FRACTION IMAGES DERIVED FROM EO-1 HYPERION MULTITEMPORAL DATA FOR DRY SEASON GREEN UP ANALYSIS IN TAPAJÓS FOREST, BRAZILIAN AMAZONIA

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Abstract

In remote sensing ecological forest studies, some researchers have paid special attention to Amazon green up in dry season [1, 2, 3, 4, 5 , 6, 7]. These studies were based on vegetation indices derived from Moderate Resolution Imaging Spectroradiometer (MODIS) satellite observations and field data carbon fluxes measurements. The MODIS time-series data is the surface spectral reflectance, corrected for the effects of atmospheric gases, aerosols, and thin cirrus clouds, and is the major input for generating the ecology land products, such as Vegetation Indices (VIs) and Leaf Area Index/Fraction of Photosynthetically Active Radiation (LAI/FPAR). This MODIS time-series product with 250 meters of spatial resolution over Amazon rainforest has showed in a regional scale a green up in dry season. However, some aspects about satellites observations (sensor view, sensor swath, spectral and spatial resolution), forest structural variations, seasonal cloud cover variations, vegetation index type can be produced a complex vegetation phenology pattern. In this study, we present other approach for phenology analysis of Amazon green-up using Linear Spectral Mixture Model applied to Hyperion multitemporal data. The study area is located in Tapajós National Forest in Pará State, Brazilian Amazonia. The climate in this region is classified as *AmW* in the Koppen system. The region has well-defined dry and wet seasons, yearly rain is about 2,100 mm, with a dry season occurring from June to October. According to RADAMBRASIL vegetation maps [8], the study area is primarily covered by dense tropical rain forest ("Floresta Ombrófila Densa") with a high number of emergent tree species. The EO-1 Hyperion data were collected over the study area in July, August and September 2001, corresponding to the start and end of the dry season. EO-1 Hyperion is a spaceborne imaging spectrometer measuring up-welling radiance in 242 spectral bands covering the 400 to 2,500-nm wavelength region at a spatial resolution of 30 m. Surface reflectance was estimated from the Hyperion

data by using the ACORN atmospheric correction code. Atmospheric water vapor bands near 1,400 and 1,800 nm were removed. The data were geo-referenced using a combination of differential-Global Positioning System measurements, field-terrain mapping, and hyperspatial IKONOS satellite data. The next step, Linear Spectral Mixing Model was applied on each calibrated spectral reflectance cubes. This model generated vegetation, soil, and shade fraction images. A unique endmembers were used assuming that Hyperion images represent the surface reflectance and then the selection of enbmember was based on digital spectral library. The vegetation fraction image shows the vegetation cover condition similar to the well known normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI), while shade fraction image enhances vegetation cover structure. Statistical analyses are being carried out to evaluate the differences within the vegetation and shade fraction images derived from medium spatial resolution Hyperion images for rainforest phenology analysis.

References

[1] S. R. Saleska, et al. , "Carbon in Amazon forests: Unexpected seasonal fluxes and disturbance-induced losses", Science, 302, 1554 – 1557. 2003.

[2] G. P. Asner, D.Nepstad, G. Cardinot, and D. Ray "Drought stress and carbon uptake in an Amazon forest measured with spaceborne imaging spectroscopy", Proc. Natl. Acad. Sci. U. S. A., 101, 6039 6044. 2004.

[3] M. Keller, et al. "Ecological research in the large-scale biosphere- atmosphere experiment in Amazonia: Early results", Ecol. Appl., 14, S3 – S16. 2004.

[4] A. R.Huete, , K. Didan, Y. E. Shimabukuro, P. Ratana, S. R. Saleska, L. R. Hutyra, W. Yang, R. R. Nemani, and R. Myneni , "Amazon rainforests green-up with sunlight in dry season", Geophys. Res. Lett., 33, L06405, 2006.[5] Xiao, X., Hagen, S., Zhang, Q., Keller, M., and Moore, B., III, "Detecting leaf phenology of seasonally moist tropical forests in South America with multi-temporal MODIS images", Remote Sensing of Environment, 465-473. 2006.

[6] Myneni et al, 2007. "Large seasonal changes in leaf area of amazon rainforests". Proc. Natl. Acad. Sci., 104: 4820-4823, 2007.

[7] Saleska et al. "Amazon Forests Green-Up During 2005 Drought". Science,: Vol. 318. no. 5850, p. 612, October 2007.

[8] RADAMBRASIL. "Departamento Nacional de Produção Mineral. Folha AS.21- Santarém. Geologia, geomorfologia, pedologia, vegetação e uso potencial da terra". Rio de Janeiro: DNPM, 510 p. (Levantamento dos Recursos Naturais, v. 10).1976.