Abstract: Dynamic Geodetic Datums: A case study in Papua New Guinea
Theme: Geodesy

National geodetic datums that span tectonic plate boundaries and deforming zones are subject to distortion increasing in magnitude with time. Relative velocities between adjoining rigid plates and zones of anelastic deformation are often highly linear, however distortion near plate margins and deforming zones is often non-linear as a result of co-seismic and post-seismic displacement. Different realisations of the International Terrestrial Reference Frame (ITRF) have provided geophysicists with a dynamic geodetic reference frame. However, few countries in tectonically complex areas have established workable national geodetic datums which include dynamic elements to allow for the temporal displacement of the datum. Motion of datum monuments with respect to ITRF can exceed 1 metre every decade. Localised deformation can be up to 10 parts per million (ppm) per year, exceeding many cadastral and engineering tolerances. Inappropriate use of positioning technology can lead to inconsistent local realisations of a national datum, if the reference datum monuments and relative point positions are dynamic with respect to each other. In the long-term this discrepancy will have an adverse affect on the spatial infrastructure where relative precision is an important consideration.

A strategy is presented whereby national geodetic datums and survey networks in tectonically active regions can include a geodetic velocity field, strain dislocation model and other non-secular offset data in order to maintain the integrity of the datum. A least-squares adjustment algorithm, including dynamic elements, is described and tested. This adjustment reduces geodetic measurements made in dynamic local networks to a reference epoch and results in significant improvements in accuracy.

Papua New Guinea, located between the Australian and Pacific Plates and including several smaller microplates, is as an ideal case study to demonstrate the application of the algorithm. Papua New Guinea is one of the world's most seismically and volcanically active countries.