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TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

TERENO-SOILCan – Status, Network Activities and Research Projects

T. Pütz, M. Hannes, J. Groh, U. Wollschläger, K. Kaiser, R. Kiese, M. Herberich, E. Priesack, E. Borg, H.H. Gerke, H. Rupp, H.-J. Vogel, H. Papen, J. Vanderborght & H. Vereecken

Agrosphere Institute, Forschungszentrum Jülich

TERENO Advisory Board Meeting, 16.-17. September 2013, Klink/Lake Müritz

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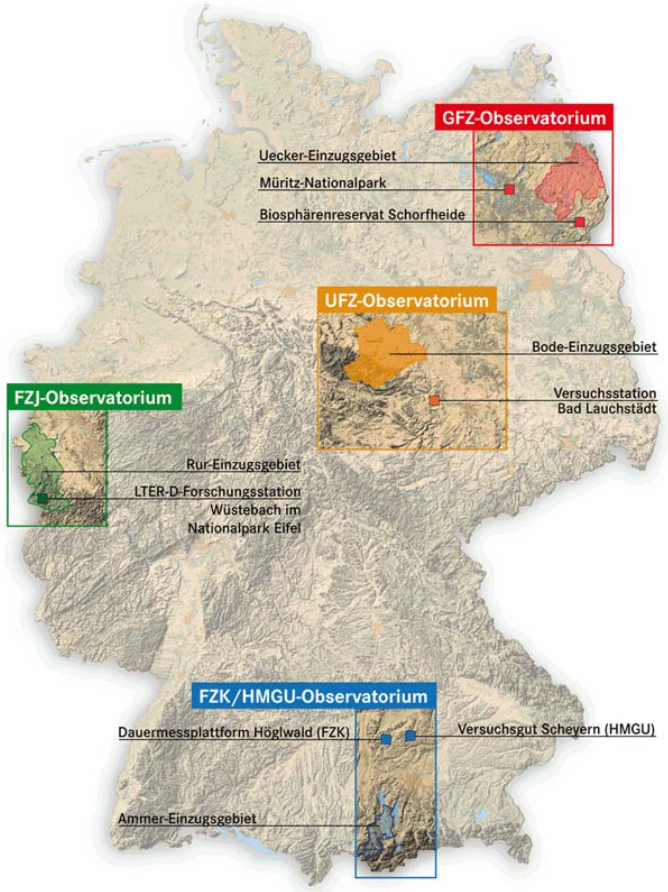
SOILCan a Large Scale Climate Feedback Experiment

- SOILCan lysimeter network
- Research topic: influence of climate change on water and nutrient budget
- Climate transect and transport of lysimeter ("space for time approach") to measure water balance components under a real climate change
- Lysimeters provides: important datas of soil temperature, θ, ψ, soil water chemistry, precipitation, dew, evapotranspiration and reliable measurements of **leachate and capillary uprise** from new lysimeter approach (FANK 2009)



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On-Going Activities, Topics and Problems

- New lysimeter technic secures a better estimation of lysimeter in- and outflow, managed by a pump device to transfer measured field conditions on the lower boundary;
- Investigation how soils react to climatic change with respect to matter cycling and water dynamics;
- Realistic identification of solute transport;
- Development of plant communities in terms of species traits (especially roots) and genetic structure in adaption to the local conditions;
- Changes of a dynamic towards a stable system;
- Discussion of the crop rotation (winter wheat, pea, winter rape, winter barley); discussion paper sent to AB with request for comments and recommendations; feedback of one AB member;
- Technical problems with pumps and pump control units (high attrition, to high pump frequencies), matric potential sensors;
- Working group for data processing;

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Modelling Water Transport in SoilCan Lysimeters

M. Hannes, U. Wollschläger, H.-J. Vogel (UFZ)

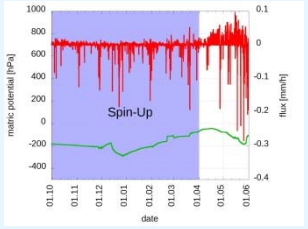
- continuous datasets
- different soil types
- same soils under various atmospheric boundaries

improved understanding of

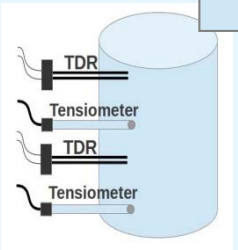
- parameterization
- relevant processes
- limitations of Richards-equation

Lysimeter measurements

Boundary conditions

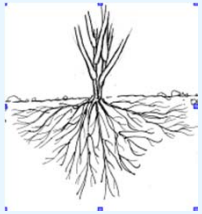


Soil water-dynamics

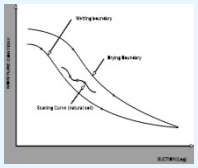


Parameterisation

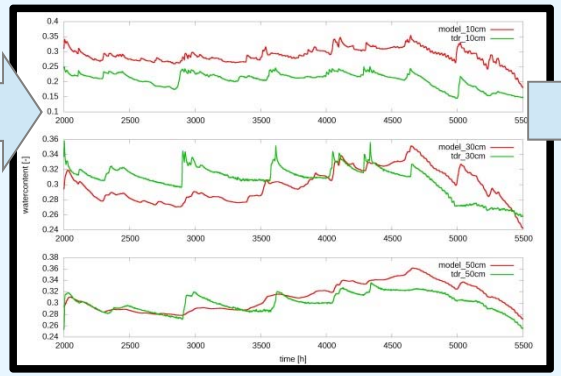
Root-model



Hystereses



Transport model



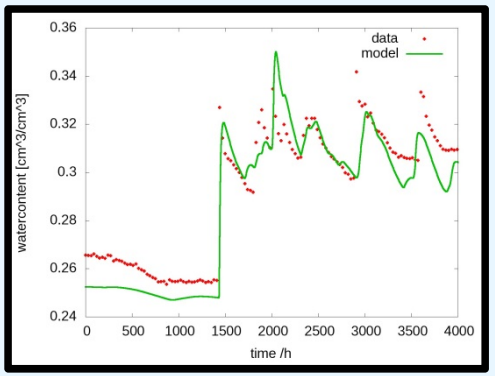
Optimization

Global opt. algorithm

Data

Model adjustment

MUPHI



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Greenhouse Gas Measurements on Lysimeter Soils of Different Origin and Climate History

D. Weymann, N. Brüggemann, T. Pütz, and H. Vereecken (FZJ)

- Assessing greenhouse gas (GHG) fluxes from several lysimeter soils
- Investigation of dissolved greenhouse gas concentrations in soil solution, indirect fluxes of GHGs representing a source of substantial uncertainty in GHG balances and –inventories.

Conclusions and Outlook

- Preliminary results underpin the importance of continuous measurements to detect short-term emission events
- Impact of induced climatic change cannot be detected so far
- Indirect GHG emissions might be particularly susceptible to climate-changing conditions
- GHG monitoring will be continued at a long-term scale

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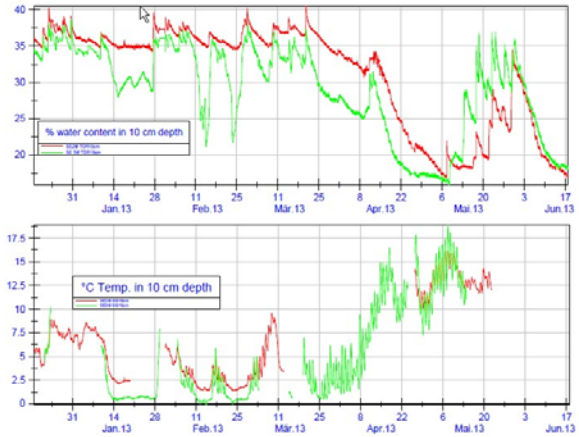
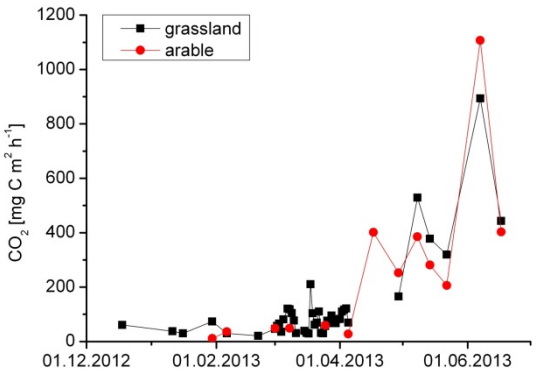
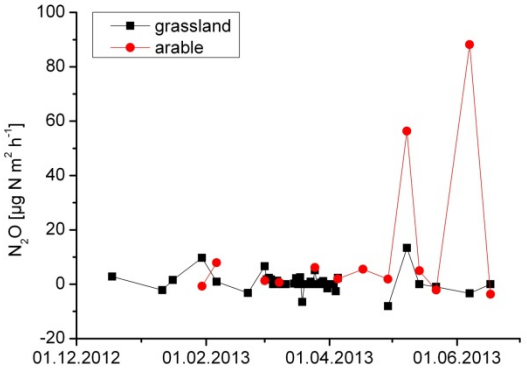
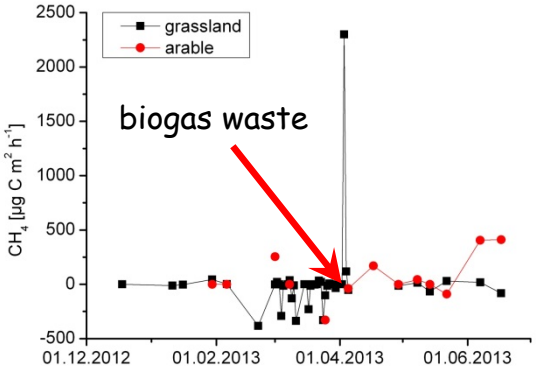
Soil water content, soil temperature, CO_2-, N_2O-, and CH_4 – fluxes from grassland and arable soils (winter rape) at the Selhausen site.

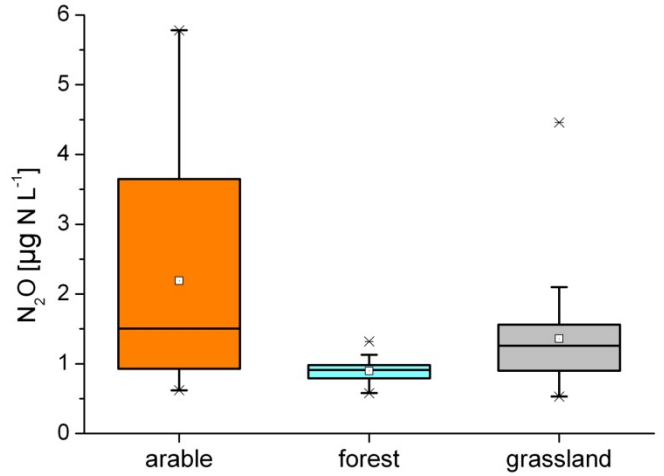


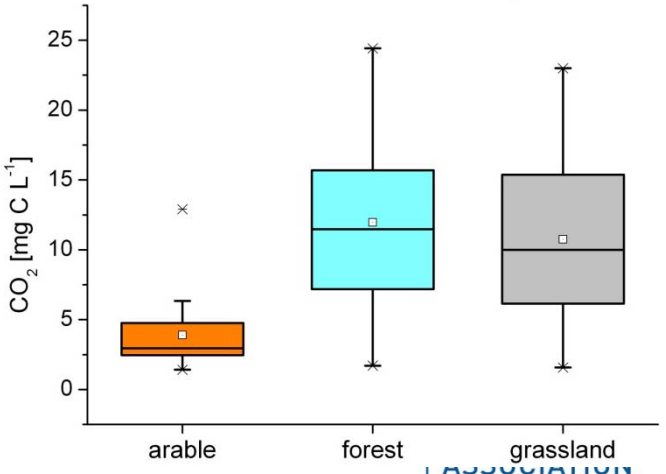






Dissolved gas concentrations of N_2O and CO_2 in soil solution from arable, forest, and grassland lysimeters





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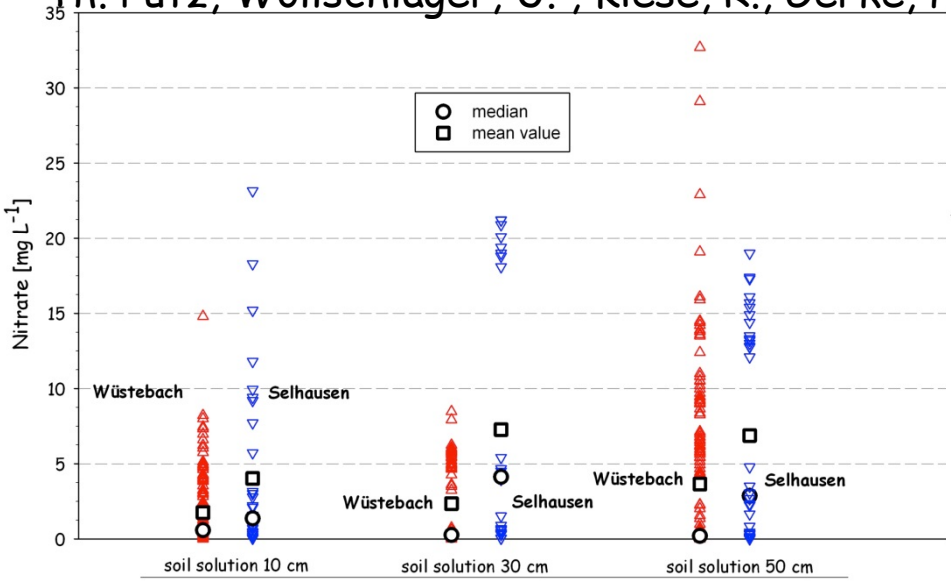
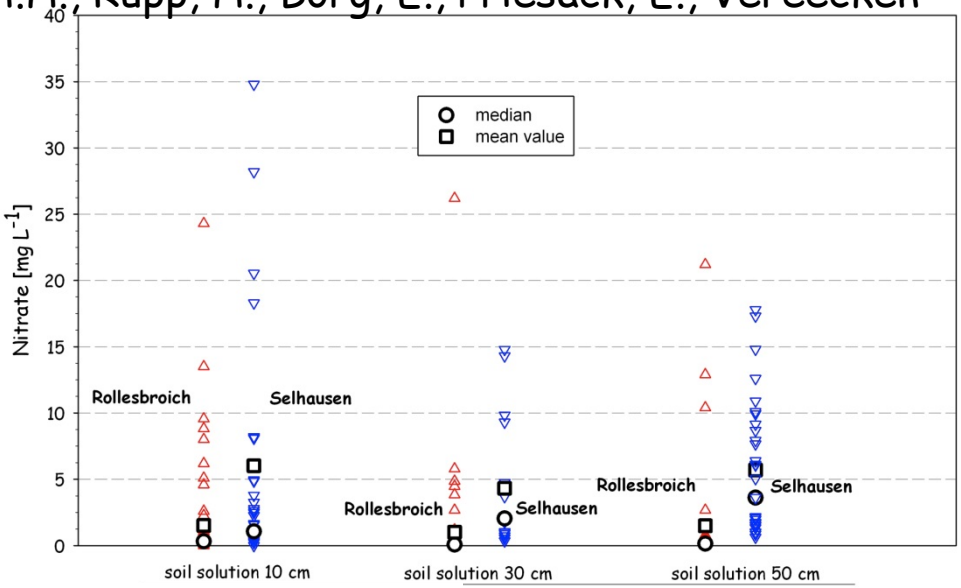
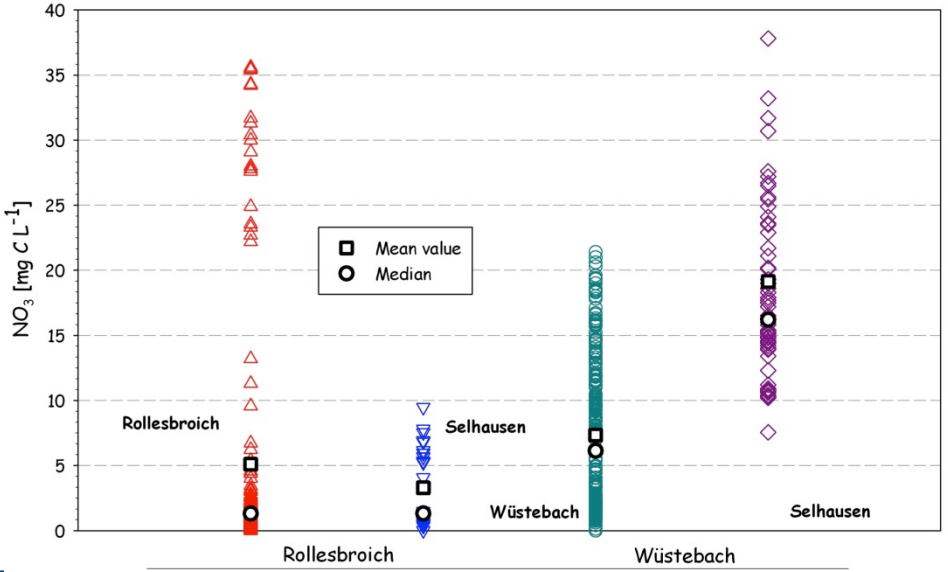
C- and N-Fluxes Influenced by Climatic Differences?

Th. Pütz, Wollschläger, U. , Kiese, R., Gerke, H.H., Rupp, H., Borg, E., Priesack, E., Vereecken







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Intermediate Conclusions and Outlook

- Selhausen is warmer and dryer than Wüstebach and Rollesbroich
- Priming effect for nitrate, minor differences for nitrate induced by lysimeter translocation
- High nitrogen input via snow in Wüstebach
- But no priming effect for DOC, minor differences for DOC induced by lysimeter translocation
- Optimization of lower boundary condition is recommended
- On-going measurement/sampling program

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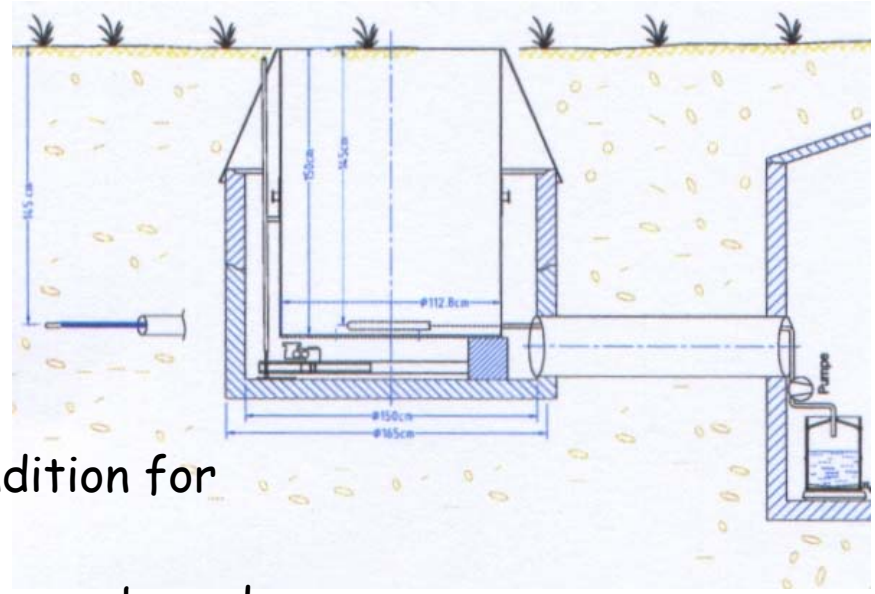
Impact of Different Lower Boundary Conditions on Water Balance Components of the SOILCan-Lysimeter Network

J. Groh, T. Pütz & J. Vanderborght (FZJ)

Lower boundary condition

- Lower boundary control for lysimeters from the „space for time" approach in Selhausen and Bad Lauchstädt (and Dedelow)
- Control by local field tensiometer measurements
- Seasonal matric potential development depends strong on soil properties and meteorological conditions



Question:

- Correctness of actual lower boundary condition for transported lysimeter?
- Can we quantify the impact of different lower boundary approaches on water balance components for grass and crop lysimeters in Selhausen and Bad Lauchstädt

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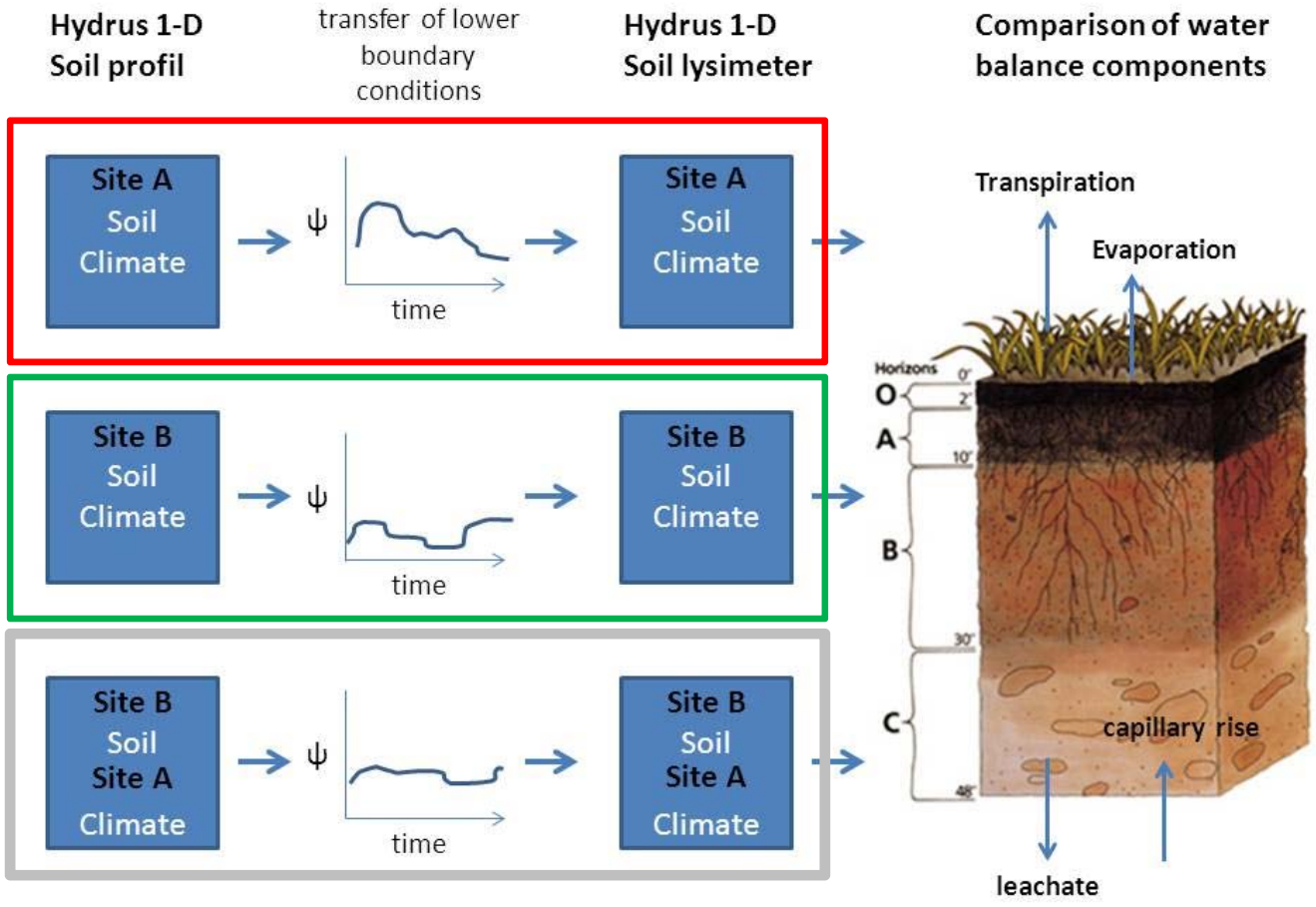
Lower Boundary Control of Lysimeters from Different Sites

Hydrus 1-D

- Virtual experiment
- Site specific soil and meteorological data
- Standard parameterization for grass and wheat

Assumption:

- Mix-model represents real field conditions
- Evaluate impact lower boundary control



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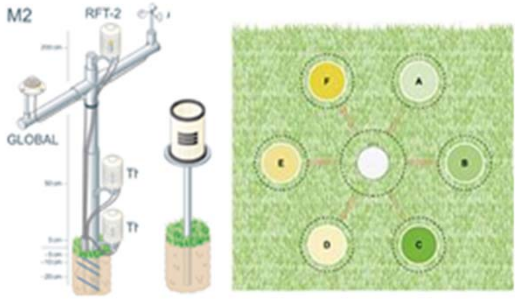
Conceptual Approach for New Lower Boundary Control

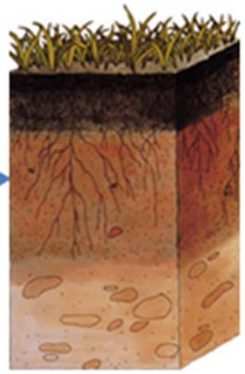
Direct local Measurement

P, T_{aMax}, T_{aMin}, R_N,
W_S, rH



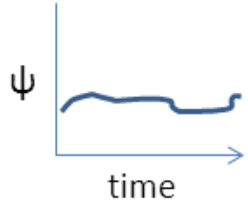
Input Data

Hydrus 1-D soil profil modeling

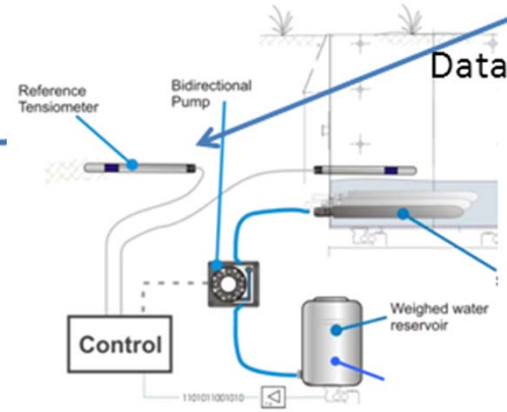


Output Data

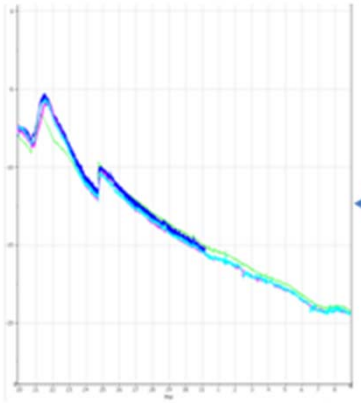
„Virtual field tensiometer" matric potential in 140cm depth



Data transfer



UMS Pumping control



Adapted lower boundary control

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Tracer Experiment within the SOILCan Network

J. Groh, T. Pütz, U. Wollschläger, M. Hannes & J. Vanderborght

Why:

- To define parameters for solute transport from the SOILCan lysimeters
- Edge-flow (wall effect) to proof excavation method or soil shrinkage effects

Aims:

- Quantification of the edge-flow effect in selected lysimeters
- Spatial variability of transport parameters in some monoliths
- **Range of the climate change impact on soil chemistry and solute transport?**

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Double Tracer Application in Selected Lysimeters

Focus:

- Testing sidewall-flow with double tracer test (i.e. SAFFGINA et al. 1977, SAXENA et al. 1992, FANK 2009)

Schedule:

- KBr and $NaCl^-$
- KBr (nearly ideal water tracer (LEIBUNDGUT 2003, Anion exclusion can lead to a quicker flow than water)
- NaCl (still need to verify background concentration in soils)

From DURNER & FANK (2008)

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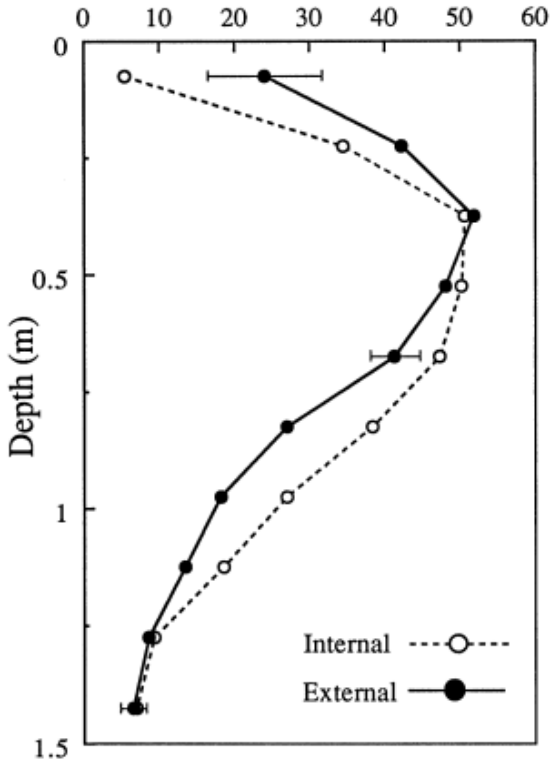
Double Tracer Lysimeter Experiment Garmisch-Partenkirchen

Additional idea to detect side-flow

- Lysimeter from Gm with a high clay content
- Swelling and shrinkage in humid or dry periodes leads to a significant crack between monolith and lysimter wall (observed)

Single or double tracer application:

- Tracer application
- Extra irrigation (during rainfall events), for a quicker transit of tracer through the vadose zone (time limited experiment)
- BTC and soil core (every 5cm) analysation (center and wall) to recieve tracer concentration over soil depth



CORWIN et al. 2000

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Thank you for your attention!

Grafik 1: Blindtext

Grafik 1: Blindtext

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Evaluating A Space For Time Approach For Soil Water Balances In Context Of Climate Change

Basic idea:

- Grass lysimeter in Rollesbroich and in Selhausen (from Rollesbroich)
- Sensitivity analysis (MC or DYNIA, WAGENER et al. 2002) parameter optimization (i.e. AMALGAM, VRUGT & ROBINSON 2009 or SCEM-UA, VRUGT et al. 2003) for both lysimeter sites

Challenge:

- Multi-objective model calibration of E_a, ψ, θ, leachate (MERTENS et al. 2006, GROH et al. 2013)

Aims:

- How react model parameters under climate change conditions (stationary, non-stationary), important information for the transferability of model parameters in climate change studies (i.e. STEFFENS et al 2013, pesticide leaching, temperature, climate change)
- Climate change impact on the water balance components (Ea, S, leachate, and ψ, θ)

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