Baseflow assessment

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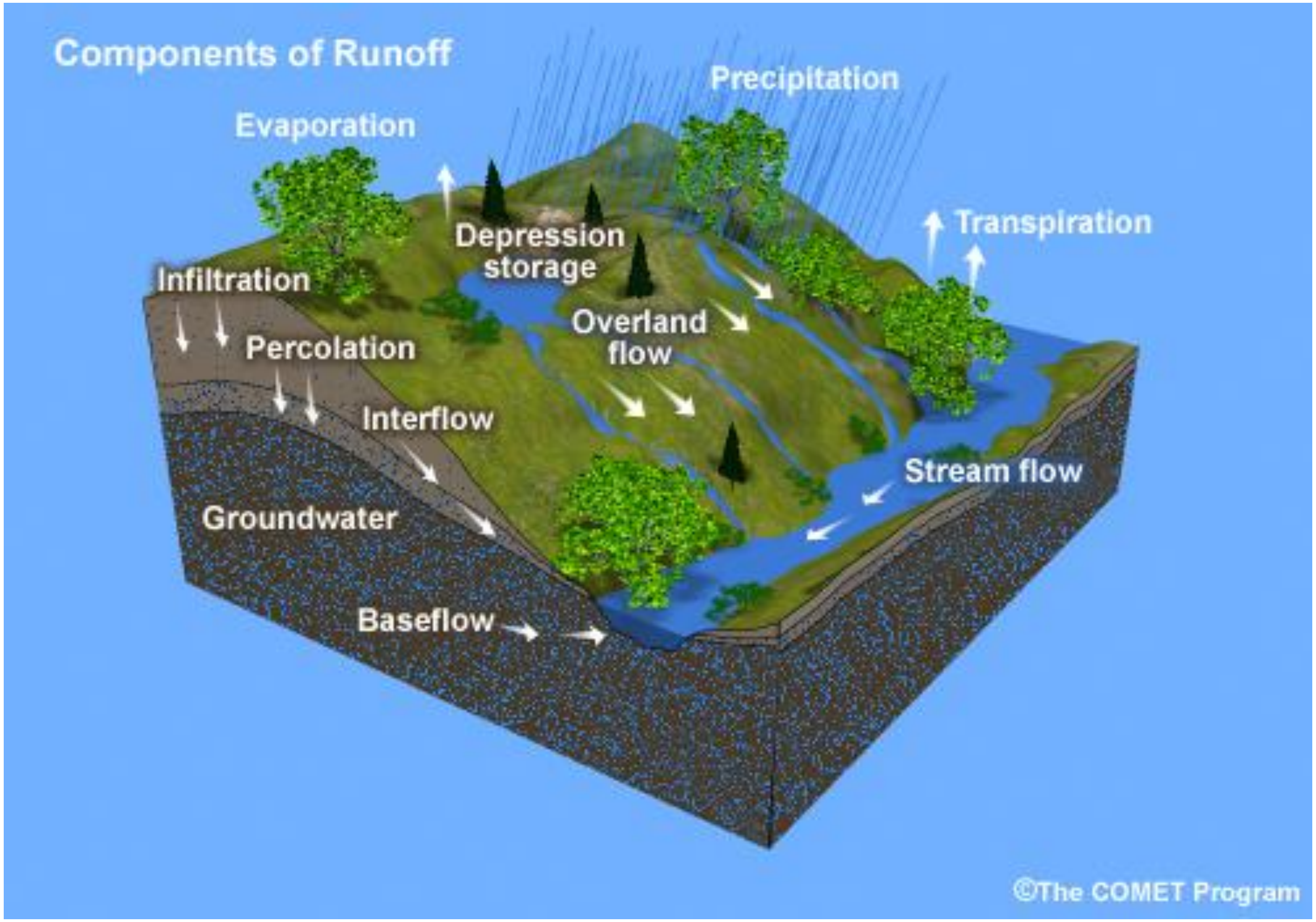
Baseflow definition

- Drought flow, groundwater recesion flow, low flow, fair-weather flow, groundwater flow
- It is a part of total river flows which represent groundwater seepage into a stream channel from natural storage
- It is a streamflow which result from precipitation that infiltrates into soil and aquifers (recharge)
- Geomorphology controls on regional baseflow

Dynamic – static GWR



Baseflow assessment methods

- Kille method (monthly minima – long-term average – regional assessment)
- Separation of hydrograph (daily data – assessment of baseflow in various years – interval in which baseflow values varies)

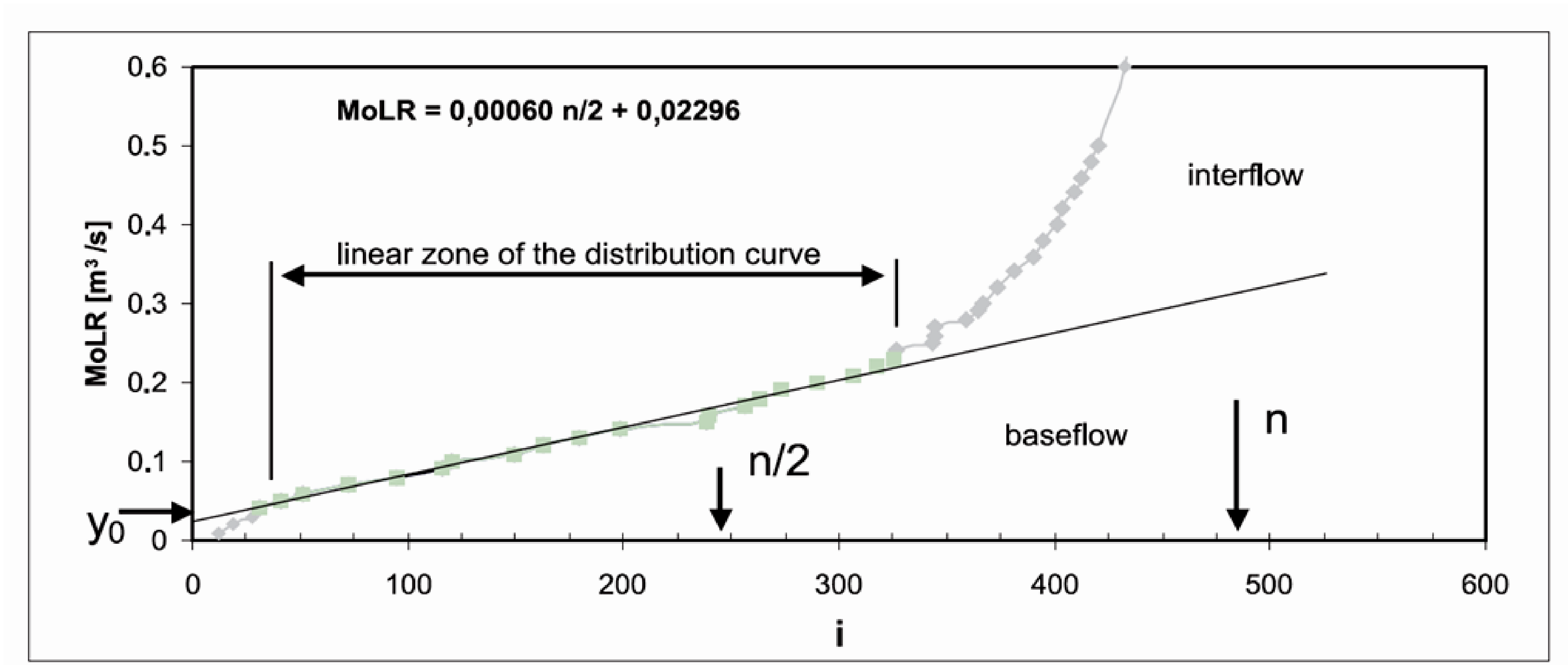
Kille method

The application of the method can be summarized as follows:

- For each month in a year the minimum daily discharge rate
- Plot rates against the corresponding orders
- The linear zone of the distribution curve represents the baseflow.

- Average groundwater recharge rate R = baseflow

Kille

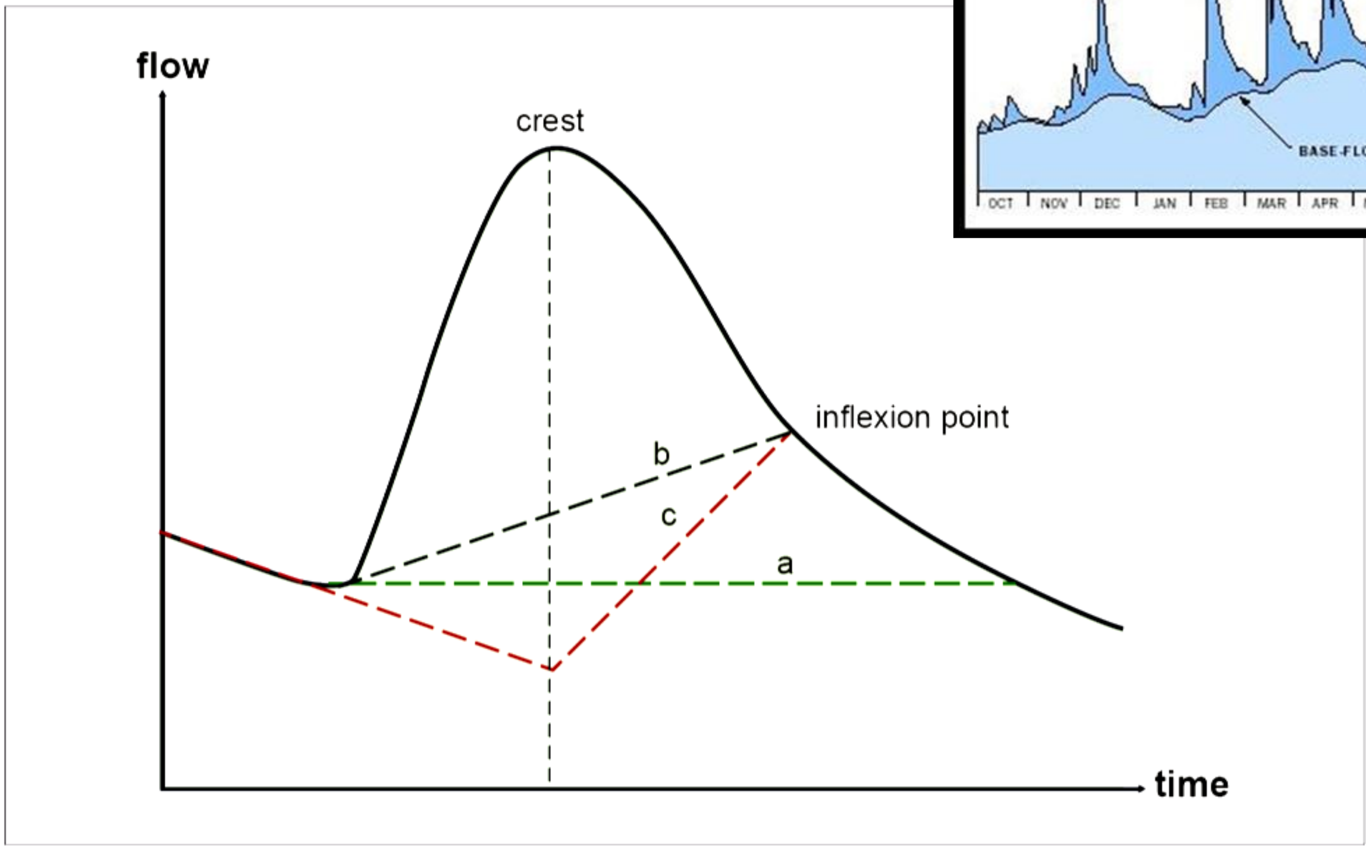

MoLR = 0,00060 n/2 + 0,02296
linear zone of the distribution curve
interflow
baseflow
n/2
n
y0
MoLR [m³/s]
i
0.6
0.5
0.4
0.3
0.2
0.1
0
0
100
200
300
400
500
600

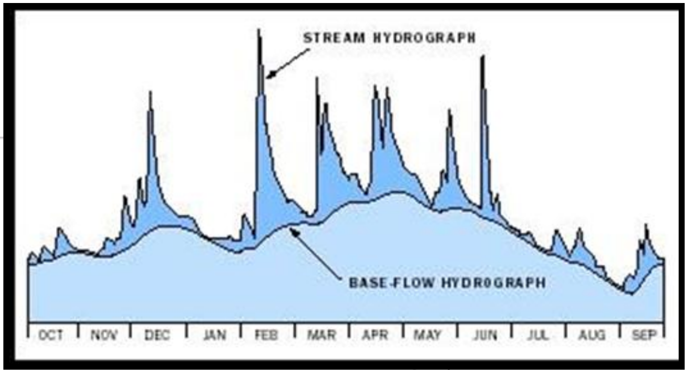
Hydrogrph separation

Graphical approaches to partitioning baseflow vary in complexity and include:

- constant slope method (**black line** on the chart) connecting the start of the rising limb
- constant discharge method (**green line**)
- concave method (**red line**) attempting to represent the assumed initial decrease in baseflow and delay in aquifer recharge

Graphical methods

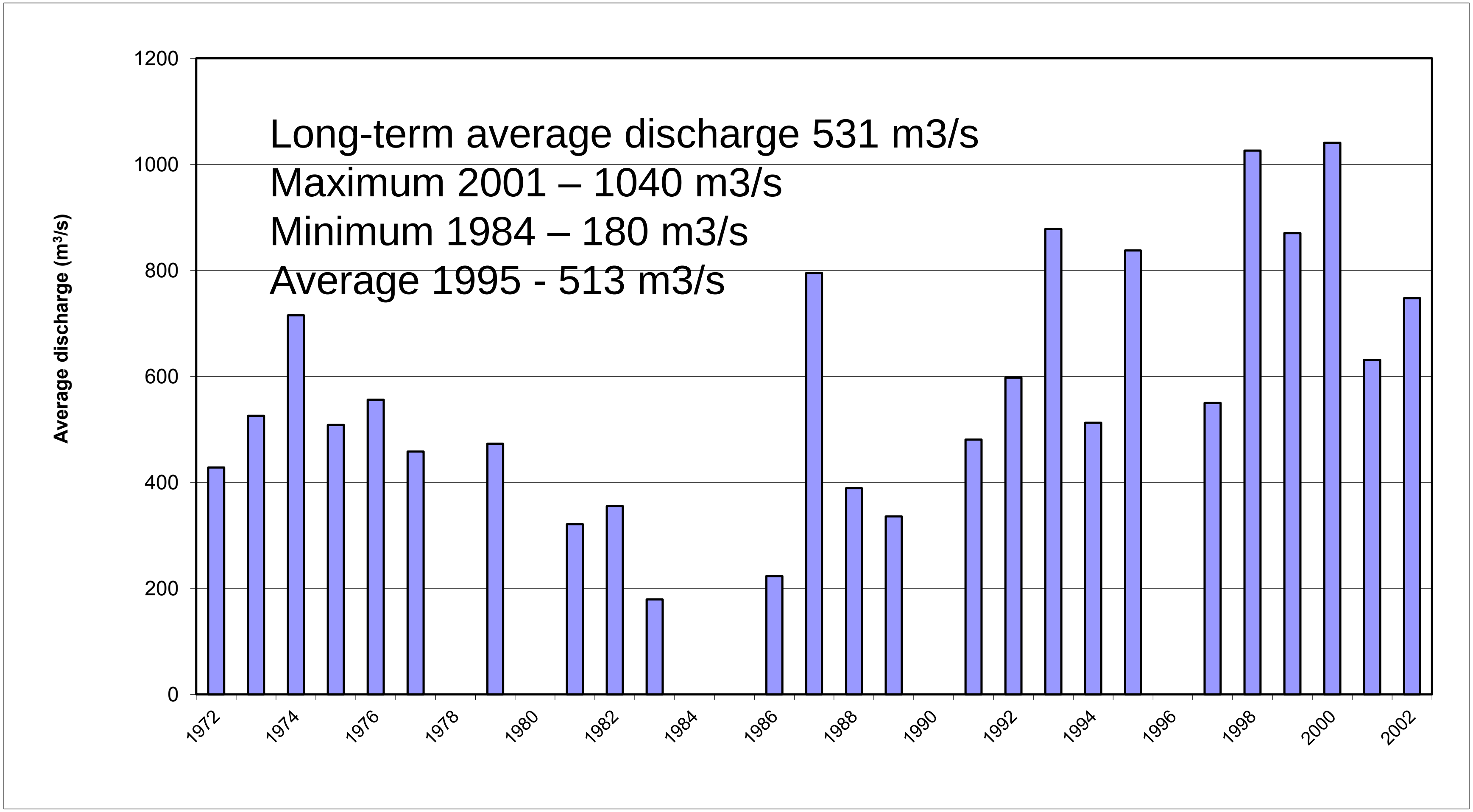




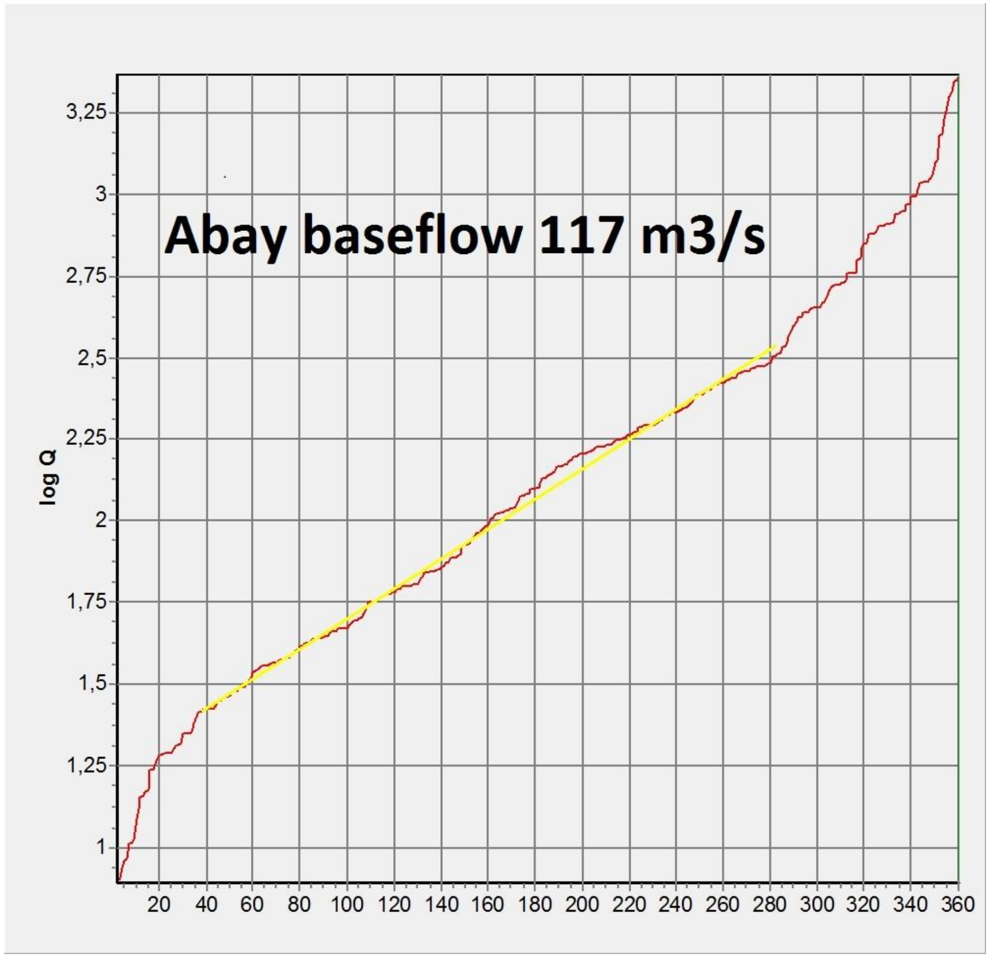
Comparing Kille and separation

Map ID	River	Area [km^2]	Specific runoff [l/s.km^2]	Kille method [m^3/s]	Hydrograph separation [m^3/s]	Specific baseflow		Aquifer
						[l/s.km^2]	[mm]	
112001	Abbay / Kessie	65,784.0	7.97	117.790	196.84	1.79/2.99	76.8	Volcanic + sedimentary
112027	Aleltu / Muka Ture	447.0	9.82	0.990	1.32	2.21/2.95	70.6	Volcanic
112029	Robi Gu-mer / Lemi	887.0	9.90	0.140	0.26	0.16/0.29	7.1	Volcanic
112034	Jemma / Lemi	5,412.0	14.78	37.370	39.74	6.91/7.43	221.6	Volcanic + sedimentary
112002	Mugher	489.0	15.87	0.240	1.52	0.49/3.11	64.5	Volcanic + sedimentary
112044	Gorfo / Gorfo	49.2	20.35	0.020	0.18	0.41/3.65	64.4	Volcanic
112012	Aleltu / Chancho	29.0	16.20	0.014	0.019	0.48/6.40	108.8	Volcanic

Abay – average discharge

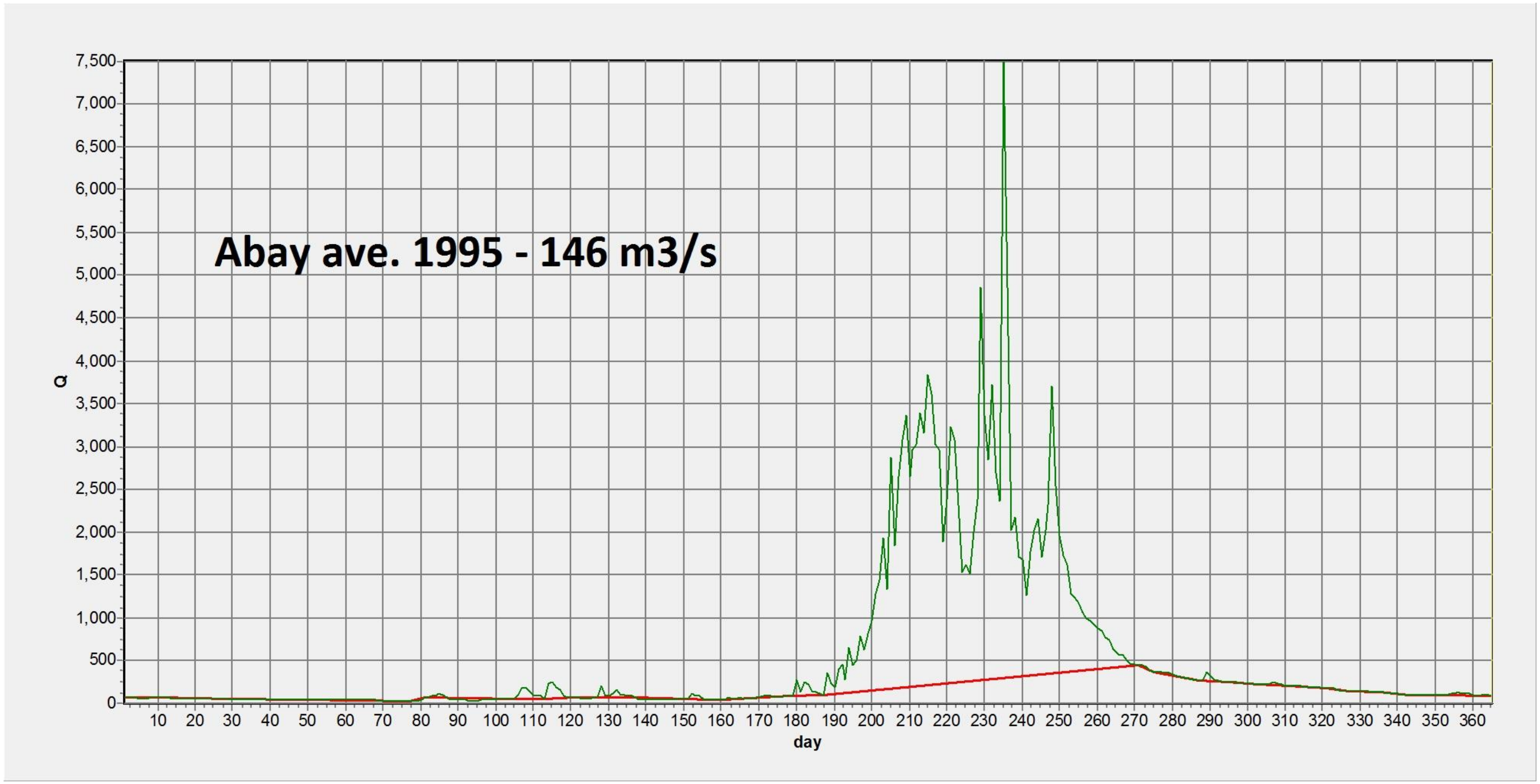


Kille

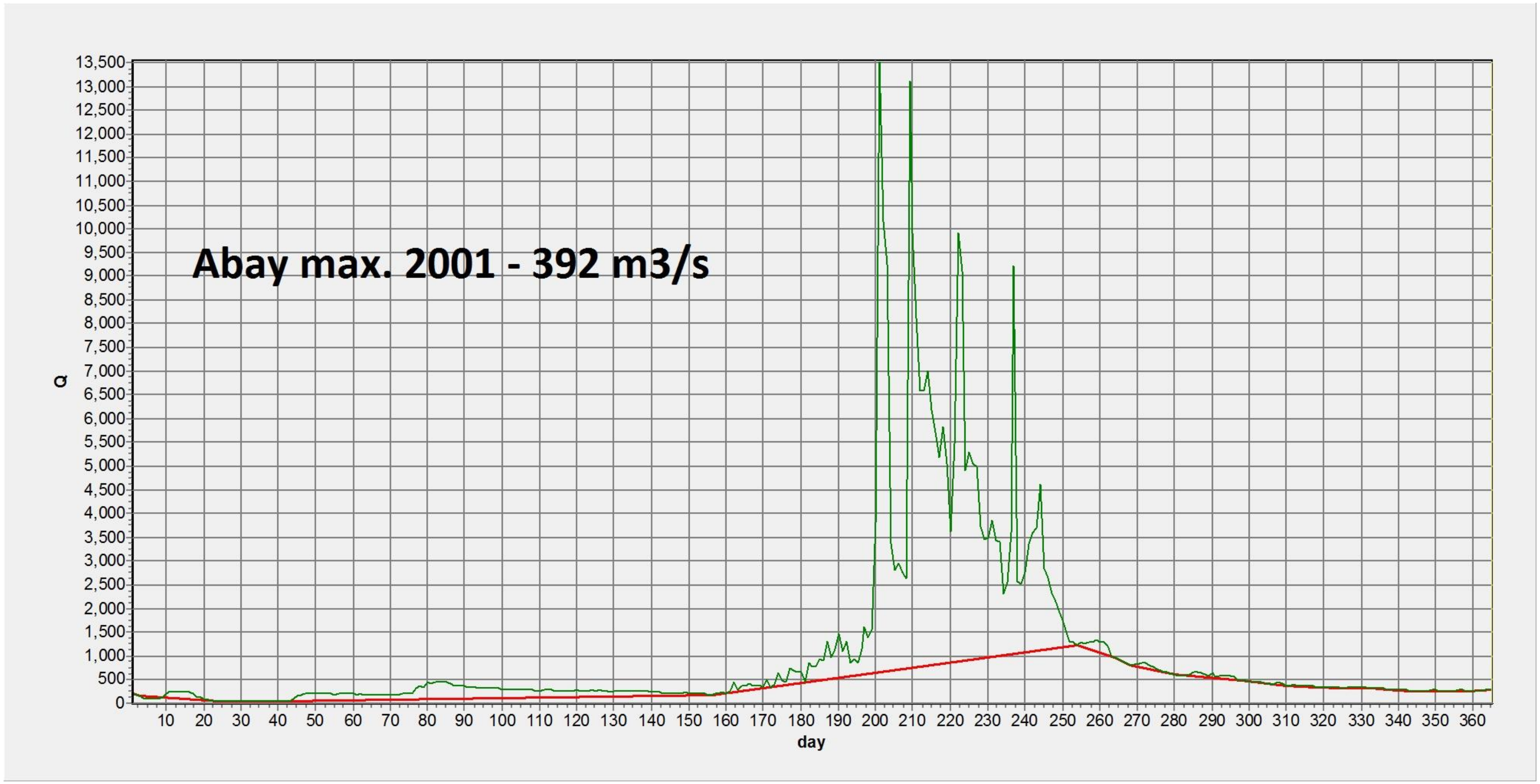


Abay baseflow 117 m3/s
log Q
3,25
3
2,75
2,5
2,25
2
1,75
1,5
1,25
1
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360

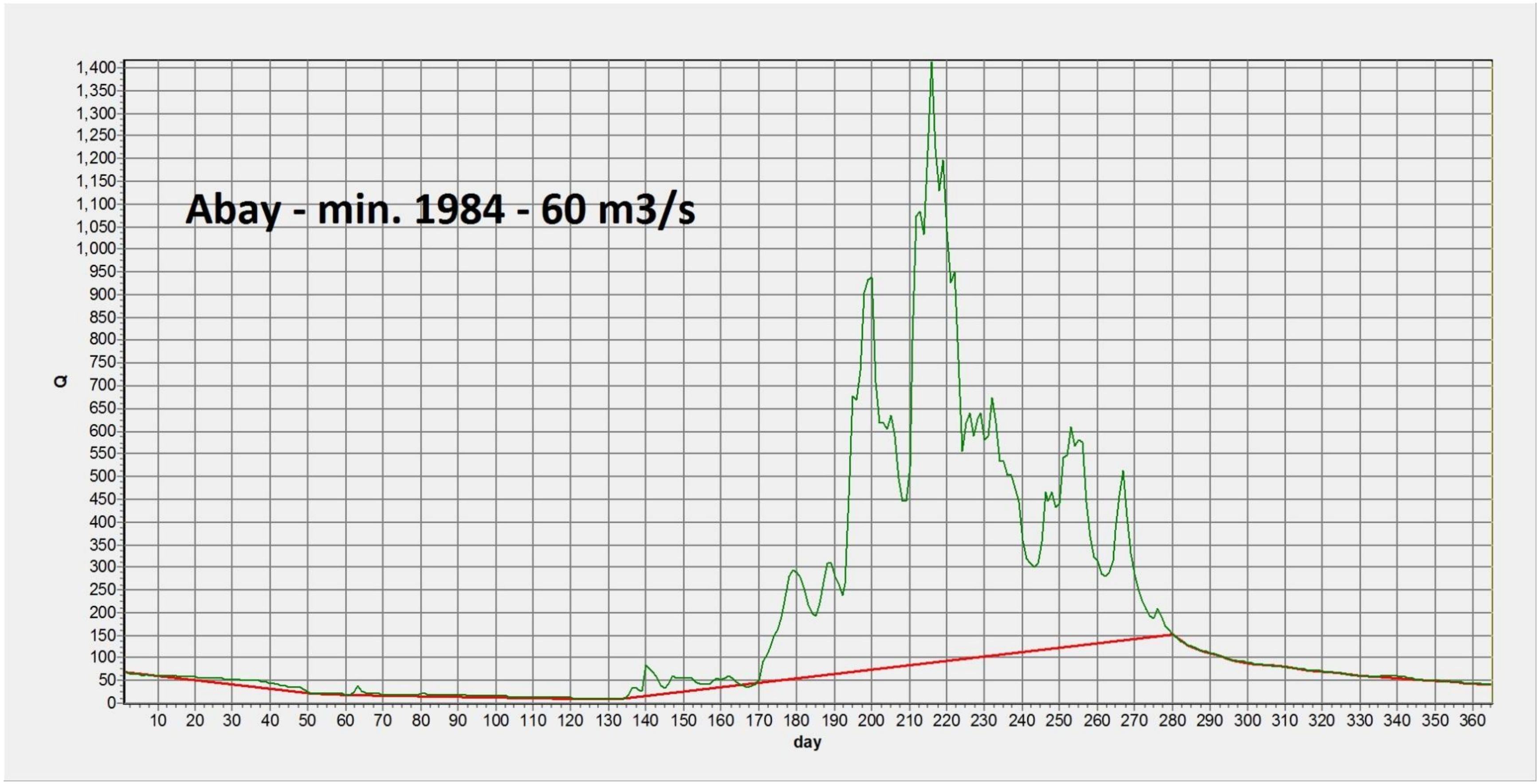
Abay - average



Abay - maximum



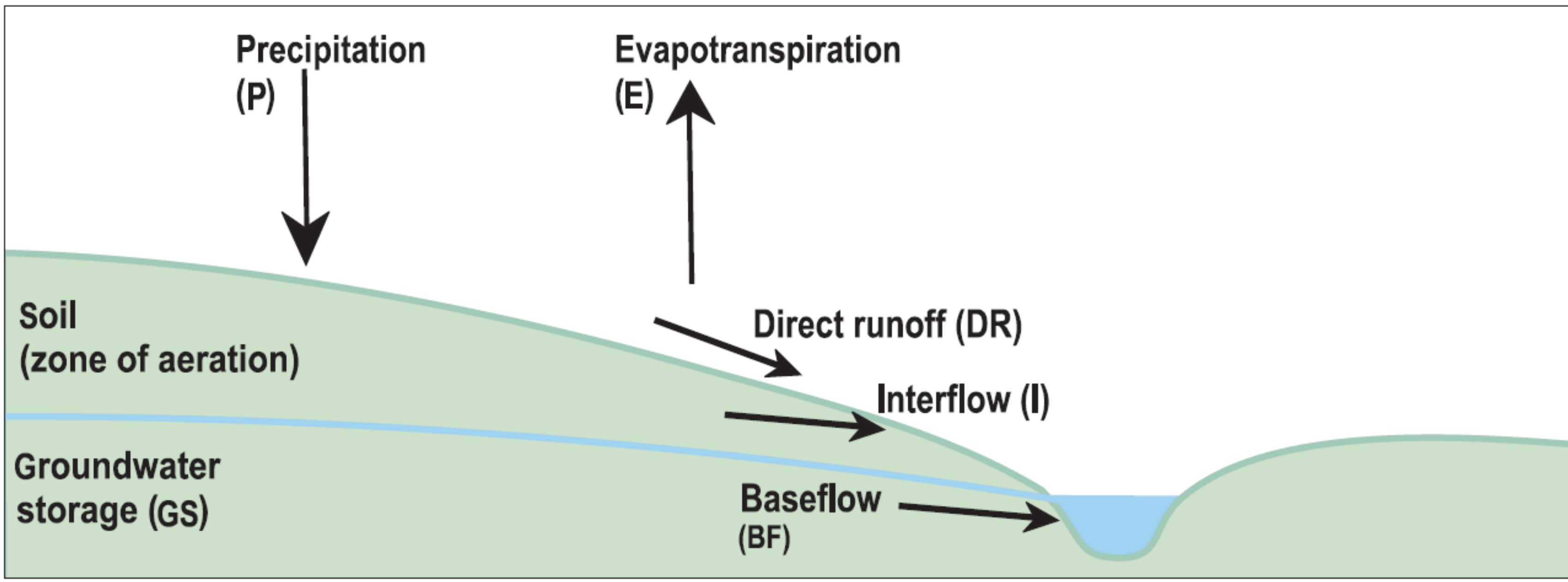
Abay – minumum



Specific baseflow and recharge

	Dodola	Ginnir	Negele	Filtu	Addis Ababa
Volcanic rocks	5.0	4.0			
Basement rocks	1.0		1.0		
Sedimentary rocks	0.14	1.0	0.14	0.14	
Average specific baseflow [l/s/km2]	2.8	1.0	0.6	0.14	2.0
Recharge [mm/y]	178.5	59.5	30.5	4.5	62.5
Precipitation (%)	21	7	4.5	1.1	5

BILAN model



Precipitation
(P)
Evapotranspiration
(E)
Soil
(zone of aeration)
Direct runoff (DR)
Interflow (I)
Groundwater
storage (GS)
Baseflow
(BF)

Baseflow and Recharge

River	Baseflow (l/s)	Specific baseflow	Recharge (mm)
Beressa	180	0.88	27/25
Aleltu	110	0.25	8
Chacha	140	0.33	11/23
Robi Gumero	140	0.16	5
Robi Jida	90	0.12	4
Jemma	1,700	0.31	10/30
Jemma (model)	2,300	0.15	5

Home made software

- Kille – (kille.exe) and (river kille.txt)
- Hydrogram – (hydrogram.exe) and river hydrogram.txt

Sources and Recommended Readings:

Lerner, D.N. – Issar, A.S. – Simmers, I. (1990):
Groundwater Recharge.– IAH Contrib.8, Heise, Hannover.

Scanlon, B.R. & Cook, P.G. (2002):
Choosing appropriate techniques for quantifying groundwater recharge.- Hydrogeology Journal 2002, 10:18-39,Springer Verlag, Berlin.