Development of Advanced and Up-to-date Hydroinformatics Tools for Improved Water Management

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Gábor Réti
HYDROInform Ltd.

HYDROInform Ltd.

- Established: in the year 2000;

- Purposes:
  - research,
  - systems development,
  - and consulting
  on hydroinformatics;

- Primary effort is to develop advanced GIS-based hydroinformatics:
  - models,
  - tools,
  - integrated systems,
  - applications
  for Improved water management and planning.

According to our professional mission statement we have focused on:

Modelling-based spatial distributed data preprocessing and mapping,

A transboundary GIS database to support our modelling works.

Physically based, large scale, high resolution modelling approaches for describe the detailed water-balance dynamic over large river basins.

Advanced stochastic analysis tools for understanding the reliable nature of the extreme events and its frequencies.

Developing software applications

The basic pillars of our developed tools

Advanced geostatistical approaches-based large-scale raster-field modelling tool for mapping meteorological data

Stochastic weather generator to simulate daily (or hourly) sequences of the weather

Physically based, distributed parameter hydrological model to simulate all essential processes of the hydrological cycle over large basins

Integrated 1D hydraulic model to simulate the hydraulic processes in a lowland area of the rivernetwork.
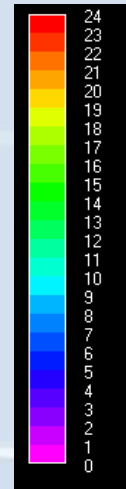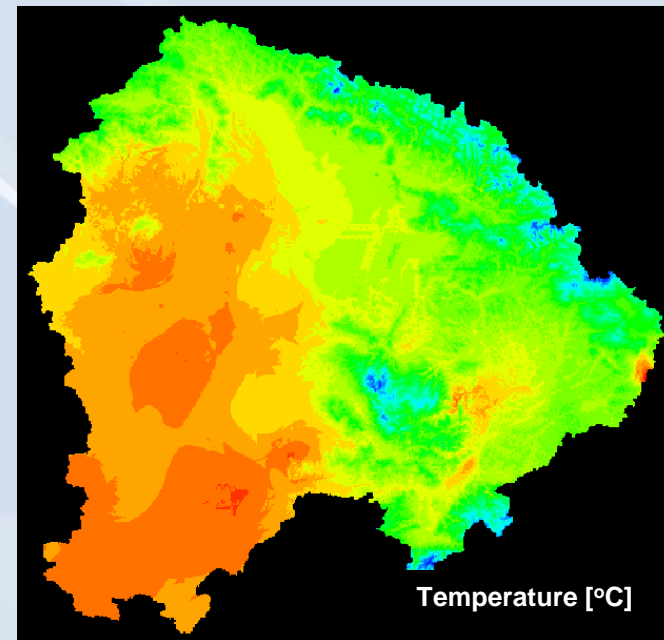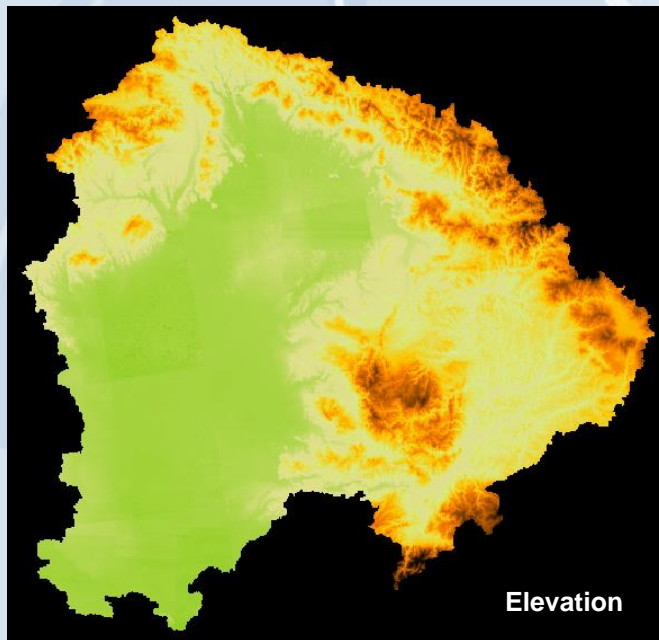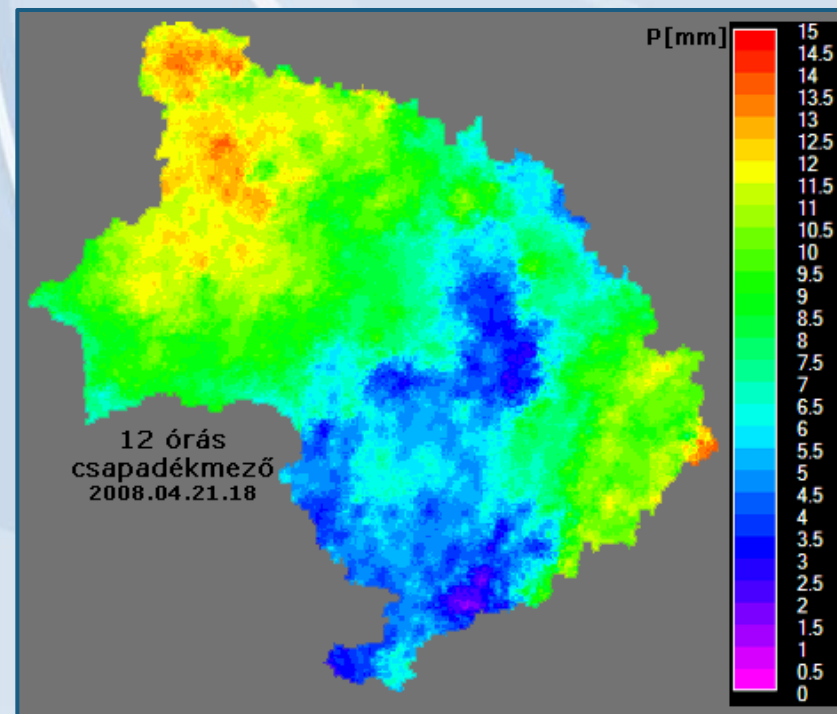
Transboundary GeoDataset.

An outline of the recent developments

Advanced geostatistical approaches-based large-scale raster-field modelling tool for mapping meteorological data

- resolution independent mapping;
- automatic semi-variogram modelling using on-line parameter calibration;
- combination of radar and rain-gauge observations;
- elevation-dependent mapping of temperature.

Illustrative results (Daily mean Temperature for Tisza: **02.08.2002**)

Elevation

Temperature [ºC]

An outline of the recent developments

Advanced geostatistical approaches-based large-scale raster-field modelling tool for mapping meteorological data

– resolution independent mapping;
– automatic semi-variogram modelling using on-line parameter calibration;
– combination of radar and rain-gauge observations;
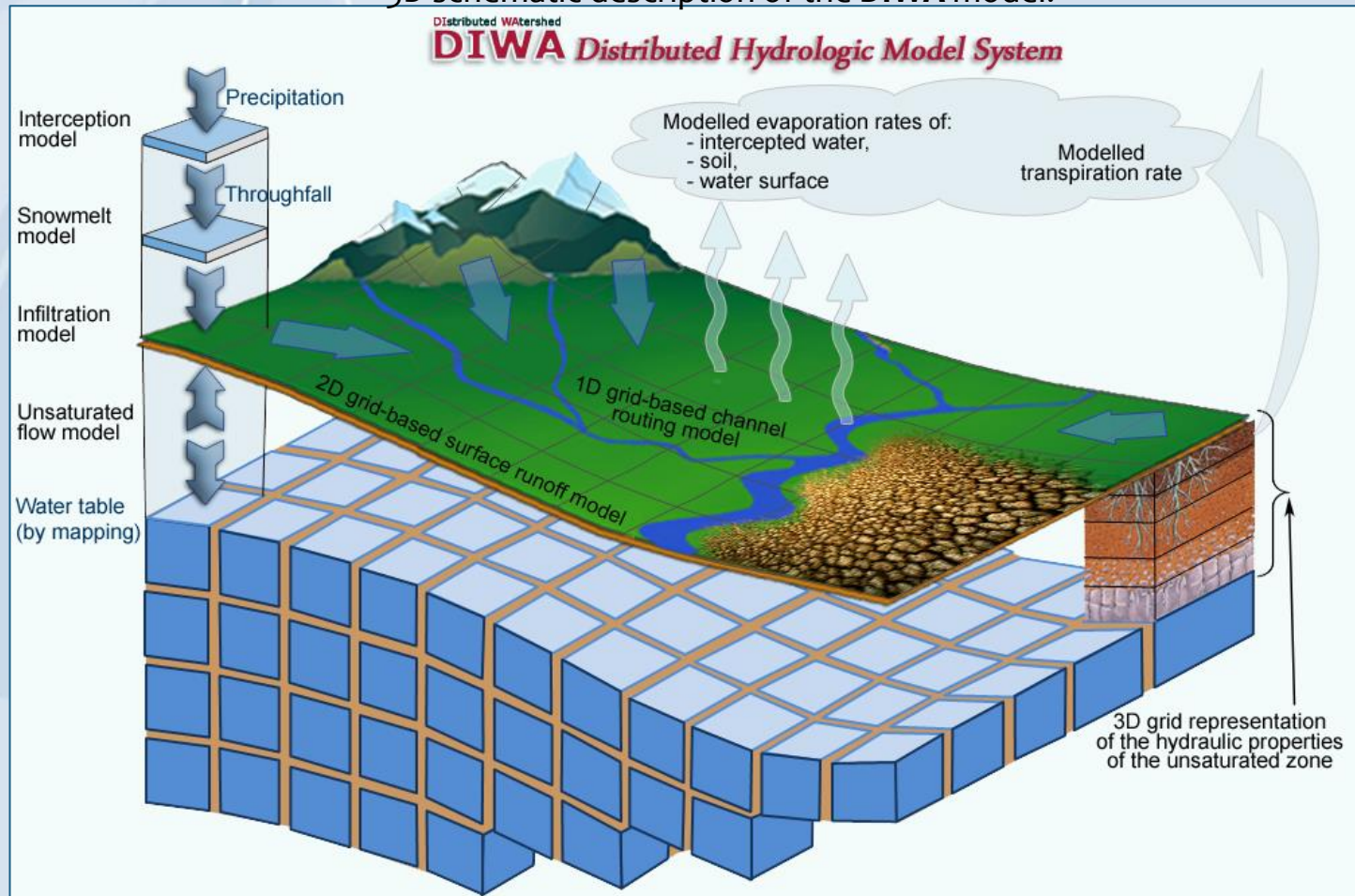– elevation-dependent mapping of temperature.

Illustrative results (combined radar and rain-gauge data)

The **DIWA** (**DI**stributed **WA**tershad) distributed hydrologic model system
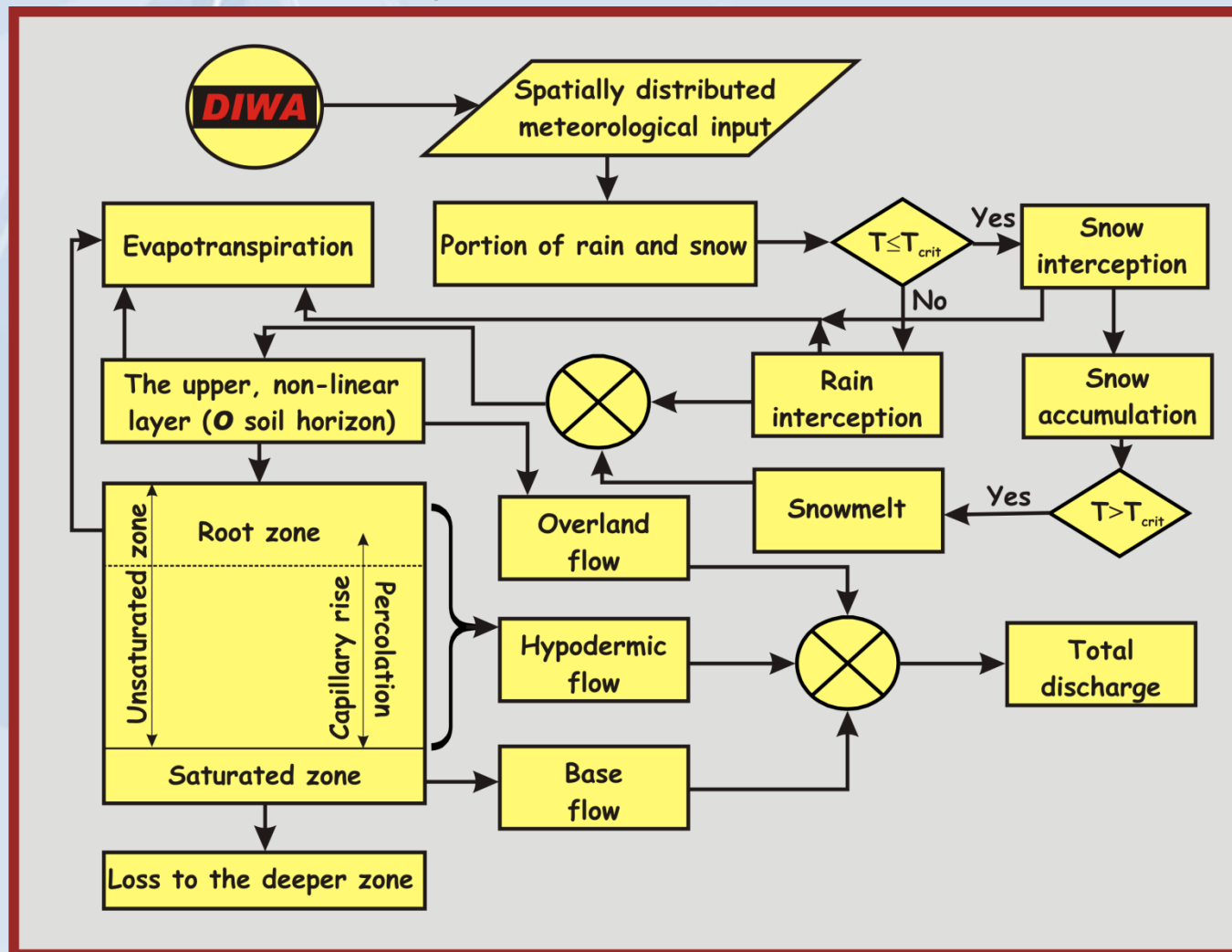
3D schematic description of the **DIWA** model.

An outline of the recent developments

The **DIWA** (**DI**stributed **WA**tershad) distributed hydrologic model system

Simplified flowchart of the **DIWA** model.
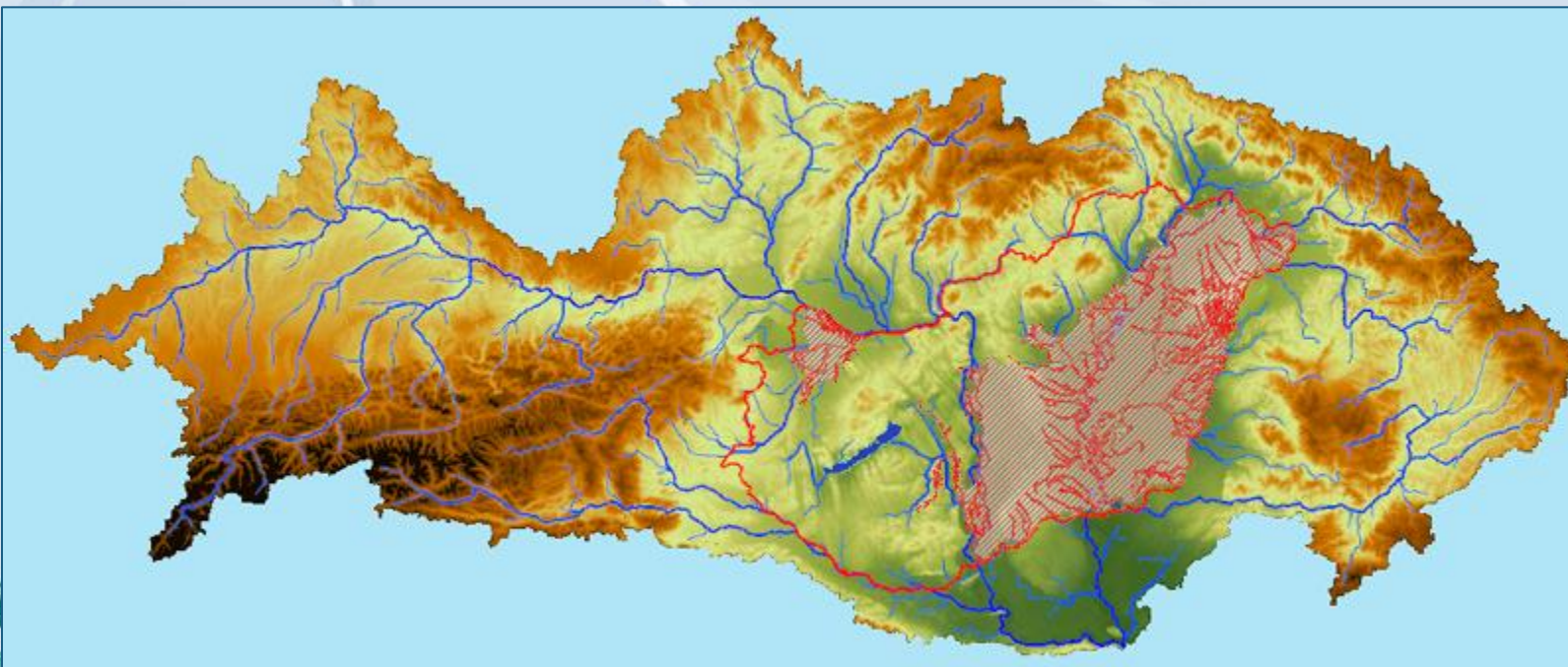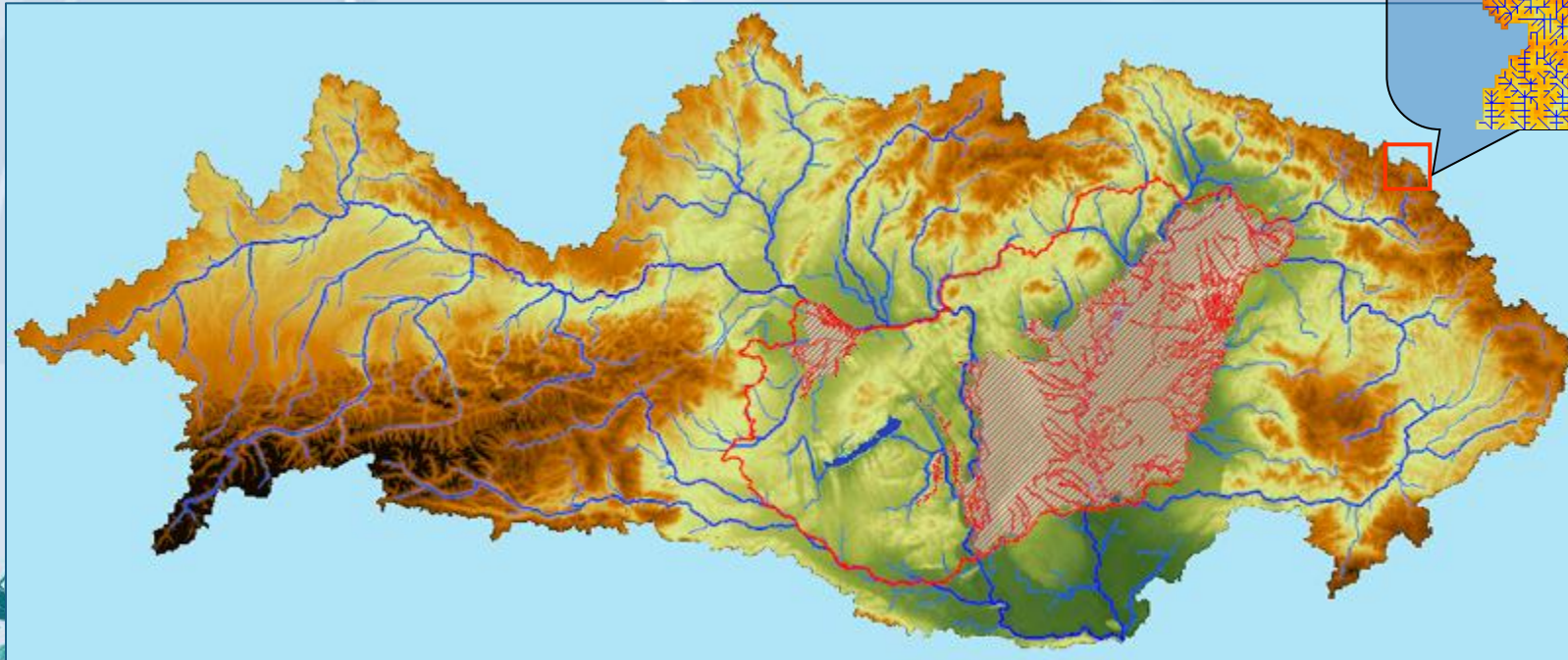
Transboundary GeoDataset

Digital terrain model and its derivates:

Sources: 100x100 m SRTM data, and 5x5 m for the non-contributing areas.

Products: 1x1 km grid data

Derivatives:

- Non-contributing areas;
- Surface slope;
- Local derange direction;
- Model stream network
- Potential daily solar-energy (Wh/m^2)
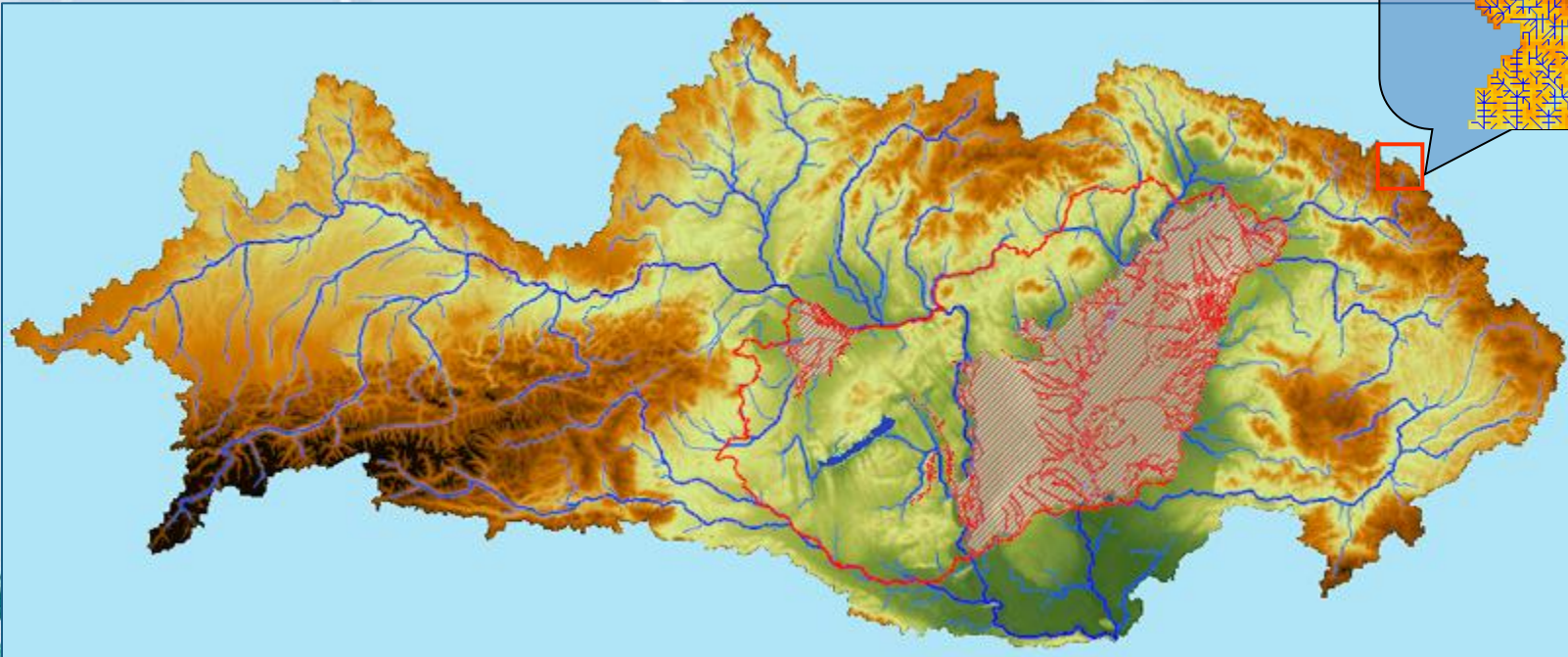
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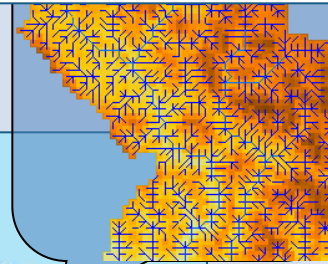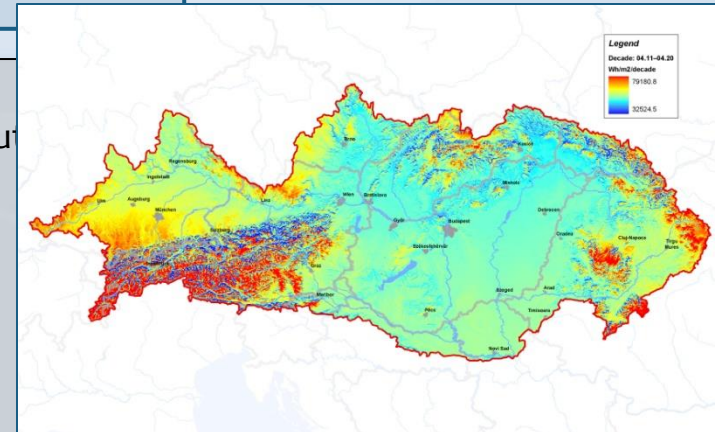
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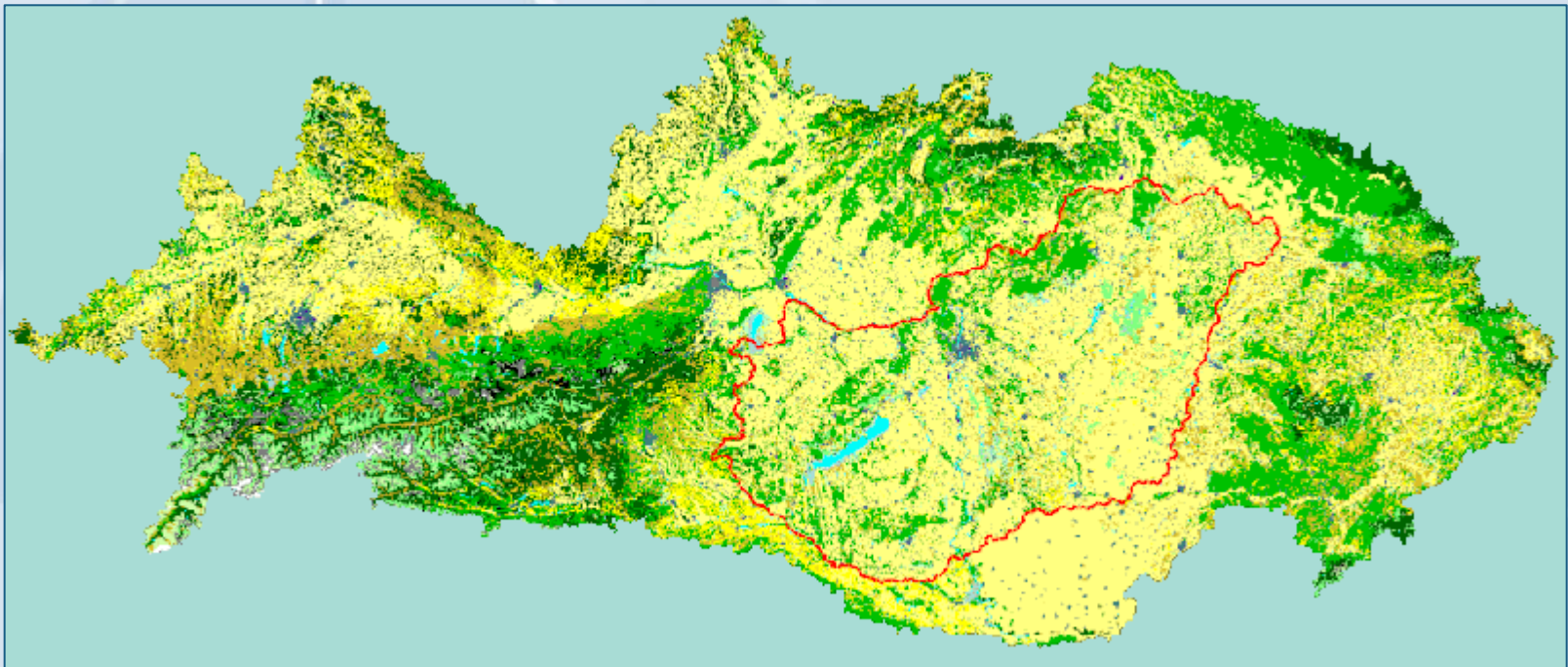
An outline of the recent developments

Transboundary GeoDataset

Land use and vegetation density:
Sources: CORINE Land Cover and satellite product of NDVI.
Products: 1x1 km grid data for 42 land cover categories, and
                        12 monthly average of NDVI
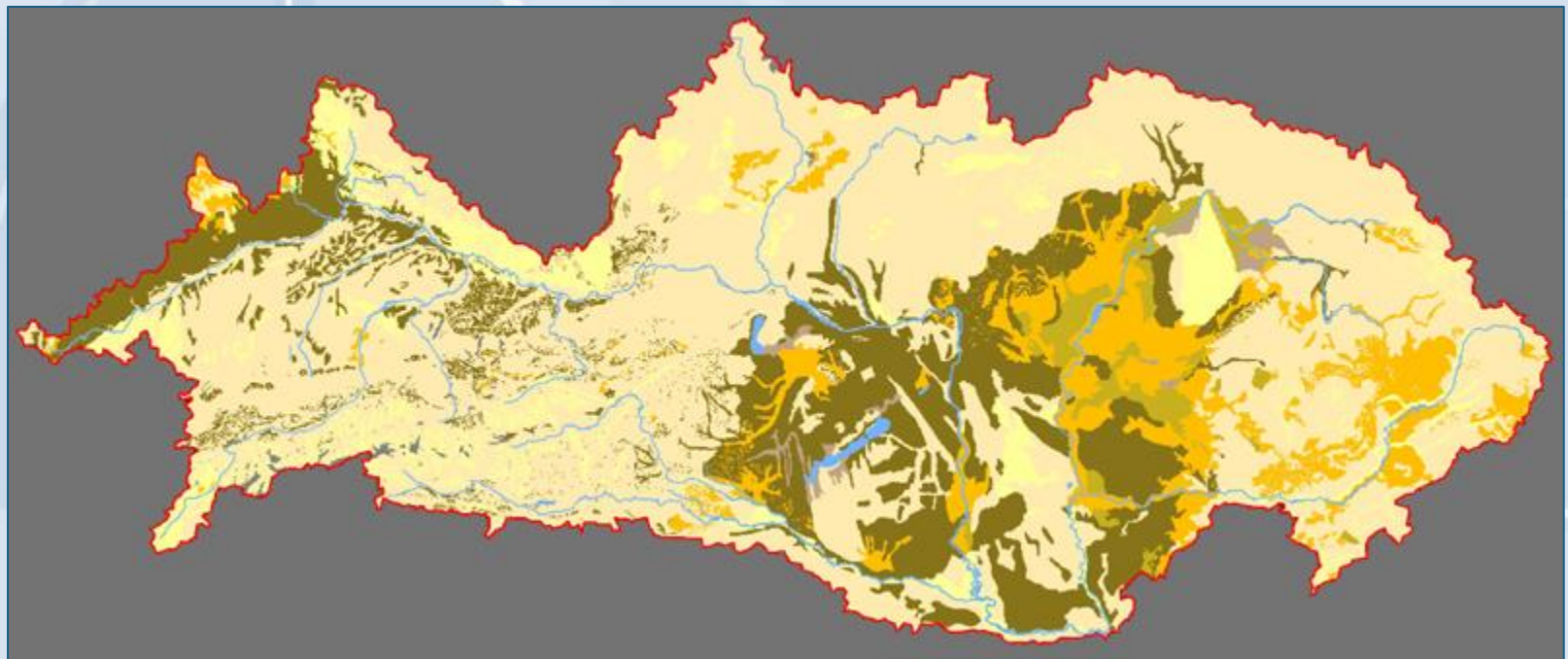Derivatives: 1x1 km grid data for LAI (Leaf Area Index)

Transboundary GeoDataset

Soil texture and hydraulic properties:
Sources: European Soil Bureau (JRC) product, and
            National Soil-map of Hungary (AGROTOPO)
Products: 1x1 km grid data of soil-texture
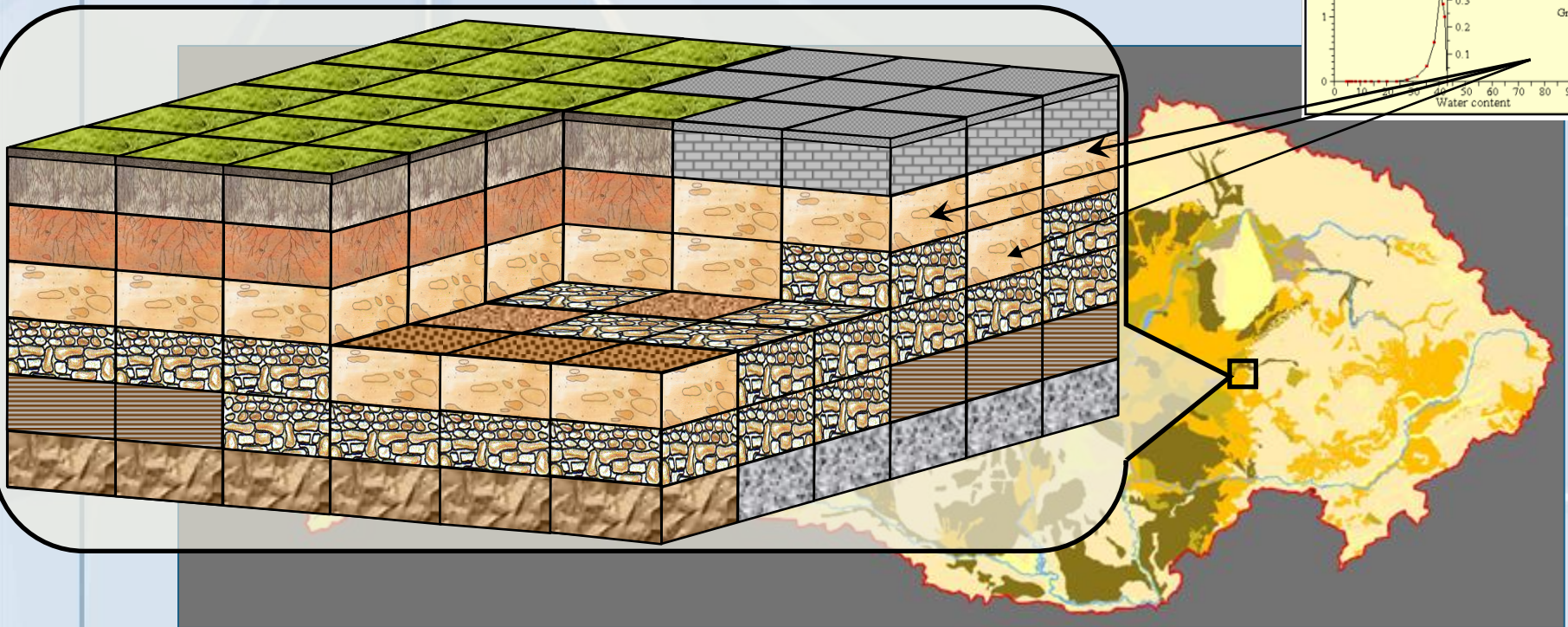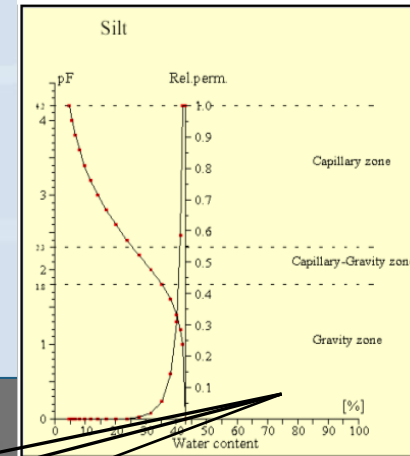Derivatives: 1x1 km grid data of soil-hydraulic parameters

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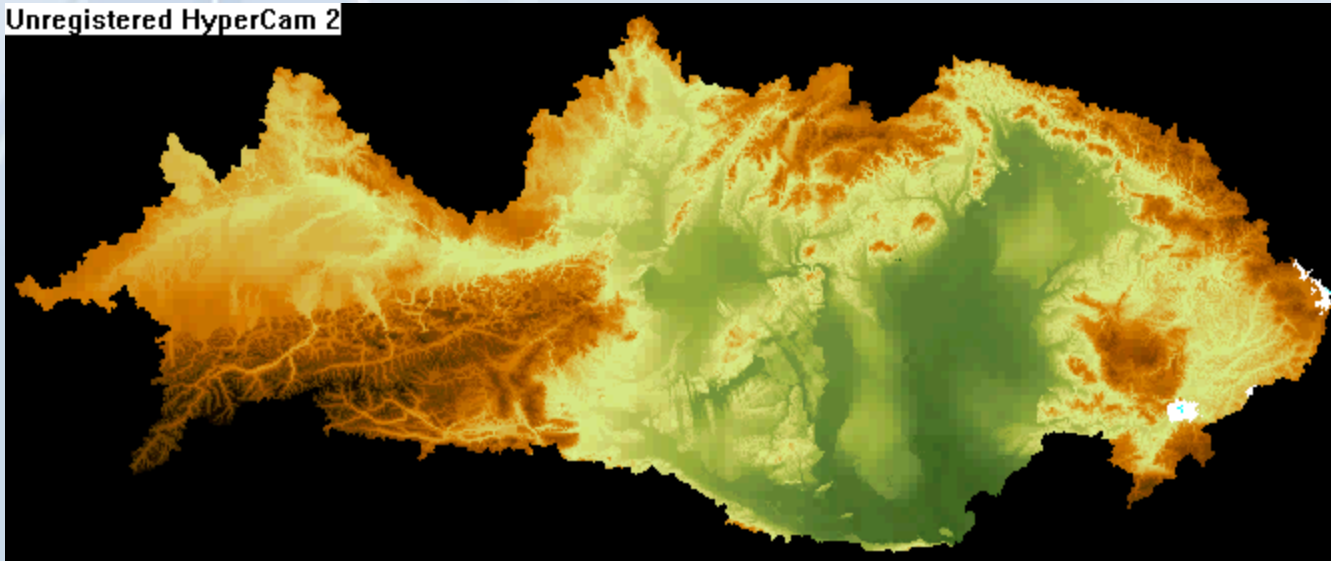Products: 1x1 km grid data of soil-texture
Derivatives: 1x1 km grid data of soil-hydraulic parameters

Pre-calibrtated model run for Danube basin
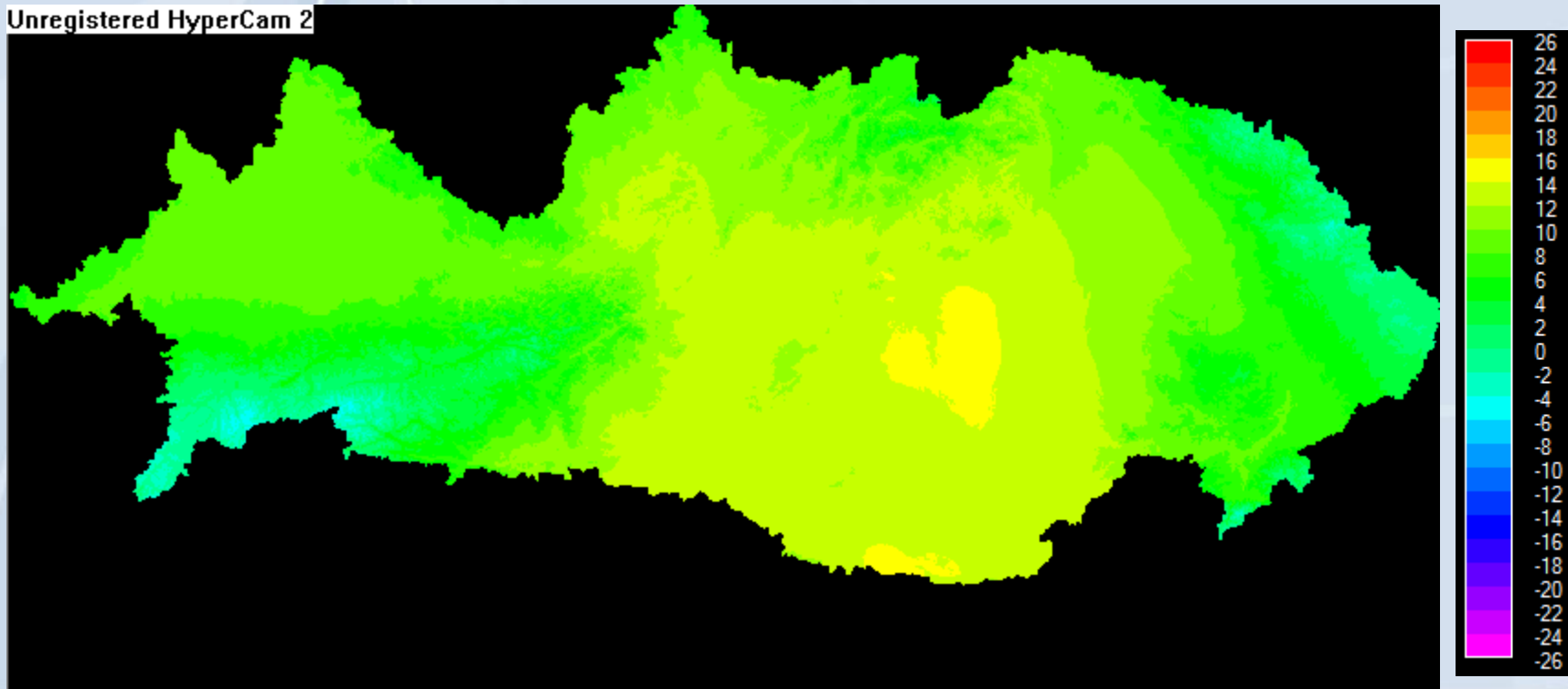
Precipitation field

Pre-calibrtated model run for Danube basin

Temperature field
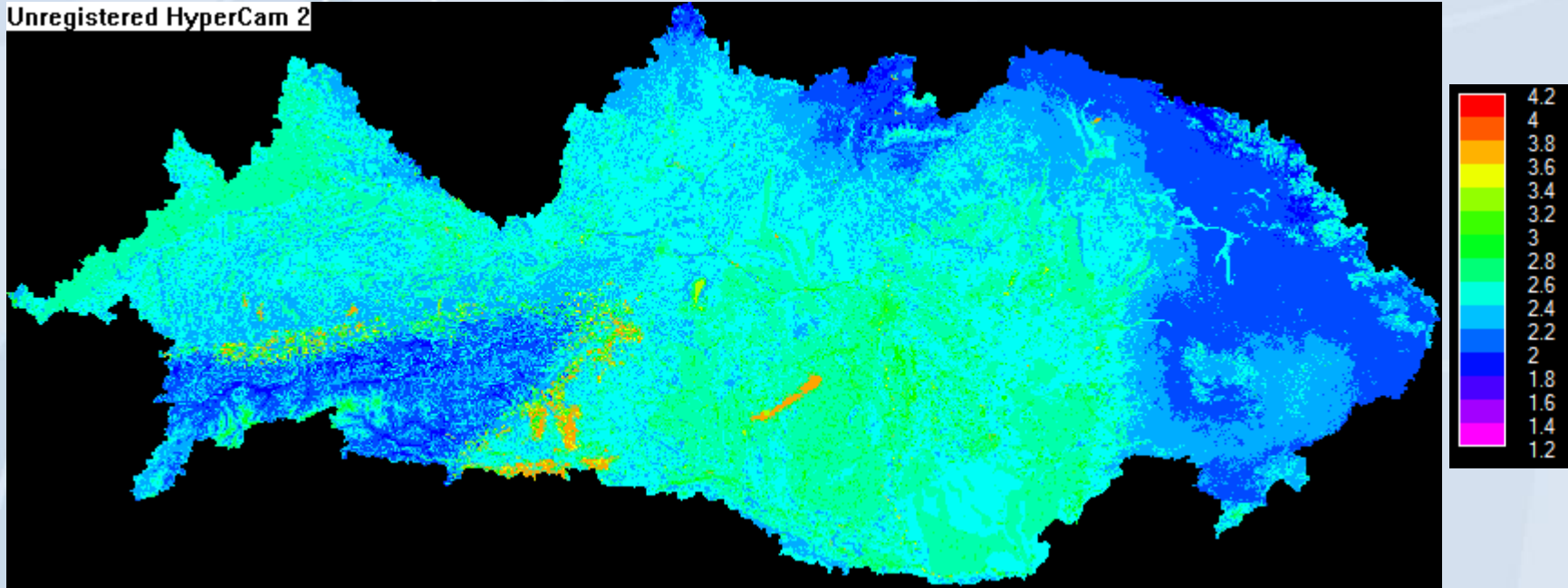
Pre-calibrtated model run for Danube basin

pF value of the root zone (10-logarithm of the pore water suction expressed as water column in cm)

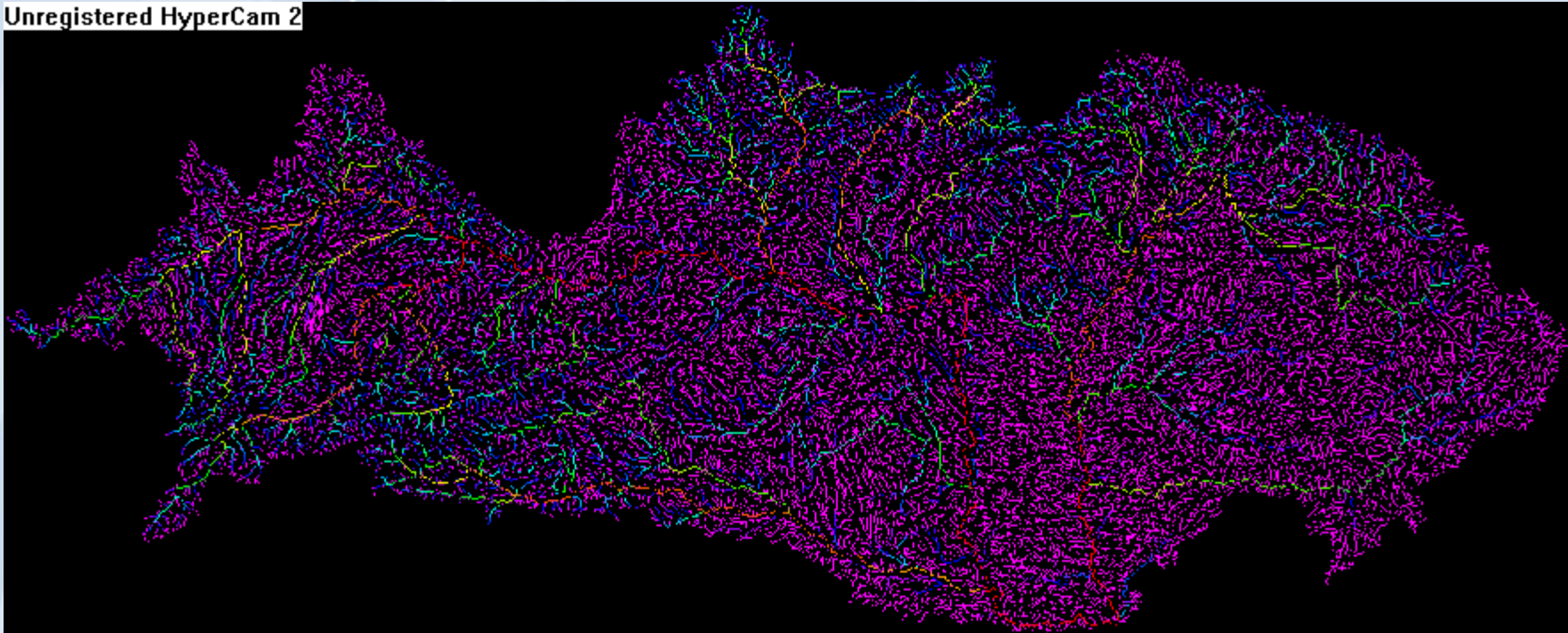# Pre-calibrtated model run for Danube basin

Channel runoff (discharge)

Some recent applications of the developed tools

Title: *"The Development of a Flood Control Information System in the Upper-Tisza River Basin"*
Period: *2012*
Sponsored by: *Swiss contribution found*
Client/Donor: *Upper-Tisza Regional Water Directorate (FETIVIZIG)*
Our position in the project: *Prime contractor*

A brief outline of our works:
Flood runoff analysis for the main river of the Upper-Tisza Basin: Analyze the basin responses to the extreme events (for the 100/200 years return periods) under the
– present and the
– future climate/land-use
conditions, using GIS-based modelling approaches.

Some recent applications of the developed tools

Title: *"Actualisation and further development of the Ukrainian complex flood protection program. "*
Period: *2012*
Sponsored by: *EU, European Neighbourhood and Partnership Instrument*
Client/Donor: *Transcarpathian Regional Water Directorate, Uzhhorod*
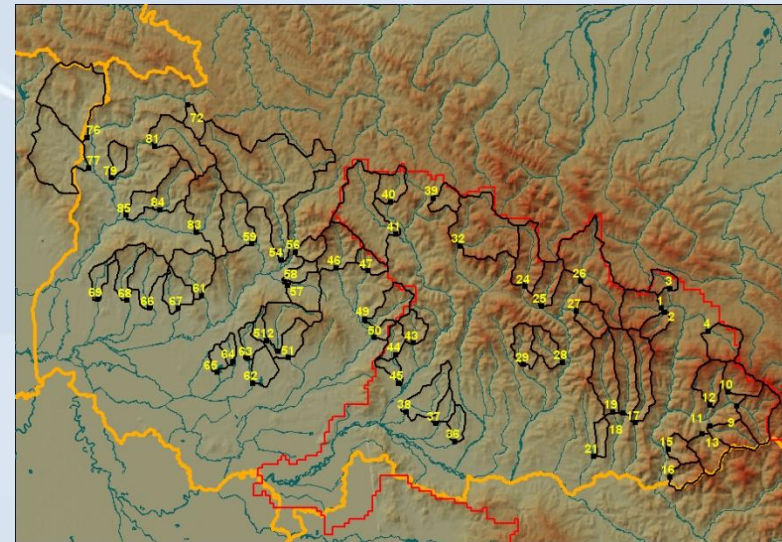**Our position in the project:** *Member of consortium, sub-task leader*

A brief outline of our works:
Design and development of an up-to-date modelling conception for determine optimal parametrization of the 42 unregulated, flow-through type flood retention reservoirs;

Executing the modelling-based calibration procedure for all the 42 reservoirs;

Impact assessment study of the flood retention reservoirs for the Upper-Tisza Basin, based on integrated model simulations.

Some recent applications of the developed tools

Title: " Common, Hungarian and Ukrainian integrated flood forecasting system for the Upper-Tisza Basin, using GIS-based model-system. "
Period: 2012-2013
Sponsored by: EU, European Neighbourhood and Partnership Instrument
Client/Donor: Upper-Tisza Regional Water Directorate
Our position in the project: Member of consortium, task leader

A brief outline of our works:
 Design and development of an integrated real-time hydrological forecasting system for the Upper-Tisza Basin, using up-to-date, physically-based, distributed hydrologic modelling technologies.
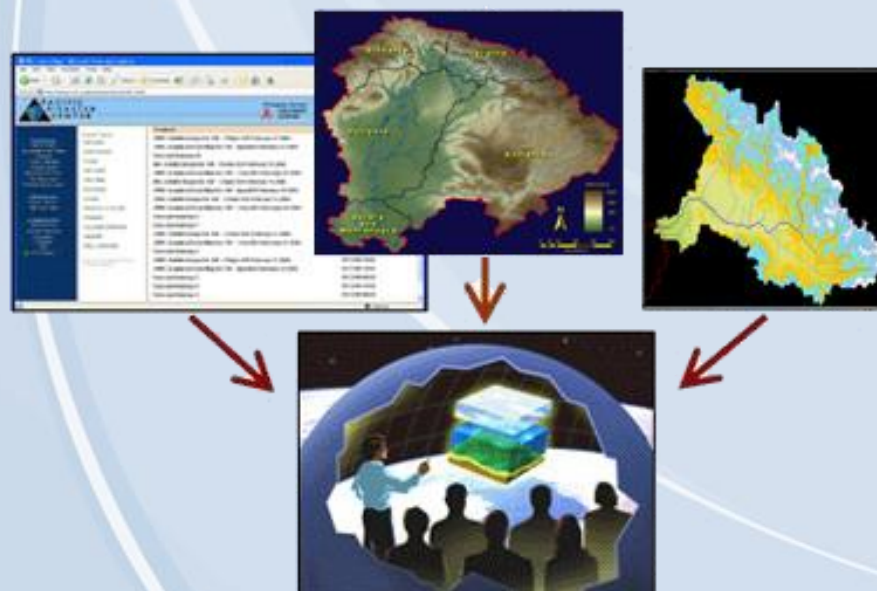

TISZA HYDRO-FOR

To develop a Decision Support System (DSS) for IWRM and RBM planning

Thank you for your kindly attention!