



The UAVSAR Gulf Oil-Spill Campaign, 2010-2012

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The Campaign

In May 2010, as oil from the Deepwater-Horizon (DWH) rig blowout that occurred on April 20th continued to spread across the Gulf of Mexico and with the specter of widespread impact to sensitive ecosystems along large portions of the United States (U.S.) Gulf Coast looming large, the National Aeronautics and Space Administration (NASA) made the decision to deploy several of its newest, most technologically advanced, airborne science instruments to the area to support response activities and scientific studies of the oil slick and its impact to the region. One of these instruments was the Jet Propulsion Laboratory (JPL) Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), an L-band (23.8-cm wavelength) radar that has been operating since 2009 for Polarimetric SAR (POLARSAR) and Differential Radar Interferometry (DInSAR) studies supporting a wide variety of science and application disciplines. The goals of the Gulf Oil-Spill Campaign included characterizing oil in the slick in open waters; tracking oil ingress into coastal waterways and marshlands; monitoring impact and recovery of oil-affected wetlands; and understanding how the instrument could support emergency responders in future disasters. The campaign was started

with the intention of repeating the collections as necessary to track ecosystem recovery in the years following the spill. Now, 2 years after the disaster, NASA is still committed to these science goals, supporting yearly science flights over areas along the Louisiana and Mississippi coasts to monitor impact and recovery of wetlands most-heavily affected by the DWH spill. Pre-spill data over parts of the impacted area were acquired in 2009 and early 2010, extensive data were acquired in June 2010 during the spill, and post-spill, repeat-track data were acquired in June 2011 and July 2012.

Regional Coverage

The first deployment of the UAVSAR Gulf Oil-Spill Campaign took place on 22-23 June 2010, at a time when the DWH well remained uncapped and it was unknown how much of the Gulf Coastline would ultimately be affected by oil from the spill. The campaign was planned to image as much of the Gulf Coastline as possible to provide a baseline data set to compare post-oiling acquisitions in the most significantly-affected coastal areas of the U.S. In 2010, UAVSAR collected quad-polarization data along nearly 5,500 km of flight lines covering an area of ~120,000 km² (Figure 1a). Most of the U.S. Gulf of Mexico

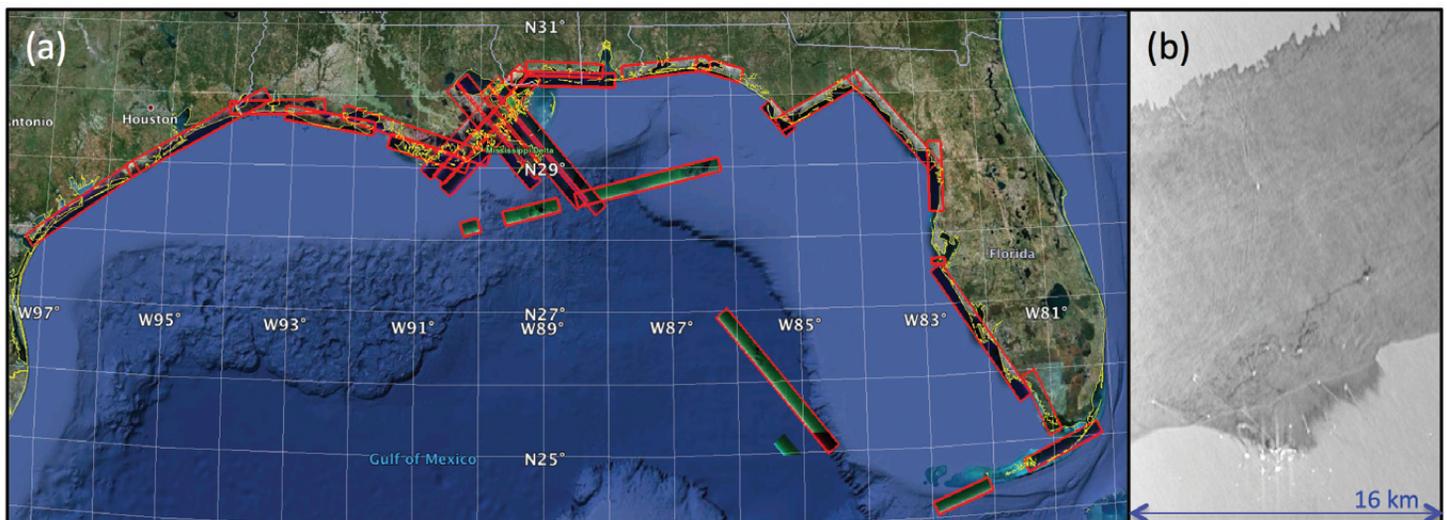


Figure 1: (a) Map of swaths in the Gulf of Mexico region imaged during the June 2010 deployment of the UAVSAR Gulf Oil-Spill Campaign for which POLARSAR data are archived at the ASF Distributed Active Archive Center (DAAC). (b) VV polarization intensity image of the main oil slick from UAVSAR line gulfc0_14010_10054_100_100623, acquired 23 June 2010. The DWH-rig site is near bottom center, distinguishable by the bright returns from many ships in the area.

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coastline, extending from the Florida Keys to Corpus Christi, Texas, was imaged, including extensive inland coverage of the southern Louisiana wetlands. Parts of the main slick that formed near the DWH-rig site (Figure 1b) and areas of the Gulf of Mexico extending from the rig site to the Louisiana coast and eastward to near Pensacola, Florida, were imaged in three flight lines. Most of the flight lines over Louisiana, Texas, and the Mississippi barrier islands were reacquired in June 2011 and July 2012. The anniversary collections match low-tide conditions and seasonal vegetation state in the heavily-impacted Barataria Bay, Louisiana. This body of data is available to researchers through the ASF DAAC.

Data Overview

Sample images from UAVSAR data collected along the Gulf Coast are shown in Figures 2 and 3. Figure 2 shows multipolarization images of Petit Bois Island, Mississippi, acquired in June 2010 and 2011, along UAVSAR flight line MSisIn_27105. UAVSAR-POLSAR data is available covering most of the barrier islands bordering the southern U.S. states. Figure 3a shows a multipolarization image of an area centered on Bay Jimmy to the northeast of Barataria Bay that contained oil-contaminated waters. A close-up of an island in the area (Figure 3b) shows reduced co-polarized returns along oiled shorelines, making these areas show up as green (HV dominant) in the image.

Two years after the first data in this campaign were collected, UAVSAR low-noise, fine spatial resolution (7-m multilooked products) and full polarization (HH, VV, and HV) capability enabled advances in oil-slick detection and characterization; oil extent mapping in coastal areas and ecosystem impact; and marine surveillance and applications of SAR for emergency response. The data collected in this campaign are of value both for studies specific to the oil spill, and as a baseline image set of the Gulf of Mexico region for future efforts to use UAVSAR data to study the ecology, geology, and anthropogenic changes in the area. To find additional articles on this topic, please visit <http://uavsar.jpl.nasa.gov/publications.html>.

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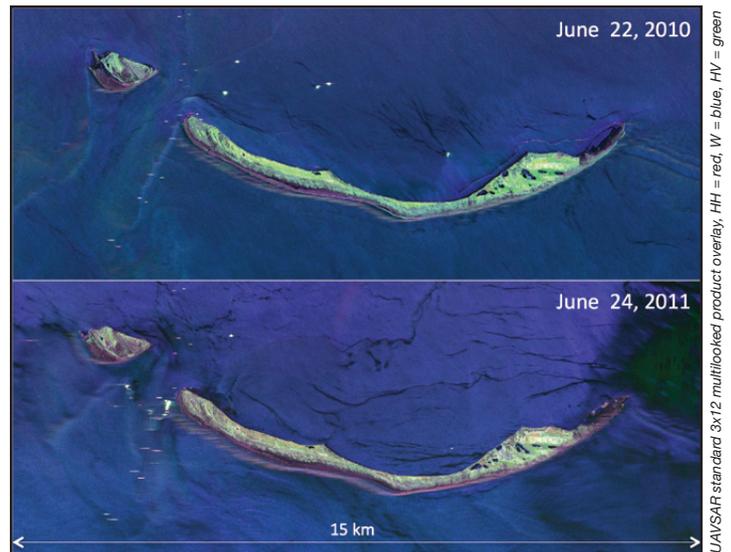


Figure 2: Multipolarization images of Petit Bois Island, a barrier island off the coast of Mississippi, collected during the DWH spill in June 2010 (top) and in June 2011 (bottom), 11 months after the well was capped. (HH = red, VV = blue, HV = green)

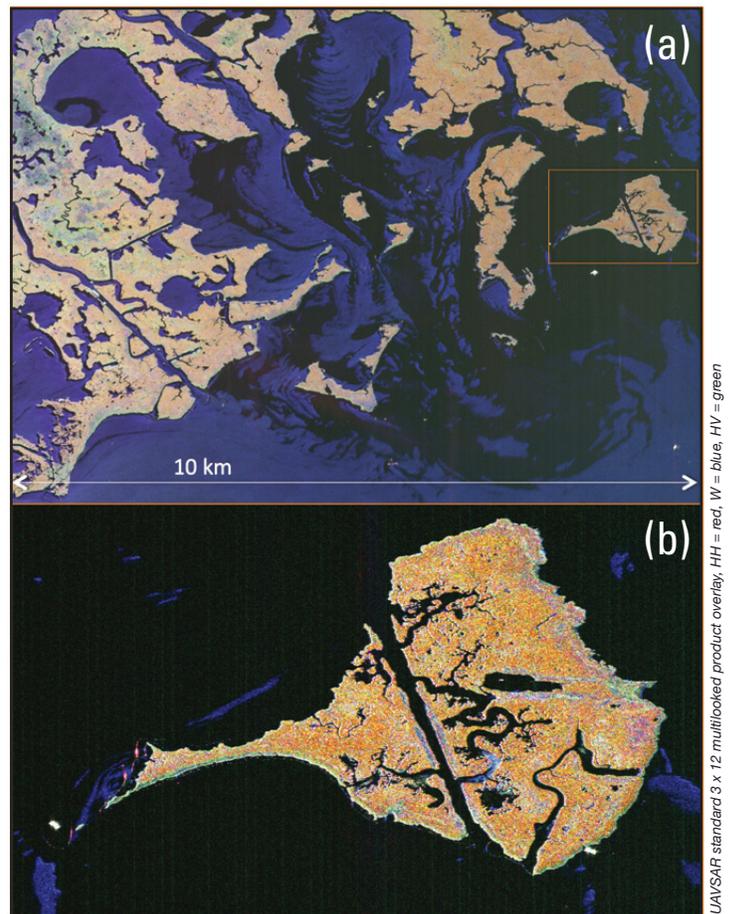


Figure 3: (a) Multipolarization image of a portion of UAVSAR flight line LAmrsh_22202_10054_002_100623 centered on the Bay Jimmy area directly northeast of Barataria Bay, Louisiana. The SAR data were acquired on 23 June 2010, while oil from the DWH spill remained in the local waters. In this image, the oil shows up as dark areas against the predominantly VV (blue) backscatter from the bay waters. (b) Close up of an island in the area with substantial oiling of the vegetation along the shorelines facing Barataria Bay, the direction from which tides brought oil into the area. (HH = red, VV = blue, HV = green)

Visualizing and Assessing Sea-Ice Motion Below the Continuum Scale

by Cathleen Geiger, Geography, University of Delaware; Gowri Somanath, Vincent Ly, Chandra Kambhamettu, and Mani Thomas, Computer and Information Services, University of Delaware; and Pablo Clemente-Colón, National/Naval Ice Center

Sea-ice cover in the Arctic is retreating and thinning as global temperatures continue to rise. The rise in temperature may eliminate Arctic sea ice during summer months creating the so-called ice-free summer condition. As the ice thins, its strength weakens. A weaker ice cover will encourage more shipping earlier in the spring and later into the fall, thereby, expanding access through polar seas much longer than ice-free periods. It is these ice-engaging activities that will push the Arctic frontier open for the most opportunistic. Hence, the need to not only monitor how much ice is melting, but how the remaining ice is behaving as a dynamic material under new climate conditions.

As a first order approximation, sea ice drifts about 10 km/day and generally follows the isobars of atmospheric pressure fields. These approximations are sufficient when estimating the general circulation of sea ice at scales of 100 km or more. But, to estimate the actual motion, one must track properties of sea ice directly. Since sea ice resides in darkness, roughly half the year, and beneath clouds and fog much of the remaining year, active- and passive-microwave sensors are needed to track ice motion over large areas at regular intervals. Using microwave-frequency instruments, correlation methods identify features in the texture of the ice based on backscatter properties. These methods have been applied to sea ice since the 1990s, with great success down to scales of about 5-10 km in the interior ice pack.

Discontinuities in the ice motion identify the hot spots of dynamic motion. In this context, these are important because they are the locations responsible for sea-ice thickness redistribution. These indicate where open water is exchanging heat between the ocean and atmosphere. The open-water passages provide easy access through pack ice. However, these same open-water areas can close as soon as the wind changes or the ice moves into new regions, constrained by land boundaries or rising sea-floor topography. Discontinuities also identify hazardous navigational areas and vulnerable infrastructure sites. Clearly, such issues require more than scientific inquiry and will need the integration of resources from academia, federal, and industrial partners. One effective approach is to develop new visualization tools at the logistical and tactical scale that track and monitor dynamic ice conditions that impact human activity.

During the International Polar Year, tools were developed to address some of the geophysical issues (Figure 4). These tools were tested in field studies in the spring of 2007 in the Beaufort Sea using RADARSAT-1 SAR-derived motion products. With results scientifically comparing well to 10-m resolution, telemetry-buoy arrays, the next obvious step is developing an open-source application that the National Ice Center can incorporate into their day-to-day operations to support ice charting, logistics, national security agencies and search-and-rescue operations in need of tactical decision-making tools (Figure 5). Some of these new developments are

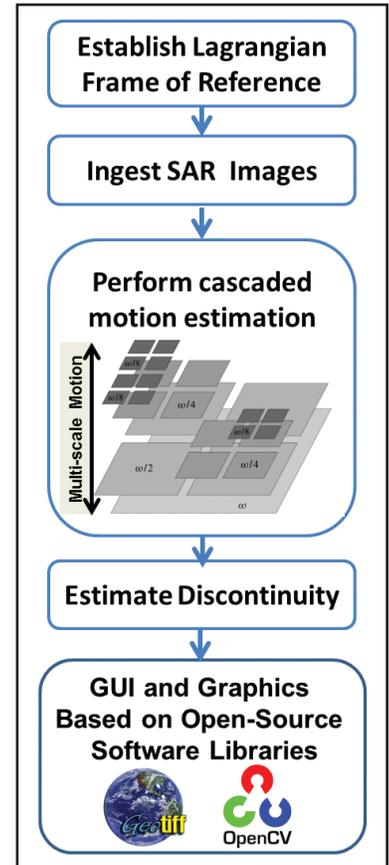


Figure 4: Overview of processing method.

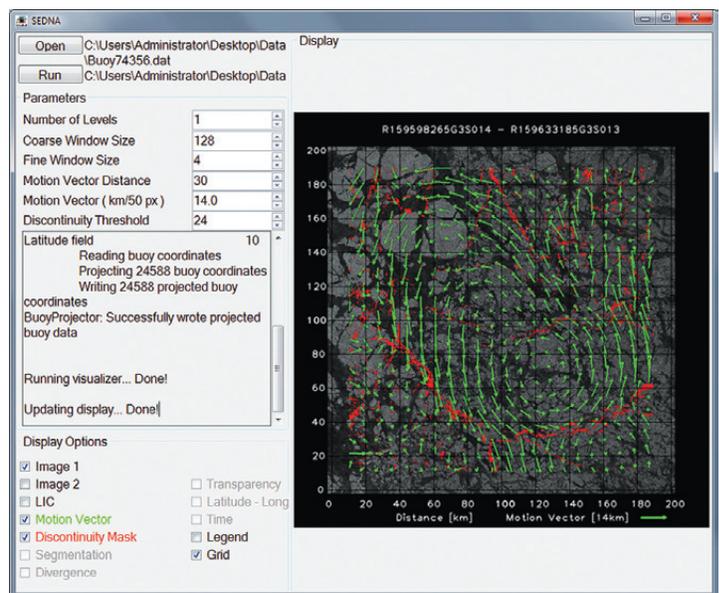


Figure 5: Overview of graphical-user interface and sample product.



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being supported by a Department of Defense and NASA-sponsored Arctic Collaborative Environment where open-source tools are shared among interdisciplinary groups. This collaborative environment is essential since no one group has the capacity to solve the enormous integrated set of problems faced as people try to understand, visualize, and operate in rapidly changing environmental conditions at high latitudes.

Because of these current and growing issues, the need exists to characterize not only the motion of ice, but also the uncertainties and scale of each resolved motion value. These two critical parameters of scale and uncertainty are essential to resolving the power-law relationships that connect cascading motion through deformation processes. More testing and development is needed and there are still many important details that need to be addressed before observed ice motion can be ingested into regional forecasts and global-climate models. Identification of discontinuities may prove to be a small, but critical part of what will be required for effective assimilation in support of these larger efforts.



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