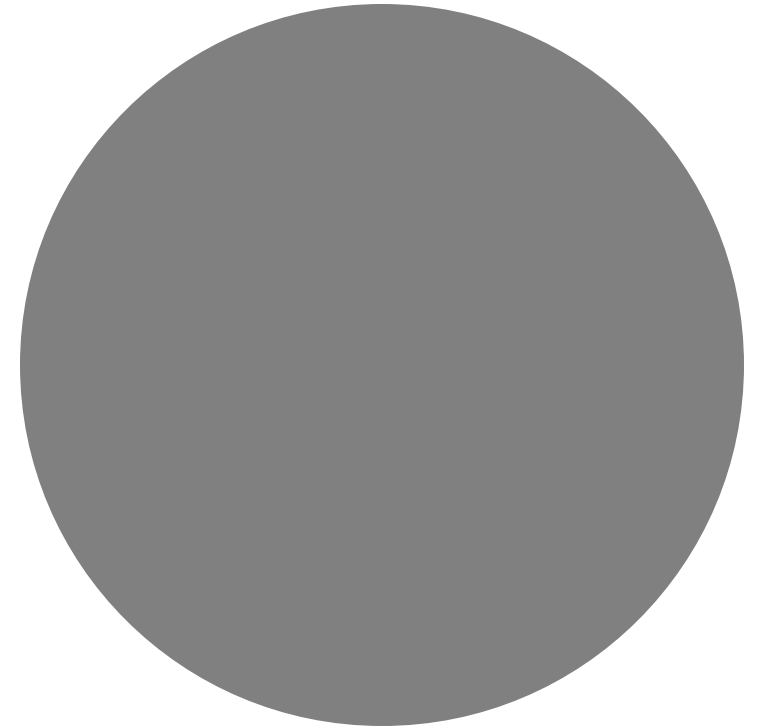
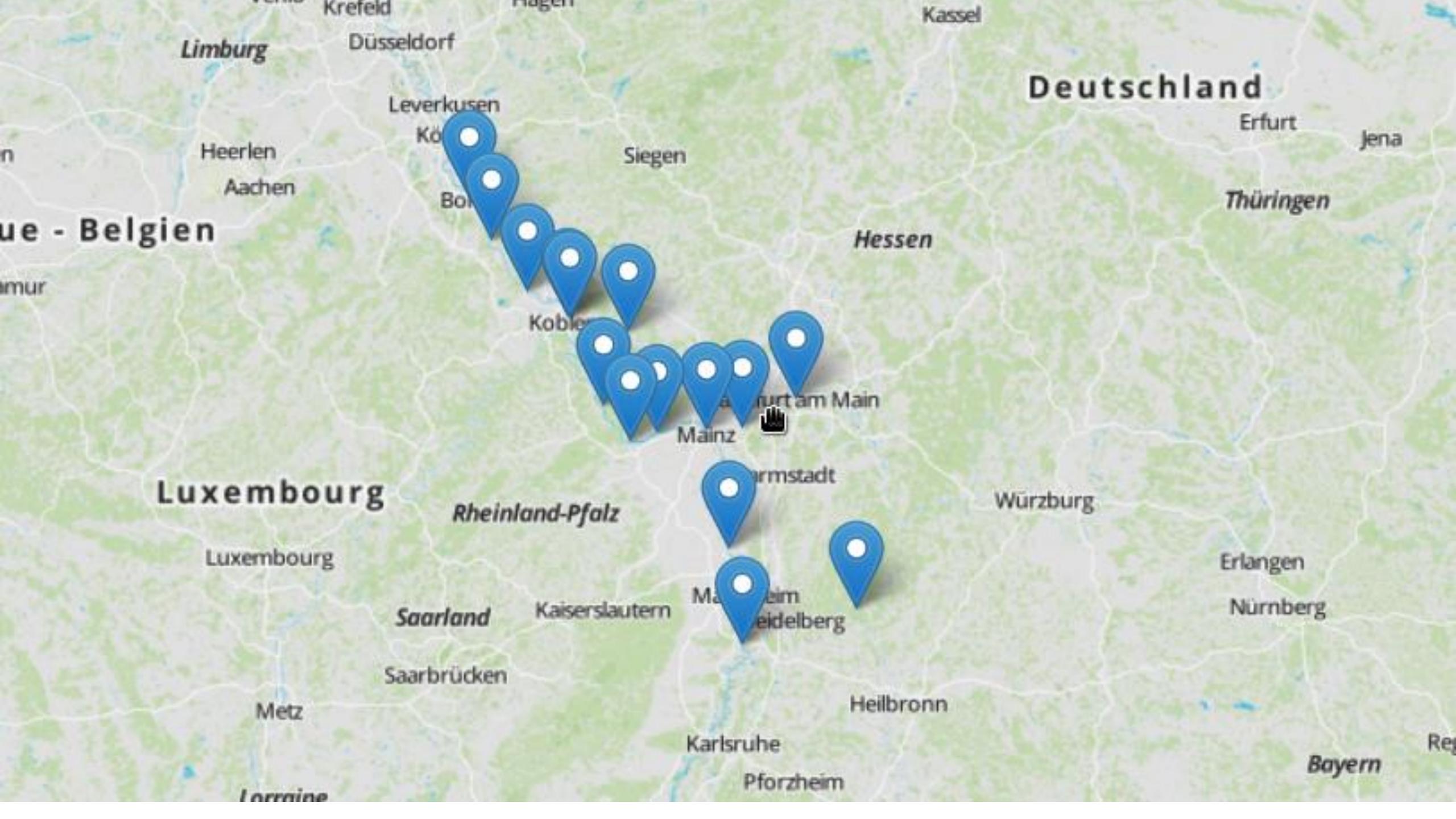


Rhinelevel Prediction

Nicolai Gerber and Lukas Pin





Limburg

Düsseldorf

Kassel

Deutschland

Erfurt

Jena

Heerlen

Aachen

Leverkusen

Siegen

Thüringen

Belgien

Hessen

Bonn

Koblenz

Mainz

Frankfurt am Main

Luxembourg

Rheinland-Pfalz

Würzburg

Luxembourg

Karlsruhe

Erlangen

Saarland

Kaiserslautern

Mannheim

Heidelberg

Nürnberg

Saarbrücken

Metz

Heilbronn

Bayern

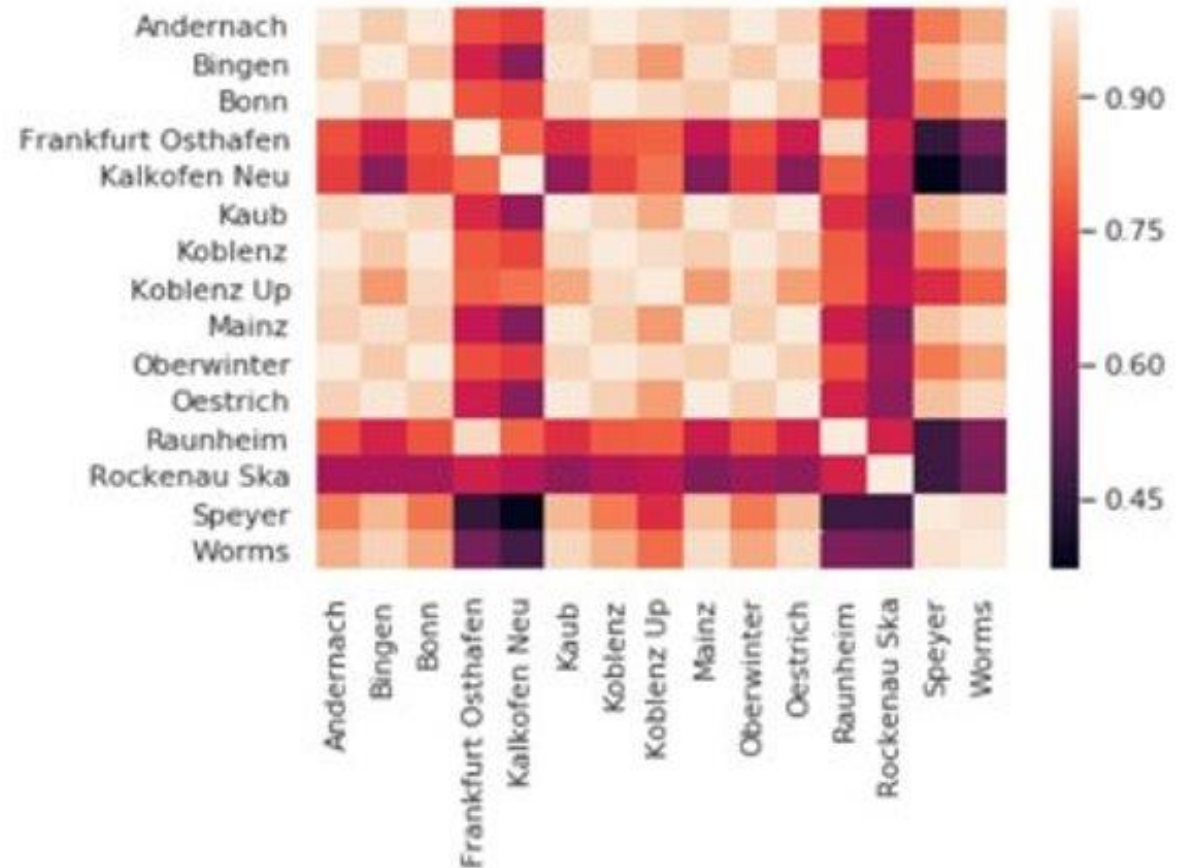
Lorraine

Karlsruhe

Pforzheim

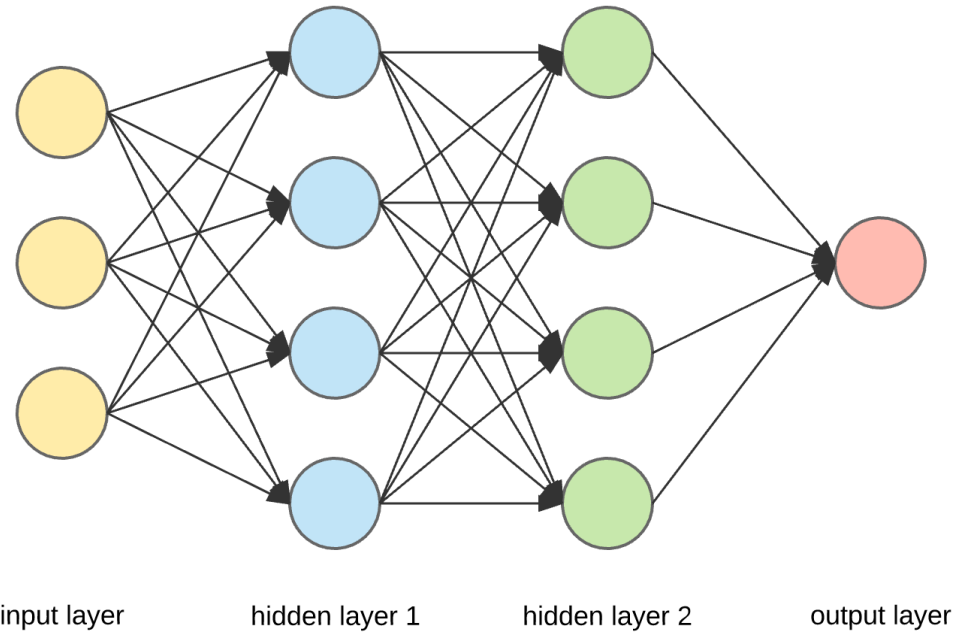
Preparation of Data

- limit time to: 1988-2013
- limit stations: 8 instead of 15
- Interpolate to erase *nan's*
- Separate Data into: train, validation and test Data
- Divide into 4 hour packets



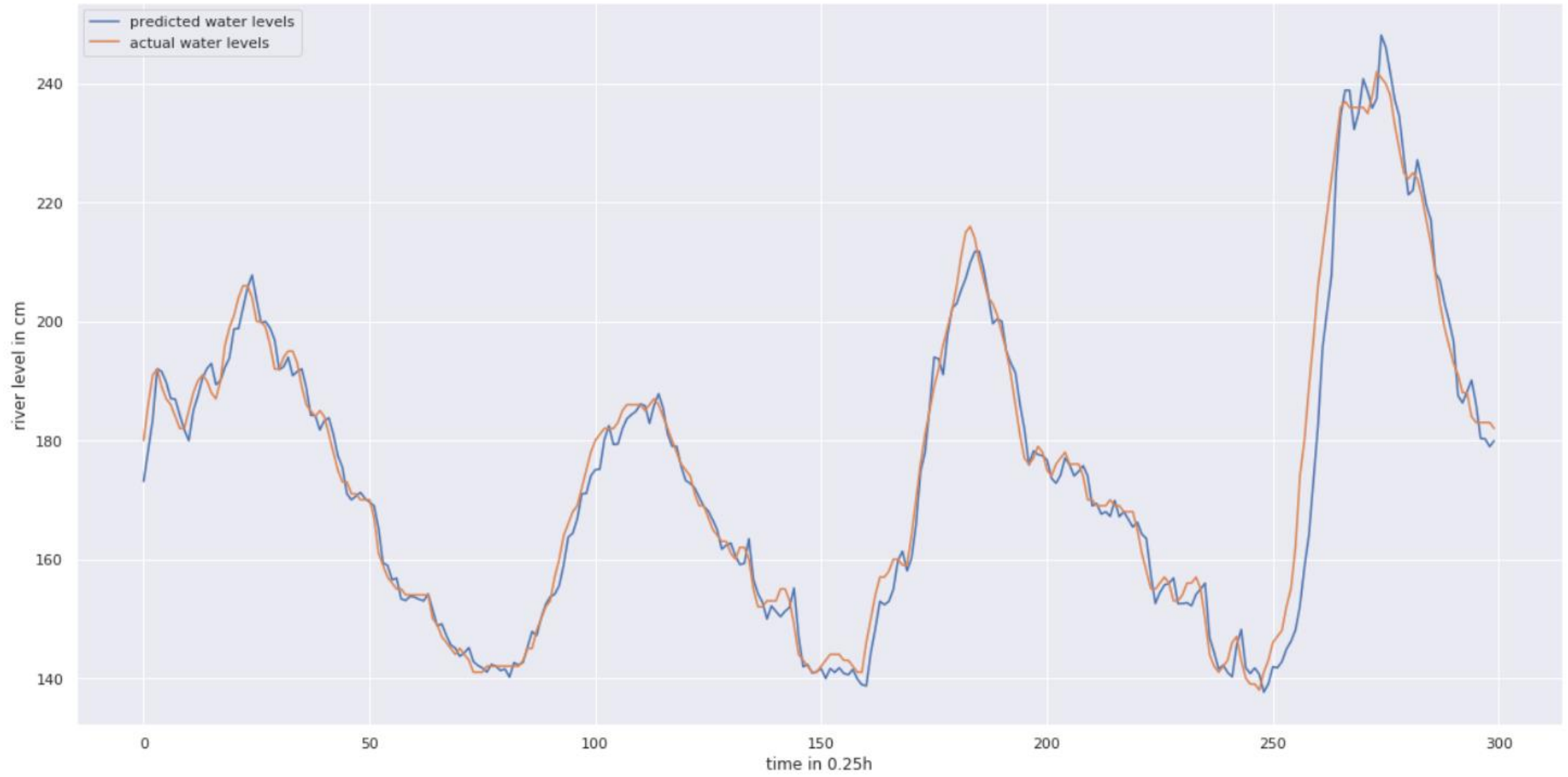
Goal: Predict water height 12 hours ahead

Deep
Neural Network
without feature
map



- Two hidden Layers (relu)
- Optimizer: Adams
- Loss: mean squared error

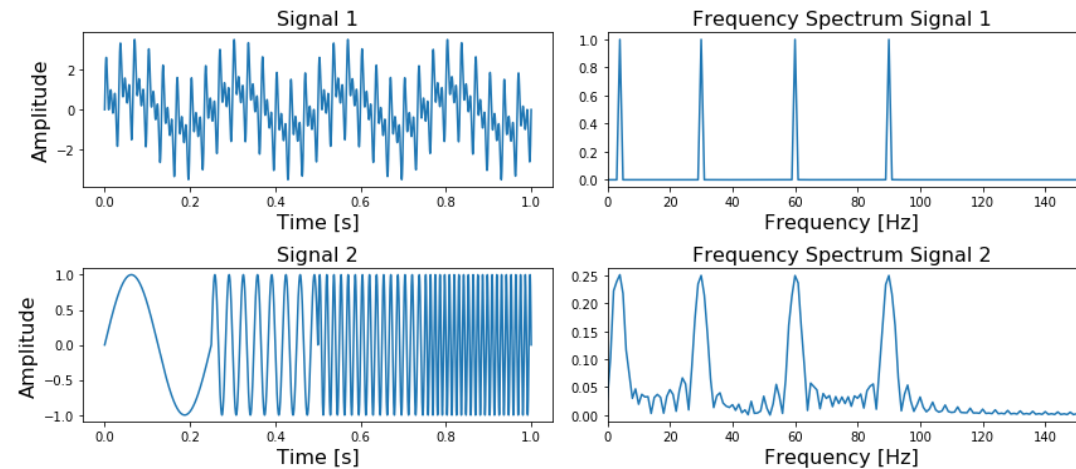
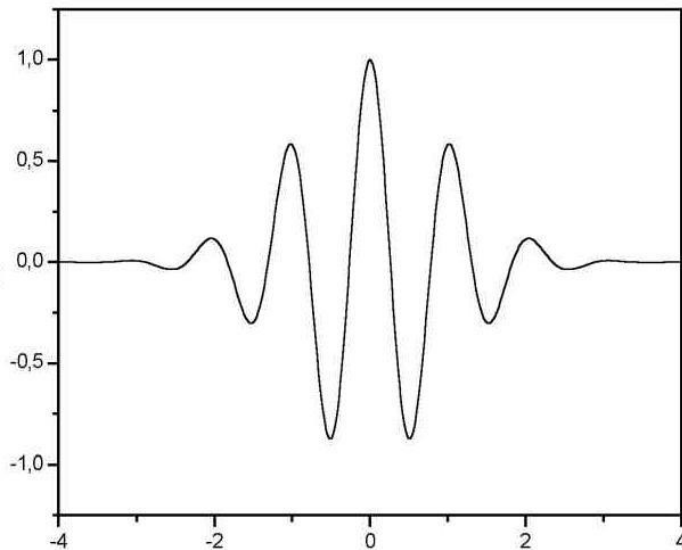
Predicted vs. actual water levels



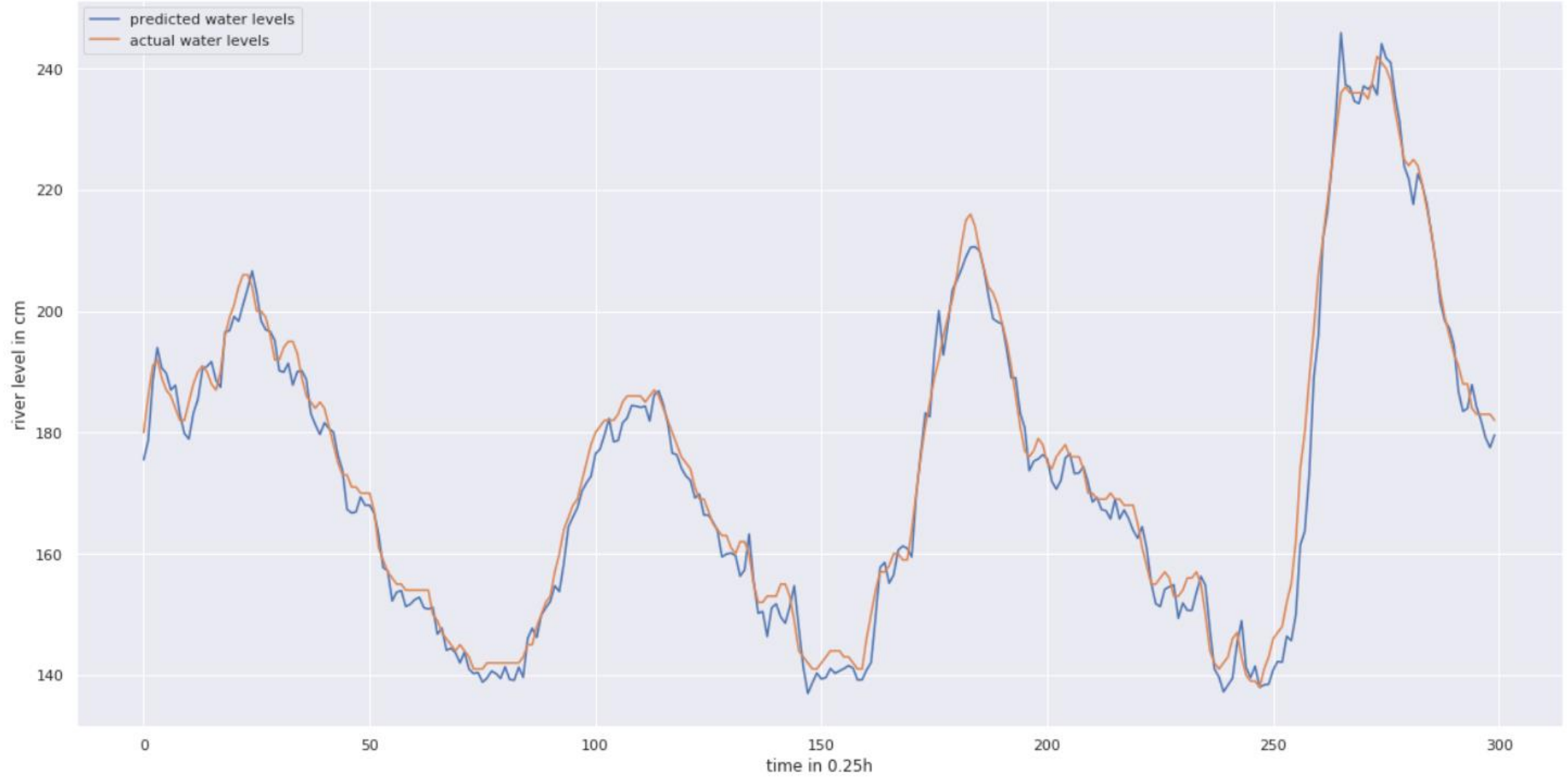
$$\mathcal{W}_\psi x(a, b) = \frac{1}{a} \int_{-\infty}^{\infty} \overline{\psi\left(\frac{t-b}{a}\right)} x(t) dt.$$

Wavelet Transforms

- Transform similar to fourier transform
- Convolution is done with a so called wavelet
- Wavelets are scaled by parameter a , therefore allowing to recognize patterns of different sizes



Predicted vs. actual water levels



	MSE	95% accuracy	5cm accuracy
DNN	34.6 cm ²	11.92 cm	77.2%
Continuous Wavelet Transform	17.93 cm ²	7.94 cm	82.02 %

Comparison of Models

Normalize data

Examine seasonal trends

Make long-term predictions

Outlook