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CARBON ACCOUNTING INCORPORATING AGRICULTURE TO URBAN LAND USE CHANGE BY FUSING MULTI-RESOLUTION OPTICAL AND SAR DATA IN THE OPEN DATA CUBE OVER THE 16 CENSUS METROPOLITAN AREAS OF CANADA

Abstract

Expansion of urban settlements onto agricultural land, is recognized as a land use change that can result in changes to net CO2 emissions to the atmosphere. In large countries such as Canada, reporting all changes in carbon on the landscape due to anthropogenic activities has proven challenging. In particular, national reporting under the United Nations Framework Convention on Climate Change requires the development of a consistent time-series beginning in 1990 which further increases the reporting challenge. The work described here uses Canada as an example and provides a methodology for compiling, processing and standardizing the data required to carry out a multi-temporal analysis of emissions and removals of carbon that occur due to urban expansion into agricultural areas around cities. This method provides a standardized approach to create data compilations required by countries in fulfilling the requirements for the UNFCCC reporting of the source category of Cropland to Settlements.

This study uses a multitude of different earth observation datasets from the Landsat series, Sentinel 2, Radarsat 1 2, and very high-resolution stereo optical imagery over sixteen Census Metropolitan areas in Canada. This data is automatically processed to Analysis Ready Data (ARD), before it is ingested into various instances of the CEOS Open Data Cube (ODC). ARD must be co-registered to 1/10th of a pixel, atmospherically and BRDF corrected, as well as pre-classified to generate a quality layer of cloud-, shadow- snow- and water-free observations. Automated land use change detection algorithms, based on Object Based Image Analysis (OBIA) segmentation and the continuous change detection and classification (CCDC) algorithm, flag areas of agriculture to urban conversion. Vegetation for both of these land use classes is classified into herbaceous and perennial woody classes (i.e. orchards, vineyards, hedges). Woody cover height is extracted from very high resolution optical stereo imagery and correlated to stored carbon. A time series of above ground woody vegetation volume is used together with vegetation responses from lower spatial resolution, higher temporal resolution, earth observation data to quantify accumulation of carbon stocks in newly developed urban areas. Cadastral information from cities and provinces as well as extensive field work and an urban forest inventory is used to validate the results.