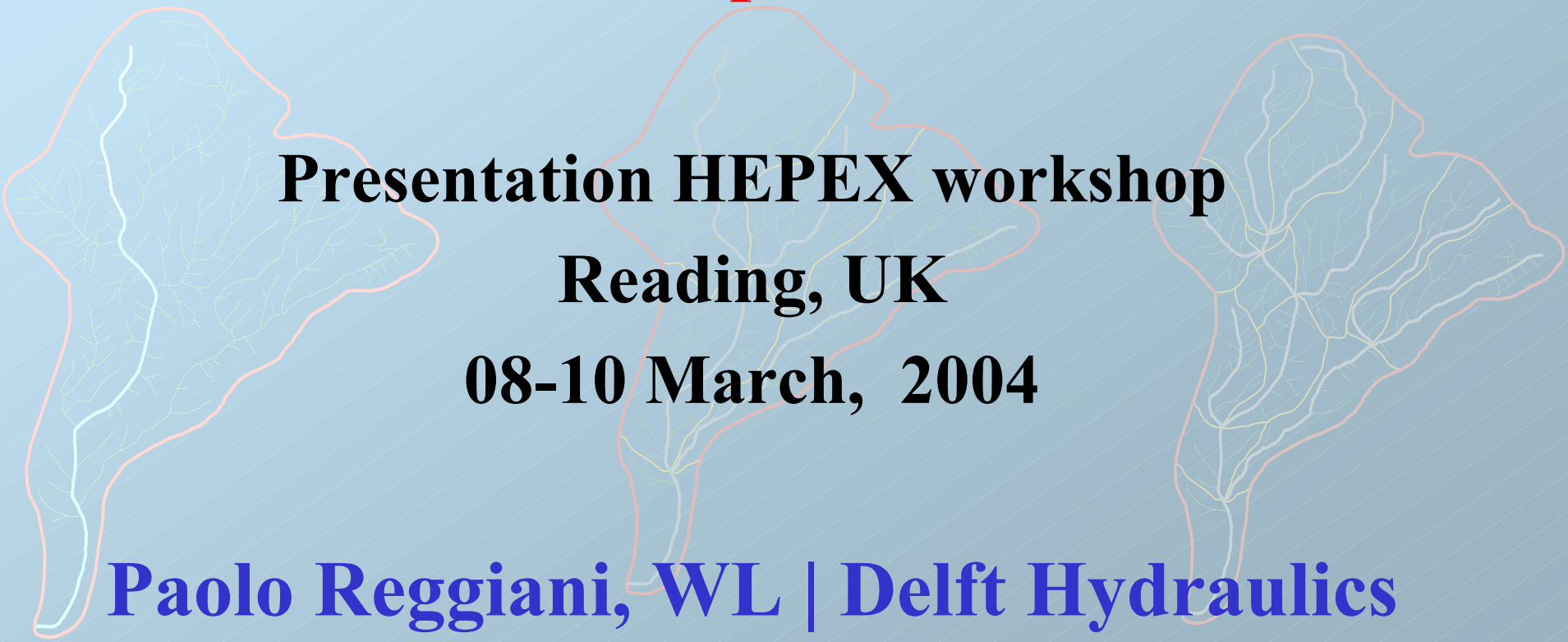
The Representative Elementary Watershed approach as platform for ensemble predictions



Presentation HEPEX workshop

Reading, UK

08-10 March, 2004

Paolo Reggiani, WL | Delft Hydraulics

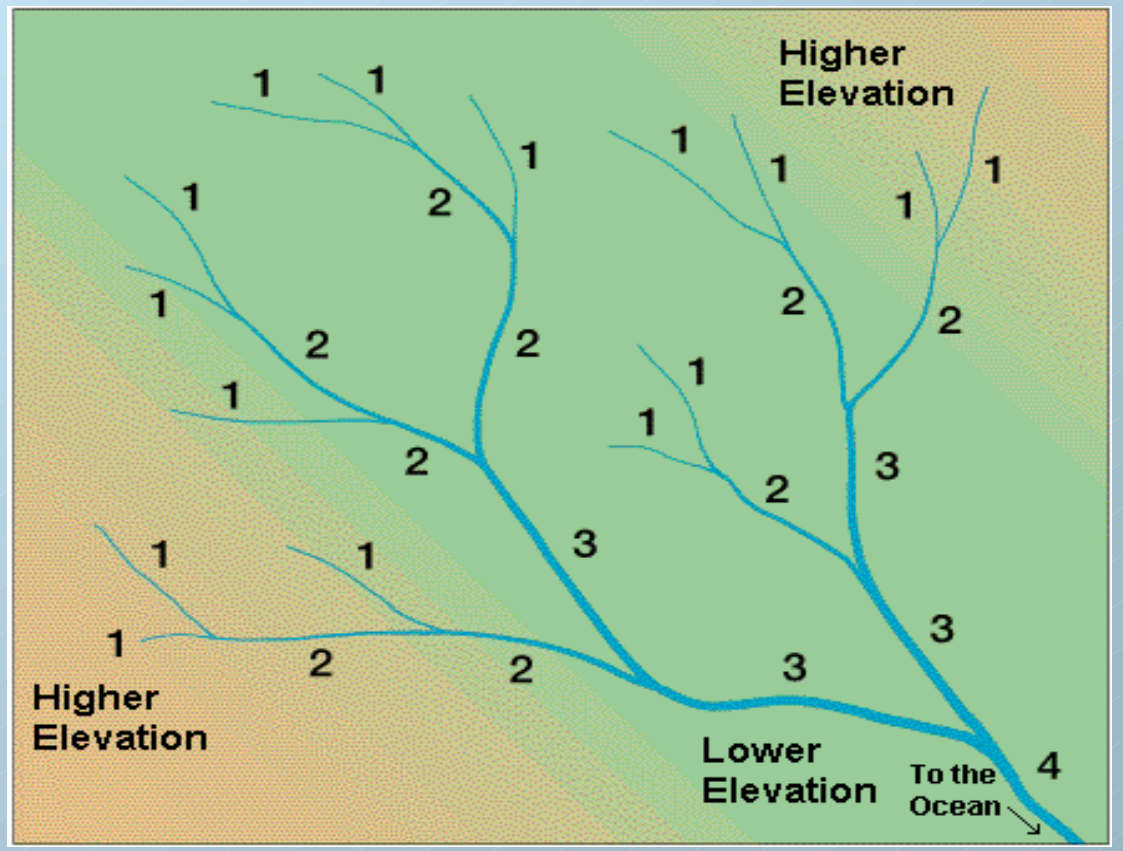
The REW approach

- Not grid-based
- Irregularly shaped elements
- Governing equations integrated form point to REW scale.
- Spatial gradients are converted to fluxes across control volume boundaries
- Governing equations are ODE's that are solvable analytically
- Platform is suitable for large-scale watershed modelling
- Platform suitable for coupling with climate models

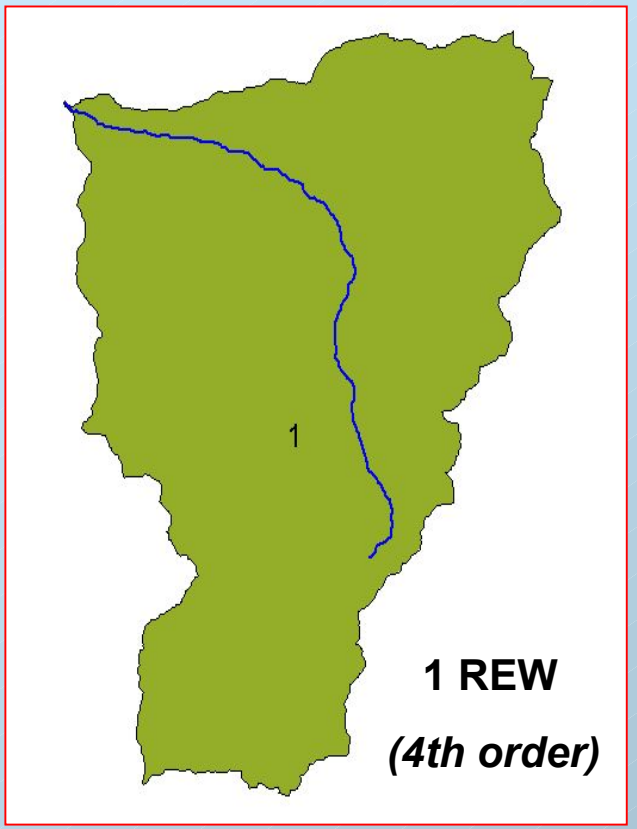
Horton-Strahler ordering system

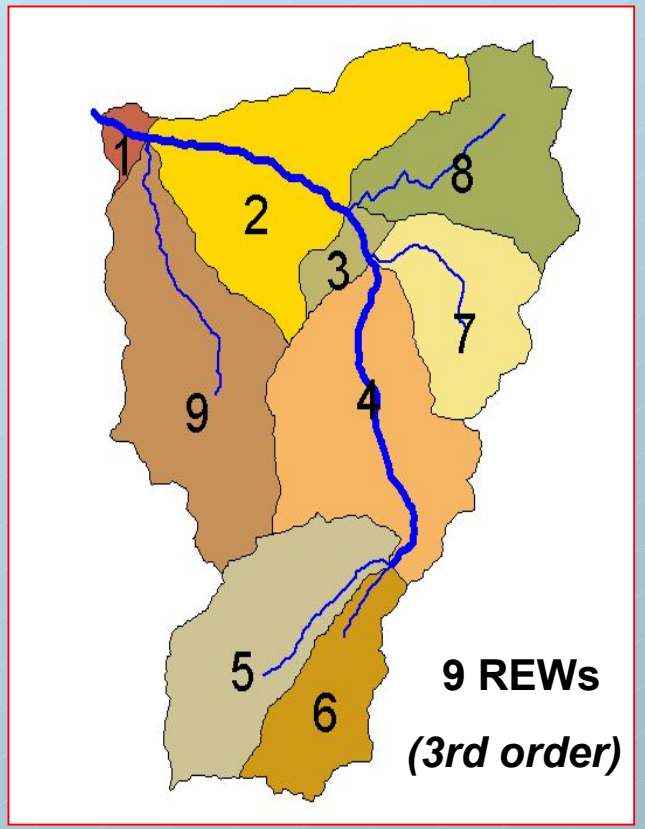
REWs are delineated on the land surface by water divides.

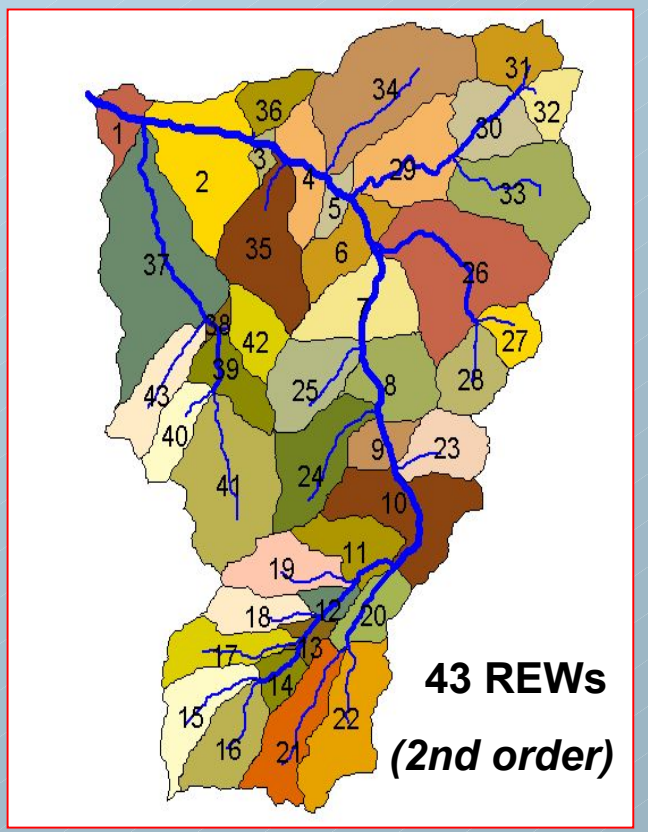
A watershed is divided into a number of REWs. The discretisation can be specified objectively via the Strahler order numbering.

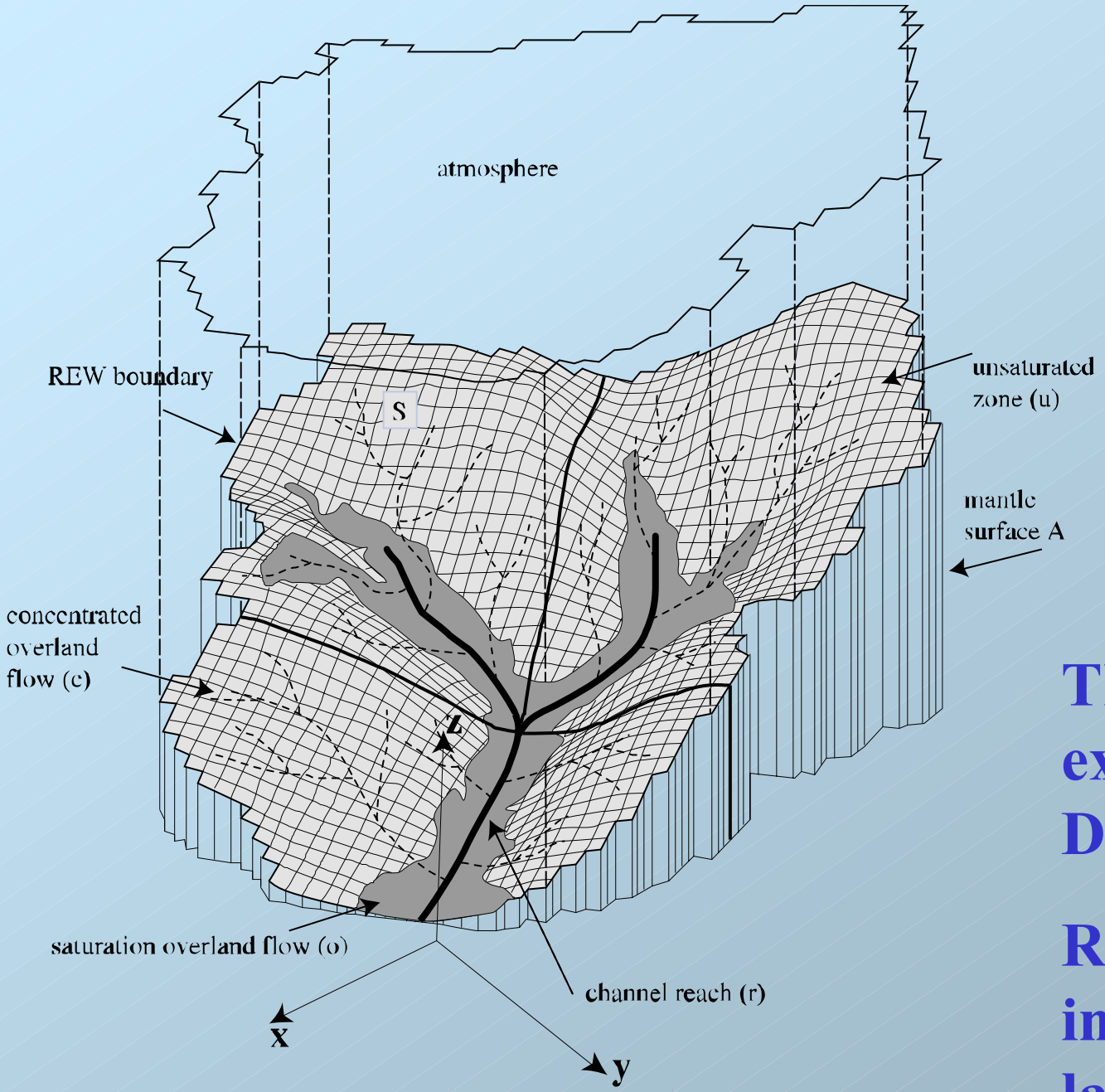


The higher the order, the less the number of the REWs.





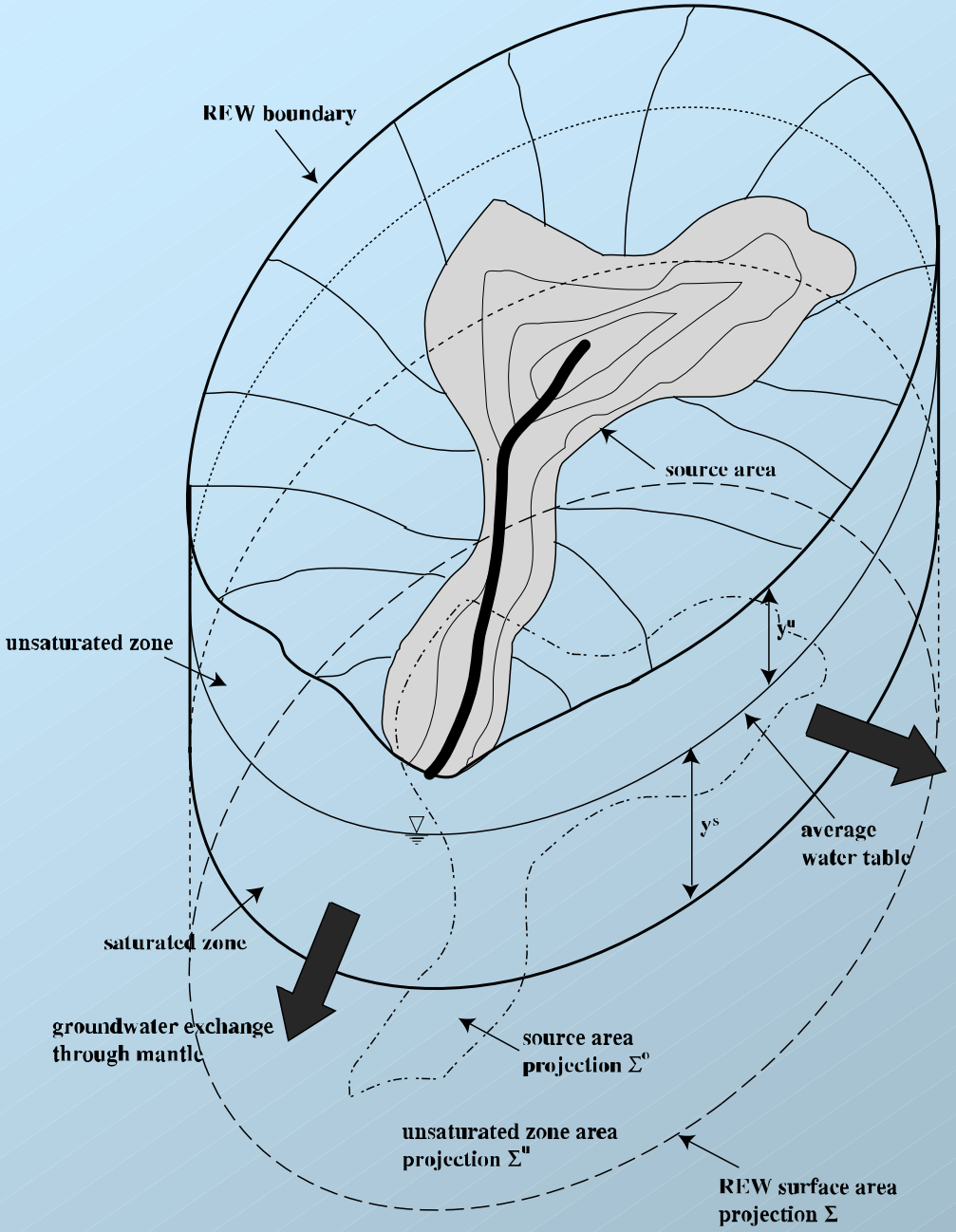




REWs are 3-Dimensional spatial regions

The REWs are extracted form a Digital terrain map.

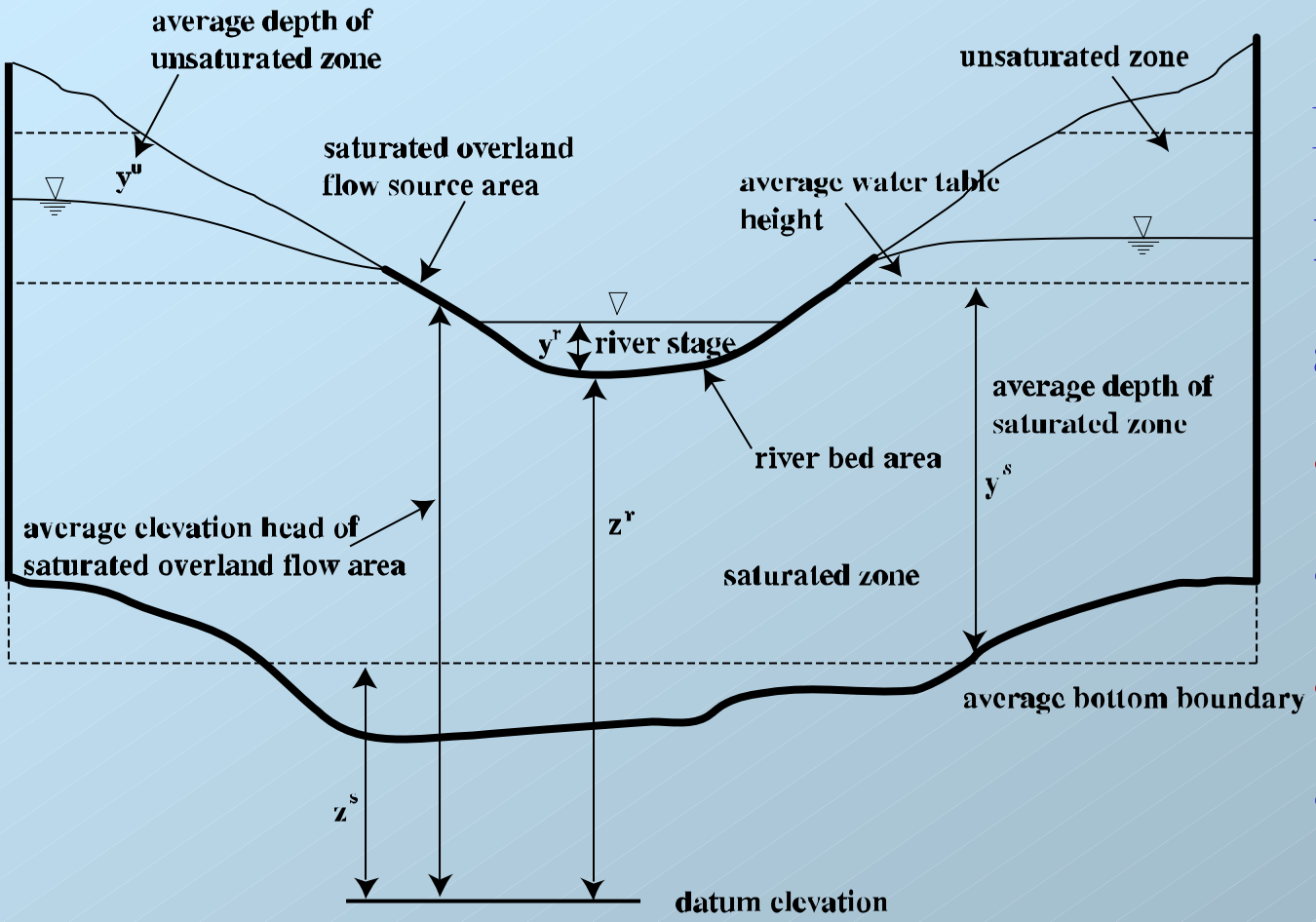
REWs are interconnected laterally



Conceptualisation of a REW as a point-scale system

The saturated areas and groundwater flow through the REW mantle are clearly visible

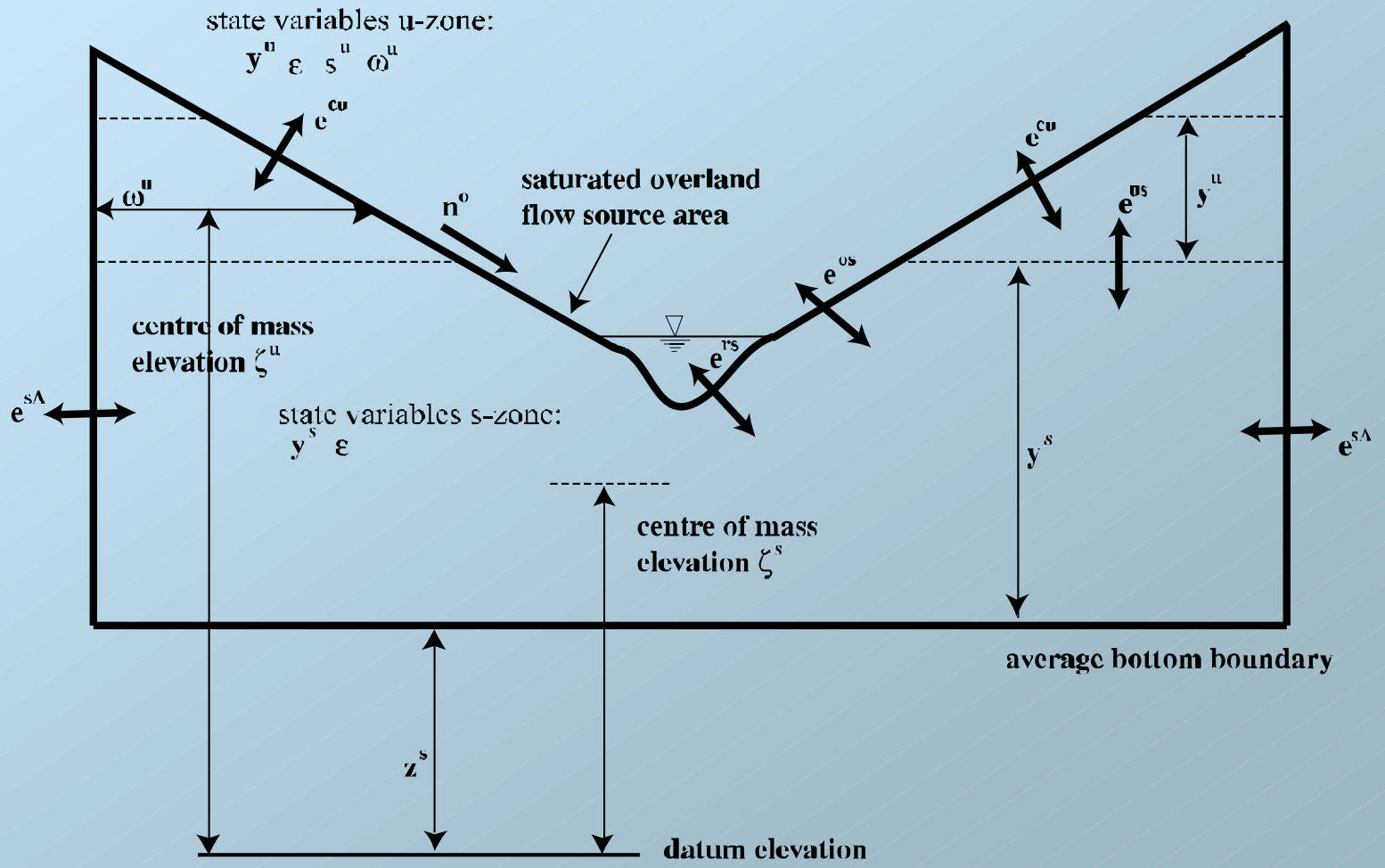
Transsect of a REW



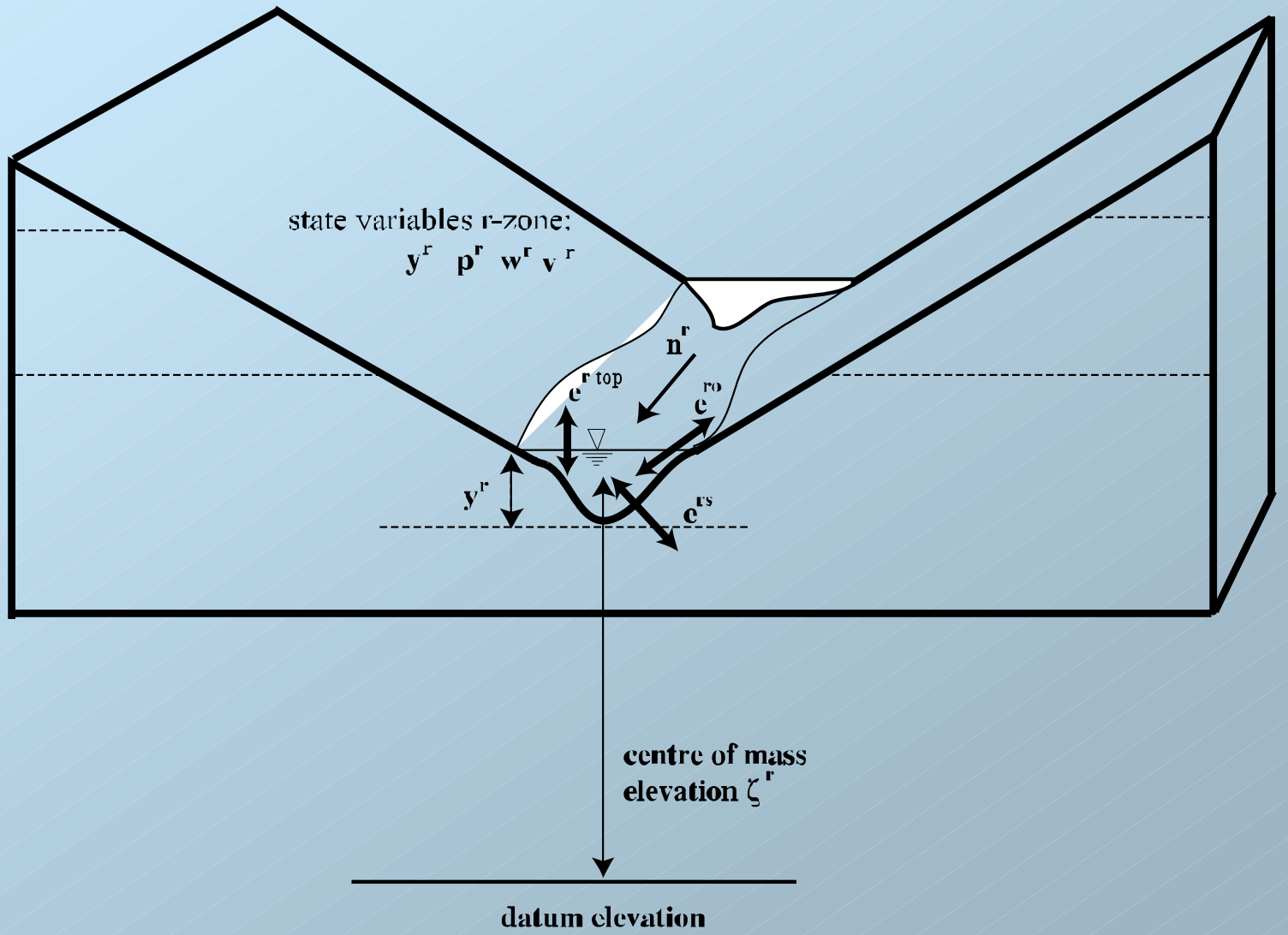
Different hydrological zones are modelled:

- saturated zone
- vadose zone
- river
- overland flow

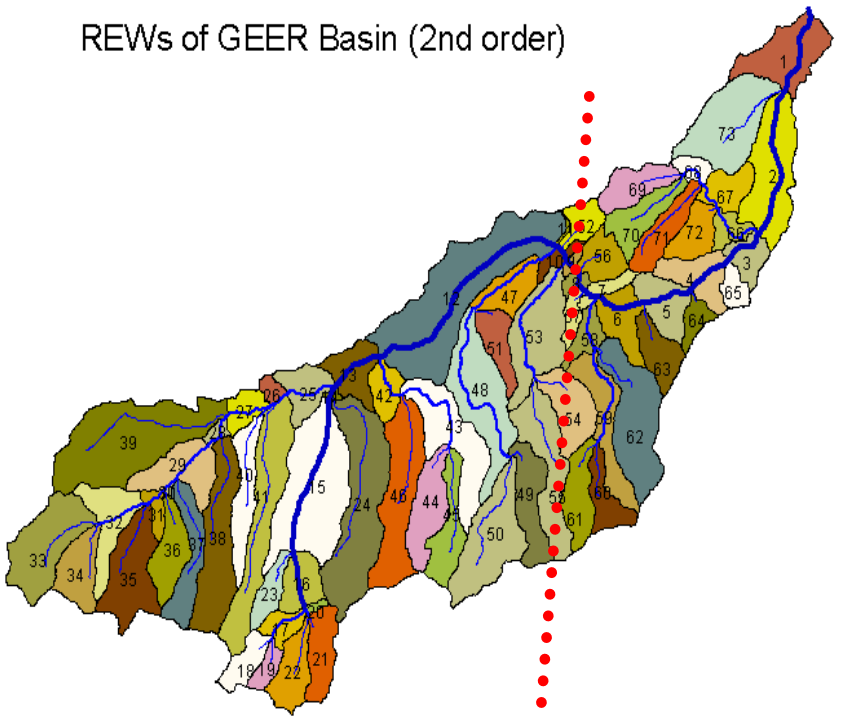
Schematic representation of the relevant hydrological fluxes

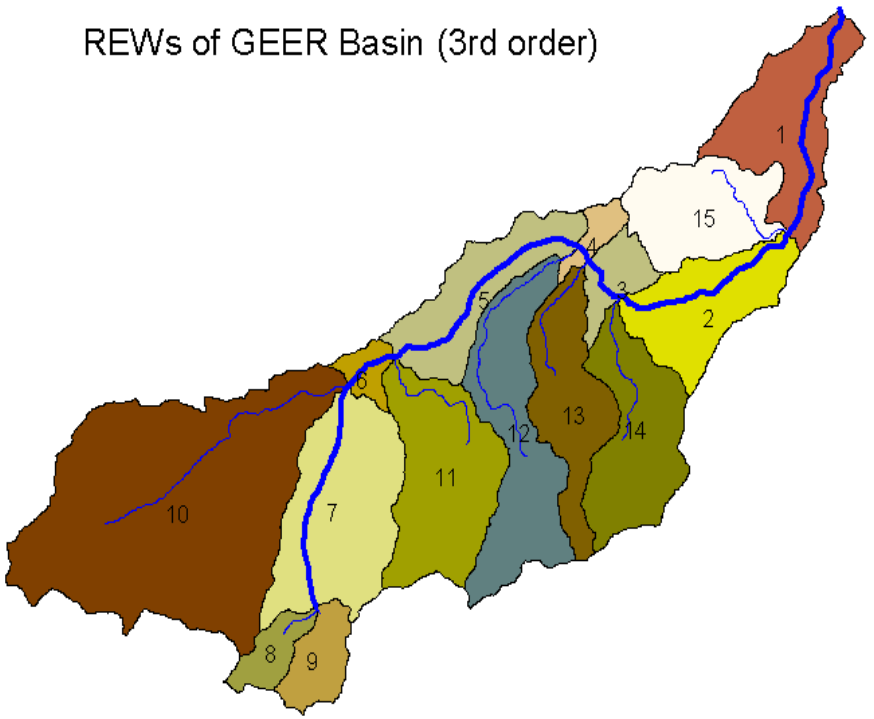


Schematic representation of the groundwater-river interaction

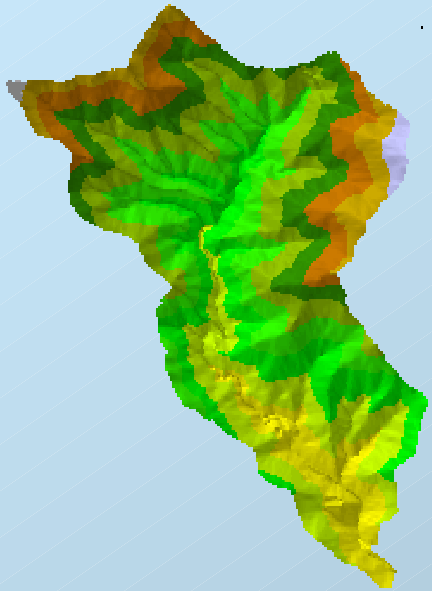


Case study Geer (Belgium)
Identification of REWs





Neccessary steps: 1: REW Analysis



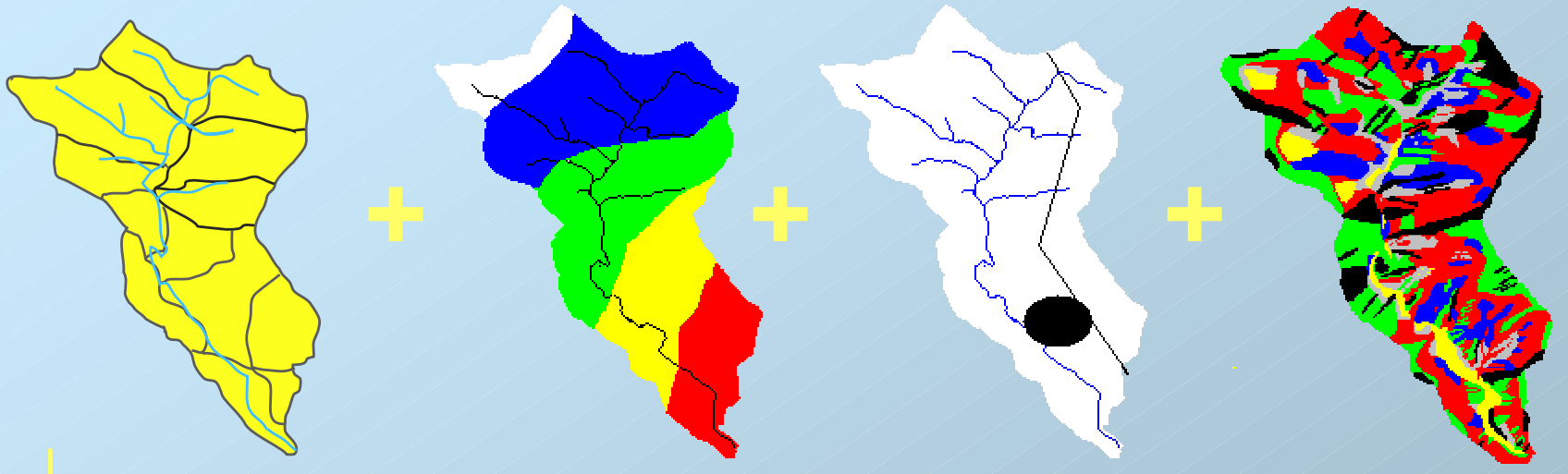
Study watershed

DEM analysis

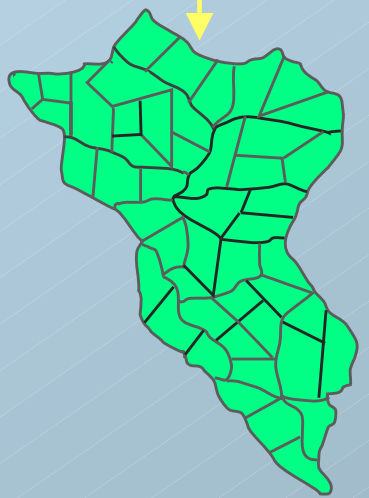
REWs

(Representative Elementary Watersheds)

2: Subdivision of unsaturated zone into smaller elements

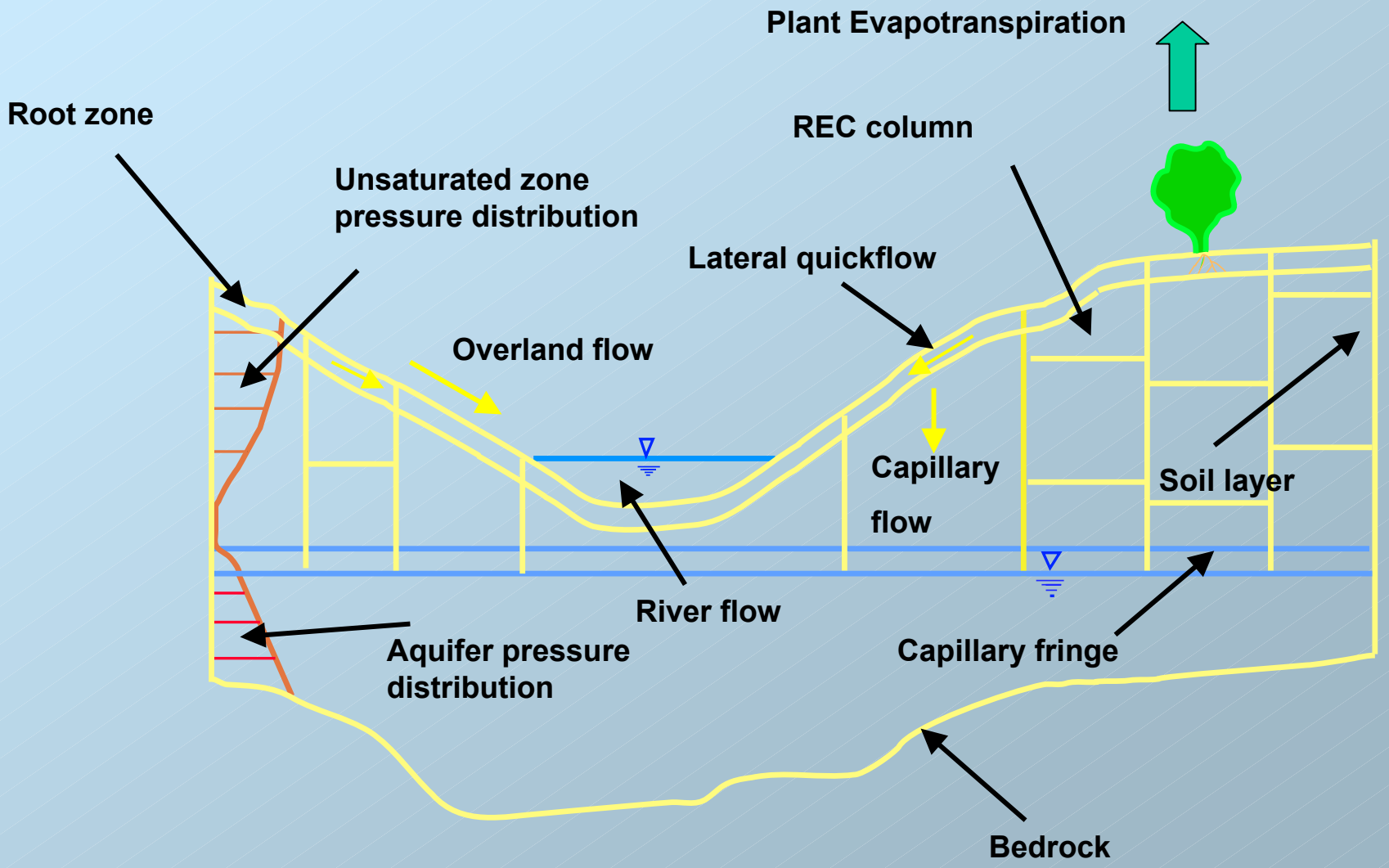


REWs + Land Use + Towns/Streets + End-User



RECs
(Representative
Elementary Columns)

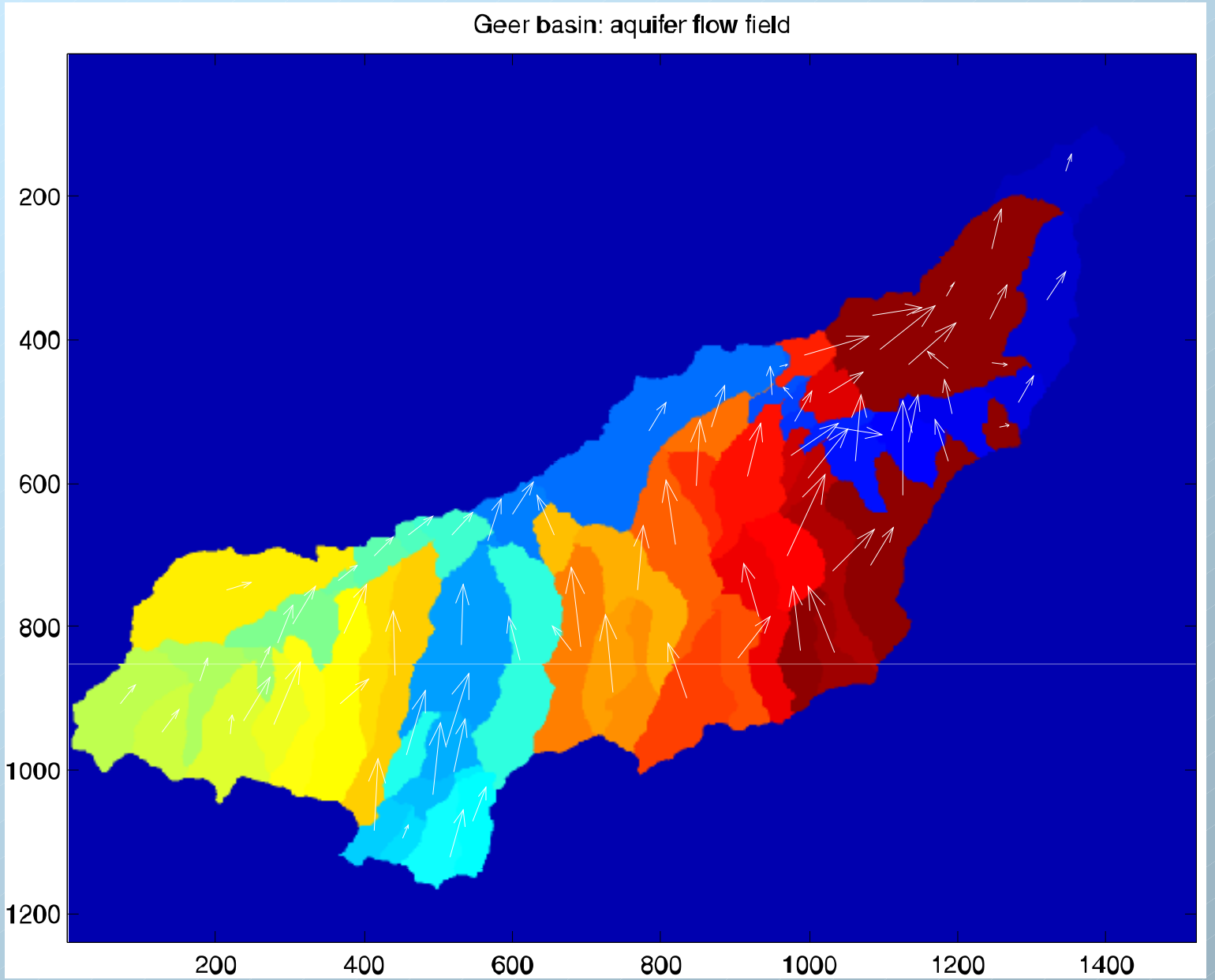
How can we account for landuse?



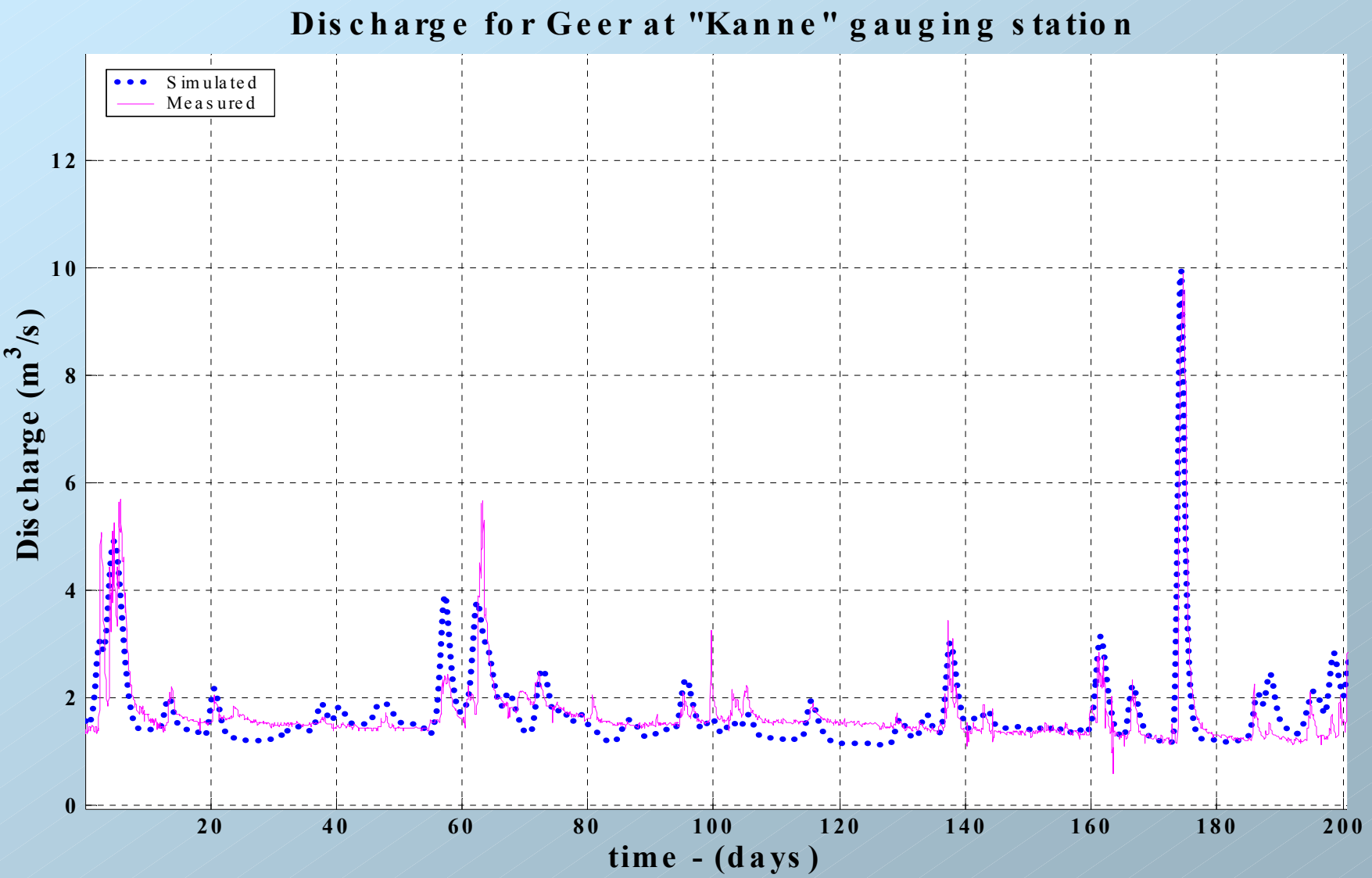
Some ongoing activities

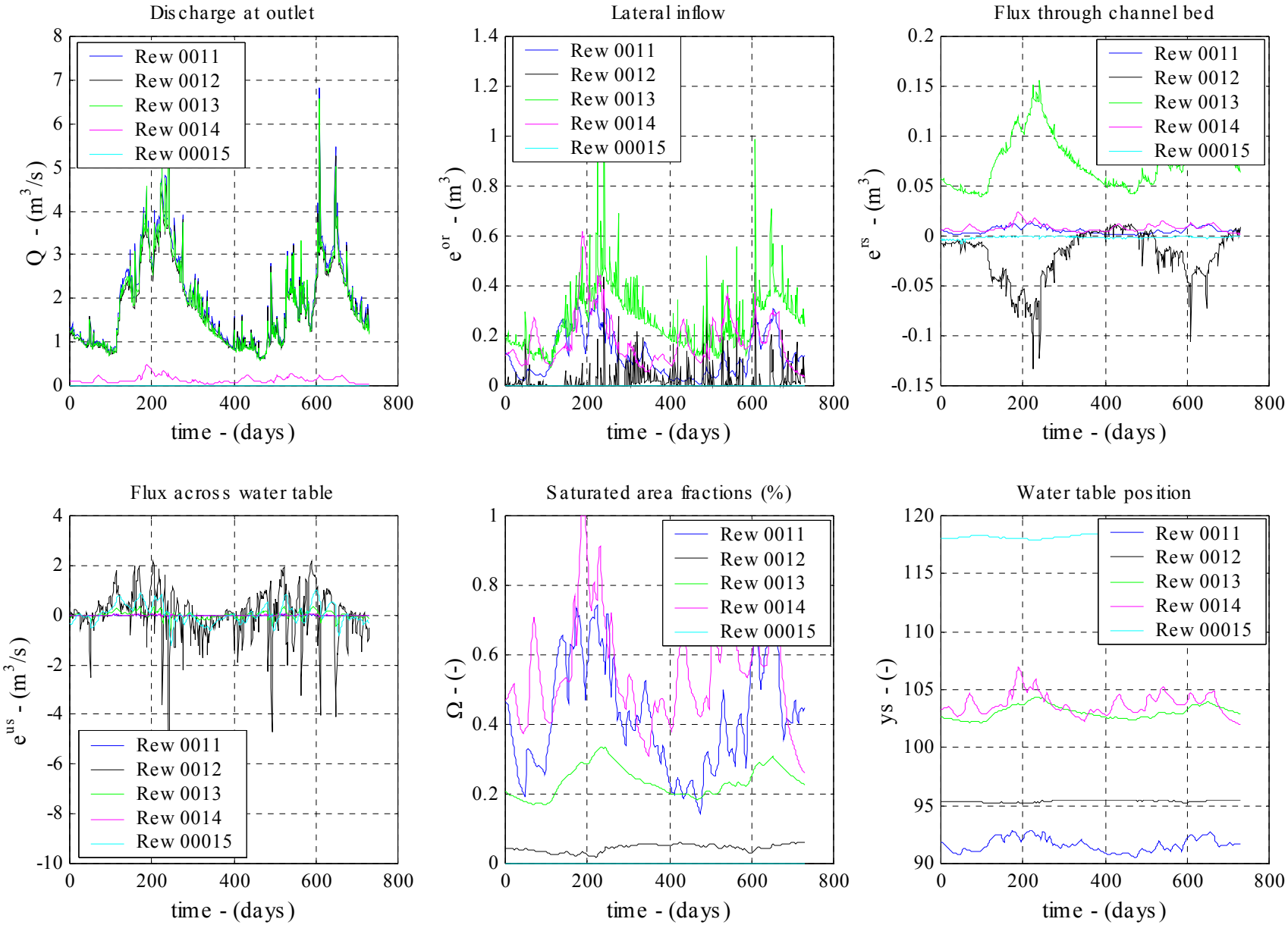
- **Application to the Geer (Be) river catchment (494 sqkm).**
- **Further application to thre Ourthe watershed (Be) are ongoing.**
- **Uncertianty analysis carried out with SCE-UA Duean et al. 1992 method.**
- **Data assimilation**

Two-dimensional aquifer flow



Modelling results: 1995-1997




Discharge at outlet
Q - (m3/s)
time - (days)
Rew 0011
Rew 0012
Rew 0013
Rew 0014
Rew 00015
Lateral inflow
eor - (m3)
time - (days)
Flux through channel bed
ers - (m3)
time - (days)
Flux across water table
eus - (m3/s)
time - (days)
Saturated area fractions (%)
Ω - (-)
time - (days)
Water table position
ys - (-)
time - (days)

Potential use of the approach

- Rainfall-runoff modeling
- Longe-term Water balances
- Effect of land-use changes
- Coupling with climate models
- Erosion studies
- Water management