Parameter space and sensitivity analysis of SMODERP2D model using a set of artificial rainfall experiments

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SMODERP2D model

- Surface runoff and erosion model.
- Spatially distributed, physically based, event-based.
- 1D and 2D version developed about lase 3 decades.

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Latest developmenit...

...by current development team

- new providers (APIs): GIS, "NO" GIS, WPS, cmd
- a lot of refactoring
- development on github.com
  - `git shortlog -s -n --all --no-merges --since="2020-01-01":` 73 Martin Landa, 67 jerabekjak, 28+25 ondrej+pesekon2, 2 kavkapet
- testing rill flow at steep slopes
- exploring parameter space and sensitivity analysis

Motivation

To obtain model parameter margins and to assess model sensitivity to provide usability limits and parameter sets for potential users.

Methods

1. Use data ensemble to optimize model parameters
2. Store parameters of all “good” runs for each measurement
3. Explore results of the “best” models
4. Explore distribution parameters of “best” models

Use data ensemble to optimize model parameters

Data ensemble:

- 55 plot scale, laboratory artificial rainfall experiments, several locations
- sheet velocity, specific discharge

Parameters:

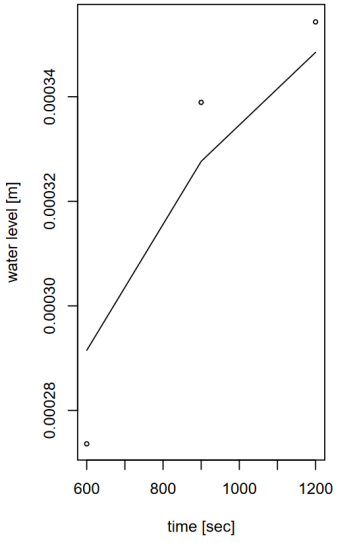
- Philips infiltration: K_s, S
- Shallow water surface flow: X, Y, b
  - $v = Xi^Y h^b$
- surface retention

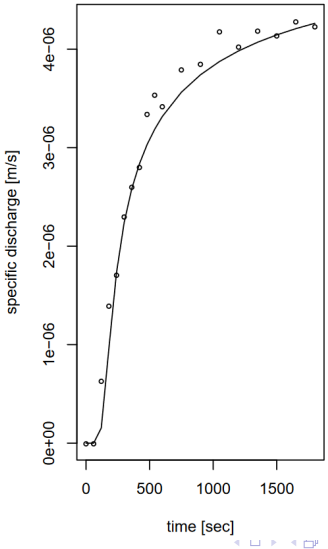
Optimization:

- Differential evolution, storing all the intermediate results
- Two variables optimized: water level h, specific discharge q
- Sum of squares as objective function (NS also calculated)

Use data ensemble to optimize model parameters

Example of single optimized measurement.

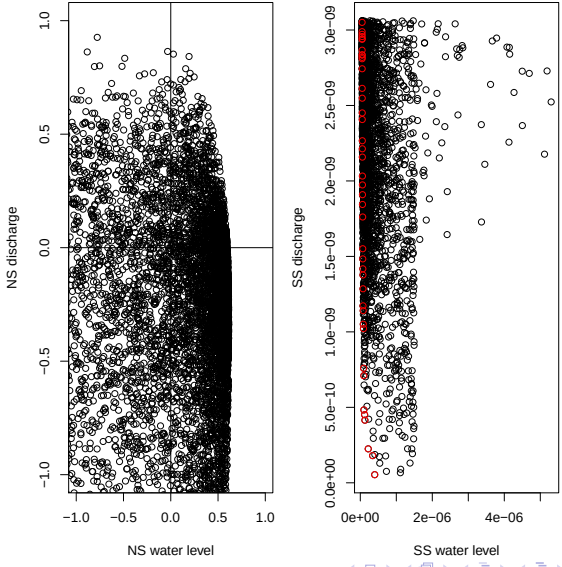




Store parameters of all "good" runs for each measurement

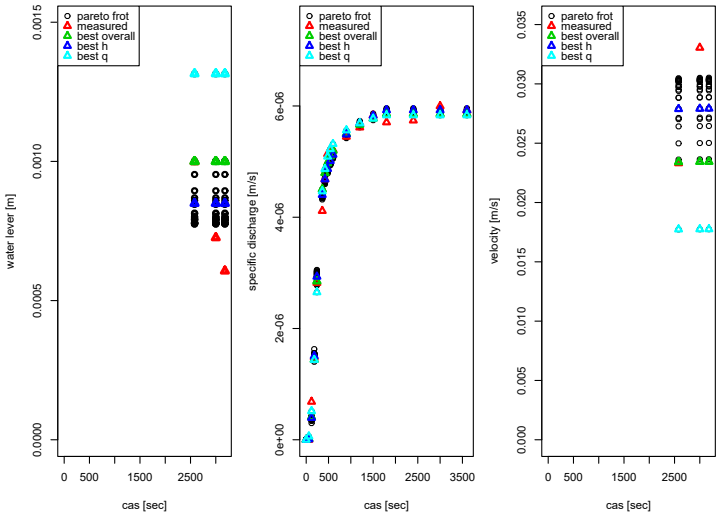
Select model runs with:
(NS(h) and NS(q)) > 0

Make a Pareto front at
the SS(h) and SS(q) scatter plot



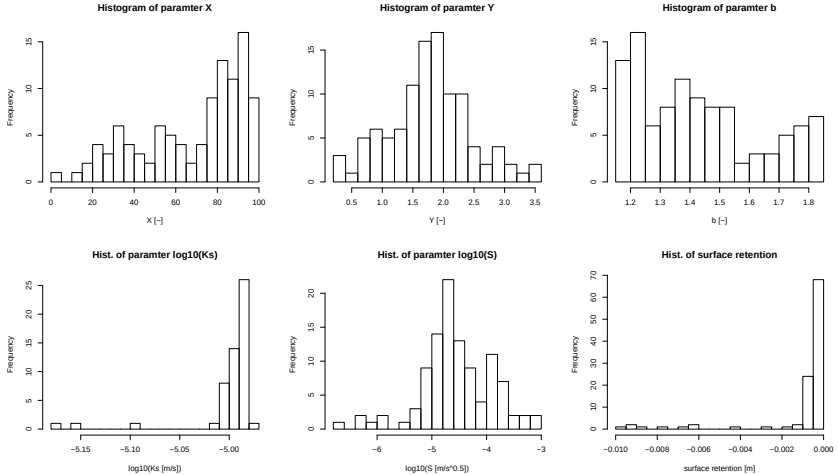
Explore results of the "best" models (in progress...)

Specific discharge is less sensitive compared to flow velocity. Specific discharge is almost not sensitive to the parameters X, Y, b.



Explore distribution parameters of "best" models (in progress...)

All parameters but X and b exhibited unimodal distribution. X is likely sensitive to current soil surface conditions.



Conclusions

- Both, surface flow velocity and discharge needs to be measured independently.
- Most parameters exhibited some sort of unimodal distribution.
- Parameter b showed multimodal distribution.

Further steps...

- Analyze the parameter space in terms of soil texture, location.
- Assess equifinality and perform valication.
- Go and the model repo at `github.com/storm-fsv-cvut`.

Thank you for your attention.