ALTERRA WAGENINGEN UR

Effects of submerged drains on water management and nutrient loading of surface water: a modelling approach

Rob Hendriks and Jan van der Akker

Introduction

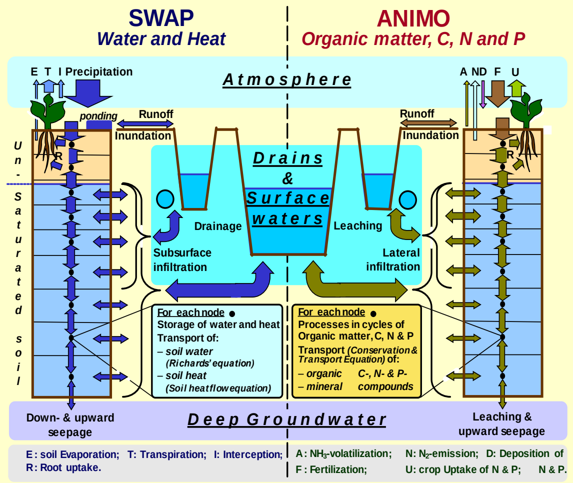
Submerged drains are promising means to reduce subsidence of peat pasture areas in The Netherlands. They enhance submerged infiltration of ditch water into the peat soil during the dry and warm summer half year. The consequential rise of the groundwater level results to substantial decrease of peat oxidation.

However, when this technique was promoted, some pressing questions arose about the possible negative side effects of submerged drains:

1. will they raise the costs of pumping out excess water due to increased drainage and will they increase the demand for – in the future possibly scarce - fresh inlet water?
2. will they increase the risk of flooding during long and heavy showers?
3. will they increase nutrient leaching from the nutrient rich peat soils?

Most of these effects are not easy to assess and all of them are strongly depending on the meteorological conditions during (short) field studies. Therefore, a modelling study was conducted on the basis of results of several pilot studies on submerged drains carried out in the Western peat pasture area in The Netherlands – the Green Heart. The SWAP-ANIMO model was used to analyse and extrapolate the obtained experimental results to gain more insight in these questions and come up with some (first) answers. This poster presents model results of the pilot in the Krimpenerwaard in the heart of the Green Heart.

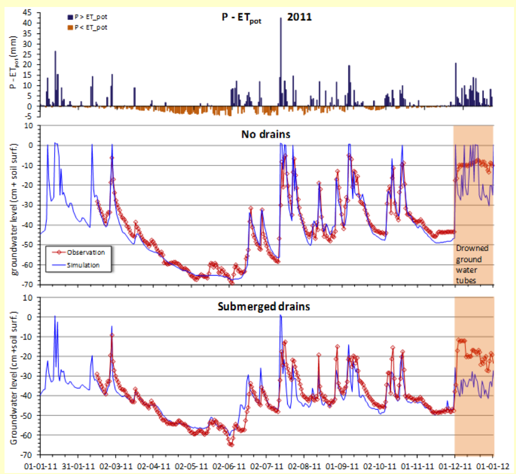
The model



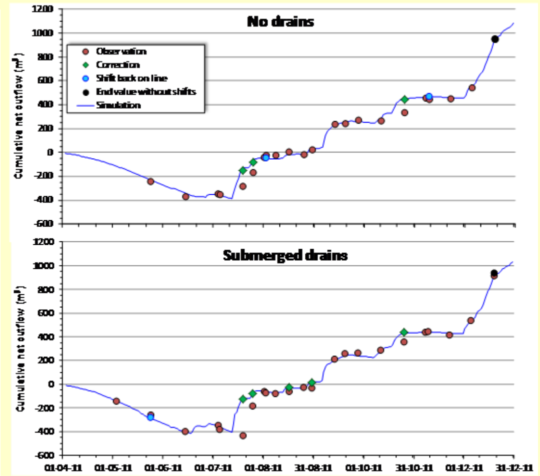
The model was set up with site specific values of hydraulic, physical and chemical properties. It was calibrated against results of groundwater level and discharge and water inlet measurements of the two-years field study.

Calibration

Groundwater level



Ditch outflow



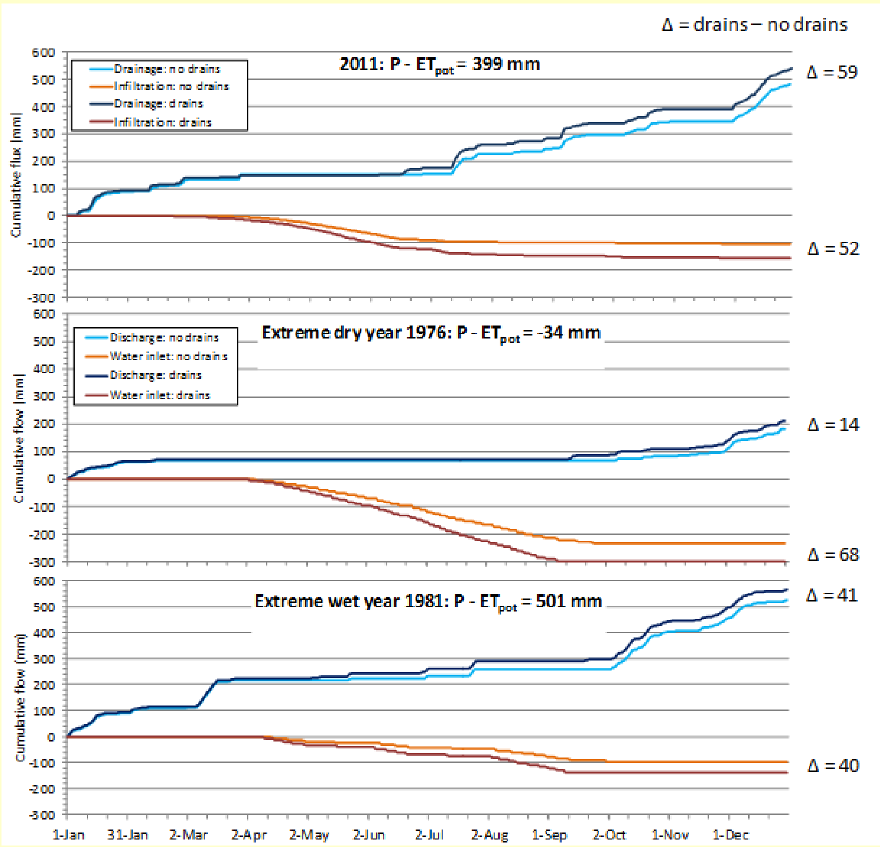
Results

	Resistances (days)	
	Drainage	Infiltration
Ditch	180	200
Submerged drains	48	56

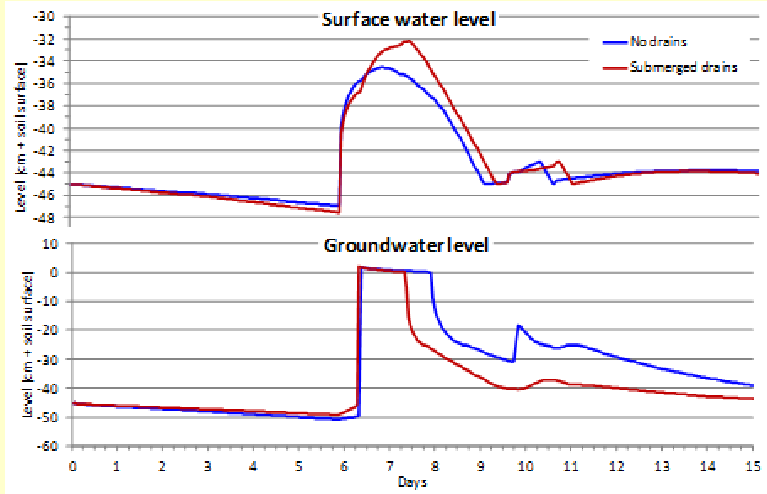
Root Mean Squared Error (RMSE) (incl. 2012)

No drains: 5.1 cm; Submerg. drains: 5.1 cm | No drains: 22 m^3; Submerg. drains: 23 m^3

Q1: effects on drainage/infiltration and discharge/water inlet



Q2: effects on flooding

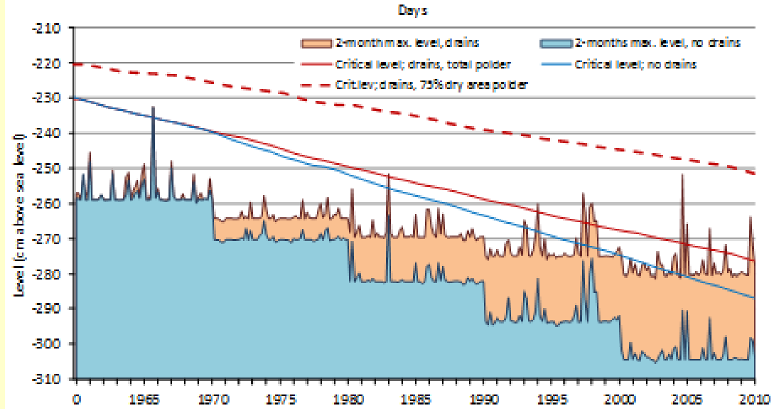


Extreme precipitation event

A shower of 48.5 mm in one hour in combination with a maximum pump capacity of 10 mm per day.

The maximum increase in the surface water level peak caused by submerged drains is 3 cm.

With drains the groundwater level is lowered to an acceptable level (40 cm) for trafficibility more than 5 days earlier.



Long term subsidence

About each tenth year drainage level is adapted to lowered soil surface level to recover drainage capacity. With submerged drains adaptations are much (50%) lower. Subsequently, downward seepage is maintained longer and in the long run total discharge will be lower with submerged drains. Further, differences in soil surface level will be leveled out. All this will lower the risk of flooding.

Q3: effects on nutrient loading of surface water

Nutrient	Scenario year	Absolute values								Differences			
		Net loads				Concentrations				Drains - No drains			
		No drains		Drains		No drains		Drains		net loads		concentrat.	
		year	sumr	year	sumr	wint	sumr	wint	sumr	jaar	sumr	wint	sumr
Phosphorus	1976	0.66	-0.40	0.67	-0.43	0.57	1.12	0.54	0.81	0.01	-0.03	-0.03	-0.31
	1981	3.41	0.26	3.05	0.22	0.65	0.70	0.57	0.57	-0.36	-0.04	-0.08	-0.12
Nitrogen	1976	8.1	-3.1	6.9	-3.4	6.0	10.3	5.0	7.4	-1.2	-0.4	-1.0	-2.9
	1981	26.9	2.5	24.7	2.2	5.1	6.0	4.5	4.9	-2.3	-0.3	-0.6	-1.1
Sulphate	1976	143	-47	66	-71	102	5	60	22	-78	-24	-42	18
	1981	187	5	174	-1	38	38	36	32	-13	-7	-2	-6

Classes (%):	< -25	-25 – -15	-15 – -5	-5 – 5	5 – 15	15 – 25	> 25

Conclusions (according to the model results)

1. the use of submerged drains will increase drainage and especially infiltration (which is the purpose). Discharge and water inlet will increase as well, but less due to buffering processes in the surface water. In the future climate, sufficient fresh water may become a problem.
2. peaks in surface water level during heavy showers will rise due to submerged drains, but only a few cm's. High groundwater tables will be lowered much (days) faster by drains which benefits the agricultural use of the fields. In the long term submerged drains may lower the risk of flooding because of maintaining downward seepage and a more level soil surface within a catchment (polder)
3. submerged drains will decrease loading of surface water with phosphorus, nitrogen and sulphate up to more then 25%. This counts for loads as well as leaching concentrations. Sulphate is the most vulnerable nutrient for submerged drains; especially in combination with low ditch water levels.

INFO: Rob Hendriks, Alterra - Wageningen Enivironmental Research, Sustainable Soil Use, Postbus 47, 6700 AA Wageningen , Tel: +31317486564, e-mail: rob.hendriks@wur.nl.
This research was partly funded by the EU projects RECARE (http://www.recare-project.eu/) and CAOS (http://www.caos-project.eu/)