



Technical Seminar on Vertical Reference Frames in Practice

Singapore, 27-28 July 2015

Report by Joanna Kuczynska-Siehien

The Technical Seminar on Vertical References Frame in Practice was held at the Marina Bay Sands - Singapore, on the 27-28 July 2015 in conjunction with the 13th South East Asian Survey Congress (SEASC 2015), 28-31 July 2015. The seminar was organized by IAG, (International Association of Geodesy), FIG (Fédération Internationale des Géomètres), UN-GGIM-AP (UN Global Geospatial Information Management for Asia and the Pacific), ICG (International Committee on GNSS) and SLA (Singapore Land Authority). I was there as one of five participants funded by the United Nations (ICG).

Participants were welcomed by organizers representatives: Mr Nic Donnelly (FIG), Prof. Chris Rizos (IAG), Dr Victor Khoo (SLA) and Ms Sharafat Gadimova (ICG). The seminar was also attended by sponsors representatives: Dr Rana Charara from Trimble and Mr Leong Shien Kwun from Leica Geosystems.

The technical program comprised of 6 technical sessions, including 2 focused on case studies. There were 10 presentations given by speakers from Australia, Singapore, Japan, China, New Zealand and Austria.

The first day's program dealt with the following topics:

- Introduction and Definitions
- Time Dependence and Transformations

The first two topics were presented by Prof. Chris Rizos from UNSW Australia. He comprehensively explained theoretical foundations of different height systems, both geometric and physical. Moreover, he presented issues related to Earth tides, Glacial Isostatic Adjustment (GIA), subsidence, episodic vertical displacements (e.g.

earthquakes, volcanos, landslides) and he emphasized the importance of vertical datums unification.

- Case study of Japan
- Modernization of Height System in Hong Kong
Case studies from Japan and Hong Kong were presented by Mr Basara Miyahara and Mr Simon Kwok. Both places recently modernized their height systems. Furthermore, hybrid geoid models dedicated to GNSS levelling, were created.
- Airborne Gravity for an improved vertical datum
Mr Nic Donnelly, using New Zealand as an example, argued that airborne gravity collection can be an efficient way to collect data for geoid computation.
- Presentation of International Committee on GNSS (ICG) at UN
Participants had also opportunity to familiarize with ICG activities presented by Ms Sharafat Gadimowa.

Topics of the second day were:

- GNSS Heighting and Application to Singapore
The presentation given by Dr Victor Khoo introduced SLA, the realisation of the height datum in Singapore (2009 Singapore Precise Levelling Network), the GNSS infrastructure and computation of the SGEIOD09 geoid model.
- Incorporation of episodic vertical displacements into vertical reference frames
Mr Nic Donnelly, again using New Zealand as an example, presented types of vertical deformation and their impact on global and local reference frames. He showed different methods of vertical deformation measuring (such as InSAR, airborne LIDAR, precise levelling) and modelling and examples of models usage.
- Case Study New Zealand
- Case Study Australia
Current status of New Zealand's and Australian height datums and also plans for the future were presented by Mr Graeme Blick and Dr John Dawson.



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INTRODUCTION:

The Technical Seminar on Vertical Reference Frame though targeted at industry needs (geodetic practices) for Vertical datum realization especially in the area of “Unification and Modification” of existing vertical datum also provides a good scientific (Academic) background on theories and methods for such realizations.

In essence, the Seminar was a very good forum of discussion where all issues (Theory and Practice) as it relates to Vertical datum were discussed and possible solutions proffered especially in the context of the peculiarities of the diverse countries represented.

Described in subsequent sessions of the report is a brief summary of the events/ presentations held per day and subsequently what I choose to describe as “Recommendations / Standard Best Practices” observed from the various presentations which I thus recommend for my Country.

DAY 01

The first day started with a two-section lecture on the definitions, theories and transformation issues in Vertical Datum realization. That was followed by series of

other presentations on the various methods adopted in the realization of a consistent height system in some selected Countries (Japan, Hong Kong and New Zealand).

The Working Group members were then finally intimated on the activities of the UNOOSA (United Nations Office of Outer Space Applications).

At the end of the presentations, all the seminar attendants took a group picture (Picture 1) after which we were treated to a beautiful dinner at the “Satay by the Bay” (Picture 2 – Picture 3)

Other interesting features in the course of the day includes the several tea breaks with the delicious snacks served at each break (Picture 4)

DAY 02:

Further presentations were made on the second day illustrating the realization methods adopted in Singapore and Australia. The co-operate sponsors of the FIG (Trimble and Leica) also briefed attendees on the new products and services that are available to the geodetic community for precise 3d positioning and deformation monitoring.

At the end of the presentations, Mr. Nick Donnell from New Zealand gave the closing remarks and the seminar was brought to a close

BEST STANDARDS / RECOMMENDATIONS

With the current rapid rate of urbanization across the globe, land is gradually getting scarce thus the need for vertical development of land especially in low land mass countries such as Singapore, Hong Kong e.t.c. This is giving rise to the concept of 3D cadaster and need for a well-defined national height system.

In the wake of these issues, after listening to the experience from the various countries, the following are recommendations I personally would wish to raise as best standard practice as countries strive towards datum unification.

1. Countries with geologically active sub-surface formations should intensify efforts more on gravimetric geoid modelling than the geometric modelling approach as is the case in New Zealand. This will help reduce the need for constant (continuous) precise levelling after each event of major crustal movements.
2. To minimize error due to data heterogeneity (gravity data) and also save cost, large expanse countries could resort to air borne gravimetry for collection of nation-wide gravity data. Results from the New Zealand experience shows that the resulting gravity anomaly map shows strong level of correlation with EGM 2008 model anomaly of same study area.
3. Countries with a physical realization of the vertical datum should embark on routine precise levelling check from the tidal level station to the countries fundamental zero point as is learnt from the Japanese experience. This will enable them to appropriate the impact of the sea level rise on the national height network.
4. Height network modification requires that the physical benchmarks within the existing network be strengthened and properly defined such that the points will not be disturbed especially within urban areas as learnt from the Hong Kong experience.
5. The use of the InSAR (Interferometric Synthetic Aperture Radar) imageries for crustal deformation monitoring is advised for large scale studies in vast countries (Japan and New Zealand)
6. Three height realization methods are presently available, the Physical realization, Geoid based realization and Hybrid realization. Countries with coastal areas thus have the luxury of utilizing both realizations (Australia)

CONCLUSION

The Seminar was highly informative and interesting. It was a really good exposure for me to see the balance between academic (Theoretical geodesy) and Industrial practice and demands. The various presenters and resource persons were highly informative and all the sessions were well presented.

The seminar also gave me the privilege of meeting up with several other key players in the geodetic community whose contributions will in no small measure contribute to the successful completion of my PhD research.

Finally, I wish to thank FIG commission 5 and UNOOSA through Ms. Sharafat Gadimova for the sponsorship and privilege to attend this seminar. Looking forward to attending the next edition of the Technical seminar at Christ Church, New Zealand.



Picture 1: Group Photograph of all the Conference participants