

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

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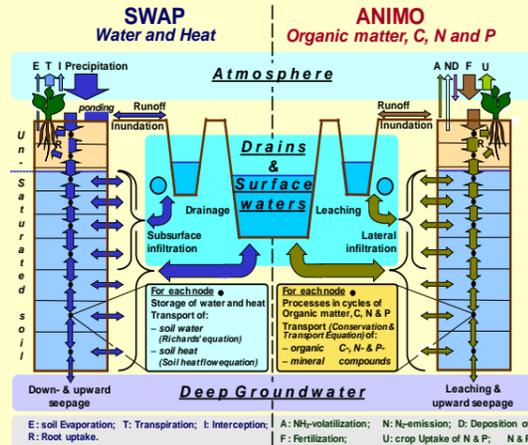
Introduction

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?

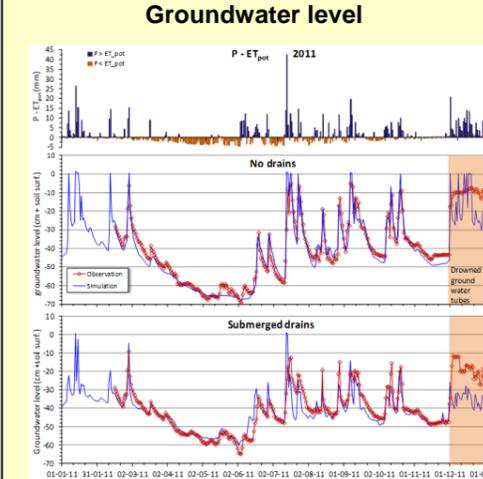
Most of these effects are not easy to assess and all of them are strongly depending on the meteorological conditions during (short) field studies. Therefore, a modelling study was conducted on the basis of results of several pilot studies on submerged drains carried out in the Western peat pasture area 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



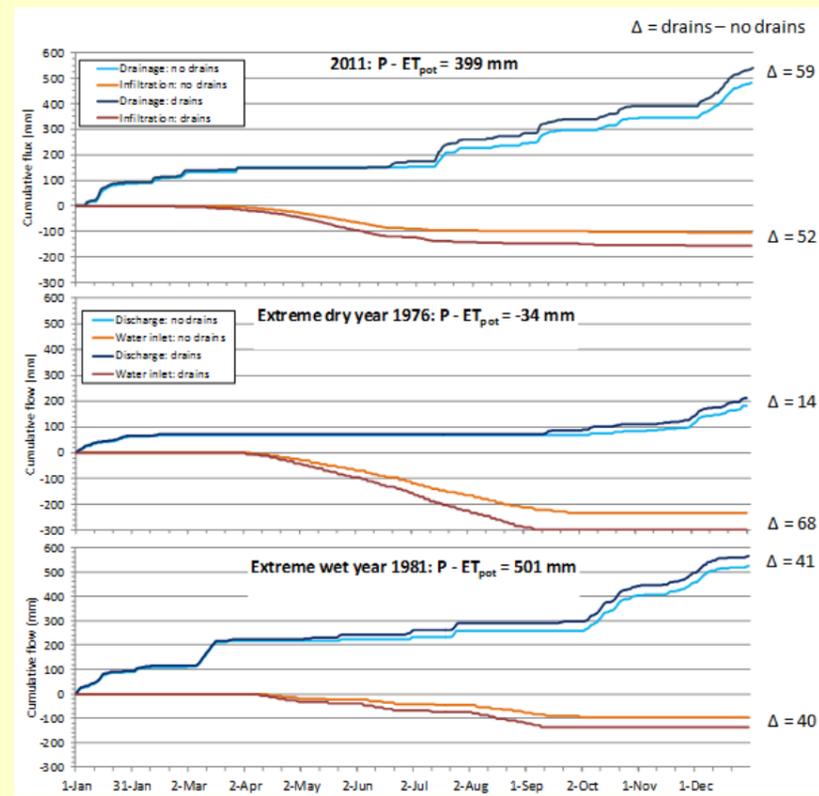
Root Mean Squared Error (RMSE) (incl. 2012)

No drains: 5.1 cm; Submerg. drains: 5.1 cm | No drains: 22 m³; Submerg. drains: 23 m³

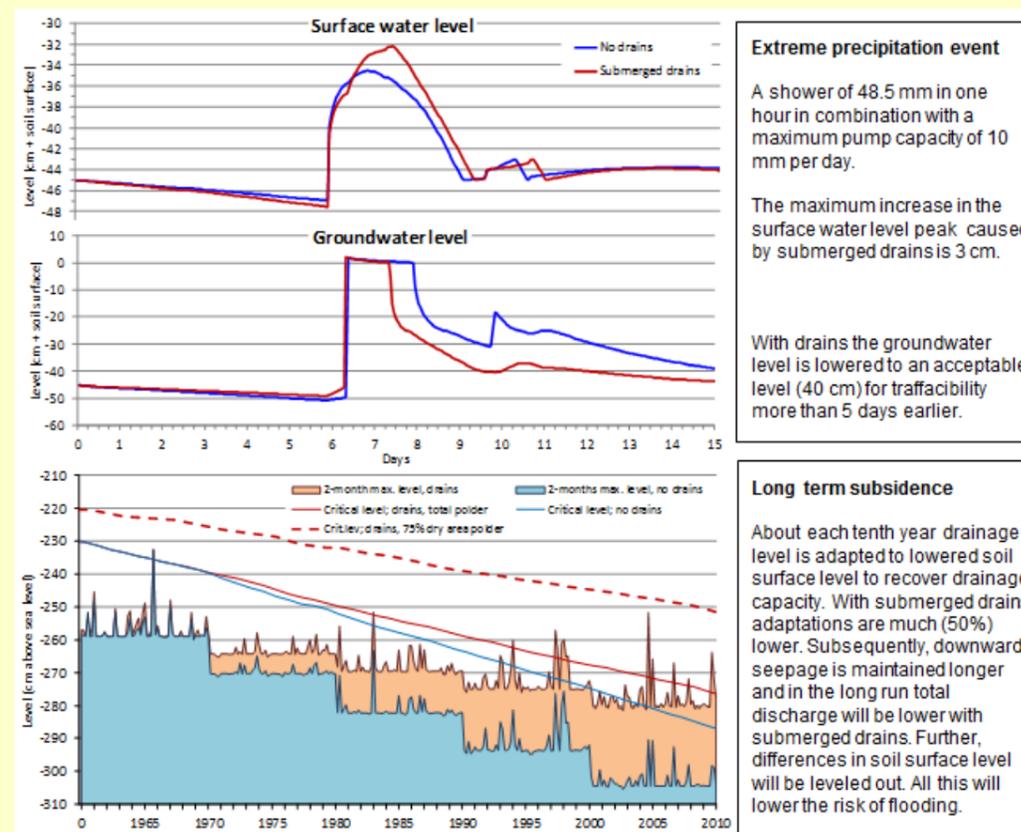
Results

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

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



Q2: effects on 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	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 than 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.