Geophysical Research Abstracts
Vol. 14, EGU2012-5451-1, 2012
EGU General Assembly 2012

Water scarcity, groundwater and base flow in Dutch catchments: effects of climate and human impact

D.M.D. Hendriks, R. van Ek, and M.J.M. Kuijper
Deltares, Utrecht, Netherlands (dimmie.hendriks@deltares.nl)

During recent years (2003, 2006 en 2008) water boards in the Netherlands have had to cope with drought and water scarcity. Because of human impacts in the area, like groundwater abstraction and extensive drainage, the upper parts of streams run dry during low precipitation periods. The lack of water is a risk for the environmental flow needs of the streams. In addition, agricultural areas encounter problems due to low groundwater levels and limited availability of water for spray irrigation. Such problems are likely to occur more frequent in the future, because of increasing frequency of dry spells, reduced water intake possibilities from large rivers and a higher demand for water for agriculture and other land use functions.

Several studies have been carried out to investigate the possibilities for structural improvement of groundwater and base flow conditions, thereby improving the situation of agriculture and ecology (Hendriks et al., 2010; Kuijper et al., 2012). The effects of both climate change and unsustainable use of water resources on base flow were assessed at various scales. For this purpose, spatially distributed groundwater models with fine meshed grids (25x25 m) were used to simultaneously assess the effects of climate and human impacts on both groundwater conditions and surface water discharge. Climatic effects were assessed by comparison of meteorologically dry and average years, as well as through climate scenarios from the Royal Dutch Weather Service (KNMI). Human impacts were assessed by modeling various scenarios with reduced or increased drainage and groundwater abstraction, including a scenario of the undisturbed situation. Also, the impact of stream morphology was studied. The suitability of a new modeling approach (Van der Velde et al., 2009), allowing a fast assessment of discharge with high accuracy, was tested to improve discharge simulations from groundwater models.

Model results show that extensive drainage systems have a large impact on base flow (25 - 40 % reduction), while the effect of groundwater abstraction was relatively small (5 - 17 % reduction). Water abstraction for spray irrigation can however significantly reduce base flow during the growing season and is likely to increase under a warmer, dryer climate. Climate change (warm and dry scenario) can have a significant effect on base flow conditions (33 – 70 % reduction in 2050). Our results show that in order to restore base flow conditions sufficiently, measures should be taken at two scales: improving stream morphology at the local scale, and reduction of human impacts at the catchment scale.

References:

Hendriks D.M.D., De Louw, P., Van Ek, R., 2010. Effecten van drainage, beregening en klimaatverandering op basisafvoer van beken, H_2O 2010(6): 40-43. 3.

Kuijper, M.J.M., Hendriks, D.M.D., Van Dongen, R.J.J., Waaijenberg, J., Worm, B. (2012) Sturen op Basisafvoer: een analyse van zomerafvoeren in het beheergebied van waterschap Regge en Dinkel en hoe daar in de toekomst mee om te gaan. Deltares, 1202530-000-BGS-0012.

Van der Velde, Y., G. H. De Rooij, et al. (2009). "Catchment-scale non-linear groundwater-surface water interactions in densely drained lowland catchments." Hydrology and Earth System Sciences 13: 1867-1885.