

A STUDY OF RIVERBED DYNAMICS USING REMOTE SENSING: A 3D CASE STUDY OF RIVIÈRE DES GALETS, LA RÉUNION ISLAND

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La Réunion Island is a geologically young (~3 Ma) volcanic island in the Indian Ocean, situated about 200km south-west of Mauritius. Due to its tropical location it receives an average of around 2000mm rain per year, though the eastern parts of the island receive up to 11 meters per year. Rivière des Galets is located on the western side of the island, and drains the Cirque du Mafate region. This region is a large eroded basin on the north-western flank of the now extinct Piton des Neiges volcano. It consists mainly of volcanoclastic sediments and debris flows related to the extinct volcano, making it a major source of sediment to Rivière des Galets. The nature and rate of erosive processes in this river has never been studied, and are of particular importance since the riverbed is extensively mined for construction materials. Furthermore, understanding the fluvial pattern of the river allows for a more informed natural hazard assessment. In this study we use a multi-temporal database of SPOT imagery and aerial photography to observe vertical and horizontal changes that occur in the Rivière des Galets riverbed over time. Since the available SPOT archive contains images as far back as the late 1980's, this provides a comprehensive overview of the river's behaviour in 2D. By digitizing the flow patterns of the river during the dry season of every year, we build a pattern of erosion-prone areas by observing the repetitive flow patterns and flow densities over time. Examining vegetative activity in the riverbed, as well as monitoring stable inter-annual reflectance features allows us to identify areas which are rarely, if ever, covered by water, and which areas are subject to consistent erosion. Using the same SPOT dataset, we also monitor the evolution of the Rivière des Galets delta, especially in response to major rainfall events such as cyclones, as well as the construction of a dyke along the lower banks of the river. Initial measurements indicate that the delta has accreted a total additional area of nearly 65 000m² in the last five years. Using two sets of stereophotographic aerial photos of Rivière des Galets captured in 2006 and 2008, we constructed digital elevation models (DEMs) of the riverbed on these two dates. Differencing these DEMs allows us to observe where erosion and deposition is occurring in the river, and to what extent. Using a cut and fill analysis, we calculate the volume of eroded and deposited material between these two dates. This also gives an indication of the minimum volume of total displaced material between 2006 and 2008. This data is supplemented by a series of 4 cross-sectional profiles across the riverbed. These profiles were surveyed in the dry season of 2006 and repeated in 2007 and 2008. They were performed by differential GPS, ensuring centimeter-scale accuracy. These consecutive profiles clearly illustrate the effect of a major rainfall event (Cyclone Gamede, February 2007) on sediment displacement in the river, the cyclone causing up to 5m vertical displacement of the riverbed in places.