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Quantifying the Physical Composition of Urban Morphology throughout Wales by analysing a Time Series (1989-2011) of Landsat TM/ETM+ images and Supporting GIS data

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Knowledge of impervious surface areas (ISA) and on their changes in magnitude, location, geometry and morphology over time is significant for a range of practical applications and research alike from local to global scale. It is a key indicator of global environmental change and is also important parameter for urban planning and environmental resources management, especially within a European context due to the policy recommendations given to the European Commission by the Austrian Environment Agency in 2011. Despite this, use of Earth Observation (EO) technology in mapping ISAs within the European Union (EU) and in particular in the UK is inadequate.

In the present study, selected study sites across Wales have been used to test the use of freely distributed EO data from Landsat TM/ETM+ sensors in retrieving ISA for improving the current European estimations of international urbanization and soil sealing. A traditional classifier and a linear spectral mixture analysis (LSMA) were both applied to a series of Landsat TM/ETM+ images acquired over a period spanning 22 years to extract ISA. Aerial photography with a spatial resolution of 0.4m, acquired over the summer period in 2005 was used for validation purposes.

The Welsh study areas provided a unique chance to detect largely dispersed urban morphology within an urban-rural frontier context. The study also presents an innovative method for detecting clouds and cloud shadow layers, detected with an overall accuracy of around 97%. The process tree built and presented in this study is important in terms of moving forward into a biennial program for the Welsh Government and is comparable to currently existing products. This EO-based product also offers a much less subjectively static and more objectively dynamic estimation of ISA cover. Our methodology not only inaugurates the local retrieval of ISA for Wales but also meliorates the existing EU international figures, and expands relatively stationary ‘global’ US/China-centric ISA research. With the recent launch of Landsat 8, our study can also provide important input to efforts focusing towards the development of a global scale operational cost-effective and consistent long term monitoring of ISA based on EO technology.