Australian Government

Geoscience Australia

Evolving a new Geodetic Positioning Framework: An Australian Perspective

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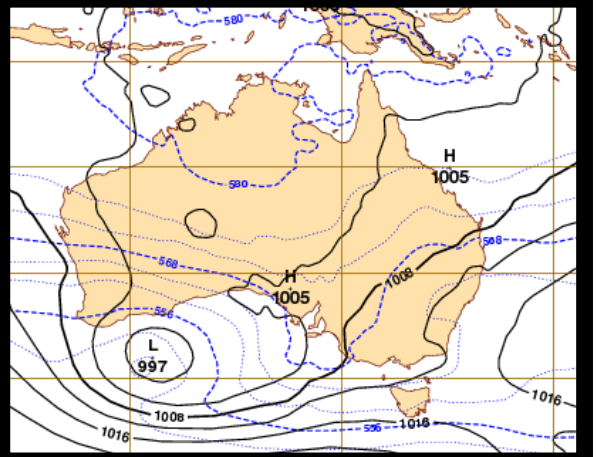
Outline

- Introduction
- Precise Positioning
- National Geospatial Reference Systems
- Asia Pacific Reference Frame
- IAG's Global Geodetic Observing System
- Conclusion

Precise Positioning

- Real time positioning
- Focus is on the interaction between instantaneous precise positioning (<5cm) and spatial data
- Applications are numerous
- Applications produce economic efficiencies, public good benefits and support Critical Infrastructure elements
- Accuracy and integrity requirements are increasing
- Precise positioning capability is not uniformly available globally because of infrastructure requirements and service provision
- Relies on accurate coordinate reference framework

GNSS supports a diverse market for positioning applications & critical infrastructure



Land, Sea, Air Navigation
- Aviation
- Marine navigation
- Fleet management
- Intelligent transport

Surveying and Mapping
- Civil engineering
- Mining
- Precision agriculture
- GIS

Military Applications
- Target designation
- Smart weapons
- Air support

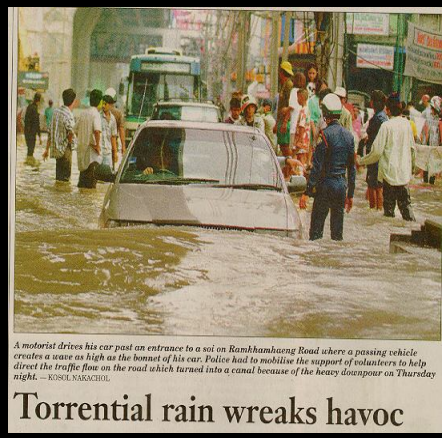
Recreational Uses
- Hiking
- Image referencing

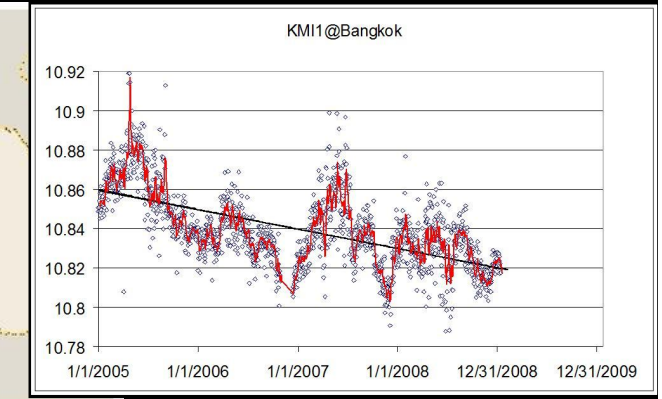
Timing
- Time transfer
- Financial transactions
- Cellular networks
- Electrical power grids

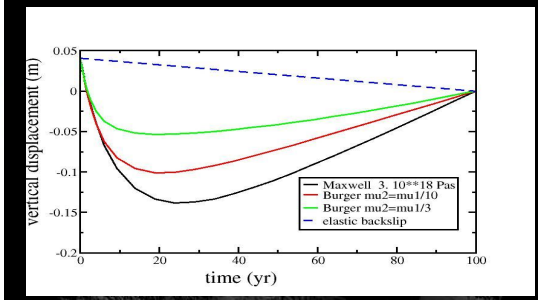
Scientific Research
- Tectonic movement detection
- Deformations
- Datum
- Environmental studies
- Forestry & Fisheries

Neotectonics

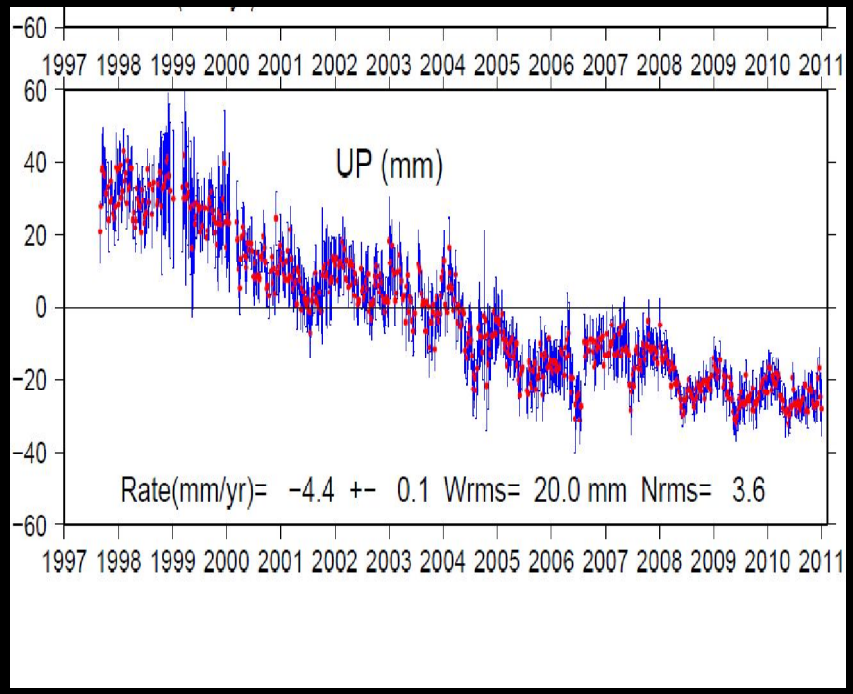
- Example: Bangkok from *Satirapod et al, IUGG 2011*
- Post Sumatra-Andaman Earthquake deformation in Bangkok is 10 mm yr^{-1}
  - Not clear how long this deformation will continue for? 25 Years
- Sea level change in Gulf of Thailand is 4-5 mm yr^{-1}

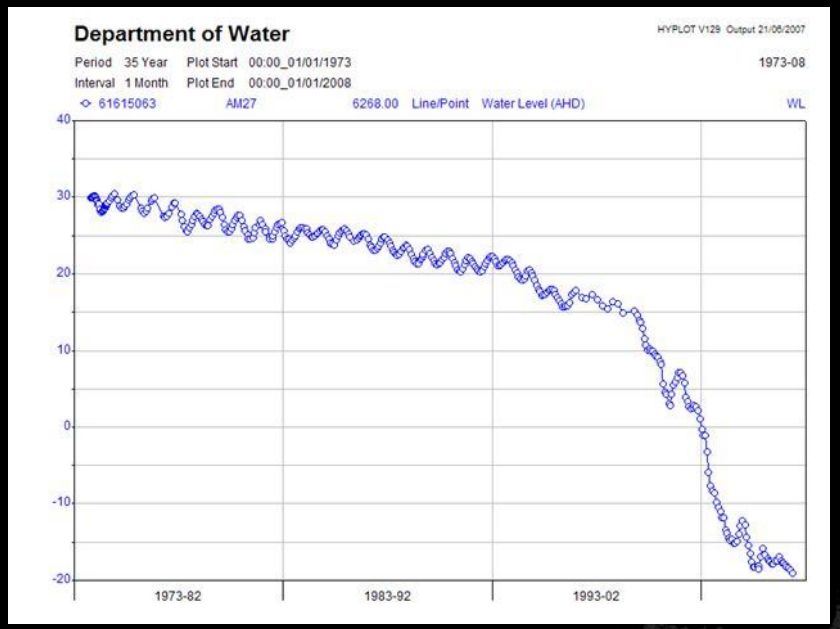






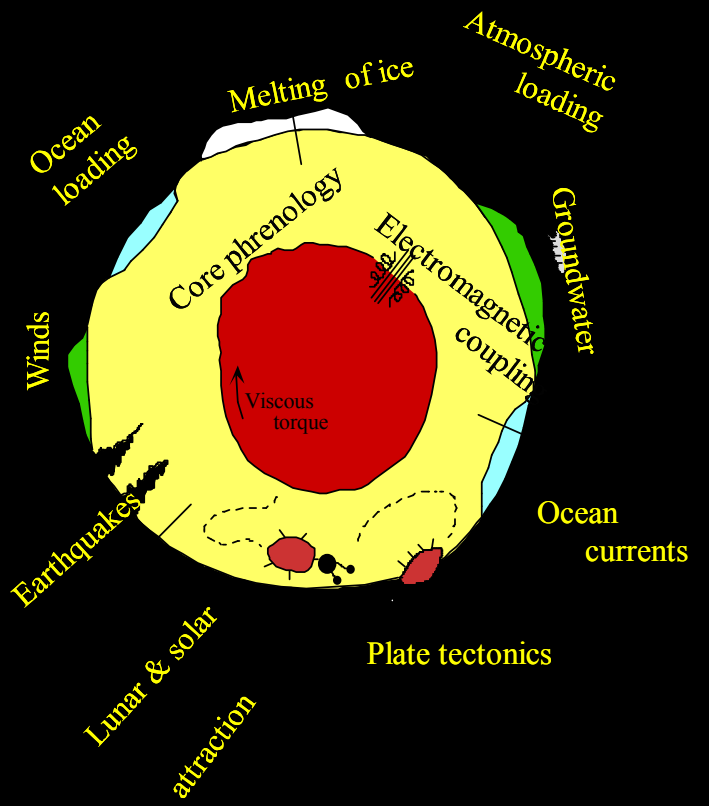
GPS monitoring of subsidence caused by groundwater pumping in Perth WA





National Geospatial Reference Systems

- Accuracies continue to improve generally by an order of magnitude every decade
- The number of users needing access to the datum is growing rapidly
- The Earth is a dynamic planet

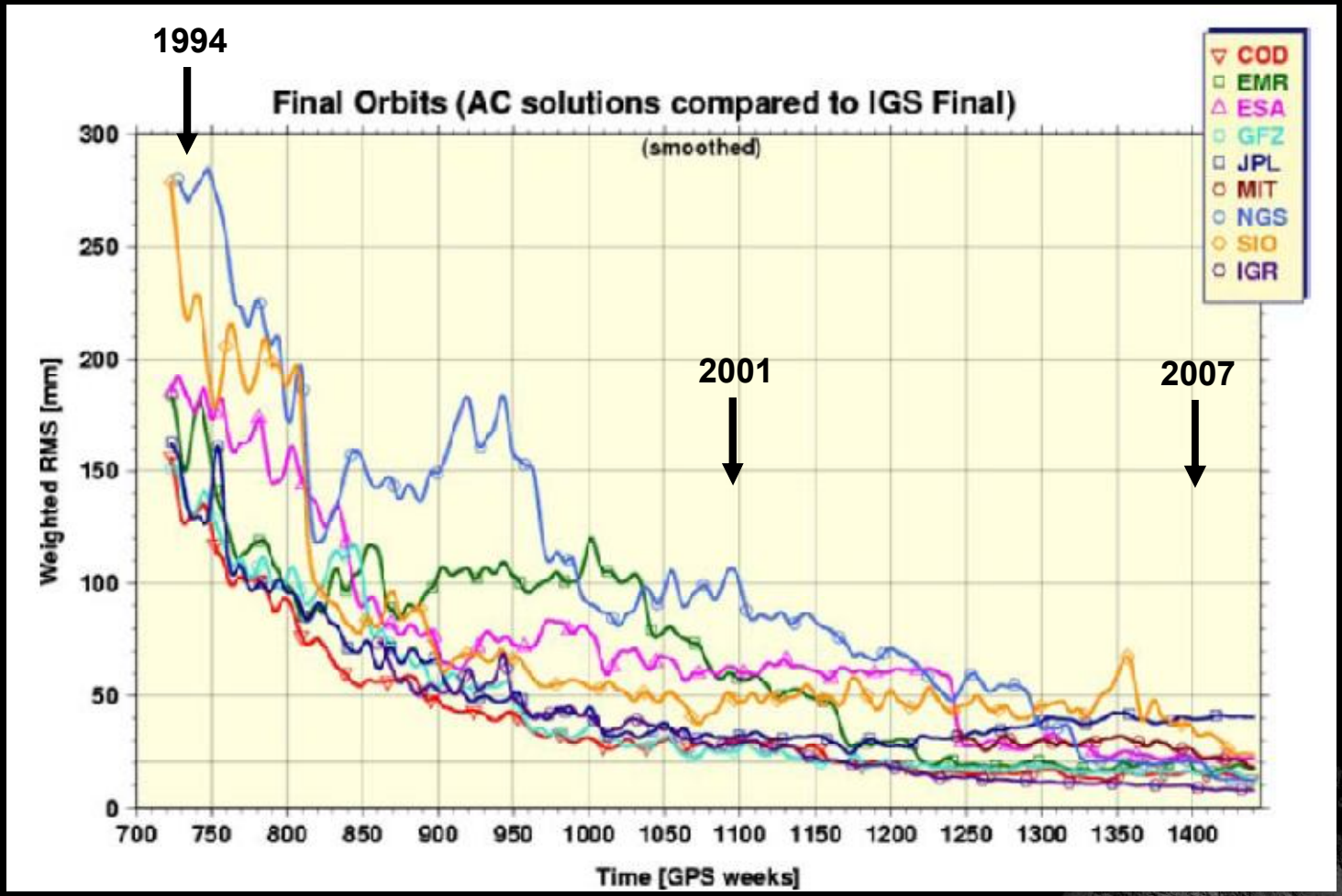


- Static National Datum no longer serving the precise positioning applications

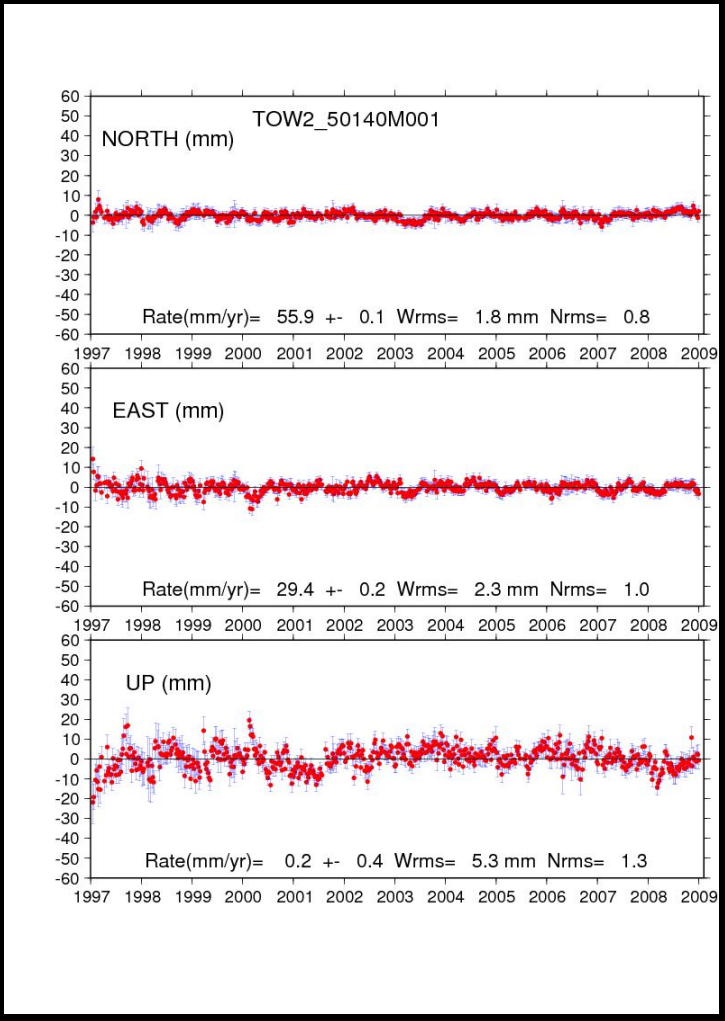
National Geospatial Reference System (Datum)

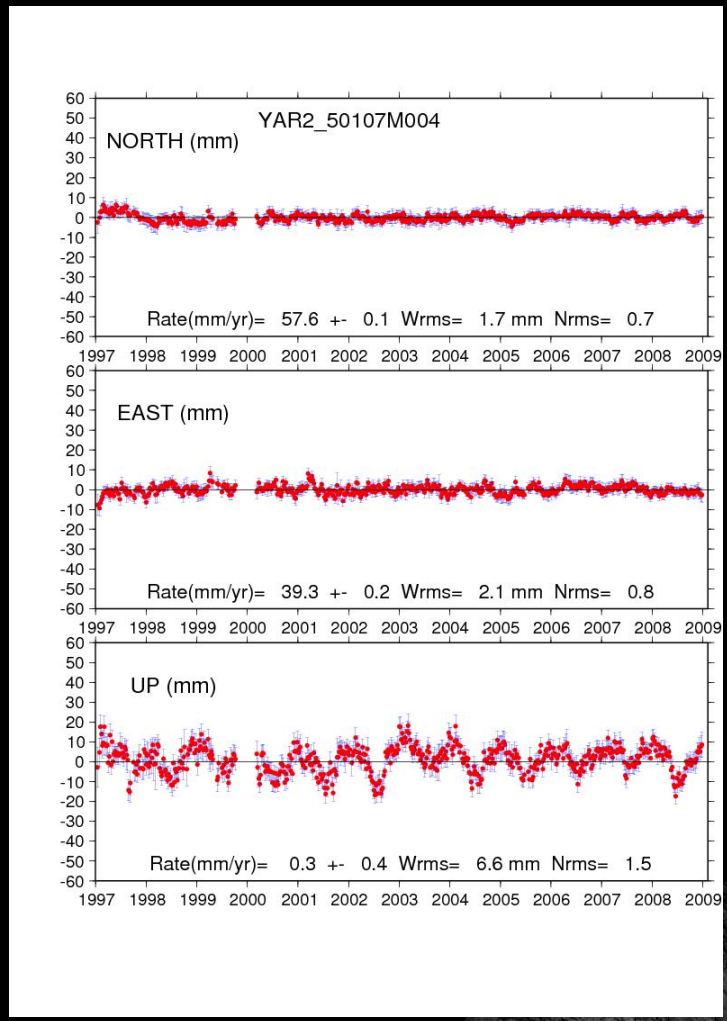
- Need to be a coordinate framework that is accurate, reliable and accessible
- Linkage to an International Reference Frame that is accurate and stable
- Flexible enough to allow for tectonic and measurement science changes
- Must provide systems and tools to allow the transformation of legacy data onto the current reference system

What are the attributes of a dynamic system that we want

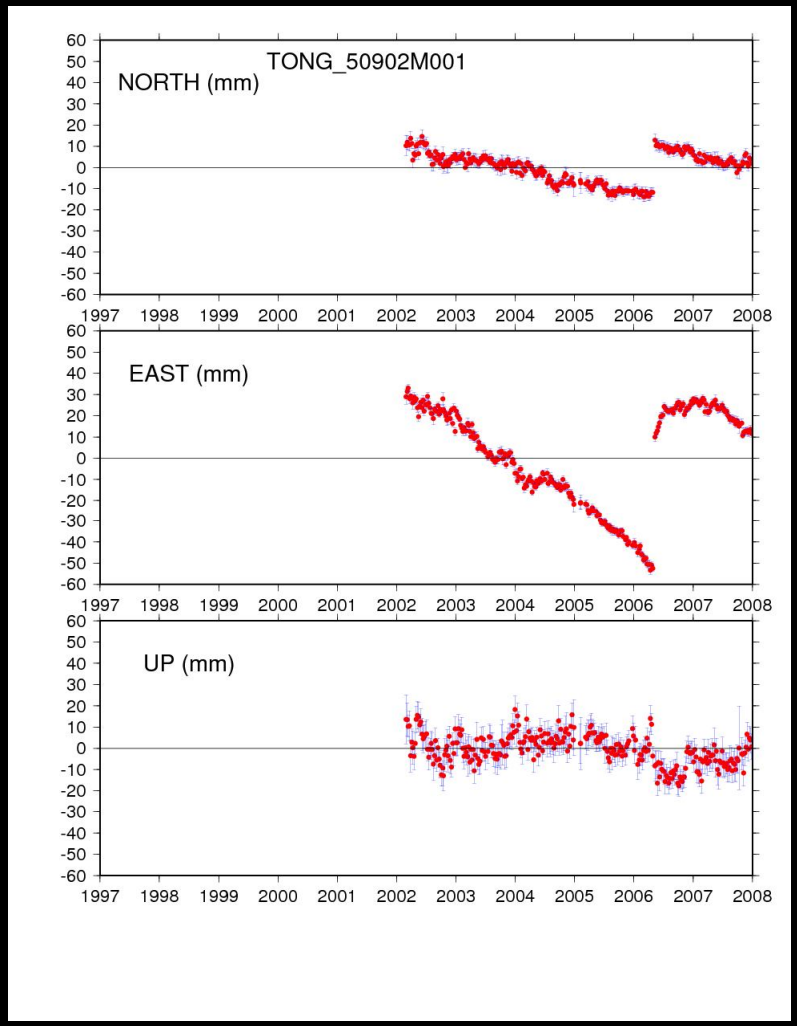


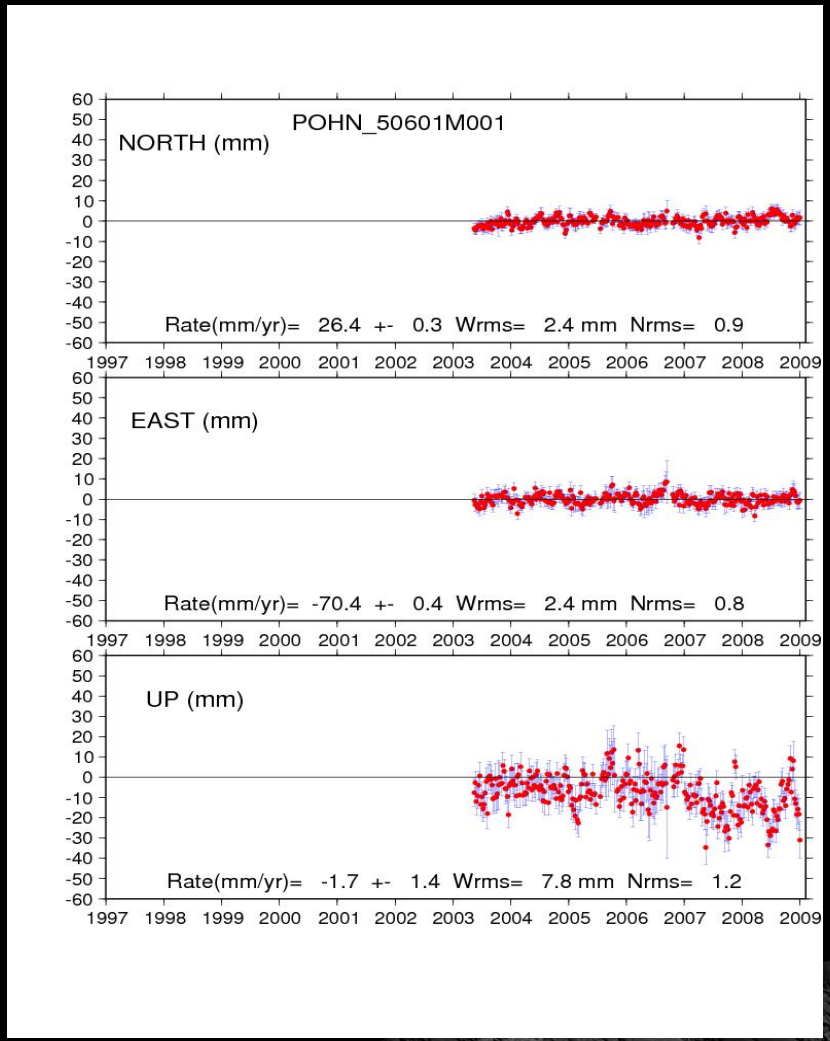
Time series signals



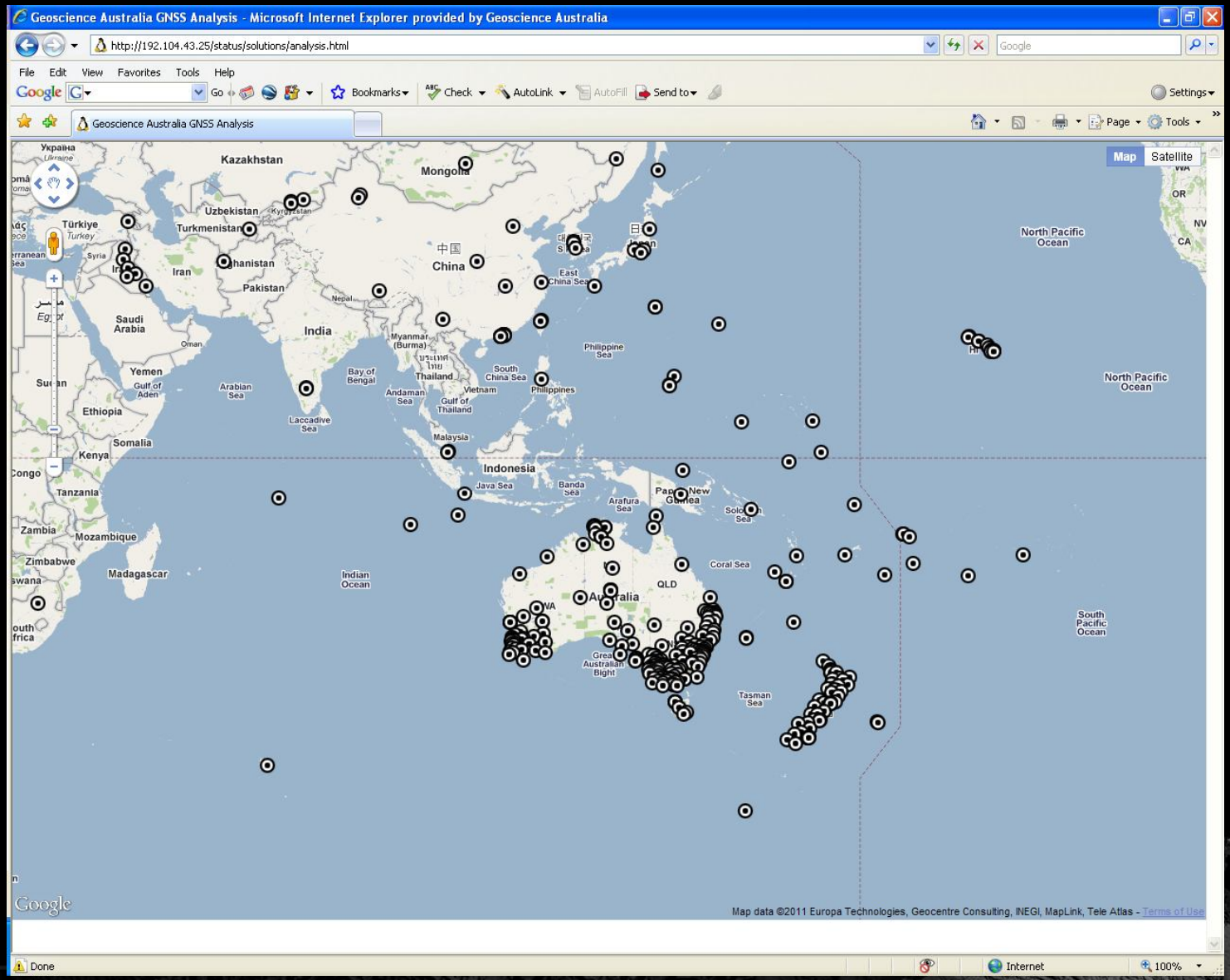


Time series steps

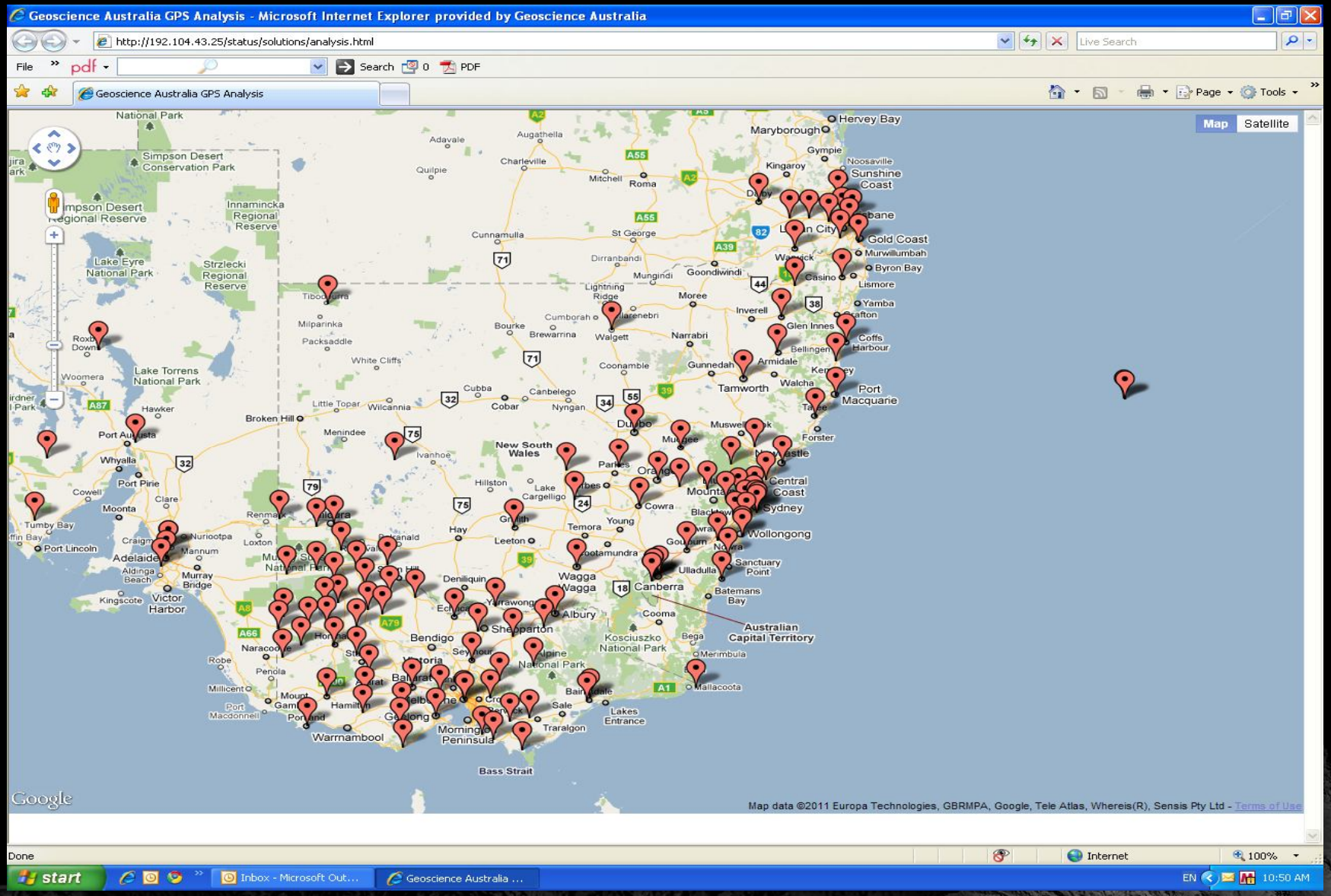




Asia Pacific Reference Frame (APREF) Network

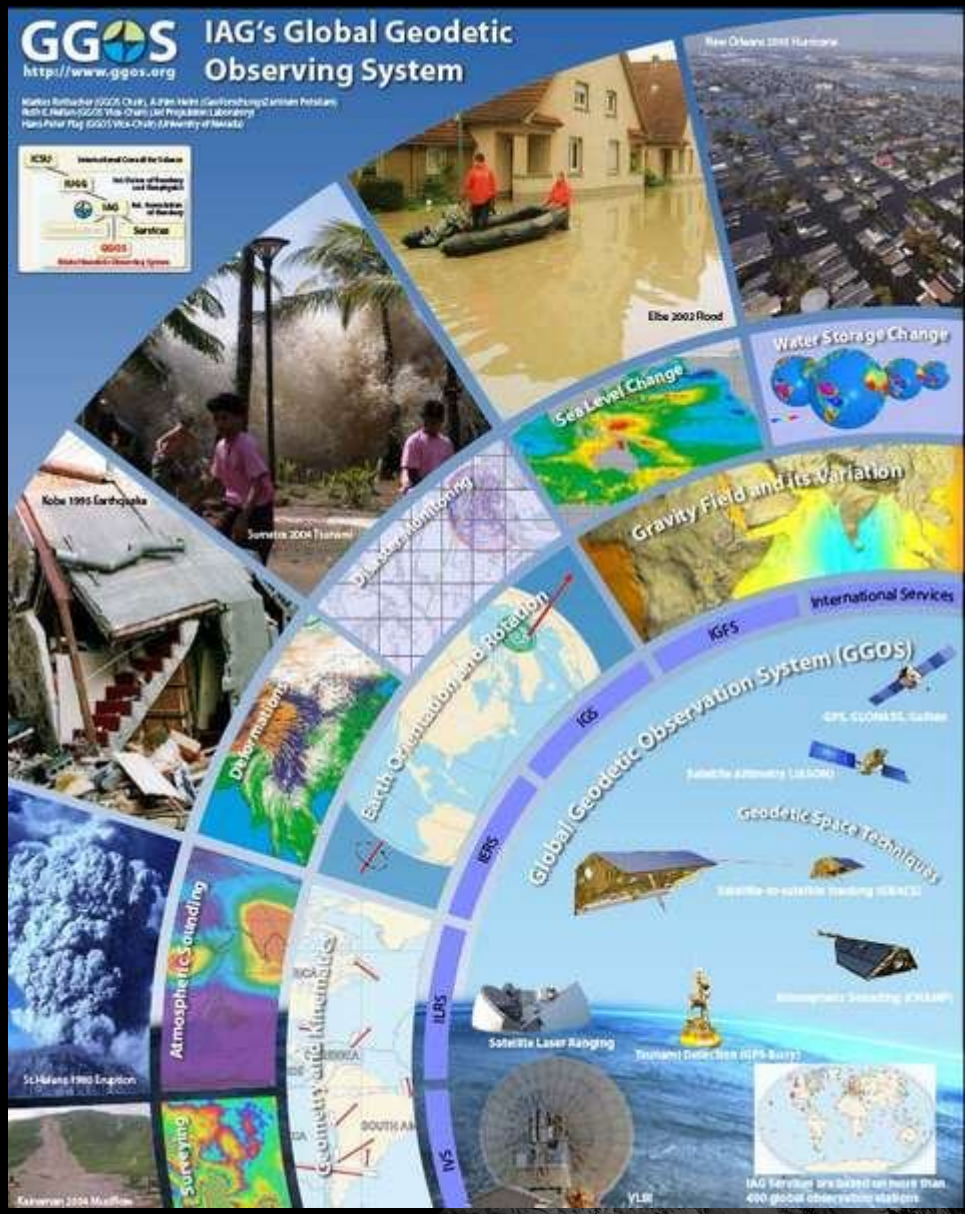


GNSS sites across SE Australia



Global Geodetic Observing System

- A uniform coverage of observing techniques
- Modern and sustainable infrastructure
- Continued refinement of analysis techniques
- Product development underpinned by robust science

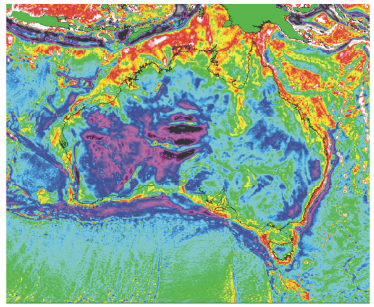


Global Geodetic Observing System (GGOS)

Shape of the Earth

Large Scale Tectonic Movement
to Local Deformation

Earth's Gravity Field



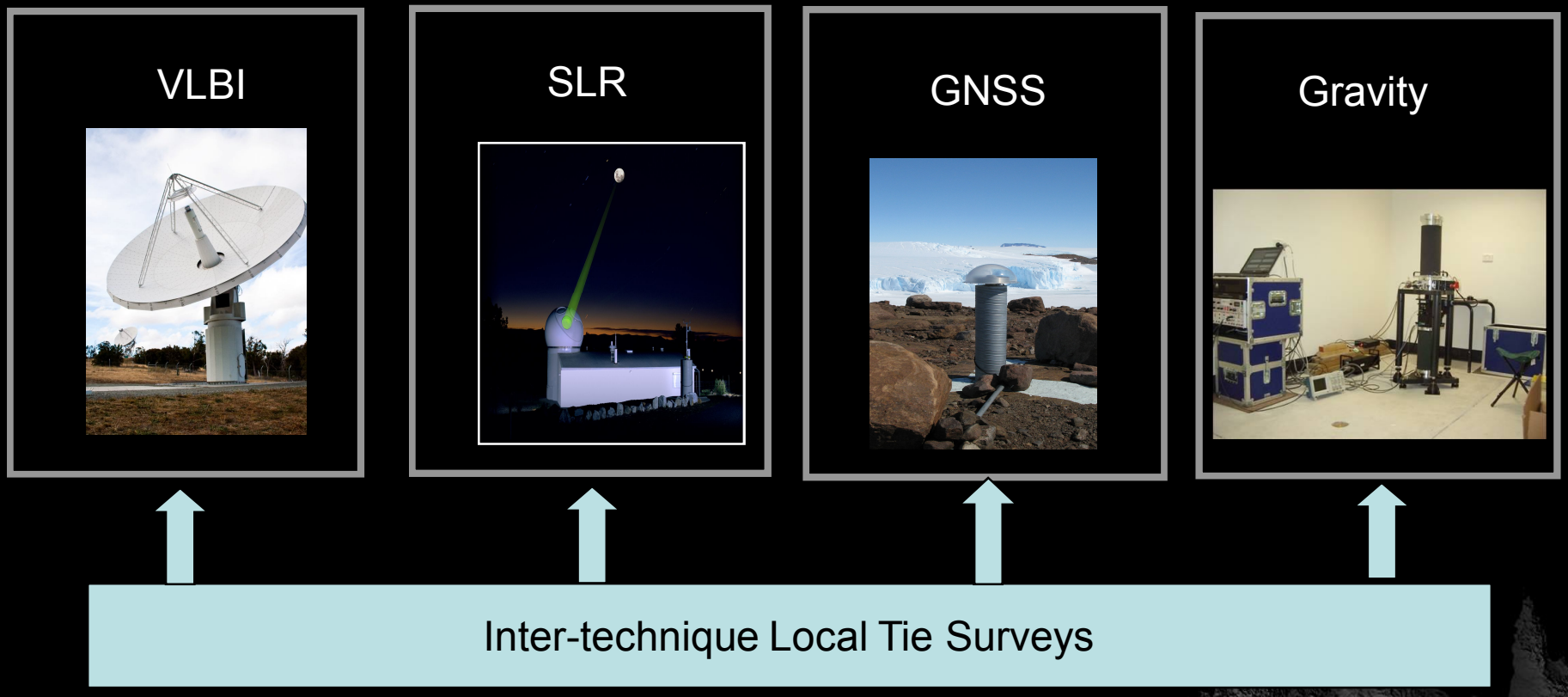
Derived from Satellite Laser Ranging,
surface measurements,
and satellite platforms

Earth's Rotation Rate

Fundamental to all Space Based Activity
Calculated from VLBI

- 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

Australia's contribution to the definition of the International Terrestrial Reference Frame – through GGOS

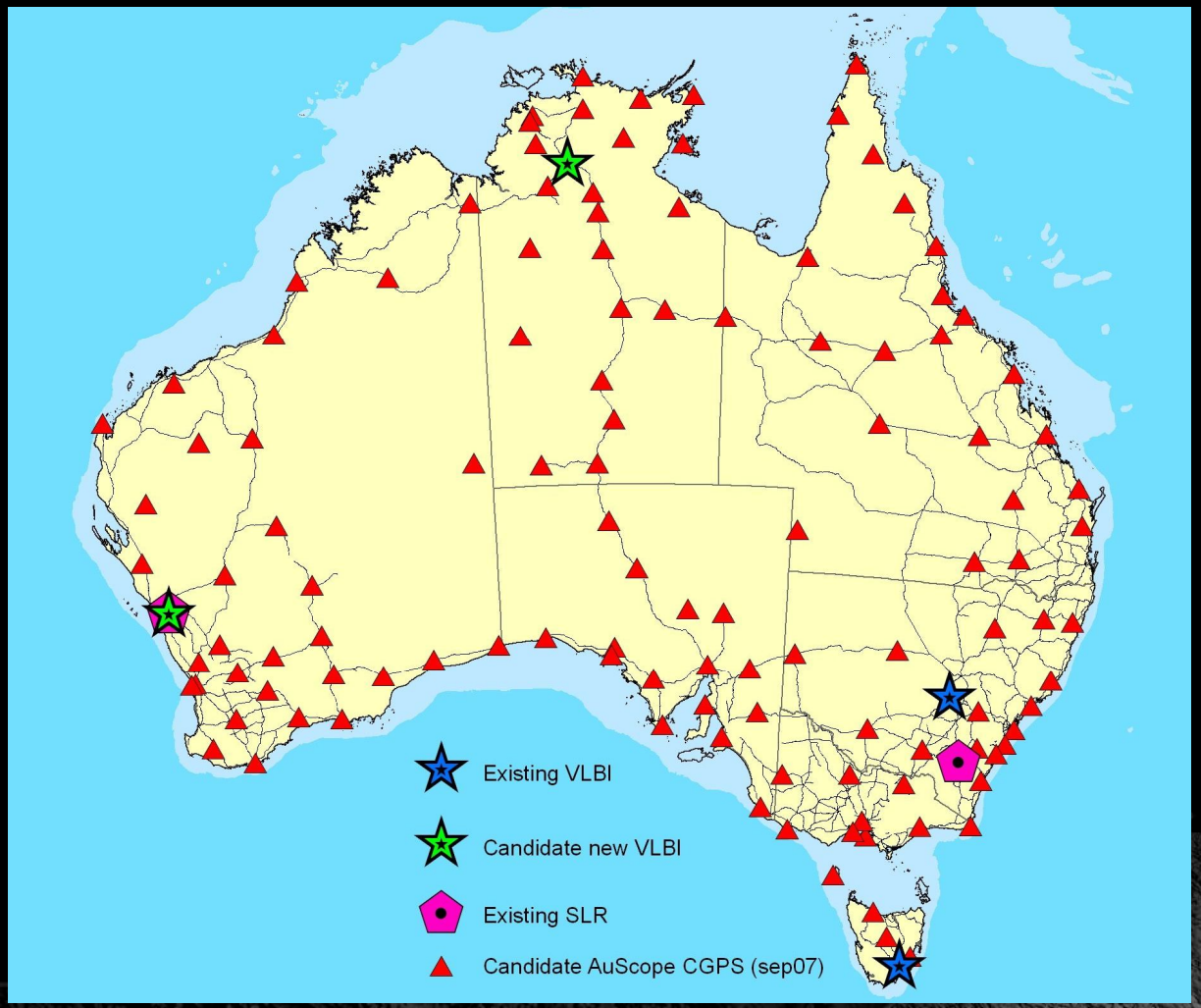


AuScope Geospatial Infrastructure Program

- 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

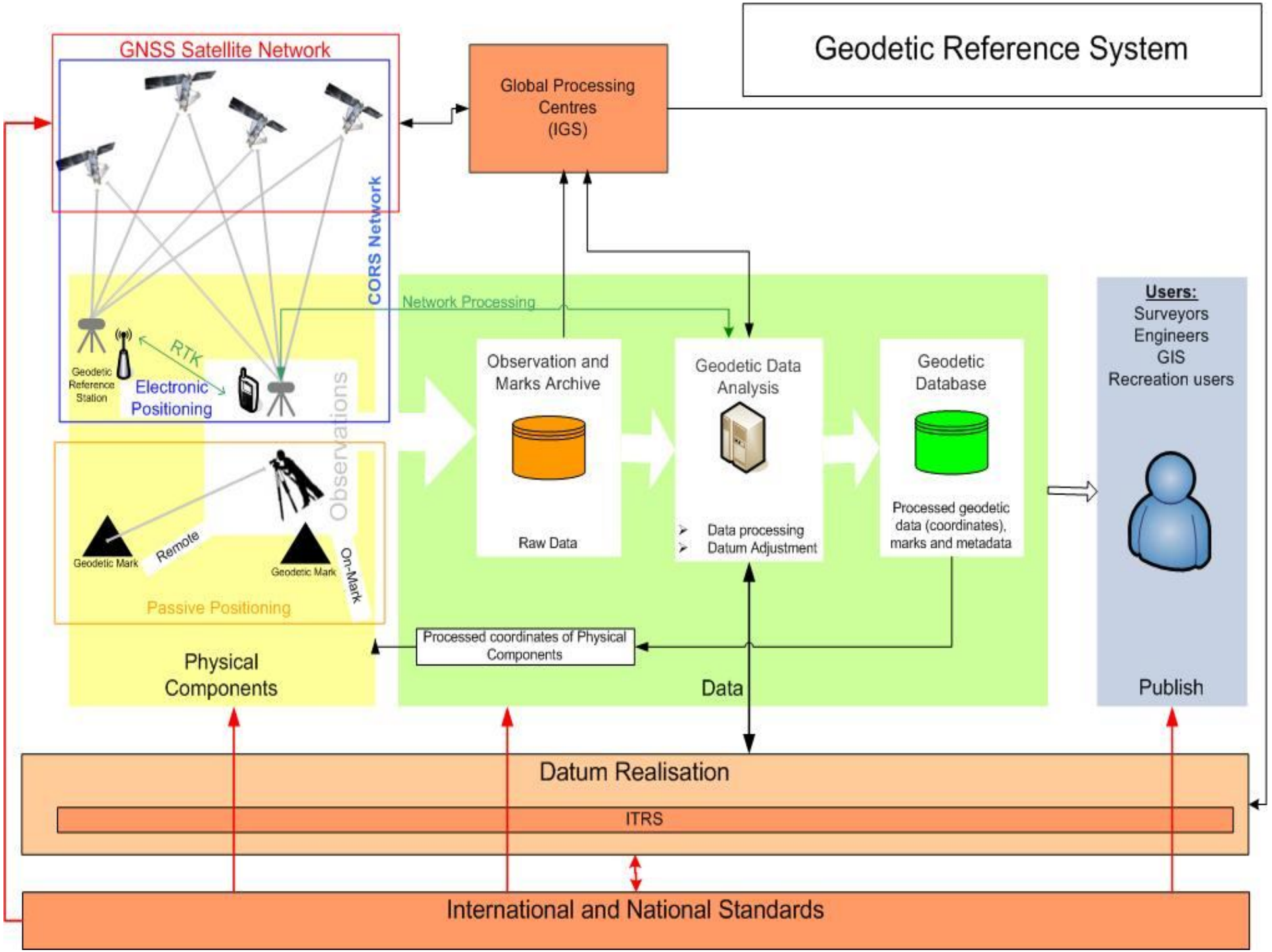
VLBI Telescopes at Hobart, Katherine and Yarragadee

AuScope GNSS Network with VLBI and SLR sites

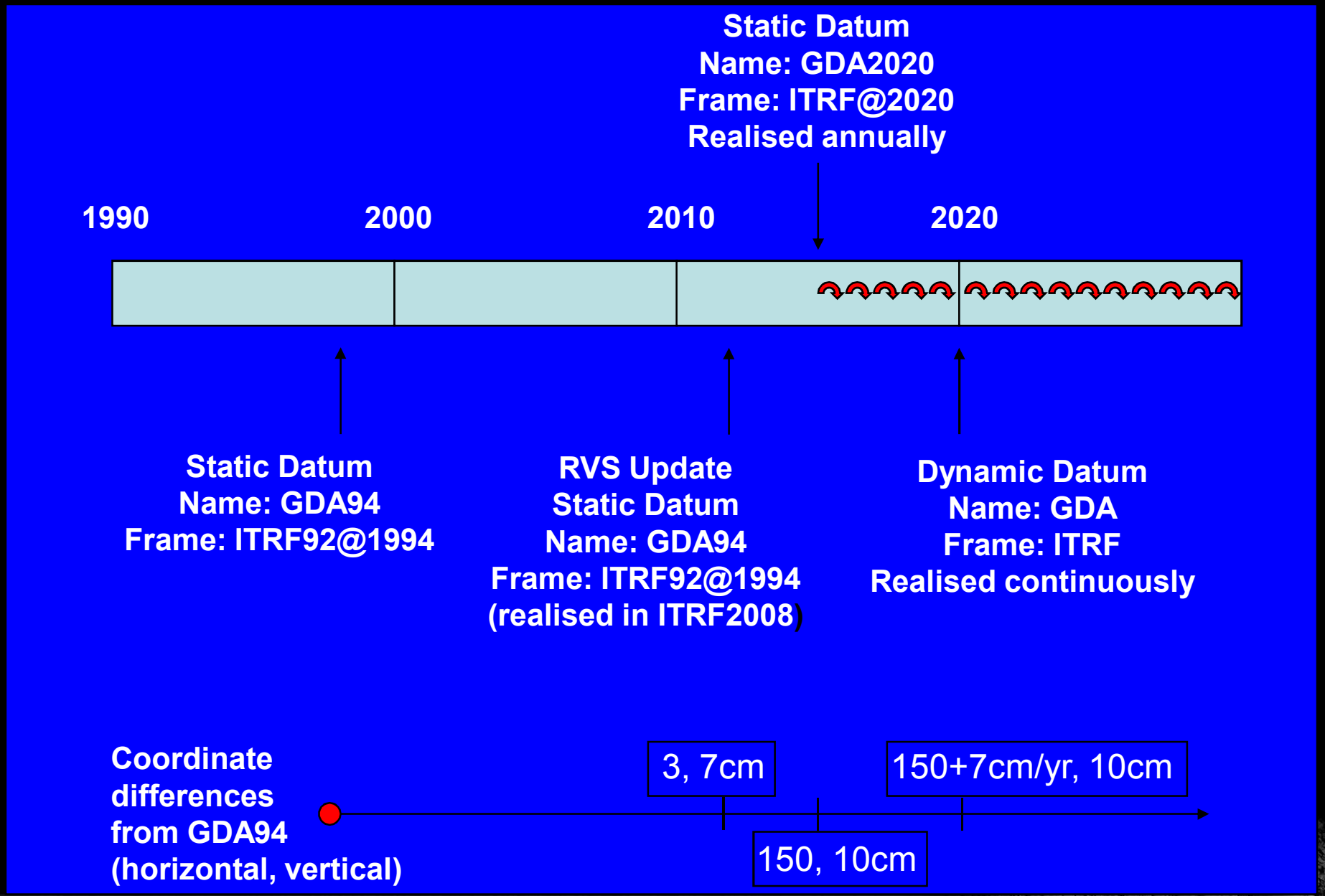


Australian Geophysical Observing System

- 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

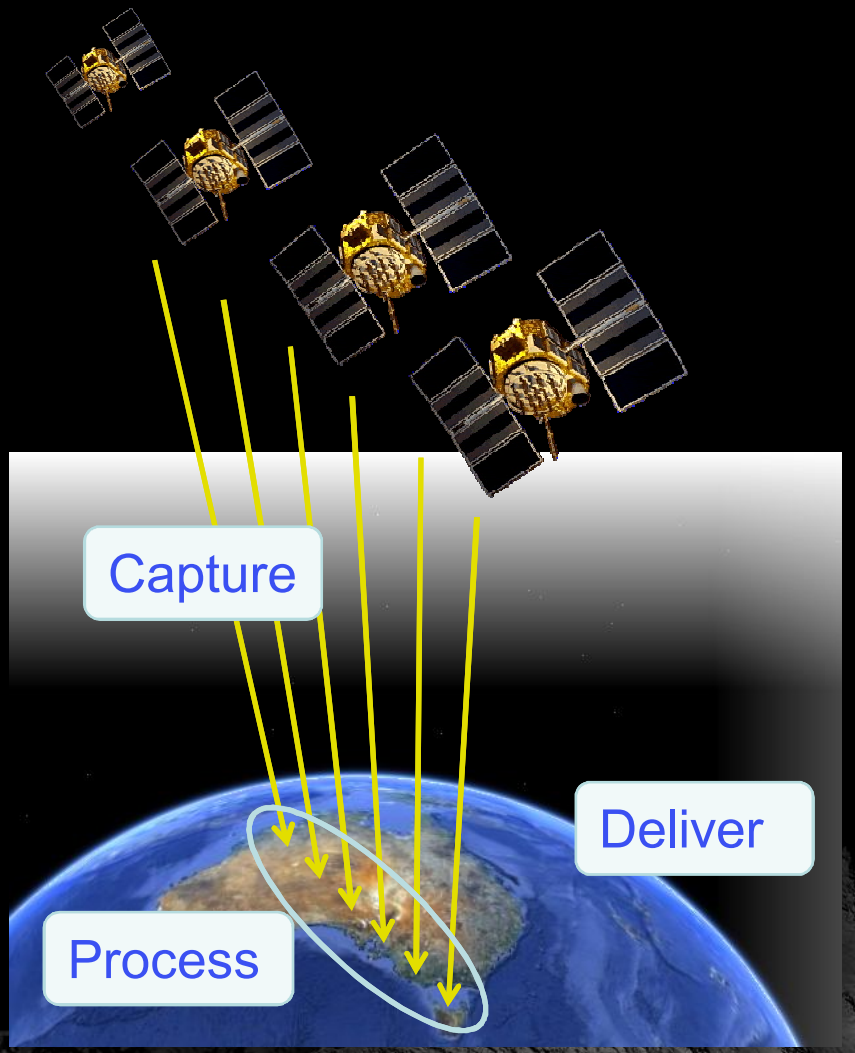

Geodetic Reference System
GNSS Satellite Network
Global Processing Centres (IGS)
CORS Network
Network Processing
Geodetic Reference Station
RTK
Electronic Positioning
Observations
Geodetic Mark
Remote
Geodetic Mark
On-Mark
Passive Positioning
Physical Components
Observation and Marks Archive
Raw Data
Geodetic Data Analysis
Data processing
Datum Adjustment
Geodetic Database
Processed geodetic data (coordinates), marks and metadata
Processed coordinates of Physical Components
Data
Users:
Surveyors
Engineers
GIS
Recreation users
Publish
Datum Realisation
ITRS
International and National Standards

National Geodetic Datum - Roadmap



Next Step – Development of a National Positioning Infrastructure

- End-to-End
- Hardware
- Software
- Monuments
- Communications
- Processing
- Analysis
- Monitoring
- Delivery



Conclusion

- The reliance of national and local positioning capabilities on the Global Geodetic Observing System is growing
- Governments need to consider investing in GGOS infrastructure as well as GNSS infrastructure
- The need for knowledge about the state of the crust; and the down stream benefits of an improved RF are driving greater investment in infrastructure
- Continued effort is required to make data available, and have it analysed homogeneously