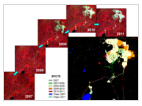
Figures and tables



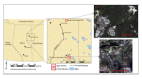
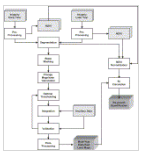
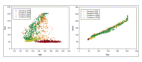
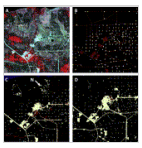
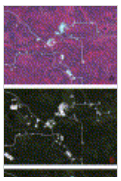


Table 1









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Quantification of anthropogenic and natural changes in oil sands mining infrastructure land based on RapidEye and SPOT5

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Highlights

- A hybrid method is proposed to monitor anthropogenic change associated with oil sands developments.
- A new landscape index, the Re-growth Index, has been formulated for monitoring reclamation of transient land disturbances.
- SPOT5 and RapidEye images have been utilized to create consistent time series of change.
- Accuracies of 80% and 90–95% are achieved for pixel and object level processing.

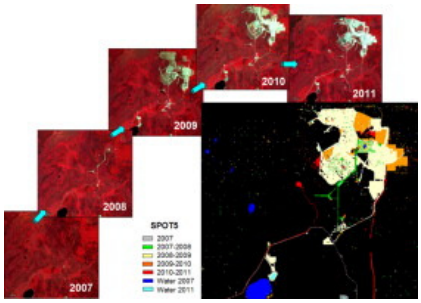
Abstract

Natural resources development, spanning exploration, production and transportation activities, alters local land surface at various spatial scales. Quantification of these anthropogenic changes, both permanent and reversible, is needed for compliance assessment and for development of effective sustainable management strategies. Multi-spectral high resolution imagery data from SPOT5 and RapidEye were used for extraction and quantification of the anthropogenic and natural changes for a case study of Alberta bitumen (oil sands) mining located in the Western Boreal Plains near Fort McMurray, Canada. Two test sites representative of the major Alberta bitumen production extraction processes, open pit and in situ extraction, were selected. A hybrid change detection approach, combining pixel- and object-based target detection and extraction, is proposed based on Change Vector Analysis (CVA). The extraction results indicate that the changed infrastructure landscapes of these two sites have different footprints linked with their differing oil sands production processes. Pixel- and object-based accuracy assessments have been applied for validation of the change detection results. For manmade disturbances, except for those fine linear features such as the seismic lines, accuracies of about 80% have been achieved at the pixel level while, at the object level, these rise to 90–95%.

Since many disturbance features are transient, a new landscape index, entitled the Re-growth Index, has been formulated at single object level specifically to monitor restoration of these features to their natural state. It is found that the temporal behaviour of the Re-growth Index in an individual patch varies depending on the type of natural land cover. In addition, the Re-growth Index is also useful for assessing the detectability of disturbed sites.

Graphical abstract

Growth of an oil sands development project near Kearl Lake, Alberta, from 2007 to 2011 based on a temporal sequence of SPOT5 images.



Keywords

Extraction of land changes; Change detection; Land disturbance; Mining land; Reclamation; Regrowth

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