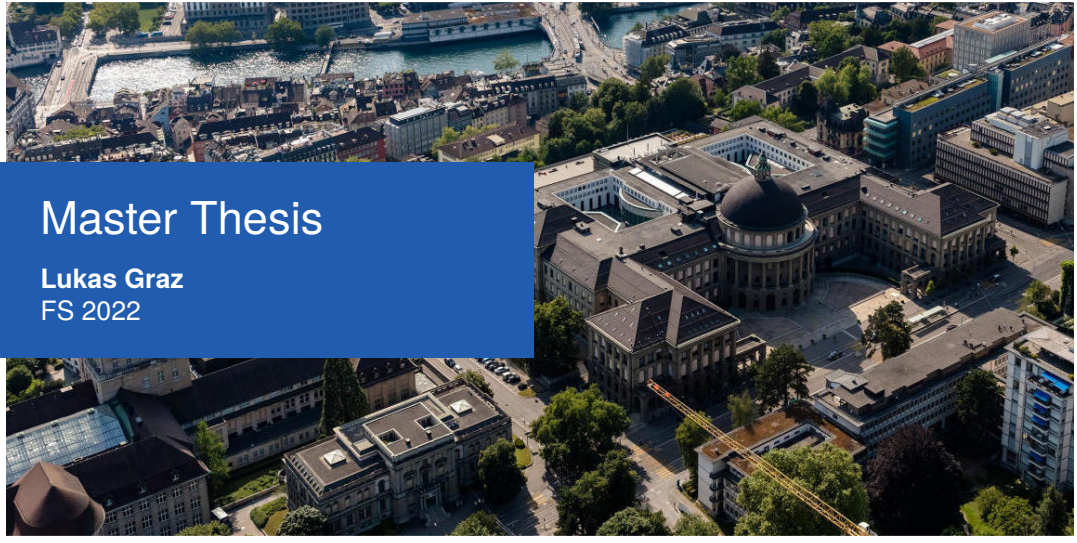
ETH zürich

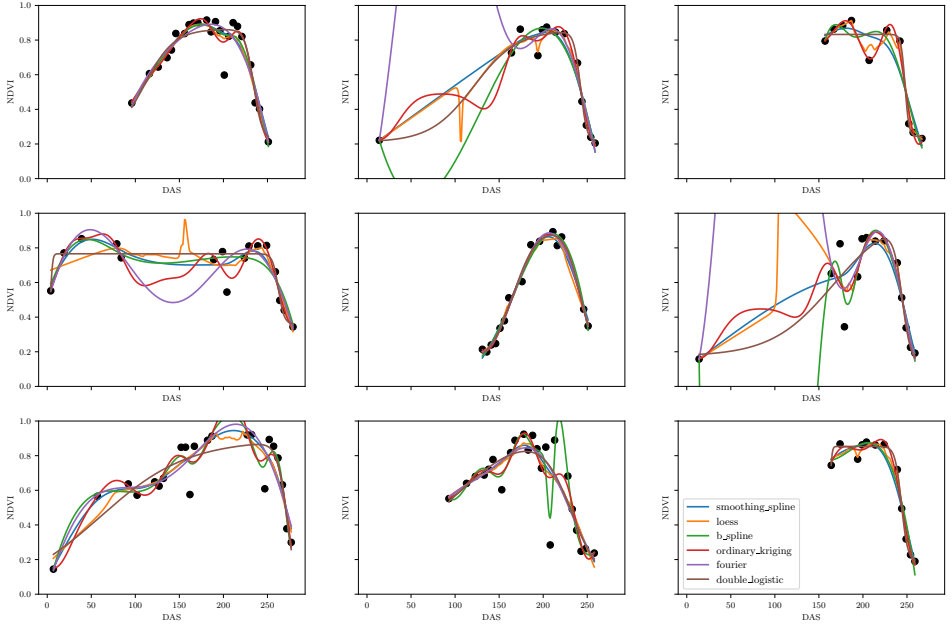
D-MATH — Seminar for Statistics
D-USYS — Crop Science



Master Thesis

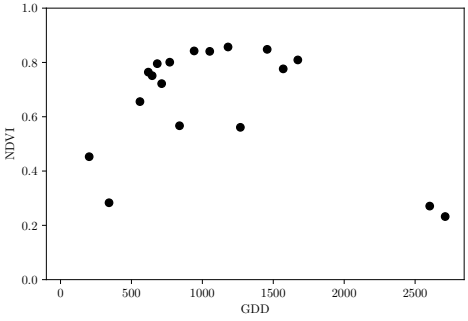
Lukas Graz

FS 2022

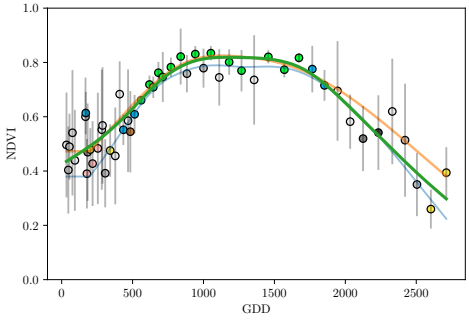

NDVI
DAS
smoothing_spline
loess
b_spline
ordinary_kriging
fourier
double_logistic

How to get ...

from ...



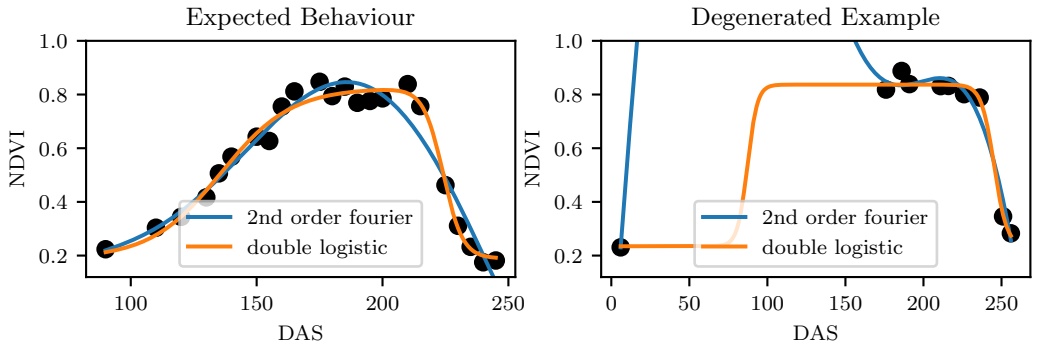
to ...



Parametric Curve

Curve fully determined by parameters (no data)

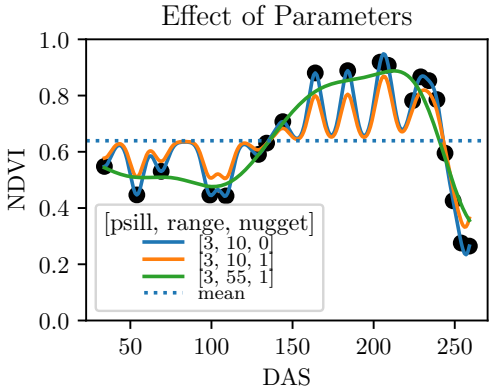
$$NDVI(t) = f(a, b, c, d, e)$$

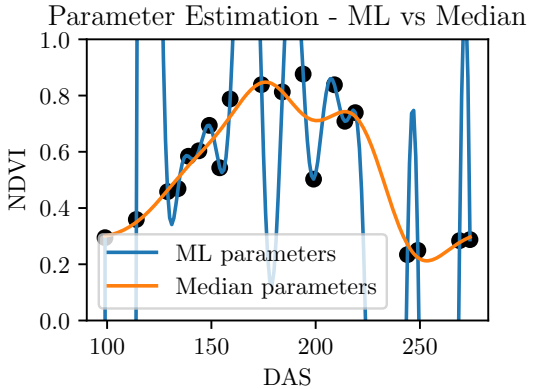


Non-Parametric — Gaussian Process Regression (Kriging)

Non-Parametric: Curve also depends on data

$$NDVI(t) = f(data, tuning - parameters)$$

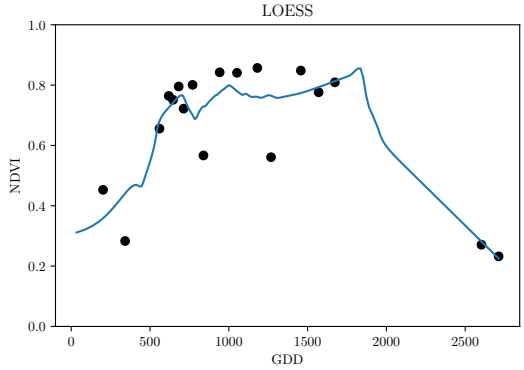




Non-Parametric — LOESS / LOWESS

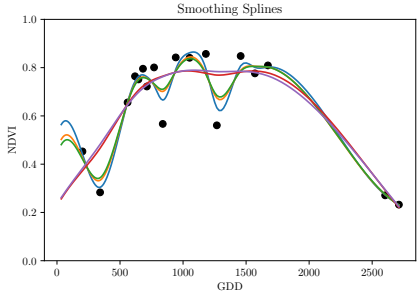
A generalization of the **Savitzky-Golay Filter**

(allows for non-equidistant points and interpolation)



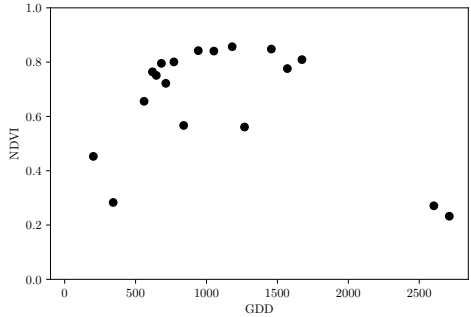
Non-Parametric — Smoothing Splines

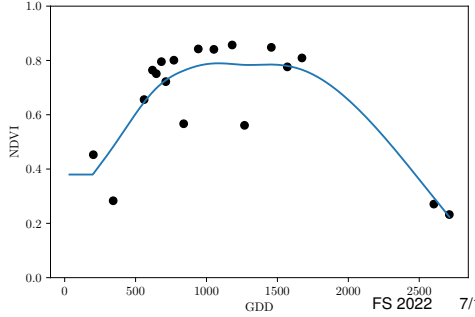
$$\hat{m} := \underset{f \in \mathcal{F}}{\operatorname{argmin}} \underbrace{\sum_{i=1}^{n} \left(Y_i - f\left(x_i\right)\right)^2}_{\text{sum of squares}} + \lambda \underbrace{\int f''(x)^2 dx}_{\text{smoothness}}$$



Similar Whittaker (but more general)

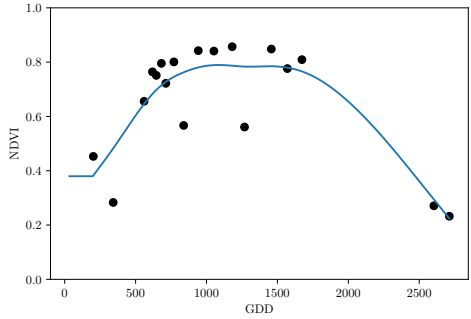
1. Interpolation





2. Robust Reweighting

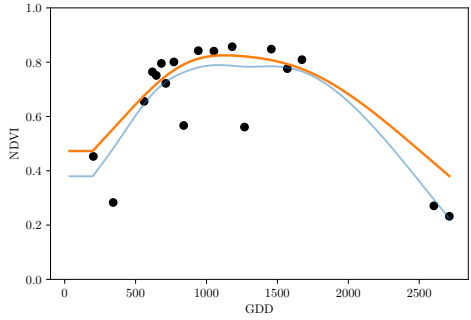
1. initial curve
2. give lower weight to outliers (high residuals)
3. re-fit curve

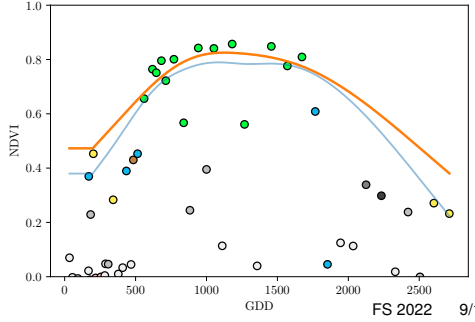


3. Other Scl-Classes

Label	Classification
0	NO_DATA
1	SATURATED_OR_DEFECTIVE
2	DARK_AREA_PIXELS
3	CLOUD_SHADOWS
4	VEGETATION
5	NOT_VEGETATED
6	WATER
7	UNCLASSIFIED
8	CLOUD_MEDIUM_PROBABILITY
9	CLOUD_HIGH_PROBABILITY
10	THIN_CIRRUS
11	SNOW

SCL = **S**cene **C**lassification **L**ayer

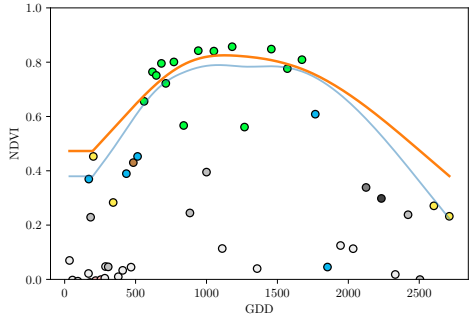


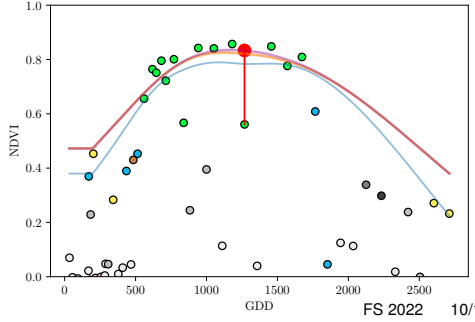


4. Correction

- get “true” NDVI
- get table:

“truth”	observed	scl-class	B2-B10	weather
“truth”	observed	scl-class	B2-B10	weather
…	…	…	…	…





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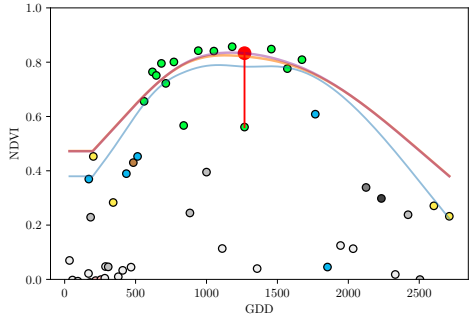
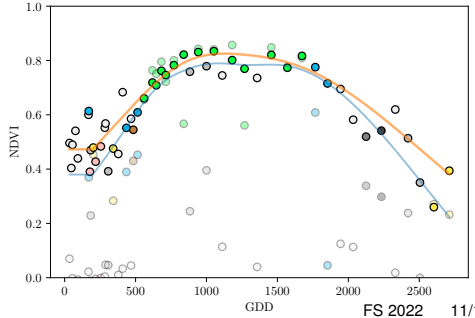
...	...	...	...	...

- Random Forest
- predict/correct NDVI
- weather – yes or no?



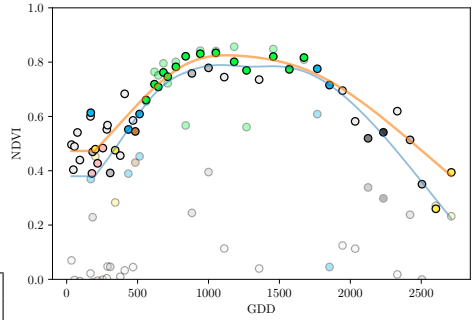


5. Uncertainty Estimation

- Table with residuals:

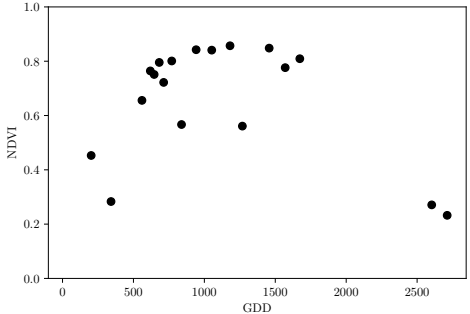
residuals	observed	scl-class	B2-B10	weather
residuals	observed	scl-class	B2-B10	weather
⋮	⋮	⋮	⋮	⋮

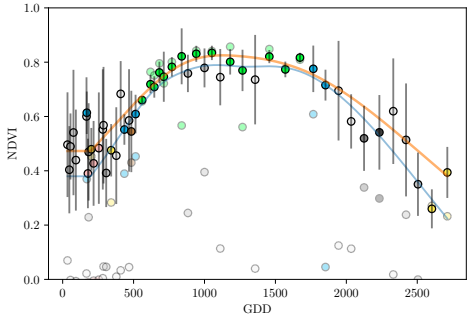
- Random Forest
- predict residuals
- $weights = \frac{1}{|residual|}$

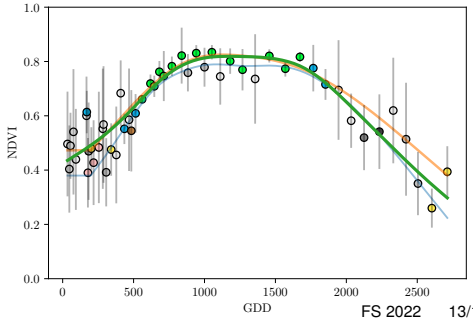


6. Robust Fit to Corrected NDVI

Reminder: Original Situation

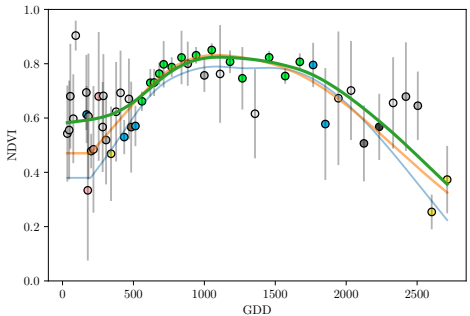






Overfitted?

Leave current year out for training



Use all years for training