



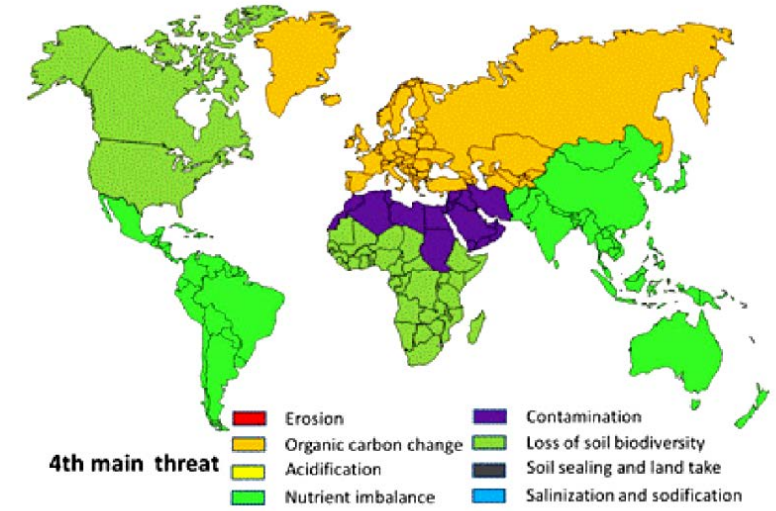
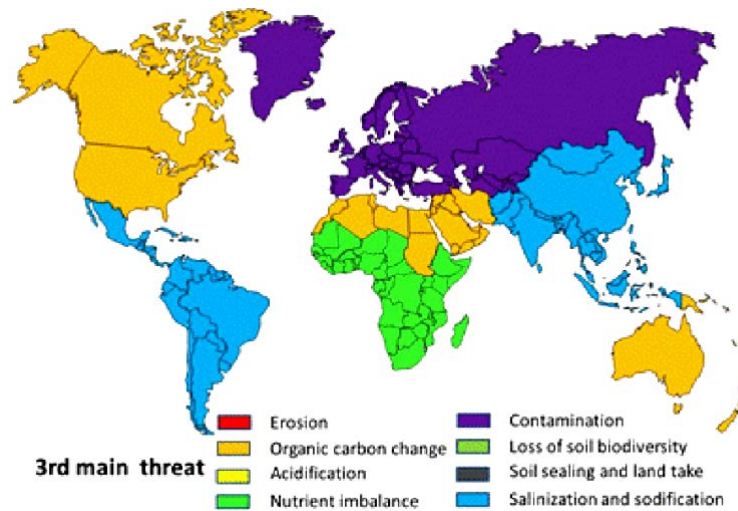
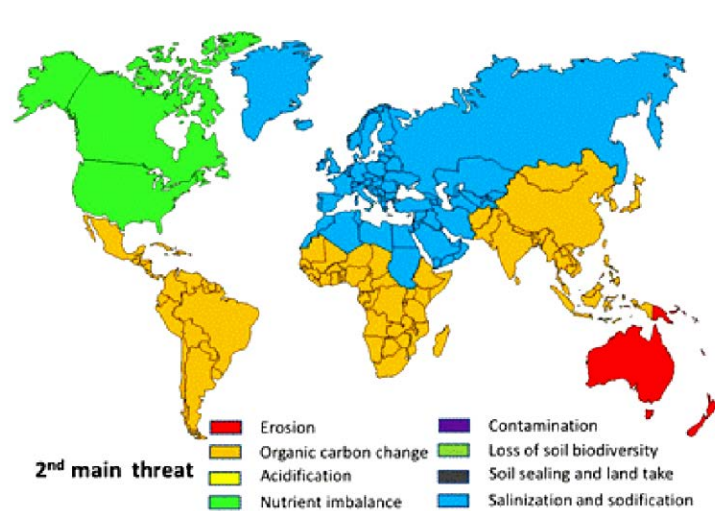
TeaTime4Schools – engaging youth in soil science

Roey Angel, Taru Sandén + TBI and TeaTime4Schools team



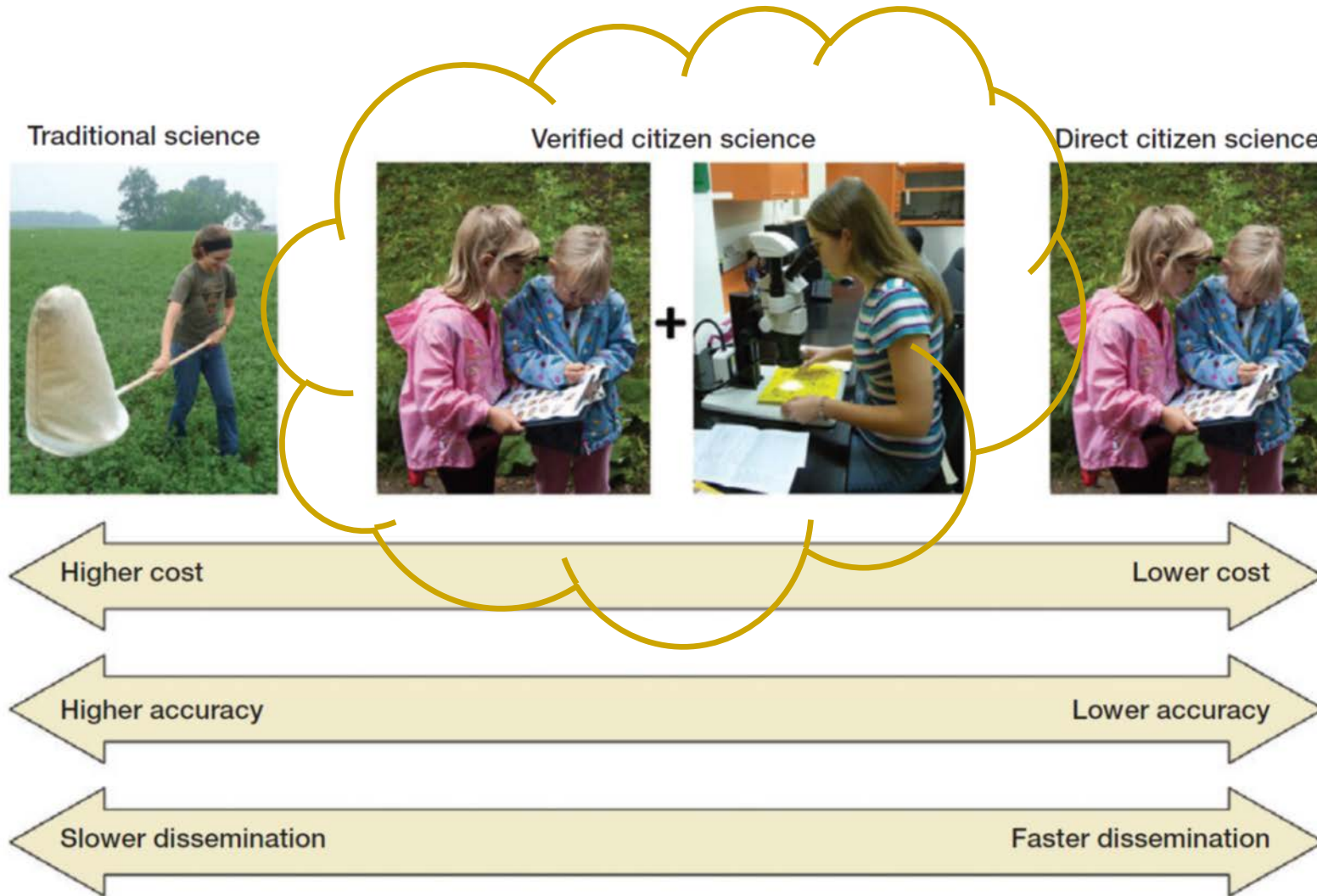
SOIL ORGANIC CARBON CHANGE

One of the biggest soil threats globally



However, students hear way too little about it in school!

AIMING TOWARDS VERIFIED CITIZEN SCIENCE



SEVERAL CITIZEN SCIENCE PROJECTS SINCE 2011

From soils to lakes, from schools to private gardens



The Tea Bag Index – UK

METHOD THAT IS EASY TO TAKE TO SCHOOLS

School becomes a part of a global research initiative



Methods in Ecology and Evolution



Methods in Ecology and Evolution 2013

doi: 10.1111/2041-210X.12097

Tea Bag Index: a novel approach to collect uniform decomposition data across ecosystems

Joost A. Keuskamp^{1*†}, Bas J. J. Dingemans^{1†}, Taru Lehtinen^{2,3}, Judith M. Sarneel^{4,5} and Mariet M. Heffting¹

TEA BAG INDEX TEAM

To bring tea bags to science since 2010



CALCULATING TEA BAG INDEX

S and k

☞ Stabilisation factor (S)

$$S = 1 - a_g / H_g$$

to which degree the labile fraction of the material is remaining after 3 months

☞ Initial decomposition rate (k)

$$Wr(t) = a_r e^{-kt} + (1 - a_r)$$

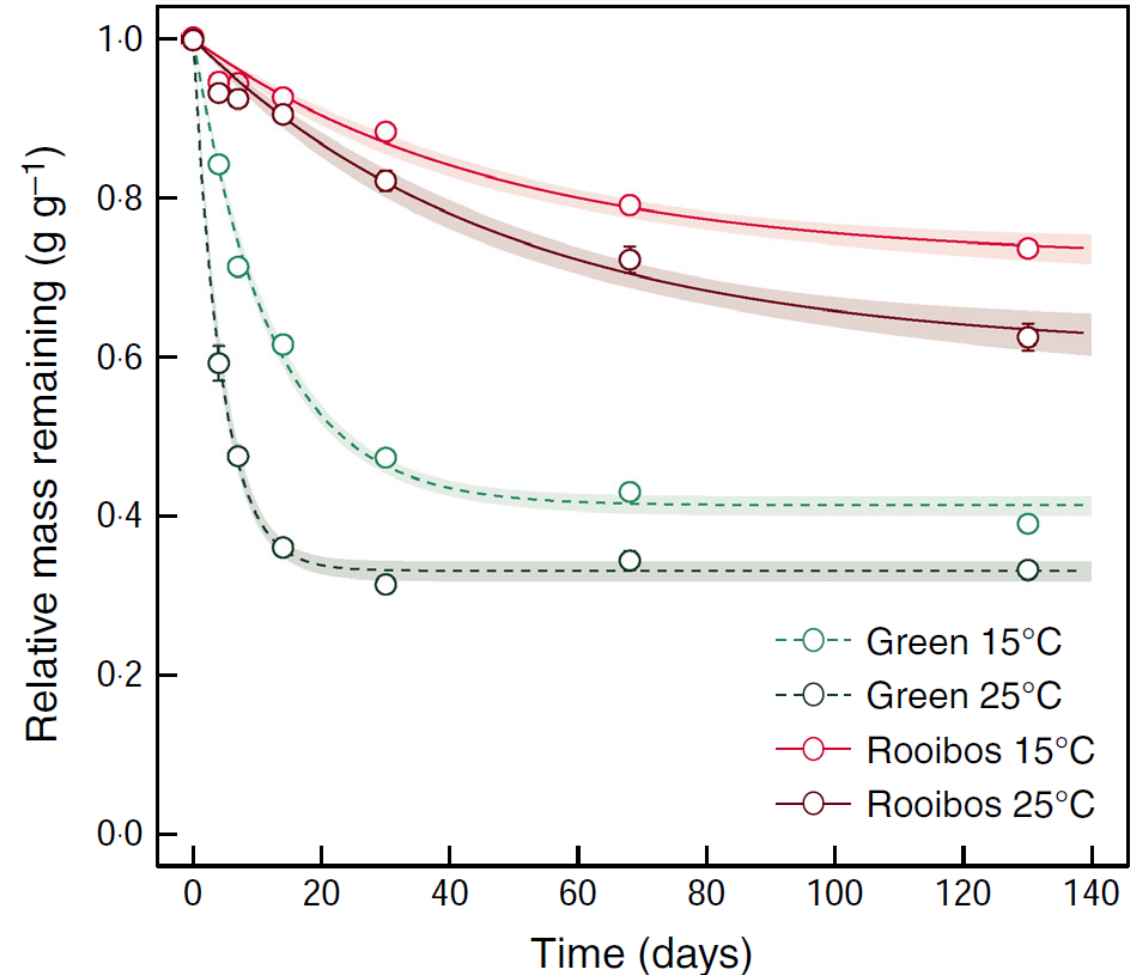
where $a_r = H_r (1 - S)$

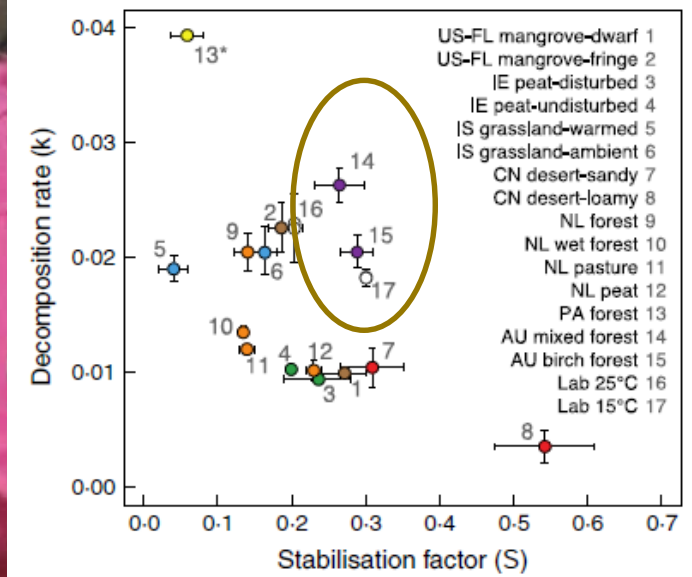
a_g = decomposable fraction of green tea

a_r = decomposable fraction of rooibos

H_g = hydrolysable fraction of green tea (water and acid solubles)

H_r = hydrolysable fraction of rooibos






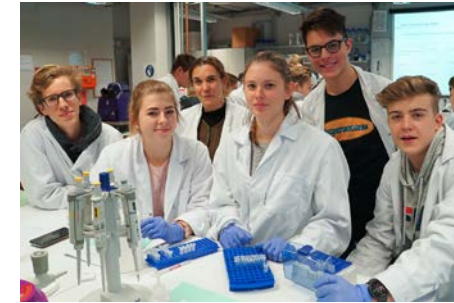
Keuskamp et al., 2013

TEATIME4SCHOOLS TEAM

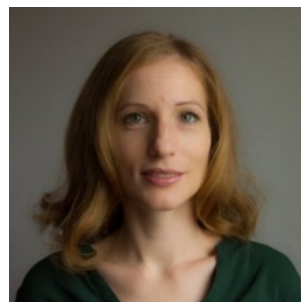
To bring soils to schools between 2017 and 2019



 HBLA und Bundesamt
Klosterneuburg
Wein- und Obstbau



 Bundesministerium
Bildung, Wissenschaft
und Forschung



HBLA Ursprung
Gymnasium Draschestrasse
Klemens Maria Hofbauer Gymnasium
Mary Ward PG und ORG
HBLA Forstwirtschaft- Bruck/Mur
+ 140 andere Schulklassen

WHAT ARE OUR AIMS WITH SCHOOLS?

TeaTime4Schools



☞ Goals of the 2-year project:

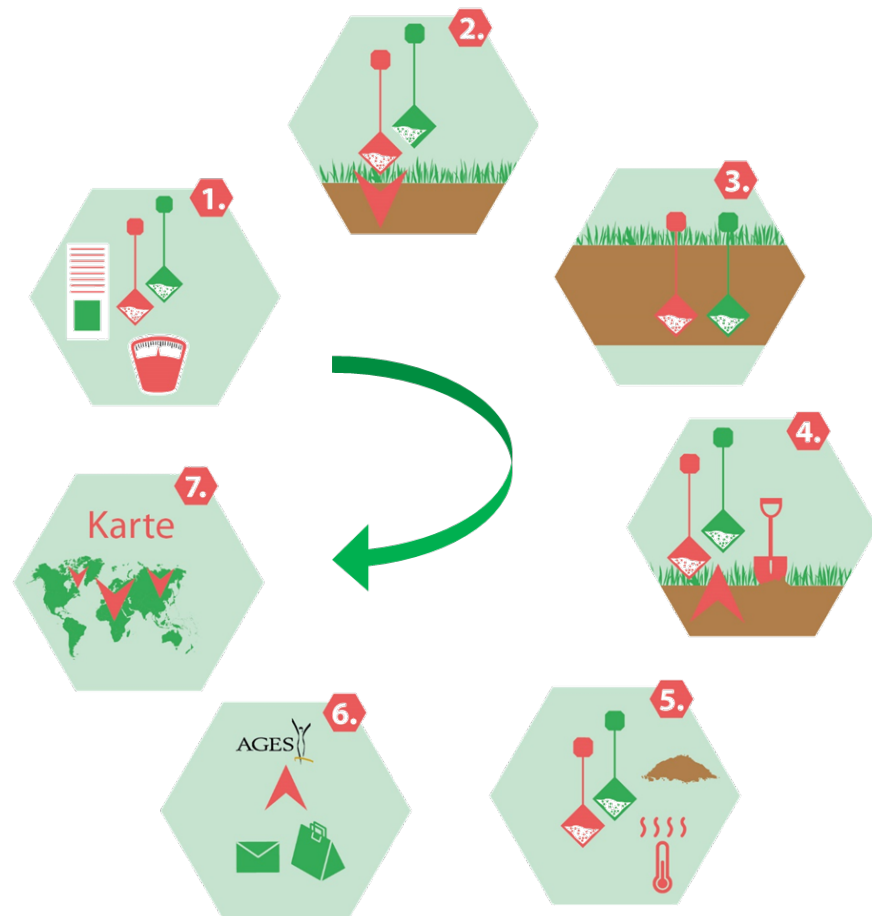
- Collection of Austrian data on decomposition with the help of 150 school classes
- Integration of the collected data to the global Tea Bag Index database
- Better understanding of the litter decomposing microorganisms in cooperation with two school classes
- Increased soil awareness in Austrian schools

TEATIME4SCHOOLS

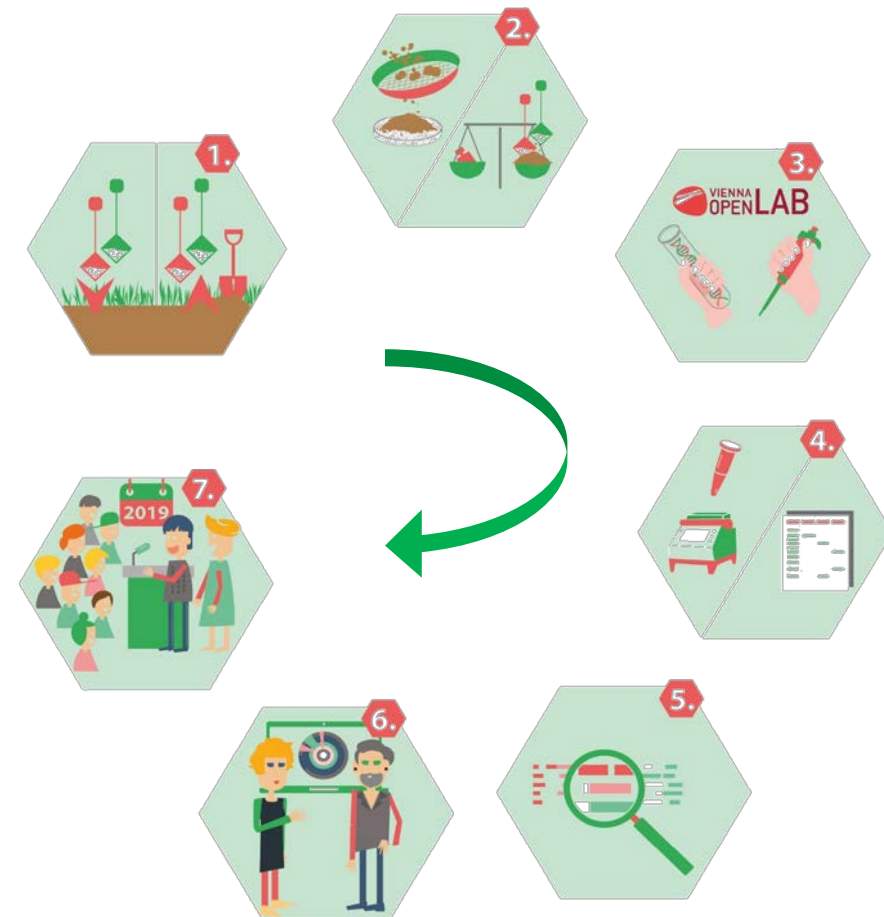
Methods



☛ Tea Bag Index – 150 school classes



☛ DNA workshops – 2 school classes



150 schools participated!

Most data already in the global database



TEATIME4SCHOOLS

Methods



UIC
UNIVERSITY
OF ILLINOIS
AT CHICAGO



December
2018

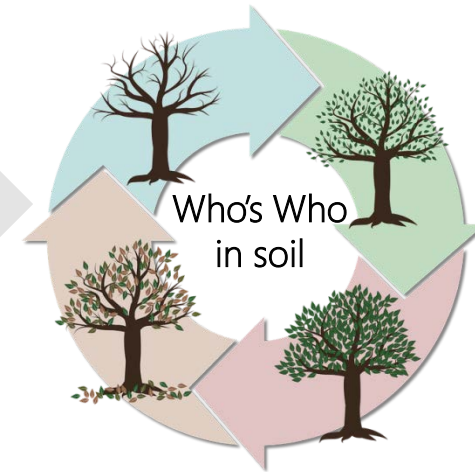
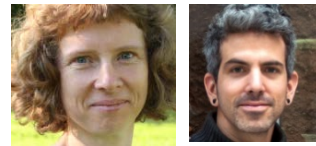
January
2019

February
2019

Sending DNA samples
for sequencing at the
University of Chicago

Sequencing on a
Illumina MiSeq platform

Workshop on sequencing
and bioinformatical
analysis of the results with
Anne Daebeler and Roey
Angel

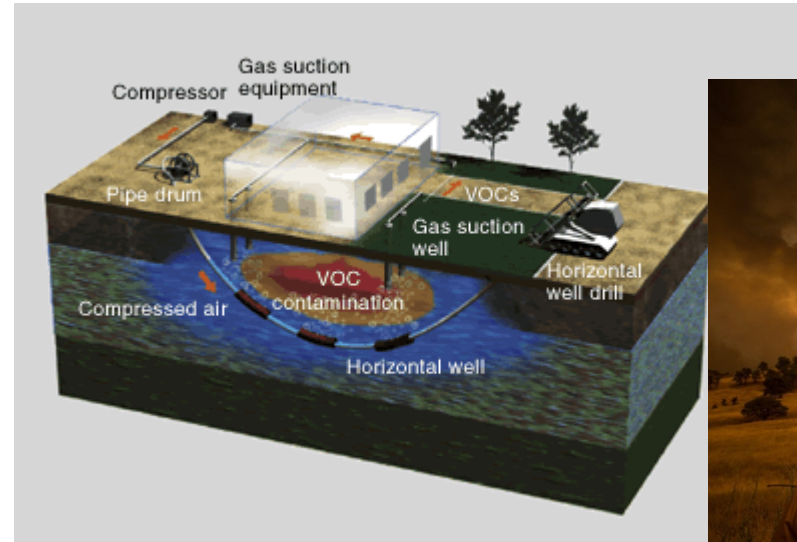


THE AGE OF MICROBIOME

Modern era of microbial ecology



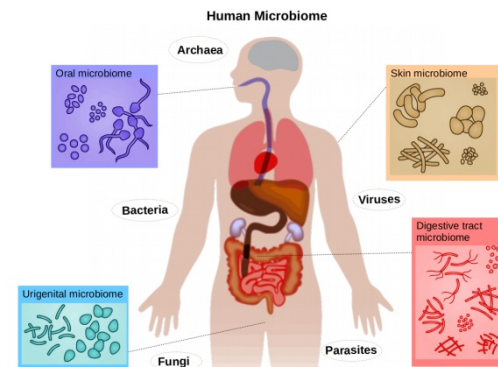
Biotechnology



Biodegradation of pollutants *in situ*



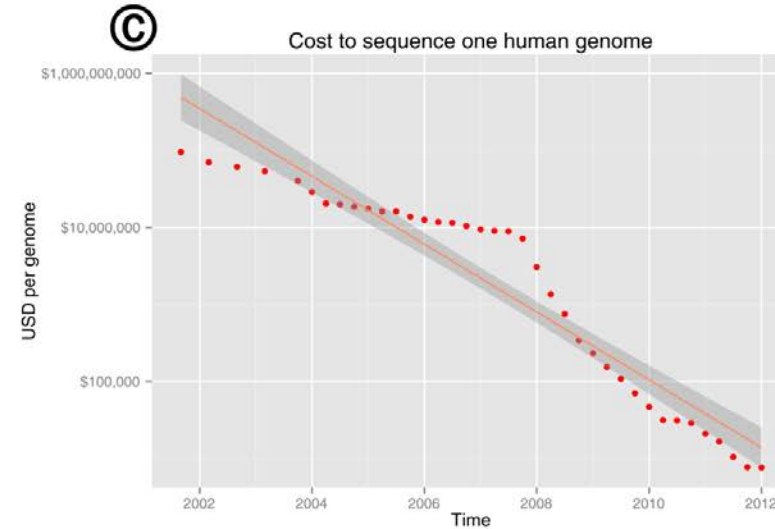
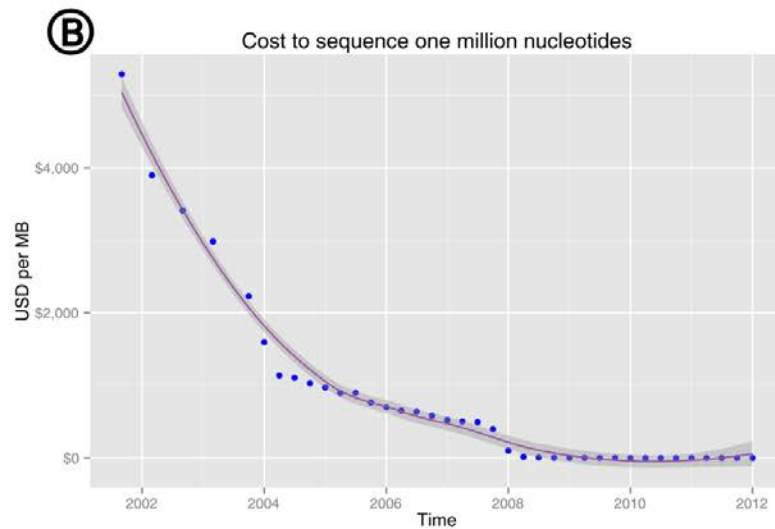
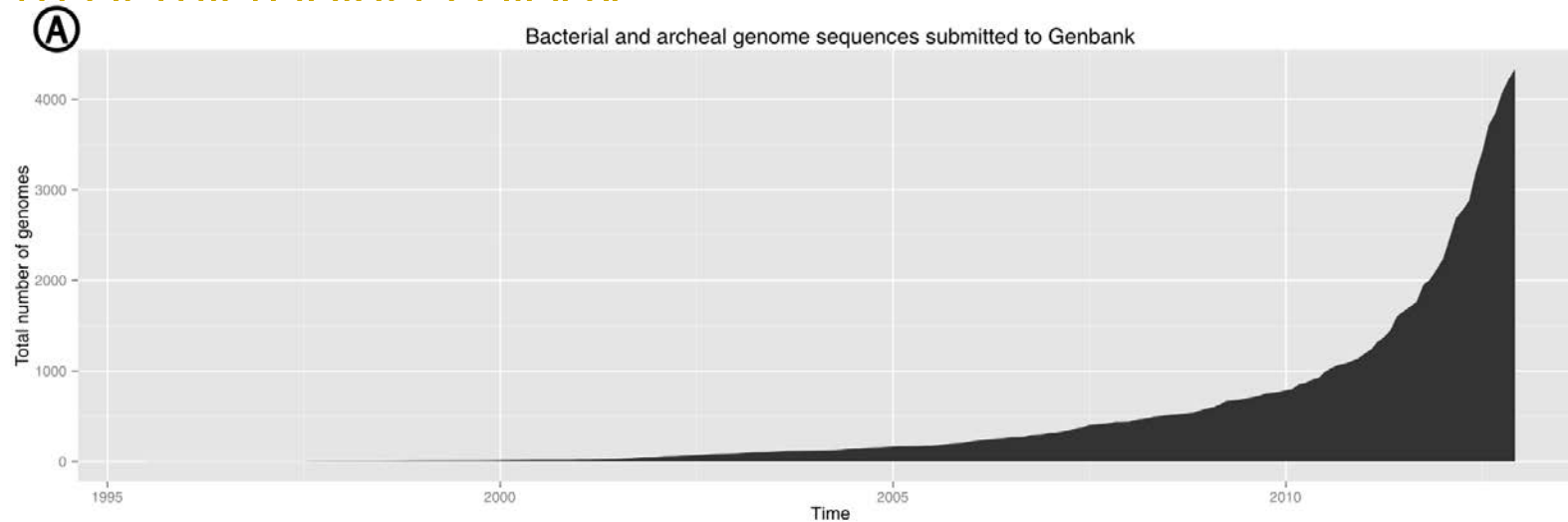
Soil management in the age of climate collapse



Personalised medicine

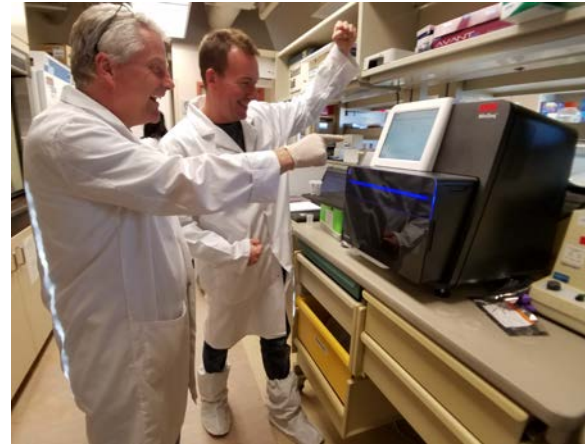
THE AGE OF MICROBIOME

Modern era of microbial ecology



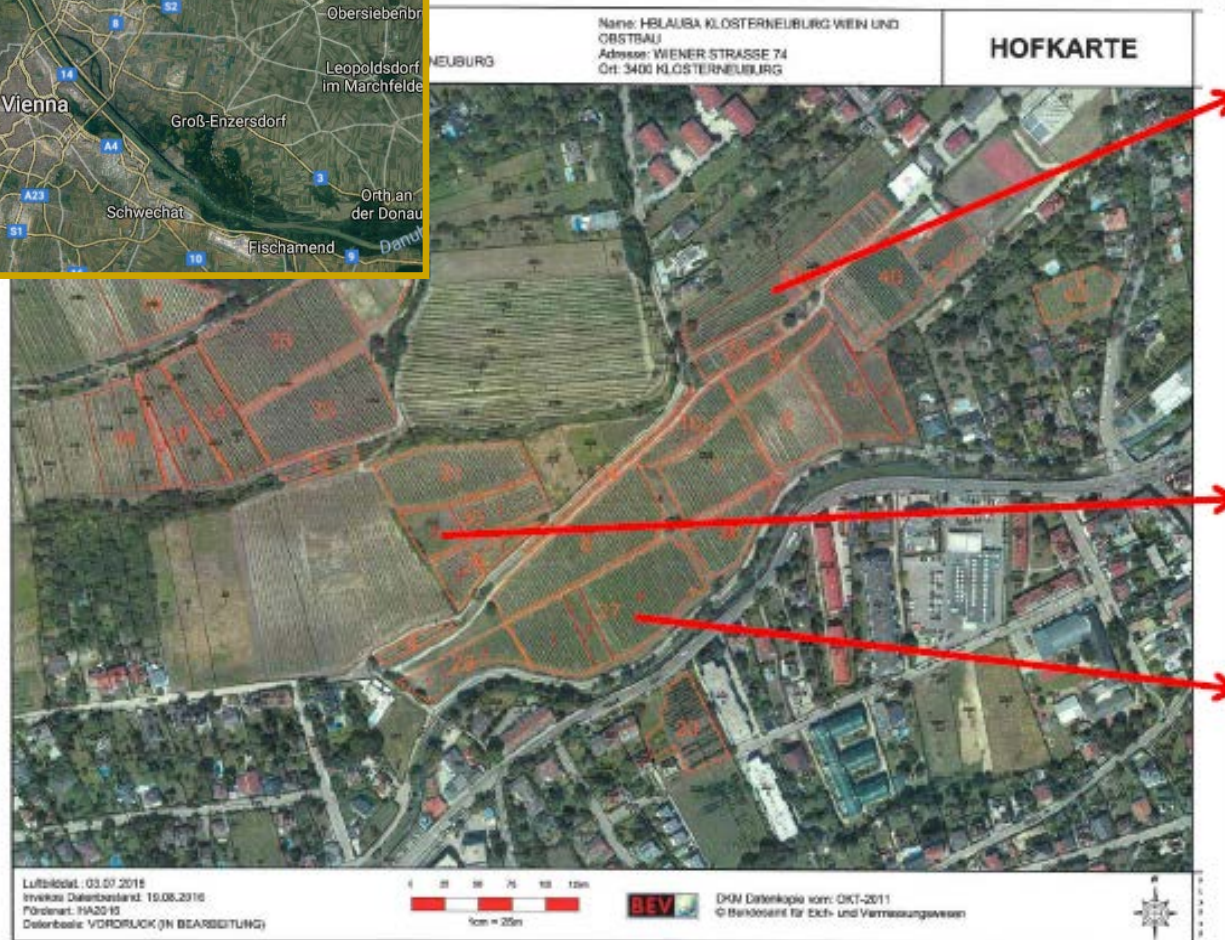
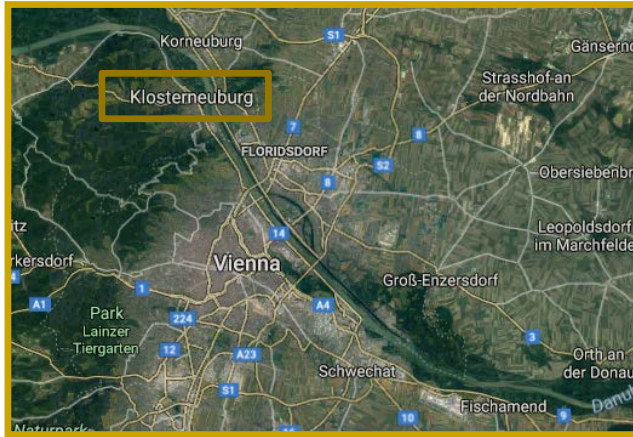
THE AGE OF MICROBIOME

Modern era of microbial ecology



TEATIME4SCHOOLS SITES IN KLOSTERNEUBURG

School vineyards



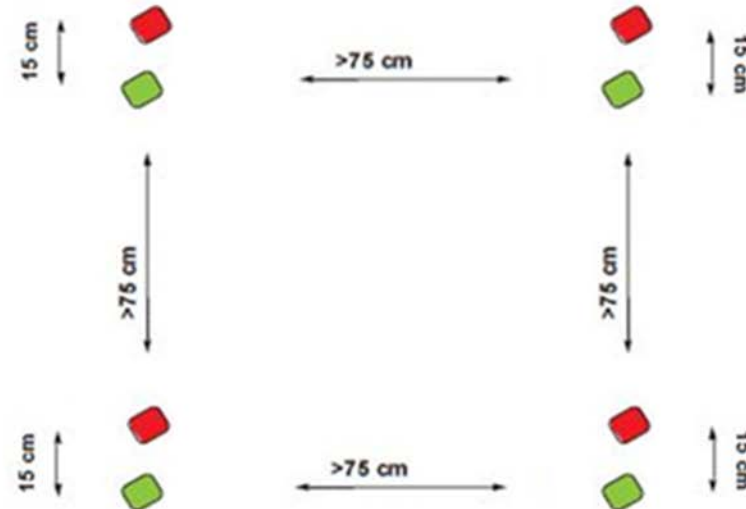
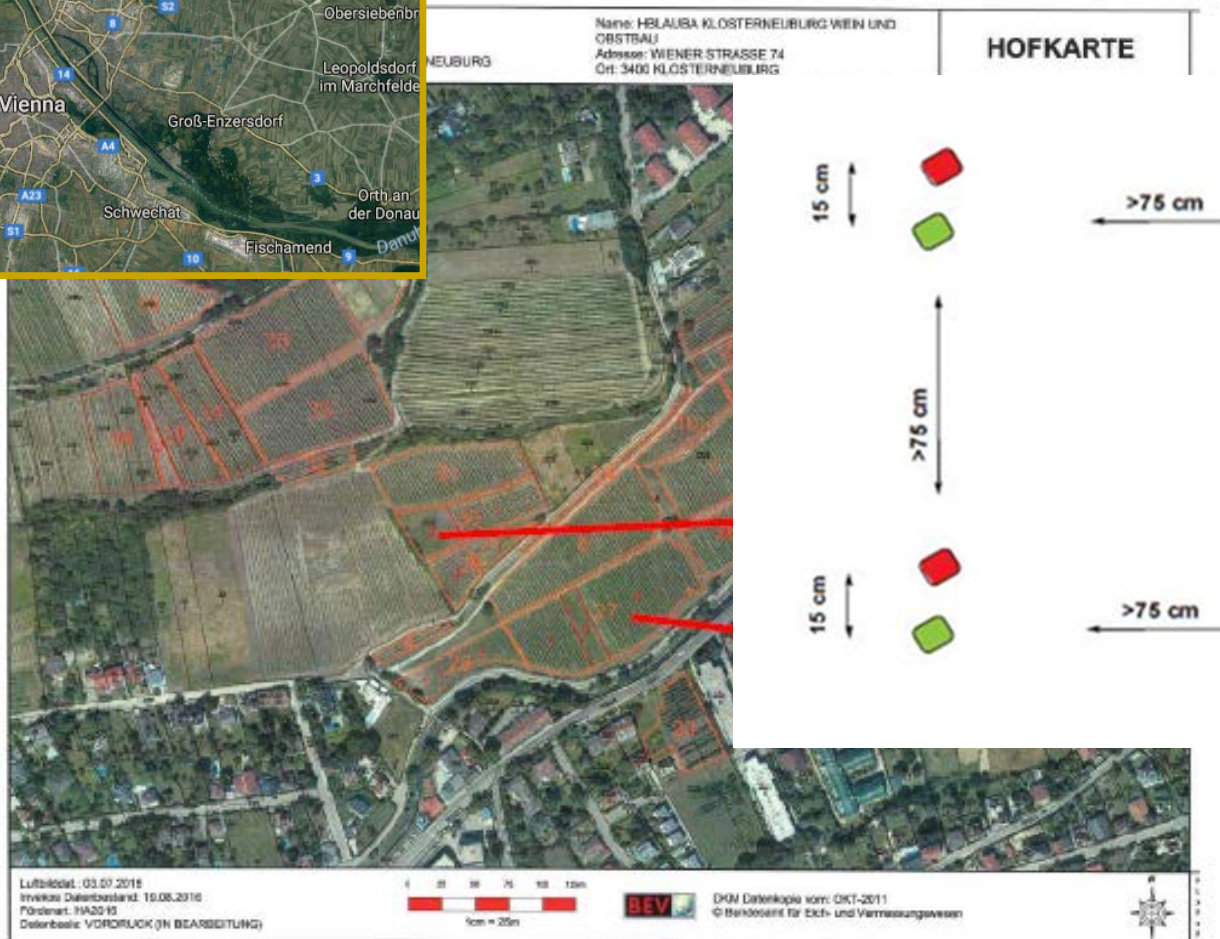
Anthrosol (Kulluvisol) – Vineyard

Cambisol (Braunerde) –
grassland in between vineyards

Fluvisol (Auboden) – Vineyard

TEATIME4SCHOOLS SITES IN KLOSTERNEUBURG

School vineyards



TEA BAG INDEX IN THE FIELD

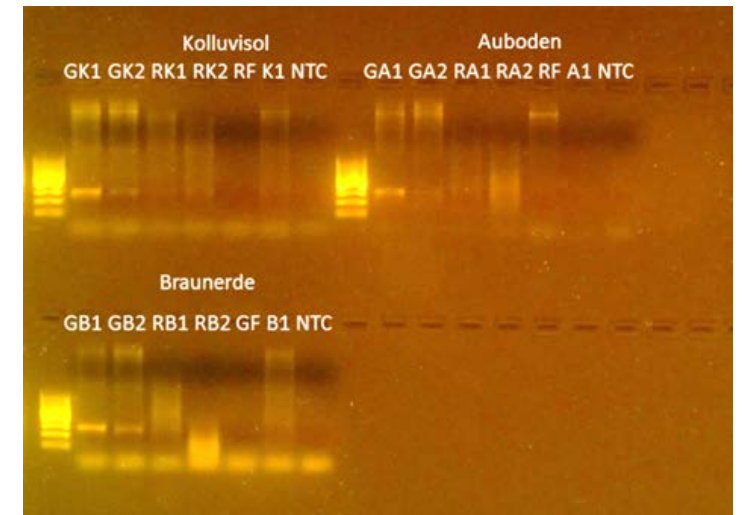


calculation_TBL_v2NW_Standard3_months.xlsx - Microsoft Excel

<div><TREATMENT CODES></div> <div><div>Treatment codes</div><div>Ambient</div><div>Treatment</div></div> <div><div>General description</div><div>Please use 'Ambient' to refer to natural or control locations without manipulation</div><div>If you have a treatment please describe its nature here, in case of multiple treatments, add an extra line</div></div>											
<END OF TREATMENT CODES>											
<SAMPLE DATA>											
Sample ID	Location	Treatment	Replicate	Date of burial	Initial weight green tea including bag, cord and label	Initial weight red tea including bag, cord, and label	Initial weight green tea tea only	Initial weight red tea tea only	Recovery date	na	
EXAMPLE	Grassland	Ambient	1	01 July 2014	2,000	2,000	2,000	2,000	29 September 2014	na	
EXAMPLE	Pasture	Ambient	2	03 July 2014	1,945	2,153	1,945	2,153	29 September 2014	na	
EXAMPLE	Grassland	Treatment	1	01 July 2014	2,001	2,138	2,001	2,138	29 September 2014	na	
EXAMPLE	Pasture	Treatment	2	03 July 2014	1,980	2,120	1,980	2,120	29 September 2014	na	
1	Wine	Treatment	1	06. Dez 17	2,085	2,141	2,085	2,141	12. Mrz 18		
2	Wine	Treatment	2	06. Dez 17	2,019	2,235	2,019	2,235	12. Mrz 18		
3	Wine	Treatment	3	06. Dez 17	1,992	2,183	1,992	2,183	12. Mrz 18		
4	Wine	Treatment	4	06. Dez 17	2,054	2,201	2,054	2,201	12. Mrz 18		
5	Wine	Treatment	13	12. Mrz 18	1,964	2,205	1,964	2,205			
6	Wine	Treatment	14	12. Mrz 18	1,897	2,141	1,897	2,141			
7	Wine	Treatment	15	12. Mrz 18	1,928	2,154	1,928	2,154			
8	Wine	Treatment	16	12. Mrz 18	1,923	2,184	1,923	2,184			
9											

DNA WORKSHOP IN VIENNA – MARCH 2018

Teabags in the soil December 2017 – March 2018



IMPORTANCE OF HIGHLIGHTING GOOD EXAMPLES

HBLA Klosterneuburg – Kinder Kurier reportage 23.9.2018





SO, WHAT DID WE FIND OUT?

Remember, it's not just about engagement but also about science



SITE CHARACTERISTICS

Soil characteristics

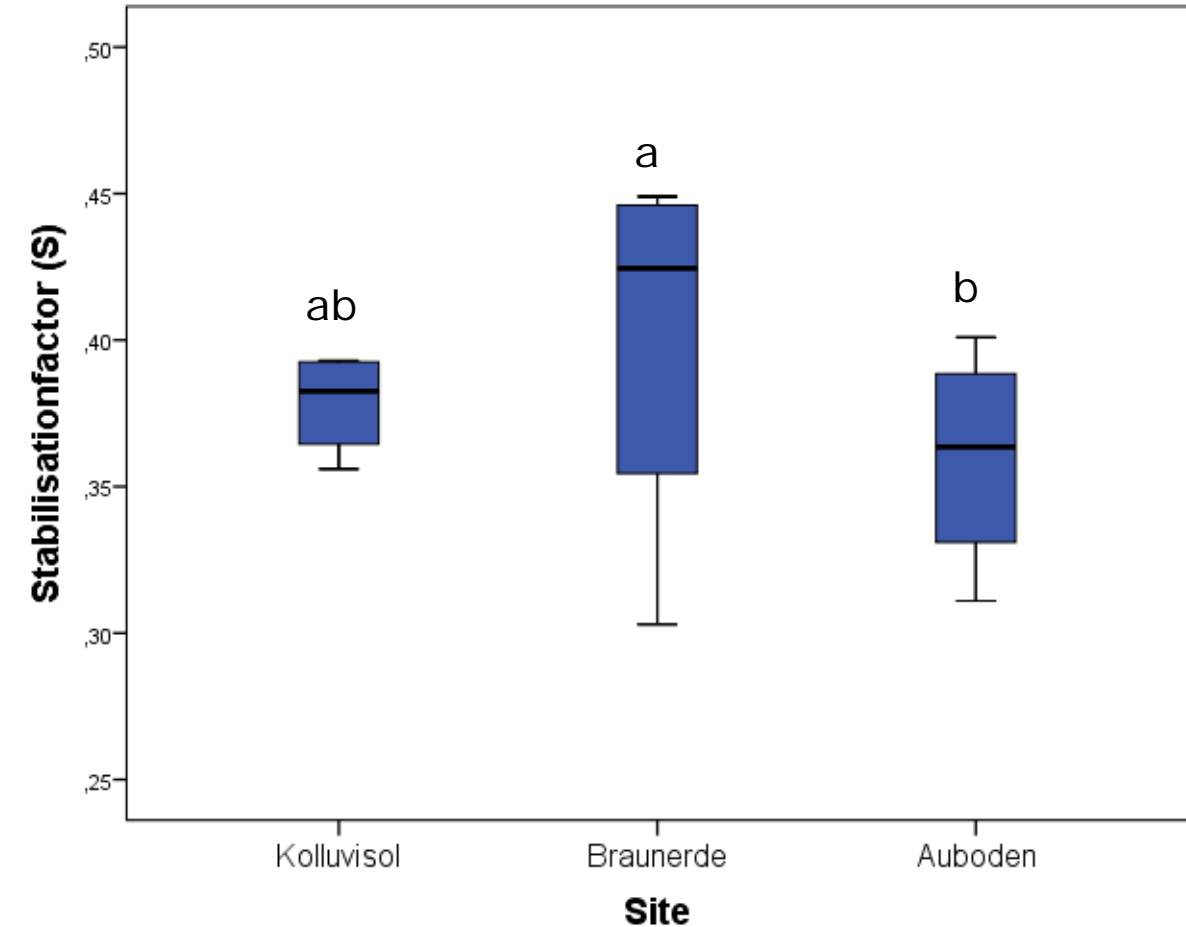
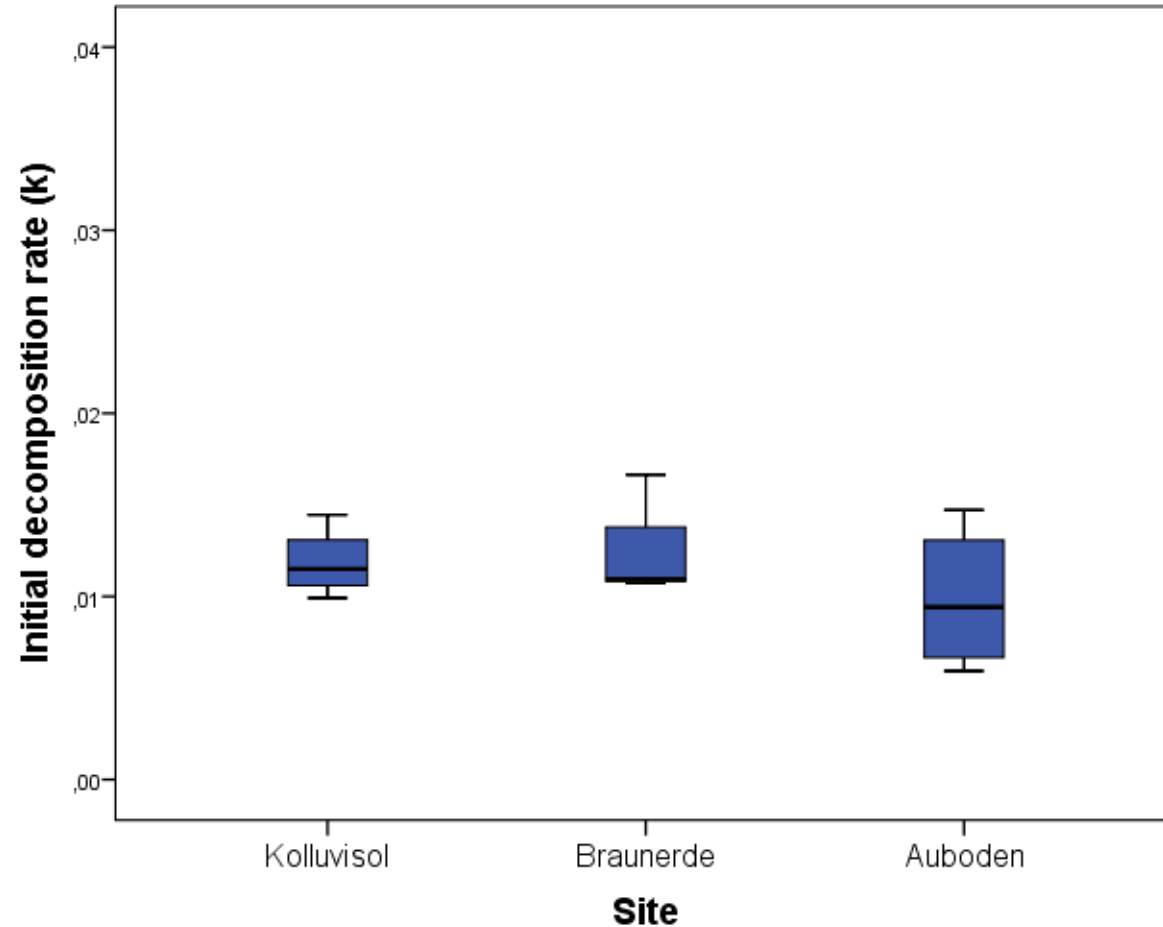


	pH	Phosphorous P _{CAI}	Potassium K _{CAI}	TOC	N _t	Labile carbon	Potentially mineralisable N	Sand	Silt	Clay
		mg/kg	mg/kg	%	%	mg/kg	mg/kg/7d	%	%	%
Dezember 2017										
Kolluvisol	7.34	163	345	1.84	0.15	522	146	15.8	63.1	21.1
Braunerde	7.08	173	645	3.02	0.19	780	179	41.6	38.4	19.3
Auboden	7.09	138	716	3.39	0.31	967	218	31.2	45.3	23.6



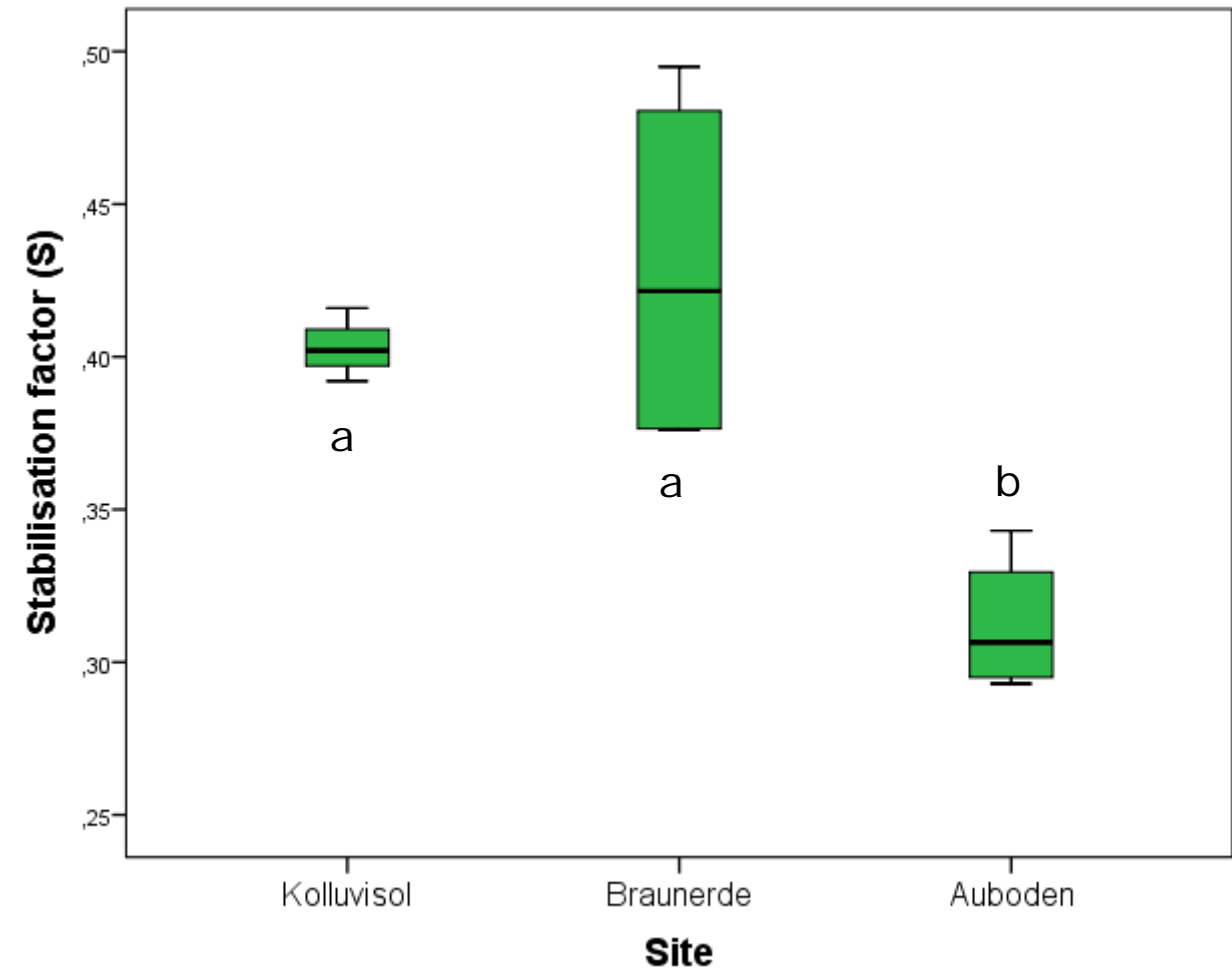
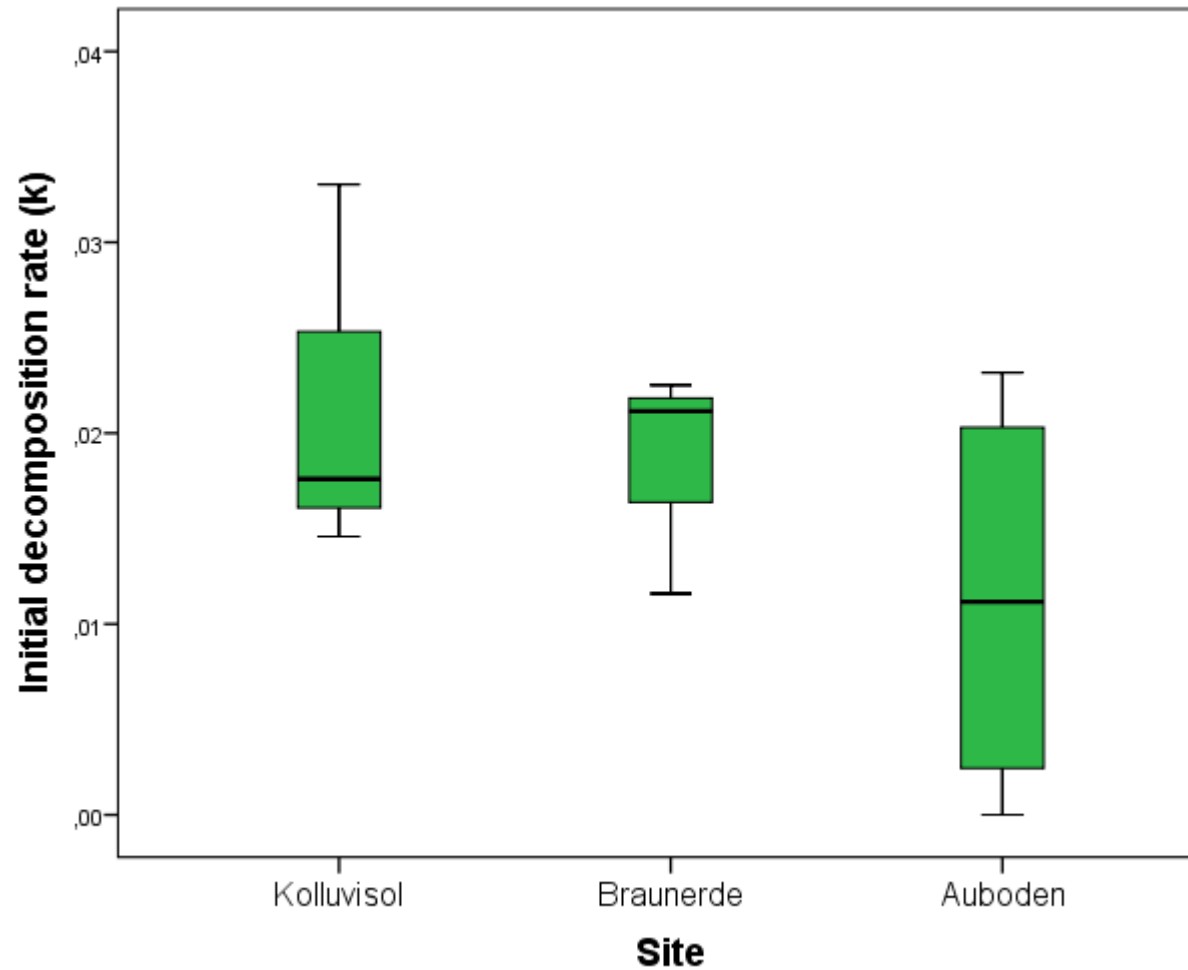
TEA BAG INDEX

December 2017 – March 2018



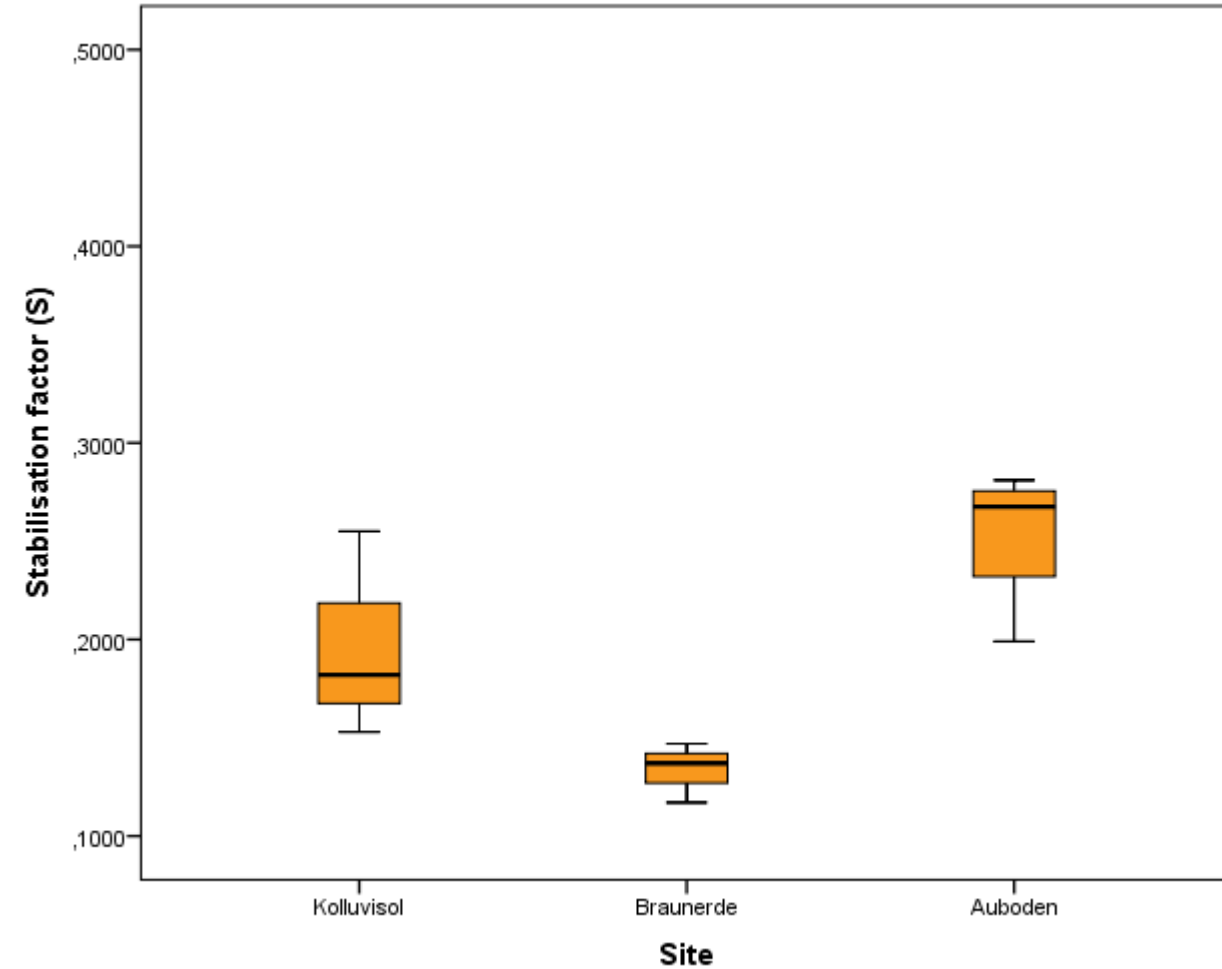
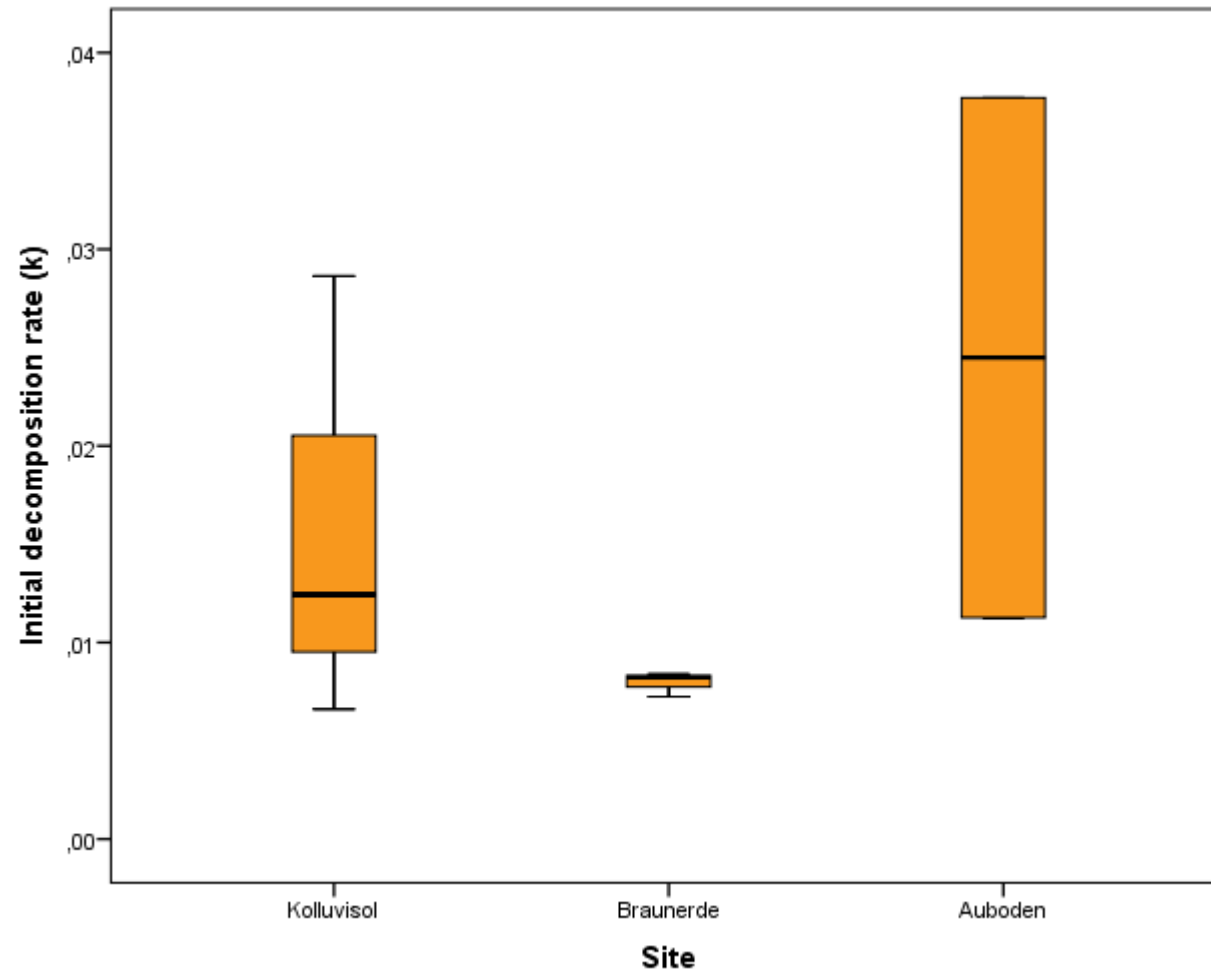
TEA BAG INDEX

März 2018 – Juni 2018



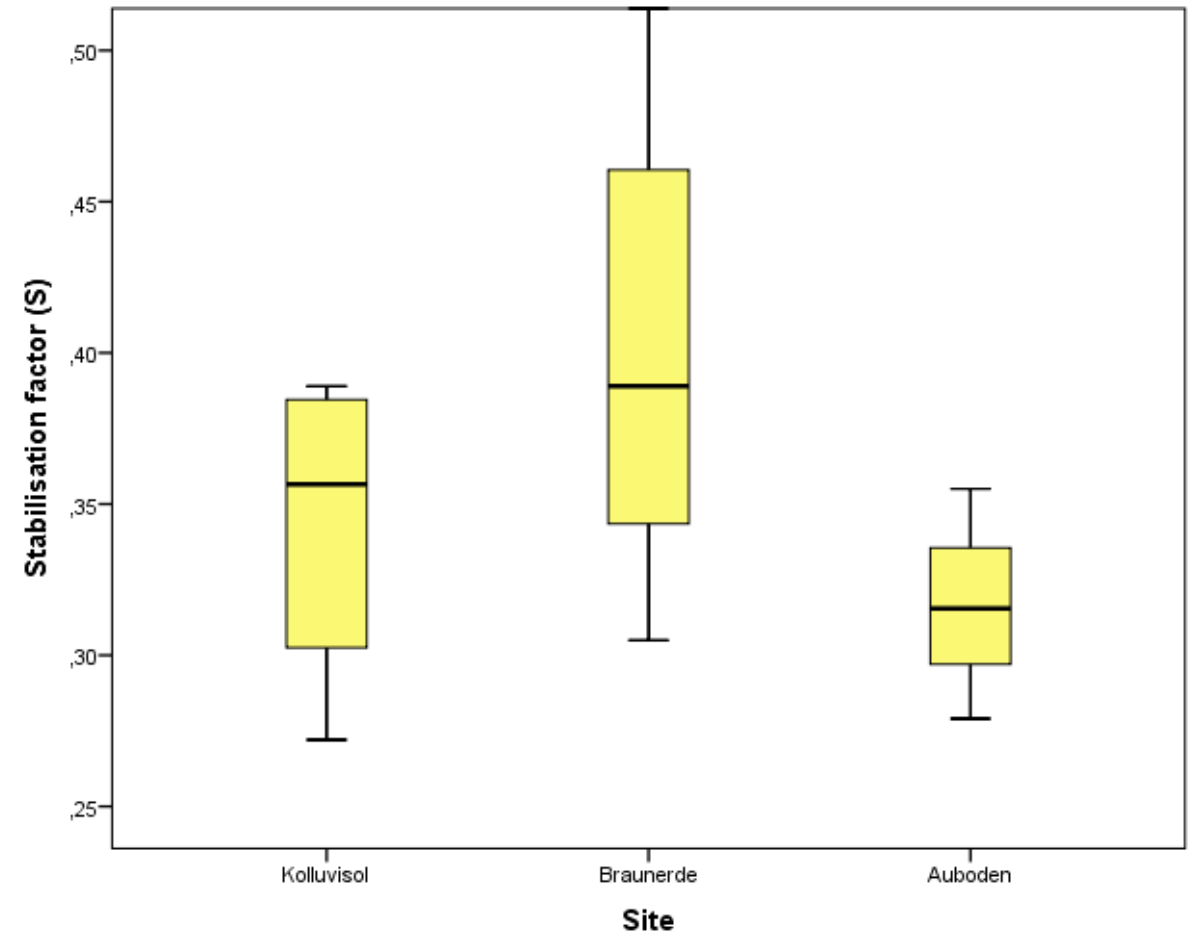
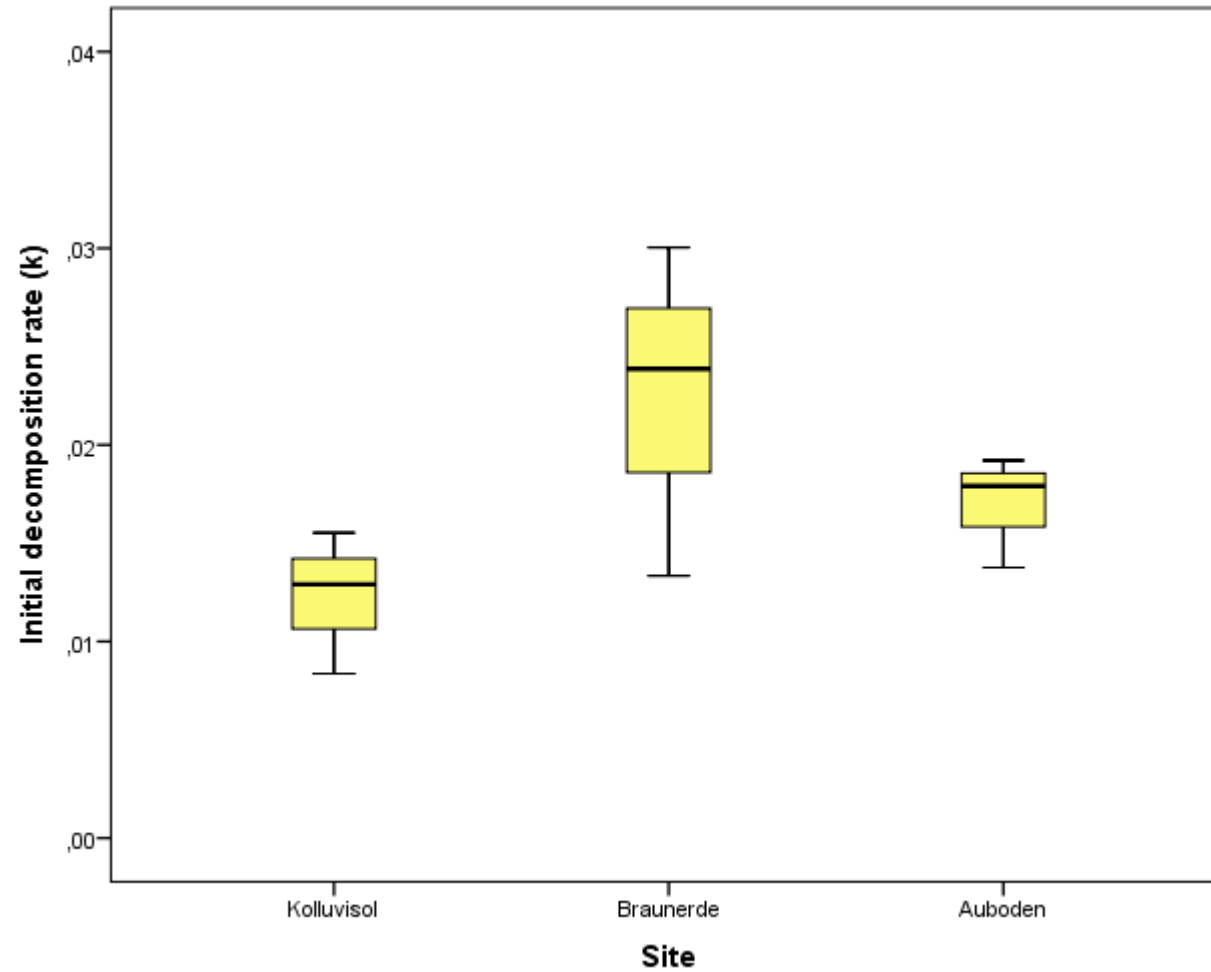
TEA BAG INDEX

Juni 2018 – September 2018



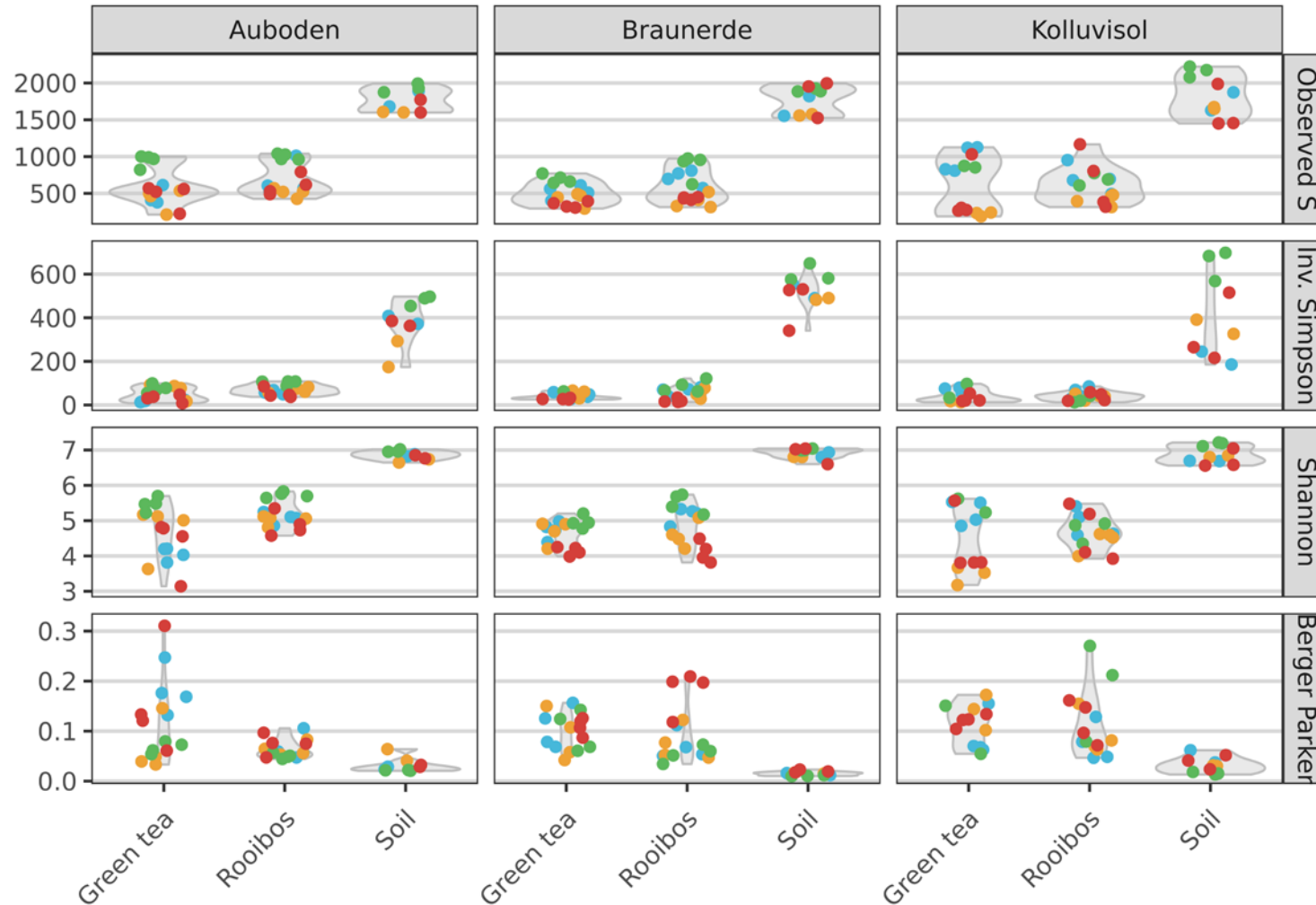
TEA BAG INDEX

September 2018 – Dezember 2018



BACTERIAL DIVERSITY IN THE TEA BAGS AND SOIL

Reduced diversity in the teabags



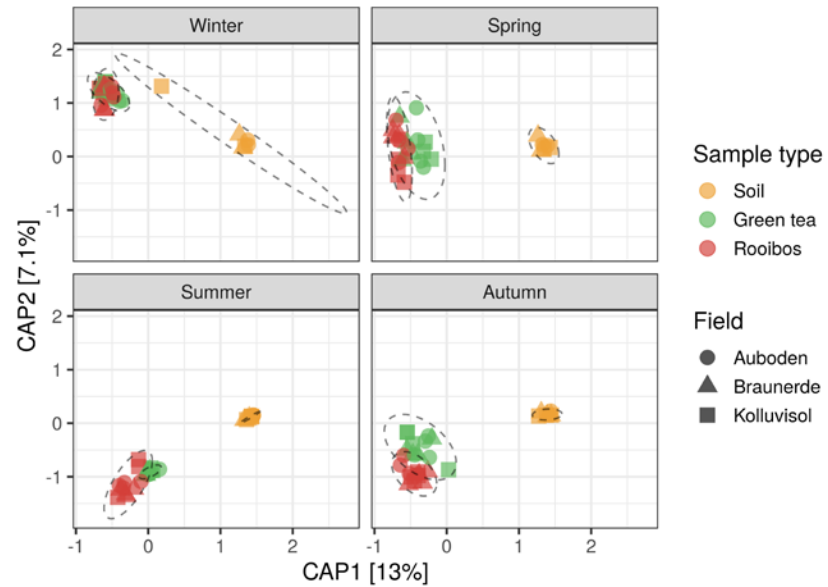
- Autumn
- Spring
- Summer
- Winter

BACTERIAL DIVERSITY IN THE TEA BAGS AND SOIL

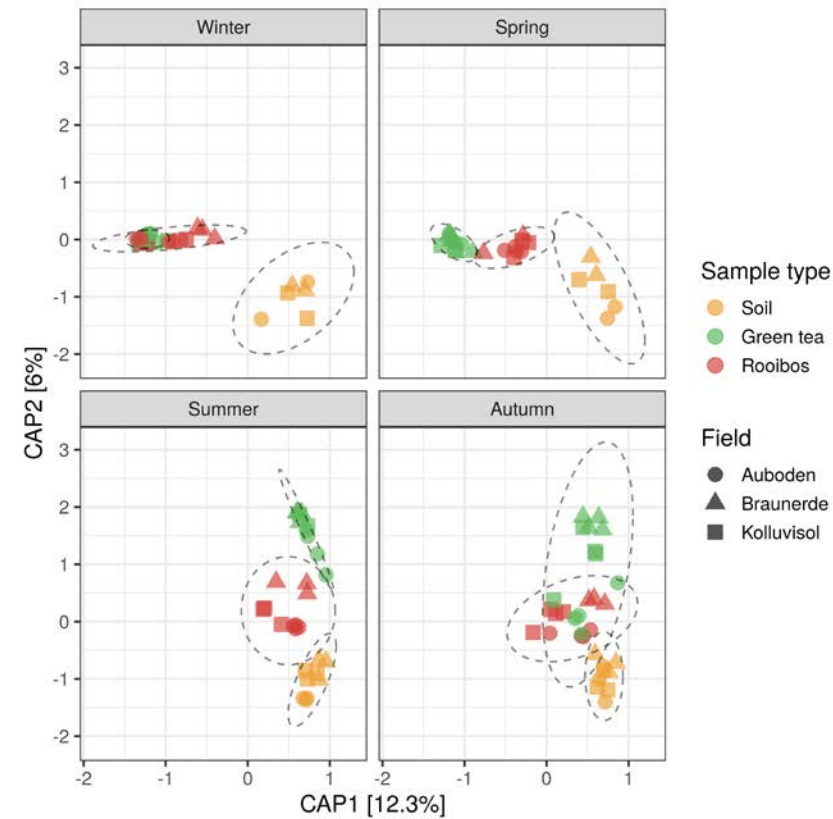
Reduced diversity in the teabags



Prokaryotes

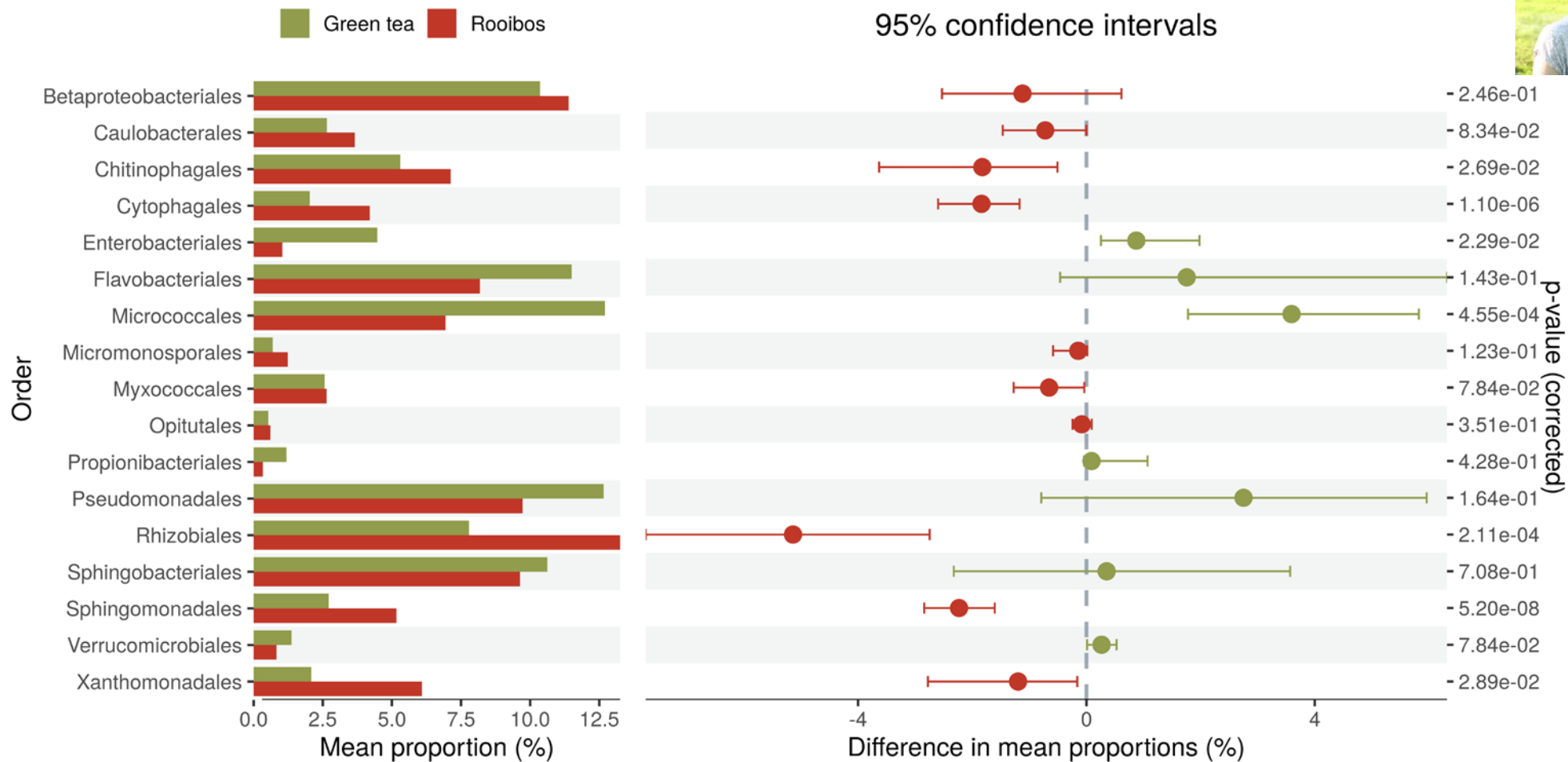


Fungi



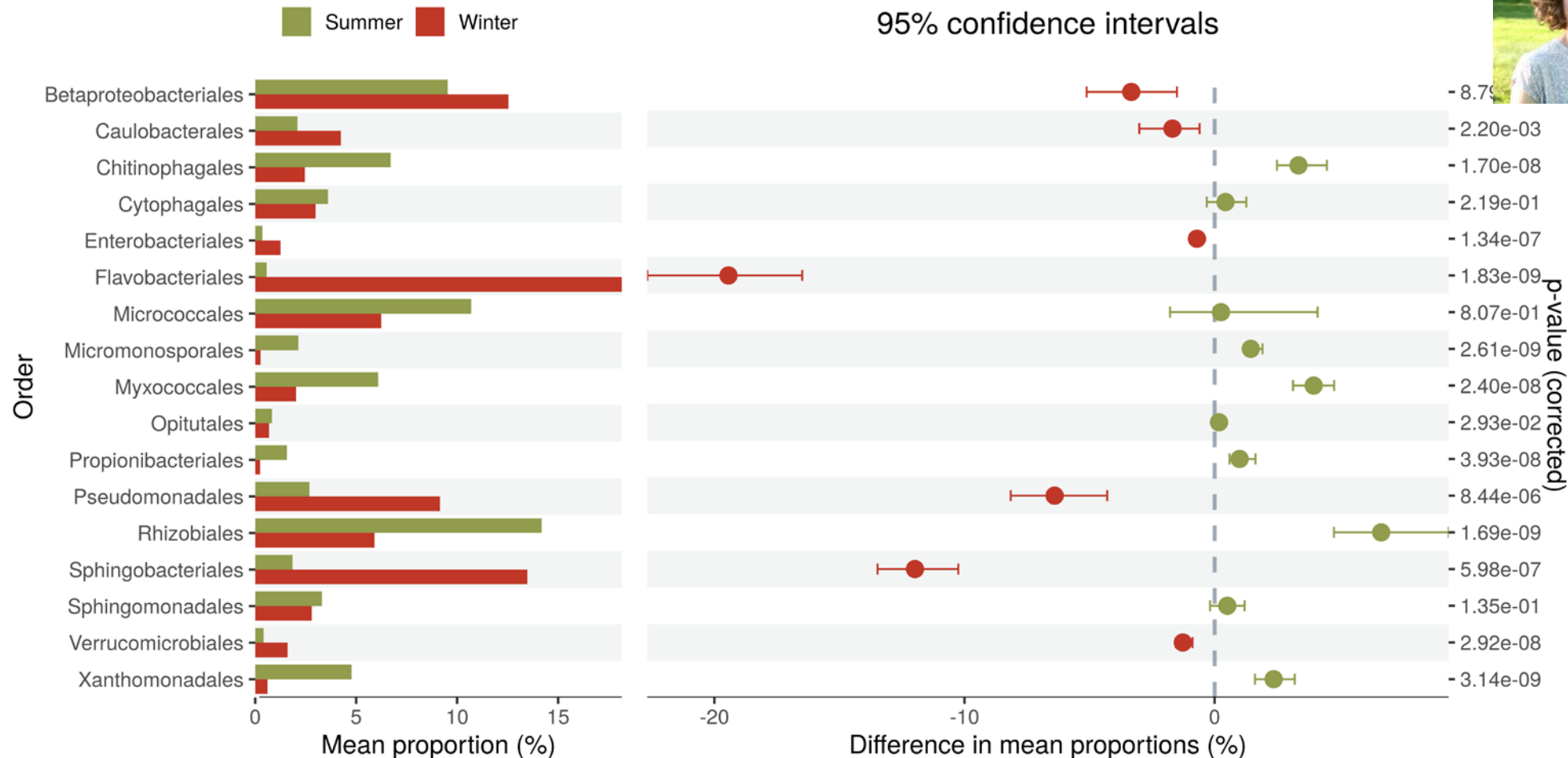
BACTERIAL DIVERSITY IN THE TEA BAGS AND SOIL

Variation in taxonomic groups between tea types



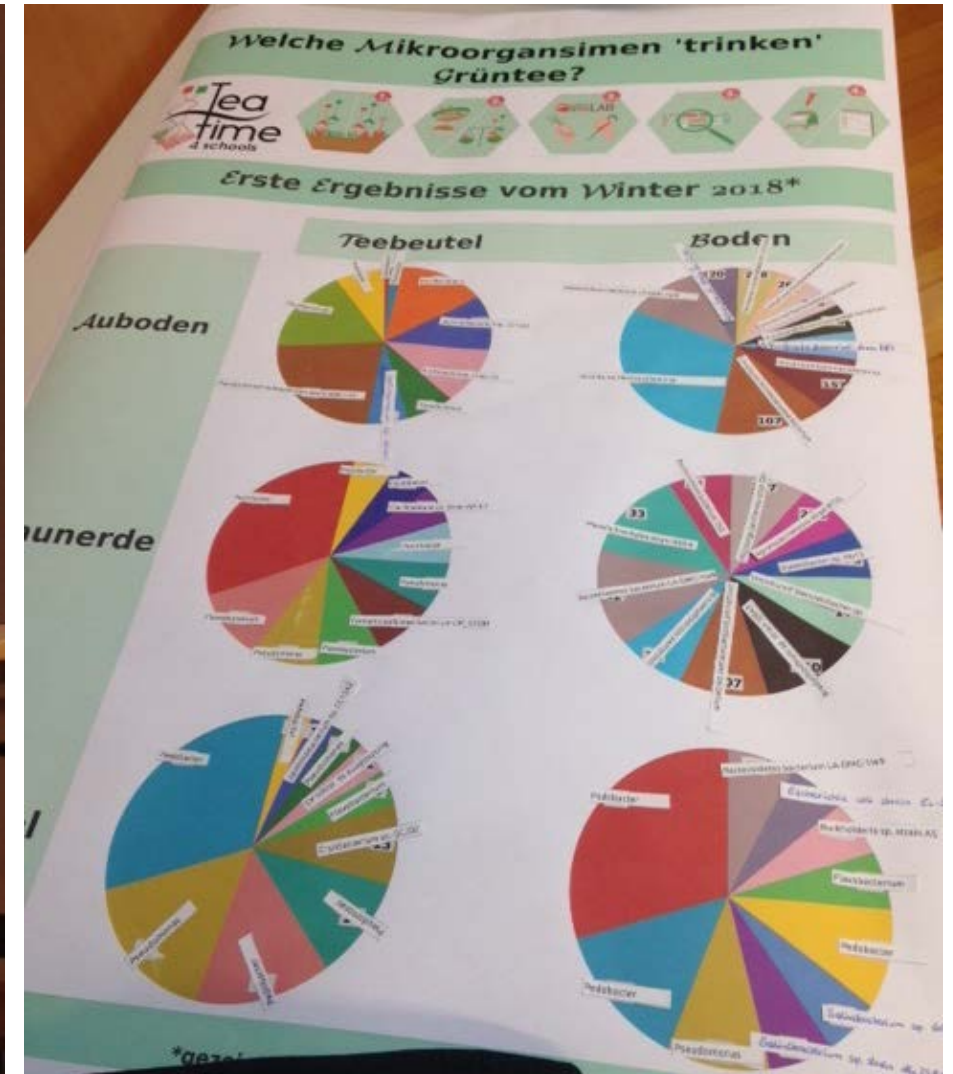
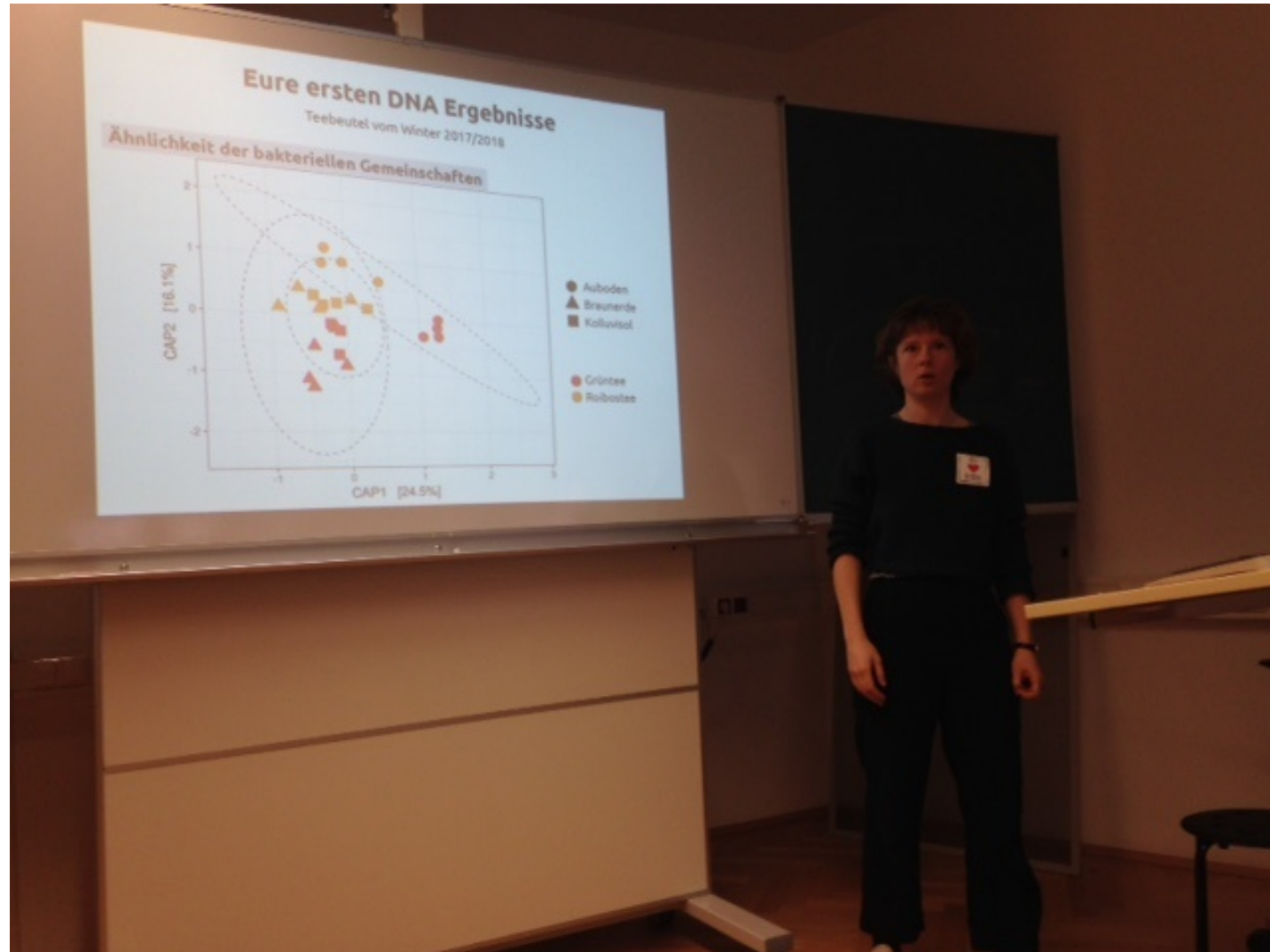
BACTERIAL DIVERSITY IN THE TEA BAGS AND SOIL

Variation in taxonomic groups between tea types



BIOINFORMATICS WORKSHOP

Finding the tea bag and soil microorganisms



BIOINFORMATICS WORKSHOP

From sequence to identification of microorganisms

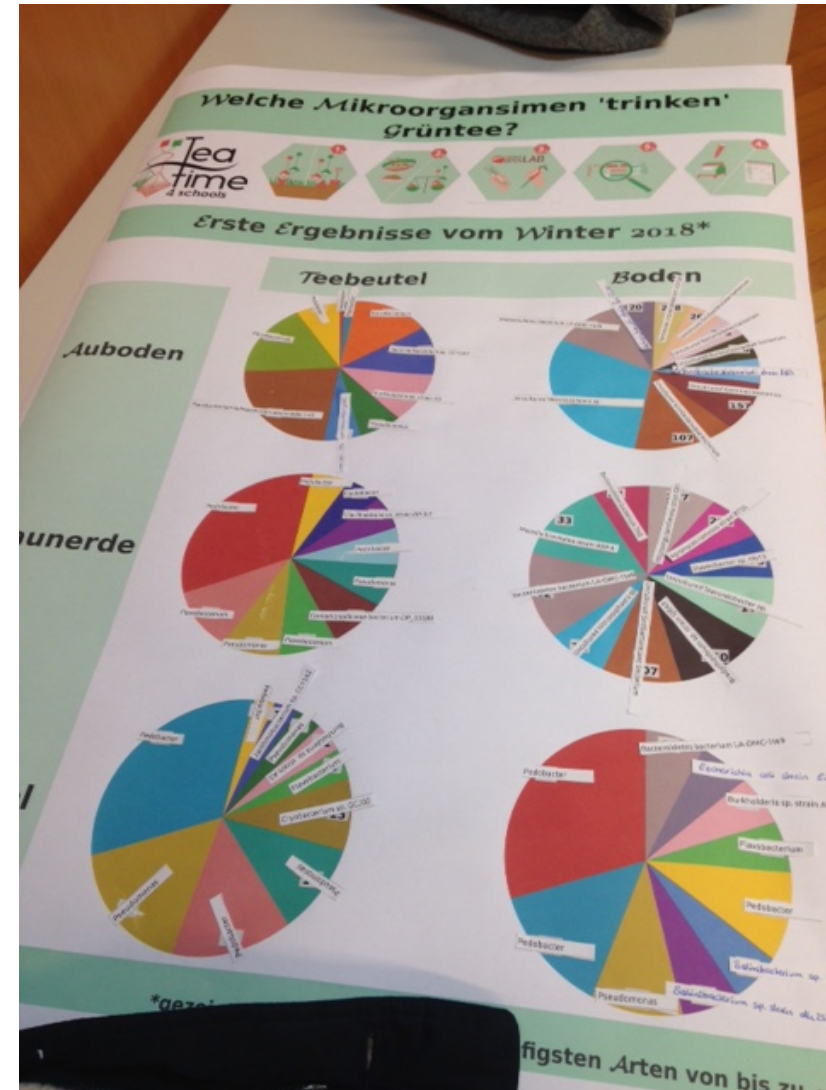
☞ Green tea – Fluvisol

>Seq_1

```
TACGGAGGATCCAAGCGTTATCCGGATTT
ATTGGGTTTAAAGGGTGCGTAGGGCGGCT
TTTTAAGTCAGGGGGTGAAAGACGTTAGC
TCAACTAACGCAGTGCCCTTGATACTGAA
GAGCTTGAATGGACTAGAGGTAGGGCGGA
ATGTGACAAGTAGCGGTGAAATGCATAGA
TATGTCACAGAACACCGATTGCGAAGGC
AGCTTACTATGGTTTAAATTGACGCTGAGG
CACGAAAGCGTGGGGGATCAAACAGG
```

☞ Nutzung der BLAST Website

<https://blast.ncbi.nlm.nih.gov/Blast.cgi>



TEATIME4APP TEAM

To bring Tea Bag Index App to schools in 2019





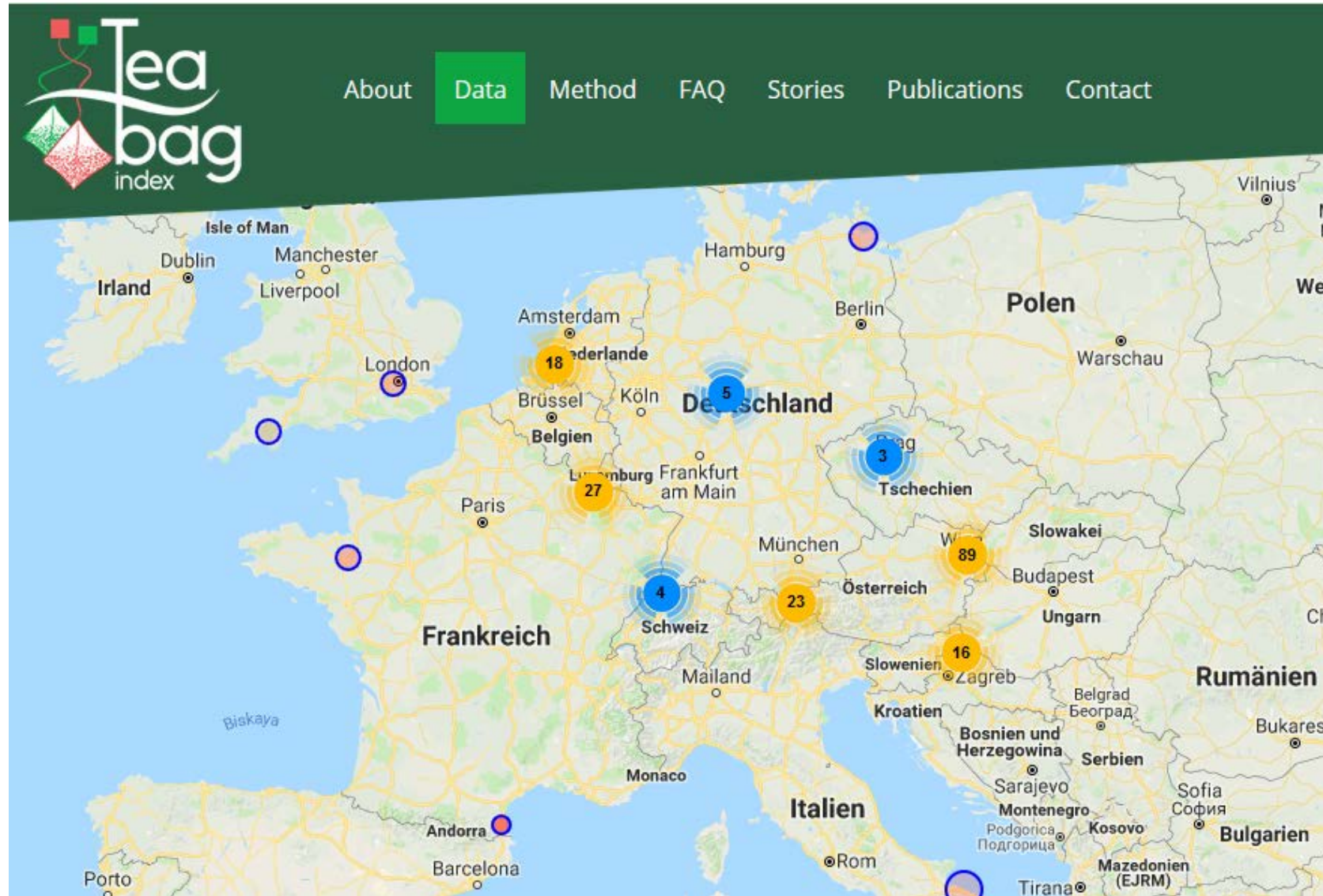
Teabag index



Image CC-BY Natural Resources Conservation Service Soil Health Campaign (flickr)

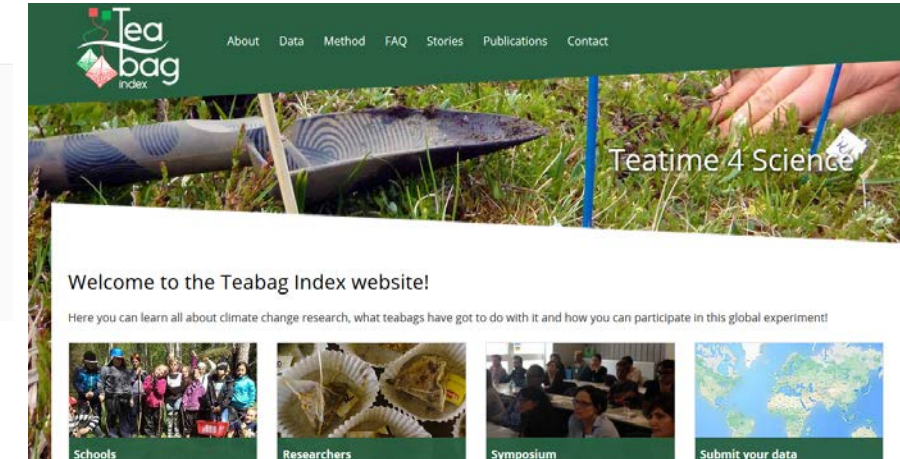
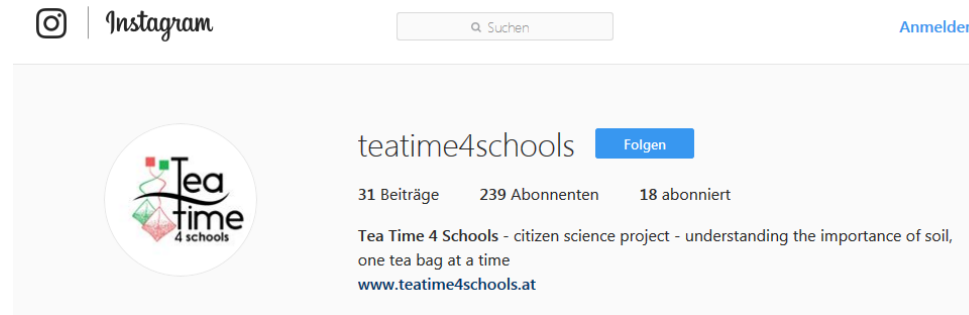
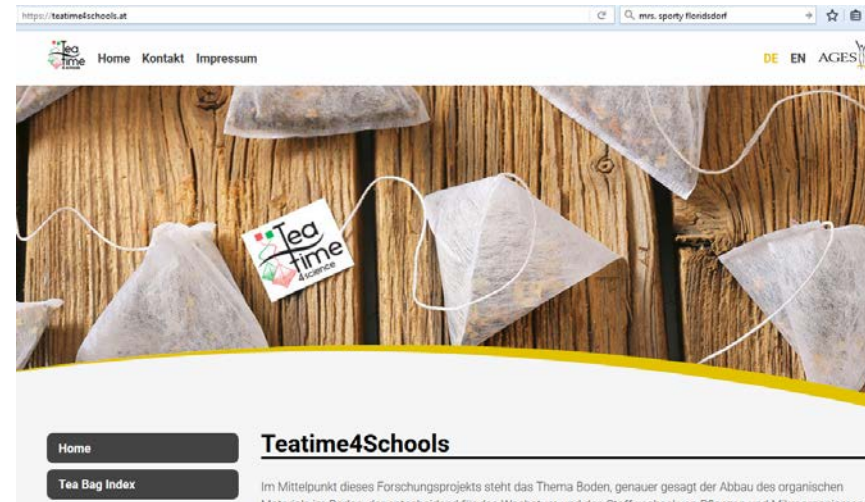
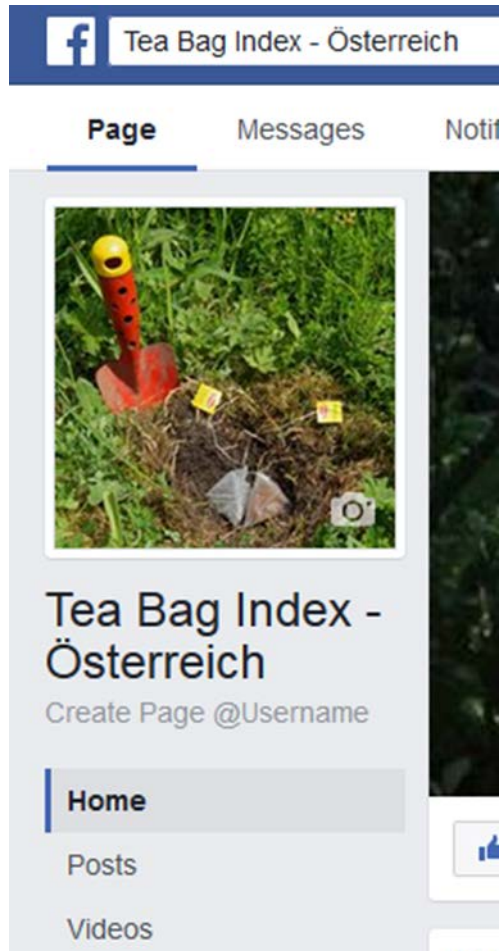
THE GLOBAL DATABASE IS AVAILABLE ONLINE

<http://www.teatime4science.org/data/map/>



OUR SOCIAL MEDIA AND ONLINE CHANNELS

#teatime4schools #teatime4app #teabagindex



TAKE HOME MESSAGES



- ☛ Successful Tea Bag Index and DNA experiments
 - Data already in standard TBI data submission templates or submitted directly through our global webpage
 - Students have successfully named their most important microorganisms
- ☛ 150 schools participated in 2018
 - In total ca. 3750 Austrian students are taking part in the experiment

☛ NOT TO FORGET:

- Citizen Science is not only about collecting data BUT about doing science together, with a desirable outcome for each one involved
- How to ensure this when working with schools?



Ten principles of citizen science



THANK YOU FOR LISTENING!

roey.angel@bc.cas.cz

taru.sanden@ages.at