The Structural Harmony Chart of Hydrosphere:

case study of the Fletcher's Creek

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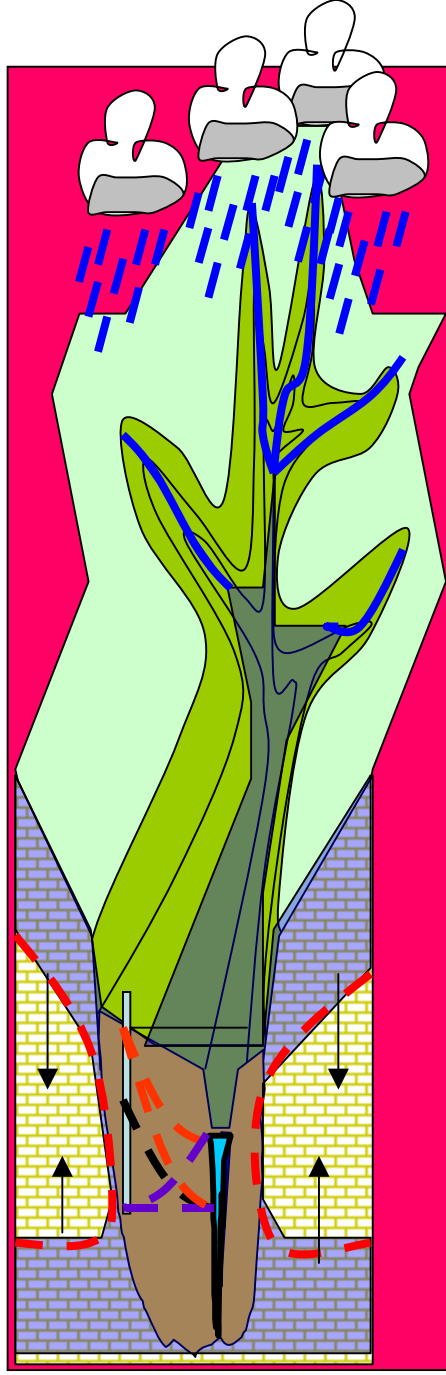
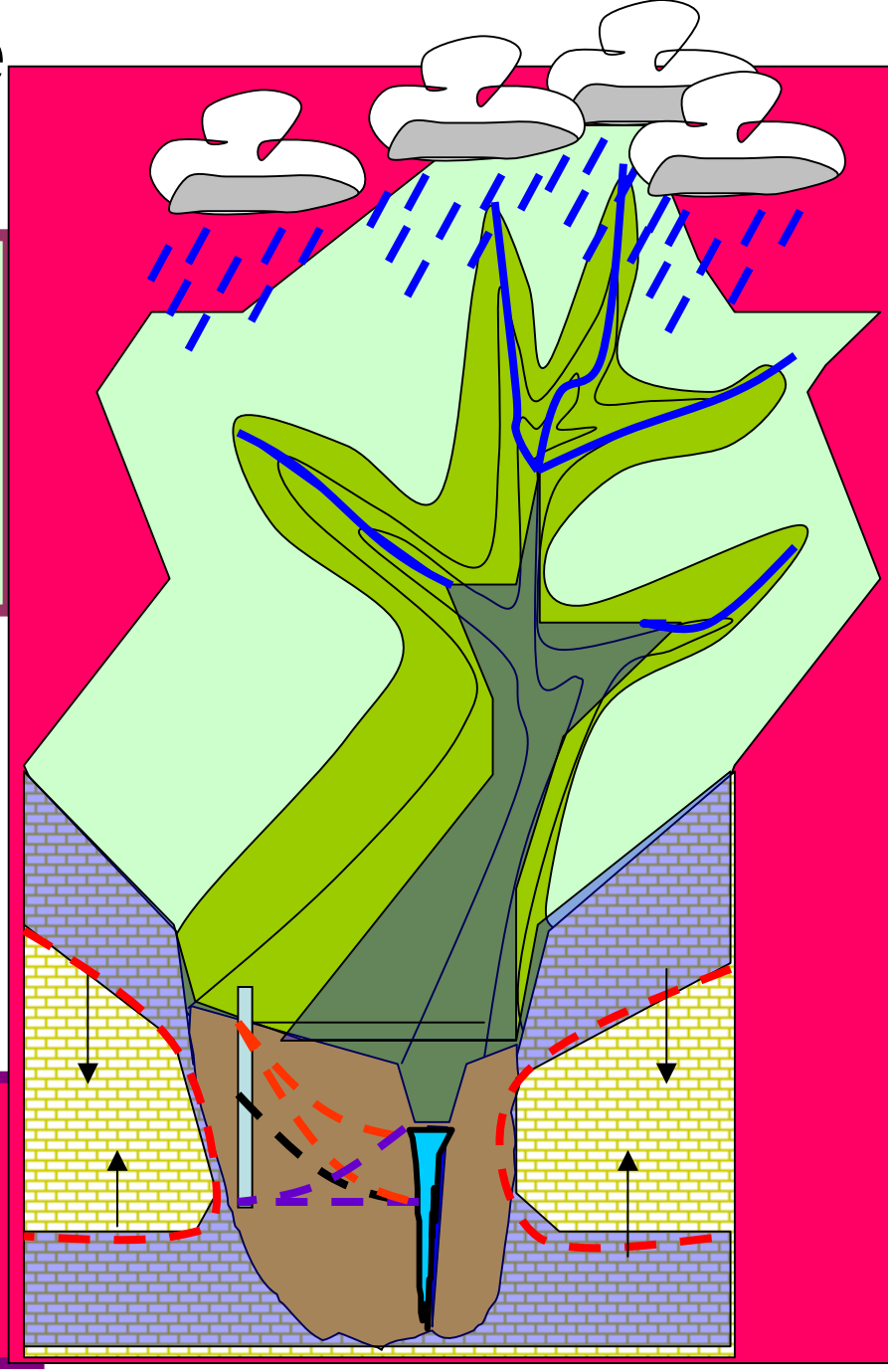


Philosophical basis of the Fletcher's Creek project

The Generalized Golden Sections are invariants, which allow natural systems in process of their self-organization to find harmonious structure, stationary regime of their existence, structural and functional stability. E. Soroko, 1984

Watershed is a self-organized functional and structurally complex unit of hydrosphere that controls life-sustaining thermo-regime within its boundaries

The definite quantitative structure of the Fletcher's creek flow, indicating different sources of its formation, provided its exact qualitative composition

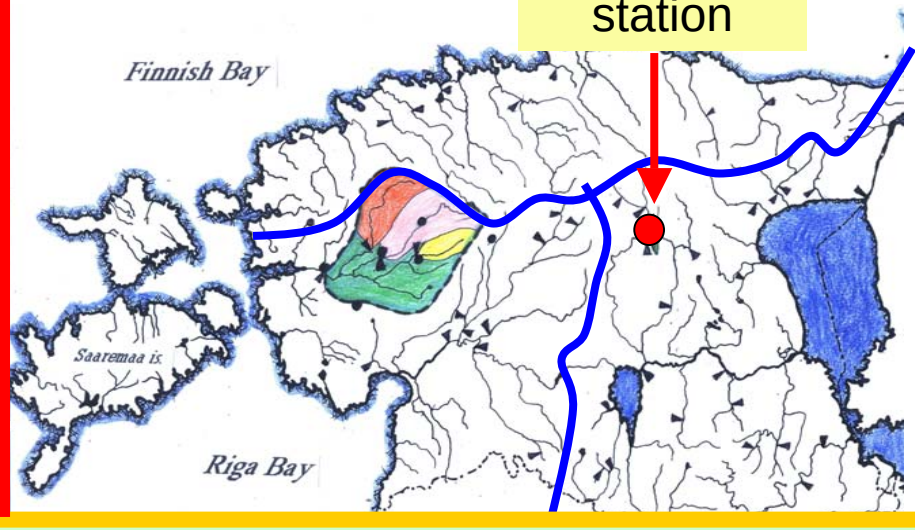


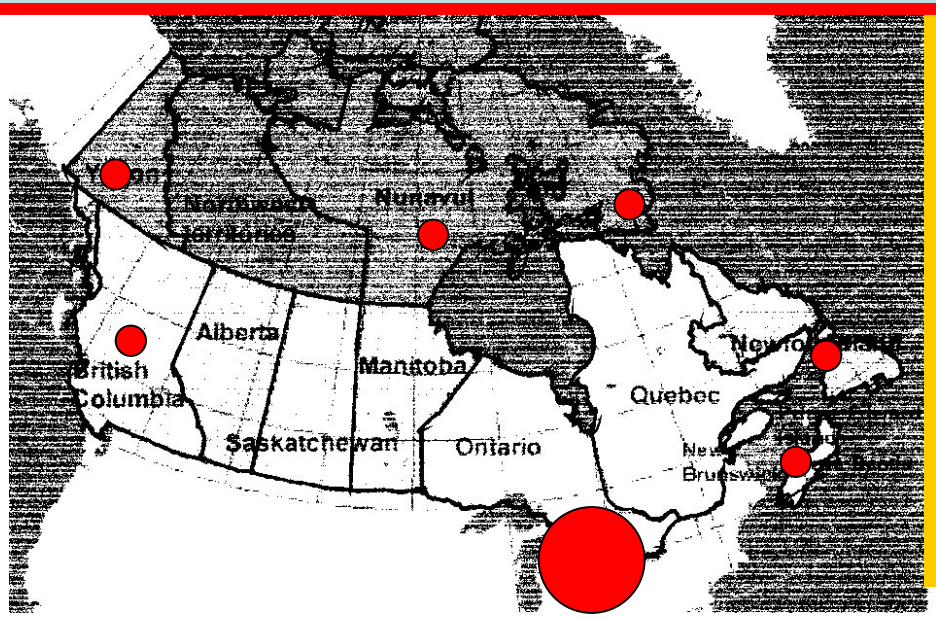
Databases used

Hydrometeorological Survey of Estonia:

Tooma Bog station: complex water and radiation balance station providing standard hydrometeorological, hydrogeological and hydrophysical daily data **(1984-90)**

Kasary wtshd: **4 subwatersheds**, **1 temperature**, **6 precipitation** stations





Environment Canada: 60 watersheds and **40 climate stations** from 6 Canadian provinces and territories **(British Columbia, Yukon, Nunavut, Ontario, Nova Scotia and Newfoundland)** for the 1995-2000 periods;

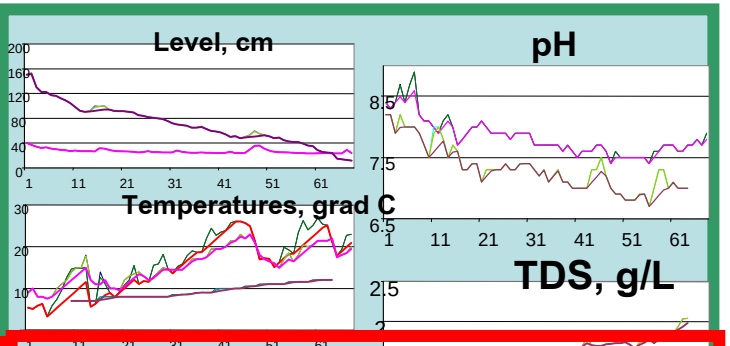
4 stations of hourly data for 1953, 2006 and 1995-2000

Fletcher's Creek daily data of the surface and groundwater quality: March – July 2005

The Separated Flux Analysis (SFAN)

Estimation of the Base component of each parameter using the **SimpleBase Delineation Model**

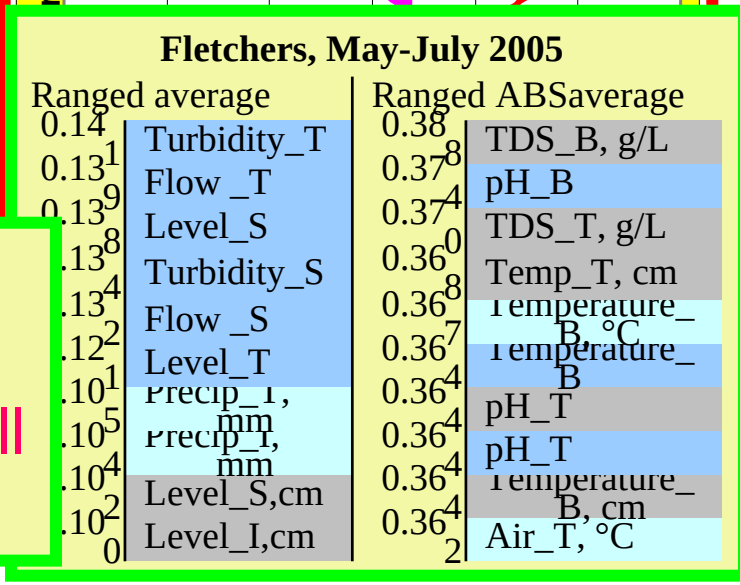
Step output: dQb, N, Kmax, BI



Creation and smoothing of **The Structural Harmony / The Elasticity Chart** (BI, MI, SI = f(Ki)) using air temperature frequency as the criterion for Ki's estimation for the other parameters and elements

Step output: Ki, MI, SI

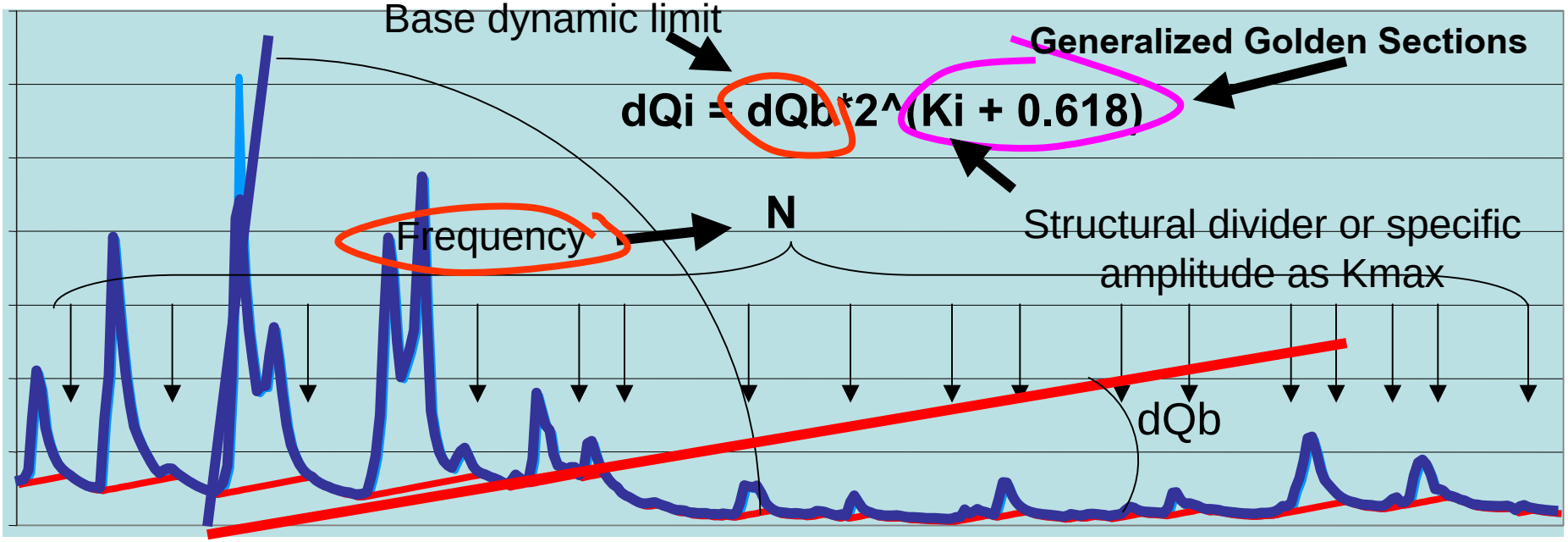
Statistical analysis of the structural composition of all parameters and elements. Step output: the priority list of all parameters' structural components



1. Base component estimation

dQb, N, Kmax, BA

- dQb — dynamic limit of a system uniformity (base dynamic limit)
- N — frequency of base component fluctuation
- Kmax — **specific** amplitude
- BA — share of the base AMPLITUDE in the total AMPLITUDE

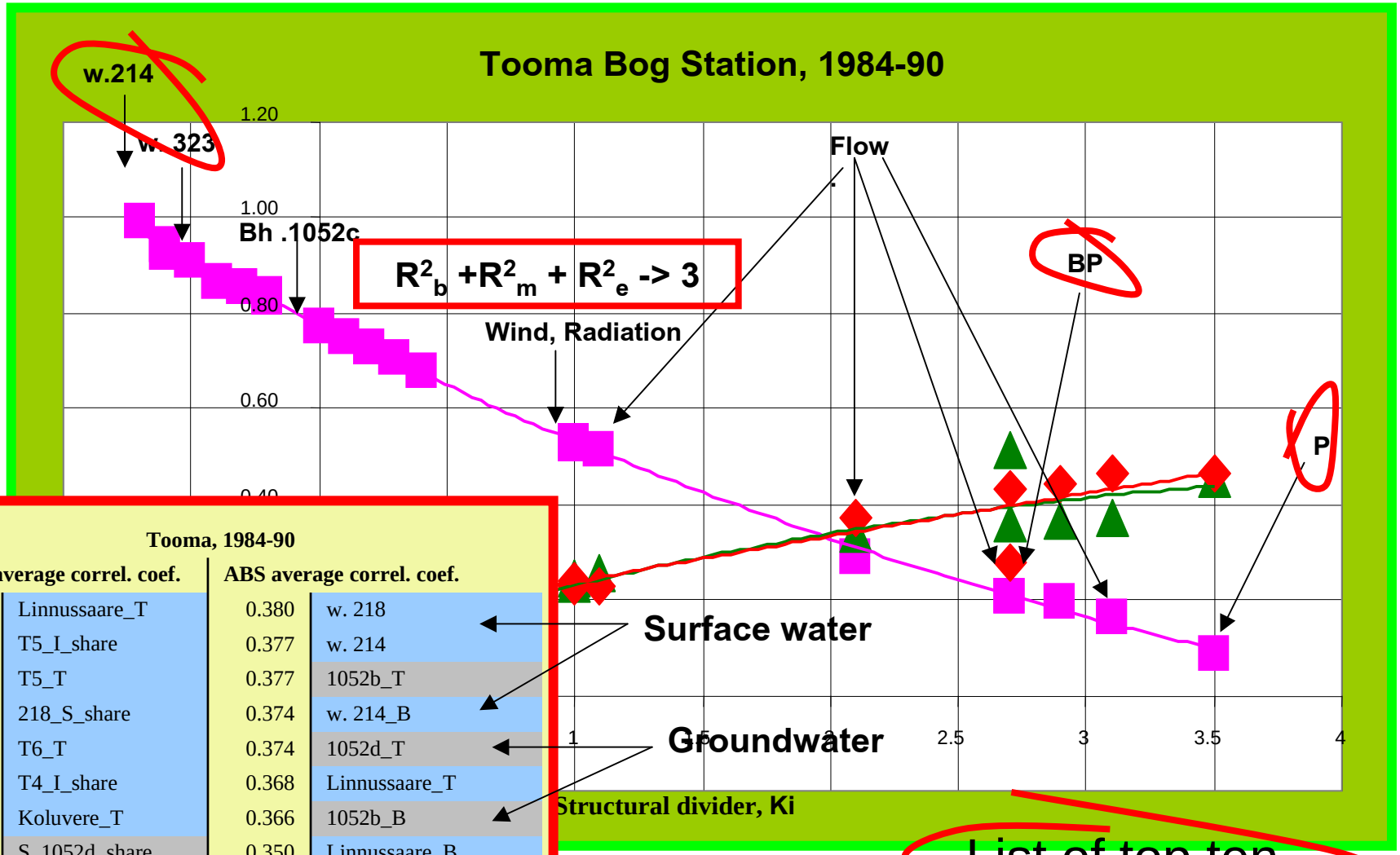


Daily dynamic limits (**dQb**), frequencies (**N**), specific amplitudes (**Kmax**), and the base amplitude share (**BA**) of hydro-meteorological parameters in ascending order of frequencies, **Tooma Bog Station (Estonia), 1984-90**

Parameter/Object	Daily limit	Freq uency	Kmax	BA	Parameter/Object	Daily limit	Freq uency	Kmax	BA
Linnussaare Cr., L/s	1.95	**12**	**4**	**0.52**	**w. 226 (pool), cm**	0.84	**30**	0	0.99
Snow (Pine-hollow lndscp), cm	0.99	**12**			**bh. 1052b, cm**	0.90	**33**	2	0.94
Snow (Pine-shroub lndscp), cm	0.99	**13**			**w. 214 (pool), cm**	0.91	**33**	0	0.99
Snow (Forest lndscp), cm	0.99	**13**			**w. 323, cm**	0.96	**33**	2	0.91
Snow (Lake-ridge lndscp), cm	0.99	**13**			**bh. 1052, cm**	0.94	**39**	3	0.73
Tooma 6 Ch., L/s	0.036	**15**	6	0.29	**bh. 1052a, cm**	0.94	**39**	2	0.84
Snow (Mineral soil)	0.99	**15**	3	0.87	**Air Temperature**	0.99	**55**	3	0.83
Koluvere Cr., L/s	0.815	**17**	7	0.21	**Water Pressure, mm**	0.49	**62**	2	0.71
Tooma 5 Ch., L/s	0.149	**19**	7	0.19	**Soil Temperature, °C**	0.94	**63**	3	0.83
Tooma 4 Ch. L/s	0.064	**20**	6	0.16	**Radiation, cal/m2**	43	**64**	4	0.53
bh. 1052d, cm	0.98	**20**	3	0.75	**Cloud, balls**	0.99	**71**	2	0.92
w. 218, cm	0.97	**24**	2	0.85	**Precipitation, mm**	0.49	**73**	6	0.08
w. 225, cm	0.96	**28**	1	0.87	**Sun shine, hour**	1.29	**73**	3	0.68
bh. 1052c, cm	0.87	**29**	3	0.77	**Wind, m/s**	0.47	**78**	3	0.53

Ki assessment: N = Nt (resonance condition)

2. The Structural Harmony Chart

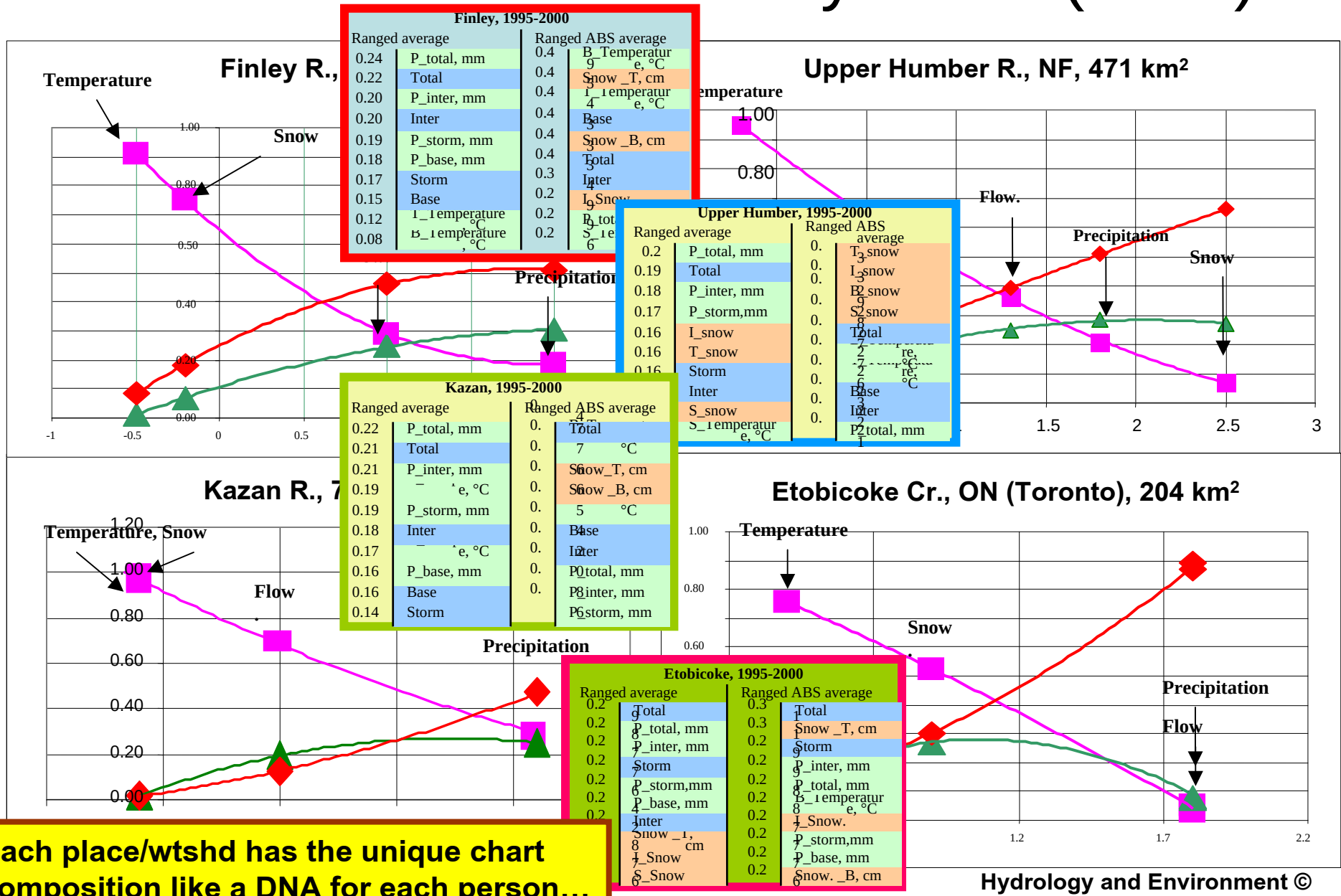


Tooma, 1984-90

Ranged average correl. coef.		ABS average correl. coef.	
0.273	Linnussaare_T	0.380	w. 218
0.260	T5_I_share	0.377	w. 214
0.259	T5_T	0.377	1052b_T
0.249	218_S_share	0.374	w. 214_B
0.245	T6_T	0.374	1052d_T
0.241	T4_I_share	0.368	Linnussaare_T
0.240	Koluvere_T	0.366	1052b_B
0.235	S_1052d_share	0.350	Linnussaare_B
0.233	T4_T	0.346	1052c_T
0.233	T6_I_share	0.345	w. 218_B

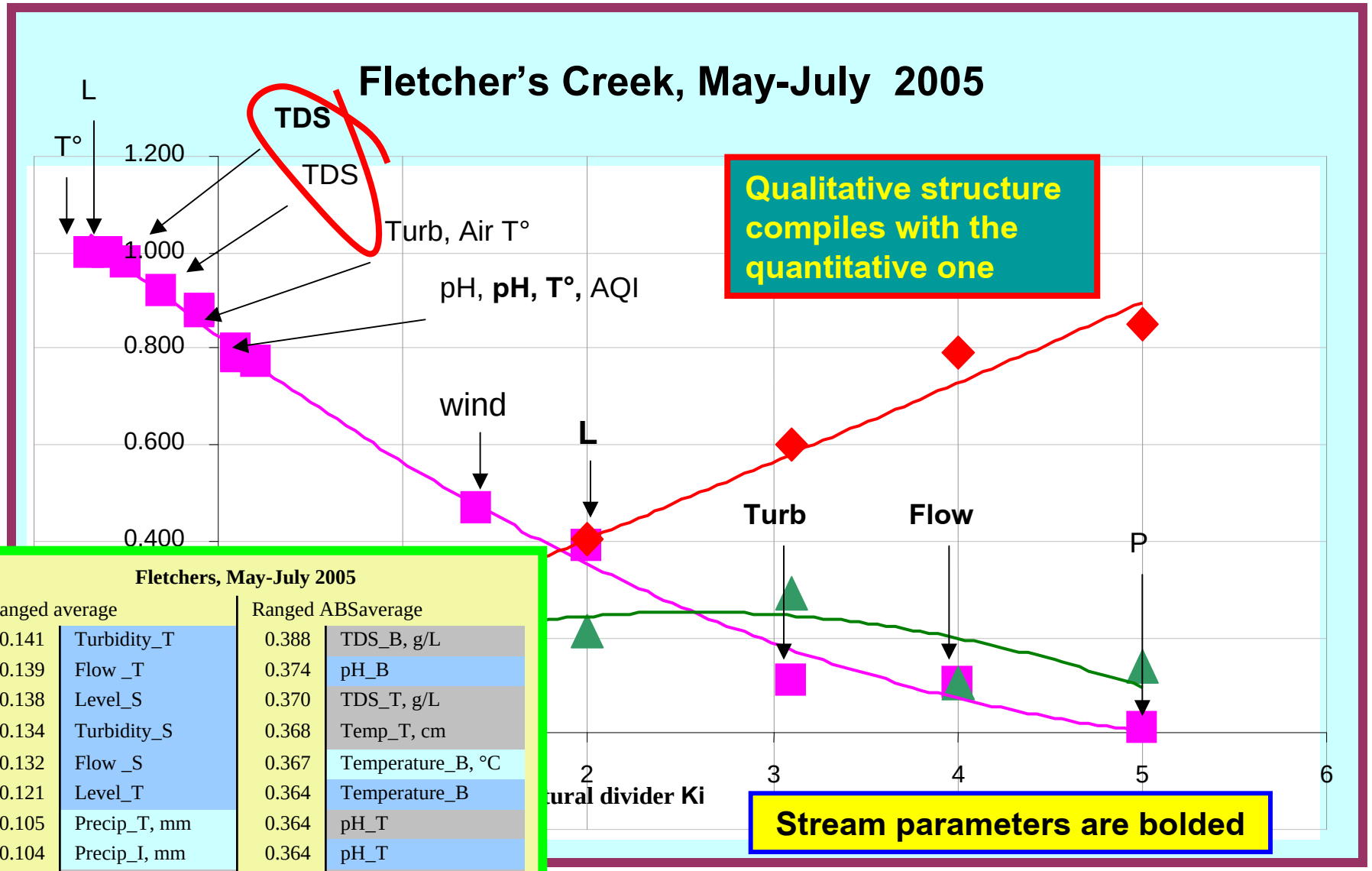
List of top ten

2. The Structural Harmony Chart (cont.)



Each place/wtshd has the unique chart composition like a DNA for each person…

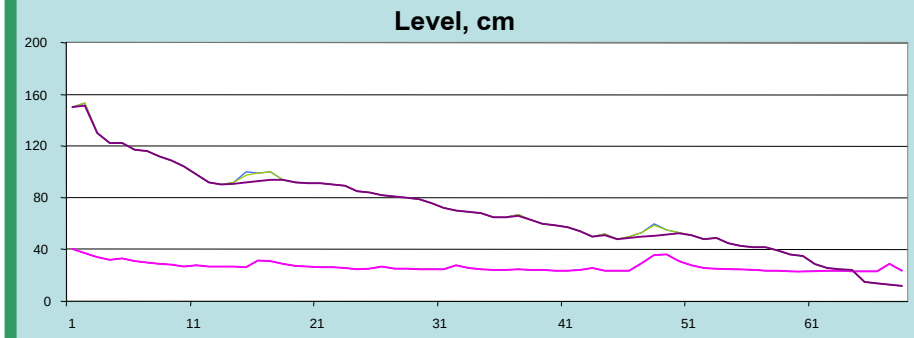
2. The Structural Harmony Chart (cont.)

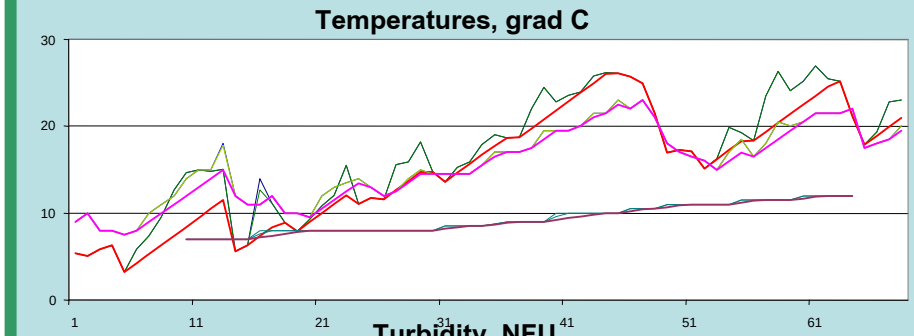


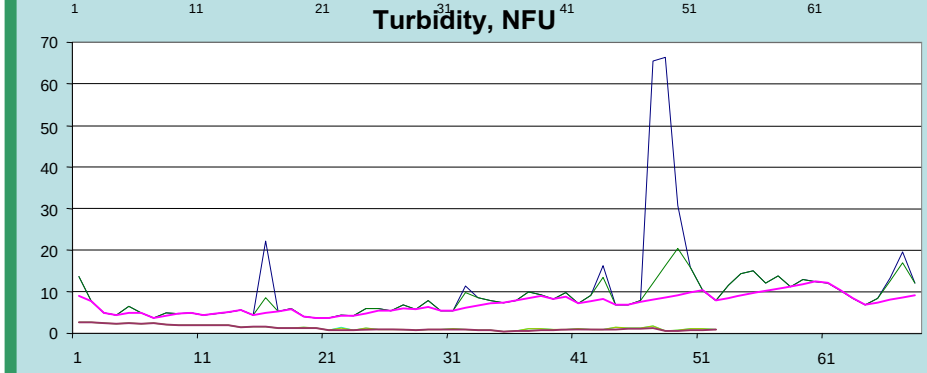
Fletchers, May-July 2005

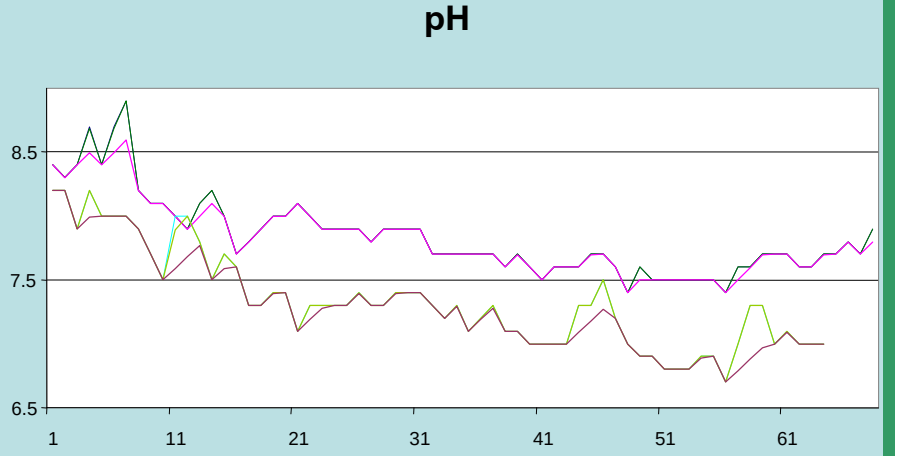
Ranged average		Ranged ABSaverage	
0.141	Turbidity_T	0.388	TDS_B, g/L
0.139	Flow _T	0.374	pH_B
0.138	Level_S	0.370	TDS_T, g/L
0.134	Turbidity_S	0.368	Temp_T, cm
0.132	Flow _S	0.367	Temperature_B, °C
0.121	Level_T	0.364	Temperature_B
0.105	Precip_T, mm	0.364	pH_T
0.104	Precip_I, mm	0.364	pH_T
0.102	Level_S,cm	0.364	Temperature_B, cm
0.100	Level_I,cm	0.362	Temperature_T, °C

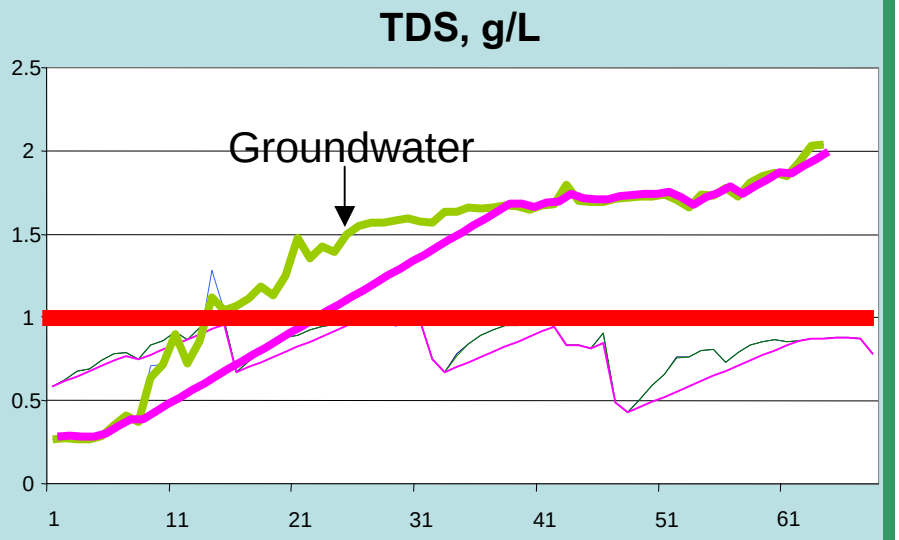
Abnormality of TDS in GW



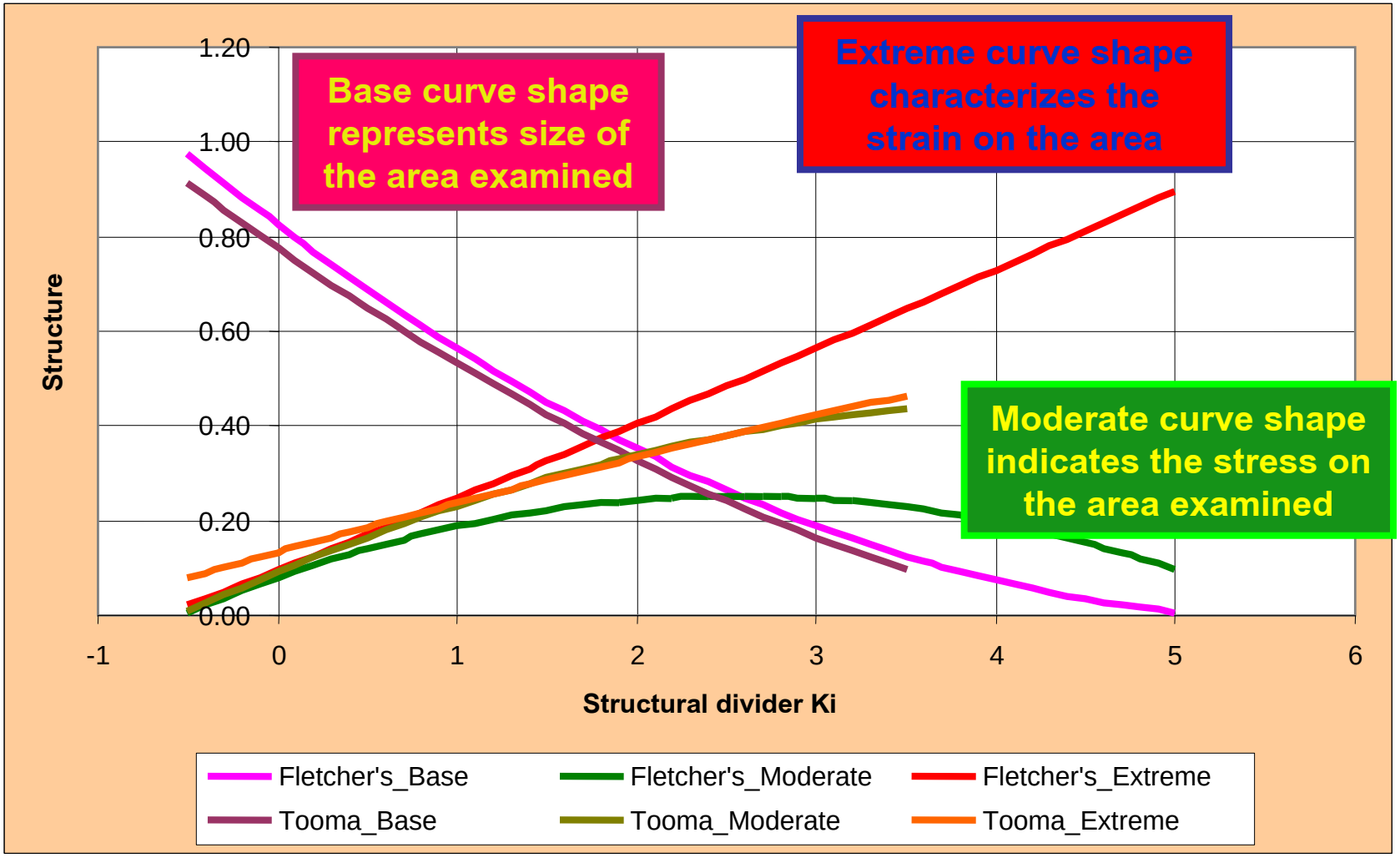








Fletcher's – Tooma comparison



Conclusions

The Structural Harmony/ Elasticity Chart seems to be the Environmental/ Hydrological Identity of a place, sensitive to not only the environmental stress and strain, but to the size of the object as well

The Separated Flux Analysis (SFAN), including the SimpleBase Delineation Model and the Structural Harmony Chart as intrinsic parts of it, seems to be a powerful tool for the environmental assessment and has to be investigated and tested more thoroughly