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Advanced radiative transfer modelling for information extraction

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Introduction

Radiative transfer (RT) modelling is one method of physically relating at-surface bidirectional reflectance (BRF) derived from remotely sensed imagery to properties of a vegetation canopy.

Several radiative transfer models have been developed to describe this relationship. One such model, the Four Scale Linear Model for Anisotropic Reflectance (FLAIR), was developed with a focus on flexibility and tractability, particularly as applied to hyperspectral applications.

Such applications include the assessment of the physiological vegetation condition in support of environment monitoring performed for policy development and regulatory enforcement for orphaned mines, and the Canadian Wildlife Service of Environment Canada. The assessment involves the detection and mapping of biochemical indicators such as canopy chlorophyll concentration and water content by applying RT models to detect relevant spectral changes in vegetation canopies.

Advances

Developments with the FLAIR model have focused on expanding the description of multiple scattering. The optical scattering and absorption in the canopy is divided into two problems: the scattering with a completely absorbing background (black soil) and the scattering for an illuminated background.

The first problem uses the relationship between photon re-collision probability and the Leaf Area Index (LAI) for simulating canopy reflectance. The second problem uses the scattering between the canopy and the background.

This approach is incorporated in the FLAIR model to describe the multiple scattered radiation field of the canopy. Preliminary results show that this approach makes a significant improvement in the ability of the FLAIR model to simulate canopy BRF in the near infrared region, where multiple scattering is most significant.

Further information

For more information about the FLAIR model and its use in simulating canopy BRF, and relating observed BRF to biophysical properties, visit the FLAIR Web site at www.ccrs.nrcan.gc.ca/flair.

References

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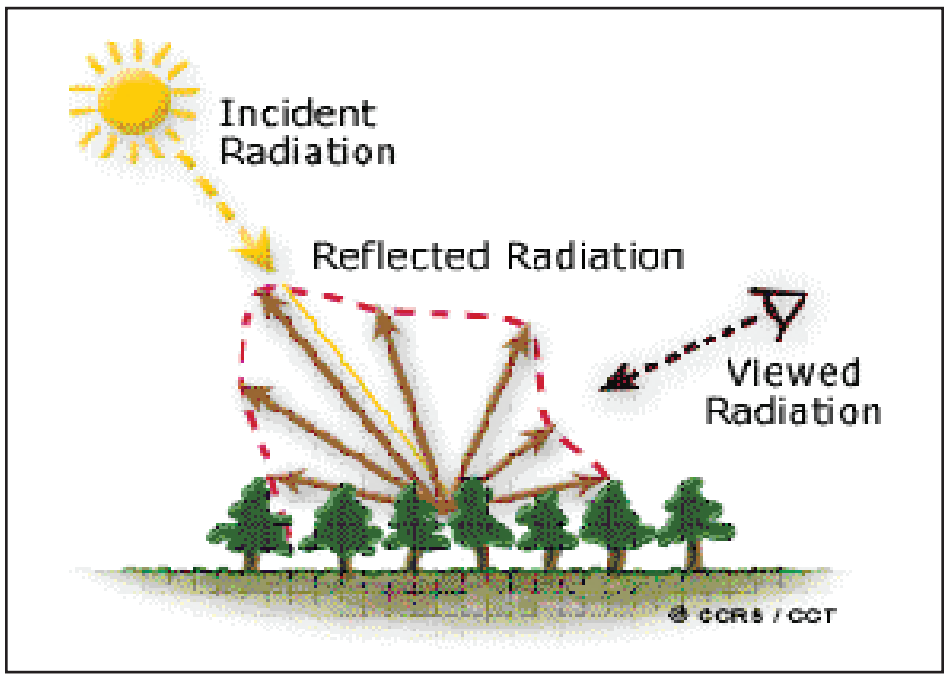
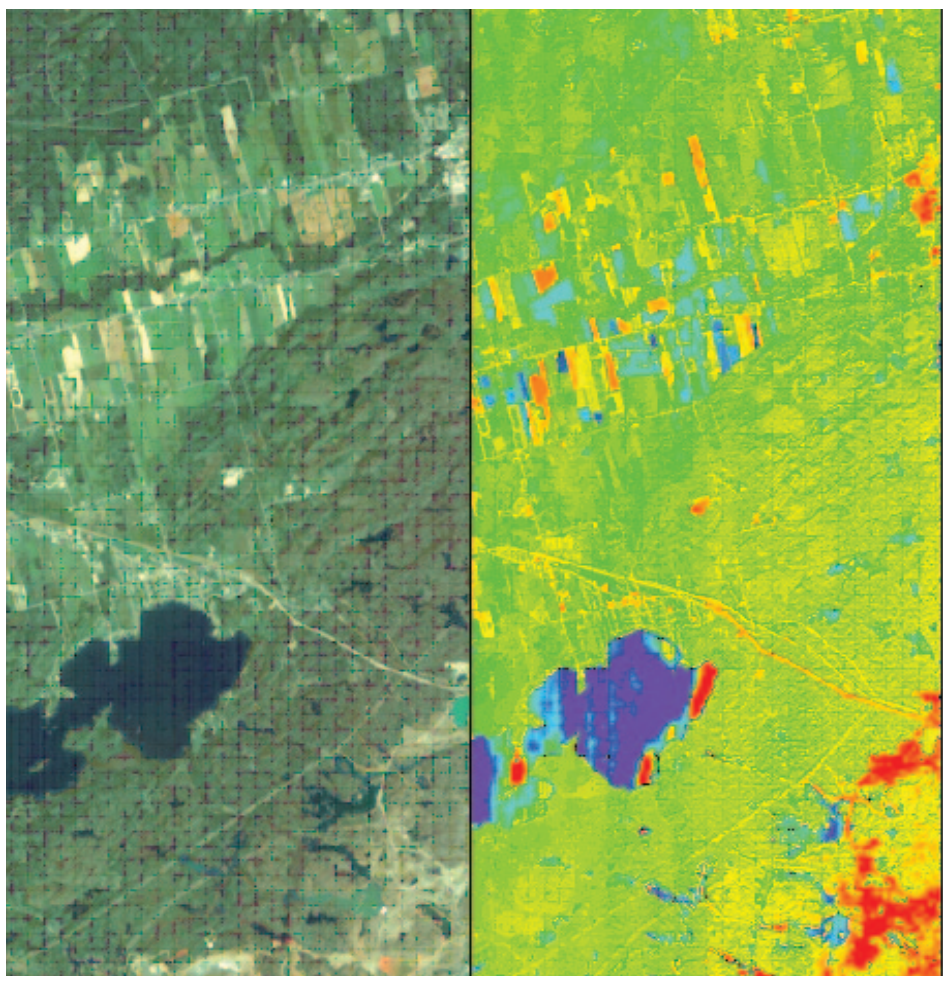


The FLAIR radiative transfer model incorporates wavelength-dependant multiple scattering when simulating interactions between the incident radiation and the vegetation canopy.



Equivalent water thickness (EWT) is mapped using hyperspectral imagery and by mapping the absorption features of suspended liquid water. Mining activity (south half of the image) is monitored for re-vegetation efforts and mine waste impacts on the surroundings. Agricultural crop vigour is also demonstrated in the north.
(red = 0% liquid water, blue = 100%.)

The FLAIR model will be used to evaluate the impact of view and illumination orientation on the observed spectral imagery to further quantify and validate these information products.

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