The intensively managed Utrechtse Vecht catchment and its wetlands, The Netherlands
A.H. van Loon, 2011-12-31

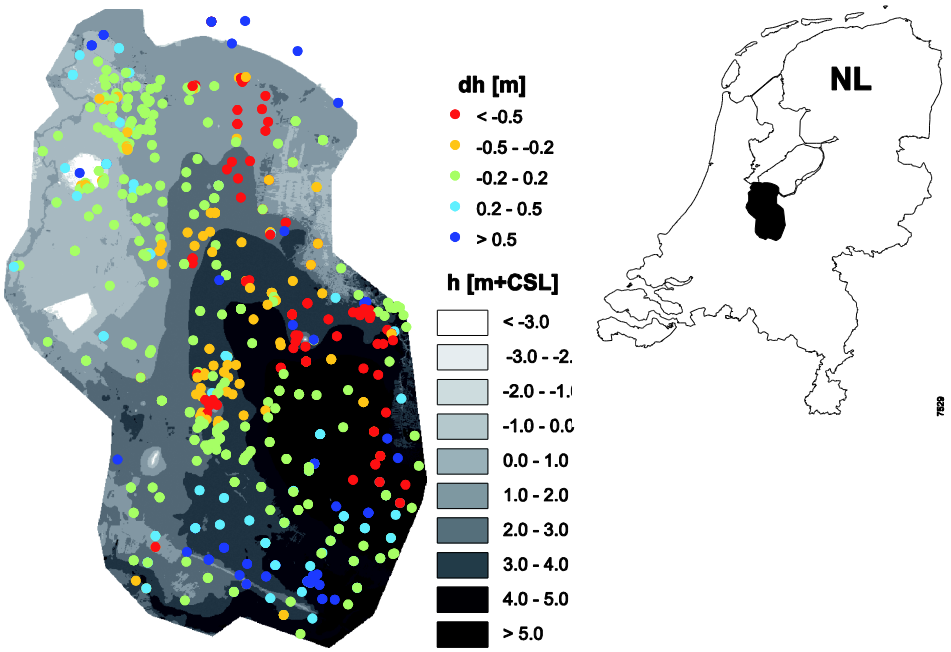

Figure 1: Ground surface elevations (h) and positions of groundwater observation wells (dh, indicating model performance) in the eastern part of the Utrechtse Vecht catchment (source: Van Loon et al., 2009a).

Background information	The Utrechtse Vecht catchment is situated in The Netherlands (52°10′N and 5°10′E; Fig. 1) and covers an area of c. 35 km2. The catchment consists of an ice-pushed ridge with ground surface elevations ranging from 0 to 30 m + CSL and a vast wetland area with ground surface elevations ranging from -5 to 0 m + CSL. Both the ridge and the wetland were drained by the River Vecht until 1500 AD. Due to water management and associated land subsidence, the River Vecht has become an infiltrating surface water and the catchment is drained by a complex system of polders with artificially controlled surface water levels.
Main research and management problems	Since 1000 years, the Vechtstreek area has gradually become an intensively water managed area in order to facilitate the co-existence of multiple land use functions. These land use functions include agriculture, housing, drinking water production and nature. Nowadays, water managers are facing numerous environmental problems like land subsidence and insufficient surface water quality and groundwater quality for drinking water production and, particularly, nature conservation. These problems often relate to a series of hydrological transitions that have occurred in the past due to water management, like water level control by supplying external, polluted surface water and drainage of excessive water. Additionally, emissions of nutrients and other pollutants to ground and surface waters from numerous sources have risen since WOII. These accumulating changes have caused a permanent evolution of the state variables that determine patterns and trends in water quality and habitat

	conditions. This makes disentangling the hydrological key-processes behind the environmental problems faced nowadays a challenging task. Also, long-term assessments of patterns and trends in water quality requires thorough insight into the continuing evolution of state variables in future. A general research question relevant for both the GWEN-network and this specific wetland is: How are long-term trends and spatial patterns in groundwater quality, surface water quality and habitat conditions determined by the wetland's hydrological state variables, management and pollutant emissions, given it's permanent evolution and geohydrochemical setting? For example, it would be very interesting to obtain more insight into past and future changes in water and ion balances, and the role of possible determining mechanisms (surface runoff, groundwater-surface water interactions, oxidation-reduction processes) and state variables (ground surface elevations, drainage patterns, vegetation).
Possible end-users	Water boards, provinces, nature organization and drinking water companies are the main stakeholders. Their interests in knowledge about the key-variables determining ground- and surface water quality is somewhat different, however. Water boards may benefit from enhanced insight into the determining factors of surface water quality particularly in relation to hydrological processes and water management. Provinces would be more interested into the relation between hydrological state variables, management and habitat conditions and patterns. Water companies are particularly interested into the relation between emissions of nutrients and other pollutants and trends in ion concentrations in groundwater. Given the past and future evolution of the wetland's state variables, comparison studies of pristine and managed wetlands, like proposed in GWEN, could be an effective approach for enhancing insight into the relevant processes including the effects of global change.
Site conditions	Originally, the wetlands in the Utrechtse Vecht catchment were comprised of low-productive fens, bogs, river forests and lakes. Their spatial configuration was largely determined by hydrology, which resulted in vast, contiguous habitats. Nowadays, the wetlands comprise a wide diversity of ecosystems that are characteristic for varying wetland types and plant successional stages; a variety of fens, bogs and lakes covered with forests, sedges, reeds, mosses etc co-exists in a matrix of antropogenic land uses. Their co-existence largely depends on nature and water management and, particularly, hydrology.
Monitoring and data	A vast amount of monitoring data is available, including time series of groundwater heads, ground surface elevations, land use/cover, ground- and surface water chemistry, and some discharge fluxes. Most of this data is publically available, though, data sources are fragmented. Also, several palaeo-studies have been conducted, providing insight into the wetland's palaeo-evolution.
Related, recent publications	**Wetland hydrology** Van Loon, A.H., Soomers, H., Schot, P.P., Bierkens, M.F.P., Griffioen, J. and Wassen, M.J., 2011. Linking habitat suitability and

	seed dispersal models to analyse the effectiveness of hydrological fen restoration strategies. Biological Conservation 144, 1025-1035. Van Loon, A.H., Schot, P.P., Bierkens, M.F.P, Griffioen, J. and Wassen, M.J., 2009a. Palaeo-hydrological reconstruction of a managed fen area in The Netherlands. Journal of Hydrology, 378, 205-217. Van Loon, A.H., Schot, P.P., Bierkens, M.F.P., Griffioen, J. and Wassen, M.J., 2009b. Local and regional impact of anthropogenic drainage on fen contiguity. Hydrology and Earth System Sciences 13, 1837-1848. Dekker, S.C., Barendregt, A., Bootsma, M.C. and Schot, P.P., 2005. Modelling hydrological management for the restoration of acidified floating fens. Hydrological Processes 19, 3973-3984. Schot, P.P., Dekker, S.C. and Poot, A., 2004. The dynamic form of rainwater lenses in drained fens. Journal of Hydrology 293, 74-84. **Related PhD-theses:** Soomers, H., 2012. Van Loon, A.H., 2010. Unravelling hydrological mechanisms behind fen deterioration in order to design restoration strategies. Dissertation, Universiteit Utrecht. Bos, I., 2010. Distal delta-plain successions: architecture and lithofacies of organics and lake fills in the Holocene Rhine-Meuse delta, The Netherlands. Dissertation, Utrecht University.