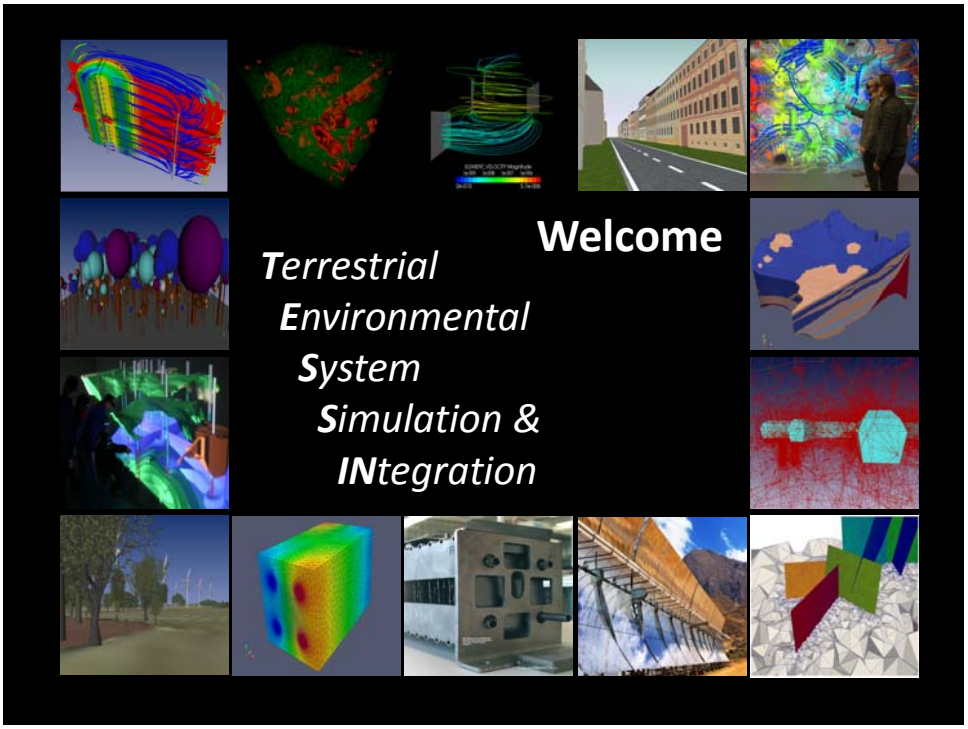
Hydroinformatics II
XMas Lecture 2012

Courtesy: Lars Bilke, Thomas Fischer, Jan Friesen, Thomas Kalbacher, Edda Kalbus, Rudolf Liedl, Karsten Rink, Tino Rödiger, Christian Siebert, Marc Walter, Björn Zehner



Contents

- *Framework: IWAS research project*
- *Data: … from the large scale (RS)*
- *Data: … ground truth*
- *Data: … preparation*
- *Model: Set-up*
- *Code: Requirements*
- *Model: Results*
- *Visualization*

Citation and sources

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IWAS – International Water Research Alliance Saxony

Management of water resources in hydrologically sensitive regions

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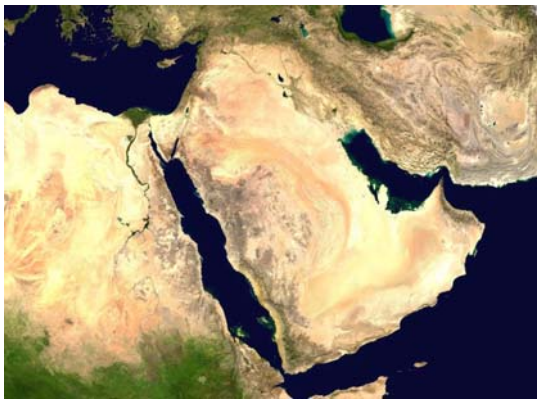
TECHNISCHE UNIVERSITÄT DRESDEN

Dornier Consulting

gtz

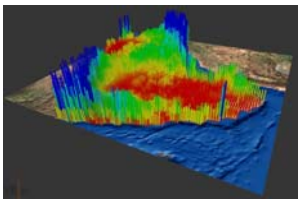


Middle East (Saudi Arabia, Oman)

funded by

Federal Ministry of Education and Research

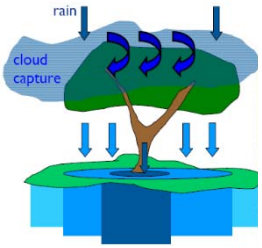
Water resources assessment in Arabian Peninsula



Jan Friesen

Climatic boundaries

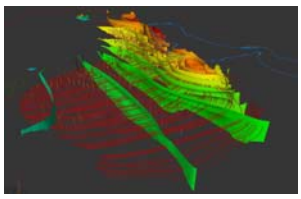
Vegetation



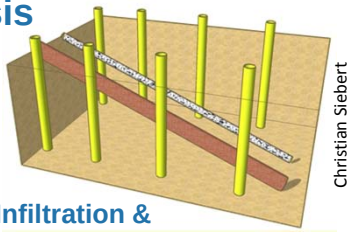
Anke Hildebrandt

Integrated hydrological synthesis

Groundwater



T Kalbacher / E Kalbus
Rudolf Liedl / Marc Walter



Christian Siebert

Infiltration & recharge

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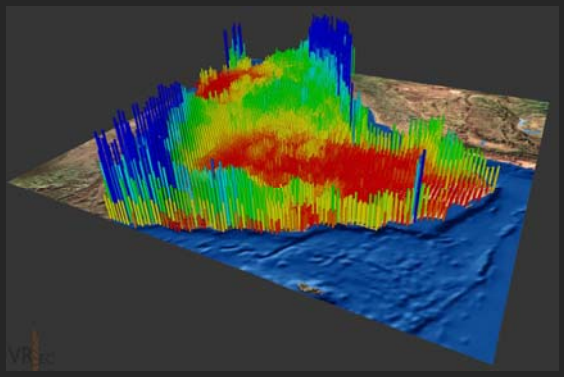
Observation - Modeling - Analysis – Management Tool



Climatic boundary conditions

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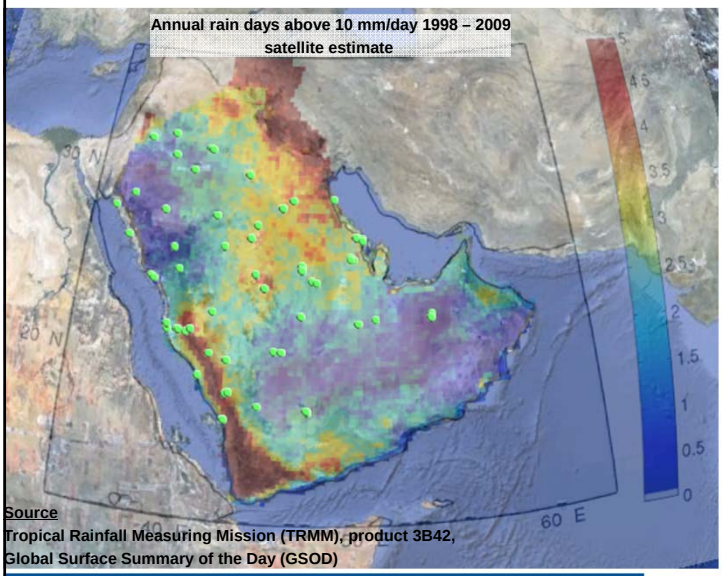
Validation using ground observation data



Source
Tropical Rainfall Measuring Mission (TRMM), product 3B42,
Global Surface Summary of the Day (GSOD)

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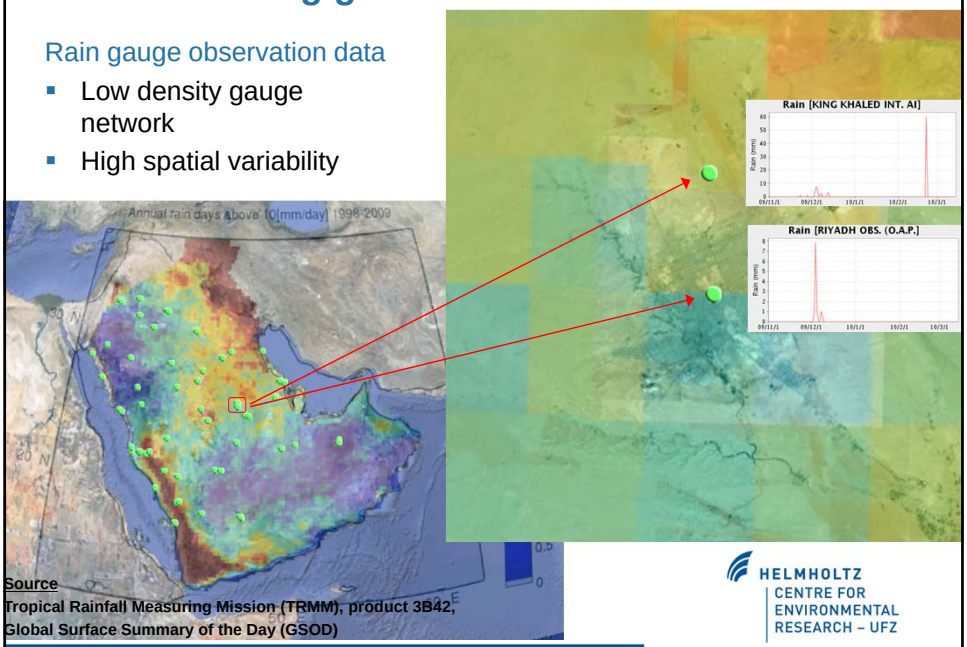
Validation using ground observation data

Rain gauge observation data

- Low density gauge network
- High spatial variability



Source
Tropical Rainfall Measuring Mission (TRMM), product 3B42,
Global Surface Summary of the Day (GSOD)

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Validation using change detection of land surface

Additional satellite data

- Vegetation indices (MODIS EVI) or Land Surface Temperature data (MODIS)
  - Change detection determines if rainfall occurred
- Challenges
  - Relate magnitude of change (Vegetation or temperature) to rainfall amount and relevance for ground water recharge

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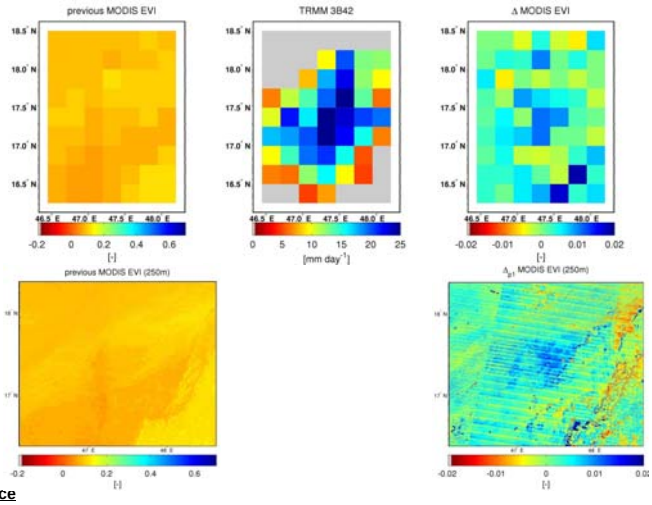
Validation using change detection of land surface

Vegetation response to rainfall



•25 km
•TRMM resolution

•250 m
•MODIS resolution

Source
Tropical Rainfall Measuring Mission (TRMM), product 3B42,
Moderate Resolution Imaging Spectroradiometer (MODIS), product 13Q1

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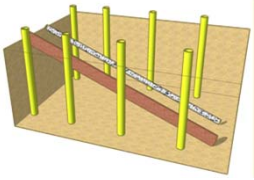
Linking ground observations to satellite data



Land surface temperature observations – on test site

- Measure land surface temperature signal before and after different sprinkler irrigation scenarios
- Determine duration and magnitude of sprinkler irrigation related surface temperature signals
- Determine relevant rainfall events required for ground water recharge

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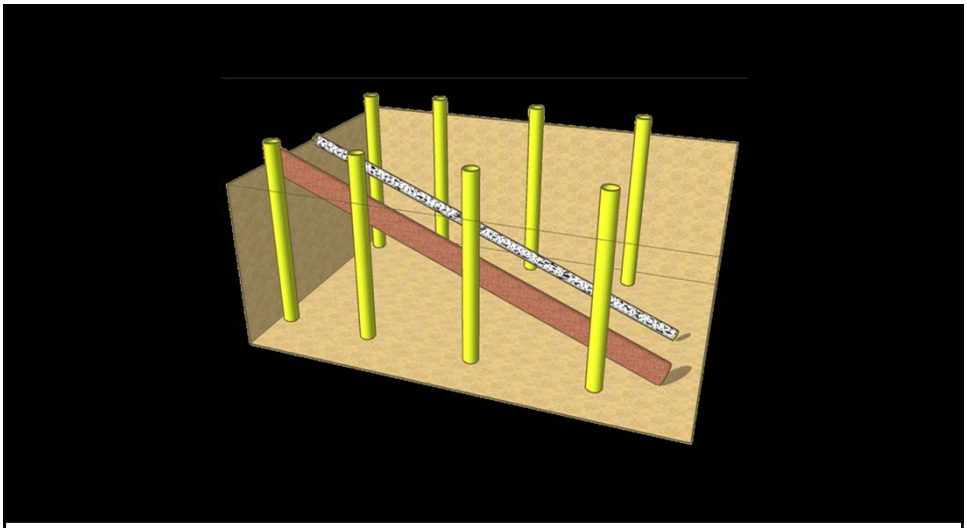

infiltration & potential recharge

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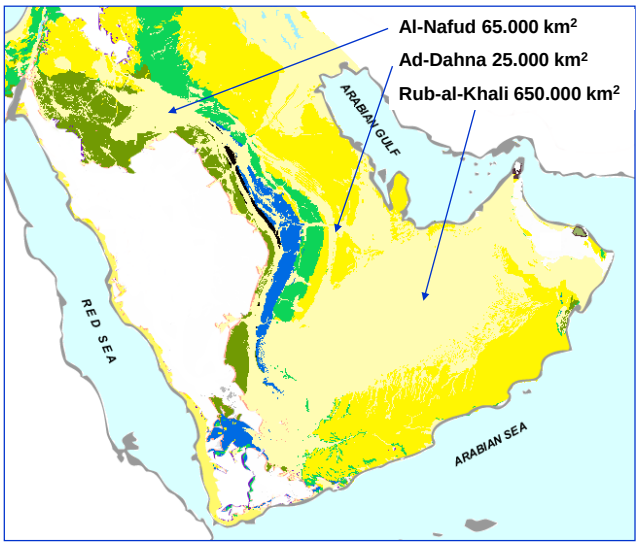
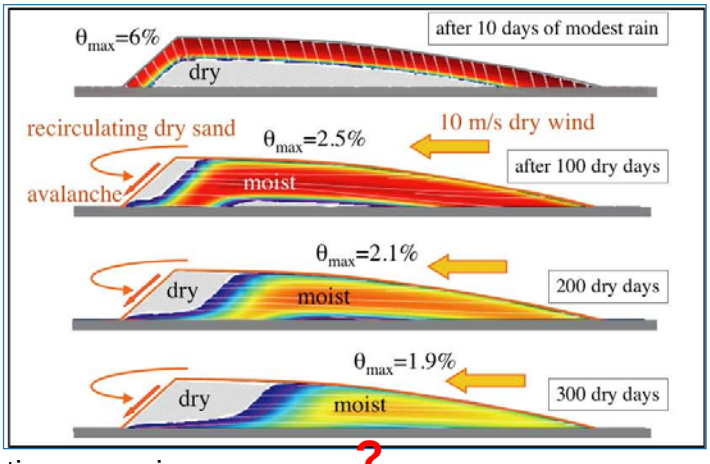
Upper Mega Aquifer: 740.000 km² sand cover



Does recharge occurs under sand cover and aridity?



?

Indications are given...

...however, investigations so far never below point of no return

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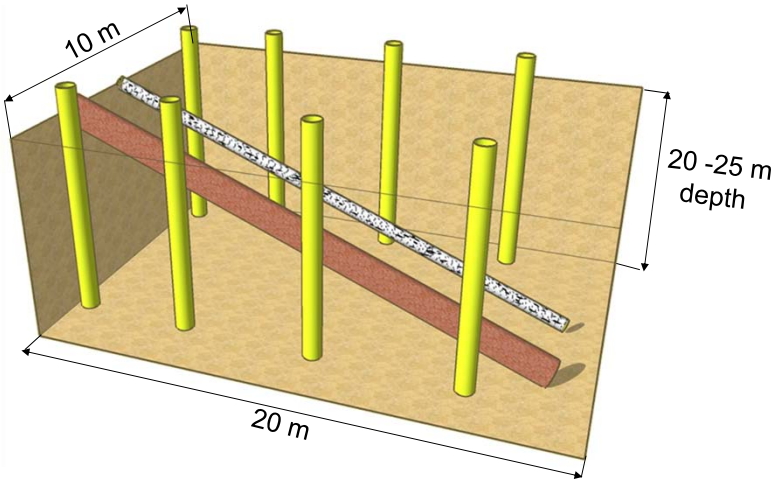
TDR monitoring full scale field experiment incl. Observation of chemical/isotopical fractionation from precipitation to recharge



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Movie

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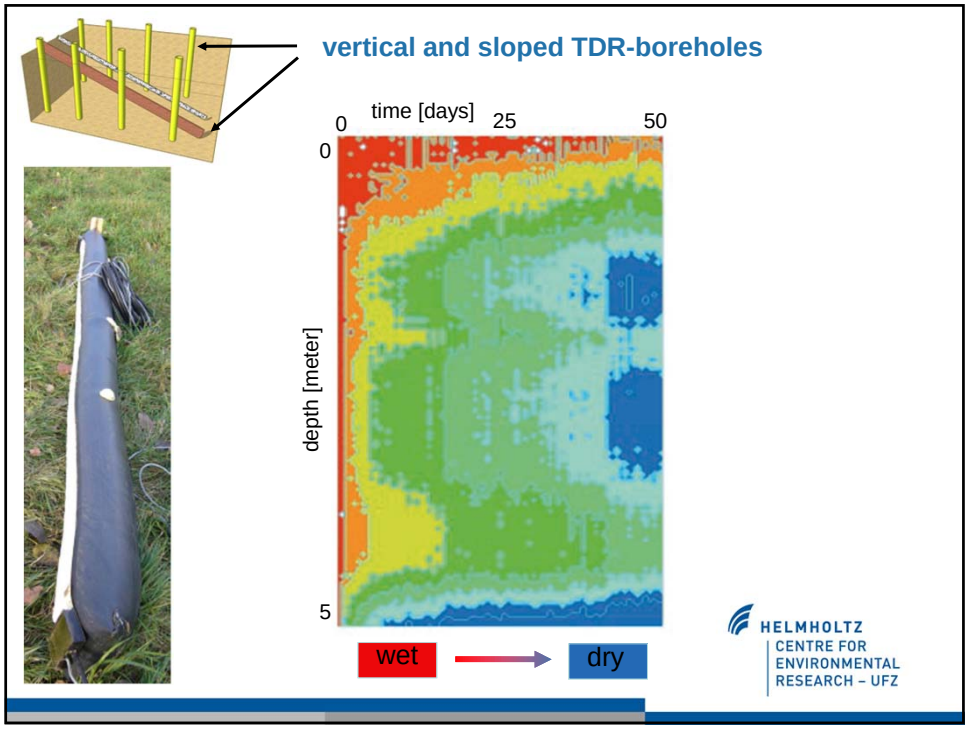
vertical and sloped TDR-boreholes
time [days]
0
25
50
0
depth [meter]
5
wet
dry
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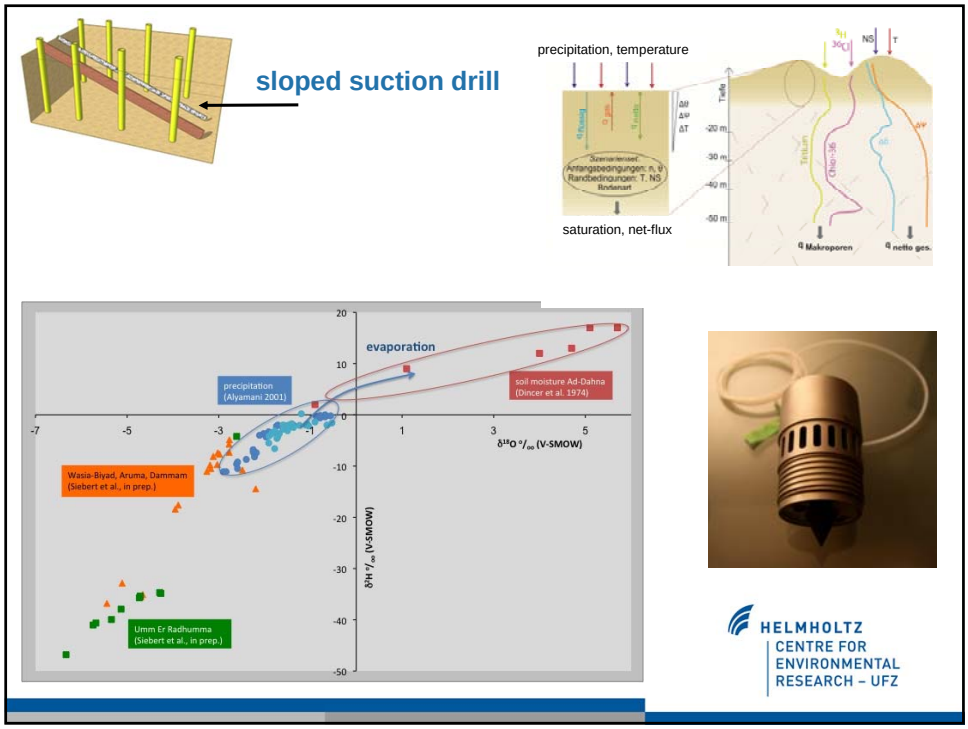
sloped suction drill
precipitation, temperature
saturation, net-flux
evaporation
precipitation
(Alyamani 2001)
soil moisture Ad-Dahna
(Dincer et al. 1974)
Wasia-Biyad, Aruma, Dammam
(Siebert et al., in prep.)
Umm Er Radhumma
(Siebert et al., in prep.)
δ18O ‰ (V-SMOW)
δ2H ‰ (V-SMOW)
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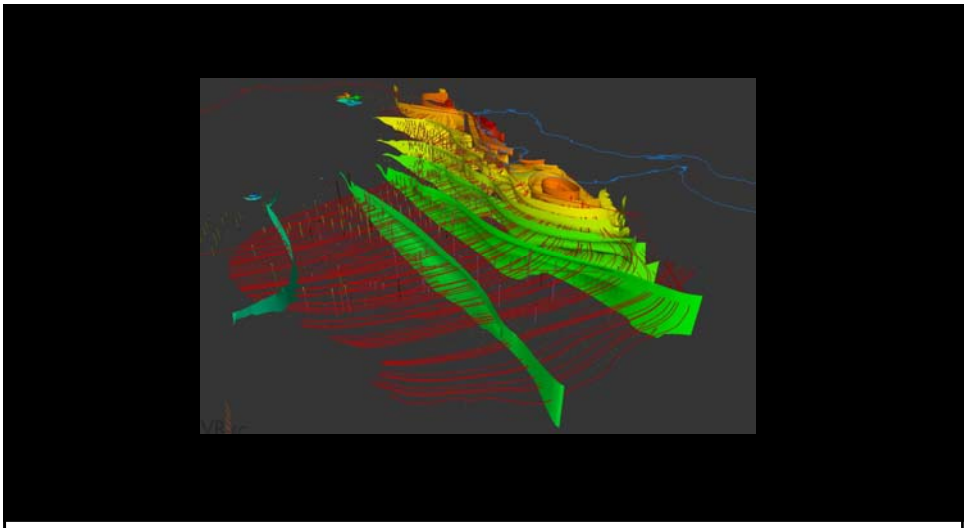
RESEARCH – UFZ



Data integration – System analysis - Visualization
New generation of Management Tools

OpenGeoSys *Scientific Software made by Helmholtz*

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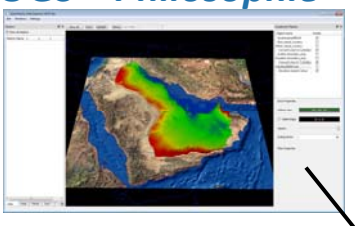
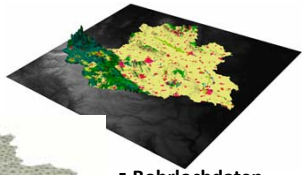
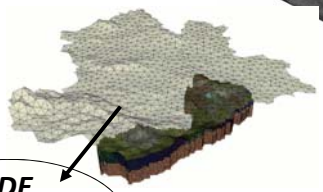
OGS – *Philosophie*

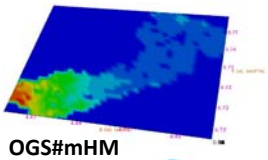




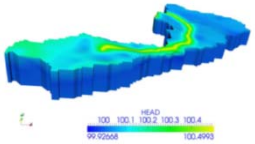


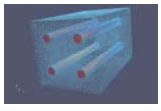
- Bohrlochdaten
- Zeitreihen
- DEM
- Landnutzung
- Strukturgeologie
- : 1/2/3/4 D
- : interaktiv

DE
OpenGeoSys
FEM

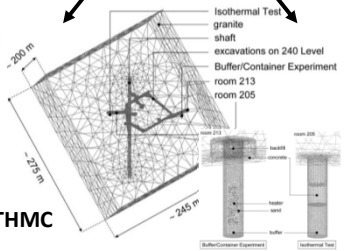


OGS#mHM

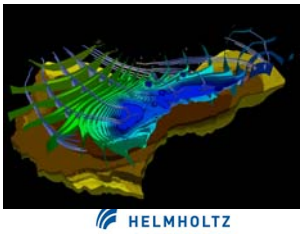




OGS-THMC



OGS-3D / OGS -> OpenSG



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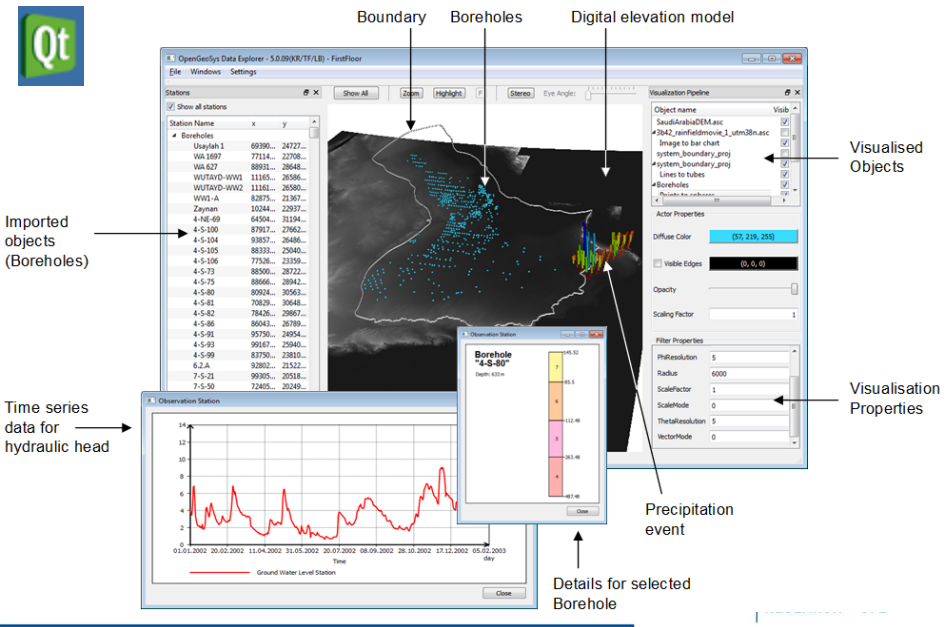
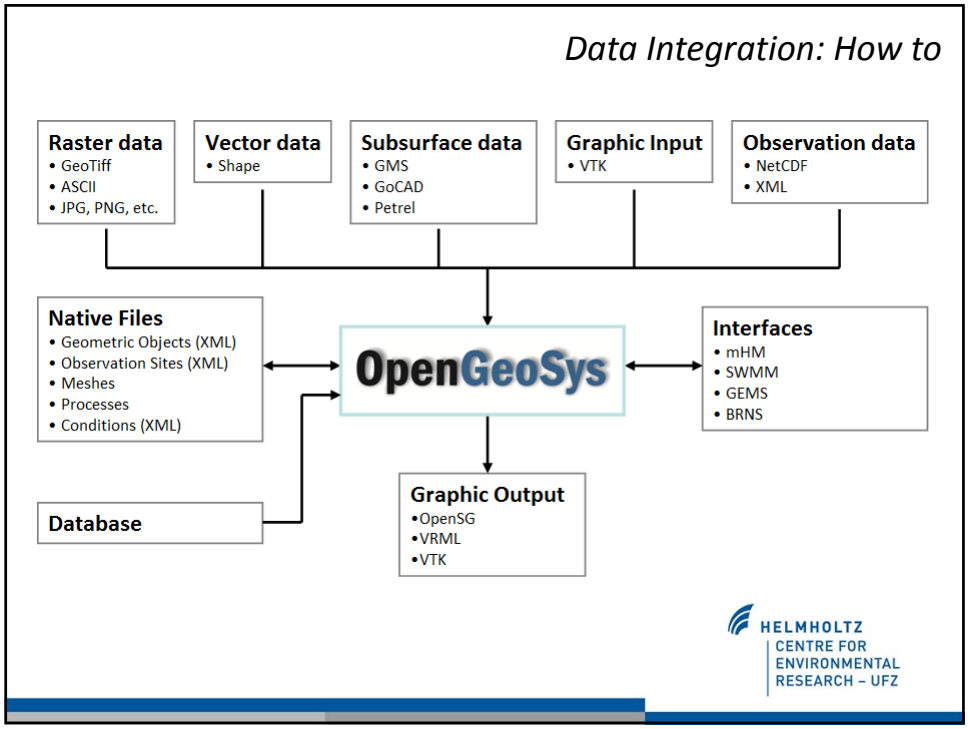
OGS – *Visibility*

Deutsch-Japanisches Wissenschafts- und Innovationsforum 2010

日独 科学・イノベーション フォーラム2010

OpenGeoSys — *Data Integration: Which*




Data Integration: How to
Raster data
• GeoTiff
• ASCII
• JPG, PNG, etc.
Vector data
• Shape
Subsurface data
• GMS
• GoCAD
• Petrel
Graphic Input
• VTK
Observation data
• NetCDF
• XML
Native Files
• Geometric Objects (XML)
• Observation Sites (XML)
• Meshes
• Processes
• Conditions (XML)
OpenGeoSys
Interfaces
• mHM
• SWMM
• GEMS
• BRNS
Database
Graphic Output
•OpenSG
•VRML
•VTK
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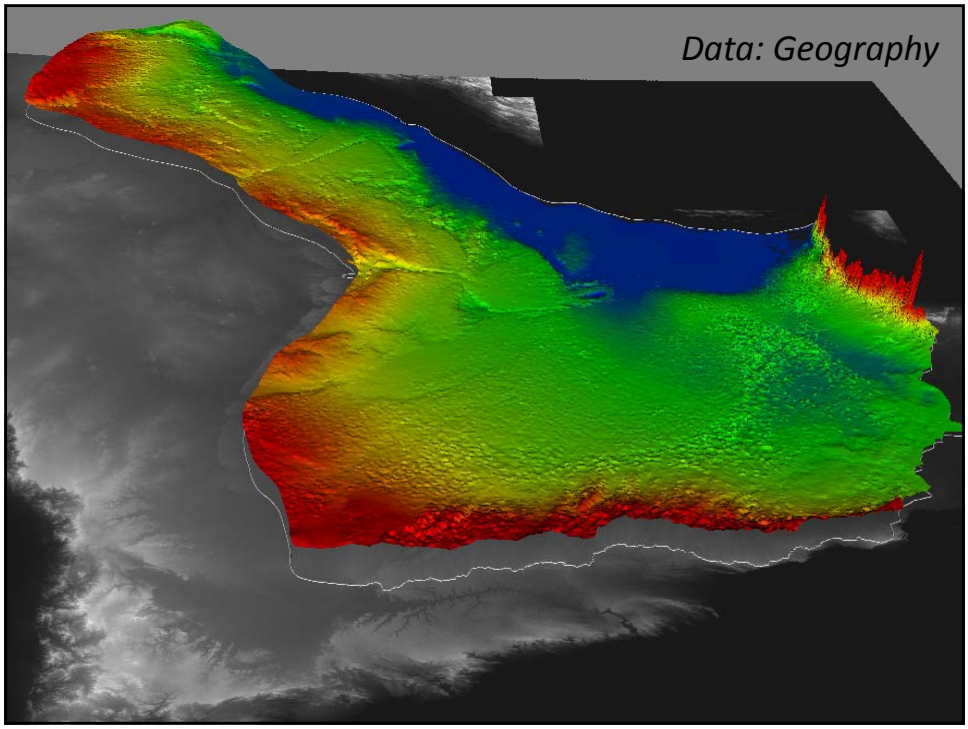
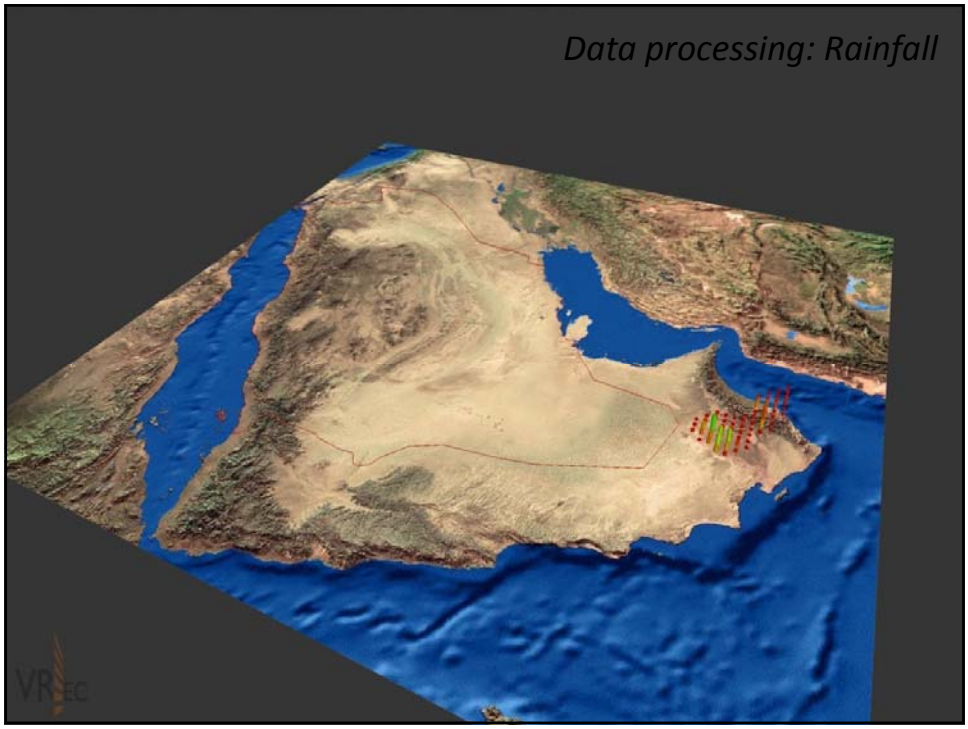
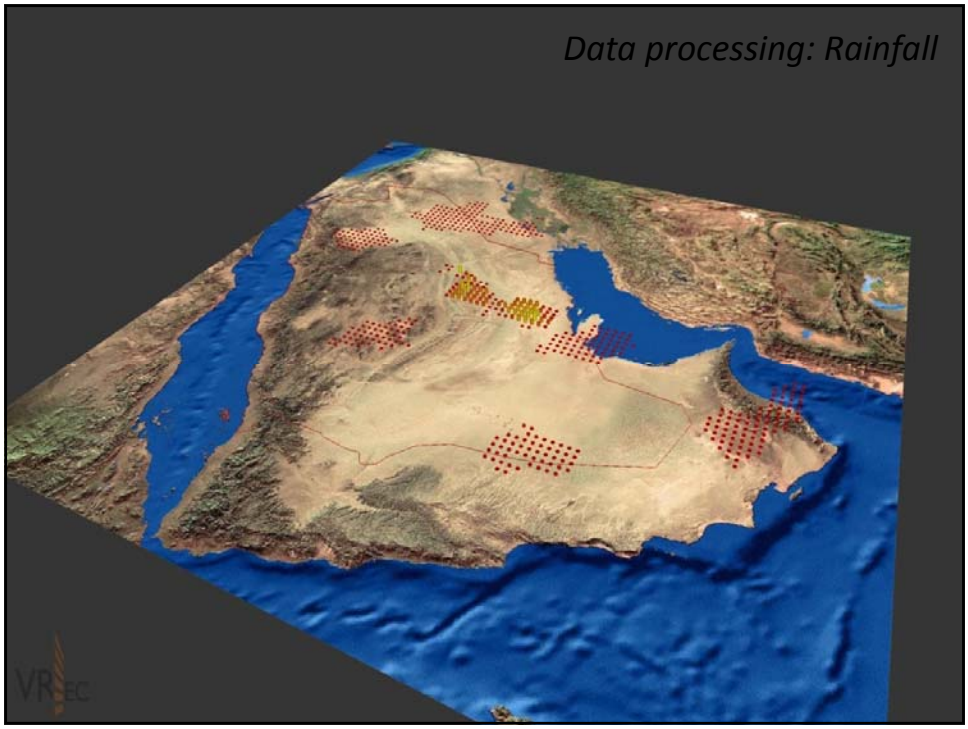
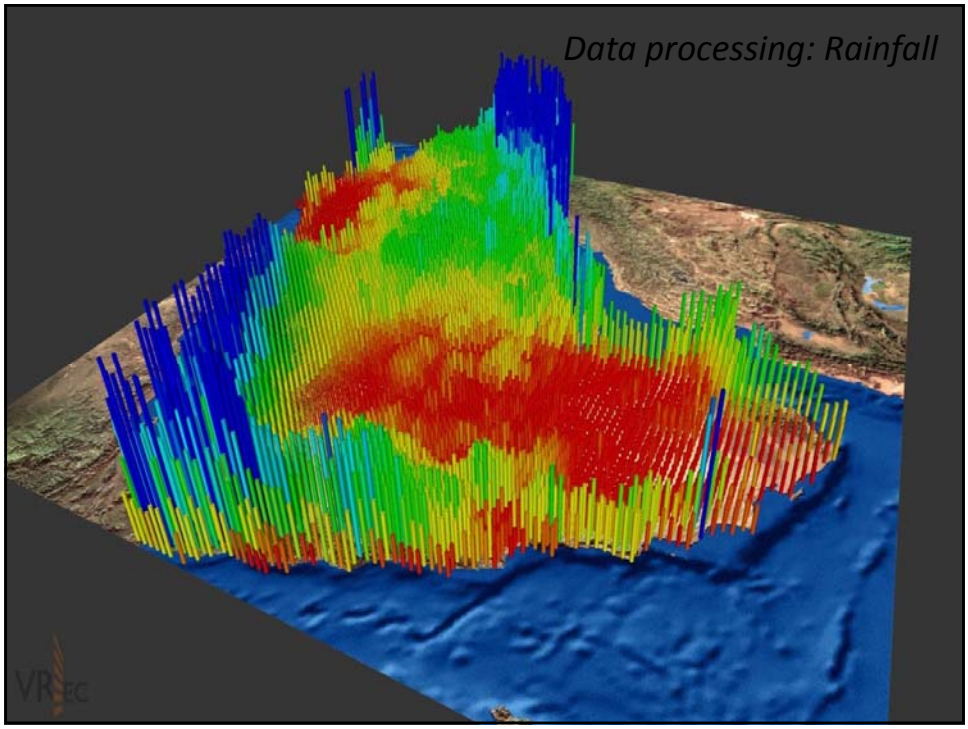
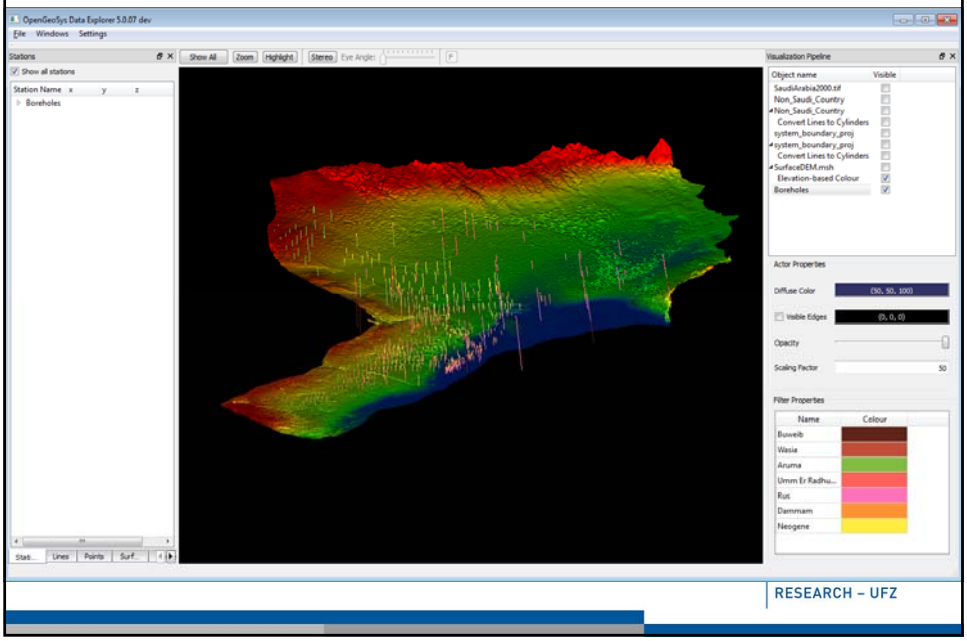

Data: Geography


Data processing: Rainfall

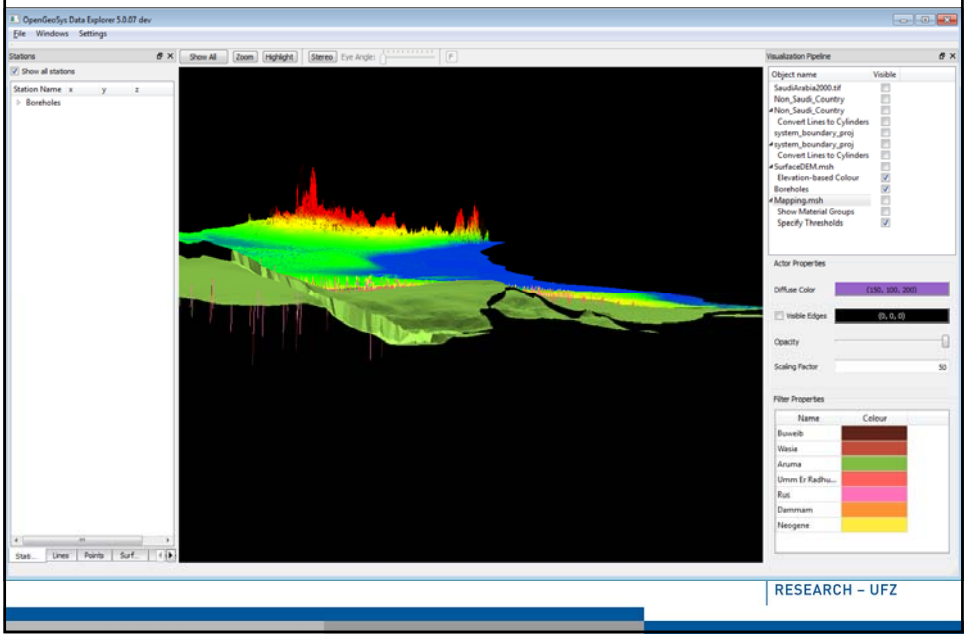

Data processing: Rainfall



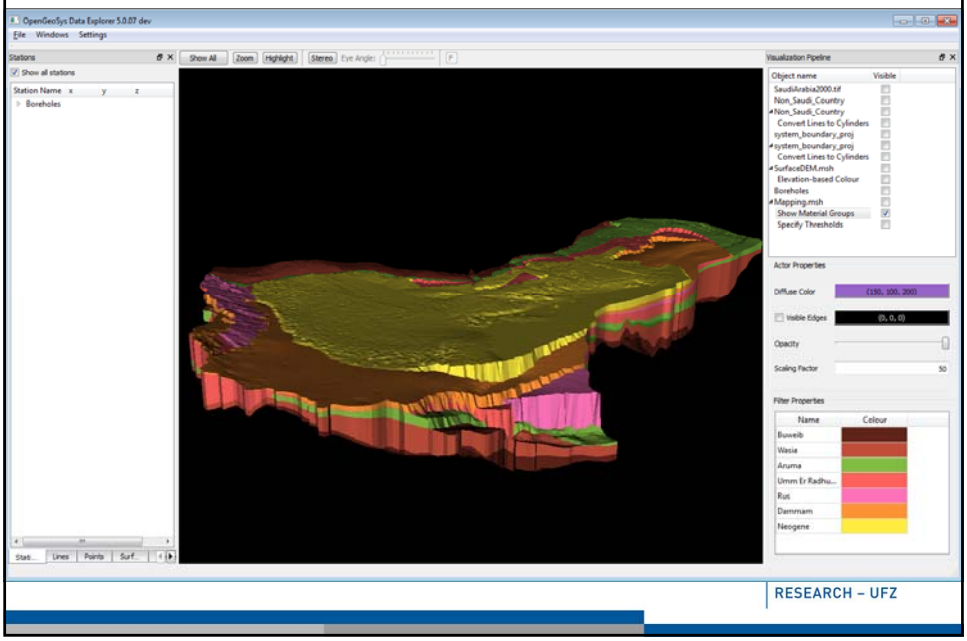
Data processing: Borehole data

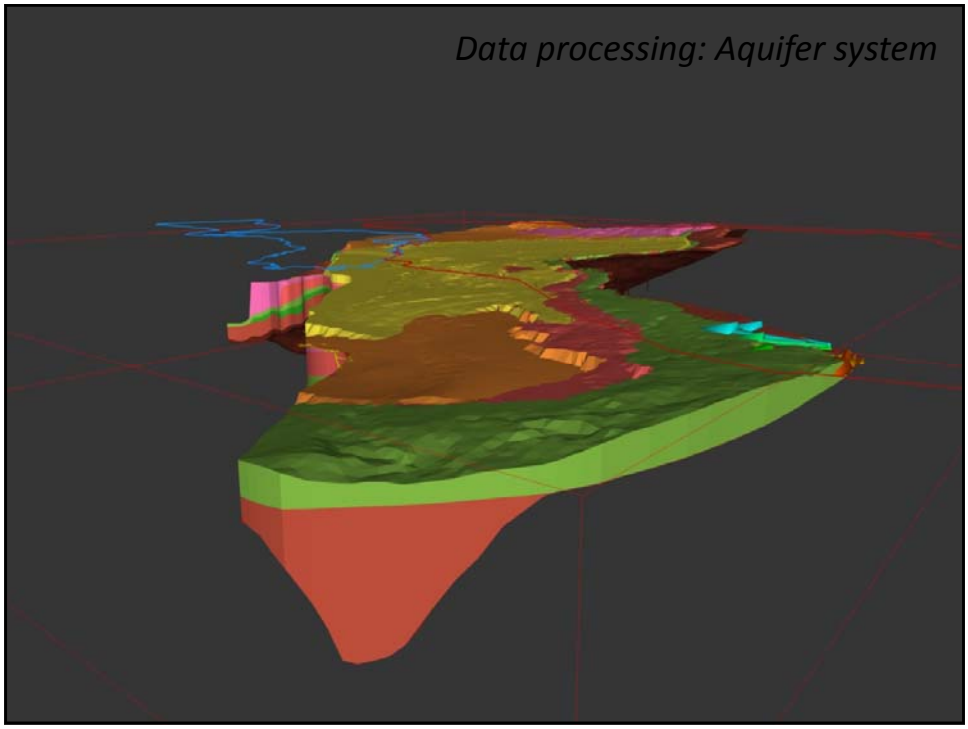


Data processing: Aquifer modeling



Data processing: Aquifer system





$$Ax = b$$

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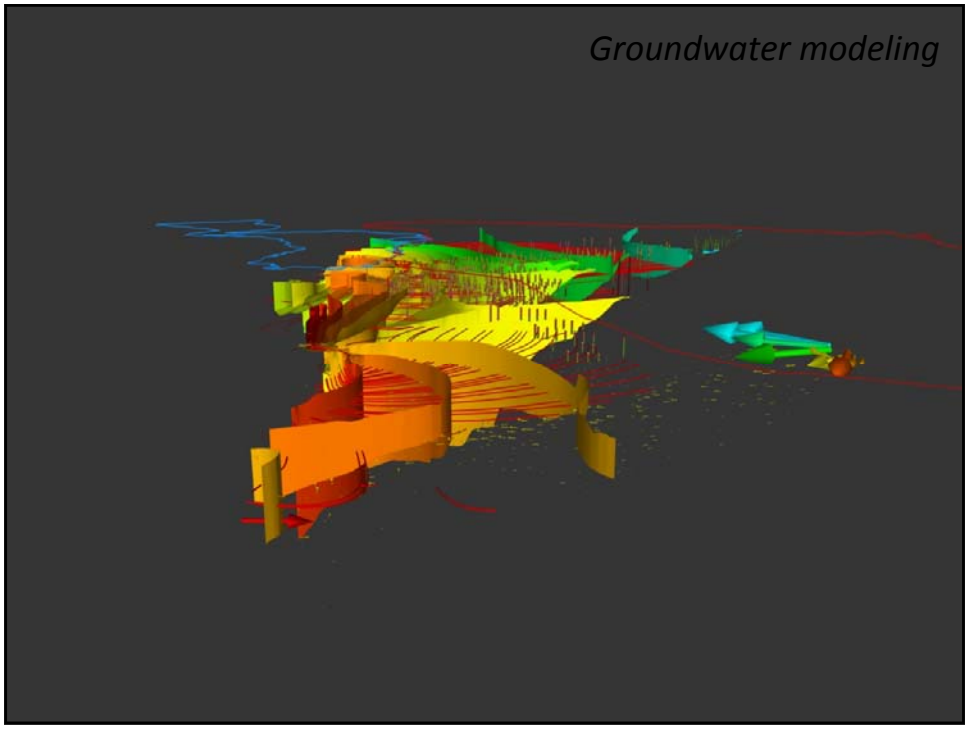
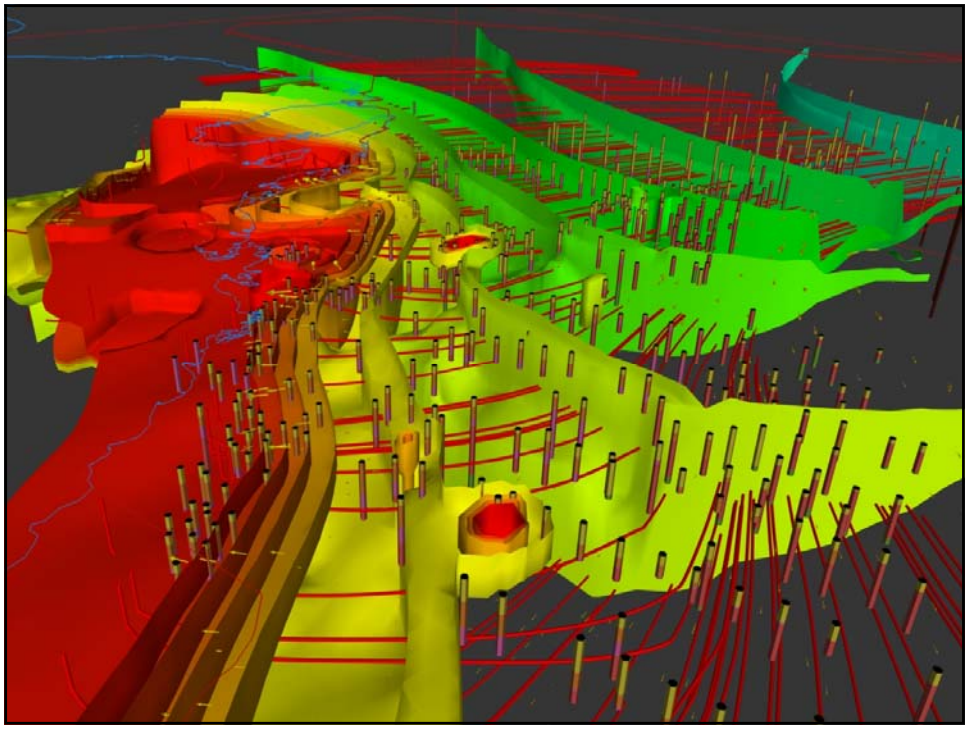
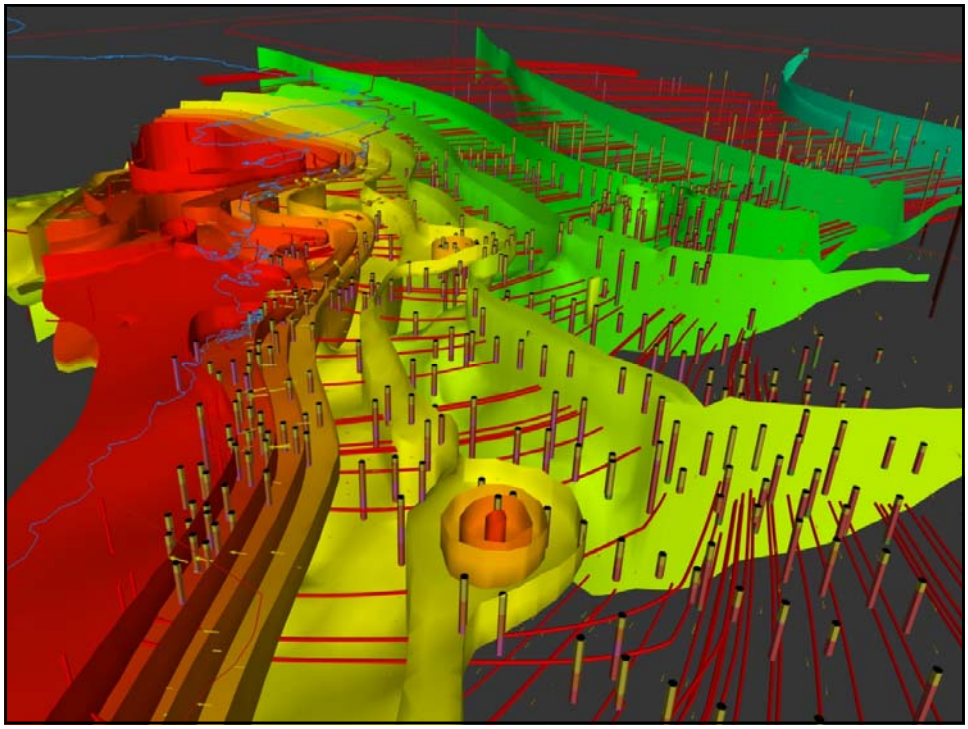
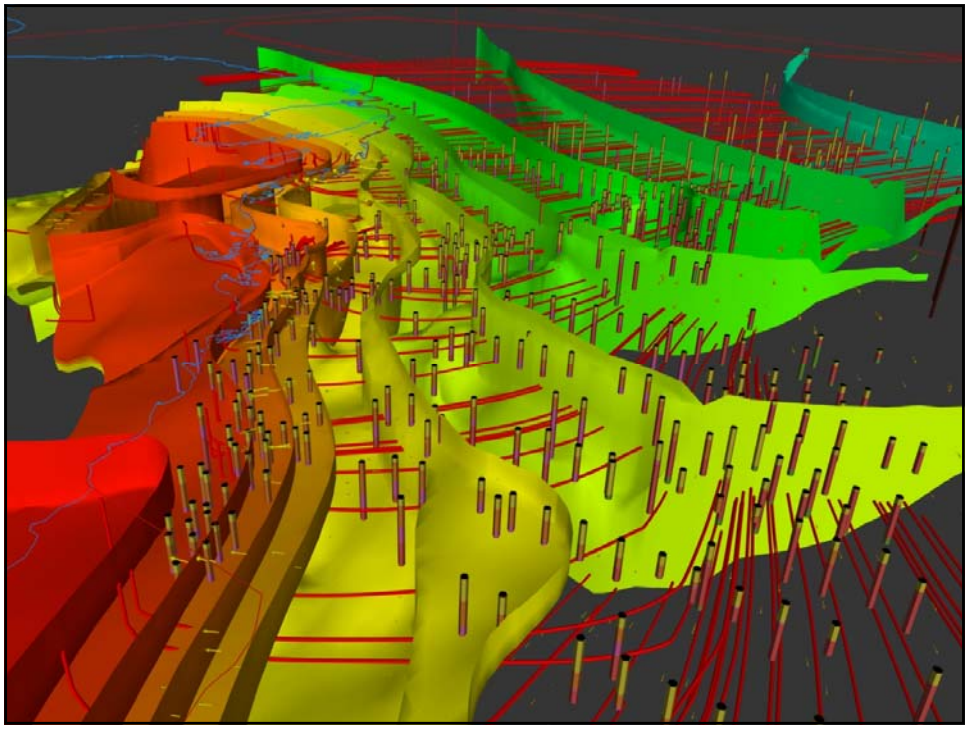
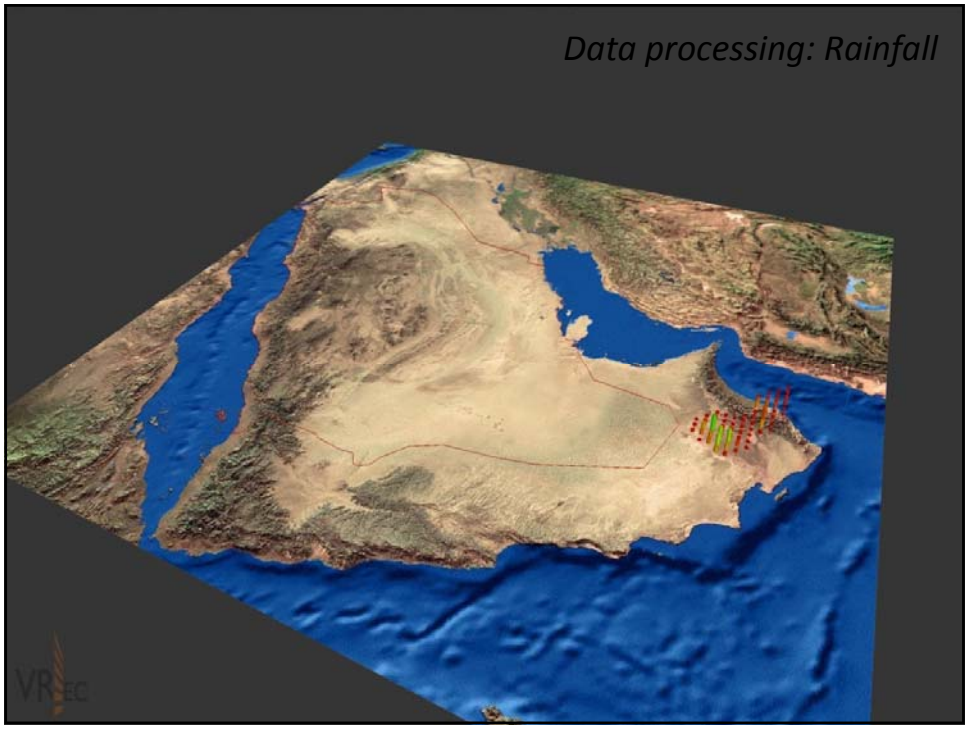

Groundwater modeling









Movie

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VISLab

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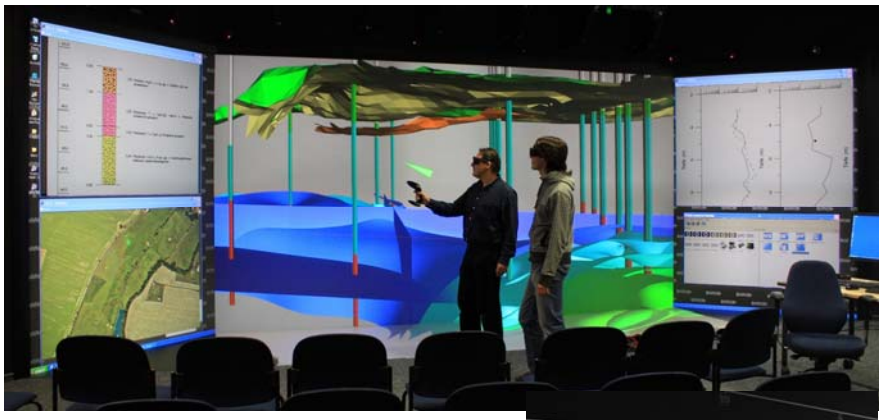
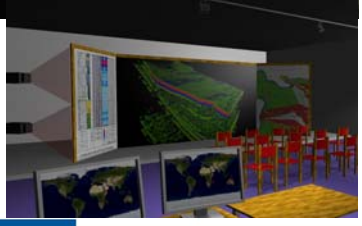
VISLab: Projects





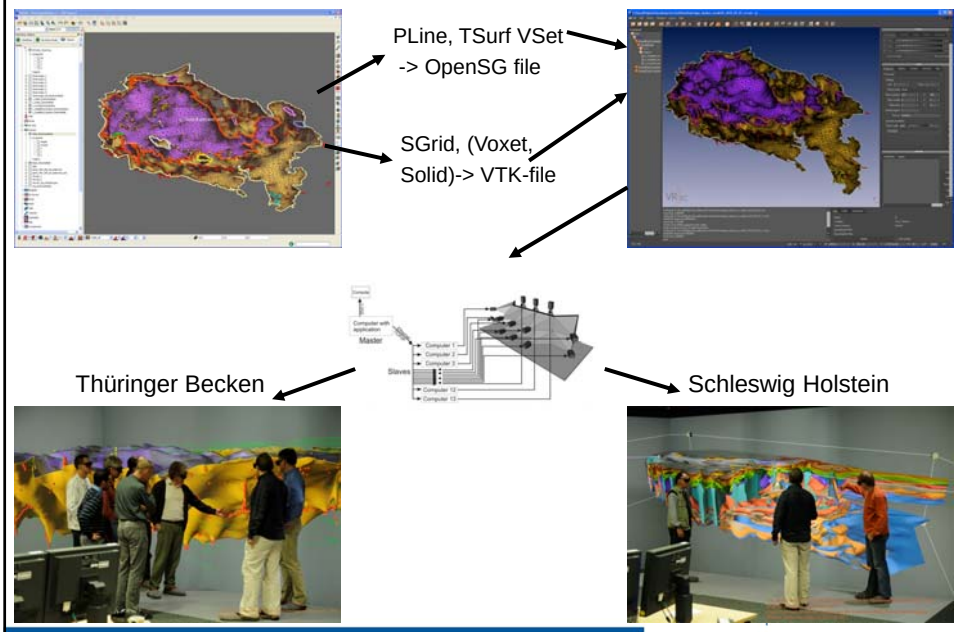
Aus: Zehner, 2009 / 2010

Probleme:

- Datenlage
- Komplexität
- Validierung

Zehner, 2005

Data processing: Rainfall



Frohe Weihnachten Guten Rutsch 2012

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