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Limited overlap between the Darwin gap and co-seismic slip of the great 2010 Chile earthquake

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The Mw 8.8 mega-thrust earthquake and tsunami that occurred on February 27, 2010, offshore Maule region, Chile, was not unexpected. A clearly identified seismic gap existed in an area where tectonic loading has been accumulating since the great 1835 earthquake experienced and described by Darwin during the voyage of the Beagle. Here we jointly invert tsunami and geodetic data (InSAR, GPS, land-level changes), to derive a robust model for the co-seismic slip distribution and induced co-seismic stress changes, and compare them to past earthquakes and the pre-seismic locking distribution. We aim to assess if the Maule earthquake has filled the Darwin gap, decreasing the probability of a future shock . We find that the main slip patch is located to the north of the gap, overlapping the rupture zone of the Mw 8.0 1928 earthquake, and that a secondary concentration of slip occurred to the south; the Darwin gap was only partially filled and a zone of high pre-seismic locking remains unbroken. This observation is not consistent with the assumption that distributions of seismic rupture might be correlated with pre-seismic locking, potentially allowing the anticipation of slip distributions in seismic gaps. Moreover, increased stress on this unbroken patch might have increased the probability of another major to great earthquake there in the near future.