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Land cover change on Mt Pinatubo, the Philippines, monitored using ASTER VNIR

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Ash fall and pyroclastic flows from the large eruption of June 1991 destroyed much of the vegetation on the flanks of Mt Pinatubo. Subsequent vegetation recovery has helped to stabilize slopes and reduce debris flow hazard. In this project, ASTER VNIR satellite imagery captured at the same time of year in 2001, 2004, and 2008, is used to quantify vegetation recovery within 22 upland watersheds on the mountain, 10 to 16 years after the eruption took place. Differences in the normalized difference vegetation index (NDVI) are used to measure the areal extent of losses and gains in ground cover and derive average net rates of change in ground cover. The success of this approach was dependent on post-processing ASTER imagery to correct for the effects of variation in satellite-sun geometry and vegetation reflectance, and to calibrate and adjust the derived NDVI images for the influence of different atmospheric conditions at the time of image capture.

All watersheds showed a variable pattern of losses and gains in vegetation and ground cover. Losses were related to shifting cultivation practices and gully and channel migration, and these amounted to 1-12% of watershed areas. Gains were related to revegetation of pyroclastic flows, recent channel terraces and abandoned gardens or initially burnt vegetation, and these amounted to 3-45% of watershed areas. Consistent overall net gains in ground cover are shown for all watersheds, with the average NDVI increasing by up to 0.074 over each consecutive 3-year period. The rates of change in NDVI are used to derive a vegetation recovery curve from bare ground, and show that it will take approximately 50 years for hillslopes to regain a dense vegetative cover in this climate. This supports published findings which indicate rapid recovery of vegetation in tropical environments following large volcanic eruptions. Results additionally show that the trajectory of change and speed of recovery is influenced by terrain type, geology, watershed morphology, and the activity of erosion and depositional processes. Prior to 2001, revegetation had been fastest on mountain slopes that helped protect vegetation from the effects of the eruption. Gains in ground cover are now greater in areas that were most impacted by the eruption.

Keywords: vegetation recovery, eruption, ASTER, NDVI, Pinatubo