

Estimation Of Net Radiation Over Complex Urban Environment - A Case Study Of Hong Kong

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Abstract: Net radiation is an important indicator of global climate change. It can be used to distinguish between climate change due to local anthropogenic activities and green house warming. It is a vital component of the urban energy balance which is often affected because of urbanisation. In order to estimate and understand urban energy balance properly – an accurate estimation of the net radiation component is necessary. The present study estimates net radiation over Hong Kong using ASTER (Advance Space borne Thermal Emission reflection Radiometer) level 1B satellite images of 30-Nov-2007 obtained at 11 am local time. The medium to high spatial resolution and wide spectral resolution of ASTER is very helpful for net radiation assessment but at the same time atmospheric correction is a challenging task. Hong Kong possess unique climatic conditions where global atmospheric correction algorithms are not appropriate, so in this study radiosonde and sun photometer values are used to define atmospheric and aerosol models respectively using the 6S radiative transfer algorithm. The atmospherically corrected VNIR and SWIR images were used to calculate emissivity and albedo and the corrected Band 13 TIR image was used to derive land surface temperature. A simple and effective method for calculating emissivity has been used based on land use and infra red images, whereas other studies have used the well knows TES (temperature emissivity separation algorithm) algorithm. Our method allow us to estimate emissivity at finer scale (15m), whereas the TES algorithm provides emissivity at 90 m. Impervious surfaces and urban morphology were accounted for much better at finer resolution, which is lacking in TES method- often results in under or over estimation of emissivity, which in them also affects the net radiation value . The estimated net radiation values over Hong Kong range between 500 and 700 watts/meter square and most urbanised regions of

the city possess high net radiation value which clearly demonstrates that anthropogenic activities have impact on net radiation values. For validation, net radiation measured using remote sensing was compared with net radiation measured using Kipp & zonen net radiometer set up on grass land during the image overpass time and the compared results were similar. The method developed here enables accurate estimation of the net radiation component of energy balance and is unique because in general people study net radiation by remote sensing or by field measurement, rather than by integrating both techniques. The techniques used here can be adopted for any city with a complex urban environment.

Keywords: Net radiation, urban energy balance, albedo, emissivity and atmospheric correction