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New GPS velocity field in the northern Andes (Ecuador - Colombia) : partial locking along the subduction and northeastward escape of the Northern Andean Block

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Rapid subduction of the Nazca plate beneath the Ecuador-Colombia margin (∼58 mm/yr) results in two different processes: (1) elastic stress is accumulating along the Nazca/South America plate interface which is responsible of one of the largest megathrust earthquake sequence during the last century (1906, Mw = 8.8, 1942 Mw = 7.8, 1958 Mw = 7.7, and 1979 Mw = 8.2) (2) the Northern Andean Block (NAB) moves northeastward with respect to Stable South America. However, kinematics of the NAB and its level of internal deformation has yet to be quantified. We present a new GPS velocity field covering the northern Andes from south of the Gulf of Guyaquil to the Carribean plate. Our velocity field includes new continuously-recording GPS stations installed along the Ecuadorian coast, together with campaign sites observed since 1994. The observed velocity field confirms that the current surface deformation results from the superimposition of a NNE motion the crustal North Andean Block occurring at ∼8 mm/yr and the elastic deformation induced by partial locking of the subduction interface. We first estimate the long-term kinematics of the North Andean block in a joint inversion including GPS data, earthquake slip vectors and quaternary slip rates on major faults. The inversion provides an Euler pole located at long. -107.8°E, lat. 36.2°N, 0.091°/Ma and indicates little internal deformation of the North Andean Block (wrms of residual velcoties is 1.3 mm/yr). As a consequence, 30% of the obliquity of the Nazca/South America motion is accommodated by transcurrent deformation along the eastern boundary of the NAB. Residual velocities with respect to the North Andean Block are then modelled in terms of elastic locking along the subduction interface. Models indicate that the subduction interface is partially locked (50%) up to a depth of 40 km over the area of rupture of the 1906 earthquake. Further south, coupling decreases with latitude, with no coupling detected at the latitude of Guayaquil.