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A new Interseismic Velocity Field along the Northern Andes

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Fast subduction of the Nazca oceanic plate beneath the South American continental plate regularly generates large earthquakes (Mw > 7.5). Among the most active area of Nazca-South America subduction zone, the Ecuador-Colombia segment has experienced one of the largest seismic sequences ever documented. The sequence started with the Mw ~8.6 1906 earthquake which rupture the northern Ecuador and southern Colombia segment. During the following decades, this same segment was ruptured again by 3 earthquakes of magnitude between 7.7 to 8.2 in 1942, 1958 and 1979 (Kanamori, H., & McNally, 1982). In April 2016, a 7.8 magnitude earthquake marked a new stage in the sequence due to it occurred at the same segment already ruptured in 1942 by a similar earthquake (Ye et al., 2016, Nocquet et al., 2017). Space geodetic techniques, in particular GPS/GNSS, allow us to quantify the movements on the surface of the upper plate with millimeter accuracy. The integration of these measurements with elastic models allows us to determine the level of interseismic coupling along the subduction interface together with the slip rates of major crustal faults on land. We analyze continuous GPS measurements acquired between 2003.0 and 2019.0 in Ecuador, Colombia, and northern Peru to derivate a new velocity field at the scale of the northern Andes. We use the Gamit/Globk v 10.7 software with a two-step geodynamics approach where loosely daily solutions are first obtained, then 7 transformation parameters are used to derive time series expressed with respect to the IGS14 reference frame. GPS time series are first corrected for seasonal variations, offsets, outliers and transient signals. Then, the time correlated noise parameters are estimated using the maximum likelihood estimator implemented in the CATS software, in order to derive realistic velocity uncertainties. We use our updated velocity field to discuss (1) the uncertainties of NAZCA/SOAM convergence (2) the kinematics of the north Andean Sliver (3) the mode of partitioning of the oblique plate convergence between slip occurring at the plate interface and motion along the major faults delimiting the eastern boundary of the North Andean Sliver.

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