→ 6th ESA ADVANCED TRAINING COURSE ON LAND REMOTE SENSING

Urban Mapping & Change Detection Practical

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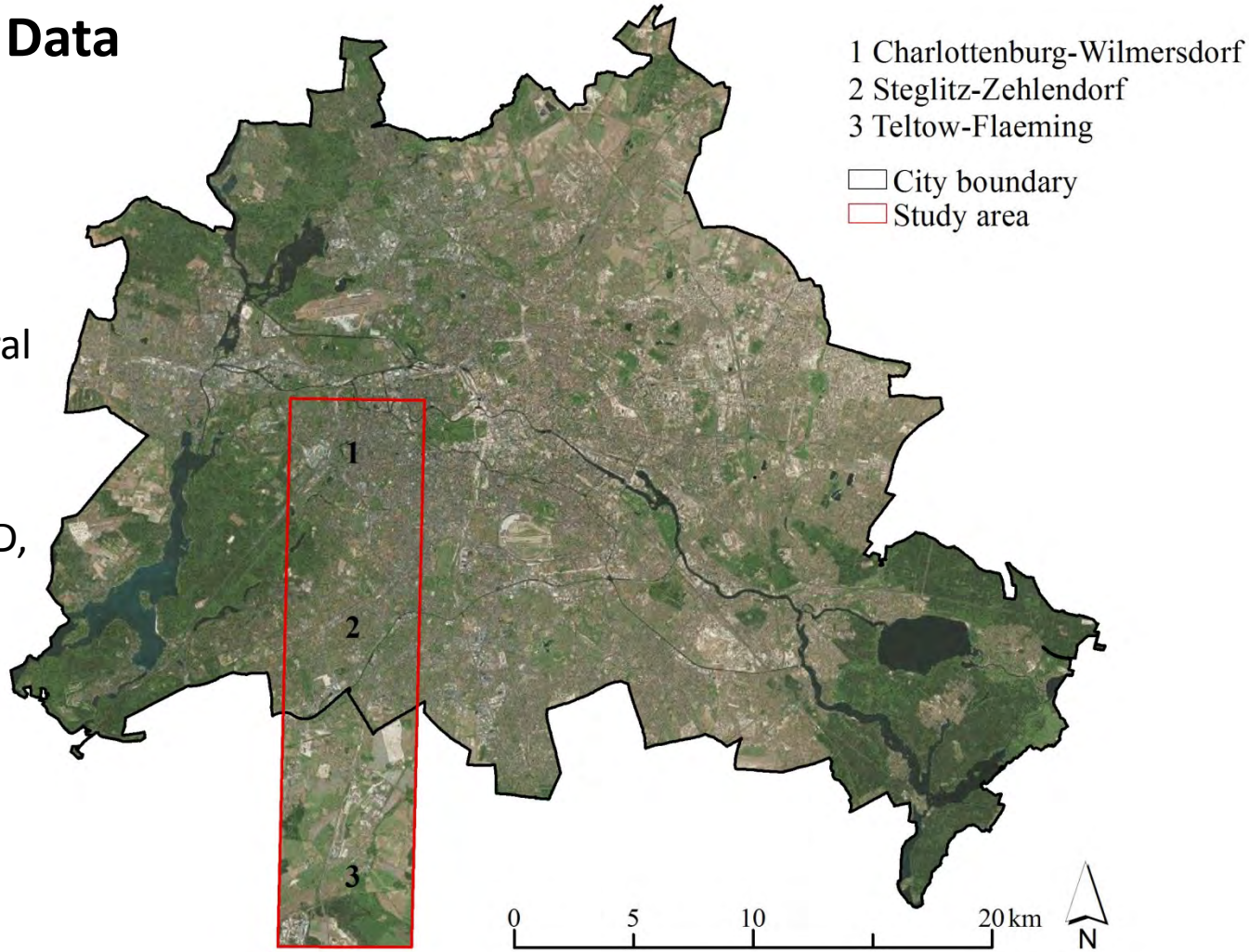
Study Area and Data

Urban-rural gradient
in Berlin, Germany

Airborne hyperspectral
HyMap data

August 2009, 9 m GSD,
126 bands

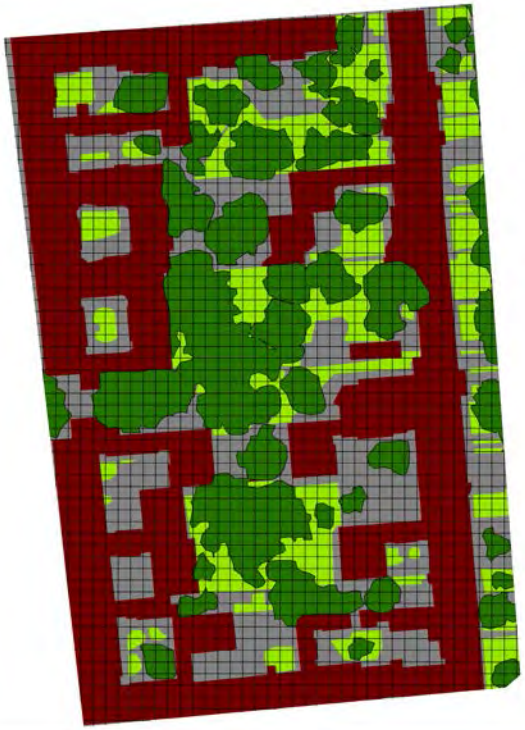


Reference data

Along the nadir line of the HyMap acquisition surface types roof, streets, trees, low vegetation and soil were manually digitized at < 0.25 m using orthophotos and laser scanning data.

Reference data

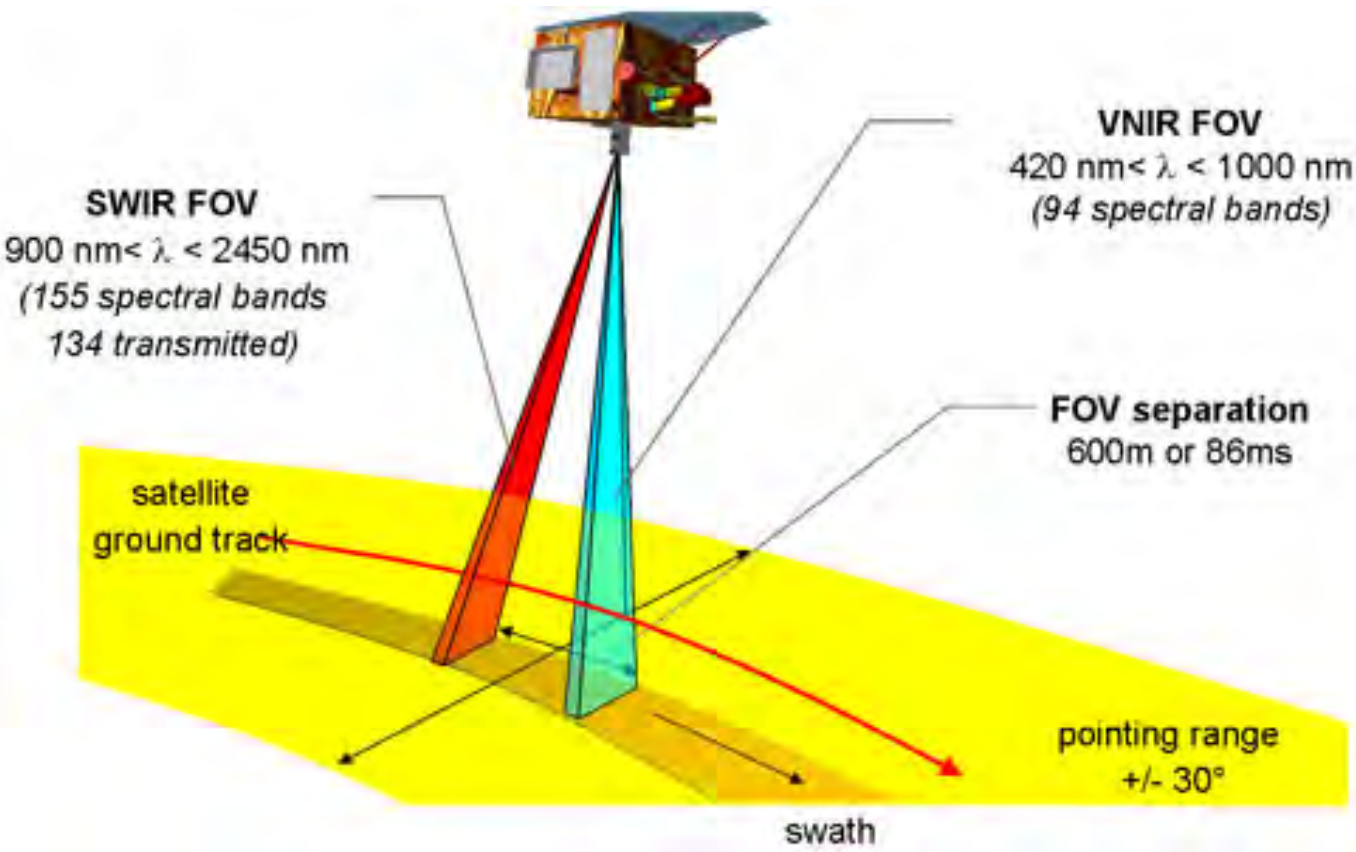
V-I-S and extended V-I-S reference data was generated at EnMAP/Sentinel-2 scale.



VHR reference map

HyMap 3.6 m (RMSE of ortho-rectification: ~4 m)

Dataset 1: Environmental Mapping and Analysis Programme



www.enmap.org

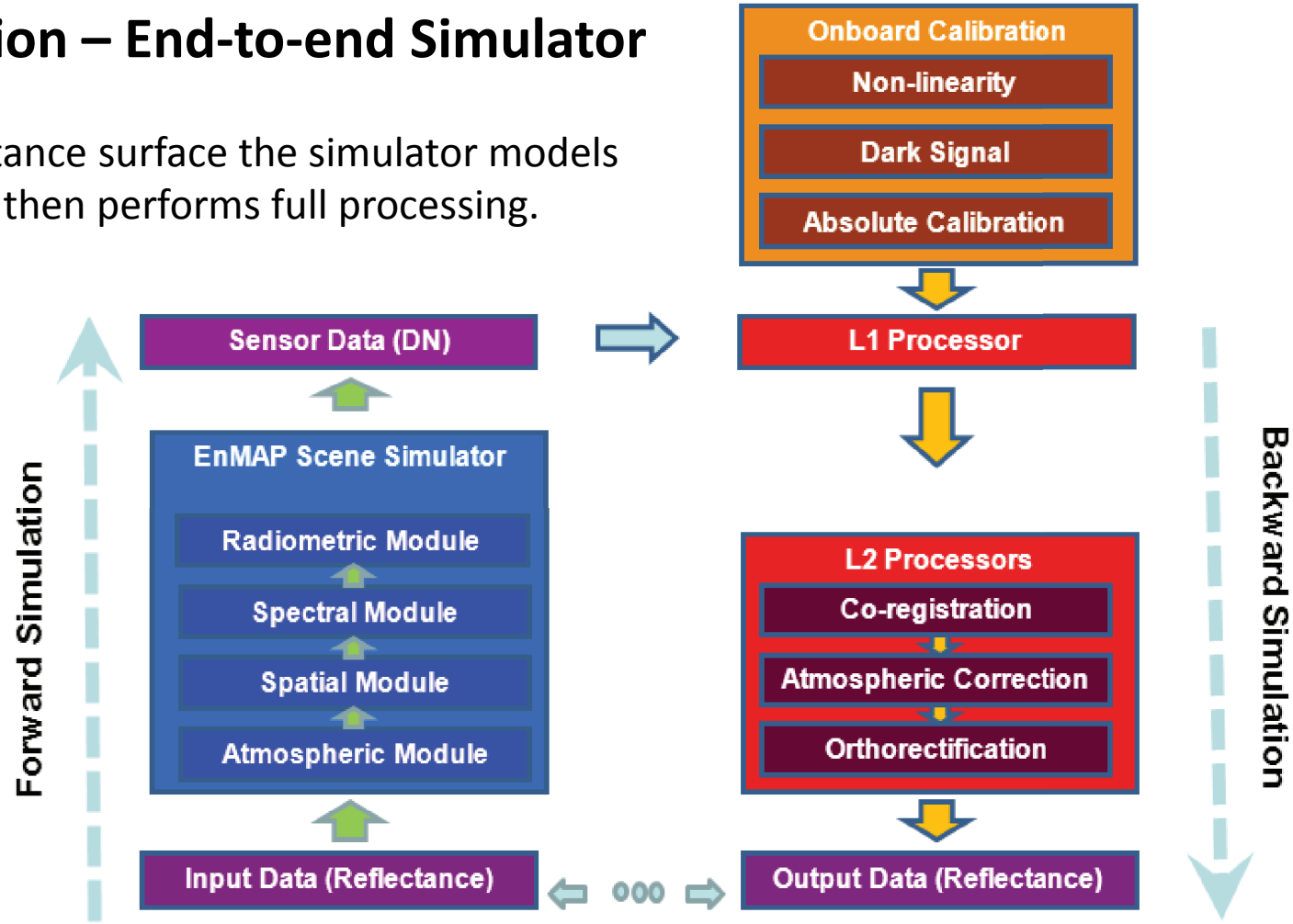
Dataset 1: Environmental Mapping and Analysis Programme

- EnMAP (Environmental Mapping and Analysis Program)
- German hyperspectral satellite mission, expected launch in 2018
- 244 spectral bands between 420-2450 nm
- Signal-to-noise ratio: > 400:1 VNIR, > 150:1 SWIR
- Ground Sampling Distance (GSD): 30x30 m
- Revisit time: 21 days (±5° off-nadir tilt), 4 days (±30° off-nadir tilt)
- Swath: width 30 km, length 5000km/day
- www.enmap.org & Guanter et al. (2015). Remote Sensing.

EnMAP Hyperspectral Imager

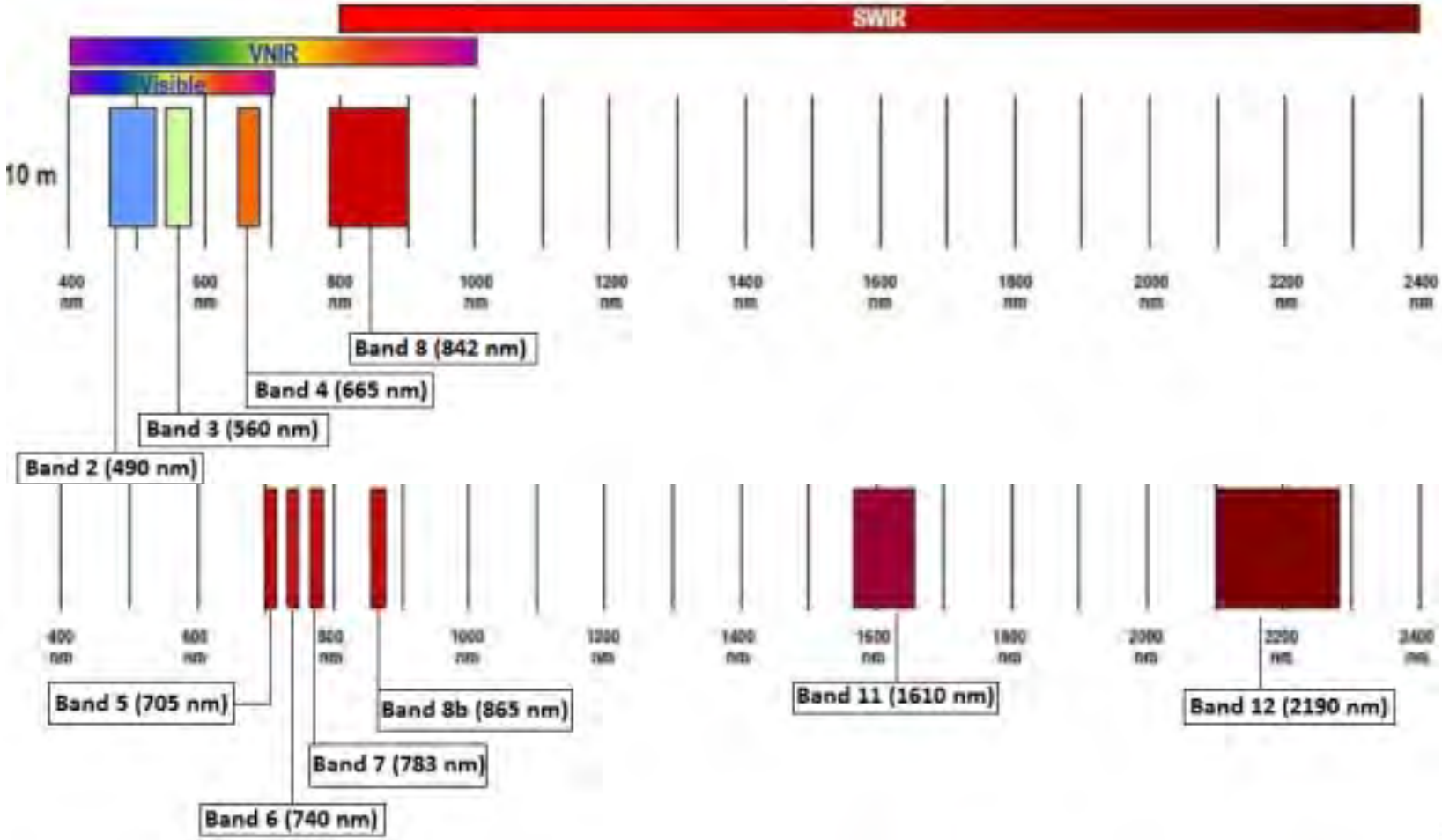
Data simulation – End-to-end Simulator

Based on a reflectance surface the simulator models at-sensor DN and then performs full processing.



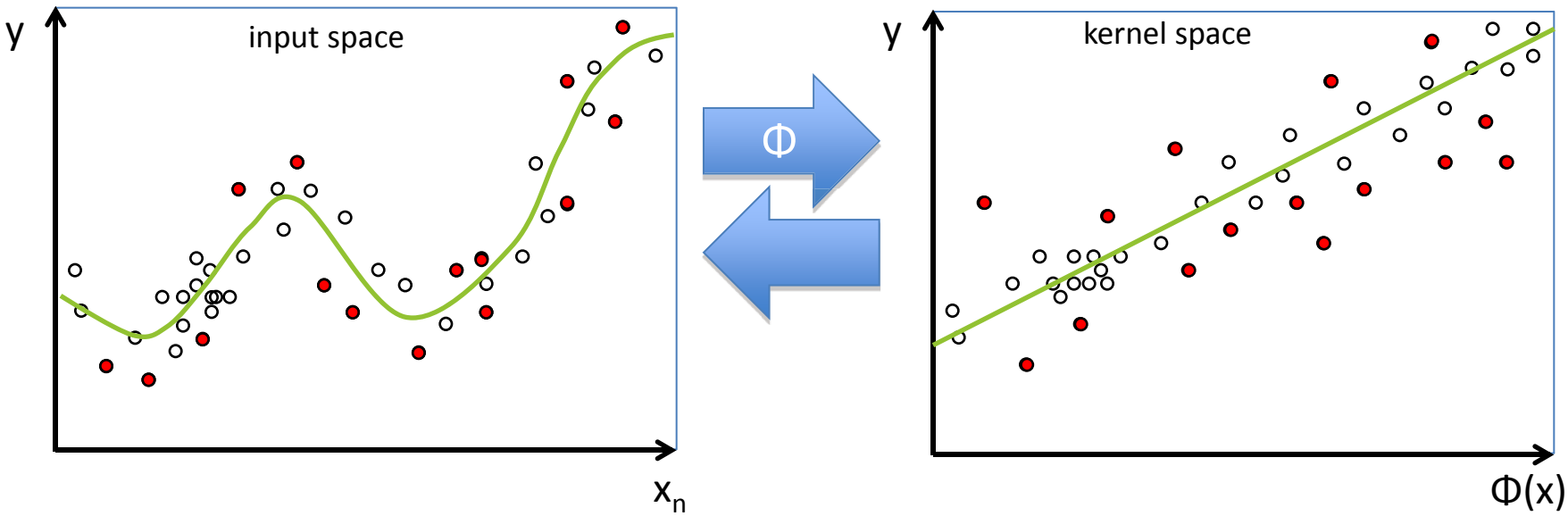
Segl et al. 2012

Dataset 2: Sentinel-2 (20 m spatial resolution)



Methods: Support Vector Regression

The basic idea



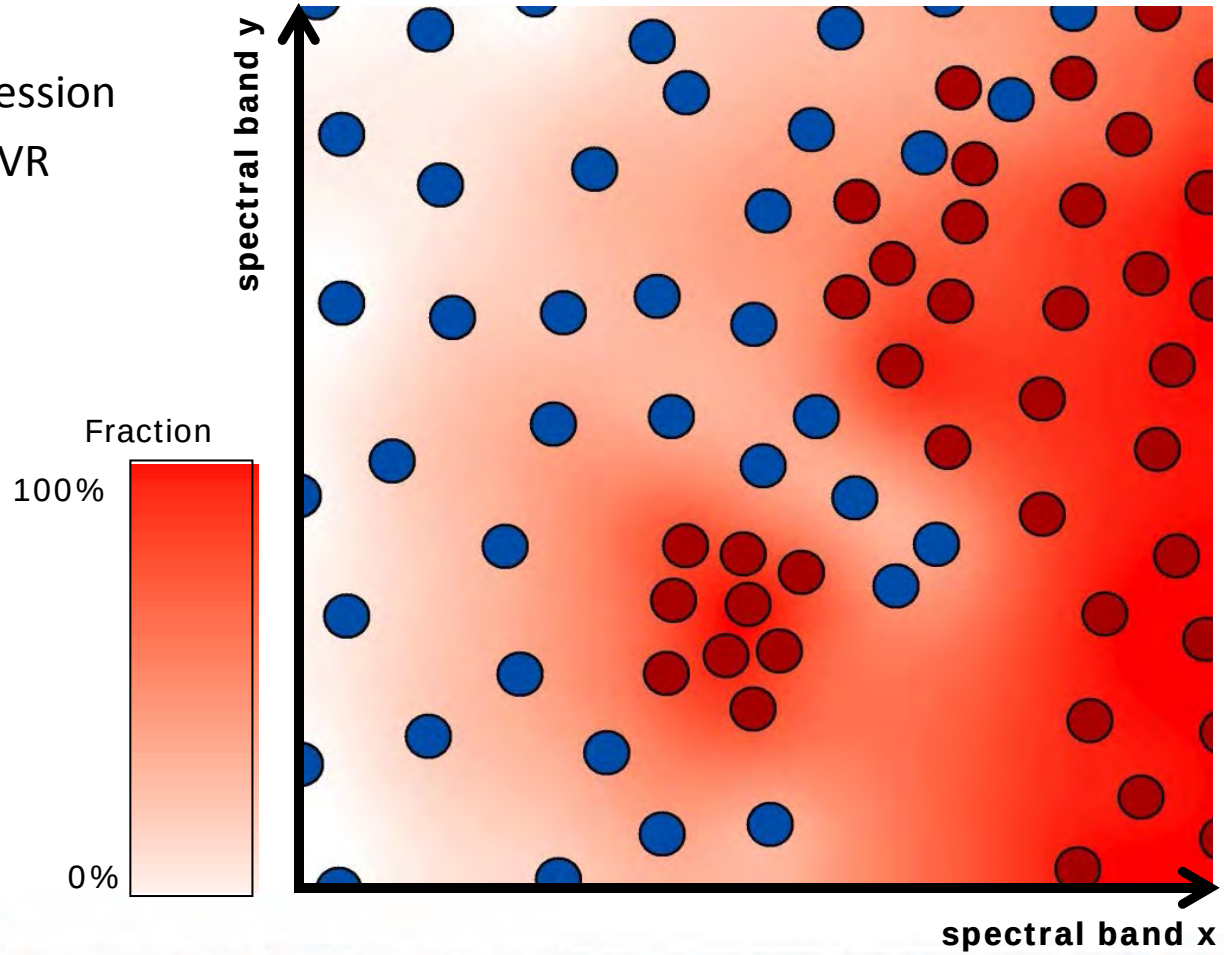
Projection Φ to map input variables into higher dimensional kernel space

Linear regression in kernel space to estimate the target variable

Support Vectors are input vectors (or spectra) used to describe the target function

Methods: Support Vector Regression

2-D representation of regression estimate with non-linear SVR



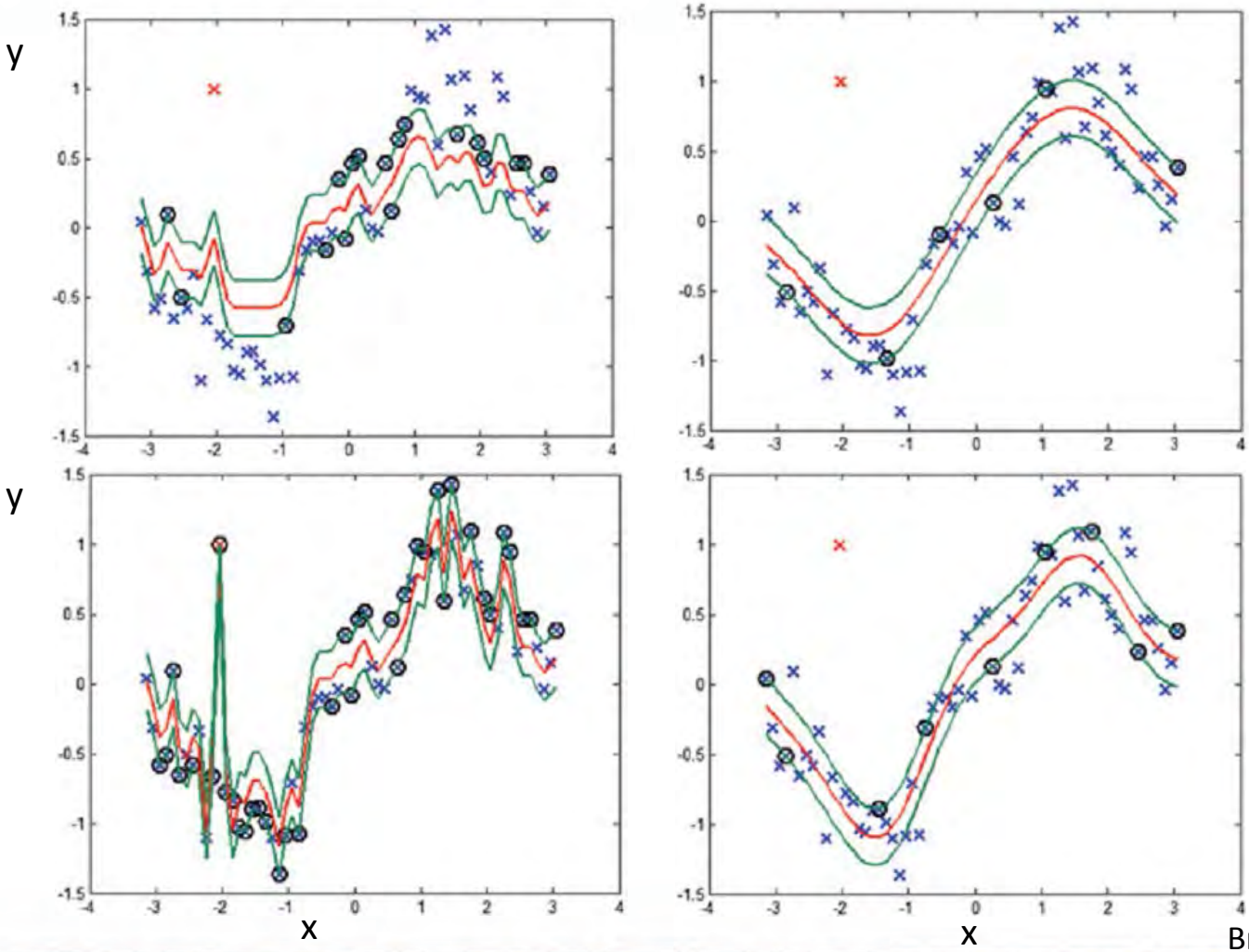
ε = 0.2

g = 0.1

g = 1.0

C = 0.25

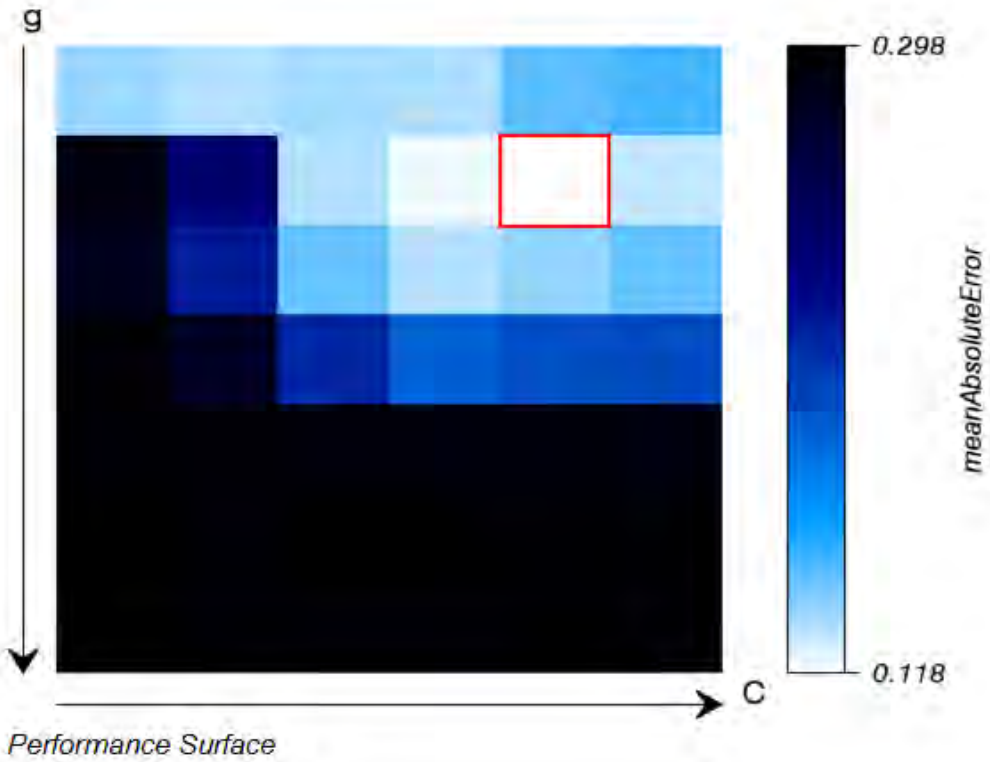
C = 5.0



Brereton & Lloyd 2010

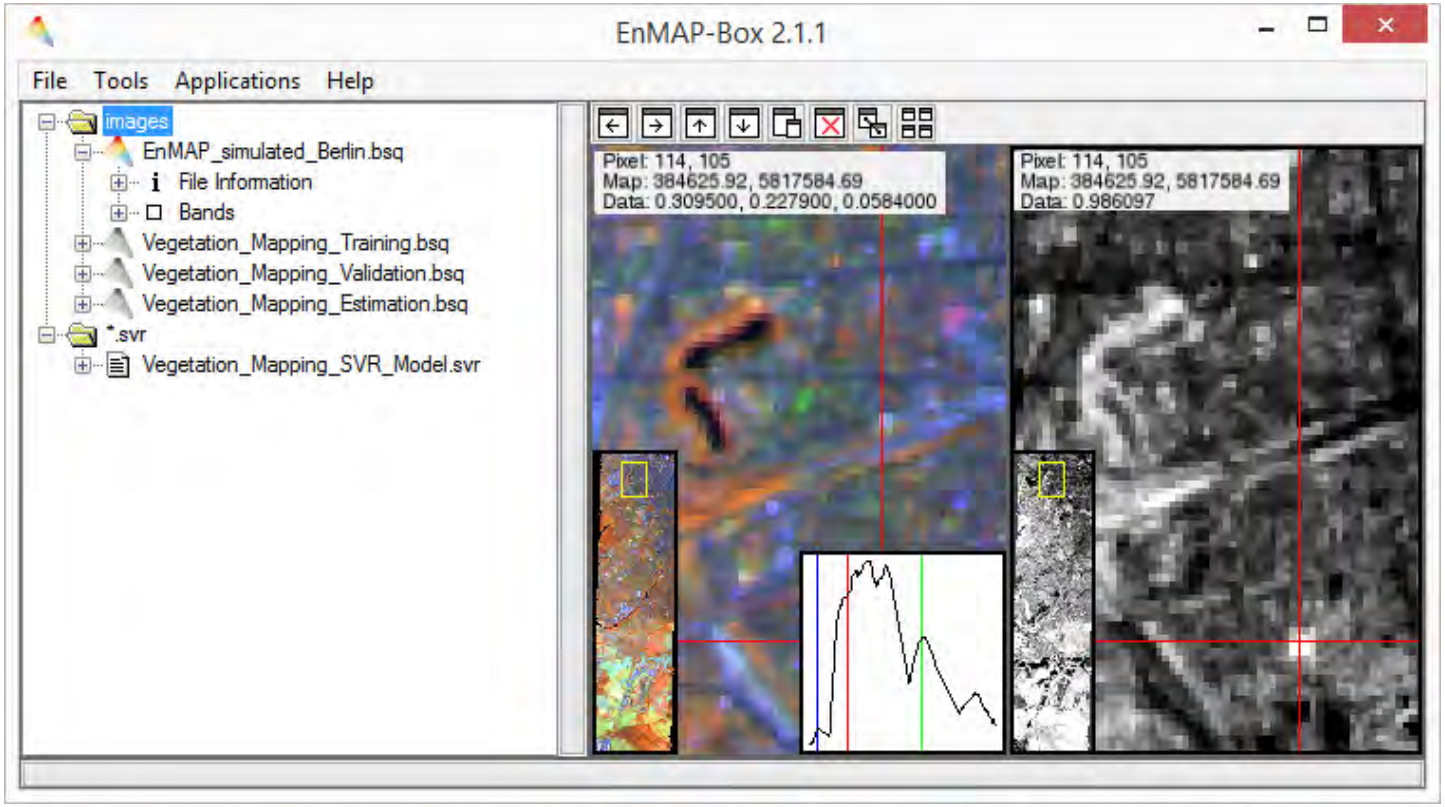
Methods: Support Vector Regression

Model parameterisation for ***γ***, ***C***, ***ε*** usually via grid search (3D or 2+1D)



Methods: imageSVM & EnMAP-Box

Free, open source software for (hyper-)spectral data processing



Methods: imageSVM & EnMAP-Box

Free, open source software for (hyper-)spectral data processing

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Technical Note

The EnMAP-Box—A Toolbox and Application Programming Interface for EnMAP Data Processing

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Methods: imageSVM & EnMAP-Box

Available at www.enmap.org

Fully functional GUI and basic image processing

Machine learning applications, especially SVM and Random Forests

Open source IDL code and application programming interface for standardized implementation of new applications

See van der Linden et al. (2015) for more information on concept and functions

References

Guanter, L., Kaufmann, H., Segl, K., Foerster, S., Rogass, C., Chabrillat, S., Kuester, T., Hollstein, A., Rossner, G., Chlebek, C., Straif, C., Fischer, S., Schrader, S., Storch, T., Heiden, U., Mueller, A., Bachmann, M., Mühle, H., Müller, R., Habermeyer, M., Ohndorf, A., Hill, J., Buddenbaum, H., Hostert, P., van der Linden, S., Leitão, P., Rabe, A., Doerffer, R., Krasemann, H., Xi, H., Mauser, W., Hank, T., Locherer, M., Rast, M., Staenz, K., Sang, B. (2015). The EnMAP spaceborne imaging spectroscopy mission for earth observation. Remote Sensing 2015, 7, 8830.

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Segl, K., Guanter, L., Rogass, C., Kuester, T., Roessner, S., Kaufmann, H., Sang, B., Mogulsky, V., Hofer, S. (2012) Eetes - the enmap end-to-end simulation tool. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 5, 522–530.

Practical


EnMAP-Box 2.1.1
File Tools Applications Help
Pixel: 178, 194
Data: 0.137871
Pixel: 178, 194
Map: 384730.64, 5816885.08
Data: 0.824375

Practical


EnMAP-Box 2.1.1
File Tools Applications Help
Pixel: 179, 751
Map: 384756.79, 5805737.25
Data: 0.280900, 0.126700, 0.0245000
Pixel: 179, 751
Map: 384756.79, 5805737.25
Data: 1.16103
Pixel: 179, 751
Map: 384756.79, 5805737.25
Data: 0.877990