

Texture-based classification of forest types using high resolution aerial photographs

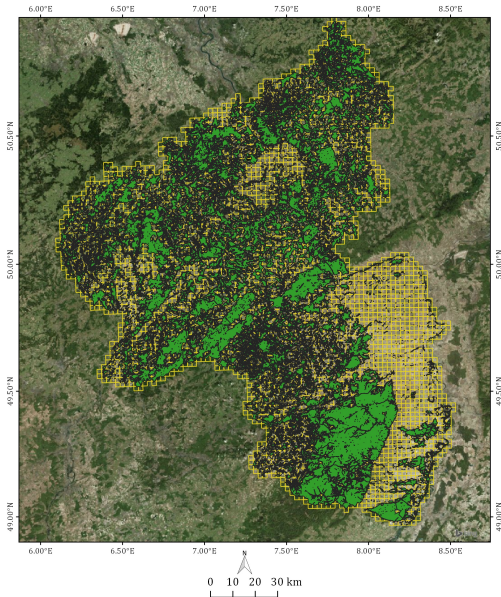
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University Trier
Environmental Remote Sensing and Geoinformatics

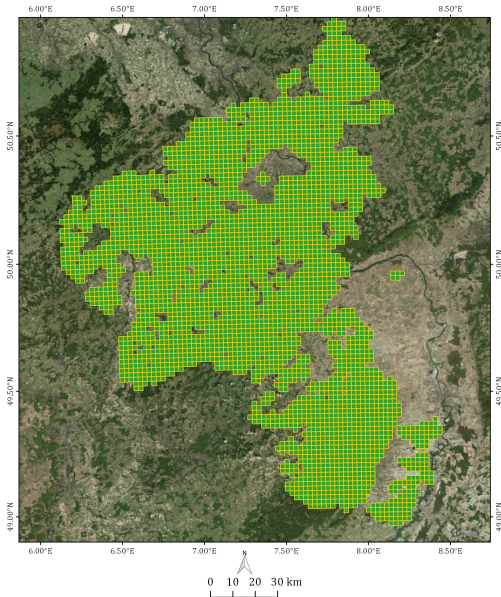
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4. *gemeinsame Jahrestagung der Arbeitskreise der Deutschen Gesellschaft für Geographie (DGfG) e.V. & Auswertung der Deutschen Gesellschaft für Photogrammetrie, Fernerkundung und Geoinformation (DGPF) e.V.*

*24./25. September 2015
Geozentrum der Universität Bonn*



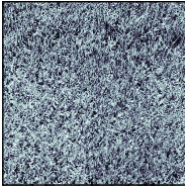
**Coverage of high resolution aerial
images in RLP (5266 tiles)**



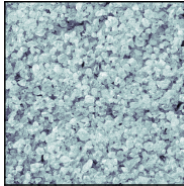
**Coverage of tiles with at least
50% forest cover (3645 tiles)**

Natural textures

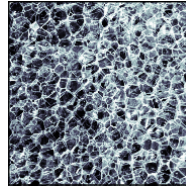
Grass (D9)



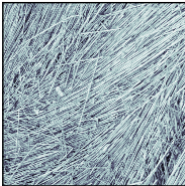
Beach sand (D29)



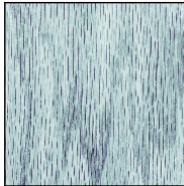
Plastic bubbles (D112)



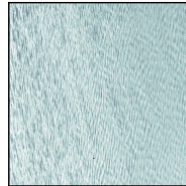
Straw (D15)



Wood grain (D68)

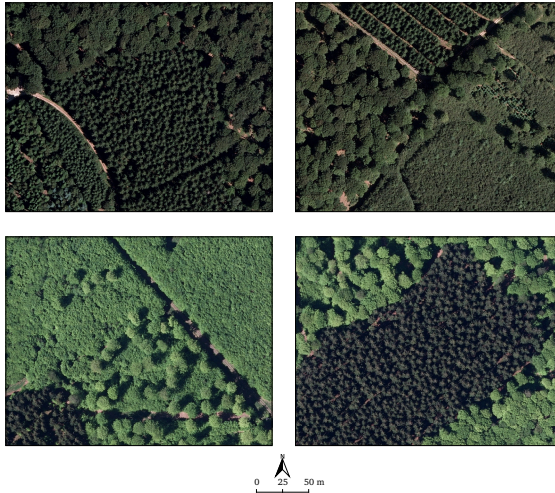


Water (D38)

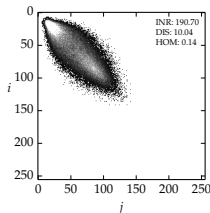
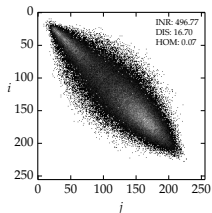
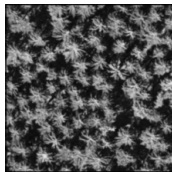
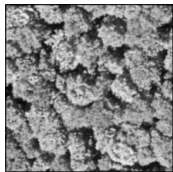


Brodatz library of natural textures [Weber, 1997]

Texture of forest types



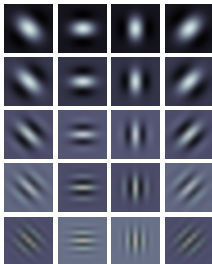
GLCM



Gray level co-occurrence texture features

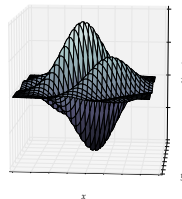
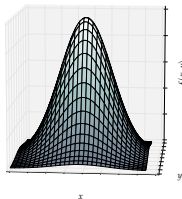
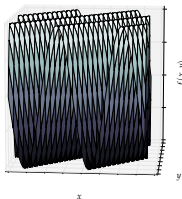
- spatial domain
- second-order statistics
- GLCM ($P(i, j | \theta, \delta)$)
- scalar texture descriptors

Gabor filter banks



Gabor filter implementations

- frequency domain
- windowed Fourier transform
- filter banks ($\Psi(x, y, f_l, \theta_k)$)
- Gabor energy feature



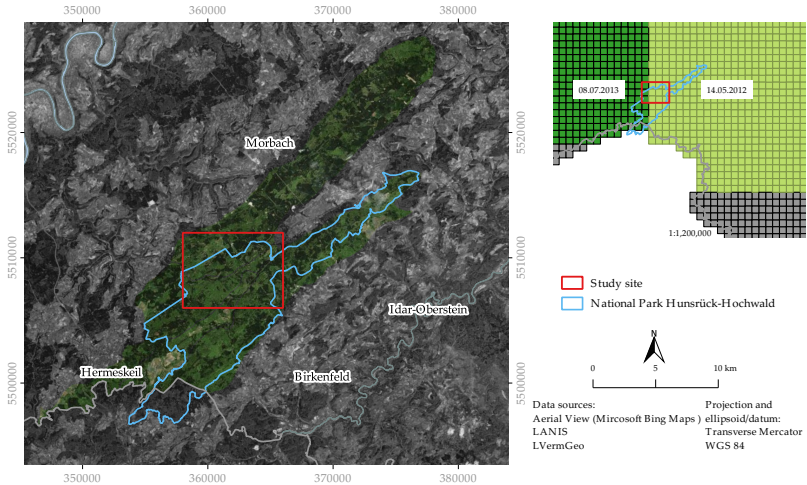
Research questions

main question

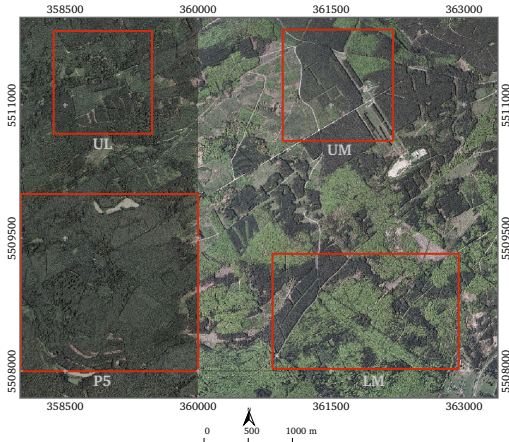
Is a texture-based classification of forest types possible?

secondary question

Which combination of parameters performs best?



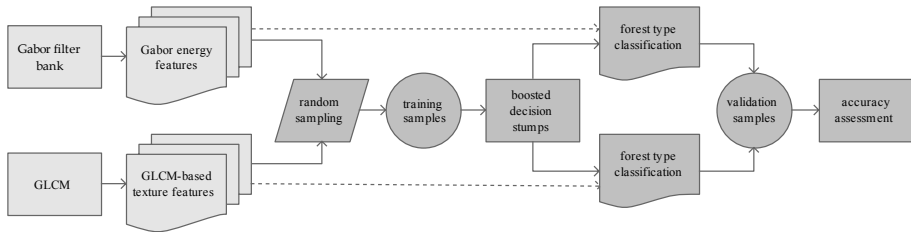
Setup



Texture processing

- R - G - B - NIR - Y
- window size
- spatial resolution
- orientation

Workflow

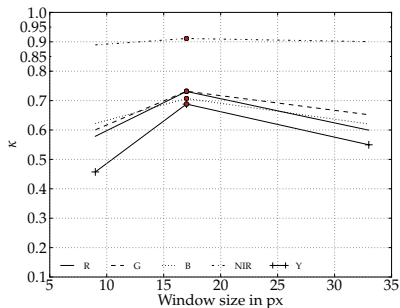
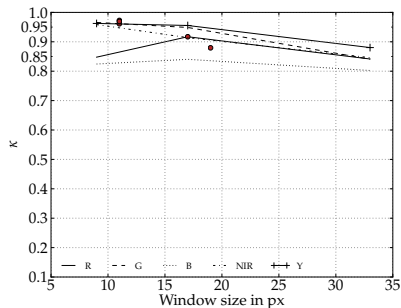


Classification accuracies

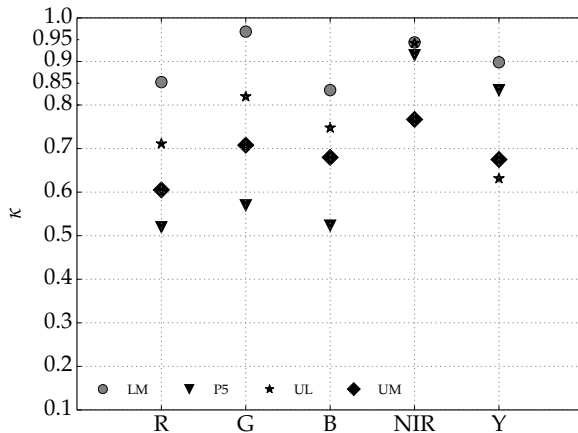
A selection of the highest achieved classification accuracies across all conducted texture-based classifications.

Setup	Subset	κ	σ
GLCM _{Y-11}	LM	0.97	0.01
GLCM _{G-9}	LM	0.97	0.02
D1 _G	LM	0.97	0.03
D2 _{NIR}	LM	0.95	0.02
D1 _{NIR}	UL	0.94	0.04
GLCM _G	LM _{2m}	0.93	0.02
D1 _{NIR}	P5	0.91	0.03
GLCM _{NIR-17}	P5	0.91	0.07
GLCM _{NIR-9}	UL	0.92	0.05
GLCM _{Y-17}	UM	0.86	0.08

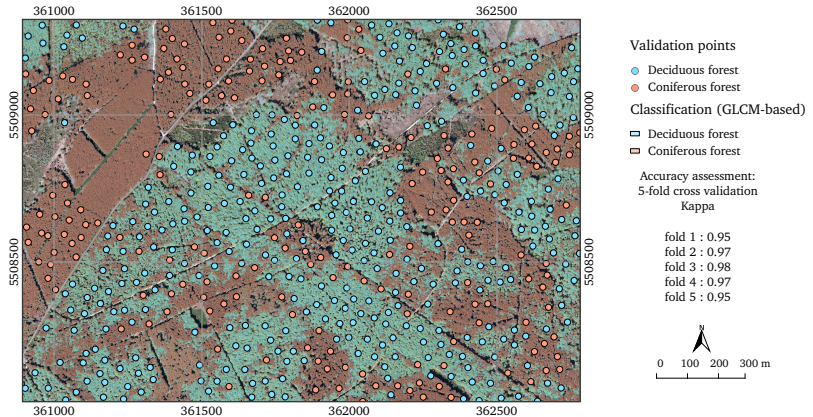
GLCM-based classification (subset LM and P5)



Gabor energy based classification



Subset LM

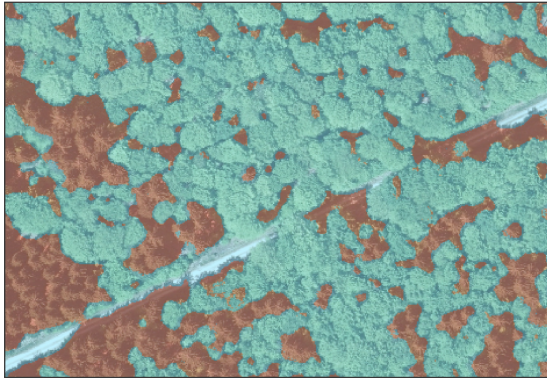


Subset LM



1:1.500

Subset LM



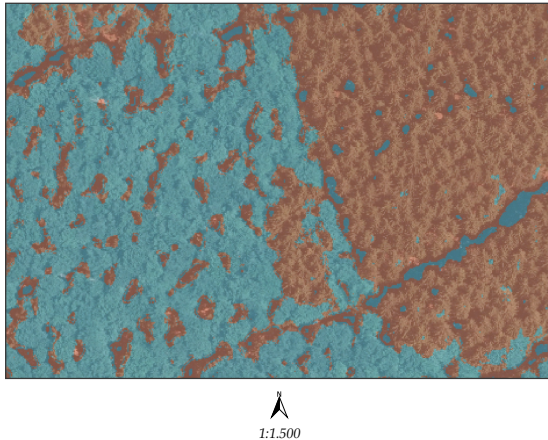
1:1.500

Subset P5

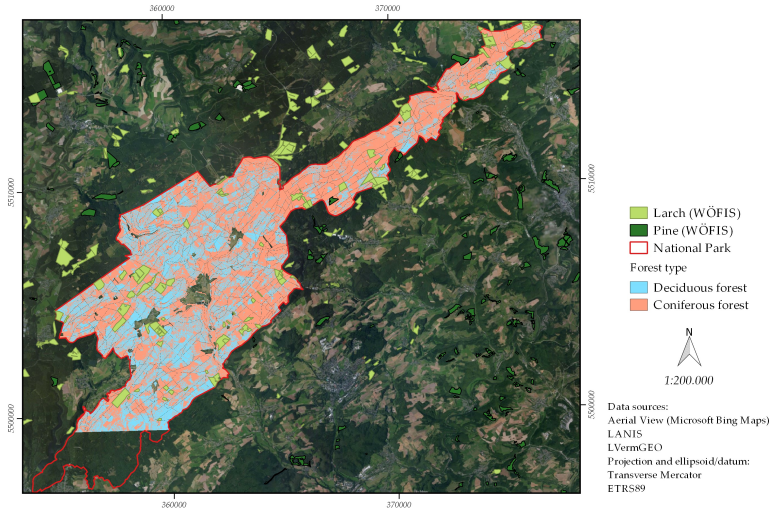


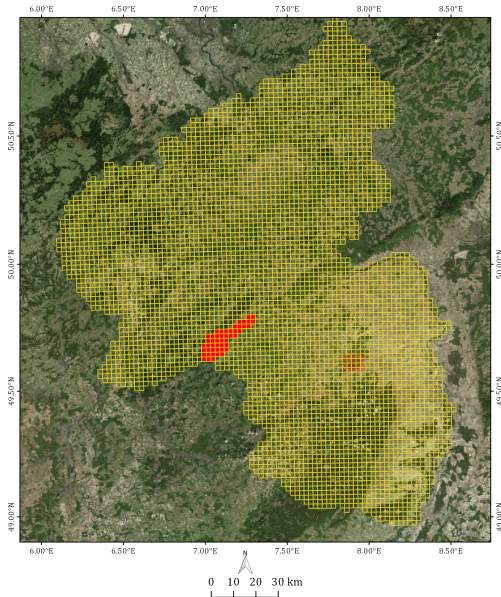
1:1.500

Subset P5



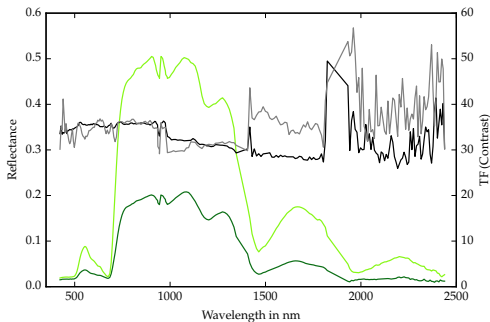
Hunsrück-Hochwald National Park





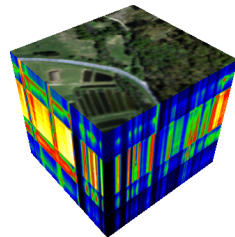
Coverage of generated forest type maps (48 tiles)

Focus areas



GLCM in 3D

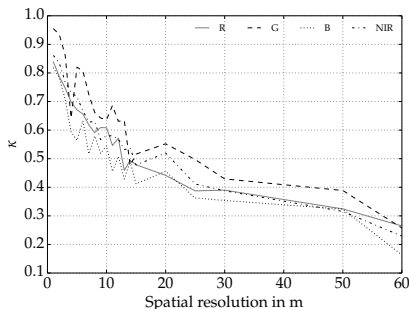
- texture of hyperspectral images
- volumetric texture features
- VGLCM [Tsai et al., 2007]



Focus areas

Topics

- spectral and textural information
- change in scale
- texture features based on geomertic properties of the GLCM
- image segmentation



References

-  Tsai, F., Chang, C. K., Rau, J. Y., Lin, T. H. and Liu, G. R. (2007)
3D computation of gray level co-occurrence in hyperspectral image cubes.
Energy Minimization Methods in Computer Vision and Pattern Recognition, pp. 429-440.
-  Weber, A. G. (1997)
The USC-SIPI Image Database: Version 5, Original release: October 1997, Signal and Image Processing Institute.
University of Southern California, Department of Electrical Engineering.
-  Haralick, R. M. (1973)
Textural features for image classification.
IEEE Transactions on Systems, Man and Cybernetics No. 6, 610 – 621.