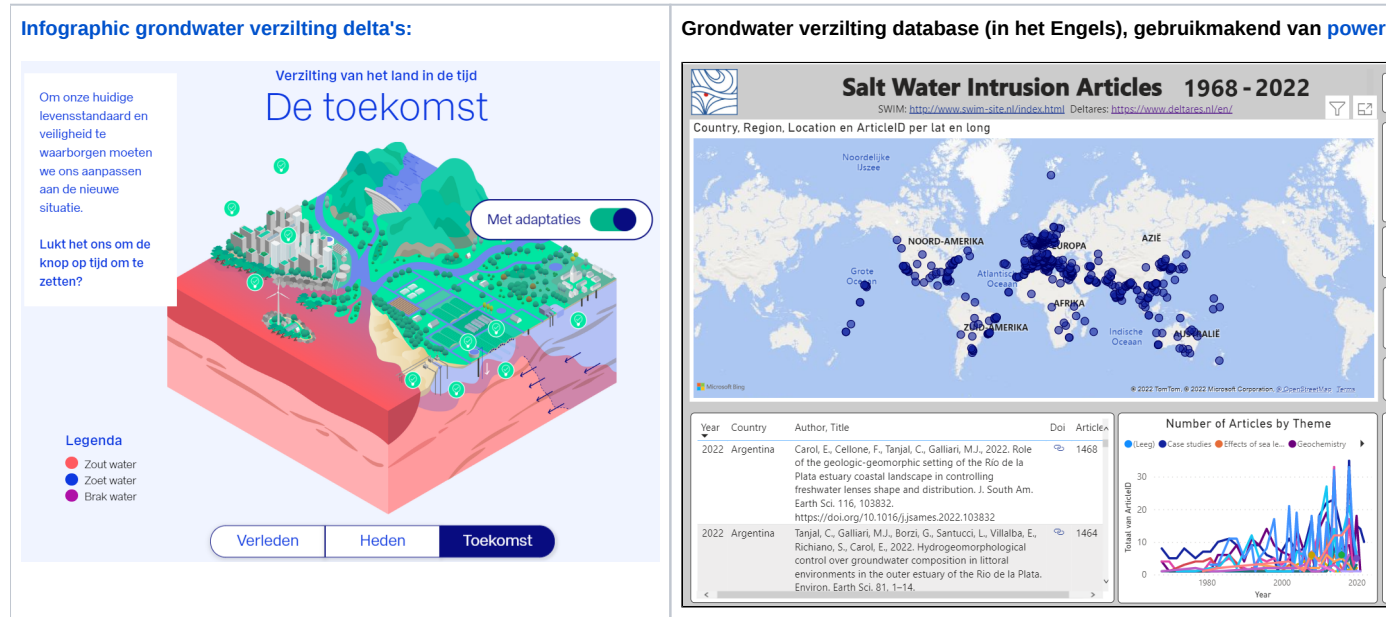


Home

Over zoet-zout grondwater in het kustgebied

<http://zoetzout.deltares.nl/>

NIEUW



Inleiding

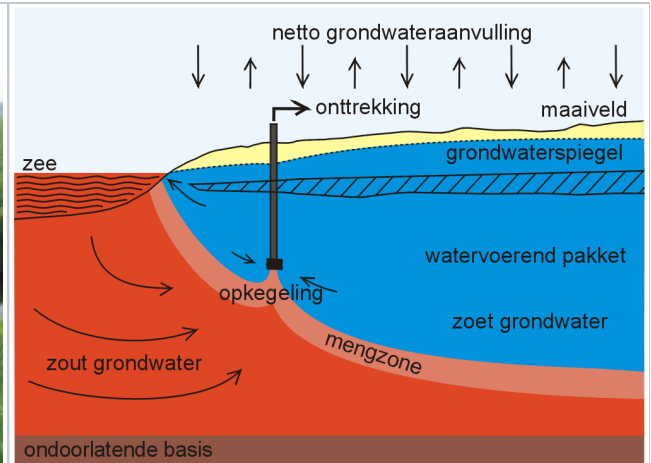
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- [Project Vietnam: Fresh water availability in the Mekong](#)
- [FRESHEM Zeeland](#) (3D kartering zoet-brak-zout grondwater verdeling provincie Zeeland): alle Helikopter Elektromagnetic (HEM) metingen
- Bijna alle Salt Water Intrusion Meeting proceedings van de afgelopen 45 jaar zijn beschikbaar op swim-site.org
- [leaflet fresh-saline groundwater Deltares online available](#)

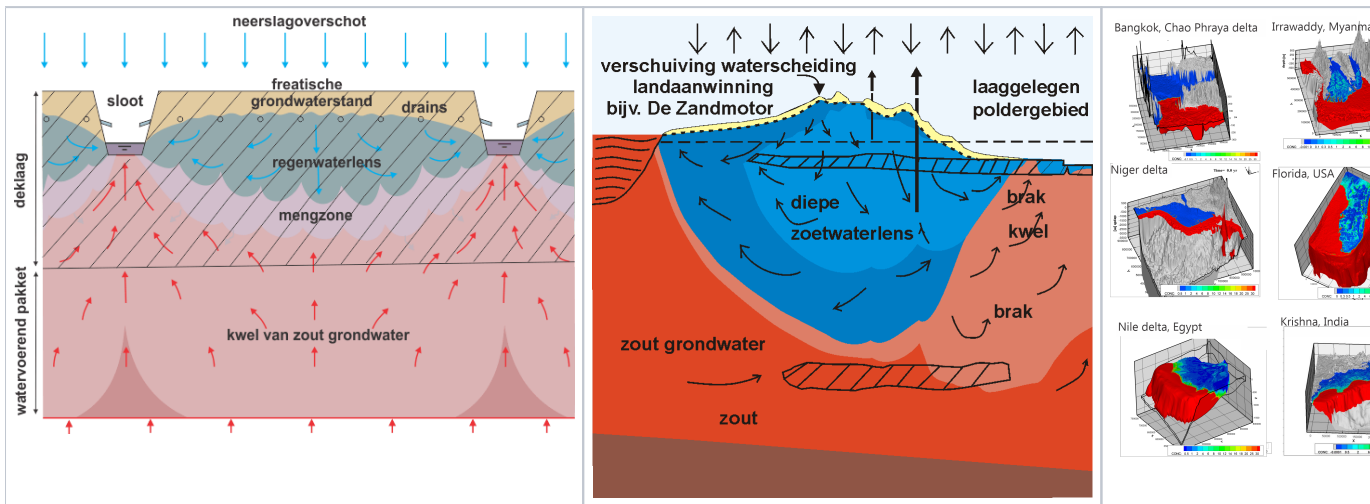


Inleiding

Wereldwijd is het grondwater in het kustgebied op veel plaatsen brak tot zout. Dit grondwater is waarschijnlijk zeewater dat honderden tot duizenden jaren geleden in de ondergrond is achtergebleven toen de zee zich na transgressies telkens terugtrok. Door ontwatering via drainage van de bodem en waterpeil verlagen stroomt brak tot zout grondwater langzaam naar de oppervlakte, leidend tot verzilting.



Verzilting	Regionale en lokale processen	Een brede benadering van verziltingsproblematiek
Dit verziltingsproces wordt versneld door zeespiegelstijging, verandering in het klimaat (waaronder drogere zomers), de verdergaande bodemdaling en menselijke invloeden als grondwateronttrekkingen. Het zoutwater wordt van het ondiepe grondwater naar de oppervlakte getrokken, dat met aangevoerd zoet water moet worden 'zoet gespoeld'. De meeste landbouwgewassen kunnen niet tegen zout water, waardoor er schade optreedt als het zoute grondwater tot in de wortelzone reikt. Wanneer er geen maatregelen worden genomen, zullen deze problemen in de toekomst op verschillende locaties in het kustgebied toenemen.	Onderzoek dat bij Deltares wordt uitgevoerd richt zich op zowel de regionale als lokale schaal en is zowel toegepast als meer fundamenteel. Op regionale schaal speelt de langjarige verandering in zoutconcentraties in het grondwatersysteem als gevolg van veranderingen in het klimaat, zeespiegelstijging of voorgenomen herinrichtingsmaatregelen. Belangrijke vraag is ook hoe deze verandering de zoutconcentraties in het oppervlaktewater beïnvloedt. Op lokale schaal kijken we onder andere naar de dynamiek van dunne regenwaterlenzen, die drijven op zout grondwater. Deze regenwaterlenzen maken landbouw mogelijk in gebieden met veel zout in de ondergrond. Onderzoek van Deltares laat zien dat klimaatverandering en zeespiegelstijging het voortbestaan van deze regenwaterlenzen kan bedreigen. Een ander belangrijk onderwerp zijn zoute wellen, kortsluitingen tussen het diepe grondwater en het oppervlaktewater, die in grote mate bijdragen aan de verzilting in laaggelegen gebieden zoals de Nederlandse polders.	Deltares heeft een mooie combinatie voorhanden om de processen die spelen bij zoet-zout grondwater beter in de vingers te krijgen. Innovatieve monitoringstools en -technieken (Airborne EM, T-EC prikstok, EM-Slimflex, online continue meettechnieken) koppelen we aan onze ruime modelleringservaring met codes als MODENS3D en SEAWAT om dichtheidsafhankelijke grondwaterstroming en stoftransport te simuleren. Tegenmaatregelen ter compensatie van de verzilting worden daarbij doorgerekend. Daarnaast zoeken we samen met stakeholders, zoals bedrijfsleven, agrariërs en regionale/lokale overheid naar oplossingen om de zoetwatervoorziening in kustgebieden te garanderen. In een aantal aansprekende projecten brengen we onze expertise over het thema samen, van o.a. Interreg IV-B ClWat, de Kennis voor Klimaat projecten Climate Proof Fresh Water Supply en GO-FRESH tot Het Kustlaboratorium en de Waterhouderij. We maken daarbij gebruik van uitgebreide geo-databestanden (van TNO) voor de geologie (REGIS, Geotop), hydrogeologie (DINO) en kwaliteitsmetingen (REGIS zoet-zout).



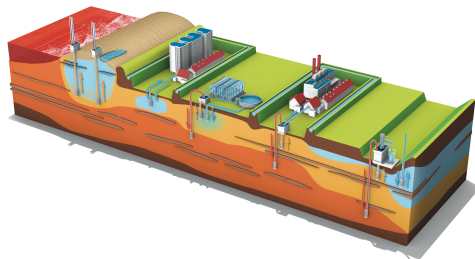
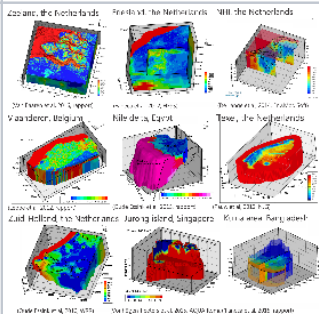
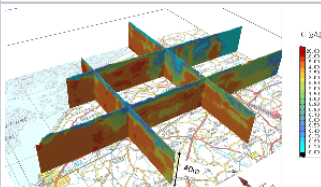
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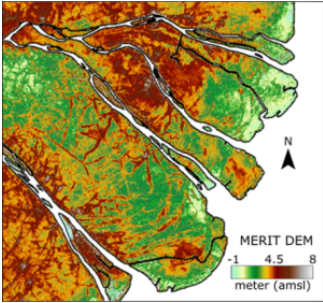
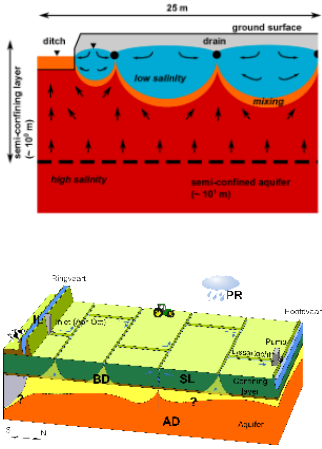
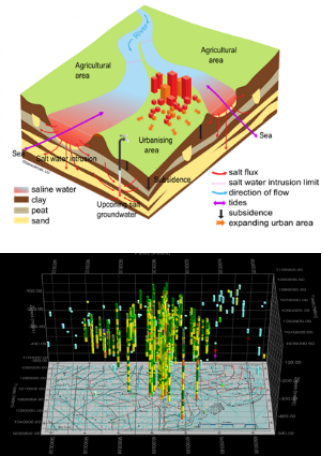
Zoet-zout grondwater in het kustgebied (Engelstalig)

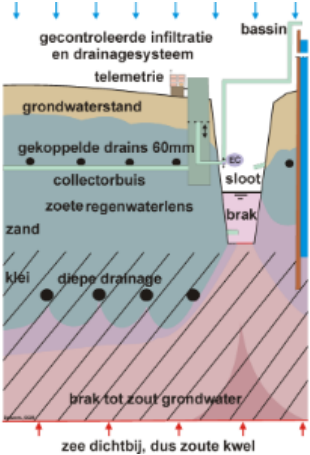
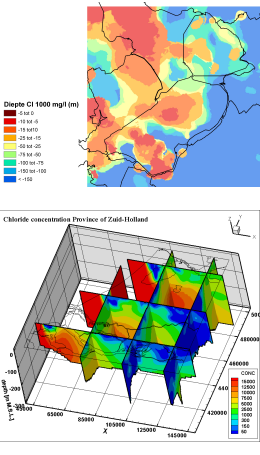
Meer Informatie

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FAME Freshwater availability Mekong Delta 	Climate Proof Fresh Water Supply 	NatureCoast De Zandmotor 	Rise & Fall (UDW) Mekong, Vietnam 	Fre Re:
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Promoties Joost Delsman Pieter Pauw Perry de Louw	Slimmer doorspoelen 	Zoetwatervoorziening 	Regionale Studies 
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Publicaties

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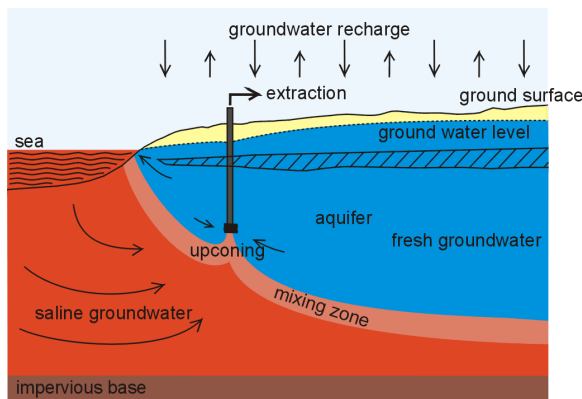

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Lecture Notes Density Dependent Groundwater Flow: Salt water intrusion in coastal aquifers

Auteur: Gualbert Oude Essink

Dictaat: [Density Dependent Groundwater Flow](#)

- 1 Introduction
- 2 Characteristics of a density dependent groundwater system
- 3 Freshwater head
- 4 The concept of a fresh-saline interface
- 5 Control of salt water intrusion
- 6 Numerical modelling
- 7 Salt water intrusion in the Netherlands
- 8 Heat transport in porous media: introduction



Lecture Notes Groundwater Modelling

Auteur: Gualbert Oude Essink

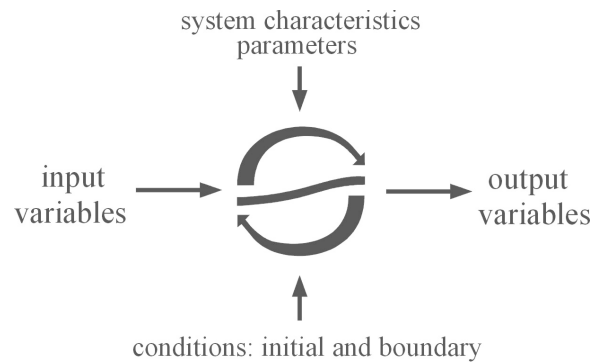
Dictaat: [Groundwater Modelling](#)

PART I Modelling Protocol

- 1 Introduction
- 2 Classification of mathematical models
- 3 Methodology of modelling
- 4 Data gathering

PART II Groundwater Modelling

- 5 Introduction
- 6 Mathematical description of hydrogeologic processes
- 7 Solution techniques
- 8 Numerical aspects of groundwater models
- 9 Some selected groundwater codes



Animations: examples of salinisation processes

Henry's profile with sea level rise	3D zoet-zout verdeling ondergrond NL	Fresh water injection to combat salinisation	3D zoet-zout verdeling ondergrond Texel	Regional (captured I
Henry's profile with sea level rise	3D zoet-zout verdeling ondergrond NL	Fresh water injection to combat salinisation	3D zoet-zout verdeling ondergrond Texel	Regional gro captured by ,
Physical barrier in the coastal zone	Dutch profile: extraction, upconing and low inland levels	Profile over 3D model: effect sea level rise on salinisation	Movement of the island De Griend (NL): creation of a freshwater lens	Evolu lens

Salinisation of a groundwater flow system The change in salt content in the subsurface due to a physical barrier in the deep coastal aquifer and a sea level rise of 0.5 m per century	Salinisation of the groundwater system Profilen door de Zandkolk-Haarnemanspolder	Rijland model (profile of column 53) Antropogene development, sea level rise and land subsidence	Movement of the island of Griend (Friesland) through the Waddasea	Evoluti	Physical barrier in the coastal zone Dutch profile extraction, upconing and low inland levels Profile over 3D model: effect sea level rise on salinisation Movement of the island De Griend (NL): creation of a freshwater lens Evoluti lens
Upconing saline groundwater under a low-lying area	Ontwikkeling van een zoetwaterlens	Interface	Saltwater pocket	Henry	Upconing saline groundwater under a low-lying area Ontwikkeling van een zoetwaterlens Interface Saltwater pocket Henry's problem
Verziltig onder de polder Groot-Mijdrecht: opwellen zout grondwater Tijd=2006 AD	Ontwikkeling van een zoetwaterlens Natuurlijke grondwater aanvulling (1 mm/dag)	Fresh-saline vertical interface 160*80 cells	Saltwater pocket	Henry's problem	Upconing saline groundwater under a low-lying area Ontwikkeling van een zoetwaterlens Interface Saltwater pocket Henry's problem

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- **25th Salt Water Intrusion Meeting: Gdansk, Polen, 17-22 Juni 2018, [website](#)**
Presentations:

- Delsman, J.R., Van Baaren, E.S., Siemon, B., Dabekaussen, W., Steuer, A., Gunnink, J.L., Karaoulis, M.C., Pauw, P.S., Vermaas, T., Bootsma, H., De Louw, P.G.B., Oude Essink, G.H.P. 2018. Large-scale, probabilistic airborne salinity mapping for groundwater management in Zeeland, The Netherlands
- De Louw, P.G.B., Bootsma, H., Kooi, H., Kramer, M., Erkens, G. 2018. Land subsidence by peat oxidation leads to enhanced salinization through boils in Dutch polders
- Zamrsky, D., Oude Essink, G.H.P., Bierkens, M.F.P. 2018. Estimating characteristic times of regional groundwater systems along the global coastline with regard to past sea level fluctuations and sediment accumulation patterns
- Van Engelen, J., Bierkens, M.F.P., Oude Essink, G.H.P. 2018. 3D Paleohydrogeological modelling of the Nile Delta
- King, J., Oude Essink, G.H.P., Karaoulis, M.C., Siemon, B., Bierkens, M.F.P. 2018. A Quantitative Review of D Airborne Electromagnetic Inversion Methods: A Focus on Fresh-Saline Groundwater Mapping
- Huizer, S., Radermacher, M., De Vries, S., Oude Essink, G.H.P., Bierkens, M.F.P. 2018. Impact of coastal forcing and groundwater recharge on the growth of a fresh groundwater lens in a mega-scale beach nourishment
- Oude Essink, G.H.P., Mulder, T., Van Engelen, J., Zamrsky, D., Pham Van, H., Weerasekera, W., Meggiorin, M. 2018. Building up D salinity models for estimating fresh groundwater resources in major deltas under global and climate stresses
- Vandeveld, D. Van Baaren, E.S., Delsman, J.R., Karaoulis, M.C., Oude Essink, G.H.P. De Louw, P.G.B., Vermaas, T., Pauw, P.S., De Kleine, M., Thofte, S., Teilmann, R., Walraevens, K., Van Camp, M., Huits, D., Dabekaussen, W., Gunnink, J.L., Vandenbohede, A. 2018. Groundwater salinity mapping of the Belgian coastal zone to improve local freshwater storage availability

Posters

- Oude Essink, G.H.P., Van Baaren, E.S., Galvis Rodriguez, S., Zuurbier, K., Raat, K., Kooiman, J.W., Boonekamp, T. 2018. Potential map for large-scale implementation of subsurface water solutions: COASTAR
- Verkaik, J., Huizer, S., Van Engelen, J., Ram, R., Vuik, K., Oude Essink, G.H.P. 2018. Parallel Computing with SEAWAT

- America, I., De Louw, P.G.B., Bier, G., Van der Zee, S. 2018. Influence of tides, bathymetry, lithology and regional flows on the salinization process in nature area the Rammegors

2017

- Zoet-zout kartering Provincie Zeeland online beschikbaar: [FRESHEM](#)
- Rapportage Zeeland model digitaal beschikbaar: [Regionaal 3D model voor zoet-zout grondwater in de Provincie Zeeland](#). [link naar wiki-pagina](#)
- **2017 23-28 April: European Geosciences Union, General Assembly**
 - Zamrsky, D., Bierkens, M. and G.H.P. Oude Essink, 2017. On aquifer thicknesses and geological complexity affecting fresh/salt groundwater distribution.
 - Van Engelen, J., Oude Essink, G.H.P., Kooi, H., Bierkens, M.F.P. 2017. On the origins of hypersaline groundwater in the Nile Delta Aquifer.
 - Boran, B.E., Rutten, M., Oude Essink, G.H.P., Delsman, J.R., Abraham, E. 2017 Smart salinity management in low-lying deltaic areas: a model predictive control scheme applied to a test case.
 - Siemon, B., Van Baaren, E., Dabekaussen, W., Delsman, J.R., Gunnink, J., Karaoulis, M., De Louw, P., Oude Essink, G., Pauw, P., Steuer, A., Vermaas, T., Meyer, U. 2017. FRESHEM - Fresh-saline groundwater distribution in Zeeland (NL) derived from airborne EM.
- Gezocht: [Gent Universiteit België: Docent-TT Hydrogeologie](#)

2016

- 2016 4-8 July, 24th Salt Water Intrusion Meeting: Cairns, Australia
- 2016 10-13 May, 4th Int. Climate Change and Adaptation Conference, Rotterdam, The Netherlands

In het Nieuws:

20151214, Volkskrant: kwelvoorziening Perkpolder

20150917, Trouw: Zilte grond vraagt om zilte groente

20150822, Nieuwe Oogst: Helivluchten Zeeland hervat

20140527, Volkskrant: Landbouw op zout water

20140428, Trouw: Zuinig op het zoete water

20140331, De Akker: Zorgen om zoute kwel; Toenemende verzilting vereist bewustere omgang met zoet water

20140407, Financieel Dagblad: Zuinig op Zoet Water

20140205, PZC: Hoe Bloemkool nog jaren kan groeien

20140125, Nieuwe Oogst: Zoute Kwel Onder De Duim Houden

20140120, Nederlands-Franse samenwerking binnen project GO-FRESH

20140129, Reformatorisch Dagblad: Boeren in Zilte Polders

20140111, Nieuwe Oogst: Sloten met zoute wellen tijdelijk isoleren

20131220, Cobouw: Achtergrond nr. 229: Verzilting diepe polders loopt vooral via wellen

20131205, Nieuwe Oogst: De rol van zoute wellen bij verzilting onderzocht

20131130, Nieuwe Oogst: Sparen als je sparen kunt

20131121, Minister overweegt financiële steun GO-FRESH project

20130924, De Boerderij: Zeeuwse telers sparen zoet water

20130906, Groenten en Fruit Actueel bericht; Jan de Rijk: Hele jaar door water sparen zonder bassin

20120404, BN de Stem Zeeuws-Vlaanderen: Een zoektocht naar zoet water

2012, Visie Deltares Magazine: Aanpak verzilting is maatwerk

20110516, Boerderij: Behoud zoetwaterlens is sleutel bij onontkoombare verzilting

Algemeen

[Salt Water Intrusion Meetings](#)

[Saltnet](#)

2015

- 2015 13-18 September, 42nd IAH AQUA2015, Hydrogeology, Back to the Future!, Rome, Italy, session S7.8: Groundwater quality issues in coastal aquifers: Improving our understanding through measurements and modelling
- 2015 28 June - 3 July: IAHR, Delft, The Netherlands, Deltas of the Future
- 2015 17 juni, middag symposium 'Zoetwaterbeheer en de rol van wetenschappelijk onderzoek'
- 2015. 9-12 June: AquaConSoil, Copenhagen, Denmark: Sustainable Use and Management of Soil, Sediment and Water Resources
- 2015 12-17 April, EGU, Wenen, Oostenrijk, HS8.2.9 Freshwater-saltwater interactions in coastal and inland aquifers
- 2015 23-26 March, Deutschen Geophysikalischen Gesellschaft, Hannover, Duitsland: o.a. Hydrogeofysica en grondwatersystemen

2014

- 2014 AGU Fall Meeting, 15-19 December 2014, San Francisco, USA
Abstract submission by Sebastian Huizer: Modeling Changing Morphology and Density Dependent Groundwater Flow in a Dynamic Environment: case study
- International Conference Deltas in Times of Climate Change II, 24-26 September 2014
->Download the Flyer (check *Fresh Water Management*)
- IAEG XII Congress, Torino September 15-19, 2014 Engineering Geology for Society and Territory, 1.4 - Climate change: impacts on natural resources and hazards
- 23rd Salt Water Intrusion Meeting, Husum, Germany, 16-20 June 2014
Presentatie: Esther van Baaren, Bouke Ottow, Marco Arts, Pieter Pauw, Gualbert Oude Essink, Sharing precious water volumes in the Water Farm
Presentatie: Marta Faneca, Gualbert Oude Essink, Gijs Janssen, Roelof Stuurman, Yangxiao Zhou, SWIBANGLA, Managing Salt Water Impacts in Bangladesh
Presentatie: Pieter Pauw, Controlled level drainage to expand freshwater lenses below creek ridges
Presentatie: Sebastian Huizer, Can a large sand suppletion lead to a substantial increase in fresh water resources?: The Sand Motor Project
Presentatie: Gualbert Oude Essink, Daniel Zamrsky, Marta Faneca, Global Quick Scan of the Vulnerability of Groundwater systems to Tsunamis (and other flooding events)
Poster: Esther van Baaren, Perry de Louw, Gualbert Oude Essink, Regional variable-density groundwater flow model: a Dutch case in the southwestern delta
- EGU, Vienna, Austria, 27 April - 2 May 2014
- FRIEND-Water2014, Vietnam, Hanoi, 24-28 February 2014: 7th Global FRIEND-Water Conference Hydrology in a Changing World: Environmental and Human Dimensions

2013

- 2013 AGU Fall Meeting, 9-13 December 2013, San Francisco, US
Session invitation: H062: "Open-Source Programming, Scripting, and Tools for the Hydrological Sciences", invited speaker Jarno Verkaik
- Deltares Software Dagen, 10 juni 2013 Symposium 'Ontwikkelingen in de Hydrologie', Ontwikkelingen Zoet-Zout Grondwater (Gualbert Oude Essink)
- MODFLOW and More 2013: Translating Science into Practice, 2-5 June 2013, Colorado School of Mines in Golden, Colorado, US
- Kennisproeverij Deltares, 24 April 2013
- AquaConSoil, Barcelona, 16-19 April 2013, 12th International UFZ-Deltares Conference on Groundwater-Soil-Systems and Water Resource Management
- EGU, Vienna, Austria, 07-12 April 2013: Freshwater-saltwater interactions and density-driven flow

2012

- Studie Brijnlozingsproblematiek Haaglanden afgerond, december 2012
- AGU, San Francisco, 3-7 December 2012: H016: Measurement, Modeling and Management of Coastal Aquifers
- Symposium BodemBreed 2012, 27-28 november 2012
- 22nd Salt Water Intrusion Meeting, Buzios, Brazil, June 17-21, 2012
Presentation: Esther van Baaren, The Water Farm: self-sufficient in water
Presentation: Gualbert Oude Essink, Local Climate Proof Fresh Groundwater Supply: adaptation water management strategy with national impact?
Presentation: Gualbert Oude Essink, Geophysics Applied to Coastal Aquifer Studies
Presentation: Gualbert Oude Essink, How to determine a reliable 3D fresh-brackish-saline distribution in data-rich coastal groundwater systems
Presentation: Joost Delsman, Salt load to an agricultural catchment: 'seepage flux times concentration', or is there more to it than that? Insights from a multi-scale tracer study
Presentation: Esther van Baaren, Climate Proof Areas: Innovative solutions for improving the freshwater availability
Poster: Pieter Pauw, Large scale drainage measures to increase freshwater supply from sandy creek deposits
Poster: Gualbert Oude Essink, Airborne Geophysics: a powerful tool to start up fresh groundwater management in the coastal zone
Presentation: Esther van Baaren, The Coastal Laboratory: salt and fresh water supply. More info?: Esther dot vanBaaren at deltares dot nl
- Tweedaagse bijeenkomst over zoet en zout water, 31 mei-1 juni 2012, georganiseerd door Kennis voor Klimaat, RWS Waterdienst en STOWA
Poster: Pieter Pauw, Vergroten van de zoetwatervoorraad onder kreekruggen in de Zuidwestelijke Delta
Poster: Gualbert Oude Essink, Airborne Geophysics: a powerful tool to start up fresh groundwater management in the coastal zone
- IV Int. Conf. on Technology Seawater Intrusion in Coastal Aquifer, Alicante, Spain, April 24-26 2012
Presentation: Marta Faneca, Effect of geological uncertainties on the salinisation of surface water systems in deltaic areas
Presentation: Gualbert Oude Essink, Local Climate Proof Fresh Groundwater Supply: adaptation water management strategy with national

[impact?](#)

In april 2012 ontving Deltares tijdens het TIAC2012-congres de 'Carlos Ruiz Celaá Award'. De award is toegekend voor een zoetwaterproject dat Deltares tijdens het congres presenteerde. over het omgaan met verzilting in kustgebieden.

- [inzending Deltares-IMARES De KREEK teRUG Delta Water Award, Vlissingen, The Netherlands, April 18, 2012](#)

2011

[World Delta Summit, The Pulse of Deltas and the Fate of our Civilization, Jakareta Indonesia, 21-24 November 2011](#)

2010

[International Centre for Advanced Mediterranean Agronomic Studies CIHEAM](#) course, 22-27 March 2010, Zaragoza, Spain, teaching [Quantitative methods](#)

[21st Salt Water Intrusion Meeting](#) 21-25 June 2010, Azores, Portugal

[Deltas in Times of Climate Change](#) 29 September- 1 October, Rotterdam, the Netherlands

Presentatie: Oude Essink GHP, Van Baaren ES, De Louw PGB, 2010, Effects climate change on coastal groundwater systems, focus on the Rhine Delta, [Proceedings Deltas in Times of Climate Change, Rotterdam, The Netherlands, Sept-Oct. 2010](#)

Blog stream

Create a blog post to share news and announcements with your team and company.

Contact

Overzicht [Inleiding](#) [Projecten](#) [Publicaties](#) [Download](#) [Nieuws](#) [Contact](#) [Stage](#)

De volgende personen werken aan de op deze pagina genoemde onderwerpen:

						
Gu Oude Essink	Perry de Louw	Esther van Baaren	Marta Faneca Sanchez	Jarno Verkaik	Joost Delsman	Gijs Janssen
Gualbert dot OudeEssink at Deltares dot nl	Perry dot deLouw at Deltares dot nl	Esther dot vanBaaren at Deltares dot nl	Marta dot Faneca at Deltares dot nl	Jarno dot Verkaik at Deltares dot nl	Joost dot Delsman at Deltares dot nl	Gijs dot Janssen at Deltares dot nl

Stage

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Al een flink aantal jaren dragen studenten bij aan Deltares projecten op het gebied van zoet-zout grondwater in het kustgebied. Soms leidt dit mooie resultaten, peer-reviewed artikel waardig! Alles bij elkaar: we zijn een groot voorstander van het begeleiden van studenten, voor een stage- of afstudeeropdrachten. De laatste jaren hebben we studenten gehad van verschillende pluimage: universiteiten (WUR, UU, VU), hogescholen (Zeeland, Larensteijn) en instituten als IHE. Ook buitenlandse (PhD-)studenten waren welkom (Universiteiten van Gent, Firenze, Bologna, Roma (La Sapienza), Aken, Teheran, etc.).

We hebben een flink aantal onderwerpen op de plank klaar liggen, van numeriek modelleren tot en met water systeem analyse en monitoring, of een combi. Neem contact met ons, of met de desbetreffende studenten. Tot hoors!



Enkele onderwerpen:

- Groundwater salinization near the IJmuiden Sea Lock
- Simulating the effect of different scenarios on climate change/sea-level rise and anthropogenic stresses on fresh groundwater in the Mekong delta, using the existing 3D model
- On the water - food nexus in the Nile delta: communicating, understanding and monitoring groundwater availability, collaboration with the universities Kafr El Sheikh and Sadat City; also a visit to Egypt is planned.
- [Comparison of 2D and 3D groundwater flow and salinity model estimations in deltaic regions](#)
- [Assessing the economic and technic feasibility of offshore groundwater pumping](#), based on the article Zamrsky, D., Oude Essink, G.H.P., Sutanudjaja, E.H., Van Beek, L.P.H., Bierkens, M.F.P., 2022. Offshore fresh groundwater in coastal unconsolidated sediment systems as a potential fresh water source in the 21st century. Environ. Res. Lett. 17, 1–22. <https://doi.org/https://doi.org/10.1088/1748-9326/ac4073>
- Assessing the effect of model parameters (e.g. solute solvers, grid convergence) on variable-density groundwater and salt transport benchmark cases using iMOD-SEAWAT and/or MODFLOW6
- Fresh groundwater resources management at a farmers level in the province of Zeeland, The Netherlands: setting up robust web-based clipping tools; a modelling study
- Assessing submarine groundwater discharge along coastal stretches: a global analysis
- Setting up a 3D variable-density groundwater flow model simulating salt water intrusion in a deltaic area: possible cases: the Bengal, Indus, Po, Yangtze, Pearl river deltas

info: gualbert dot oudeessink at deltares dot nl

Afstudeeronderwerpen sinds 2005:

2021

- Thijs Hendriks, Utrecht University, [Numerical computation of hurricane-induced saltwater intrusion on fresh groundwater availability in peninsular Florida under different climate scenarios](#)

2020

- Obeid, A.A.A., [Sensitivity analysis of variable-density groundwater models.](#)
- Josh Shankel, Utrecht University, [Exploration of shallow sandy ridge systems for aquifer storage and recovery solutions in the Vietnamese Mekong Delta](#)
- Wouter Goofers, Utrecht University, [Paleo-hydrogeographic reconstruction of the groundwater salinity in the Ayeyarwady Delta, Myanmar, using a 3D variable-density groundwater model](#)

2019

- Eva Schoonderwoerd, Utrecht University, [Modelling density-dependent flow with the use of MODFLOW 6, The effect of spatial and temporal discretization](#)
- Lennart Brokx, Utrecht University, [Projecting the Effects of Saltwater Intrusion on the Fresh Groundwater Resources of Southeastern Louisiana and the New Orleans Area , USA , based on 3D Variable-Density Groundwater Modelling](#)

2018

- Lars Geitenbeek, Utrecht University, [Saline groundwater extraction as a measure to increase the freshwater availability; A case study for the western parts of the Netherlands](#)
- Hendriks, N., Utrecht University, [Identifying the most important factors that determine fresh groundwater availability in deltaic areas](#)
- Hugo Hagendoorn, Delft University of Technology, [Measuring and modelling to optimise a salinity monitoring network for use in the optimal control of flushing: Case study: Lissertocht catchment](#)

- Colin Mainz, University of Aachen, Germany, [Variable-density groundwater flow and coupled salt transport models of the Chao Phraya Delta, Thailand](#)
- Tobias Mulder, Utrecht University, [Constructing 3D variable-density groundwater flow models for six deltas using global data sets](#)

2017

- Wayangi Lakshani Weerasekera, IHE-Delft, [3D Variable-density Groundwater Modelling of the Red River Delta, Vietnam](#)

2016

- Lubna Badi, Utrecht University, BSc, [Securing freshwater supply with measures to diminish the effect of sea-level rise by climate change \(Literature review on state-of-art SWI research and a case study on SIDS in the Pacific\)](#)
- Björn Bolhuis, Utrecht University, [Developing an automated open source system for coastal multi-hazard assessment and management of water resources in a changing climate \(Based on the Coastal Hazard Wheel system\)](#)

2015

- Steven Ros, Utrecht University, The Nile Delta, Egypt: creating a fresh-salt water model
- Marjolein Vogels, Utrecht University, [Modelling the central coastal groundwater system of Bangladesh](#)

2014

- Jan Snel, Wageningen UR, [Oplossingen ten behoeve van zoetwatervoorziening voor de landbouw op Schouwen-Duiveland](#)
- Mieke Hulshof, Wageningen UR, [Spatial scales in salinity modeling, case Waterdunen, Zeeland \(Folkert Hellinga Award 2014\)](#)
- Daniel Zamrsky, Wageningen UR, [Coastal vulnerability to tsunami impacts and modelling SWI in aquifers situated in the most vulnerable areas](#)
- Carlos Rosado de Palacio, Utrecht University, [Water system analysis and numerical modelling of a coastal aquifer in western Mexico: a case study](#)

2013

- Marjan Sommeijer, WUR, [Identifying suitable locations for infiltration of fresh water in creek ridges](#)
- Thomas Boerman, UU, [Fresh water lenses under creek ridges: a pilot study in Zeeland to increase fresh water supply](#)
- Pieter Winters, Universteit Gent, Belgie, [Estimating flow patterns to an agricultural ditch by inverse modeling of temperature and salinity measurements](#)

2012

- Maitri Fischer, UU, [Managing freshwater lenses in a Dutch coastal setting - increasing freshwater availability by aquifer storage and recovery.](#)
- Martijn Visser, UU, [Aquifer storage and recovery in a fossil creek bed - managing droughts in a brackish environment](#)
- Irene Lugten, UU, [The effects of salt water intrusion from the Dintel into the surface and groundwater in the regio](#)
- Kyra Hu-A-Ng, UU, [Understanding Holocene coastal development and the resulting evolution of groundwater chloride distribution in the North-West coastal region of the Netherlands - a historical modelling approach](#)

2010

- Bernard Voortman, UU, [Invloed van gebiedseigenschappen en klimaatverandering op de dikte en vorm van regenwaterlenzen in de Provincie Zeeland en bijdrage aan Hydrol. Earth Syst. Sci., 15, 3659-3678](#)
- Aileen Mirasol-Robert, UU, [Analysis of Submarine Groundwater Discharge to Manila Bay - 3D Density Dependent Hydrogeological Modeling of the South-eastern coastal zone of Bataan, Philippines](#)
- Dagmar Schnitzer, UU, [Response of a fresh-brackish groundwater system to hydrological management in and around the Naardermeer wetland, the Netherlands](#)

2008

- Tommaso Letterio, Uni of Firenze, Italy

2007

- Bas de Veen en Sjors Stevens, VU, [Meetcampagne regenwaterlenzen in de Provincie Zeeland](#)
- Corne Prevo, Hogeschool Zeeland, [Aquatische Ecotechnologie: Regenwaterlenzen binnen de Provincie Zeeland](#)
- Francesco Sergi, La Sapienza, Roma, Italy, [Salinisation processes in the Province of Zeeland, the Netherlands, bijdrage aan Near Surface Geophysics, 401-412, 2007](#)
- Marian Koskamp, WUR, [Modelstudie naar chlorideconcentratie in bodemvocht en ondiep grondwater in een zout kwelsysteem, conceptverslag](#)
- Valentina Marconi, Uni of Bologna, Italy, [Characterization of shallow fresh groundwater lenses in the Province of Zeeland with 2D geo-electrical surveys](#)
- Vesna Tripkovichs, UNESCO-IHE, [Salt water intrusion in The Province of Zeeland, the Netherlands - water system analysis and numerical modeling](#)

2006

- Elles Bader, VU, [Verziltings- en verzoetingsprocessen in Nederland; met speciale aandacht voor de Wieringermeerpolder](#)
- Piet Maljaars en Runa Wils, Hogeschool Larenstein, [Regenwaterlenzen in zoute kwelsystemen](#)

2005

- Beatrice Giambastiani, Uni of Bologna, Italy, [Saltwater intrusion and water management in the unconfined coastal aquifer of Ravenna \(Italy\): a numerical model J. Hydrol. 340, 1-2, 91-104, 2007.](#)

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Enkele onderwerpen:

- Freshwater management techniques as a bridge between water demand and supply in the Mekong Delta, Vietnam (including fieldwork provinces Ben Tre or Tra Vinh)
- Analysis of upconing of saline groundwater under deltaic areas (numerical study)
- Effect of model parameters (e.g. solute solvers, grid convergence) on variable-density groundwater and salt transport benchmark cases (e.g. Henry, Hydrocoin, upconing; numerical analysis using iMOD-SEAWAT)
- Fresh groundwater resources management at a farmers level in the province of Zeeland, The Netherlands: setting up robust web-based clipping tools; a modelling study
- Assessing submarine groundwater discharge along coastal stretches: a global analysis
- Setting up a 3D variable-density groundwater flow model simulating salt water intrusion in a deltaic area: possible cases: the Bengal, Indus, Po, Yangtze, Pearl river deltas

info: [gualbert dot oudeessink at deltares dot nl](mailto:gualbert.dot.oudeessink@deltares.nl)

Afstudeeronderwerpen sinds 2005:

2020

- Josh Shankel, Utrecht University, [Exploration of shallow sandy ridge systems for aquifer storage and recovery solutions in the Vietnamese Mekong Delta](#)
- Wouter Goofers, Utrecht University, [Paleo-hydrogeographic reconstruction of the groundwater salinity in the Ayeyarwady Delta, Myanmar, using a 3D variable-density groundwater model](#)

2019

- Lennart Brokx, Utrecht University, [Projecting the Effects of Saltwater Intrusion on the Fresh Groundwater Resources of Southeastern Louisiana and the New Orleans Area , USA , based on 3D Variable-Density Groundwater Modelling](#)

2018

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- Irene Lugten, UU, [The effects of salt water intrusion from the Dintel into the surface and groundwater in the regio](#)
- Kyra Hu-A-Ng, UU, [Understanding Holocene coastal development and the resulting evolution of groundwater chloride distribution in the North-West coastal region of the Netherlands - a historical modelling approach](#)

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- Corne Prevo, Hogeschool Zeeland, Aquatische Ecotechnologie: [Regenwaterlenzen binnen de Provincie Zeeland](#)
- Francesco Sergi, La Sapienza, Roma, Italy, [Salinisation processes in the Province of Zeeland, the Netherlands, bijdrage aan Near Surface Geophysics, 401-412, 2007](#)
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