Co-seismic deformation along the Sumatra Andaman fault derived from GPS data and tsunami models

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Data collected at ∼60 Global Positioning System (GPS) sites in southeast Asia are used to determine the bed displacements (uplift) that occurred in the Indian Ocean during the 26 December 2004 Sumatra-Andaman earthquake. This data are then used as the initial surface displacement fields in a numerical model of the tsunami. The GPS data are first inverted in order to determine the slip and then vertical bed displacements are derived from these results. However, the inversion process requires knowledge of the underlying fault geometry. Two realisations of the slip and corresponding uplift are presented; the first is based on mapping of the faults in the area, whereas the second is based on an analysis of the 3D geometry of the aftershocks following the main shock. It is noteworthy that the plane defined by the after shocks is different to that defined by the mapping of the faults. Modelled tsunami arrival times were compared to satellite and coastal tide gauge data. This was found to be an excellent means to differentiate between the accuracy of the different GPS inversions, demonstrating that the aftershock data are valuable for improving the results of the GPS inversion. However, a first inversion of the GPS data based on local fault maps could be available within 30 minutes. Hence, GPS data should be included as an important component of future tsunami warning systems.