First Generation Operational Modes for ARM Radars

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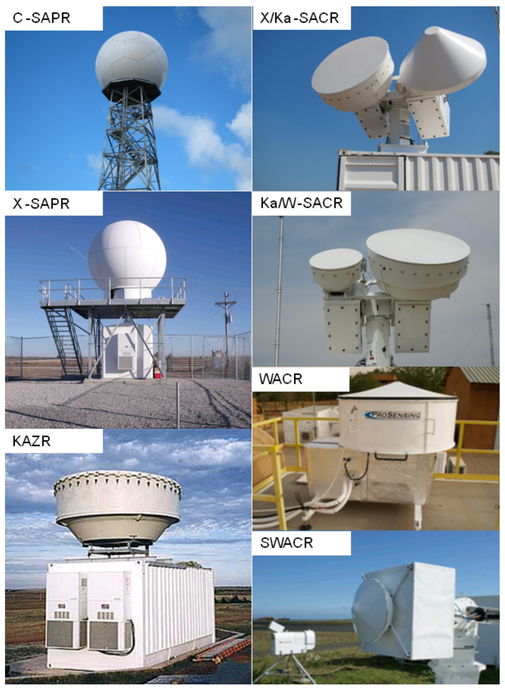
The ARM profiling radars have been used to observe cloud systems for over a decade. The cloud profiling radars have provided valuable data sets for the study of clouds. However, the profiling radars were limited to observing cloud properties in a vertical column. Recently, the ARM Climate Research Facility has added scanning cloud and precipitations radars to its facilities. The primary purpose of these radars is for the three-dimensional observation of clouds and spatial-temporal mapping of cloud properties. Cloud systems have been observed at various scales and differing structures. The cloud systems classification is used as a guide (to include the spatial scale and structure of the clouds) to facilitate the design radar scan strategies. The observation of cloud systems in three dimensions has not been done in a 24x7 operational environment. The first-generation scan strategy is aimed to meet a few base-level objectives of the ARM Facility. The data from the first generation will provide data to evaluate the sampling strategies for the scanning ARM cloud radars (SACRs) and scanning ARM precipitation radars (SAPRs). The first-generation operating modes will provide a framework to build long-term operational scanning modes that are tailored for each of the radar sites, which cover a wide range of climatic regimes.

1 ARM Radars

The ARM radars are deployed at four fixed sites and on two mobile facilities (AMF1 and AMF2) for regional climate studies. The four fixed sites are Southern Great Plains (SGP) in Oklahoma, North Slope of Alaska (NSA) in Barrow, Tropical Western Pacific (TWP) Darwin in Australia and TWP Manus Island in Papua New Guinea. These radars will be located with the baseline instrument suites at the ARM sites for comparative measurements.



Radar name	Description
X-SACR	Scanning ARM cloud radar at X-band (when deployed as standalone)
Ka-SACR	Scanning ARM cloud radar at Ka-band (when deployed as standalone)
W-SACR	Scanning ARM cloud radar at W-band (never deployed as standalone)
X/Ka-SACR	Dual frequency SACR with X-band and Ka-band on single pedestal
Ka/W-SACR	Dual frequency SACR with Ka-band and W-band on single pedestal
KAZR	Ka-band Zenith Pointing Radar
WACR	W-band ARM Cloud radar
SWACR	Scanning W-band ARM Cloud radar (WACR with pedestal)
X-SAPR	Scanning ARM precipitation radar at X-band
C-SAPR	Scanning ARM precipitation radar at C-band

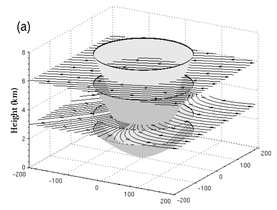
Parameter	C-SAPR	X-SAPR	W-SACR	Ka-SACR	X-SACR
Transmitter					
Type	Magnetron	Magnetron	EIKA	EIKA	TWTA
Center frequency (MHz)	6250	9450	93930	35290	9510
Peak power output (kW)	350	200	1.7	1.7	20
Duty cycle (%)	0.1	0.1	1.0	5.0	1.0
Max pulse width (μs)	2.0	2.0	1.5	13.0	40.0
Transmit polarization	H+V	H+V	H	H	H+V
Max PRF (kHz)	2.7	2.7	20.0	10.0	10.0
Antenna and Pedestal					
Antenna size (m)	4.27	2.4	0.9	1.82	1.82
3-dB Beam width (Deg)	0.90	1.00	0.30	0.33	1.20
Gain (dB)	45.1	45.0	54.5	53.5	42.3
Maximum scan rate (deg/s)	36.0	36.0	36.0	36.0	36.0
Receiver					
A/D (bits)	14	16	16	16	16
Receive polarization	H+V	H+V	H+V	H+V	H+V
Noise figure (dB)	2.8	3.0	6.0	5.0	4.5
Sampling rate (MHz)	40	80	120	120	120
Decimation factor	Adj	Adj	Adj	Adj	Adj
Video Bandwidth	Adj	Adj	Adj	Adj	Adj

H+V=Simultaneous horizontal and vertical polarization and H=Horizontal polarization

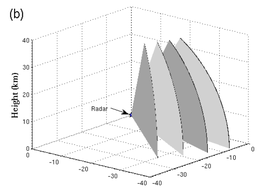
2 ARM Scan Nomenclature

- ❑ The radar controls are set to sweep the pencil beam in azimuth and elevation axis with either the azimuth or elevation fixed while scanning
- ❑ Scan segments setup based on targeted cloud properties retrievals

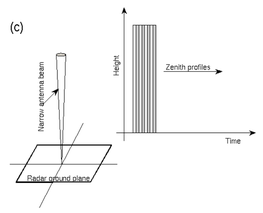
❑ PPI: Plan position indicator



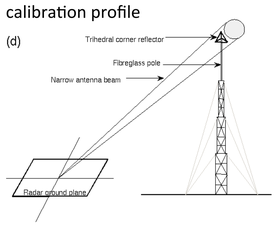
❑ RHI: Range height indicator



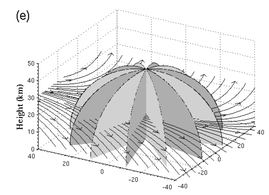
❑ VPT: Vertically pointing profile



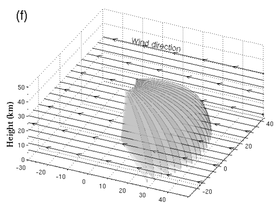
❑ CRCAL: Corner reflector calibration profile



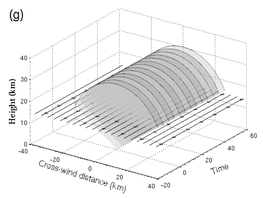
❑ HSRHI: Horizon-to-horizon range height indicator



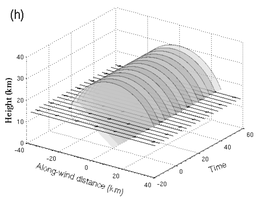
❑ BLRHI: Boundary layer range height indicator



❑ CWRHI: Cross-wind range height indicator



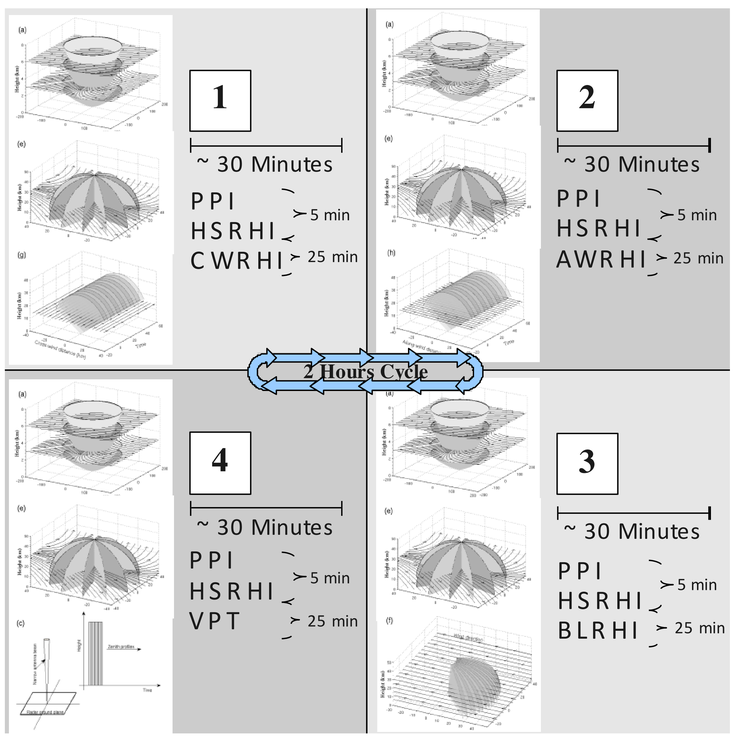
❑ AWRHI: Along-wind range height indicator



3 SACR Scan Strategy

- ❑ The profile integration time is set to sample at the beam-width of the antenna
- ❑ Cloud surveillance scans every 30 minutes: low level PPI sweep at 2 degree elevation and HSRHI scan
- ❑ The wind directions is preliminarily selected based on the climatology of the site
- ❑ Routine corner reflector calibration scan is planned and will become part of the scan pattern once the calibration procedure is verified
- ❑ Data files stored in one cycle (2 hours):

1) PPI : 4 files
2) HSRHI : 4 files
3) CWRHI : 2 files
4) ALRHI : 2 files
5) VPT : 1 file
6) BLRHI : 4 files

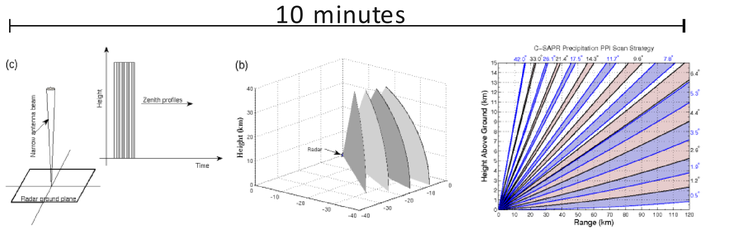


4 SAPR Scan Strategy

C-SAPR

- ❑ The profile integration time is set to sample at the beam-width of the antenna
- ❑ Data files stored in one cycle (10 minutes):

1) VPT (Bird bath): 1 file
2) RHI : 3 sweeps over KAZR, 1 file
3) PPI : 17 tilts, 1 file



❑ PPI: Bird bath; 360 degree sweeps at zenith

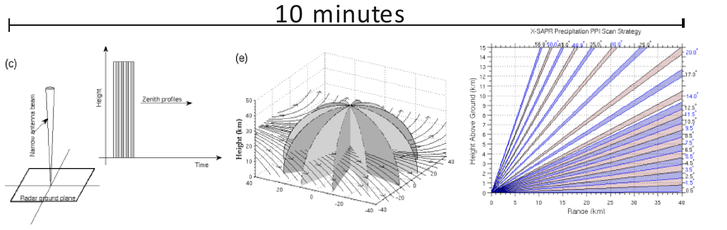
❑ RHI: Range height indicator ; sweeps over KAZR

❑ PPI: Plan position indicator

X-SAPR

- ❑ The profile integration time is set to sample at the beam-width of the antenna
- ❑ Data files stored in one cycle (10 minutes):

1) VPT (Bird bath): 1 file
2) HSRHI : sweeps over KAZR, 1 file
3) PPI : 23 tilts, 1 file



❑ PPI: Bird bath; 360 degree sweeps at zenith

❑ HSRHI: Horizon-to-horizon range height indicator; sweeps over KAZR

❑ PPI: Plan position indicator

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For operational information about ARM radars visit:
http://radar.arm.gov
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