Geophysical Research Abstracts
Vol. 20, EGU2018-17819, 2018
EGU General Assembly 2018

Earth Observation for Planning Sustainable Cities

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Rapid global urbanisation has resulted in more than half of the world's population (54.5% in 2016) currently residing in cities and this is expected to increase by 2.5 billion by 2050 or 66% of the world's population. To accommodate the large increase in urban population urban area is expected to triple by 2030 based on current trends (2000 baseline of 652,825 km^2). Anthropogenic landscape modification from natural cover to manmade impervious surfaces is considered the most extreme cumulative effect of land cover change generating socio-economic, physical and environmental consequences. Nevertheless current planning urban estimates frequently used for future development plans, infill and density attainment and monitoring environmental impacts are based upon aggregated census data and metrics unrepresentative of actual land cover change, underestimating overall urban area. Of the urban induced environmental impacts the Urban Heat Island (UHI) effect, defined by increased atmospheric and surface temperatures over surfaces covered by manmade urban materials, is considered one of the major problems posed to humans in the 21st century. The UHI effect has been associated with adverse health impacts, increased energy consumption and emissions, water usage escalation, and economic expenditure. The latter estimated at $300 million (AUD) per annum by the city of Melbourne in the first global UHI economic quantification. However the UHI effect is frequently defined as a single value representing the temperature difference between urban and natural surfaces being inappropriate for targeted policy incorporation. Here we showcase the novel use of satellite earth observation in creating consistent and accurate temporal land cover estimates and associated temperature change relationships across space to understand the UHI dynamics in greater detail for appropriate policy integration. The application area is the rapidly expanding Perth Metropolitan Region in Western Australia, where urban area has increased 45.3% (320.34 km^2) since 1990 alongside a booming resource sector now accounting for 95% of the state's export earnings. In alignment with international frameworks (e.g. C40 Cities Climate Leadership Group's guide for cool cities, 2030 sustainable development goals and City Resilience Framework) we exhibit how inclusion of earth observation data into development policy can facilitate a future transition towards sustainable cities.