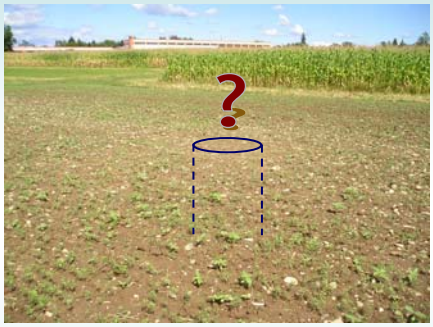
Measuring Results at the Wagna Research Field – a Complex Dataset for Model Preparation and Validation on the Lysimeter Scale



Messergebnisse am Forschungsfeld Wagna – ein komplexer Datensatz zur Modellerstellung und -validierung auf der Lysimeterskala

MMM Conference Graz
January 2007

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Outline

Soil water balance
Solute transport equation

I

C ← D

Conclusion: requirements on models

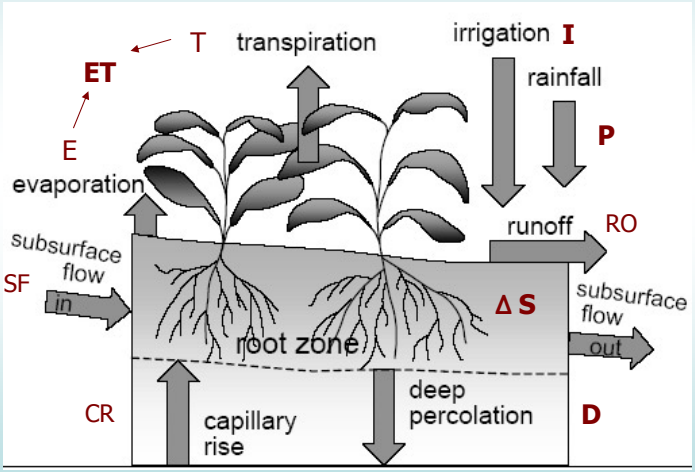
Data sets for model development and validation:

- Atmosphere
- Unsaturated zone
- Agriculture

2

Model Basics – Soil Water Balance

$$P + I - ET - D - \Delta S = 0$$



Soil water balance of the root zone
according to ALLEN et al. 1998, p. 12, modified

3

Solute Balance

$$Dep + F - V - L - \Delta M = 0$$

Dep = atmospheric deposition

Dep = P*Pc + I*Ic + wet Dep

F = fertilisation
V = losses through vegetation and gas transport
L = leaching

L = D*Dc

Δ M = change of mass

Δ M = ΔS* Δc

according to Fank 2006

4

D

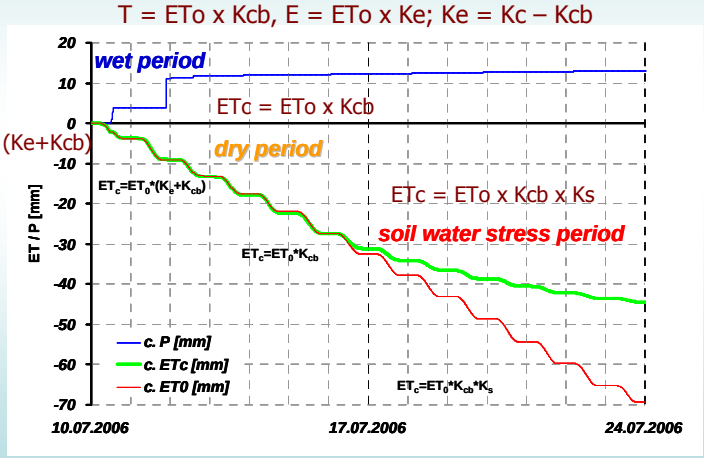
Atmosphere

ETo (reference evapotranspiration): according to Penman-Monteith

ETc (crop ET under standard conditions) = ETo x Kc (crop coefficient)

Kc = Kcb + Ke

T = ETo x Kcb, E = ETo x Ke; Ke = Kc – Kcb



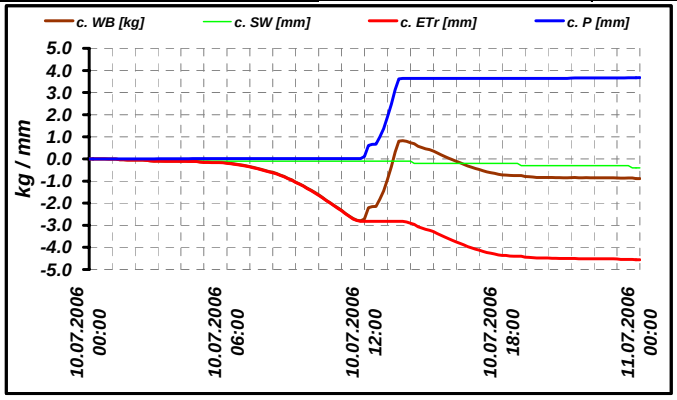
Evaluation of crop factors and soil water stress factors from lysimeter measurement and short term evaluation of grass-reference evapotranspiration *(WALTER et al., 2005)*

5

D

Unsaturated Zone – Water Balance

Water balance		P - ET - D - ΔS = 0 3.68 - 4.16 - 0.40 + 0.88 = 0	
Precipitation P [mm]	3.68	ETr [mm]	4.16
Seepage Water SW [mm]	0.40	Weight Balance WB [kg]	-0.88



Daily water balance elaborated from lysimeter measurement

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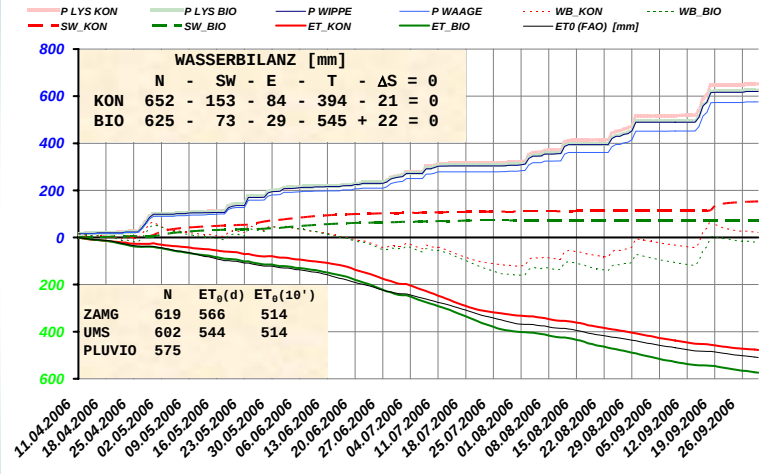
D

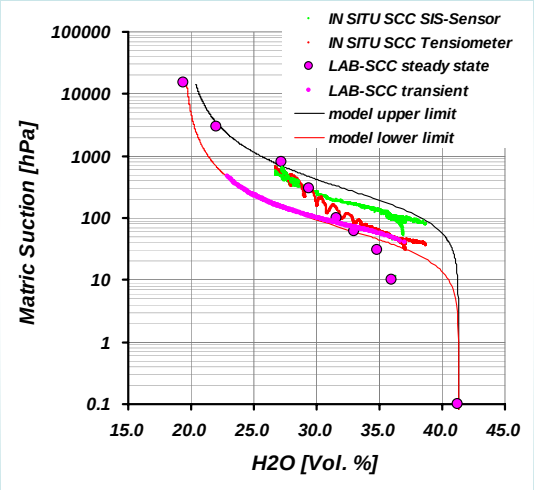
Unsaturated Zone – Water Balance



Water balance for a vegetation period; comparison between two different cropping systems
(KON = maize, conventional farming, BIO = clover/grass, organic farming)

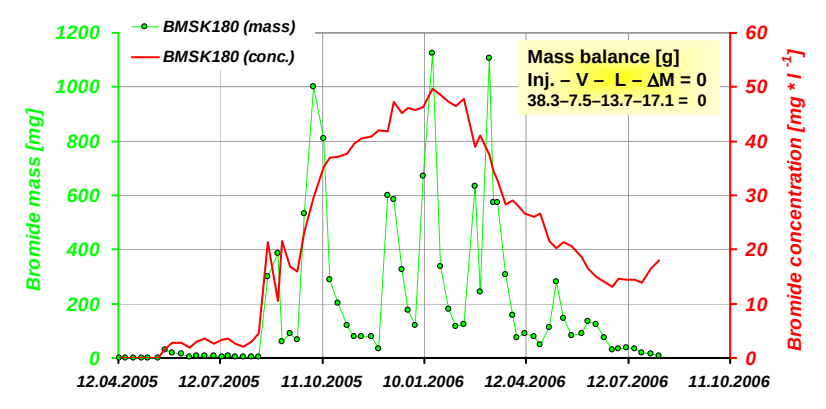
D

Unsaturated Zone – Soil Physics



Soil physics (water content, matric suction):
comparison of different data bases

D Unsaturated Zone – Tracer Balance



Tracing experiment: tracer mass balance

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D Agriculture – Crop Development

02.06.2005, 06.07.2005, 03.08.2005,
25.08.2005, 13.09.2005, 24.09.2005

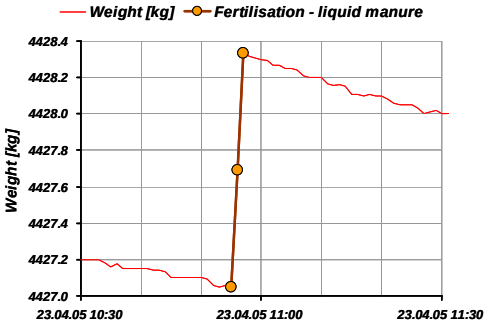
10

D Agriculture – Plant and Yield Data

Yield and plant content

	organic farming				conventional farming				
Sample	**Tendril**	**Pumpkin seeds**	**Pumpkin pulp**	**cum. sum**	**rotten pumpkin**	**Tendril**	**Pumpkin seeds**	**Pumpkin pulp**	**cum. sum**
Dry weight [kg/m²]	0.030	0.141	0.366	0.537	0.053	0.036	0.091	0.139	0.319
Harvesting weight [kg/m²]	0.033	0.233	6.544	6.810	0.097	0.042	0.147	1.847	2.133
Water content [kg/m²]	0.003	0.092	6.178	6.273	0.044	0.006	0.056	1.708	1.814
Nitrogen (Kjehldahl) [g/100g]	1.560	5.890	1.965		4.890	1.500	5.580	1.595	
[kg/ha]	4.674	82.891	72.010	159.576	25.898	5.450	50.856	22.095	104.299
Phosphorus [g/100g]	0.180	1.000	0.185		1.050	0.300	1.140	0.290	
[kg/ha]	0.539	14.073	6.780	21.392	5.561	1.090	10.390	4.017	21.058
Potassium [g/100g]	0.740	0.520	3.815		1.700	0.930	0.660	4.620	
[kg/ha]	2.217	7.318	139.806	149.341	9.004	3.379	6.015	63.999	82.396
Calcium [g/100g]	4.420	0.050	0.655		0.820	3.590	0.060	0.350	
[kg/ha]	13.244	0.704	24.003	37.951	4.343	13.042	0.547	4.848	22.781
Carbon [g/100g]	61.200	95.300	83.750		86.100	64.000	94.700	82.400	
[kg/ha]	183.380	1341.176	3069.136	4593.692	456.003	232.512	863.096	1141.446	2693.057
Magnesium [g/100g]	0.280	0.390	0.205		0.450	0.260	0.460	0.140	
[kg/ha]	0.839	5.489	7.513	13.840	2.383	0.945	4.192	1.939	9.460
Boron [mg/1000g]	22.400	25.400	48.200		39.500	11.400	22.200	47.250	
[kg/ha]	0.007	0.036	0.177	0.219	0.021	0.004	0.020	0.065	0.111
Manganese [mg/1000g]	316.100	47.800	17.400		115.400	381.600	44.700	7.750	
[kg/ha]	0.095	0.067	0.064	0.226	0.061	0.139	0.041	0.011	0.251
Sodium [mg/1000g]	111.600	13.700	46.550		27.200	138.700	17.600	38.950	
[kg/ha]	0.033	0.019	0.171	0.223	0.014	0.050	0.016	0.054	0.135
Copper [mg/1000g]	12.220	12.250	8.380		15.660	10.350	10.110	7.615	
[kg/ha]	0.004	0.017	0.031	0.052	0.008	0.004	0.009	0.011	0.032
Zinc [mg/1000g]	53.600	99.000	33.850		92.700	51.600	118.800	29.350	
[kg/ha]	0.016	0.139	0.124	0.279	0.049	0.019	0.108	0.041	0.217
Iron [mg/1000g]	8774.000	102.600	288.900		1406.300	10673.900	118.800	120.300	
[kg/ha]	2.629	0.144	1.059	3.832	0.745	3.878	0.108	0.167	4.898

D Agriculture – Fertilisation



10:55 – 10:57
Δ weight = 1.382 kg
~ 12.830 kg * ha^{-1}

Video surveying system to check fertilisation (left) and
lysimeter data to quantify the amount of fertilisation applied

D

Conclusion

When models are or will be applied to larger areas, they have to be …

✓ validated on real data and

✓ calibrated regionally

as information of a single point (lysimeter) is used.

Numerical models have to be capable of simulating measured data of water and solute parameters of well known lysimeters before they are applied regionally (where less data is available).

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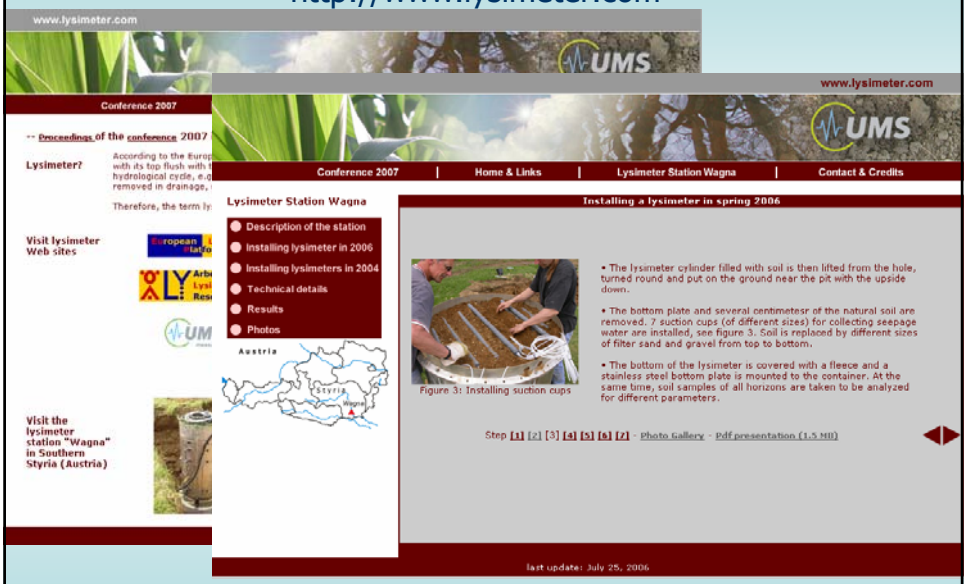
Site characterisation, technical description, results, photos …:
http://www.lysimeter.com



Thank you for your attention!