

Interactive comment on “Estimation of future groundwater recharge using climatic analogues and Hydrus-1D” by B. Leterme et al.

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This paper describes a case study of future groundwater recharge in which analogue sites are used for projecting the future climate for a site in Belgium. The paper is well written and well organized but I do have a couple of concerns that need to be addressed before this is submitted. The IPCC's general projections are for an increase in rainfall for the next century but only one of the considered analogue sites has an increase in rainfall, I would suggest that a greater range of analogue sites needs to be considered to at least sample the range of projected climates that are generated from the various GCMs. The vegetation cover is assumed to be static with an LAI of 2 for every climate considered; it is more realistic to think that there is a feedback between a change in climate and a change in LAI.

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P1390,L11 – The selection of a single analogue site for further modeling seems overly certain for a very uncertain future.

P1392,L19 – 25 years of climate data is very short to produce a baseline. WMO recommend at least 30.

P1392,L19 – north rather than northern

P1393,L19 – Was any consideration given to analogue sites that have higher daily rainfall intensities? The IPCC's general projections are for an increase in rainfall intensity and also for an increase in daily extreme rainfall. Changes in rainfall intensity can have an influence over recharge (Barron et al. 2011; Crosbie et al. 2012).

P1395,L5 – I think the vegetation needs to be looked at in more detail. Assuming a uniform grass cover with a 30 cm rooting depth may be appropriate for what is on the site now, but in 1000 years time can you be certain that it will remain the same? Changes in vegetation can produce bigger changes in recharge than a change in climate (Crosbie et al. 2010a; Crosbie et al. 2010b)

P1395,L8 – If there is a possibility that indurated layers may develop within the soil profile within the time period under consideration, then couldn't a simulation be run to see if it affects recharge?

P1396,L20 – The depth to groundwater at which the water table influences ET is also dependent upon soils and vegetation. In a coarse textured soil with shallow rooted vegetation the calculated depth of 2.8 m may be enough that ET is independent of the depth to groundwater, see (Peck 1978)

P1398,L16 – If the IPCC's general projection for northern Europe is for a 9% increase in rainfall, then why is the most extreme case considered only a 5% increase in rainfall? Some GCMs project more than 9% increase in rainfall by 2100 and looking ahead 1000 years is even more uncertain, I think a more extreme case needs to be considered.

P1399,L6 – Dessel is the baseline not an analogue

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P1402,L4 – The assumption that LAI will not change is very simplistic especially as the range of climatic inputs range from a 2/3 reduction in P to a doubling of ET0. It has been shown that changes in climate variables can have a large effect on LAI and consequently recharge independent of any changes in rainfall (McCallum et al. 2010).

P1402,L4 – How was the interception capacity of 55 mm determined? This seems extremely high for an LAI of 2. Using the FAO-56 definition of ET0 as being a grass of uniform height of 0.12 m, then the grass is half underwater before any water in the model reaches the soil. If this parameter was determined via calibration, is there the possibility that it is compensating for something else within the model?

Table 1 – Why does Nuuk have 2 elevations?

Table 3 – Of the 8 analogue sites considered only 1 has an increase in rainfall even though the IPCC's general projections are for an increase in rainfall for northern Europe. Why were more sites with an increase in rainfall not considered?

Table 3 – The 3 sites with Cs climate have a lower percentage of interception than Dessel even though ET0 is higher and P is lower. Is this to do with daily rainfall intensity; are there fewer rain days but more rain per rain day?

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