Satellites that see the Earth move

Sheila Peacock summarizes the British Geophysical Association’s annual Advances in Geophysics meeting, which took place on 10 and 11 February 2005, on the theme of “The Impact of Satellite Measurements on the Observation and Modelling of Continental Deformation”.

With the Earth still ringing from the disastrous Sumatra–Andaman earthquake of 26 December, the British Geophysical Association (BGA) had an apt tectonics theme for its annual research meeting. One of the key speakers was Kerry Sieh (Caltech), who had made measurements in the right place at the right time, of rings round corals pushed up above the low-tide mark around islands off northwest Sumatra. These markers of ancient uplift, combined with observations of drowned coconut plantations and rice paddies, allowed the tectonic uplift and subsidence sequence accompanying the earthquake cycle on the Sumatra subduction zone to be extrapolated backwards in time from modern GPS geodetic measurements. Sieh had worked to the south of the 26 December rupture; he expected funding to expand the GPS network to the Banda Aceh region to monitor post-seismic deformation.

Chris Chapman (Schlumberger Cambridge Research), a tsunami survivor, had the wit to get a holiday beach cleared and hence saved many lives on the southern tip of Sri Lanka (Eos 2005 86 13–14). He explored the physics of the tsunami as the Airy phase of bounded water waves, that is, the large-amplitude latest arrival of a velocity-dispersive wavetrain for which the waves, that is, the large-amplitude latest arrival.

The conference then turned to the Middle East, where new GPS measurements show that the original plate tectonic view of Turkey pushed headlong into Greece by a pincer movement of the Arabian and Eurasian plates (“Turkey in the Scissors” from Nigel Calder’sment of the Arabian and Eurasian plates) is being replaced. Turkey is rotating en bloc as its western end is pulled southwards by the general convergence of mantle flow on the Hellenic trench subduction zone, as shown in figure 1. Key evidence is the slight extension, not compression, that accompanies strike-slip motion on the East Anatolian Fault near the Syrian border.

To the east, the Arabian plate pushes northwards into Iran; to the south and west of Greece, there is subduction along the Hellenic interface from the surface to 35 km down is fully locked, awaiting rupture, but there is gradual slip on the corresponding 35–53 km zone, to be equalled or exceeded when the seismogenic zone above finally ruptures. The corresponding deep zone of the Cascadia subduction thrust fault beneath Vancouver Island ruptures episodically in slow “tremor” lasting about 15 days, with 14–15 month recovery periods in between. During the tremor the rupture progresses north-westwards for 300 km. The seismogenic zone above remains locked and capable of a magnitude 8 or greater earthquake, more likely during the 15-day tremor part of the cycle.

No such meeting could be complete without western California: here we heard that the Hayward fault, partner to the San Andreas on the east side of San Francisco Bay, is gradually tearing Berkeley’s football stadium apart, but geodetic modelling shows that it is locked below 10 km and could rupture in a M = 7 earthquake.

Finally, the global perspective of satellite gravity measurements was applied by Dan McKenzie (Cambridge) to Mars and Venus. The observed gravity combined with a model derived only from topographic height, allows deduction of the elastic thickness of the planet surface. On Mars it varies from 14 km under the south pole to 70 km under the Tharsis volcanics. On Venus it is uniformly remarkably thick at 30 km, because the rocks are dry – and so less ductile than wet Earth rocks – at the high temperature.

The meeting organizers – Barry Parsons, James Jackson and Paul Cross of the Centre for the Observation and Modelling of Earthquakes and Tectonics (COMET; a NERC Earth Observation Centre of Excellence) – assembled an excellent and varied programme with a wide international input on this global subject. This year’s meeting is being organized by Ian Main of Edinburgh University for 9–10 March 2006 and is entitled “Scale Invariance and Scale Dependence in Earth Structure and Dynamics”.●

Sheila Peacock, Meetings Secretary, BGA, now at AWE Blacknest; s.peacock@blacknest.gov.uk.