Kennis voor Klimaat

Knowledge for Climate

Newsletter Climate-proof Fresh Water Supply
Issue September 2010

Foreword

Eelco van Beek & Ad Jeuken, coordinators
(Contact: Eelco.vanBeek@deltares.nl, Ad.Jeuken@deltares.nl)

After a preparation period of nearly one year we got in March 2010 green light from the Knowledge for Climate programme to start our actual research activities. KfC supports our theme of 15 projects divided in 6 work packages with a subsidy of 2,5 m€. A further 1.3 m€ is contributed by various co-financing agencies while as research institutes we contribute ourselves about 1.3 m€. This brings the total of our research programme at more than 5 m€. We are looking forward to carry out the research and share the results with you all. You can find our research programme and all further information on our activities on the website mentioned on the last page of this newsletter.

Starting up the research takes time. PhD's (7) have been recruited; work plans are being developed, often in close interaction with the hotspots and other stakeholders. A kick-off with the research team was held in April. We are also pleased that our Steering Group was appointed and that we could have the first meeting of the Steering Group on 1 September 2010. The Steering Group is chaired by prof. Sybe Schaap who is able to guide us from his practical experience as regional water manager as well as his academic position at the Delft University of Technology. The Steering Group is further composed of our main co-financing organizations and include Cor van Meyenfeldt (Ministry of Agriculture, Nature and Fisheries), Jos van Dalen (Ministry of Public Works, Transport and Water Management, Rob Ruijtenberg (STOWA), Jan Smits (hotspot South-West Delta), Jorien Burger (hotspot Haaglanden), Jacques Vermaas (Province Zuid Holland), Henk Ketelaars (Evides) and Theo Olsthoorn (TU Delft).

This newsletter aims to inform you regularly on our activities, progress and (preliminary) results. We look forward to communicate with you about our work and you are invited to get in touch with us, either directly with the researchers or through our communication officer.

Research on salt resistant potatoes in the news

Contact: Jelte Rozema, Arjen de Vos (jelte.rozema@falw.vu.nl)

Arjen de Vos PhD student at the department of Systemecology appeared in the news last week in response to the harvest of the first harvest of salty potatoes on Texel.

Cultivation of salty potatoes takes place within the research project Salty Agriculture Texel, in which the Free University of Amsterdam under supervision of prof. Jelte Rozema participates. In this project new and traditional crops are on their salt tolerance and market potential. In addition an agronomic system based on the use of saline seepage is being developed and the new crops are brought to the market. The cultivation of salt tolerant crops on salty lands can contribute to a solution for increasing salization threatening parts of our planet.

http://www.falw.vu.nl/nl/onderzoek/ecological-sciences/systems-ecology/research/zilte-landbouw-texel.asp

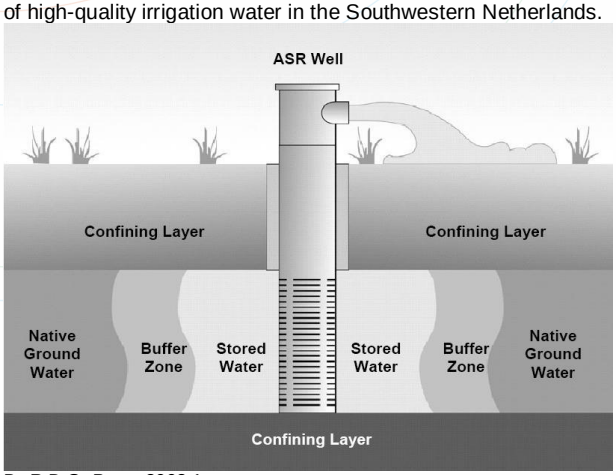
Improvement of self-sufficient irrigation water supply

Contact: Koen Zuurbier (PhD) koen.zuurbier@kwrwater.nl,

High-quality freshwater supply for irrigation is an essential factor for the agri- and horticulture in the Southwestern Netherlands. Extensive use of rainwater storage using artificial reservoirs cannot provide sufficient volumes of irrigation water during periods of drought. Availability of qualitative freshwater in the shallow aquifers is at the same time limited due to salinization, requiring use of surface water or reverse osmosis on brackish water (producing brine water) for irrigation water production. Use of the shallow brackish aquifers for storage of rainwater excess and additionally pretreated surface and wastewater is regarded as a solution for self sufficient irrigation water supply.

This study (WP-4.1 in the Knowledge for Climate Research Program) focuses on improvement of present aquifer storage systems (Aquifer Storage and Recovery (ASR) by well injection of rainwater) and the development of new storage systems (open infiltration in high-lying former stream ridges and use of the fresh maker concept). Water quality development and freshwater distribution in the brackish aquifer will be studied using pilot locations. Reactive-transport modeling will be performed to obtain insights in governing processes.

This study will result in fundamental insights regarding efficiency and sustainability of multiple aquifer storage systems for storage of high-quality irrigation water in the Southwestern Netherlands.



By R.D.G. Pyne, 2002 1

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More contacts at KWR Watercycle Research Nieuwegein:


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Research Project 'Increasing the robustness and flexibility of fresh water lenses in saline seepage regions under climate stress
(Contact: Pieter Pauw, Pieter.pauw@deltares.nl)

In many saline seepage regions in the Netherlands, salt groundwater is present at shallow depth. Agricultural activities are possible because of freshwater lenses, which are fed by excess precipitation. However, this source of water will be reduced during (long) periods of drought in the future. Crop damage may occur because of these droughts and because of salt groundwater encountering the root zone. The ongoing climate change and sea level rise will very likely reduce these fragile fresh water resources. In these low-lying regions, surface water is also suffers from salinisation. The conventional strategy to cope with this problem is to take in large amounts of surface water from the main rivers (mainly the river Rhine), in order to dilute the surface waters of polders and to reduce the effects of saline groundwater seepage. However, this strategy might not be sustainable, as the discharge of the rivers in summer will decrease and the salt water wedge from the sea intrudes further upstream.

In order to minimize the reliance of external sources of freshwater, other sources have to be used. These sources include fresh groundwater stored in fossil sandy creeks and dune areas, but these too will be subjected to climate change and sea level rise. The main goal of this research project is to investigate the possibilities to increase the robustness and flexibility of freshwater reserves in saline seepage regions on a local (agricultural parcel), medium (fossil sandy creek) and large (dune area) scale, under climate stress.

Therefore, on the first of October, Pieter Pauw will start his PhD Research Project 'Increasing the robustness and flexibility of fresh water lenses in saline seepage regions under climate stress'!

The research includes an extensive fieldwork to collect geophysical, hydrological and geohydrological information to better understand the behavior of fresh water lenses to changing boundary conditions and the development of modeling tools, which can be used to predict the impact of sea level rise, climate change and measurements to adapt to and mitigate the salinisation. It partially builds further upon research in two other PhD-studies, where the presence and behavior of shallow fresh groundwater in areas with saline seepage under present conditions is being studied and monitored. Furthermore, Pieter will collaborate with Joost Delsman, who started his research on September, 1st. His research will be focussed on the temporally and spatially dynamic interaction between groundwater and surface water in saline seepage areas.

Projects have started to get underway!
(Contact: Joost Delsman, joost.delsman@deltares.nl)

As of September 1, PhD student Joost Delsman has started his Knowledge for Climate research project. After over a year of preparing, refining and finalising the research proposal, the real work can begin! Joost will investigate the availability of fresh water in the coastal region of the Netherlands during current and future dry periods. His research will focus on the temporally and spatially dynamic interaction between groundwater and surface water. Using a combined fieldwork and modelling approach, he will hope to gain insight in research questions like: what exactly are the fluxes of water and salt between groundwater and surface water, and how do they vary with time and place? How do local processes affect the regional variations in fresh water availability? How will future climate change affect groundwater – surface water interactions and hence fresh water availability? And what can we do about it?

The coastal region of the Netherlands is currently dependant on the intake of fresh water from the river Rhine for maintaining water levels and a good water quality and thereby supporting water-dependant functions. Projections of future climate conditions see the availability of water in the river Rhine during summers declining. At the other side of the water balance, the water demand is expected to increase, as higher temperatures result in an increase in evapotranspiration. Furthermore, saline seepage is expected to increase, resulting in a deteriorating water quality. More fresh water will be needed to dilute concentrations to an acceptable level. So the water balance won't add up anymore, calling for a set of measures to sustain water-dependant functions in this coastal region.

But what will Joost actually be doing? Well, at the moment he is busy acquainting himself with all the work others have done before him. And that involves a lot of reading! Meanwhile he is planning a field campaign in two of the case studies, where he will measure the interaction between groundwater and surface water using a variety of techniques like observation wells, geophysical

techniques, temperature sensors. This field campaign will commence somewhere in the early months of 2011 and continue over the summers of 2011 and 2012. The fieldwork should provide more insight in local processes controlling the interaction between groundwater and surface water, such as geological heterogeneity, the role of infiltration, preferent pathways and more. Joost will then try and incorporate this knowledge in a quantitative modelling framework, to enable assessment of climate change impacts and possible measures. In this newsletter we will keep you updated on the progress of this research project.

Recent progress in risk analysis of salt accumulation in the root zone: including climatological unpredictabilty

(Contact: Sjoerd van der Zee[1], Sjoerd.vanderZee@WUR.nl)

In a cooperation between Hamid Shah[1], Willem Vervoort[2], Samir Suweis[3], Andrea Rinaldo[3], and Sjoerd van der Zee, progress has been made with respect to risk analysis of salinity. The first paper has just been published, and the second one is submitted.

Groundwater uptake by plants can be an important source of both water and salts in semi-arid areas and therefore capillary pressure induced upward water flow (capillary up flow) may cause root zone salinization. To identify which conditions may lead to either acceptable or hazardous salt concentrations in the root zone, we combined the mass balance equations for salt and water. As such, this is not innovating, as salinity research has received attention during the past six decades at least. The real innovation is that we did our modeling in a stochastic framework. This is necessary, because weather is unpredictable. Weather of e.g. June 1, 2010 has no (or better: little) predictive power for the weather of June 1, 2011. In this respect, predicting salinity risks is not much different from predicting the necessary heights of dikes. Therefore, we extended risk analysis, to account for the erratic weather.

In our first approach, we did so by assuming Poisson-distributed daily rainfall, which means that we statistically characterize the amount of rainfall and the period in between showers. The rationale for this is that whereas weather may be unpredictable, its statistical characterization is not: everybody who checks the chance of sunny days for a holyday locations knows that! Though we considered Poisson statistics, our analysis can be equally well done on the basis of historical weather records. Only, in the latter case, simple mathematical formulae are not feasible, whereas also scenario studies for changing climate become more complicated.

For the water fluxes (leaching, capillary up flow, and evapotranspiration), we account for osmotic effects due to the dissolved salt mass with Van 't Hoff's law. Root zone salinity depends on the magnitude of the salt transport, which is determined by capillary upflow. The motor for salinization is that evaporation and water uptake and transpiration by plants withdraw water from the root zone. Hence, replenishment by upflow of saline water (or by irrigation/sprinkling with brackish ditch water) leads to salinity of the root zone. Obviously, dry climate conditions and shallow groundwater favor high salinity. Both a wet climate and shallow groundwater lead to wetter root zone conditions, which in combination with periodic rainfall enhances salt removal by leaching. For wet climates, root zone salinity (concentrations) increases as groundwater grows more shallow (larger groundwater influence). For dry climates, root zone salinity increases as groundwater is deeper (dryer root zone leads to less leaching), and for intermediate climates, opposing effects can push the salt balance in either way.

Our simple analytical approach is computationally fast (Suweis et al., 2010) and considers salinity due to sprinkling with brackish water. Numerical modeling is more versatile and demanding and resulted for instance in the figure as shown below. In this figure, the long term salt concentration in the root zone is shown for designated weather, soil, crop/vegetation, and groundwater conditions. Using the currently available schemes to judge how serious such salinities are with regard to e.g. crop yield reductions, a rapid impression can be gained that is practically relevant. In the Conference Deltas in times of Climate Change, Rotterdam, 2010, some results are shown in the poster session. Also shown are examples of relevant system properties that could be analyzed, besides just salinity.
In the Knowledge for Climate Theme 2 Fresh Water Supply programme, that started July 2010, this risk analysis research is further extended by the above team, the Free University (Jelte Rozema) and the Integral Water team of Alterra (Frank van der Bolt and co-workers). In addition, the salinity tolerance framework used in the Netherlands for different crops (both "saline and non-saline" crops and vegetations) is re-assessed. For natural vegetations, we consider the risk of significant adverse effects if saline pressures increase in the low parts of The Netherlands.

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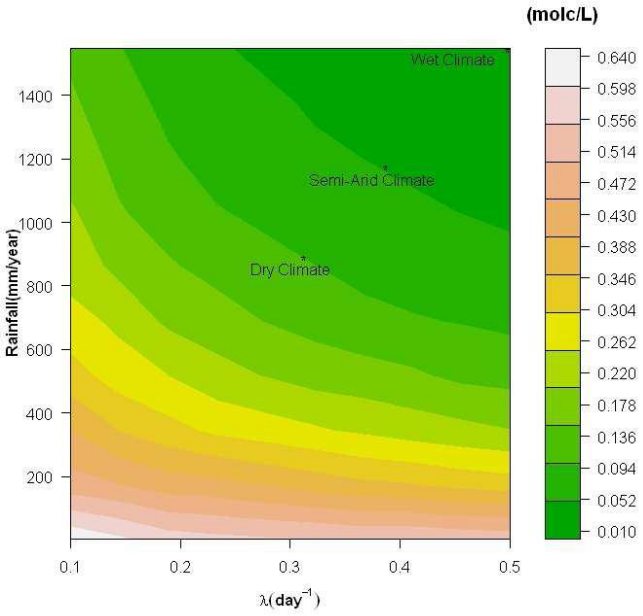

Figure: Long term salt concentration levels in the root zone (in colors, see legend to the right) depending on rainfall amount (vertical axis) and frequency (horizontal axis).

Reference: Suweis et al., 2010, Geophysical Research Letters, Vol. 37, L07404, doi:10.1029/2010GL042495, 2010

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Working togetheter with the climate programme of the Dutch waterboards, Deltaproof.
(Contact: Rob Ruijtenberg: ruijtenberg@stowa.nl)

Deltaproof identifies questions of the waterboards about watersafety and fresh water availability en seeks together with them practical answers. Next to questions considering the watersystem also spatial planning, governance and socio-economic issues are considered. Deltaproof is a dynamical programme which is evaluated yearly and works together with several partner programmes. Deltaproof will run from 2009 until 2012. For that period in total 4,1 million euro budget is available.
Protection against floods and safeguarding fresh water supply are the main purposes of the programme. For fresh water supply
For fresh water supply the programme is focusing on two issues:
First of all the national hydrological modelinstrument NHI should be made 'region proof'. This instrument build to model the national waterdistribution will be tested and improved in several regional pilots in order to be useful for the waterboards.
Secondly selfsustainability is an important issue: the ability of an area to be able tot fulfill its own water needs, also under dry circumstances
Increasing this self sustainability could be achieved in several ways: by more efficient intake of water, by retention in wetlands, by water level controlled drainage in agriculture or by the concept of 'water farming' (in Dutch Waterhouderij). Within Deltaproof with with weatherboard the practical possibilities are explored.
With the knowledge for climate programme ' Climate proof fresh water supply' a firm cooperation has been established on above mentioned issues. STOWA the executor of the Deltaproof programme is therefore one of the main cofinancing organizations.

Climate Change Impacts on Water Management and Adaptation Strategies in The Netherlands: Stakeholder and Scientific Expert Judgements
(Contact: Jeroen Veraart, jeroen.veraart@wur.nl))

In June a paper appeared in which the results of a survey presenting stakeholder and scientific expert judgments regarding the impacts of climate change on water management in the Netherlands in 2001. The main methodological findings were put into broader perspective by discussing the role of stakeholder and scientific expert judgment in the context of the Dutch national research programme 'Climate changes Spatial Planning' (CcSP) in the period 2001–2007.
We focus on flood risks, and impacts on freshwater resources because they were mentioned most in the 2001 survey.
For the flood risks, a high degree of consensus amongst stakeholders and scientific experts was discovered about knowledge, values and aims involved. This was not the case for the impacts of climate change on freshwater resources. The approach, chosen in 2001, enabled the researchers to explore the different opinions regarding the impacts of climate change. It appeared, however, very difficult to prioritize available adaptation options and to formulate cross-sectoral adaptation strategies. Within the CcSP programme, initiated after the 2001 survey, it can be observed that stakeholders become more involved in expert judgements about climate change impacts and adaptation strategies. The interaction between scientists and stakeholders is gradually shifting from a collaborative/consultative approach towards a real participatory approach in the research and design process of combined regional and sectoral adaptation strategies.
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