Hydrol. Earth Syst. Sci. Discuss., 11, C4986–C4989, 2014
www.hydrol-earth-syst-sci-discuss.net/11/C4986/2014/

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "From days to decades: numerical modeling of freshwater lens response to climate change stressors on small islands" *by* S. Holding and D. M. Allen

Anonymous Referee #1

Received and published: 10 November 2014

This is an interesting paper that aims to identify critical factors and stressors that may affect freshwater lenses on Andros Island and other small, low-lying islands of a similar hydrogeological setting. Specifically, the paper explores the impact of storm surge over-wash, sea-level rise and recharge change using the density dependent numerical groundwater modeling codes HydroGeoSphere and SEAWAT. A physically based soil drainage model (HELP) is used to estimate recharge under current conditions and future climate change scenarios.

The paper is very well written. The study site is described in sufficient detail as is the development of the models. The work is technically sound and, for the most part,

achieves the objective. Clarification is required in areas outlined below.

Specific comments:

11440L6 HydroGeoSphere was used to account for unsaturated zone processes, as opposed to differences in spatial or temporal scale. Please modify the sentence starting with 'To account for. . .'.

11440L14 If space permits, please add that a flux-controlled conceptualisation applies to the Andros Islands, which limits the impact of sea-level rise. Also, to clarify the sentence about response times, a statement could be added about lens response times increasing as sea-level rise and recharge change increased. The method of implementing the changes (i.e., incremental instantaneous shifts) could also be noted.

11448L8 What value of specific yield and porosity were applied? Table 1 lists only the specific storage. Were the model layers set as unconfined or confined? The response times will be highly dependent on the storage parameters, and the freshwater volume will be proportional to the porosity, so it is important to list these and comment on the accuracy and possible range of these values.

11449L11 Please also list the maximum and minimum recharge values predicted by HELP and the months in which these occurred.

11449L16 The wellfields are not included in the model being used explore the impact of sea-level rise and recharge change. From Figure 1 there are numerous trench wellfields along the east of the island and close to the coast. Please discuss the likely impact of not including the wellfield on the analysis of sea-level rise and recharge change. Do the wellfields impact on the ability of the water levels to rise in the aquifer (i.e., because the water in the trenches evaporates or is extracted)? If so, head-controlled conditions may occur in these areas, which will increase the impacts of sea-level rise compared to the flux-controlled conceptualisation used in the model.

11450L14 Please list the new recharge values including maximum and minimum values

HESSD

11, C4986–C4989, 2014

and months they occurred in.

11450L19 What was the average loss of land surface, especially along the east coast where the wellfields and settlements are located?

11451L4 Please replace incremental shifts with incremental instantaneous shifts, or similar.

11451L22 The use of GIS analysis to calculate lens area and volume is a nice approach. The resulting figures are very nice. Please add details of whether the aquifer porosity was included in the volume calculations.

11455L4 'Most" implies that some did not, please clarify.

11457L5 A thin lens is not present throughout most of the domain because Figure 5 shows that the lens is thick in areas. Please rephrase this sentence.

11457L12 Is the given volume the volume of aquifer or the volume of freshwater? Please clarify.

11459L9 Please add the change in volume associated with recharge change and sea-level rise for the north island.

11460L9 Table 3 does not contain calibration criteria, rather model parameters, please amend.

11461L19 Please explain the cause of the temporary rise in relative concentration, most clearly shown for Drain Day 1 in Figure 10.

11463L12 It should be stated somewhere in this paragraph that land surface inundation was not considered in the analysis. The results may well be different if it were, and so it is important to be explicit about this.

11464L20 It is interesting that the lens have a larger response time as the magnitude of sea-level rise and recharge change increased. Is there a physical explanation for this?

HESSD

11, C4986–C4989, 2014

Does the work of Stoeckl and Houben (2013) offer further insight, at least for recharge change?

11466L1 What element of the analysis forms the basis for conclusion 1?

11466L8 Please rephrase as 'Reduction in groundwater recharge to Andros Island is identified. . .'. The analysis shows that it produces more impact than sea-level rise on Andros Island but this may not be the case elsewhere, for example on islands that are topographically limited and where sea-level rise causes large land surface inundation.

Technical comments

11467L15 Behzad, A. A. needs to be replaced with Ataie Ashtiani, B.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 11439, 2014.