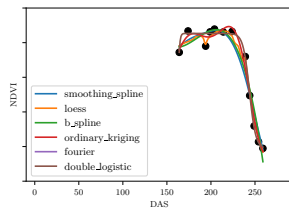
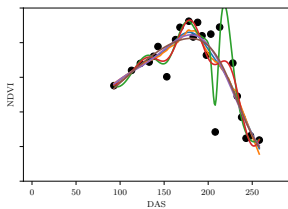
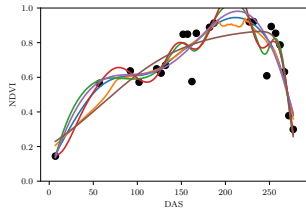
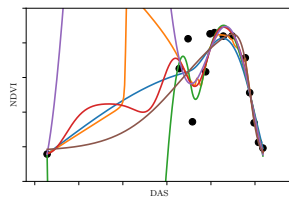
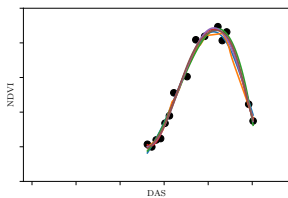
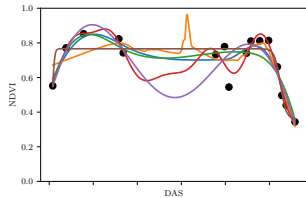
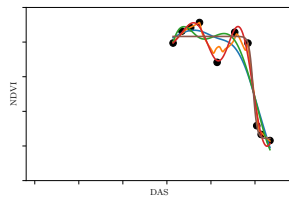
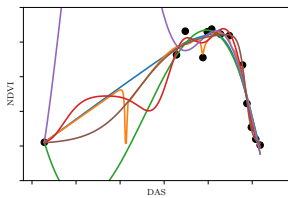
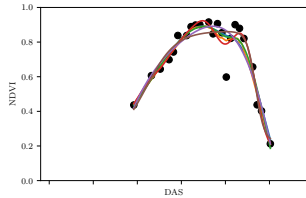


Master Thesis

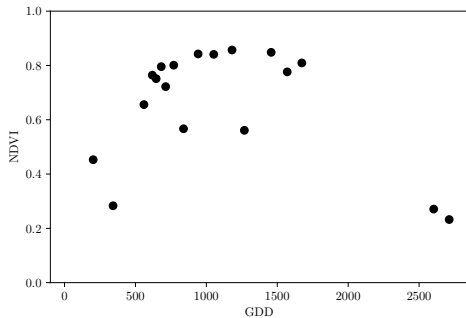
Lukas Graz
FS 2022



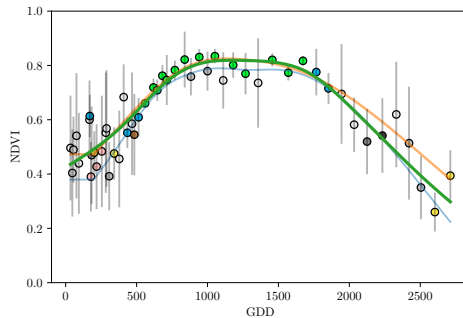


How to get ...

from ...



to ...

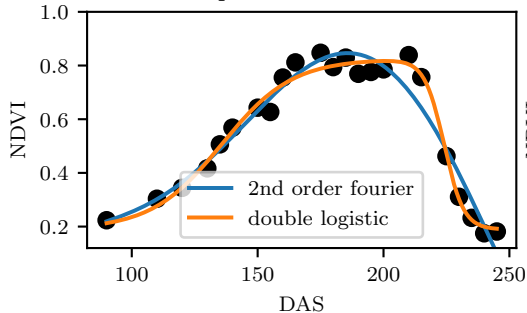


Parametric Curve

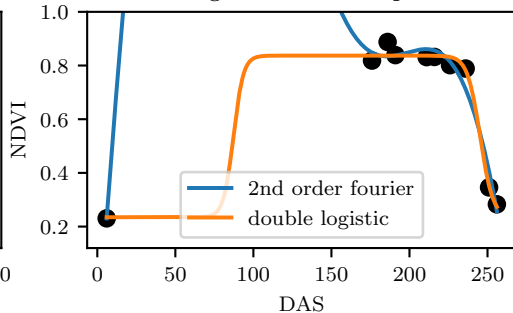
Curve fully determined by parameters (no data)

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

Expected Behaviour



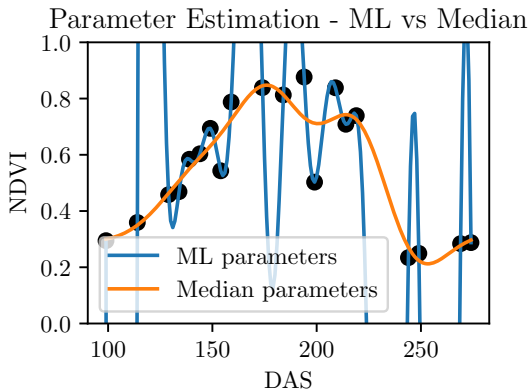
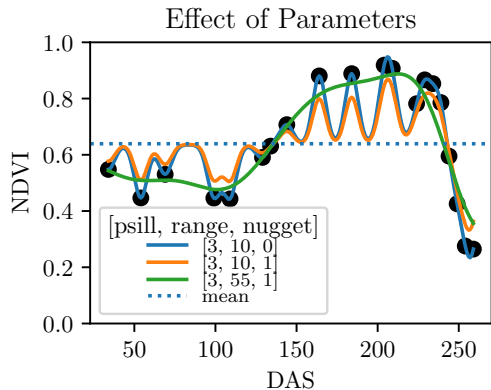
Degenerated Example



Non-Parametric — Gaussian Process Regression (Kriging)

Non-Parametric: Curve also depends on data

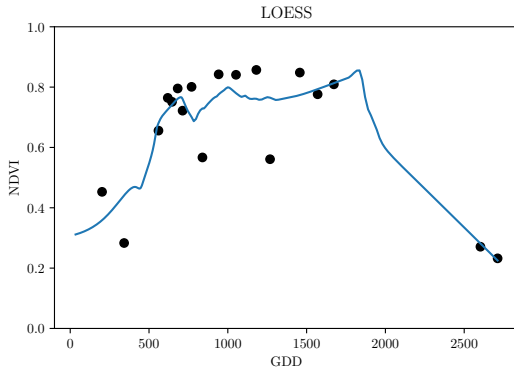
$$NDVI(t) = f(\text{data}, \text{tuning-parameters})$$



Non-Parametric — LOESS / LOWESS

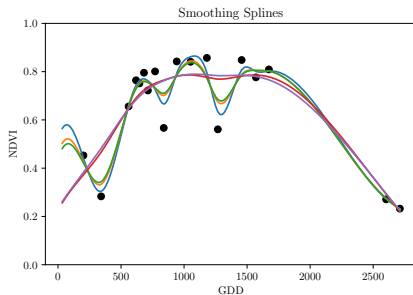
A generalization of the **Savitzky-Golay Filter**

(allows for non-equidistant points and interpolation)



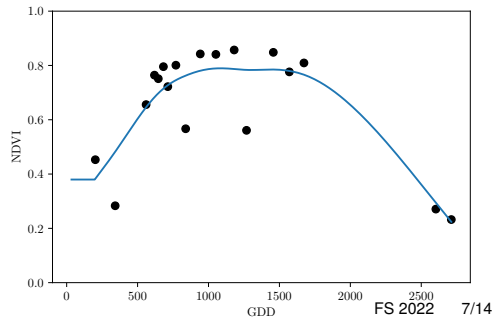
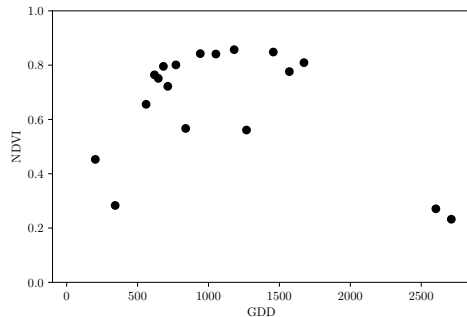
Non-Parametric — Smoothing Splines

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



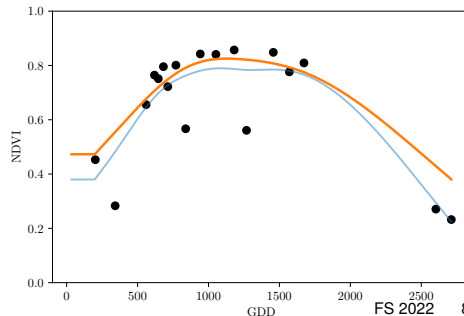
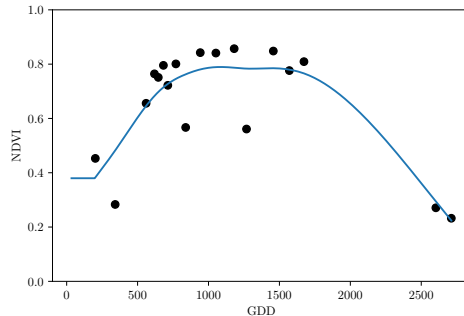
Similar Whittaker (but more general)

1. Interpolation



2. Robust Reweighting

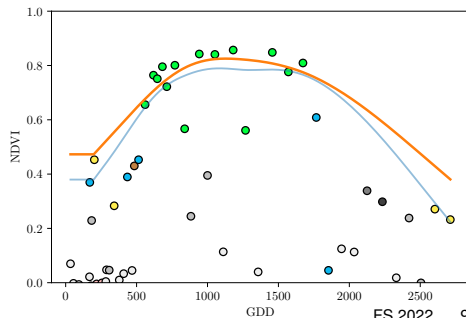
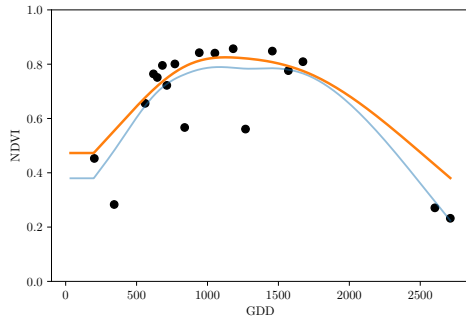
1. initial curve
2. give lower weight to outliers (high residuals)
3. re-fit curve



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

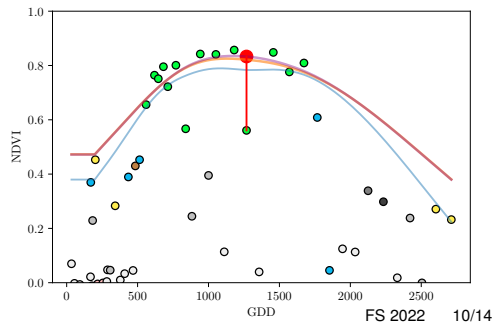
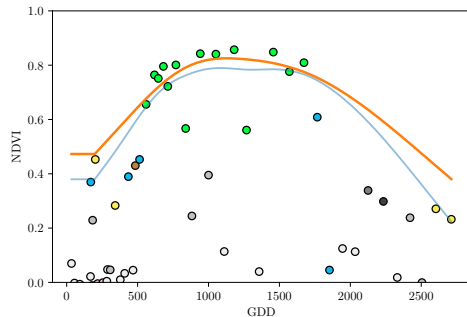
SCL = Scene Classification Layer



4. Correction

- get “true” NDVI
- get table:

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

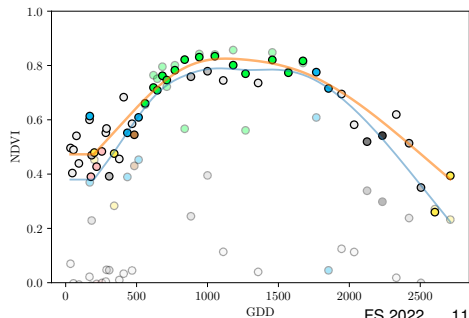
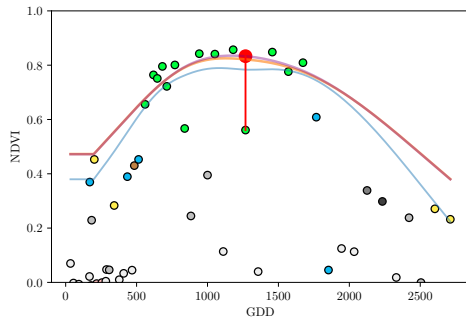


4. Correction

- get “true” NDVI
- get table:

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

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

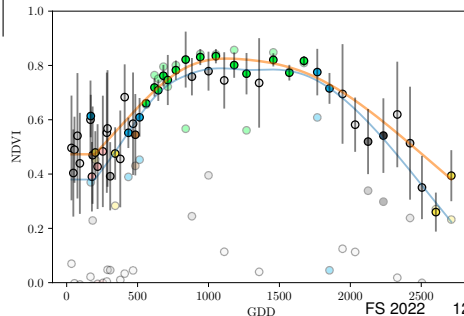
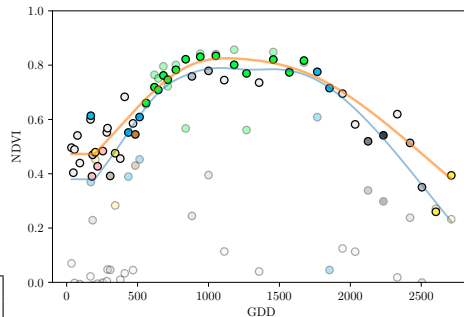


5. Uncertainty Estimation

- Table with residuals:

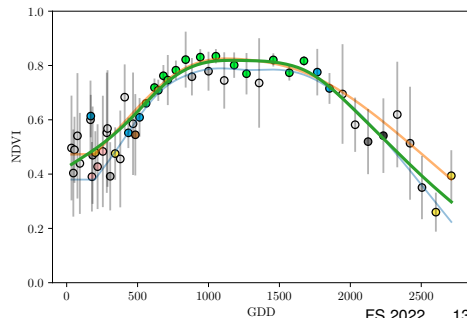
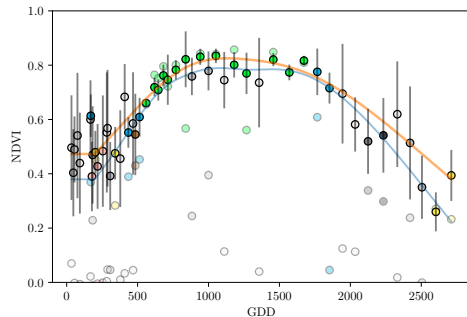
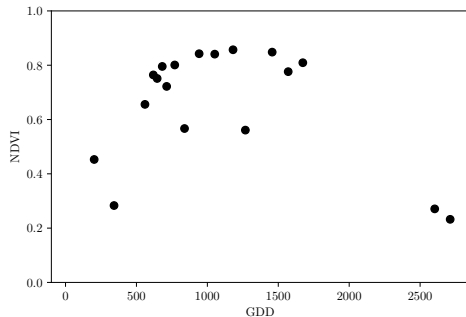
residuals	observed	scl-class	B2-B10	weather
residuals	observed	scl-class	B2-B10	weather
⋮	⋮	⋮	⋮	⋮

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



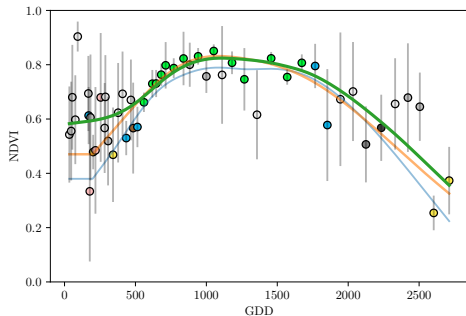
6. Robust Fit to Corrected NDVI

Reminder: Original Situation



Overfitted?

Leave current year out for training



Use all years for training

