Detecting burnt scars from space: A case study of the January 2019 wildfires along the eastern flank of Piton de la Fournaise Volcano, La Réunion

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Abstract

Like many other tropical environments, La Réunion island hosts a vast variety of indigenous and endemic species. This is not only due to its geographical isolation in the Indian Ocean, but also because of the rich diversity of natural habitats, and the existence of many micro-climates. The island is of volcanic origin and the landscapes of its eastern part are, until today, continuously transformed by the active Piton de la Fournaise Volcano. Besides frequent volcanic eruptions that produce basaltic lava flows, wildfires also threaten the vegetation along the volcano's flanks. A major wildfire occurred between 20 and 27 January, 2019, in the Grand Brûlé, an area characterized by extremely steep slopes, dense vegetation and seaward ground movement of _˜3 cm/yr that is caused by gravitational edifice spreading. The area affected by the fires was estimated to roughly 2000 ha by the *Service Départemental d'Incendie et de Secours (SDIS)*. We used Synthetic Aperture Radar (SAR) imagery collected by the European Sentinel-1 satellite in order to more accurately map the extent of the burn scar by applying two main techniques: a) a change detection technique comparing the backscatter intensity before (2019/01/17) and after (2019/01/29) the wildfires, and b) SAR interferometry, a technique that allows tracking surface changes over time by calculating the difference between the post- minus the pre-event interferometric coherence in order to estimate the areas of vegetation loss. Our results suggest that a minimum of 1500 ha of vegetation were lost during the fires. Ground investigations during and after the event allowed for the identification of two main types of fire dynamics: a) In densely forested areas,

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mainly the ground vegetation was destroyed, while larger trees survived, producing characteristic discontinuous patterns in satellite imagery, b) Mosses and lichens covering younger lava flows burned entirely, appearing as distinctive continuous patterns in satellite imagery. Our analysis helped mapping and characterizing the total area affected by the January 2019 wildfires along the eastern flank of Piton de la Fournaise Volcano, and demonstrates the applicability of SAR satellite imagery for rapid mapping of burnt scars.

Keywords: La Réunion, wildfire, biodiversity, SAR remote sensing, coherence