Regionalization of land use, groundwater and discharge along the Tarim River

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SuMaRiO Implementation Conference
in Munich, Germany

Federal Ministry of Education and Research
FONA
SUSTAINABLE LAND MANAGEMENT
MEECAL Deutsch-Chinesisches Zentrum
SuMaRiO

Outline

1. Categorization of landuse in the Tarim River Basin
2. Spatial distribution of the groundwater
3. Tarim Water allocation
4. Salinization and the unsaturated zone
5. Regionalisation in the Decision Support System

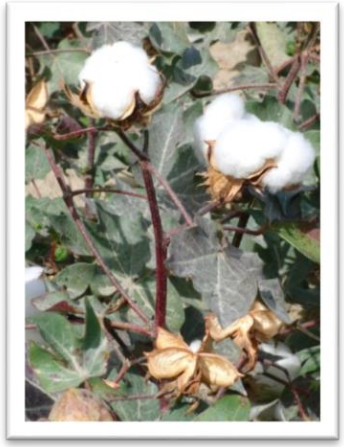
1. Categorization in the Tarim River Basin

Our research domain: nearly 30 000 km²

Aim: Regional model for the whole basin

Challenge: develop methods and implement processes, which are offering satisfying accuracy within acceptable computational demand

1. Categorization in the Tarim River Basin



Main focus on the agriculture, the natural vegetation and the environmental impact:

- **Cotton production**
- **Fruit production**

- **Tugai floodplains in the upper/middle AND the lower reaches**

- **Natural vegetation**

Three major research areas

Upper reaches	Middle reaches	Lower reaches
Aksu/Alar	Yingbaza	Arghan
Agriculture	Natural Flooding	Ecological releases
Salinization	River <-> Groundwater	Tugai vegetation

1.1. Agriculture in Aksu/Alar

- **Dominated by the cotton cultivation**

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Groundwater is highly influenced by the irrigation measure and the drainage measures

→ Salinization effects

1.1. Agriculture in Aksu/Alar

Groundwater modelling:

- **Calibrate the model with the measured well data**
- **Run the model without the ET**
- **Result 1: underestimated irrigation volumes**
- **Result 2: undisturbed groundwater development**

Input for the DSS

- **Real groundwater recharge rates for every time step**

1.2. Flooding in Yingbaza

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- Mixture of agriculture and Tugai forests
- Salinization process
- River ←→ Groundwater

→ Correlation of depth of impounded water and the resulting groundwater recharge

User input: water volume for flooding of natural vegetation

Result: Recharge matrix in the DSS

1.3. Ecological releases in Arghan

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Lower reaches require special handling, due to the:

- **landuse, which is composed only by Tugai floodplains**

  → **investigated by KU Eichstätt, TU Berlin, University Trier**
  upscaling the insights on the micro-scale to the over-regional scale of the DSS

- **groundwater; which is highly dependent on the ecological releases**

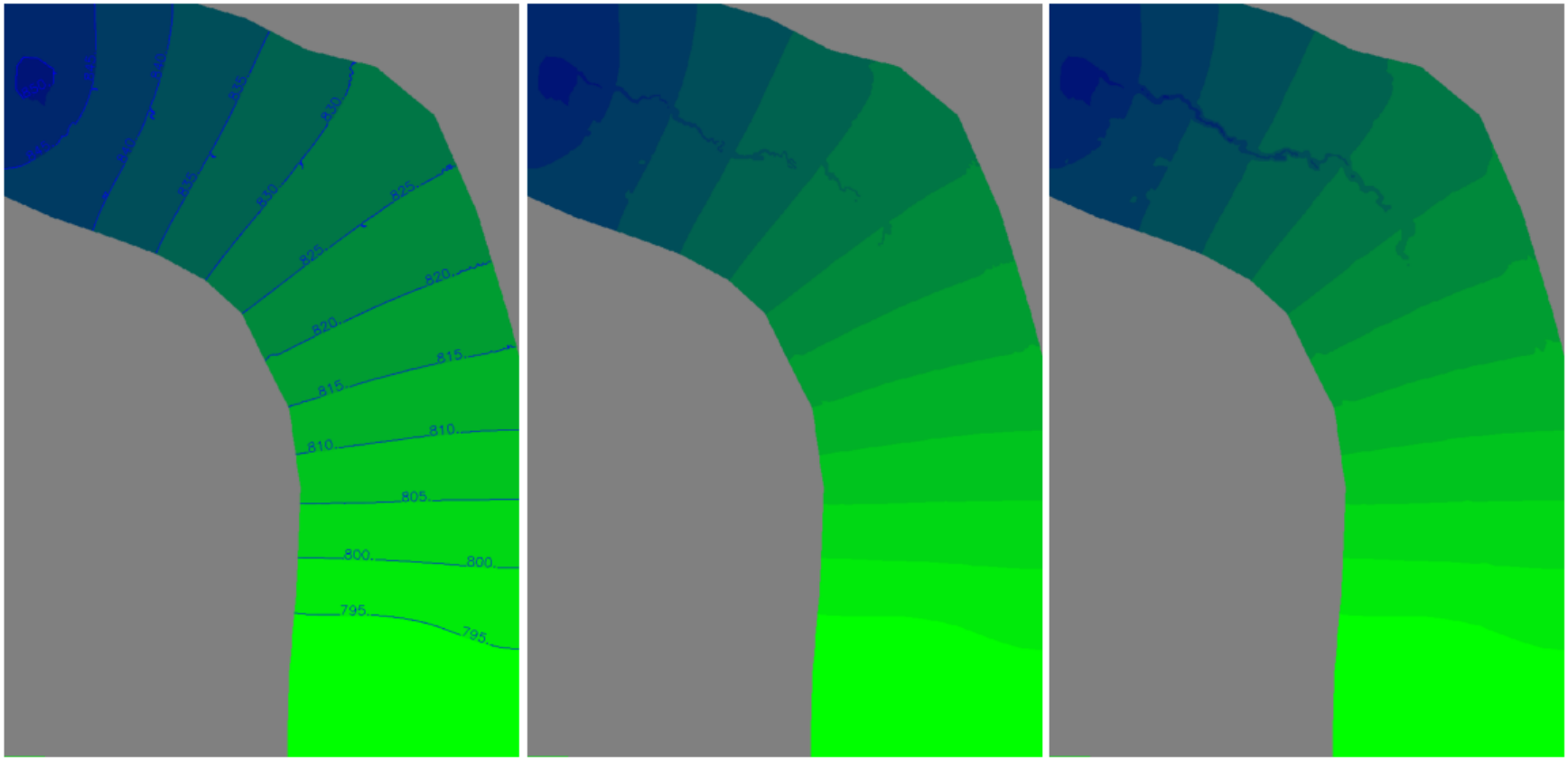
  → **Extra investigation by a subproject of ETH Zurich**

1.3. Ecological releases in Arghan

- Landuse limited to Tugai cells
- Dissemination process of Tugai trees
- Separate modelling of the groundwater
- Aim for the Daxihezi reservoir filling level

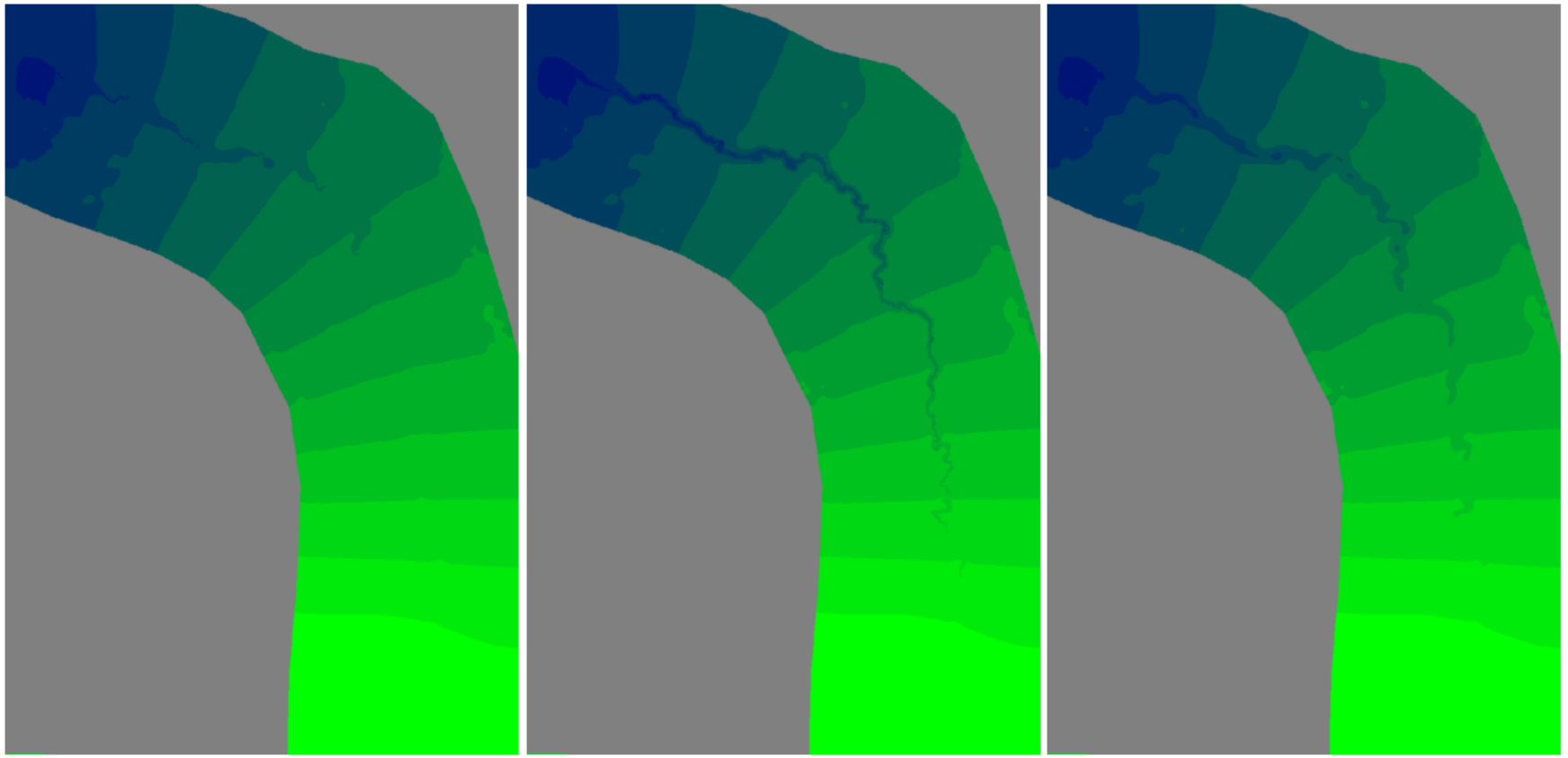
→ Composed of the residue water of the upper reaches plus the contribution of the Boston Lake

1.3. Ecological releases in Arghan



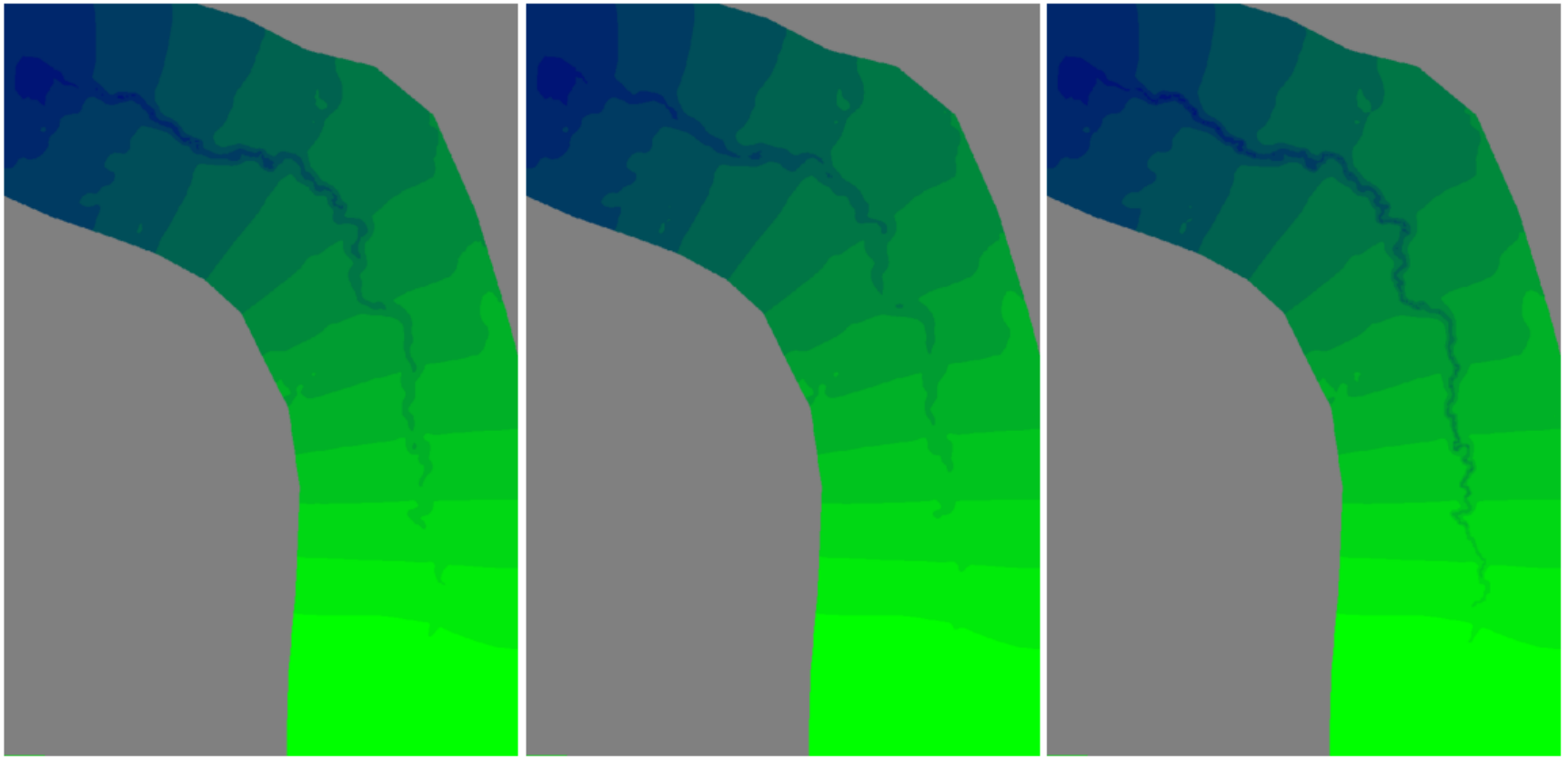
(a) Day 14: start of the 1st release; (b) Day 30: during the 1st release; (c) Day 73: end of the 1st release

1.3. Ecological releases in Arghan



(d) Day 188: start of the 2nd release; (e) Day 281: end of the 2nd release; (f) Day 335: before release 3.1 ;

1.3. Ecological releases in Arghan



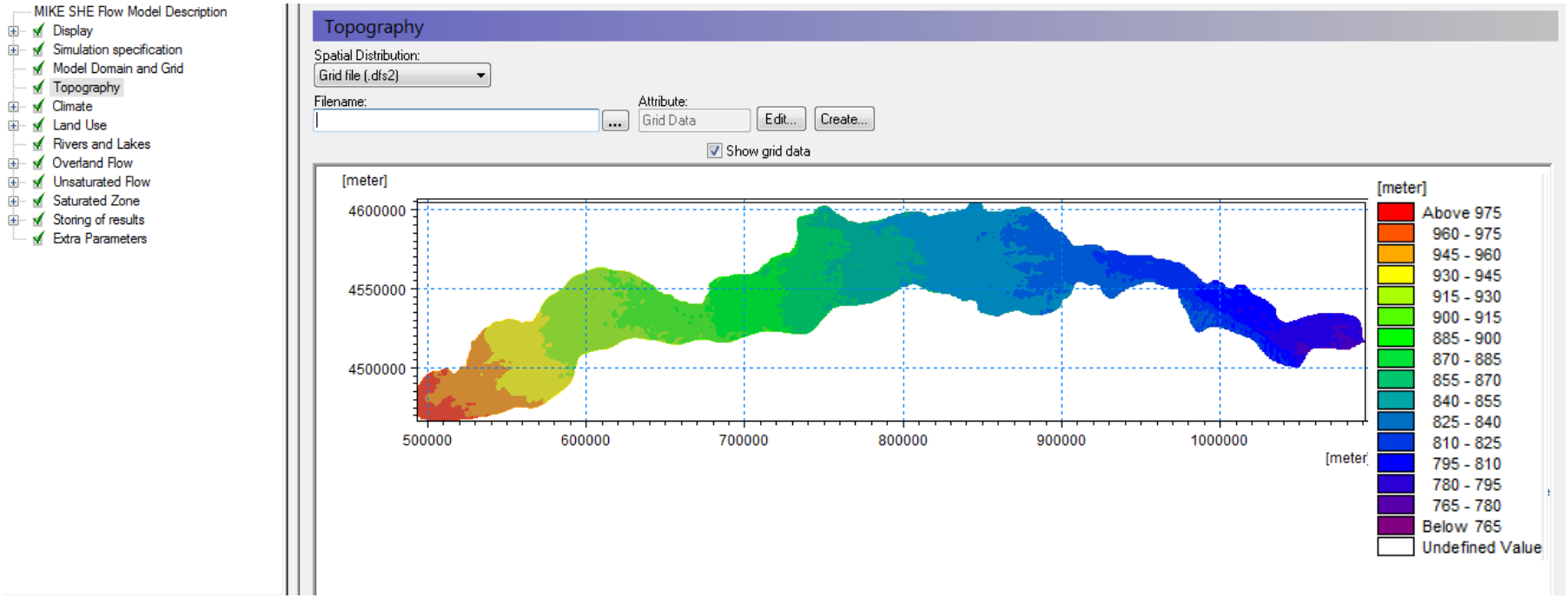
(g) Day 432: end of relase 3.1; (i) Day 500: before release 3.2; (j) Day 566: end of release 3.2.

1.3. Ecological releases in Arghan

The tests of the different release strategies illustrates that a combination of different flood sizes and flood durations is the best method to ensure a sustainable forest in the lower region of the Tarim River. It is shown that the forest can be preserved in a corridor of at least 1000 m on both sides of the river bank. This strategy also allows for a dynamic management of the fluctuating water resources.

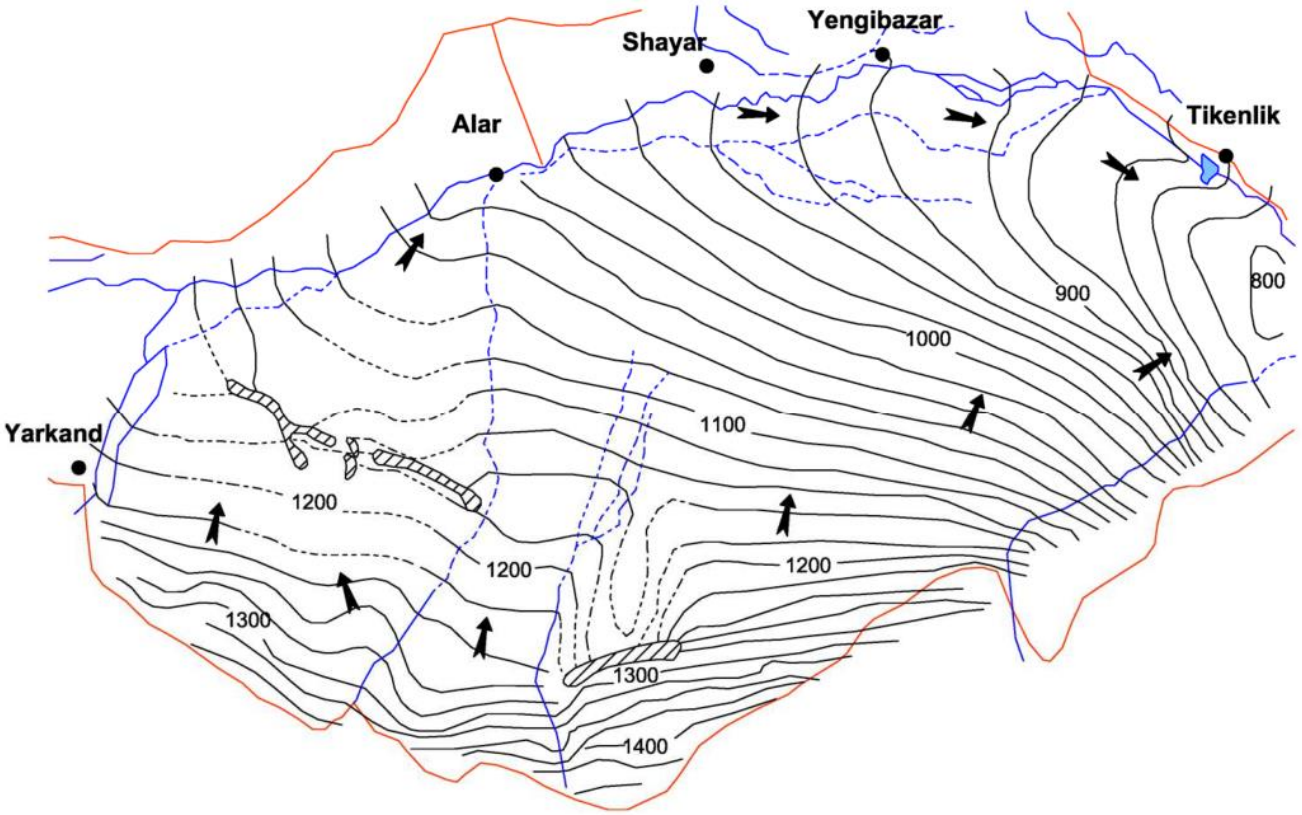
2. Spatial distribution of the groundwater

First model setup in MIKE SHE



2. Spatial distribution of the groundwater

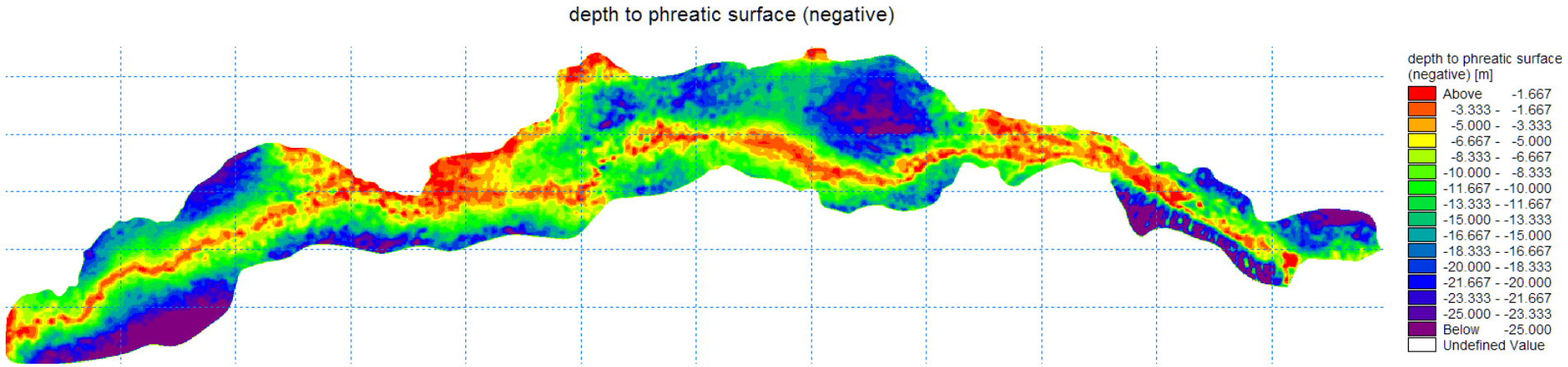
Groundwater gradient in the Tarim Basin and the Taklamakan Desert



(Source: Li et al.,2000)

2. Spatial distribution of the groundwater

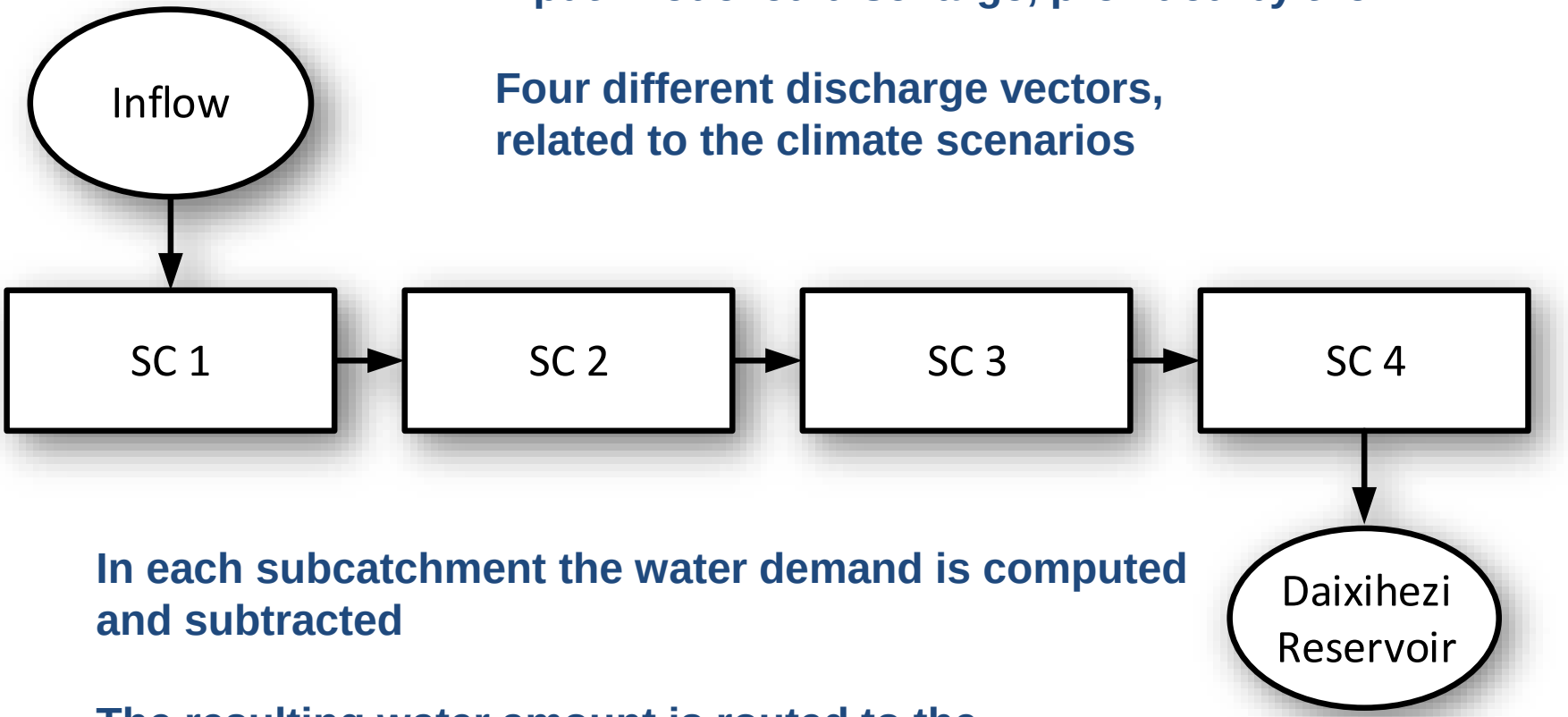
Depth of the groundwater table in the irrigation period



3. Tarim Water Allocation in the DSS

Input: Modelled discharge, provided by the PIK

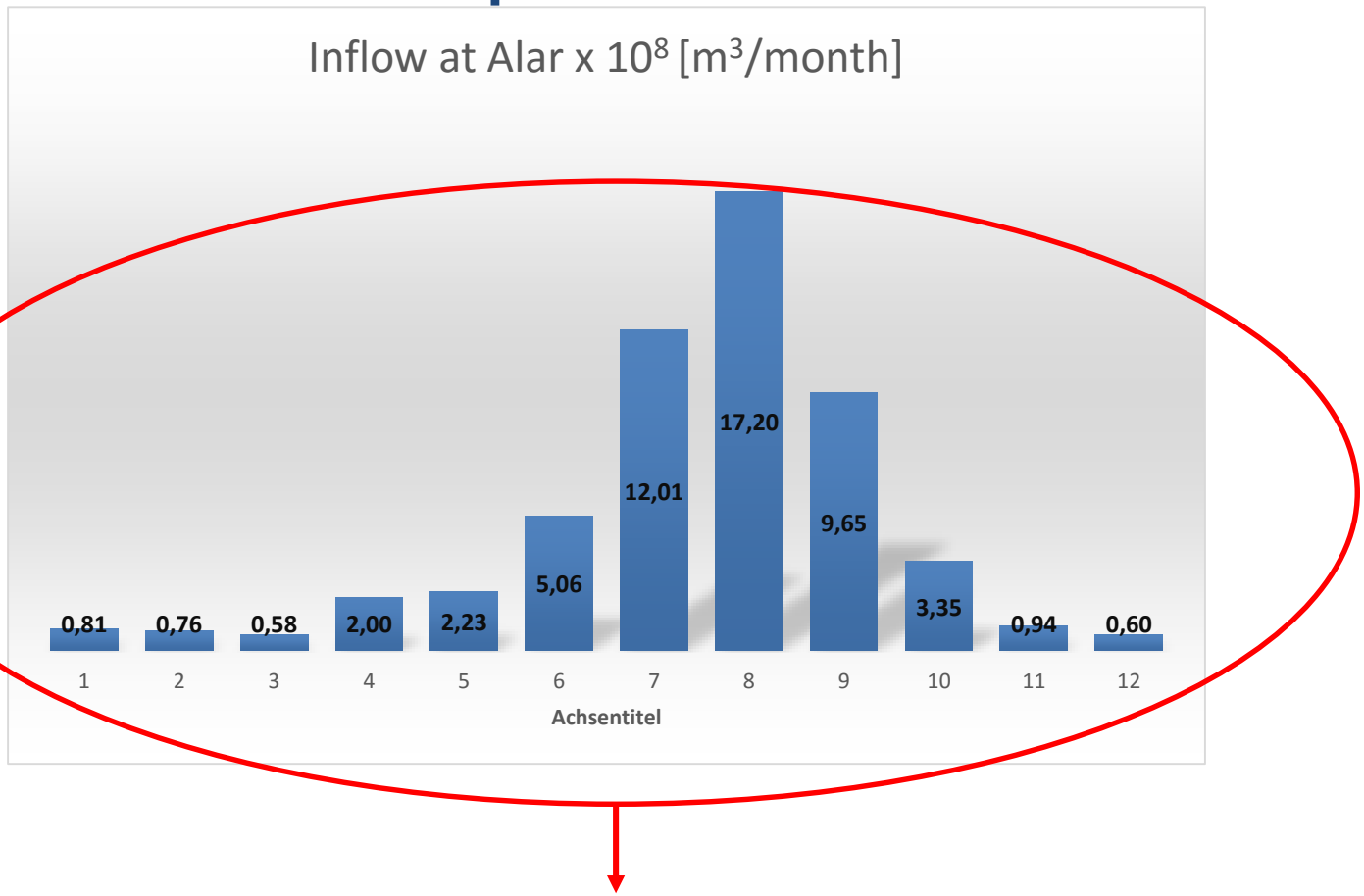
Four different discharge vectors, related to the climate scenarios



In each subcatchment the water demand is computed and subtracted

The resulting water amount is routed to the subsequent catchment

Schematic representation of the simulation process



Water Volume available in the Tarim in [m³/year]

4. Salinization

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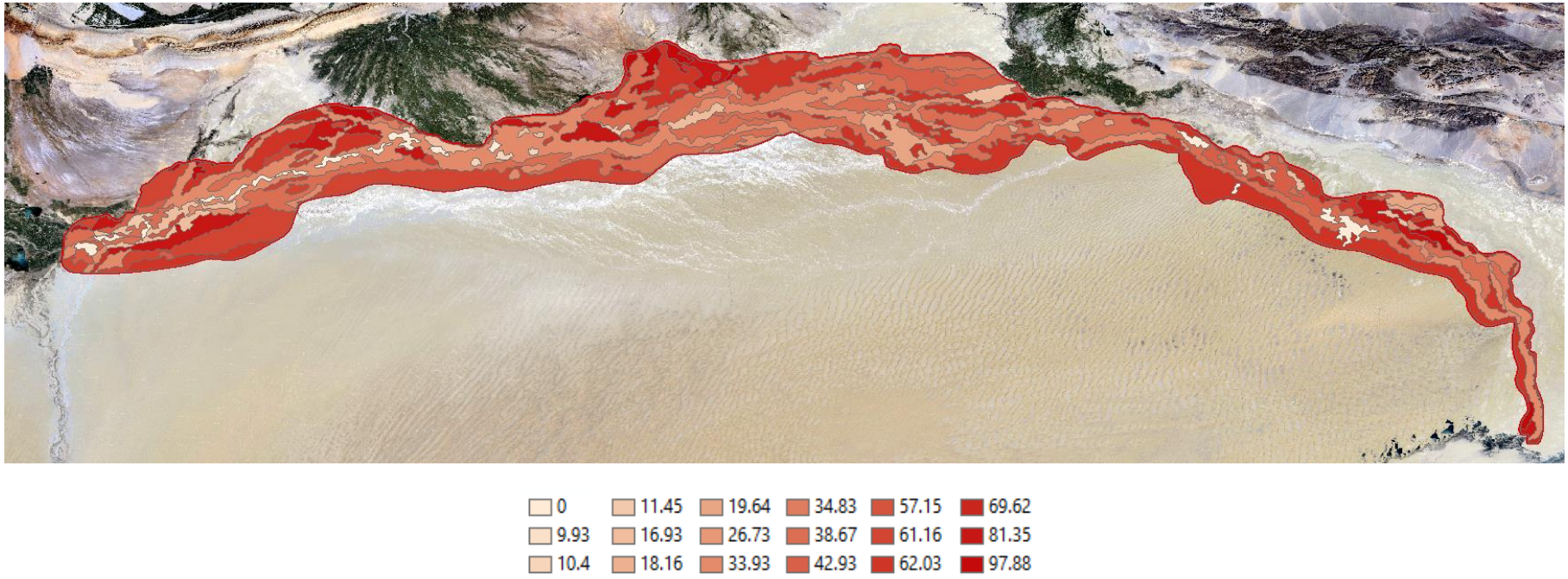
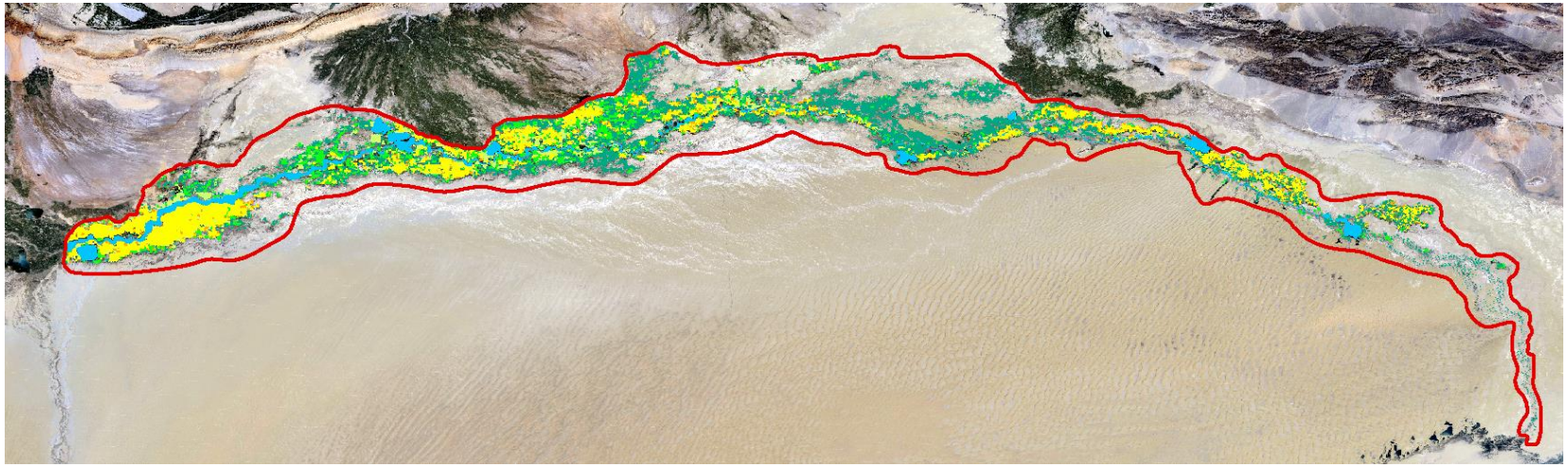
“ECe” = saturated paste extraction



5. Regionalisation in the Decision Support System

The core of the DSS and the main tool for the regionalization is the

Landuse grid



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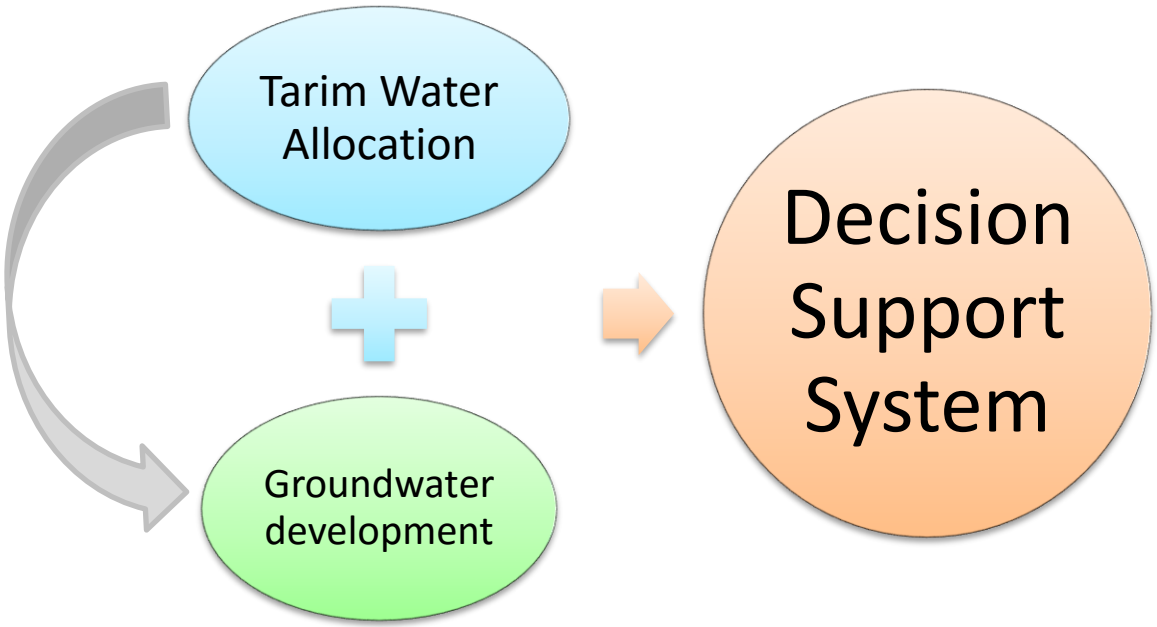
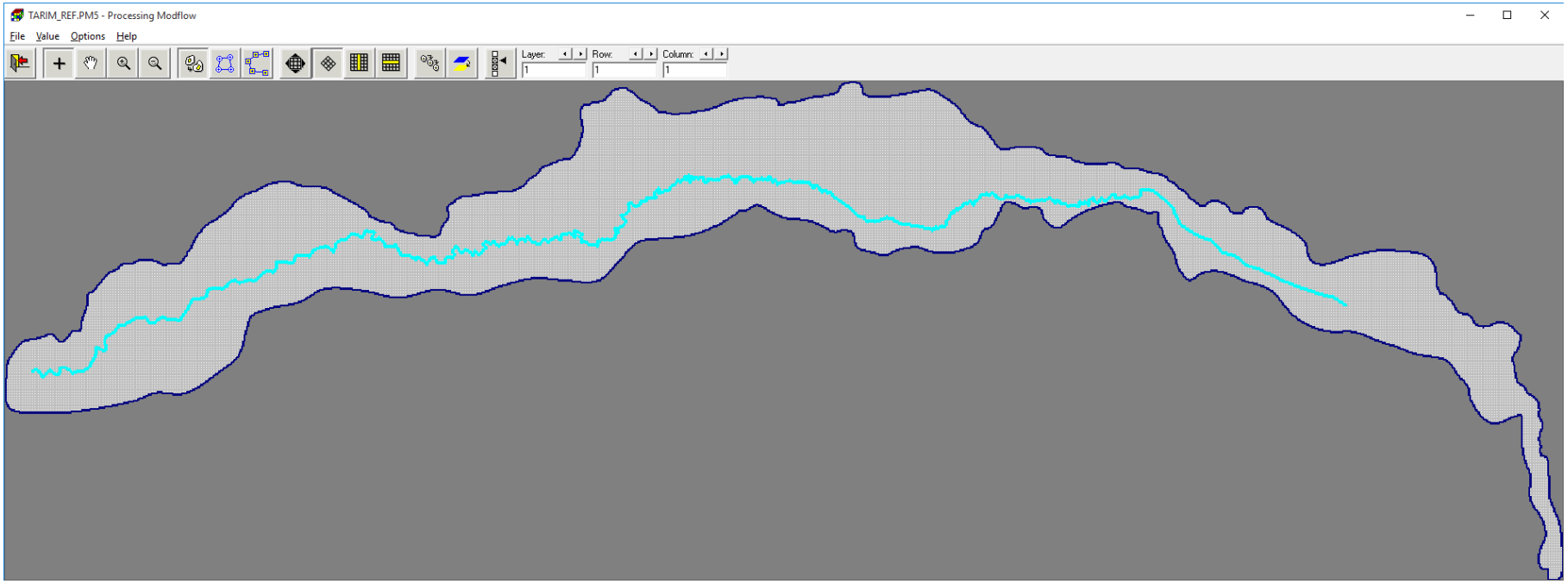


5. Regionalisation in the Decision Support System

The groundwater resources are modelled by MODFLOW, which is started and evaluated by the DSS



Outlook