

Mid-volume Rescan of Low-level Elevations (MRLE)

A New Approach to Enhance Sampling of Quasi-Linear Convective Systems (QLCSs)

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Joe N Chrisman
ROC Engineering
Joe.n.chrisman@noaa.gov

Operational Need

(From Ron Przybylinski)

- QLCS mesovortices develop quickly
- Most QLCS mesovortices form within the 1.25 to 2.5 km (4000 to 8000 ft) layer.
- When QLCS mesovortex genesis is close to the radar the genesis layer is not sampled by the 0.5 degree slice.
 - The 0.5 degree elevation slice provides velocity data at approx 2000 ft ARL at ~25nm range.
 - SAILS repeats the lowest scan and therefore is not helpful when looking for mesovortex genesis
- When QLCS mesovortex genesis is close to the radar (0 - 50 nm) having more frequent “elevated angles” are needed to give the forecaster more information from the mesovortex genesis region.

QLCS and WSR-88D History

- Initial concept for providing additional QLCS mesovortex genesis layer data was VCP Sequencing
 - Alternating full and abbreviated VCPs
 - Full VCP, Abrev VCP, Full VCP, Abrev VCP,
 - Complex implementation
 - Confusing operation
 - Would introduce a lot of risk

New Approach

- Mid-volume Rescan of Low-level Elevations (MRLE)
 - Leverage the success of the SAILS concept
 - Rescans multiple elevations (SAILS scans just 0.5°)
 - Lessons and code from SAILS implementation reduces risk

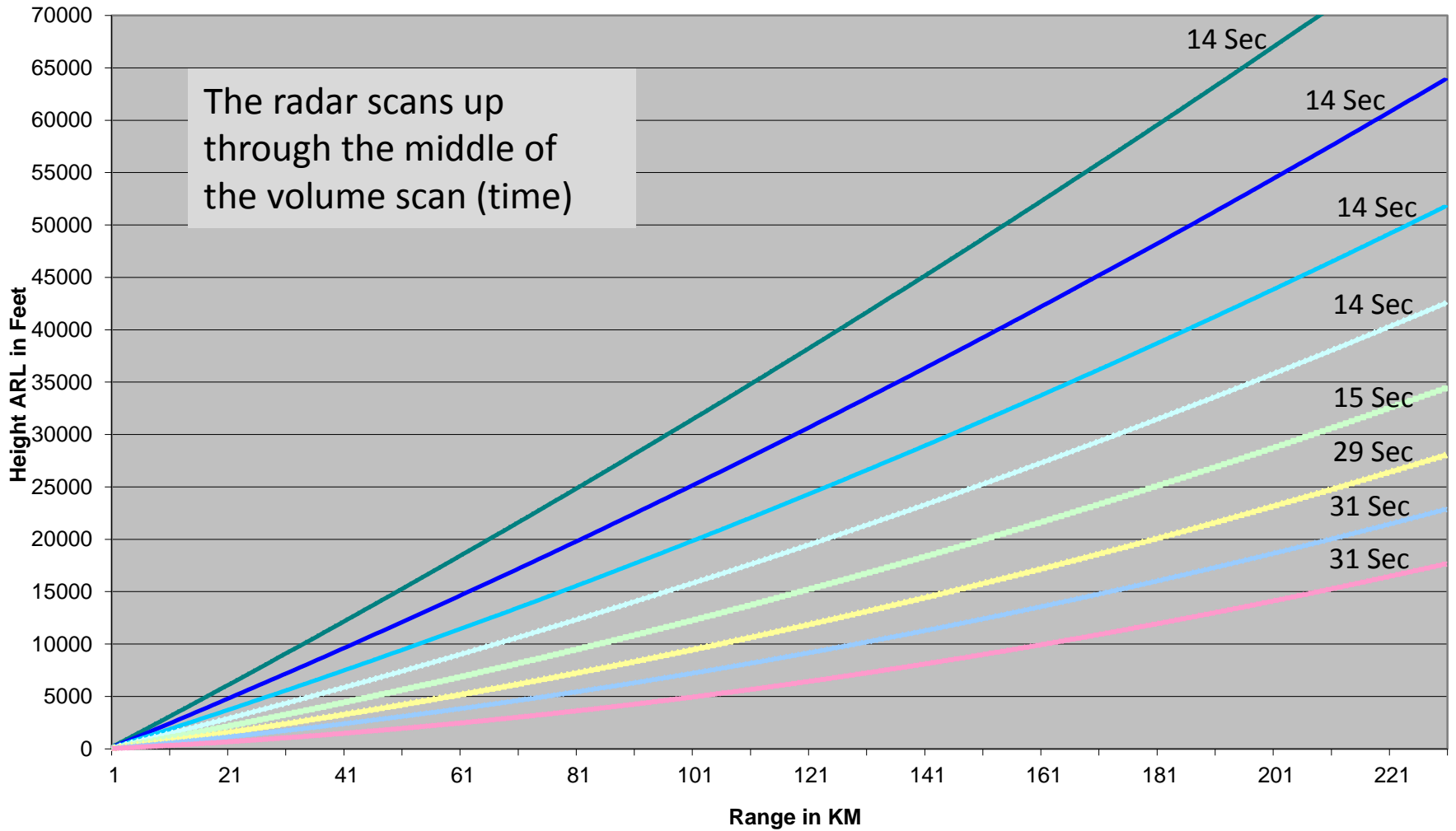
How Does Mid-Volume Rescan of Low-Level Elevations (MRLE) Work?

- MRLE: in the middle of a volume scan—rescan a selected number of sequential elevation angles
 - The “middle” is determined dynamically due to AVSET
 - The number of elevations selected by forecaster
 - The radar resumes normal completion of the volume scan after the rescan of the desired elevations
- MRLE is a variant of the proven SAILS concept

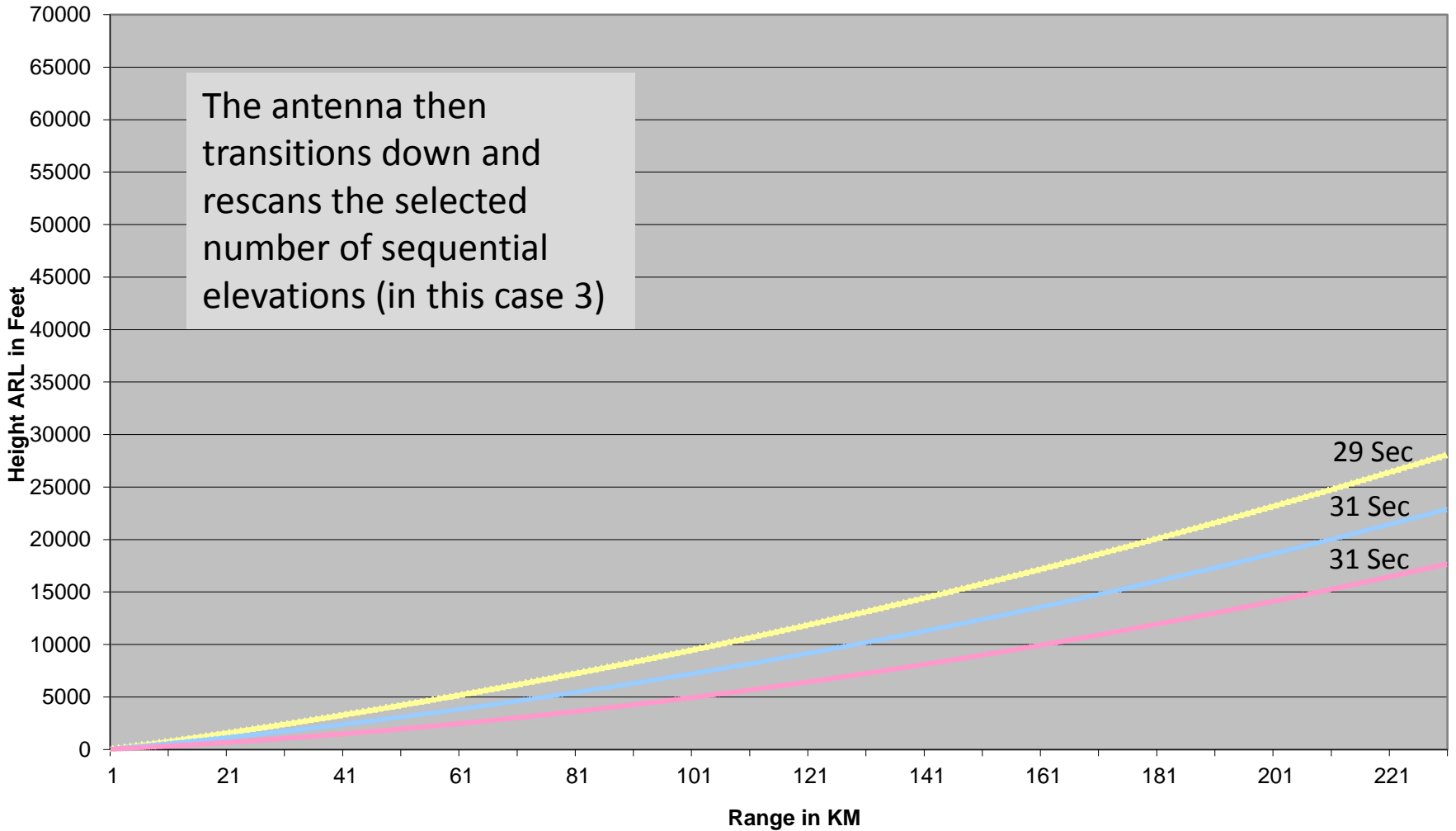
MRLE Example

- In the following example, the forecaster selected MRLE with 3 elevations
 - MRLEx3 = 0.5°, 0.9° and 1.3° elevations
 - VCP duration is equivalent to SAILSx3
- In this example AVSET is either OFF or there are radar returns close to the RADAR (termination angle is 19.5°)

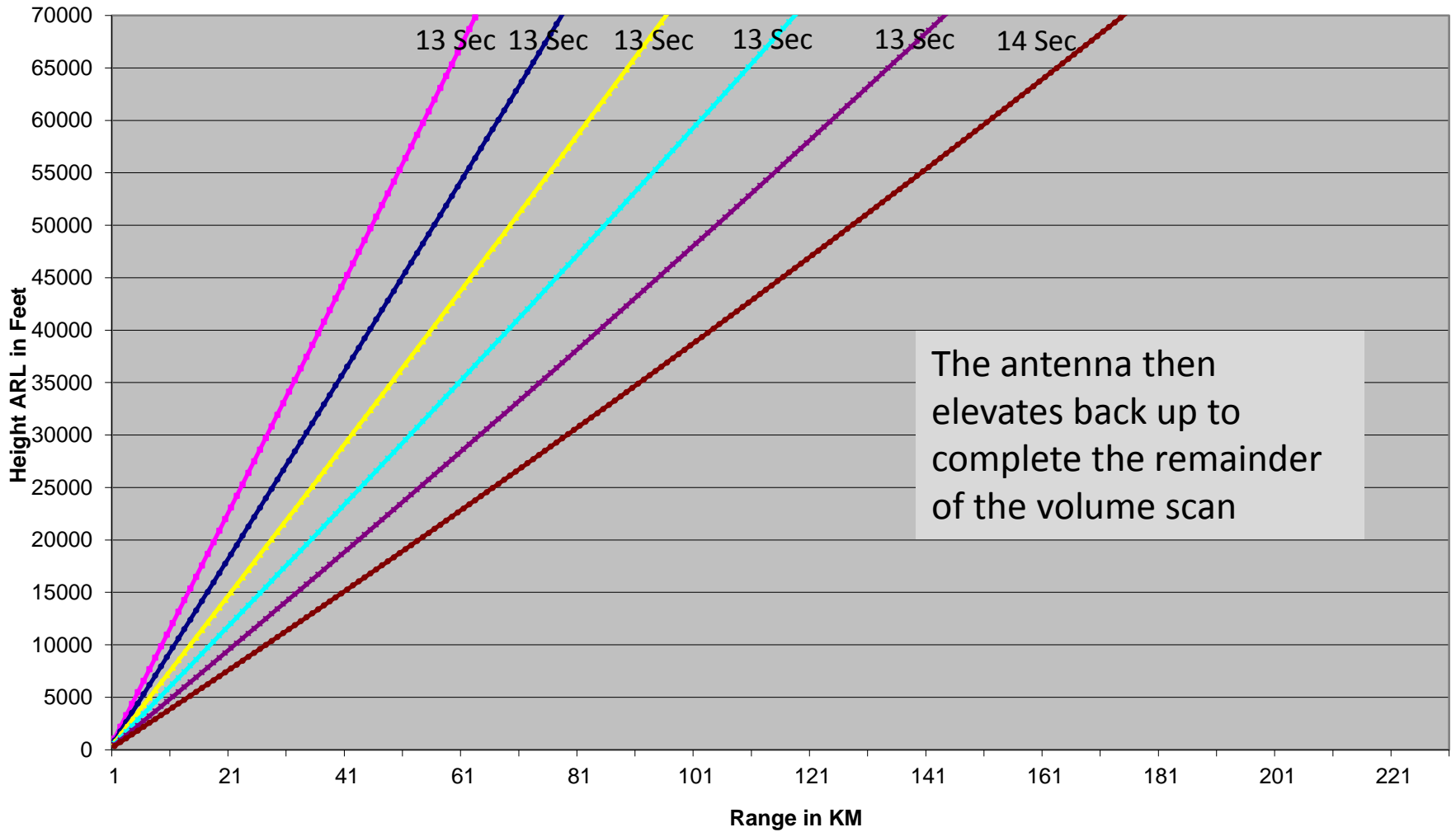
VCP 12 with MRLEx3
Termination angle of 19.5



VCP 12 with MRLEx3
Rescans lowest three elevations



VCP 12 with MRLEx3
Completes volume scan



VCP 12 with MRLEx3

VCP 12																			
VCP 12 with Mid-Volume Rescan of Low-Level Elevations (MRLE) - 3 Elevations (password VCP)																			
Elev	Wave Form	Surv PRF	Dop PRF	Surv Pulses per Second	Dop Pulses per Second	Surv Pulses per Sweep	Dop Pulses per Sweep	Surv Pulses per Radial	Dop Pulses per Radial	Rotation Rate (DPS)	RPM	Scan Time (Seconds)	SuperRes Est SD	Rmax (km)	Rmax (nm)	Vmax (m/s)	Vmax (kts)	Beam Hgt at Rmax (ft)	Cumulative Scan Time
0.5	CS	1		321.89		5400		15		21.459	3.58	17	1.53	466.00	251.46	8.05	15.64	59550	17
0.5	D		5		1013.51		14400		40	25.338	4.22	14	1.38	148.00	79.86	25.34	49.25	8898	32
0.9	CS	1		321.89		5400		15		21.459	3.58	17	1.53	466.00	251.46	8.05	15.64	70223	49
0.9	D		5		1013.51		14400		40	25.338	4.22	14	1.38	148.00	79.86	25.34	49.25	12288	65
1.3	CS	2		350.26		5400		15		23.351	3.89	15	1.53	428.25	231.09	8.76	17.02	70902	80
1.3	D		5		1013.51		14400		40	25.338	4.22	14	1.38	148.00	79.86	25.34	49.25	15677	96
1.8	B	3	5	389.36	1013.51	1080	10440	3	29	27.534	4.59	13	1.63	385.25	207.88	25.34	49.25	71282	111
2.4	B	4	5	446.43	1013.51	1080	10800	3	30	27.533	4.59	13	1.60	336.00	181.31	25.34	49.25	70185	125
3.1	B	5	5	512.8	1013.51	1080	10800	3	30	28.208	4.70	13	1.60	292.51	157.84	25.34	49.25	70105	139
4	B	6	5	602.41	1013.51	1080	10800	3	30	28.918	4.82	12	1.60	249.00	134.36	25.34	49.25	70179	152
5.1	B	7	5	719.39	1013.51	1080	11160	3	31	28.771	4.80	13	1.60	208.51	112.51	25.34	49.25	70062	166
0.5	CS	1		321.89		5400		15		21.459	3.58	17	1.53	466.00	251.46	8.05	15.64	59550	183
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0.9	D		5		1013.51		14400		40	25.338	4.22	14	1.38	148.00	79.86	25.34	49.25	12288	231
1.3	CS	2		350.26		5400		15		23.351	3.89	15	1.53	428.25	231.09	8.76	17.02	70902	248
1.3	D		5		1013.51		14400		40	25.338	4.22	14	1.38	148.00	79.86	25.34	49.25	15677	264
6.4	B	8	5	862.07	1013.51	1080	11520	3	32	28.528	4.75	13	1.60	174.00	93.89	25.34	49.25	70075	277
8	CD		6		1094.89		13680		38	28.813	4.80	12	1.42	137.00	73.93	27.37	53.21	66548	291
10	CD		7		1181.1		14400		40	29.528	4.92	12	1.32	127.00	68.53	29.53	57.40	75785	305
12.5	CD		8		1282.05		15840		44	29.138	4.86	12	1.32	117.00	63.13	32.05	62.30	85994	317
15.6	CD		8		1282.05		15840		44	29.138	4.86	12	1.32	117.00	63.13	32.05	62.30	106139	331
19.5	CD		8		1282.05		15840		44	29.138	4.86	12	1.32	117.00	63.13	32.05	62.30	131046	343

The Standard Deviation estimates derived from these calculations are meant ONLY as estimates to provide a quick overview of impacts that result from changes made to VCP definitions.

VCP 12 with MRLEx3 – AVSET

VCP - 12																			
VCP 12 with Mid-Volume Rescan of Low-Level Elevations (MRLE) - 3 Elevations and AVSET (Lowest Termination) (password VCP)																			
Elev	Wave Form	Surv PRF	Dop PRF	Surv Pulses per Second	Dop Pulses per Second	Surv Pulses per Sweep	Dop Pulses per Sweep	Surv Pulses per Radial	Dop Pulses per Radial	Rotation Rate (DPS)	RPM	Scan Time (Seconds)	SuperRes Est SD	Rmax (km)	Rmax (nm)	Vmax (m/s)	Vmax (kts)	Beam Hgt at Rmax (ft)	Cumulative Scan Time
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6.4	B	8	5	862.07	1013.51	1080	11520	3	32	28.528	4.75	13	1.60	174.00	93.89	25.34	49.25	70075	277

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Proposed MRLE Implementation

- Based on previous QLCS expert input we are limiting the rescanning elevations to 0.5° , 0.9° , 1.3° and 1.8° elevations (KLGX = 0.2° , 0.5° , 0.9° and 1.3°)
 - Forecaster option to select the desired number of elevations (e.g., 2, 3 or 4) similar to current SAILS implementation
 - MRLEx2 = 0.5° and 0.9° elevations
 - MRLEx3 = 0.5° , 0.9° and 1.3° elevations
 - MRLEx4 = 0.5° , 0.9° , 1.3° and 1.8° elevations
- NOTE: For a single elevation, invoke SAILS

MRLE Control HCI

Thursday May 26, 2016 12:32:48 UT

State: **OPERATE**
Oper: **ONLINE**

0.5 MRLE

Volume 7 (Seq: 7) Start: May 26, 2016 12:32:48 UT

RPG

RDA KCRI

Control

Alarms

Gen Off

Control

Products

Status

VCP: 212
AVSET: **ENABLED**
SAILS: **DISABLED**
MRLE: **ACTIVE/4**
PRF Mode: **MULTI-STORM**
Perf Check In: 137207h 48m

Mode Conflict: **NO**
Clear Air Switch: **AUTO**
Precip Switch: **AUTO**

Base Data Display
CLUTTER REGIONS
BYPASS MAP

MRLE Control

Close

MRLE Status: **ACTIVE**

MRLE Control

Select number of MRLE cuts for the next volume scan

0 2 3 4

Selecting "0" cuts will disable MRLE. Selecting 2 will rescan the lowest two elevations, 3 will rescan the lowest three elevations and 4 will rescan the lowest four elevations of the VCP.

Precip Status: **ACCUM**
VAD Update: **ON**
Model Update: **ON**
Super Res: **ENABLED**
CMD: **ENABLED**
Load Shed: **NORMAL**
RDA Messages: **ENABLED**
H Delta dBZ: **0.50 dB**
V Delta dBZ: **-2.25 dB**

Blockage Data Display
Miscellaneous

Feedback: May 26,16 [12:26:45] >> MRLE set to 4 cut(s)
Status: May 26,16 [12:32:21] >> Narrow Band line 6 has **CONNECT PENDING**
Alarms:

Proposed MRLE Implementation (Cont)

- Always rescan from 0.5 up through the selected elevation (repeating the lowest “n” elevations)
 - MRLE will provide information about severe weather signatures at or near the surface
 - MRLE will provide data from the QLCS mesovortex genesis region
- The four-elevation option results in volume scan completion time of ~15 seconds greater than SAILSx3 duration
 - Three elevations equivalent to SAILSx3
 - Two elevations equivalent to SAILSx2

SAILS, MRLE and AVSET

- SAILS, MRLE and AVSET are all independent functions
 - SAILS and MRLE CANNOT be used together
 - The software will automatically toggle one off when the other is commanded on
 - AVSET will operate with both SAILS and MRLE
 - MRLE will only be allowed for VCPs 12, 212, 215 and 35
- The operator may choose to invoke AVSET and either SAILS or MRLE functions

MRLE Elevation Data

- MRLE elevations will be tagged as supplemental elevations (similar to SAILS elevations)
- Level II data
 - Collected and distributed in the normal Level II data stream
 - Will not be sent to algorithms unless they are specifically configured via `task_attr_table` to receive that data.
- Level III Products
 - Base Products - DR (#94), DV (#99), SDR (#153), SDV (#154), and SDW (#155)
 - Dual Pol products DZD (#159), DCC (#161), DKD (#163), DHC (#165), MC (#166), SDC (#167), and SDP (#168)
- MRLE`x#` is expected to have virtually the same impact on resources as SAILS`x#`

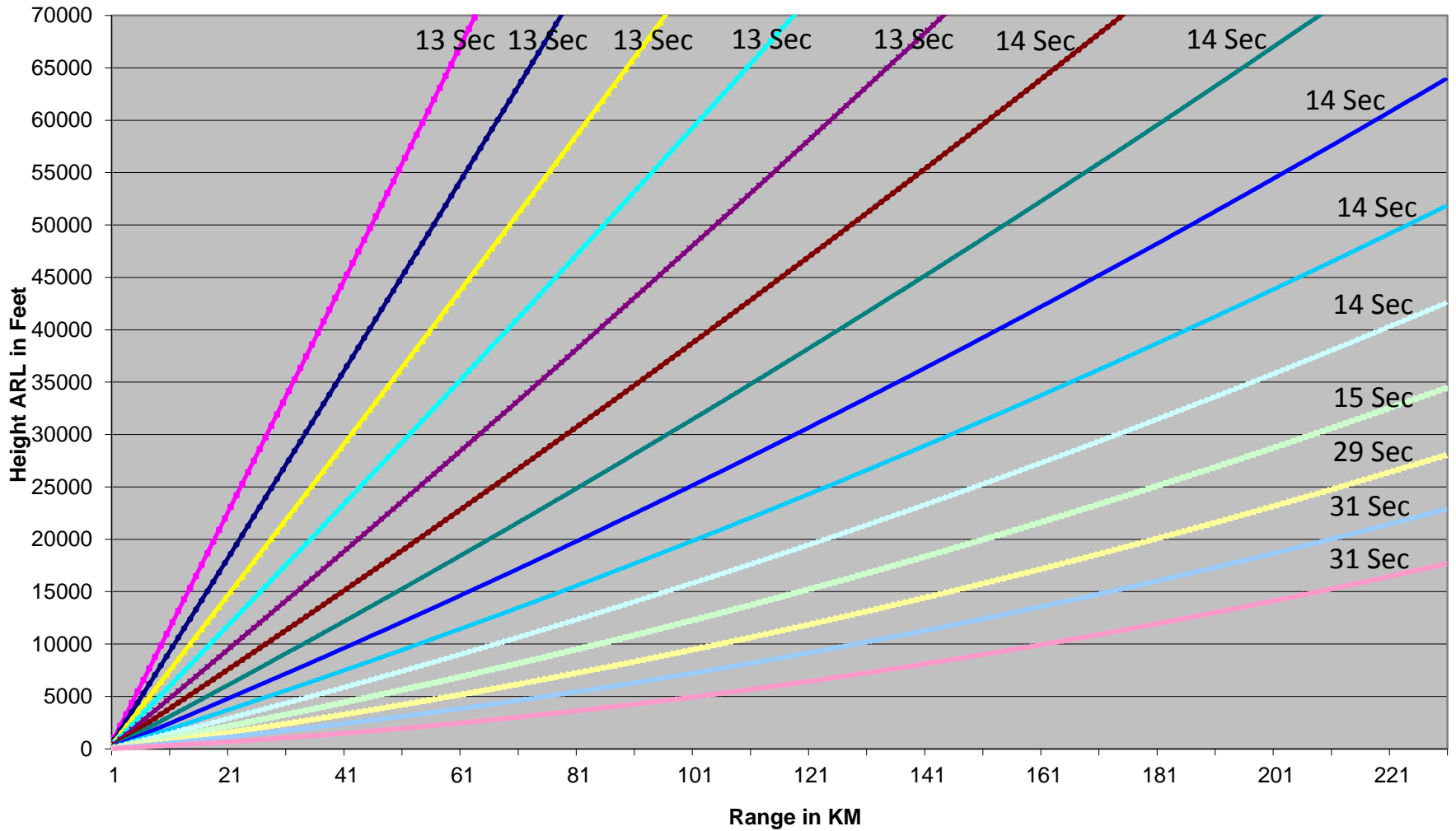
MRLE - Next Steps

- MRLE function included in RPG Build 18 as Non-Operational
- Once Build 18 RPG and RDA drops are available – collect MRLE data
 - Test algorithm performance
 - Ensure software behaves as expected
 - Ascertain/document problems, if any, with AWIPS, WARP, etc.,
- Possible Field Test after Build 18 deployed

Questions ?

BACKUP Slides

VCP 12
Completion Time ~ 180 to 250 Seconds



SAILS x3 with AVSET

Elevation Angles (VCP 12)	VCP 12 Elevation Duration	Term Angle 19.5	AVSET Term Angle 15.6	AVSET Term Angle 12.5	AVSET Term Angle 10.0	AVSET Term Angle 8.0	AVSET Term Angle 6.4
0.5°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.9°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.5°				31 Sec	31 Sec	31 Sec	31 Sec
1.3°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.5°		31 Sec	31 Sec				
1.8°	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec
0.5°				31 Sec	31 Sec	31 Sec	31 Sec
2.4°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
3.1°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°			31 Sec				31 Sec
4.0°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°		31 Sec				31 Sec	
5.1°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°				31 Sec	31 Sec		
6.4°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°			31 Sec				
8.0°	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec	
0.5°		31 Sec					
10.0°	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec		
12.5°	13 Sec	13 Sec	13 Sec	13 Sec			
15.6°	13 Sec	13 Sec	13 Sec				
19.5°	13 Sec	13 Sec					
Duration	243 Sec	336 Sec	323 Sec	310 Sec	297 Sec	284 Sec	271 Sec
0.5 Elevation Update Times	243 Sec	93 Sec, 88 Sec, 72 Sec and 93 Sec*	93 Sec, 74 Sec, 73 Sec and 93 Sec*	62 Sec, 77 Sec, 87 Sec and 94 Sec*	62 Sec, 77 Sec, 87 Sec and 81 Sec*	62 Sec, 77 Sec, 73 Sec and 82 Sec*	62 Sec, 77 Sec, 59 Sec and 83 Sec*
		Avg 89 Sec	Avg 86 Sec	Avg 83 Sec	Avg 79 Sec	Avg 76 Sec	Avg 73 Sec

* 10 Seconds Added to Account for Retrace Time. Avg estimate includes 10 additional seconds to account for elevation transition time