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PREDICTIONS OF MICROPOLLUTANTS IN THE FUTURE FRESHWATER BASIN VOLKERAKMEER/ZOOMMEER, THE NETHERLANDS

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INTRODUCTION/AIM

In 1987 a new freshwater basin will be created in the SW part of The Netherlands. The new freshwater basin will receive water from the rivers Rhine and Meuse, two of the most polluted rivers in Europe. Because of the high concentrations of organic and inorganic micro-pollutants in these rivers, the Volkerakmeer and Zoommeer will slowly be contaminated.

A good prediction of the concentrations of micropollutants in the water column and bottom sediments and a good understanding of the processes that determine the concentrations is therefore absolutely necessary to establish a good management strategy. Furthermore, the slow contamination offers a unique scientific opportunity to test models for the behaviour of micropollutants by comparing the predictions with measurements after 1987.

In our poster the set-up of the modelling, the calibration of the model with data from the Hollands Diep/Haringvliet and the first preliminary results for the Volkerak/Zoommeer are reported.

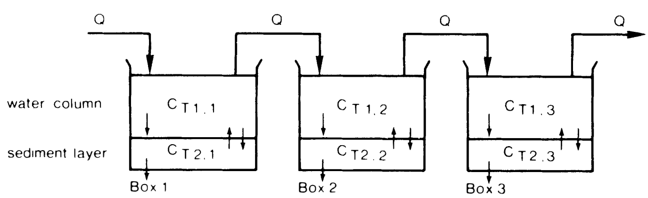

Fig.1 3-Box-model for the Volkerakmeer/Zoommer.

MODEL DEVELOPMENT

The Volkerak/Zoommeer is divided into three boxes (Fig. 1). Each box contains a water column and a sediment layer. In each box the concentration of a micropollutant is assumed to be homogeneous within the water column and the sediment layer. The processes describing the behaviour of a micropollutant in a box, adopted from the model of DiToro and others (1982), are depicted in Fig. 2.

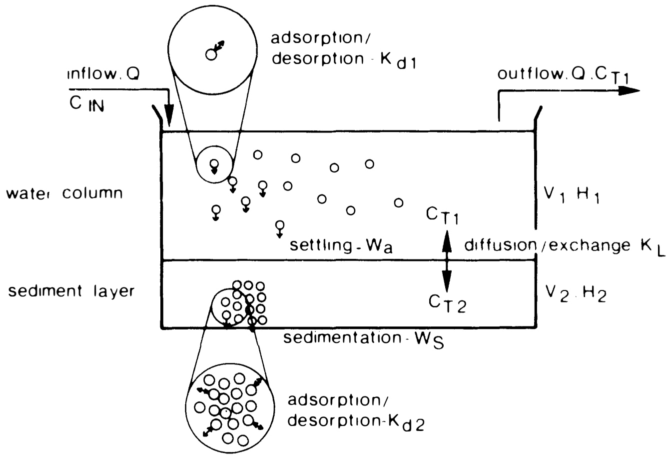

Fig. 2 Processes in one-box.

The inflowing water contains the micropollutant in the dissolved phase as well as bound to suspended matter. The equilibrium between the dissolved and the particulate phase is determined by the partition coefficient K_d and the concentration of suspended matter. Part of the suspended matter with the micropollutant settles and enters the bottom layer. In the bottom layer a new equilibrium is established between the concentration in the dissolved and particulate phase. This causes a difference in the dissolved concentrations in water and sediment and therefore transport of micropollutant. An amount of sediment equal to the amount of settled particulate matter, is transported to deeper layers and leaves the system.

The concentrations in the water column and sediment layer in one box can be described with the two differential equations shown in Table 1. The equations can be solved analytically, assuming the process parameters are constant during a certain time interval.

$$\frac{dC_{T1}}{dt} = -\frac{Q}{V_1}C_{T1} - \frac{K_L}{H_1}(f_{d1}C_{T1} - f_{d2}C_{T2}) - \frac{W_a}{H_1}f_{p1}C_{T1} + \frac{Q}{V_1}C_{IN}$$

$$\frac{dC_{T2}}{dt} = \frac{K_L}{H_2}(f_{d1}C_{T1} - f_{d2}C_{T2}) + \frac{W_a}{H_2}f_{p1}C_{T1} - \frac{W_s}{H_2}f_{p2}C_{T2}$$

Table 1 Differential equations describing concentrations in water and sediment.

CALIBRATION

The model has been calibrated with data for Zinc from the Hollands Diep/Haringvliet. The HD/HV is also a former estuary: it was closed off from the sea in 1970. It also receives water from the rivers Rhine and Meuse and is nowadays seriously contaminated.

For the calibration, a three-box model has been applied. Input concentrations and process parameters are kept constant during quarterly periods. Values are shown in Table 2. Results of measured and calculated concentrations are shown in Fig. 3.

		Hollands Diep / Haringvliet			Volkerak / Zoommeer		
	unit	Box 1	Box 2	Box 3	Box 1	Box 2	Box 3
V_1	10^6 m^3	280	289	240	150	75	52
H_1	m	6.22	6.50	5.00	5.20	5.20	5.20
H_2	m	0.25	0.20	0.10	0.20	0.20	0.20
K_{d1}	l/g	30-200	30-200	30-200	100	100	100
K_{d2}	l/g	15-100	15-100	15-100	50	50	50
K_L	m/d	1	1	1	1	1	1

Table 2 Used process parameter values.

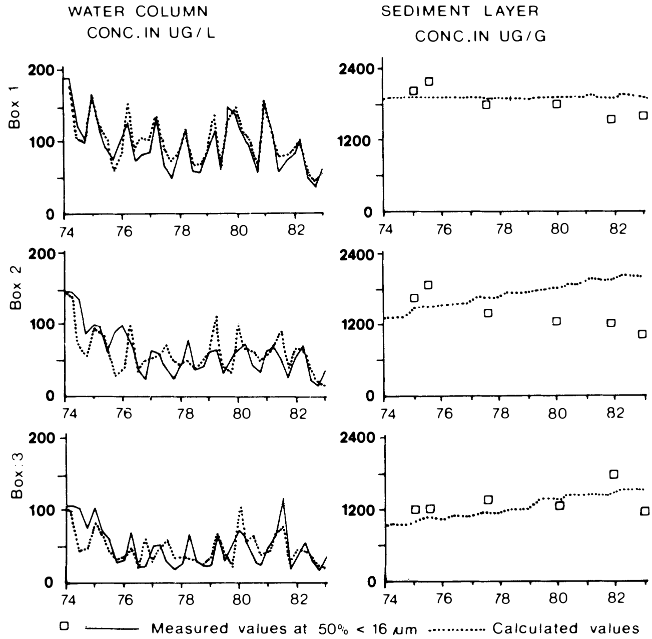

Fig.3 Measured and calculated zinc concentrations in three boxes of the Hollands Diep - Haringvliet.

PREDICTION FOR VOLKERAK/ZOOMMEER

For the prediction of the concentration of Zinc in the period 1985-2185 a three box-model is applied. Two different flushing regimes are simulated. One with a flow rate of 50 m^3/s and the other with 150 m^3/s. Input concentrations and process parameters are kept constant. Values used are shown in Table 2. Results are shown in Fig. 4.

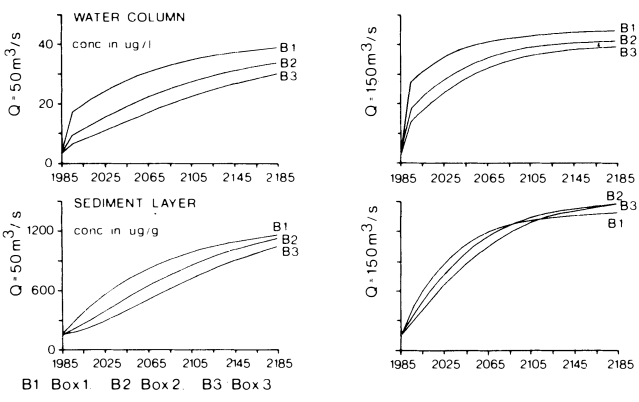

Fig.4 Predicted zinc concentrations in the Volkerak/ Zoommeer for two flowrates(Q).

DISCUSSION

More information is needed about the influence on the model results of the following process parameters:

- Diffusion/Exchange on the water sediment interface.

- Thickness of the active sediment layer.
- Settling/Sedimentation/Resuspension/Production of suspended matter.
- Distribution coefficients as functions of environmental conditions.

Finally it must be emphasized that the model only calculates total concentrations. Speciation or biological availability is not predicted.

CONCLUSION

From the results of the present study it can be concluded that the model is capable of simulating concentrations of micropollutants in water and sediments.

Sensitivity analysis, however, will be needed to determine the uncertainty of the model results and to indicate which data or process parameters need further investigation.

REFERENCE

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