FROM SCANSAR TO SWEEPSAR: EVOLVING TECHNOLOGY TO MEASURE EARTH'S CHANGING LANDSCAPE

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Earth scientists have often benefitted from synoptic views of Earth from space. Synthetic aperture radar (SAR) remote sensing is one powerful method to achieve wide area coverage from space for imaging dynamics of the oceans, ice sheets, and land surfaces. Scientists are often most interested in repeated observations with the shortest revisit time as possible, and given the broad applicability of SAR to science on all parts of the globe, they often insist on global coverage with fast revisit times. The broader the swath coverage of the SAR, the faster the revisit time of an orbiting SAR satellite can be, but for conventional "stripmode" SAR imaging, the practicalities of developing a spaceborne antenna limited the achievable swath – until Dick Moore came up with the idea of ScanSAR imaging, using an electronically scannable antenna to time-share between different beam pointing directions in elevation. ScanSAR was a technique that promised to allow a many-fold increase in swath width, and therefore many-fold shorter revisit time, at the expense of image resolution in one dimension.

ScanSAR was first implemented as an experimental mode on the NASA/JPL Shuttle Imaging Radar (SIR-C) which flew on two space shuttle missions in 1994. SIR-C was fully polarimetric at L-band and C-band wavelengths, and could be operated with both frequencies and various polarizations simultaneously in ScanSAR mode. SIR-C was followed to orbit shortly thereafter by Canada's Radarsat-1 mission, which began a new era of regular ScanSAR observations over years by Radarsat-1 and other international radar missions. The NASA/JPL Shuttle Radar Topography Mission was the first spaceborne radar interferometer to map Earth's topography, and ScanSAR was essential to allow the wide swath needed to view the accessible surface twice completely in an 11-day mission.

The loss of resolution and difficulties of radiometric balancing from one observation to the next in a particular beam has led technologists to devise new approaches to achieving wide swaths either without the radiometric difficulties or without loss of resolution, or both. The reverse-spotlight method known as "Terrain Observations by Progressive Scan" being implemented on the ESA Sentinel-1 radar satellite, and the scan-on-receive technique known in the US as "SweepSAR" being considered for proposed US and German SAR missions in the future, have been devised to achieve these objectives.

This paper will review the progression of technology from the original concept of ScanSAR to the impressive systems revolutionizing our understanding of Earth.

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