Monitoring vegetation in the southern bracken experiment using balloon aerial photography

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Introduction

Aerial photography has been used for the investigation of bracken invaded pastures in the tropical mountains of Southern Ecuador. Since 2008, a tethered balloon was deployed to monitor an experimental plot of 1000 m2 (S 3° 58' 18'', W 79° 4' 45'') covered by pasture grass (*Setaria sphacelata*) and the southern bracken (predominantly *Pteridium arachnoideum*). The acquired data have now been processed for the monitoring of the vegetation cover. In parallel, climate driven simulations of vegetation growth have been pursued. The initialization and validation of such simulations depend on canopy data of the fractional projective cover, which are derived from the balloon-air-photos. For this purpose the conversion of fractional projective cover to leaf area index, which is the model input/output, is needed. In this poster, we present the methodology used for processing the aerial photos and classification results of a time series including the canopy regrowth after the burning experiment from Nov 2009.

Material and Methods

The instrumentation consisted of a visible and a near infrared digital camera, an automatic shutter and a 3 m³ helium tethered balloon. Image processing and classification steps are shown in Fig. 1. Image mosaicing consisted of brightness uniformization, stitching and rectification. Brightness was uniformized for each mosaic based on the response of selected targets in a way similar to Hall et al. 1991. The photos were then stitched together by their overlapping area, after a suitable geometrical transformation. Rectification was carried out using geographical coordinates from landmarks. The final mosaics are shown in Fig 2. The classification algorithm consisted of three major components. The first segmented an enhanced image by setting a threshold. The second calculated geometry parameters and first and second order textural parameters (Haralick and Dinstein 1973) for each segment. The third classified the segments by using boosted regression tree models (Friedman 2001). The resulting and validated maps are shown in Fig 3.

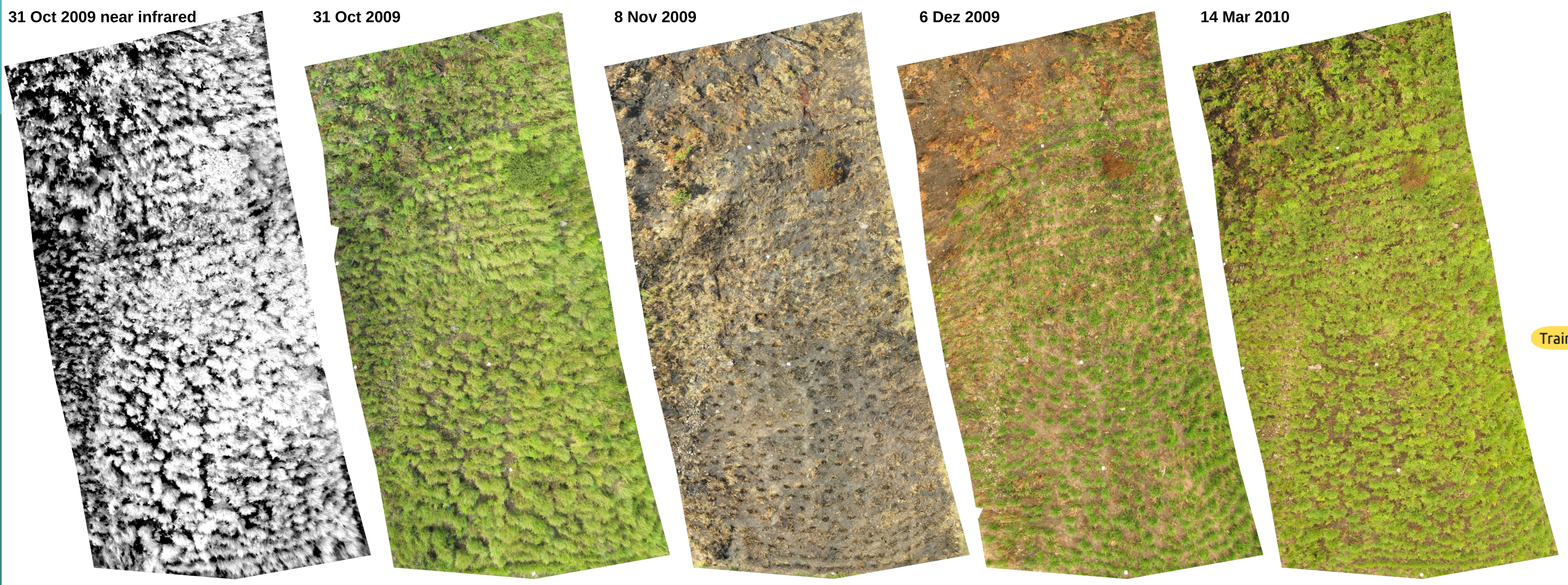

Fig. 2. Aerial photos (visible channels) from the experimental plot before and after the burning in the beginning of November 2009. For the purpose of this presentation only the near infrared image of 31 Oct 2009 is shown.

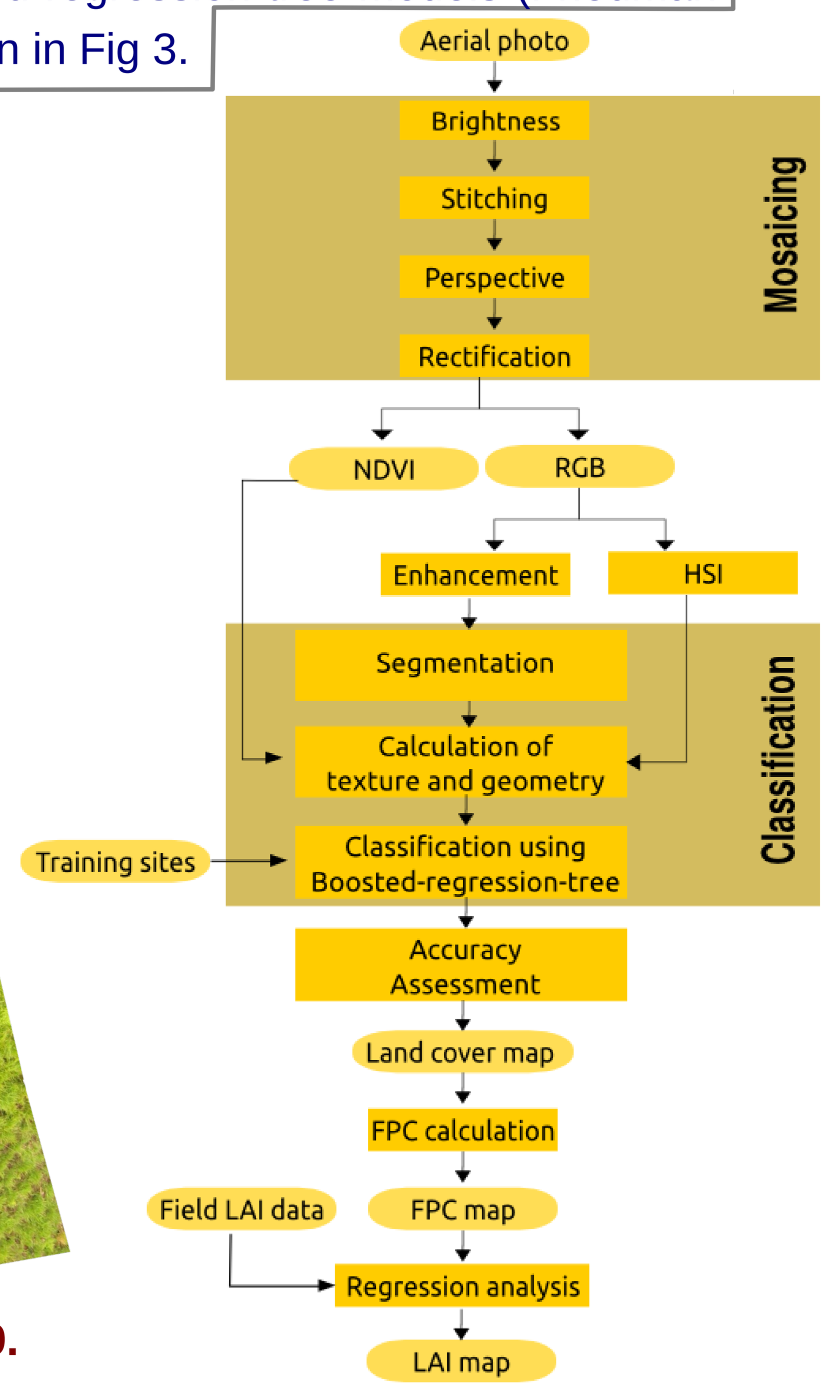

Fig. 1. Processing algorithm and workflow

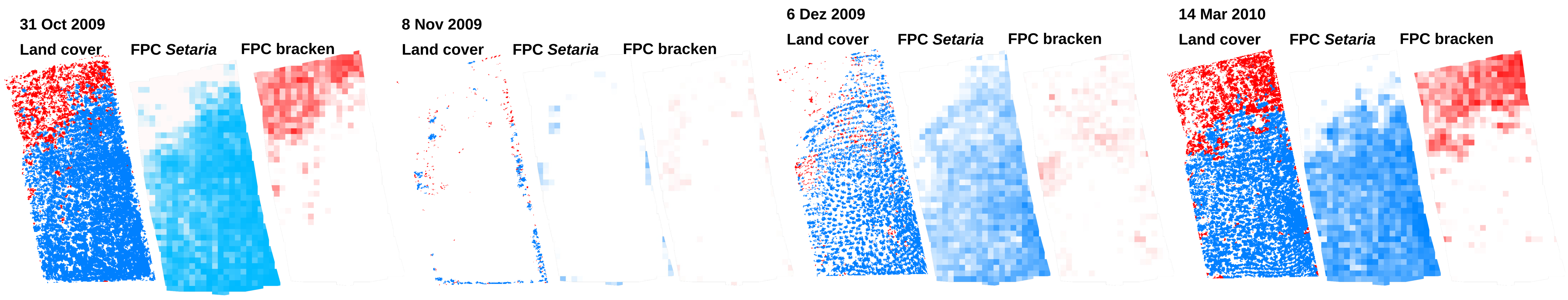

Fig. 3. Land cover and fractional projection cover (FPC) maps for *Setaria* grass (in blue) and bracken (in red). In the FPC maps blue and red tones represent the ratio of cover from zero (white) to one (saturated color).

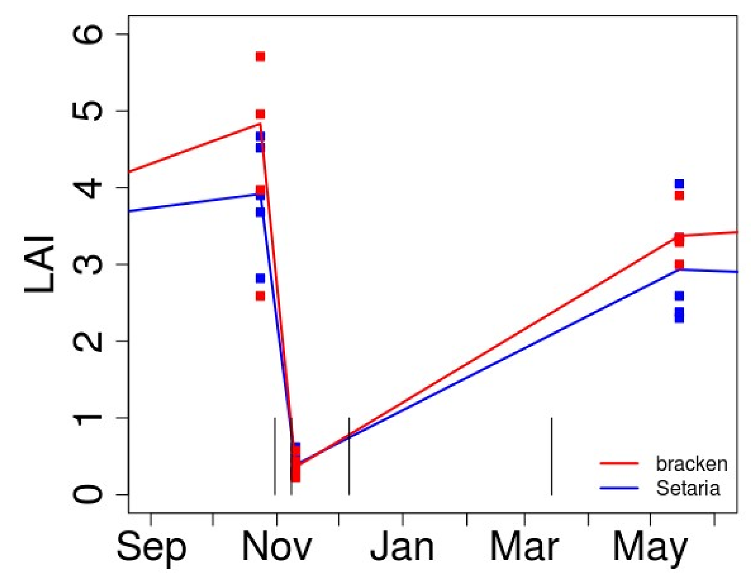

Fig. 4. Field LAI (m²/m²) data from the period of observation. Flight dates are marked with vertical lines.

Results and Discussion

Image mosaics showed a high spatial resolution with canopy details and a good spatial accuracy. Main problems were related to multiple perspective effects of composing photos and partial blurring due to weather instability during flight. Regarding the image classification, maps of land cover and fractional projection cover are in good agreement with visual interpretation. Main problems here were the similar reflectance of leaves from both species, including that in the near infrared. Using sampling sites the regression analysis of FPC and LAI field data will provide the transformation required for the comparison with simulation results.

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