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Comparison of present-day and long-term deformation rates in New Zealand

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Surface velocity estimates from repeated or continuous GPS observations provide information on present-day crustal deformation, which includes a combination of long-term deformation, aseismic deformation, and elastic strain accumulation due to interseismic coupling on faults. The slip rates and styles of active geological faults provide information on long-term deformation, at least that part that is accomplished through surface-faulting earthquakes. If the deformation fields derived from GPS and from active faults are expressed in the same format, they can be compared to understand their differences, particularly in regard to the roles of elastic strain accumulation and aseismic deformation.

We have extended the methods pioneered by John Haines and Bill Holt to derive continuous velocity and strain-rate fields throughout New Zealand, using both GPS velocities and active faults as data sources. The GPS data consist of more than 800 point velocities throughout New Zealand derived from various GPS campaigns between 1991 and 2005. The active fault data are from nearly all known active faults in New Zealand. The data vary from complete characterisation of slip rate and style to information on style only, especially for faults whose estimated slip rates are less than about 1 mm/yr.

We compare these velocity and strain rate fields to assess regions where elastic strain is building towards large earthquakes, regions where deformation may be accomplished through small earthquakes or aseismically, and regions where faults may be missing or their slip rates inconsistent with the values in our active faults database.