Creating Trust in Satellite Earth Observation to Grow the Market:

Satellite Earth Observation Quality Assurance

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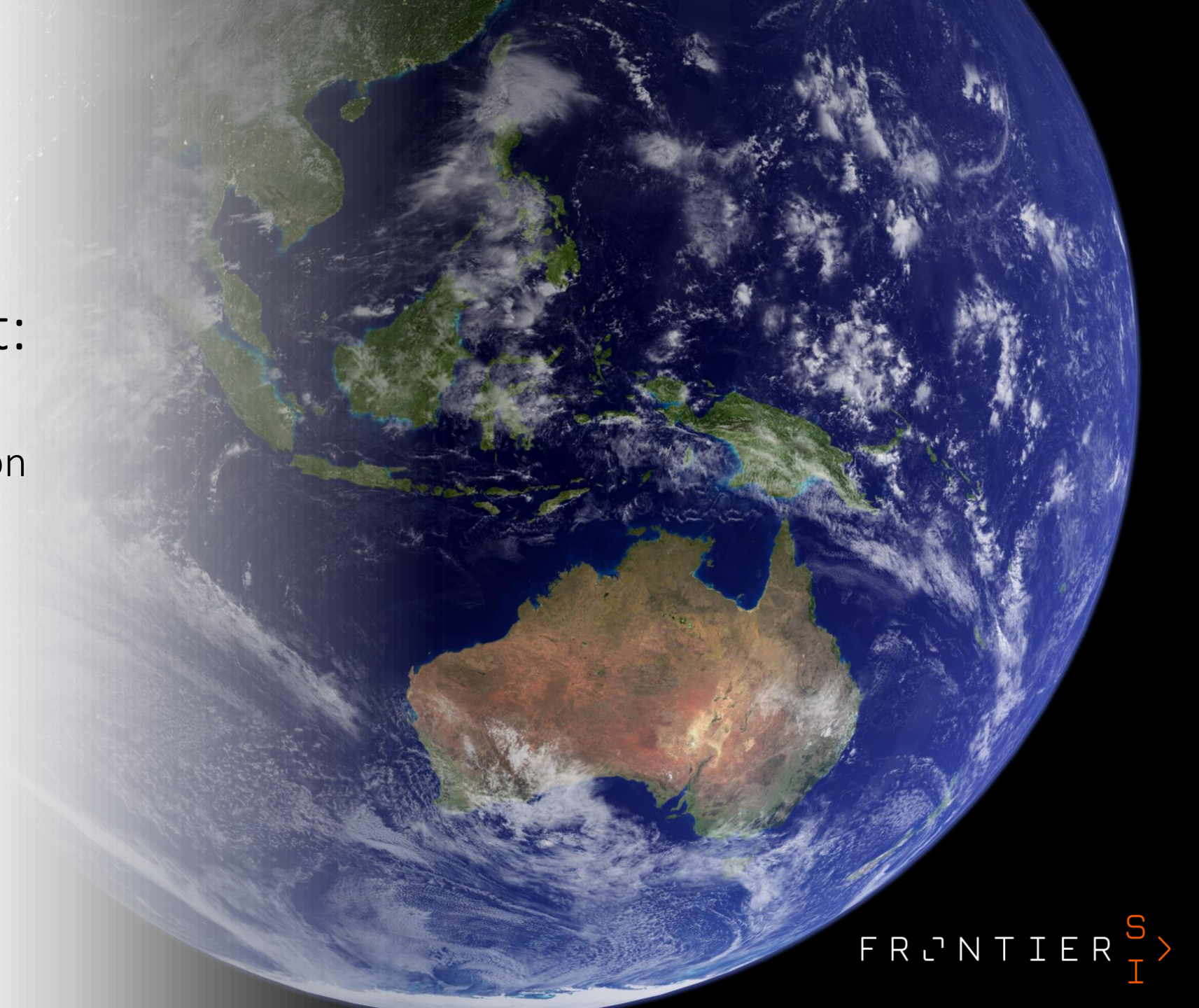
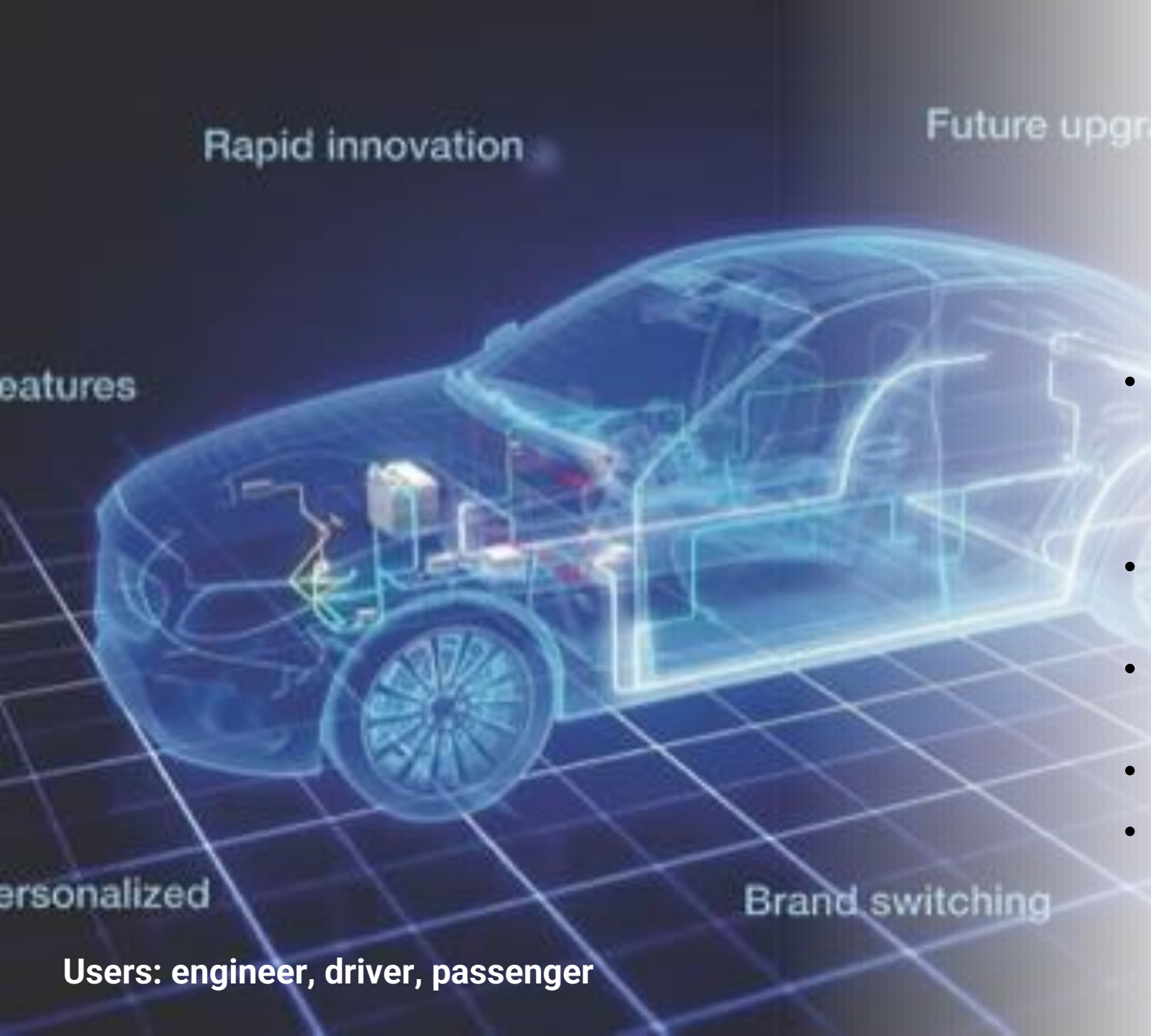


Use Case: EO Satellite Data and Derived Products

- Industry, government, defence, academia and NGOs rely on EO data for their mapping, monitoring, and modelling activities across many application areas for decision making and policy
- Satellite EO contributes over $5 billion annually to Australian GDP and $543 billion to APEC economies.
- Internationally many new Earth observation satellites are planned in the next few years.
- Lots of new ‘start-ups’ both space providers and application/platform providers
- Creating a proliferation of EO data and products in the market place – but what is their quality?



Creating Uptake of Satellite Earth Observation

- For EO data and products to become widely used and adopted, providing the right level of “trust” is critical
- Different users and use cases require different levels of trust
- Different quality fit for different purposes
- How do we trust “what is new”?
- How do we trust “what we understand vs not understand”?

SmartSat CRC Testbed Project

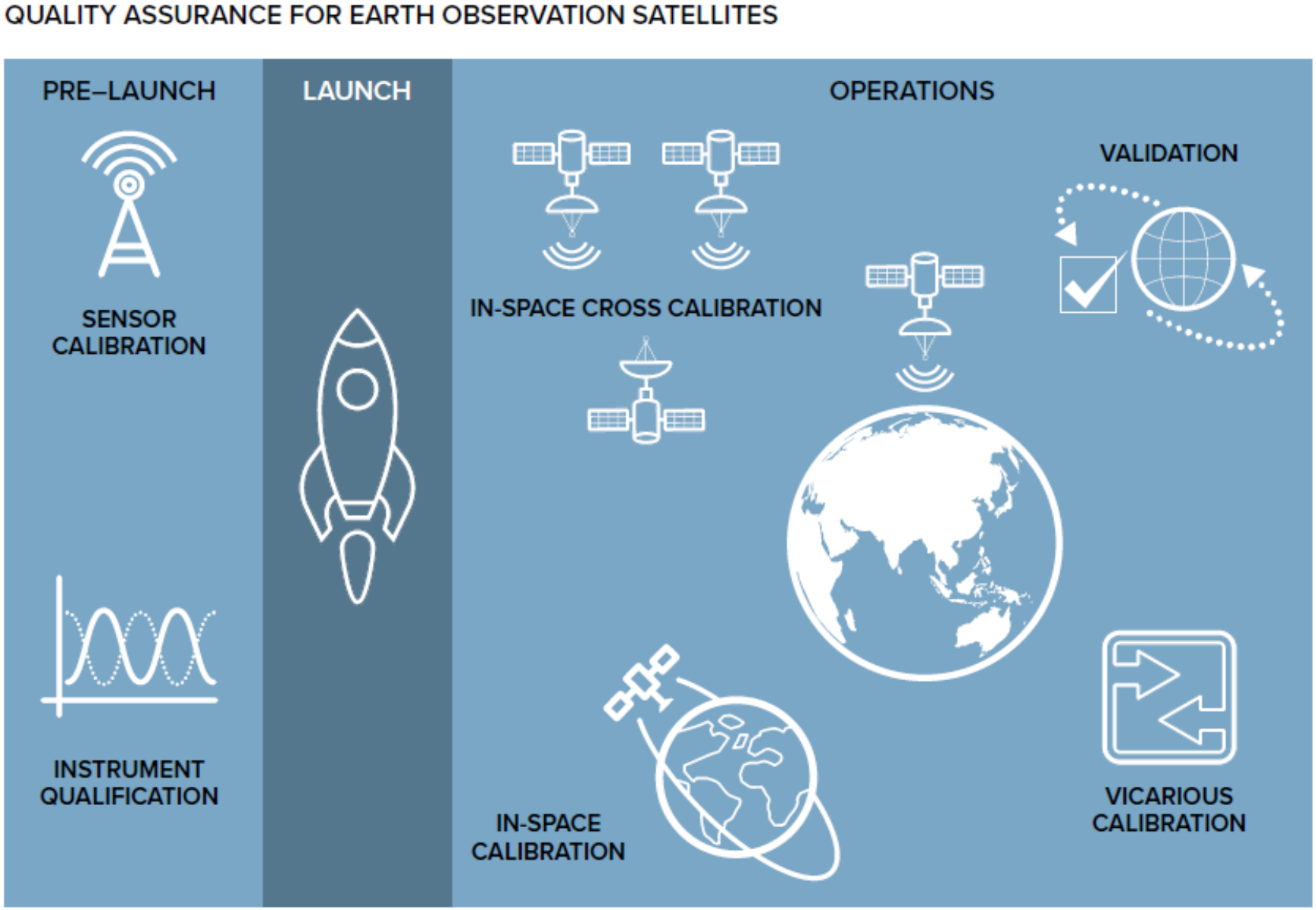
- Key sectors where benefits of EO could be invaluable are agriculture, mining, emergency services, and natural resources in aquatic and terrestrial environments.
- Trust comes from understanding the explicit link between the satellite derived information and sampled ground measurements (calibration) as well as knowing its level of accuracy (validation).
- The project aims to identify promising areas of research in the field of testing of Earth Observation sensors (calibration), and algorithms and analytics (validation) for derived products.
- Interviews to determine requirements on developing a prototype testbed for calibration and validation for commercial or research satellites.
- Working with providers and end users to determine requirements.

How is Trust Created for Satellite EO?

Data is considered to have sufficient quality if it is “fit for intended uses”. This can be determined by reporting:

- Calibration and validation
- Data standards, metadata and quality indicators
- Performance
- User-stories
- FAIR: findable, accessible, interoperable and reusable
- Industry engagement, awareness and education (push and pull market strategy)

What is Calibration and Validation for EO?



Characteristics affecting Data Quality Reporting Requirements

USER MATURITY

Experts vs non-experts require different information to build trust (UML 1-5)

USE CASE

Object identification

Classification

Quantitative measurements or modelling

Change detection

SATELLITE CHARACTERISTICS

Satellites require different forms of cal/val based on their characteristics

LIFECYCLE PHASE

Raw imagery

Data products

Data analytics

Decisions

Data Quality Decision Matrix

Example: Landsat (30m) vs Planet vs Worldview 3 (1.2m)

Cal/Val required for most common UML and End-Use

Cal/Val required to satisfy all UML and End-Uses

	Raw imagery	Data products	Data analytics	Decisions
Lifespan of Satellite Years, Orbit				
Swath Width and Capture Mode				
Single Satellite Constellation				
Resolution Coarse, Medium, High				
Acquisition mode Tasking vs continuous				
Sensor type i.e. radar, multi, hyper-spectral				

Questions: Do different types of satellites have fundamentally different end-uses and therefore different cal/val needs?

Data Standards

ISO standards

- ISO has 3 Technical Specifications for Calibration and validation of remote imagery sensors and data:
  - ISO/TS 19159-1:2014 Geographic information — Calibration and validation of remote sensing imagery sensors and data — Part 1: Optical sensors
  - ISO/TS 19159-2:2016 Geographic information — Calibration and validation of remote sensing imagery sensors and data — Part 2: Lidar
  - ISO/TS 19159-3:2018 Geographic information — Calibration and validation of remote sensing imagery sensors and data — Part 3: SAR/InSAR
  - Under development - fundamentals of ‘Calibration and validation of remote sensing data and derived products’ – expected publication date 2022.

Quality indicators

- Metadata
- Model development
- Training data
- Formal accuracy and precision
- Guide on use/usability
- Currency

The ‘Deep Fake’

- Fake, AI-generated satellite imagery
- Create hoaxes i.e. wildfires or floods, or to discredit stories based on real satellite imagery.
- Military planning software is fooled by fake data that shows a bridge in an incorrect location.

https://www.theverge.com/2021/4/27/22403741/deepfake-geography-satellite-imagery-ai-generated-fakes-threat

What happens without trust?

Data isn't used – not seen as fit for purpose:

- Time series
- Quantitative analysis
- Algorithm transfer
- Image basemaps
- Comparison between different satellites

Prevents the user from utilising the system to its full extent

Not seen as reliable for decision making

Active and passive users need different information to calibrate trust

EO quality indicator assessment models for different lifecycle stages and end-uses

Summary

Trust is essential to grow the market for satellite EO:

- Upstream
- Downstream

Trust in EO needs to be created through:

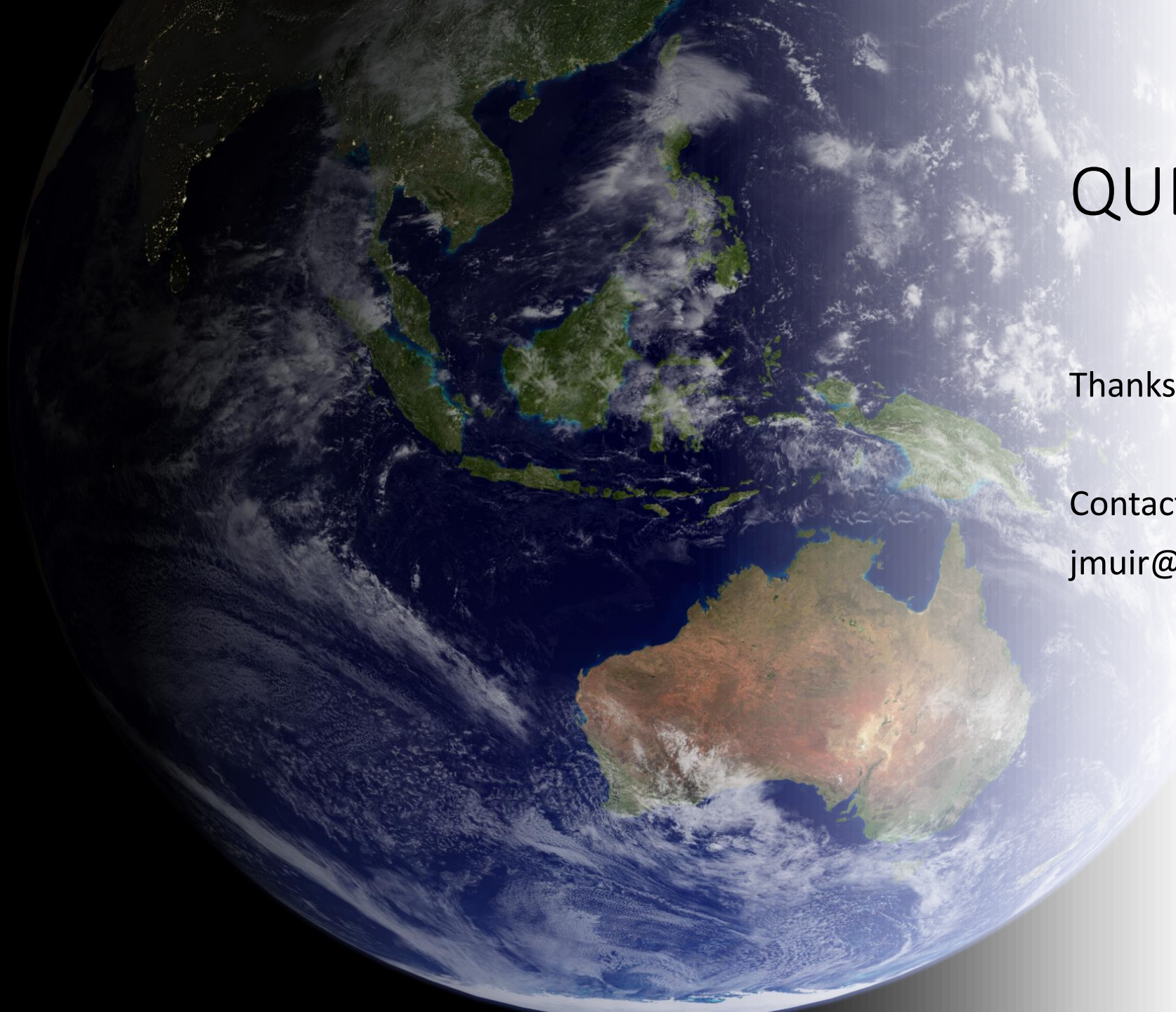
- Reliability and performance (it works),
- Well documented cal/val and workflow metadata adhering to defined standards (I know why it works)
- Shared through user-stories of success (it worked for me)
- Communicate to end-users in a manner they understand

Not one size fits all for cal/val:

- Satellite characteristics
- User (passive vs active, UML)
- End-use
- Data lifecycle phase

For trust in EO to develop:

- Cal/Val
- Data standards
- User education
- User understanding
- Targeted communication



QUESTIONS

Thanks for listening!

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