Appendix C

Full Description of Steps to Acquire Programs, Convert Data, and Run the Terrcorr Terrain Correction Program.

Terrcorr Steps

1. Download the terrain correction program called "Terrcorr" form the Alaska SAR Facility (ASF). From the ASF main page

(http://www.asf.alaska.edu/step/intro/man/Terrcorr.html) click on the tools link, terrain correction link, and finally the Terrcorr link to the download page at http://www.asf.alaska.edu/step/intro/man/Terrcorr.html. The manual page for Terrcorr is at: http://www.images.alaska.edu/man/Terrcorr.html. All the programs from ASF and the LAS (step #5) site require a UNIX computer. (Our computer had problems running Terrcorr using the pre-compiled binaries, but after self-compiling the program ran well.)

a. Load the compressed source file into an empty directory. Terrcorr expands into over 350 files in 30 directories.

b. In the base directory created by the Terrcorr install, run the script called "config" (type "./config" at the command line). Answer the questions that are issued to allow the software to set itself up correctly for the subject system. Note: For SunOs users the GCC compiler must be used and not the standard compiler installed on the system.

c. Type "make" to start compilation. The programs are located in a directory below (not in) the asf_tools directory called "bin."

Download and run test data to make sure the program is operating correctly.
Our test data of the Fairbanks, Alaska area came from Dorothy Corbett
(dcorbett@asf.alaska.edu). This data should be available soon as a resource on the
Terrcorr web page.

3. The resolution of the DEM must be less than or equal to the resolution of the SAR data. The metadata reader available at ASF displays the SAR pixel size (http://www.asf.alaska.edu/step/intro/metadata/).

4. The SAR data should already be in UTM (Universal Transverse Mercator), and this is verifiable by the ASF metadata reader program. For this experiment, some data manipulation was required to prepare DEM for conversion into the LAS format.

a. The DEM was converted into UTM using ArcInfo.

The commands used were: project grid dem50k30 50k30utm # bilinear 30; output; projection utm; zone 58; parameters; end.

b. The DEM was converted into ASCII format in ArcInfo using the following command: gridascii 50k30utm 50k30utmascii.

c. All headers were removed.

d. The "no data" values in the DEM were changed from -9999 to 0 (zero).

5. The DEM must be in LAS format. The Land Analysis System (LAS) is an image analysis system designed to ingest, manipulate, and analyze digital image data and to provide the user with a wide spectrum of functions and statistical tools for image analysis. The website is located at

http://edcwww.cr.usgs.gov/programs/sddm/lasdist/.

a. To access the programs to download, you must first register.

Responses to a registration request take a week or so.

- b. LAS binaries require no recompilation.
- c. Make a directory for the LAS and TAE software in the home directory

(mkdir las72), and gunzip the tar/gzip compressed LAS and TAE packages.

gunzip -c ../las_72_sun_tar.gz|tar -xof gunzip -c ../taesun.tar.gz|tar -xof -.

d. Set up the environment variables needed by the software and run the lasinit routine.

setenv EDCSOFT \$HOME/las72 setenv TAE \$EDCSOFT/tae set reponse=las72 source \$EDCSOFT/env/las/assign/lasinit

e. Convert the DEM file with: makeing outfile.img 50k30demlas.img

4875 4244 (makeimg, name_of_output_image, name_of_DEM,

number_of_rows_in_DEM, number_of_columns_in_DEM).

6. A *.ddr file is the metadata companion to the LAS DEM. The LAS

conversion program made a *.ddr file, but all the fields were zero. The ASF makeddr

program was used to make a useful metadata *.ddr file. The command used was: makeddr 50k30demlas 4875 4244 2 UTM 58 -8572783.9698809 376926.96591685 -8719033.9698809 503246.96591685 30. The corners were calculated by multiplying the DEM cell size (30) to the total number of rows and columns and adding the results to the x and y of the lower left point of the DEM. The ASF program dspddr displays all the information in the *.ddr file.

7. In this experiment, Terrcorr was run with the following commands: Terrcorr - cf1 E219549658G1S005 [the SAR image] 50k30demlas2 [the DEM].

8. The final corrected image had "smearyness" on the mountain sides sloping away from the SAR beam. Normally this correction artifact is on the slopes facing the SAR beam. This raised concern about the accuracy of the correlation, a concern shared by Tom Logan from ASF, who speculated that the DEM might contain some inaccuracies. Terrcorr was re-run using the -1 flag in order to save intermediate files. For unknown reasons some of the needed files were still being deleted. Terrcorr was run again both with the "-1" flag and using the UNIX "link" command saving copies of the intermediate files into another directory (ln pE219549658G1S005 pE2.save).

The fsE219549658G1S005 (filtered simulated image) and the pE219549658G1S005 (preprocessed SAR image) images (which are created in an intermediate Terrcorr step) were compared in ENVI (a remote sensing image analysis program) using the offsets found in the coef.ppf file.

AZ1COEF	R 1 0.0
AZ2COEF	R 1 0.0
AZ3COEF	R 1 -59.782897 [the line offset]
GR1COEF	R 1 0.0
GR2COEF	R 1 0.0
GR3COEF	R 1 3.758089 [the sample offset]

The two images were still considerably offset from one another. The displacement

from the fsE219549658G1S005 (filtered simulated image) to the

pE219549658G1S005 (preprocessed SAR image) was calculated, and the offsets

were inserted into the coef.ppf file as follows:

AZ1COEF	R 1 0.0	
AZ2COEF	R 1 0.0	
AZ3COEF	R 1 -140.0	[line offset]
GR1COEF	R 1 0.0	
GR2COEF	R 1 0.0	
GR3COEF	R 1 6.0	[sample offset]

If there are any other numbers where 0.0 is displayed, they should be deleted. These numbers are for the 2-d planar warp map. When Terrcorr successfully correlates, it creates a 2-d planar warp map using many points across the image, fitting a function in range and a function in azimuth. The other numbers (AZ1, AZ2, GR1, and GR2) are no longer valid if the absolute offsets (AZ3, GR3) are changed.

Sargeom (which is one of the final steps in Terrcorr) was then invoked with the command: sargeom pDEM (the clipped DEM file) pE219549658G1S005 (the pre-processed SAR image) coef E21.corr4 (the output terrain corrected file). This step only took a few minutes to run and yielded the final image. Tom Logan (ASF) noted that the image was not a particularly "crisp" terrain correction, but was "fairly good" and much better than what the Terrcorr auto-correlation yielded.