A Survey of Temporal Decorrelation from Spaceborne Repeat-pass SIR-C L-band InSAR Observations

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Abstract

The SIR-D/IA-L component of the NASA-Directed mission for measuring vegetation 3-D structure from space, consists of one out of four possible approaches. These are:

- Use of radar backscatter (single-pol, dual-pol, or quad-pol) to relate backscatter to biomass, in a manner that is consistent with methods used to achieve this relationship developed over the last two decades.
- Use of interferometric phase and a secondary source of bare earth elevation data (such as the National Elevation Dataset, NED).
- Use of interferometric correlation magnitude data generated from repeat-pass observations (single- or multi-baseline) for estimating the vegetation vertical structure.

- Use of PolInSAR (polarization interferometry) relative phase for determining the vertical extent of the canopy.

The work shown in this poster describes an ongoing effort to utilize repeat-pass InSAR observations from SIR-C to explore relationships between the different data types and their ability to estimate biomass. To this end, we have processed over one million (1,000,000) hectares of SIR-C repeat-pass L-band data from one-day repeat-pass SIR-C, which overflew the eastern coast of the United States in October of 1994. While this particular set of repeat-pass observations had baselines that varied from +/- 30 meters (translating into a vertical wavenumber of 0.006 rad/m; or ≤ 1 deg/m), thus making it difficult to convert interferometric phase into height, the data set is ideal for exploring the effect of temporal decorrelation on various parameterizations of vegetation height. A tandem InSAR mission would correct this problem, as would a more intensive reliance on interferometric phase.

This poster illustrates the results from these computations, and shows that the effect of temporal decorrelation is significant enough to provide the use of repeat-pass correlation magnitude only measurements for estimating vegetation vertical extent. A tandem InSAR mission would correct this problem, as would a more intensive reliance on interferometric phase.

The National Elevation Dataset (NED) subtracted from the SRTM derived DEM. Height differences on the order of 15 meters are seen, likely due to the presence of vegetation, or slight errors in the two datasets.

A large region of one-day repeat-pass SIR-C L-band data was processed for examining the effects of temporal decorrelation. The significant findings are:

1. The degree of the decorrelation is dependent on land cover type, and latitude, and is likely weather dependent.

2. The season (fall) that the observations took place may play a factor as well.

3. The temporal decorrelation does not significantly affect the phase information, but use of the correlation magnitude in estimation algorithms for vegetation structure may prove problematic.

4. There are clear wind signatures in the data, and where present, effect forests more than crops.

5. The cumulative distribution functions derived from the plots described above for the four different landcover types. Plot values are mean, median, and standard deviation. A large region of one-day repeat-pass SIR-C L-band data was processed for examining the effects of temporal decorrelation. The significant findings are:

Conclusions

1. The temporal decorrelation can be seen everywhere.

2. The degree of the decorrelation is dependent on land cover type, and latitude, and is likely weather dependent.

3. The temporal decorrelation does not significantly effect the phase information, but use of the correlation magnitude in estimation algorithms for vegetation structure may prove problematic.

4. The season (fall) that the observations took place may play a factor as well.

5. There are clear wind signatures in the data, and where present, effect forests more than crops.

6. Cumulative distribution curves were generated that can be used as a reference for a mission design that requires statistics on the probability of experiencing a certain degree of temporal decorrelation.