

## ***Interactive comment on “Modelling climate change effects on a Dutch coastal groundwater system using airborne Electro Magnetic measurements” by M. Faneca Sánchez et al.***

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Comment referee

Detailed comments -section 2.3.3: -This section describes how the geological model is constructed instead of discussing the hydraulic conductivity field, although both are of course highly related. How was the conversion done from geology the Kh and Kv? I have the impression that a conversion table is used: lithology x is assigned values x1 and x2 for Kh and Kv, lithology y values y1 and y2, etc. Is this the case? Where do the values of Kh and Kv originate from? What about implementation of field data

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in the form of aquifer tests? - The last part of the modeled time is transient. How where values for specific elastic storage and specific yield (or storage coefficient near the water table) assigned? -fig8: What is shown on this figure? Is it the complete dataset where values of FFa and t where available (both sand and clay cases) or only for clay cases? It seems to me that too few data points are present based on the description of available data given on p 6141 and 6142. -p6149: -A lot of effort is put in the creation of an initial Cl field and it turned out that the autonomic evolution of the model with this Cl field is judged too large considering the current boundary conditions. Can the authors comment on the reasons for that: uncertainty because interference of clay in the translation of bulk resistivity to Cl, uncertainty in boundary conditions, other reasons, ... - Now the model is run for 15 years to obtain an initial, current day, Cl distribution. After these 15 years, “numerical inaccuracies” and “irregularities” are stated to be eliminated. This is clearly based on expert judgment. Obtaining the initial (current) Cl distribution is a crucial steps in the modeling. So what do the authors see as next steps forward to decrease the uncertainty on the initial Cl distribution: more direct measurements of Cl, still better interpretation methods of geophysics, higher degree of hard data in the interpretation of geophysics, ...? The authors mention this in the conclusions but perhaps this can be discussed a bit more. - section 3.1, figure 14-17. It was state earlier that the first 95 years were calculated steady state with a stress period of 1 year. So, how do you get a summer and winter calculation here? - p6155: What is PZH?

Reply:

Section 2.3.3 Q1: Indeed, the geological model is constructed first, starting with the information from boreholes, results from a previous study about the position and thickness of the glacial till and general geological knowledge of the area. The Holocene sequence is modeled with an stochastic technique, while the Pleistocene units are taken from the existing Regis model.

From lithology to kh/kv is carried out by a table, relating the kh and kv to the geological

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Formation and lithology class (clay, sandy clay, fine sand etc.) The original values are collected in the past from a wide range of sources: lab-tests, field tests (pumping tests), etc. A table of the kh/kv data will be presented in the paper. The data collection for the kh/kv is carried out for the entire The Netherlands for every combination of Formation – lithology class. This assumes that the data for a specific combination of Formation – lithology class is applicable for the entire country, regardless of the geographical location the data was collected. Although this is a rather bold assumption, it gives the opportunity to have data on kh/kv for every area in which the geological Formation and the lithology class is known. The data on the geology / lithology is much more abundant than data on kh/kv.

Because of the saline groundwater, there are no pumping tests available in the area, since there was always little interest in the aquifer properties for drinking water purposes.

Q2: The values for the specific storage was 0.15 in the first modeled layer and 0.0001 for the other layers

Figure 8 Figure 8 shows the entire dataset for which total resistivity, resistivity of the groundwater and lithology is known. This is a rather limited dataset, consisting of data from the ECPTs and some wells in which both the resistivity of the groundwater and a logging was carried out. A lot of wells in the area have been measured for groundwater quality (a.o. CL) but no resistivity was measured. It is data from the first 2 data sources mentioned on page 6142, with the first data source containing only a small number of wells with resistivity data measured.

P6149 Q1: Reasons for the CL field not in balance are (a.o.) the fact that the distinction between sandy and clay sediments is set at a kv of 0.05 m/d. This filters out the small scale variability, that might have influenced the airborne resistivity measurements, that were used in deriving the CL-field. Also the model is 100x100m gridcell size with a varying thickness, causing loss of detail.

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Q2: We will discuss it more in the conclusions. It is correct that one of the options is to have more data, collected either by geophysics or groundwater samples. Another option is to make a deeper analysis of the changes in the different geohydrological areas. This would still be based on expert judgment but would give more security in choosing the initial field

Section 3.1 figure 14-17 The first 95 years were simulated indeed with year stress periods, meaning that there was no summer and winter. After 95 years, the average yearly situation was used for the last years when summer and winter were simulated in a non-steady way.

Page 6155 PZH is the Province Zuid Holland model, we will write all the words

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