Satellite Scatterometry: Winds, Vegetation, and Ice

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Abstract

Remote sensing is the study of the environment from a distance. Recent developments in satellite-based sensors and computer processing techniques offer unique perspectives of our planet. *Microwave remote sensing* includes active (radars) and passive (radiometers) sensors. This talk focuses on the applications of a class of active microwave remote sensors known as *scatterometers*. Satellite scatterometers have been built and flown by several nations including, the U.S., ESA, India, and China. W*ind scatterometers* are satellite radars designed to measure near-surface vector winds over the ocean. The scatterometer does not directly measure the wind. Rather, it measures the normalized radar backscatter (σ^o) of the surface. Then, from multiple σ^o measurements, the wind blowing over the ocean's surface is inferred. Scatterometer wind measurements have wide application in air-sea interaction and weather observation. Wind scatterometers typically operate at one of two bands, C (5.4 GHz) or Ku (13.4 GHz). Ku band is more sensitive to wind, but also to the adverse effects of rain. However, this sensitivity can be exploited to simultaneously estimate wind and rain.

Scatterometers also collect σ^o measurements over land and ice. While the low resolution (25 km) of the scatterometer measurements can limit their utility in land and ice studies, reconstruction processing enables the generation of enhanced resolution σ^o images from past and present scatterometers. Such enhanced resolution scatterometer images have been proven to be useful for high resolution wind/rain estimation as well as in a variety of studies of polar ice and tropical vegetation. In particular enhanced resolution scatterometer observations have been used over land to study deforestation of tropical rain forest and desertification. Over the glaciated regions of Greenland and Antarctica, the radar signal is very sensitive to melting conditions and can thus be used to global warming conditions. The contrast between ocean and ice scattering enables tracking of major Antarctic icebergs in all weather conditions. In this talk, a brief overview of scatterometer remote sensing is provided and a number of applications of microwave remote sensing are described.

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Dr. Long received the Ph.D. degree in Electrical Engineering from the University of Southern California early in 1989 after previously receiving the B.S. and M.S. degrees in Electrical Engineering at Brigham Young University in 1982 and 1983, respectively.

From 1983 through 1990 he was employed at NASA's Jet Propulsion Laboratory (JPL) in the Radar Science and Engineering Section. He was responsible for the design and development of the NASA Scatterometer (NSCAT) system to measure ocean surface winds from space. NSCAT successfully flew aboard Japanese ADEOS spacecraft in 1996. He was a Group Leader in the Radar Systems Engineering Group at JPL were he supervised work on the design and analysis of spaceborne scatterometer and SAR systems including NSCAT, SIR-C, and Magellan. He was the original Experiment Manager for SCANSCAT (now known as SeaWinds, it was first launched in 1999 on QuikSCAT, again in 2003 on ADEOS-II, and again as RapidScat on the International Space Station in 2014).

Since 1990 Dr. Long has been on the faculty of the Electrical and Computer Engineering department (www.ee.byu.edu) at Brigham Young University (www.byu.edu). He is full Professor who teaches radar, remote sensing, communications, and signal processing. He is the Director of the BYU Center for Remote Sensing and Head of the Microwave Earth Remote Sensing Laboratory (www.mers.byu.edu). Since 2012 has been an Associate Dean of the Ira A. Fulton College of Engineering and Technology (www.et.byu.edu).

Dr. Long has been the principal investigator for a continuing NASA-funded research projects in scatterometry, climate studies, rain observations, SAR, and the Scatterometer Climate Record Pathfinder (www.scp.byu.edu). He has had extensive experience in developing tower, aircraft, and spaceborne scatterometers and aircraft SAR systems. He has been a member of several NASA Science Teams including the Ocean Vector Winds Science Team (OVWST) and the Tropical Rain Mapping Mission (TRMM). His publication record includes over 118 journal papers and 300 conference papers. He has received several *NASA Award of Achievement* and *Team Recognition Awards*. His research interests include microwave remote sensing, spaceborne scatterometry, synthetic aperture radar, signal processing, polar ice, and mesoscale atmospheric dynamics. He is an associate editor for *IEEE Geoscience and Remote Sensing Letters*. He is a co-author of the textbook, F. Ulaby and D.G. Long, *Microwave Radar and Radiometric Remote Sensing*, ISBN: 978-0-472-11935-6, University of Michigan Press, Ann Arbor, Michigan, 2013, available through Artech House and Amazon.