Reference Frames and GNSS CORS

Geospatial and GNSS CORS Infrastructure Forum
Kuala Lumpur Malaysia

Dr. John Dawson, Australia

Global Geodetic Reference Frame (GGRF)

- The GGRF underpins the global coordinate system which allows us to know where we and things on the Earth are

- The GGRF requires a well-distributed **global** infrastructure of observatories

- Countries access the GGRF through regional and national GNSS CORS networks

GGRF: Global

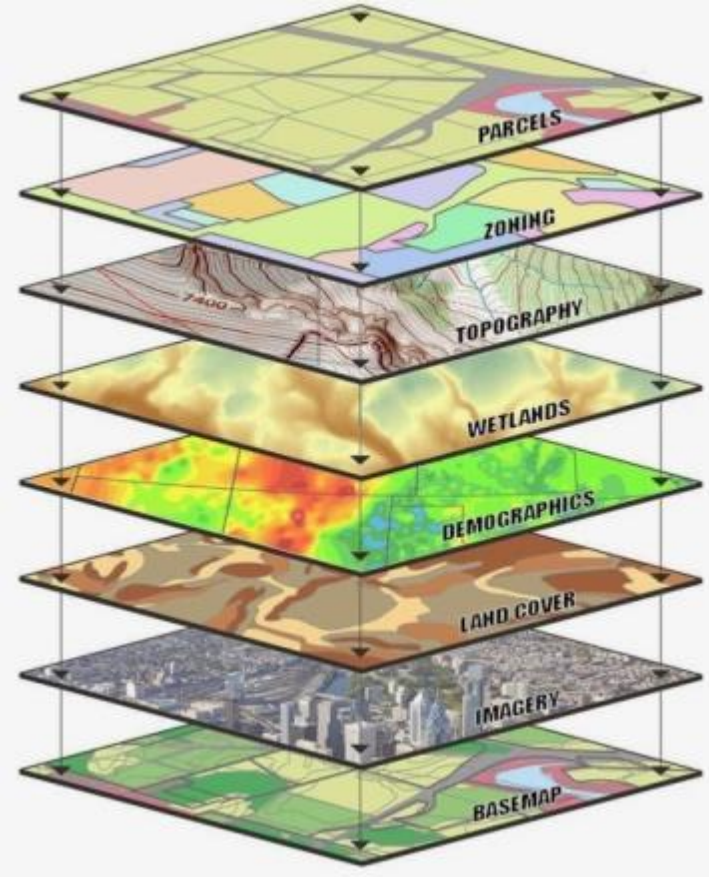
- The GGRF has global science applications and is vital for climate change and disaster risk reduction
- These include measuring sea level change and measuring crustal deformation
- The information derived from the GGRF is important for making decisions and contributes to sustainable development

The GGRF is Important

- Recognising its importance the UN General Assembly adopted resolution 69/266 in February 2015, entitled ‘A Global Geodetic Reference Frame for Sustainable Development’

- Important opportunity for agencies with geodetic programs

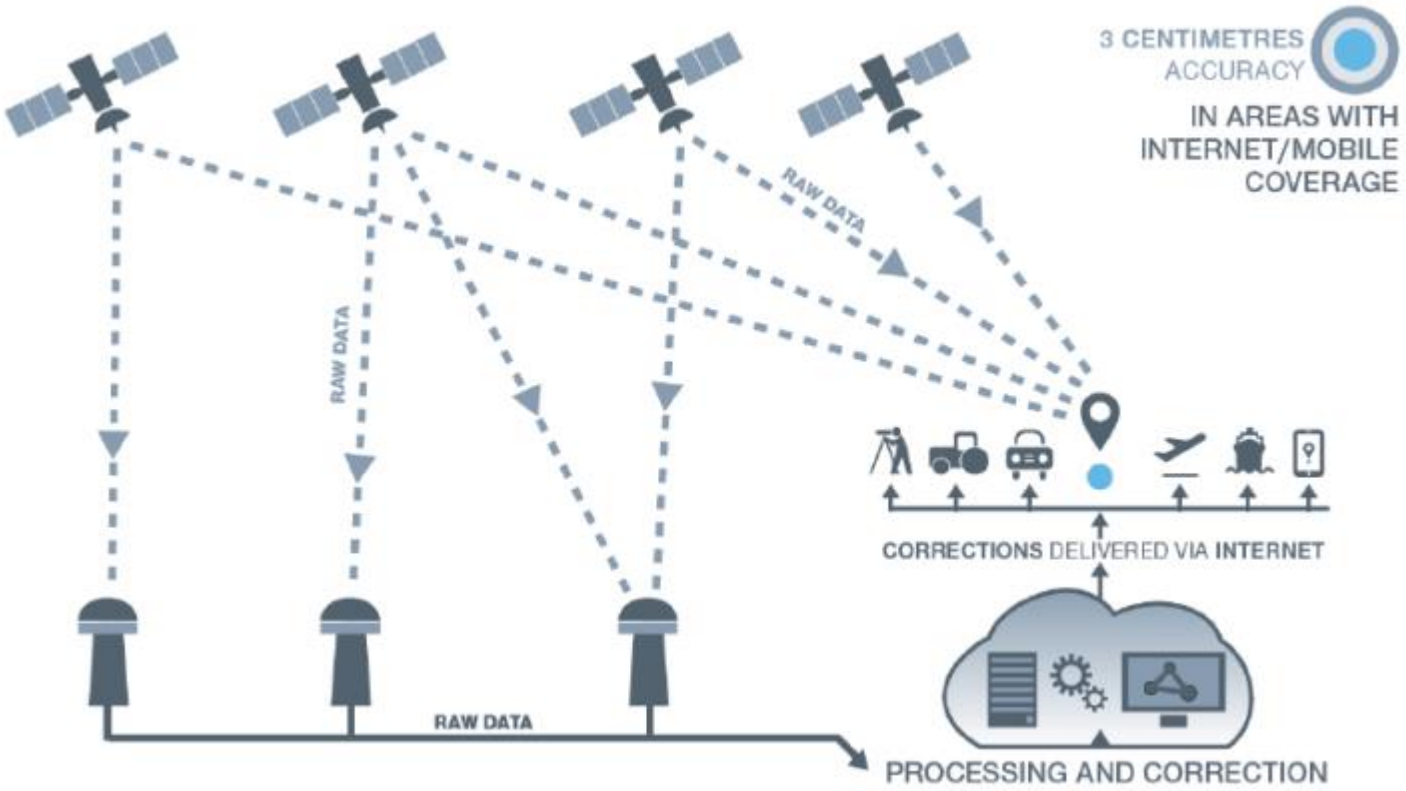
GGRF: Geospatial Data Management



Positioning Infrastructure

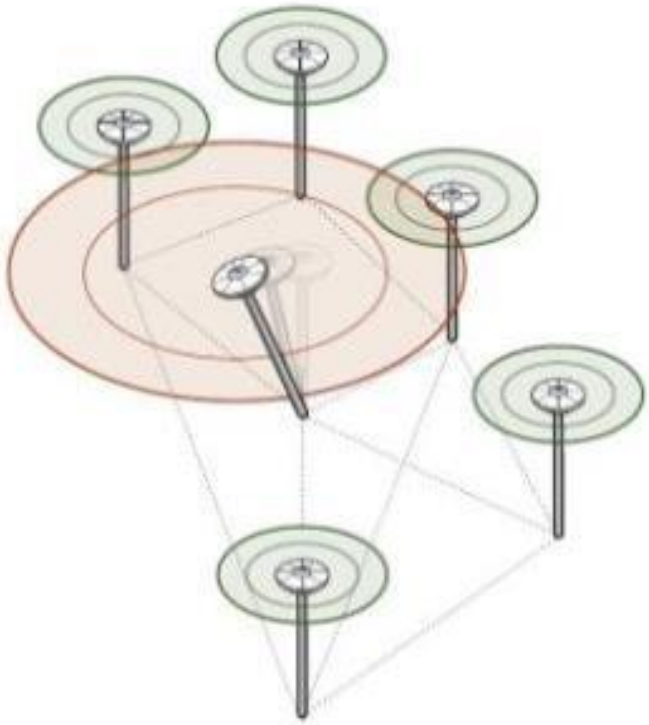
- To confidently integrate different datasets that are measured with different techniques and collected at different times
- Measure once, use multiple times

GGRF: Augmented GNSS



GGRF: Applications

- The GGRF has many national applications these include mapping, mining, agriculture, construction, mitigating climate change impacts
- More stations = more applications but requirements likely to vary country to country
- Need emerging to share data between countries




Construction Zone
Zone: Commercial
Area: 6000 sq m
Building Value: $213m
Materials: Steel/Concrete
TAXI
Speed:
34 km\hr
Time to
arrival: 4 min
Underground
infrastrcuture
TRAM
Route: 48
Destination: North Balwyn
Flood history
Lower Collins St
1891: River flood to 0.6m
1934: River flood to 1.0m
1972: Flash flood to 0.4m
2010: Flash flood to 0.3m
N


Source: U.S. DOT

GGRF: Global to national

GGRF: Global

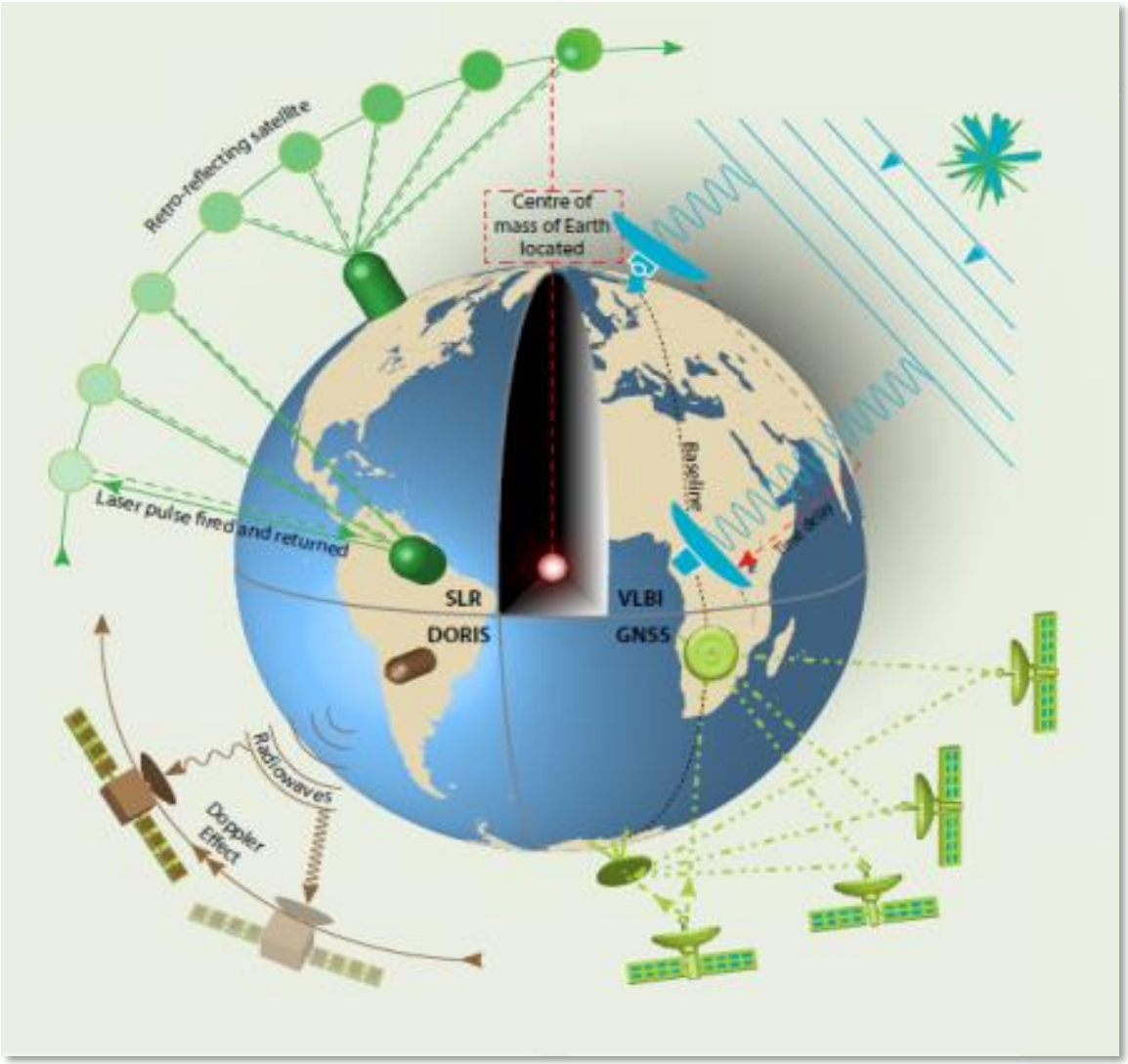
- International Terrestrial Reference Frame (ITRF)

- Reference frame based on the combination of observations from global networks of:
  - Satellite Laser Ranging (SLR)
  - Very Long Baseline Interferometry (SLR)
  - DORIS
  - GNSS

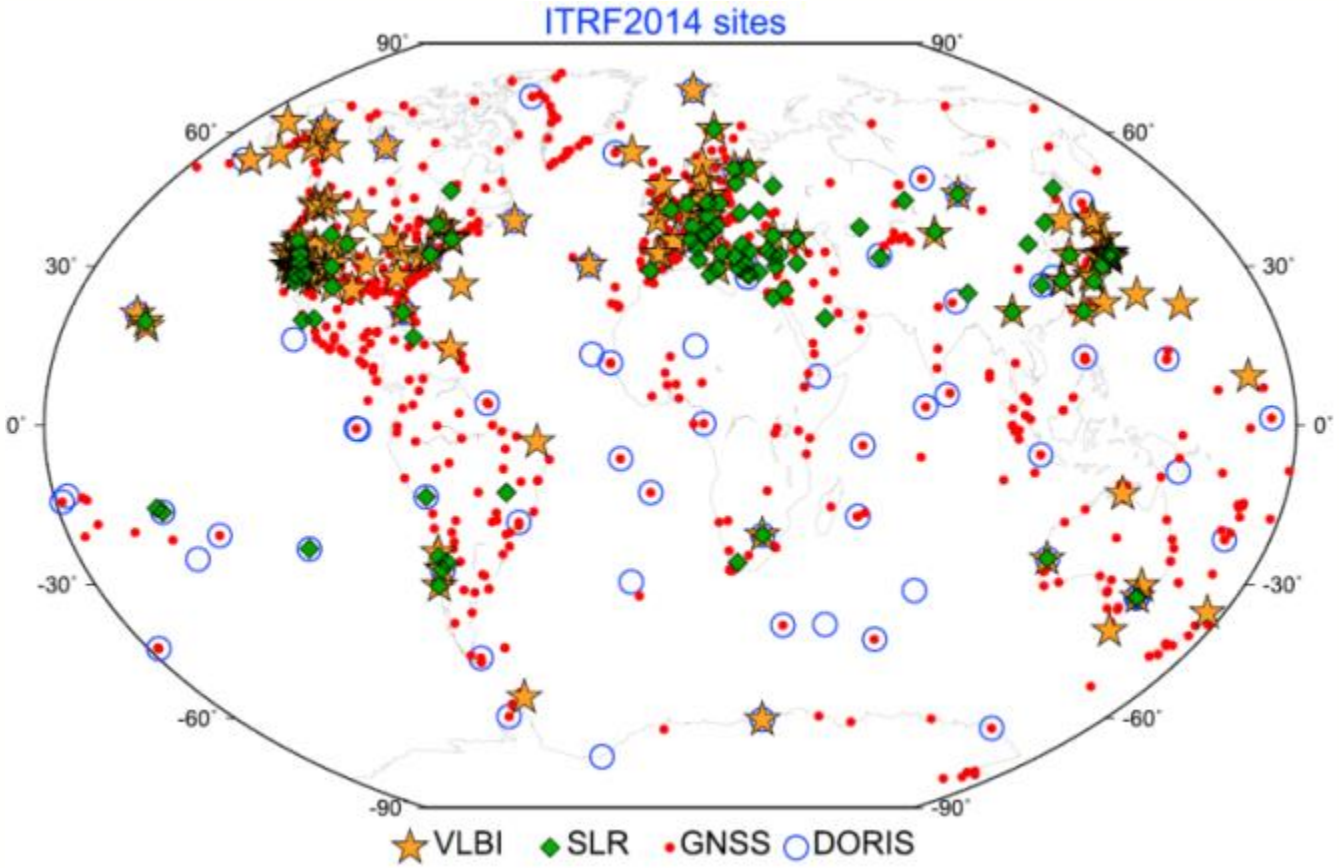
- Important: all GNSS now align to ITRF (including WGS84)

- ITRF can be realised with high accuracy, WGS84 cannot

GGRF: Multiple Techniques



GGRF: ITRF Sites

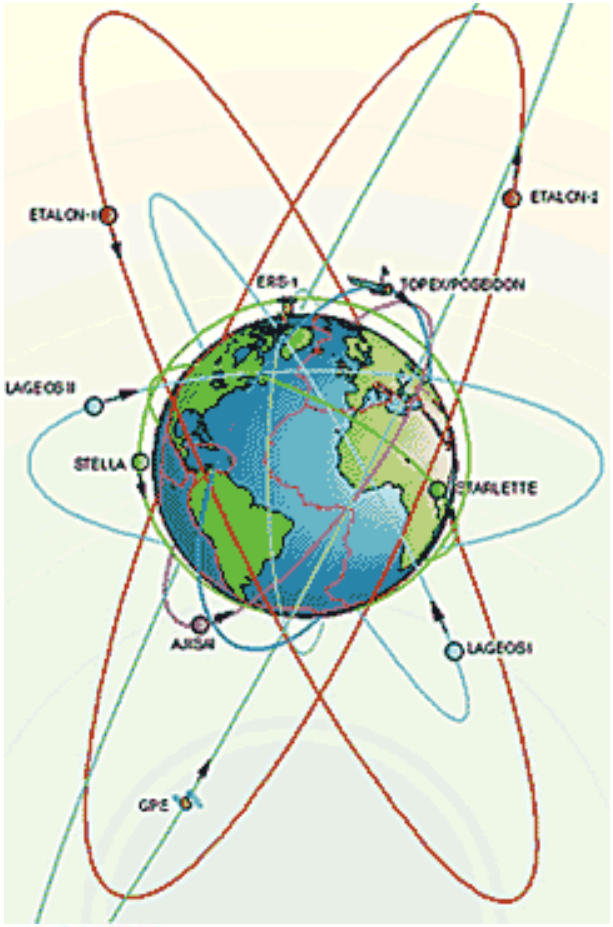


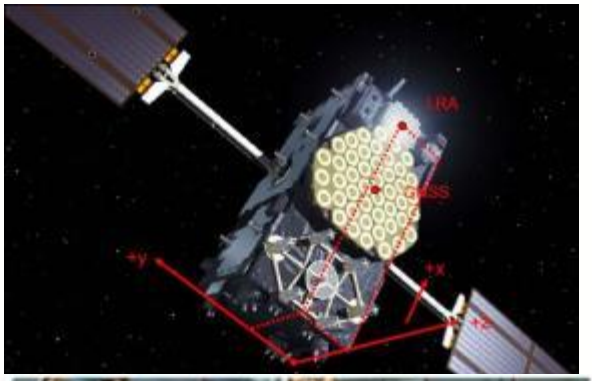
- Contributions by hundreds of agencies world-wide

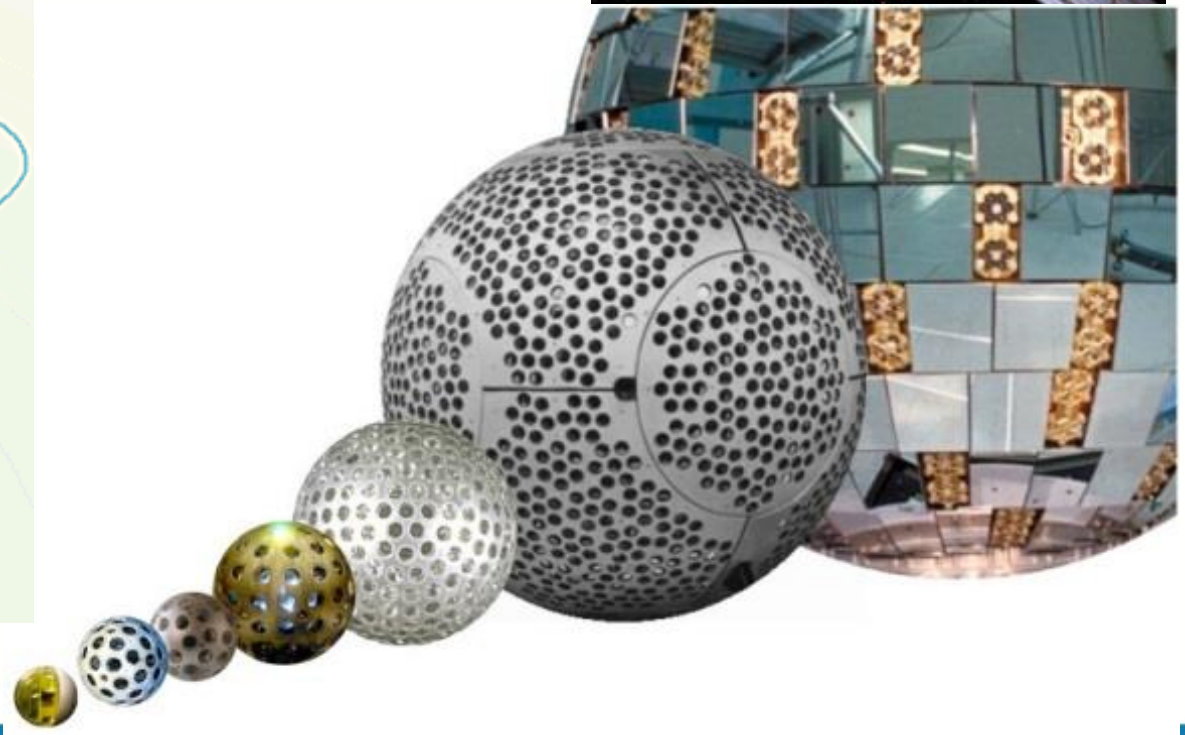
Yarragadee VLBI

Mount Stromlo Geodetic Observatory, ACT

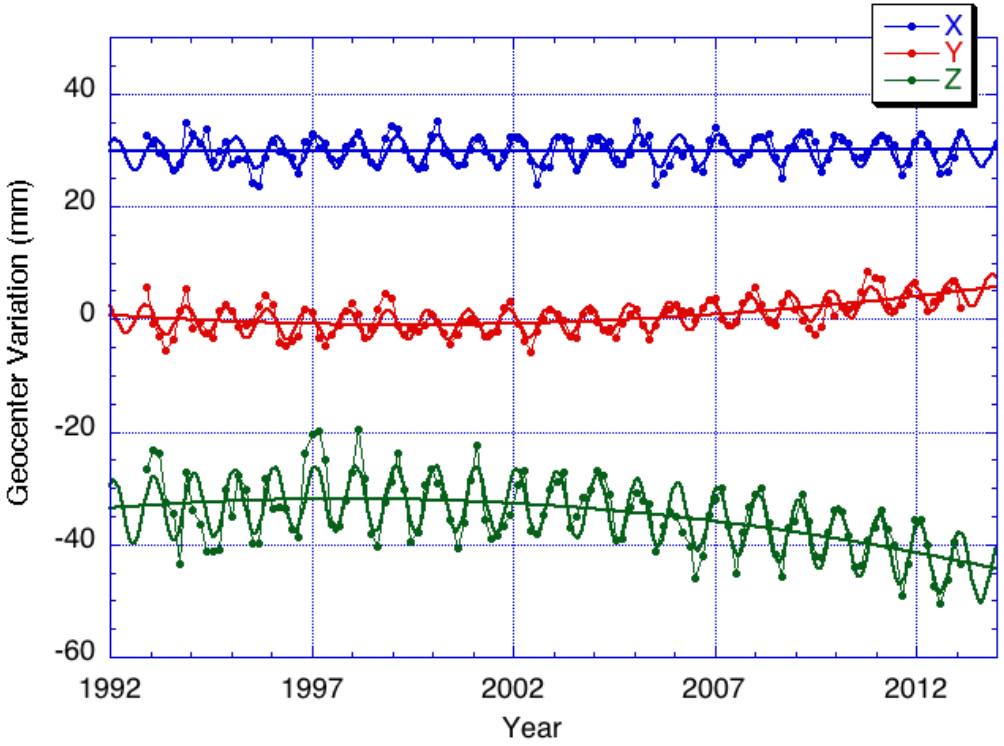
Satellite Laser Ranging –Targets

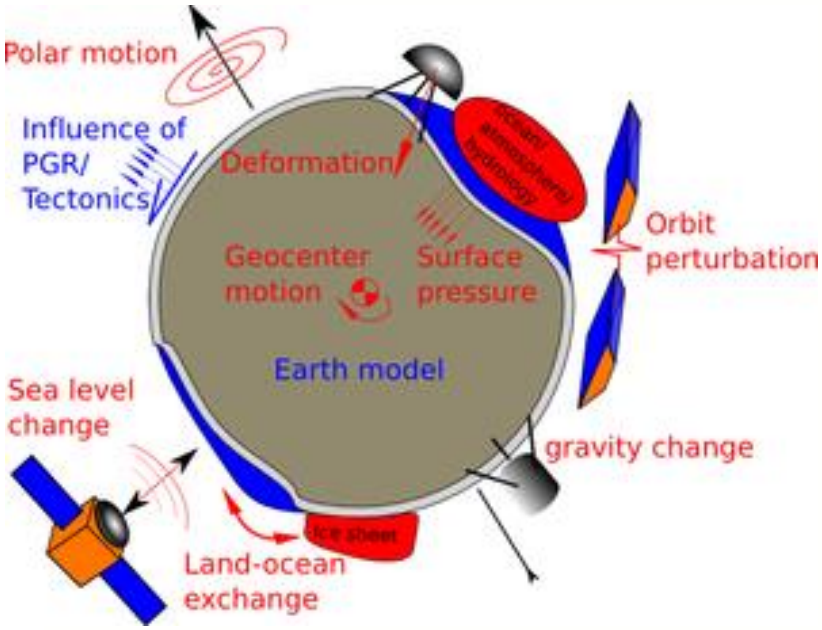




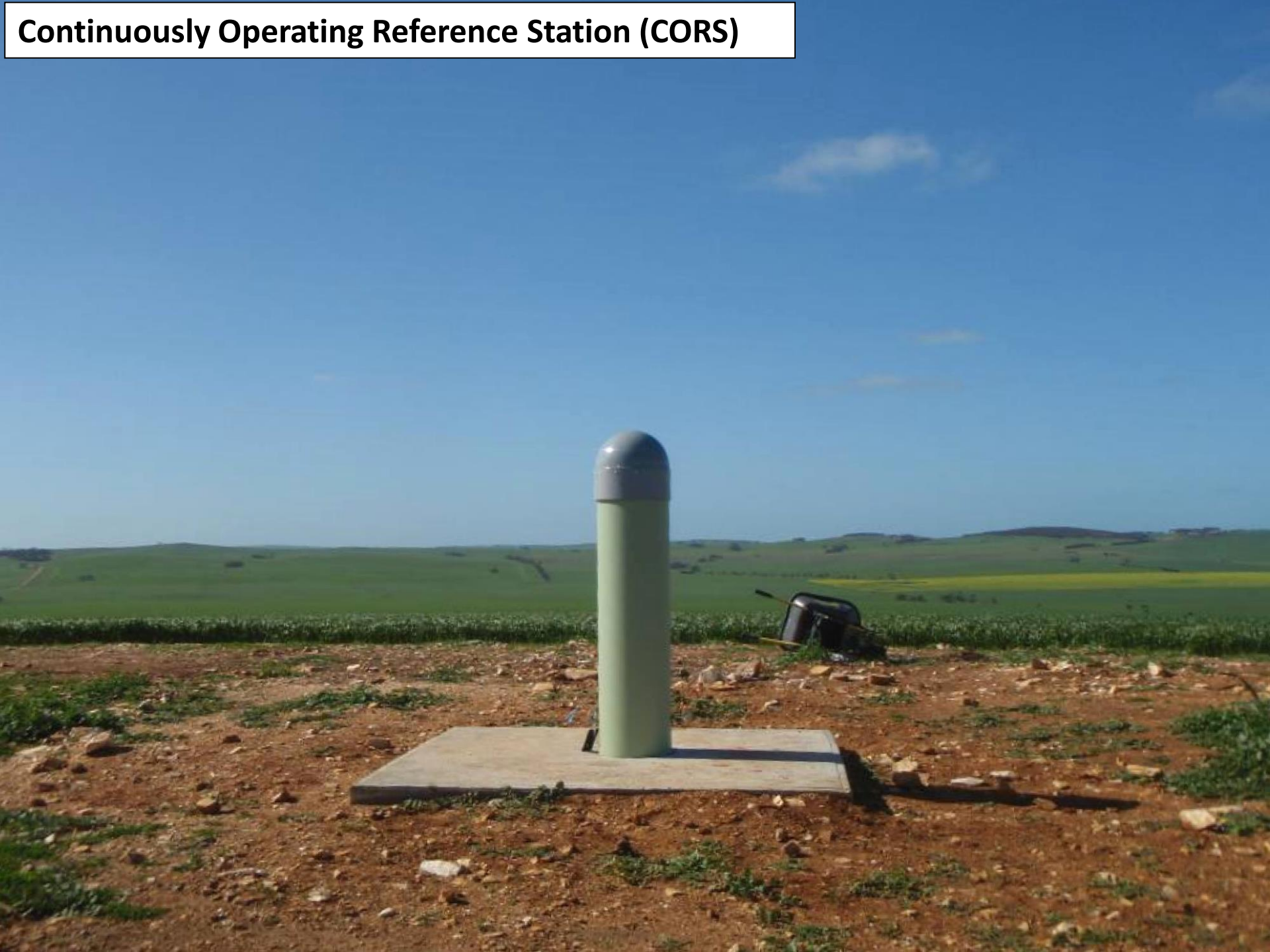


Satellite Laser Ranging: Unique Products

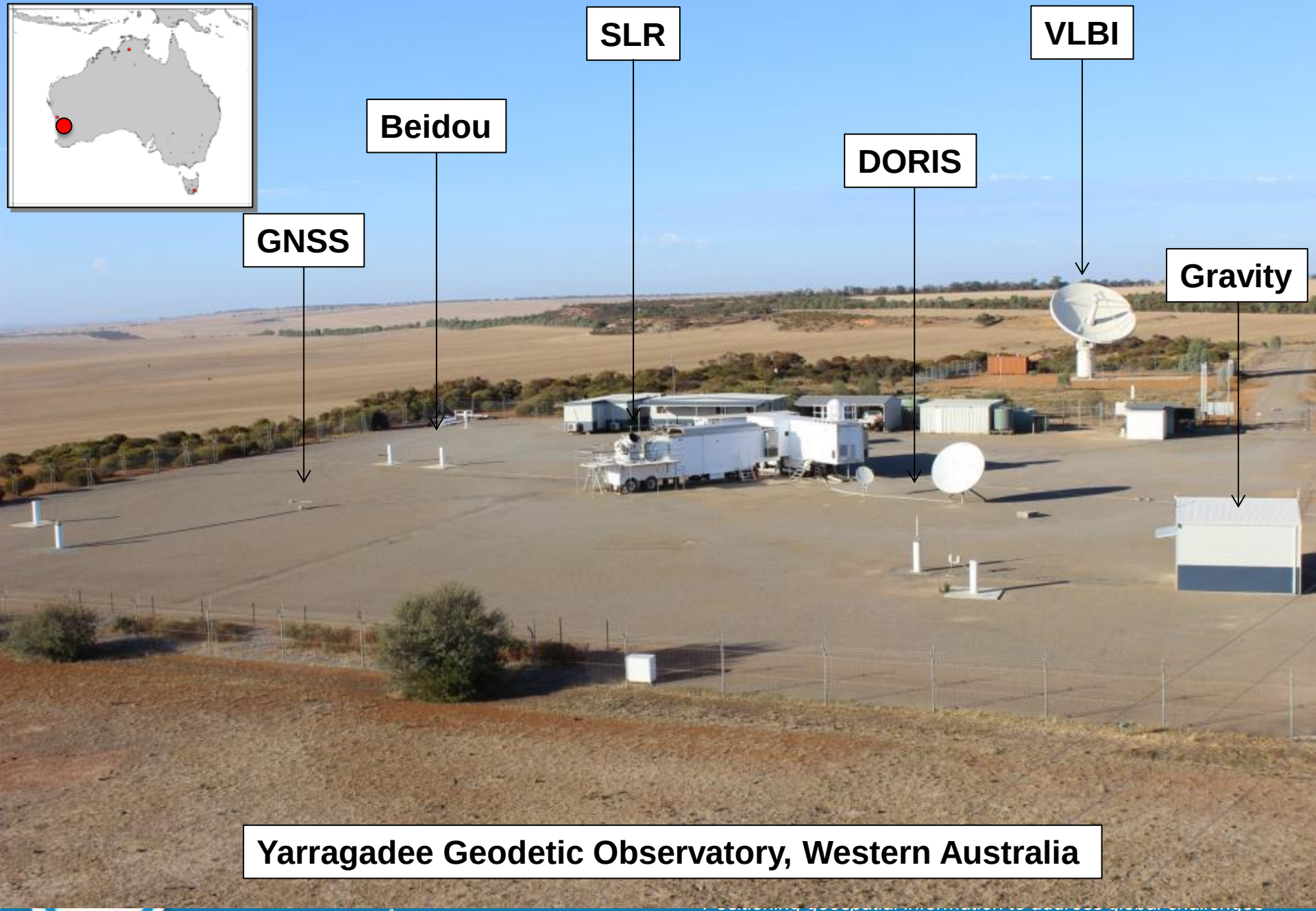




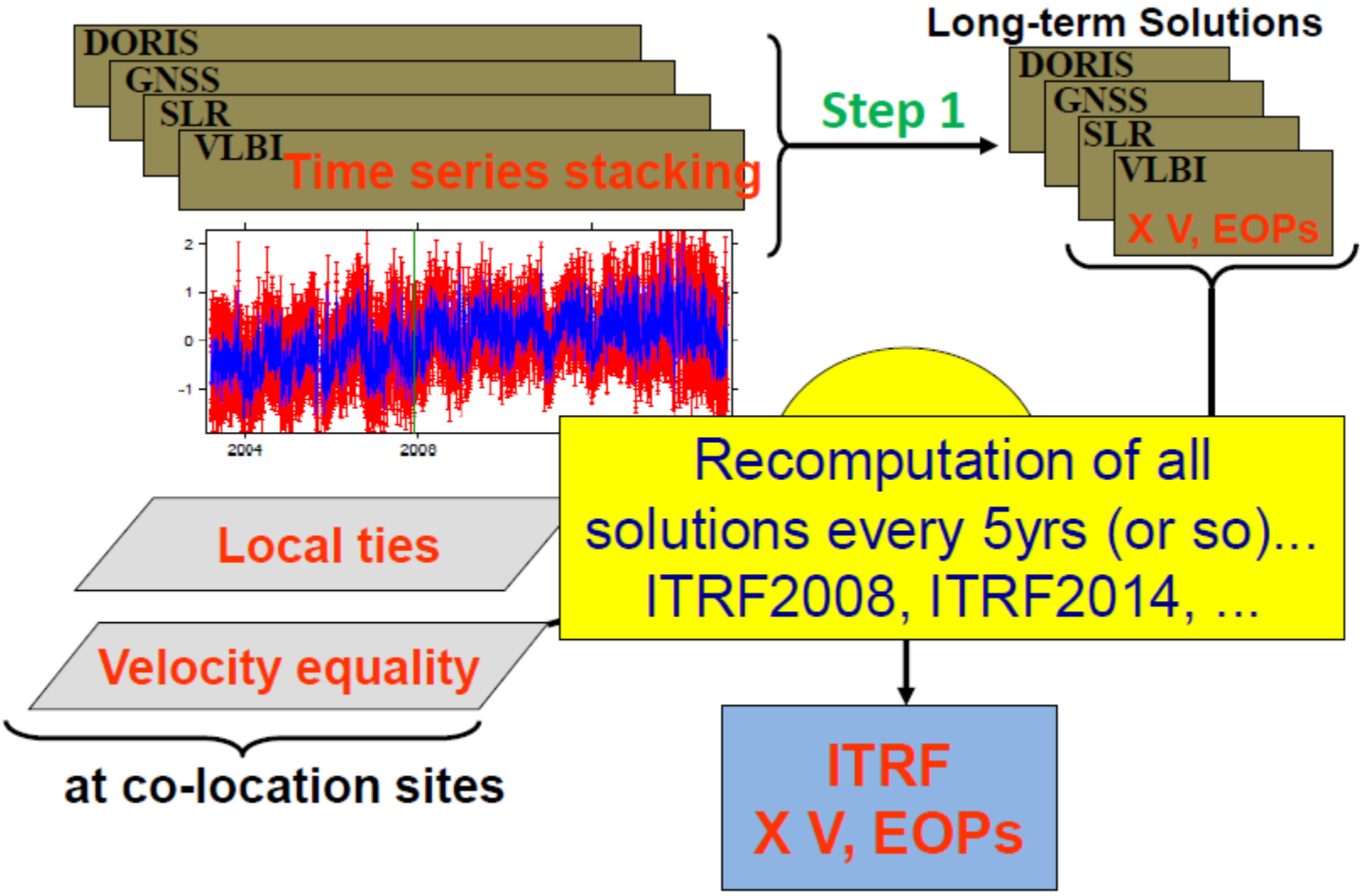
Continuously Operating Reference Station (CORS)



DORIS Beacon

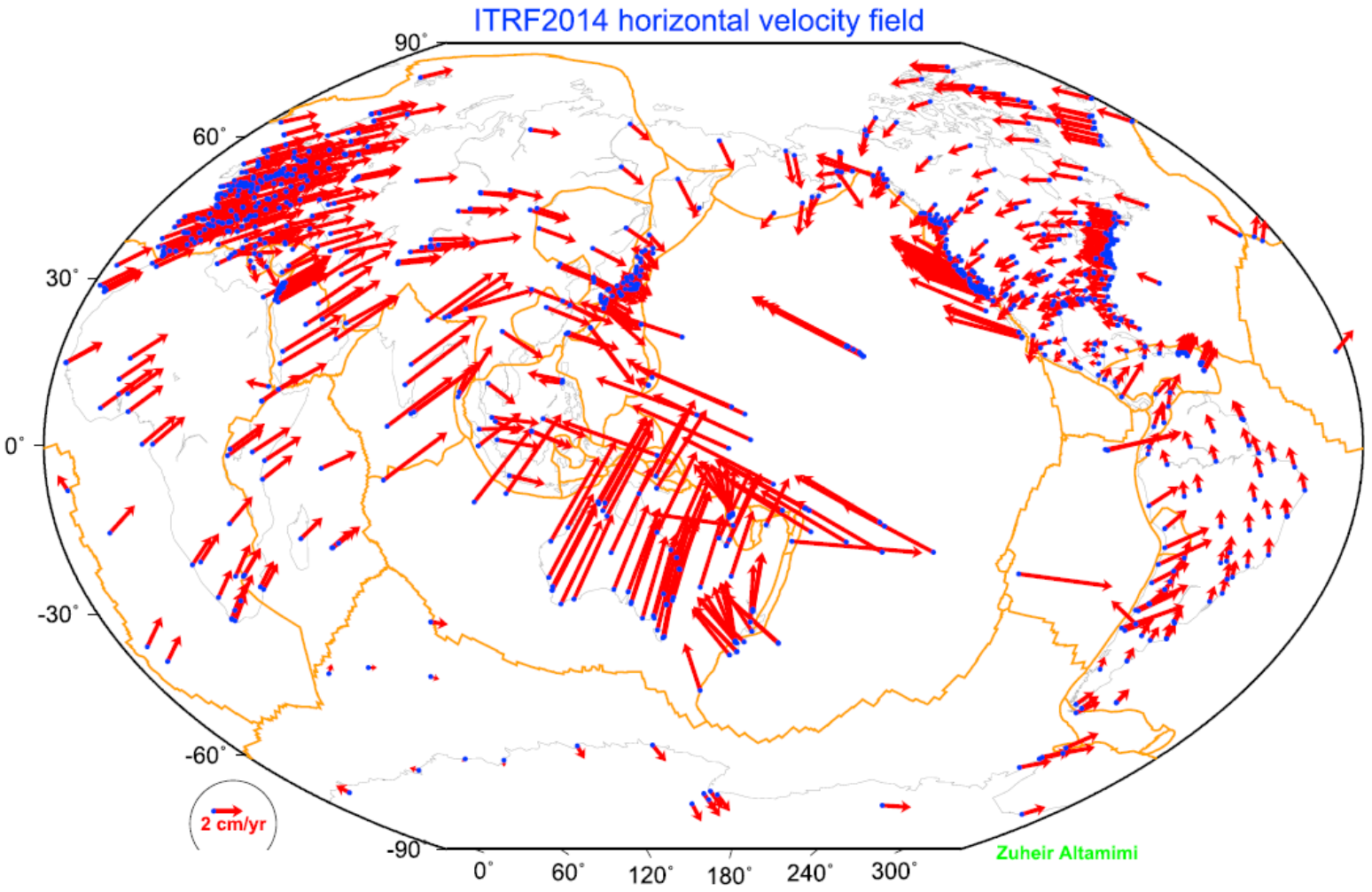

SLR
VLBI
Beidou
DORIS
GNSS
Gravity
Yarragadee Geodetic Observatory, Western Australia

Connecting the techniques by ‘local tie’

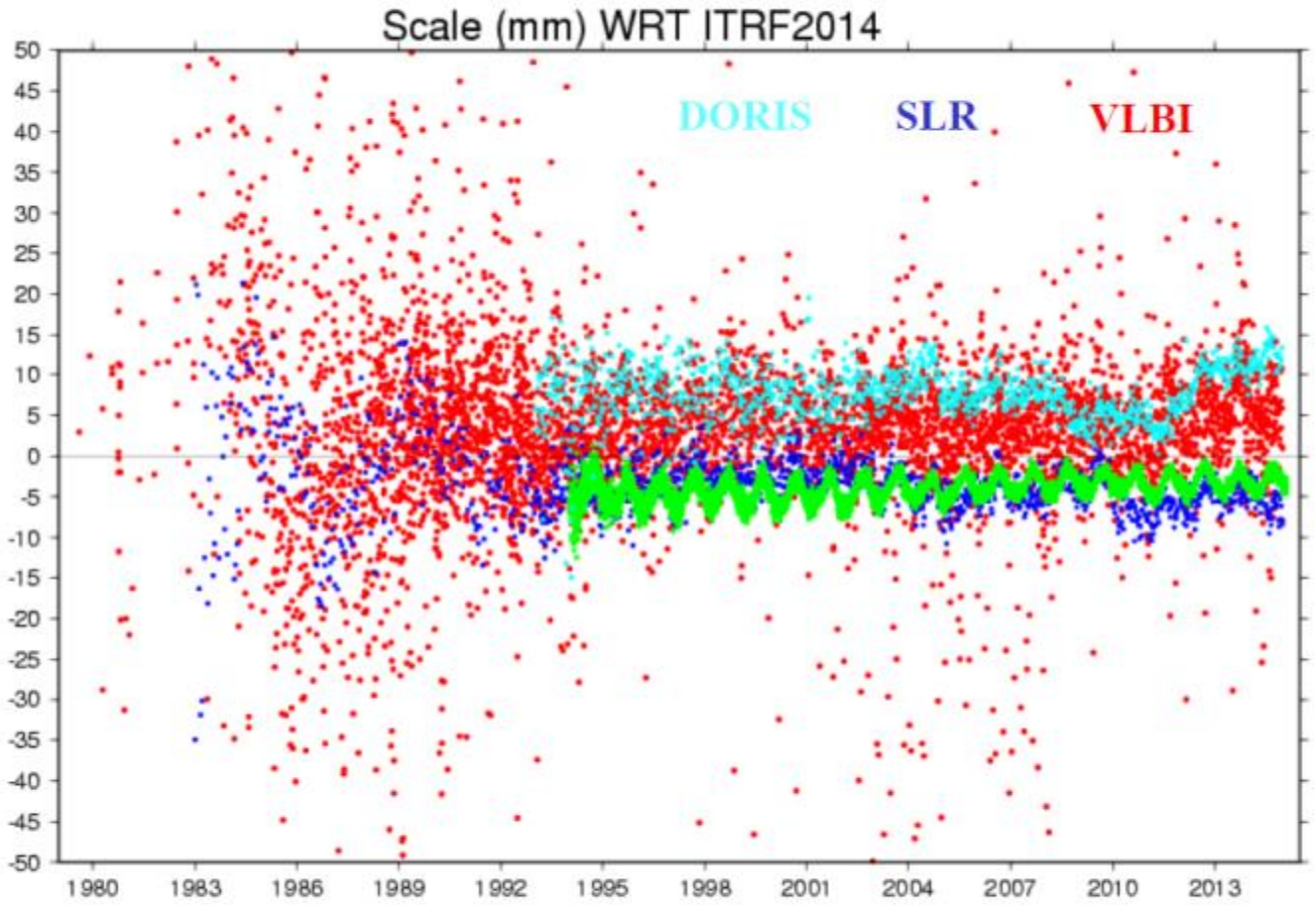


ITRF2014 material: Zuheir Altamimi, Paul Rebischung, Laurent Métivier, Xavier Collilieux

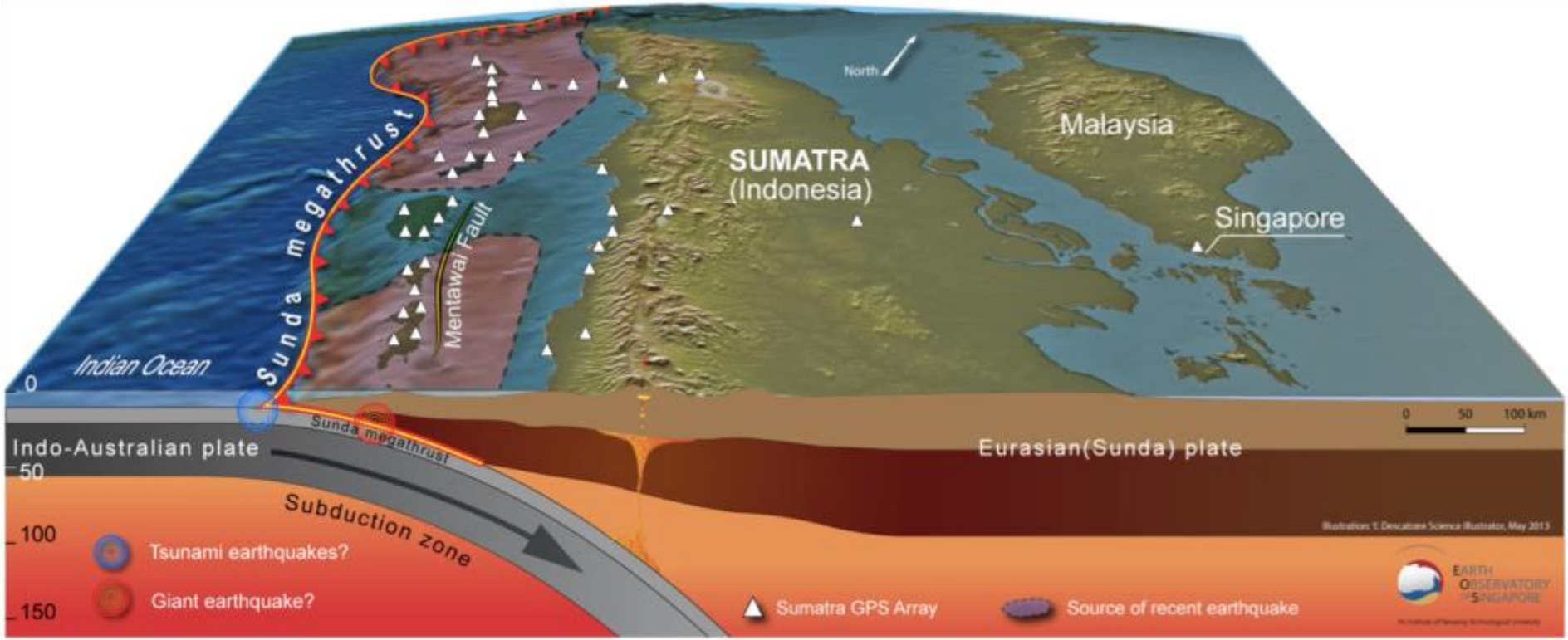
ITRF Velocities



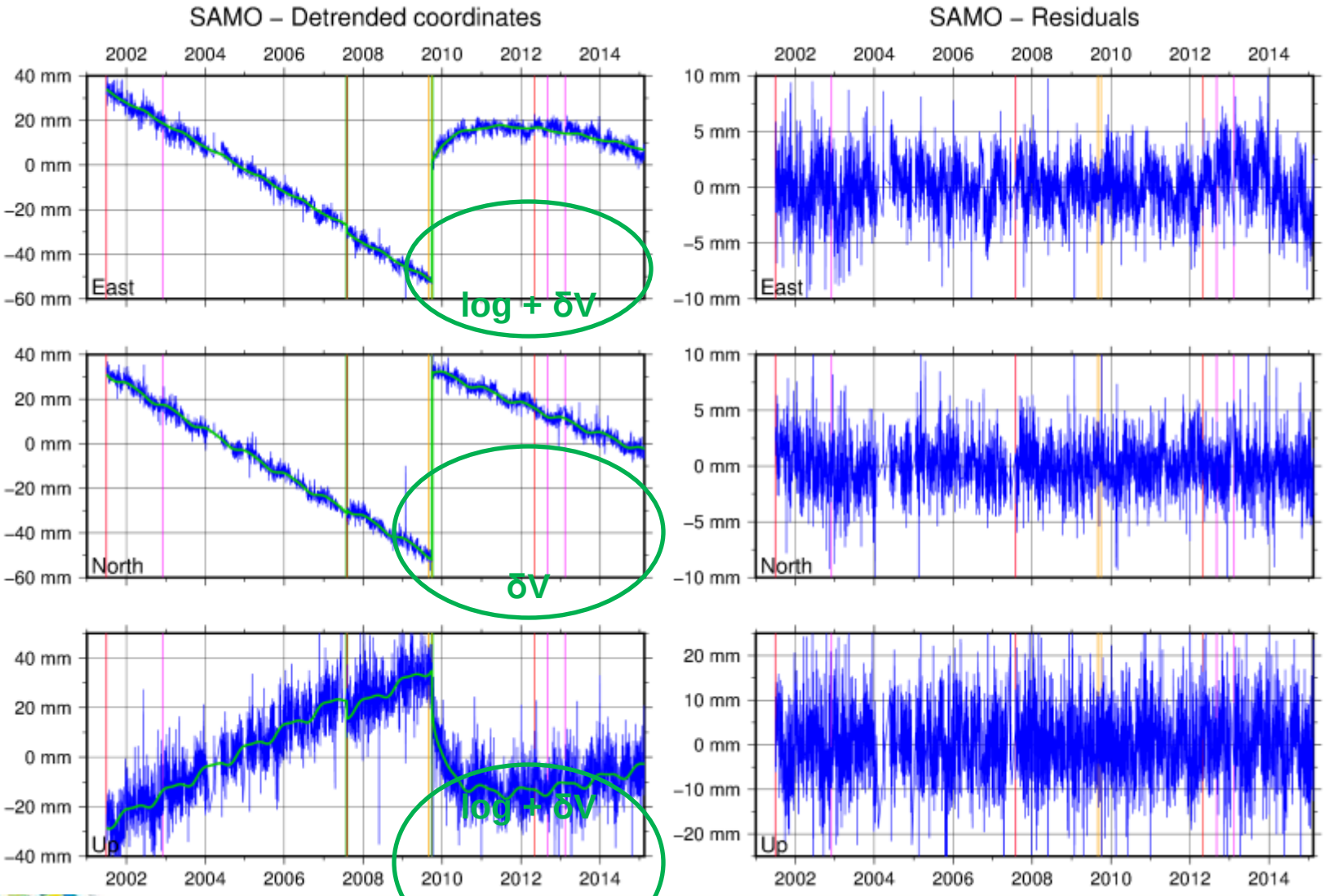
VLBI, SLR & DORIS Scales wrt ITRF2014



GNSS

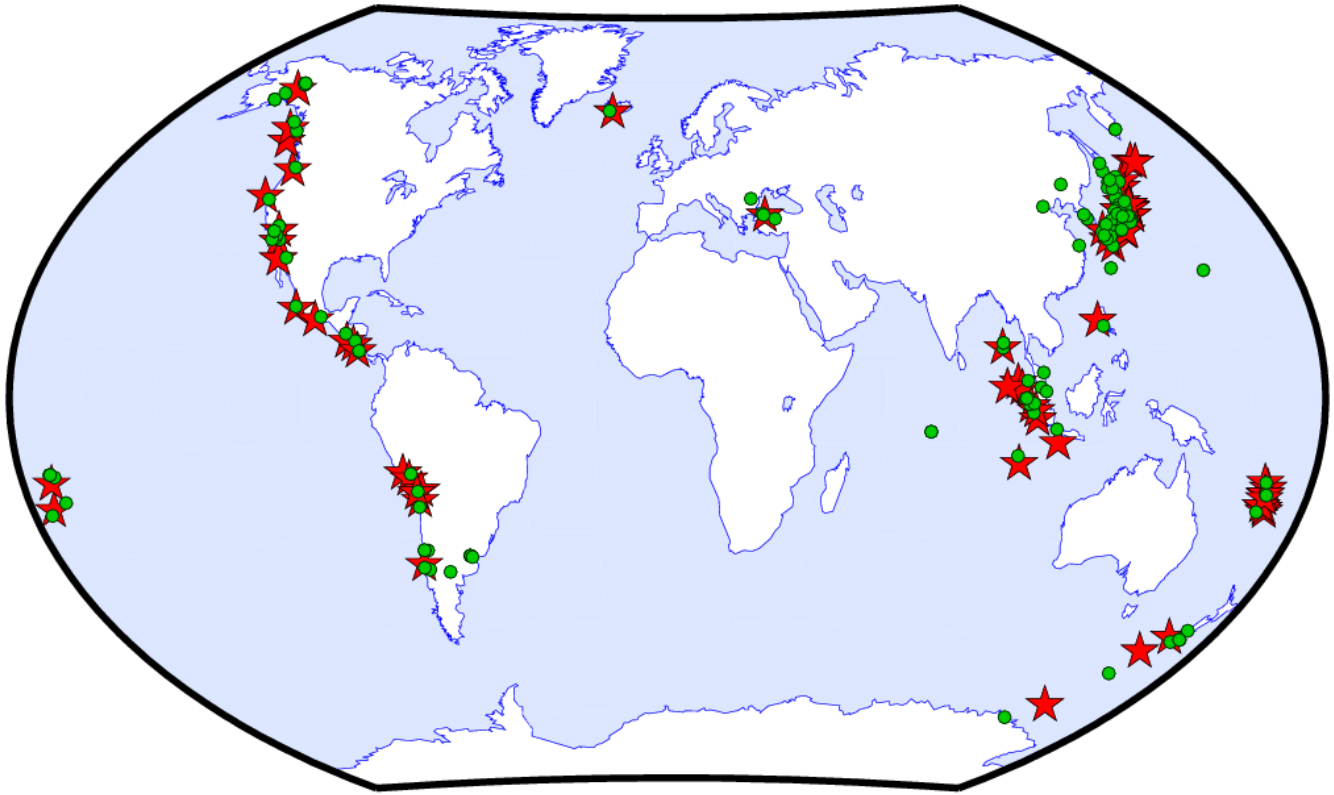

North
Malaysia
SUMATRA
(Indonesia)
Singapore
Sunda megathrust
Mentawai Fault
Indian Ocean
0
Indo-Australian plate
50
100
150
Sunda megathrust
Subduction zone
Tsunami earthquakes?
Giant earthquake?
Eurasian(Sunda) plate
0 50 100 km
Sumatra GPS Array
Source of recent earthquake

Earthquake Deformation - Samoa



Post Seismic Deformation

- **ITRF14 ~ 139 stations, ~ 65 earthquakes**

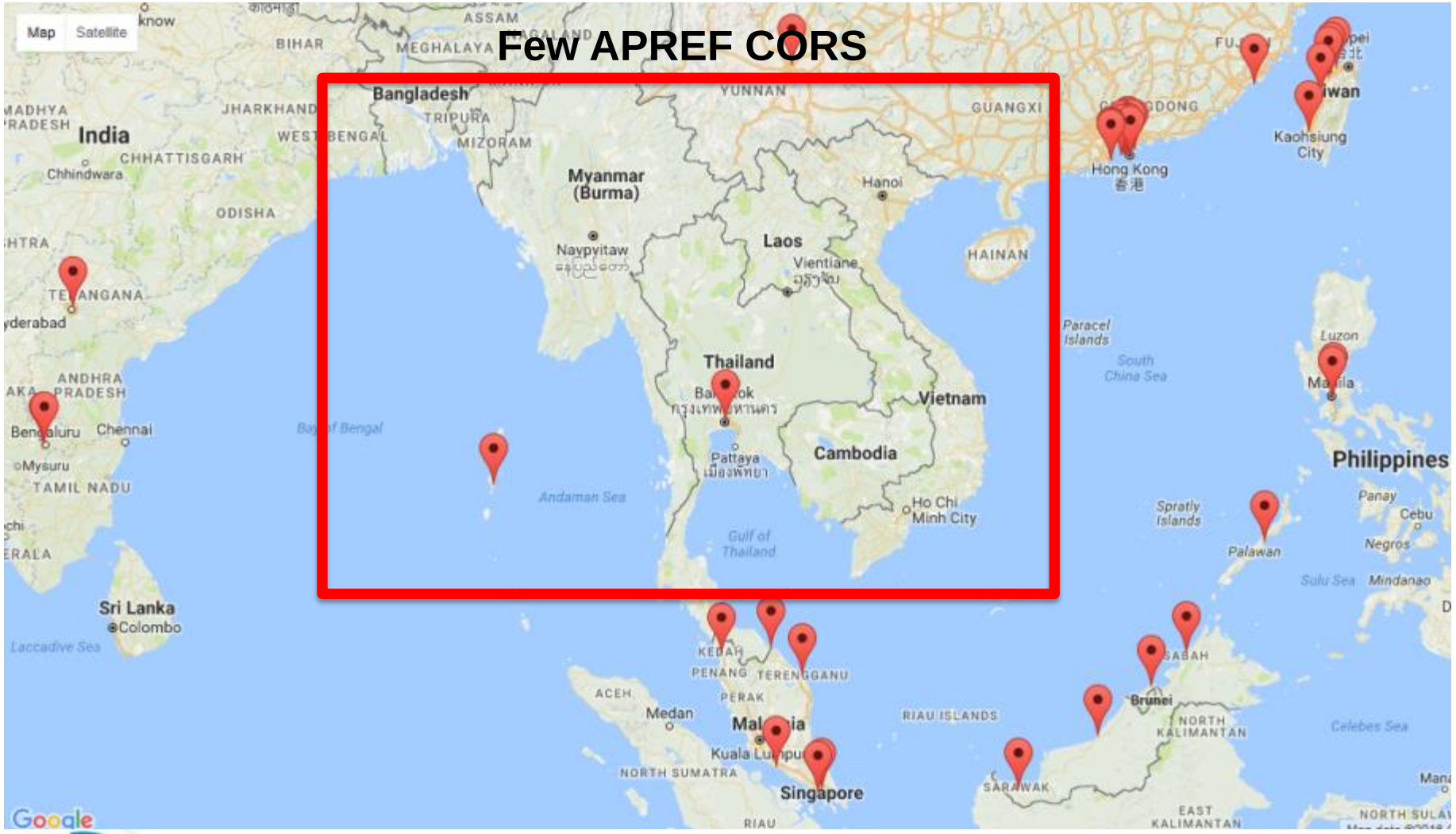


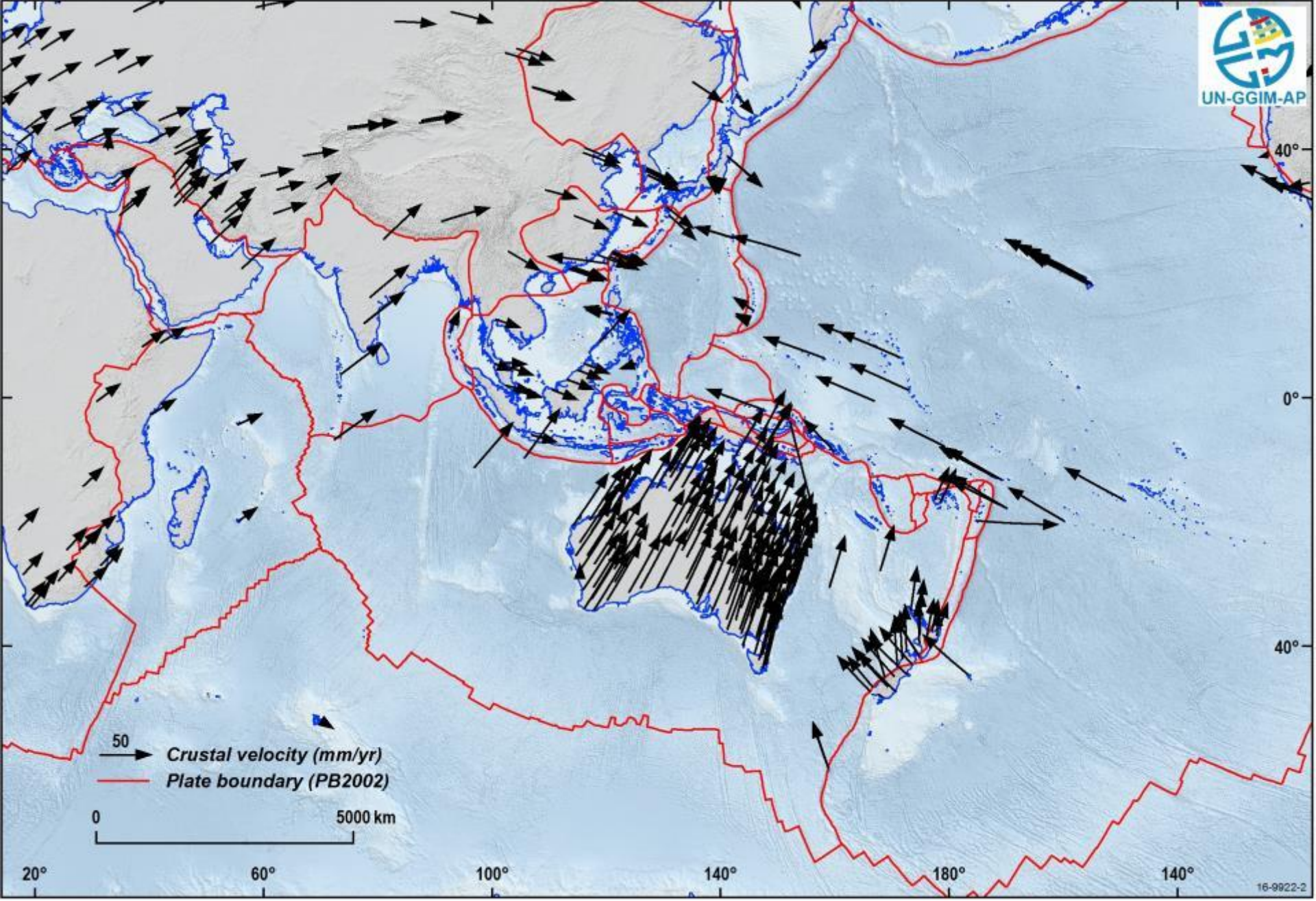
GGRF: Regional

- Asia Pacific Reference Frame (APREF)
- UN-GGIM-AP and IAG joint project
- Densify ITRF in the Asia Pacific
- 600+ stations, 28 Countries, 4 analysis centres
- Geoscience Australia is central bureau

Current APREF Network

Current APREF Network



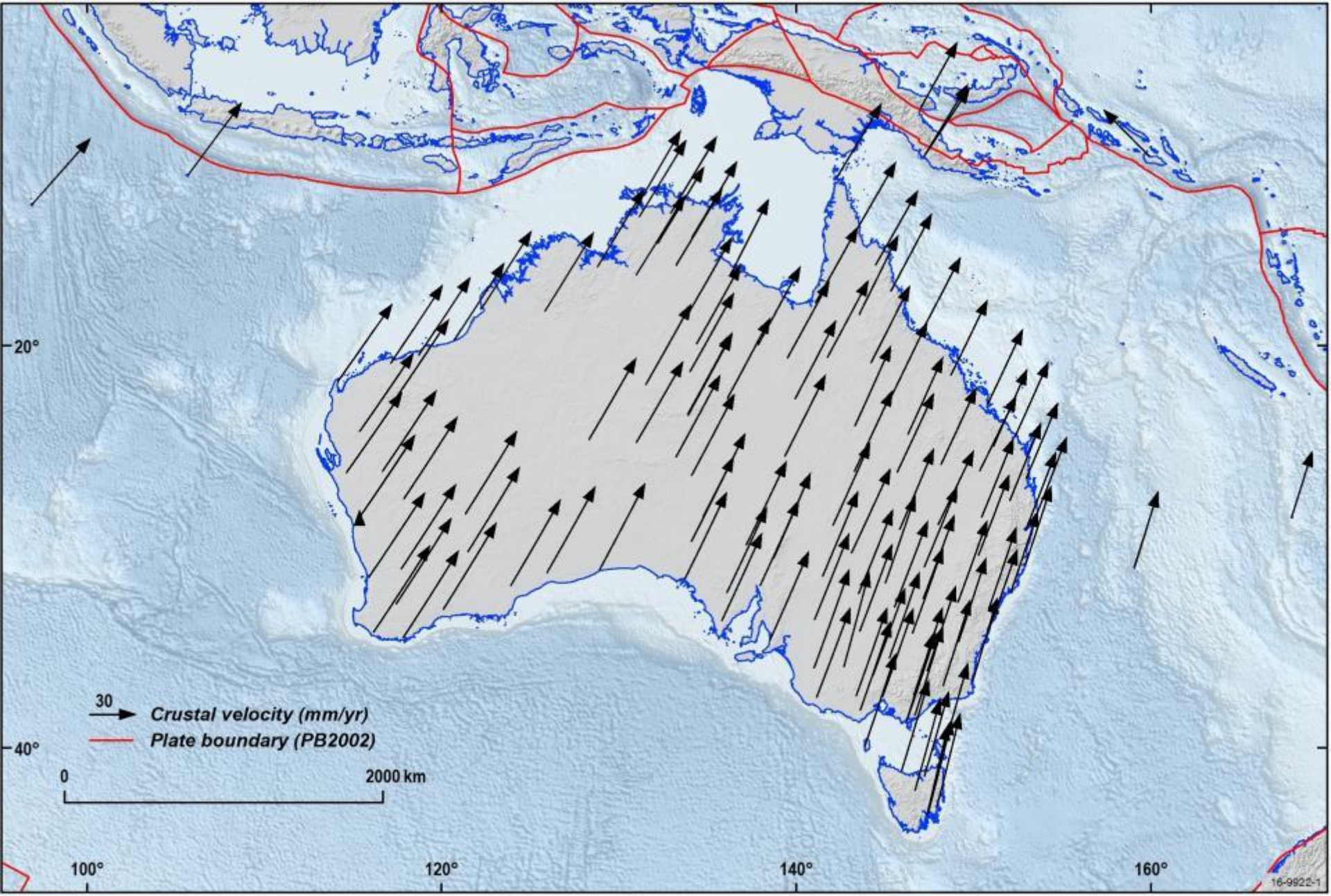

UN-GGIM-AP
40°
0°
40°
50
Crustal velocity (mm/yr)
Plate boundary (PB2002)
0
5000 km
20°
60°
100°
140°
180°
140°
16-9922-2

GGRF: APREF

- http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/asia-pacific-reference-frame

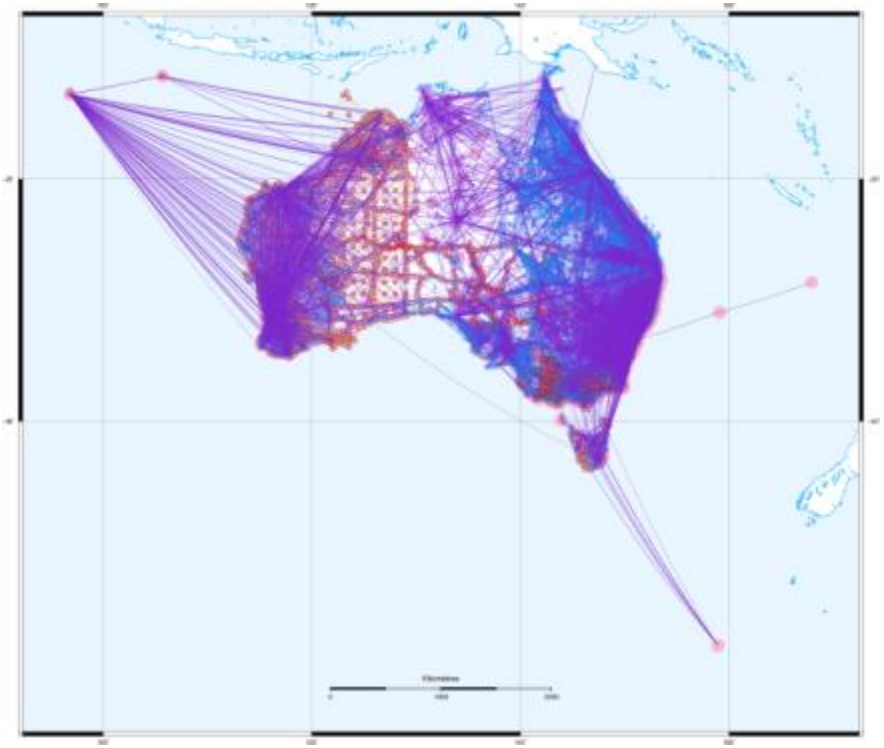
- Google: APREF at GA

- Products:
  - ITRF coordinates and velocities for contributing stations
  - Coordinate time-series
  - Station performance


20°
40°
30
Crustal velocity (mm/yr)
Plate boundary (PB2002)
0
2000 km
100°
120°
140°
160°
16-9922-1

National Geodetic Datum

- Geocentric Datum of Australia 2020
- Built on CORS infrastructure
- 250,000 stations
- 1.9 million measurements



Key Messages

- Global
  - ITRF is the international standard for reference frames
  - Important (and beneficial) for all countries to make a contribution to the global community

- Regional:
  - APREF can provide countries with access to the ITRF
  - Asia Pacific region still has regions without CORS coverage

- National:
  - National datums (reference frames) built on national CORS infrastructure

Reference Frames and GNSS CORS

Geospatial and GNSS CORS Infrastructure Forum
Kuala Lumpur Malaysia

Dr. John Dawson, Australia