

# Review of Symposium on Reference Frames for Applications in Geoscience

Accurate reference frames are fundamentally important for Earth science studies, satellite navigation, mapping, international time transfer and many applications relying on geospatial information. Increasingly, they are also used for demanding commercial applications such as agriculture, aviation, construction, public safety and transportation.

Approximately 100 geodesists and geoscientists from 24 countries met recently to discuss the role of global and regional reference frames in science and practice. The international symposium, REFAG2014, took place at the Melia Hotel in Kirchberg, Luxembourg, from 12-17 October 2014. The symposium featured sessions on six topics: the theory and concepts underpinning reference frames; the space-based geodetic techniques required to generate the reference frames; the theory to tie the terrestrial reference frame (TRF) to the celestial reference frame (CRF) (and the associated Earth rotation parameters); regional and national reference frames; the importance of reference frames in the geosciences; and how georeferencing is used in practice.

Among the most-discussed topics at the meeting was the analysis of station positions, velocities and Earth orientation parameters from the space geodetic measurement techniques that will eventually be incorporated into the next update of the international TRF: the *ITRF2013*, which is expected to be released in early 2015.

The meeting gave researchers detailed insight into the background modelling in the satellite laser ranging (SLR), global navigation satellite system (GNSS), very long baseline interferometry (VLBI), and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) data processing. Presentations examined efforts to improve modelling of the neutral troposphere propagation delay and solar pressure models on the satellite orbits, compared error characteristics of station positions from SLR and GNSS data, reported on ongoing efforts to measure and improve the inter-station vector ties at ground stations equipped with co-located techniques, and presented progress on a proposed space-based mission to link the space geodetic techniques.

The question of the relationship of regional reference frames to the global reference frame was also discussed, in particular in light of the large-scale effects of mega-earthquakes. The possible use of a 'two-frame' geodetic datum was proposed, a system that would benefit from both a time-based reference frame such as ITRF as well as a plate-fixed datum for local geospatial applications.

Scientific applications, in particular observations of sea-level rise, present-day ice-mass loss and elastic ground rebound due to local and regional water extraction, place the most stringent demands on the reference frame stability. The uncertainties in the realisation of the ITRF for long-term sea-level rise studies were discussed.

REFAG2014 also provided a forum for attendees to discuss the question of how reference frames are used in practice (e.g. for national geodetic/mapping datums and precise positioning). This is an issue that is of considerable interest to the International Federation of Surveyors (FIG), and the IAG and FIG will continue to work closely to ensure that the ITRF is promoted to the wider user community. This includes joint initiatives such as 'Reference Frame in Practice' workshops (see IAG article in the September 2014 issue of *GIM International*).