EXAMINATION OF THE SRTM CORRELATION DATA FOR VEGETATION STRUCTURE ESTIMATION

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The Shuttle Radar Topography Mission (SRTM) flew for 10 days on the space shuttle in February 2000, and successfully accomplished a remarkable feat: it acquired Synthetic Aperture Radar (SAR) imagery that was used to produce a near-global, high-accuracy 30 meter pixel-spacing topographic map of the Earth. It was able to do this because SRTM operated as a single-pass interferometer: one C-band SAR was in the cargo bay of the Shuttle; while 60 meters away, attached to a retractable mast, was another C-band antenna that could receive SAR imagery as well. The complex imagery from each antenna was used to form an interferogram with a 60 m baseline. From this interferogram, the SRTM DEM was created. During the course of processing the interferometric data, several additional products were generated: the image (or radar brightness) data, a height error estimate, and the correlation (at various polarizations and incidence angles) between the images. These latter products comprise a unique and independent data set that have never been exploited.

The SRTM ground processing effort produced two correlation products: the total observed correlation γ_{obs}, and the volumetric correlation γ_{vol} (which was produced through estimation and then removal of geometric and systematic thermal noise terms). Both these correlation values are interleaved into the SRTM correlation product, and each may be independently retrieved. The volumetric correlation γ_{vol} is a function of the volumetric scattering of the radar waves, and is a result of scattering of radar signals from multiple heights within each resolution element.

Several previous studies have shown that the magnitude of the interferometric correlation has a well-defined relationship to vegetation structure (Treuhaft et al, 2002,2003,2004; Treuhaft and Siqueira, 2004). Unfortunately, for repeat-track systems, de-correlation associated with weather events and transitory changes in vegetated areas can overwhelm this signature, and prevents this technique from being successfully applied routinely to widely available repeat-pass Interferometric SAR (InSAR) data (Ahmed et al, 2008). However, since SRTM was a single-pass InSAR mission, the vegetation structure should be observable within the SRTM correlation data.

The accuracy by which vegetation structure may be estimated from the SRTM correlation is dependent on the following factors: 1) removing or ameliorating the impact of any systematic errors in the data, 2) the SRTM interferometric baseline, incidence angle, and polarization 3) the calibration of the correlation data, 4) how well the vegetation structure may be modeled, and 5) the extinction of the C-band radiation by the forest canopy.

The SRTM backscatter imagery and correlation imagery display a systematic error known as ‘scalloping’, which may be seen as roughly horizontally varying changes in brightness. The systematic variation in correlation magnitude observed in the data is approximately 1% peak to peak. Scalloping is widely known to be caused by estimation errors for the pointing of the azimuth beam determined from the Doppler centroid, when the SAR is operating in a 'burst' mode, as SRTM was (Hawkins and Vachon, 2003). Example data will be displayed and techniques to reduce the magnitude of these errors will be discussed and examined.

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