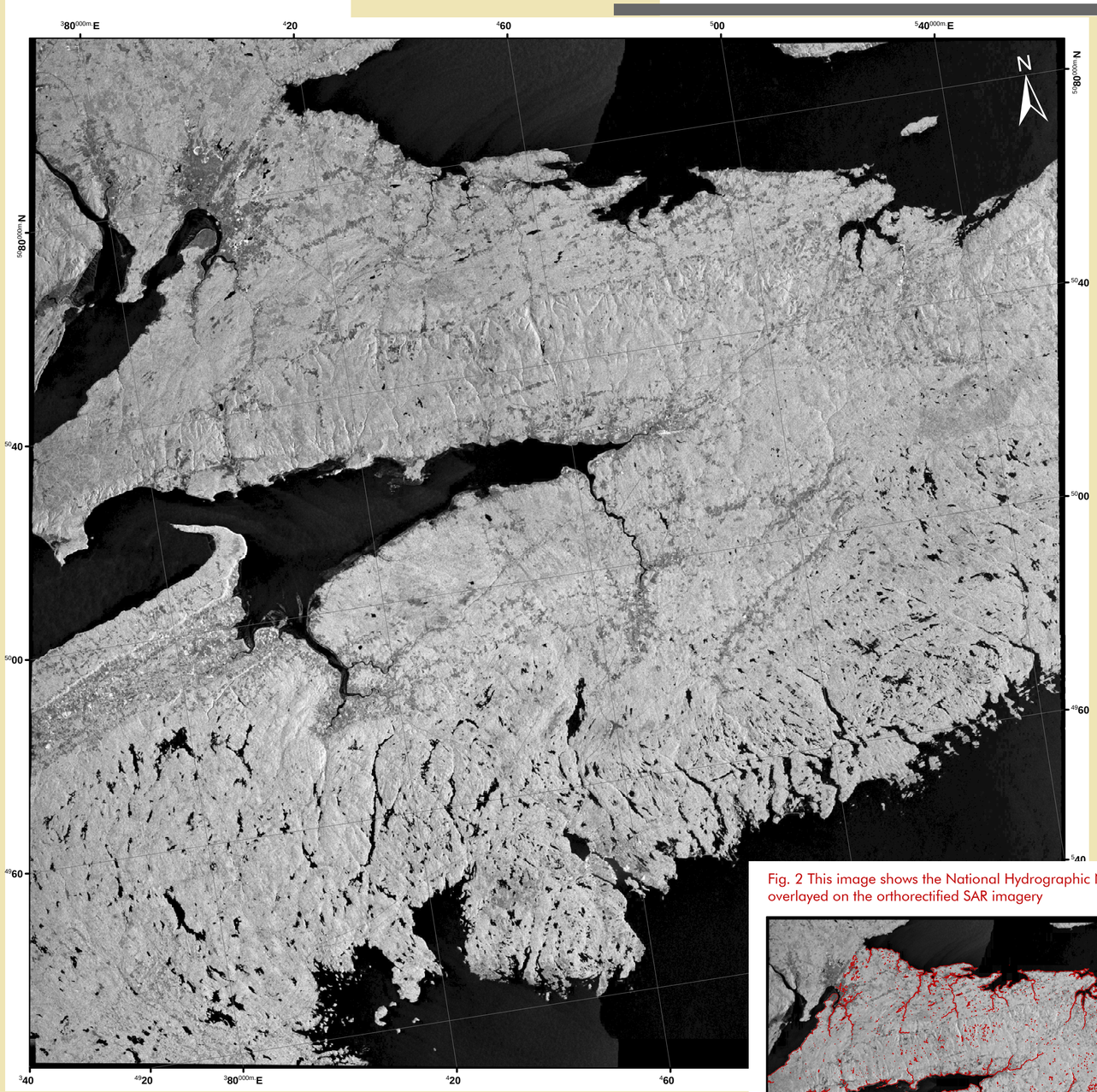
SAR Orthorectification and Mosaic

Fig. 1 The final result for an orthorectified mosaic of four SAR images of central Nova Scotia.



Projection: Universal Transverse Mercator, Zone 20 North
Datum: North American Datum 1983 (CSRS98)

	Acquisition Date	Source	Wavelength	Beam Mode	Swath Width	Nominal Resolution	Incidence Angles	Orbit
Scene 1	12/10/1996	RADARSAT-1	C-band at 5.3 GHz frequency	Standard 7	100 km x 100 km	25 cm x 25 cm	45° - 49°	Descending node
Scene 2	12/10/1996							
Scene 6	19/10/1996							
Scene 7	19/10/1996							

OVERVIEW

The goal of this project was to create a seamless mosaic of SAR imagery that corresponded to ground coordinates. This was accomplished using a combination of EASI scripts and manual use of PCI Geomatica's OrthoEngine.

The imagery that was provided depicts central and north western Nova Scotia with a portion of New Brunswick. This study area contains a variety of responses based on the ground cover type. For instance urban areas like Halifax and Truro have areas of pixels with bright, near white values. This is indicative of areas with buildings, which cause this by corner reflectance, or concentrations of metal (like bridges) which have high dielectric constant properties. Whereas Nova Scotia's vast forest cover creates a "noisy" appearance from the volume scattering which occurs amongst the canopy. Also seen in this imagery is the response of a variety of water sources like the Fundy bay, lakes, and Atlantic Ocean, which all appear extremely dark based on the specular reflection of calm water surface.

PROCEDURE

To start the project four raw SAR images needed to be imported into PIX file types. This was scripted using the import command in EASI and provided a text report with detailed information about the images, including extents and acquisition dates.

At this point OrthoEngine was used to orthorectify each image using Radar Toutin's Model and a projection of UTM Zone 20 NAD 83 CSRS98. As reference a 20m DEM was used for the control elevation (Z) while an altered National Hydrographic Network, showing only banks, was used for the Easting (X) and Northing (Y) values. In total 61 ground control points (GCPs) were collected and 12 control points (CPs). This equated to about 15 GCPs and 3 CPs per scene and connects a point in the image to a corresponding location on the reference vectors. Tie points were also selected to associate a shared location between images; because these points are shared only 15 TPs were collected but appear in each image about 6-10 times, depending on the image's overlap coverage. When the model was run a Radar Kuan Filter was selected as the resampling method to reduce the "noise" of the radar imagery, with a filter size of 3x3. Based on the imagery being a Standard 7 beam mode the Image Format's Power and the Number of Looks was set to 4. The resulting orthorectification is compared to the reference vectors in Figure 2.

The next step in preparing the 16-bit images for mosaic was to match the colour values. Histograms were outputted to a text file by an EASI script to view the distribution of DN values. Based on these another script was written where a select range of DN values were scaled to 0-255 in a new 8-bit channel. This occurred within each image's PIX file.The last preparation for the mosaic was to create an empty PIX file where the final results could be saved. EASI's GEOREP function provided the information necessary to determine the upper left and lower right most extents needed to house all four images; subsequently these values were used as parameters for CIMPRO, the function which creates a PIX file.

The MOSAIC function was used to add the first image to the new file, whereas each successive image had AUTOCUT performed before MOSAIC to trim the image along the overlap for optimal "blending" results. Afterwards the cutline vectors produced by autocut were imported to the mosaic pix file for one stop storage and are viewable in Figure 3. The final mosaic result was exported as a TIFF using the FEXPORT script command; this result produced the main image to the right, Figure 1.

Fig. 2 This image shows the National Hydrographic Network overlayed on the orthorectified SAR imagery

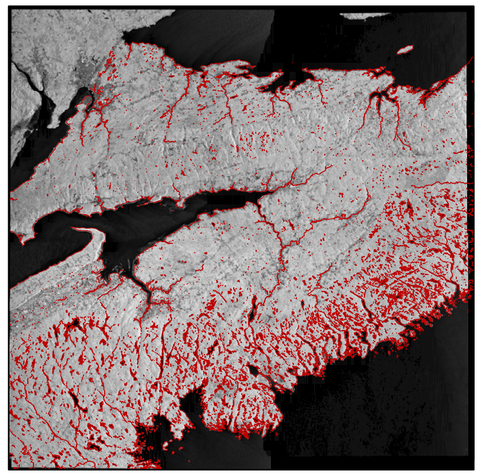
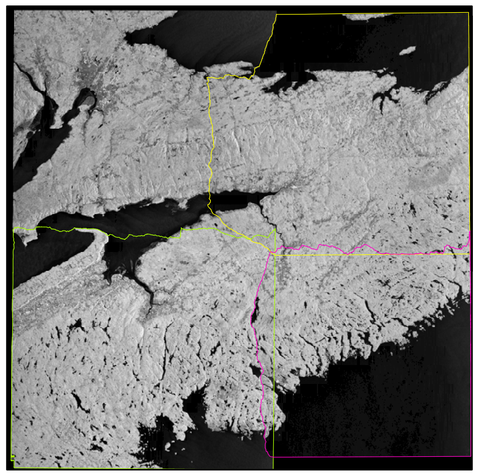


Fig. 3 This image displays the results of the AUTOCUT command, identifying each image's edge.



RESULTS

Overall the result of the orthorectification and mosaic are quite satisfactory. The RMS error for the GCPS fell below the maximum allowance of 25 m (pixel resolution of imagery) with an X RMS at 15.39 m and Y RMS at 16.07 m. Check points fared better with an X RMS of 10.96 m and Y RMS 14.34 m. A visual assessment of the mosaic procedure shows no obvious areas where cut lines exist and colour remains balanced amongst the four comprising images. The exception to this are larger bodies of water, like the Atlantic Ocean and the Northumberland Strait, which have distinctive cutlines from difference in tidal activity.

DATA SOURCES
Vectors derived from National Hyrdographic Network, "banks" feature class, http://www.geobase.ca
DEM Data from Canadian Digital Elevation Data, 1:50,000. http://www.geobase.ca
RADARSAT Imagery Copyright [1996] Canadian Space Agency

PCI Geomatica 2012's EASI and OrthoEngine for generating imagery and ESRI ArcMap 10.0 for poster design.
Microsoft Office 2012's Excel and Word for text and tables.

This map is produced as a portion of the requirements of the Geographic Sciences Program at the Centre of Geographic Sciences, NSCC, Lawrencetown, Nova Scotia.

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