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Impact of hydrological, hydraulic modelling approach to a flash flood event in the Hidegvíz watershed in Hungary

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Study area:

The watershed is in the north-western side of Hungary, near Sopron. The Hidegvíz Valley's been a long time experimental watershed of the University of Sopron.
The watershed area contains 3 different sub-basins:

Rák-stream - 4.41 km^2
Farkas valley - 0.6 km^2
Vadkan valley - 0.93 km^2

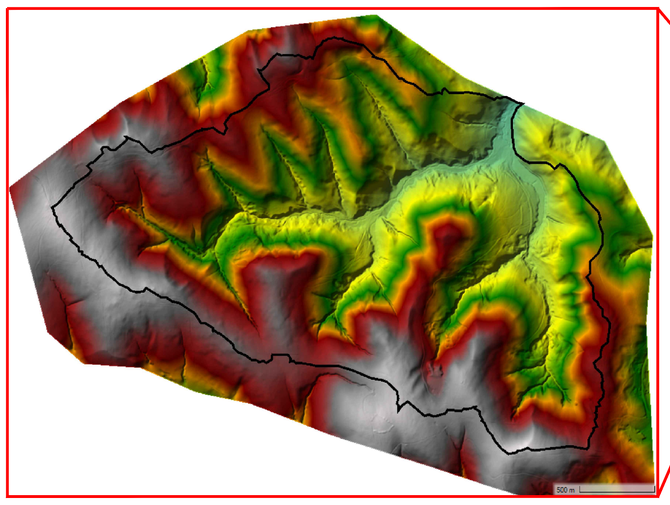
There are different survey areas for different parameters (rainfall, outflow, groundwater) also a complete hydrometeorological survey complex.
The base of the model geometry was a high detailed LiDAR survey.
For unsaturated soil parametrization the 3D Hydrosoil map was used.

szerintem ez túl nagy

ha errl beszélsz, le kell határolni a DEM-n

nem értem

types of soil, nevezd meg



DEM of the Hidevíz Valley

Measured Data (provided by the university of Sopron
Rainfall date
Runoff at station Date

Boundary conditions:

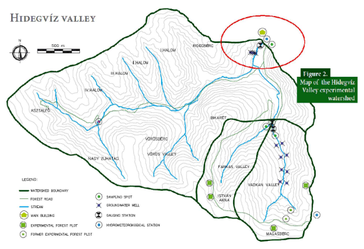
In this study the data provided by the researchers of the University of Sopron were used as boundary conditions and measured data for calibration on both models.
Upper boundary condition:

Precipitation data from the hydrometeorological station, for the rainfall event on 06/07/2012 14:30 - 16:50

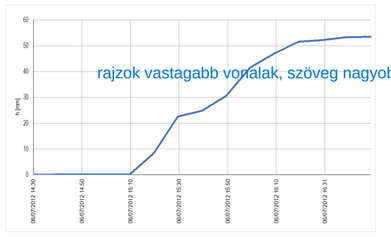
Outflow time series for calibration:

Calculated flow time series from the cauging station at the outflow area on 06/07/2012 14:30 - 07/07/2012 14:30

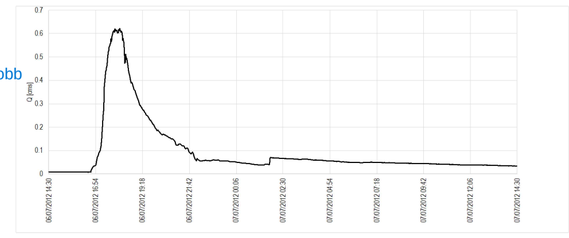
jelmagyarázat nagyobb nem látszik



Hydrometeorological station and gauging weir



Measured cumulative rainfall time series



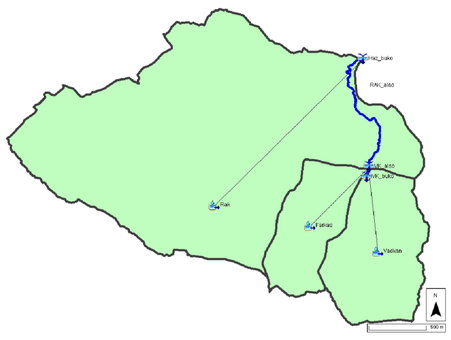
Outflow time series from measured data

Models

Hydrological flood modeling:

Watershed model with lumped parameterization on each sub-basin (HMS).
The used modules in the model was built up by the schema below:

Simple canopy → Clark Unit Hydrograph → Green & Ampt infiltration → Baseflow (recession)



Hydrological model geometry

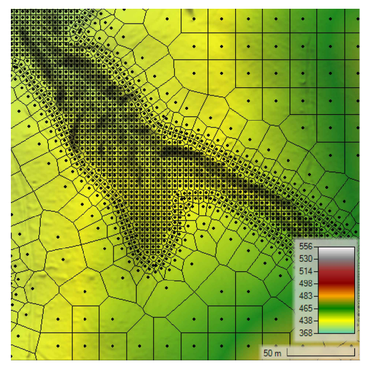
Hydrodynamical flood modeling:

2D FVM surface flow model, with solver based on SWE (shallow water equations) (HEC-RAS).
In this study a new solver type was used, SWE-LIA (local inertia):

$$\frac{\partial V}{\partial t} + \cancel{(V\cdot\nabla)V} + f_c k \times V = -g\nabla z_s + \frac{1}{\cancel{h}}\nabla\cdot(\cancel{\nu_t h}\nabla V) - \frac{\tau_b}{\rho R} + \frac{\tau_s}{\rho h}$$

The modified governing equation's goal is to guarantee stabile and faster calculation. The time step for calculating overland flow is small, around or under 1 seconds.
Also an eddy viscosity model was added: $\vartheta_t = Du^* h + (C_s\Delta)^2|\bar{S}|$
The geometry was based on LiDAR, where adaptive mesh was created

For the unsaturated soil, same Green & Ampt model was used, with the same soil type distribution.



Part of generated mesh

Calibrated values:

táblázat, simple canopy

Canopy [mm] = 5
tc [h] = 1.68, 2.02, 2.68
tR [h] = 0.9, 0.9, 1.2
K [mm/h] = 27.596
Sf [mm] = 216.55
Initial deficit = 0.173
Imperviousness [%] = 0.01
Initial flow [cms] = 0.0014, 0.0009, 0.0065
Recession constant = 0.2
Ratio to peak = 0.32, 0.32, 0.09

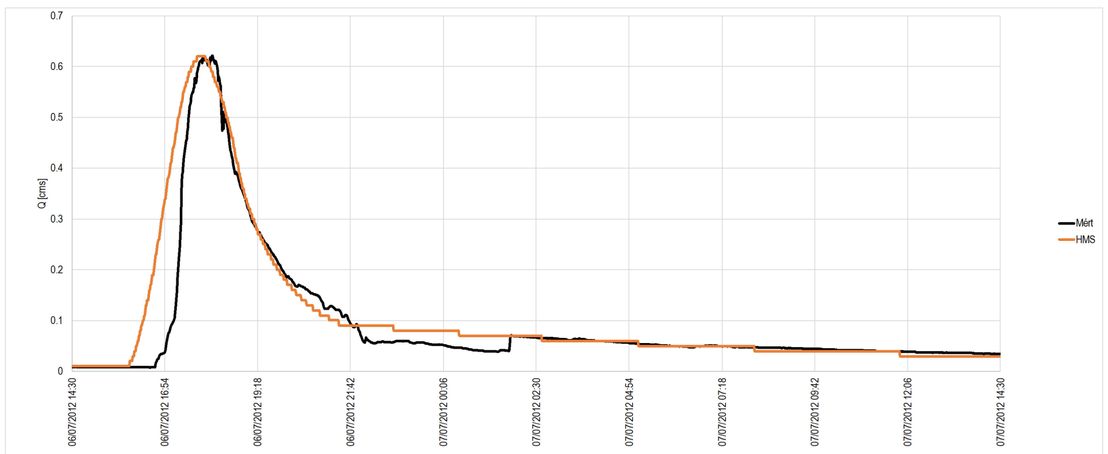
nem kell

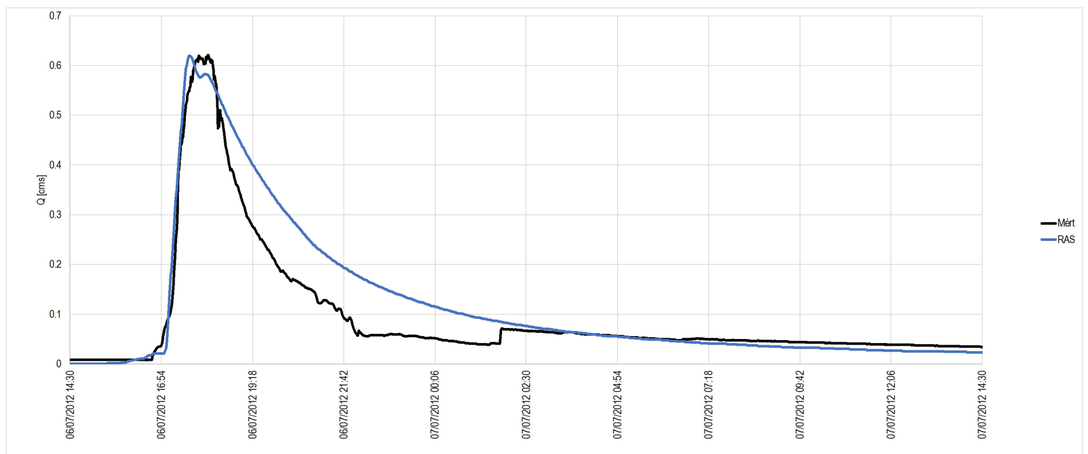
Calibrated values:

Manning's n, forest = 0.16
Manning's n, stream = 0.04
K [mm/h] = 26.667
Sf [mm] = 219.05
Initial content = 0.179
Saturated content = 0.353
Resudial content = 0.0314
Pore size distribution = 0.395

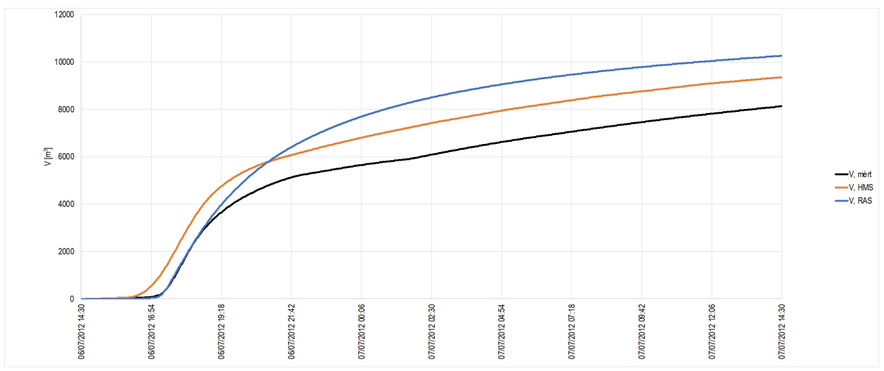
Results on the outlow section

rResults





Cumulated outflow volume



Conclusion:

1. Both models can be calibrated for peak flow, for time of concentration or for decreasing flow the models have errors. Therefore the outflow volume has differences as well, although the ratio of overland flow in both results are around 3%
   put the number in
2. Models with different physical content on a same area need slightly different calibrations and some parameters' sensitivity can differ
   ez ide nem való
3. It is suggested that the models' with different physical content can be used as comparational studies on ungauged watersheds for flash-flood prediction
   ez nem ennek a konklúziója

írd le amit látni a rajzon-rising limb with hms, recession limb with ras
+ a hec ras eredménye problémák,
hec ras was aable to generate runoff hydrograph, but need more refinement-can be used for

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