

PhD studies

Joost Delsman (2015) Saline groundwater – surface water interaction in coastal lowlands, VU University Amsterdam, 194 pp.



Hydrological processes and physiographic factors that affect this are not fully understood. The research presented in this thesis aims to identify the processes and physiographic factors controlling the spatial variability and temporal dynamics of the exfiltration of saline groundwater to surface water, and hence the contribution of saline groundwater to surface water salinity. Topics covered include a paleo-hydrogeological model simulation of the Holocene evolution of groundwater salinity as a result of paleo-geographic changes; surface water salinity dynamics in a densely-drained lowland catchment; hydrograph separation in an agricultural catchment; observations of heads, flow, solute concentration and temperature to constrain a detailed, variable-density groundwater flow and transport model; and a model to simulate the salinity dynamics of exfiltrating groundwater to support operational water management of freshwater resources in coastal lowlands. The thesis further outlines the implications of these findings for freshwater management in the Netherlands. It demonstrates that the salinity of groundwater exfiltrating in polders in the Netherlands, and hence surface water salinity, varies on a wide range of spatial and temporal scales. Download [here](#)

Articles Joost

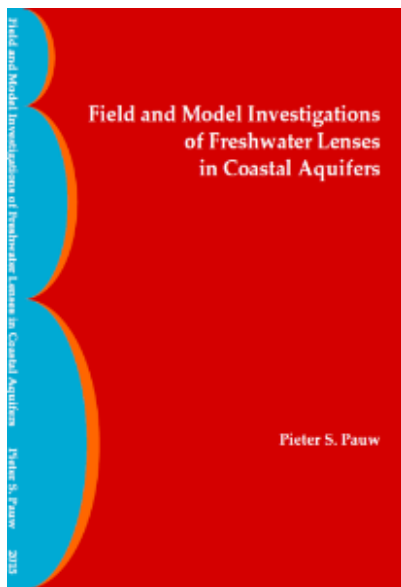
Delsman, J.R., Waterloo, M.J., Groen, M.M.A. Groen, J., Stuyfzand, P.J. 2014 Investigating summer flow paths in a Dutch agricultural field using high frequency direct measurements, *J. Hydrology*, doi: [10.1016/j.jhydrol.2014.10.058](https://doi.org/10.1016/j.jhydrol.2014.10.058)

De Lange, W.J., Prinsen, G.F., Hoogewoud, J.C., Veldhuizen, A., Verkaik, J., Oude Essink, G.H.P., van Walsum, P.E.V., Delsman, J.R., Hunink, J.C., Massop, H.T.L., Kroon, T., 2014. An operational, multi-scale, multi-model system for consensus-based, integrated water management and policy analysis: The Netherlands Hydrological Instrument. *Environmental Modelling & Software* 59, 98–108, doi: [10.1016/j.envsoft.2014.05.009](https://doi.org/10.1016/j.envsoft.2014.05.009)
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Delsman, J.R., Hu-a-ng, K.R.M., Vos, P.C., de Louw, P.G.B., Oude Essink, G.H.P., Stuyfzand, P.J., & Bierkens, M.F.P. 2014. Paleo-modeling of coastal saltwater intrusion during the Holocene: an application to the Netherlands. *Hydrology and Earth System Sciences*, 18(10), 3891–3905, doi: [10.5194/hess-18-3891-2014](https://doi.org/10.5194/hess-18-3891-2014)
[link to paper](#) [link to animation](#)

Delsman, J.R., Oude Essink, G.H.P., Beven, K.J., Stuyfzand, P.J. 2013. Uncertainty estimation of end-member mixing using generalized likelihood uncertainty estimation (GLUE), applied in a lowland catchment, *Water Resour. Res.*, 49, 4792–4806, doi: [10.1002/wrcr.20341](https://doi.org/10.1002/wrcr.20341).
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Pieter Pauw (2015) Field and model investigations of freshwater lenses in coastal aquifers, Wageningen University, 168 pp.



Freshwater lenses are convex bodies of fresh groundwater that are underlain by groundwater with a significant higher salinity. In coastal areas, freshwater lenses are of vital importance for ecosystems and freshwater supply. A major problem of sustaining freshwater supply from freshwater lens is saltwater intrusion, i.e., the invasion of saline groundwater into a fresh groundwater body. In many coastal areas saltwater intrusion has led to well closure and reduced freshwater supply. Furthermore, in the future saltwater intrusion is expected to increase due to sea level rise, climate change, land subsidence, and increasing population density in coastal areas. In the Netherlands, these stresses will also have a severe impact on the fresh coastal groundwater reserves. In view of this, a research project aimed at (1) Improving the insight into the modeling of freshwater lenses and (2) defining measures to increase freshwater supply from freshwater lenses. Download [here](#).

Articles Pieter:

Pauw, P.S., Van Baaren, E.S., Visser, M. De Louw, P.G.B., Oude Essink, G.H.P., 2015, Increasing a freshwater lens below a creek ridge using a controlled artificial recharge and drainage system: a case study in the Netherlands, *Hydrogeology Journal*. doi: [10.1007/s10040-015-1264-z](https://doi.org/10.1007/s10040-015-1264-z)
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Pauw, P.S., van der Zee, S.E.A.T.M., Leijnse, A., Delsman, J.R., De Louw, P.G.B., de Lange, W.J., Oude Essink, G.H.P. 2014. Low-Resolution Modeling of Dense Drainage Networks in Confining Layers, *Ground water*, 1-11, doi: [10.1111/gwat.12273](https://doi.org/10.1111/gwat.12273)

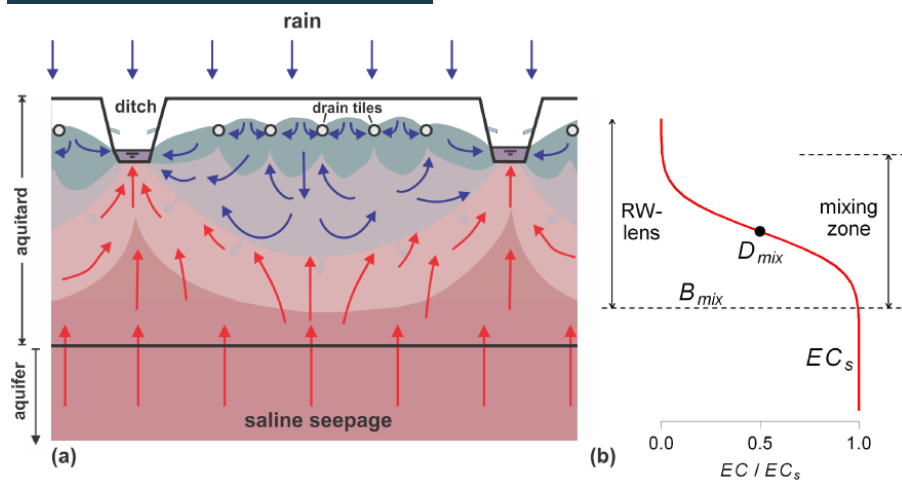
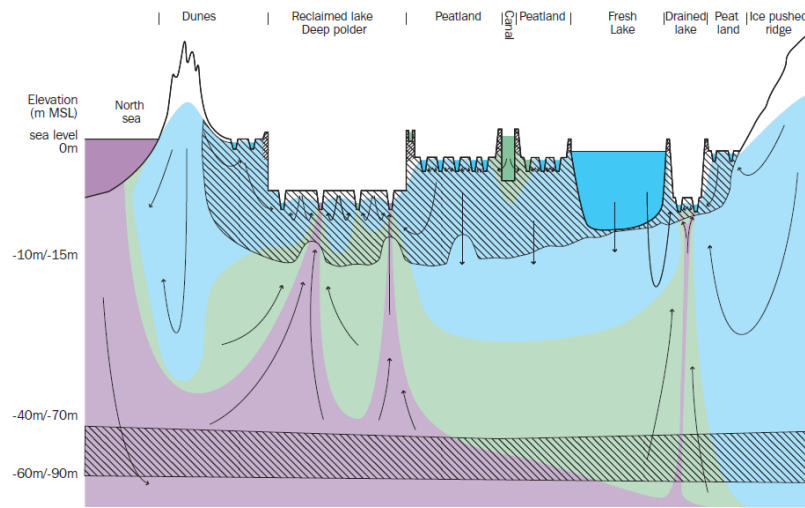
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Perry de Louw (2013) Saline seepage in deltaic areas

Preferential groundwater discharge through boils and interactions between thin rainwater lenses and upward saline seepage

[PhD-thesis_Saline-seepage_DeLouw2013.pdf](#)



1. De Louw, P.G.B., Eeman, S., Oude Essink, G.H.P., Vermue, E., Post, V.E.A. 2013. Rainwater lens dynamics and mixing between infiltrating rainwater and upward saline groundwater seepage beneath a tile-drained agricultural field. *J. Hydrology*, 501, 133-145. <http://dx.doi.org/10.1016/j.jhydrol.2013.07.026>
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2. De Louw, P.G.B., Vandenbohede, A., Werner, A.D., Oude Essink, G.H.P. 2013. Natural saltwater upconing by preferential groundwater discharge through boils. *J. Hydrol.*, <http://dx.doi.org/10.1016/j.jhydrol.2013.03.025>.
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3. De Louw, P.G.B., Eeman, S., Siemon, B., Voortman, B.R., Gunnink, J., van Baaren, E.S., and Oude Essink, G.H.P., 2011, Shallow rainwater lenses in deltaic areas with saline seepage, *Hydrol. Earth Syst. Sci.*, 15, 3659-3678.
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4. De Louw, P.G.B., van der Velde, Y., and van der Zee, S.E.A.T.M. 2011. Quantifying water and salt fluxes in a lowland polder catchment dominated by boil seepage: a probabilistic end-member mixing approach, *Hydrol. Earth Syst. Sci.*, 15, 2101-2117
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5. De Louw, P.G.B., Oude Essink, G.H.P., Stuyfzand, P.J., Zee, van der, S.E.A.T.M., 2010, Upward groundwater flow in boils as the dominant mechanism of salinization in deep polders, The Netherlands, *J. Hydrol.* 394, 494-506.
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