VALIDATION OF AN EMPIRICAL MODEL, LAI~VI, TO FORCE A GRASS GROWTH MODEL ON REUNION ISLAND, FRANCE

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ABSTRACT

The Leaf Area Index (LAI) is a parameter of many growth models used to predict biomass. LAI was used, for instance, in the Mosicas (Martiné, 1999) and Gamede (Vayssières *et al*., 2009) growth models for sugarcane and grass respectively, on Reunion Island, France. Those models have exhibited some limitations and prediction error can be significant. The aim of our study was to estimate LAI from satellite imagery in order to force a grass growth model. Around 430 samples were obtained from nine experimental plots situated around Saint-Pierre and Plaine-des-Cafres (South-West of the island) from April to August 2015. The sample LAI values were averaged by plot and associated with average vegetation indices (VIs), computed from Spot5take5 data (simulation of Sentinel-2 data). From testing of different VIs we observed a stronger correlation between NDVI (Normalized Difference Vegetation Index) and LAI compared to other VIs. The relation was so great that we found correlation values of 0.87 and 0.92 for temperate and tropical grass, respectively.

KEYWORDS

SPOT5take5, Leaf Area Index, Vegetation Index, NDVI, Grass, Growth Model.

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1. INTRODUCTION

Due to its insularity and constantly increasing population, Reunion Island is exposed to certain agricultural problems, such as land pressure and environmental issues. Livestock farming on the island is an agricultural sector undergoing continual change. The ruminant sector wishes to develop production and increase the self-sustainability of the island for meat and milk production, despite severe land availability constraints. More frequent drought periods have been seen in the last few years. To compensate for the lack of grass, farmers import luzerne and wheat straw, generating heavy costs for the farming economy. Today, the major issue is to be able to estimate forage availability, on a territory scale, in order to optimize forage distribution throughout the year, and anticipate the need for forage imports.

Available forage biomass (per unit area) can be predicted using grass growth models based on soil, plant and meteorological parameters. However, Reunion Island is an extremely complex territory due to its steep relief of volcanic origin and its different microclimates. While these models are correct, they are impacted by extreme and highly fluctuating meteorological conditions. In addition, they need field control measurements, such as grass samples, in order to calibrate the models according to different types of soils, grass species, etc. Such measurements are time-consuming and constraining.

Satellite imagery is an essential tool for vegetation monitoring, on both local and global scales (Xie *et al*., 2008). Imagery for agriculture is very useful for biomass prediction goals. Most often, we find studies on a territory scale (region, country) with mid-spatial resolution, such as MODIS or Landsat (Yunxiang *et al*., 2014, Zhao *et al*., 2014, Samimi et Kraus, 2004, Schino *et al*., 2003) or low resolution (Wylie *et al*., 1995). Some studies can also be found on a plot scale for crop monitoring (Bacchini et Miguez, 2015). To estimate biomass, such studies use an empirical model between a vegetation index (VI) and biomass yield measurements. However, this leads to a loss of the functional aspect of the growth model which allows daily estimations, unlike high resolution satellite images taken at a lower time frequency.

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