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Compact Polarimetry: Multi-Thematic Evaluation

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This on-going study evaluates the potential of a compact polarimetric SAR mode concept for meeting Earth Observation requirements relevant to Canadian thematic issues. In a hybrid-polarity architecture (CL-pol), SAR transmits circular polarization and receives two orthogonal mutually-coherent linear polarizations. The resulting radar is relatively simple to implement, and has unique self-calibration features and low susceptibility to noise and cross-channel errors. It also permits the maintainence of larger swath coverage as compared to fully polarimetric SAR systems. This configuration is being evaluated by a multi-disciplinary team, for applications relevant to the Government of Canada, for input to future SAR system design and for data selection from the growing array of SAR data products available worldwide.

As preliminary results, a quick comparison based on scattering mechanisms between RADARSAT-2 fully polarimetric data and simulated compact polarimetry is presented as RGB composite images (figure 1), where the Red, Green and Blue channels are representing respectively the double bounce, multiple (vegetation) and single bounce scattering mechanism. Most of the relative intensity between the scattering mechanisms is preserved, nevertheless a less dynamic intensity range is observed.

The results will help evaluate the tradeoffs between ground coverage, information content, processing complexity and data volume.

Stoke Representation

Fully Polarimetric

$$\begin{bmatrix} 1 \\ \cos\psi_R \cos\chi_R \\ \sin\psi_R \cos\chi_R \\ \sin\chi_R \end{bmatrix} = \begin{bmatrix} Kennaugh \\ 4X4 \end{bmatrix} * \begin{bmatrix} 1 \\ \cos\psi_T \cos\chi_T \\ \sin\psi_T \cos\chi_T \\ \sin\chi_T \end{bmatrix}$$

Compact Mode CL

$$\begin{bmatrix} \langle |E_{RH}|^2 + |E_{RV}|^2 \rangle \\ \langle |E_{RH}|^2 - |E_{RV}|^2 \rangle \\ 2\,\mathrm{Re}\langle E_{RH} E_{RV}^* \rangle \\ -2\,\mathrm{Im}\langle E_{RH} E_{RV}^* \rangle \end{bmatrix} = \begin{bmatrix} Kennaugh \\ 4X4 \end{bmatrix} * \begin{bmatrix} 1 \\ 0 \\ 0 \\ -1 \end{bmatrix}$$

[Receive] = [Target] * [Transmit]

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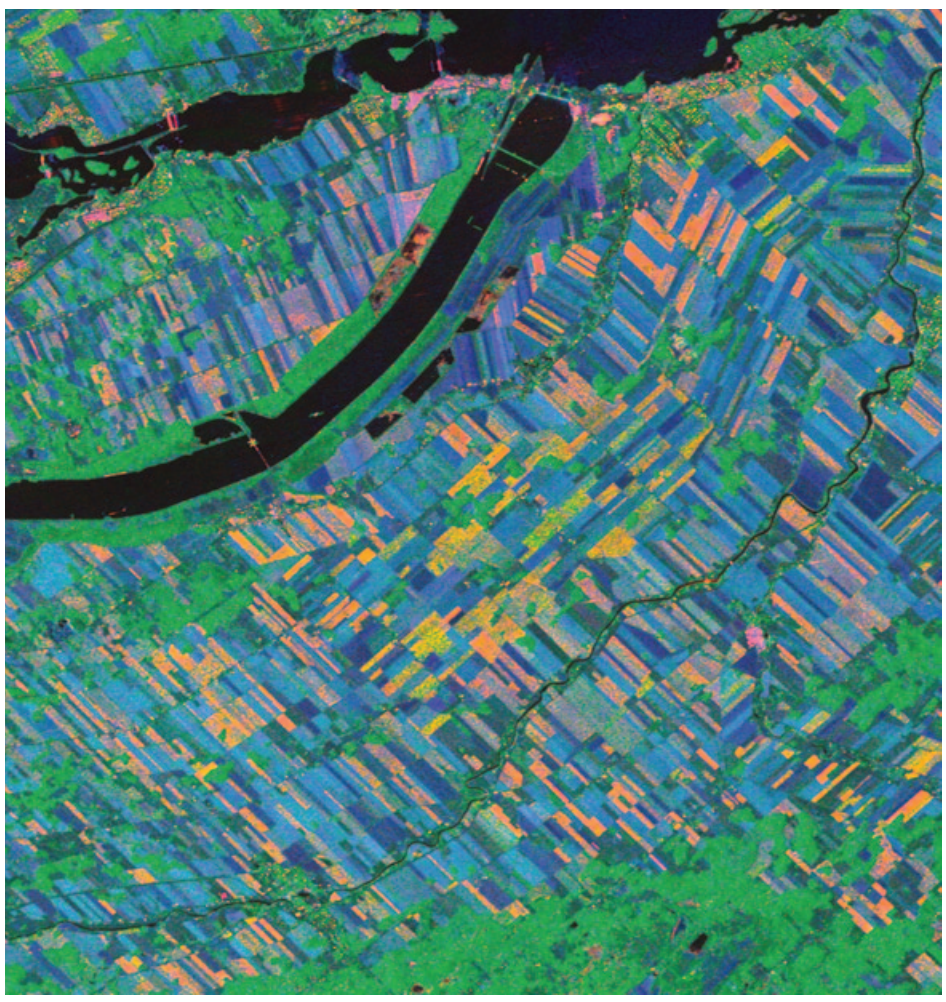
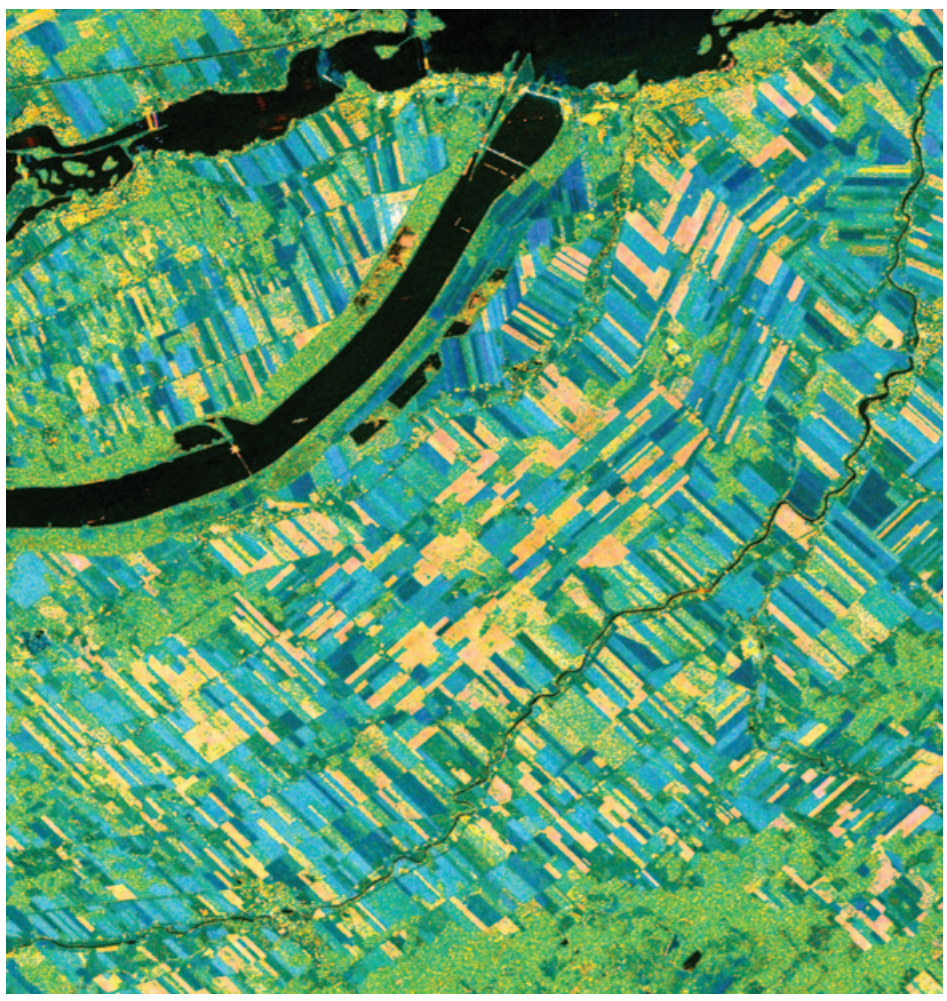
Figure 1. Scattering mechanism decomposition images



a) Fully polarimetric data (Freeman-Durden decomposition)



b) m-δ Simulated compact polarimetric mode (CL)

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