



## Modular conception of Lysimeter techniques, scales and applications

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### Modulare Konzepte der Lysimetertechnologie für differenzierte Anwendungsbereiche und deren Einordnung in die Skalenproblematik

Georg von Unold

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Soils have a key role for many environmental research tasks

and

Weighable Lysimeters are tools to determine soil water relations, combining precision of laboratory setups under true field condition.

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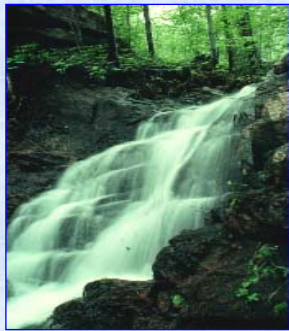
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## Modular conception of Lysimetterechniques, scales and applications

- ⇒ Why do we need scales?
- ⇒ Why is it important to measure under field conditions?



„Panta Rhei! “

„All is in a state of flux“ Heraklit, 550 – 480 v. Chr.

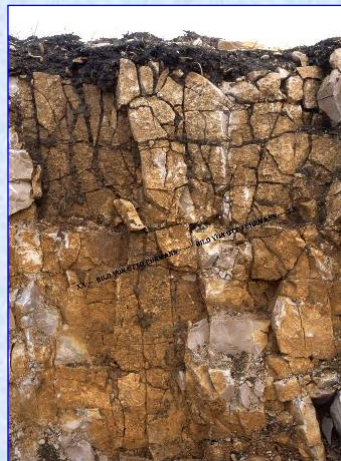
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*But how is water flowing there?*

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## Scales and levels for soil hydrologic research

### Scale 1: Soil physical laboratory scale

Measuring and modeling of soil and water specific functions and characteristics at small sample sizes, i.e. soil sample rings and miniature lysimeters.

- ⇒ Retention curves
- ⇒ Conductivity
- ⇒ Sensor calibration
- ⇒ Bio remediation
- ⇒ Microcosms scale



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## Scales and levels for soil hydrologic research

### Scale 2: Hydrologic laboratory scale

Determination of hydraulic coherences with soil monoliths

- ⇒ Substance transport
- ⇒ Flux determination
- ⇒ Sorption and buffer behaviour



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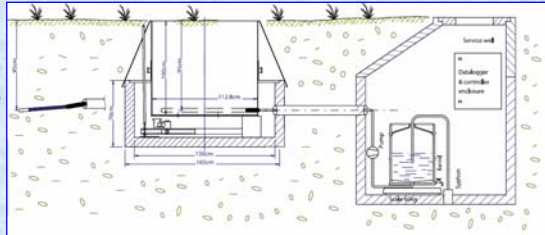
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## Scales and levels for soil hydrologic research

Scale 3: Lysimeter stations combine the advantage of precision measures with soil monoliths with defined surface and volume under field conditions, field vegetation and cultivation.

Water balance  
 ET &  $ET_0$ , drainage  
 Groundwater recharge  
 Substance transport  
 Metabolism research  
 Cultivation methods  
 Climatic research  
 Energy balance  
 Model calibration



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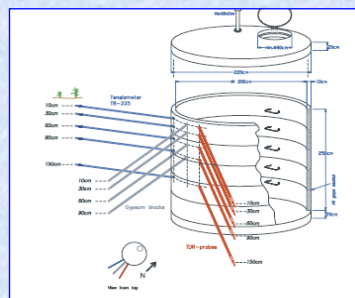
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## Scales and levels for soil hydrologic research

Scale 4: In-the-field measuring sites

⇒ Field studies to describe in situ retention curves and water fluxes or as input data for groundwater recharge models, leachate determination and soil water sampling.



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### General requirements

#### 1. Site and Excavation



Representative soil profiles



Control of cutting edge

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### Lysimeter vessel module



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### 3. Weight measurement module



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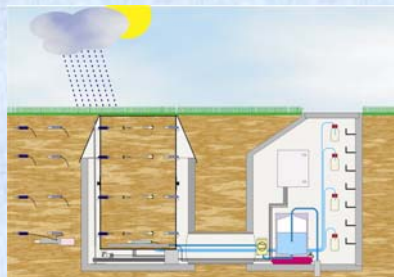
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### Techniques for water balance-, solute flux- and bioremediation investigations



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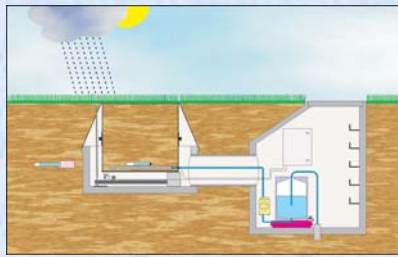
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⇒ Hydro-Lysimeter to measure & determine directly



- ⇒ Rain, true to soil surface
- ⇒ Dew corresponding to the current vegetation
- ⇒ Water equivalent of snow
- ⇒ Hoar frost
- ⇒ Evapotranspiration
- ⇒ Drainage

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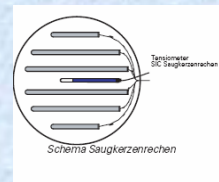
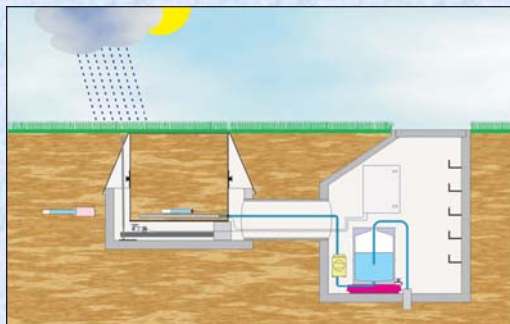
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Hydro-Lysimeter, to model

- ⇒  $ET_0$
- ⇒ Groundwater recharge capability



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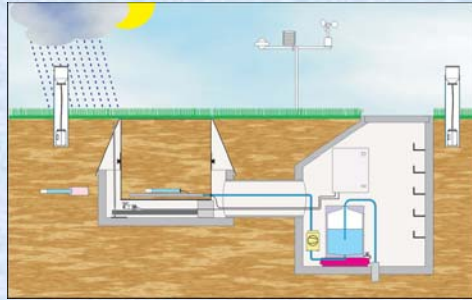
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### Meteo-Lysimeter



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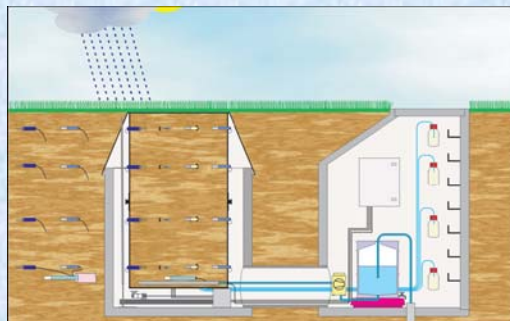
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### Scientific-Field-Lysimeter



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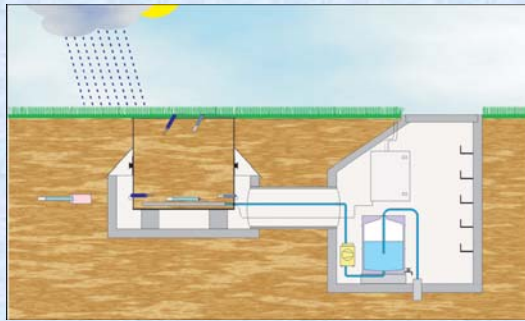
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### Agro-Lysimeter



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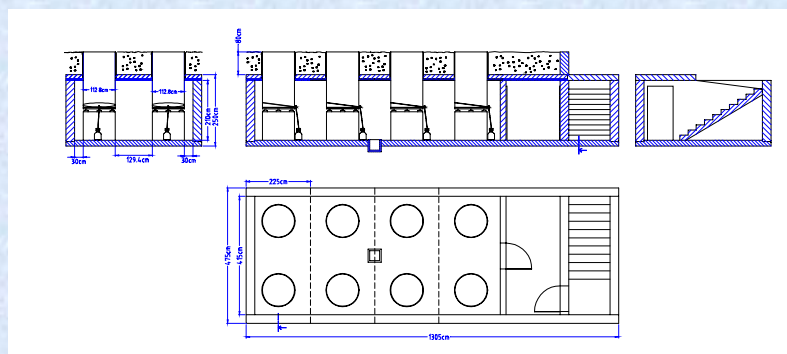
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### 4. Cellar



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### 4. Cellar



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## Modular conception of Lysimeter techniques, scales and applications

### 4. Cellar



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## Modular conception of Lysimeter techniques, scales and applications

⇒ Limits of lysimeters:

- ⇒ lysimeters at slopes need special construction because of surface water and lateral flow
- ⇒ lysimeters in forests need to consider and include active and growing roots.

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Thank you

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