CHAPTER XVIII. DC-8 SAR

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A. INTRODUCTION

The objectives of the Synthetic Aperture Radar flights with the DC-8 NASA aircraft during WASHITA 94 were to extend the data collection window of the Shuttle mission and to provide at least one data collection flight concurrent with the Shuttle overpass. The measurement strategy was carried out with two principal goals; one to provide additional data over areas where detailed ground data have been taken for development and testing of radar scattering models and inversion algorithms, and two, to provide wall-to-wall coverage of the Little Washita Watershed to evaluate the capability of the synoptic processing mode for mapping soil moisture.

B. METHODS

Because of the high demand on the JPL DC-8 during the SIR-C/X-SAR mission, only two flight dates were scheduled for each mission. For the Chickasha site these two dates were the day before the first scheduled shuttle data take and the second was concurrent with the first shuttle data take.

To obtain the necessary spatial coverage, four flight lines to provide overlapping coverage of the entire Little Washita Basin were established. The general orientation of the flight lines was parallel to the ascending orbits. The general coverage is illustrated in Figure XVIII-1.

1. Instruments:

The radar system on board the NASA DC-8 was first installed in the airplane in l987. The current radar is a substantially upgraded version of the original L-band SAR that was destroyed in a fire in l985. The new NASA/JPL Airborne Imaging Radar system incorporates all the characteristics of the old system but also includes P-band and C-band channels. The new system is capable of producing fully polarimetric data from all three frequencies simultaneously, yielding twelve coherent, co-registered radar images of any target scene with approximately l0 m resolution. A comprehensive description of the radar and DC-8 capabilities is given in Table XVIII-1.

2. Data Processing:

A quick look L-band HH image is produced during the flight and this medium is used for cursory evaluation of the flight as well as for selecting what parts of the flight lines and target areas are to be processed. The data are processed at the JPL SAR processing facility. SAR processing is an expensive and time consuming procedure; consequently, we have not simply requested that all the data be processed.

3. Data form and calibration:

The standard AIRSAR frame product consists of sixteen-look (20 MHz) or eight-look (40 MHz) "polarization compressed" digital file for each frequency on a 2 Gbyte 8 mm tape cartridge. These data are then used as input to polarization synthesis software to create an image. There is also a synoptic product which consists of a floating point digital image file for each frequency. The synoptic image is good for large areas but is limited to single frequency and polarizations with a degraded spatial resolution of about 120m. In addition to the standard frame processing, we have requested the scattering matrix for each scene identified (not, however, the synoptic scenes). The standard frame processing provides an image of about 12 km in azimuth and 8 km in range with a spatial resolution of about 6 by 12m. Since l990, JPL is providing calibrated images for the standard products.

4. Flight dates:

Two flights were conducted for each Shuttle mission. In addition, we were fortunate to obtain two flights during the period following the aborted Shuttle launch in August. This was fortunate because of the extensive field data collection activities during that period. Table XVIII-2 lists the flight dates for l994.

Table XVIII-1. NASA/JPL Airborne Imaging Radar (SIR) parameters.

	L-Band	C-Band	P-Band
Frequency (Mhz)	1260-1237.5	5310-5287.5	450-427.5
Center Frequency (Mhz)	1248.75	5298.75	438.75
Wavelength (m)	0.2402	0.05662	0.6838
Pulse length (μ s)	11.25	11.25	11.25
Bandwidth (Mhz)	19	19	19
Chirp Rate (Mhz/s)	1.6	1.6	1.6
Peak Power (W)	6000	1000	1000
Ave. Power (W)	110	19	19
Antenna size (inches)	63 x 18	55 x 6.5	72 x 36
Az. 3dB Beamwidth (deg)	8	2.5	19
EL. 3dB Beamwidth (deg)	44	50	38
Nominal Gain (d3)	18.3	23.3	14.1
Nominal Altitude (ft)		15,000 to 40,000	
Nominal ground speed (kts)		500	
PRF/Polarization (Hz) (=1.36 or 0.68 x ground speed)		250 to 70	
Look Angle Range (deg)		30 to 70	
Caltone Frequency (Mhz)		21.796875	
Caltone Input Level (dBm)		-70	
Receiver Gain (d3)		30 to 56	
Digital Sampling Rate (Mhz)		45	
No. of Bits/Real Sample (no I and Q)			8
Tape Recorder Rate (Mbits/s)		80	

	L-Band	C-Band	P-Band
Tape Recorder Capacity (min/tape)		15	
Azimuth presum Factor		PRF/8	
Azimuth Pixel Spacing (m)		3.03 or 12.1	(1-look or 4-look)
Slant Range Pixel Spacing (m)		6.67	
Number of Looks		1 or 4	
Image size (1-look Complex) (pixels)		40750	
Data Modes		Dural or quad-pol one, two, or three frequencies	

Table XVIII-2. JPL AIRSAR flight dates.

Date	Aircraft Heading	Flight Lines
4/10/94	220°	4
4/12/94	220°	4
8/19/94	220°	4*
8/20/94	220°	4*
10/1/94	220°	4
10/2/94	220°	4

*Problem in navigation resulted in only the eastern half of the watershed being imaged.

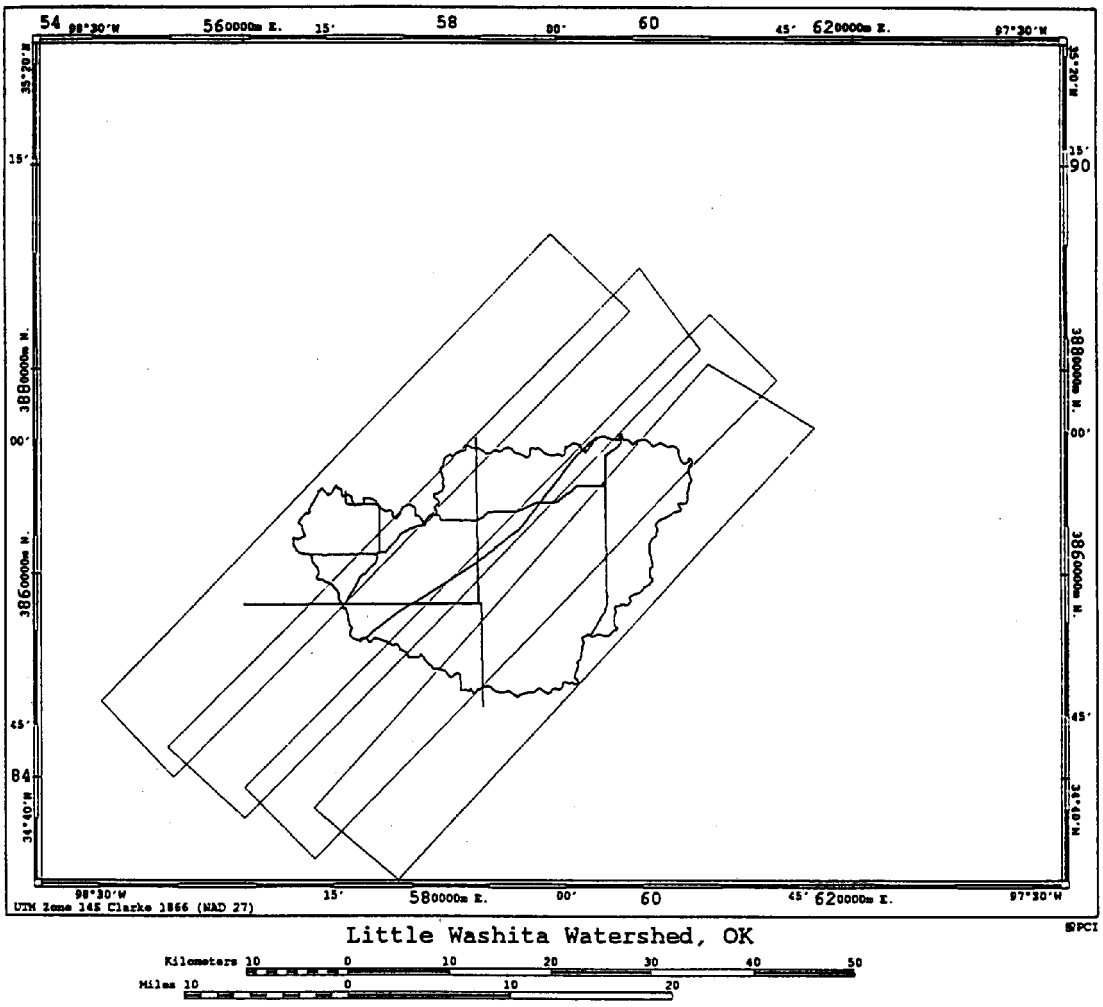

Figure XVII-1. JPL AIRSAR flight line and radar swath coverage.