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USING THE DRENAFEM MODEL IN THE SIMULATION OF SUBSURFACE DRAINAGE IN BAIXO VOUGA BASIN

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1. INTRODUCTION

When dealing with subsurface drainage problems, analogue and mathematical models are used in order to determine the various design parameters of a subsurface drainage system, such as spacing and depth of drains. Analytical equations are commonly used, subject to restrictions and premises that are sometimes unrealistic to the problem under study.

In recent decades, due to the increasing computing power, computational solutions of the fundamental flow equations were generated from versatile numerical methods.

This study aims to simulate the behaviour of the phreatic surface in a specific drainage situation at the BVL's Pilot Polder, using the model DRENAFEM (Castanheira, 2006). The simulation is compared with data obtained in the Pilot Polder. The model determines the potential of pressure throughout the flow field, also identifying the position of the phreatic surface and flows leaving the system (drain flow, evapotranspiration).

2. MATERIALS AND METHODS

Measurements indicated that the behaviour of the drain was clearly not ideal, due to excessively high hydraulic head on its vertical plane. Sometimes the water table had become flat, a symptom of malfunction of the drain. The cause for the high water entrance resistance was likely to be the clogging of the drain orifices due to precipitated iron, and / or irregular slope of the drain. The option of installing a battery of piezometers in a single line would limit the study of the behaviour of the phreatic surface, since in that section the drain could be more clogged than elsewhere. Two more lines of piezometers were thus installed, as close to the drain and halfway between the drains as possible (Figure 1).

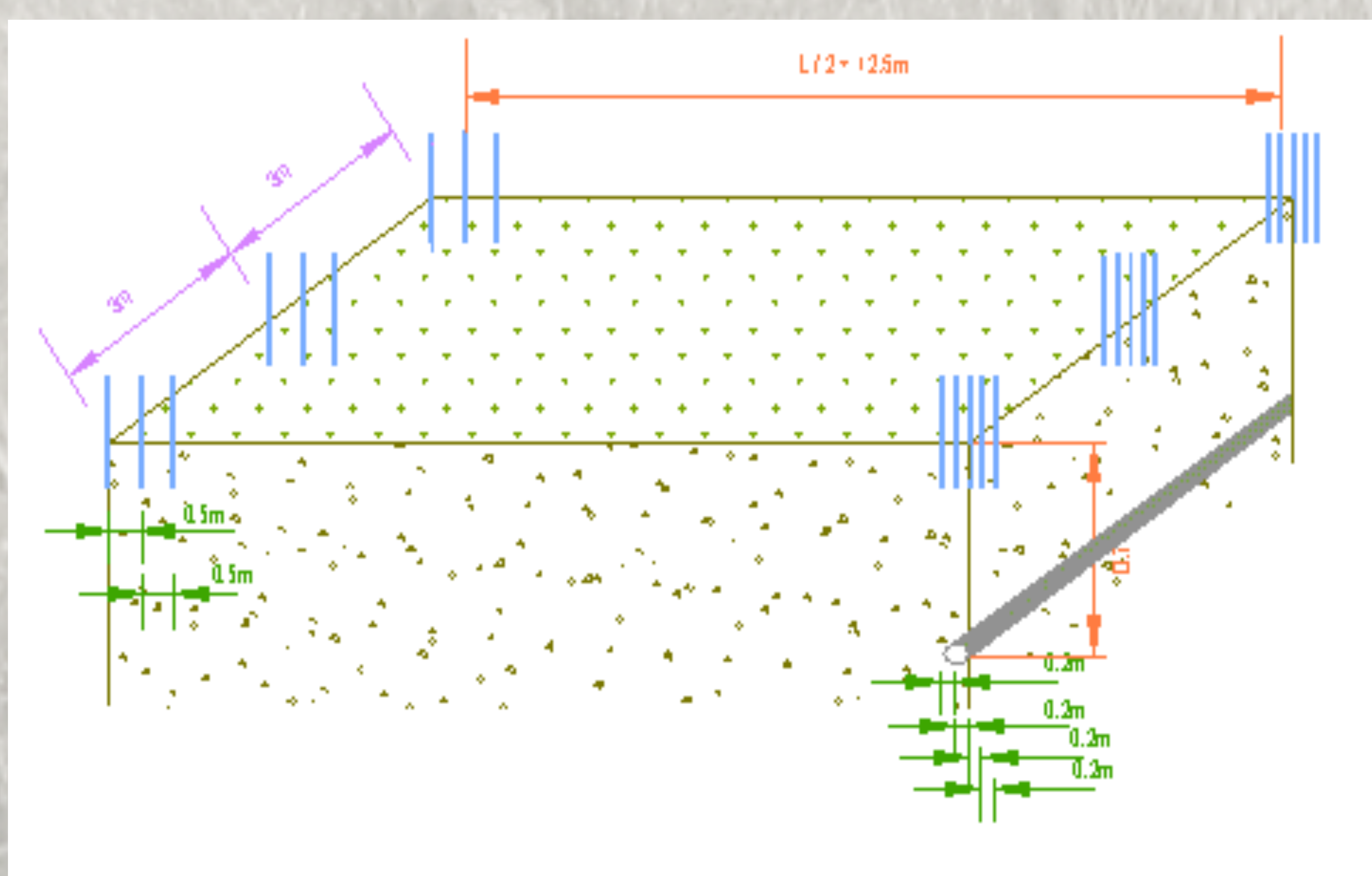

Figure 1 - Scheme of installation of piezometers in drainage plot 31

Measurements were taken of the flow and the hydraulic head during 38 consecutive days. Values of the hydraulic head midway between drains, above the horizontal plane of the drain (h_m), as well as the hydraulic head on the vertical plane of the drain (h_r) were determined, being q the specific flow in the drain (m day-1).Throughout the observation period, which ran in March and April 2003, the water table has never reached the ground surface, so the soil never got to be completely saturated along the profile. It was also observed that at the time of rise, especially following more intense precipitations, the water table is almost flat, increasing evidence of non-ideal behaviour of the drain. (Figure 2).

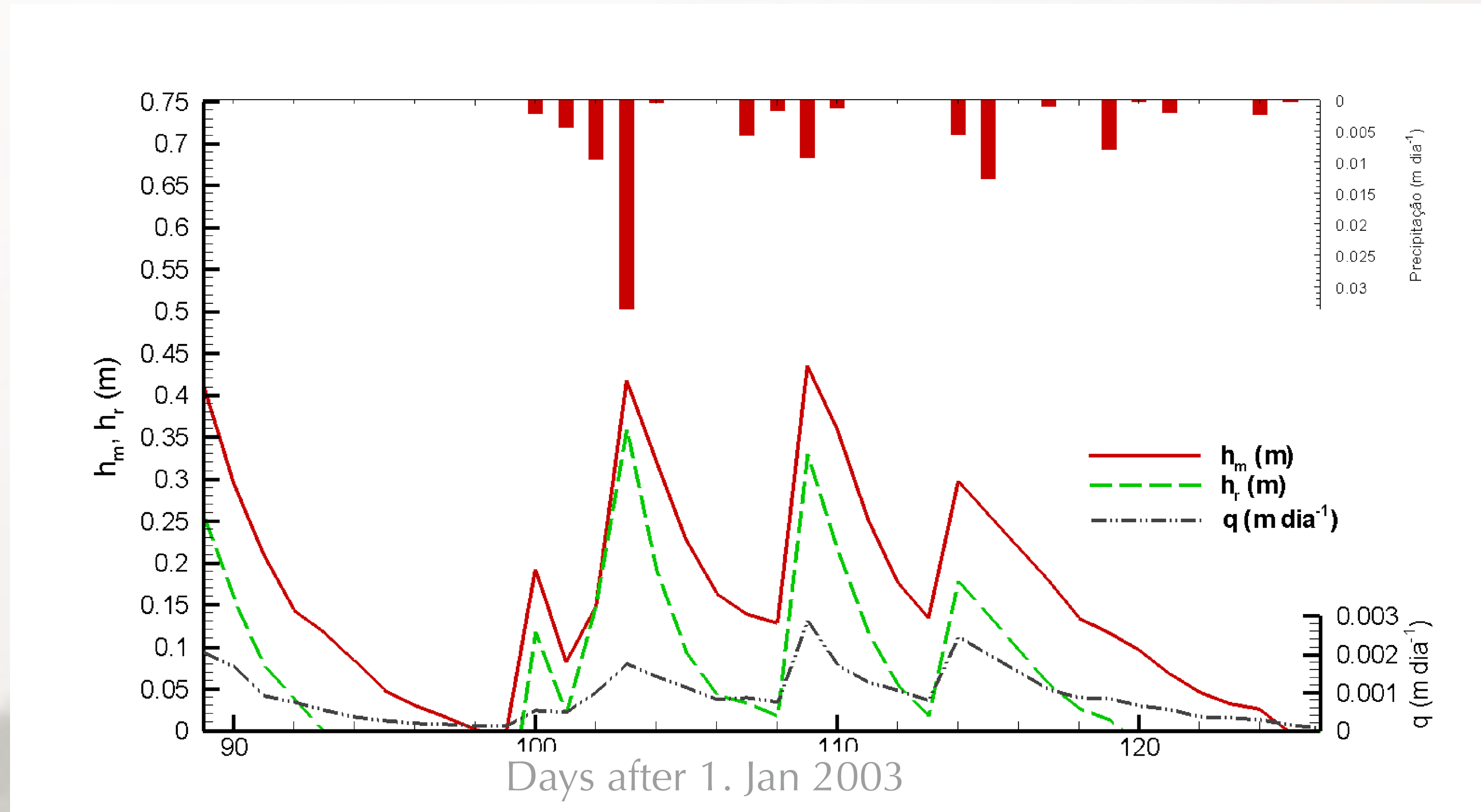

Figure 2 - Temporal evolution of h_m, h_r and specific flow rate

3. RESULTS AND DISCUSSION

The simulation of the water table behaviour midway between drains during 20 consecutive days in Baixo Vouga Lagunar, is represented in Figure 3. Although the simulated h_m values are lower than the ones observed *in loco*, they follow the trend of groundwater levels with consistency. The need to obtain fully reliable comparisons relates to the need to have the initial condition of the numerical model match the field observations, a situation somewhat difficult to achieve. The observed non-ideal drain behaviour also requires a prior calibration on the Vimoke factor, to better simulate the input resistance in the drain.

The simulation was started two days before, with infiltration values manually calibrated, so that at the beginning of the comparison, both the observed and simulated values were as close as possible. The fact alone that the Baixo Vouga Lagunar system is operating with non-ideal drains dramatically complicates the comparison, given the difficulty in simulating the entrance resistance. Improvement in the agreement between observed and simulated results can only be achieved through several trial and error calibration attempts, before a reliable calibration of the drain behaviour is achieved. After several attempts to simulate the drain non-ideal conditions, through the changing of the Vimoke factor, the result shown in Figure 3 was the best result achieved, mainly because the field data entered into the model showed great sensitivity to the changes in this factor, probably due to high anisotropy of K_s in the second layer of this soil.

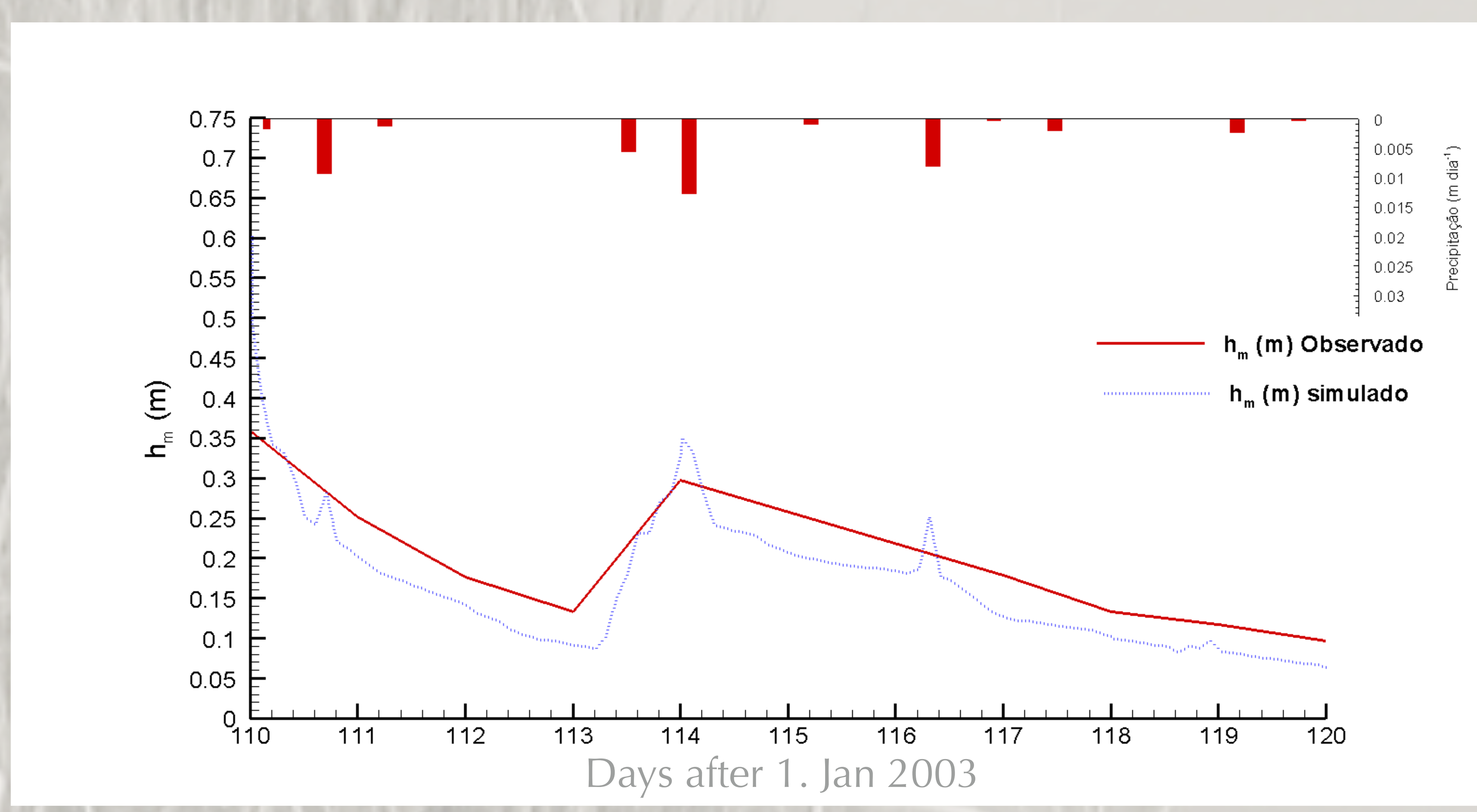

Figure 3 - Values of simulated and observed h_m

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