ASSESSMENT OF URBAN EXTEND AND IMPERVIOUSNESS OF CAPE TOWN USING TERRASAR X AND LANDSAT IMAGES

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Abstract

Urban sprawl is a global phenomena and one of the most dynamic land use changes. In developing as well as developed countries the urbanization advances rapidly and the enormous dynamics of changes in urban environments requires an adequate monitoring. Hence, effective and sustainable urban management increasingly demands alternative concepts and techniques to obtain up-to-date information on the status and development of urban areas. Space borne earth observation has become a promising tool to provide updated geo-information on the location, shape and development of built-up areas. Besides the expansion of urban areas, the growing imperviousness of this areas are of major concern due to the negative effects on the environment.

With the high spatial resolution of up to one meter, the ability to record data independently of weather or daytime and a revisit time of up to 3 days the new German radar satellite TerraSAR-X provides promising potential for collecting data on urban dynamics. On the other hand optical data like Landsat have a high potential for detection of imperviousness due to their high spectral resolution.

For the example of Munich in Germany the identification of built-up areas using radar images and the calculation of imperviousness using optical images has been demonstrated. In this study these techniques developed and tested in Germany are transferred to South Africa using the example of Cape Town.

The classification of urban areas is based on an object-oriented analysis approach using TerraSAR-X data. As a supplement to the single-polarized radar intensity data, a second layer was calculated, which contains information on speckle statistic variation compared to a modelled speckle distribution. The urban area of Munich in Germany could thus be classified with an overall accuracy of 90 % (Thiel et al., 2008).

The imperviousness of urban area was calculated using a support vector regression on a basis of Landsat data and aerial images. The latter were used as reference for training and validation. The analysed region was restricted to residential, industrial and transport areas. First, the information on the position and extent of the according regions was provided by vector data of the German Official Topographic-Cartographic Information System (ATKIS). Using the classification of urban areas with TerraSAR-X the ATKIS information can be substituted. The comparison of the results on imperviousness on a block by block basis for Munich showed a modelled degree of impervious surface of 50 % compared to a mean imperviousness of 54 % for the reference data.

The semi-automated classification of the urban areas of Cape Town using TerraSAR-X data revealed similar high accuracies as for Munich. Errors occurred mainly in settlement areas which have a high degree of large tree

stands. It could be demonstrated, that a regression model build for one region can be transferred to another region within Germany (Esch et al., 2008). The transfer of the regression model build on a German city to Cape Town is more difficult and a good atmospheric correction is essential in order to use the same regression model. However, modeling imperviousness with a local regression model build with high resolution aerial images of Cape Town achieves higher accuracies.

The study results show that in principle the method developed for Germany can be transferred to South Africa and that the combination of radar images and optical data for monitoring of urban areas allows on one hand the identification of urban areas and on the other the calculation of imperviousness within these areas. Thus the accuracy of the imperviousness can be increased by using exclusively remote sensing data.

References

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