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Carbon dioxide emission from Cuicocha Volcanic Lake, Ecuador

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The Cuicocha volcanic caldera lake is a relatively young lake-filled caldera system, which is situated on the Western Cordillera, about 110 km north of Ecuador's capital Quito. Cuicocha is one of the two active volcanic lakes of Ecuador. Due to the presence of a considerable amount of population living within a 20 km radius of Cuicocha caldera rim, monitoring the Cuicocha volcano crater lake has been a priority task in Ecuador. We report herein the results of a CO_2 efflux survey carried out at this caldera lake during September 2017, with the aim of evaluating temporal variations of CO_2 efflux and their relationships with volcanic activity since 2006. A total of 113 CO_2 efflux measurements were performed on the lake surface by means of the floating accumulation chamber. At each sampling site pH, temperature and conductivity were measured at 15 cm depth from the water surface. To study the possible water stratification and CO_2 accumulation in the lake a vertical profile reaching 80 m depth was also performed at Cuicocha caldera lake. The CO_2 efflux values ranged between 14 and 1,800 g·m^{-2}·d^{-1}with an average value of 70.6 g·m^{-2}·d^{-1}. CO_2 efflux spatial distribution maps were constructed using sequential Gaussian simulation from 100 simulations and in order to compute the diffuse CO_2 emission at the studied area. The highest values of diffuse CO_2 efflux and water temperature were observed at the north sector of Teodoro Wolf island (>200 g·m^{-2}·d^{-1}). The diffuse CO_2 output was computed as 244 $\pm$ 10 t·d^{-1}, being released through an area of 4.7 km^2. The computed diffuse CO_2 output presents a range from 100 to 652 t·d^{-1} with an average value of 278 t·d^{-1}in the 2006-2017 period. During March 2012, more than a hundred of earthquakes (M<3) have been recorded in the southwestern zone of the Cuicocha volcanic caldera lake by the national monitoring system, coinciding with the maximum value of diffuse CO_2 emission, as demonstrated in the current study. To continue the periodic diffuse CO_2 emission surveys will be tremendously useful to improve the early warning system of future magmatic reactivations.