived on the basis of laboratory experiments to an application on the field scale. Monolithic field lysimeters cover one scale of scientific or applied research working level, which is suited between laboratory scale and field scale. They combine the advantages of true field conditions and laboratory possibilities of varying parameters, handling and maintenance.