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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Groundwater mean residence time of a sub-tropical barrier sand island" *by* Harald Hofmann et al.

Anonymous Referee #1

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General comments

The paper nicely shows how environmental tracers provide information on groundwater ages and on the functioning of groundwater systems. The issue addressed in this paper – hydrogeology of sand barrier islands – is of global relevance. Presented results contribute to the understanding of this important groundwater resource and its sustainability under conditions of population growth and climate change.

The paper is well written and structured. The background, environmental context and purpose of this work are clearly explained, followed by a well-balanced and comprehensive presentation of the tracer and modeling approaches. The data and modeling results are presented in a clear manner.

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Discussion paper

A question arises, however, what is the main contribution of this work? The discussion and conclusions sections highlight two results of the tracer exercise: (i) spatial distribution of groundwater ages identifies groundwater flow paths, (ii) low permeability units are responsible for long MRTs.

Ad (i). It is not surprising that the distribution of MRTs conforms the presumed picture of a "groundwater mound" with uniform recharge and dominant unconfined flows perpendicular to island's axis simply because the LPM was selected accordingly. What is an added value coming from the application of tracers? Furthermore, in my opinion the dependence of tritium concentrations on the distance from island's centre and bore depth as shown in Fig. 5 is not obvious. There is a lot of scatter in these data. Could this scatter and other discrepancies in MRT results be due to a more complex than assumed structure of groundwater flow? The authors mention "minor" longitudinal flows due to the complex topography not discussing this question further. This is understandable as the study is based on one transect only, which might be its main shortcoming. If the topography is complex, then could the longitudinal flows occur? For example, do the dunes have any dominant orientation (due to prevailing wind conditions in the past), or is the island's relief completely irregular?

Ad (ii). The only direct evidence for that comes from a comparison of MRTs in two bores. How relevant is this finding to the overall flow patterns? Again, how widespread are peat deposits along the island? Are they continuous or patchy?

Unfortunately the conclusions section lacks the clarity and accuracy of earlier sections. The contribution and added value of the paper should be more clearly expressed.

Specific comments

Given some ambiguity in the understanding of terms "residence time" and "transit time" it is advisable not to use them interchangeably.

Lines 83-90. A more detailed description of topography (with a picture showing the

landscape?) will help to comprehend the natural setting – see the general comments. Is the vegetation cover of dunes continuous?

Lines 92-93. How do precipitation and evapotranspiration vary seasonally?

Figure 4. Some of groundwater samples seem to be affected by evaporation. Could the low d-excess waters indicate recharge from wetlands? On the other hand, two samples have very high d-excess values. Do the stable isotopes have in this case any potential as indicators of recharge areas and flow paths?

Line 261. The decrease of tritium activities with distance from centre is obvious for the first 2500 m only – see general comments.

Lines 230-1. What is a possible source of carbonate in this presumably carbonate-free geological setting? Are there any secondary carbonate deposits associated with paleosoils? If not, does the bedrock contain any carbonate? In the latter case, higher carbonate dissolution is related to groundwater contact with the bedrock or groundwater discharge from the basement.

Line 325. What is the actual carbon isotopic signature of soil DIC and how was it derived?

Technical comments

Figure 5.A is not mentioned in text.

Line 267. Test hole or testhole?

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