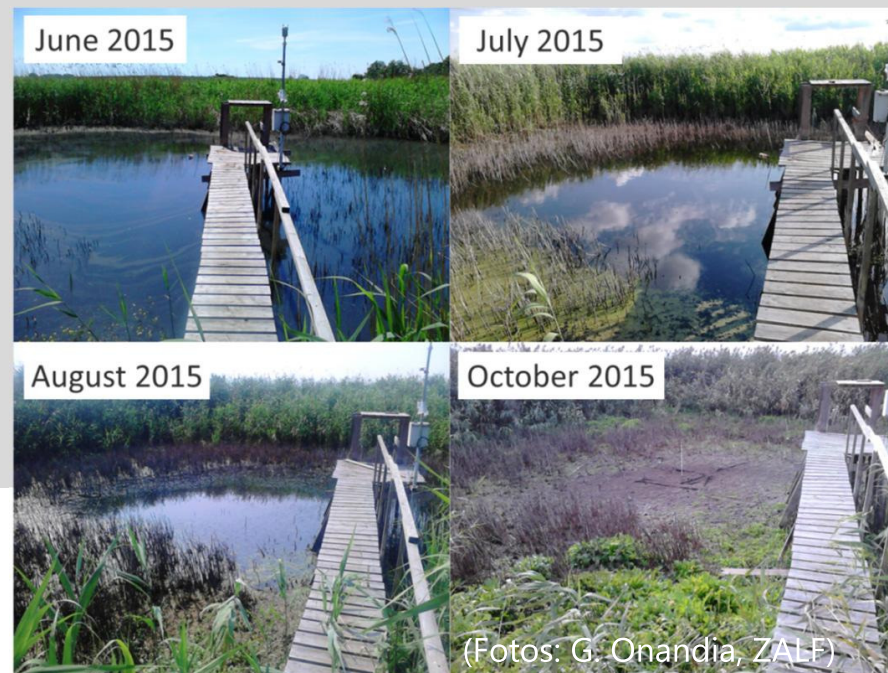


Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V.

Das unterschätzte Gedächtnis: Entwicklung der Grund- und Seewasserstände in Nordostdeutschland

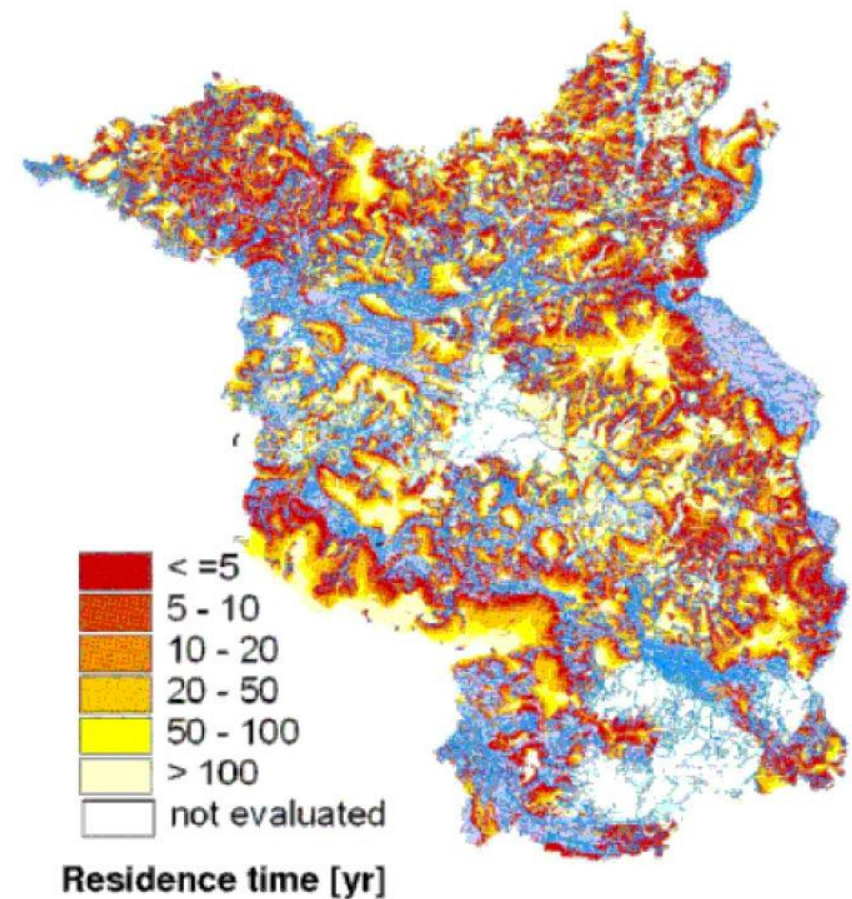
Prof. Dr. Gunnar Lischeid

Neubrandenburg, 18.09.2019



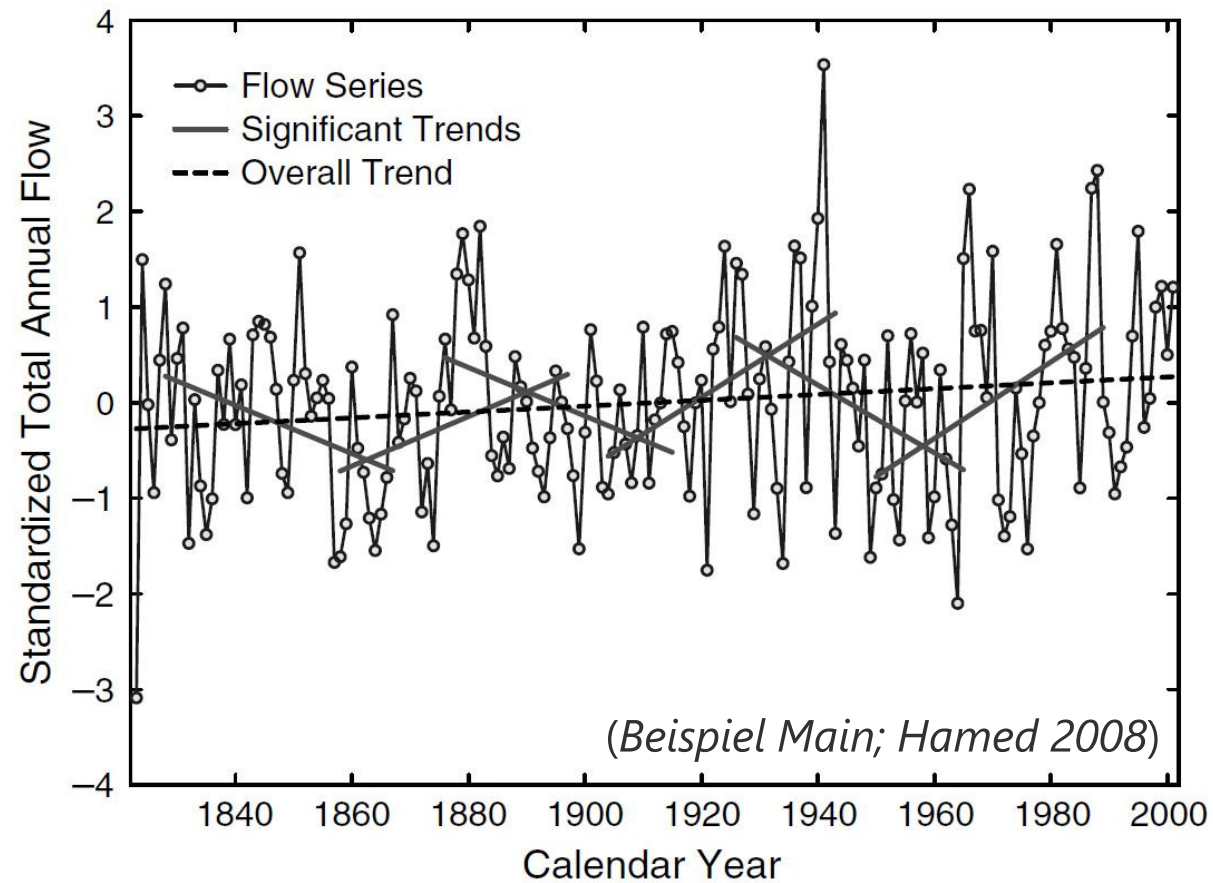
Das Gedächtnis des Grundwassers ...

1. ist lang (*ist bekannt, s. rechts*)
2. ist nicht-linear (*wird auch von Fachleuten in seiner Auswirkung oft unterschätzt, Bsp. Trendanalyse*)



(Merz et al. 1999;
Merz und Pekdeger 2011)

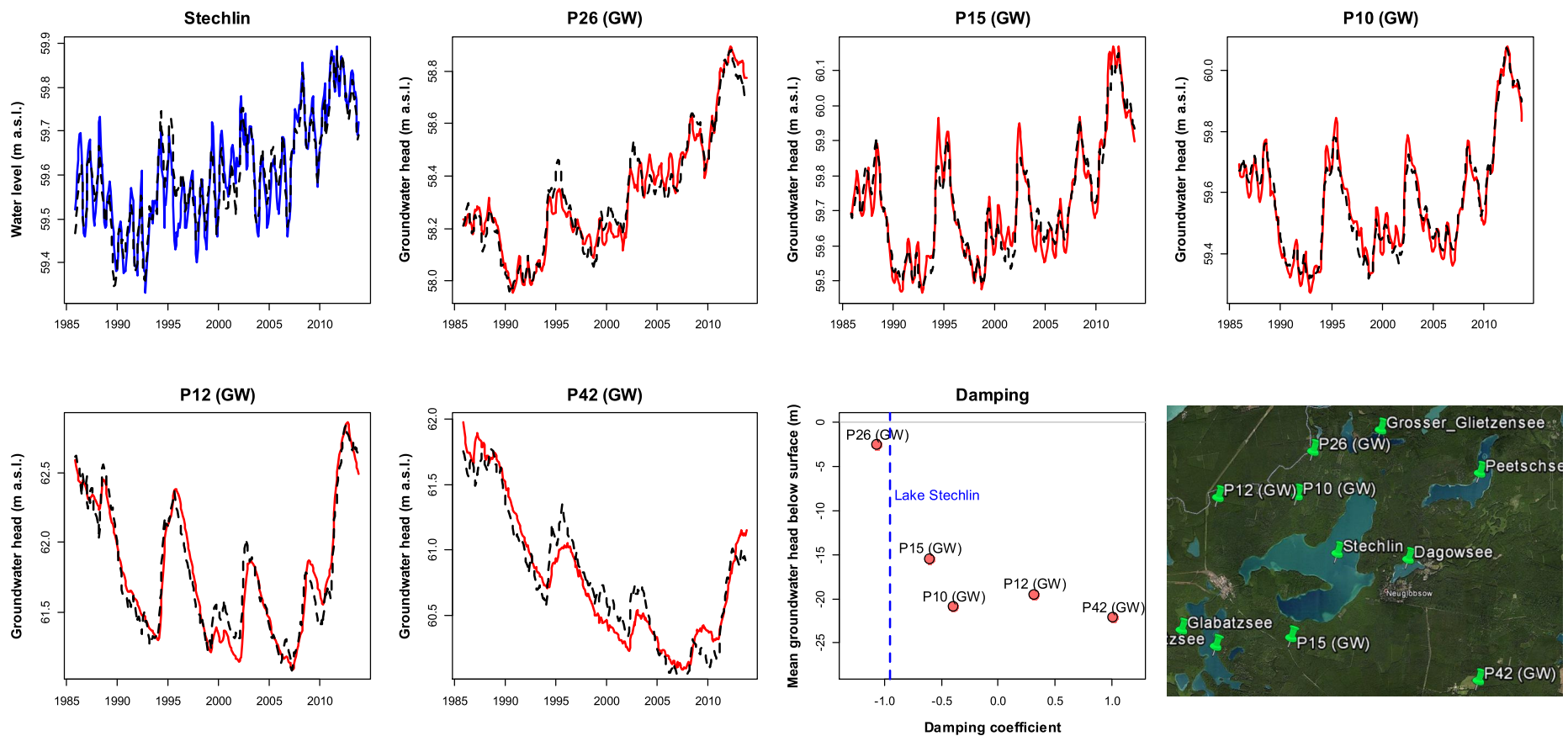
Trends



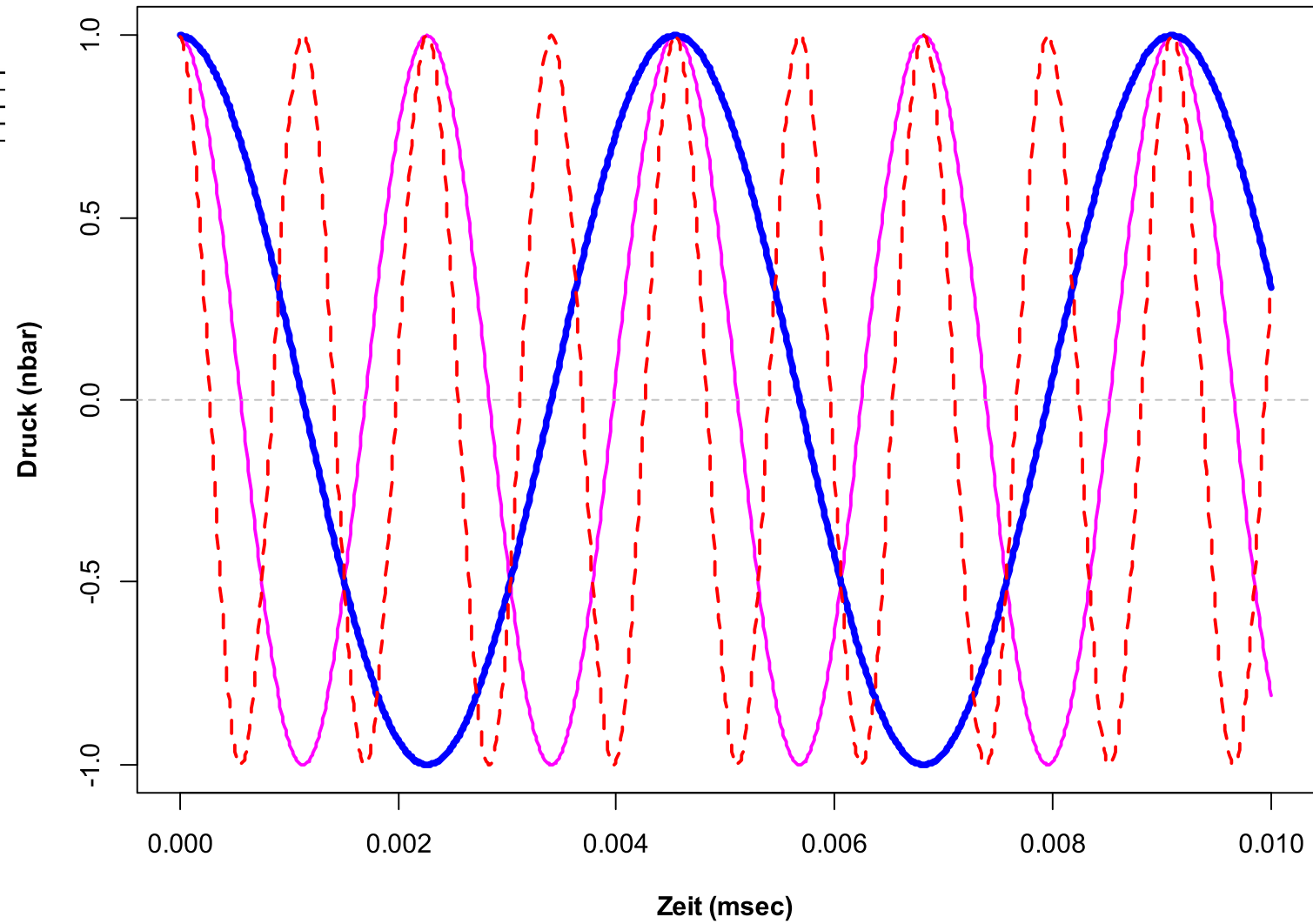
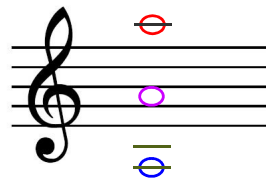
Beispiel: Stechlin-Gebiet

Maximale Entfernung der Grundwasser-Messstellen vom See: 3,5 km

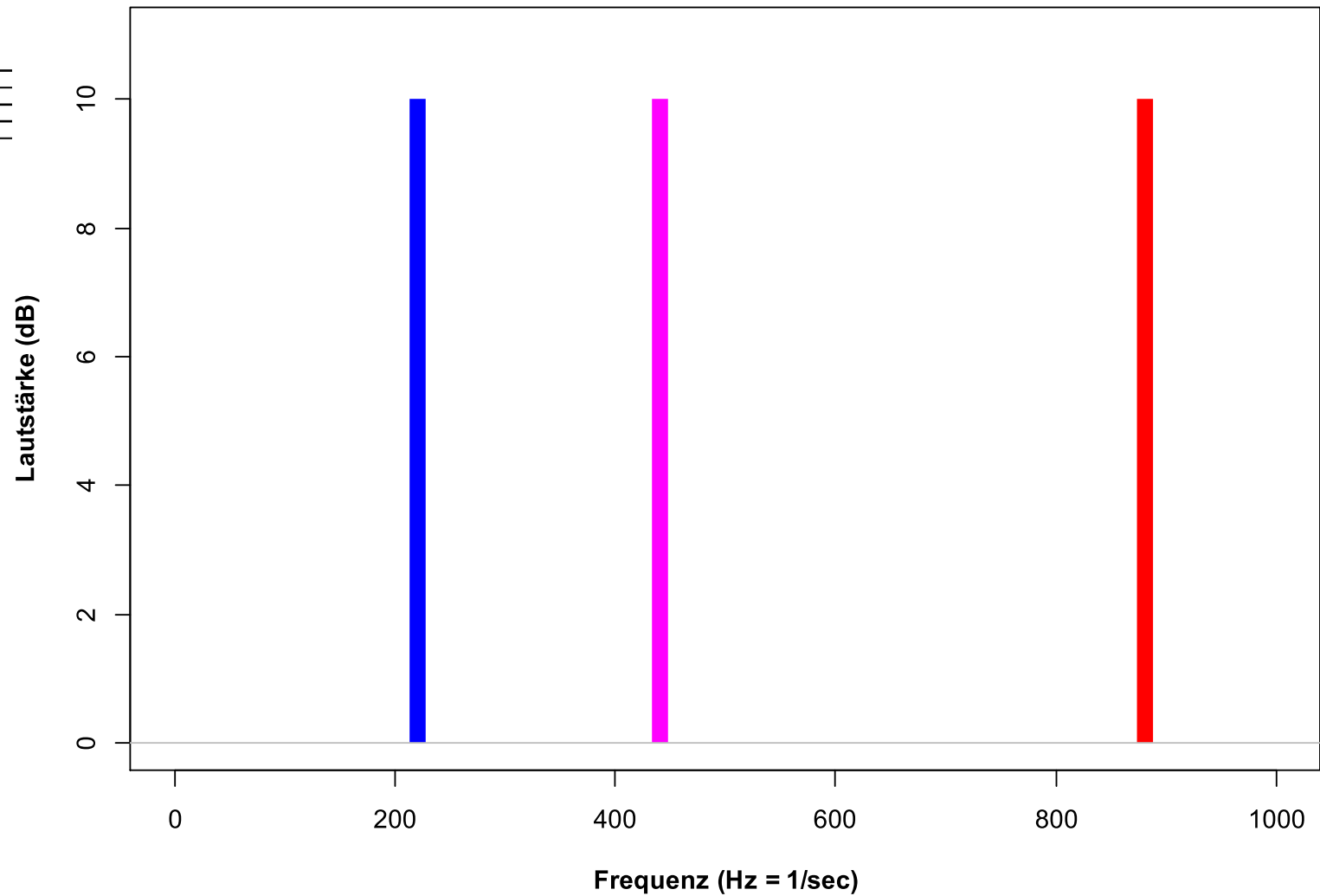
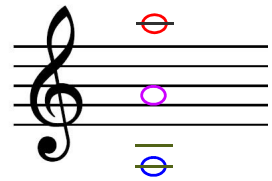
(Lischeid et al., eingereicht)



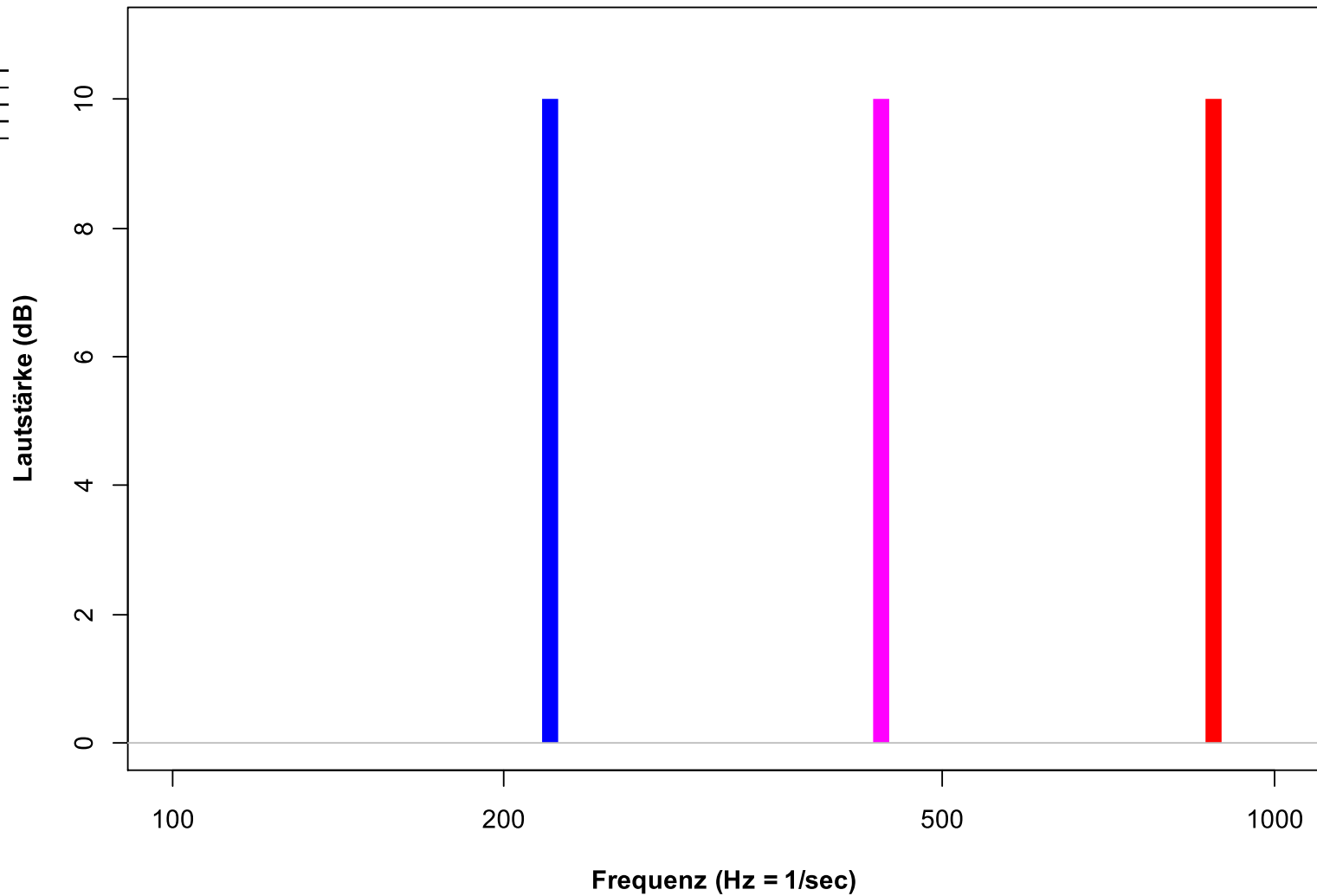
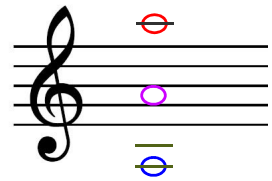
Physik der Musik



Spektrogramm



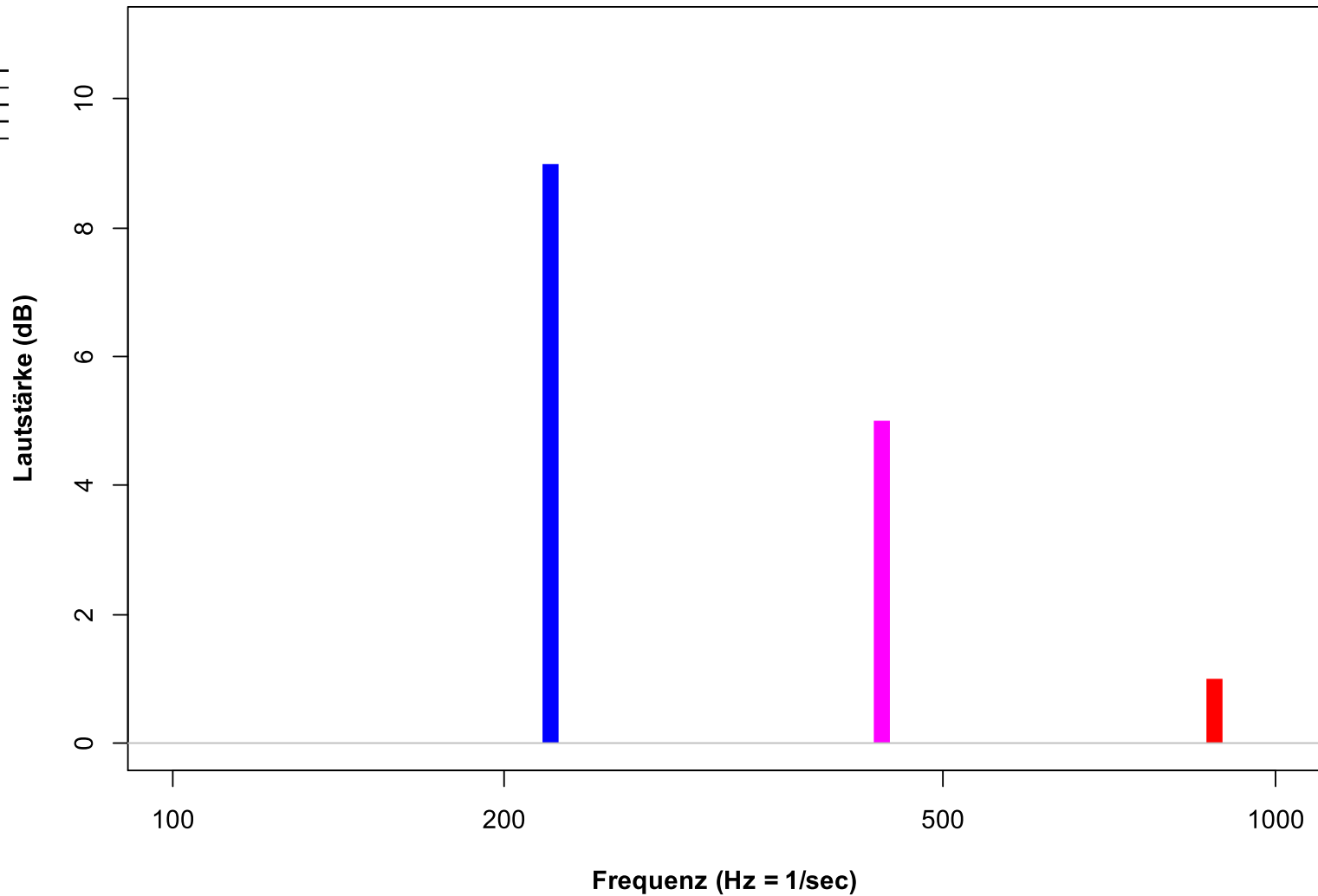
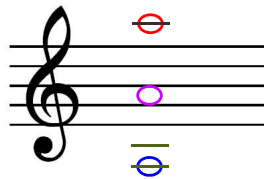
Spektrogramm

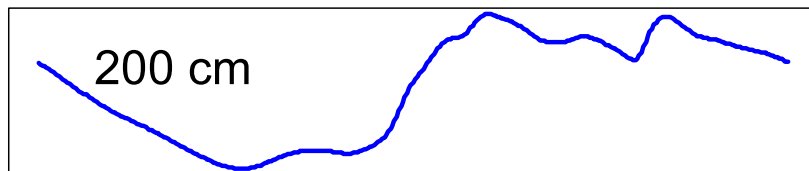
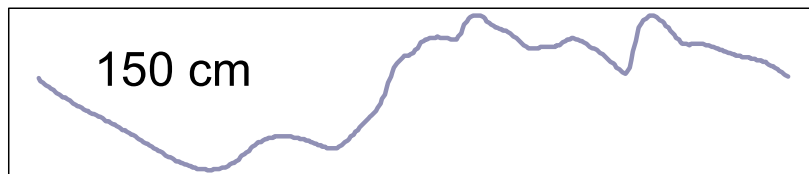
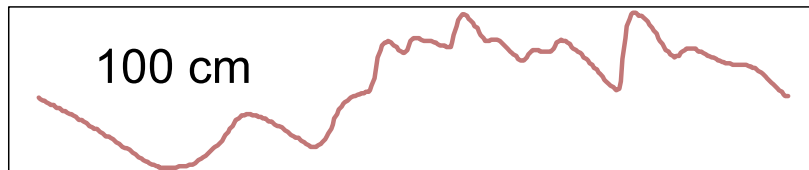
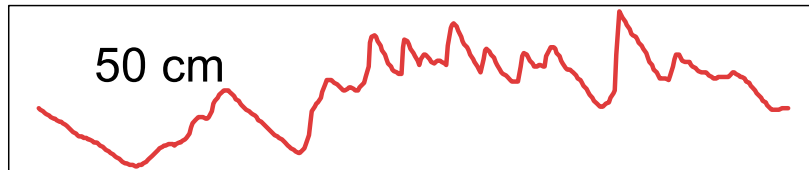
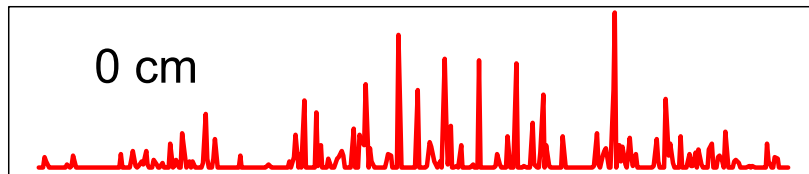


Spektrogramm



Hinter der Wand: Stark gedämpft

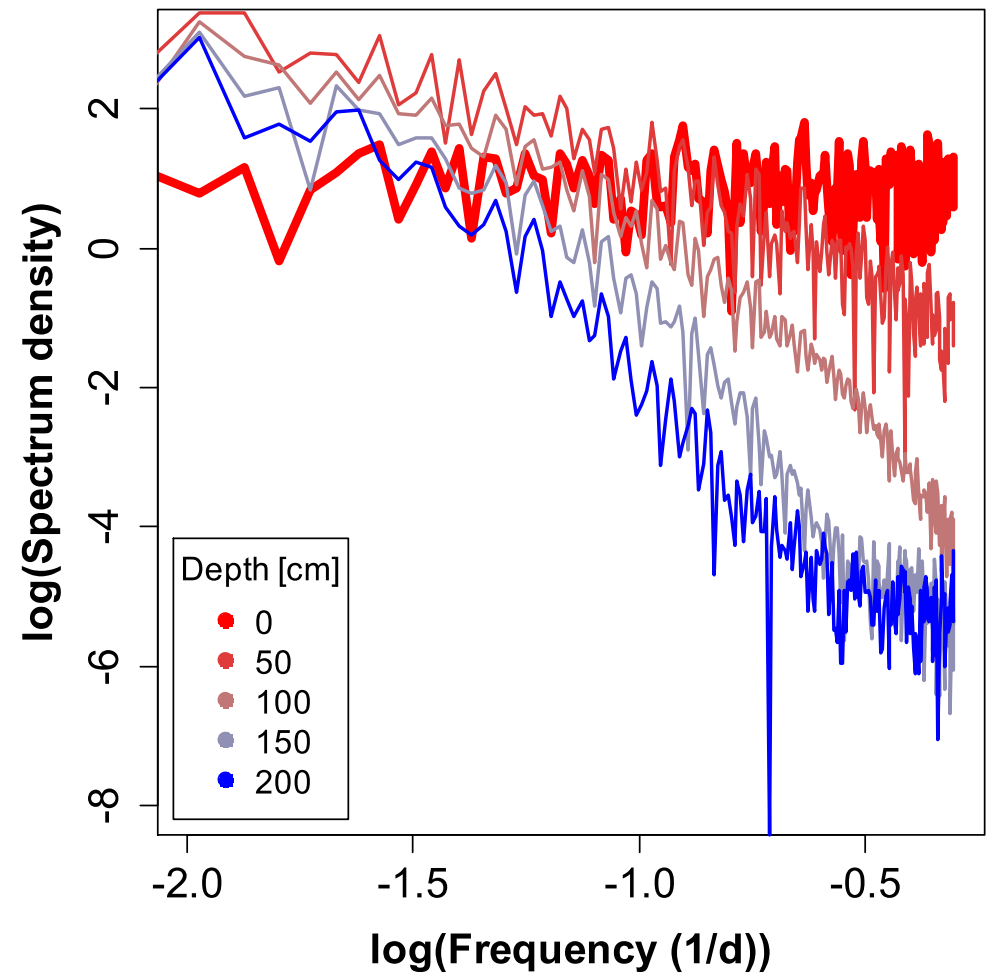
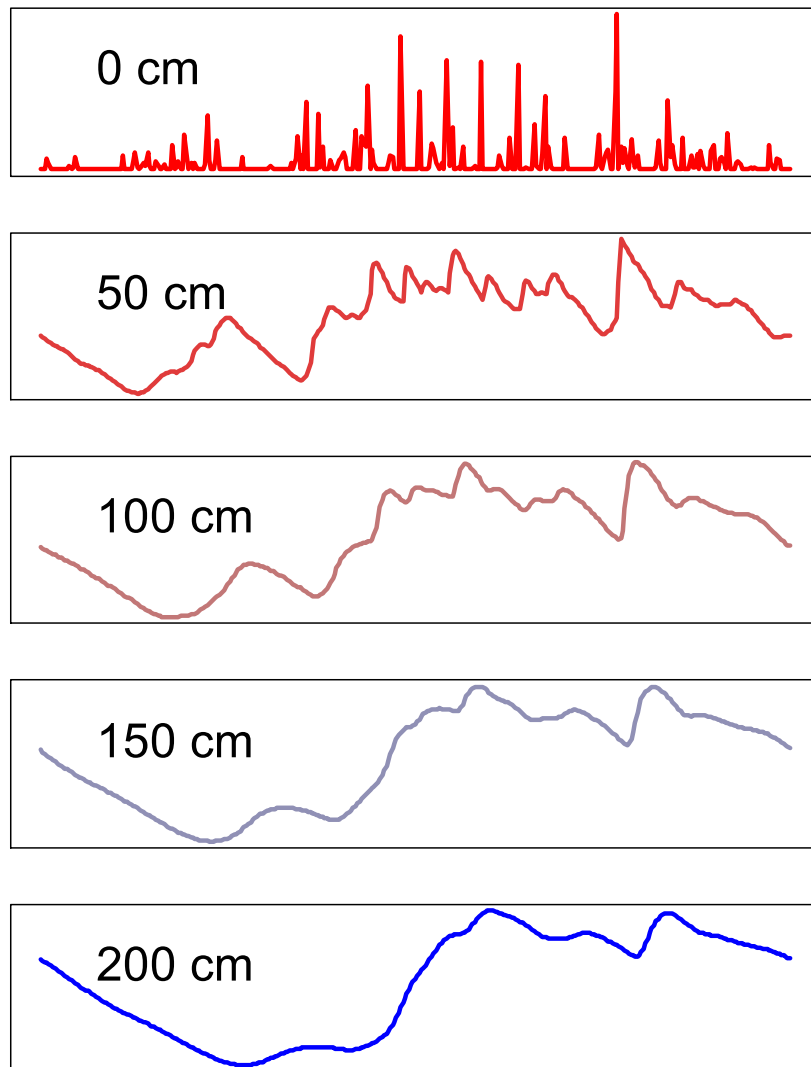




Simulierte Daten des Bodenmatrix-
potentials (T. Hohenbrink):

- 1D Modell, Richards-Gleichung (Hydrus-1D)
- Homogener Boden, 5 m tief
- Van Genuchten-Mualem-Parameterisierung

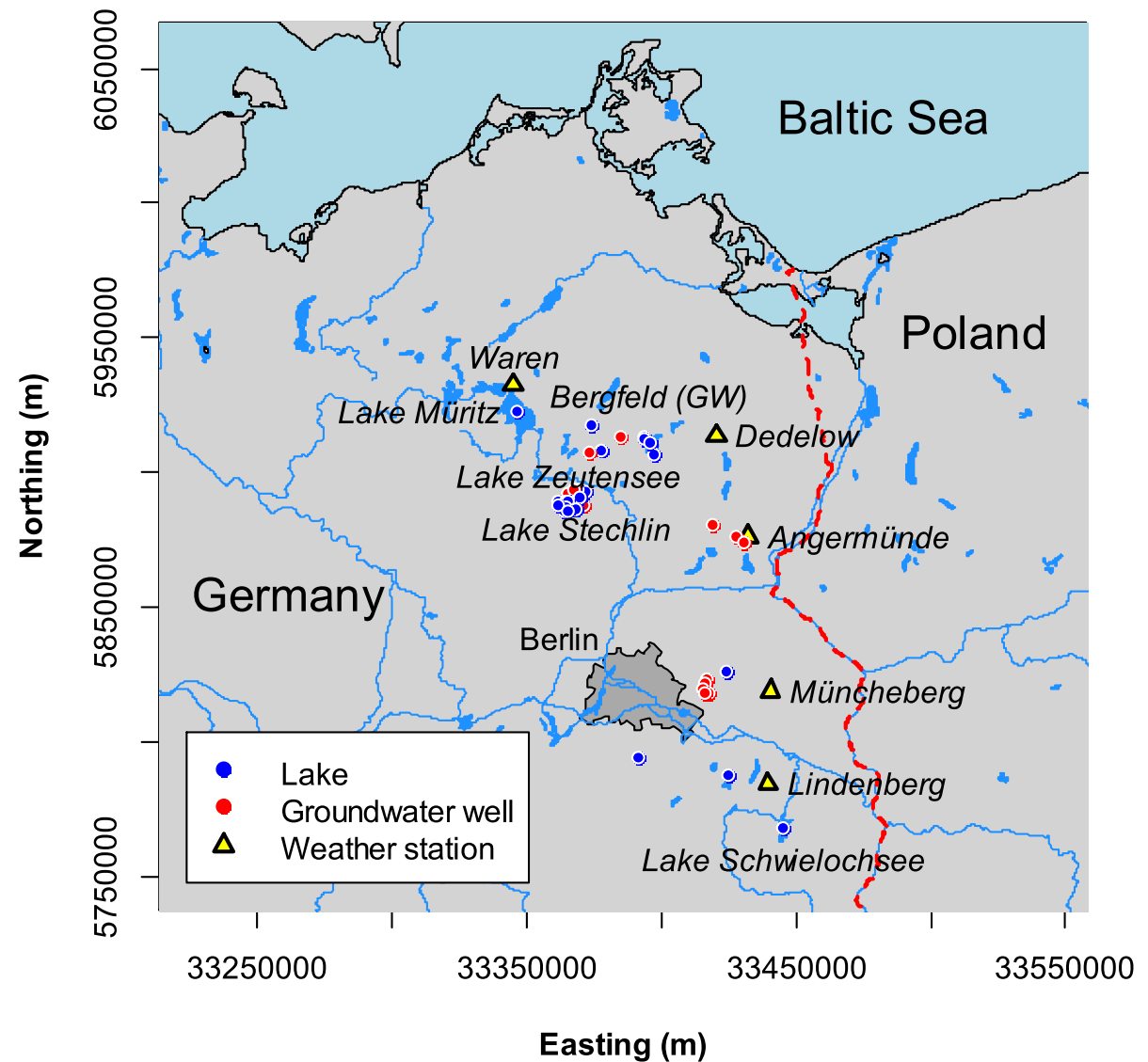
Dämpfung: Spektrum



Datensatz BB + MV



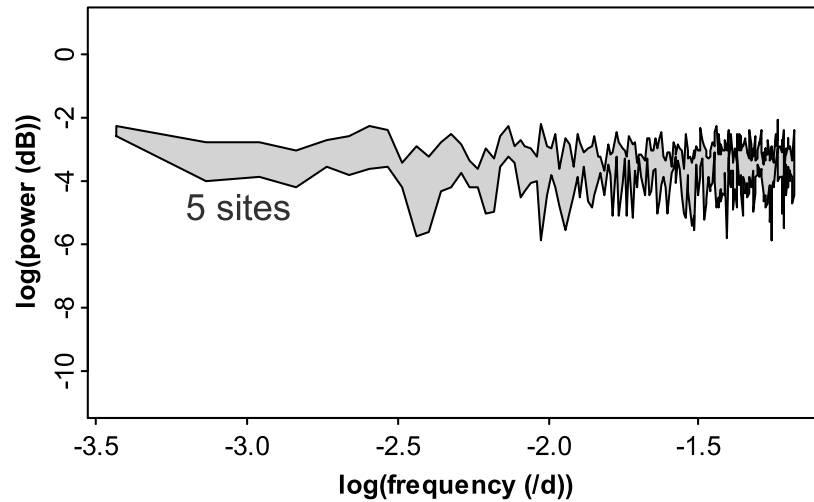
- Monatswerte des
 - Seewasserspiegels (n=23)
 - Grundwasserspiegels (n=17)
entlang eines NW-SE Transekts
(180 km)
- Tageswerte meteorologischer
Größen (n=5)
über 28 Jahre (Nov. 1985 – Okt. 2013)
(Lischeid et al., eingereicht)



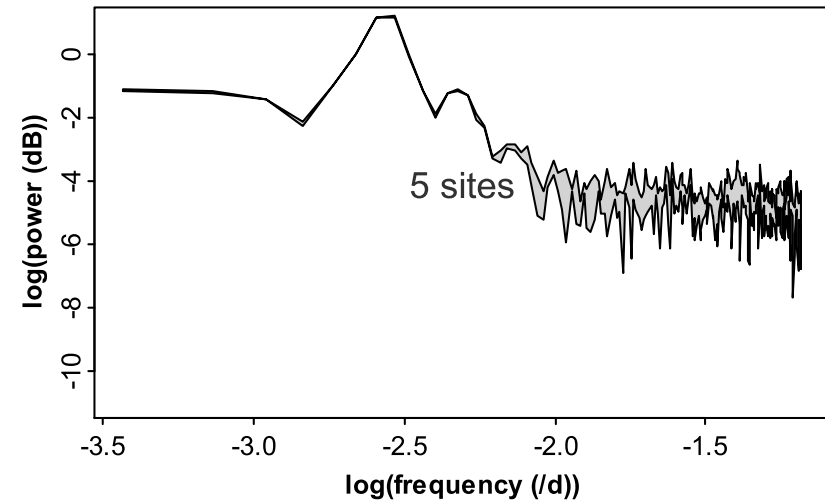
Spektren



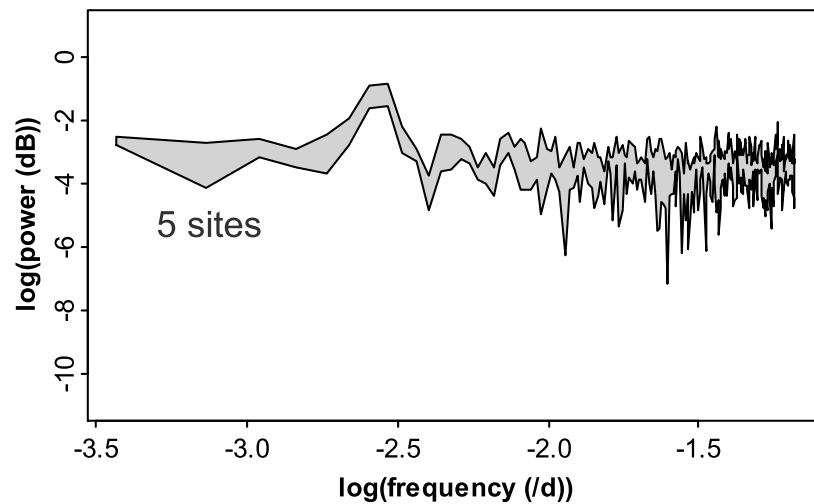
Precipitation



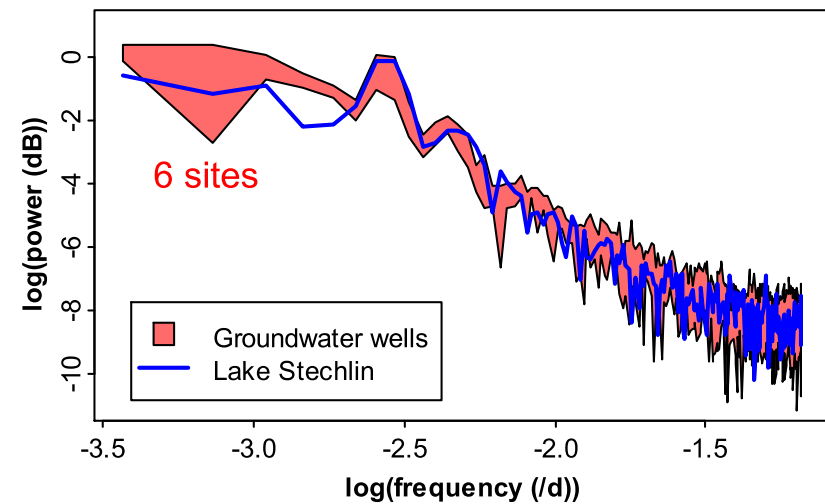
Potential evapotranspiration



Climatic water balance



Lake water level and groundwater head

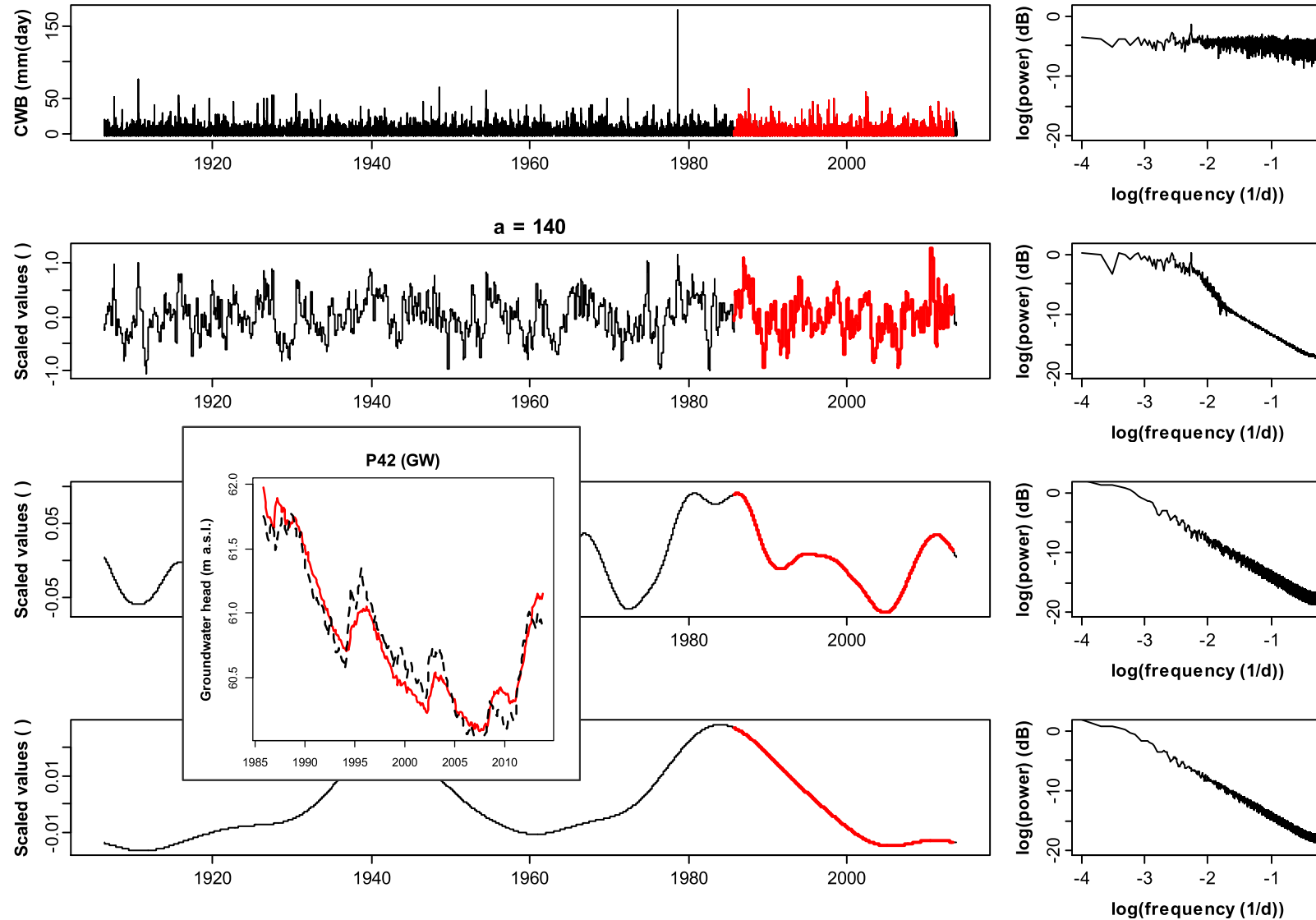


(Lischeid et al., eingereicht)

Dämpfung

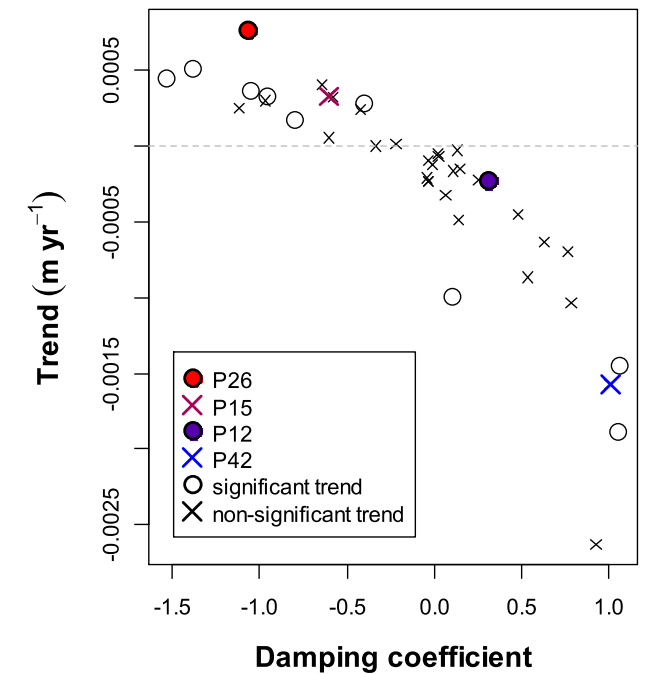
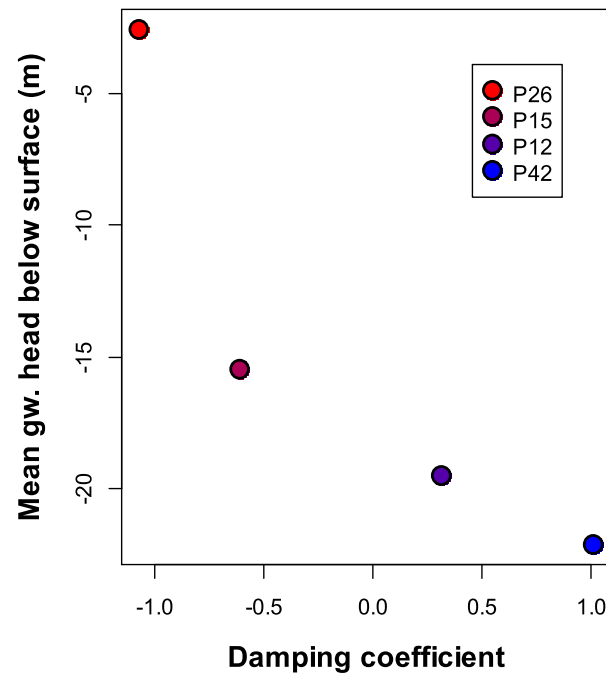
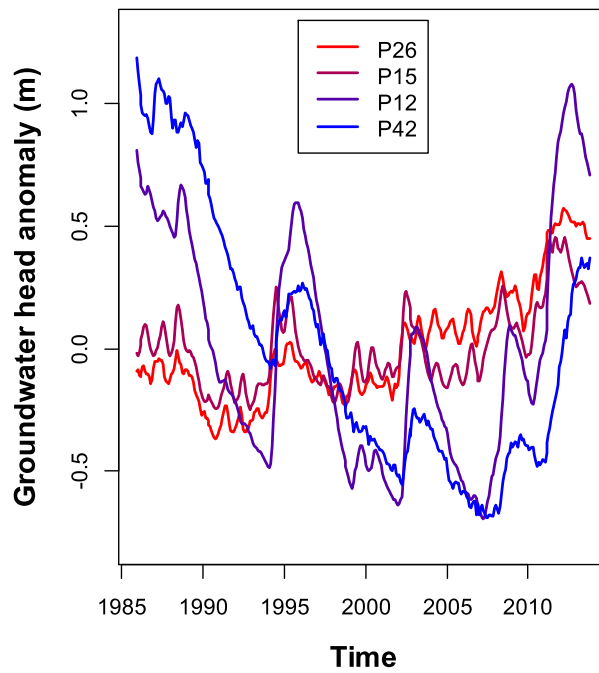


Klimatische Wasser-Bilanz Lindenberg, 01.04.1906 – 31.10.2013



(Lischeid et al., eingereicht)

Grundwassermessstellen Stechlin

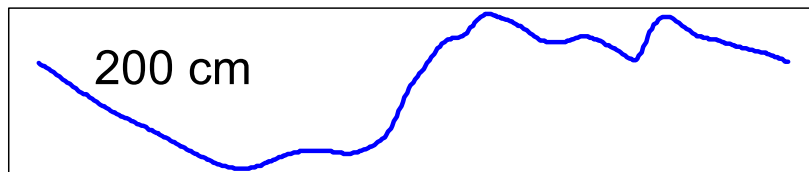
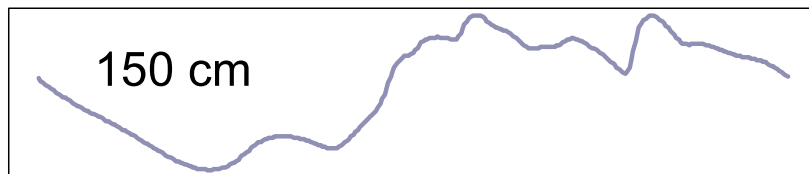
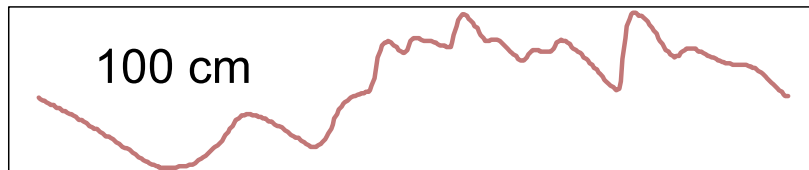
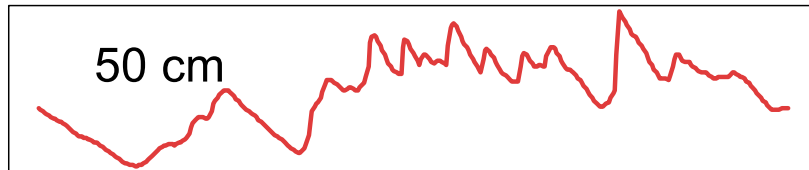
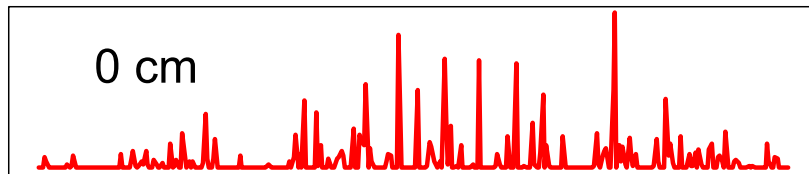


(Lischeid et al., eingereicht)

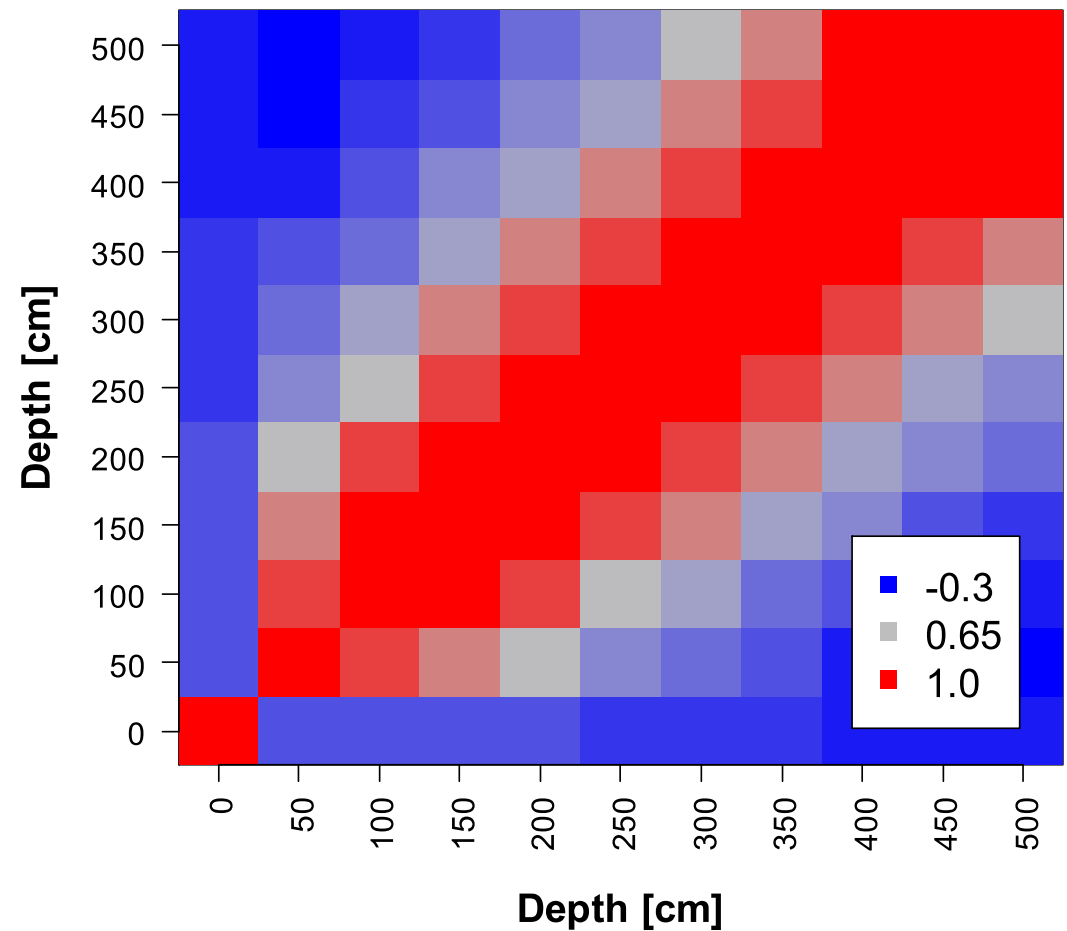
Natürliche vs. anthropogene Effekte



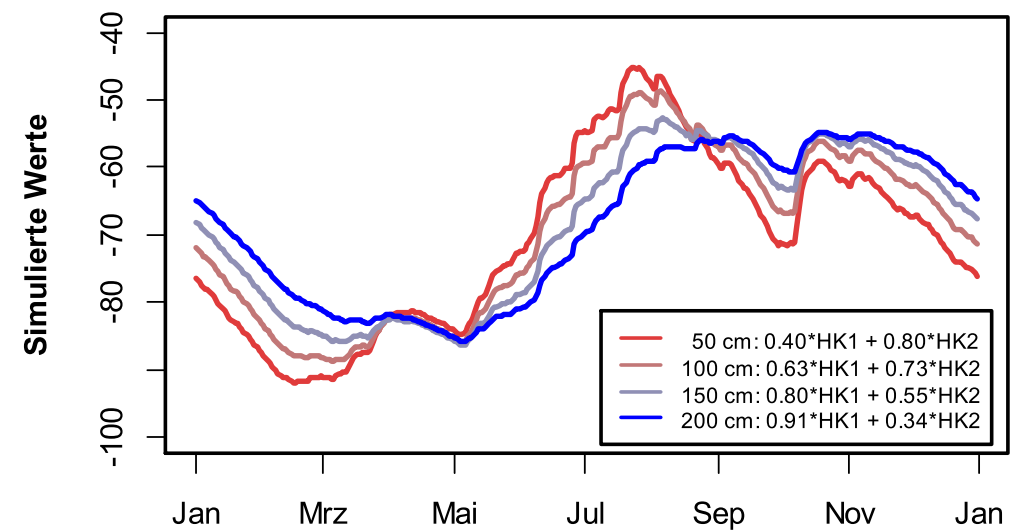
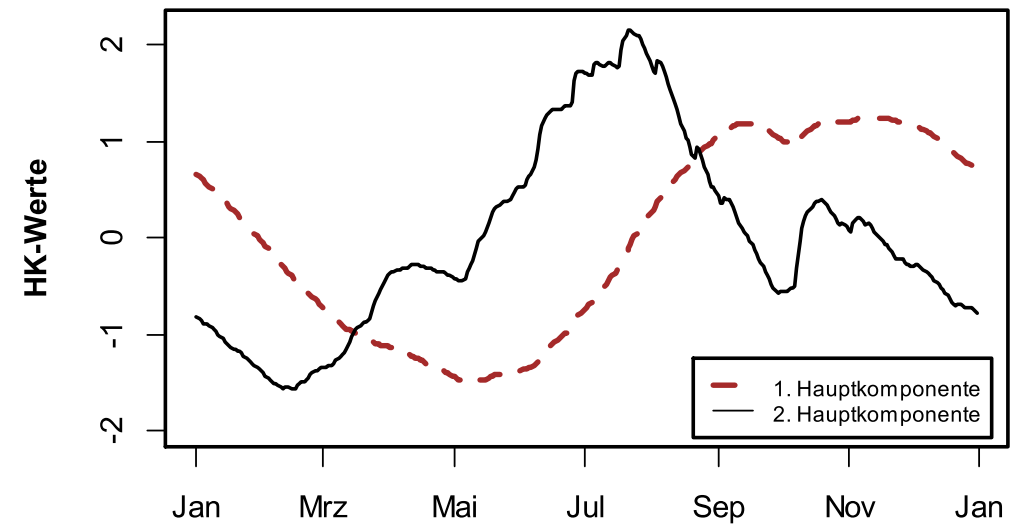
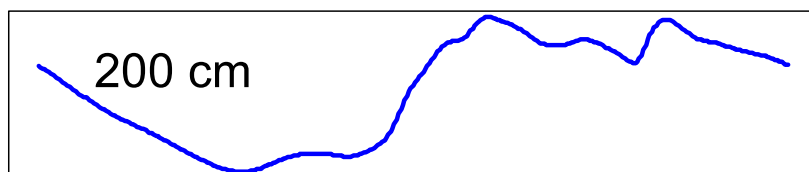
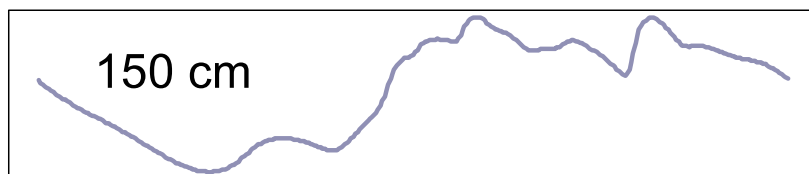
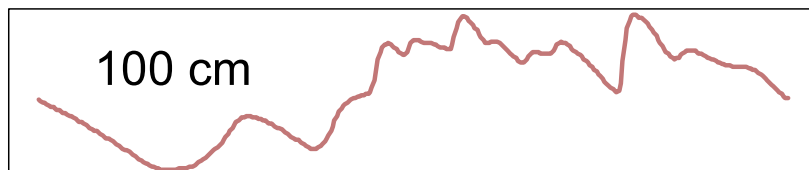
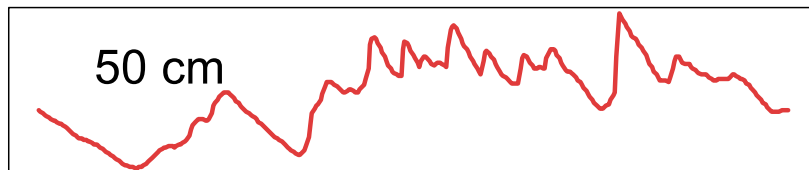
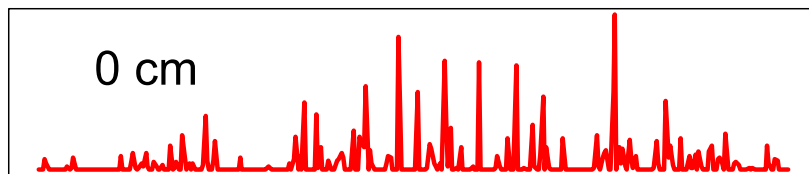
Korrelationen



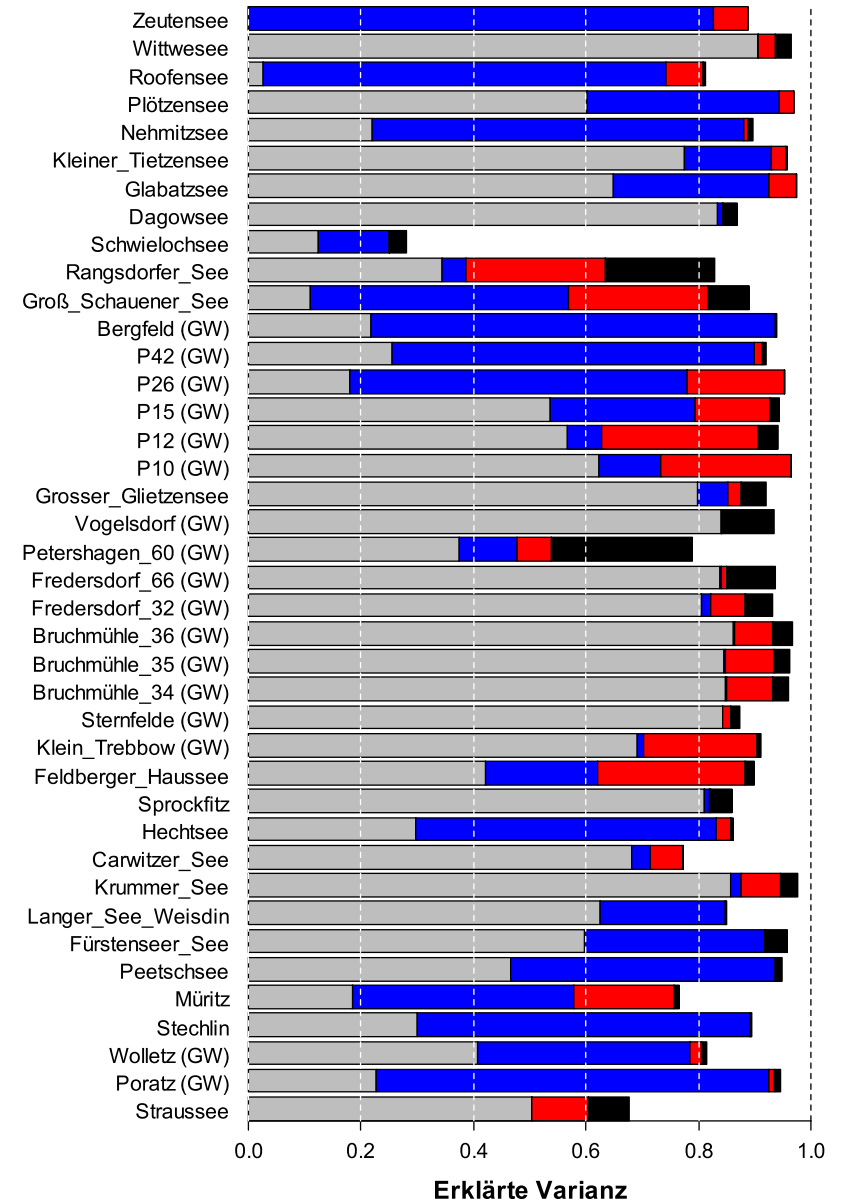
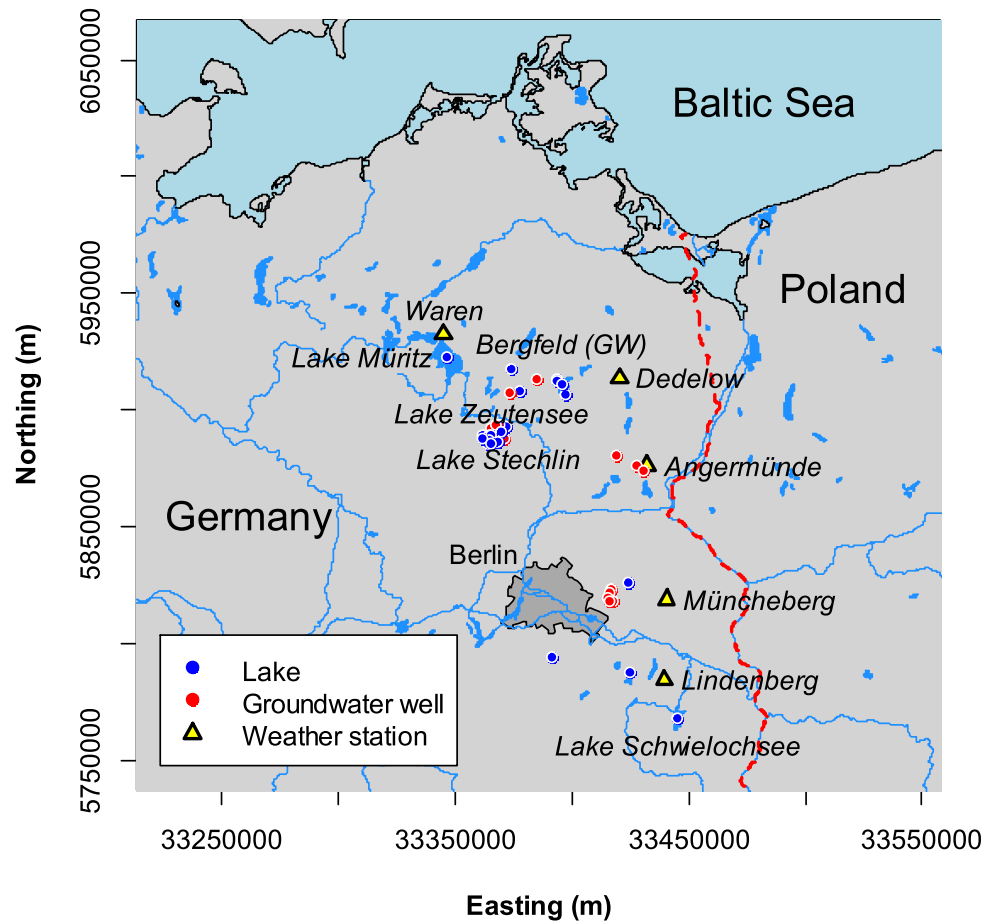
Korrelations-Matrix



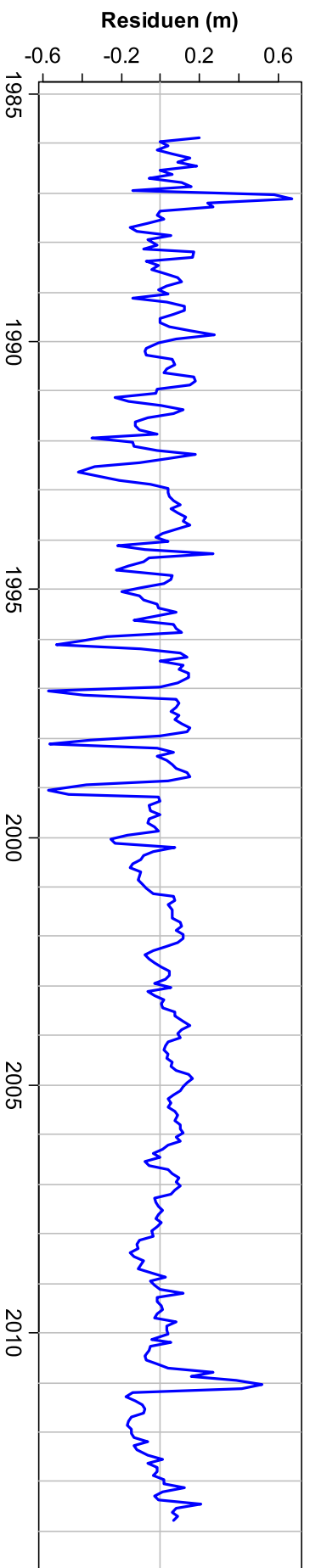
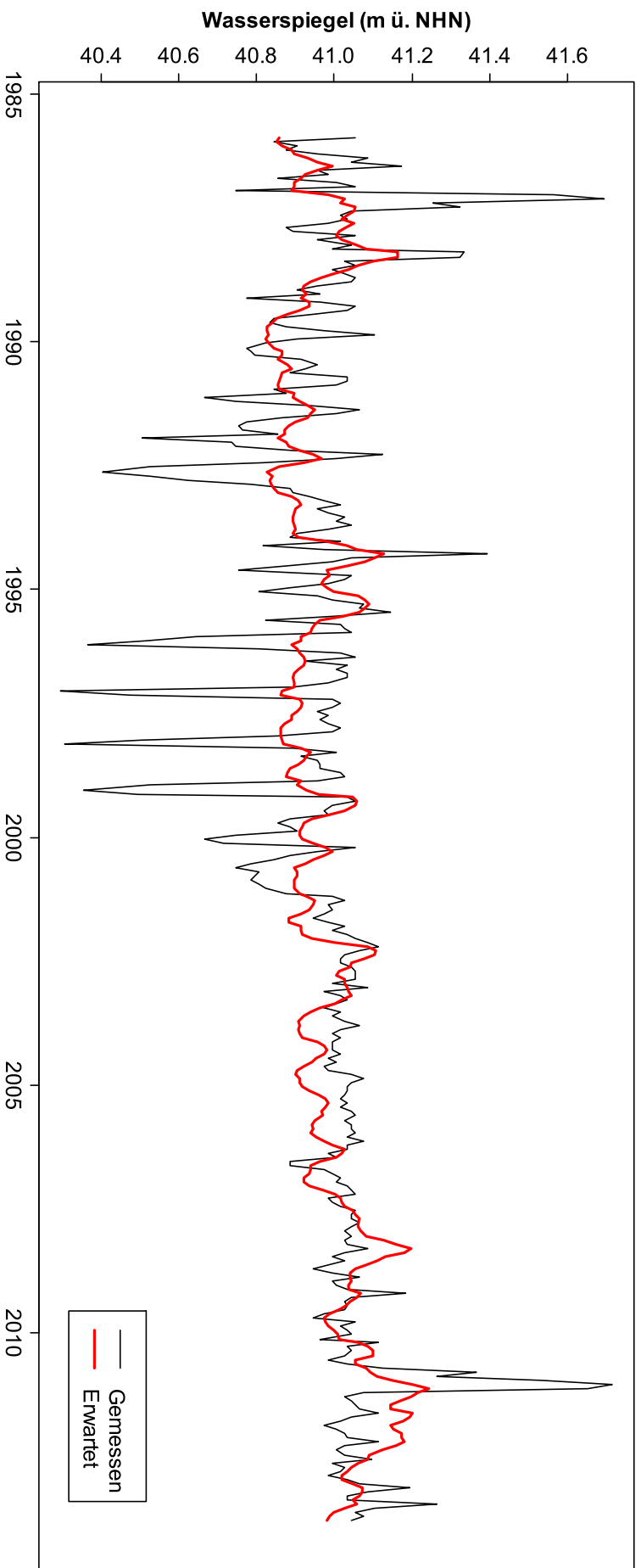
Hauptkomponentenanalyse



Datensatz BB + MV: Erste 4 Hauptkomponenten



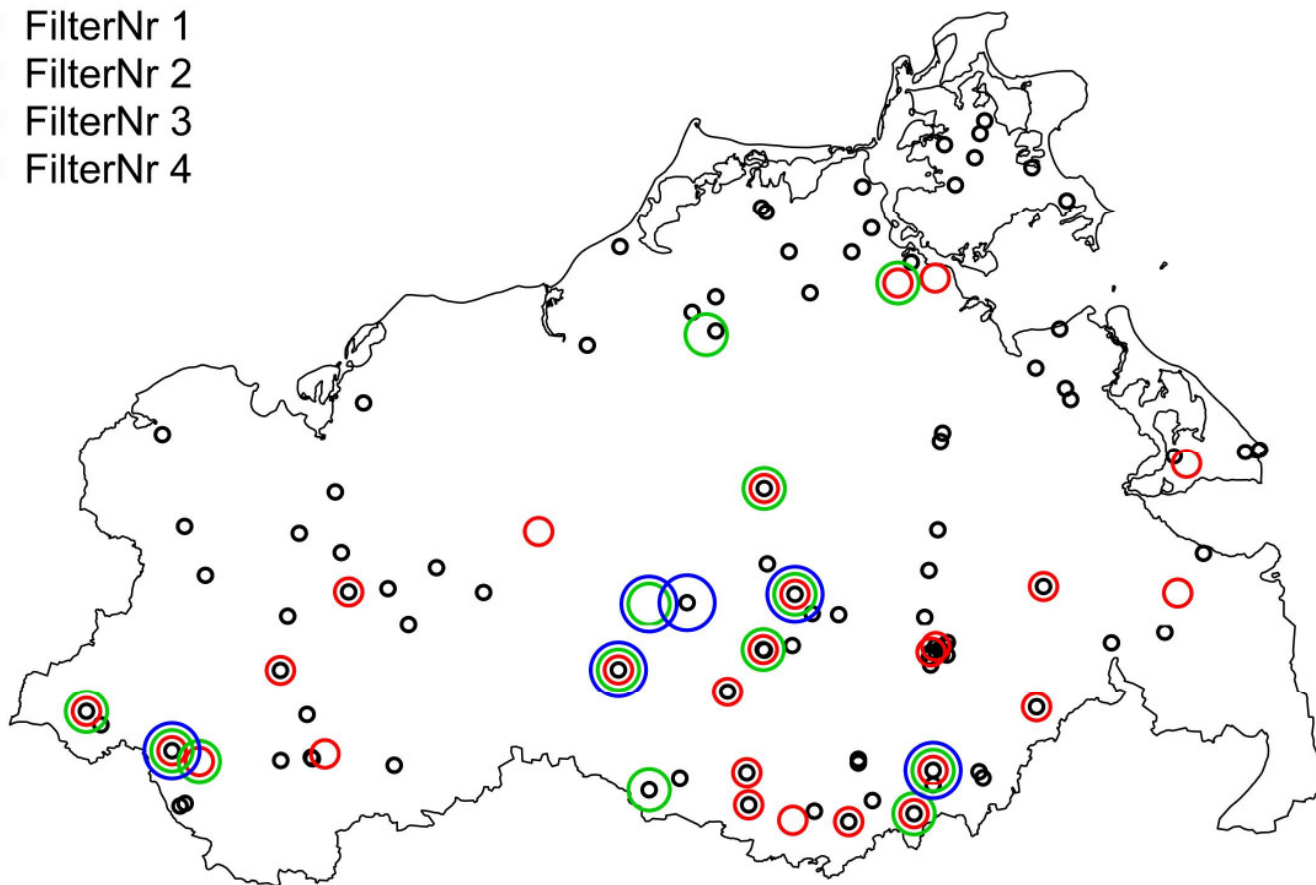
Schwielochsee



Datensatz LUNG MV

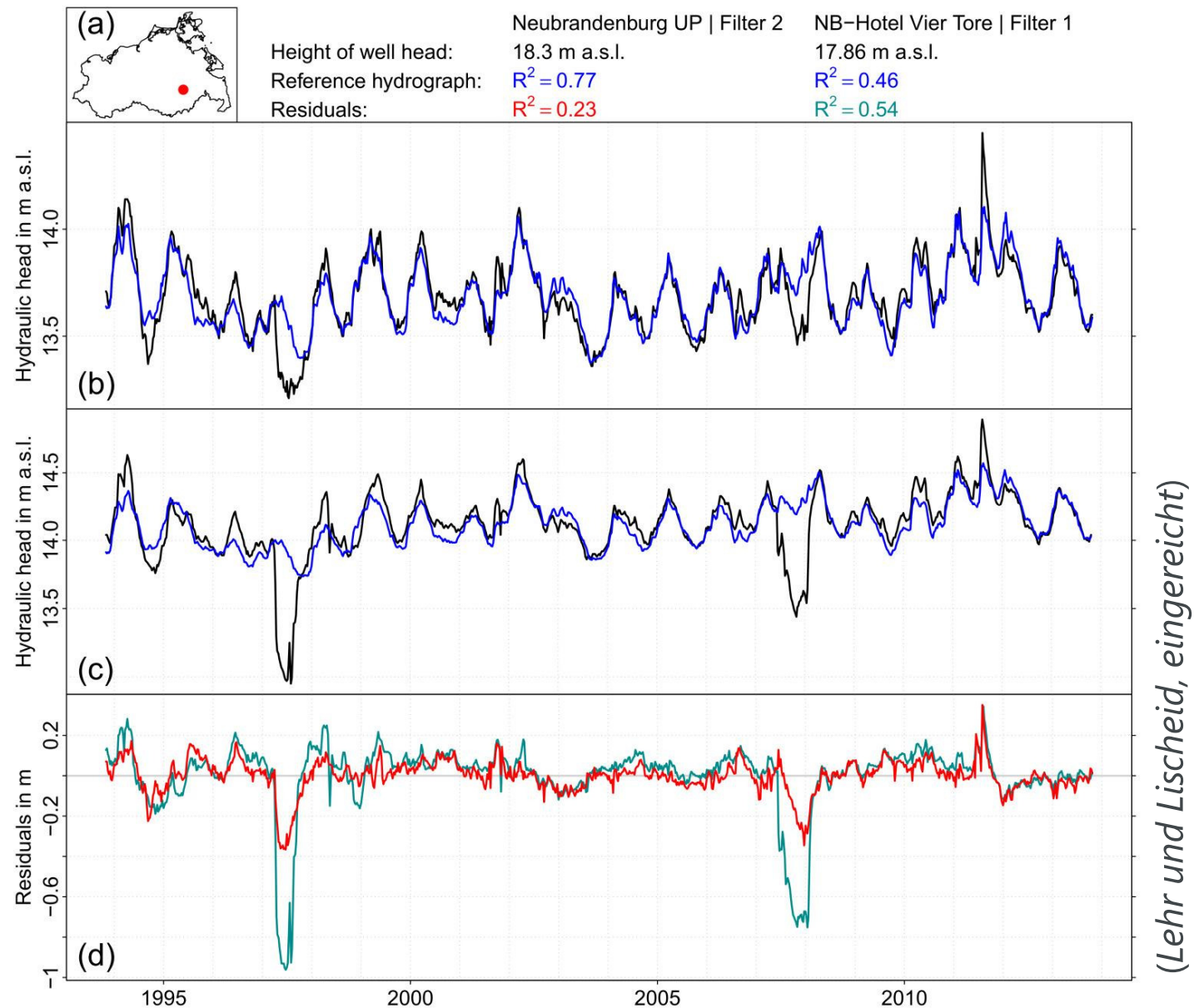
141 Grundwasserganglinien des LUNG Mecklenburg-Vorpommern
20-Jahres-Zeitraum 1993-2013, quasi-wöchentliche Intervalle

- FilterNr 1
- FilterNr 2
- FilterNr 3
- FilterNr 4



(Lehr und Lischeid, eingereicht)

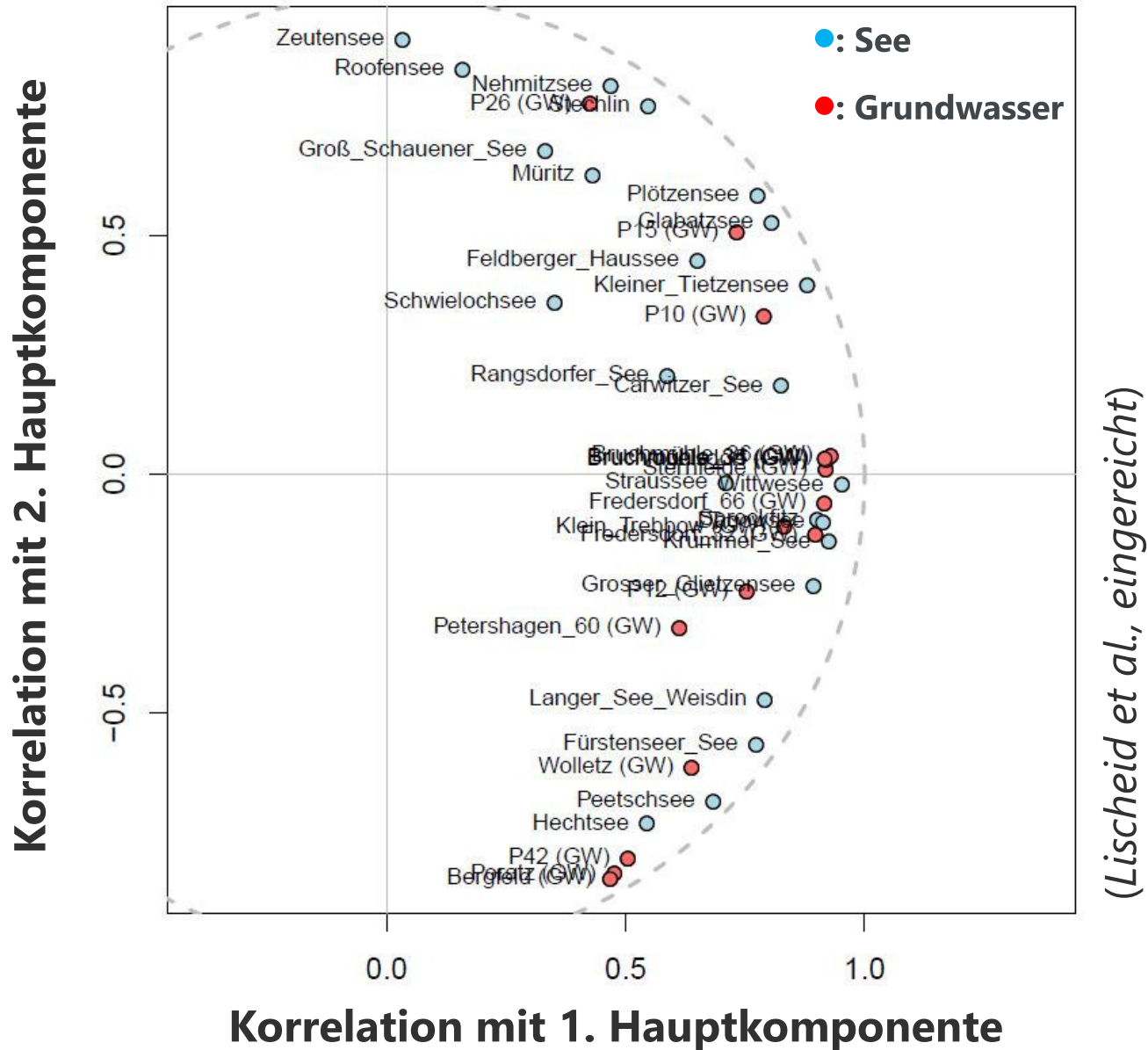
Natürliche vs. anthropogene Effekte



Grund- und Oberflächengewässer



Grund- und Oberflächengewässer



Grund- und Oberflächengewässer



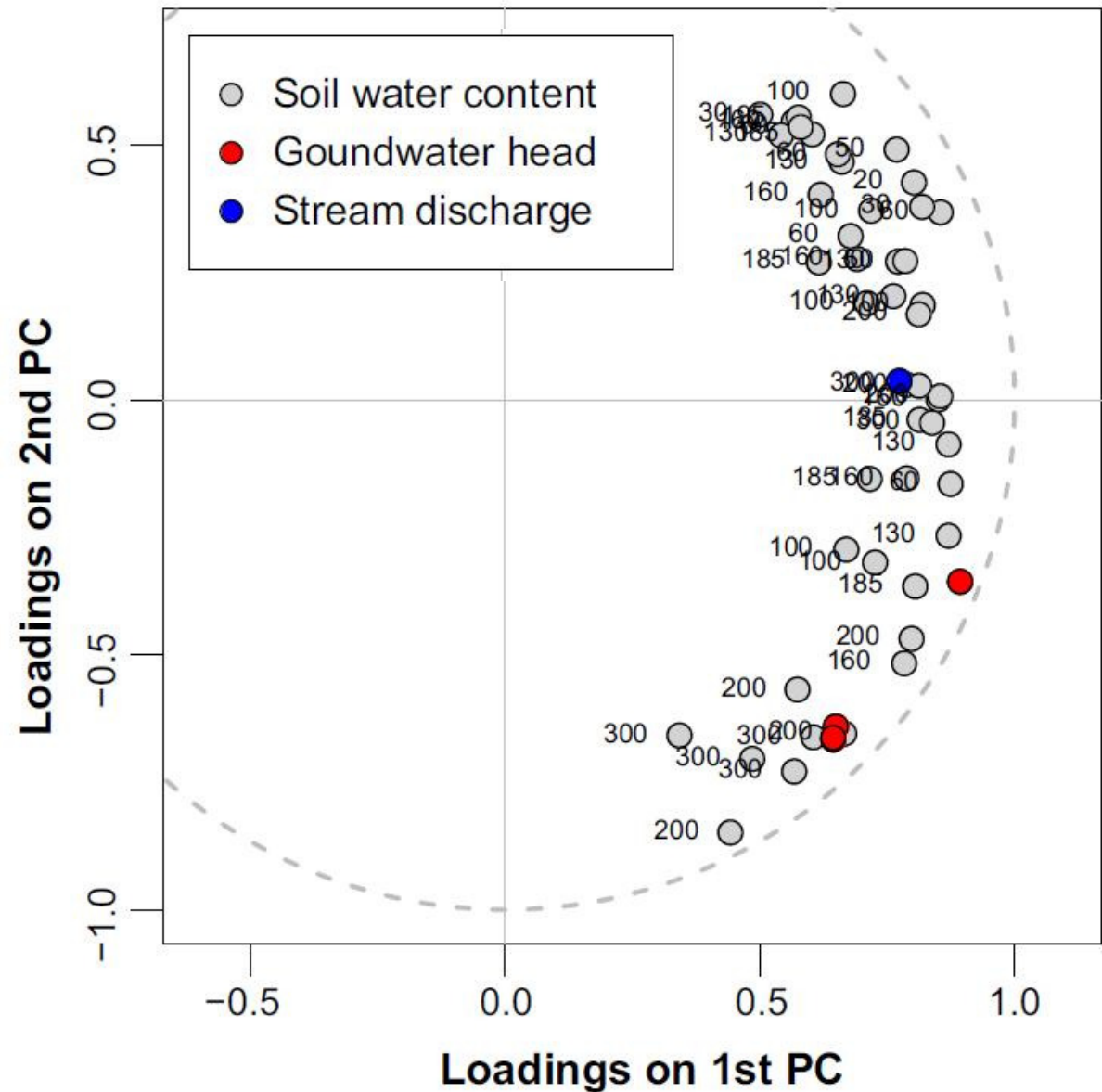
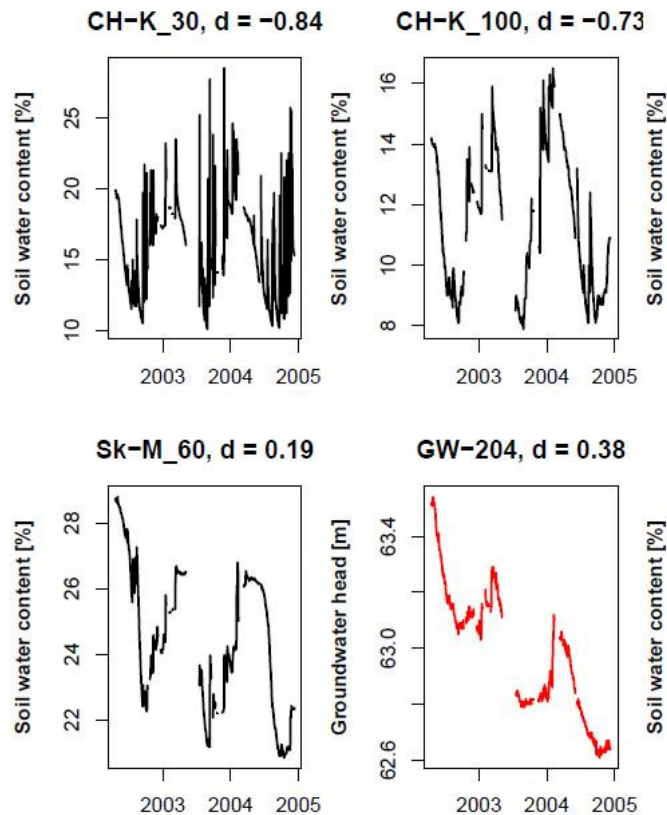
n.s.: not significant ($p > 0.05$)

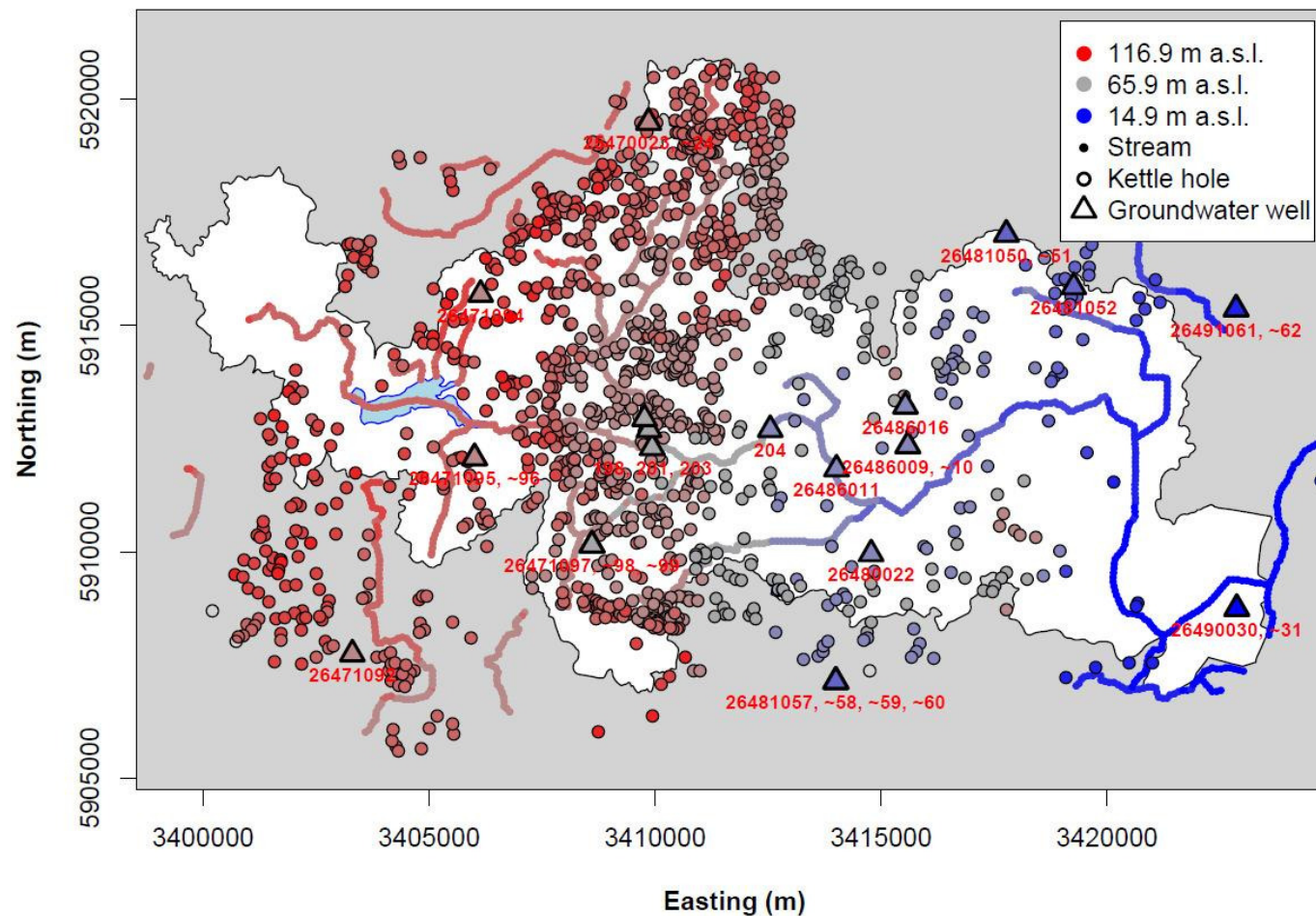
	PC1 loadings (53%)	PC2 loadings (25%)	PC3 loadings (7%)	PC4 loadings (3%)
Federal state	n.s.	n.s.	n.s.	n.s.
Type (groundwater vs. lakes)	n.s.	n.s.	n.s.	$p = 0.002$
Easting	n.s.	n.s.	n.s.	n.s.
Northing	n.s.	n.s.	n.s.	$p = 0.030$
Forest landcover	n.s.	n.s.	$p < 0.001$	$p = 0.014$
Mean water level (a.s.l.)	n.s.	n.s.	n.s.	n.s.
Groundwater: Mean depth to groundwater	n.s.	n.s.	n.s.	n.s.
Lakes: Mean water depth	n.s.	n.s.	n.s.	n.s.
Lakes: Maximum water depth	n.s.	n.s.	n.s.	n.s.
Lakes: Area	n.s.	n.s.	n.s.	n.s.
Lakes: Volume	n.s.	n.s.	n.s.	n.s.
Lakes: Stream inflow	n.s.	n.s.	n.s.	n.s.
Lakes: Stream outflow	$p = 0.047$	n.s.	$p = 0.047$	n.s.

(Lischeid et al., eingereicht)

Bodenfeuchte, Grundwasser, Abfluss

Quillow-Gebiet (Uckermark)
(Lischeid et al. 2017)

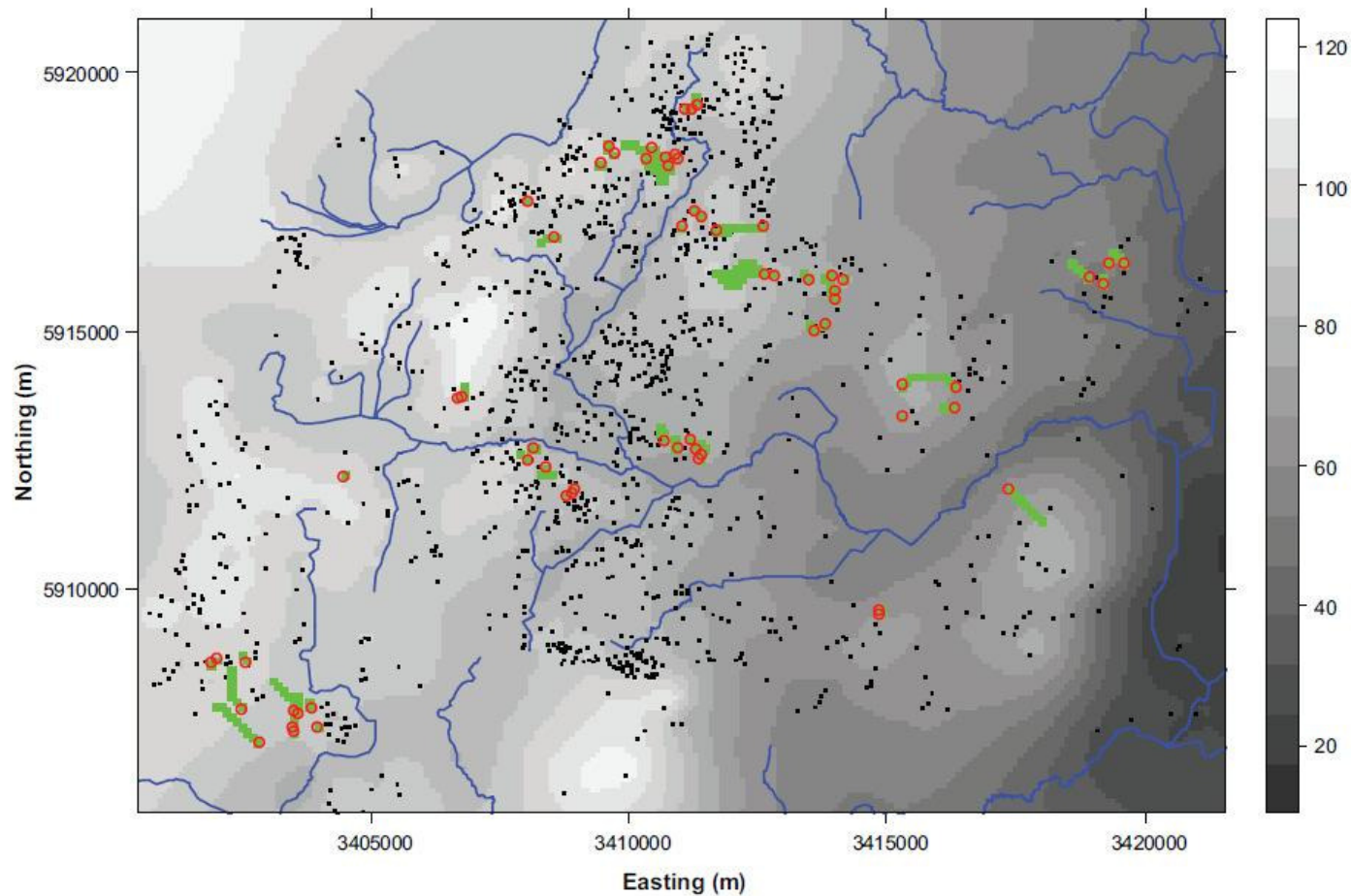




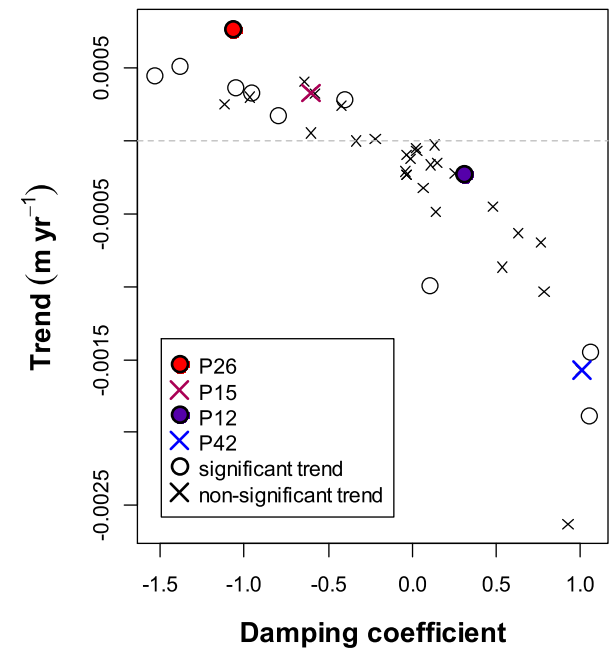
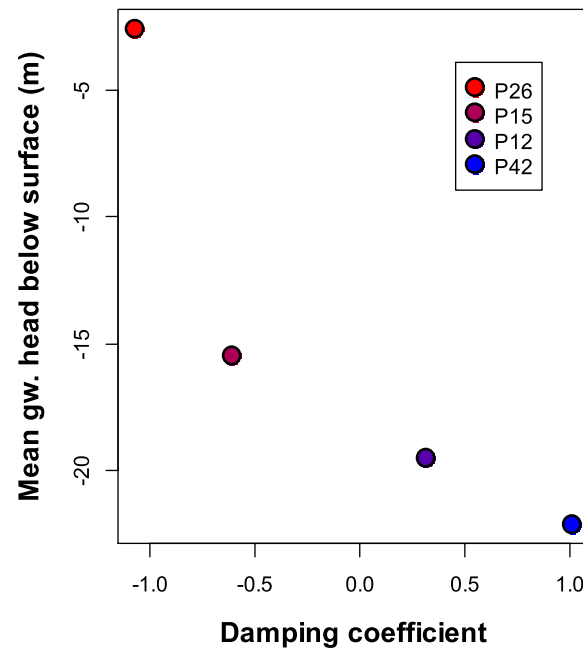
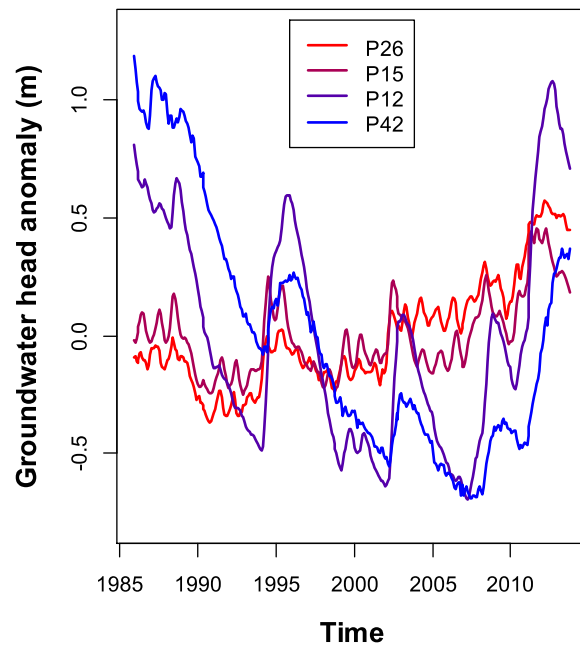
Sölle im Quillow-Gebiet (Uckermark)



Wasserspiegel der Oberflächengewässer, abgeleitet aus dem DGM1 der Landesvermessung und Geobasisinformation Brandenburg (*Lischeid et al. 2017*)



Schlussfolgerungen



(Lischeid et al., eingereicht)

1. Grundwässer (und Seen) haben ein langes und **nicht-lineares** Gedächtnis.
2. Direkte anthropogene Effekte auf Grund- und Seewasserganglinien lassen sich
 - **nicht** mittels Trendanalyse;
 - jedoch mittels **Hauptkomponentenanalyse** nachweisen.
3. Im „tieferen“ Grundwasser (und in Seen) Nordostdeutschlands werden momentan klimatisch bedingt **längerfristig abnehmende Wasserstände** beobachtet.

Kommentare, Kritik, Kooperation? → lischeid@zalf.de