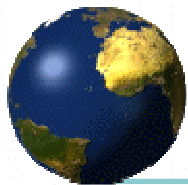




Instituto Nacional de Pesquisas Espaciais (INPE)

Ministério da Ciência e Tecnologia (MCT)

Spectral Temporal Approach by Response Surface (STARS): Methodology



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Contextualização

- ✓ Dados de Sensoriamento Remoto
 - Multiespectral
 - Multitemporal
 - Caracterização da superfície da Terra
 - Detecção e monitoramento de mudanças
 - Práticas agrícolas
 - Desmatamento
 - Padrões (“*Signature Change Pattern*”)





Perguntas...

- ✓ Existe uma maneira de sintetizar os dados de uma serie temporal de imagens multiespectrais?
- ✓ Essa possível metodologia poderia representar as assinaturas de mudança?





Objetivos

- ✓ Descrever a metodologia STARS
 - Estatística clássica
 - Geo-estatística
- ✓ Apresentar sua capacidade de representação
 - Um caso de aplicação
 - Colheita da cana-de-açúcar



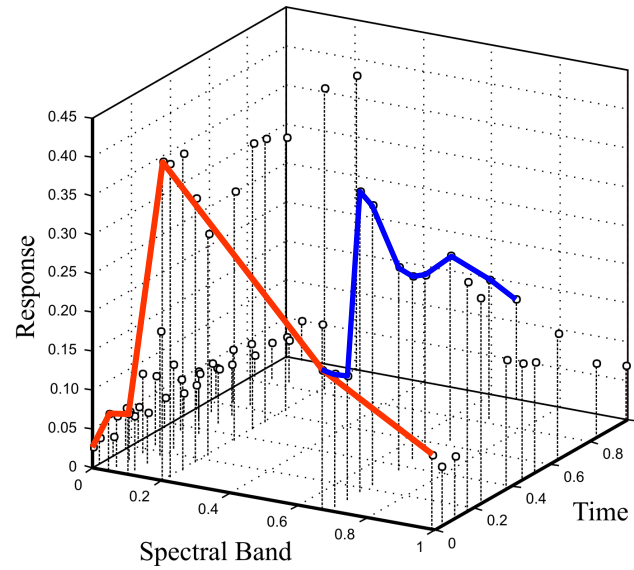
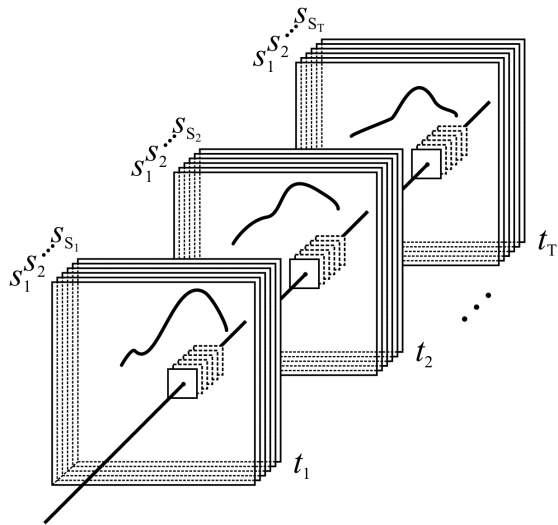


Metodologia (visão geral)

Multispectral imagery over time

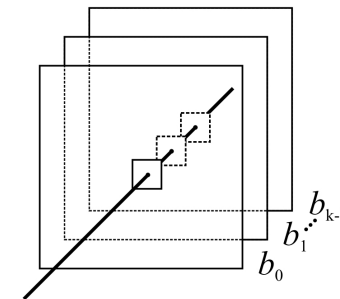
STS points

STARS image



$$r = f(t, s)$$

$$r = \beta_0 + \beta_1 t + \beta_2 s + \dots + \beta_{k-1} s^d + \epsilon$$





Modelo Estatístico

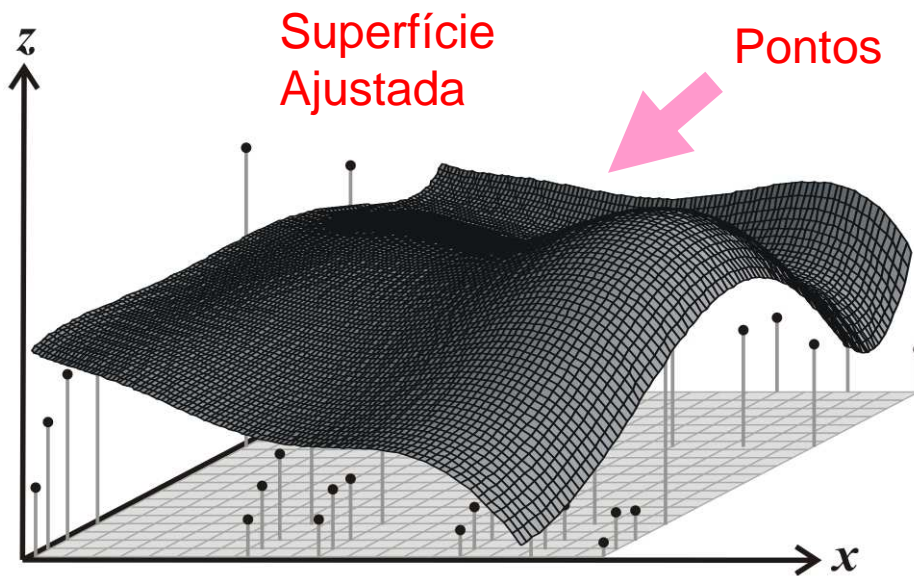
O ajuste da superfície

Superfície de Tendência Polinomial
(PTS: *Polynomial Trend Surface*)

Grau do polinômio = 3

$$\hat{z} = f(x, y) = a_0 + a_1x + a_2y + a_3x^2 + a_4xy + a_5y^2 + a_6x^3 + a_7x^2y + \dots + a_{\frac{(d+1)(d+2)-2}{2}} y^d$$

$$\hat{z} = f(x, y) = 0,08 + 0,47x + 2,42y - 3,99x^2 - 1,25xy - 27,81y^2 + 9,90x^3 - 0,31x^2y + \dots + 107,20y^3$$



Método dos Mínimos Quadrados (MMQ)

observacoes = pontos do espaço espectro temporal
incógnitas = coeficientes (a_i)





Abordagens estatísticas

- ✓ Estatística Clássica...

$$\mathbf{b} = (\mathbf{X}'\mathbf{X})^{-1} \mathbf{X}'\mathbf{r}$$

- ✓ Geo-estatística...

$$\mathbf{b} = (\mathbf{X}'\mathbf{V}^{-1}\mathbf{X})^{-1} \mathbf{X}'\mathbf{V}^{-1}\mathbf{r}$$



Motivação

- *Environ Health Perspect*, v. 114, n. 5, p. 725-729, 2006. Research

The Impact of Sugar Cane–Burning Emissions on the Respiratory System of Children and the Elderly

José E.D. Cançado,¹ Paulo H.N. Saldiva,¹ Luiz A.A. Pereira,^{1,2} Luciene B.L.S. Lara,² Paulo Artaxo,⁴ Luiz A. Martinelli,³ Marcos A. Arbex,^{1,5} Antonella Zanobetti,⁶ and Alfesio L.F. Braga^{1,2,7}

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- *Agriculture, Ecosystems & Environment*, In Press, Corrected Proof, 2009.

Expansion of sugarcane production in São Paulo, Brazil: Implications for fire occurrence and respiratory health

María Uriarte*, Charles B. Yackulic, Tamar Cooper, Dan Flynn, Marina Cortes, Tanja Crk, Georgina Cullman, Meghan McGinty, Jason Sircely

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ABSTRACT

Recent increases in the price of oil have generated much interest in biofuel development but the social and environmental impacts of large scale adoption of biofuels at both regional and national scales remain uncertain. Rising oil prices for oil may slow

- *Bioresource Technology*, v. 98, n. 9, p. 1695-1699, 2007.
Use of post-harvest sugarcane residue for ethanol production

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Department of Biological Sciences, Nicholls State University Thibodaux, LA 70310, USA

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Available online 28 August 2006

Abstract

Agricultural residues are produced in large quantities throughout the world. Approximately, 1 kg of residue is produced for each kilogram of grains harvested. This ratio of grain/residue translates into an excess of 40 billion ton of crop residue produced each year in the world. This residue is a renewable resource that can be used for ethanol production.





Tema Atual



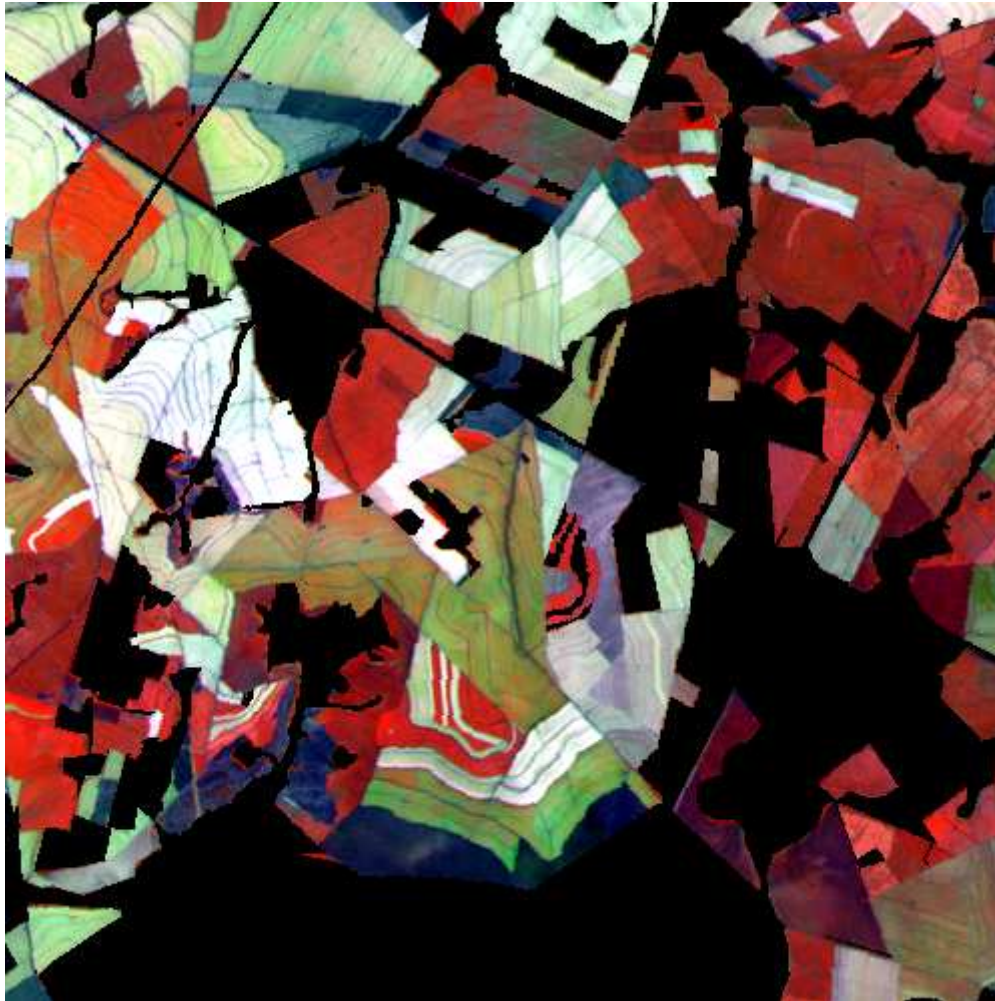
“Se 10% do combustível fóssil do mundo vier a ser substituído por etanol, a mistura E10 traria um benefício ambiental considerável, e criaria mais empregos”

(José Serra)



Série temporal

- ✓ Comportamento espectro-temporal da colheita
 - Padrão visual (composição R4G5B3)



Data1



Data2

Data3

Data4

Data5

Data6



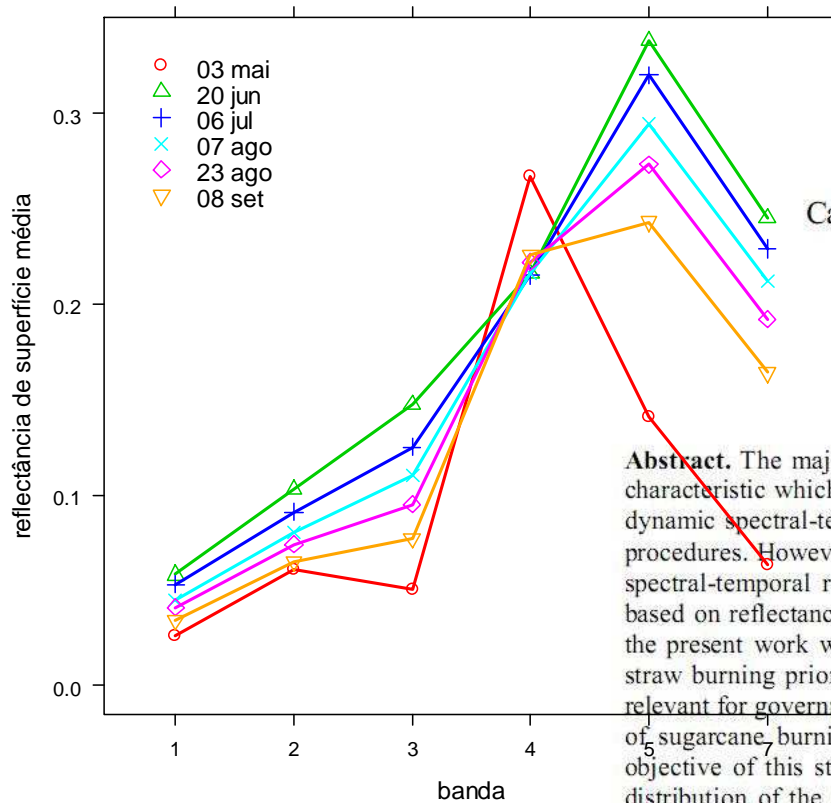


Resultados

XIV SBSR

Comportamento espectro-temporal da cana-de-açúcar: uma nova proposta na distribuição espacial dos pontos de controle utilizados na interpolação de superfícies de resposta espectro-temporais

Cana Crua



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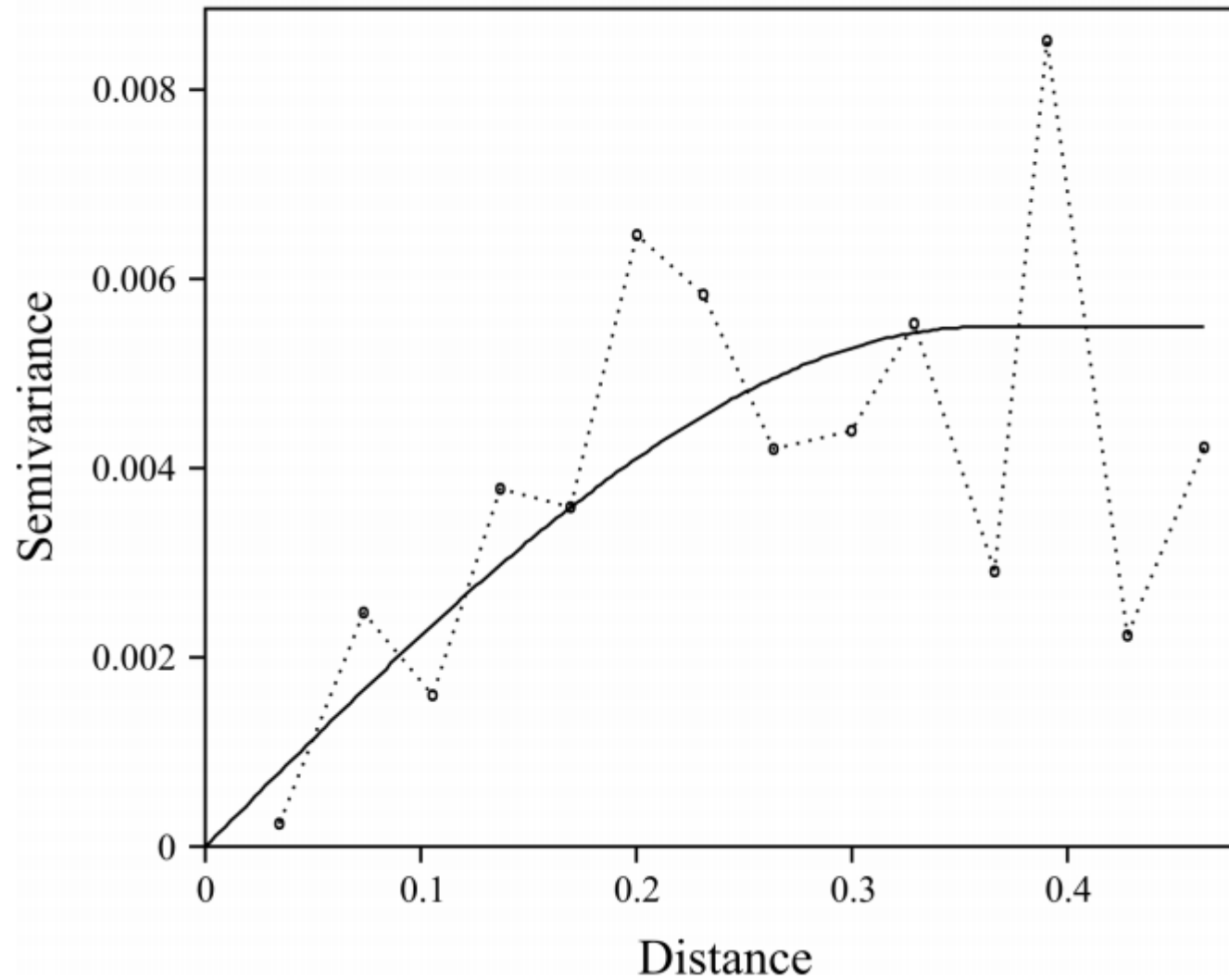
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Abstract. The major attribute of remotely sensed images to observe the land surface is the spectral-temporal characteristic which is paramount for accurate agricultural crop area classification. Agricultural targets present a dynamic spectral-temporal behavior that is very helpful to discriminate among different crops in classification procedures. However, there are only few methods that address this issue in depth. One promising method is the spectral-temporal response surfaces (STRS) approach which uses control points to define response surfaces based on reflectance observed for specific targets of interest at specific spectral bands and at specific dates. In the present work was analyzed the spectral-temporal behavior of sugarcane fields harvested with and without straw burning prior to harvest. The information about sugarcane harvested with and without straw burning is relevant for government to evaluate the effectiveness of the effort to gradually reduce the harvest practice of sugarcane burning which should cease by 2014 for fields that can be mechanical cultivated. The major objective of this study is to improve the STRS interpolation method. Therefore, two methods for the spatial distribution of the control points were compared. Three sugarcane classes (non-burned cane, burned cane and non-harvested cane) were investigated using 5,000 samples for each class and six Landsat5/TM images acquired from April to September 2007 to interpolate the STRS. Best result was obtained using the method of equidistant values distribution for the wavelength axis. With this new interpolation method it is expected to largely improve the classification of sugarcane fields harvested with different harvest practices.





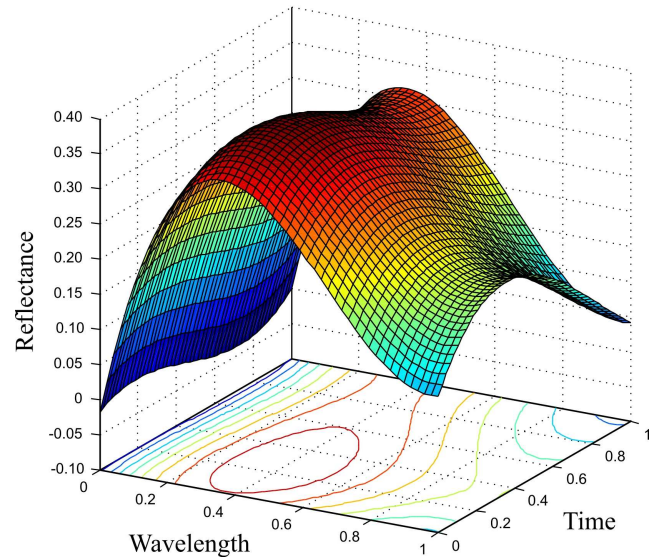
Semivariogram



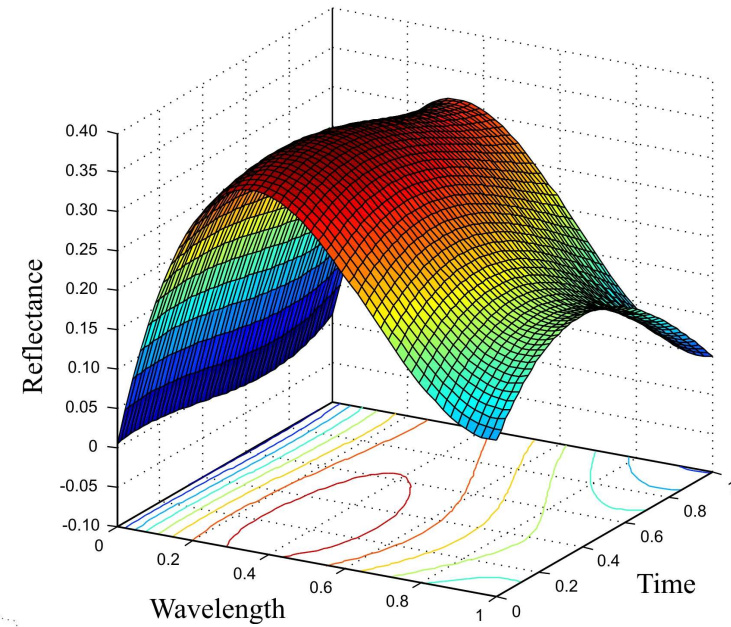


Superfícies Ajustadas...

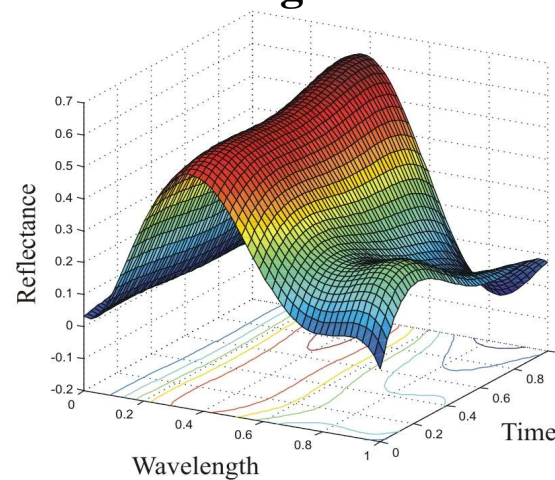
Independence Assumption



Dependence Assumption



Degree = 5





O STARS está no R!!!

The screenshot shows the RGui - [R Console] window. The menu bar includes File, Edit, View, Misc, Packages, Windows, Help, and a newly added STARS menu. The STARS menu is open, showing options: "How can I reference (cite) the STARS ? Before to begin...", "Convert dataset images to STARSImage", and "Rescaling STARSImage bands to [0,1]". The console displays the R version 2.10.0 (2009-10-26) and copyright information. Below this, there are several paragraphs of text providing information about R, including its warranty status, natural language support, and collaborative nature. The user has entered the command `> source("F:\\marcio\\Desktop\\STARS_v1.0.R")` and the cursor is on the next line. An "Information" dialog box is open in the foreground, displaying an information icon and the text "Now you can use the new R menu 'STARS'", with an "OK" button at the bottom.

```
RGui - [R Console]
File Edit View Misc Packages Windows Help STARS
How can I reference (cite) the STARS ?
Before to begin...
Convert dataset images to STARSImage
Rescaling STARSImage bands to [0,1]

R version 2.10.0 (2009-10-26)
Copyright (C) 2009 The R Foundation for Statistical Computing
ISBN 3-900051-07-0

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> source("F:\\marcio\\Desktop\\STARS_v1.0.R")
> |
```

Information

Now you can use the new R menu 'STARS'

OK





Trabalhos futuros...

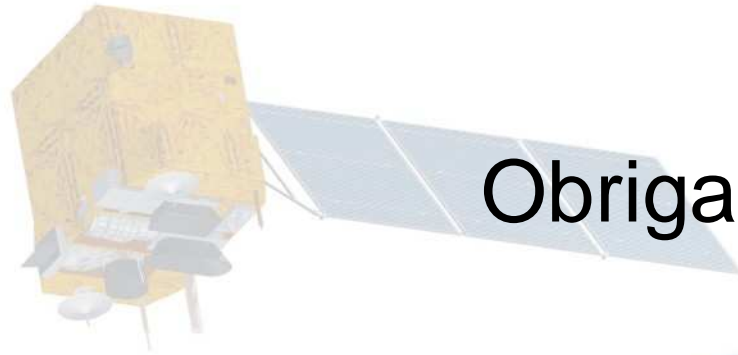
- ✓ Classificar a imagem STARS
- ✓ Verificar seus padrões
- ✓ Testar modelos
- ✓ ...



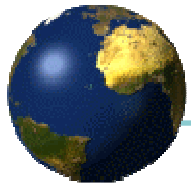


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Obrigado!



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