



**THE EXPERIENCE OF 400
INSTALLED LYSIMETER SYSTEMS**



YOUR PARTNER IN ENGINEERING AND CONSTRUCTION WORK

**Dear Reader,
Dear Valued Customer,**

True to the motto "It is our aim to give our customers the best possible support in their tasks" it is our dedication to offer you the best technical solutions and excellent service. We started to design and construct lysimeter stations over 20 years ago. With an experience of 400 installed lysimeter systems, we offer 1 square meter standard, 2 square meter standard or customized dimensions.

Projects of large lysimeter stations require beneath the lysimeter specific needs a construction company with expertise in civil and underground engineering.

The know-how combined with the innovation of UMS is reflected in a multitude of representative lysimeter projects e.g. In the year 2010/11 we set up 142 large scale UMS lysimeters in 22 lysimeter stations all over germany for our scientific partners (Helmholtz ResearchCenter, KIT, Jülich ResearchCenter) in close co operation with construction companies. Further we developed and installed solutions for industrial partners and governmental institutes world wide. So UMS confirmed its achievement potential in the building of high quality solutions. You will find a list of reference „20 years lysimetry“ attached in our short presentation.

We are looking forward to co operate with you.

Yours

Georg von Unold

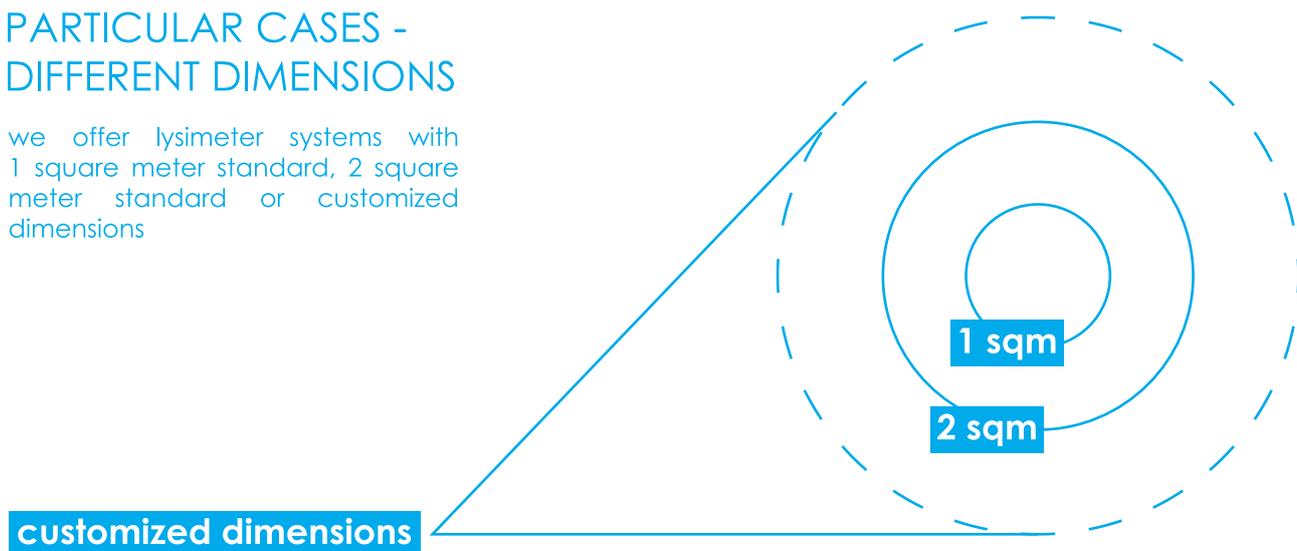
LYSIMETER SOLUTIONS

In all our systems we place great importance on reliable and proven technology and a high degree of investment security. On one hand we design customized solutions for our partners in research and industry. On the other hand we supply systems which have proven their reliability under various conditions all over the world.

The use of high-grade components and materials assures a maximum in system availability and data continuity. Out of your ideas and visions, which are the guideline for our systems, new fundamental scientific findings can be gained.

PARTICULAR CASES - DIFFERENT DIMENSIONS

we offer lysimeter systems with 1 square meter standard, 2 square meter standard or customized dimensions



BENEFITS

Quality assurance with the UMS cutting method

As each soil is unique, it is essential to have experience in the cutting of Lysimeter soil columns. In the past 20 years, UMS has extracted hundreds of soil columns all over the world, and in many types of soil: typical farmland, permafrost, forests, rubble plains or alpine habitats, nearby or as far as China.

Precise and gentle shear-off procedure

The bottom of the soil column is sheared off with a polished cutting plate. The plate's specially shaped cutting edge together with a hydraulic drive allows careful and accurate shearing.

Soil conserving lifting and rotation method

After the soil column is cut and sheared off it is lifted and turned upside down. The UMS method has four particular advantages:

1. The lifting force is applied evenly and close to the balance point to prevent column deformation. The soil body is kept safe and free of deformation.
2. The Lysimeter cylinder is not deformed when lifted as the induced load torque is reduced to a minimum. The load is extensively distributed from the short bolts over the largesized welded on base plate.
3. The round bolts allow the easy, smooth and safe rotation of the whole cylinder. This saves costs by reducing the efforts for installation as well as for maintenance when the Lysimeter needs to be lifted.
4. The integrity of the soil body is assured by the safe and easy handling.

The filled Lysimeters are transported on trucks with special air suspension to ensure that the soil column remains undisturbed. The height of the soil column is checked for quality assurance. The UMS lifting and rotating method prevents a deformation of the soil body and eliminates the development of gaps inside the cylinder – an essential quality criterion for receiving substantial data.

Field-identical water regime with UMS Lysimeter technique

A main point of criticism against Lysimeters has always been the difference between the “water regime” in the field and inside the Lysimeter. In conventional gravity Lysimeters the leachate is just drained out of the bottom of the Lysimeter. In reality variable matric potentials, which are the driving force for water flow, occur in the field. In rainy seasons or wet periods the field’s soil water is pulled towards the lower groundwater. This does not happen inside the Lysimeter as the potential on the very bottom is zero. As a result the Lysimeter has more moisture than the field. In dry periods, depending on the soil type, capillary suction causes the water in the field to rise. As this is not the case in the conventional Lysimeter the soil in the Lysimeter remains drier than the soil in the field.

In UMS Lysimeters this problem is solved by measuring and comparing the matric potential in both, the bottom of the Lysimeter and in the field at the same depth. If the Lysimeter has more moisture, water is sucked out the Lysimeter through the suction cups rake. If the Lysimeter is drier, water is injected. This technique is installed in all UMS Lysimeters since 2004 with great success.

Precision weighing for reliable mass balances

Measuring small changes of a large load under field-identical conditions: this innovative technology is what makes UMS Lysimeters so valuable.

For UMS Lysimeters this means:

- Measurement of the soil column mass with an accuracy of 100 grams which corresponds to a precipitation or water column of 0.1 mm. The resolution is even 10 grams or 0.01 mm precipitation.
- Leachate is measured with an accuracy of 10 grams and a resolution of 1 gram.

The precision weighing system in UMS Lysimeters allows the highly accurate measurement of mass increase and decrease in the Lysimeter. Thus, water balance parameters rain, dew, frost, snow and evapotranspiration are determined with highest resolution.

Already the first UMS Lysimeters were placed on three weighing cells. This minimizes measurement errors due to a shift of the load caused by wind and reduces the statistical error. The weighing cells offer highest accuracy, they are hermetical sealed and, as other parts, made of durable stainless steel. Measuring the leachate discharge is even more precise as leachate is collected and weighed in a separate tank.

With the special design the weighing system excludes transverse forces (patent pending). Another advantage is the easy and quick replacement and calibration of the weighing cells.

Field-identical temperature dynamics

All chemical and microbial processes are temperature dependent, as well as hydraulic processes. When designing a Lysimeter it is of great importance that the temperature dynamics of the field are transferred to the Lysimeter as efficient as possible. The well rings are made of porous concrete. Thus, the evaporation enthalpy creates a thermal equilibrium between Lysimeter soil and the surrounding field – adequately from the soil surface down to the bottom. The bottom side is equipped with a high thermal conductivity heat exchanger which re-establishes the thermal conduction usually interrupted in conventional Lysimeters.

Sealing the rim gap

The gap between Lysimeter cylinder and collar is properly sealed to prevent the intrusion of rain, melting water or stones. This reliably eliminates a former cause of error. In addition the circulation of

air caused by thermal effects is reduced. This sealing of the rim gap was first implemented 15 years ago, but was improved since then and now in no way influences the weighing precision.

Snow – a interfering factor?

Snow and snow melt are important, not only in alpine regions. With UMS Lysimeters you can directly measure the water equivalent of snow and the snow cover growth by weighing. This is achieved by a special rotating unit which cuts a small gap into the snow cover straight over the Lysimeter rim. With this gap the Lysimeter is weighable again, and snow fall or melting processes cause little disturbance, utility patented. Please order this option separately.

Simple maintenance and easy replacement of sensors

Most sensors can be replaced without lifting the Lysimeter through a service hatch in the collar. The weighing cells are not fixed to the bottom side of the cylinder but are hooked sideways. Thus, they can be replaced easily.

Careful selection of material and material processing

UMS Lysimeter vessels are made of a special stainless steel and are manufactured only by skilled specialists with advanced welding experience. The narrow tolerances and the passivated welding seams must pass a strict quality control. The construction's dimensions and stability are verified and tested to guarantee long-term operation of the system.

UMS Lysimeters are placed inside concrete well rings which have a thermal transmission comparable to the soil. They are designed to withstand geodynamic pressures and assure stability for years. A proven design for long-term precise weighing!

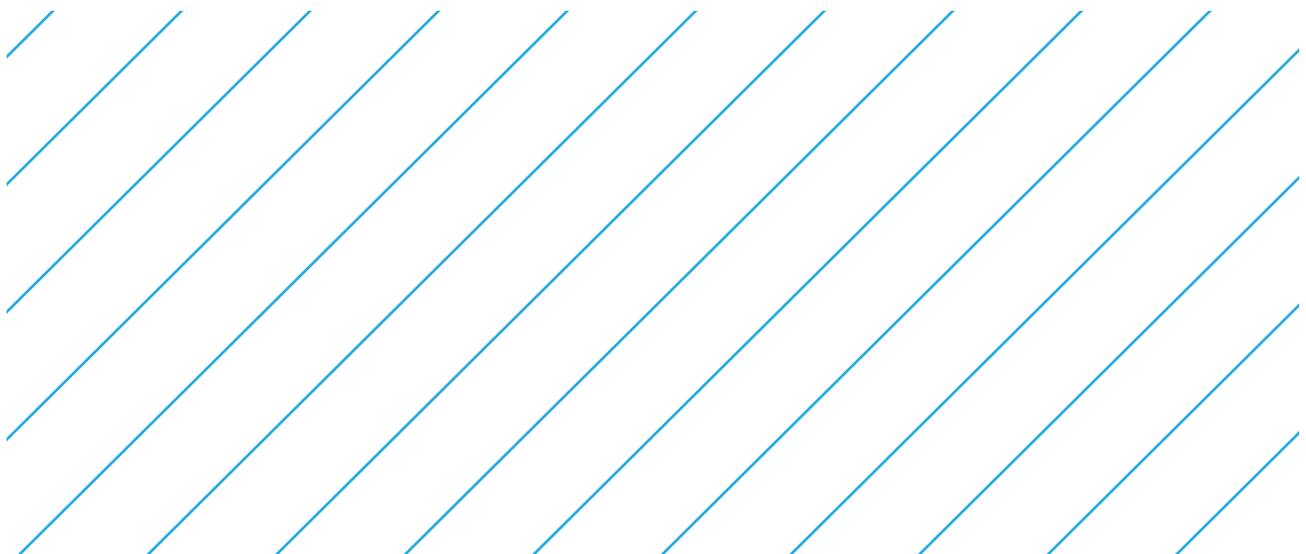
UMS know-how for customized solutions

The UMS team has more than 20 years of experience and consists of graduated engineers, geoscientists, master craftsmen and technicians having skills in

- soil physics,
- hydrology,
- forestry,
- electronics,
- precision mechanics,
- metal and construction working.

UMS advises and supports you in planning, designing, constructing and finally in training your team in set-up and maintenance.

Beside complete solutions and Lysimeter stations with one to 60 Lysimeters, or complete, web server based networks we also supply single components, sensors or 1-channel-loggers.



**Reference Univ. Doz. Dr. Eckart Priesack,
Helmholtz-ResearchCenter Munich**

„We'd like to express our thanks for many years of good cooperation with the company UMS in the development, set-up and operation of the Lysimeter station. Especially the excellent competence of UMS in soil physics, the prompt support and reliable on-site service contributed to the success of the experiments with our soil-plant-systems in Lysimeters.“



**Reference Dr. Thomas Pütz, Agrosphäre, Research
Center Jülich**

„UMS has been selected as supplier for the Lysimeter systems inside the project „TERENO-SoilCan“. UMS fulfilled the technical and the quality requirements completely. Based on the competence in soil science and engineering and the excellent cooperation and long term relationship with UMS, we are looking forward to receiving professional setup and service for our new Lysimeter network.“

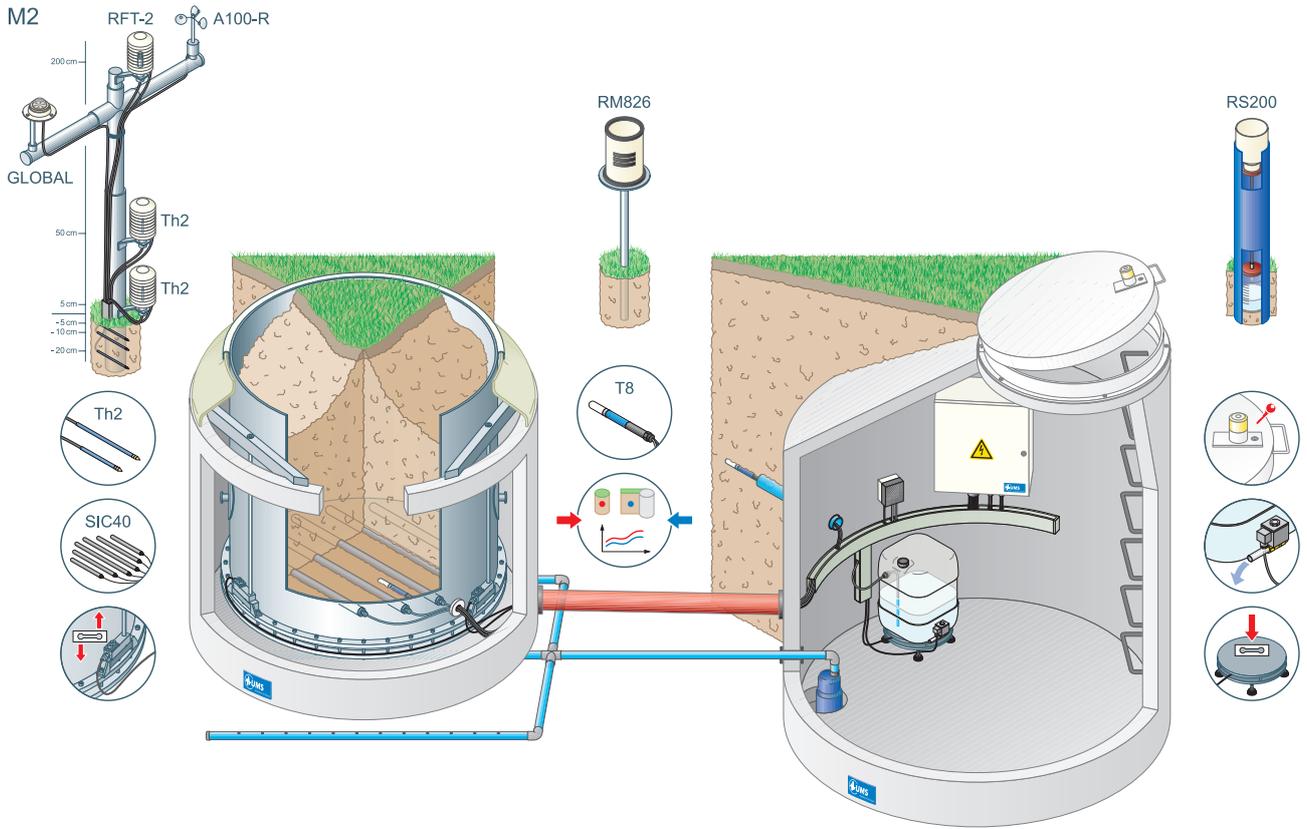


**Reference Univ. Doz. Dr. Johann Frank, Joanneum
Research Wagna**

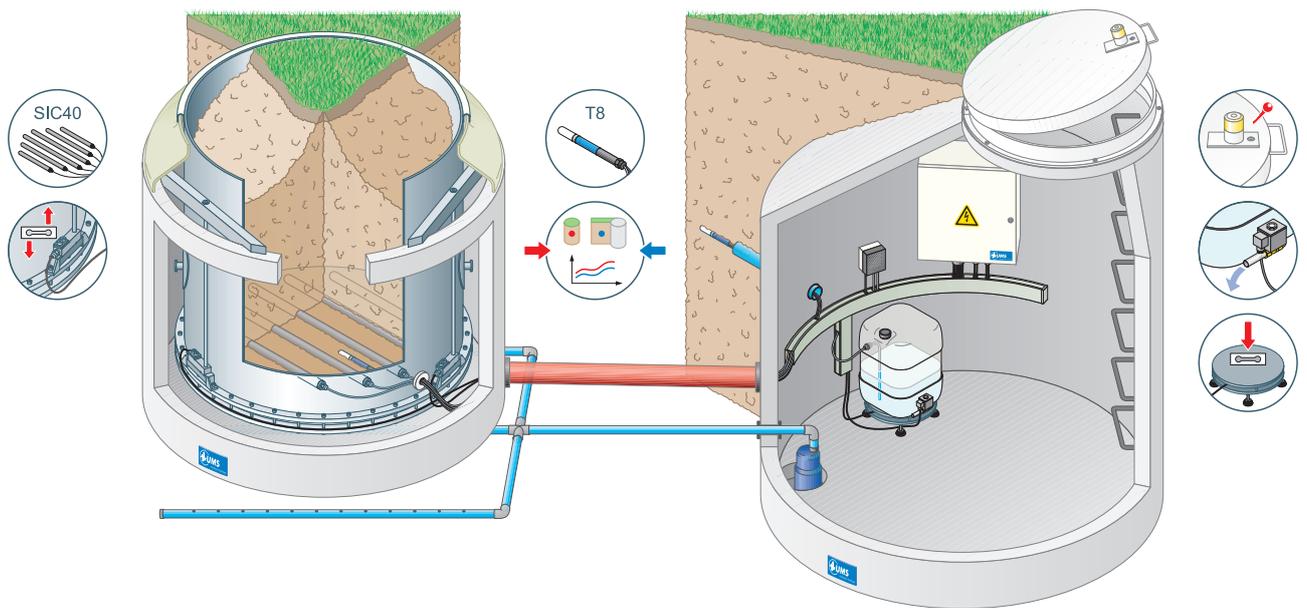
„Over the complete period of time from the conceptual design until the erection and launch of this complex Lysimeter site, including all concomitant soil hydrological measurements, the Joanneum Research Center has been accompanied by UMS as a competent and especially reliable partner. The cooperation in research, development and realization of innovative measurement technology for the protection of ground water supplies has been exemplary at any time. Especially for inventive tasks UMS can be explicitly recommended as a partner in research and development. It is our intention to realize further developments and new concepts insistently in cooperation with UMS.“



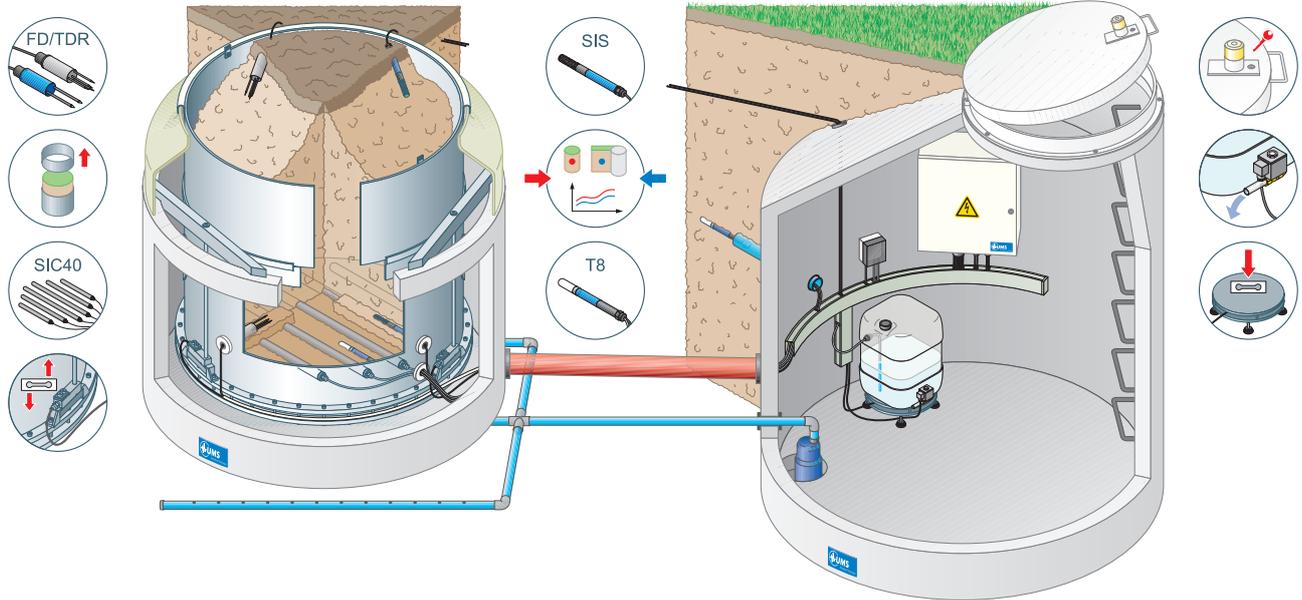
Meteo-Lysimeter



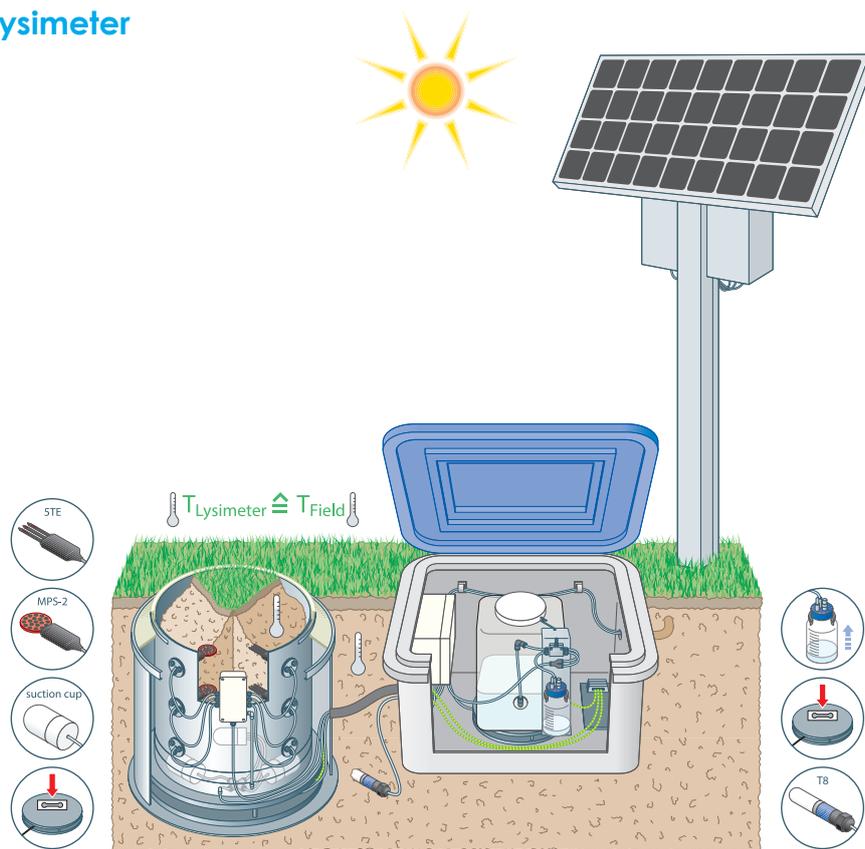
Hydro-Lysimeter



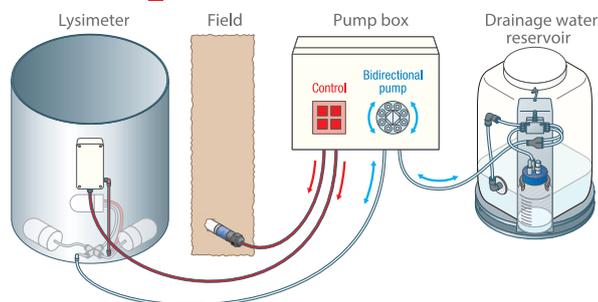
Agro-Lysimeter



Smart-Field-Lysimeter



suction tension $\hat{=}$ reference tension



SELECTED REFERENCES LYSIMETRY

1989: Helmholtzforschungszentrum Munich: Lysimeter facility / 48 weighable gravitation monolithic lysimeter. Georg von Unold was employed at GSF as engineer being responsible for metrological planning, installation and support.

1993: FAM (Forschungsverbund Agrarökosysteme Munich): Planning and realisation of a „virtual lysimeter measuring network“ conceived as a soil hydrological measuring system with 18 measuring tunnels Ø 2m, depth 3 m, approx. 320 tensiometers, 320 TDR-sensors, 8 climatic measuring stations.

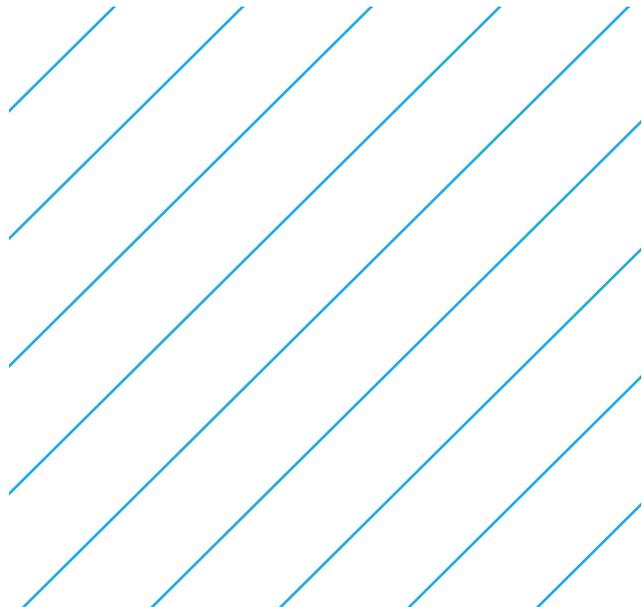
1995: Lysimeter facility Hirschstetten (Bundesamt u. Forschungszentrum für Landwirtschaft): 8 filled, non-weighable lysimeters 6,3 sqm area, 2 m depth. UMS was involved in planning, project planning and execution via the Forschungszentrum Seibersdorf. UMS delivered sensors and soil water probe systems.

2000+: Soil hydrologic measuring network (Hydrologic Central Bureau HBZ Austria): Continual expansion of the measuring network „unsaturated area in Austria“. 11 stations, partially equipped with lysimeters and climatic stations.

2002: Lysimeter facility Wielenbach (Bayerisches Landesamt für Wasserwirtschaft): UMS is responsible for planning and project management as well as building construction of the basement, measurement technology and support of the entire facility.

2004: Lysimeter facility Oberschleißheim (Bayerisches Landesamt für Landwirtschaft): 20 monolithic lysimeters, 4 of them weighable, 36 rectangle lysimeters, punctually weighable via crane level. Planning, project planning, building of the basement and complete realisation by UMS.

2005: Lysimeter station Wagna: monolithic extracted lysimeter: Transfer of the matrix potential to the lysimeter monolith. 3 monolithic lysimeters and open filed measuring profiles with approximately 110 measuring channels. Planning, project planning and complete realisation by UMS.



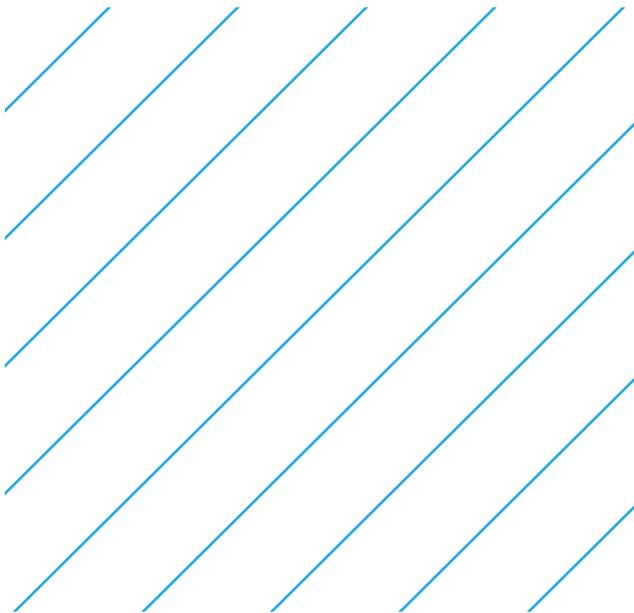
2006: Lysimeter station Universita Federico Secondo di Napoli: monolithic extracted lysimeter: Comparable to the Wielenbach project, 8 weighable monolithic lysimeters with controllable, artificial ground water level, transfer of the matrix potential to the lysimeter monolith, equipped with gas sparging and a gas measuring device. UMS is responsible for planning, project planning, construction and complete execution.

2006: Hydro-Lysimeter for Austrian Research Centre Joanneum: monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith

2007: Lysimeter station TEZNO (Slovenia): monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith.

2008: Lysimeter facility Jinzhou (China): monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith.

2008: Lysimeter station Wettzell (GTZ Potsdam): monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith.



2008: 3-Channel Lysimeter station Friedrich-Schiller-Universität Jena: 1 x monolithic extracted lysimeter, 2 x filled lysimeters, gravity lysimeter.

2008: EU-Project acronym (SOILCAM FP7-ENV-2007.3.1.2.2.): WP2, WP5: Developing and advancing project (see BWA, page1) for the development of the "Third generation lysimeters".

2008: BOKU, Wien: Delivery of a precision lysimetry weighing system with DT85 data logger for laboratory lysimeters.

2008: Measuring station Moreppen/Oslo (Friedrich-Schiller-Universität Jena): Delivery of 10 small lysimeters with Redox sensors, FD sensors and tensiometers, gravity lysimeter, non-weighed.

2009: Lysimeter facility Harbin (China): monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith.

2009: Facility with small lysimeters (University of Bucarest): 10 monolithic extracted small lysimeters with Redox sensors, FD sensors and tensiometers, gravity lysimeter, non-weighed, data logger DT85.

2009: IMK-IFU: 6 lysimeter facilities, consisting of 6 weighable monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith.

2009: Lysimeter facility of the Hydrographischen Dienstes Burgenland: monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith.

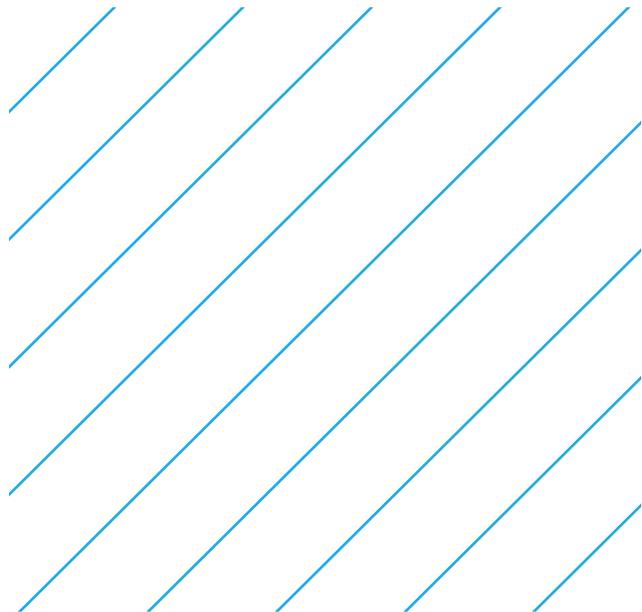
2009: Lysimeter facility IRGO Ljubljana (Slovenia): monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter monolith.

2009: Lysimeter facility in Anhui (China): Refilled lysimeter, height 4 m, surface 4 sqm, with transfer of the matrix potential to the lysimeter monolith.

2009: Development co operation with project planning together with HelmholtzZentrum Munich, Prof. Charles Munch, to optimize the extracting process.

2009: IKT-Petzenkirchen: precision weighing system and metrological data collection with DT85 for laboratory lysimeter pile, height 4 m, surface 0,5 sqm,

2009: Lysimeter facility of the Hydrographischen Dienstes Burgenland: monolithic extracted lysimeter with transfer of the matrix potential to the lysimeter



2009: TERENO-Partner KIT (Karlsruhe, Institute for climate research in Garmisch Partenkirchen): 36 Lysimeters for climate feedback.

2009: Georg August University Göttingen: 16 synthetic lysimeters.

2010: Lysimeter station for climate change & water resources science for Federal Research Institute Gumpenstein: containing a 6 Lysimeter with 1 sqm surface and 1.5 m depth.

2010/2011: TERENO-Soilcan (TERENO Coordinator Research Center Juelich): 90 Lysimeters.

2011: Ecotron Montpellier (France): 12 Lysimeters, 2 sqm surface, 2 m depth.

2011: Lysimeter station in IASA (Romania): 10 weighable lysimeters 1 sqm surface, 2 m depth.

2011: Technische Universität Braunschweig: 16 synthetic lysimeters.

2012: Puconci (Slovenia): 1 Meteo-Lysimeter, 1 sqm, 1 m height.

2013: University of Ljubljana (Slovenia): 2 Agro-Lysimeter, 1 sqm, 1 m height.

2014: GFZ Potsdam (Germany): Lysimeter Hexagon

2014: Universidad Austral de Chile (Chile): 1 large scale lysimeter, 2 sqm, 2 m height.

DATA SUPPORT

- AutoCAD®
- ArcMap/GIS®
- Adobe Illustrator®
- Adobe Photoshop®
- Diadem
- Microsoft Excel®
- Solid Works®

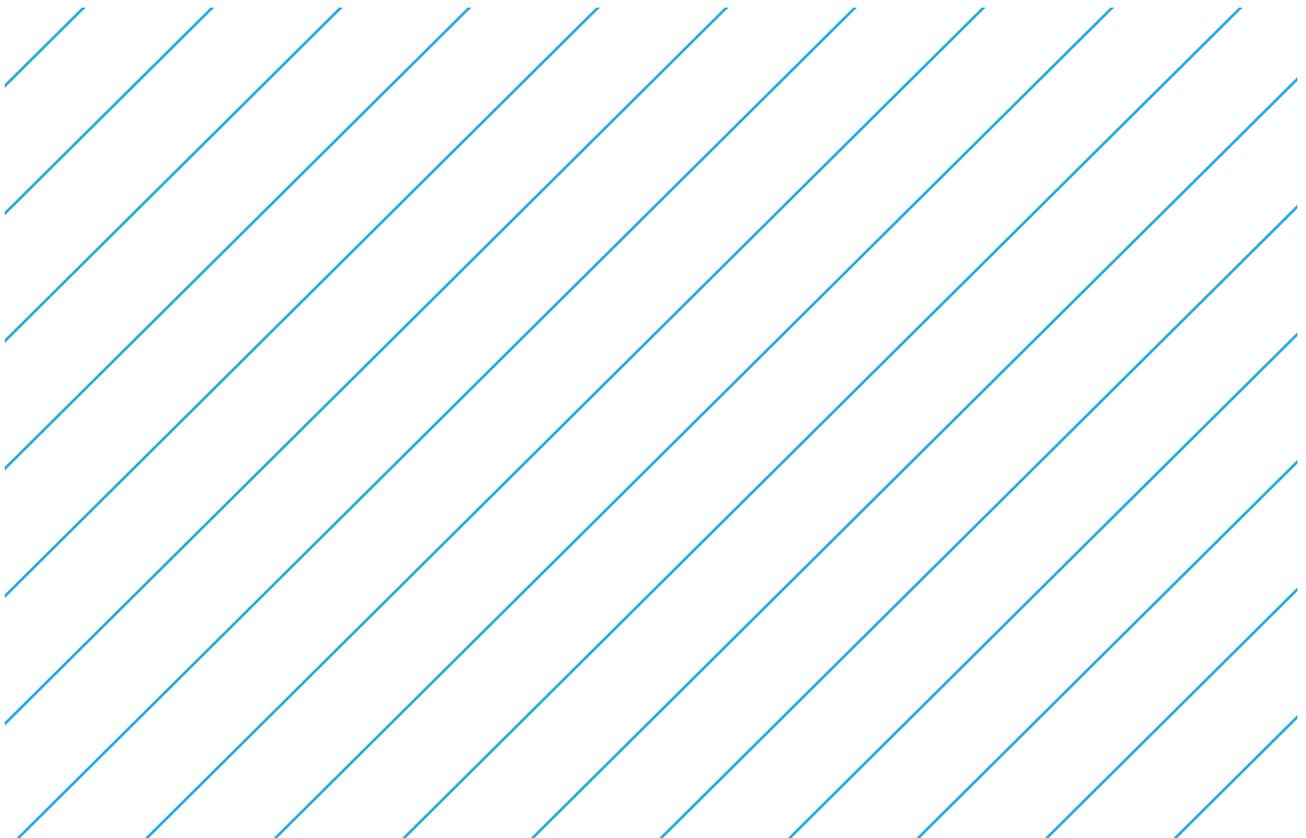
MEMBER OF SOCIETIES

- DGB - German Soil Scientific Society
- Waterpool – Network of Competence for Water
- ÖBG / Austria Soil Scientific Society
- Arbeitgruppe Lysimeter / Lysimeter Research Group
- German standardization committee member (DIN) NAW I 2/UA 5/AK4 for the standardization of pore water sampling and sampling methods

CERTIFICATION



DIN EN ISO 9001



REFERENCES

Head Clients



HelmholtzZentrum münchen

Deutsches Forschungszentrum für Gesundheit und Umwelt



Industries

- BASF/ Agriculture
- Bayer AG
- BMW
- Shell Solar
- Geoconsult ZT GmbH
- BRGM France
- ECT Ökotoxikologie GmbH
- UMEG GmbH
- BEAK Consultants
- LGA - Bavarian Public Corporation Service Company

Universities

- Technische Universität München / Germany
- Ludwig-Maximilians-Universität München / Germany
- Universität Göttingen / Germany
- Universität Hohenheim / Germany
- Universität Gesamthochschule Kassel / Germany
- Ruhr-Universität Bochum / Germany
- Universität Bayreuth / Germany
- University of Natural Resources and Applied Life Science, Vienna / Austria
- University of Napoli / Italy
- University of Bangor / Wales
- Universidad de Estudio de Postgrado / Ecuador

State Institutes

- LfU - Bavarian Environmental Protection Agency / Germany
- FAM - Research Association Agro Ecosystems / Germany
- LfL - Bavarian State Institute for Agriculture / Germany
- WWA - Bavarian State Institute for Water Management / Germany
- LWF - Bavarian State Institute for Forestry / Germany
- LAF - Forest Institute, State of Saxony / Germany
- Austrian State of Styria / Austria
- Austrian State of Tyrol / Austria
- Austrian State of Carinthia / Austria
- Austrian State of Lower Austria / Austria
- Austrian Joanneum Research Center / Austria
- Austrian Research Center Seibersdorf / Austria
- United States Department of Agriculture / U.S.A.



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