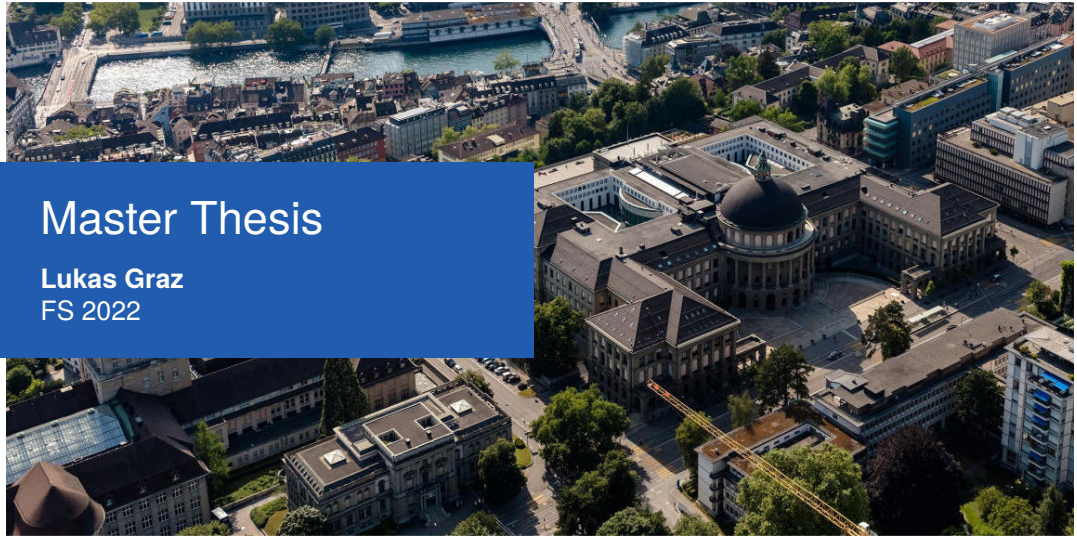
ETH zürich

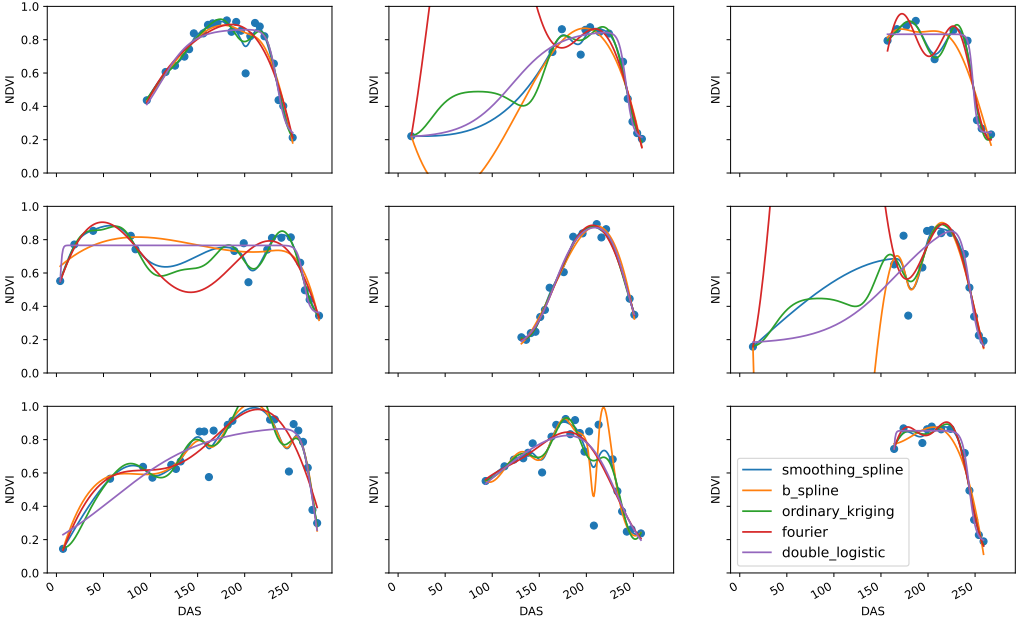
D-MATH — Seminar for Statistics
D-USYS — Crop Science



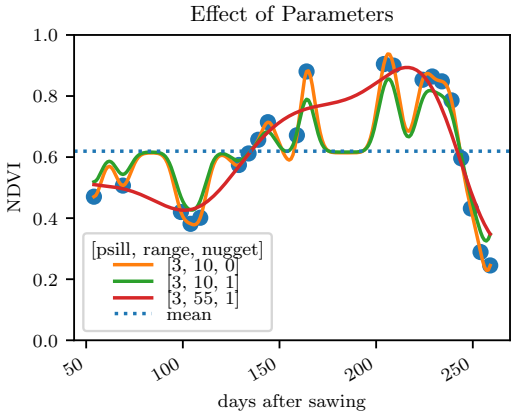
Master Thesis

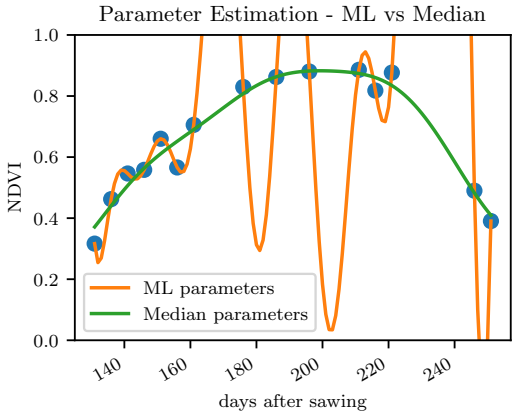
Lukas Graz

FS 2022


NDVI
DAS
smoothing_spline
b_spline
ordinary_kriging
fourier
double_logistic

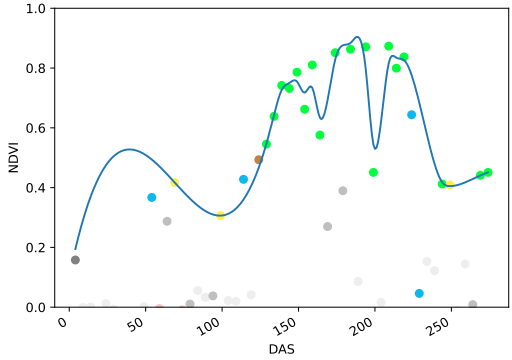
	assumtpions	pros	cons	weights	bounded
Savitzky-Golay filter	– high frequencies are noise (low.pass filter) – equidistant points		– cannot deal natively with missing data (need some interpolation)	no	yes
+ NDVI	– upper envelope – vegetation cannot grow faster than some slope	– biological knowledge	– bad "upper envelope" since weights are not used for the estimation itselfe	(no)	yes
Loess					
Smoothing Splines	– 2cd derivative of function is integrable	– intuitive meaning of penalty – general assumptions – flexible shape	– unbounded	yes	no
B-Splines + Smooth	– function can be approximated by a linear combination of B-splines basis functions	– general assumtion – flexible shape	– unbounded – no intuitive meaning for smoothing		no
(Gaussian) Kernel Smoothing		– simple – general assumptions	– bandwidh: failes if there are big data-gaps	yes	yes
Double-Logistic	– function first increases then decreases – ndvi has a minimal value	– good for evergreen plants (if snow masks ndvi) –upper envelope	– parameterestimation can go seriously wrong – strange behaviour for long data-gaps	yes	yes
Universal Kriging	– function is a realization of a stationary gaussian process	– informative parameters – flexible	– regression to the mean – assumptions clearly not met	yes	yes

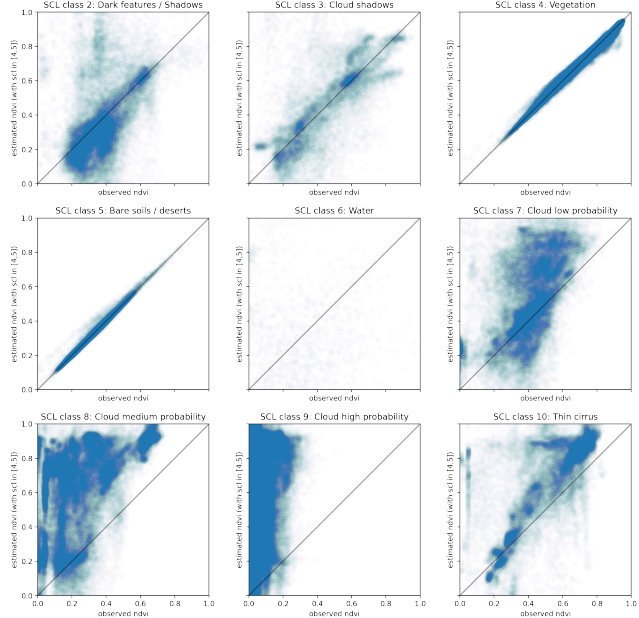

Effect of Parameters
NDVI
1.0
0.8
0.6
0.4
0.2
0.0
50
100
150
200
250
days after sawing
[psill, range, nugget]
[3, 10, 0]
[3, 10, 1]
[3, 55, 1]
mean


Parameter Estimation - ML vs Median
NDVI
1.0
0.8
0.6
0.4
0.2
0.0
140
160
180
200
220
240
days after sawing
ML parameters
Median parameters

scl class table from https://mdpi-res.com/d_attachment/remotesensing/remotesensing-13-00300/article_deploy/remotesensing-13-00300-v2.pdf?version=1611106659

No.	Class	Color
0	No Data (Missing data on projected tiles) (black)	
1	Saturated or defective pixel (red)	
2	Dark features / Shadows (very dark gray)	
3	Cloud shadows (dark brown)	
4	Vegetation (green)	
5	Bare soils / deserts (dark yellow)	
6	Water (dark and bright) (blue)	
7	Cloud low probability (dark gray)	
8	Cloud medium probability (gray)	
9	Cloud high probability (white)	
10	Thin cirrus (very bright blue)	
11	Snow or ice (very bright pink)	




SCL class 2: Dark features / Shadows
SCL class 3: Cloud shadows
SCL class 4: Vegetation
SCL class 5: Bare soils / deserts
SCL class 6: Water
SCL class 7: Cloud low probability
SCL class 8: Cloud medium probability
SCL class 9: Cloud high probability
SCL class 10: Thin cirrus
estimated ndvi (with scl in [4,5])
observed ndvi
0.0
0.2
0.4
0.6
0.8
1.0