Landsat-based above ground biomass estimation in pasture area in São Paulo, Brazil

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Introduction

Brazilian Cerrado biome occupies 2,039,243 km², of which 29.5% (600,832 km^2) is planted pasture area (MMA, 2015). A considerable portion of these pastures are considered degraded, thus identification and recovery of such areas could result in production gains. In the remote sensing (RS) context, pasturelands have been investigated in order to discriminate intensive and extensive grazing system areas. Intensive systems includes soil and animal management, with pasture fertilization and animal rotation in different paddocks. Extensive grazing systems do not have this management. As RS medium spatial resolution data and field measurements on biomass estimates have strong positive correlation (EDIRISINGHE et al., 2012) future researches points to assess the feasibility on grazing systems discrimination through temporal analysis. Thus, the objective of this work was to assess the Surface Algorithm for Evapotranspiration Retrieving (SAFER) potential, applied in with OLI/Landsat-8 images, to discriminate intensive and extensive grazing system areas through estimates of above ground biomass.

Material and Methods

The study area is an experimental pasture area in the Cerrado biome, located in Pirassununga, São Paulo state. It consists of six rotational (RGS) and three extensive grazing system (EGS) paddocks (Figure 1).

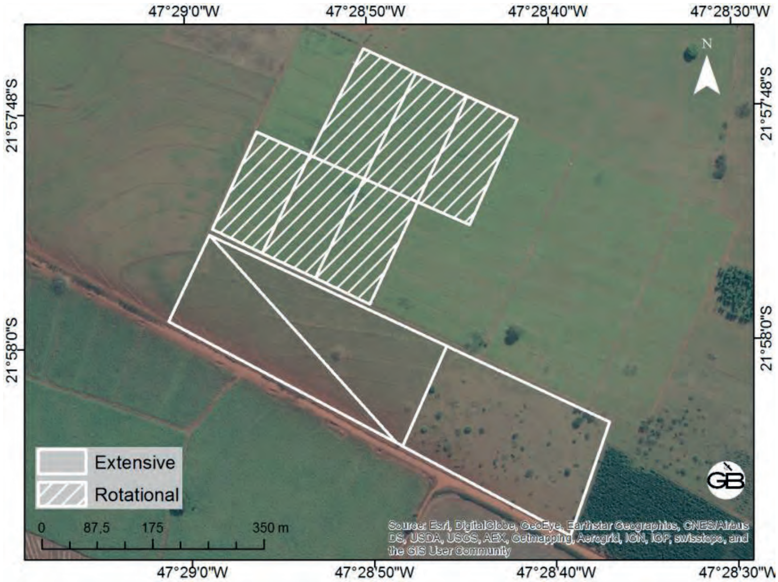

Figure 1. Experimental design from the study area

Landsat-8 images of the dry and rainy seasons from 2013 to 2015 were used, resulting in 29 cloud-free images. Dry period extends from April to September and wet, from October to March. Cumulative precipitation was 1,599.8mm, 1,046mm and 1,612.80m for years 2013, 2014 and 2015, respectively. Bands 1-7 and thermal bands 10 and 11 were used with climatic data from a weather station located inside of experimental area borders. Schematic flowchart of SAFER algorithm, described by Teixeira et al. (2015), can be observed in Figure 2.

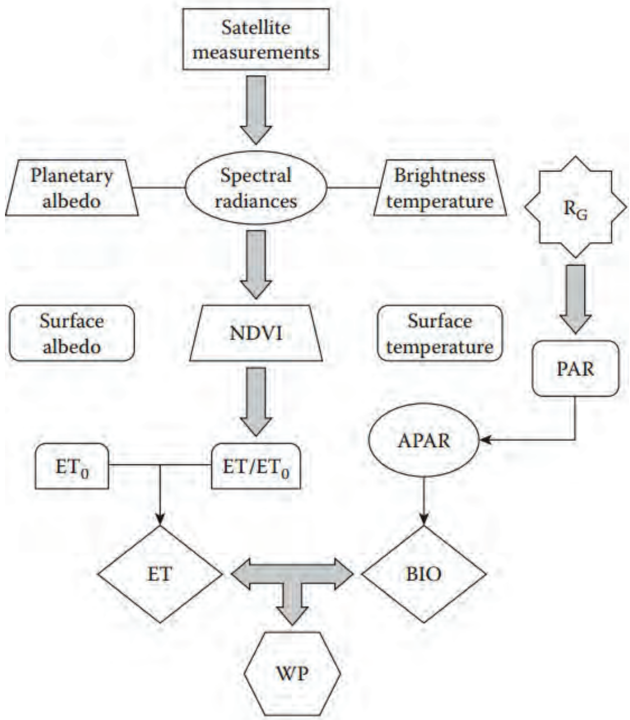

Figure 2. Schematic flowchart of SAFER algorithm. RG is the global solar radiation, PAR is the photosynthetically active radiation, aPAR is the photosynthetically active radiation absorbed, BIO is the biomass, NDVI is the Normalized Difference Vegetation Index, ET is the Evapotranspiration, ET0 is the Reference Evapotranspiration and WP is the Water Productivity. Source: Teixeira et al. (2015).

Results and Conclusions

Figure 3 shows temporal biomass estimates from 2013 to 2015 in kg ha^{-1} day^{-1}, obtained from the SAFER model. Lower accumulate precipitation values influenced vegetation production in 2014. As expected, in 2013 and 2015 biomass was higher on rotational than extensive grazing systems on most of images. In dry period, mean biomass for RGS was 48.5, 31.1 and 55.5 kg ha^{-1} and in extensive grazing system, 26.2, 23.4 and 27.7 kg ha^{-1} in 2013, 2014 and 015, respectively. In wet season, mean biomass for RGS was 54.1 and 82.1 kg ha^{-1} and in extensive grazing system was 25.9 and 45.7 kg ha^{-1} in 2013/2014 and 2014/2015, respectively (Table 1).

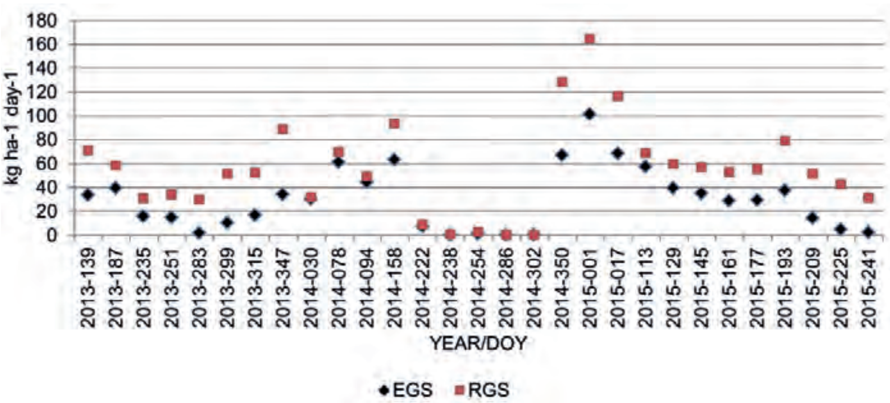

Figure 3. Biomass estimates using SAFER model for extensive grazing system (EGS) and rotational (RGS) paddocks.

Table 1. Mean biomass estimative per period, in kg ha^{-1}.

Production systems	DRY 2013 (4)*	WET 2013/14 (6)*	DRY 2014 (5)*	WET 2014/15 (5)*	DRY 2015 (9)*	2013-2015 MEAN (29)*
Extensive	26.2	25.9	23.4	45.7	27.7	29.8
Rotational	48.5	54.1	31.1	82.1	55.5	54.6

* Landsat images

SAFER algorithm is a feasible tool on biomass estimates. Future works should take into account *in situ* data in order to calibrate SAFER algorithm. Thus, the biomass can be estimated in large areas through upscaling process.

References

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