Hydrol. Earth Syst. Sci. Discuss., 9, C1440–C1442, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C1440/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Numerical modelling of climate change impacts on freshwater lenses on the North Sea Island of Borkum" *by* H. Sulzbacher et al.

Anonymous Referee #2

Received and published: 14 May 2012

General comments

In this paper, a comprehensive description of an extensive hydrological, geophysical and geological dataset of the island of Borkum is presented. This dataset is used for the construction of a hydrogeological model and the calibration of a numerical groundwater flow model. The numerical model is used for the quantification of future scenarios.

I appreciate the 'holistic' approach of this study, and the fact that it has clear added values for society. In my opinion, this study is certainly suited for publication. However, I do have some comments that might improve the paper.

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Interactive Discussion
Discussion Paper

Although the description of the hydrological, geological and geophysical data and model calibration is extensive, the description of the numerical model has been given relatively little attention. This model is however important, as it is used for the quantification of future scenarios. Moreover, the title of this paper suggests that numerical modelling is a core focus of the paper. I therefore suggest to expand the description of the numerical model (see also below). As a result, the paper might become too extensive. My other general remark is therefore to reduce the description of (geophysical) dataset and calibration procedure, or change the scope and title of the paper.

In order to improve the structure of the paper and hence, enhance its readability, define some specific objectives in the introduction of the paper. Then, in chapters 3, 4 and 5, try to reduce the amount of words by only mentioning the things that are relevant for these specific objectives.

Specific comments

p. 3478, line 12. Abbreviate like: mean sea level (m.s.l.), not the other way around.

p. 3485, line 22-24. What kind of numerical model did you use? Can you elucidate this a bit more?

p. 3486, line 15-18. Can you elucidate why the numerical model is almost three times as large as the island of Borkum itself? What is the relationship with the (offshore) boundary conditions that have been adopted here?

p. 3486. Last two lines and p. 3487, first two lines. I don't understand what you mean with: 'a specified mass boundary condition at the surface nodes of the groundwater table'. Shouldn't this be: A specified flux boundary condition with an assigned (constant) concentration? And why didn't you apply a specified flux?

p. 3487, line 6-10. I would merge these two paragraphs.

p. 3488, line 10. The units of the hydraulic conductivity are missing.

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9, C1440–C1442, 2012

Specific comment on the section 4.2 A particular problem in using finite element codes to simulate density dependent groundwater flow and solute transport is the numerical dispersion that is introduced when the element size becomes larger then about 4 times the dispersion length. Typical dispersion lengths are normally no more then 1 meter in relatively homogeneous aquifers. How did you deal with this (i.e., what dispersion length did you use and what is the maximum element size?)

Caption Figure 3: Include the meaning of the dotted line.

Caption Figure 4: Omit abbreviation of electrical conductivity (ec).

Figure 5: in the upper right picture, 'L29.1' is missing.

Caption Figure 5: second line, after 'bottom panel': cross sectional view along transects T13.9 and L 29.1.

Caption Figure 6: Instead of 'surface of the groundwater table', use 'phreatic surface' or 'water table'. Moreover: line 4: 'at the surface' instead of 'at surface'.

Figure 9: I would omit the left panel of the figure, it does not have an added value. 3510

Caption Figure 10: Please reformulate this caption

Caption Figure 17: Please omit 'altitude'.

Technical comments (typing errors)

Page 3486, line 15. I would use 'code' instead of 'programme'.

Page 3486, line 26. 35000 mg/l instead of 3500.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 3473, 2012.