Supplementary Materials

A new scenario-based framework for conflict resolution in water allocation in transboundary watersheds

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Content:

SM-1: Rating-curve analysis.

In open-channel flow, a well-defined relationship exists between water depth and flow under uniform-flow conditions. Therefore, establishing this correlation is always a reasonable first step in assuring the quality of the data collected. In the Cuareim/Quaraí watershed, measured data did not always conform to this relationship. In particular, it was possible to identify a group of data points that seemed to follow particular laws and some "random data points". Each data point was identified as corresponding to the respective hyetograph and a time during the rainfall period. It is believed that these "random data points" arose from potential measurement mistakes, because they characterized peak flows that occurred while the hyetograph was equal to zero.

The best approximation to the flow rate and water depth data was obtained using a combined relationship described by the following four equations:

$$Q = 58.107(H - 0.6)^{2.914} \qquad \text{for } 0.70 \leq H \leq 1.16$$
$$Q = 35.219(H - 0.6)^{2.047} \qquad \text{for } 1.17 \leq H \leq 2.38$$
$$Q = 45.136(H - 0.6)^{1.617} \qquad \text{for } 2.39 \leq H \leq 8.80$$
$$Q = 4.483(H - 0.6)^{2.715} \qquad \text{for } 8.81 \leq H \leq 13.50$$

where Q is the flow [m^3/s] and H is the water depth [m].

In Fig. I, measurements of water level/flow and the rating curve are shown.

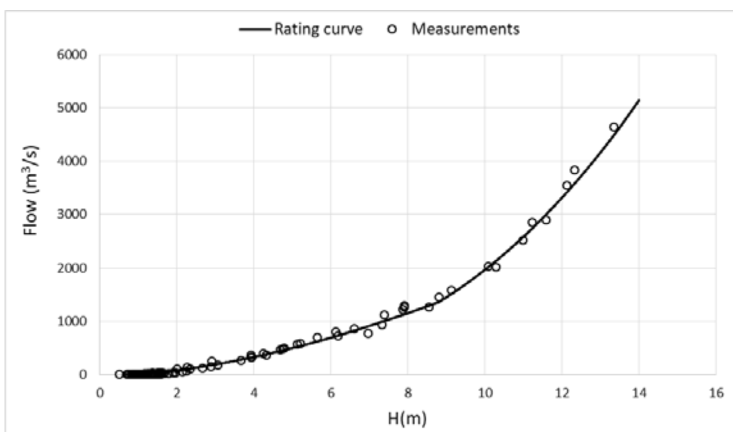

Figure I. Rating curve.

SM-2: MGB-IPH parameters.

Nine parameters were used to calibrate the hydraulic/hydrologic model. Their physical description and range of variation are shown in Table I.

Table I. Parameters of the hydraulic-hydrologic model.

Parameter	Description	Range of variation
Wm (mm)	Maximum storage capacity of the surface-soil layer. It depends on the soil type. A value for each HRU.	50 - 1000
b	Variability of the reservoir-maximum volume that represents the surface layer of the soil. It depends on the soil type and its thickness. It affects surface runoff. A value for each HRU.	0.12 - 1.6
K_{int} (mm/d)	Sub-surface flow rate when the soil is saturated. It depends on the soil type. It affects the sub-surface runoff. A value for each HRU.	4 - 40
XL	Soil porosity index. It depends on the soil type. It affects the sub-surface runoff. A value for each HRU.	~0.67
K_{bas} (mm/d)	Groundwater-flow rate when the soil is saturated. It depends on the soil type. It affects underground runoff. A value for each HRU.	0.05 - 5
Wc	Parameter without any physical meaning, which avoids negative values and instabilities of the model. A value for each HRU. In general, it is not recommended to use values different from 0.1.	0.1
Cs	Multiply the concentration time to define the surface-response time of the mini-catchments. It affects the superficial discharge flow. A unique value for all HRUs.	1 - 20
Ci	Multiply the concentration time to define the sub-surface response time of the mini-catchments. It affects the sub-surface discharge flow. A unique value for all HRUs.	50 - 200
TKB (h)	Response time of the ground flow of the mini-catchments. Affects the ground discharge flow. A unique value for all HRUs.	1200 - 8000

SM-3: Water-balance components in SiGBaH-Irriga.

In Fig. II, a general scheme of the water-balance components of rivers and reservoirs for a single mini-basin is presented.

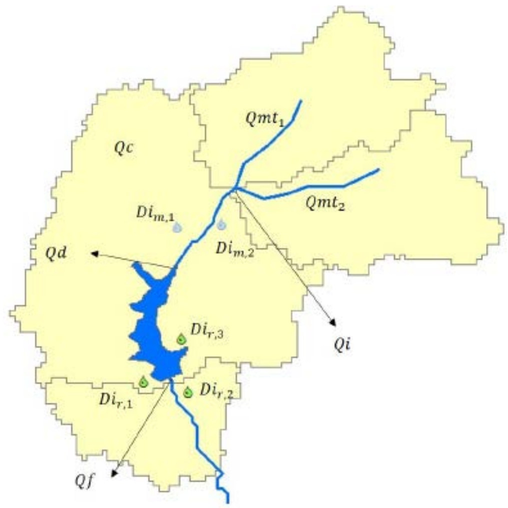

Figure II. Conceptualization of river and reservoir-water balance in a mini-basin for SiGBaH-Irriga.

The following variables are represented by vectors with a size corresponding to the number of the simulation time steps: $Qmt_1, Qmt_2, \dots Qmt_n$ is the flow rate of each mini-basin upstream of the simulated one, where *n* is the number of upstream mini-basins; Q_i is the initial flow of the mini-basin; Q_c represents the incremental flow; Q_d is the accumulated flow in the mini-basin decreased due to withdrawals; $Di_{m,1}, Di_{m,2}, \dots Di_{m,j}$ represent individual water demands directly associated to the river link in each mini-basin, where *j* is the number of demands; $Di_{r,1}, Di_{r,2}, \dots Di_{r,k}$ are individual demands associated to the mini-basin reservoir, where *k* is the number of demands; and Q_f represents the outlet of the mini-basin.