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# GRaCE: G-band Radar for Cloud Evaluation

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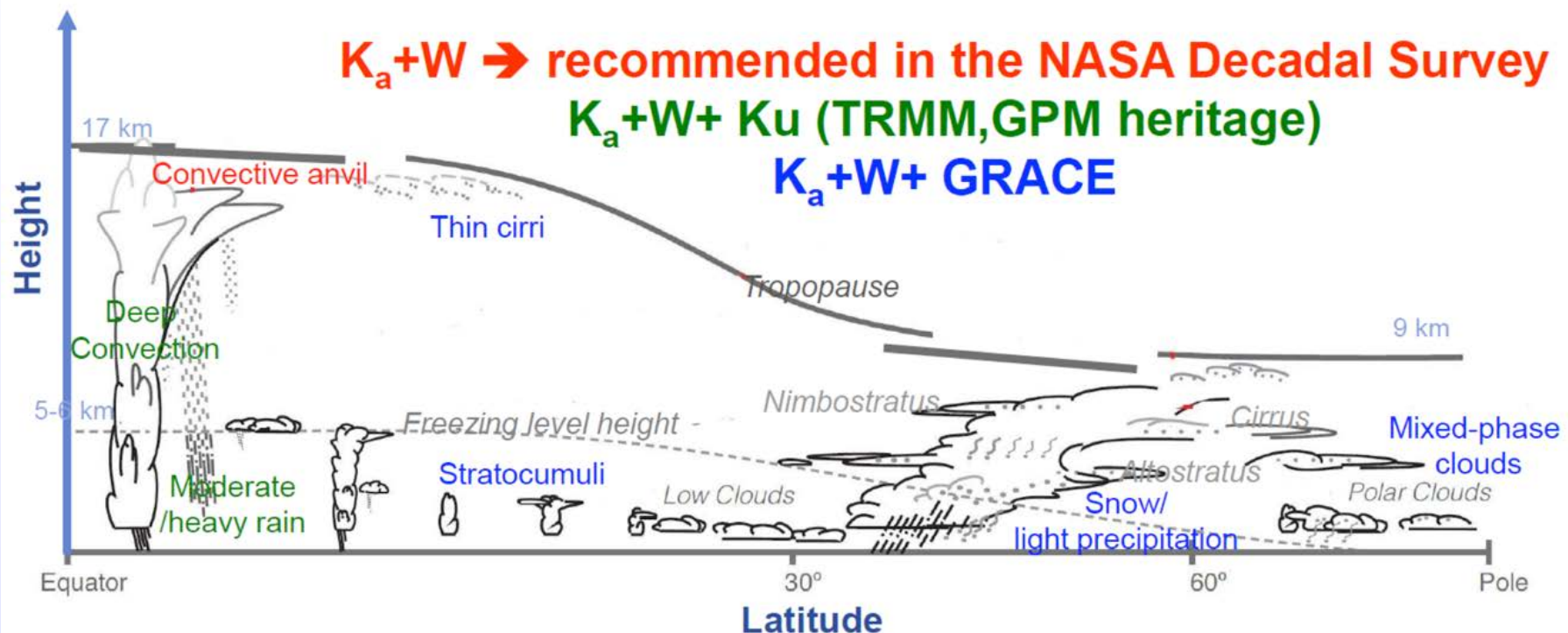


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# Benefits of Space Cloud Radar

- G-Band, circa 200 GHz, radar delivers enhanced information on small water droplets and ice in the atmosphere: better scientific understanding
- Combine with lower frequency radar observations: better numerical weather prediction

## Cloud types targeted by multi-frequency radar





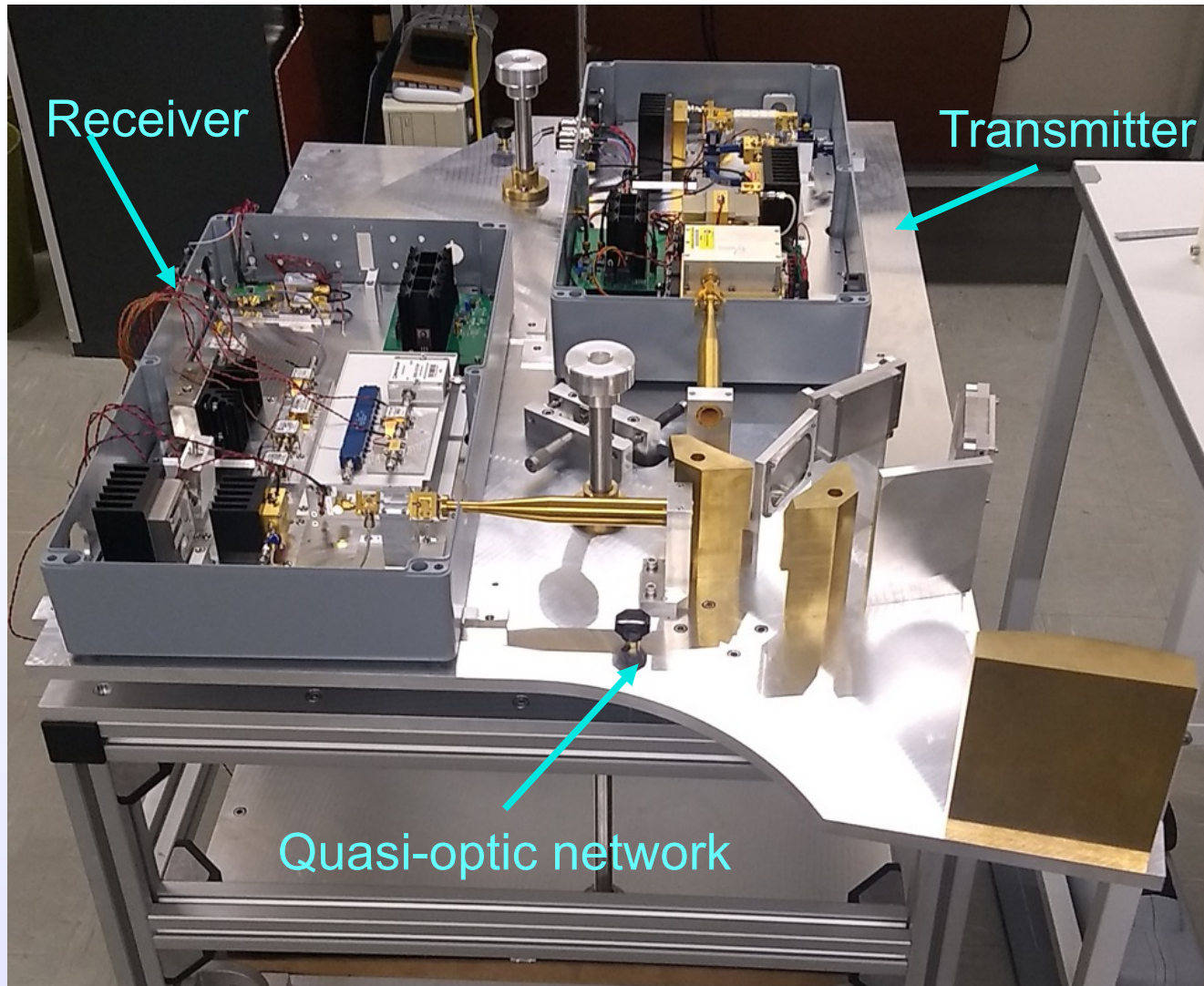
# The GRaCE project



- Ground based science and technology demonstrator for a future space radar (export opportunity)
- Monostatic, pulsed, Doppler, zenith looking, radar
- Exclusively solid state technology
- Deployment & comparison with other cloud radars at Chilbolton Observatory, Hampshire
- Frequency, 199.5 GHz, set by OFCOM and atmospheric transmission



# Completed Hardware



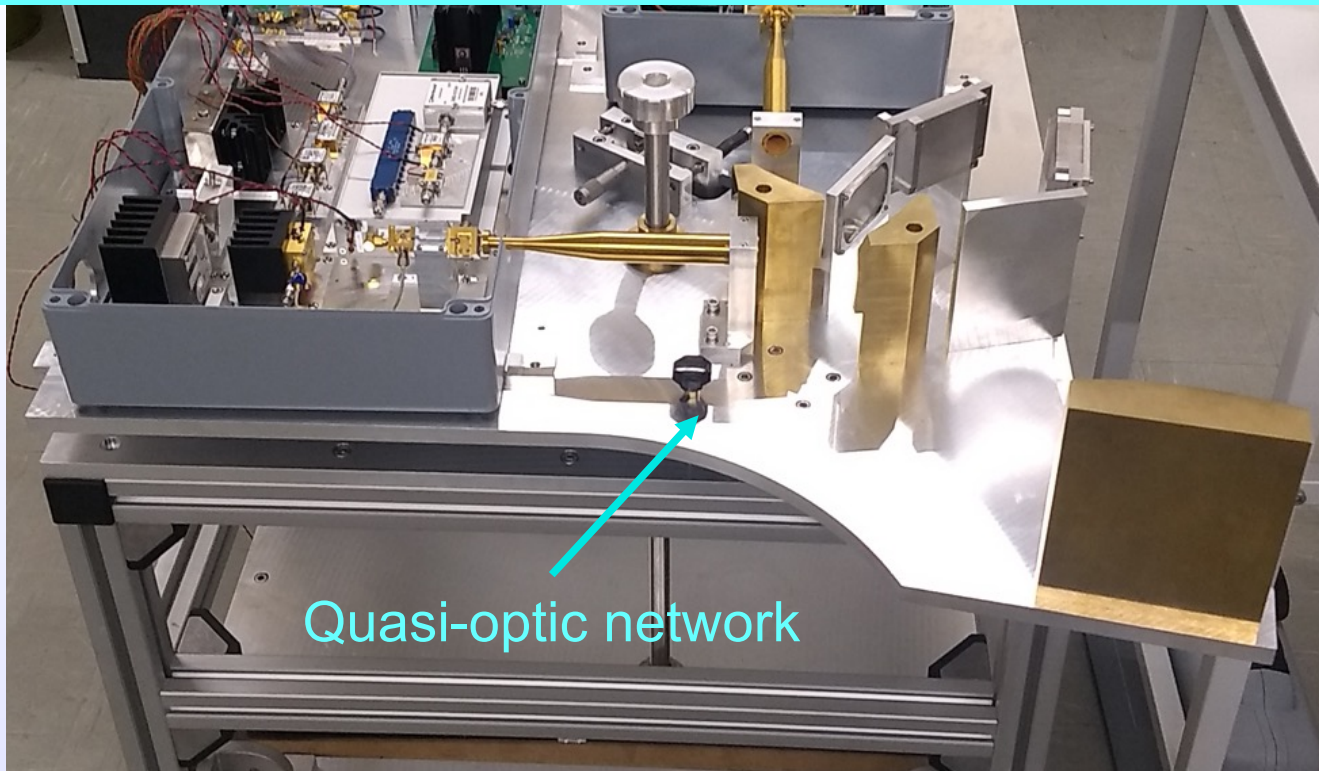




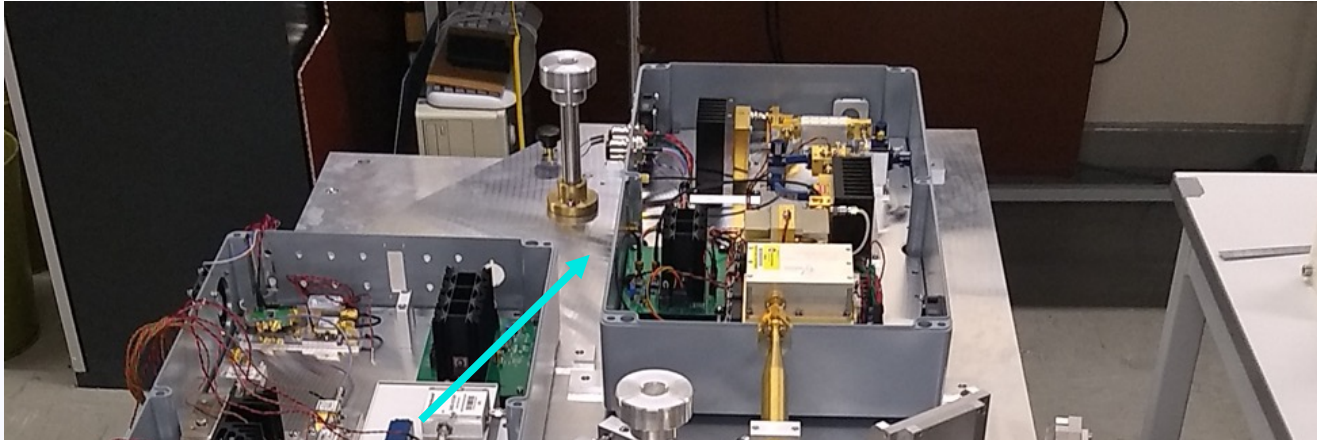
# QON

Quasi-optic network allows transmitter and receiver to share common antenna

- Corrugated feedhorns: measured single pass insertion loss at 200 GHz is  $\approx 0.35$  dB
- Network insertion loss at 200 GHz is  $\approx 1.2$  dB
- Polarisation rotation gives Tx to Rx Isolation  $> 60$  dB
  - Prevents a high power transmitter destroying the receiver



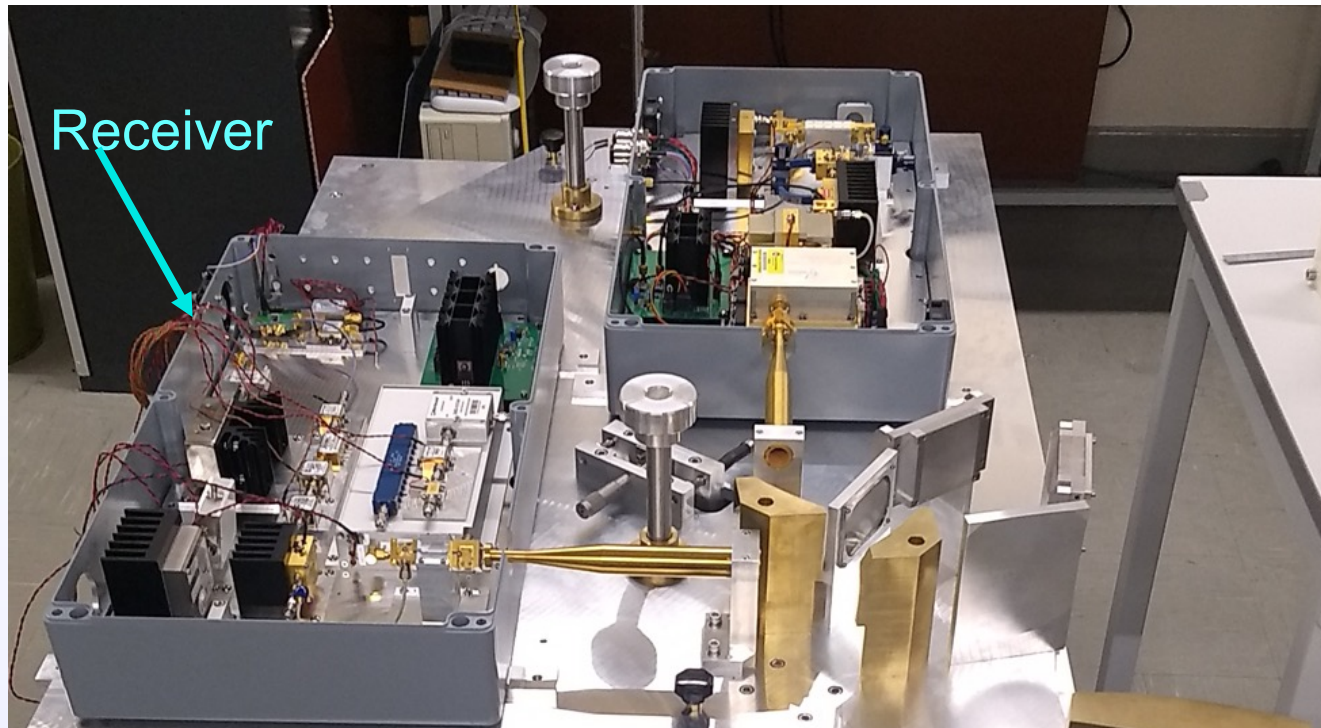
Quasi-optic network



## High power solid state transmitter

- 100 GHz QuinStar power amplifier
- Teratech frequency doubler
- Pulse lengths 10 ns to 300 ns via fast pin switch at 33 GHz
- Range resolution 3 m to 100 m
- Peak transmitted power 80 mW



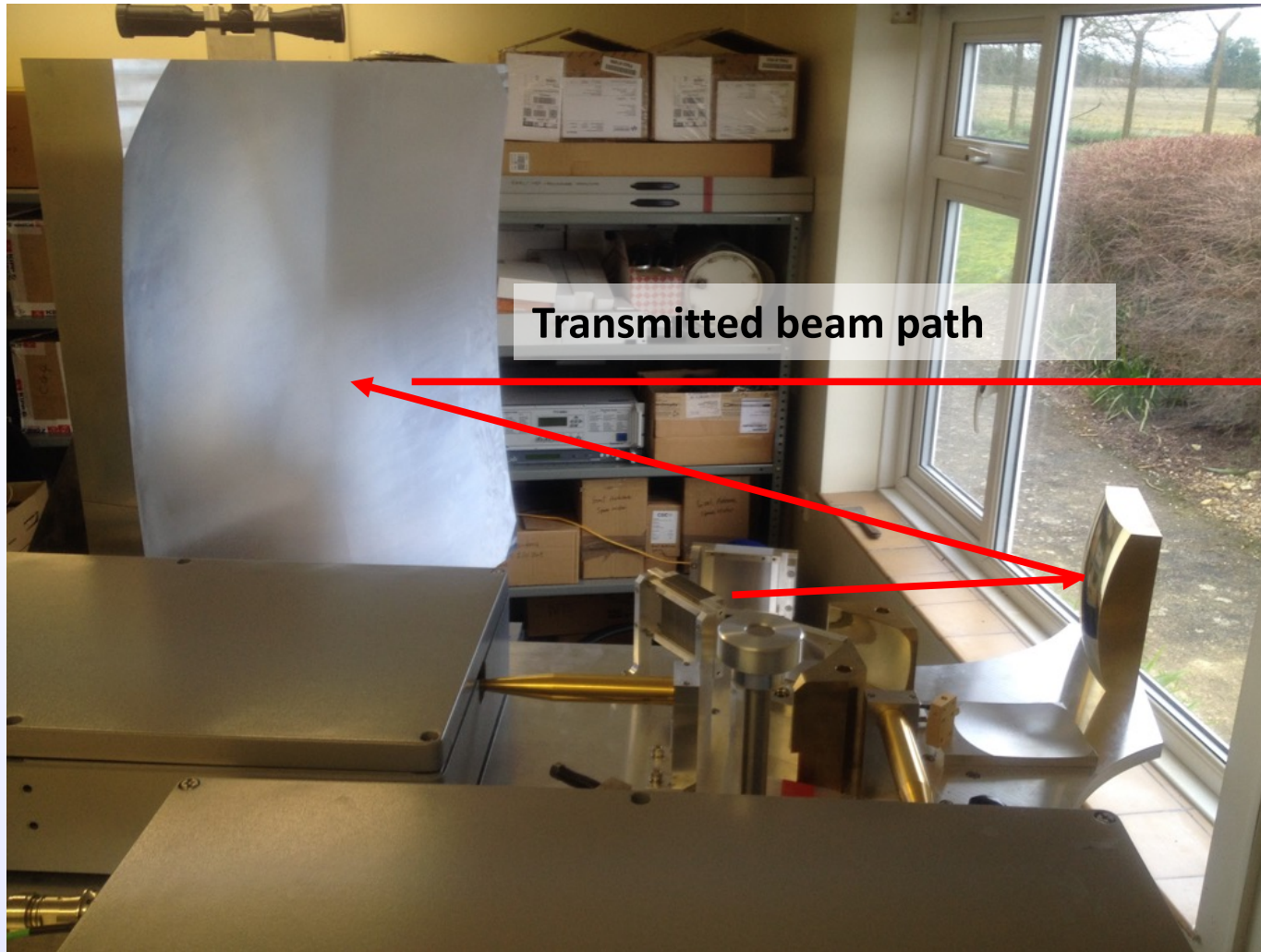


## Sensitive super-heterodyne I & Q receiver

- 200 GHz subharmonic mixer from MetOp-SG
- Conversion loss  $\approx 6$  dB
- Noise temperature  $\leq 600$  K



# Optics





# Installation



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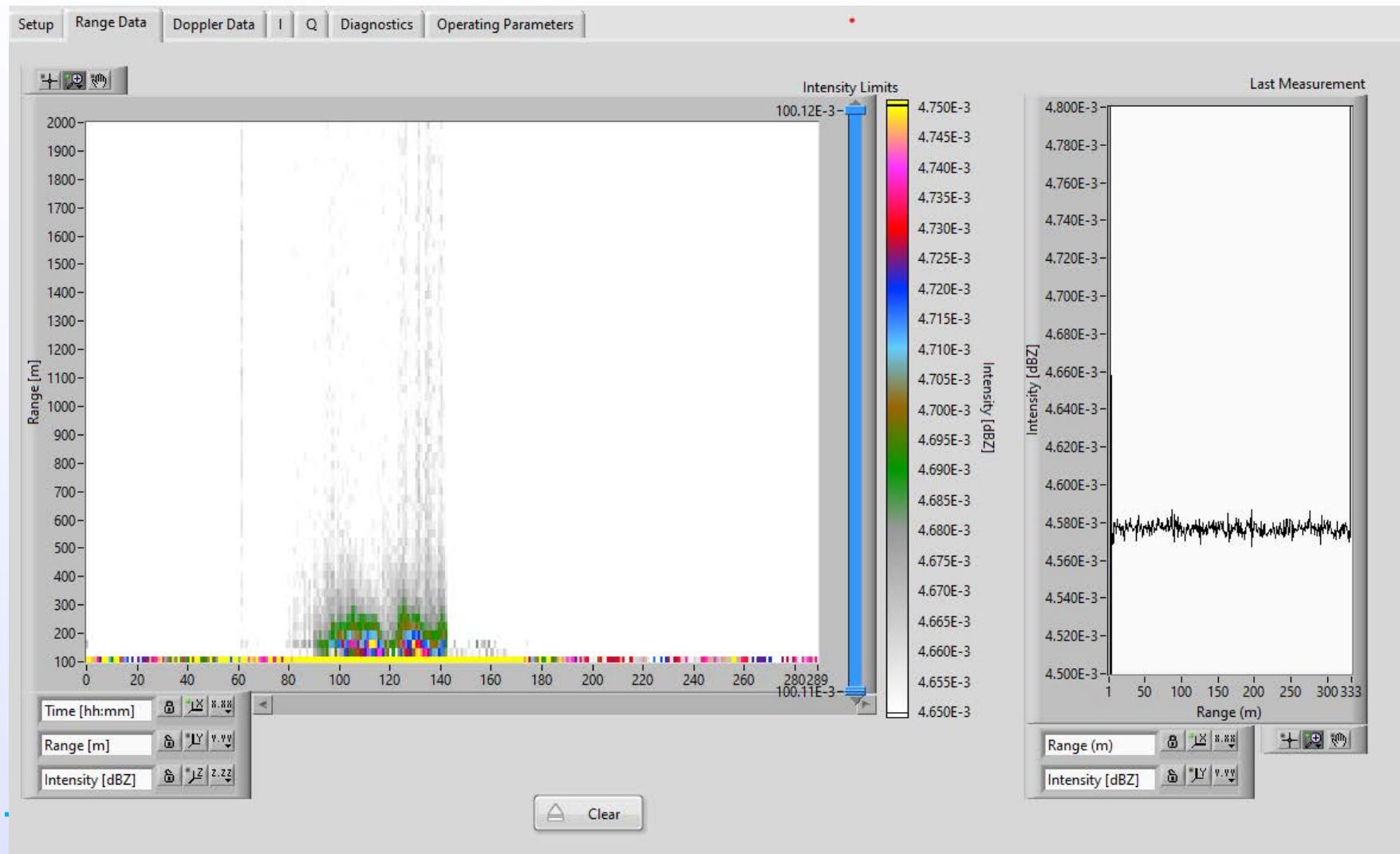


This window pane is removed during operation

# First atmospheric results



- Returns from a passing shower on June 18<sup>th</sup>
- Sensitivity not yet at design value





# Conclusion



- GRaCE hardware completed and software at advanced stage
- Instrument installed in Chilbolton prior to March shutdown
- First atmospheric returns have been obtained.
- Hardware improvements and completion of dielectric window are outstanding

## Acknowledgement

GRaCE is grant funded by the UK Space Agency through the UK Centre for Earth Observation Instrumentation

