Die Bedeutung räumlicher Strukturen und Muster für das hydrologische Prozessgeschehen

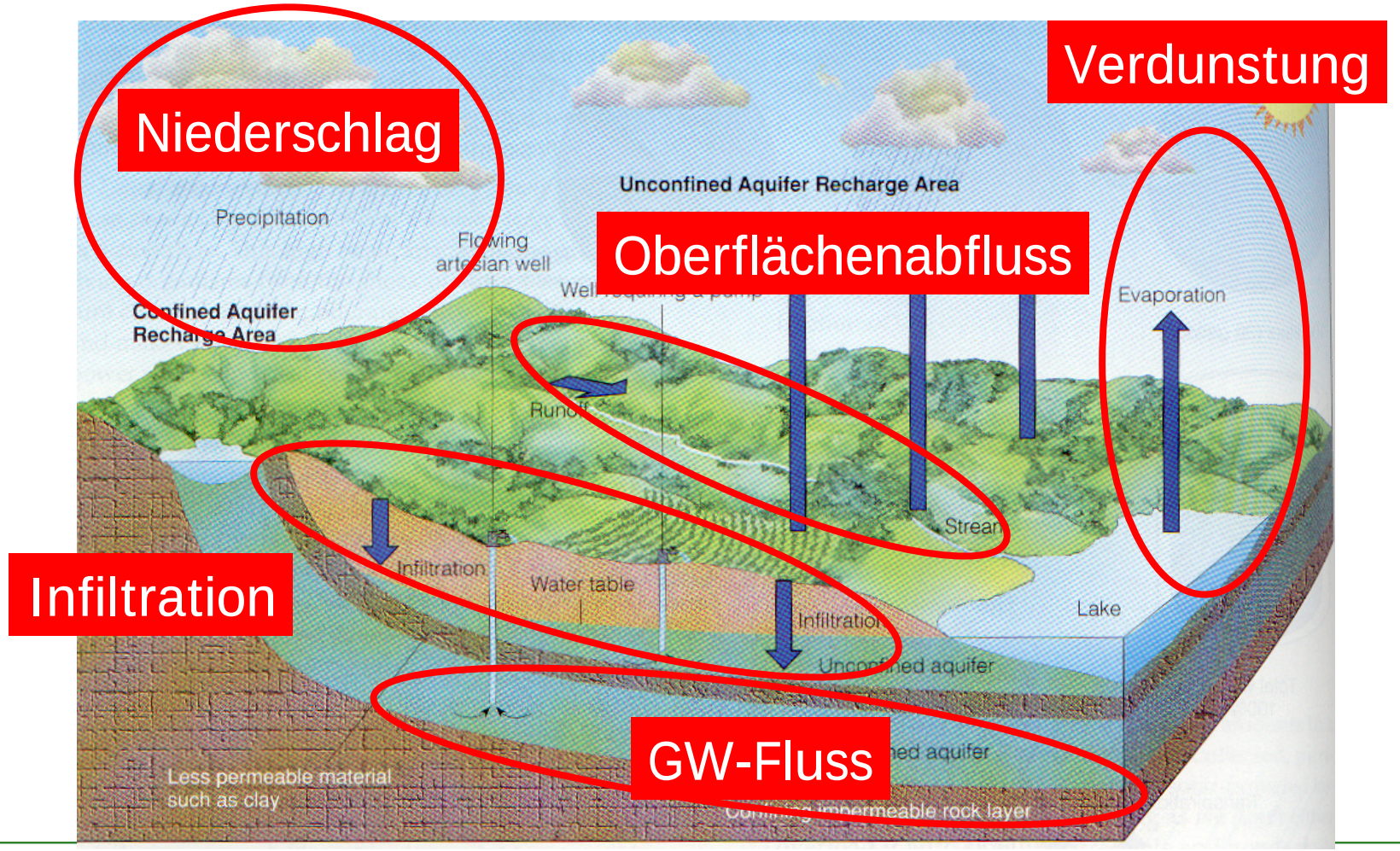
Dr. Karsten Schulz

Fachbereich Umweltsystemmodellierung
UFZ - Umweltforschungszentrum Leipzig-Halle

Inhalt

- Bedeutung hydrologischer Prozesse
- Einfluss von Strukturen
  - Infiltration
  - Oberflächenabfluss
  - Verdunstung
- Forschungsbedarf
- Zukünftige Aktivitäten

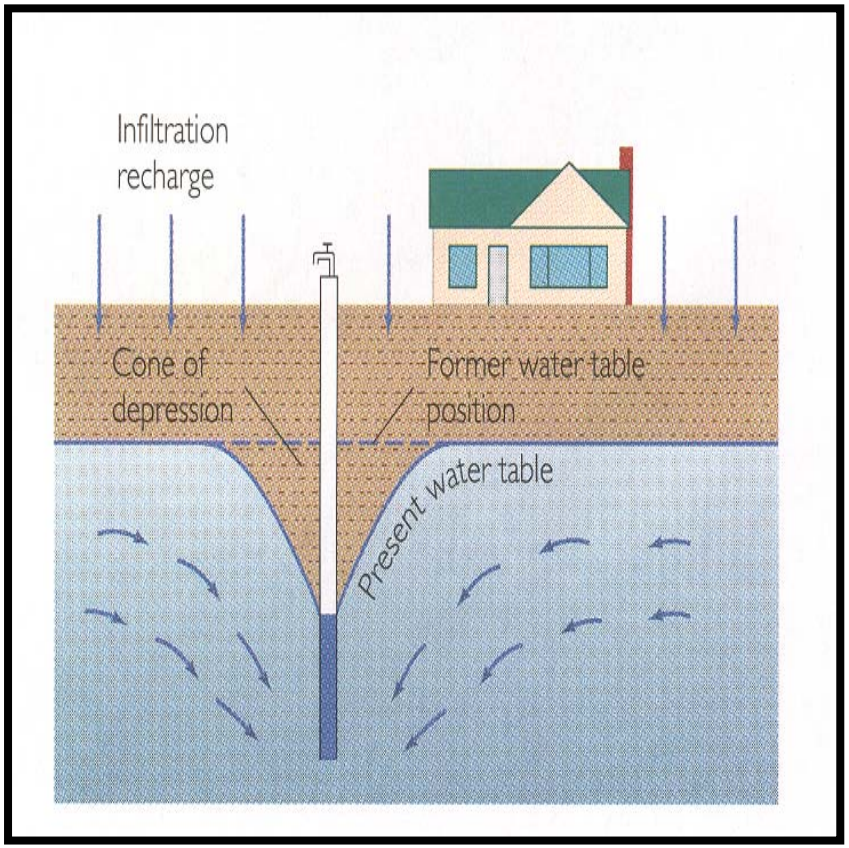
Bedeutung hydrologischer Prozesse



(aus Miller, 1990)

Bedeutung hydrologischer Prozesse

- Trinkwasser



Bedeutung hydrologischer Prozesse

- Trinkwasser
- Landwirtschaftliche Produktion

Bedeutung hydrologischer Prozesse

- Trinkwasser
- Landwirtschaftliche Produktion
- Transport und Verlagerung von Schad- und Nährstoffen

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- Trinkwasser
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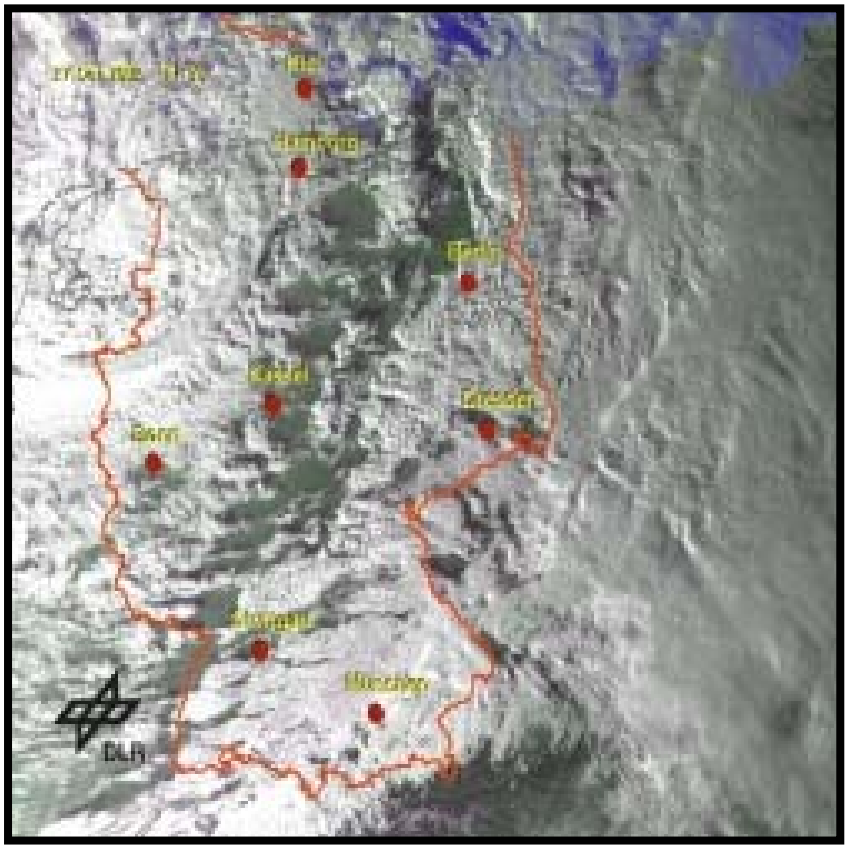
- Transport und Verlagerung von Schad- und Nährstoffen
- Klima und Wetter

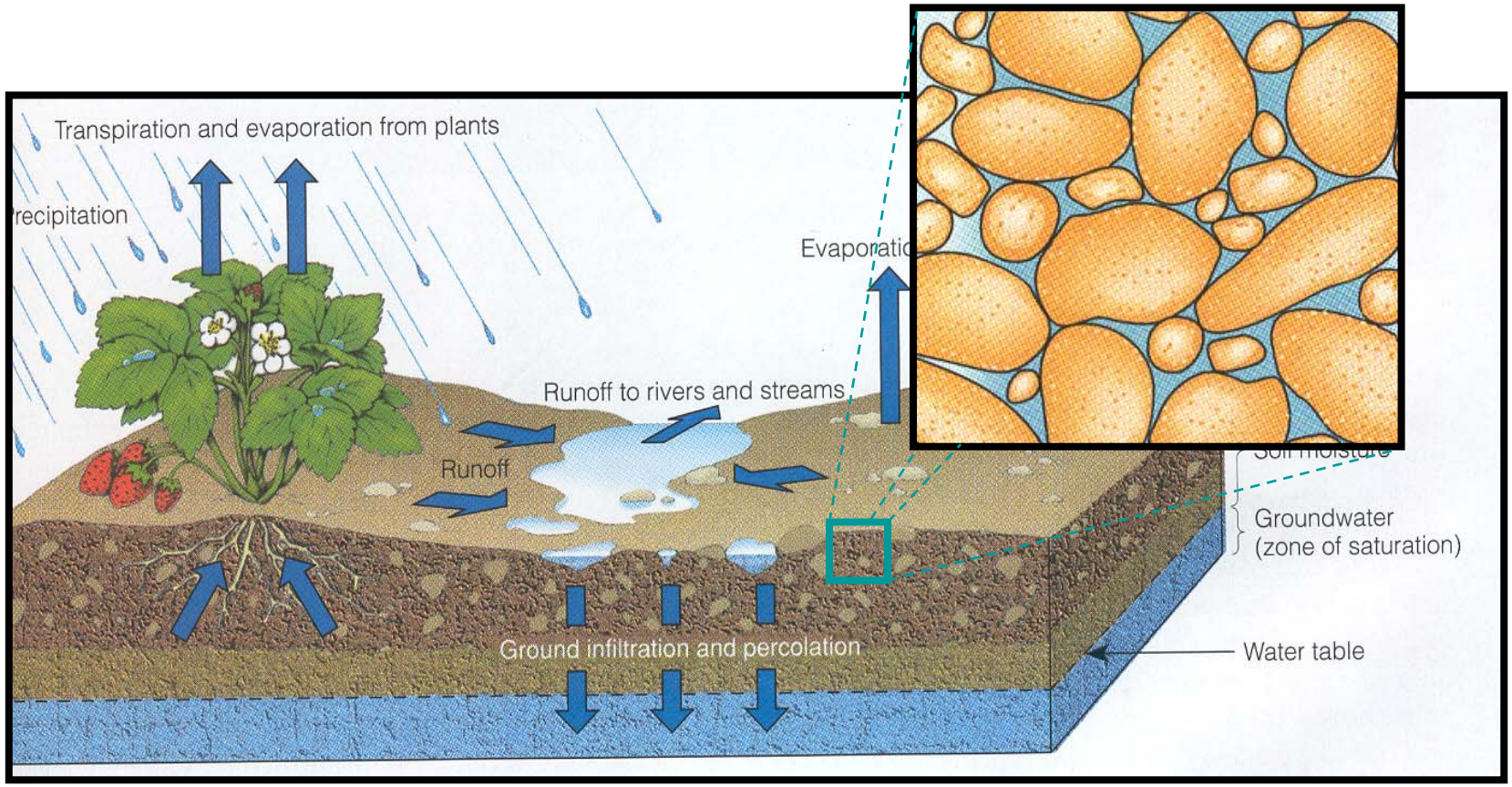


Bedeutung hydrologischer Prozesse

- Trinkwasser
- Landwirtschaftliche Produktion
- Transport und Verlagerung von Schad- und Nährstoffen
- Klima und Wetter
- Hochwasser

Landschaftswasserhaushalt

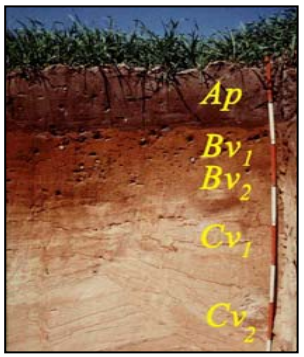
Wassergehalte an der Bodenoberfläche



(aus Miller, 1990)

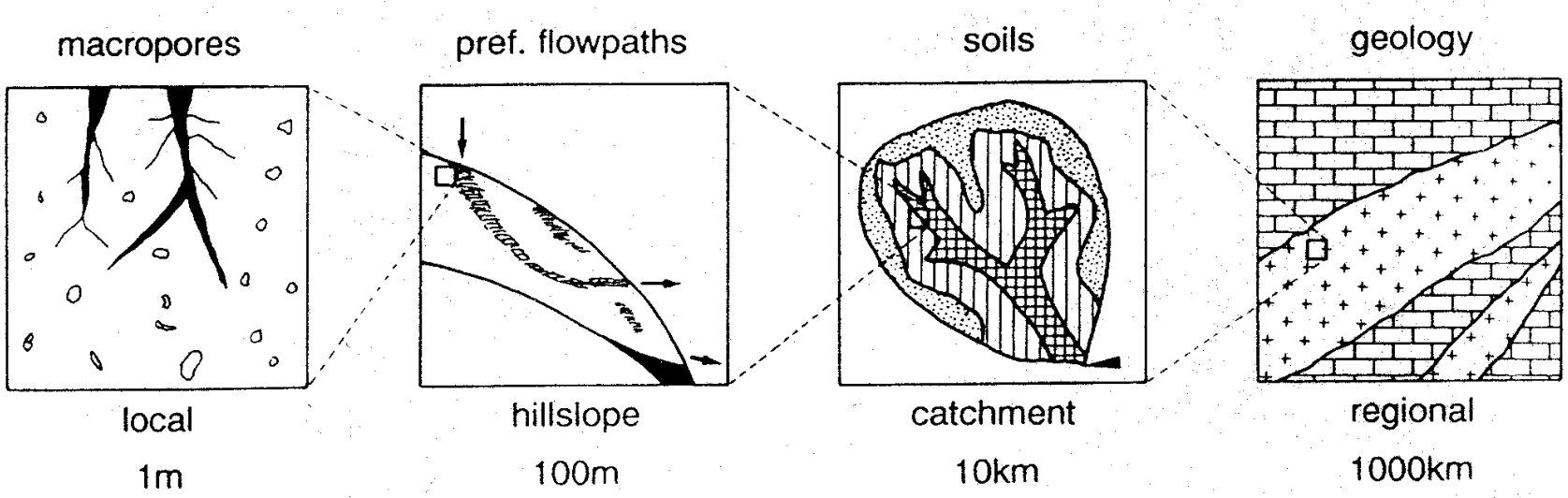
Skalenproblematik

Labor (REV) → **Feld** → **Einzugsgebiet**



$$\psi, K_S, K_u \longrightarrow \overline{\psi}, \overline{K}_S, \overline{K}_u$$

Räumliche Variabilität - Skalen



Blöschl (1995)

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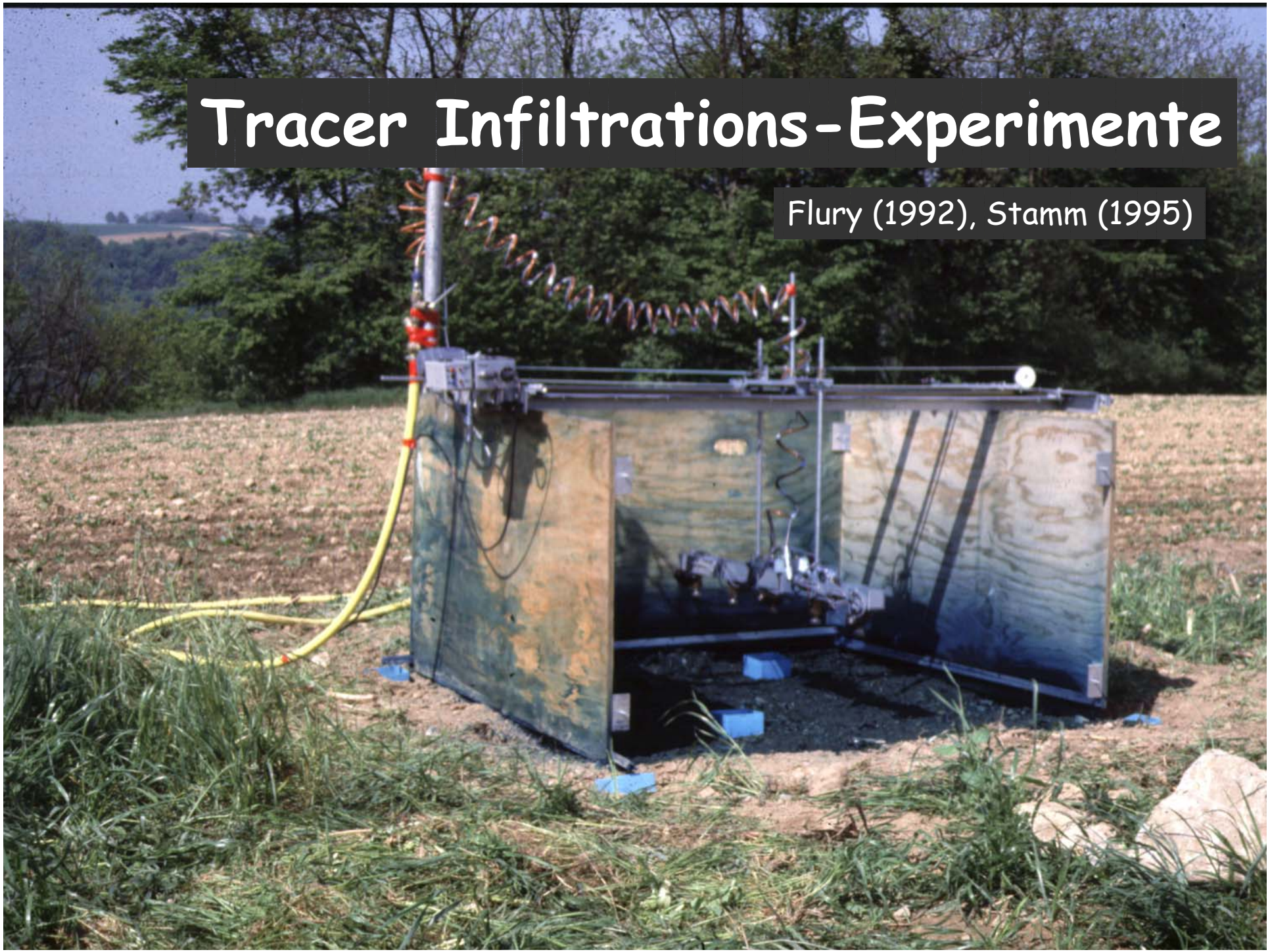
Tracer Infiltrations-Experimente

Flury (1992), Stamm (1995)



Strukturen - Infiltration

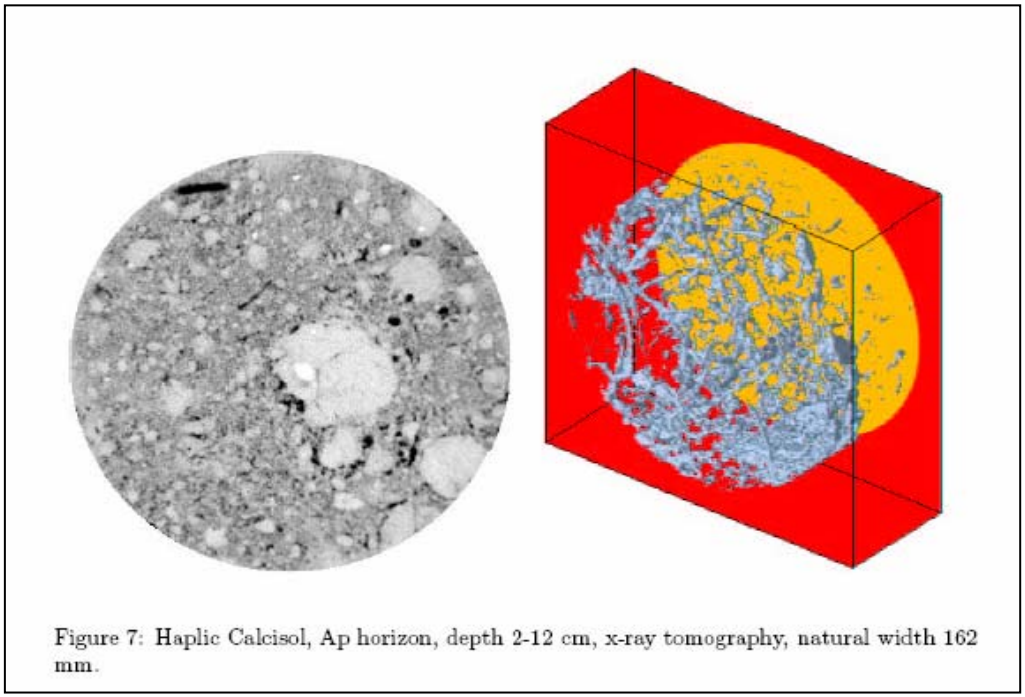


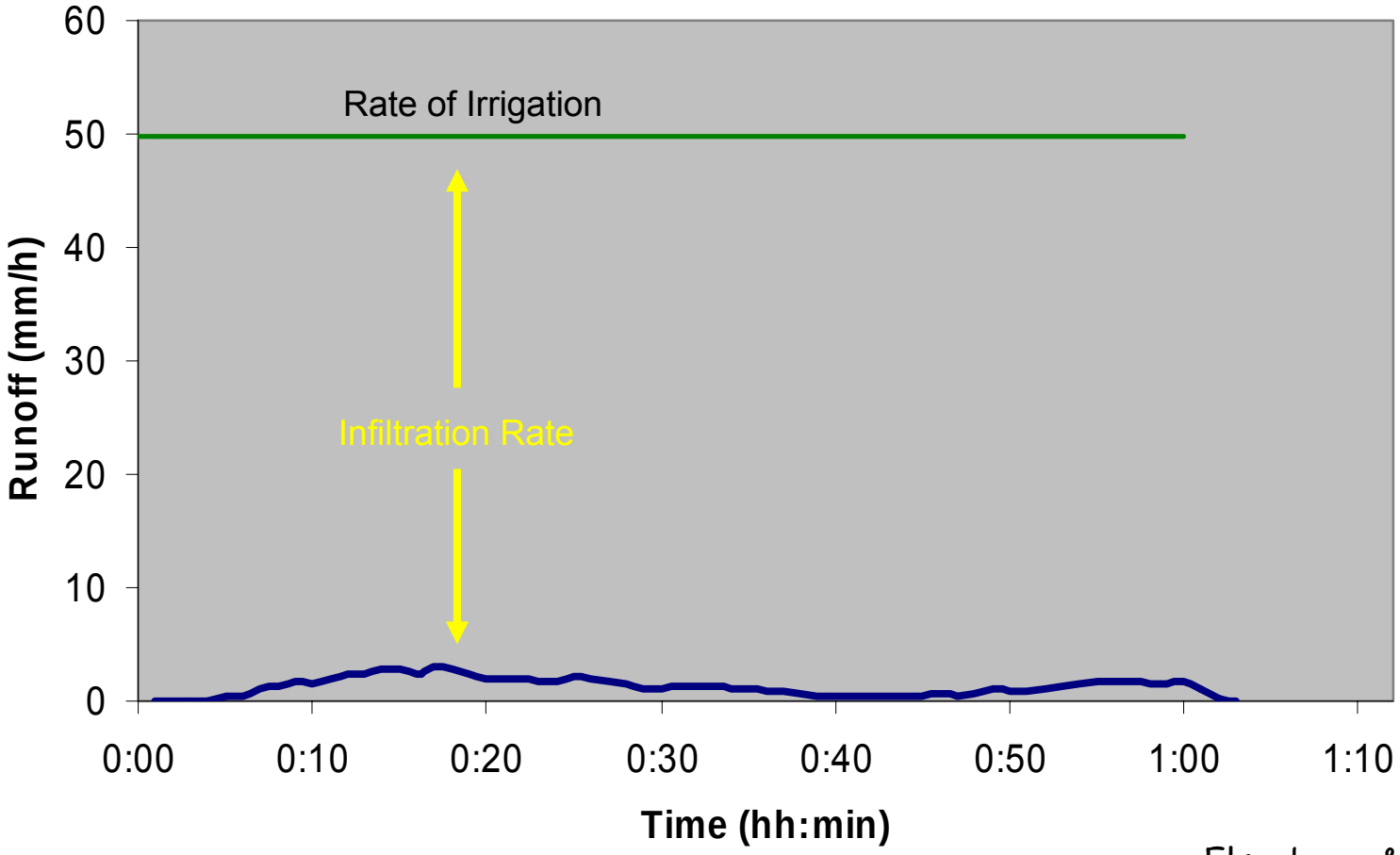
Figure 7: Haplic Calcisol, Ap horizon, depth 2-12 cm, x-ray tomography, natural width 162 mm.

Vogel & Babel (2004)

Oberflächenabfluss im Tropischen Regenwald

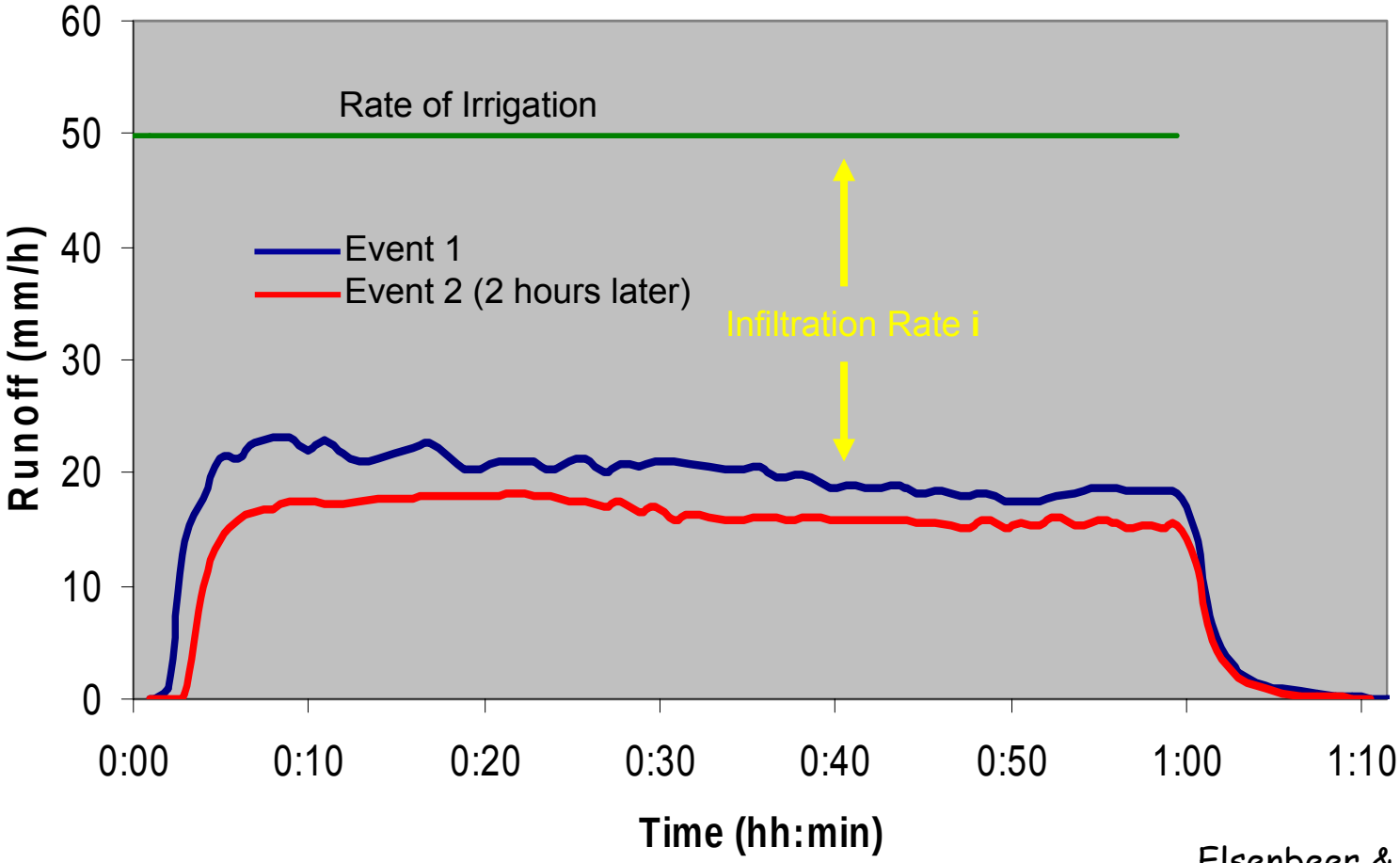
Elsenbeer & Godsey (2003)

Abflussbildung 1



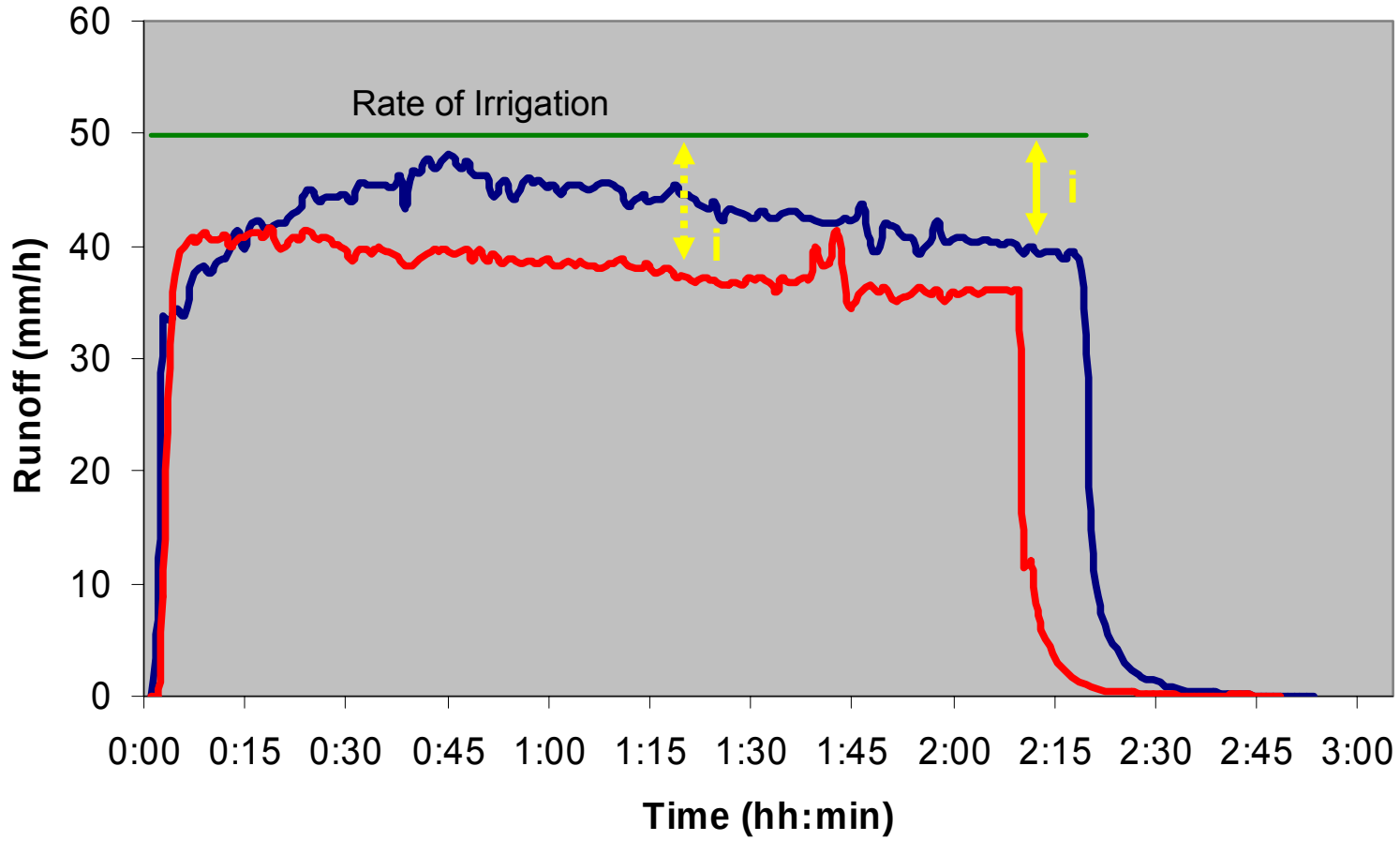
Elsenbeer & Godsey (2003)

Abflussbildung 2



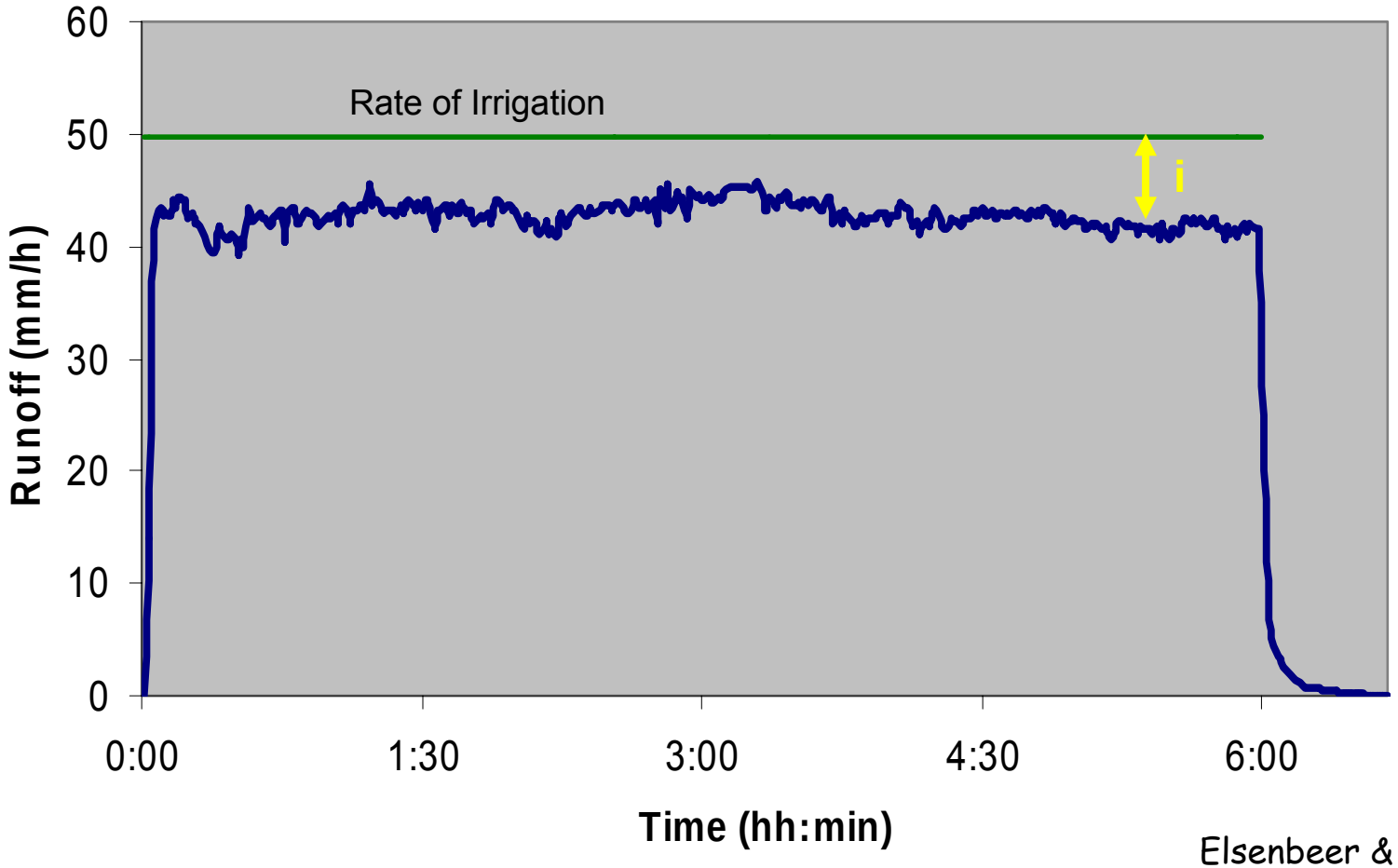
Elsenbeer & Godsey (2003)

Abflussbildung 3



Elsenbeer & Godsey (2003)

Abflussbildung 4

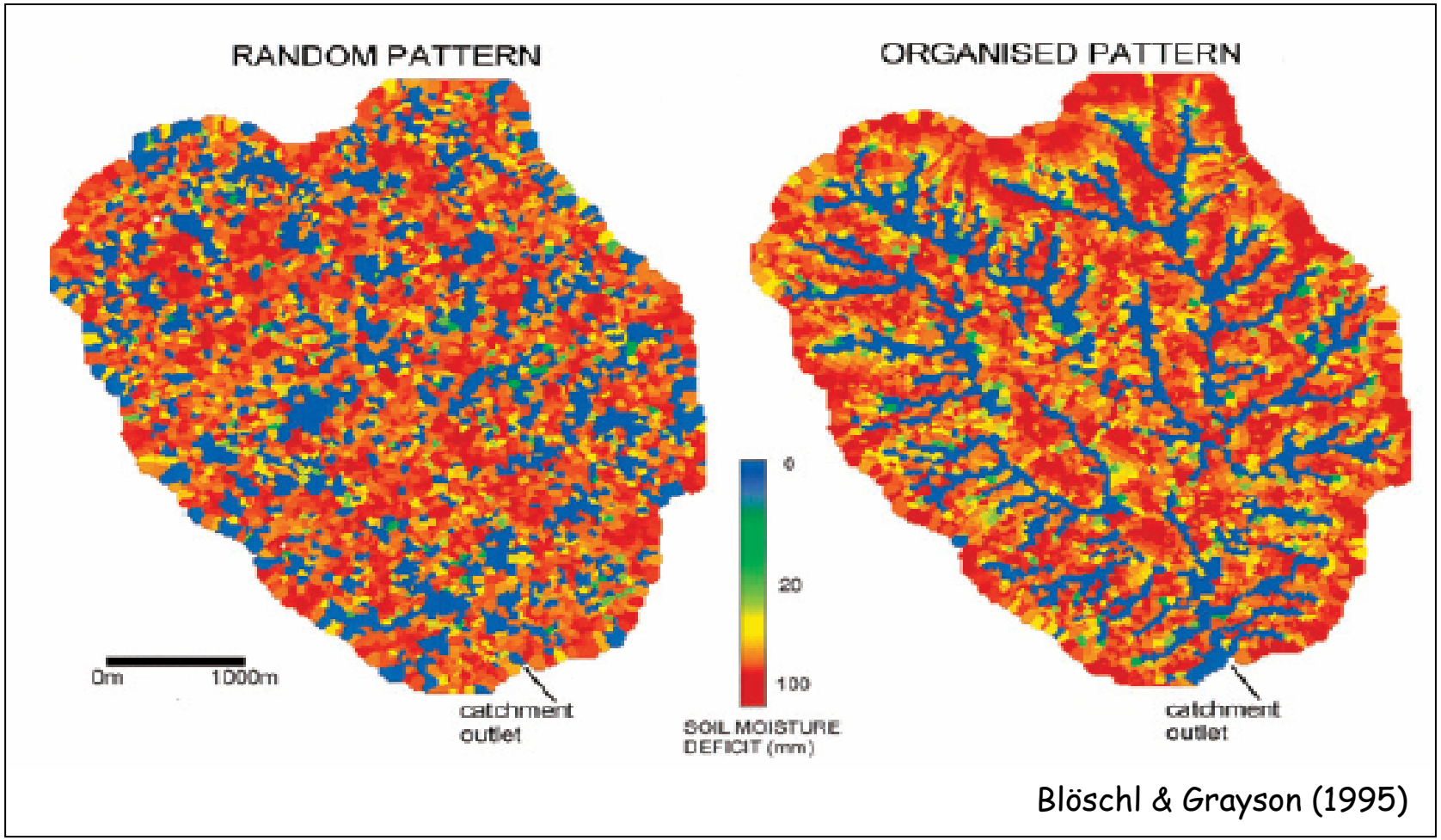


Elsenbeer & Godsey (2003)

Hydrophobizität

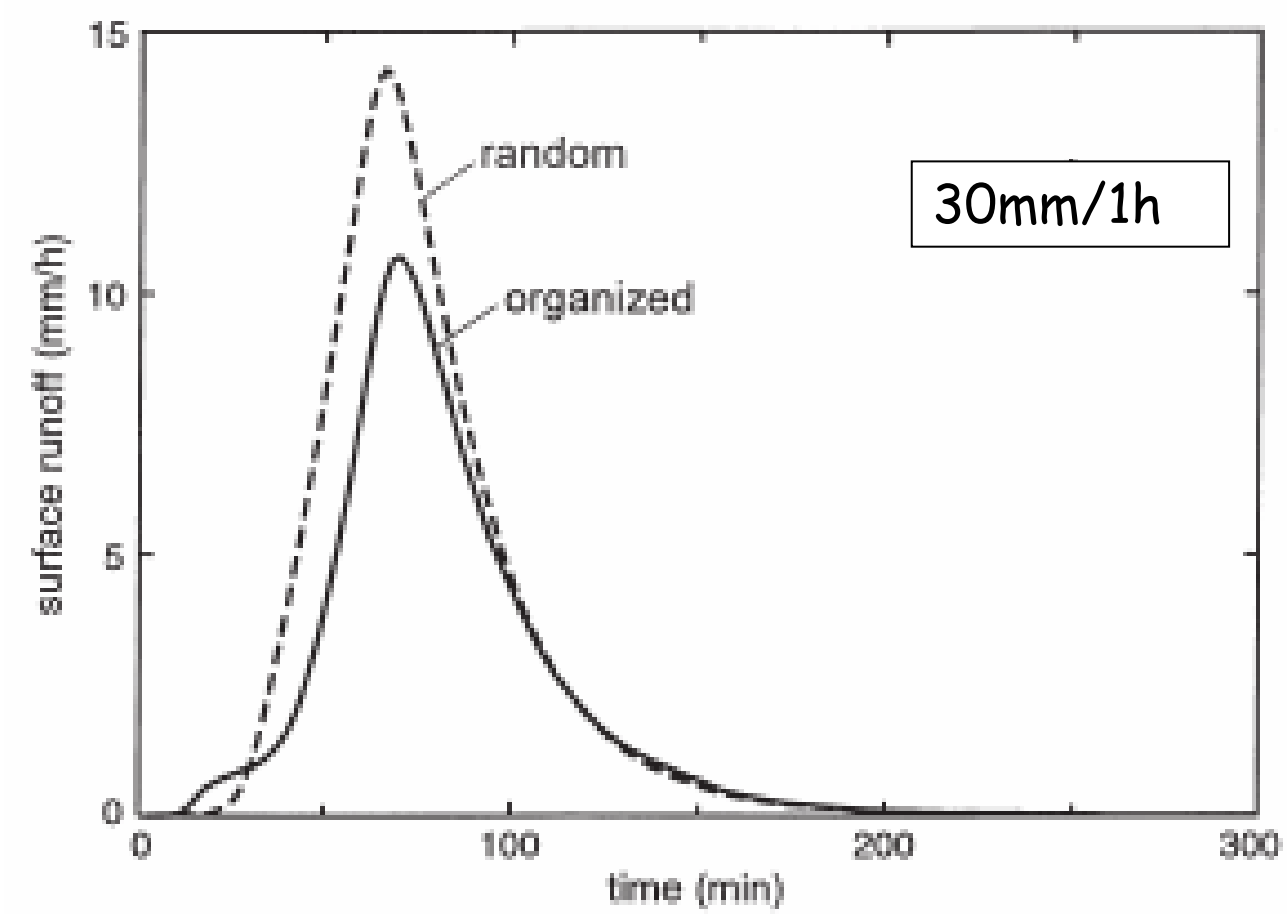
Durner (2000)

Strukturen - Runoff



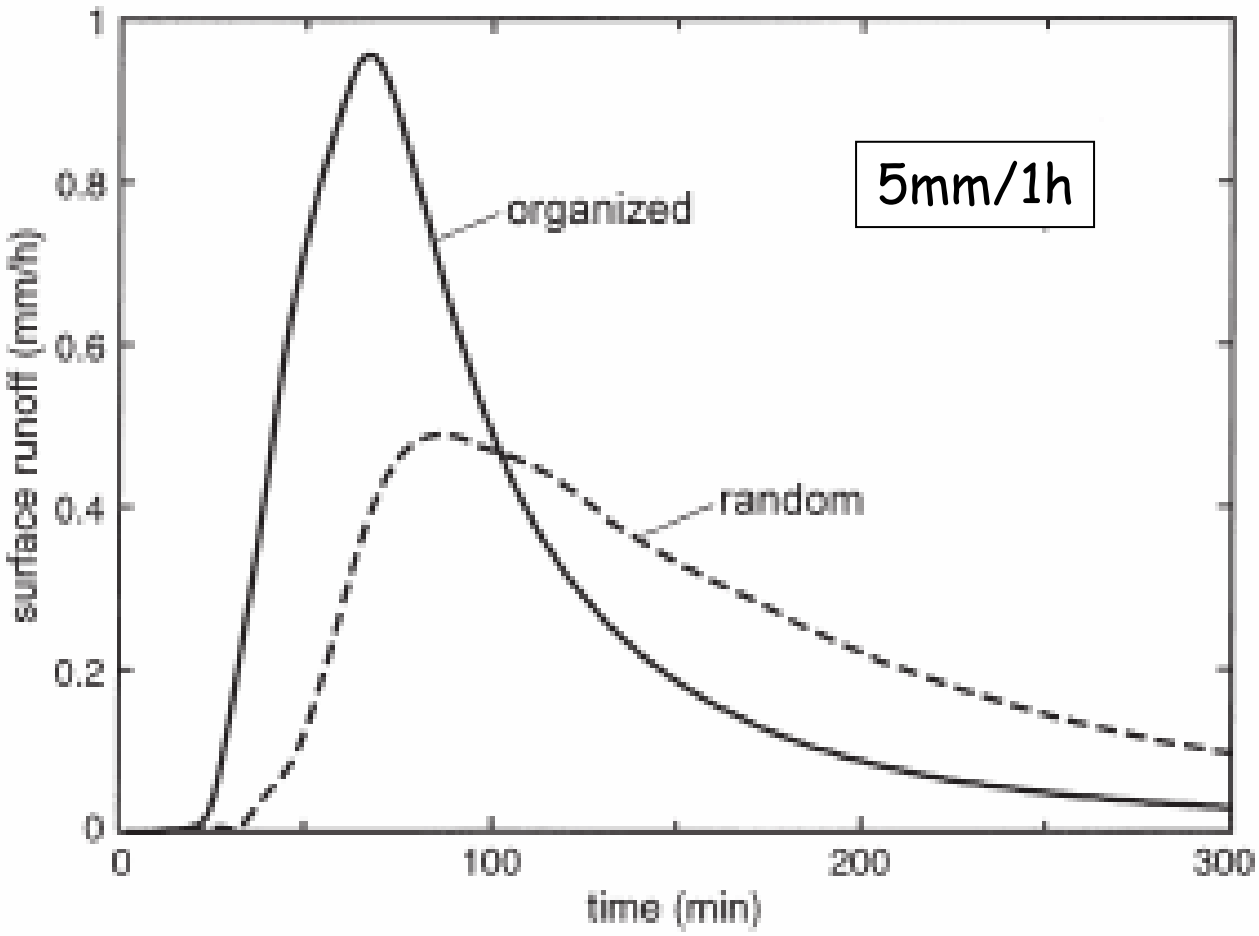
Blöschl & Grayson (1995)

Strukturen - Runoff



Blöschl & Grayson (1995)

Strukturen - Runoff



Blöschl & Grayson (1995)

Strukturen - Verdunstung

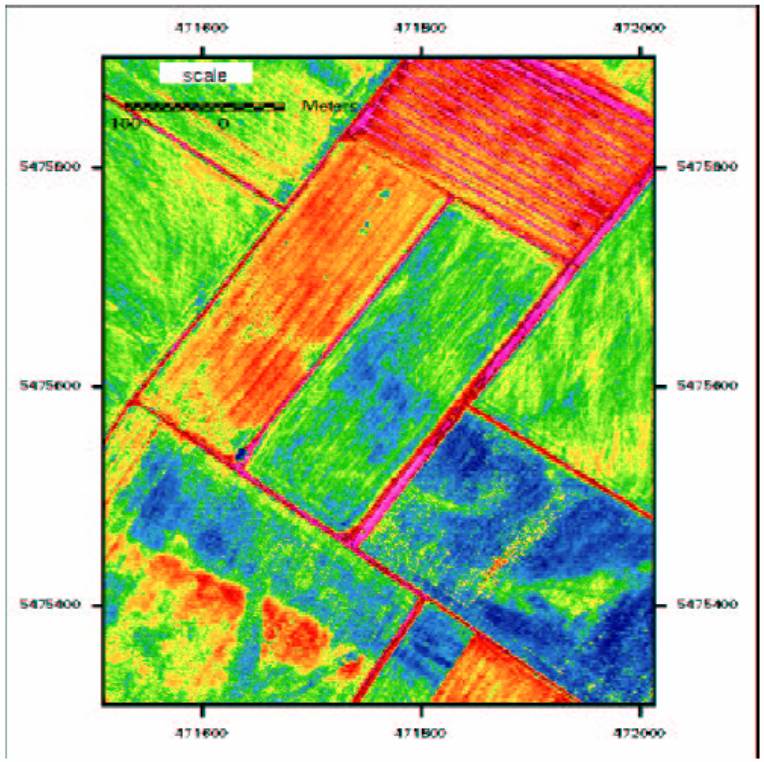
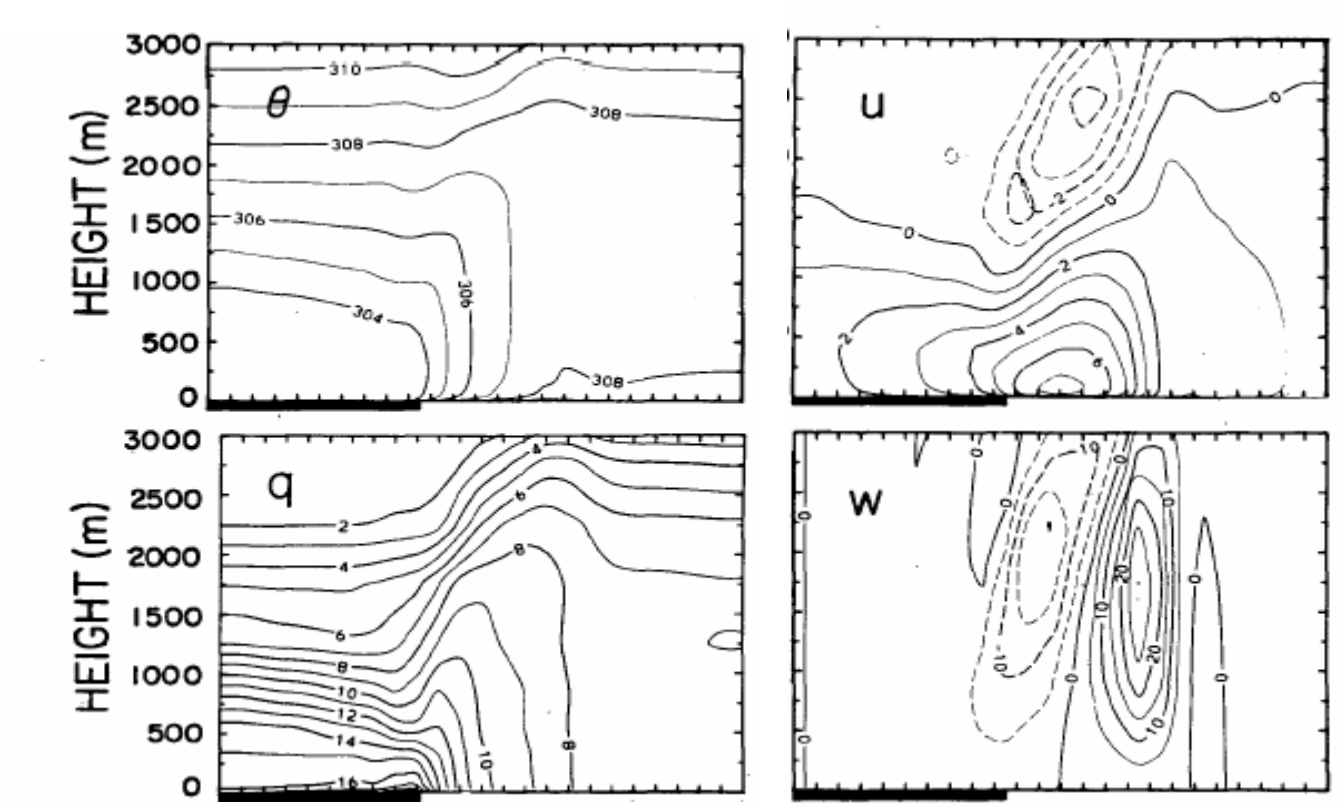


Figure 12: Air photograph of surface temperature, Rhein valley, Heidelberg, natural width 0.5 km.

Vogel & Babel (2004)

Strukturen - Verdunstung



Avissar & Pielke (1989)

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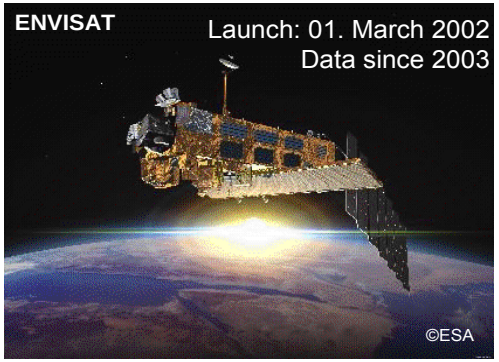
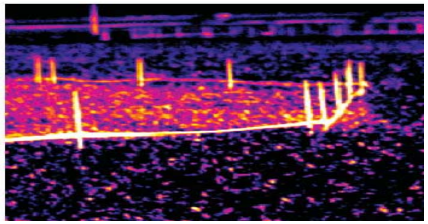
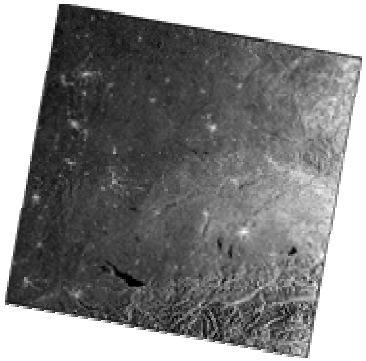
  - Verdunstung
- **Forschungsbedarf**
- Zukünftige Aktivitäten

Forschungsbedarf

- Erfassen von Strukturen und ihrer Dynamik
  - Fernerkundung







Forschungsbedarf

- Erfassen von Strukturen und ihrer Dynamik
  - Fernerkundung
  - Geophysikalische Methoden

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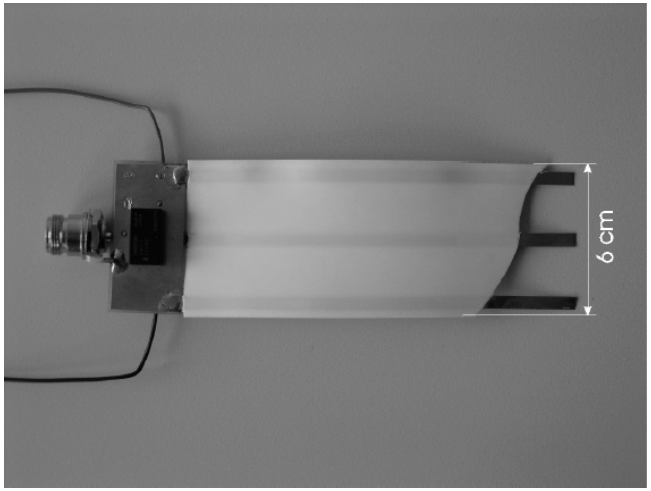
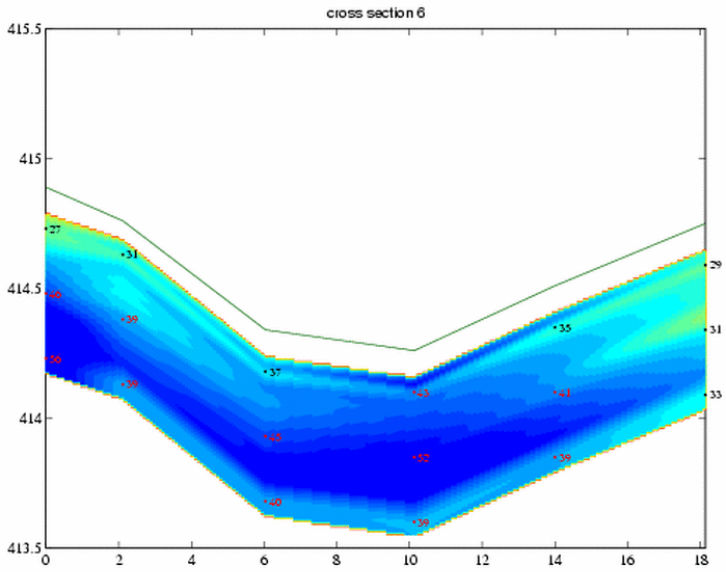


Schlaeger (2005)



Schädel (2003)

Forschungsbedarf

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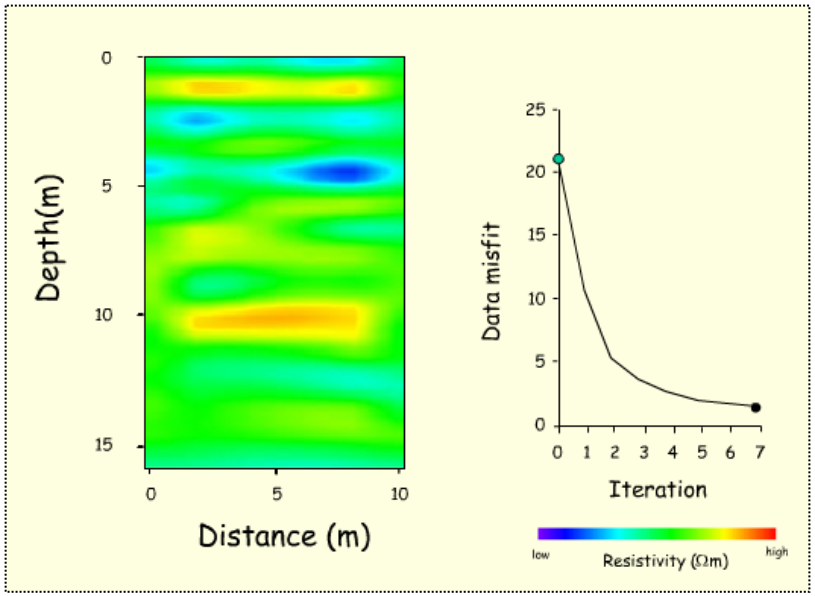
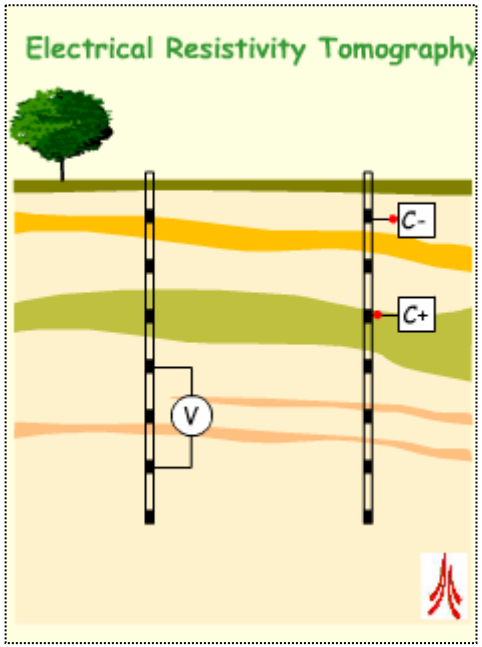




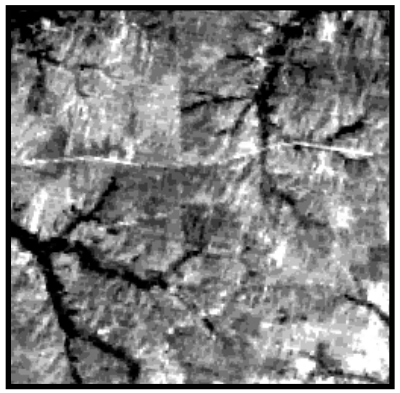
Binley (2004)

Forschungsbedarf

- Erfassen von Strukturen und ihrer Dynamik
  - Fernerkundung
  - Geophysikalische Methoden
- Mathematische Beschreibung
  - Topologie, Mathematische Morphologie

Variabilität

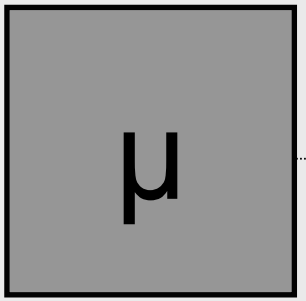
„Realität"

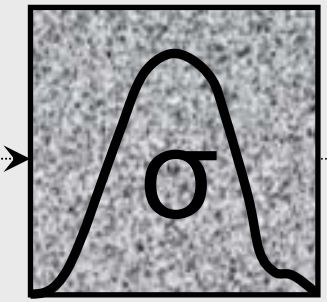


?

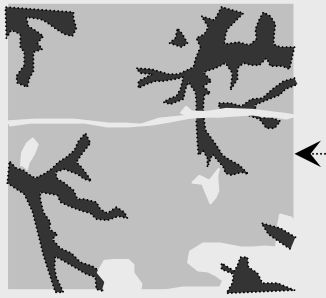
Mittelwert

Varianz

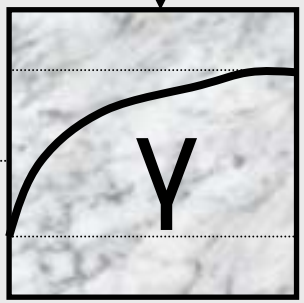




Topologie/Struktur



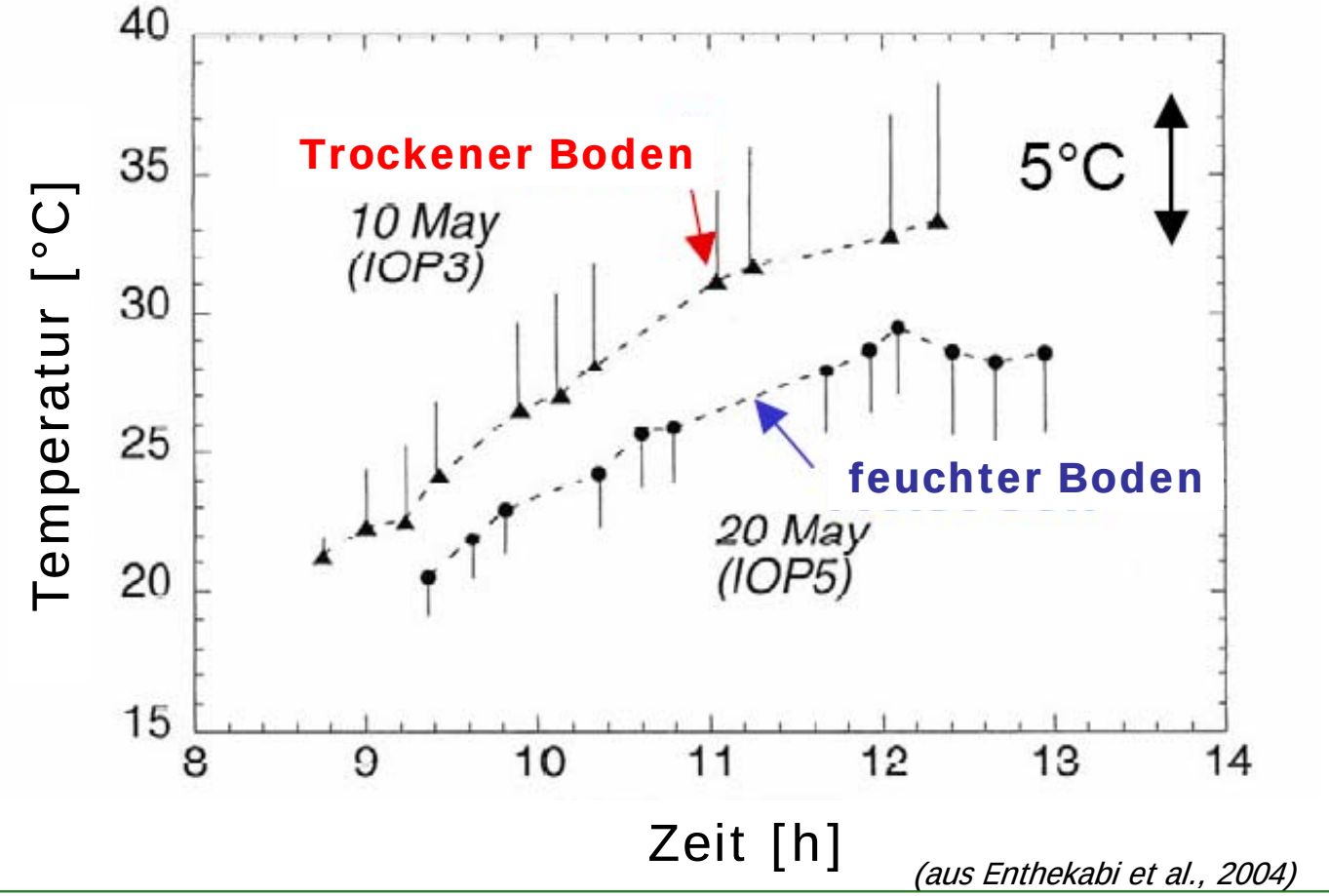
Semivarianz



Forschungsbedarf

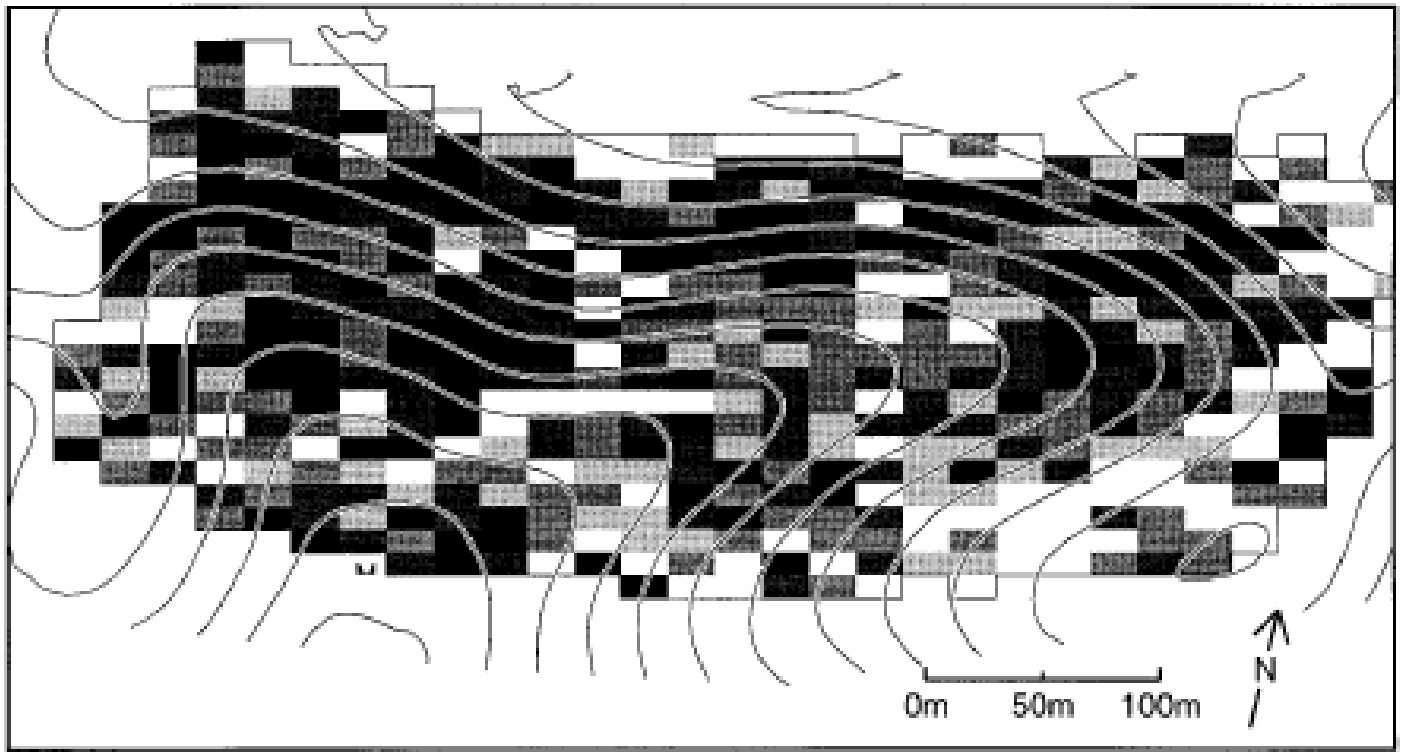
- Erfassen von Strukturen und ihrer Dynamik
  - Fernerkundung
  - Geophysikalische Methoden
- Mathematische Beschreibung
  - Geostatistik, Topologie, Mathematische Morphologie
- Zeitliche Dynamik

Verdunstung



(aus Enthekabi et al., 2004)

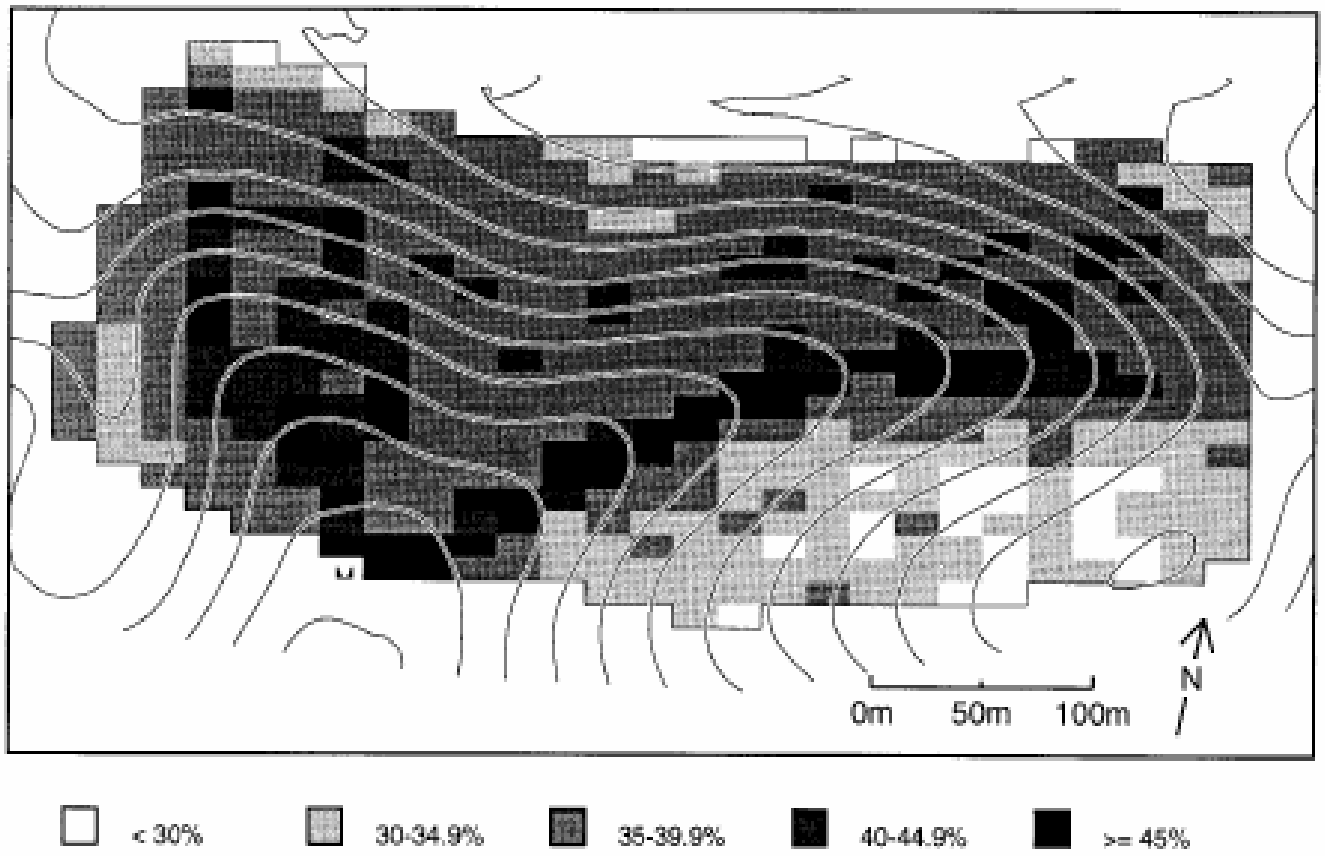
Strukturen - Verdunstung



< 19% 19-19.9% 20-20.9% 21-21.9% >= 22%

Grayson et al. (1997)

Strukturen - Verdunstung



Grayson et al. (1997)

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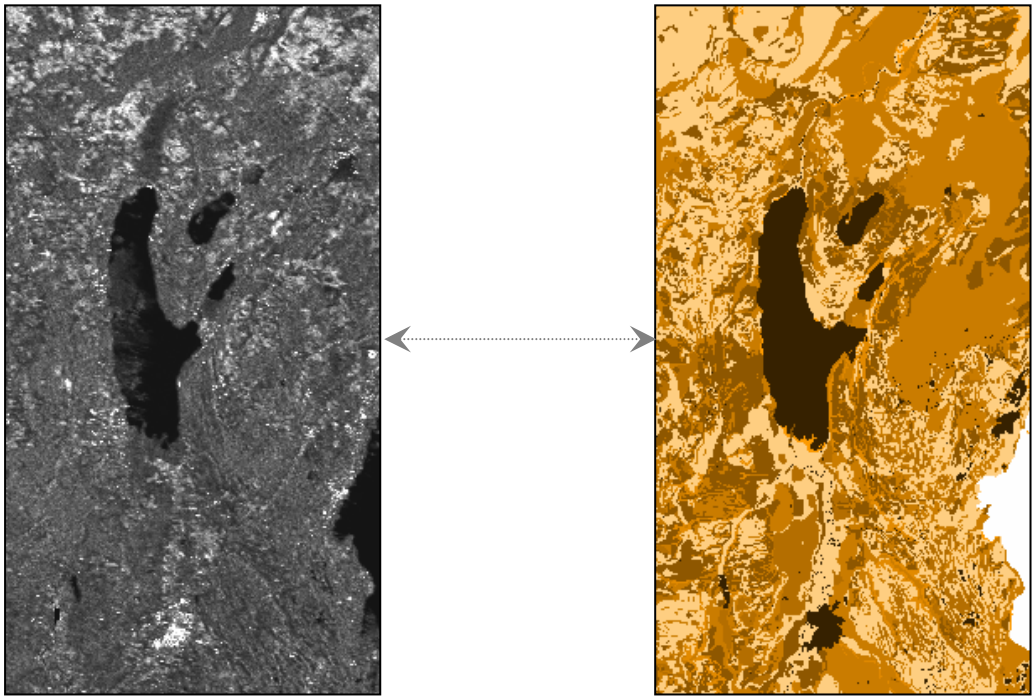
  - Geostatistik, Topologie, Mathematische Morphologie
- Zeitliche Dynamik
- Zusammenhang zwischen Strukturen

Forschungsbedarf

Wassergehalt



Textur,

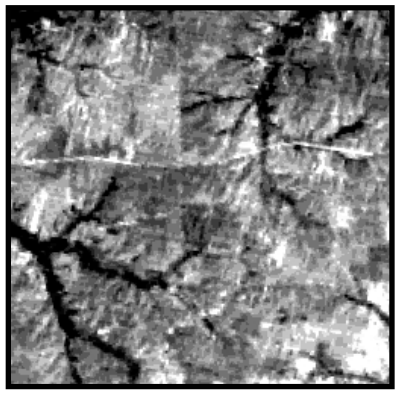
Oberflächen-
temperatur

PRI, Wetness Index

...

Variabilität

„Realität"



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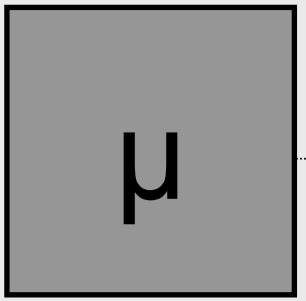
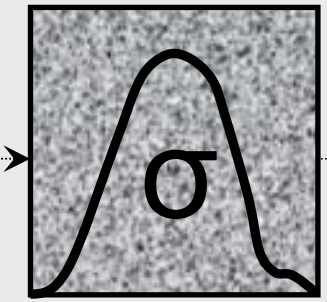
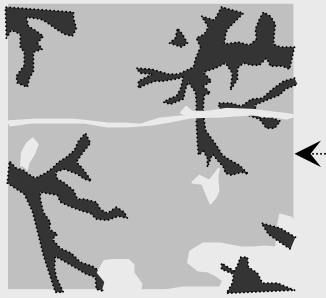
Mittelwert

Varianz

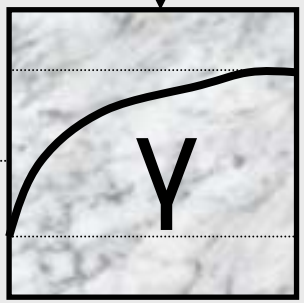




Topologie/Struktur



Semivarianz



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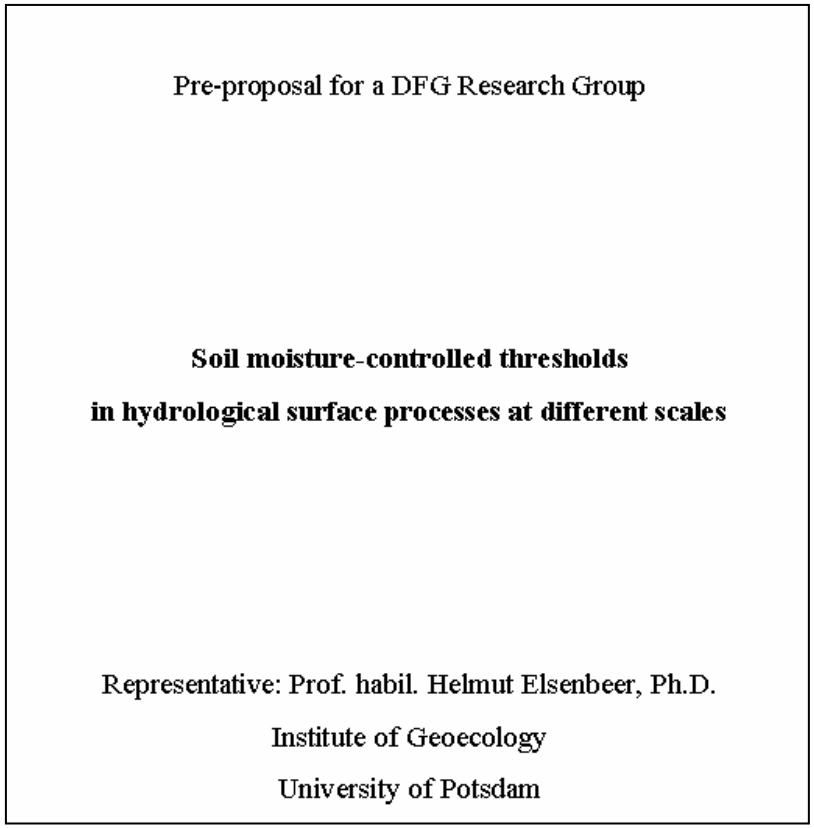
Aktivitäten

- DFG-Forschergruppe
  - BAT IIa (O) 50%



Pre-proposal for a DFG Research Group

Soil moisture-controlled thresholds

in hydrological surface processes at different scales

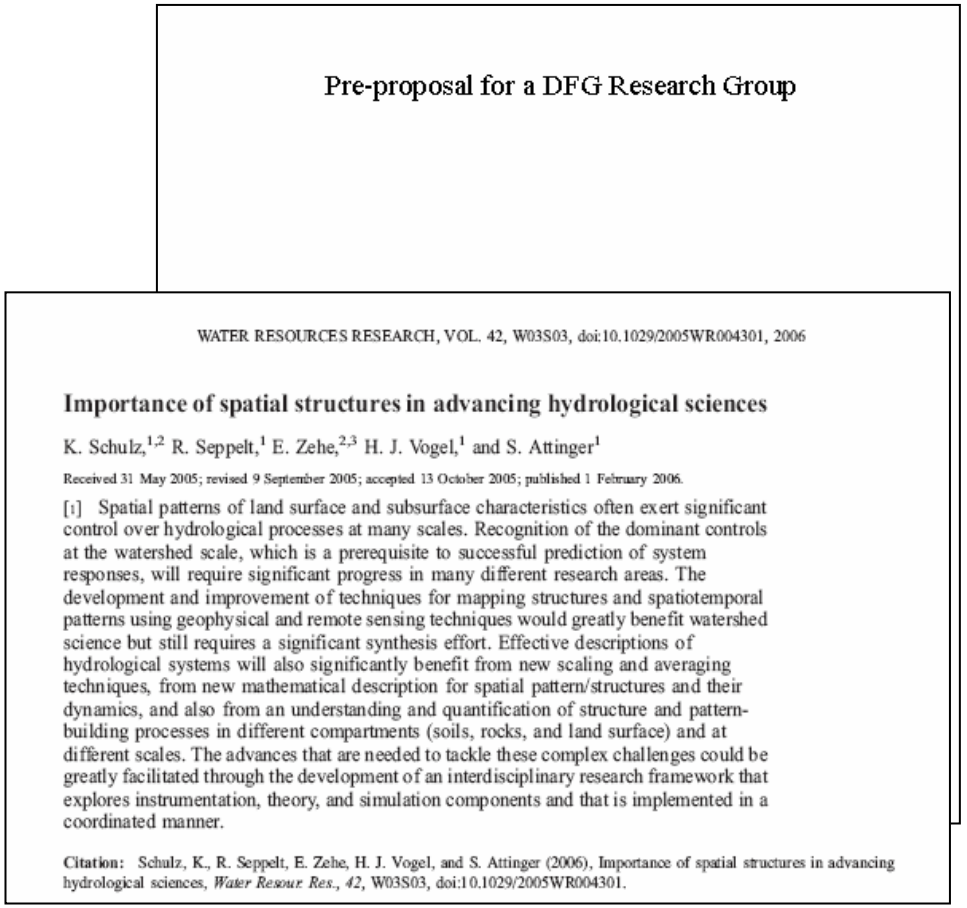
Representative: Prof. habil. Helmut Elsenbeer, Ph.D.

Institute of Geoecology

University of Potsdam

Aktivitäten

- DFG-Forschergruppe
  - BAT IIa (O) 50%
- „Vision“-Paper WRR



Pre-proposal for a DFG Research Group

WATER RESOURCES RESEARCH, VOL. 42, W03S03, doi:10.1029/2005WR004301, 2006

Importance of spatial structures in advancing hydrological sciences

K. Schulz,[1,2] R. Seppelt,[1] E. Zehe,[2,3] H. J. Vogel,[1] and S. Attinger[1]

Received 31 May 2005; revised 9 September 2005; accepted 13 October 2005; published 1 February 2006.

[1] Spatial patterns of land surface and subsurface characteristics often exert significant control over hydrological processes at many scales. Recognition of the dominant controls at the watershed scale, which is a prerequisite to successful prediction of system responses, will require significant progress in many different research areas. The development and improvement of techniques for mapping structures and spatiotemporal patterns using geophysical and remote sensing techniques would greatly benefit watershed science but still requires a significant synthesis effort. Effective descriptions of hydrological systems will also significantly benefit from new scaling and averaging techniques, from new mathematical description for spatial pattern/structures and their dynamics, and also from an understanding and quantification of structure and pattern-building processes in different compartments (soils, rocks, and land surface) and at different scales. The advances that are needed to tackle these complex challenges could be greatly facilitated through the development of an interdisciplinary research framework that explores instrumentation, theory, and simulation components and that is implemented in a coordinated manner.

Citation: Schulz, K., R. Seppelt, E. Zehe, H. J. Vogel, and S. Attinger (2006), Importance of spatial structures in advancing hydrological sciences, *Water Resour. Res.*, *42*, W03S03, doi:10.1029/2005WR004301.

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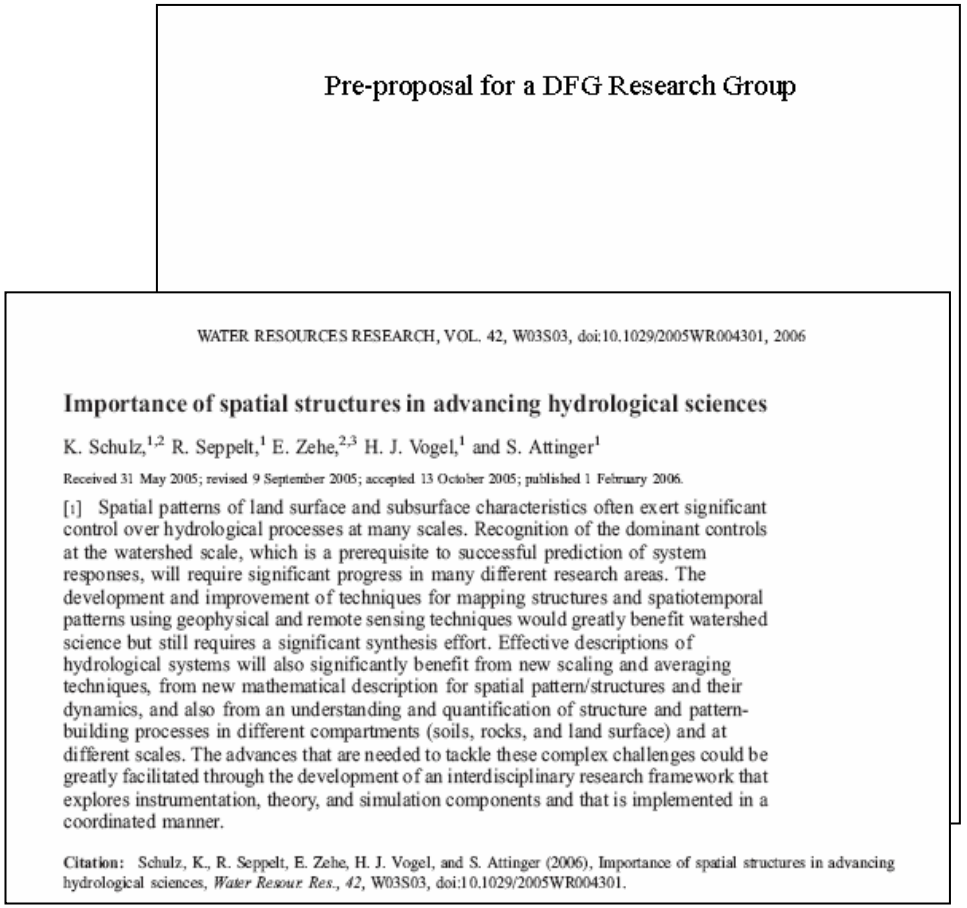
- „Vision“-Paper WRR
- UFZ – Projekt



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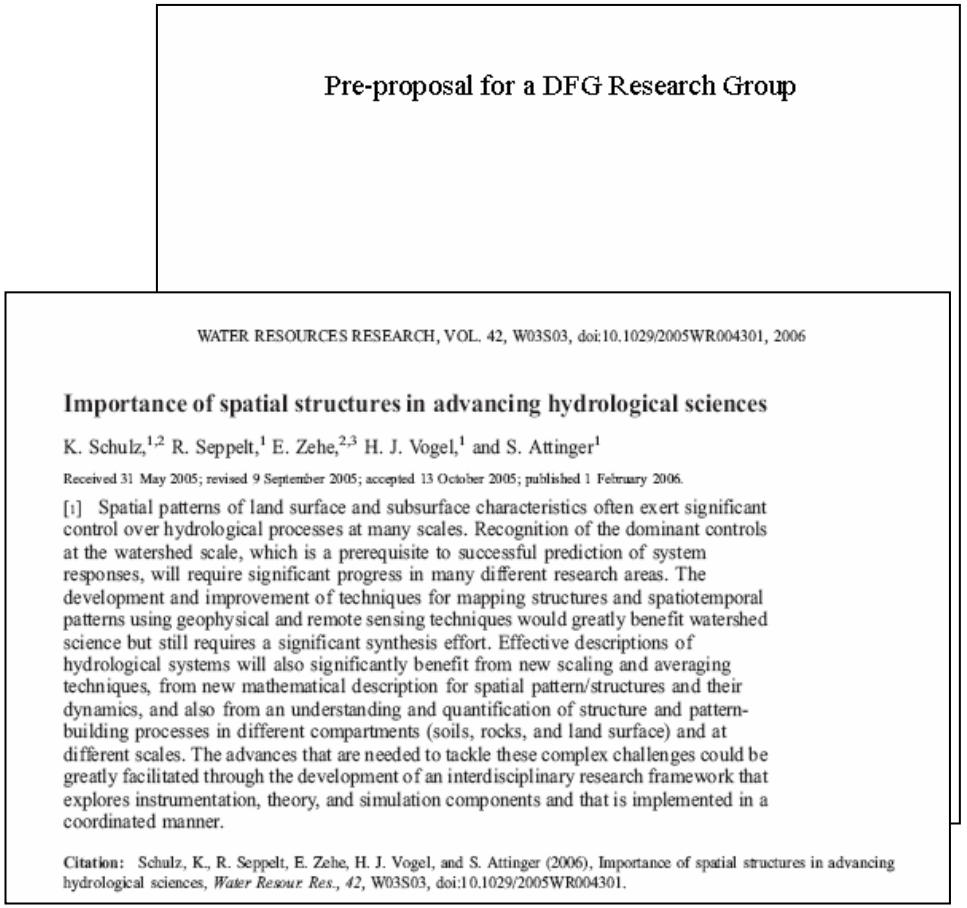
  - BAT IIa (O) 50%
- „Vision“-Paper WRR
- UFZ – Projekt
- Einbindung TERENO



Pre-proposal for a DFG Research Group

WATER RESOURCES RESEARCH, VOL. 42, W03S03, doi:10.1029/2005WR004301, 2006

Importance of spatial structures in advancing hydrological sciences

K. Schulz,[1,2] R. Seppelt,[1] E. Zehe,[2,3] H. J. Vogel,[1] and S. Attinger[1]

Received 31 May 2005; revised 9 September 2005; accepted 13 October 2005; published 1 February 2006.

[1] Spatial patterns of land surface and subsurface characteristics often exert significant control over hydrological processes at many scales. Recognition of the dominant controls at the watershed scale, which is a prerequisite to successful prediction of system responses, will require significant progress in many different research areas. The development and improvement of techniques for mapping structures and spatiotemporal patterns using geophysical and remote sensing techniques would greatly benefit watershed science but still requires a significant synthesis effort. Effective descriptions of hydrological systems will also significantly benefit from new scaling and averaging techniques, from new mathematical description for spatial pattern/structures and their dynamics, and also from an understanding and quantification of structure and pattern-building processes in different compartments (soils, rocks, and land surface) and at different scales. The advances that are needed to tackle these complex challenges could be greatly facilitated through the development of an interdisciplinary research framework that explores instrumentation, theory, and simulation components and that is implemented in a coordinated manner.

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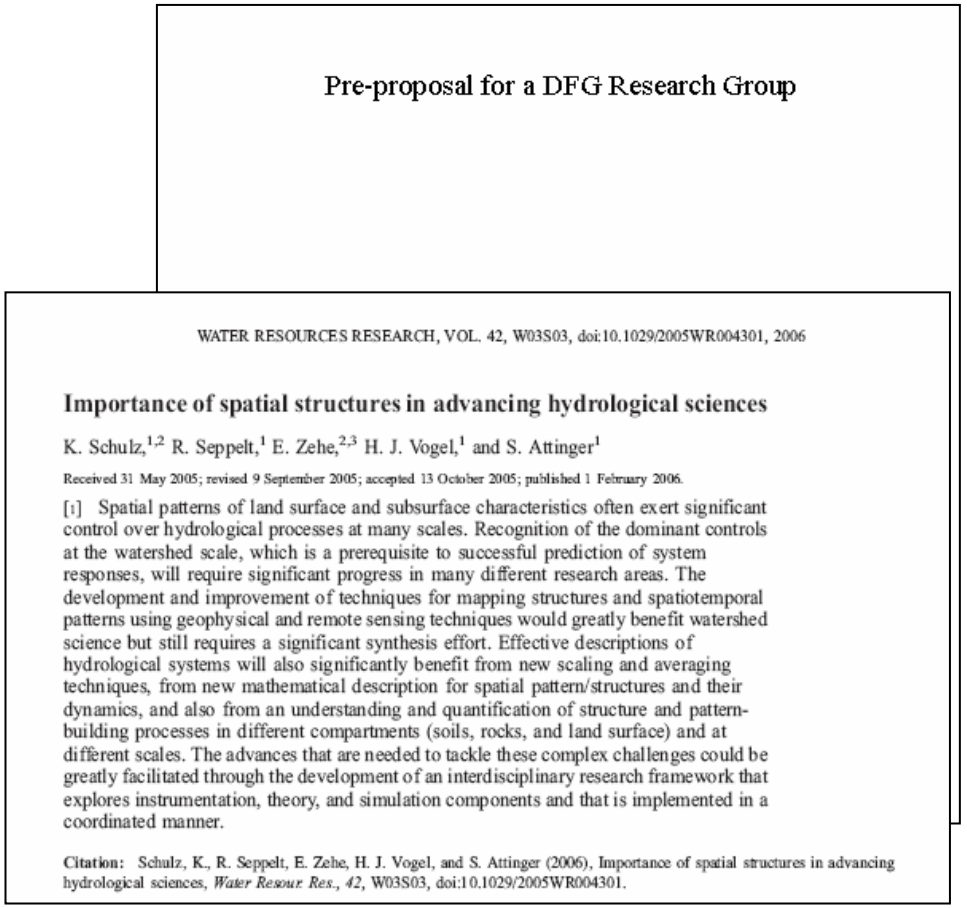
Aktivitäten

- DFG-Forschergruppe
  - BAT IIa (O) 50%
- „Vision“-Paper WRR
- UFZ – Projekt
- Einbindung TERENO
- ...



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