Both laboratory experiments and dynamic simulations suggest that earthquakes can be preceded by a precursory phase of slow slip. Observing processes leading to an acceleration or spreading of slow slip along faults is therefore key to understand the dynamics potentially leading to seismic ruptures. Here, we use continuous GPS measurements of the ground displacement to image the daily slip along the fault beneath Vancouver Island during a slow slip event in 2013. We image the coalescence of three originally distinct slow slip fronts merging together. We show that during coalescence phases lasting for 2 to 5 days, the rate of energy (moment) release significantly increases. This observation supports the view proposed by theoretical and experimental studies that the coalescence of slow slip fronts is a possible mechanism for initiating earthquakes.