MEOSAR Performance and Moving Beacons

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Introduction

- Suspect Alerts
- MEOLUT Accuracy
  - EOC vs IOC
- Moving Beacons
- Composite vs elementals
- Improving Performance
  - MEOLUT Upgrades
  - Phased Array MEOLUT
  - Commissioning Other MCCs
- Future Work
  - UAVs
  - Buoys
  - Networking

Suspect Alerts

- MEOLUT vendor identified one fix and implemented in Spring 2018
- Approximately 2 “suspect” alerts are being distributed daily to RCCs, down from 5 per day
- Other ideas for reducing the amount of suspect alerts have been considered but at this time, the rate seems manageable.

MEOLUT Accuracy

- On 13 December 2016 the Cospas-Sarsat system entered the Early Operational Capability (EOC) for the MEOSAR System

- The MEOLUT location accuracy requirements for EOC are:
  - Single burst: 70% within 5 km; and 90% within 10 km
  - Multiple burst: 95% < 5 km and 98% < 10 km, within 20 minutes

- Location accuracy requirements for Initial Operational Capability/ Full Operational Capability (IOC/FOC:
  - Single burst: 90% within 5 km (no 10 km criteria)
  - Multiple burst: 95% < 5 km and 98% < 10 km, within 10 minutes
  - Slow Moving beacons (0.5 to 10 m/s):
    - Single burst: 70% within 10 km, 95% within 20km
    - Multiple burst: 75% within 5 km, 95% within 7 km, within 10 minutes

- The US MEOLUTs are currently meeting the EOC location accuracy requirements and in most cases the IOC/FOC requirements for static beacons

Moving Beacons

- Based on real-world cases, tests and analysis, location accuracy is degraded for beacons that are moving. How degraded?
- The issue is acknowledged and the international community has agreed it must be addressed before moving to IOC
- The USA SARSAT Program, has been actively studying the issue and ways to mitigate it.
- NASA SARLAB has conducted various moving beacon tests using UAVs as platforms.
- Engaged with the MEOLUT vendor and consultants on different algorithms that can be employed
- International Partners have done a great deal of work as well on the issue

Improvements in Performance

- Recent upgrade to FL MEOLUT to process Second Generation Beacons has also led to improvement in First Generation Beacon detection and location accuracy. HI MEOLUT to receive upgrade in the next two weeks.
- Aging LEOLUTs were replaced with LEO/MEOLUTs to provide additional MEOSAR data when not tracking LEOSAR satellites
- NOAA contracted with AGI and Orbit Logic to provide scheduling software that maximizes coverage of the US AOR. The USMCC is completing the project to generate and send integrated tracking schedules to the MEOLUTs
- The MEOLUT contractor has committed to meeting more stringent Time of Arrival / Frequency of Arrival (TOA/FOA) measurement accuracy requirements.
- NOAA has contracted for acquisition of a new phased array MEOLUT to be installed at Holloman AFB, New Mexico in April 2020
- USMCC working diligently to get other MCCs commissioned as “LGM” or LEO/GEO/MEO, so that they can send MEO data operationally.

Additional Future Improvements

- The MEOLUT contractor will implement updated location algorithms to better address moving beacons and meet the IOC/FOC requirements
- Canada will be installing phased array MEOLUTs from the same vendor. There is a bilateral working group established to harmonize designs and eventually network MEOLUT data
- When Australia MCC (AUMCC) is LGM commissioned, data can be networked from the Australian and New Zealand MEOLUTs.
- NOAA is in discussions with the National Data Buoy Center to deploy reference beacons on buoys to gauge system performance and provide reference / calibration data.
- And… Second Generation Beacons

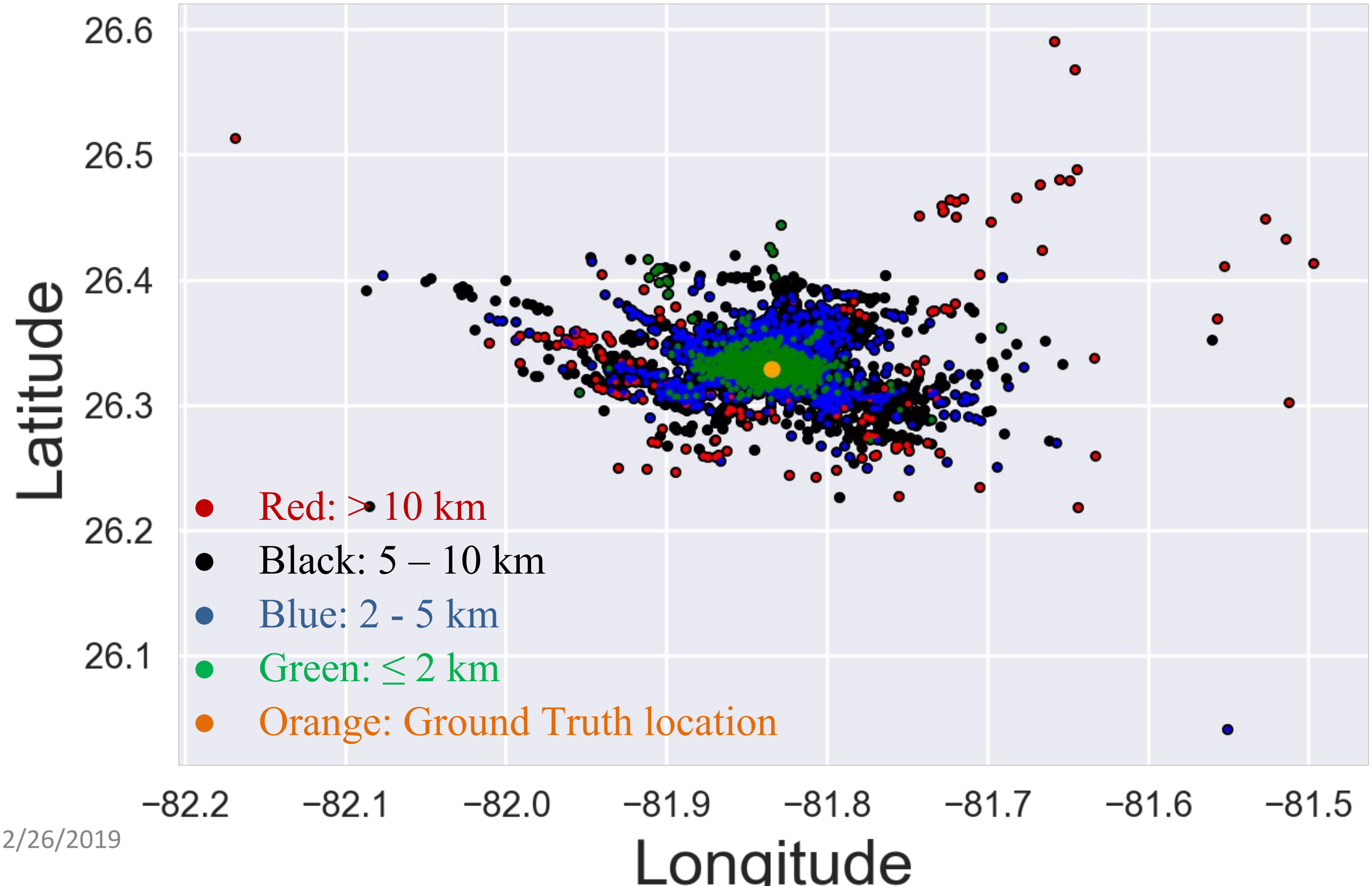
Composite versus Elemental Solutions

- The USMCC generates and updates a confirmed or composite location for each site, when corroborating data has been received. In LEOSAR era, this was referred to as a “resolved” location.
- RCCs receive this composite (when available) but will also receive “elemental” locations at times. There are various criteria that result in the MCC sending an updated location containing elementals.
- At times these elementals may be less accurate due to the timing of when they are sent

Supplemental Slides

Machine Learning

Classifying MEOLUT solutions of a real SAR case using a Random Forest Classifier

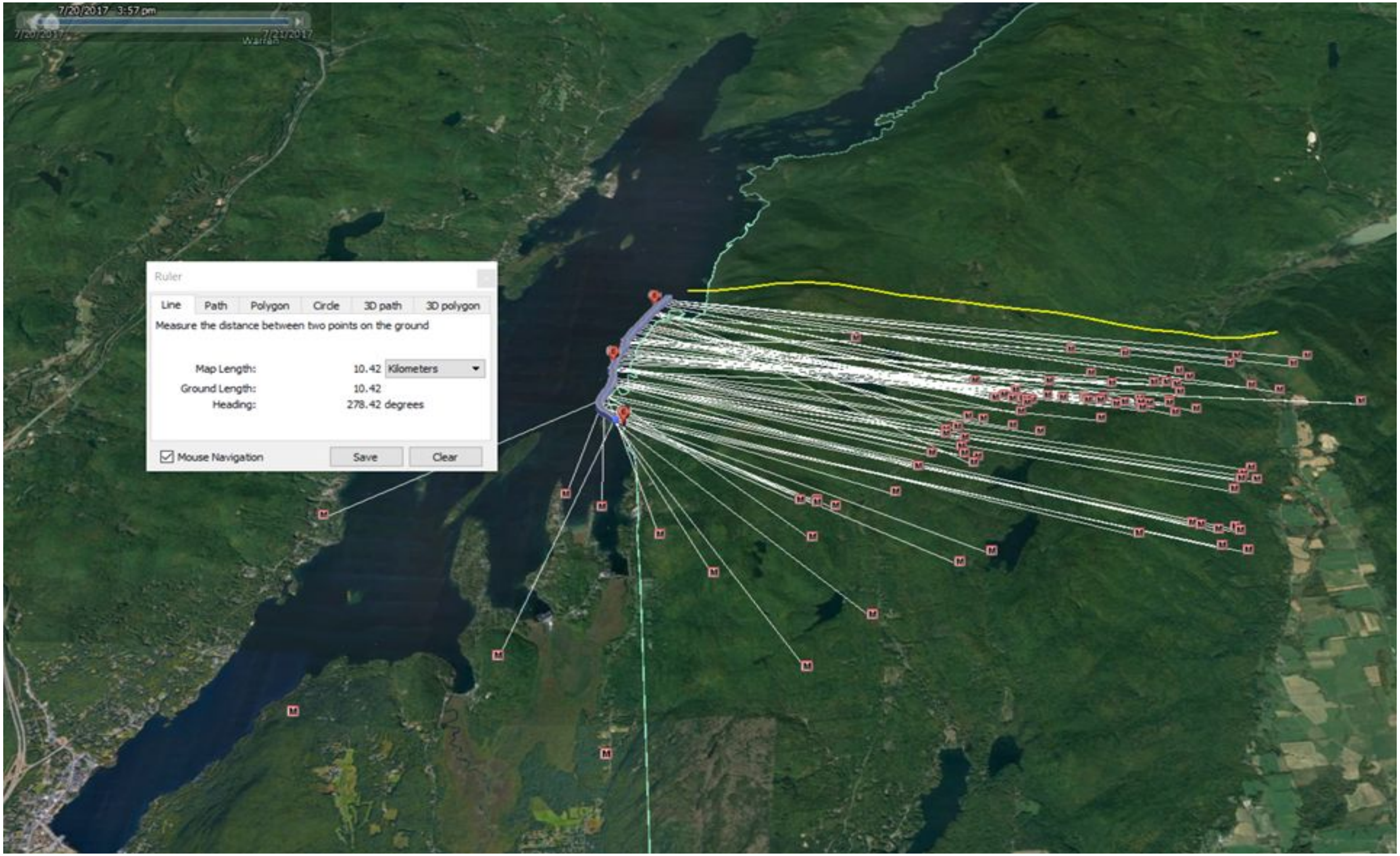


Moving Beacon Study
Lake George

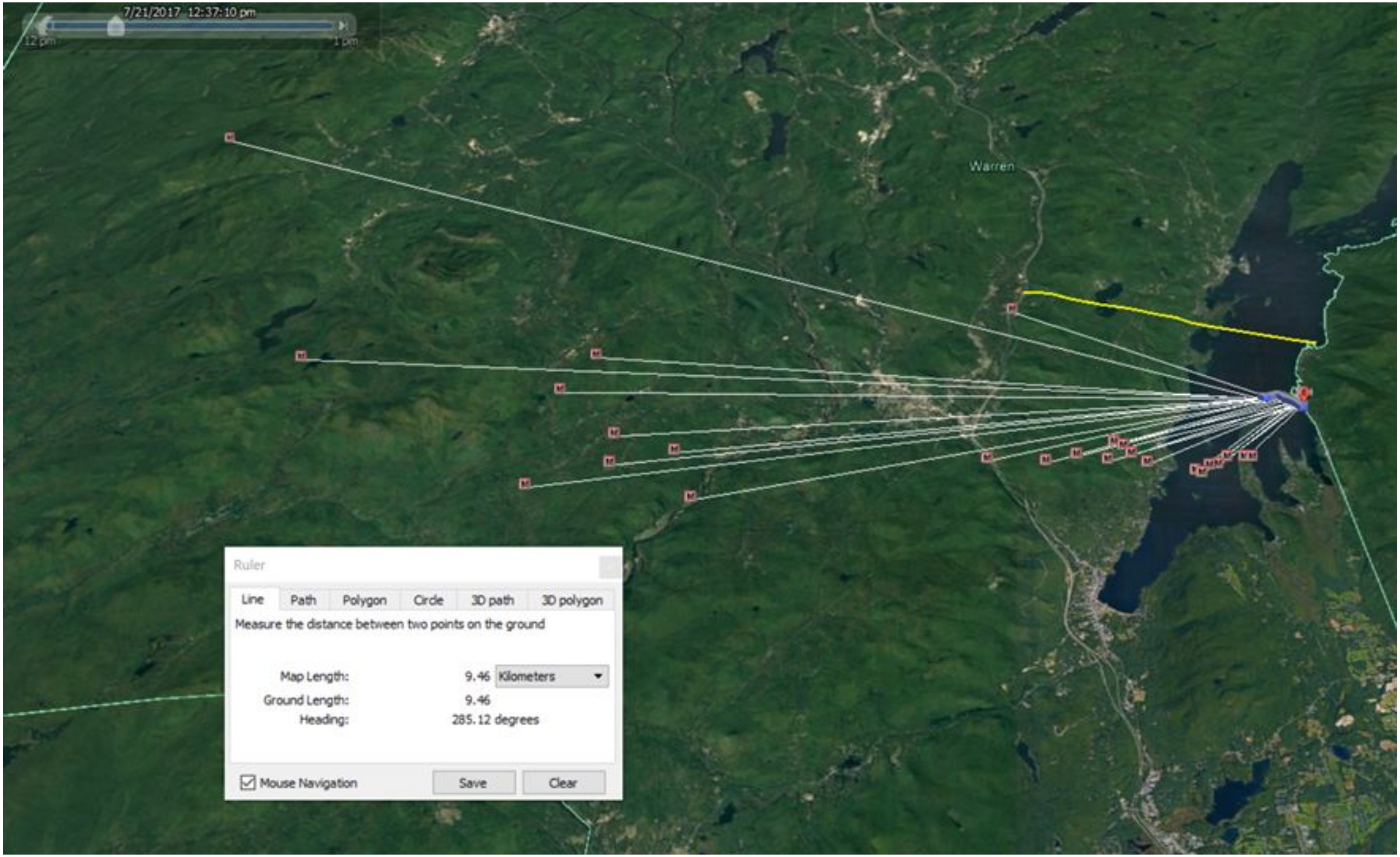
- A PLB was used for a series of tests on and around Lake George in upstate New York (7943 km from Hawaii, 2080 km from Florida, location is 43.493, -73.63)
- The results appear typical of MEOSAR performance during moving beacon events.
- Focus on Config #1 and #5

Location	# locations	ave	# <5 km	% < 5 km	# < 10 km	% < 10 km	# < 20 km	% < 20 km	median (km)	75% (km)	90% (km)	95% (km)
Config # 1 - Slow speed – Boat	399	7.71	132	0.33	301	0.75	383	0.96	6.73	9.92	13.17	18.59
Config # 2 - High speed – Hand	25	19.73	2	0.08	5	0.2	23	0.92	12.48	14.31	15.89	68.72
Config # 3 - Bobbing Dock	155	2.62	146	0.94	155	1	155	1	2.26	3.32	3.76	5.08
Config # 4 - Bobbing Morring	1583	2.29	1497	0.95	1571	0.99	1576	1	1.83	2.65	3.89	5.2
Config # 5 - Slow speed – Hand	64	11.04	22	0.34	38	0.59	53	0.83	6.97	16.76	21.71	34.74
Config # 6 – Hike	231	7.13	127	0.55	185	0.8	220	0.95	4.41	8.97	14.91	19.85
Config # 7 - Fixed Dock	538	1.75	518	0.96	537	1	537	1	1.42	2.2	3.1	4.56

Config #1


7/20/2017 3:57 pm
7/20/2017
7/21/2017
Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the distance between two points on the ground
Map Length: 10.42 Kilometers
Ground Length: 10.42
Heading: 278.42 degrees
Mouse Navigation
Save
Clear

Config #5


7/21/2017 12:37:10 pm
Warren
Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the distance between two points on the ground
Map Length:
9.46
Kilometers
Ground Length:
9.46
Heading:
285.12 degrees
Mouse Navigation
Save
Clear