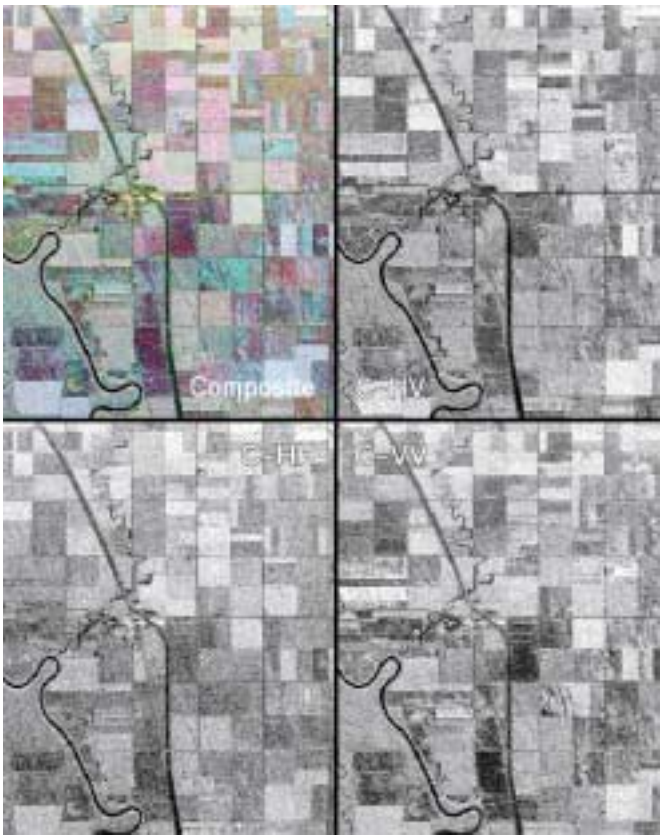
Canadian Space Agency | Agence spatiale canadienne

RADARSAT-2
Flexible polarimetric imaging



HH, VV, HV and colour composite of linear polarization images of agricultural fields in Southern Manitoba. (© CCRS 1993. Acquired by CV-580 C-band SAR. Processed and provided by CCRS.)

QUAD-POLARIZATION IMAGING MODE

Existing conventional remote sensing radar satellites like RADARSAT-1 operate with a single polarization antenna configuration. As a result, only the amplitude of the returned signal is measured. Any additional information is lost. Therefore, accurate discrimination between similar scattering returns is difficult and, depending on the system's polarization configuration, many features go undetected. Polarimetric radars, like RADARDAT-2, are able to transmit and receive both horizontal and vertical polarizations. With this configuration, four linearly polarized signals are measured coherently in the scattering matrix: HH, HV, VH, and VV. Consequently, the user can derive additional information about the target to aid in the analysis

Scattering matrix

$$S = \begin{vmatrix} S_{HH} & S_{HV} \\ S_{VH} & S_{VV} \end{vmatrix}$$

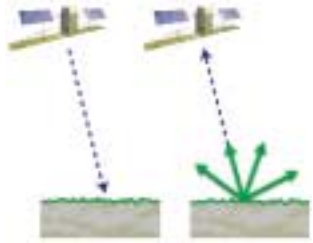
Scattering elements

$$S_{xy} = |S_{xy}| e^{i\phi_{xy}}$$ ← Phase

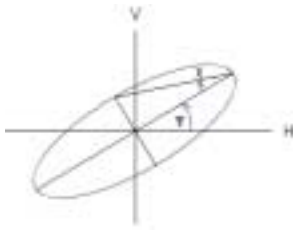
↑ Magnitude

SCATTERING PROPERTIES OF THE EARTH'S SURFACE

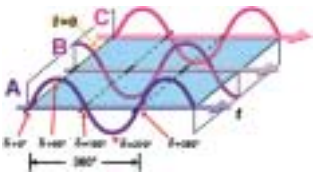
Each scattering element has varying sensitivities to different surface characteristics and properties, helping to improve the discrimination between features. In addition to measuring the magnitude of the returned signal for each polarization, RADARSAT-2 will be able to record phase information of the returned wave. This can be used to characterize the polarimetric signature of various surface features. Quad-polarization data will be very useful in the study of scattering mechanisms and in resolving ambiguities about the source of scattering.



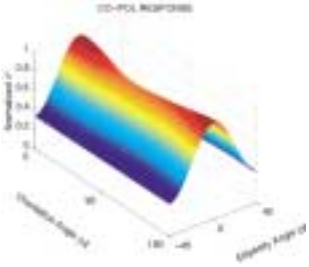
MAGNITUDE
The magnitude describes the strength of the transmitted signal that is redirected back to the sensor after the scattering events, which depends on the target. The normalized measure of the radar return from a distributed target is the backscatter coefficient (σ°).



POLARIZATION
Polarization describes the orientation of the electric field vector. The polarization is described by the ellipticity angle (χ) and the orientation angle (Ψ). RADARSAT-2 will transmit in H and V polarization and the received wave will be decomposed in both orthogonal components.



PHASE
The phase is related to the oscillation of the radar electromagnetic wave. In this figure, the wave B is 90˚out of phase from the waves A and C (a complete phase is 360˚). The phase difference between two signals contains useful information on the properties of the target.



POLARIZATION SIGNATURE
The polarization signature draws the scattering coefficient as a function of any assumed transmit and receive antenna polarization, allowing the measurement of the variation of the scattering coefficient with polarization. Different targets will generate different signatures, providing unique information.

RADARSAT-2 Programme
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