Water quality modeling of Parana River, between the Yacyretá dam and its junction with the Paraguay River.

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Abstract

The following work shows the results of a study on the dispersion capacity of six hypothetical pollutants and the variation of their concentration along a section of the Paraná River, between the Yacyretá dam and the confluence with the Paraguay River. The Paraná River is a river in east-central South America that flows through Brazil, Paraguay, and Argentina.

The water quality module in HEC-Ras software was used to model this study and the data was obtained from a practical case seen in the subject Maths Models, as part of the postgraduate course in Sanitary Engineering at University of Buenos Aires.

Keywords: Pollutant, dispersion, advection, diffusion, decay, Paraná River, HEC-Ras.

Methods

The HEC-Ras water quality module was used to evaluate the dispersion capacity of a section of the Parana River.

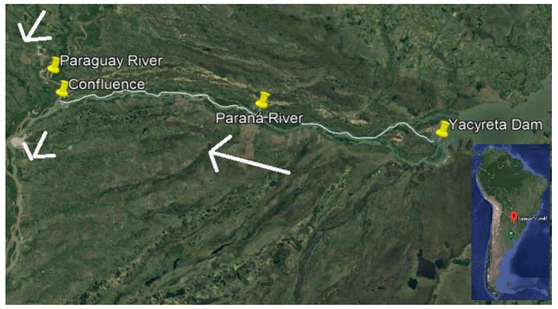

Figure 1. River Paraná location.

Table1. Pollutant type, initial conditions and coefficient decay for modeling.

POLLUTANT	TYPE OF POLLUTANT		COEFFICIENT OF DECAY (K=-1/d)	INITIAL CONDITIONS - CONCENTRATION (ml/l)
P-1	Constant	conservative	0	10
P-2	Constant	Non conservative	-1	10
P-3	Variable	conservative	0	10
P-4	Variable	Non conservative	-1	10
P-5	Punctual	conservative	0	0
P-6	Punctual	Non conservative	-1	0

Table 2. Pollutant type and boundary conditions for modeling.

POLLUTANT	EDGE CONDITIONS -CONCENTRATION (mg/l)								
	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9
P-1	10	10	10	10	10	10	10	10	10
P-2	10	10	10	10	10	10	10	10	10
P-3	10	8	6	4	10	8	6	12	20
P-4	10	8	6	4	10	8	6	12	20
P-5	0	0	0	0	10	0	0	0	0
P-6	0	0	0	0	10	0	0	0	0

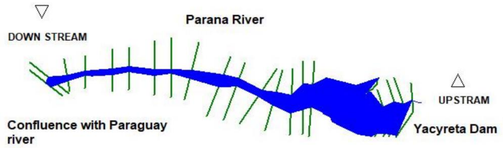

Figure 2. Representation of the model in Hec Ras– Pollutant input: Yacyretá Dam.

Results

- Pollutants 2, 4 and 6, being non-conservative, have smaller curve areas than pollutants 1, 3 and 5 respectively.
- Point pollutants have graphs in Gaussian form.
- The peak concentration of the pollutant decreases along the river.

Figure 3.

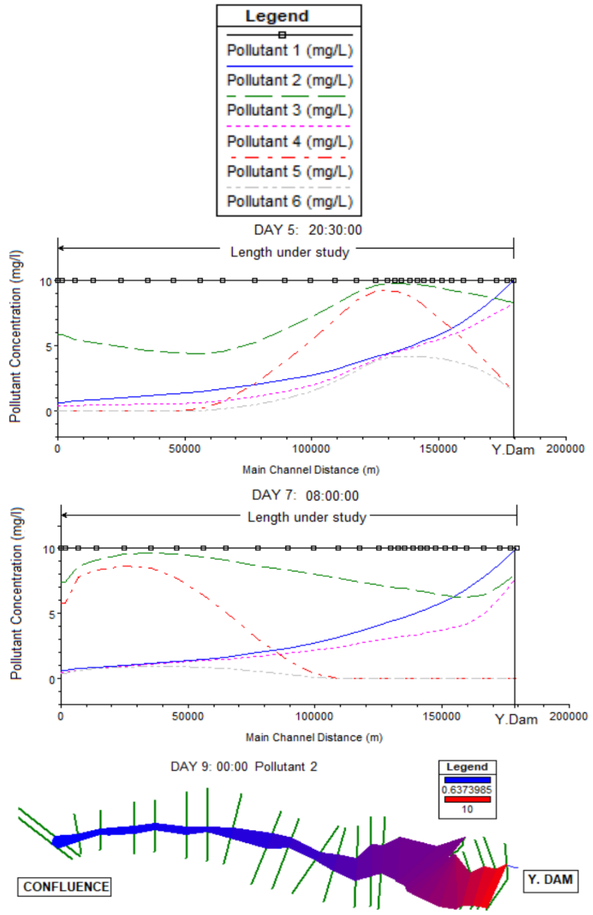

Figure 3. Pollutant concentration vs channel length for day 5,7 and 9.

Conclusions

- Non- conservative pollutant have a decay rate "K", less than zero and the concentration decreases over time.
- Conservatives pollutants are only diluted by dispersion.
- In point pollutants the peak moves by advection and decreases by diffusion.
- The HEC-Ras water quality module allows researchers to create simulations which represent different future scenarios found in nature in order to establish the most probable behavior of water bodies. It is also possible to study different conditions by modifying the input data, since it allows evaluating the variations in the concentration of a pollutant versus **space** and **time**.

Bibliography

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