

Motivation for NR extreme long range communications

Telstra

RP-181741

Background

To enable operators to provide service in very remote and maritime conditions, an “extreme rural” scenario has been defined for NR

– The extreme rural scenario is described in 38.913

Table 6.1.6-1: Attributes for extreme rural

Attributes	Values or assumptions
Carrier Frequency	Below 3 GHz With a priority on bands below 1GHz Around 700 MHz
System Bandwidth	40 MHz (DL+UL)
Layout	Single layer: Isolated Macro cells
Cell range	100 km range (Isolated cell) to be evaluated through system level simulations. Feasibility of Higher Range shall be evaluated through Link level evaluation (for example in some scenarios ranges up to 150-300km may be required).
User density and UE speed	User density: NOTE1 Speed up to 160 km/h
Traffic model	Average data throughput at busy hours/user: 30 kbps User experienced data rate: up to 2 Mbps DL while stationary and 384 kbps DL while moving NOTE2

NOTE1: Evaluate how many users can be served per cell site when the range edge users are serviced with the target user experience data rate.

NOTE2: Target values for UL are lower than DL, 1/3 of DL is desirable.

This contribution provides real world measurements from a live 3G network with extreme rural support for context

Extreme long range is about supporting “fortuitous” coverage

Classic propagation models / simulations suggest coverage beyond 100 km is unlikely

- We agree – for most deployment scenarios, coverage beyond 100 km is not possible
- But classic propagation models do not adequately predict “fortuitous” coverage, which occurs regularly on a number of our sites

We have real world examples where we regularly provide service beyond 100 km

- These examples are evidence of our customers using their 3G services beyond 100 km today

Maritime use cases are particularly valuable

- Many countries have commercial operations out to sea
- These regularly benefit from coverage beyond 100 km thanks to atmospheric effects that benefit propagation over water

Pathloss and propagation distance measurements from live 3G cells

Two measurement campaigns were conducted on live 3G cells (band 5) configured for extreme range (up to 200 km) over a series of days

- UE periodic reporting activated on ~50 cells
- RACH statistics collected on ~500 cells

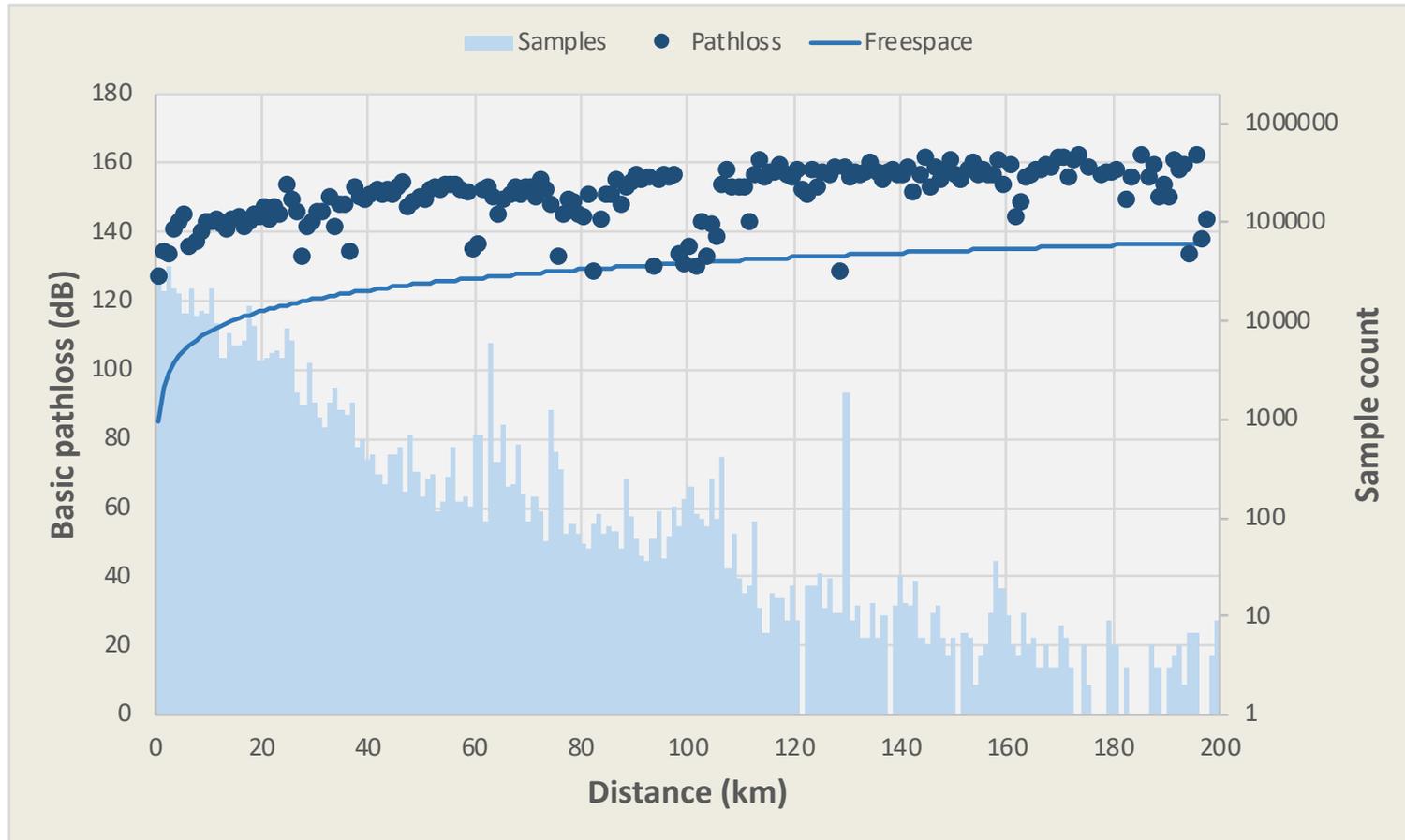
UE periodic reporting

- Provides correlated pathloss and propagation measurements for connected UEs
- Yielded ~360,000 measurement samples
- Reflects viable links only

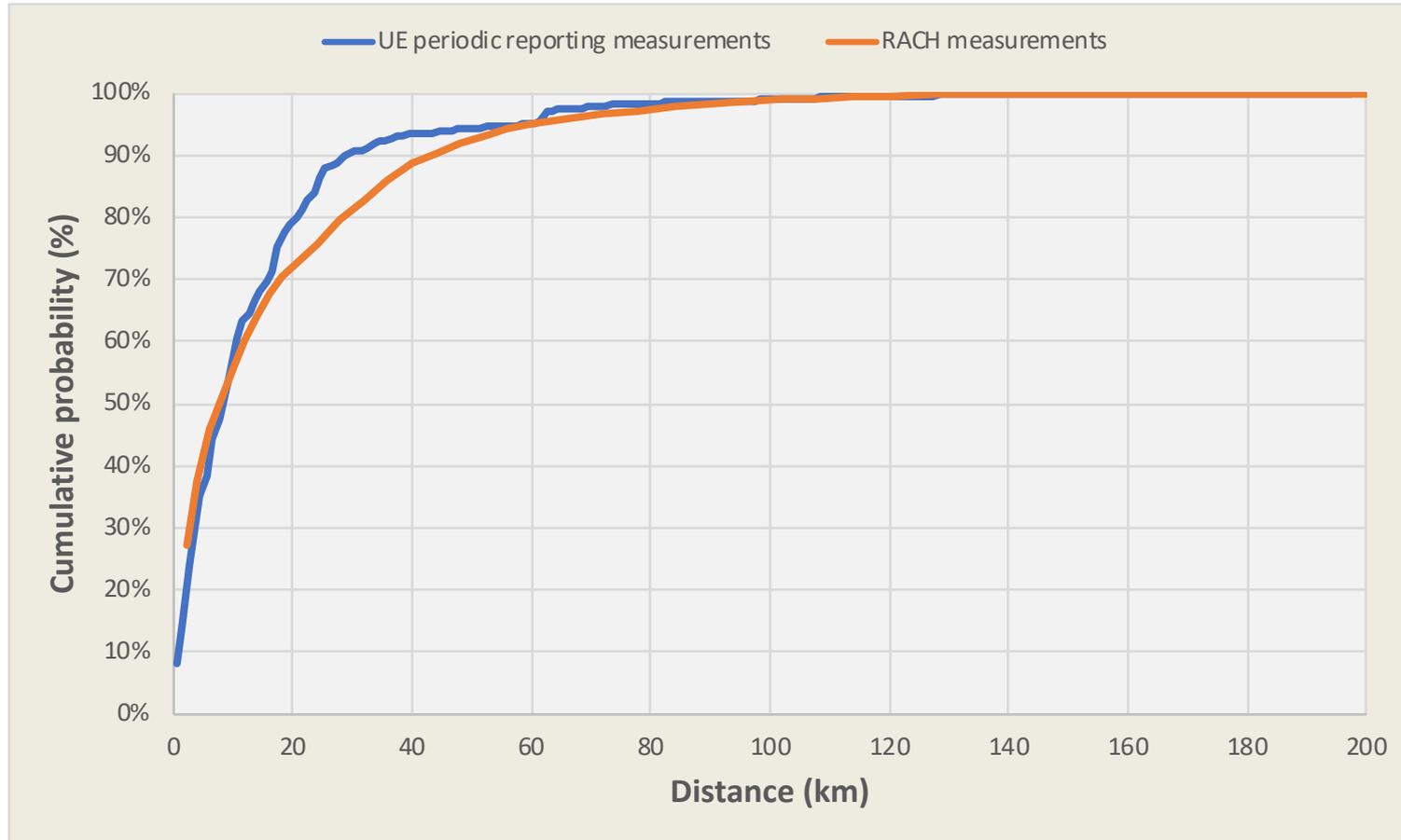
RACH statistics

- Provides propagation statistics based on RACH preamble
- Yielded 3.3 billion samples
- Reflects both successful and unsuccessful RACH attempts

Pathloss measurements



Propagation distance probability



Observations

Observation 1

- Extreme rural capability is being used today in live 3G networks and provides valuable service for operators and their customers

Observation 2

- Our statistics can be used to inform extreme rural pathloss and traffic distribution

Proposal

- Provide full support for the extreme long range scenario for NR in the low band

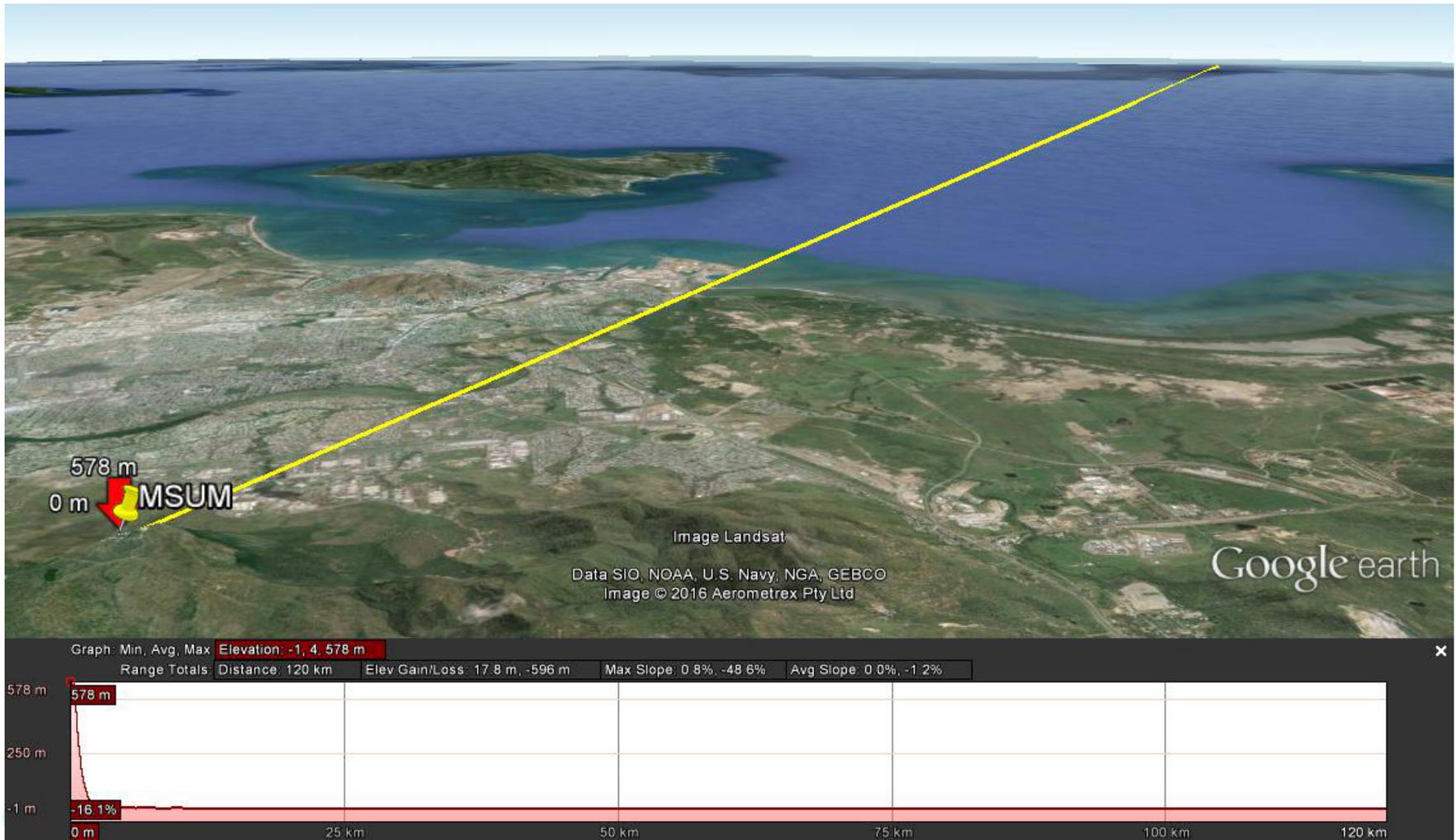
Appendix

4 extreme rural site examples

Case studies

MSUM – path profile

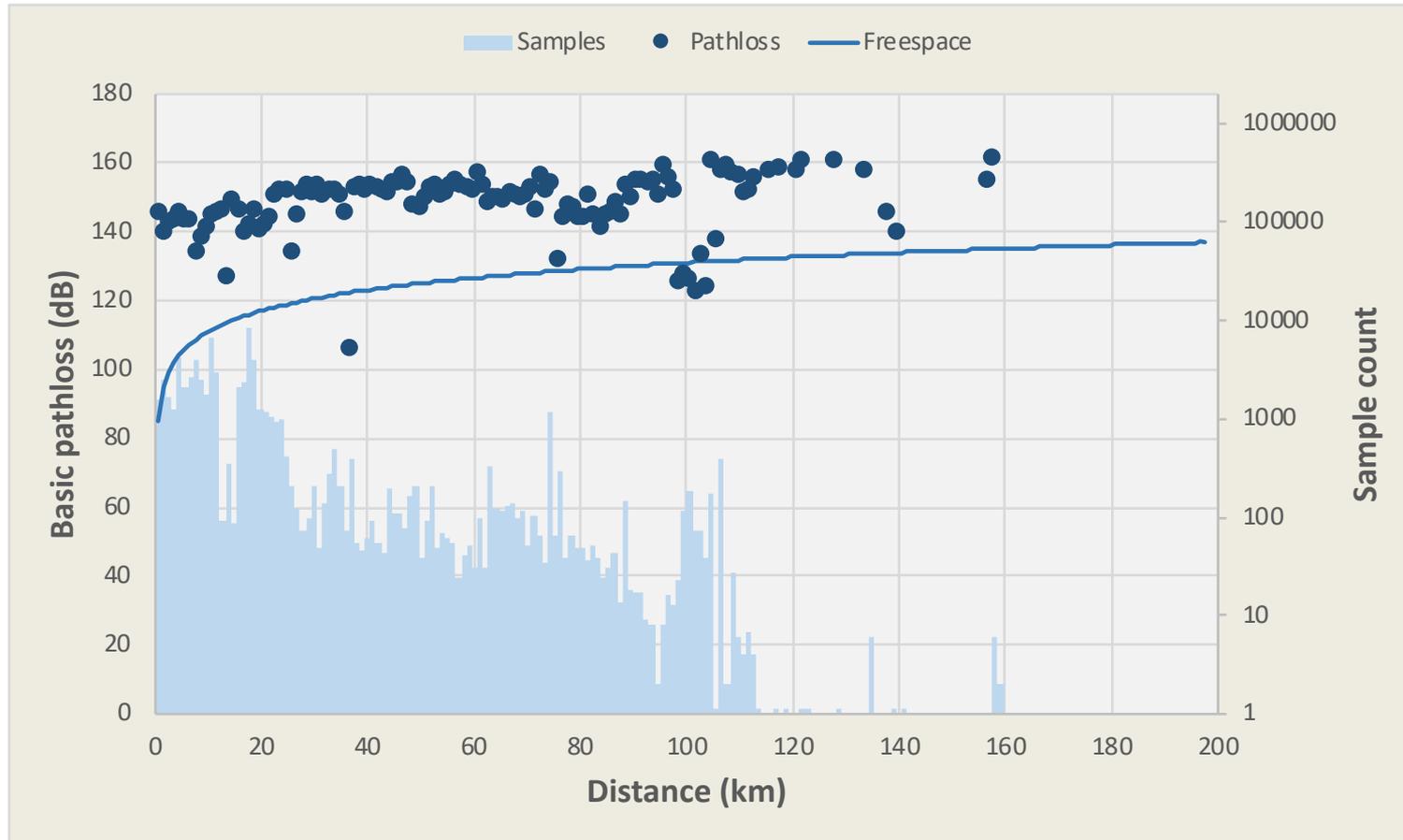
- High site on high hill overlooking large regional centre
- Long distance coverage out to sea up to 120 km



Antenna height = 35 m (structure) + 678 m (hill) = 713 m

Case studies

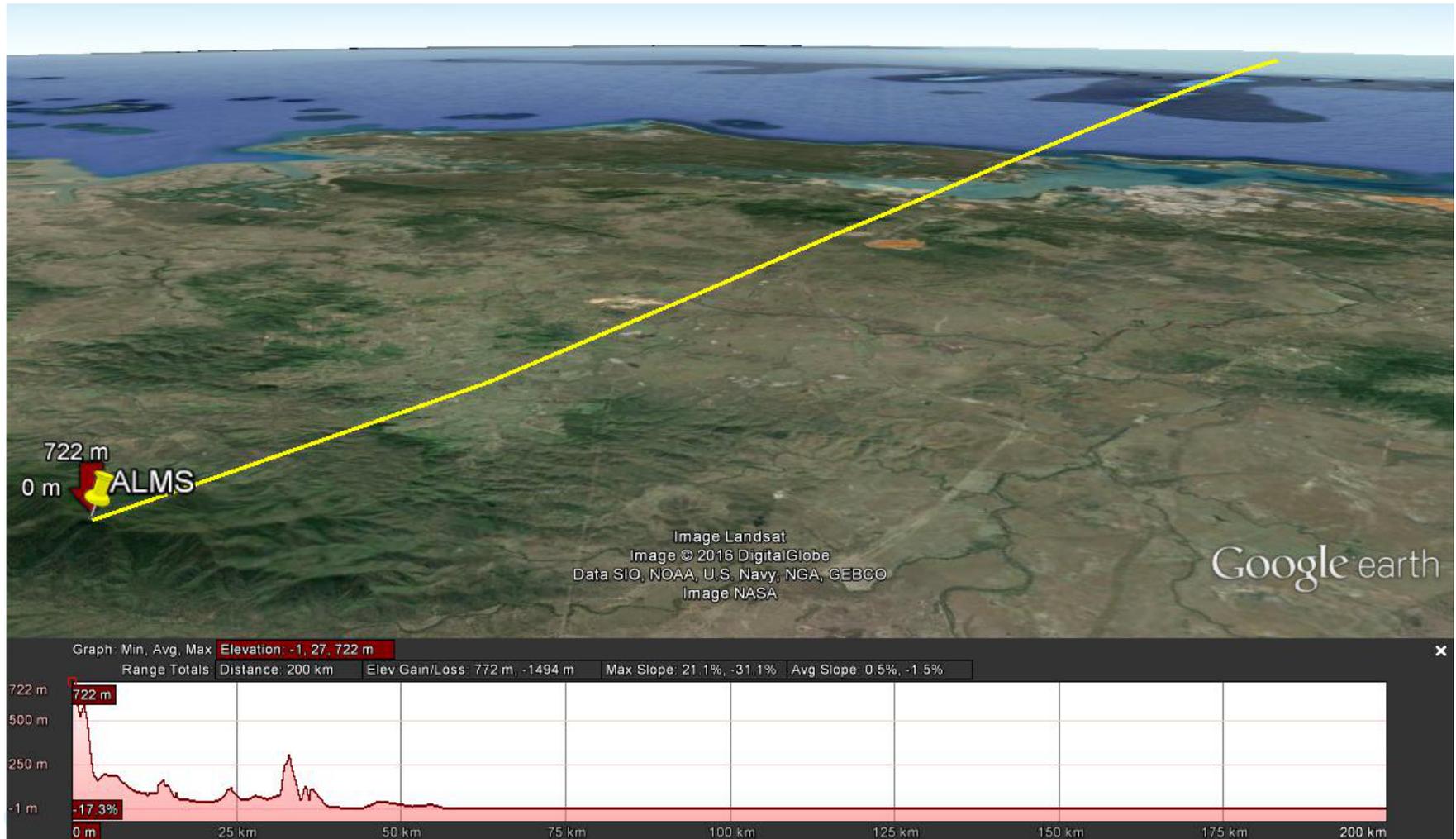
MSUM – propagation measurements



Case studies

ALMS – path profile

- High site on high hill overlooking large regional centre
- Long distance coverage out to sea up to 200 km

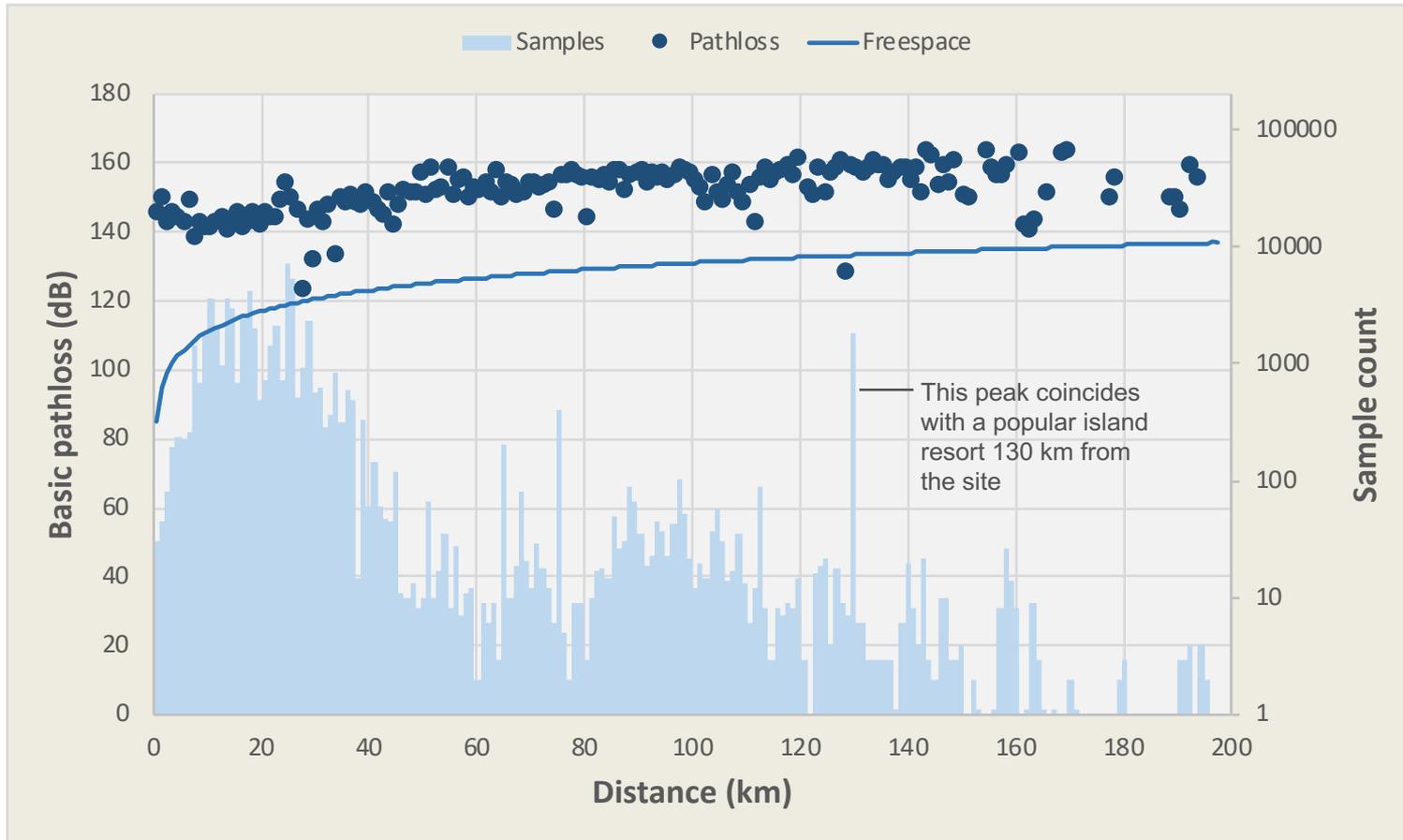


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Antenna height = 21 m (structure) + 722 m (hill) = 743 m

Case studies

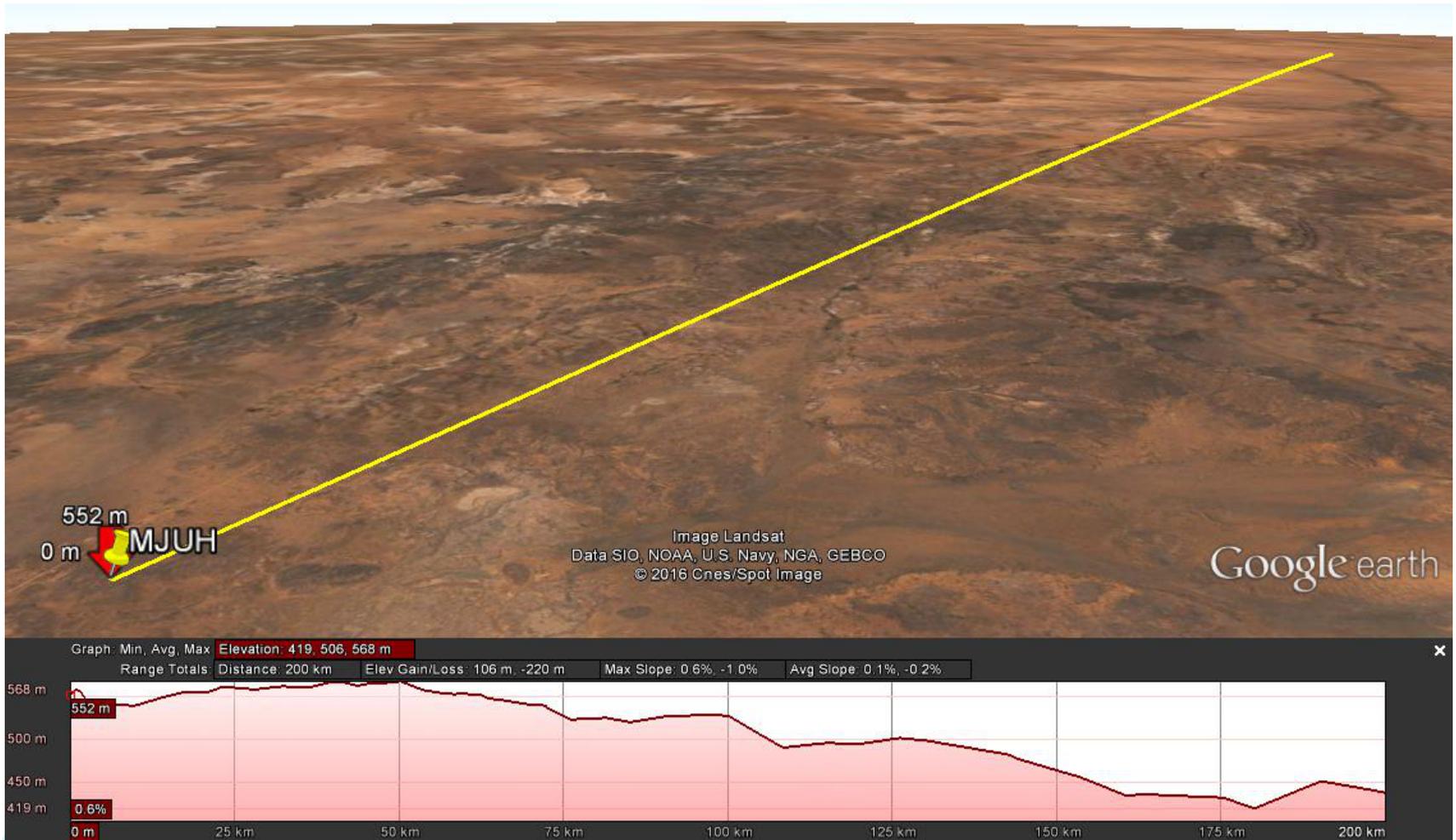
ALMS – propagation measurements



Case studies

MJUH – path profile

- High site overlooking desert and mining sites
- Long distance coverage out to 200 km over flat desert expanse

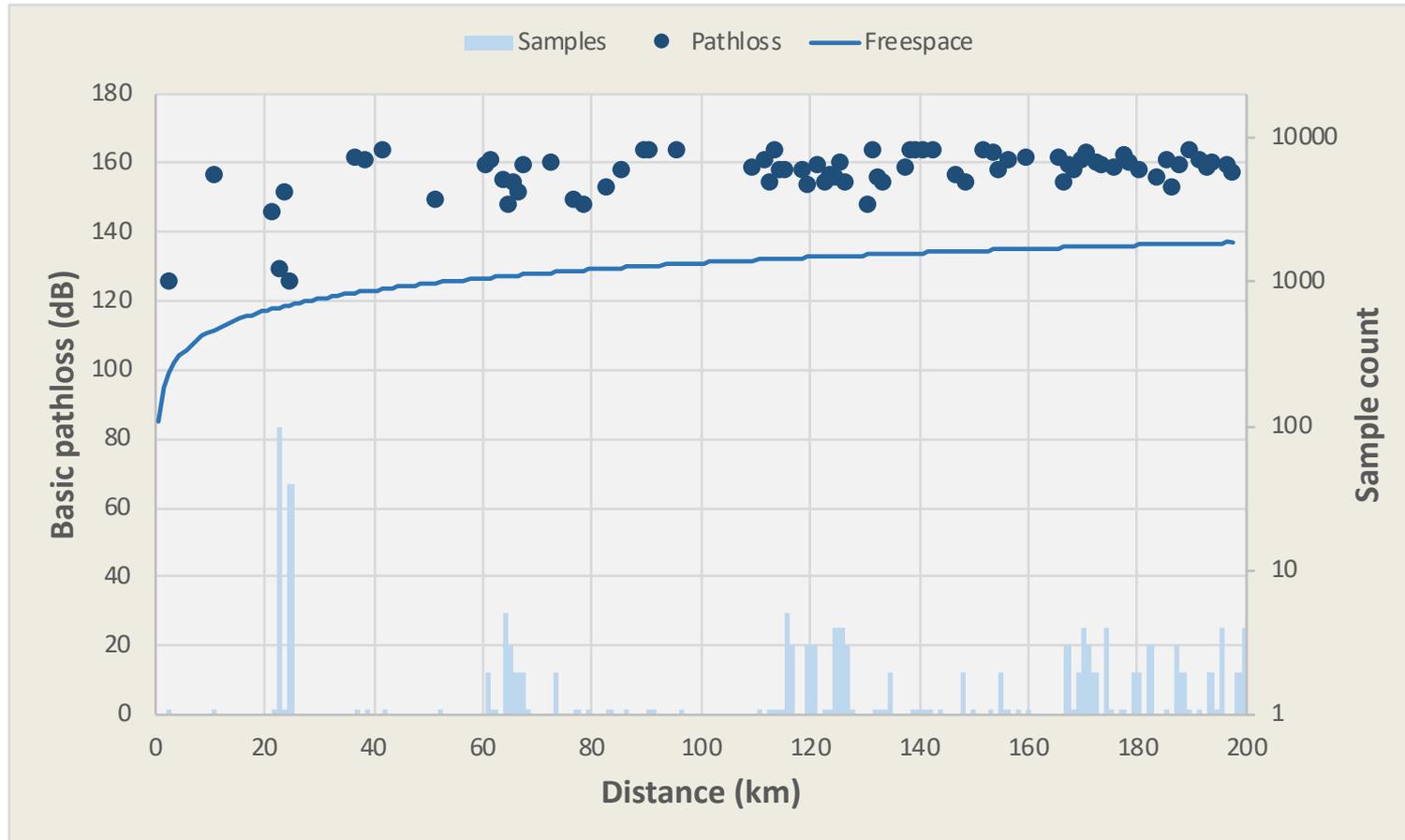


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Antenna height = 59 m (structure) + 552 m (hill) = 611 m

Case studies

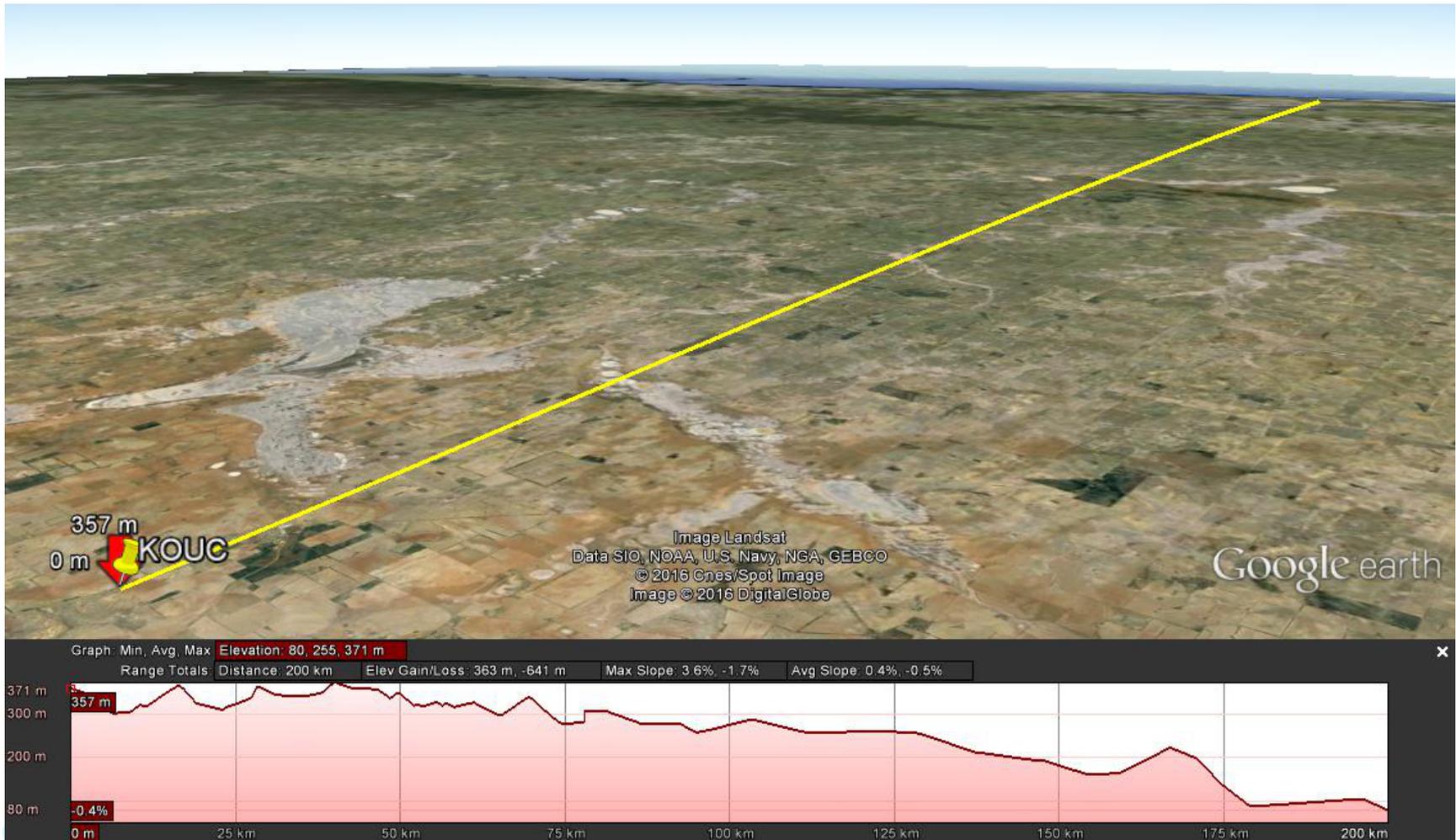
MJUH – propagation measurements



Case studies

KOUC – path profile

- High site overlooking small remote agricultural communities
- Long distance coverage out to 180 km over flat rural expanse



Antenna height = 60 m (structure) + 357 m (hill) = 417 m

Case studies

KOUC – propagation measurements

