Interferometric Coherence analysis of wetlands: The Everglades (south Florida) as a case study

Sang−Wan Kim(1), Shimon Wdowinski(1), Falk Amelung(1), and Timothy H. Dixon(1)

(1) University of Miami, 4600 Rickenbacker Cswy, Miami, FL 33149, United States

Abstract

InSAR observations of wetlands reveal spatially detailed, quantitative images of water levels, capturing dynamic water level topography. These new observations are very useful for monitoring and managing wetland water resources, as well as detecting flow patterns in floodplains. In order to determine the best acquisition parameter for this new InSAR application, we obtained a variety of SAR data acquired over the south Florida wetlands. Most of the archived data (JERS−1, ERS−1/2, and ENVISAT) were acquired with standard acquisition parameters. However, more recent data (ENVISAT and RADARSAT−1) was ordered, specifically for this purpose, with various acquisition parameters. In this study, we measure and analyze coherence variations in southern Floridas wetlands according to satellite system, vegetation type, acquisition geometry and temporal conditions of interferometric pair. For evaluating optimal acquisition parameters we used the following SAR data: two adjacent JERS−1 tracks (463 and 464), two adjacent ERS tracks (240 and 011), Envisat (HH and VV polarization), and RADARSAT−1 images acquired from four different observation modes over south Florida. As south Florida wetlands are characterized by various vegetation type, we analyzed our data according to the five principal marsh communities: Cypress (type of tree), mixed shrub, sawgrass marsh, Mangrove swamp, and Graminoid prairie marsh. Based on the 1999 south Florida land cover map (distributed by the South Florida Water Management District), we selected small areas, which are representative of each of the wetland communities to perform our analysis. We also included other typical area types corresponding to agriculture, urban, and forests. For each such polygonal area we calculated the average interferometric coherence. Our preliminary results indicate that cypress wetlands have better coherence than herbaceous wetlands like sawgrass and cattail. This finding is consistent for all satellite systems (ERS, Envisat, RADARSAT−1, JERS−1). In mangrove marsh, RADARSAT−1 and JERS−1 show high coherent signal as much as in cypress, but ERS−1/2 shows a similar coherence with sawgrass. In the case of JERS−1 data, the coherences in wetlands are almost independent on temporal baseline (at least up to 3−year), while it is likely that they are relative to geometrical baseline. The C−band coherence in woody and herbaceous wetlands seems to gradually decrease according as the temporal baseline, but coherences in woody wetlands are also affected by seasonal change. JERS−1, RADARSAT−1, and Envisat pairs with HH polarization have much higher coherence than ERS−1/2 data. RADARSAT, Envisat, and ERS have C−band wavelength, while they have different polarization and/or resolution. Our study clearly indicates that HH polarization is more suitable to wetland InSAR application. In fact, reflection coefficients of trunks and ground surfaces (or water in wetlands) play an important role in the backscattering intensity of the double−bounce scattering mechanism. Usually, HH backscatter is four−six stronger than VV for the trunk−ground structure. Our results also show that RADARSAT−1 provides better results than ERS with respect to temporal decorrelation. In the case of fine beam RADARSAT−1 data, high coherence occurs even with large baseline (1~2 km).