Hydrology of the karst spring Jadro (Croatia)

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The catchment is composed mainly of carbonates, well permeable Mesozoic, Eocene and Perms limestone and less permeable dolomites and impermeable Triassic clastic deposits and Eocene flysch.
The Jadro Spring is principal water-supply source for the Split town and wider surrounding area (> 300,000 inhabitants). Forming the river Jadro which inflow after the 4.5 km into the Adriatic Sea.
\[ Q_{\text{mean}} = 9.85 \text{ m}^3/\text{s} \ (\text{mean annual discharge}) \]
\[ Q_{\text{max}} = 70.1 \text{ m}^3/\text{s} \ (18 \text{ Dec. 2004}) \]
\[ Q_{\text{min}} = 3.72 \text{ m}^3/\text{s} \ (07 \text{ Aug. 1995}) \]

(limited outflow capacity)
ŽRNOVNICA SPRING

1990-2009

$Q_{\text{mean}} = 1.83 \, \text{m}^3/\text{s}$

$Q_{\text{max}} = 16.7 \, \text{m}^3/\text{s} \text{ (18 Dec. 2004)}$

$Q_{\text{min}} = 0.215 \, \text{m}^3/\text{s} \text{ (9, 10, 11, 14 Sep. 1993)}$
Cetina River catchment
Catchment area and boundaries !???
The regression line (Q_{year}-P) crosses the abscissa at the point P_0, which means that an annual rainfall equal to or smaller than P_0 could not cause any runoff on the catchment under consideration.
From the hydrological point of view this is unacceptable and can be explained by fact that the Jadro Spring is feed with water from another source.
Time series of the mean annual discharges

1995-2009

$Q_J = 0.006 \times t - 2.0676$
$r = 0.02$

$Q_{Jav} = Q_{Tav} = 9.85 \text{ m}^3/\text{s}$

$Q_T = 0.176 \times t - 342.47$
$r = 0.235$

defined by Turc equation

measured

$D = P / \sqrt{0.9 + (P^2 / L^2)}$

$L = 300 + 25 \times T + 0.05 \times T^3$

$A_{JADRO-TURC} = 502.5 \text{ km}^2$

$A_{ŽRNOVNICA-TURC} = 80.1 \text{ km}^2$
Relationship between the Jadro Spring mean annual discharges defined by Turc equation ($Q_{TURC}$) and measured data ($Q_{JADRO}$)

$Q_T = 2.363 \times Q_J - 13.421$

$Q_J = 0.356 \times Q_T + 6.3406$

1995-2009

$A = 502.54 \text{ km}^2$

$r = 0.917$

$Q_{TURC}$ ($\text{m}^3/\text{s}$)

$Q_{JADRO}$ ($\text{m}^3/\text{s}$)

5.68 m$^3$/s

6.34 m$^3$/s
$c$ – annual runoff coefficient

$c$ - measured; $c_T$ - Turc

$c = -0.0153 \times c_T + 0.648$

$r = 0.473$

$A = 502.54 \text{ km}^2$

$c_T = 0.0551 \times Q_J - 0.0569$

$r = 0.919$

$Q_{JADRO} (\text{m}^3/\text{s})$
RQ = Q_j - Q_T  
(m³/s)  

P = 1256 mm  

RQ = -0.0091 × P + 11.45  
r = 0.959  

RQ = Q_j - Q_T  
(m³/s)  

Q_j = 9.85 m³/s  

RQ = -1.363 × Q_j + 13.421  
r = 0.799
Subtraction of 6.01 m³/s from the measured Jadro Spring mean annual discharges

\[ Q_{JADRO} - 6.01 \] (m³/s)

\[ Q_J - 6.01 = 0.0051 \times P - 2.6248 \]
\[ P = 165.8 \times (Q_J - 6.01) + 620.1 \]

1995-2009

\[ r = 0.923 \]

\( P_0 = 515 \) mm
\( P_0 = 620 \) mm

\( P_0 \) is between 515 and 620 mm
Δt = 1h
28 Sep. – 8 Nov. 2010 (in progress…)
$T_{\text{min}} = 12.38 \, ^{\circ}\text{C} - T_{\text{max}} = 13.05 \, ^{\circ}\text{C}$
(1979-1985) $T_{\text{min}} = 10.77 \, ^{\circ}\text{C} - T_{\text{max}} = 15.02 \, ^{\circ}\text{C}$
$E.C._{\text{min}} = 0.30 \, \text{mS/cm} - E.C._{\text{max}} = 0.35 \, \text{mS/cm}$
Analysis is in progress!
Thank you for your kind attention!