

Comparison of satellite-derived chlorophyll-a and Turbidity measurements with probe data at Lake Rummelsburg, Berlin



Philipp Vormeier
Christian Reinhardt-Imjela
Jens Bölscher
Achim Schulte

Problem

- Urban waters have a high recreational potential (Dahm et al. 2014)
 - The bathing options at river Spree will increase in the near future



The aim of project „Flussbad Berlin“ is to convert the tributary Kupfergraben of River Spree to a bathing area. Therefore a 750 meter long bathing area will be implemented into the historical city centre of Berlin.

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- Algae blooms can be poisonous fo the human body (Köhler & Fromme 2002)



Streiking Cyanobacteria at the water surface. (Unterhavel*)

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- The goals of the eu water framework directive is to have a good ecologically and chemical status of surface waters
 - Could not be implemented so far (Karrasch et al. 2016)

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 - Could not be implemented so far (Karrasch et al. 2016)
- The operative Monitoring is not capable of covering the water quality with a high temporal and spatial frequency (Quick et al. 2016)



Similar results in Mecklenburg-Vorpommern by Dörnhöfer et al. (2018)


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Water remote sensing offers the only option of complex water quality monitoring regarding the short-term spatial-temporal dynamics of water bodies (Zumbroich et al. 2012)

Research question

To what extent does the extracted satellite data match with the Chlorophyll-a and Turbidity data of the in situ measurements?

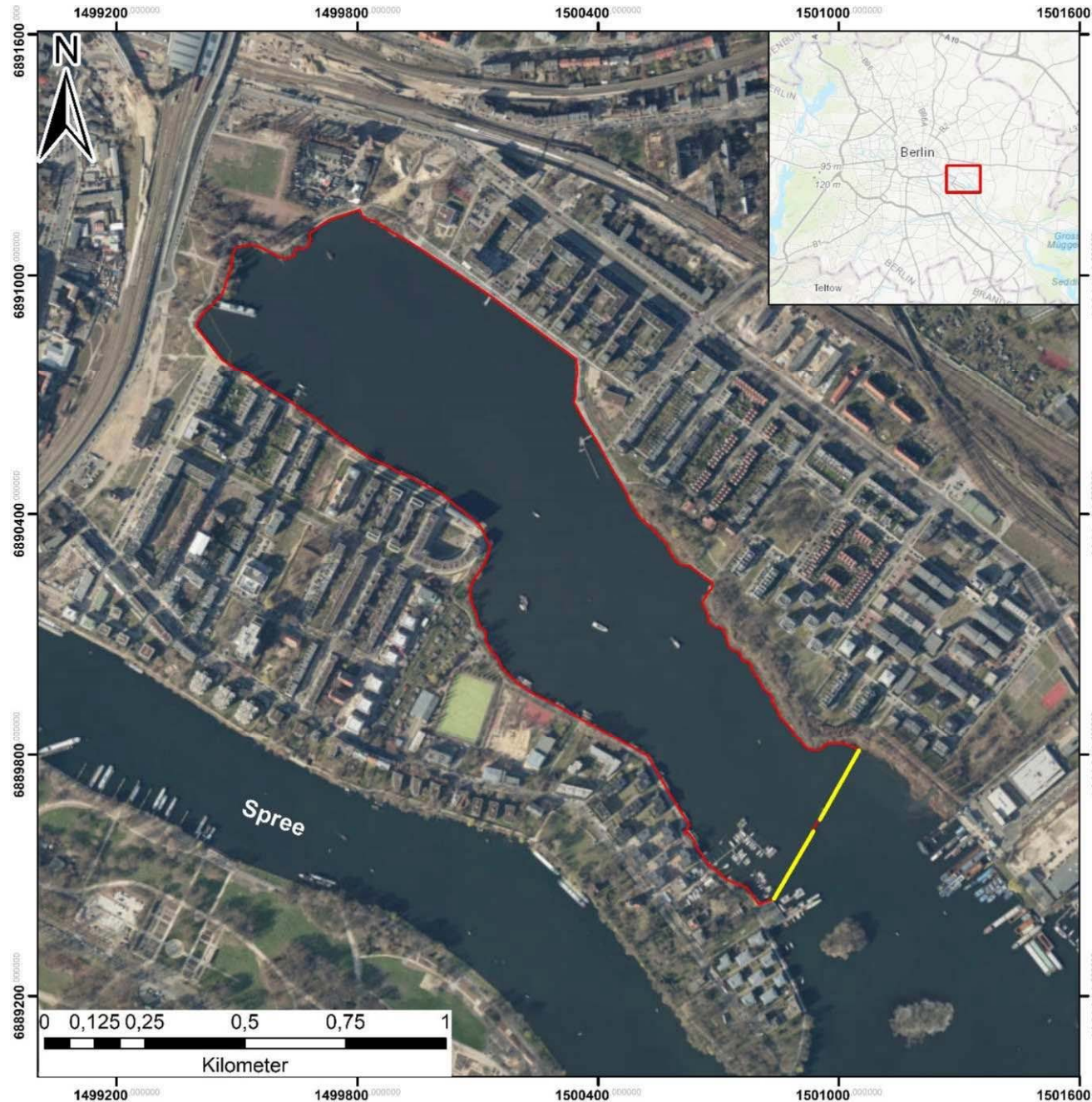


What is the actual persistence of Chlorophyll-a und Turbidity at Lake Rummelsburg and how comparable is the data with satellite-based measurements?





Is the represented concentration distribution of satellite-based data for Chlorophyll-a and turbidity spatially correct? And therefore does the reflection at the benthic has an effect concerning the accuracy of the results?

Study area



Untersuchungsgebiet Rummelsburger See

Legende

-  Untersuchungsgebiet
-  Spundwand

Autor:
Philipp Vormeier

Erstellungsdatum:
07.10.2017

Koordinatensystem:
WGS 84 UTM Zone 33N

Daten:
Esri Basemap

To what extent does the extracted satellite data match with the Chlorophyll-a and Turbidity data of the in situ measurements?



Regression analysis
Kruskal-Wallis-Test
Bonferroni-method

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Autocorrelation of the measuring period (10 days before and after)

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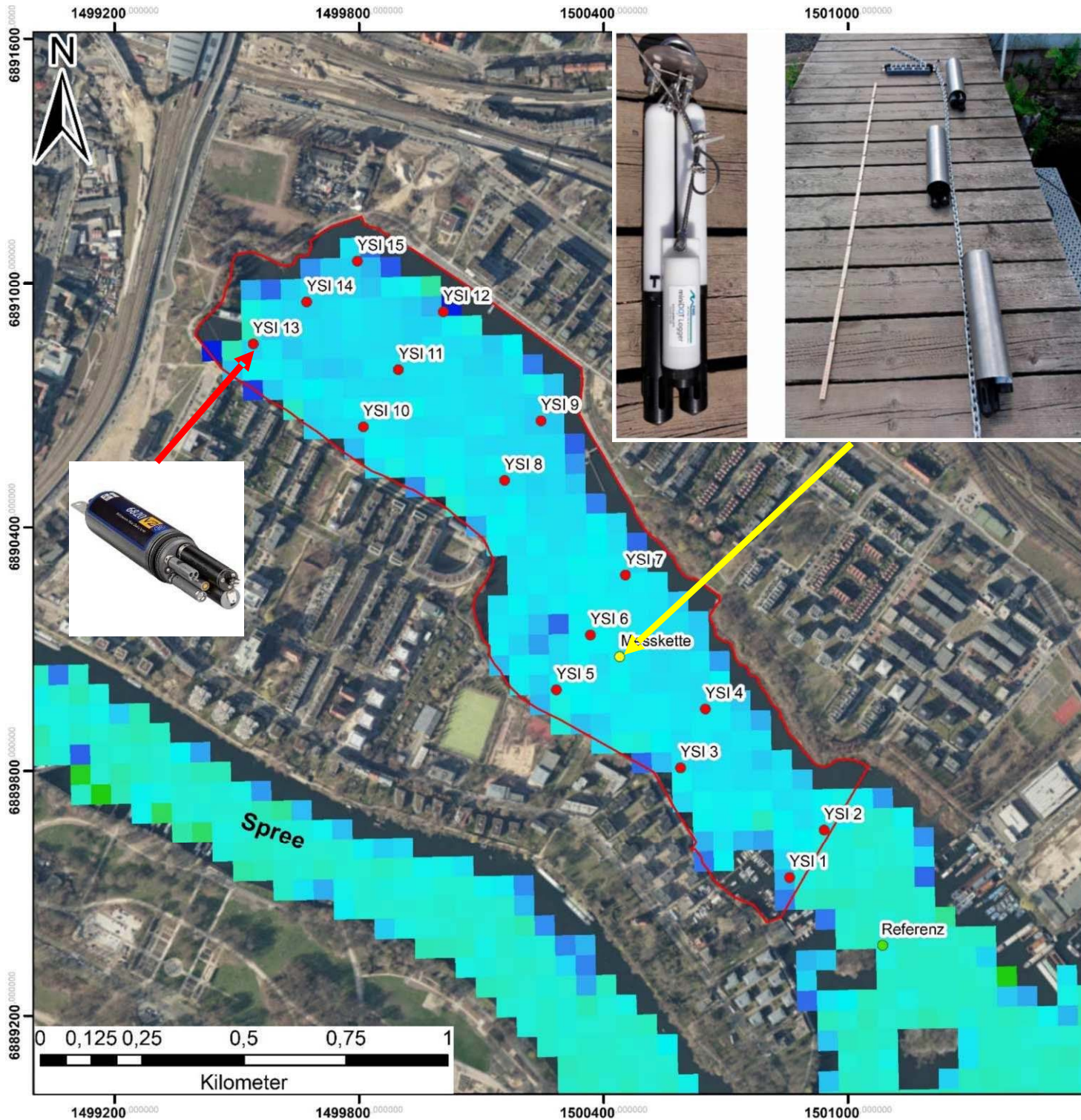
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Flow-Chart-Diagram
→ Moran's Index
→ Spatial correlation analysis



Versuchsaufbau der Validierung

Legende

-  Untersuchungsgebiet
-  Messkette
-  Referenz
-  Sondenmesspunkte

Eomap Trübungsgrad 10.04.2015



Autor:
Philipp Vormeier

Erstellungsdatum:
04.10.2017

Koordinatensystem:
WGS 84 UTM Zone 33N

Daten:
EOMAP GmbH & Co KG / Esri Basemap

Freie Universität  Berlin

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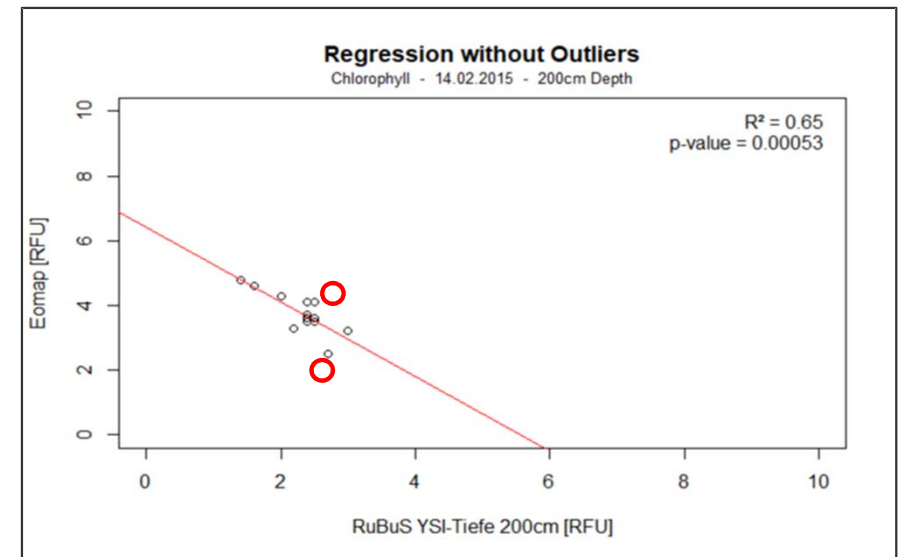
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To what extent does the extracted satellite data match with the Chlorophyll-a and Turbidity data of the in situ measurements?



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- The results of the regression analysis shows significant differences between the two datasets
 - The biggest match were captured in the depth of 150cm and 200cm



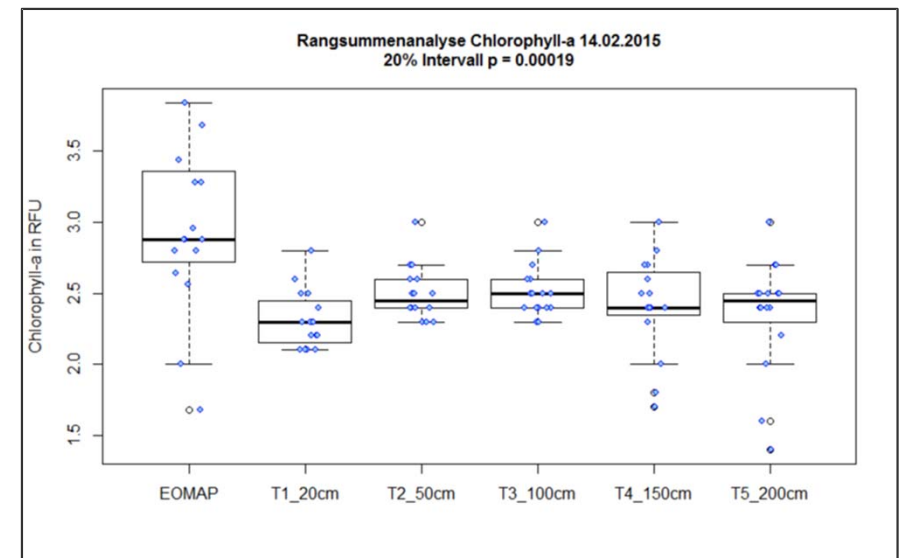
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- The test of mean differences shows also significant differences between the two data sets
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 - The biggest match were captured in the depth of 150cm and 200cm
- The test of mean differences shows also significant differences between the two data sets
 - he biggest match were also captured in the depth of 150cm and 200cm
- The post-hoc Bonferroni-method shows also significant differences between the two data sets

p-Werte für Chlorophyll-a am 14.02.2015					
Datenreihen	T1_20cm	T2_50cm	T3_100cm	T4_150cm	T5_200cm
T2_50cm	1	-	-	-	-
T3_100cm	1	1	-	-	-
T4_150cm	0,3735	1	1	-	-
T5_200cm	1	1	1	0,6880	-
EOMAP	0,0128	0,0008	0,0004	3,67E-07	0,0051

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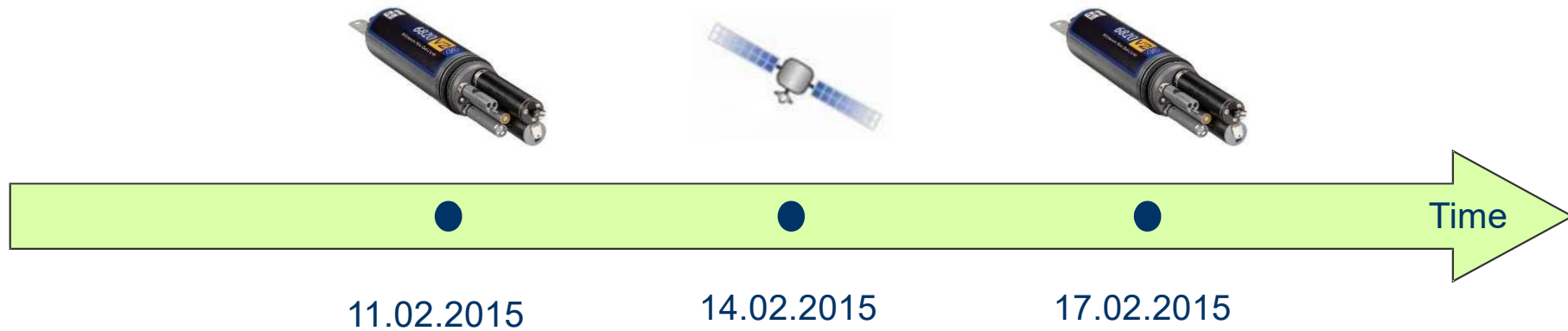
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Autocorrelation of the measuring period (10 days before and after)
Data: Sensor measuring chain



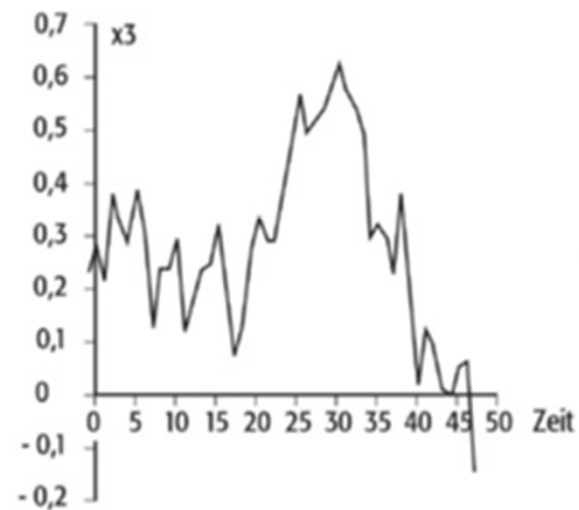
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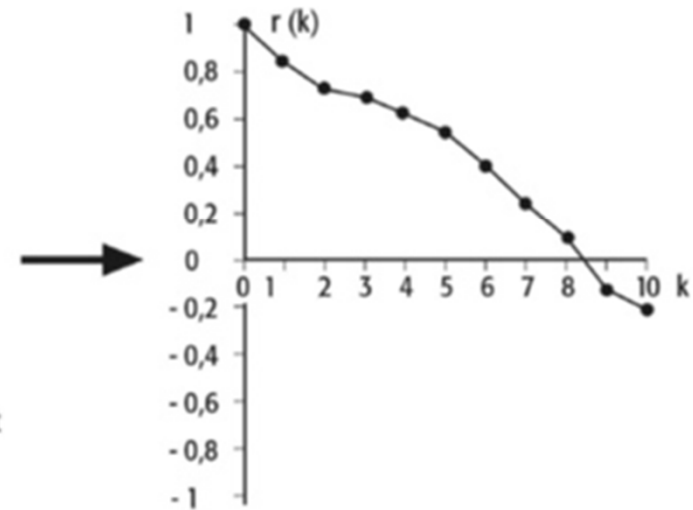


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Zeitreihe



Autokorrelationsfunktion

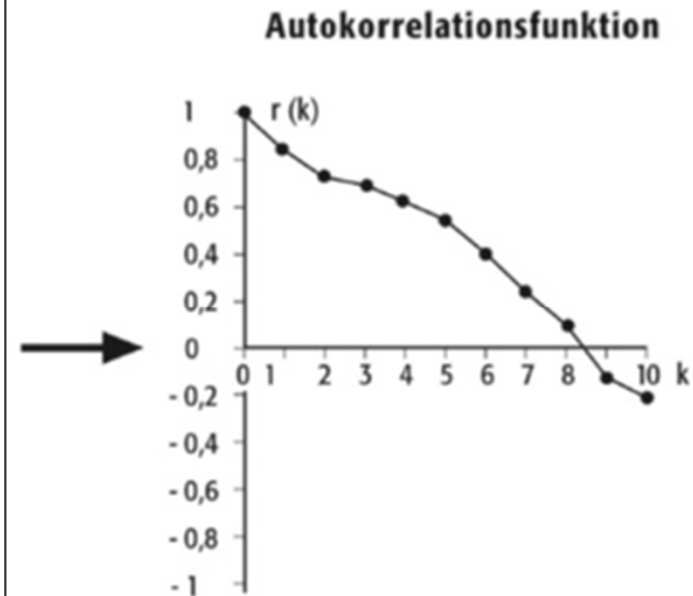
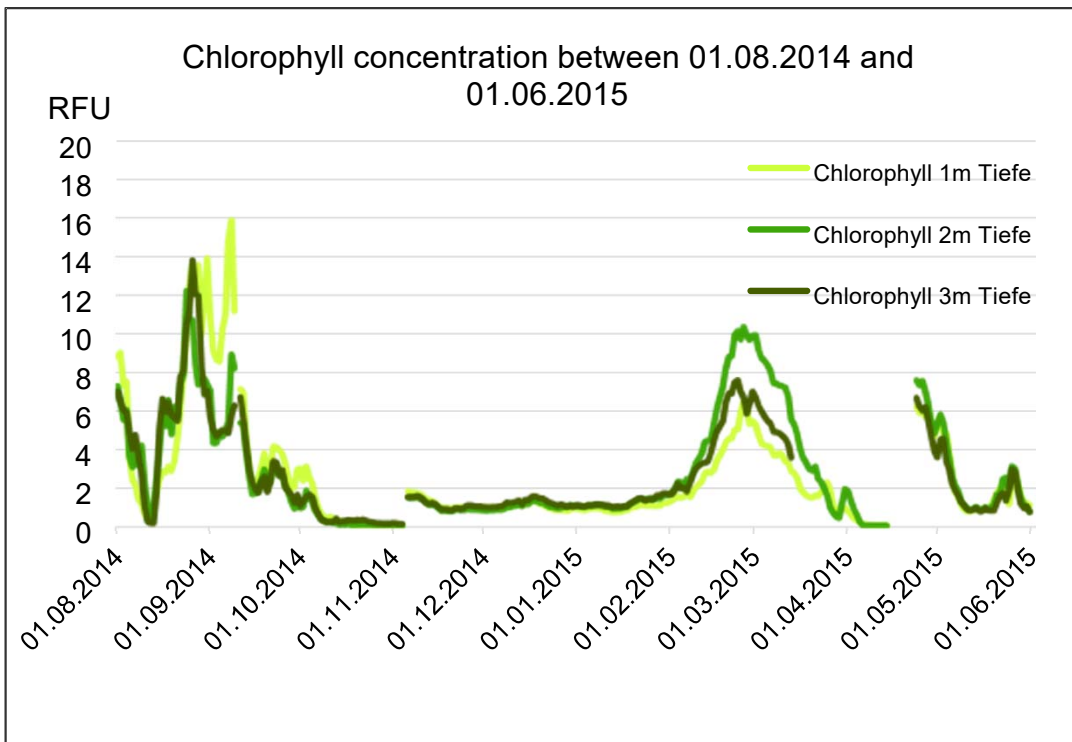


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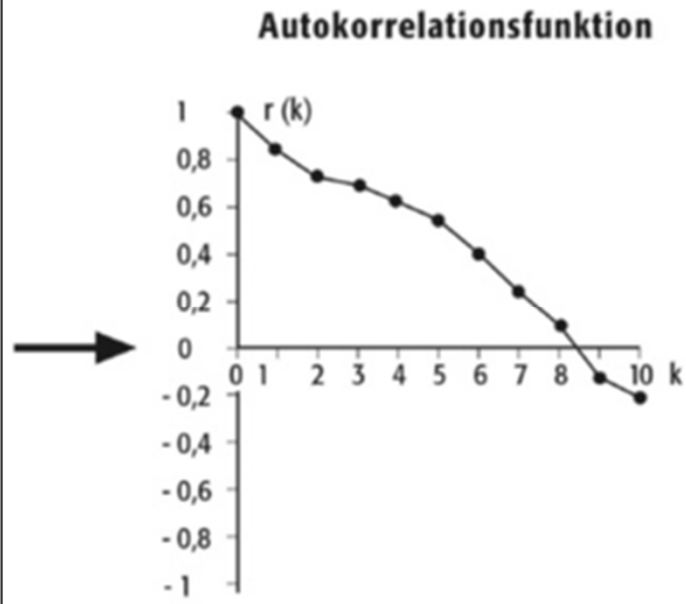
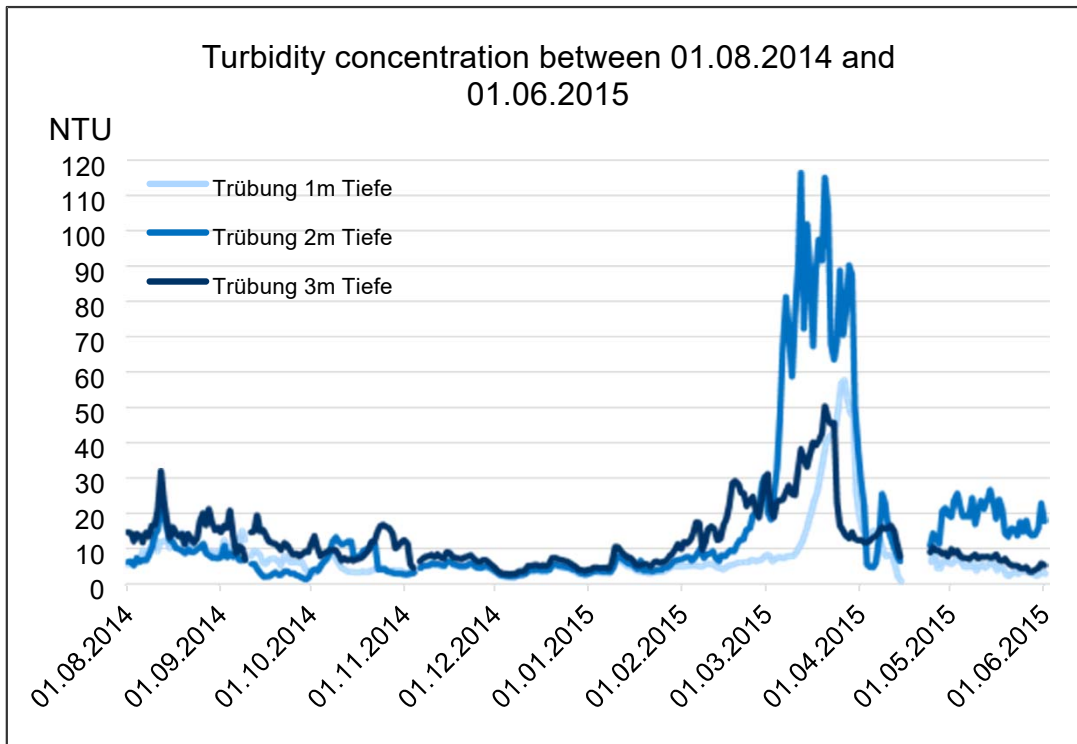


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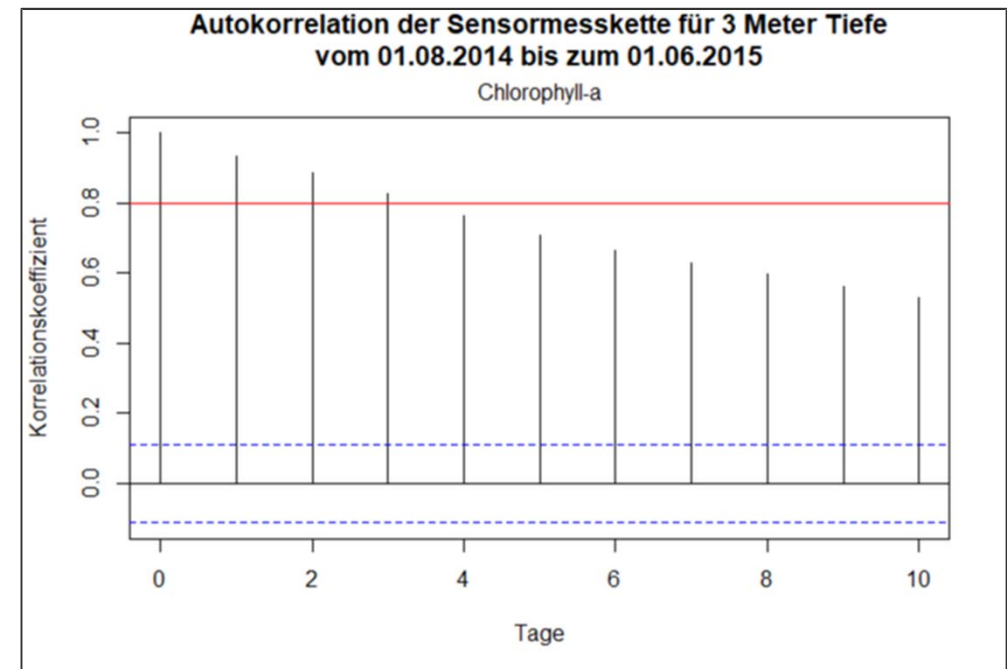
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- The complete investigation period has a daily persistence of 3 days
 - Independent of depth
 - Turbidity is slightly more persistent

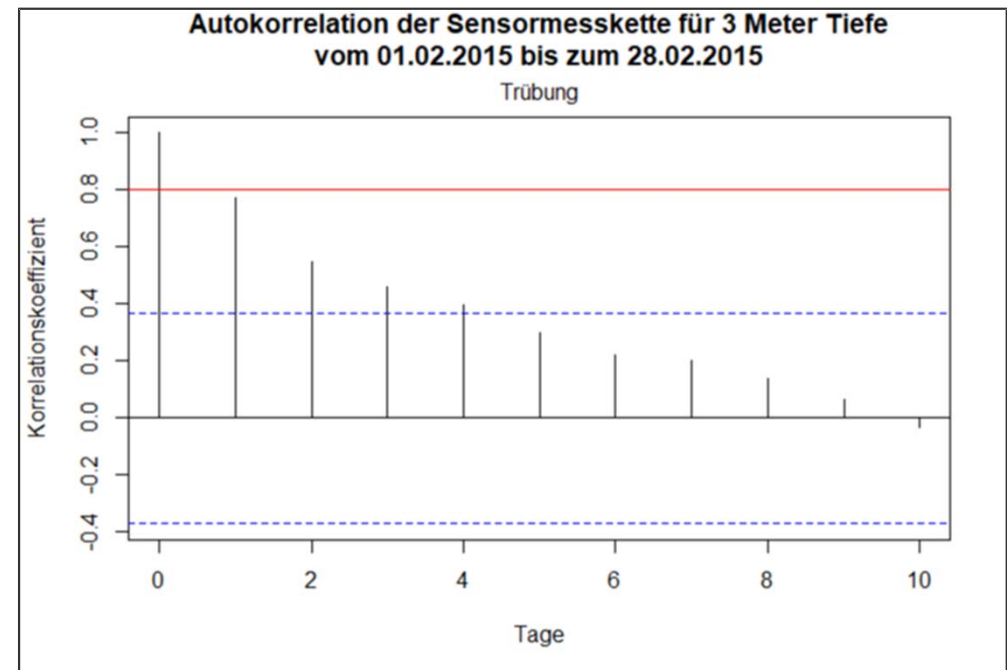


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Autocorrelation of the complete investigation period (RuBuS project)
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Data: Sensor measuring chain

- The complete investigation period has a daily persistence of 3 days
 - Independent of depth
 - Turbidity is slightly more persistent
- The daily persistence of the measuring period is considerably lower
 - Chlorophyll-a → 2 days
 - Turbidity → < 1 day



Is the represented concentration distribution of satellite-based data for Chlorophyll-a and turbidity spatially correct? And therefore does the reflection at the benthic has an effect concerning the accuracy of the results?



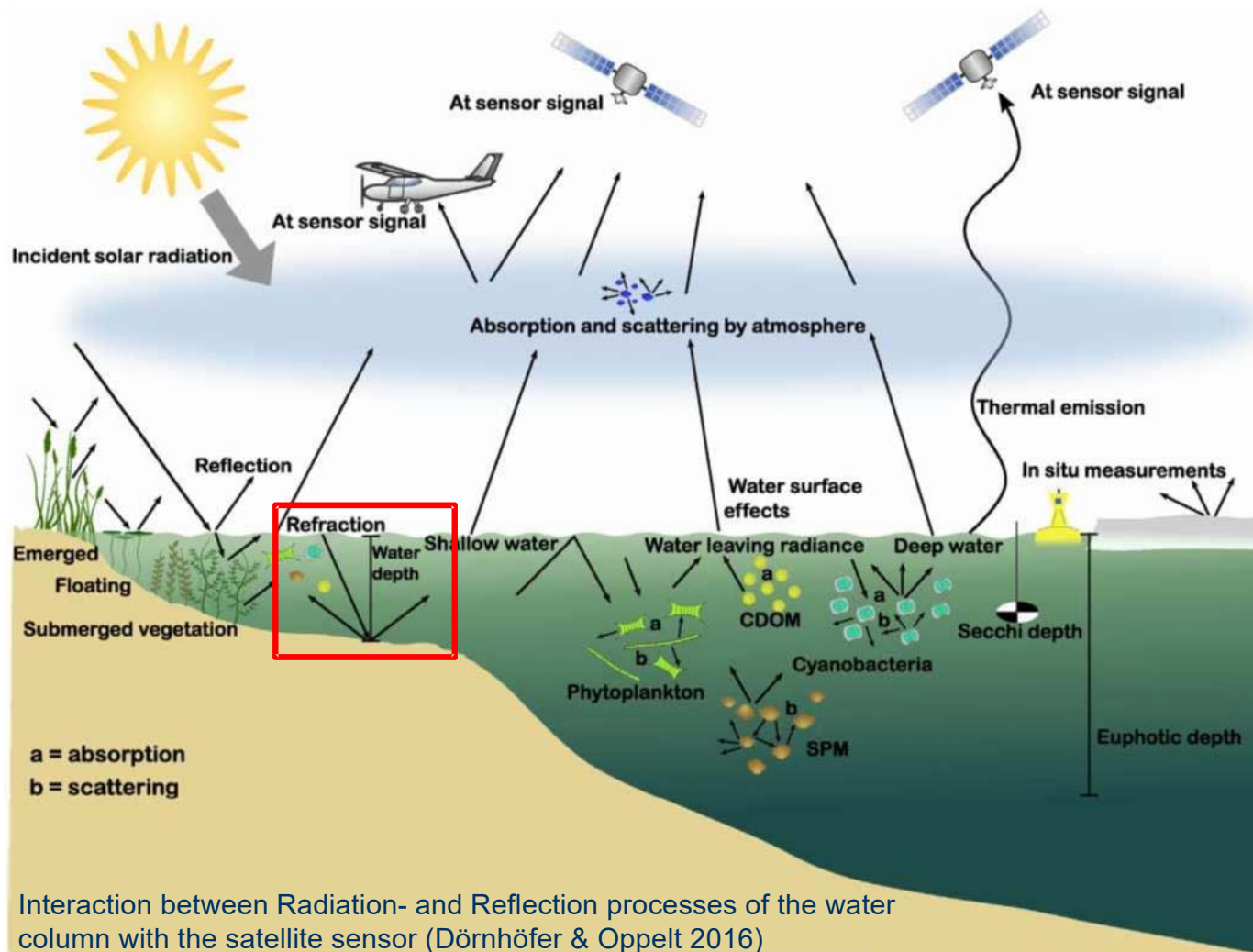
Flow-Chart-Diagram
→ Moran's Index
→ Spatial correlation analysis

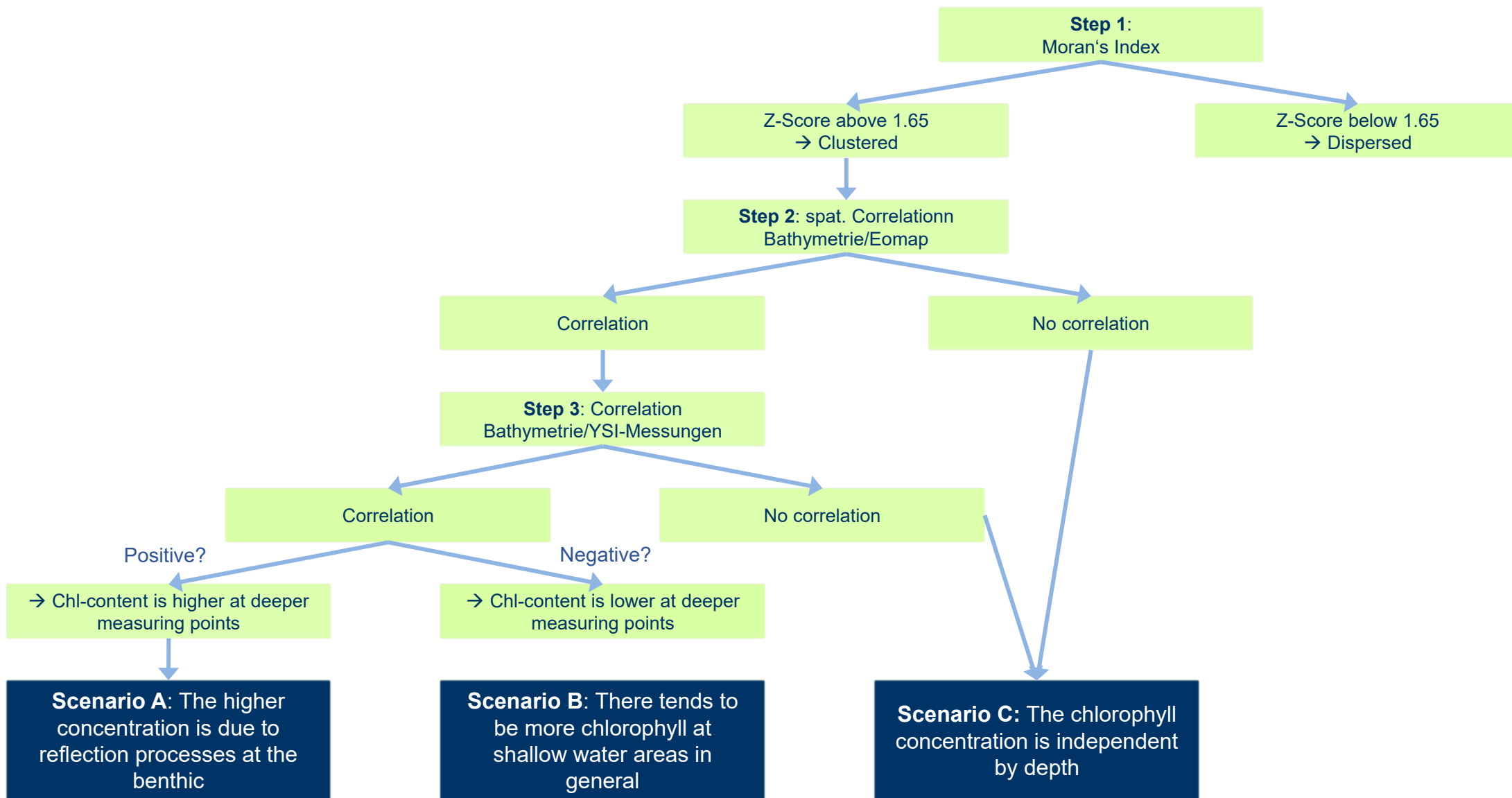
Methodology

Is the represented concentration distribution of satellite-based data for Chlorophyll-a and turbidity spatially correct? And therefore does the reflection at the benthic has an effect concerning the accuracy of the results?



Flow-Chart-Diagram
 → Moran's Index
 → Spatial correlation analysis
 Data: Bathymetry, EOMAP, YSI-Sonde data





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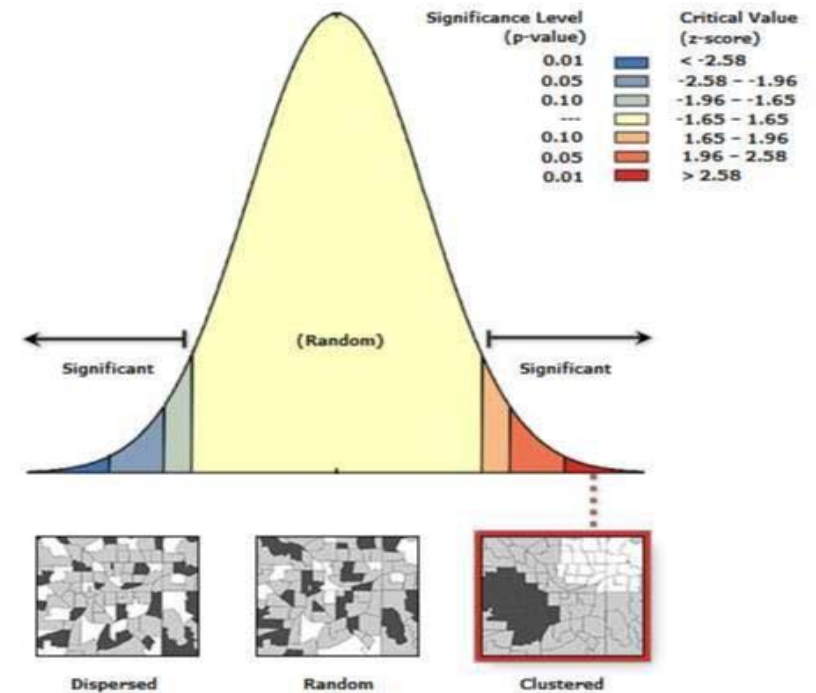


Flow-Chart-Diagram

- Moran's Index
- Spatial correlation analysis

Data: Bathymetry, EOMAP, YSI-Sonde data

- Step 1:
 - 3 of 4 raster data sets are clustered



EOMAP Trübung 14.02.2015

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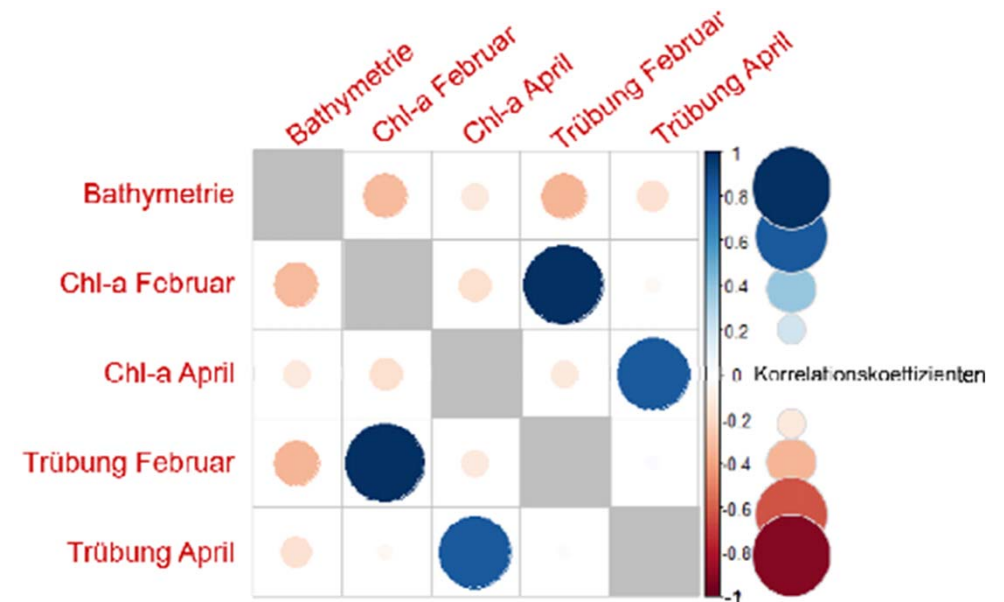
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- Step 1:
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- Step 2:
 - There is no correlation between the satellite data and the bathymetry

Korrelationsmatrix zwischen den Konzentrationsgehalten (EOMAP) und der Bathymetrie



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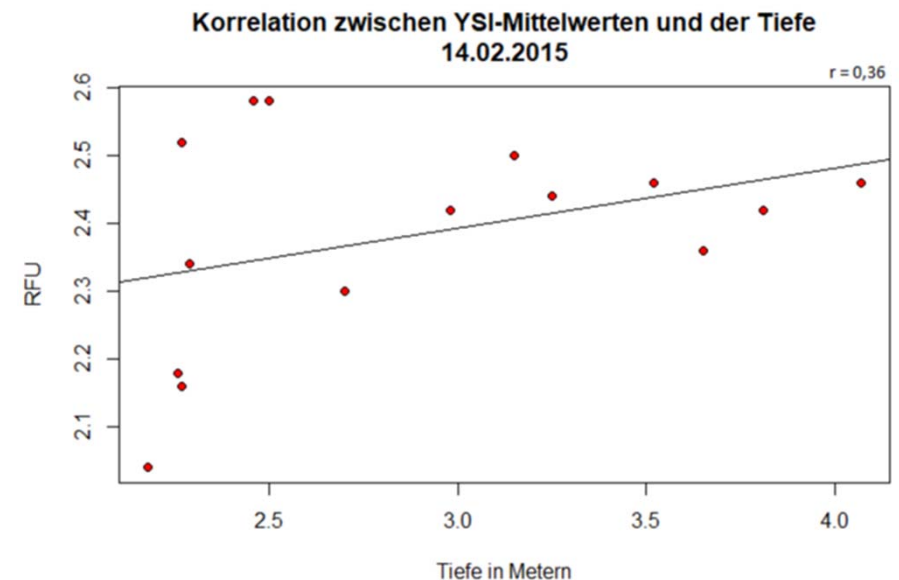


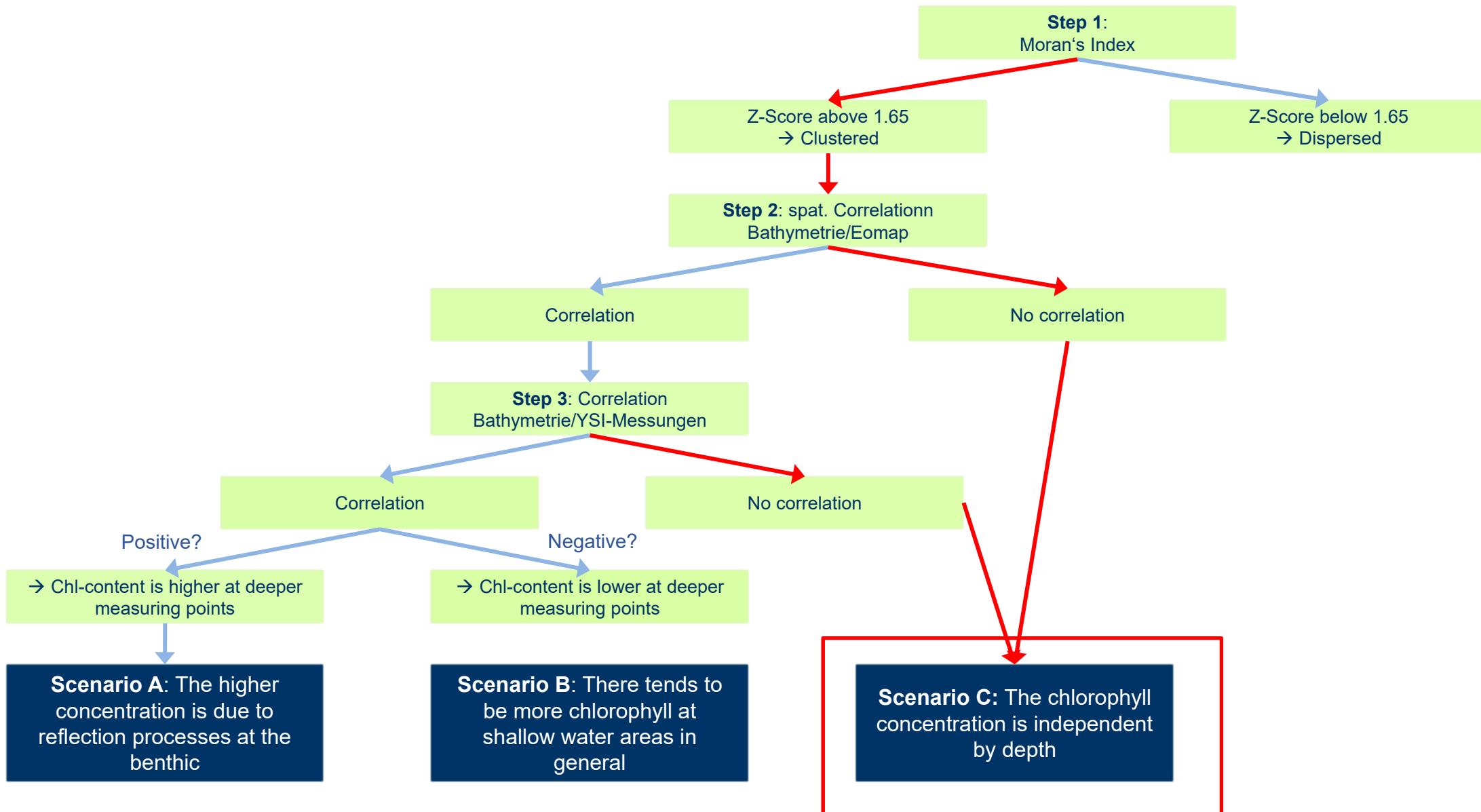
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Data: Bathymetry, EOMAP, YSI-Sonde data

- Step 1:
 - 3 of 4 raster data sets are clustered
- Step 2:
 - There is no correlation between the satellite data and the bathymetry
- Step 3:
 - There is a weak correlation between the multiparametersonde data and the bathymetry





Conclusion

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The difference of three days between the recording dates is too large

The distribution of concentration is displayed similar by both measurements and is therefore not influenced by reflection processes at the benthic

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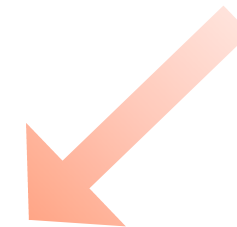
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The time difference between the two recording dates is too large, and as a result of the literature research the kind of sonde that is used has absolutely to be taken in account

- Critical consideration of both measuring points
 - Same recording date
 - Standardized measuring methods (laboratory analysis)
-
- Data sets with higher spatial accuracy
 - A complete time series for autocorrelation analysis (whole year)
 - Study area with high concentrations of chl and turbidity (lishanas for instance)

Thank you for your attention!

