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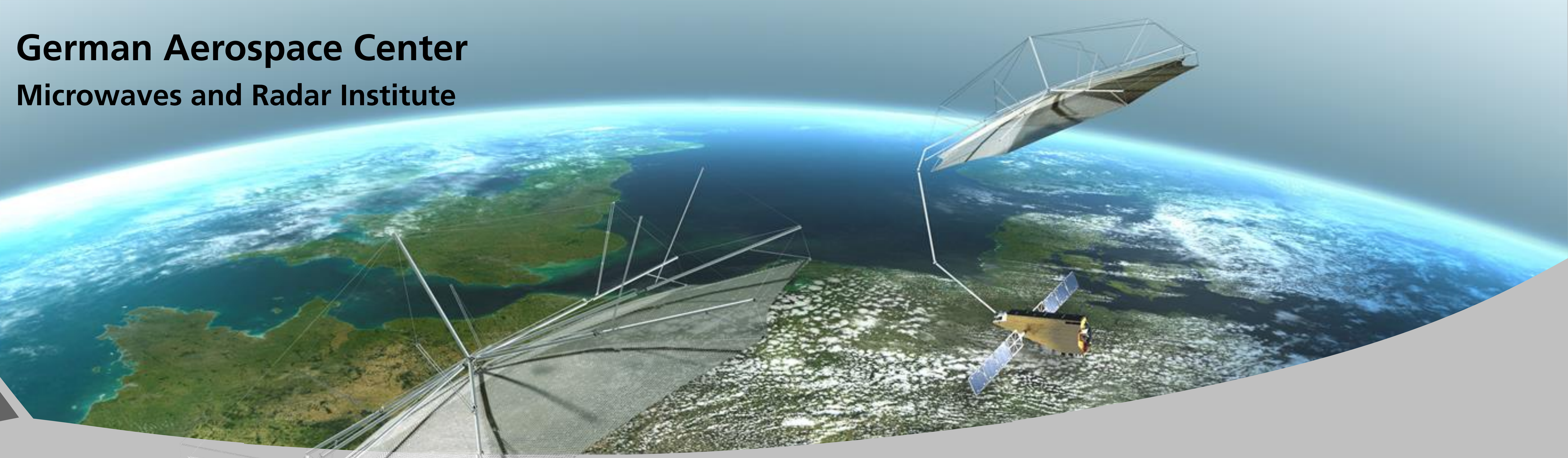


Generation of a New Global Water Body Layer from TanDEM-X Data

Motivation

The identification of water bodies is of great interest for land cover classification, global change detection, flood monitoring, coast line detection, and for several applications in the fields of agriculture, cartography, geology, forestry, as well as for regional environmental planning.

We present a method to generate **water body maps** from TanDEM-X [1] interferometric SAR data, that provides an enhanced detection performance over mountainous terrains.

The Algorithm is based upon a modified version of the well-known **Watershed** image segmentation algorithm.

We used **two datasets**: one over Pennsylvania (USA) and one over Berchtesgaden Alps (Germany).

The first dataset is used to compare the Watershed technique, applied over coherence data processed with an ordinary boxcar estimation window, to the coherence estimated with the Nonlocal Filtering technique.

The second dataset is an example of the new global water body layer over a complex terrain area.

Approach

The Watershed algorithm is a "region growing" algorithm that classifies an image in homogeneous areas taking defined seeds as starting point for the growing process.

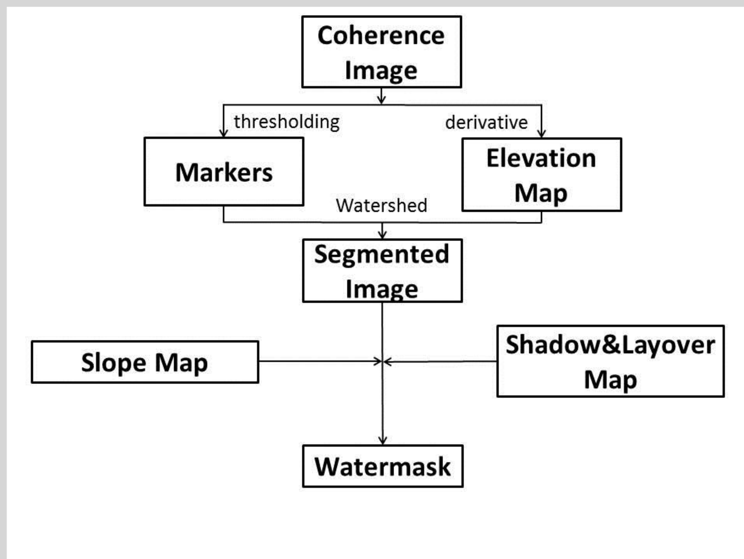
Seeds (or Markers) for the Watershed algorithm are selected looking at low coherence values.

The Watershed algorithm iterates over an image representing the derivative of the interferometric coherence.

The derivative operator flattens the homogeneous areas and enhances the inhomogenoeus ones:

- Define homogeneous areas where we have "water" or "not-water" seeds.

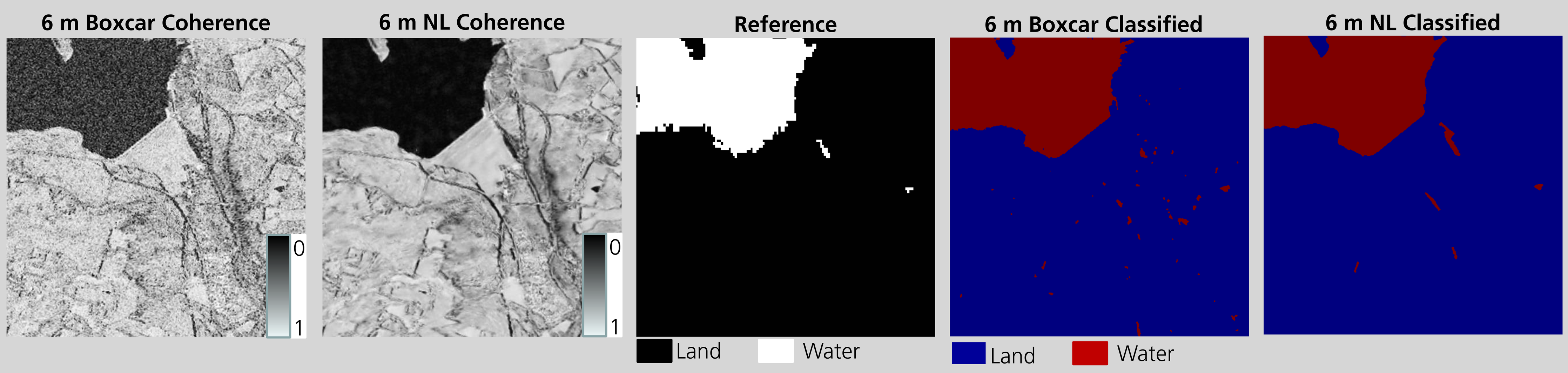
The final classification provides a binary map of "water" and "not-water".



Watershed Algorithm Workflow

Results

Detail of an High-Resolution Image at 6 m resolution (512 512 px): 6 m Boxcar Coherence vs 6 m Nonlocal Coherence



Accuracy (Acc) over the entire 6 m Pennsylvania Dataset		
	Boxcar	**Nonlocal**
Training Set	0.97	0.97
Test Set	0.97	0.98

The accuracy shows that the detection algorithm performance is very similar both for Boxcar Coherence and Nonlocal Coherence.

As Nonlocal Coherence estimation is computationally expensive, this algorithm can guarantee good performances with standard Boxcar Coherence.

Validation is performed with respect to a 30 m resolution Landsat Water Map [2].

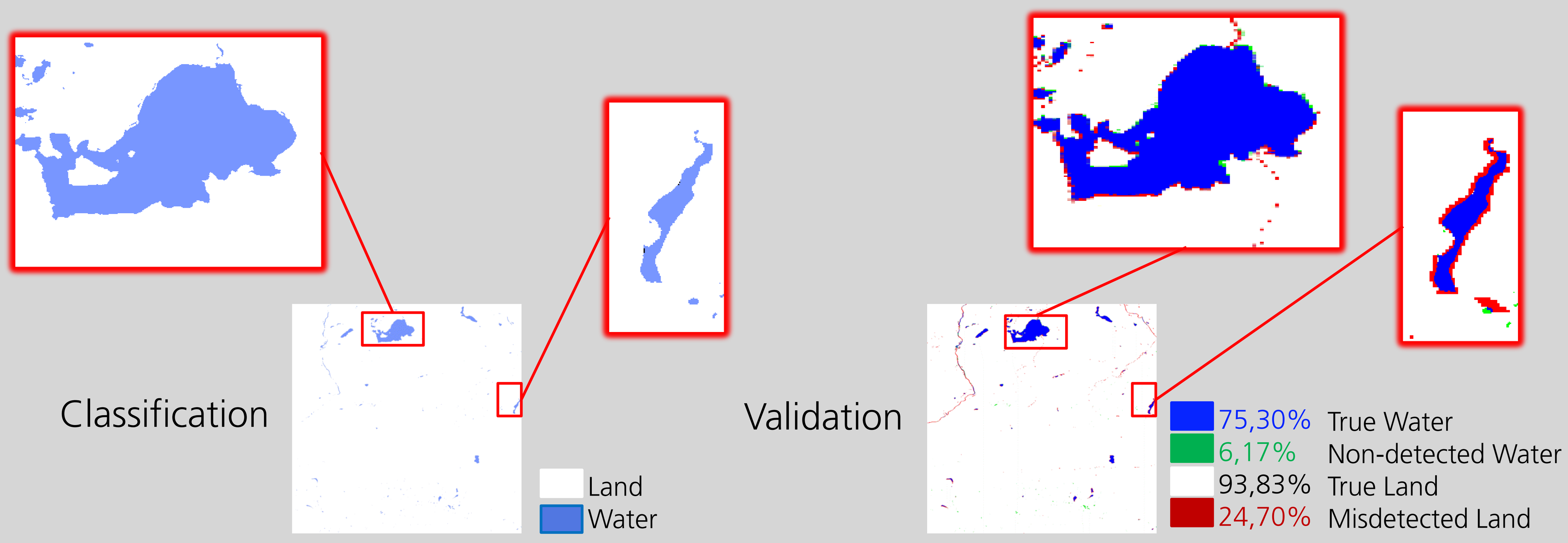
$$ACC = \frac{(TP + TN)}{TOT}$$

TP = True Positive
TN = True Negative
TOT = Number of pixels

Mosaicking of the classified 50 m resolution acquisitions over the Berchtesgaden area, 1°x1° tile.

Validation is performed with respect to a 300 m resolution ESA water bodies map [3].

As the percentage shows, the correctly detected water is 75,30% but we kinow that most of the 24,70% misdetected water pixels come from undetected rivers within the reference.



Next step: generation of a **global** layer

First example of Global Water Bodies Layer: mosaicking of Australia

[1] G. Krieger, A. Moreira, H. Fiedler, I. Hajnsek, M. Werner, M. Younis, and M. Zink: *TanDEMX: A Satellite Formation for High-Resolution SAR Interferometry*, IEEE Trans. Geosci. Remote Sens., Vol. 1, N. 11, pp. 3317–3341, Nov. 2007.
[2] J.F.Pekel, A. Cottam, N. Gorelick and A.S. Belward: *High-resolution mapping of global surface water and its long-term changes*, Nature 540, 418-422 (2016). (doi:10.1038/nature20584)
[3] Kirches, G., Santoro, M., Wevers, J., Boettcher, M., Brockmann, C., Lamarche, C., Bontemps, S., Deofurny, P., 2015. Land Cover CCI - Product User Guide - Version 2. ESA Public Document CCI-LC-PUG, Issue 2.4

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