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# **AuScope Geospatial: Measuring the Contemporary Deformation of the Australian Crust**

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# Introduction

- Background
- How has Geodesy Changed
- Global Geodetic Observing System
- AuScope
- AuScope+
- Looking Forward
- Conclusion



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## Background

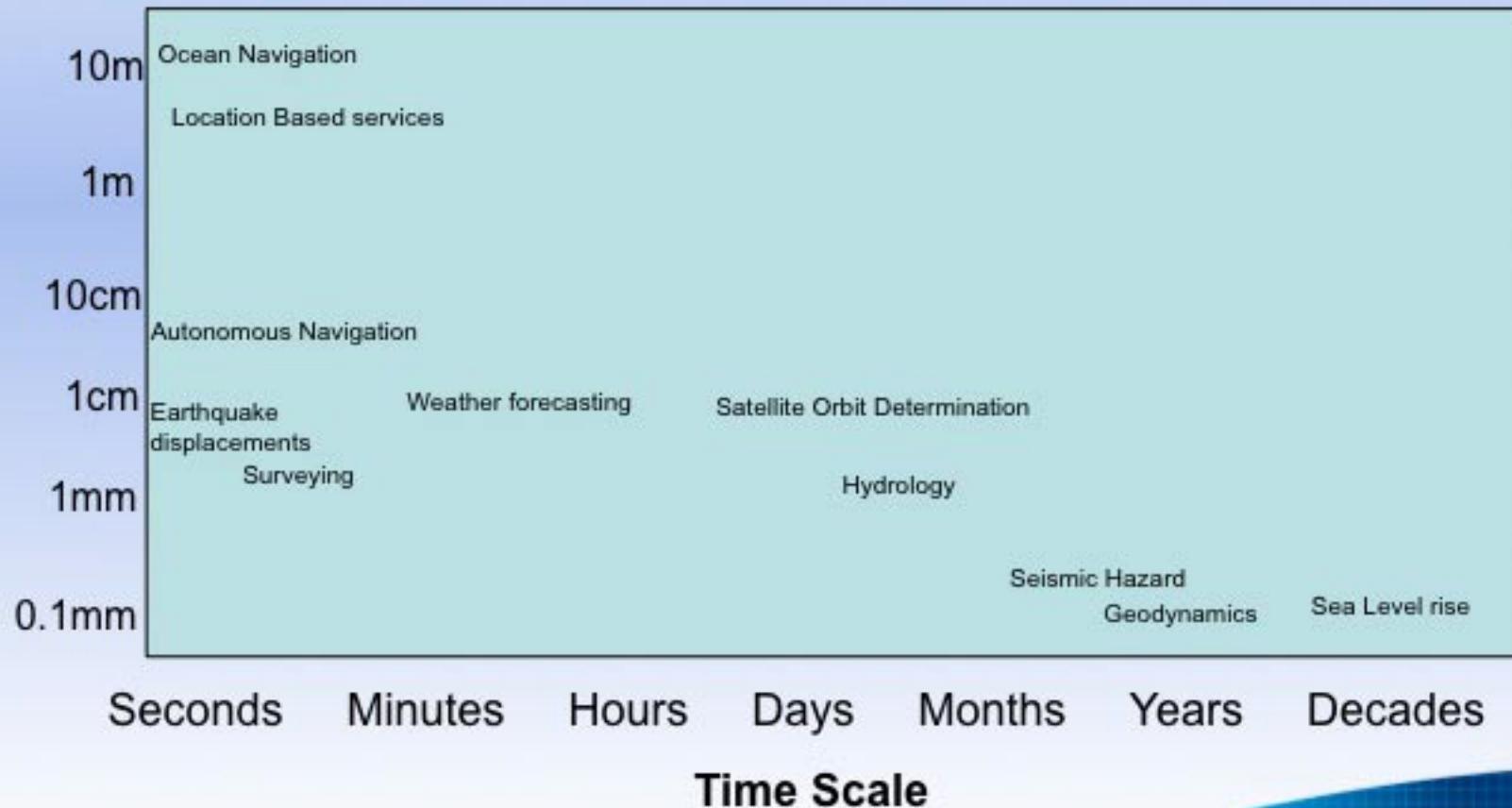
- Geodesy has historically been used for generating a coordinate framework for mapping and the spatial sciences
- Science has driven the need for greater accuracies
- Society has also built a heavy reliance on accurate positioning
- Geophysical signals were once considered to be noise to geodesists, now geodesy is used as a tool for detection and measurement of these signals
- The International Association of Geodesy (IAG) has developed the Global Geodetic Observing System to face the ongoing challenge of greater accuracies and the study of Earth processes



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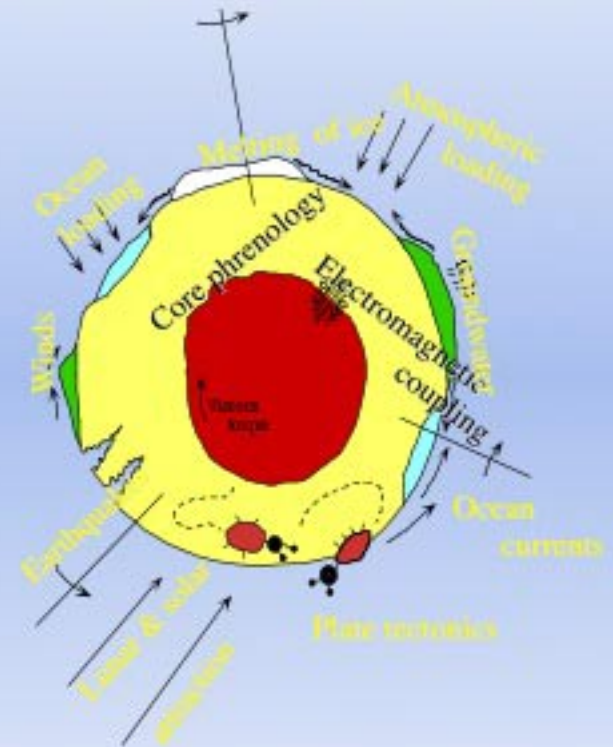
# Geodetic Time scale





## How has Geodesy changed

- Accuracies continue to improve generally by an order of magnitude every decade
- Higher Temporal Resolution  
Higher Spatial Resolution
- The number of users has grown by several orders of magnitude  
Australia is a dynamic continent on a deforming planet

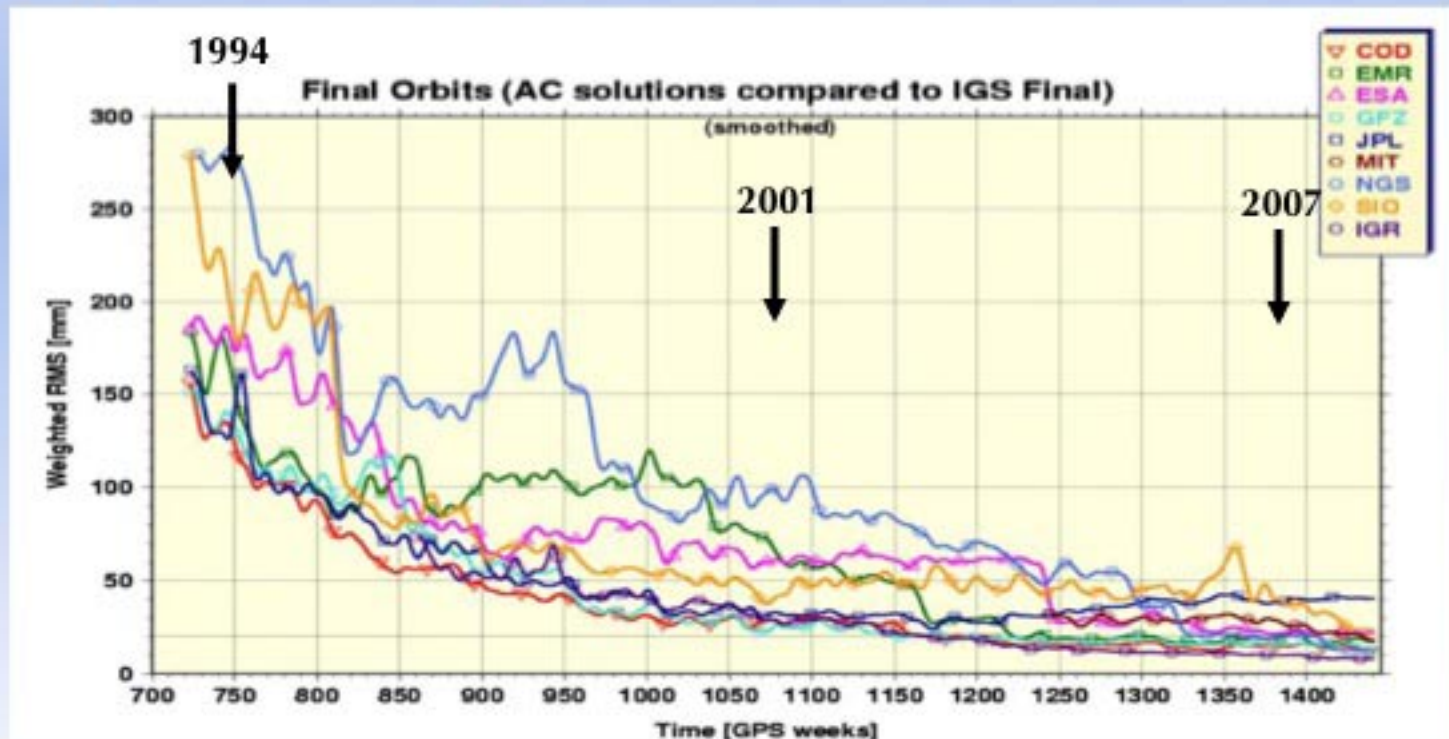




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## What are the attributes of a dynamic system that we want





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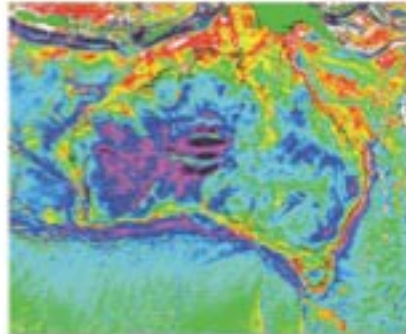
# Global Geodetic Observing System (GGOS) – 3 pillars of Geodetic Science

## Shape of the Earth



Large Scale Tectonic Movement  
to Local Deformation

## Earth's Gravity Field



Derived from Satellite Laser Ranging,  
surface measurements,  
and satellite platforms

## Earth's Rotation Rate



Fundamental to all Space Based Activity  
Calculated from VLBI



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# Global Geodetic Observing System

Provides quantitative measurements of the dynamic nature of the Earth including:

- Plate tectonics / intraplate tectonics
- Anthropogenic Subsidence
- Earthquake induced crustal deformation
- Sea Level Rise
- Atmospheric Modelling

**The key product is the International Terrestrial Reference Frame (ITRF), which is a fully dynamic global coordinate system**



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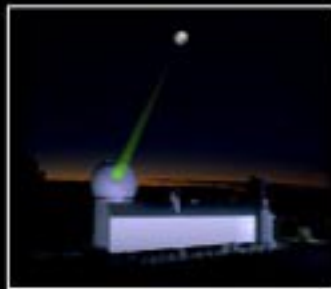
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# Australia's role in defining the ITRF – contributing to GGOS

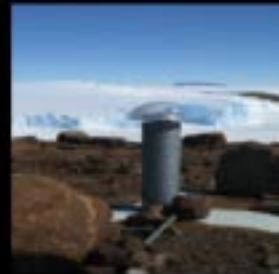
VLBI



SLR



GPS



Gravity



Inter-technique Local Tie Surveys



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## **AuScope Geospatial**

- 3 new 12m VLBI telescopes;
- A VLBI observation correlation facility;
- 4 new Gravity instruments (1 Microg FG5 absolute gravimeter plus 3 gPhone Earth Tide Metres) and observation program around a national network;
- A Laser power upgrade at the Mt Stromlo Satellite Laser Ranging observatory;
- 100 new GNSS sites



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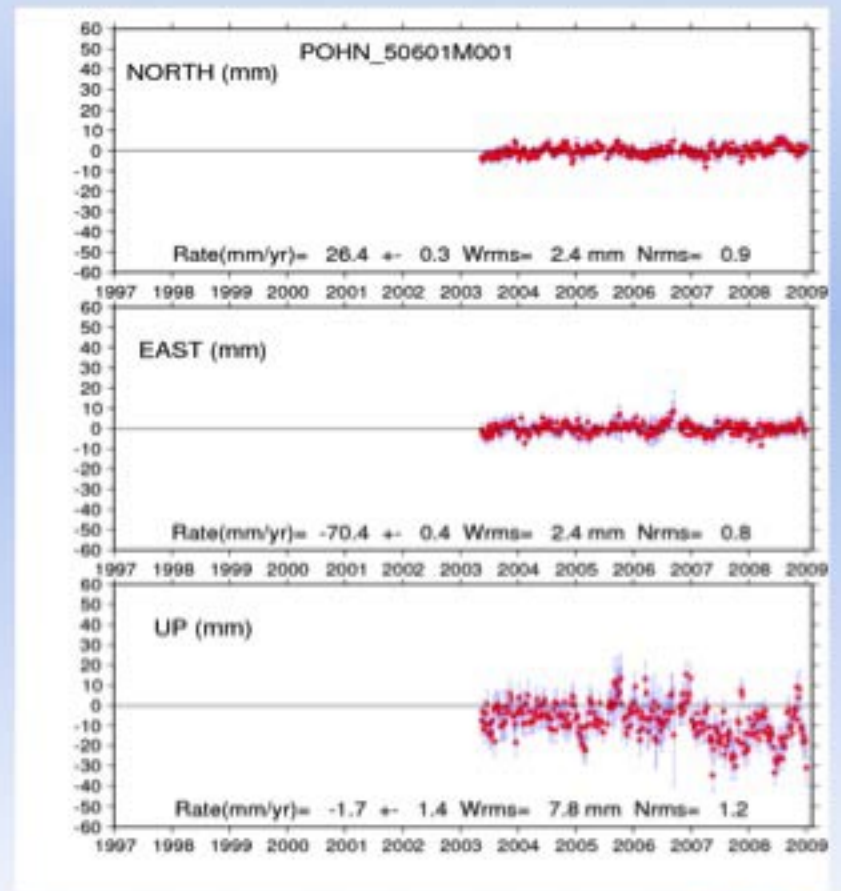
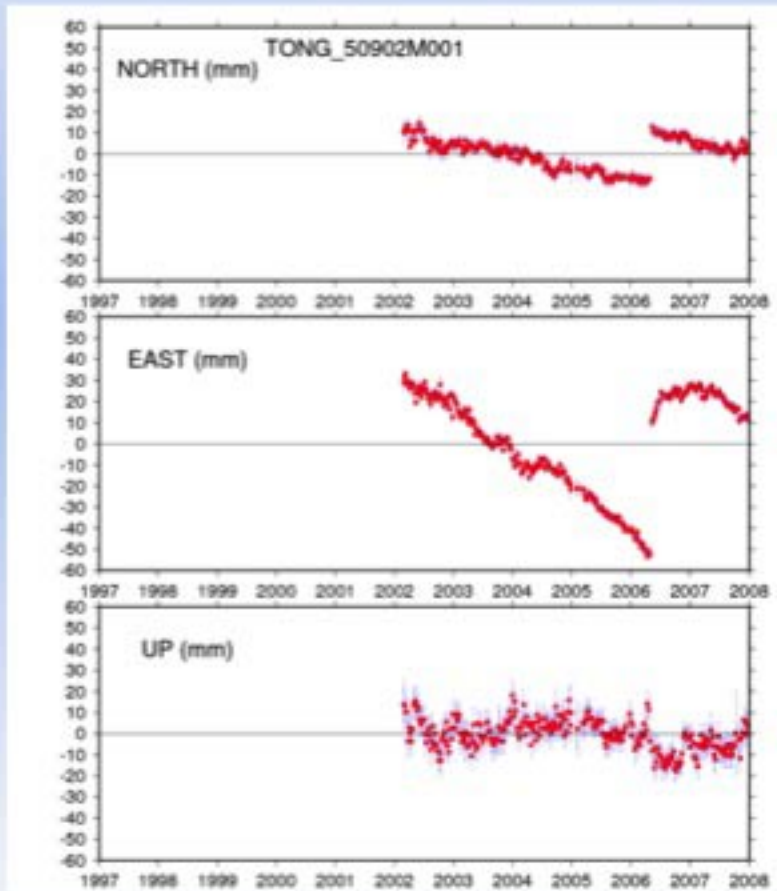
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# Infrastructure Distribution





## Time Series steps

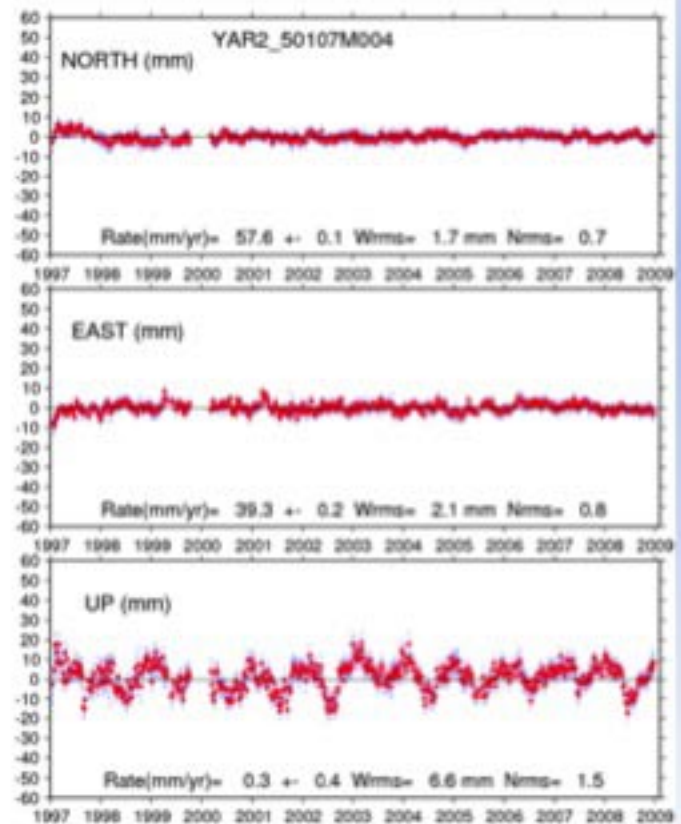
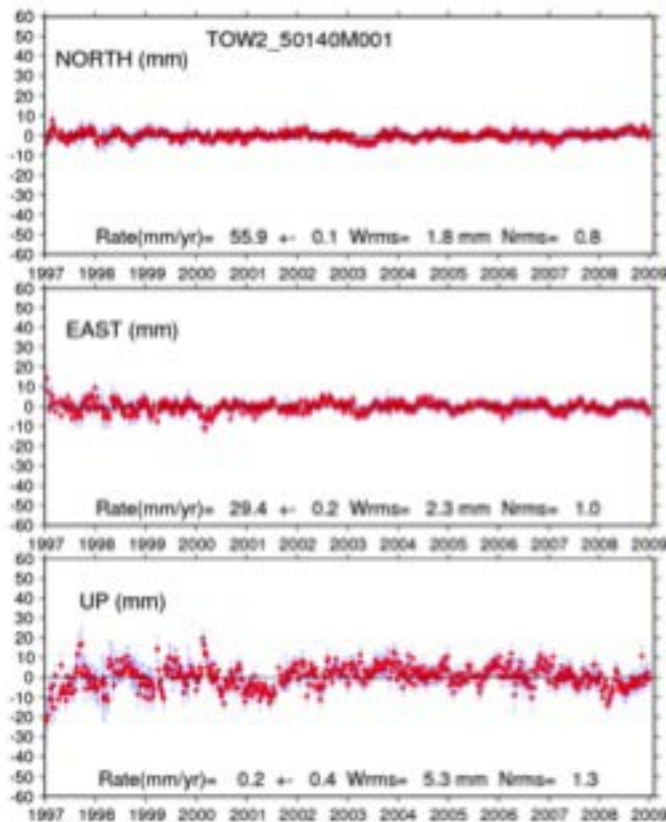




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# Time series signals





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## Step 2

- AuScope provided the national framework and connection to GGOS
- Spatial resolution is however still  $> 200\text{km}$
- AuScope+ provides finer spatial resolution and introduces new geodetic imaging techniques
- AuScope+ also provides for refinement of accuracies through system calibrations



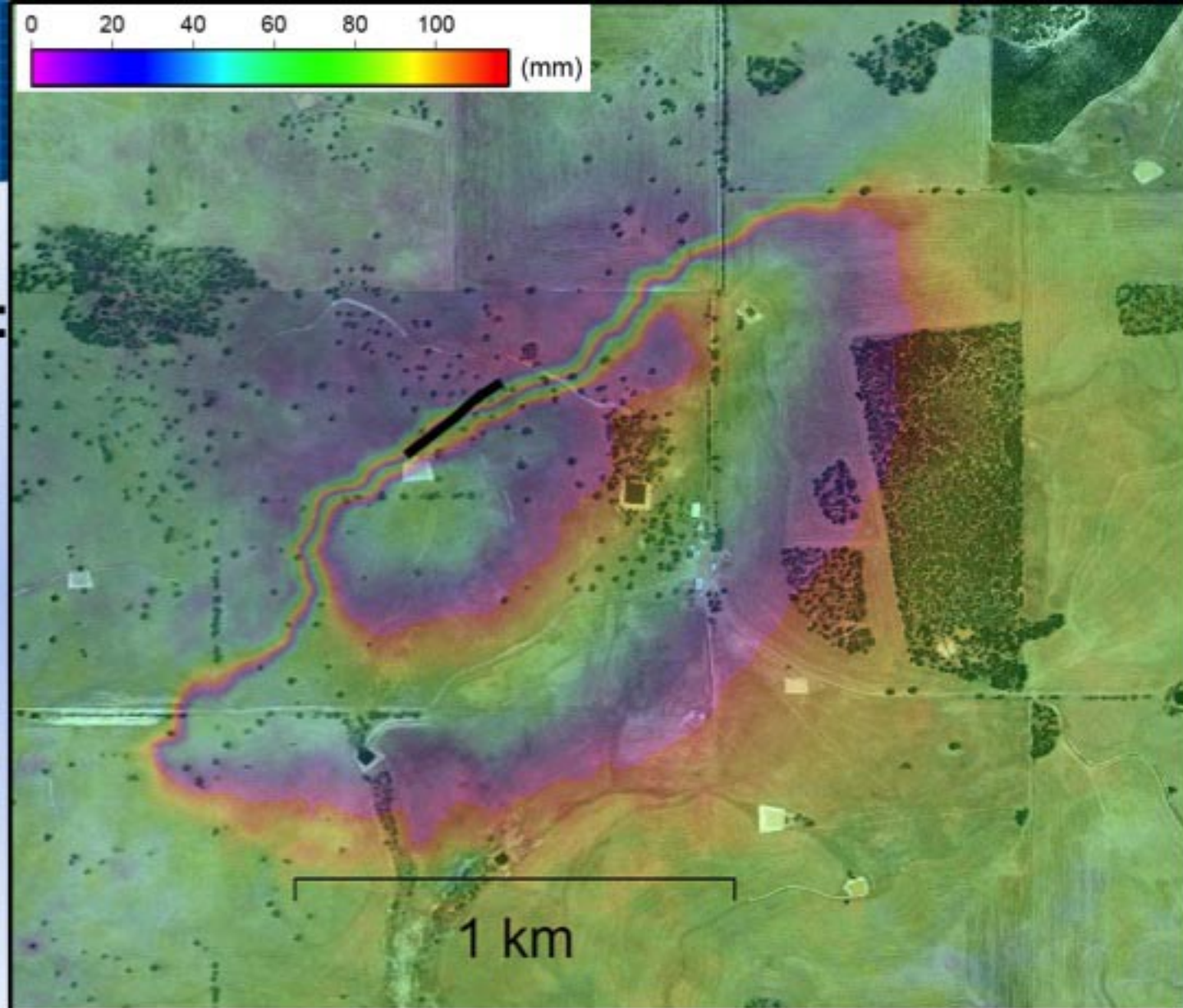
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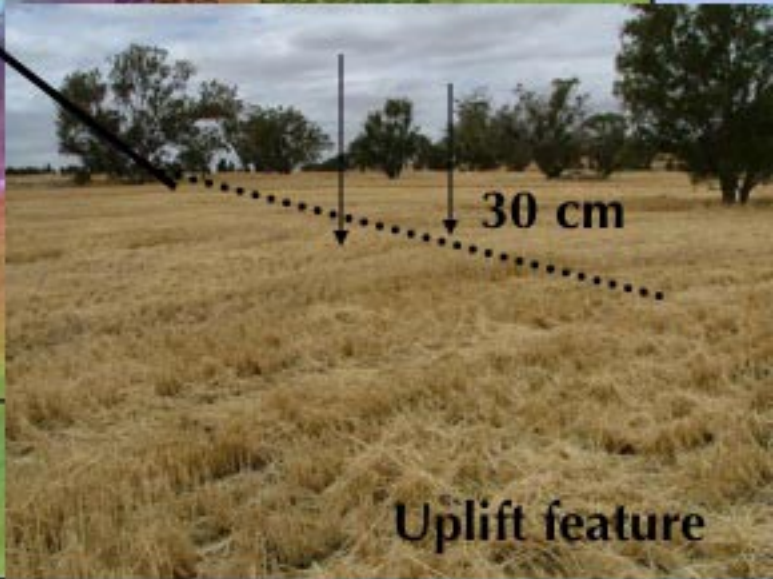
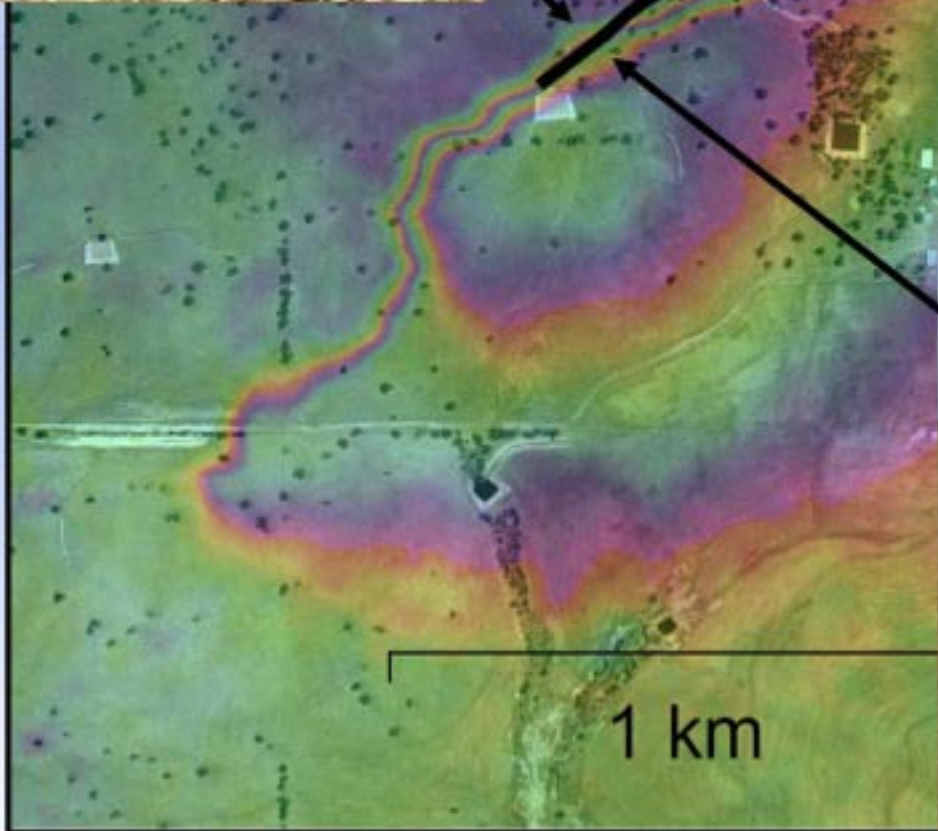
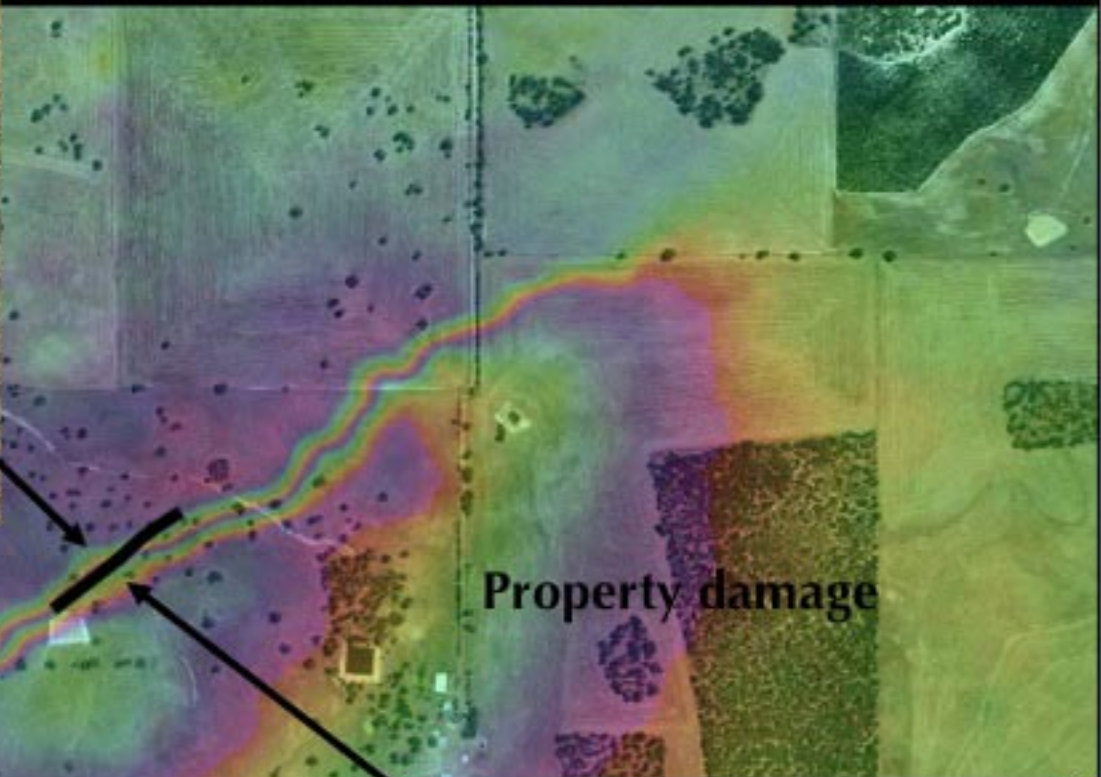
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## **AuScope+**

- A pool of GNSS instrumentation (100 sets)
- A geodetic calibration system including VLBI and GNSS antenna measurement systems
- Construction of arrays of survey marks for use with the pool of GNSS equipment and radar reflectors
- Installation of the 4 new permanent GNSS stations at key sites
- Development of a Remote sensing web portal including a pool of INSAR data

**InSAR  
Deformation:  
M4.7  
Katanning  
Earthquake**







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## Looking Forward

- Need to incorporate desirable attributes of ITRF into a national geodetic systems
  - Continually refined
  - Observes Earth dynamics
- Geodetic Imaging possible through multi technique combinations(GNSS and INSAR)
- Higher temporal and spatial resolutions will allow the study of signals not previously detected



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## Conclusion

- GGOS and the IAG services have developed systems, data and methodologies for measuring with a dynamic Earth
- AuScope is developing the tools to follow the GGOS example in an Australian context
- Trend towards greater temporal and spatial resolution will continue resulting in near real time geodetic imaging
- The resultant dynamic coordinate system will keep Australia's positioning applications accurate and current, and therefore internationally competitive