***Dear Prof. Dr. Weller,***

**We first want to thank you for your constructive comments on our paper. We read the comments carefully and we have already done most of the revisions. Find our comments and new text below each point.**

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1- Permeability prediction from IP data has got a considerable tradition (e.g. Börner et al.,1996). It is not only recently (see page318, line 13) that a relation between K and Spor has been postulated as can be seen in Pape et al. (1987).

***Regarding to your comment, we have rewritten this sentence to be:***
***Hydrogeophysical researches of the IP method have shown that SIP data can be correlated with physical properties of the pore space in non-metallic soils and rocks, such as the specific surface area (Spor) and K (e.g., Pape et al., 1987; Börner et al.,1996; Weller et al 2010a).***

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2- It is not justified to state in the introduction (page 5318, lines 20ff) that a direct link between imaginary conductivity and an "effective hydraulic length scale" is missing. I would accept this statement only after a careful discussion in the conclusions.

***We shifted this sentence (page 5318, lines 22-26) from the introduction to be in the conclusions (page 5336, line 2, before "however, Slater……").***

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3- The statement on page 5321 line 12 is not correct. Neither Börner et al. (1996) nor the other papers state that there exists a power law dependence between **real part of resistivity** and *Spor*.

***We reformulated this sentence to be "There exists a substantial volume of literatures demonstrating the dependence of imaginary part of conductivity ($\sigma''$) on Spor…".***

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4- Börner at al. (1996) state in their equation 17 a proportionality. It is a misinterpretation to assume *a* = 1. You find the exact formulation for permeability in their equation 15.

***We will replace Eq. 6 in our paper with the exact formulation for permeability (Eq. 15, in Börner at al. (1996) paper, PARIS equation). Then we will refer to the modification of PARIS equation by Börner at al. (1996), i.e., Eq. 17 in their paper, in the text of our paper.***

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5- There is a contradiction between equation 11 and the describing text. The equation does not include the imaginary conductivity but the DC resistivity. This equation is quite similar to the so-called "new approach" in equation 12 that considers both resistivity and relaxation time.

***We changed the text describing Eq. 11 to be:***
***"Weller et al. (2010a) presented a generalized power-law relation using DC resistivity, chargeability, and mean relaxation time (which were derived from DD) to predict $k$ for isotropic and anisotropic samples,***

$$k = a \cdot (\rho')^{b} \cdot M^{c} \cdot (\tau_m)^{d}. \tag{11}$$

***The four empirical parameters a, b, c and d are determined by a multivariate regression analysis.***

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6- I cannot see how the sample preparation for laboratory SIP experiment guarantees in situ compaction, water conductivity, and water saturation. We know from own experiments that slight changes in compaction of the same material causes significant changes in the resulting complex conductivity spectra. This is one reason that makes a comparison between lab and field data complicated.

***We referred to the sample preparation and saturation in page 5328. For Fuchus equipment, the soil samples should be compacted and full saturated. We drilled a borehole and the water from the aquifer was pumped and used for sample saturation. Because we don't mention the compaction process of soil samples, we will refer to that at the beginning of first paragraph in page 5328. Further, regarding to Revil comment no 12, we added a new figure shows that we measured the SIP response at different water salinities.***

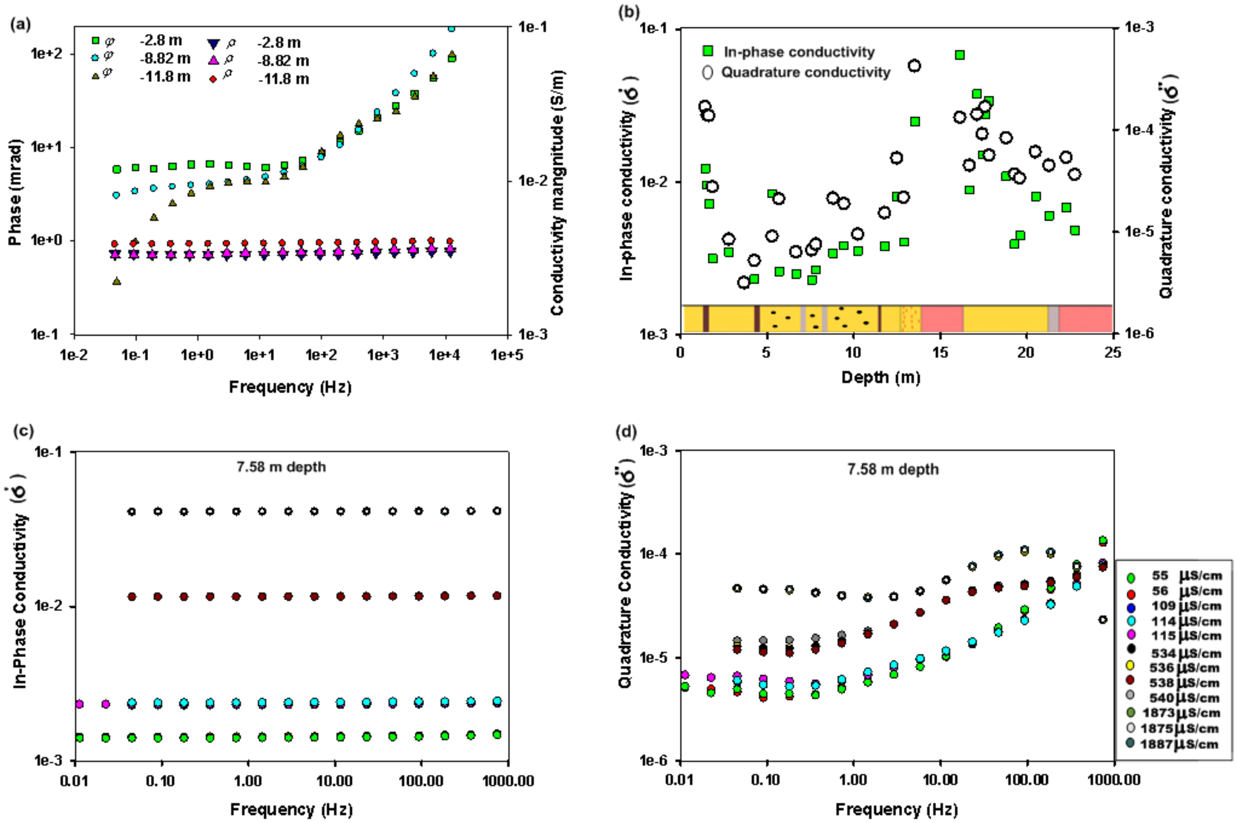

*Fig. 6. (a) Exemplary of SIP response at three samples at different depths (2.8 m, 8.82 m and 11.8 m) and (b) in-phase and quadrature conductivities (at 1.5 Hz) at different depths. (c and d, respectively) In-phase and quadrature conductivities at different water salinities of the collected sample at 7.58 m depth.*

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7) Please discuss the accuracy of K determination by grain size analysis. All these formulas do not consider the state of compaction.

***Indeed, we didn't measure the K values, but we used these data as a reference (Sass, 2010). We referred to that in page 5324 (line 11). Also, the presented equation here was based on the K values of the upper aquifer, which were calculated using coring sleeves. Accordingly, the measured $K$ derived from direct measurements nor from grain size analyses. Then the derived equation was tested for the second aquifer. The grain size analysis equations were applied only for the second aquifer (13 samples).***

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8- Changes in water conductivity and water chemistry also cause changes in the IP spectra (see Weller et al., 2011; Weller and Slater, 2012). The used equations are based on water conductivity of about 100 mS/m.

***First, we will refer to your recent references in the text under section 4.2. In addition we will use these references to indicates that DD successfully fitted the broad range of shape of complex conductivity spectra and was stable for all samples and all salinities (Weller et al. 2011). These references will be valuable to comment on the new figure we added (see Revil reply, no. 12) to show the dependence of IP spectra on water salinity. Also we observed in our data that there is a slight difference in IP response at low water conductivity values ranging 55 and 109 µS/cm (at ~ 1.5 Hz). In our data, the used water conductivity was around 450 µS/cm. Regarding to Weller et al. (2011) and Weller and Slater (2012), it was observed a direct relation between water conductivity and the real component of electrical conductivity. In addition, the imaginary conductivity exhibits a steeper increase at low salinities and asymptotic behavior (flattens) at high water conductivity.***

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*9* - Please indicate the errors in your phase data. We know that sands are characterized by low phases (see your figure 11 with a phase of ~ 1.5 mrad at 1 Hz). Slight errors in the phase measurement cause considerable changes in the resulting hydraulic conductivity.

***Added: Phase data were quite accurate with stacking errors of about 0.1 mrad which allowed the spectral analysis of very small residual phases (Fig. 11). Due to the number of frequencies measured, the derived relaxation time spectrum is relatively independent on statistical errors.***

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10- The discrepancy between the 1D and 2D inversion results should be discussed in more detail. I assume that the 1D inversion is done considering the borehole information. It would have been better to consider the 1D result as starting model for the 2D inversion (e.g. Olayinka and Weller, 1997).

***Yes, we derive the starting model for 1D inversion from the borehole data. We will refer to that at the beginning of section 4.1 (page 5326). Similarly, we will refer also at line 12, page 5362, that we used the borehole data and 1D inversion results as a starting model for 2D inversion to constrain the inversion process regarding to Olayinka and Weller, 1997.***

***"Regarding to Olayinka and Weller (1997), the 1D inversion results and the borehole information were used as a starting model for 2D inversion to constrain the inversion process".***

***At the beginning of discussion (page 533), we refer to the discrepancy between 1D and 2D inversion:***

***"Since it is hard to gain a full control of the subsurface structures in natural geological environments during the 2D inversion, the discrepancy between 1D and 2D inversion results can be observed (Fig. 7). Because the 2D inversion process is carried out using a fixed mesh size, the small IP response can be embedded within the general IP response of the layer, which could be amplified during the inversion process. On the other hand, the 1D inversion shows the IP response for a part of a layer with depth and accordingly, the lateral effect of IP response will be ignored."***

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11- Please indicate how tau_max and tau_lw have been determined? I guess that tau_lw corresponds to the mean relaxation time as proposed by Nordsiek and Weller (2008) in their equation 8 with logarithmic weighting.

***In our paper tau_50 corresponds to Zisser et al., 2010. Tau max is the maximum tau value of god fit of debye model.*** ***Tau_lw=*** $\frac{\sum mi.logtau}{\sum mi}$ .

***We will refer to that in the text (at section 5.2).***

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12- The real part of resistivity does not indicate grain size distribution as stated at page 5331, line 19f.

***Yes, we considered that the real resistivity depends on the grain size and water salinity based on previous studies (e.g., Kresnic, 2007; Chandra et al., 2008; Attwa et al., 2009; Attwa, 2012). Accordingly, we will re-write the sentence in line 19f to be:***

***"For our samples from the first aquifer, which has a homogenous fluid resistivity, If we consider the $\rho'$ as a measure of grain size and pore-size distribution (e.g., Kresnic, 2007; Chandra et al., 2008; Attwa et al., 2009; Attwa, 2012), the aquifer resistivity could be well correlated with the K values of the aquifer (Eq. 5)".***

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13) Regarding the remark 15 of A. Revil, it can be stated that even buried dead wood exhibits measureble polarization effects (see Weller et al. 2006).

***Regarding to your comment and Revil's remark, we will refer to all these results in the discussion in comparison with our results:***

"***Regarding to Weller et al. (2006) and Revil et al (2012b), a considerable variation in the spectra of conductivity amplitude and phase shift can be observed in laboratory investigations of peat, wood and soil samples. Weller et al. (2006) concluded hat characteristic features of phase spectra can be used to detect wooden relics of trackways or pile dwelling from laboratory investigations. Revil et al (2012b) developed a quantitative model to investigate the frequency domain induced polarization response of suspensions of bacteria and bacteria growth in porous media. They showed that the induced polarization of bacteria ($\alpha$ polarization) is related to the properties of the electrical double layer of the bacteria. The high IP effect can be attributed to the surface of the bacteria, which is highly charged due to the presence of various structures extending away from the membrane into the pore water solution. Consequently, the dead cells (i.e. organic material) could show low IP effects."***

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14- I cannot get the message of the statement at page 5334, line16f. We have shown that there exists a reliable correlation between *Spor* and imaginary conductivity.

***For the statement at page 5334, we mean that Eq. 8 (Weller et al., 2010) was derived based on extensive samples and accordingly we used this equation without measuring Spor by BET measurements. Regarding to your comment, we will re-write this sentence to be:***

***"Here, the correlation between Spor and $\sigma''$ cannot be proved because Spor values were not measured (i.e. by BET measurements). Because Eq. (8) after Weller et al. (2010b) was derived from an extensive sample database, the direct relation can be shown between Spor and $\sigma''$ for unconsolidated sediments by using Eq. 8."***

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15- Looking at Figure 8, I recognize a variation in real part of resistivity between 200 and 500 Ohm*m (variation of less than a factor of 2.5!), in imaginary part of resistivity between 5*10^-6 and 3*10^-5 Ohm*m (variation of less than a factor 6), and in hydraulic conductivity between 2*10-4 and 8*10-4 m/s (variation of less than a factor 4). This limited range of variation, which is close to the accuracy of the measured values, does not enable reliable correlations. This is the main weak point of the manuscript. Reliable correlations require a wide variation of the investigated parameters (especially of hydraulic conductivity). I fear that a variation of the hydraulic conductivity between 10-4 and 10-3 m/s is hardly resolvable by both hydraulic experiments and SIP. A variation of K over two decades as stated at page 5334, line 20 is not supported by the presented data.

***We agree that the correlations require a wide soil samples and variation of the investigated parameters. Accordingly, we mentioned at line 12, page 5332 that "A multivariate power law relationship*** $(A(\rho')^{B}(\tau_{lw})^{C})$ ***was examined and it was observed that the exponents B and C are nearly equal". In addition, it is worthwhile mentioning here that we presented a case study and we attempted to predict the hydraulic conductivity based on the available data. We derived and applied our approach for the upper aquifer and then we tested the derived equation on the second aquifer in comparison with other published approaches. Under the geological conditions of the study area, the derived equation shows better hydraulic conductivity predictions than other approaches we presented in this paper. The derived equation in this study is not expected to apply to other areas, but the methodology will. For this reason, we mentioned in line 14, page 5336, that "it would be more meaningful if the above relation is tested in areas with diverse geological environments".***

***Regarding to your comment, we will refer to your notes in conclusion at line 15, page 5336 that "a limited range of hydraulic conductivity variation over the study area can be observed and, consequently, the derived equation in this study is not expected to apply to other areas, but the methodology will."***

***A variation of K over two decades as stated at page 5334, line 20 will be re-written to be "over one decade".***

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16- The last statement in the discussion chapter is not correct. Weller et al. (2010a) recommended the mean relaxation time that seems to be equivalent to the so-called "logarithmic weighted average relaxation time". Zisser et al. (2010b) recommended the median relaxation time.

***We corrected this sentence.***

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Minor errors:
P. 5325, line 2: topics -> optic
P. 5332: reference to equation 13 should be replaced by a reference to equation 12
Several referenced papers are missing in the list of references:
P. 5321: Slater et al. (2006)
P. 5321: Weller and Börner (1996)
P. 5336: Börner et al. (2002)
Fig. 12: labels at vertical axis are missing

***We did all.***

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Further references:
Olayinka, A.I.; Weller, A.: The inversion of geoelectrical data for hydrogeological applications in crystalline basement areas of Nigeria. Journal of Applied Geophysics 37 (1997), 103-115.
Weller, A.; Slater, L.: Salinity dependence of complex conductivity of unconsolidated and consolidated materials: Comparisons with electrical double layer models. Geophysics 77 (2012), No. 5, D185-D198.
Weller, A.; Breede, K.; Slater, L.; Nordsiek, S.: Effect of changing water salinity on complex conductivity spectra. Geophysics 76 (2011), No. 6, F315-F327.
Weller, A.; Bauerochse, A.; Nordsiek, S.: Spectral induced polarisation – a geophysical method for archaeological prospection in peatlands. Journal of Wetland Archaeology 6 (2006), 105 – 125.

***We added these references in the text and the references section.***