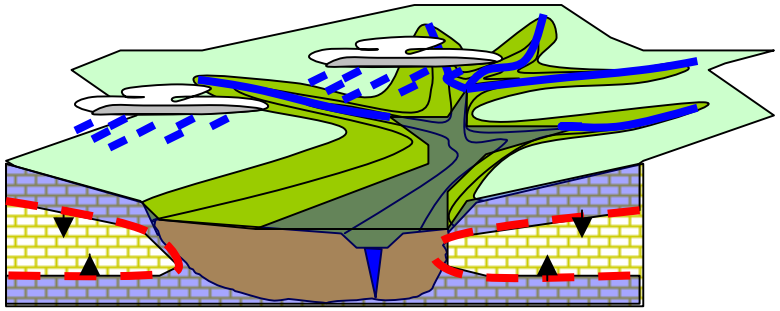
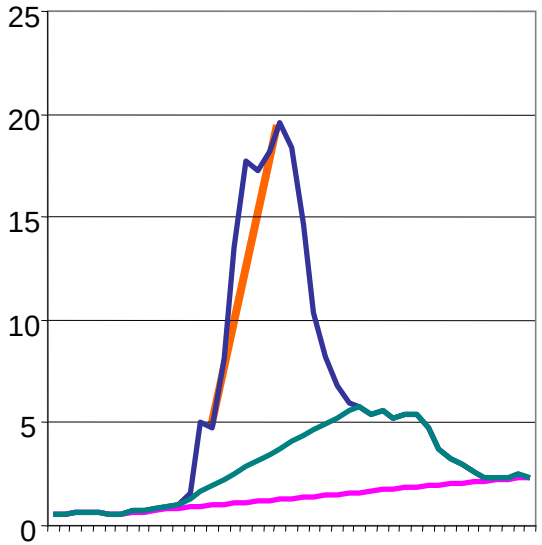


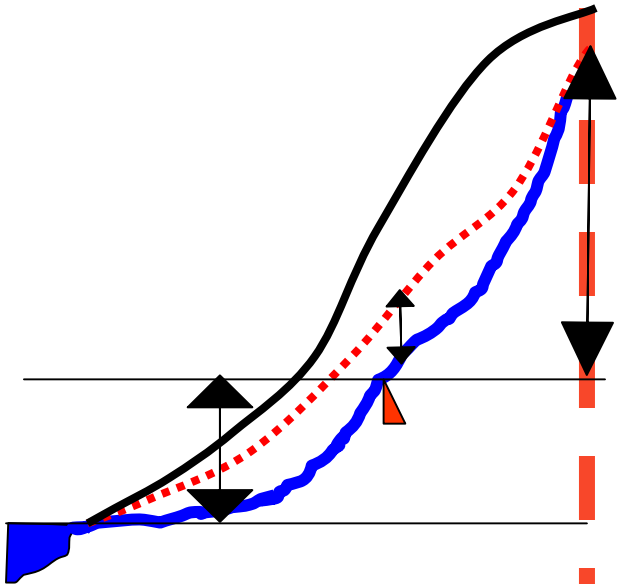
SimpleBase Delineation Model™: a new tool for Water Investigation and Assessment

R. Vedom, Ph. D.
Hydrology and Environment
905 823 6088
rimma@sprint.ca
www.hydrology.ca



12th World Water Congress,

November 23-25, 2005, New Delhi



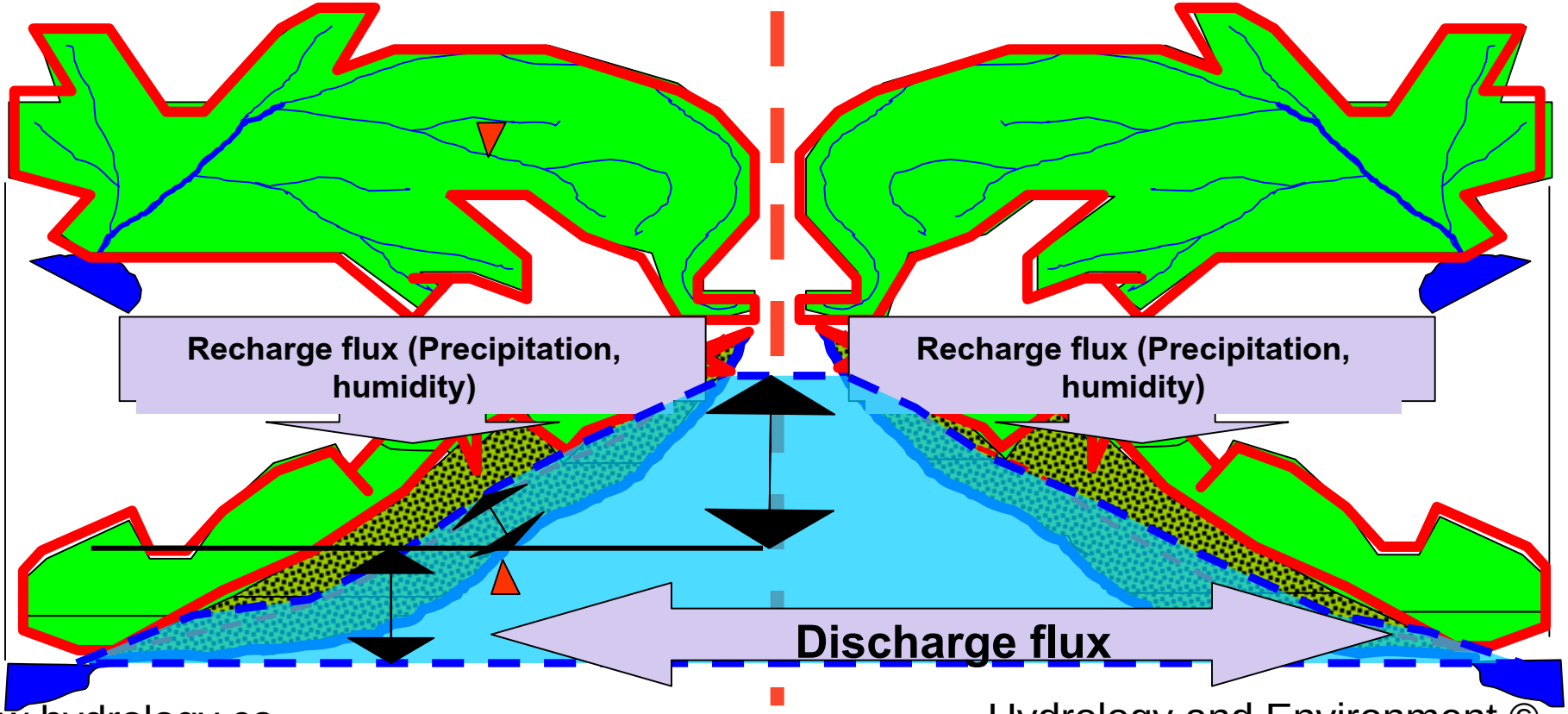
Presentation Outline

1. Introduction to the SimpleBase Delineation Model: the **physical concept** and its math expression
2. model output
3. model results and interpretation obtained on **randomly arranged data**
4. **Fletcher's Creek project example:** results obtained on the specially arranged data for model accuracy evaluation
5. Conclusions

SimpleBase Delineation Model

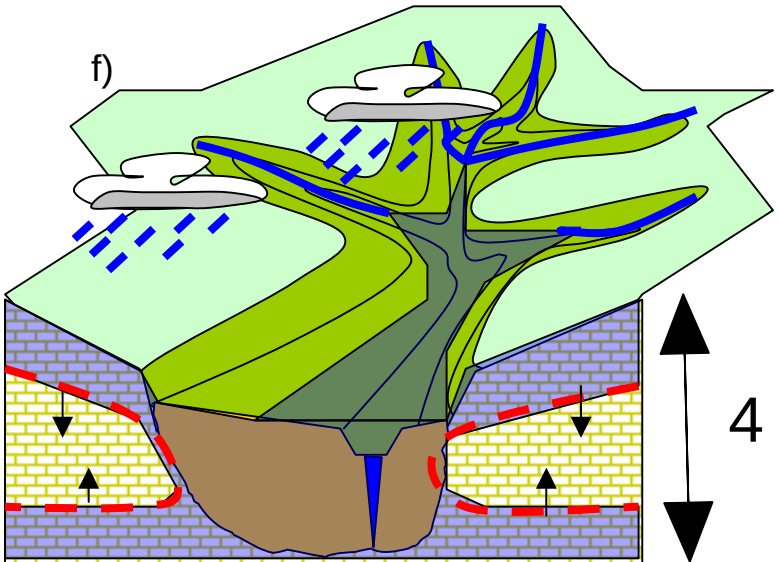
The concept:

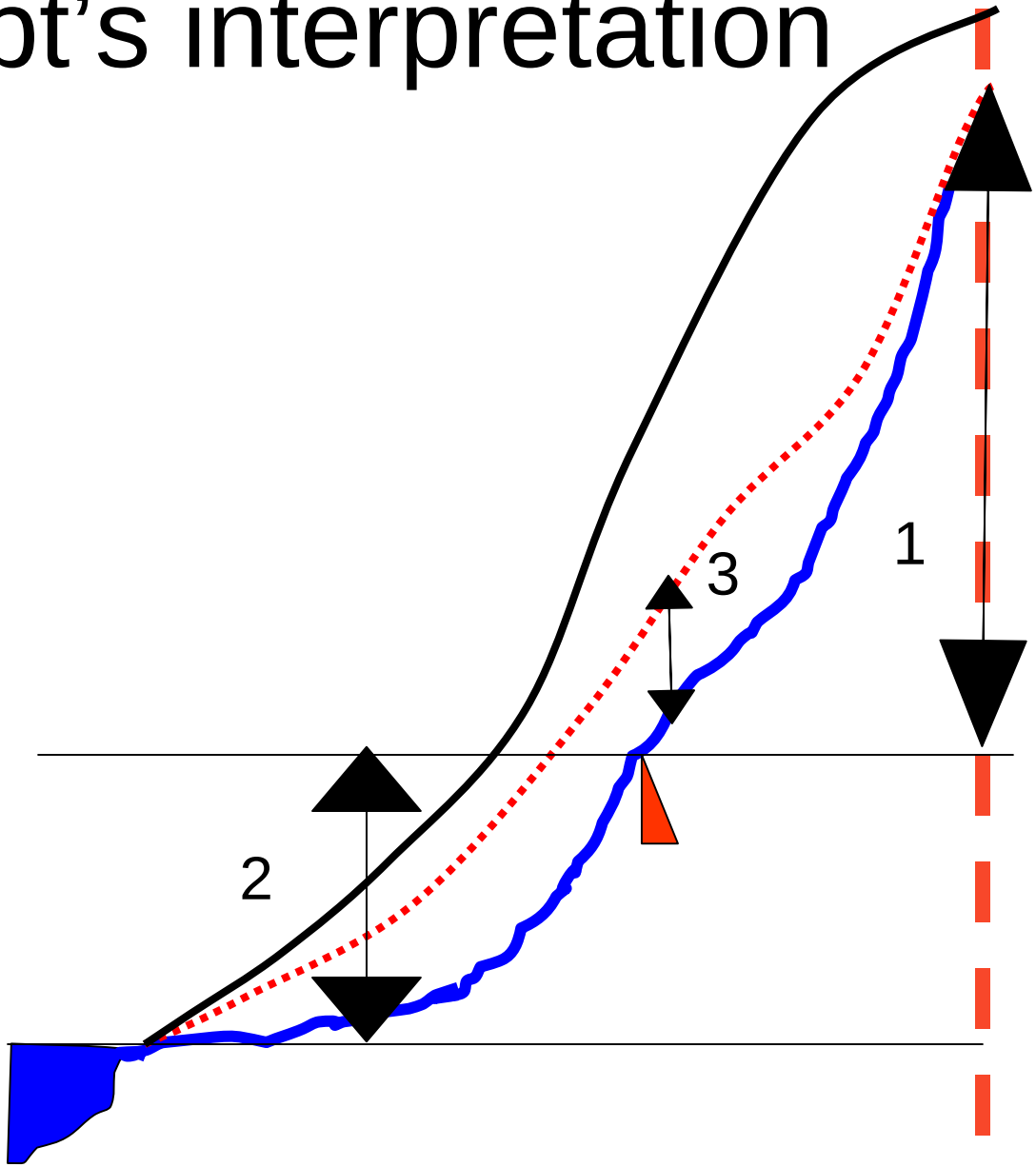
Any river system is the self-organized functional drainage structure, in which the permanent flow component, baseflow, has the highest frequency of dynamic responses to the external wet conditions change (static fluxes) at any particular point of the system.



The concept's interpretation

1. Pressing head
2. Suction head
3. Flipping head
4. Pushing head





The SimpleBase Model's math

Baseflow delineation algorithm:

if $(Qt)_t - (Qt)_{t-1} > dQb$,

$(Qb)_t = (Qt)_{t-1} + dQb$,otherwise

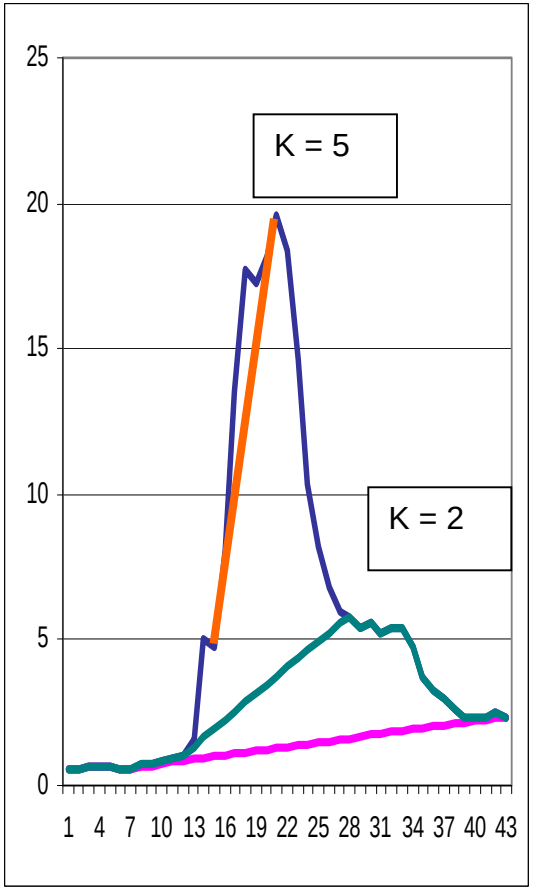
$(Qb)_t = (Qt)_t$,

End point of a discharge flux:

$(Qt)_t = (Qb)_t$, $(Qt)_{t-1} > (Qb)_{t-1}$, $(Qt)_{t+1} = > (Qb)_{t+1}$

Interflow delineation line

dQi = dQb * 2^(**Kmax**+0.618)

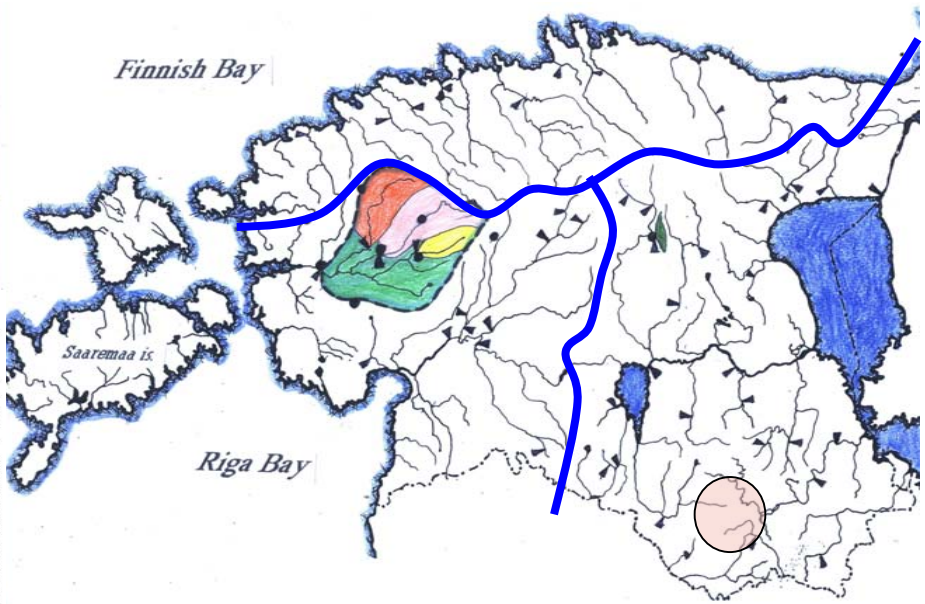


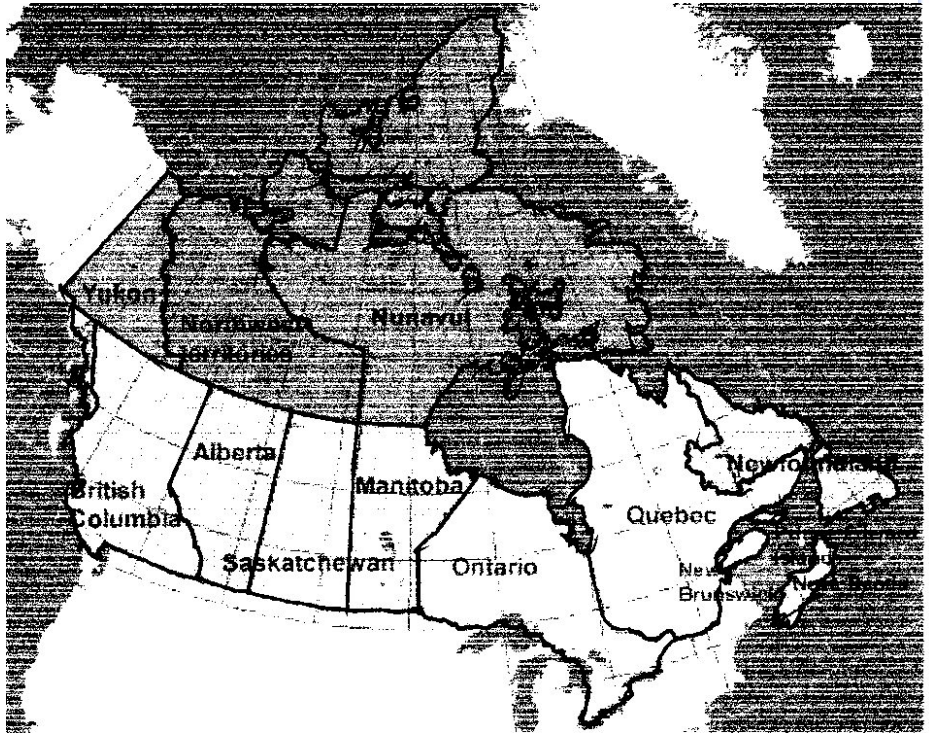
The model output (advantages)

- **Factual** (authentic) daily base, inter and surface **components of stream flow**
- **dQb, m3/s** - the dynamic limit of system uniformity – characterizes the response of the transregional groundwater discharge to a recharge event at the particular reach
- **BFI** – baseflow index – indicates how much of drained water is uniformed at the particular reach; **IFI,** and **SFI**
- **Nd** – the highest number of response fluxes cut – characterizes dynamical integration of responses at the particular reach
- **Kmax** – characterizes the dynamic buffer relative size at the particular reach: takes positive integer numbers from 1 to 9 for pristine watersheds; presence of stormwater network increases Kmax and decreases the usable part of the dynamic buffer
- **dQi** – the dynamic limit of the structural addition – characterizes the dynamic buffer filtration capacity

Random database

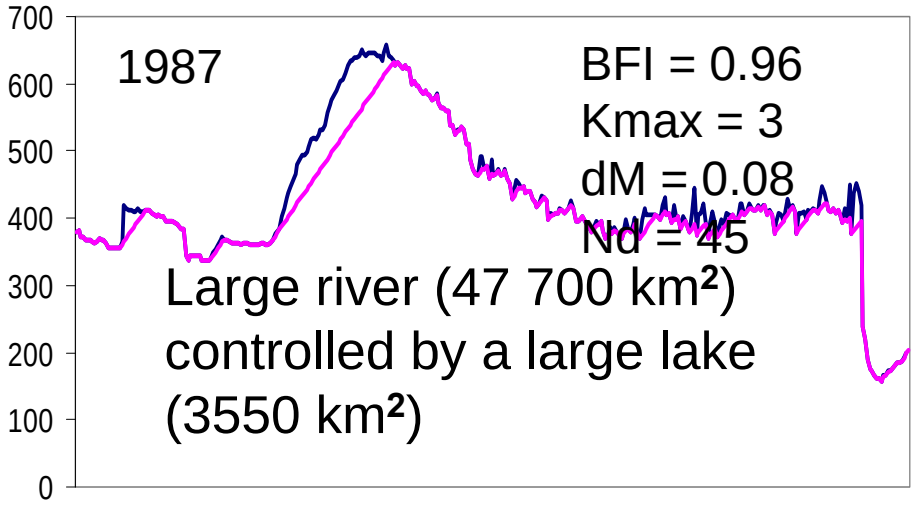
Estonia: 50 stations 1986-87, 92-93
Kasari 1981-90 (4); Tooma Peat Bog 1984-90 (7);
Total area 45 000 km²; Highest elevation 367 m a.s.l.

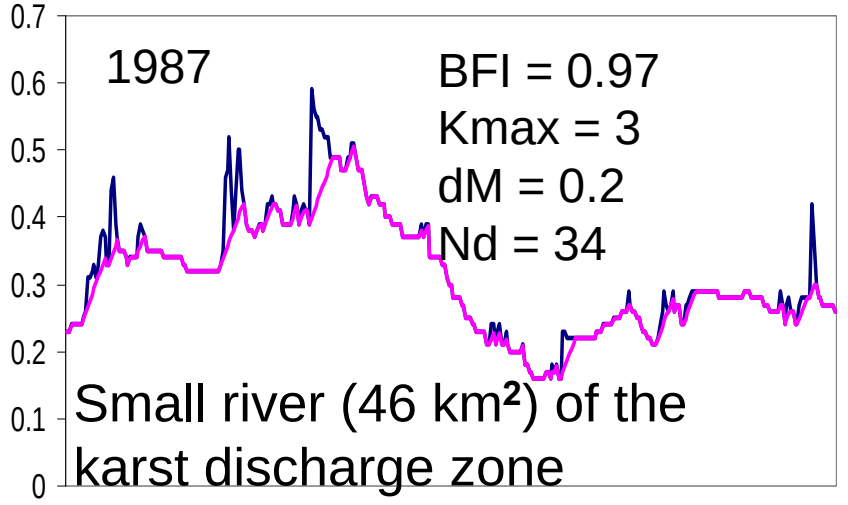


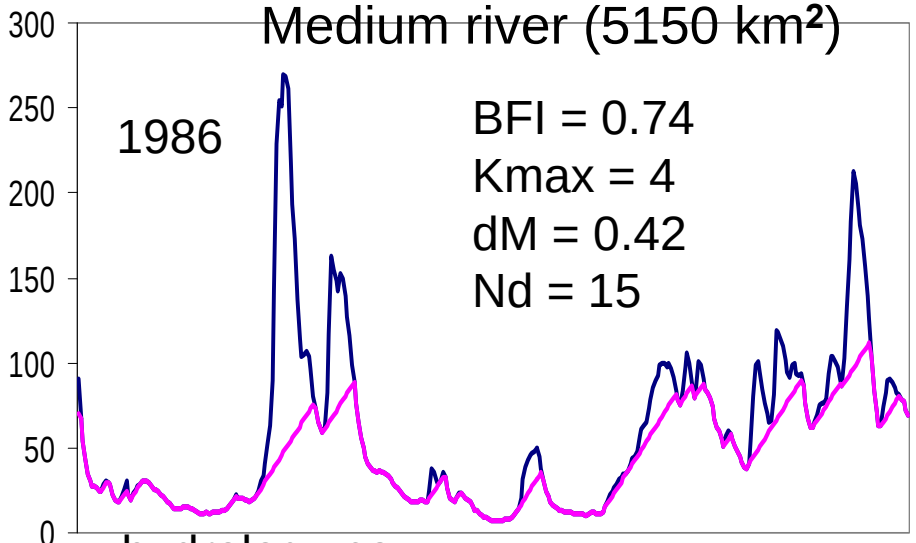


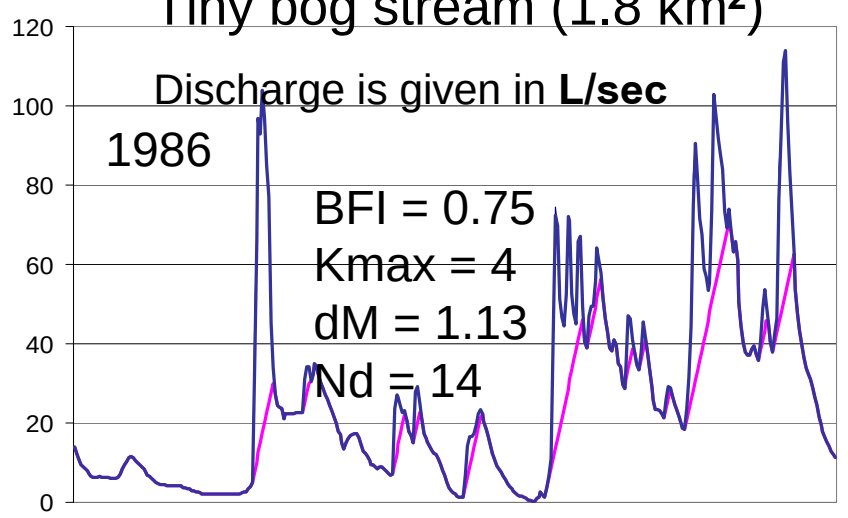
Canada: 60 watersheds and subwatersheds from 5 Canadian provinces and territories **(British Columbia, Yukon, Nunavut, Ontario, and Newfoundland)** for the 1995-2000 periods.

Results of Random Database: Estonia

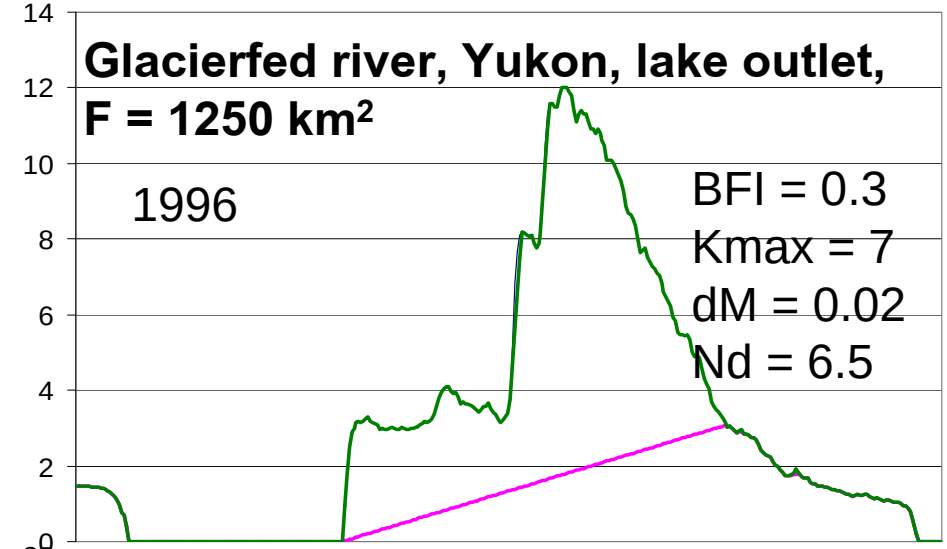


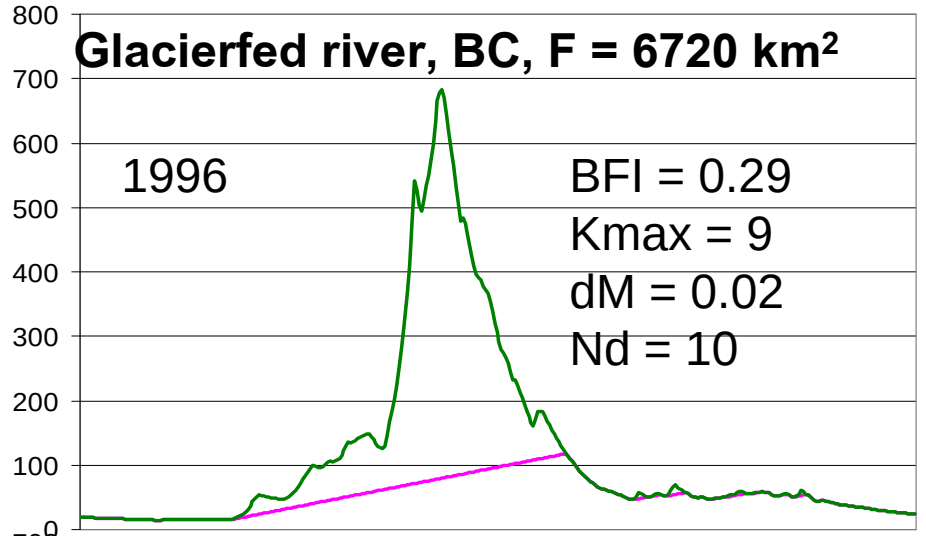


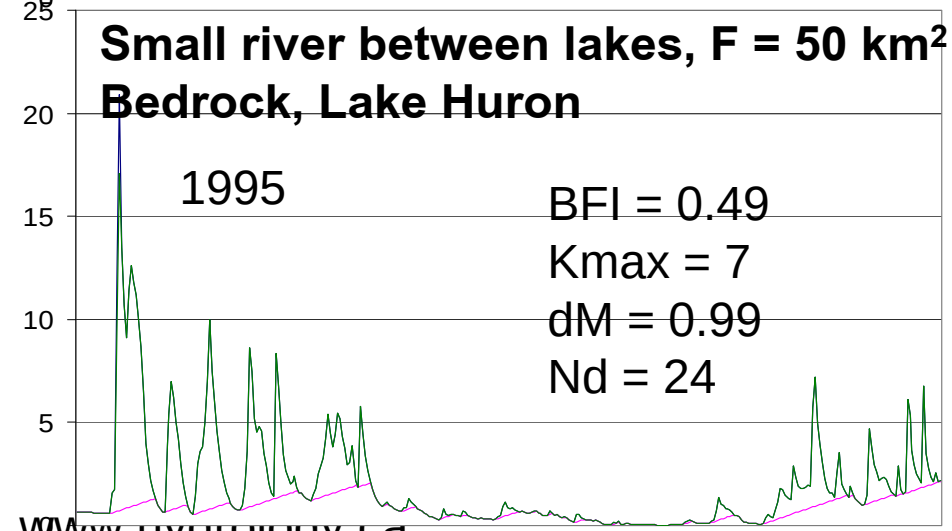


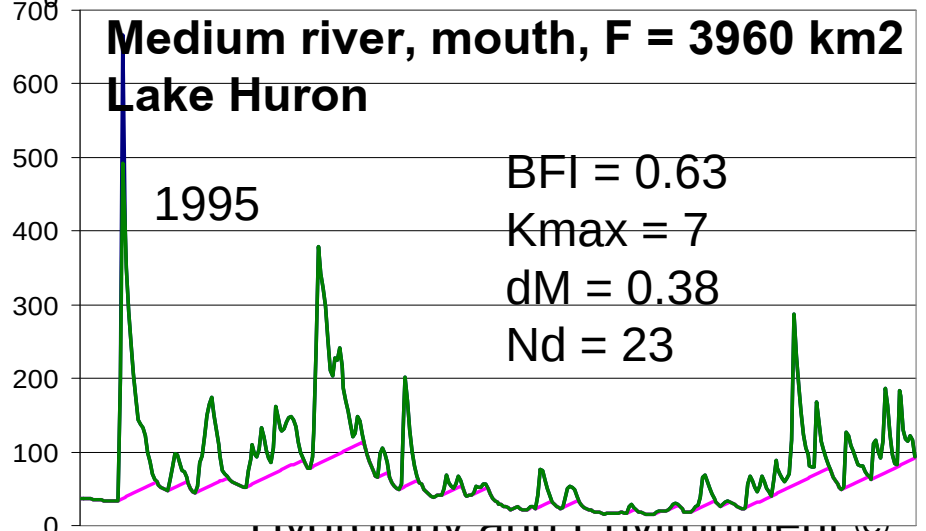


Results of Random Database: Canada

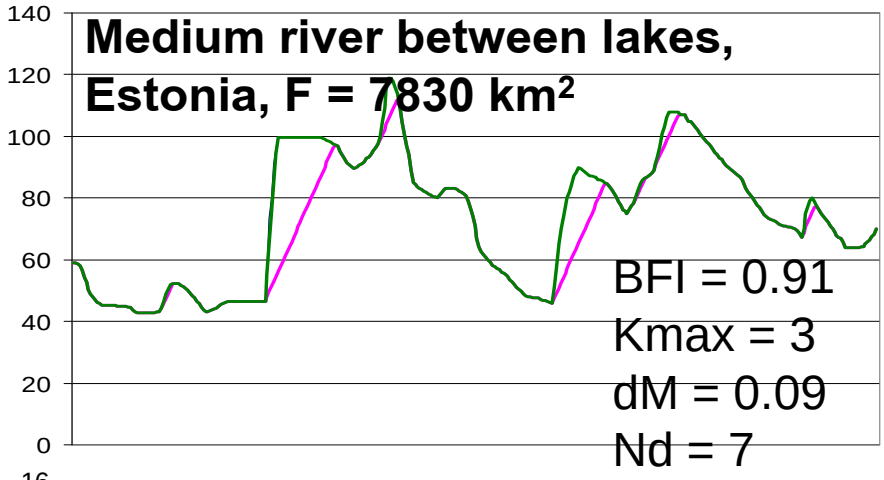


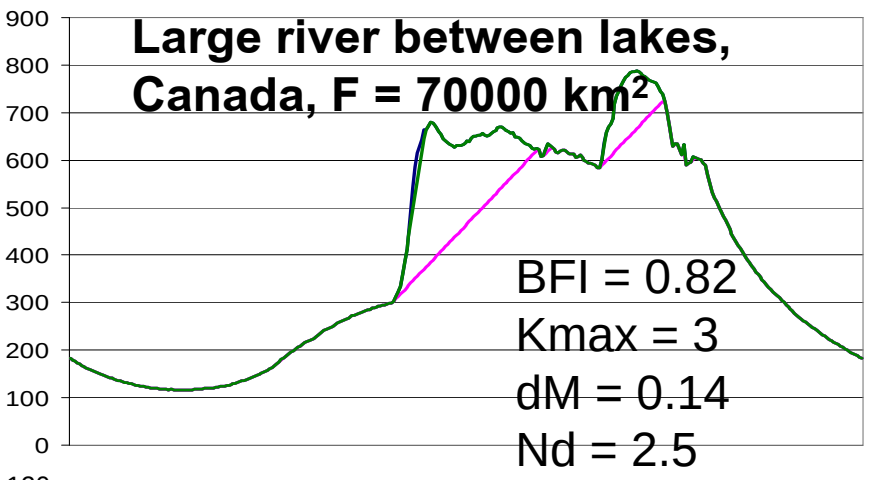


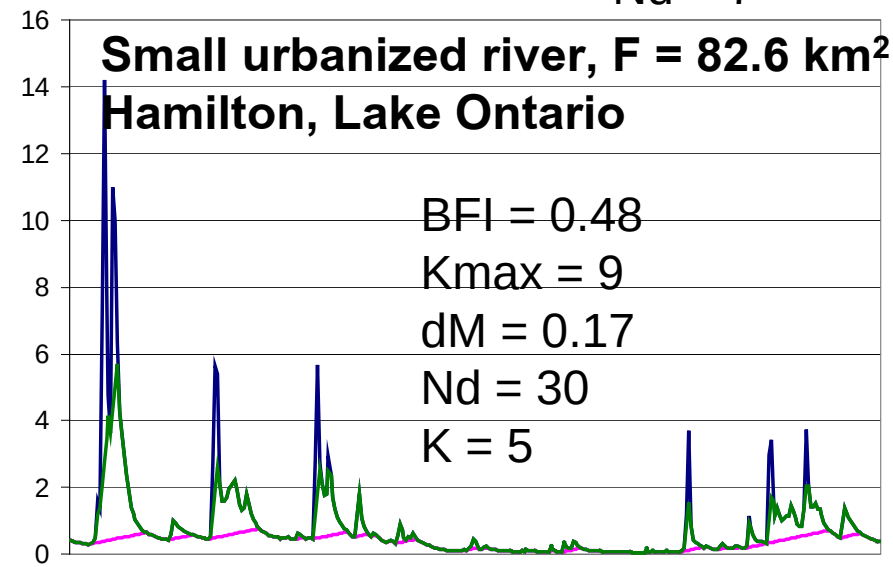


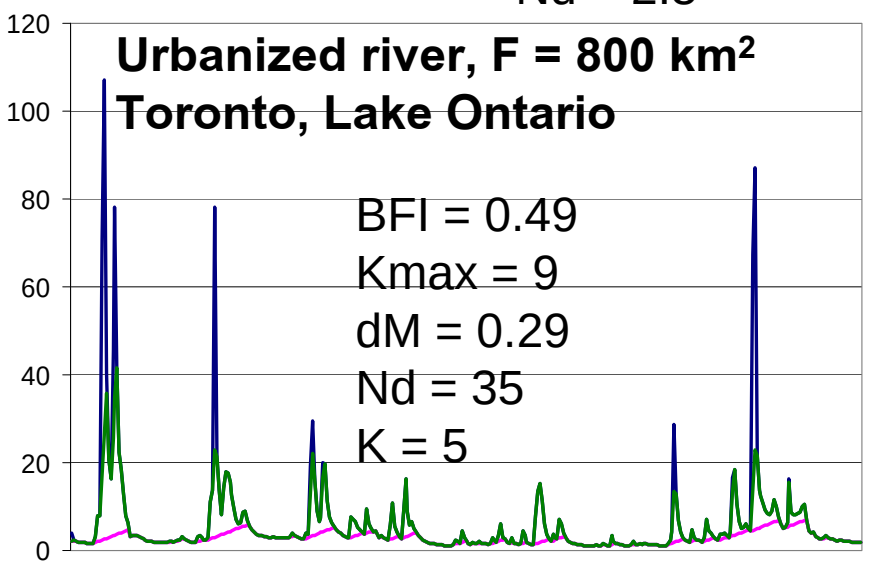


Results of Random Database: Estonia - Canada









Model accuracy evaluation: Fletcher's Creek Project

Objective:

To evaluate the adequacy of quantitative separation using measured qualitative parameters of daily flow as criteria

$$Ct = (Qb*Cb + Qi*Ci + Qs*Cs)/Qt$$

Ct, Qt - Total flow concentration and discharge

Cb, Qb - Baseflow concentration and discharge

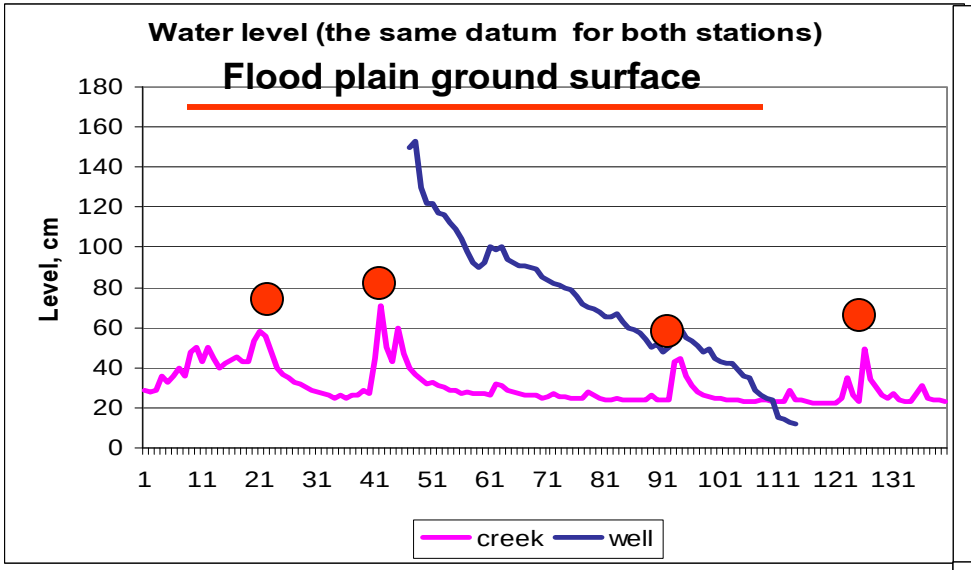
Ci, Qi - Interflow concentration and discharge

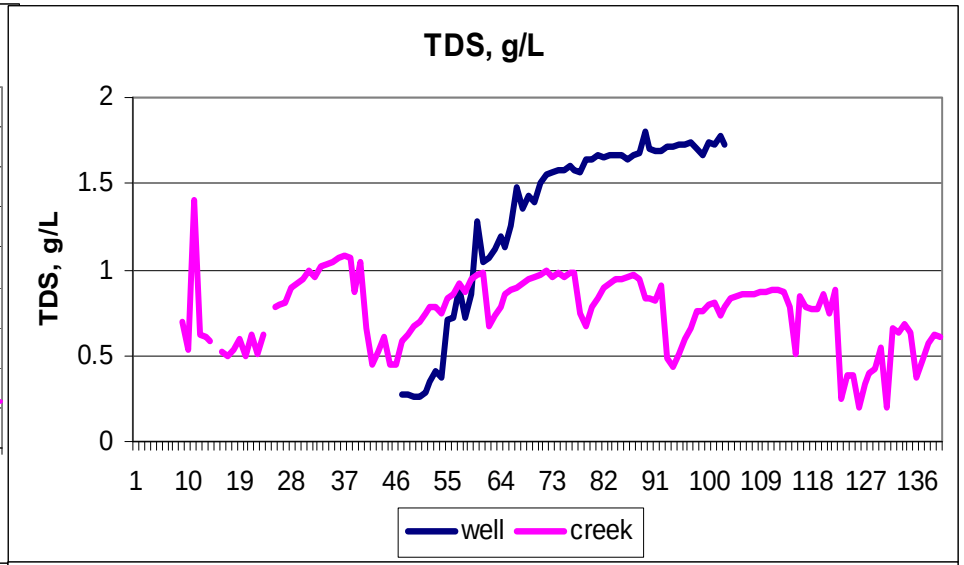
Cs, Qs - Surface flow concentration and discharge

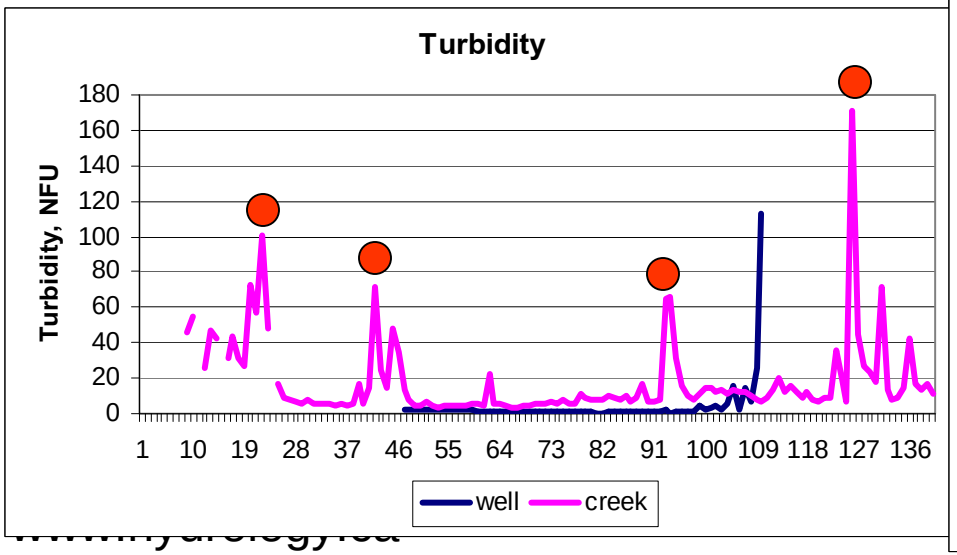
Plan:

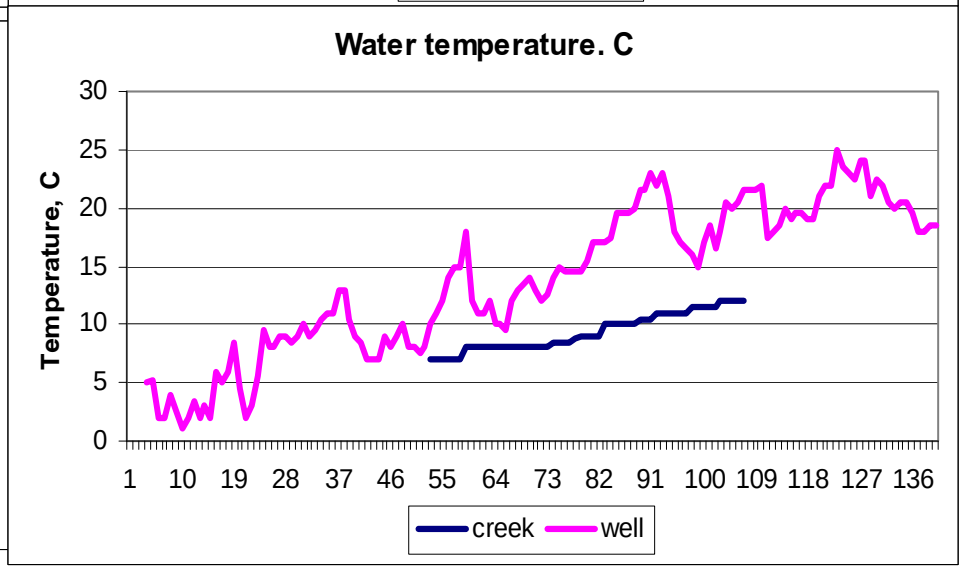
- To conduct daily measurements of the creek and its flood plain groundwater
- To process and re-process data as soon as a regime phase passes by observing all changes in parameters caused by the series length increase
- To compare final results obtained as the weighted averages with the measured ones

Daily measurement results

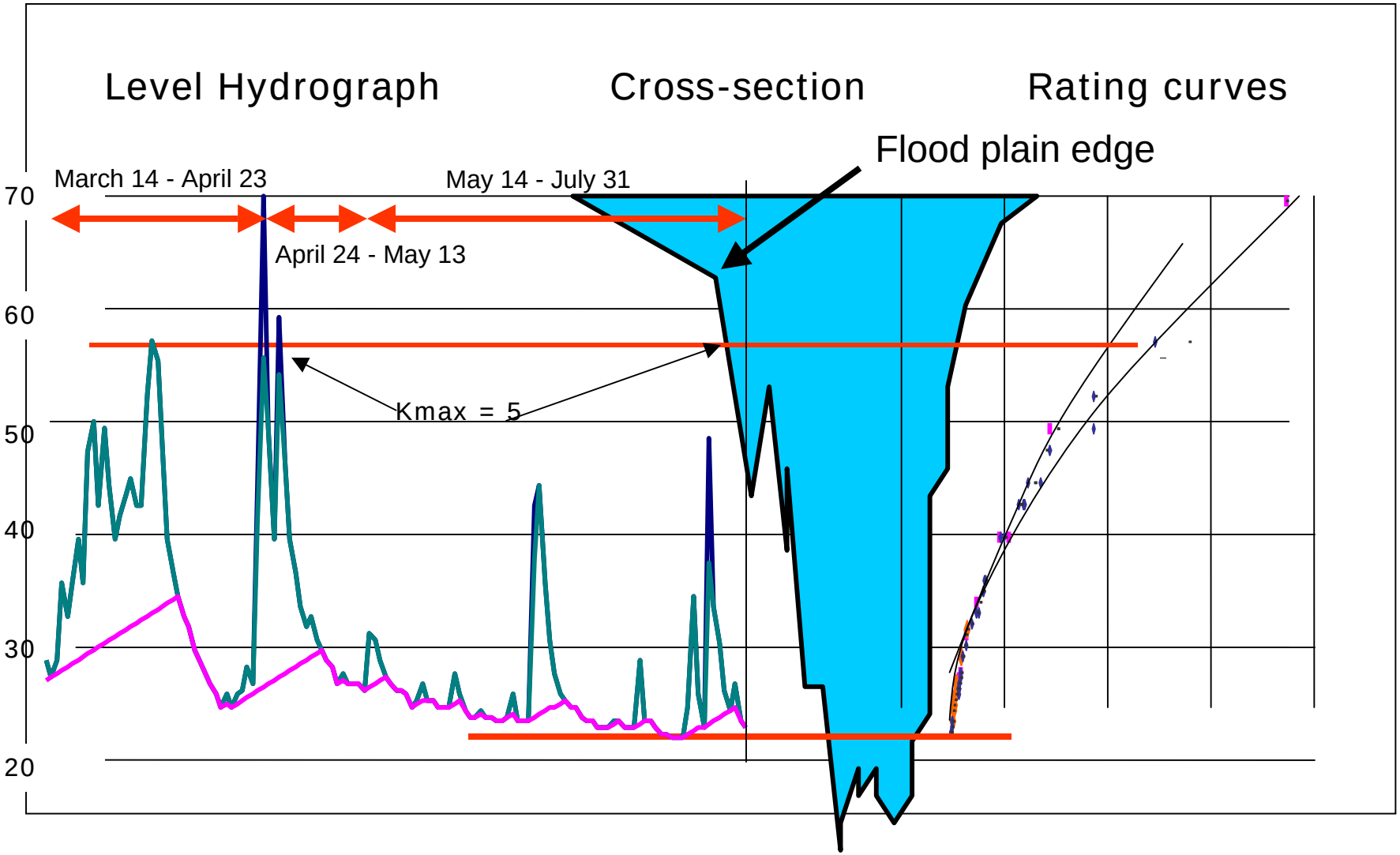




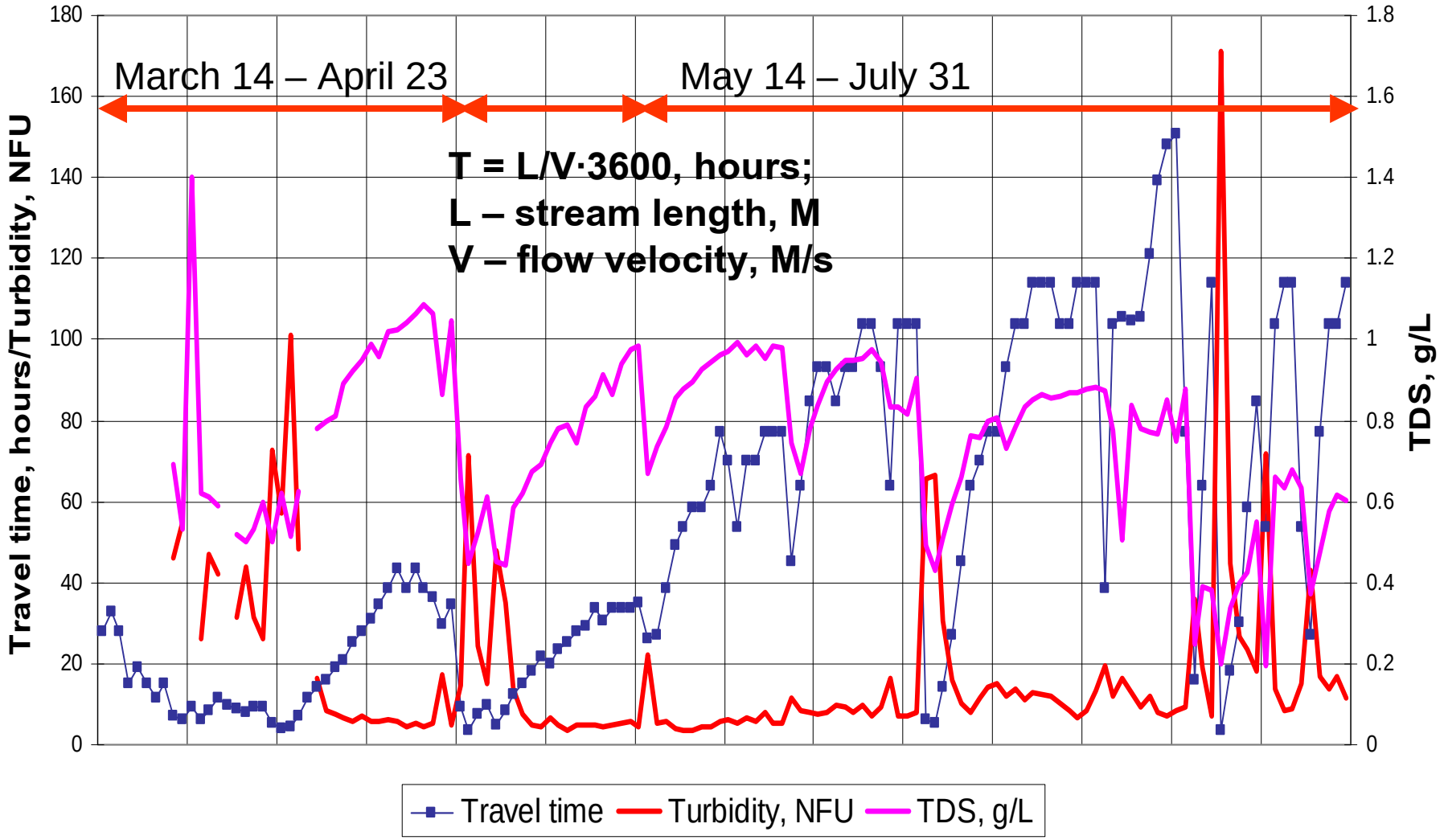




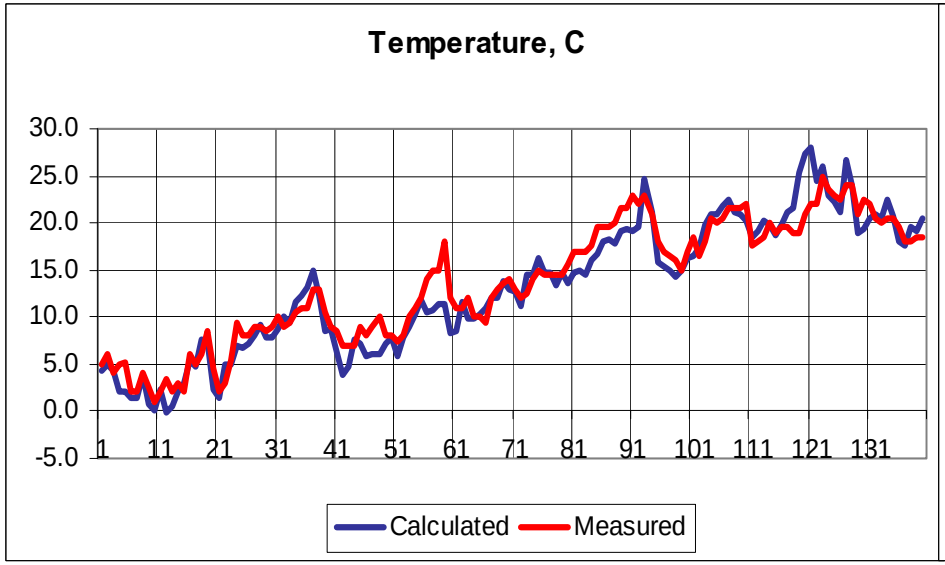
Flow estimation results

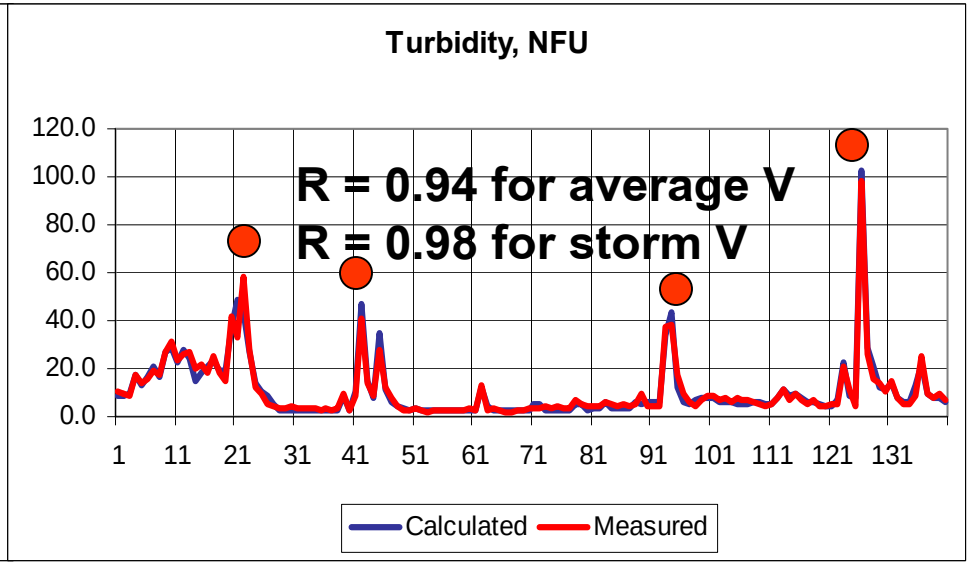


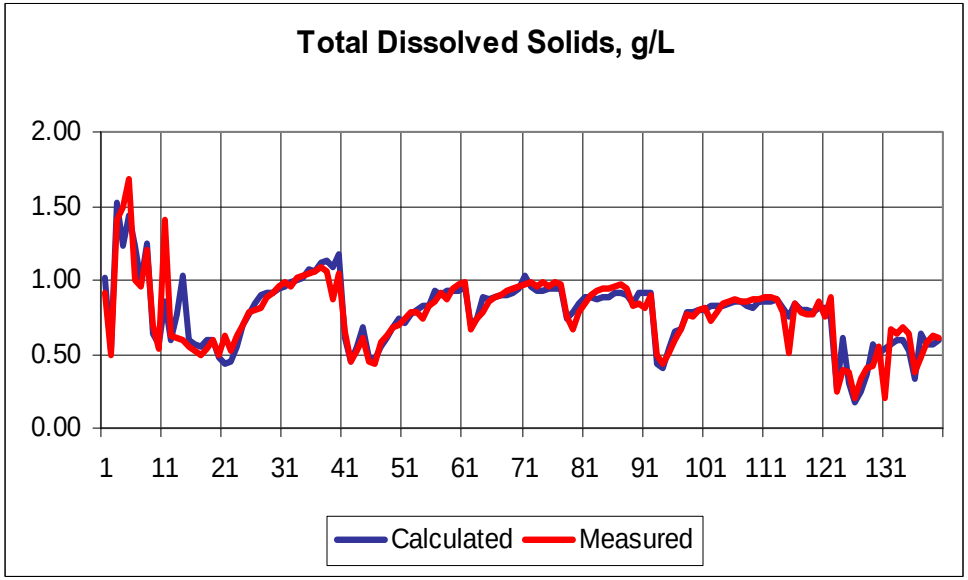
Travel time



Fletcher's Creek project results







Daily values reconstruction:

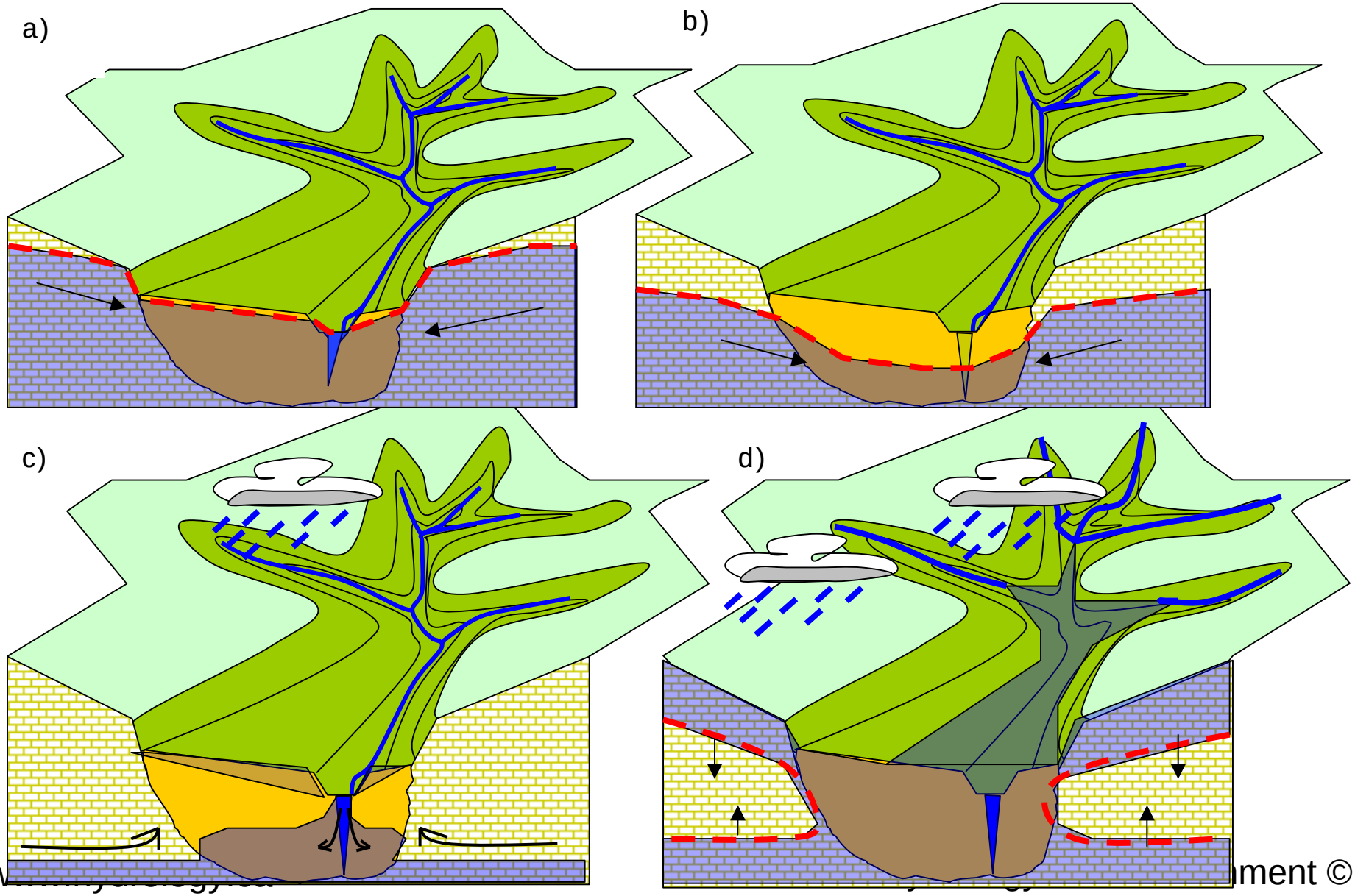
Temperature: **R = 0.962**

TDS: **R = 0.910**

Turbidity: **R = 0.977**

Travel or residence time

Visual illustration of the river flow formation concept based on Fletcher's Creek results



Conclusions

- The SimpleBase model, a new model for flow and level hydrograph delineation (decoding), is the universal, extremely accessible and powerful tool for water resources' investigation and assessment;
- A watershed response expressed as a level or discharge flux is the key parameter of the model displaying the current extensiveness and complexity of the river system based on water continuity and incompressibility;

Conclusions

- Quantitative parameters such as dQb/dLb, dQi/dLi, Nd, **kmax** and their interrelation obtained by the model application to 110 watersheds reveal the global regularity that can be identified as a pattern of the Law of Structural Harmony of System
- Due to this regularity and despite of the fact that each stream has its own set of dQb/dLb, Nd, and **k-**s defined by geomorphologic features of the river channel and the river valley, long-term and current state of groundwater level conditioned by the climate and current weather, the set can be estimated from the single year dataset of the stream level and flow hydrographs.

Comparison of delineation methods:

special thanks to A.Piggott (NWRI) for granting the data