Improving the Geodetic Infrastructure of the Asia-Pacific Region

John Dawson, Australia

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SUMMARY
Increasingly, positioning applications in hazard assessment, mining, agriculture, construction, emergency, land, utility and asset management have a demonstrated need for centimetre level or better geodetic infrastructure. However, the geodetic infrastructure in the Asia-Pacific, when compared to other geographical regions, can be generally assessed as being sparse, inhomogeneous in accuracy, infrequently realised and difficult to access. Correspondingly, it has become increasingly clear that the Asia-Pacific infrastructure is below the standard that is now available in other regions, such as Europe and the Americas, and it represents a loss in competitive advantage. The Permanent Committee for GIS Infrastructure Asia-Pacific (PCGIAP) and the International Association of Geodesy (IAG) have made some progress in developing the Asia-Pacific geodetic infrastructure; however, it can still be characterised as being a work in progress. In this presentation, we review recent efforts to improve the region's geodetic infrastructure. Specifically, we focus on crustal deformation and show results from the Asia-Pacific component of the International Association of Geodesy (IAG) working group on regional velocity fields, which includes crustal velocity estimates for over 1200 stations. This velocity field incorporates solutions derived from Continuous GPS (CGPS) data, episodic campaign based data and also velocity-only information where precise coordinates are not available. Our combination method, including our approach of incorporating velocity-only information expressed in a variety of reference frames, such as plate-fixed frames, will be overviewed. Finally, we will review the key elements of the Asia-Pacific Reference Frame (APREF) initiative, which will create and maintain a modern regional geodetic framework based on continuous GNSS data.

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Geoscience Australia

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John Dawson, Guorong Hu
Earth Monitoring Group

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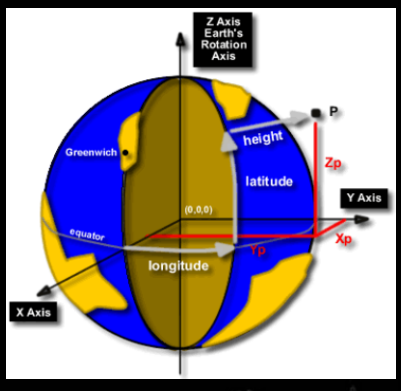
Reference frames and positioning

- Cornerstone of all geospatial measurements
  - Earth-observation, mapping, positioning, navigation and timing
- Applications
  - mining, agriculture, construction
  - emergency, land, utility and asset management
  - science e.g., hazard assessment, sea-level change, crustal dynamics



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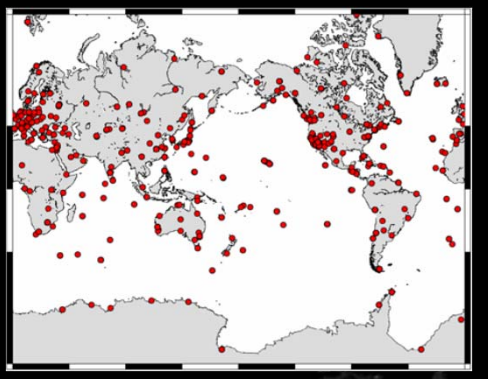
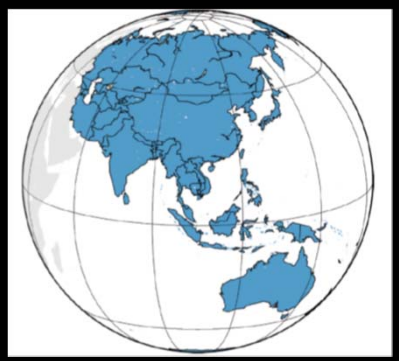
Reference frames: global

- International Terrestrial Reference Frame
  - Global, consistent, accurate, dynamic
  - Determined using GPS, SLR, VLBI, DORIS
  - Continuously refined
- Densification of ITRF occurs on a regional basis e.g., EURREF



Asia-Pacific (AP) Region

- Significant component of the Earth's
  - Area, population and economic output
- Access to high quality positioning infrastructure is essential for effective competition with the other regions, including Europe and the Americas
- Coordination of regional geodetic activities not well developed in the AP



PCGIAP Efforts

- Who
  - United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC)
  - Established (1994): Permanent Committee for GIS infrastructure, Asia-Pacific (PCGIAP)
  - National survey agencies and others
- Aim
  - Establish and maintain a precise geodetic network across region supporting geodetic activity
- Activity
  - Episodic GPS observations, 1997-2009 (ongoing).

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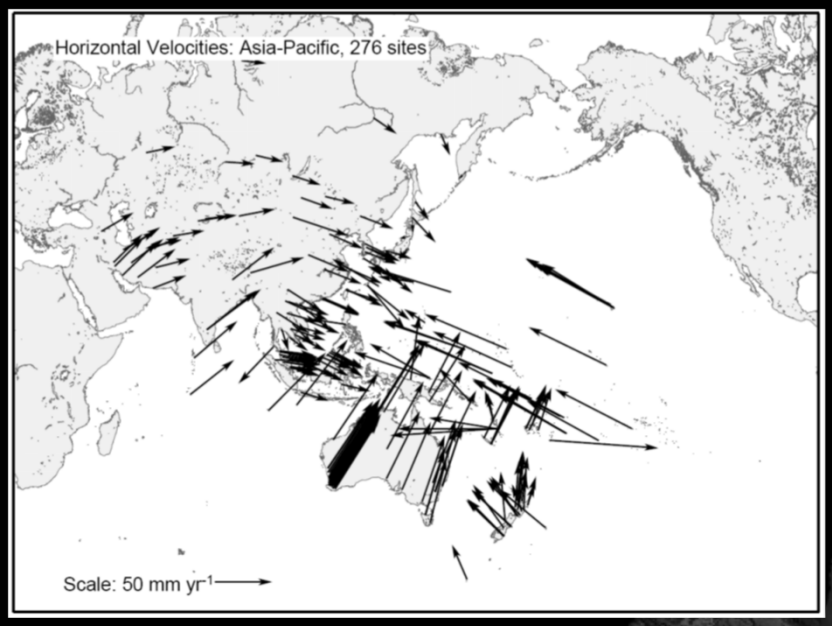

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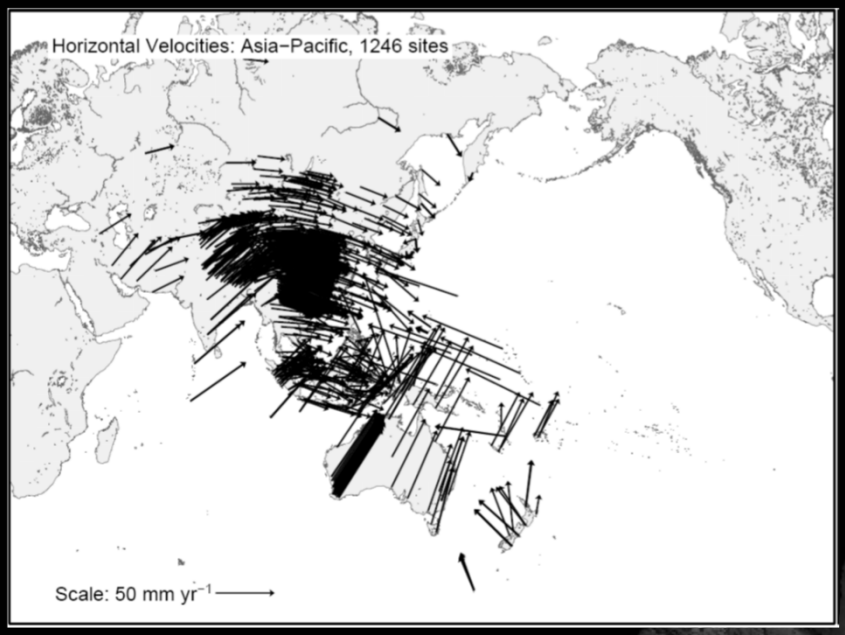
IAG Efforts

- International Association of Geodesy (IAG), Commission 1 (reference frames)
  - Sub-commission 1.3 - Regional dense velocity field Working Group
    - Asia-Pacific region
    - 1200+ velocity estimates
  - Incorporates crustal deformation measurements across the region
  - Generally episodic measurements



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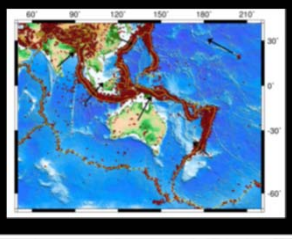
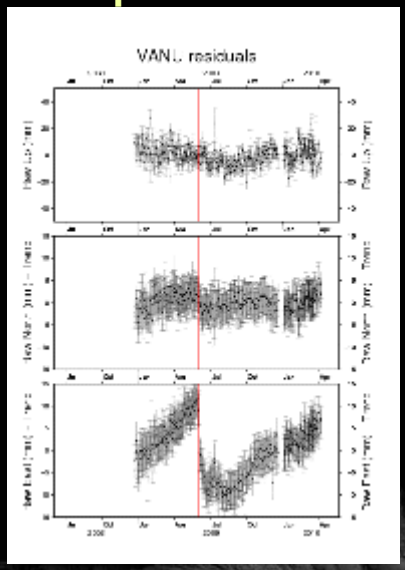
Episodic observations are problematic





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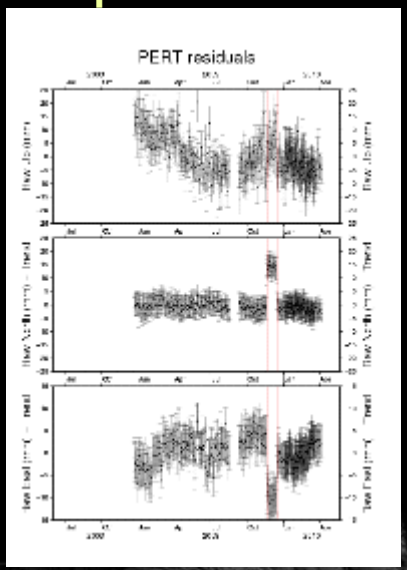


Joint IAG and PCGIAP Initiative

- Asia-Pacific Reference Frame (APREF)
- Call for Participation: 1 March 2010
- APREF mandated by UNRCC Resolution
- Endorsed by the UNOOSA, FIG and IGS

Asia-Pacific Reference Frame Project

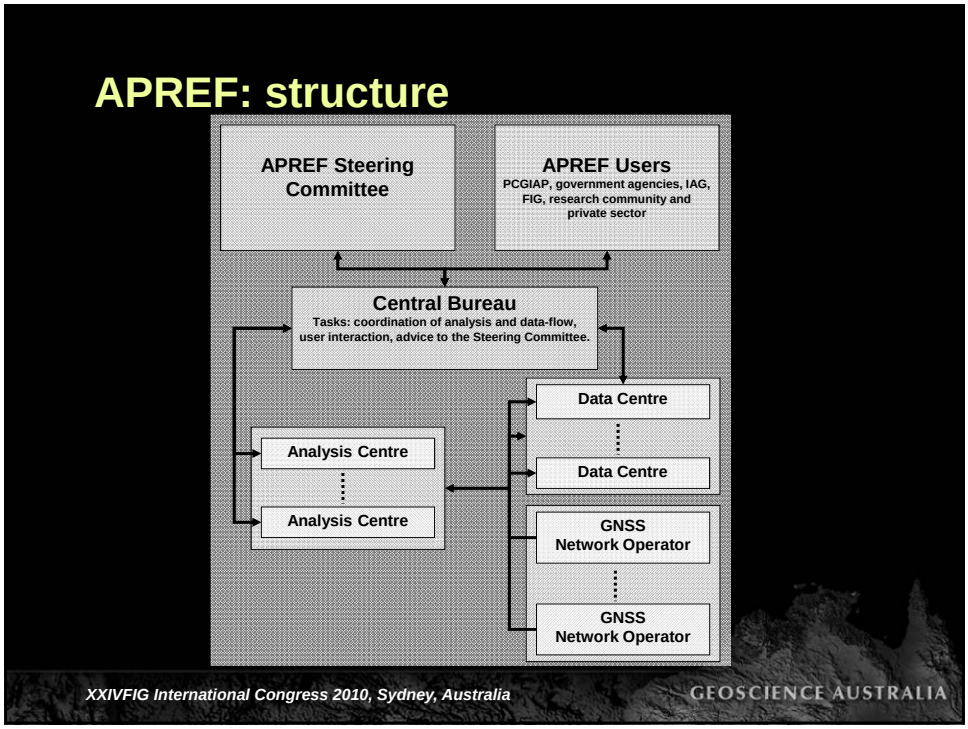
- The broad objective of APREF is to
  - Create and maintain an accurate and densely realised geodetic framework, based on continuous observation and analysis of GNSS data
- Major benefit for participates
  - Continuous link between national datums and CORS networks to the ITRF

Asia-Pacific Reference Frame Project

- Open to all organisations involved with CORS data collection and/or analysis
  - Government, research, private
- Responding organisations must be able to make a long-term commitment
  - 2+ years
- APREF will provide an opportunity and a forum towards improving the regional geodetic infrastructure
  - Next generation geodetic infrastructure

APREF: Products and benefits

- An authoritative source of coordinates and their respective time-series for geodetic stations in the Asia-Pacific region
  - Provided with a time delay of 3-4 weeks
  - High quality connection to ITRF
- Improved access to regional CORS data
  - For the benefit of all


APREF: structure
APREF Steering Committee
APREF Users
PCGIAP, government agencies, IAG, FIG, research community and private sector
Central Bureau
Tasks: coordination of analysis and data-flow, user interaction, advice to the Steering Committee.
Data Centre
Data Centre
Analysis Centre
Analysis Centre
GNSS Network Operator
GNSS Network Operator
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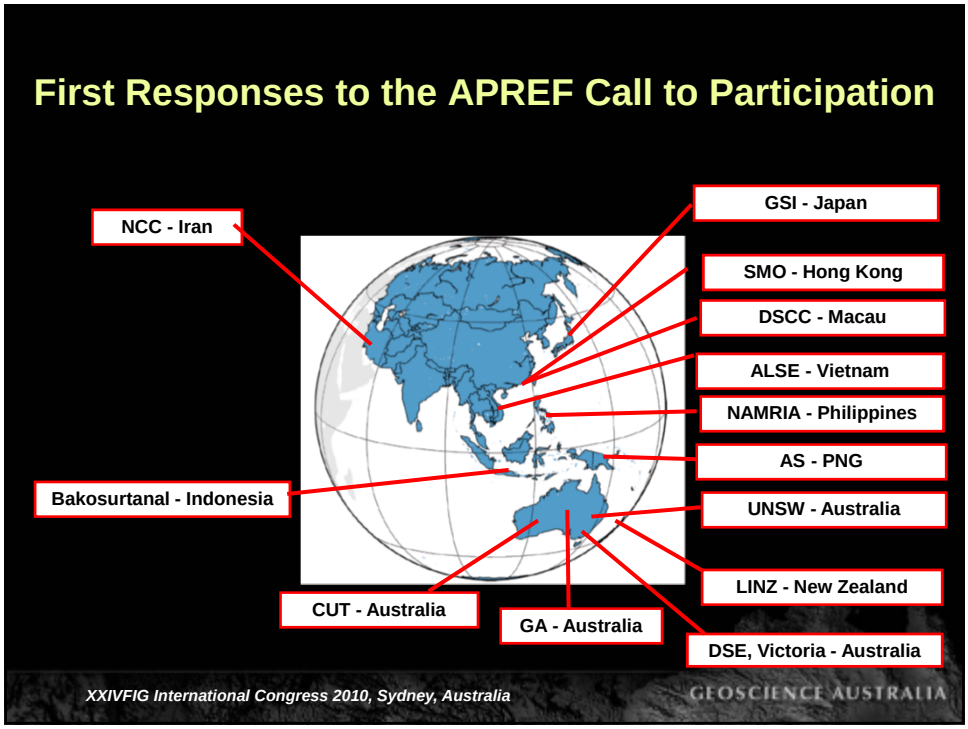
First Responses to the APREF Call to Participation
NCC - Iran
GSI - Japan
SMO - Hong Kong
DSCC - Macau
ALSE - Vietnam
NAMRIA - Philippines
AS - PNG
Bakosurtanal - Indonesia
UNSW - Australia
LINZ - New Zealand
CUT - Australia
GA - Australia
DSE, Victoria - Australia
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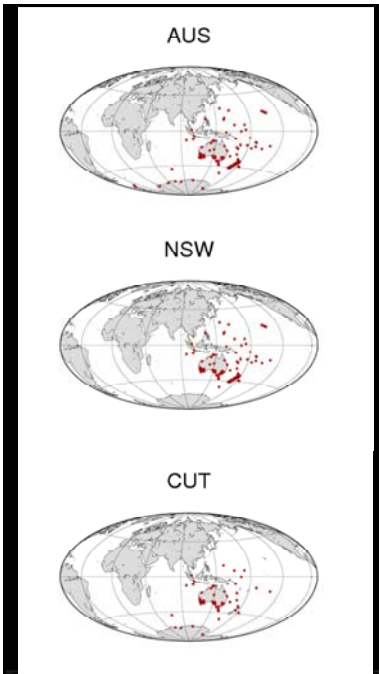
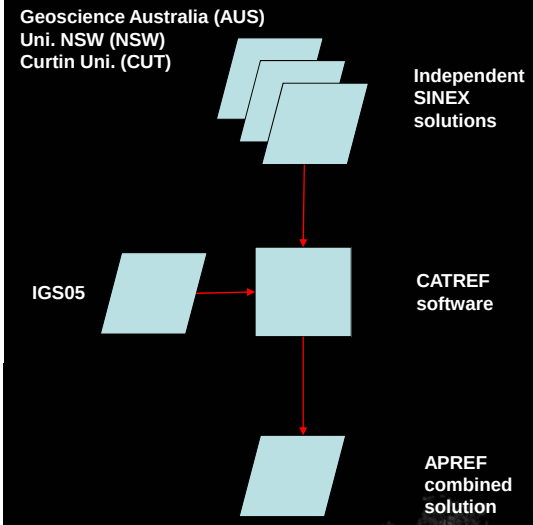
APREF First results – validation study

- Analysis Centres
  - Geoscience Australia (AUS)
  - Curtin University of Technology (CUT)
  - University of NSW (NSW)
- Test data from 2010
- SINEX combination
  - Geoscience Australia
  - CATREF software (Altamimi – ITRF)





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RMS Residuals w.r.t. Combination

	East (mm)	North (mm)	Up (mm)
Geoscience Australia	0.6	0.4	1.6
Uni. NSW	2.7	2.0	8.8
Curtin Uni.	0.6	0.6	1.9

- GPSWEEK 1568 (24/1/2010 – 30/1/2010)

Final Remarks

- APREF Call for Participation will remain open until January 2011
- APREF would benefit from broader participation
  - More CORS contributions
    - commitments of 2+ years
  - More independent Analysis Centres

Final Remarks

- For more information, APREF Central Bureau
  - john.dawson@ga.gov.au
- APREF Steering Committee
  - John Dawson, Australia
  - Shigeru Matsuzaka, Japan
  - Hanjiang Wen, China
  - Cecep Subarya, Indonesia
  - Hadi Vaezi, Iran
  - Chris Rizos, International Association of Geodesy