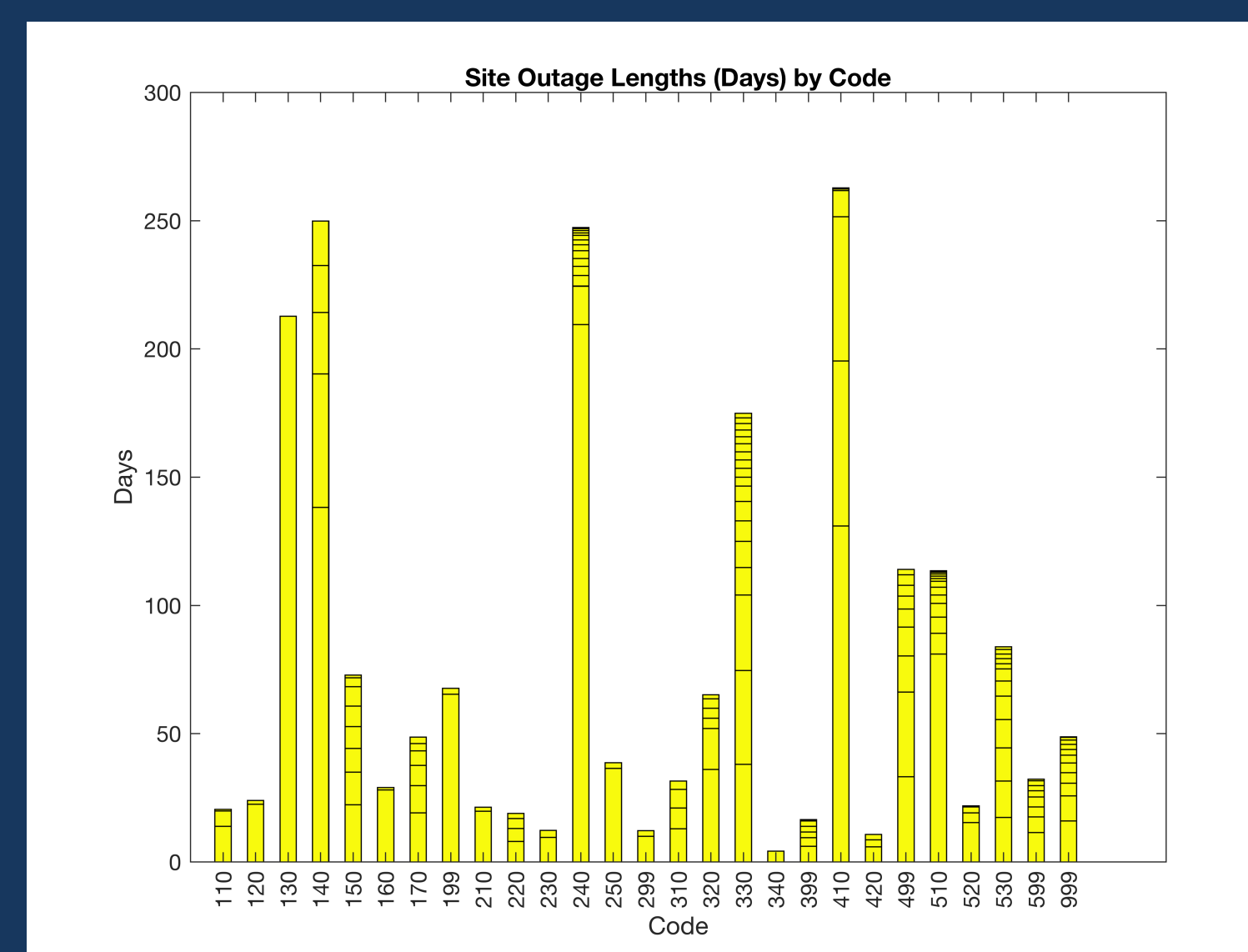# A Study of HF Radar Outages in the Mid-Atlantic

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Database records of 157 Mid-Atlantic and North Carolina HF radar station data outages have been analyzed and each outage characterized by failure type. Power and communication failures were most common followed by hardware failures and then computer/software-related failures. This type of documentation effort can provide insights which may guide operations and maintenance efforts to minimize site downtime. The present analysis could be expanded in the future using information collected by a newly launched U.S. National Network outage database.

Operations & Maintenance Considerations

- Ground fault/breaker trips: Simplify wiring if possible. Install GFI where necessary and consider "grade" of GFI. Weatherproof electronics as needed. Replace GFI if tripped more than once. Avoid multiple in-line GFI's.

- UPS does not turn on after power failure: Review the UPS switch to battery settings and diagnostics. Arrange for remote power cycle?

- In four cases, someone at the site had unplugged/turned off power. If the equipment is located in an area where others work, alert staff and use "Do not unplug." and "Do not turn off." labels.

- Simplify routing/network configuration as much as possible.

- If there are multiple failures at one site, revisit potential options for communication.

- Upgrade router/modem periodically.

- Cables: Protect cables in an appropriate way (bury for high traffic areas, above ground conduit for protection in remote areas, perhaps clearly mark cables in some cases). Alert on-site staff to presence of cables to help avoid accidental cuts.

- GPS: Corrosion of Trimble bullets often starts near the O-ring. Add sealant where the base meets the housing. Keep spare Trimble bullets on hand. Antcom antenna may be an option although it is more expensive.

- Radar Equipment: Use IOOS equipment loans or have spare equipment on hand.

See the Receiver Troubleshooting Guide posted on ROWG's website that addresses loss of receiver connection and settings. (This is a working document compiled at ODU and written with input from CODAR support; it can be updated as needed.)

Code	Description	Count	Length (days)
100	**Hardware**	**29**	**725.1**
110	Transmitter	3	20.5
120	Receiver	2	23.9
130	Transmit Antenna	1	212.7
140	Receive or Combination Antenna	5	249.8
150	Cable	8	72.8
160	Enclosure/Climate Control	2	29
170	GPS	6	48.7
199	Other	2	67.7
200	**Computer/Software**	**25**	**350.8**
210	Computer Hardware Failure	2	21.4
220	Operating System Crash	4	18.9
230	Software Program/Processing Failure	2	12.3
240	Communication to Receiver/Transmitter Lost	13	247.3
250	Disk Space Full	2	38.7
299	Other	2	12.2
300	**Communications**	**37**	**292.2**
310	Service Provider Outage	5	31.5
320	Hardware Failure (Modem,Router, etc)	6	65.1
330	Local Network Configuration	18	174.9
340	National Network Portal or Node	1	4.2
399	Other	7	16.5
400	**Site Operation and Maintenance**	**18**	**387.5**
410	Routine/Preventative Maintenance	6	262.8
420	Incorrect User-Defined Operational Settings	3	10.7
430	Incorrect Hardware/Cable Configuration	0	0
440	Radio Frequency	0	0
499	Other	9	114
500	**Power**	**37**	**251.4**
510	Service Provider Outage	13	113.5
520	Hardware Failure (UPS, Power Switch,…)	4	21.8
530	Circuit or Ground Fault Trip	12	83.9
599	Other	8	32.2
999	**Unknown**	**11**	**48.8**

Summary of outage codes. Each outage is assigned one code that identifies the cause of the outage. When there are multiple causes, the code is assigned based on the failure that results in the most downtime. Major category codes (100, 200, etc) were assigned by operators. The author assigned subcategories based on operator notes. The values associated with major categories above represent the sum of subcategory values.

Site downtime grouped by outage cause code. Each box within a bar represents an individual outage incident.

Tag	Description	Count
W	Weather / Environmental	10
LO	Land Owner / Property	11
V	Vandalism	NA
A	Animal	NA
LPA	Limited Personnel Availability	NA
LSA	Limited Site Access	NA
RMA	Radar Manufacturer RMA	3
RI	Radio Interference	1
MF	Multiple Failures	13

The tags listed above are used to track some of the additional factors that affect outage cause and station downtime. Outages can be assigned multiple tags. This tagging system was not in use when the outages were originally reported. It was possible to tag some outages based on operator notes after the fact. "NA" indicates that information is not available to provide counts at this time.

"Repeat Offenders"

Site	Code	Count
WOOD	240	5
NANT	330	3
NAUS*	499	3
BLCK	510	4
SUNS	530	3
SUNS	510	3

Stations with more than 2 incidents of the same type of outage. *NAUS codes are associated with a recurring HAM radio event.

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