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Interactive comment on "Long-term geochemical and hydraulic measurements in a characteristic confined/unconfined aquifer system of the younger Pleistocene in northeast Germany" *by* C. Merz and J. Steidl

C. Merz and J. Steidl

CMERZ@ZALF.DE

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We thank P. Lachassagne for his constructive hints and comments. Regarding the comment to the sentence "Changing hydraulic boundary conditions and how they influence the observed dynamics of the subsurface water geochemistry are poorly understood (Hansen et al., 2011). The cause-effect chains of different impacts often remain unclear" it seemed to be a misunderstanding. We absolutely agree with P. Lachassagne′s statement that these issues can be tackled on the basics of water science, at least hy-

draulically. What we want to express is that this issue is not a trivial problem with regard to groundwater chemistry, and that we need a lot of efforts to solve this problem. The recent hydrological water cycle in northeastern Germany is characterized by changes (climate driven and direct anthropogenic influences) showing a high quantity of different hydraulically-geochemically coupled processes with distinctive non-linear interactions at different spatial and temporal scales. In our opinion there is a substantial uncertainty in modeling the future magnitudes and rates of these processes. Therefore, the cause/effect chain of climate and technological changes and their impacts on water resources has to be assessed explicitly. In order to avoid misunderstanding due to our unclear wording we modify the statement to: "Changing hydraulic boundary conditions and how they influence the observed dynamics of the subsurface water geochemistry are poorly understood (Hansen et al., 2011). The cause-effect chains of different impacts are often still unclear".

In response to P. Lachassagne′s additional comments, we revised the manuscript considering the recommended clarifications and additions: P.L: The qualification of "long term" is not sustained by the data; in fact, in hydrogeological systems, 14 years may be "short term".

Answer: We decided to change the title and skip the qualification "long term" but we don′t agree that 14 years of measurements can be characterized as "short term" measurements in general. It strongly depends on the systems dynamics. Therefore we used a neutral wording: "Data on geochemical and hydraulic properties of a characteristic confined/unconfined aquifer system of the younger Pleistocene in northeast Germany".

P.L: Duration of pumping for each sampling for analyses must however be checked.

Answer: Sampling was carried out after a minimum pumping duration of 45 minutes and until geochemical parameters remain stable.

P.L: Are automatic piezometric data loggers calibrated from the manual measure-

ments?

Answer: Yes, calibration of the data logger was done on the basis of manual measurements.

P.L: Similar data may be available in this region, particularly those resulting from the Water Framework Directive networks. These other data should be cited and located.

Answer: Groundwater measurements are very rare in this region. Before the unification (1998) the groundwater monitoring network was better established but just focused on hydraulic measurements. Geochemical investigations were limited to the surroundings of water works. None of these data have been published and only a few hydraulic data are actually available for further interpretation. At the time being, 11 groundwater wells are constantly hydraulically monitored in this region by the State Office of Environment, Health and Consumer Protection (LUGV). Locations are shown in figure 3. Seven of these wells are additionally geochemically monitored (2 times a year for 20 parameters: EC, pH, O2, anions and cations). The data sets are available from the LUGV and partly being published in annual environmental reports.

P.L: Why these boreholes were drilled and monitored is not explained. This should be done, and also which results have already been gained from this survey.

Answer: The installation based on a scientific monitoring program funded by the ZALF Müncheberg. The Quillow catchment was selected as a typical complex area for the glacially formed Pleistocene landscapes with an agriculturally dominated land use system. The aim was to identify and to quantify the main hydraulic and geochemical process interactions at the different interfaces in the glacial landscape and to develop a set of parameters and indicators that function as proxies for characterizing the substance dynamics in the Pleistocene aquifer systems under consideration of different land use systems. Sub selections of these data have been used in a publication before to identify redox conditions in aquifer systems of the State Brandenburg (Merz et al 2009), combined with data not yet available through open datasets.

P.L: Lots of mandatory data are lacking, and moreover these data can surely not be accessed, such as: a) a conceptual hydrogeological model of the site indicating with maps and cross sections the geological structure and hydrogeological functioning of the experimental site. Answer: We will add a new figure with a geological cross section from the local field site and the whole catchment with detailed hydrogeological information (Figure 1).

b) the detailed geological, hydrogeological and technical logs of each well. Answer: Before installing the wells, a complete geological log was taken using driving core soundings down to a maximum depth of 24 m. The complete drilling profiles including the main stratigraphic units are shown in a new figure (Figure 2).

c) the way the wells were drilled and developed, to avoid clogging risks, and, a very important point to check the validity of the head measurements and sampling, the way the wells were sealed (grouted) and the length of the grouted zone in each well. Answer: The deeper wells (HDPE material) were installed with the hollow drilling auger system and sealed in zone between surface and the impermeable till layer (thickness of 4-5 m) using clay pellets to fill up the gap between the piezometer tube (diameter 60 mm) and the drilling auger system (maximum diameter 200 mm). Depending on groundwater level and lithology the shallow wells were sealed in the first 100 – 200 cm of the borehole. The filter screens with 2 mm wide slits are in direct contact to the sandy aquifer material.

d) results of hydrodynamical characterization of the aquifers. Answer: The hydraulic conductivity of the aquifer material was not determined for this site. But investigation was carried out for the same stratigraphic layers (shallow aquifer, Upper Weichselian Aquifer and deeper aquifer, Weichselian-Saalian Aquifer) some kilometers south of the Quillow catchment using the grain size distribution analysis by Hazen and Meyer. The hydraulic permeability ranges from 5.5 E-5 m s-1 to 6.4 E-4 m s-1 (UWA) and 4.0 E-5 m s-1 to 2.6 E-4 m s-1 (WSA). The hydraulic conductivity of the Weichselian till was measured in the Quillow catchment by Rieckh et al. (2012) with values between 1.9

E-6 – 8.1 E-7 m s-1, but we expect even lower values (1 E-7 m s-1).

e) water level data (to be preferred to discharge data) in the local river, to understand surface- ground- water relationships. Answer: We will add a new figure showing the surface - groundwater interaction near wells 198 and 199 and the Quillow River showing water level data from the groundwater and the surface water over a period of 14 years.

P.L: Some other data, that may be available from other existing data bases, such as rainfall, meteorological parameters to allow to compute potential and real evapotranspiration, for instance on a daily time step.

Answer: A complete meteorological data set since 1991 including temperature, radiation, pot. evapotranspiration and precipitation is available from the ZALF homepage, as example for 2010 under doi: 10.4228/ZALF.2010.253.

P.L: Landuse/landcover over the region; - from regional to local (the site) geological and hydrogeological framework and particularly of the studied aquifers.

Answer: We will add new figures with a landuse/landcover map as well as a piezometric map for the Weichselian-Saalian Aquifer – regional and local site (Figure 3 and Figure 4). The regional piezometric map for the shallow aquifer (UWA) is not available.

Interactive comment on Earth Syst. Sci. Data Discuss., 8, 113, 2015.

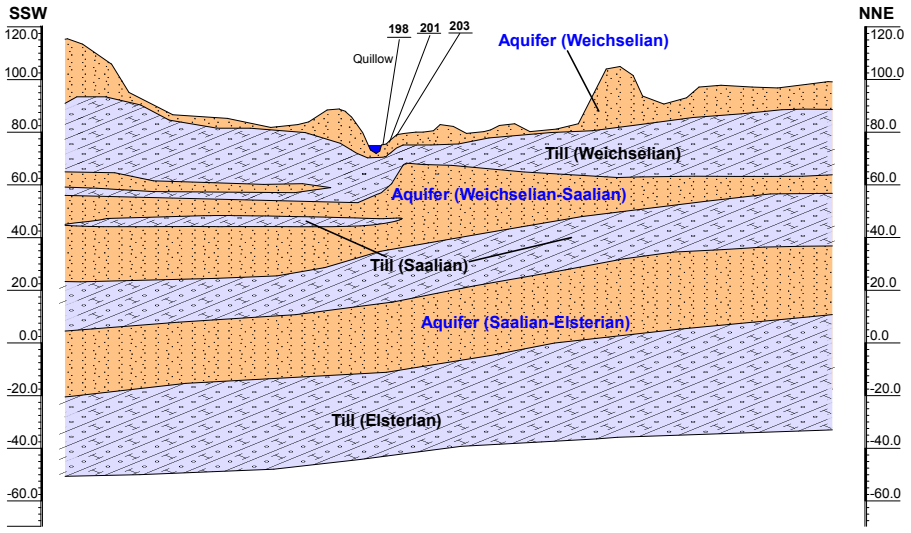
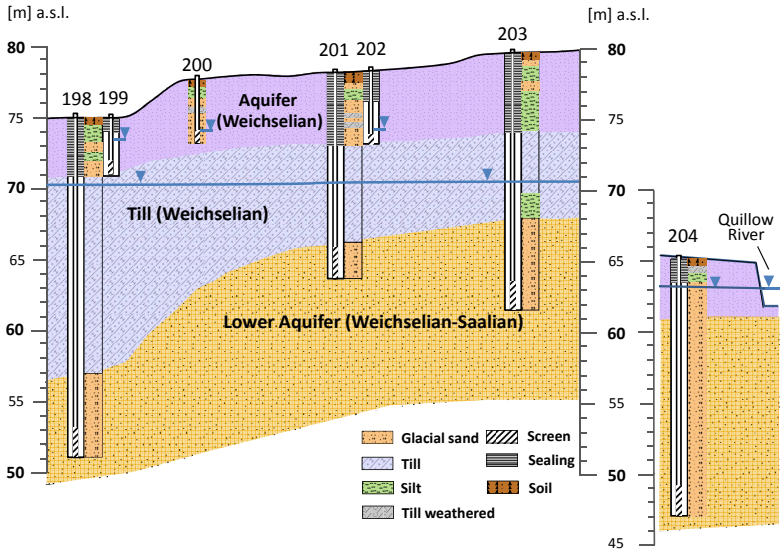


Fig. 1.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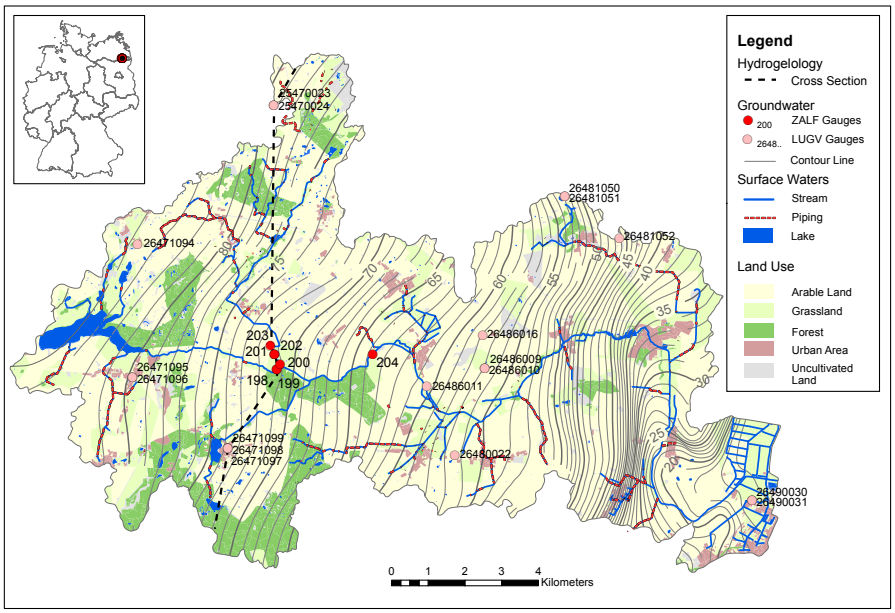
Quillow River
Aquifer (Weichselian)
Till (Weichselian)
Lower Aquifer (Weichselian-Saalian)
Glacial sand
Till
Silt
Till weathered
Screen
Sealing
Soil

Fig. 2.


Legend
Hydrogeology
Cross Section
Groundwater
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2648.. LUGV Gauges
Contour Line
Surface Waters
Stream
Piping
Lake
Land Use
Arable Land
Grassland
Forest
Urban Area
Uncultivated Land
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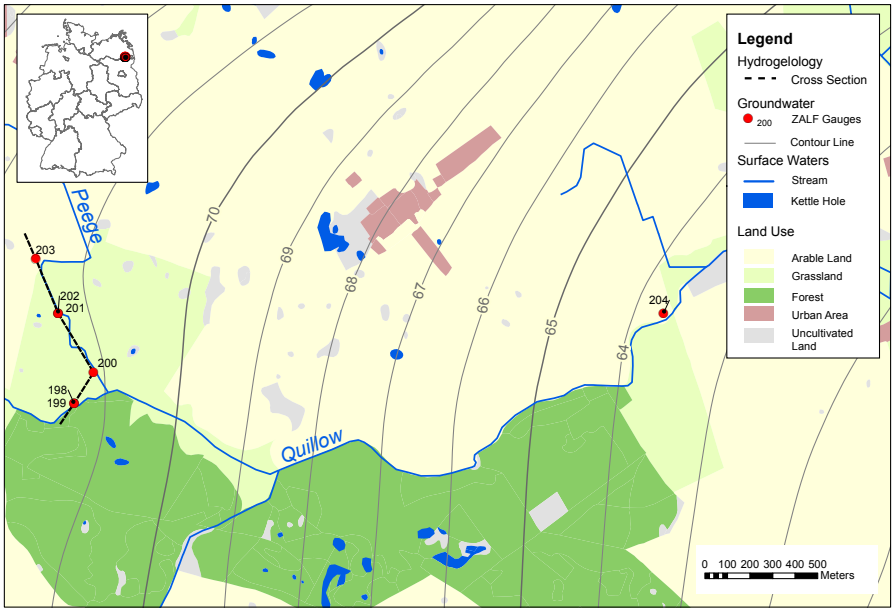
Fig. 3.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Urban Area
Uncultivated Land
Peede
Quillow
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Meters

Fig. 4.