

Importância das geotecnologias na formação acadêmica



Fábio Marcelo Breunig

Professor Associado

E-mail: breunig@ufsm.br

Telefone: 055 3744-0683

Frederico Westphalen, RS

08/04/2022

Sala:



“Scientists who can combine geographic information systems with satellite data are in demand in a variety of disciplines.” (Virginia Gewin, 2004)

“US Department of Labor identified *geotechnology* as one of the three most important emerging and evolving fields, along with *nanotechnology* and *biotechnology*” (Virginia Gewin, 2004)

Gewin, V. (2004) ‘Mapping opportunities.’, *Nature*, 427(6972), pp. 376–7. doi: 10.1038/nj6972-376a.

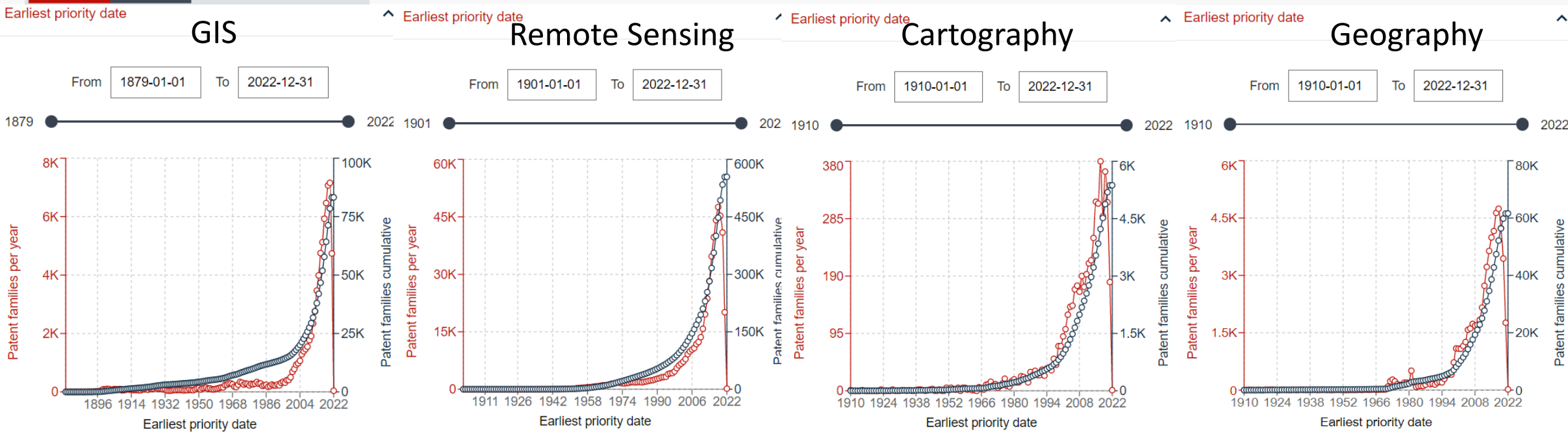
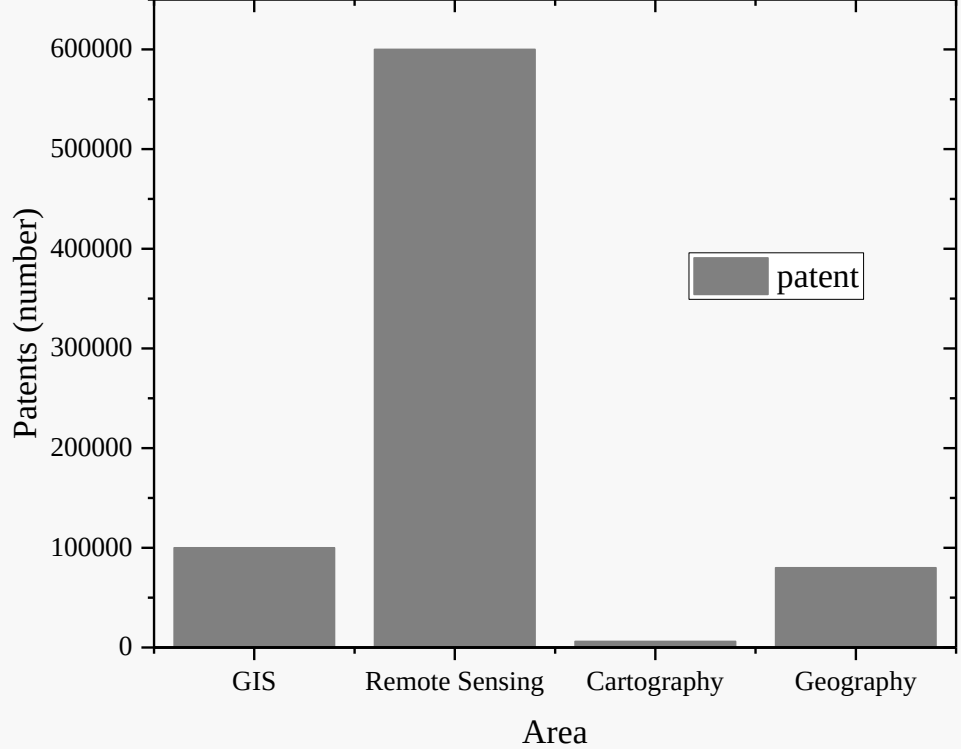
“Expectations are rising and so are the risks”

“Everyone uses location-based services”

“Every platform is becoming location aware”

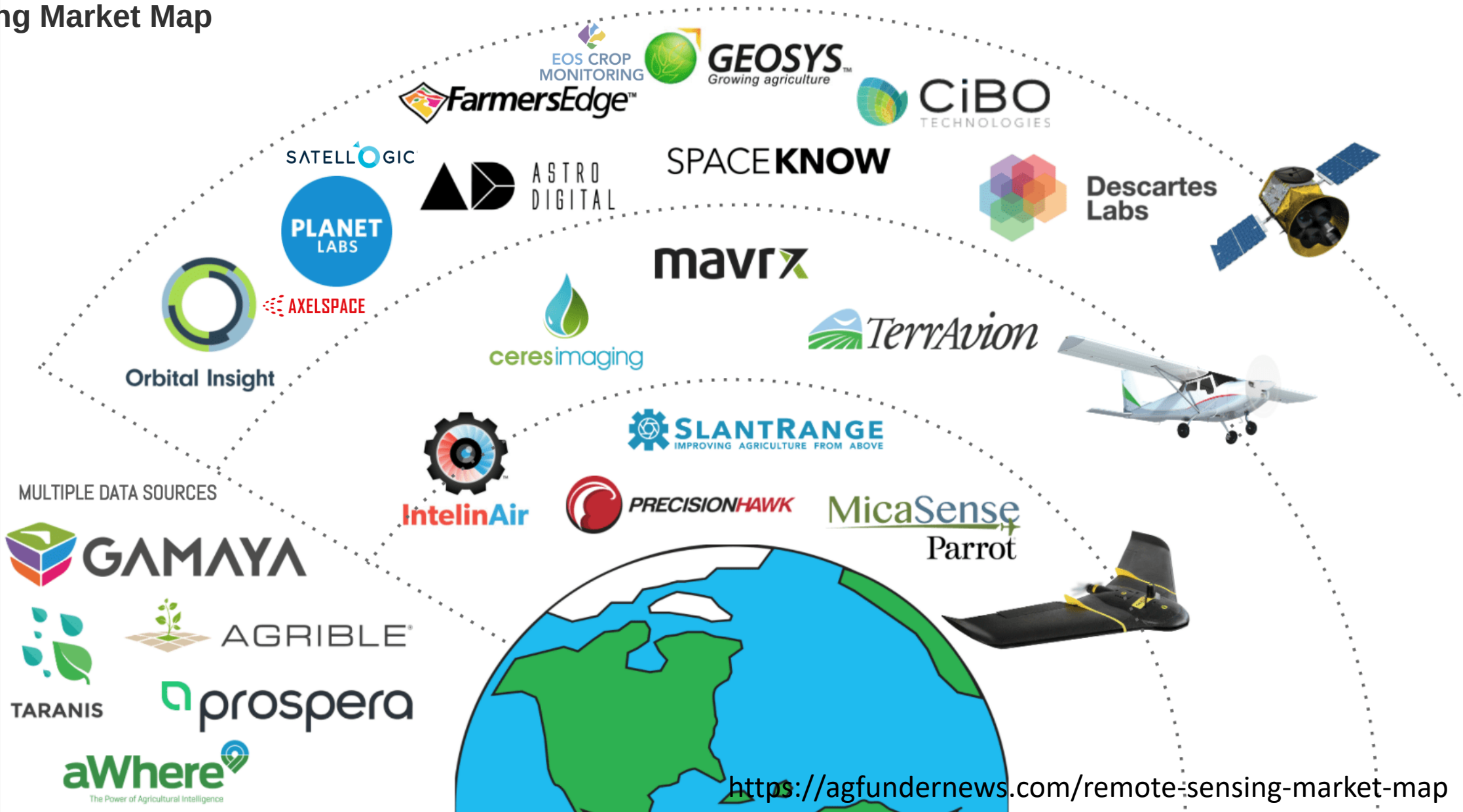
“Research opportunities and challenges”

Shekhar, S., Feiner, S. and Aref, W. G. (2015) ‘From GPS and virtual globes to spatial computing - 2020’, *GeoInformatica*, 19(4), pp. 799–832. doi: 10.1007/s10707-015-0235-9.





Remote Sensing Market Map





O que se espera – perspectiva das habilidades em geotecnologias

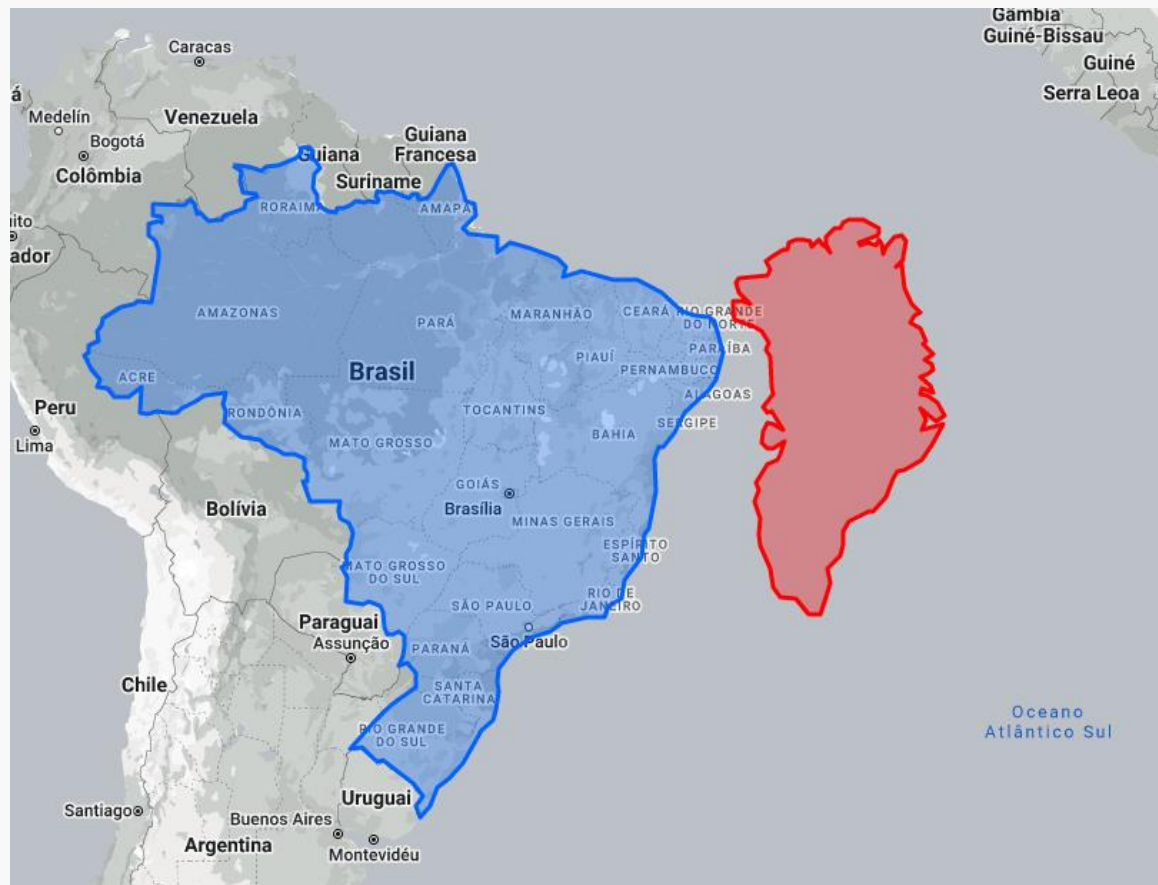
- ✓ Conhecer a base teórica de forma consistente.
- ✓ Mapear e monitorar (multitemporal – cubo de dados).
- ✓ Organizar um centro de dados/Banco de dados.
- ✓ Criar e treinar de equipes/Grupo de trabalho.
- ✓ Desenvolvimento e proteção de um processos e produtos.
- ✓ Domínio de softwares básicos e programação/coding (ex. R, Python, etc.)
- ✓ Receber e atender novas demandas.





Questões de escala cartográfica e de abordagem

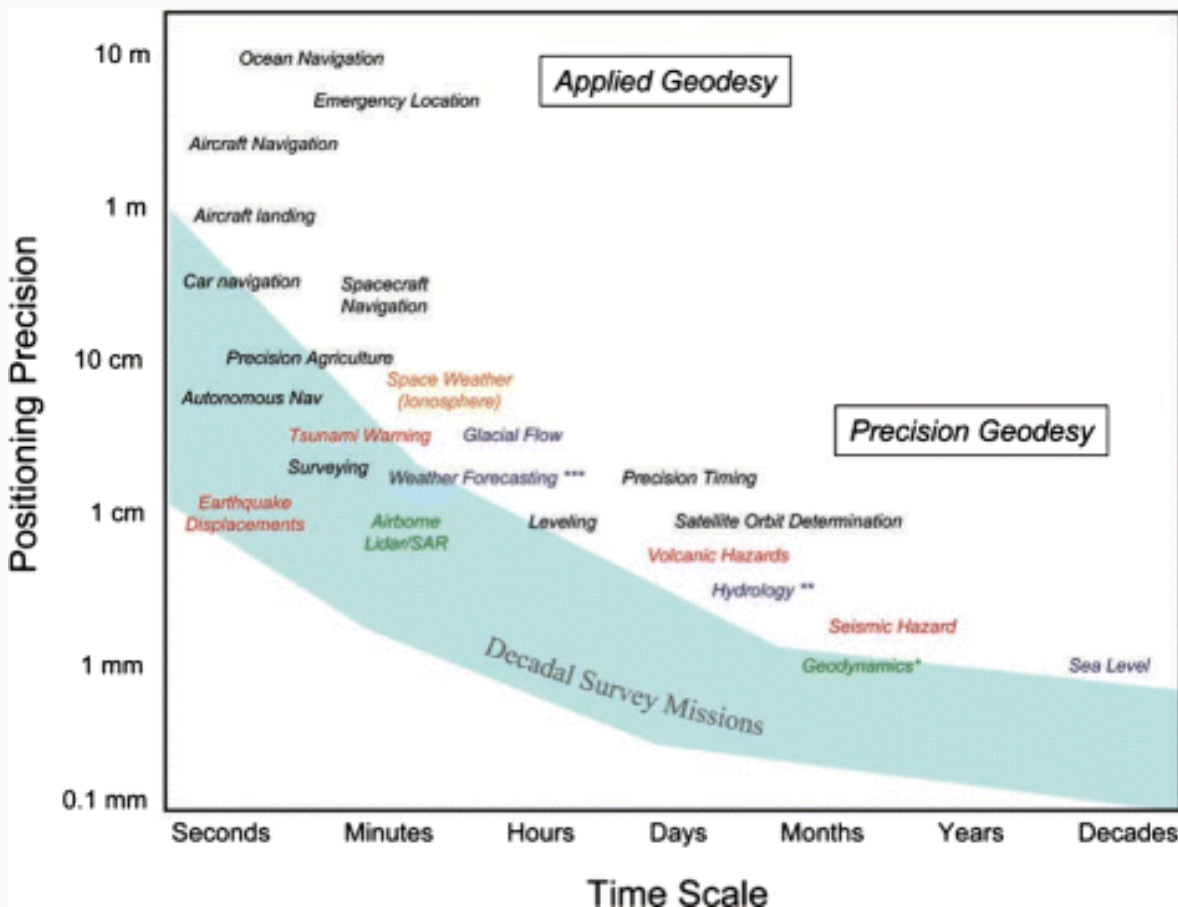
THE TRUE SIZE OF



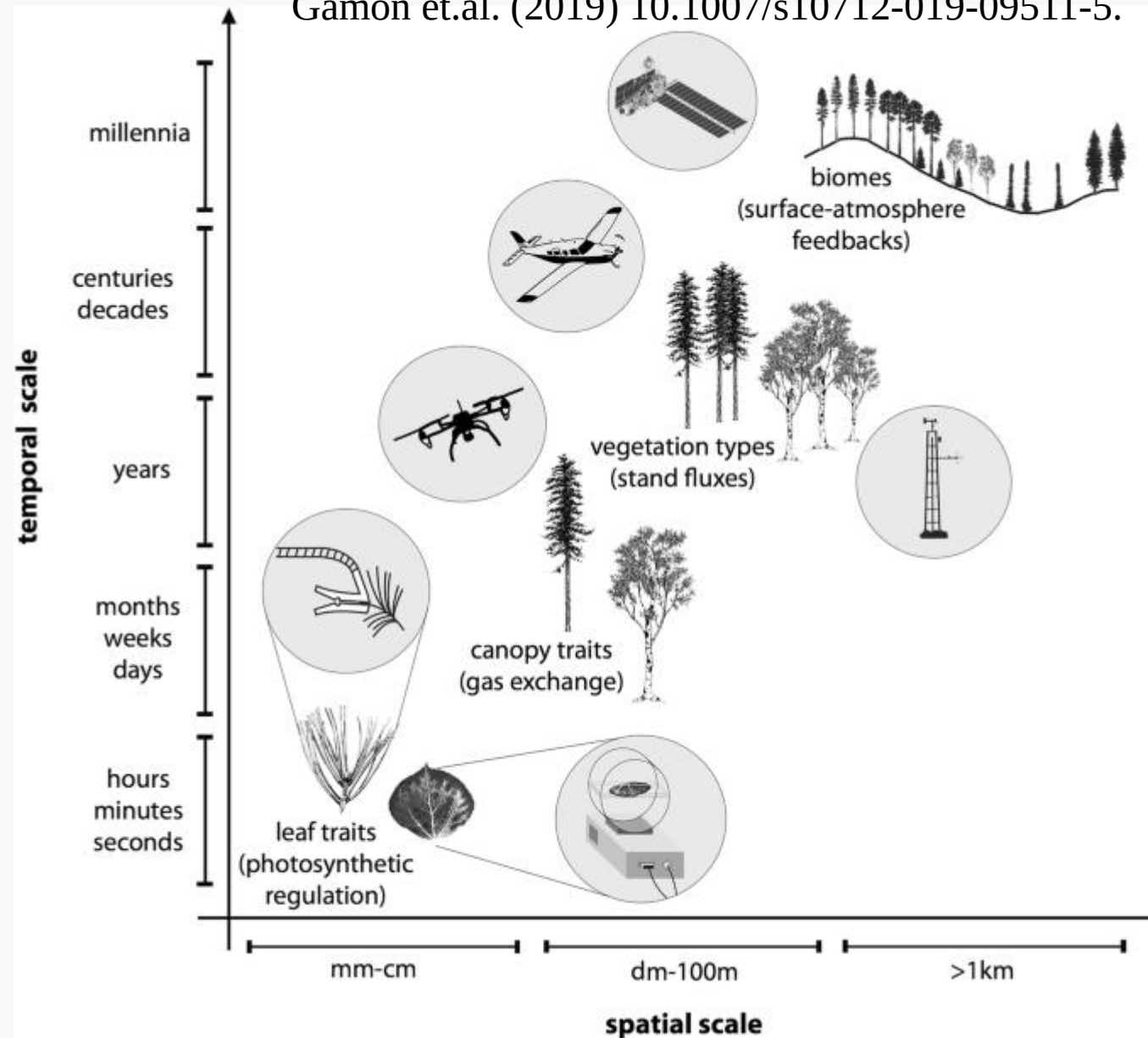
[https://www.thetruesize.com/#?borders=1~!MTEwNjQ4MjA.NDA1MTQwMw*MjM0NTE5OTk\(NjcyNjQxMw~!BR*MA.MTgwMDAwMDA\)Mw~!GR*MA.MTgwMDAwMDA\)NA~!GL*OTMwMTc4NQ.MzQ1MjUxMjA\)NQ](https://www.thetruesize.com/#?borders=1~!MTEwNjQ4MjA.NDA1MTQwMw*MjM0NTE5OTk(NjcyNjQxMw~!BR*MA.MTgwMDAwMDA)Mw~!GR*MA.MTgwMDAwMDA)NA~!GL*OTMwMTc4NQ.MzQ1MjUxMjA)NQ)



Questões de escala cartográfica e de abordagem

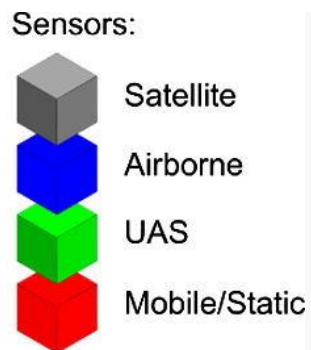
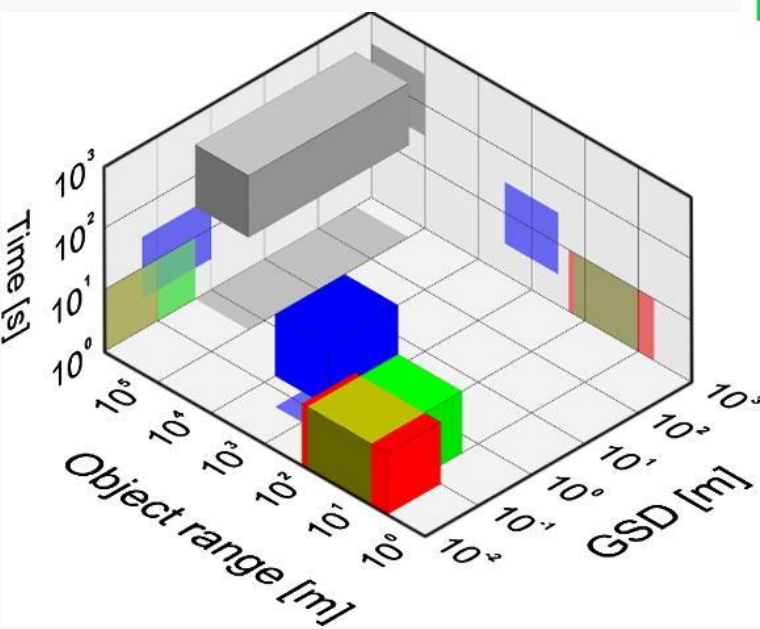
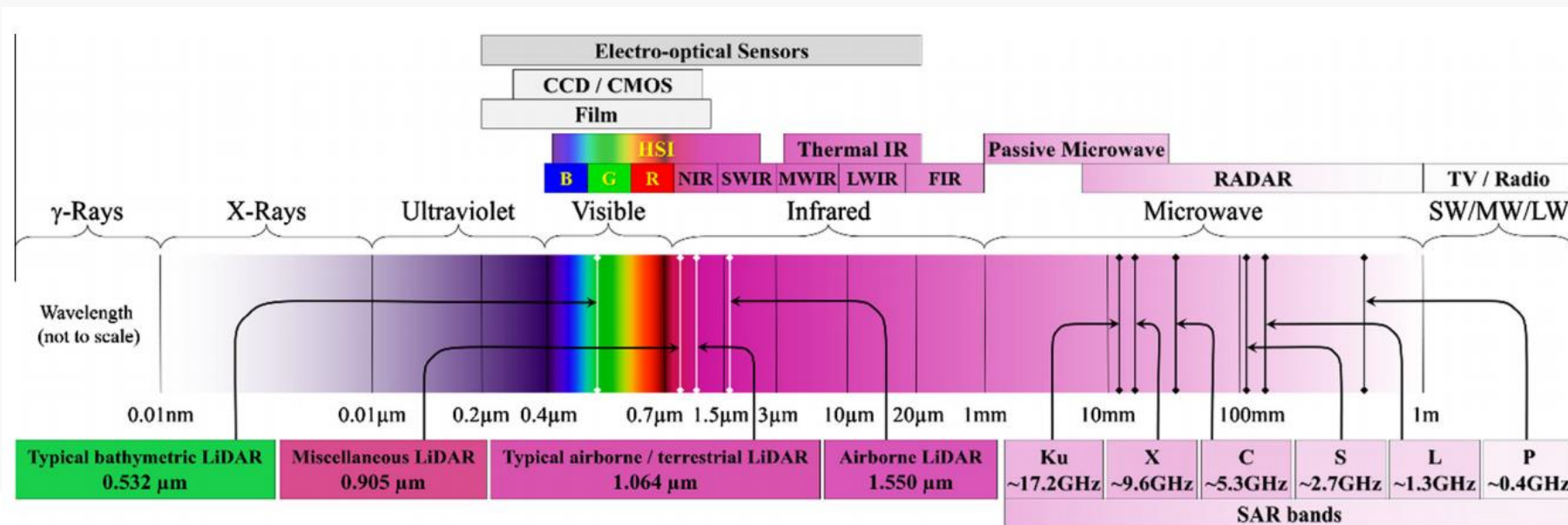


Gamon et.al. (2019) 10.1007/s10712-019-09511-5.

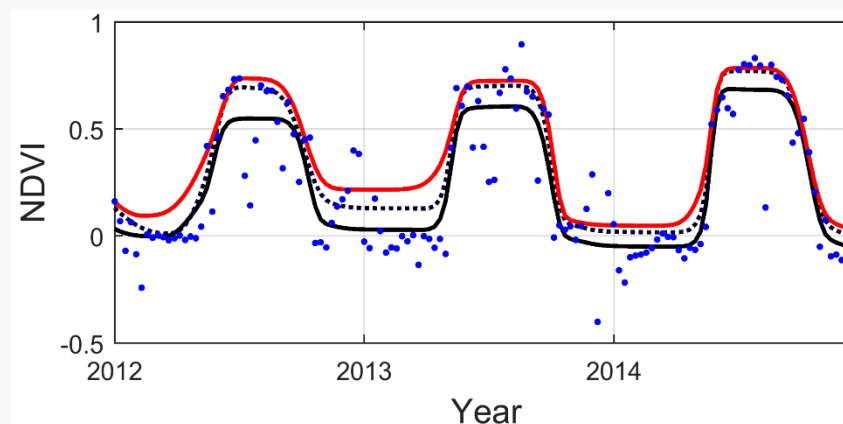




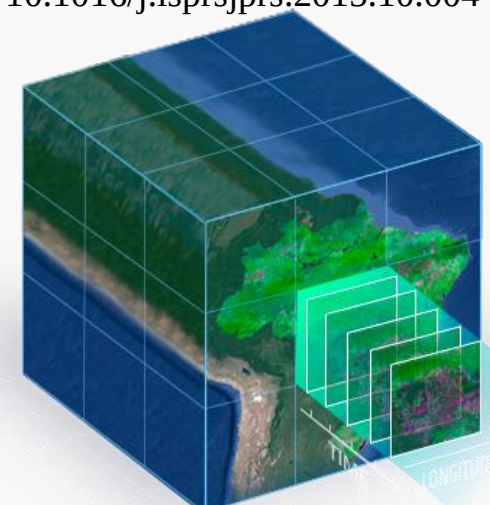
Faixas espectrais
Escala de abordagem
Níveis de coleta
Cubo temporal



Toth e Józków (2016) - 10.1016/j.isprsjprs.2015.10.004



Cai et al. (2017) - 10.3390/rs9121271

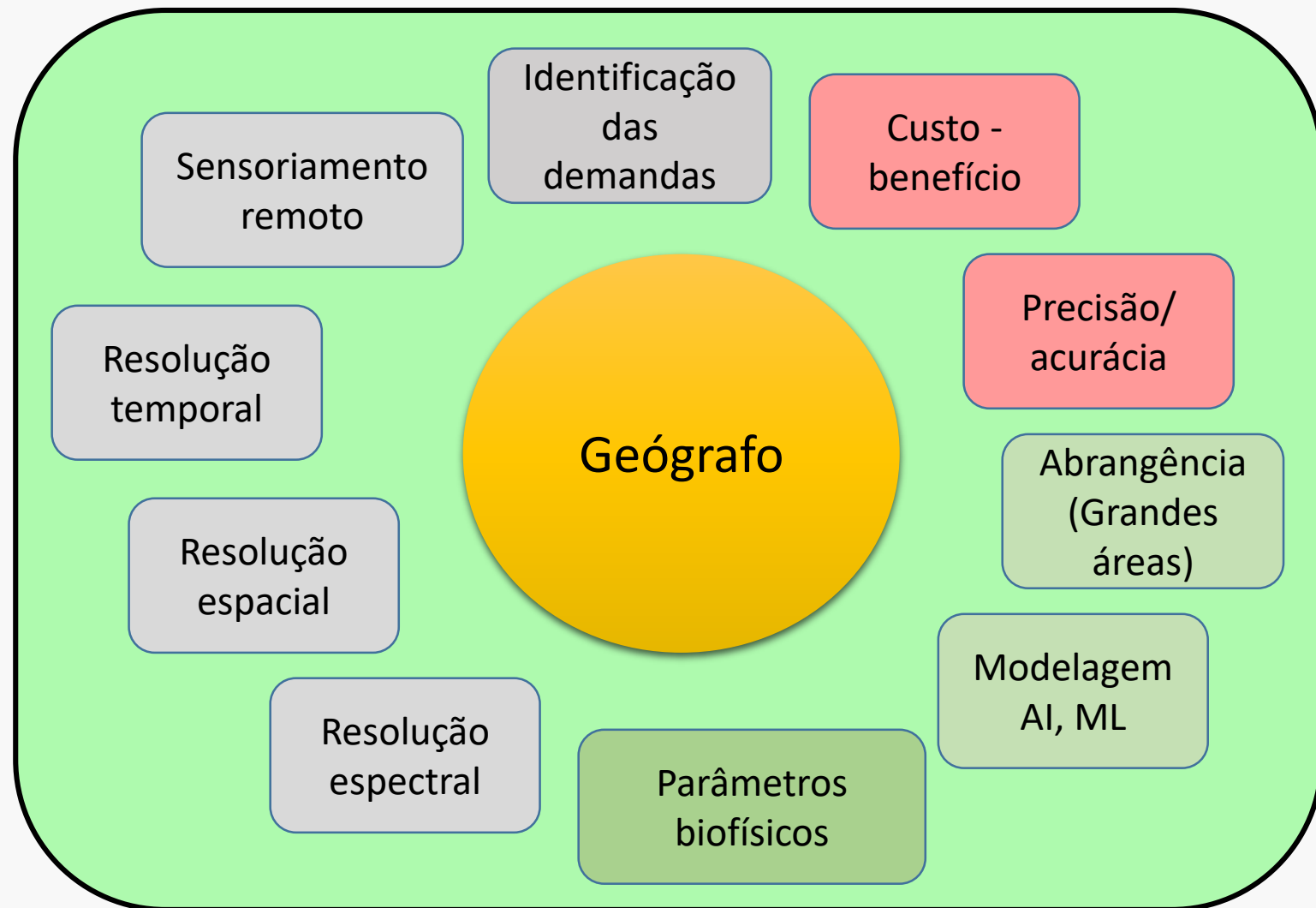
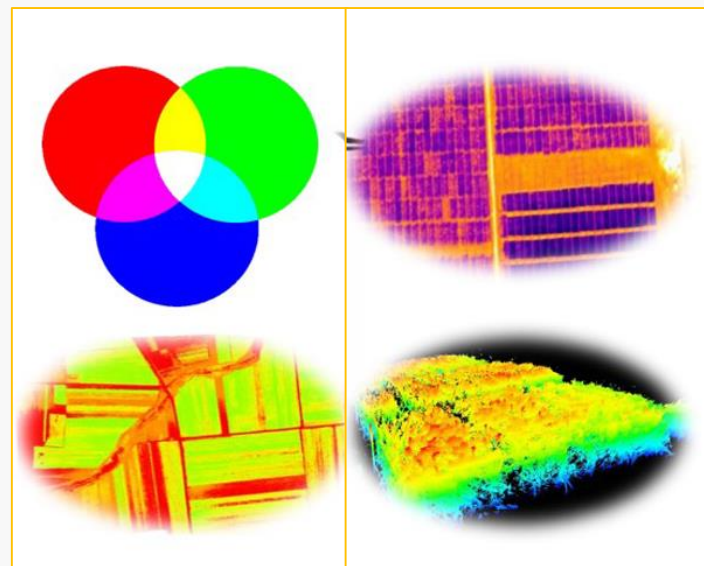
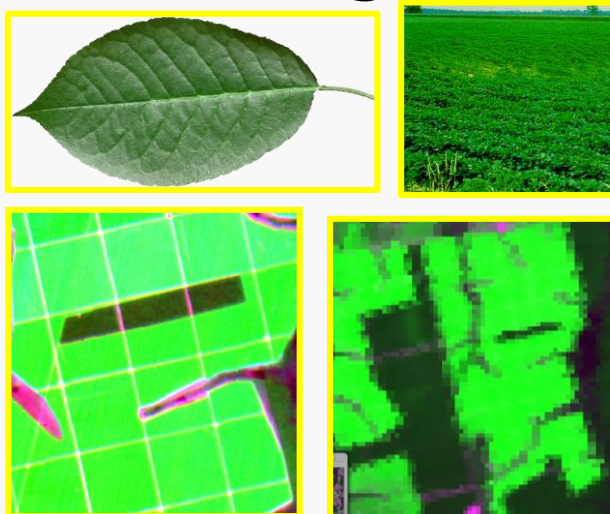


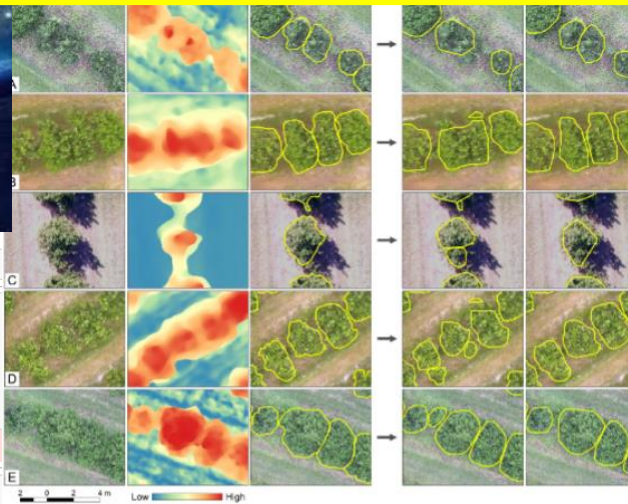
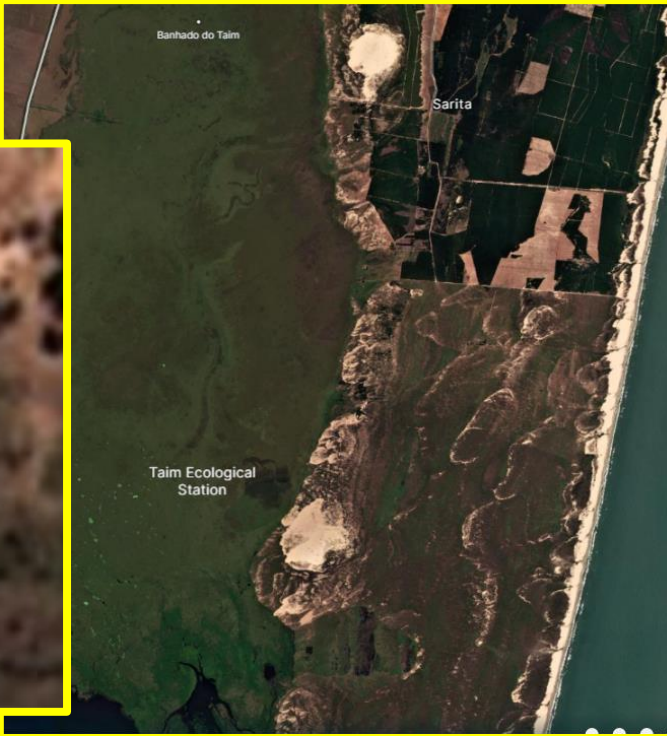
Fonte: Brazil Data Cube - WTSS

Toth e Józków (2016) - 10.1016/j.isprsjprs.2015.10.004



Geotecnologias





```
In [1]: import line_orchard_detection as ld

In [2]: path = '../datasets/area_estudo_testel/sections/pera/'
        pontos = ld.gpd.read_file(path + 'centroids_perla.geojson')

        linhas, pts = ld.detect_lines_uni(pontos, row_inverse=True, pt_inverse=False)

        # linhas.to_file(path + 'line_prediction.geojson', driver='GeoJSON')
        # pts.to_file(path + 'centroids_area_mapped.geojson', driver='GeoJSON')

        Finalizado! 100%|██████████| 100/100 [01:00<00:00, 1.65it/s]

In [ ]:
```



APLICAÇÕES AO SETOR PRODUTIVO

- TECNOLOGIAS SUSTENTÁVEIS E CONSERVAÇÃO AMBIENTAL
- TECNOLOGIAS PARA A GESTÃO TERRITORIAL E TURISMO
- AGRONEGÓCIO E AGROTECNOLOGIA
- CIÊNCIA DE DADOS E INTELIGÊNCIA ARTIFICIAL



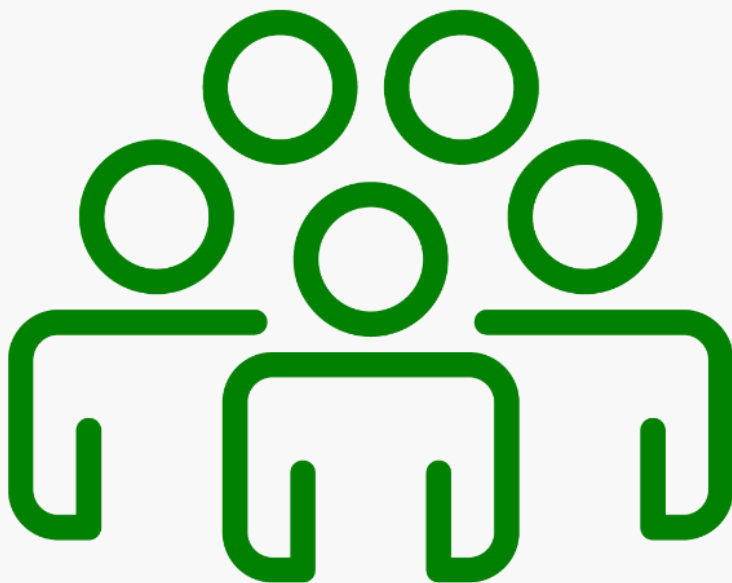
TECNOLOGIAS ESTRATÉGICAS

- INTELIGÊNCIA ARTIFICIAL
- SOFTWARE E HARDWARE
- COMPUTAÇÃO EM NUVEM



Geotecnologias como integradora de dados e geração de soluções para diversas áreas do conhecimento.

Pessoas



Instituições



Empresas





Fontes diversificadas de informação

Base de campo e laboratório (numéricos ou alfanuméricos)

Uso de múltiplos sensores
VIS+NIR+SWIR+TIR+LiDAR
Orbital + aéreo + Laboratório/campo

Software + Inteligência Artificial + Aprendizado de Máquina + +
Segmentação + Reconhecimento de padrões + etc.

Aplicações geográficas variadas



Equipamentos



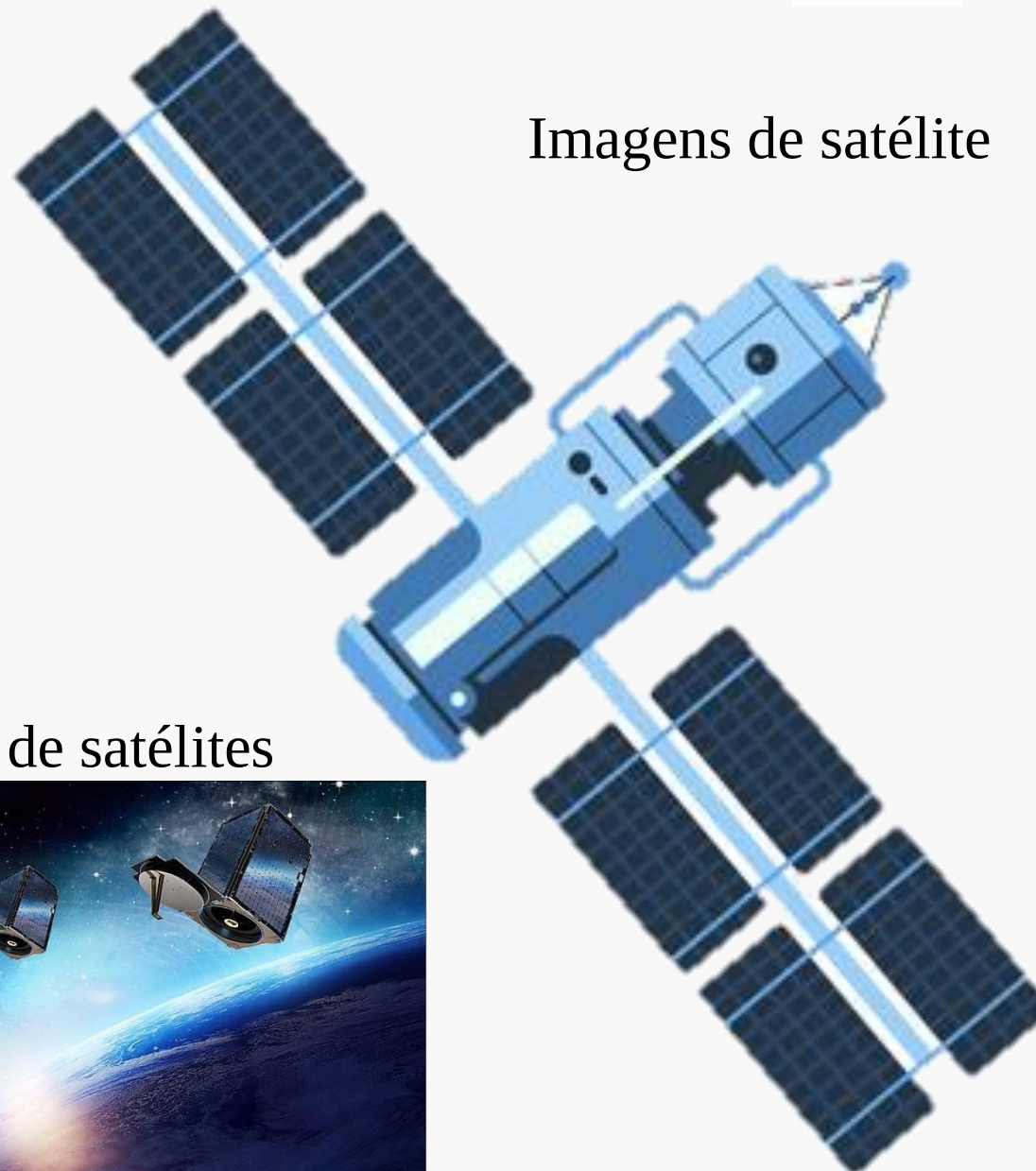


Equipamentos



Veículo de apoio

Imagens de satélite



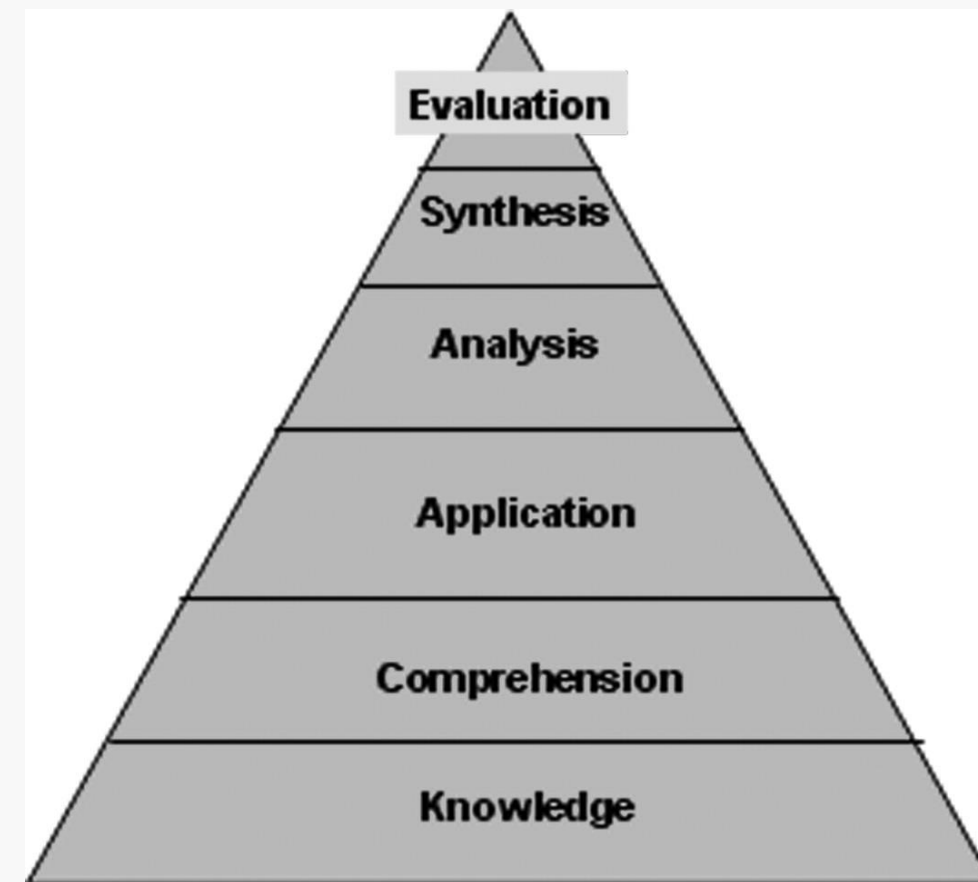
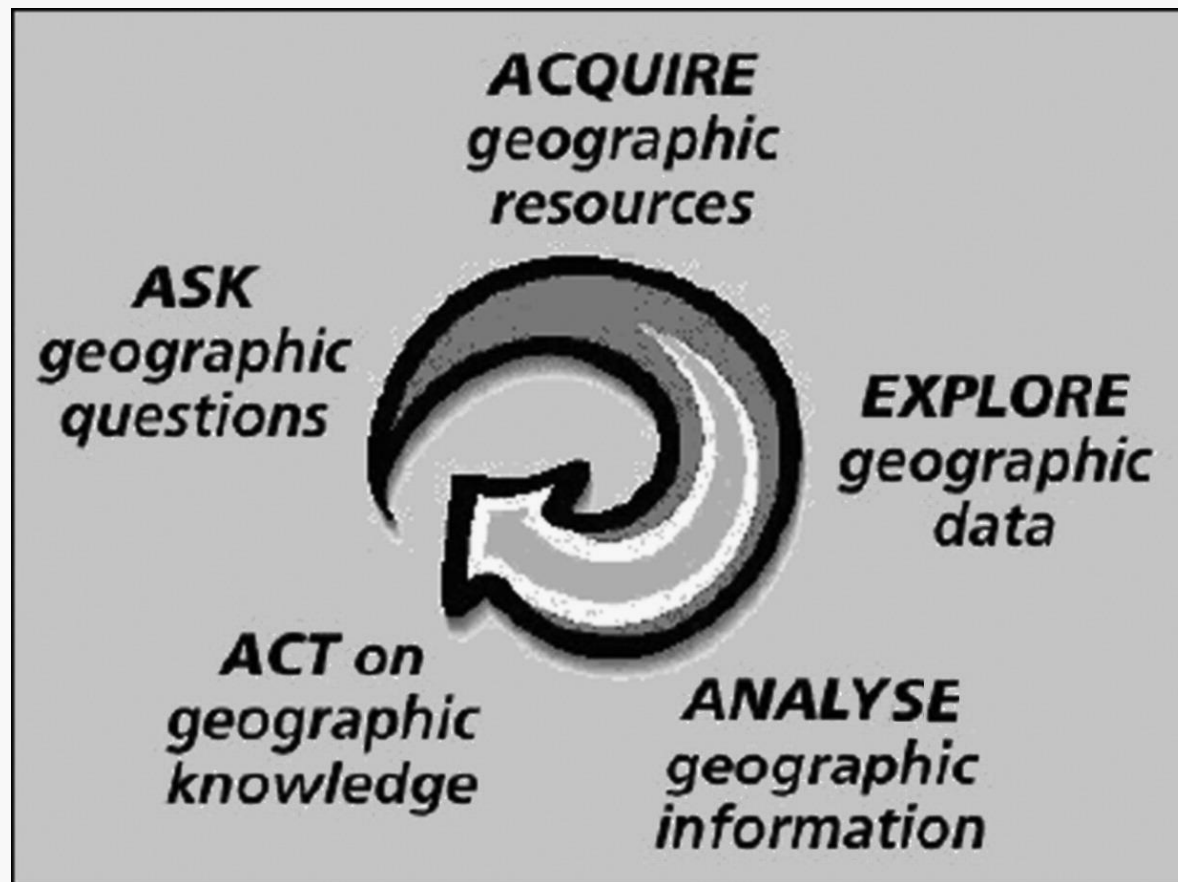
Constelação de satélites

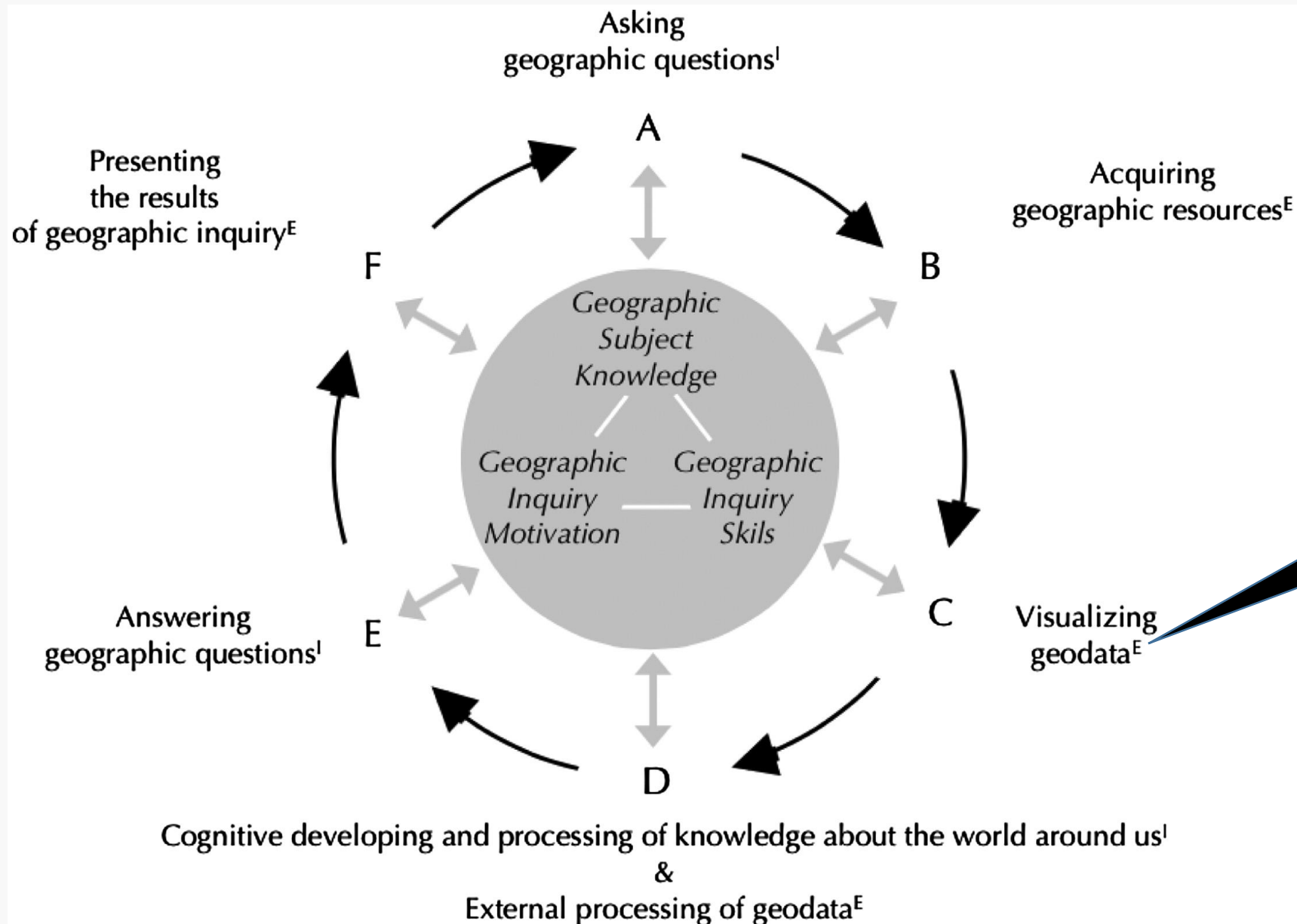




RS and GIS

“Geotechnologies are not the only way, but provide a key means of achieving spatial literacy goals.” (Kerski, 2008)





RS and GIS

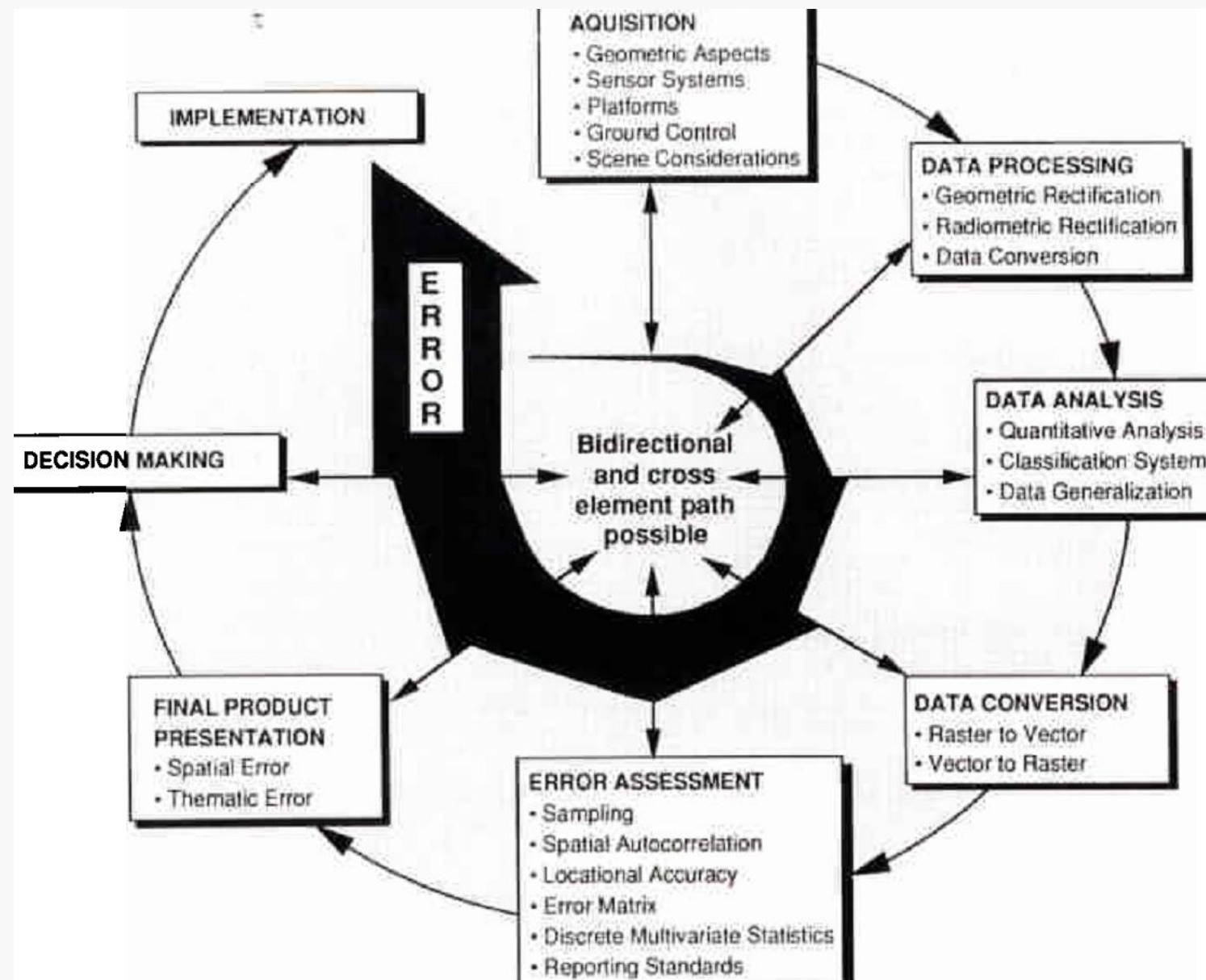


Bearman, N., Jones, N., André, I., Cachinho, H.A., DeMers, M., 2016. The future role of GIS education in creating critical spatial thinkers. *J. Geogr. High. Educ.* 40, 394–408. <https://doi.org/10.1080/03098265.2016.1144729>



Acurácia de dados de Sensoriamento Remoto e SIG

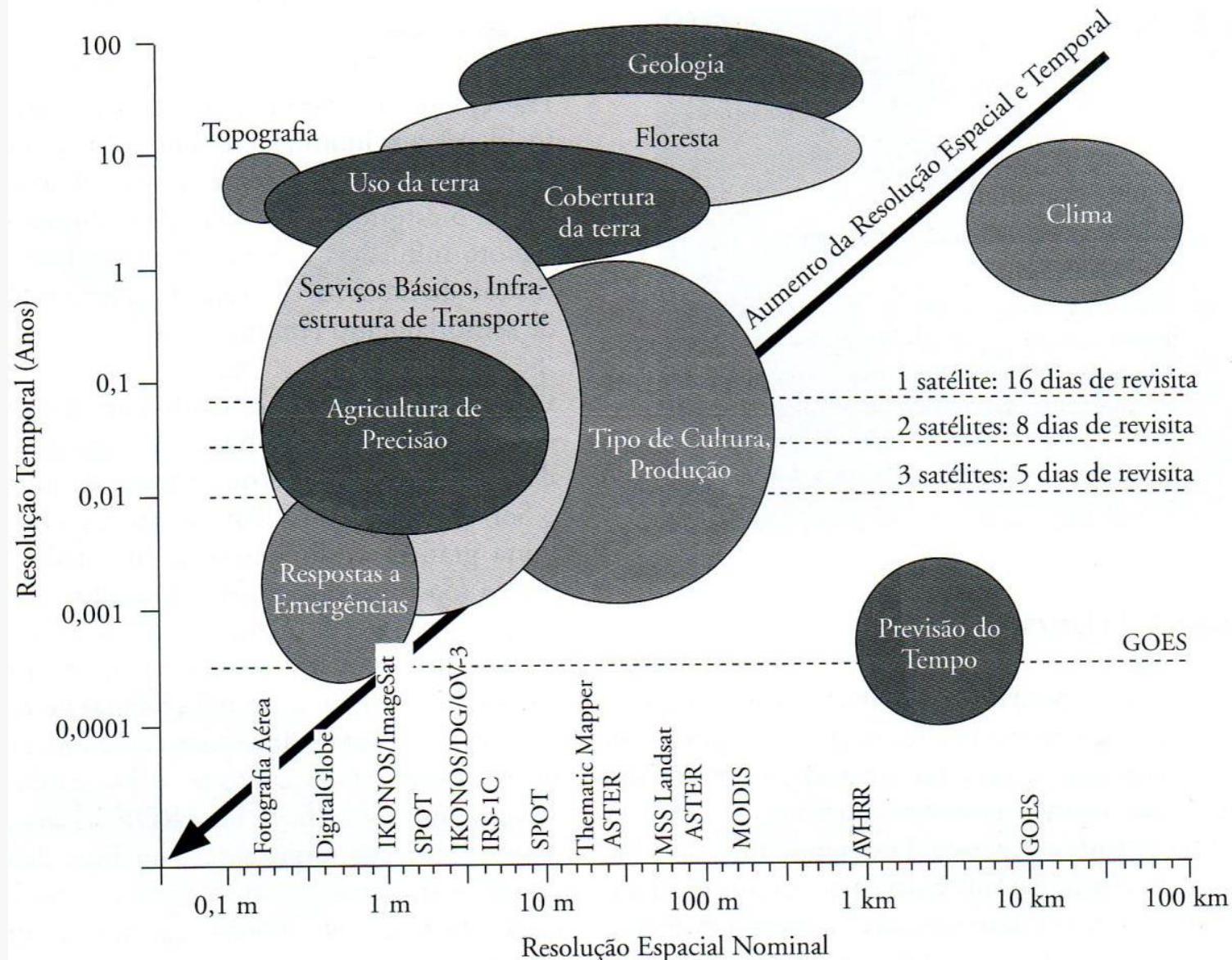
Fontes de erros ao longo do processo de utilização de imagens



Fonte: LUNETTA, R. S.; CONGALTON, R. G.; FENSTERMAKER, L. K. et al. Remote-Sensing and Geographic Information-System Data Integration - Error Sources and Research Issues. Photogrammetric Engineering and Remote Sensing, v. 57, n. 6, p. 677-687, 1991.



Resolução Espacial e Temporal para Aplicações Selecionadas



Jensen, J. R. (2009) *Sensoriamento Remoto do Ambiente: Uma perspectiva em Recursos Terrestre*. 1st edn. São José dos Campos: - Brasil: Editora Parêntese. Available at: <http://books.google.com/books?id=3dBIPgAACAAJ&pgis=1> (Accessed: 5 March 2014).



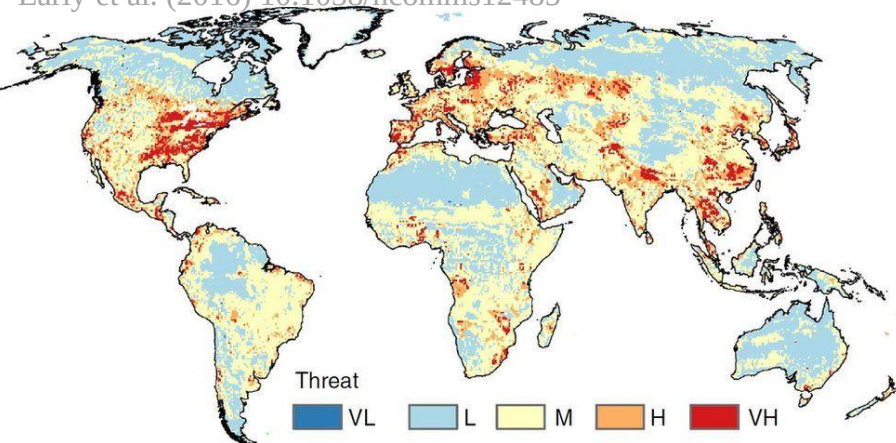
Exemplos de aplicações em diversas áreas

Desafios e oportunidades



Espécies invasoras – contexto

Early et al. (2016) 10.1038/ncomms12485



Problema local, regional e global.

“Poluição biológica”

No RS – ex. flora invasora

Hovenia dulcis
(Uva do Japão)



Eragrostis plana
(Capim-annoni)



Gomes et al., 2021

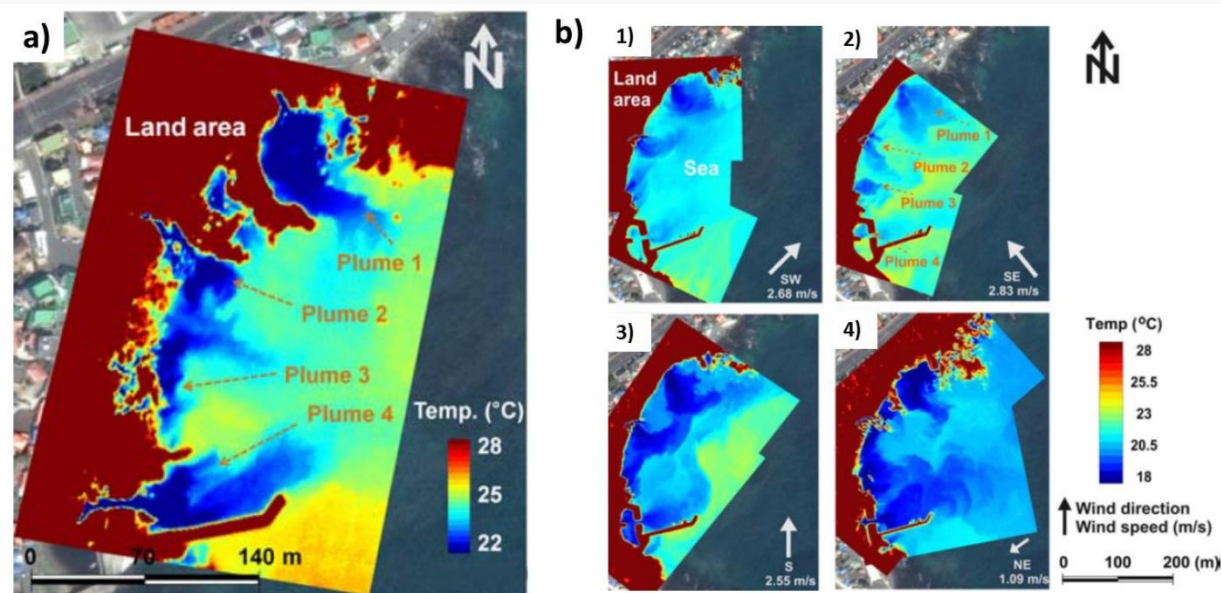
Pinus elliottii
(Pinus)



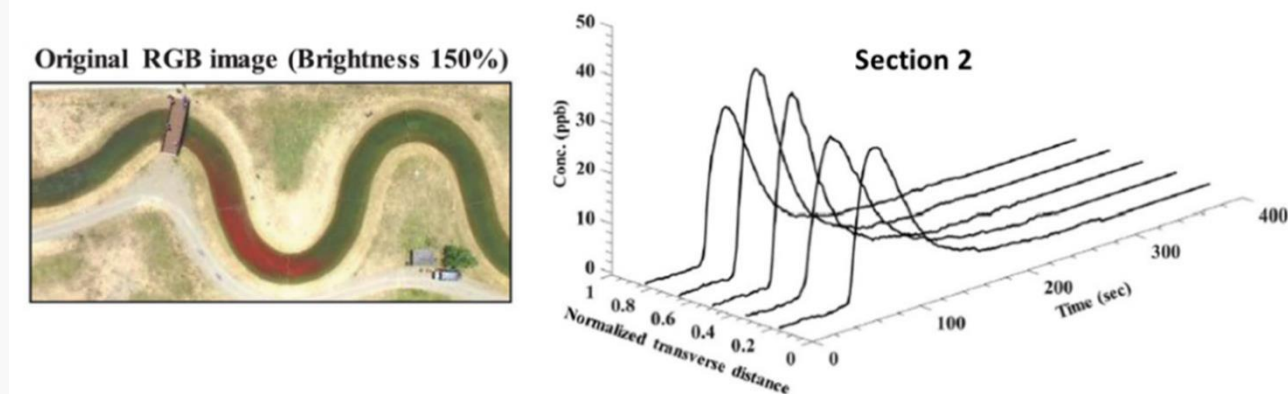
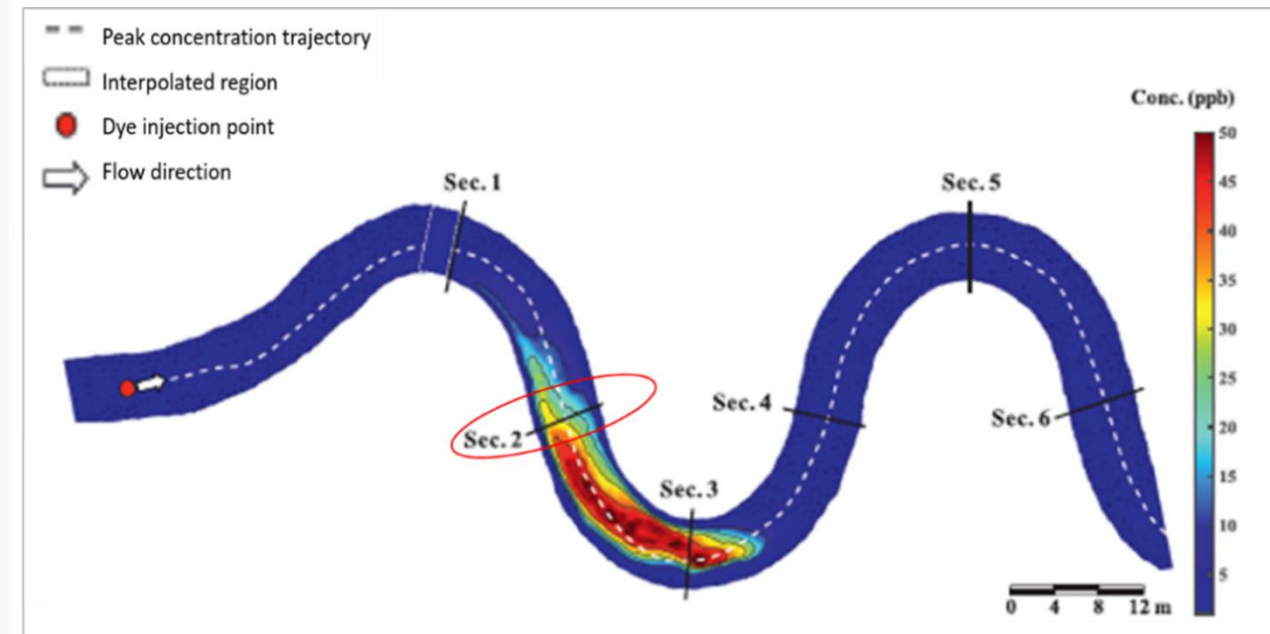
Hipótese – justificativa



Aplicações – água



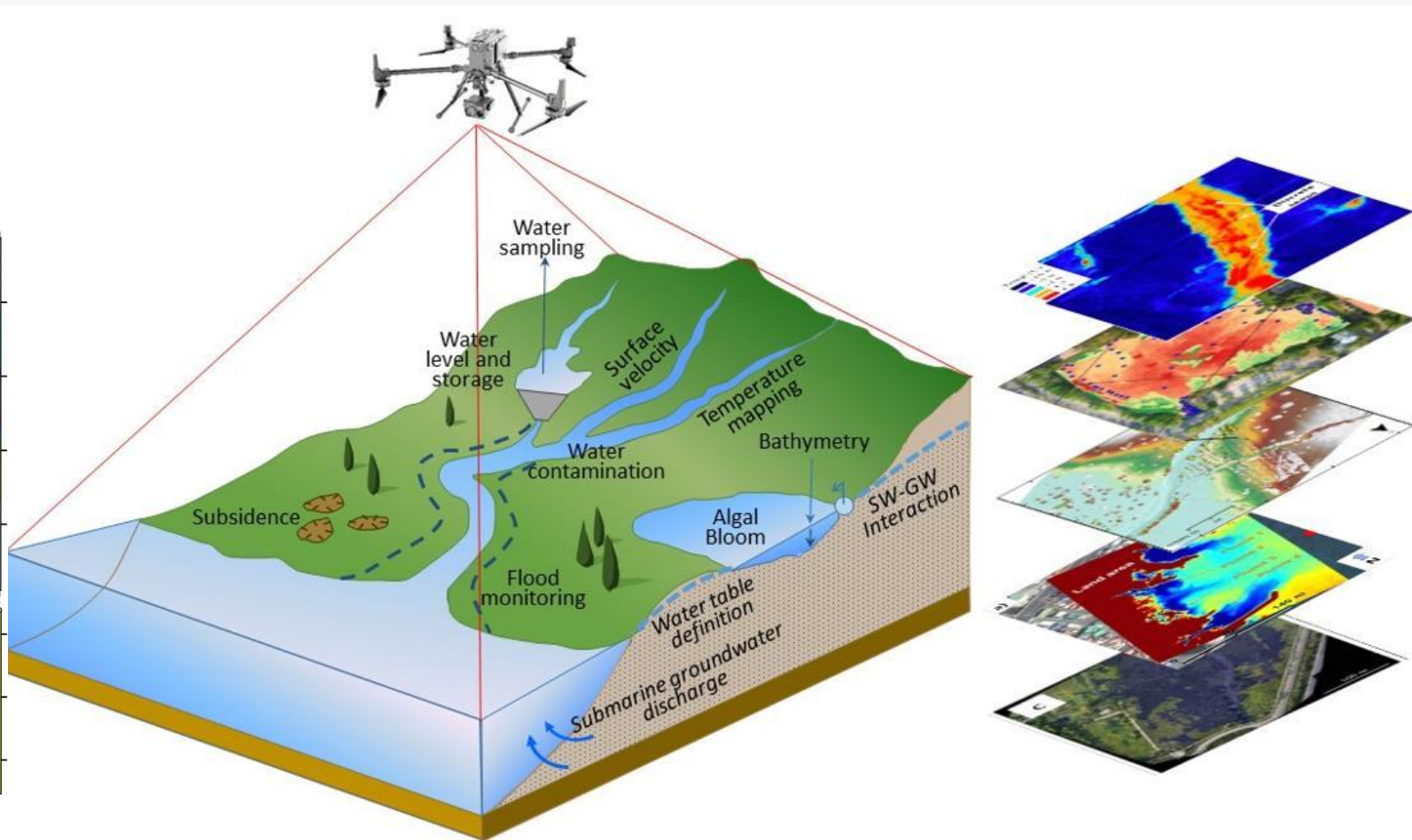
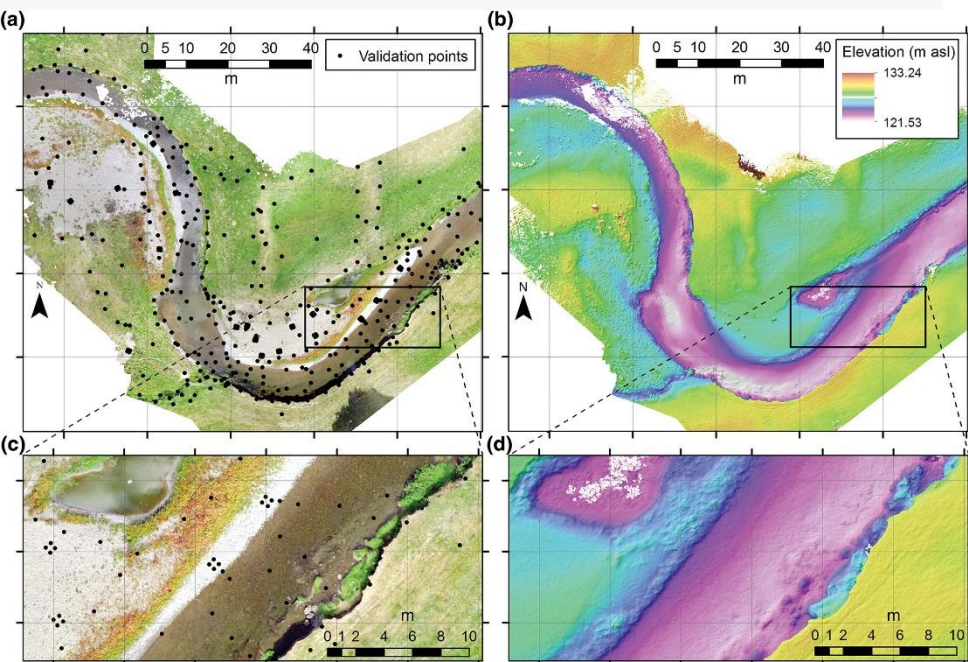
Vélez-Nicolás, M. *et al.* (2021) 'Applications of unmanned aerial systems (UASs) in hydrology: A review', *Remote Sensing*, 13(7), p. 1359. doi: 10.3390/rs13071359.





Aplicações – água

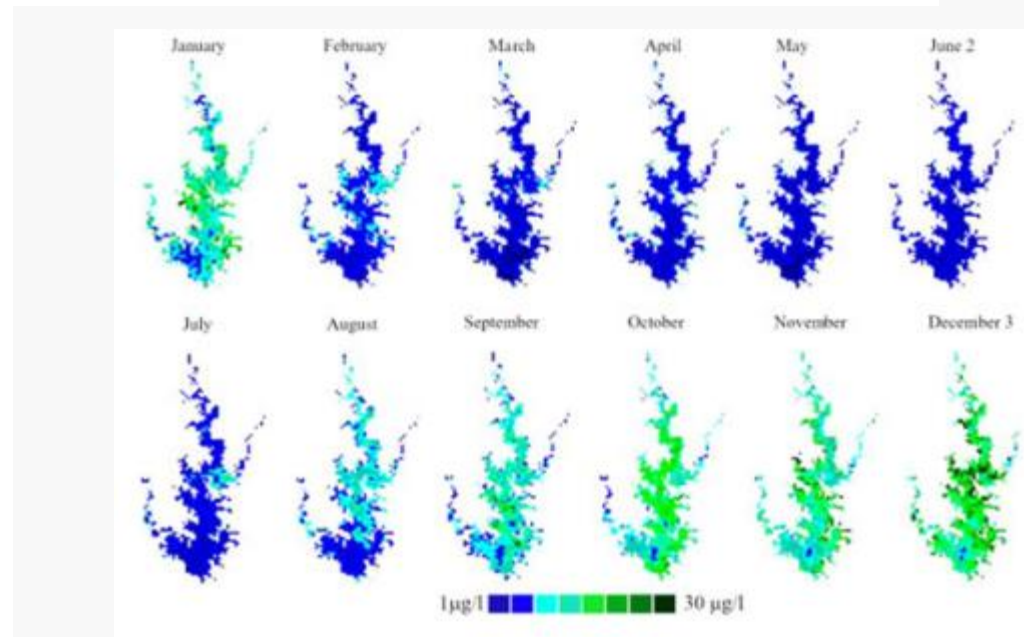
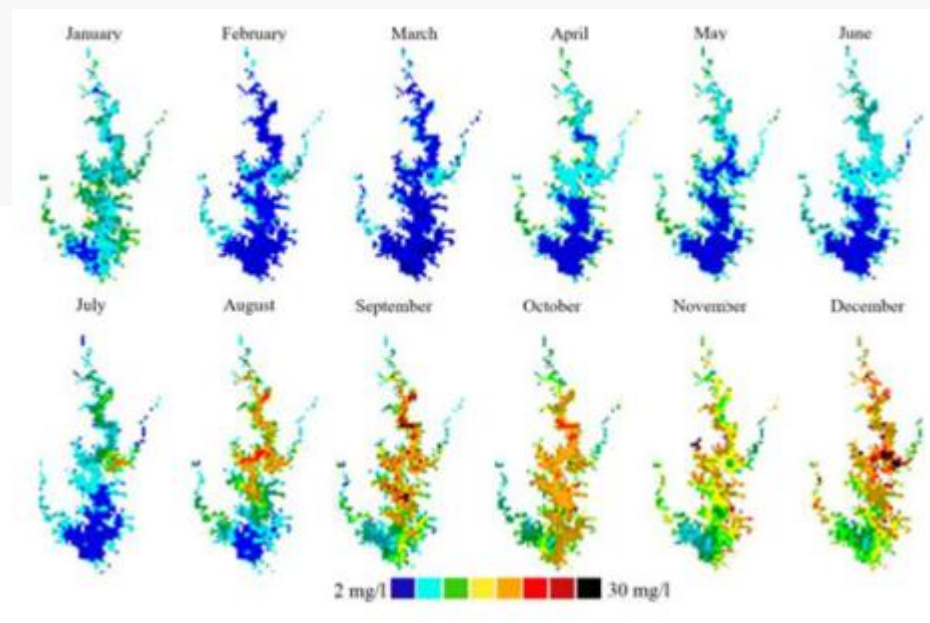
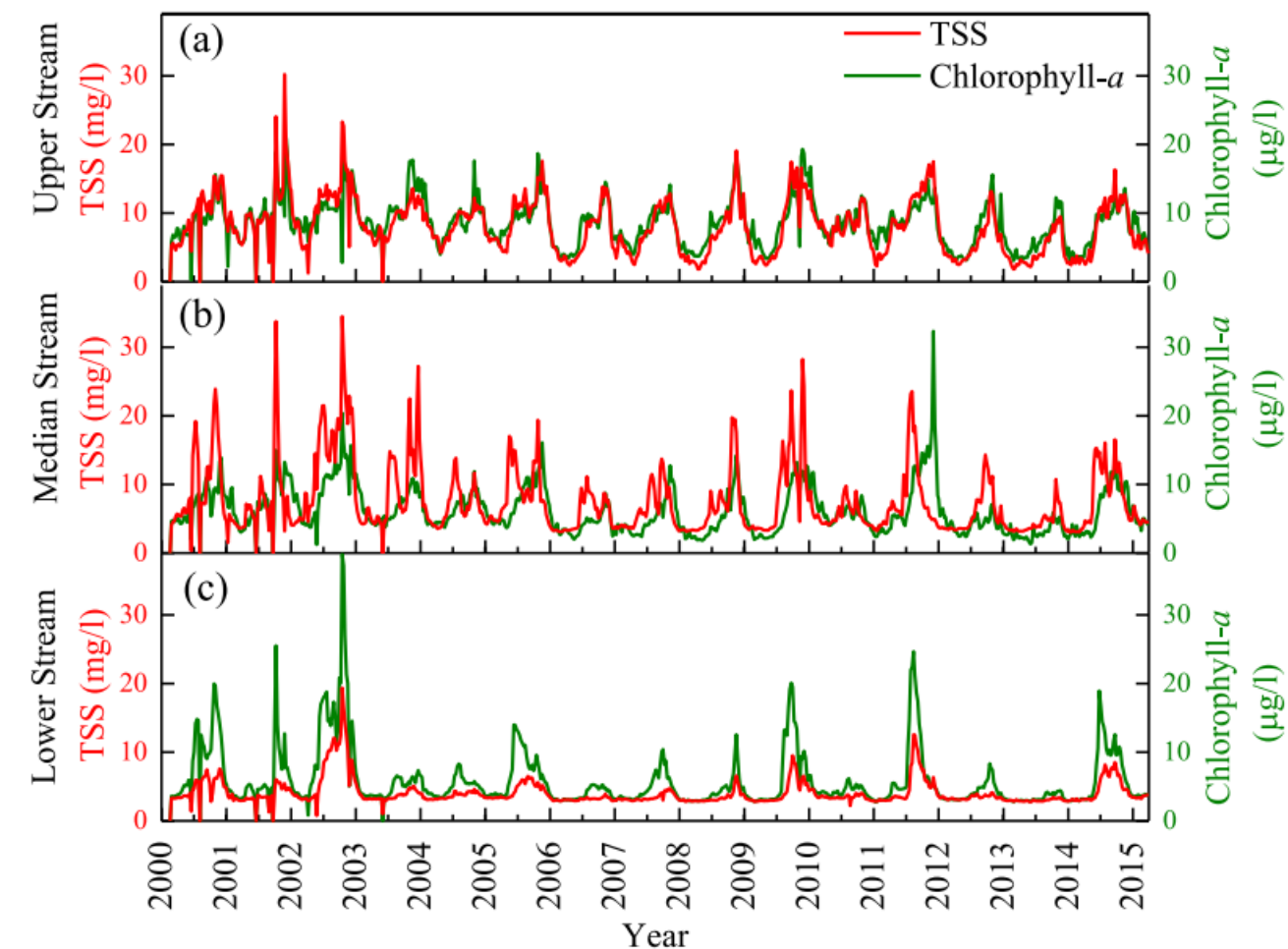
Woodget, A. S. *et al.* (2017) 'Drones and digital photogrammetry: from classifications to continuums for monitoring river habitat and hydromorphology', *WIREs Water*, 4(4). doi: 10.1002/wat2.1222.



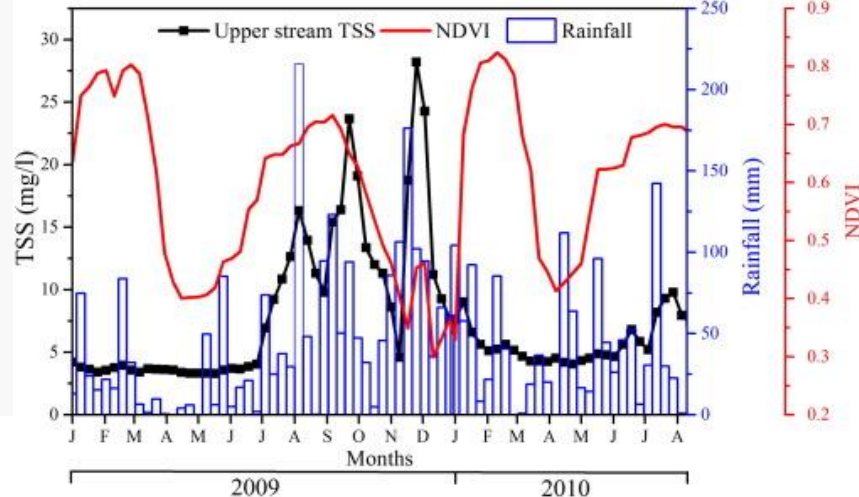
Vélez-Nicolás, M. *et al.* (2021) 'Applications of unmanned aerial systems (UASs) in hydrology: A review', *Remote Sensing*, 13(7), p. 1359. doi: 10.3390/rs13071359.



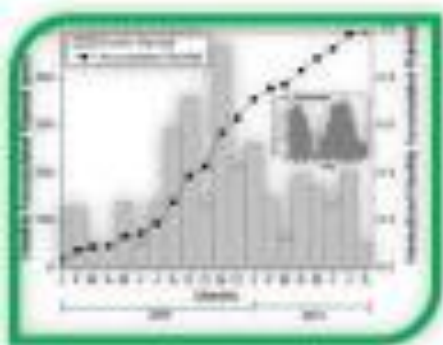
Aplicações – água



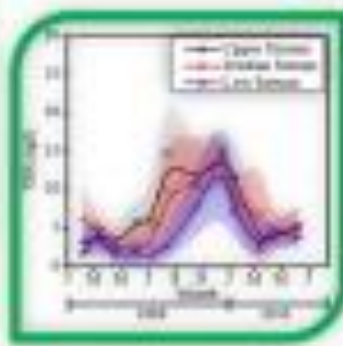
Aplicações – água



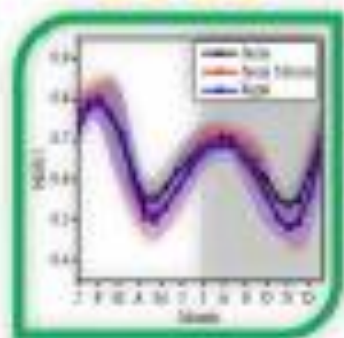
Meteorology



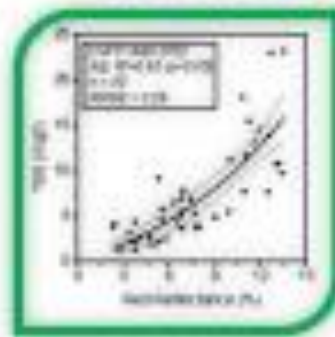
Limnology



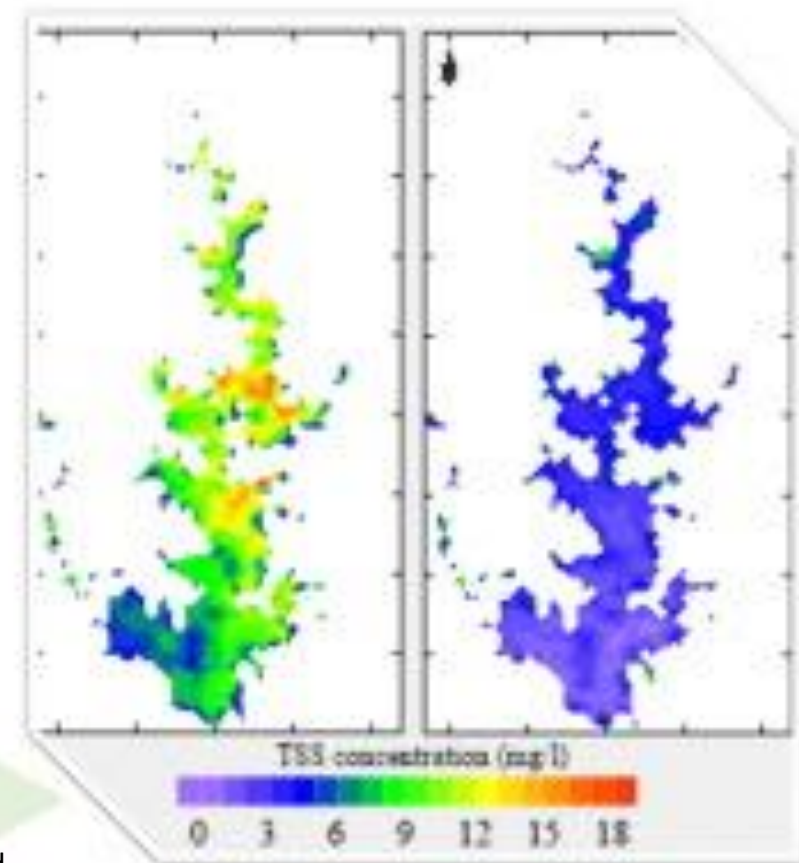
LUCC



Models

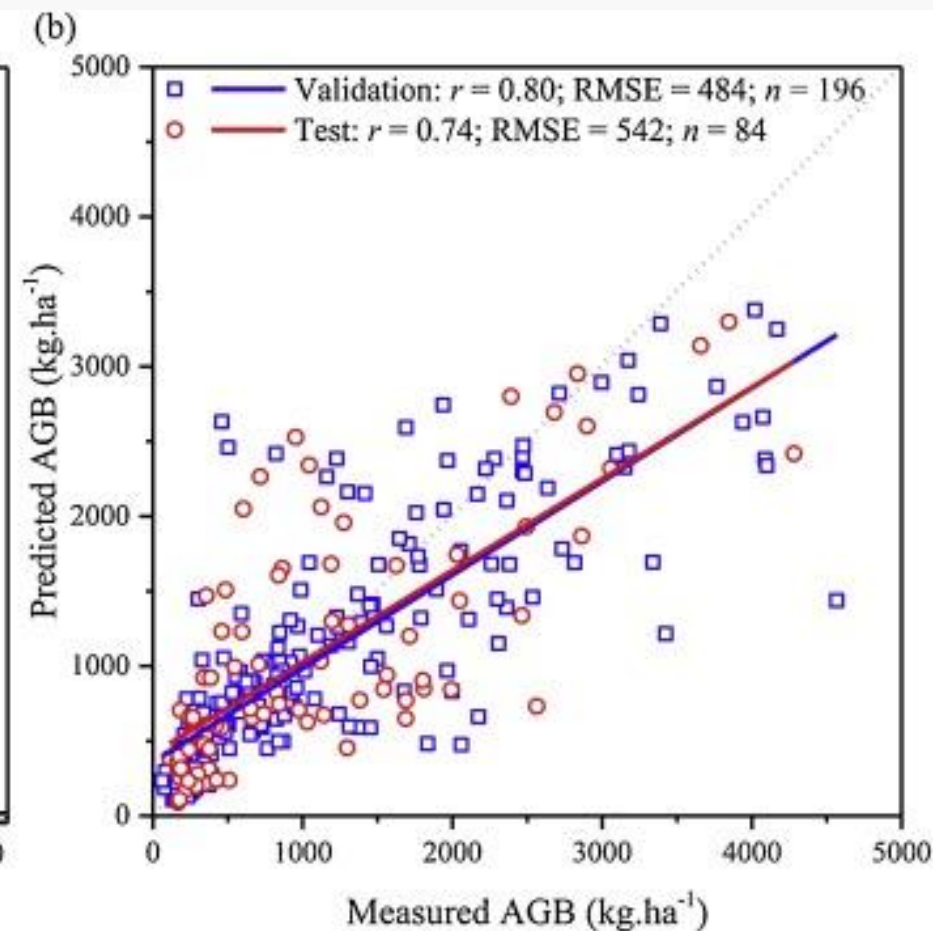
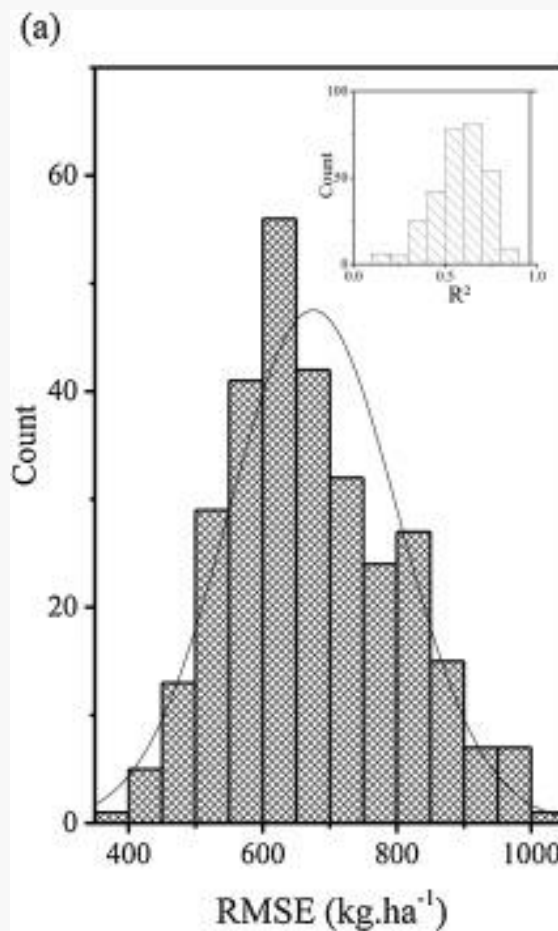
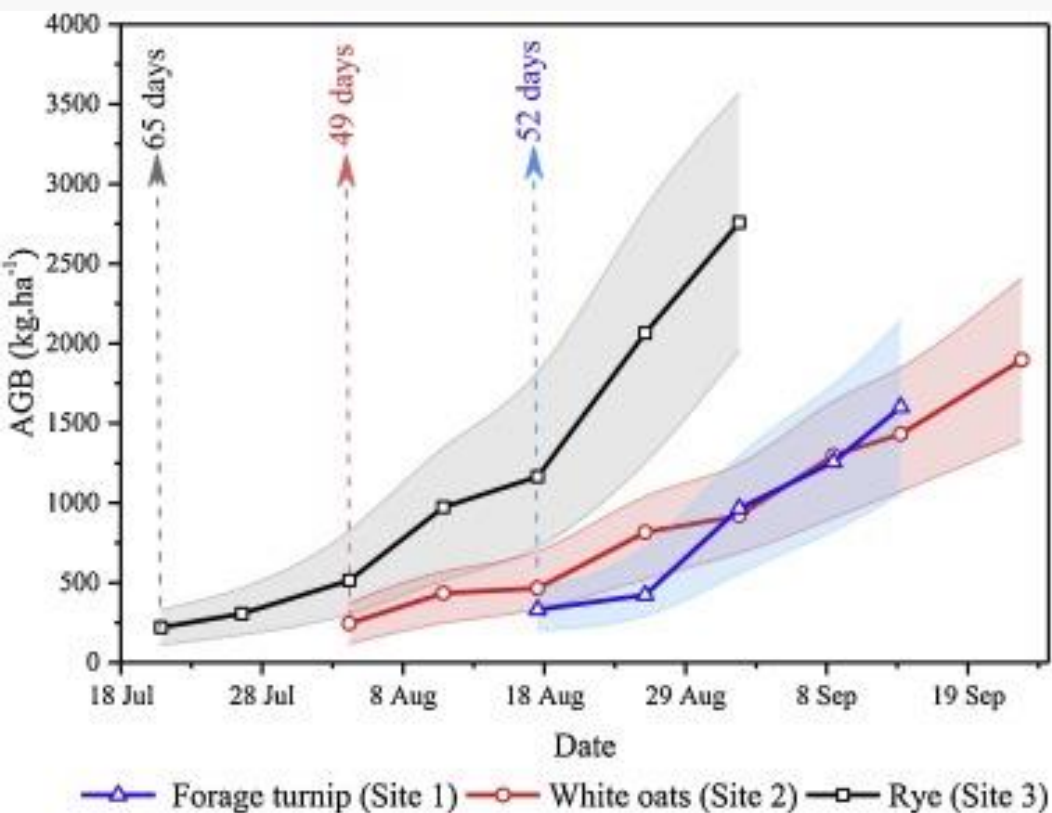


TSS estimates



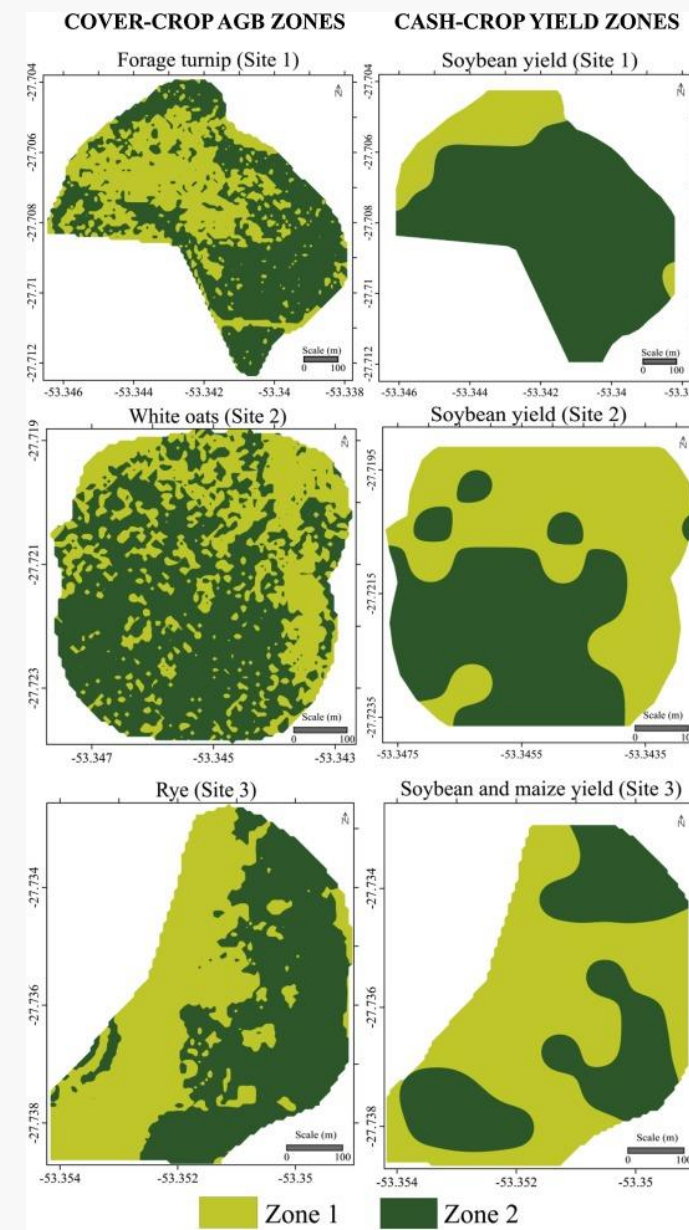
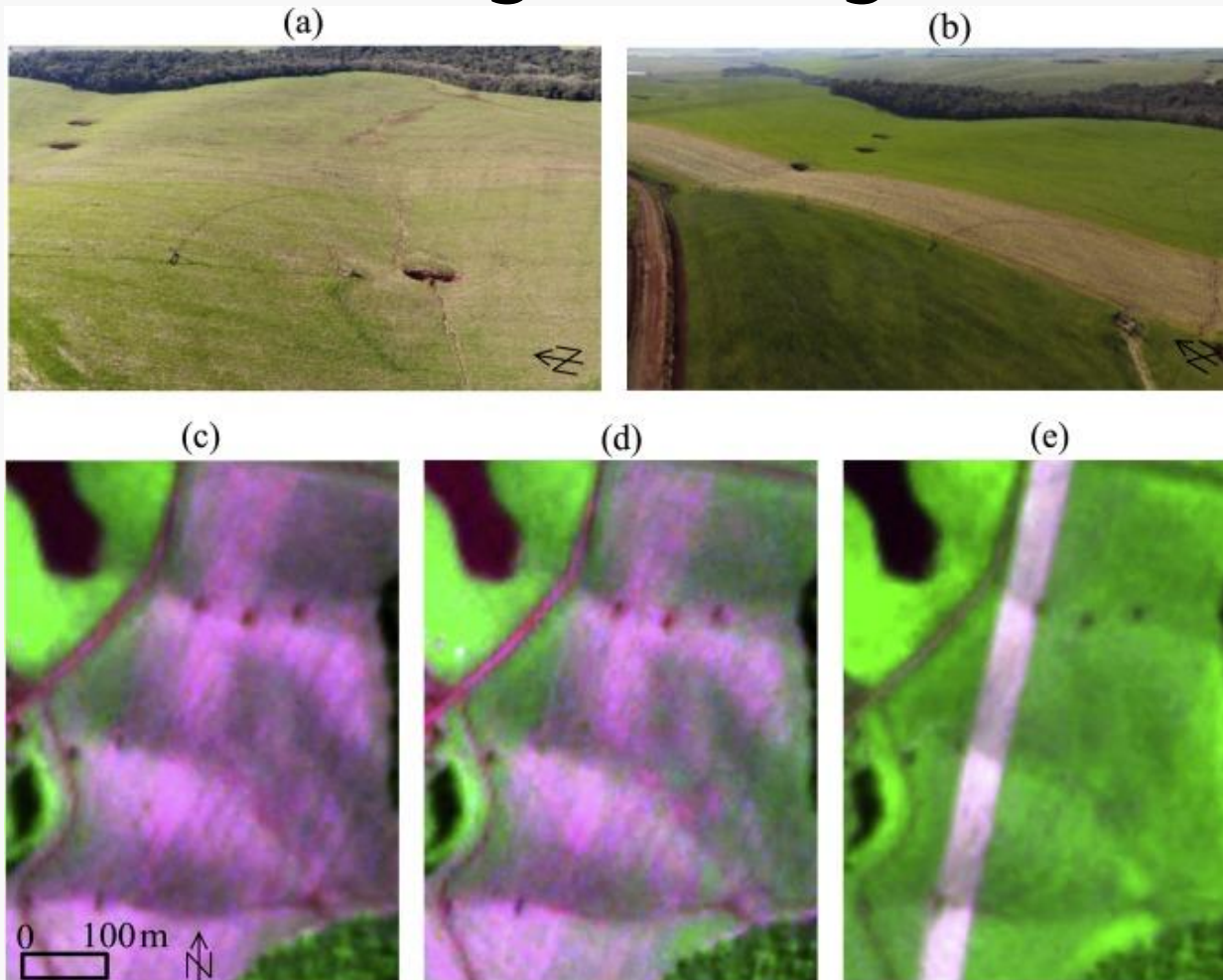


Geotecnologias na agricultura





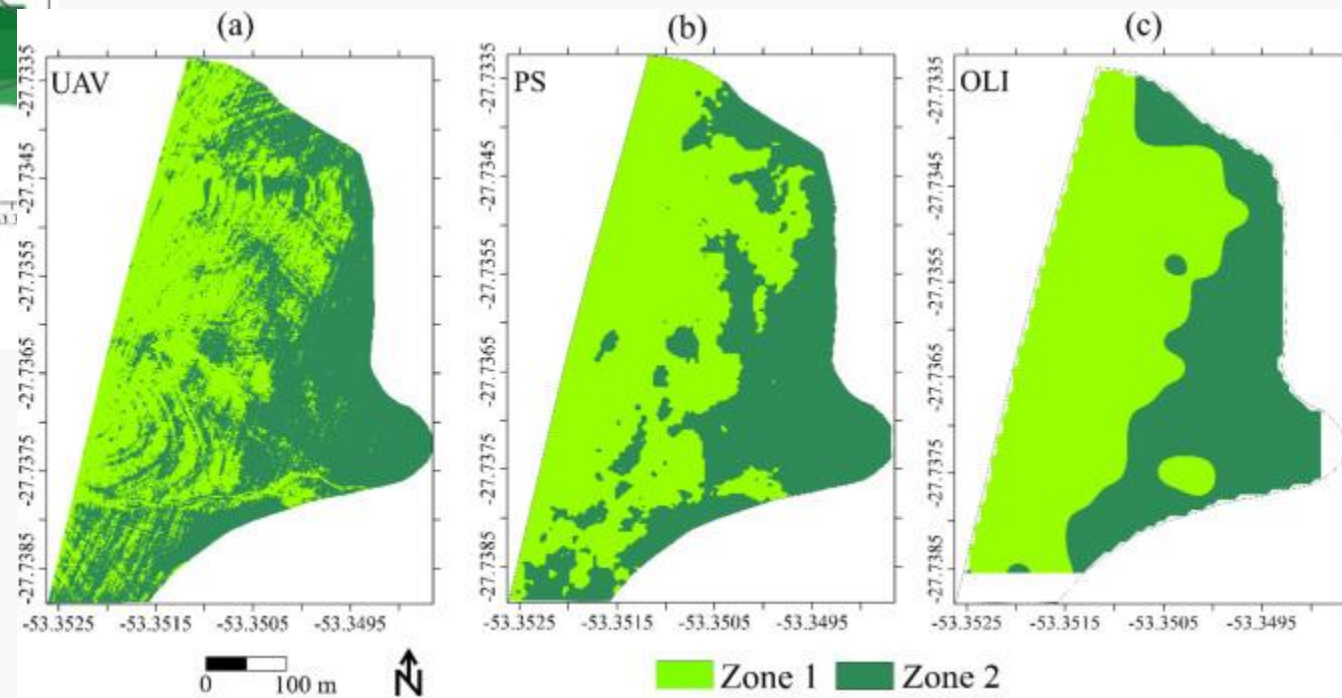
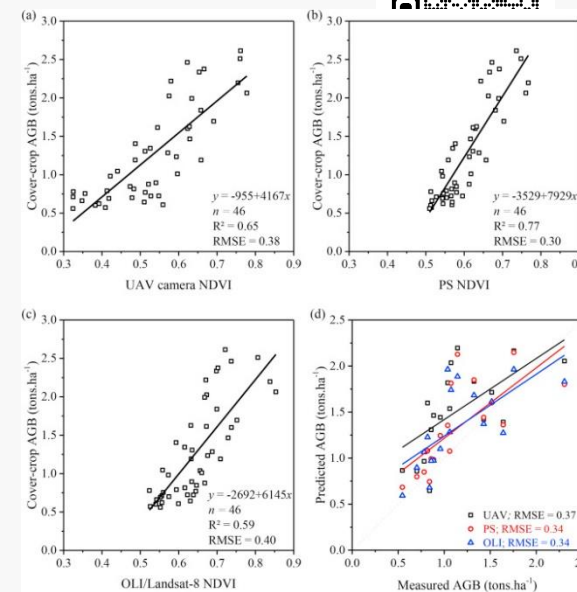
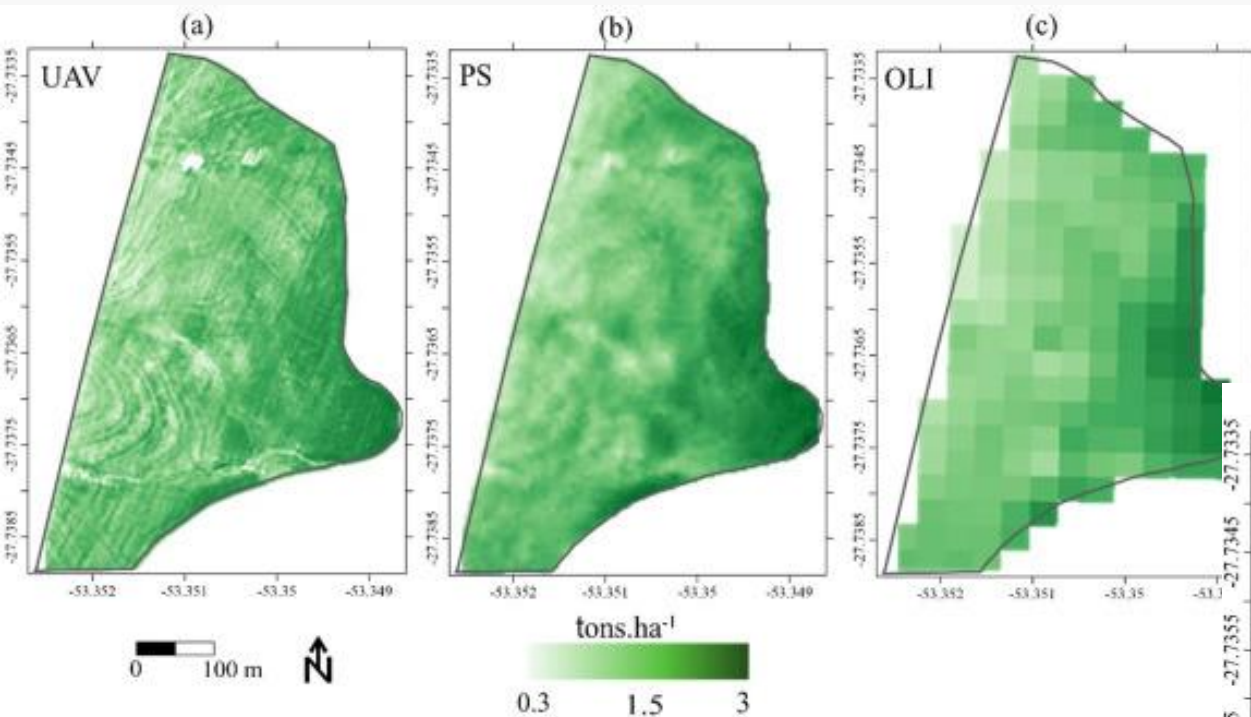
Geotecnologias na agricultura



Breunig, F. M. *et al.* (2020) 'Delineation of management zones in agricultural fields using cover-crop biomass estimates from PlanetScope data', *International Journal of Applied Earth Observation and Geoinformation*, 85, p. 102004. doi: 10.1016/j.jag.2019.102004.



Geotecnologias na agricultura



Breunig, F. M. *et al.* (2020) 'Assessing the effect of spatial resolution on the delineation of management zones for smallholder farming in southern Brazil', *Remote Sensing Applications: Society and Environment*, 19, p. 100325. doi: 10.1016/j.rsase.2020.100325.



Geotecnologias na agricultura

Call for papers: CSPP/IM x Get Started with Earth Engine x Center Pivot Irrigation D x Google Earth Engine Exp x

Seguro | <https://code.earthengine.google.com>

Apps M Z M Y GEE_CE GEE GEAPI KF G USH USH NSI FISK WP Au E P D Meteorologia BITC Doodle EOX Outros favoritos

Google Earth Engine Search places and datasets...

Scripts Docs Assets

- HDR Landsat
- Hillshade
- Landcover Cleanup
- Reduce Region
- Bitwise And
- Canny Edge Detector
- Center Pivot Irrigation Detector
- Clamp
- Connected Pixel Count
- Download Example

Center Pivot Irrigation Detector

```

1 // Center-pivot Irrigation Detector.
2
3 // Finds circles that are 500m in radius.
4 Map.setCenter(-106.06, 37.71, 12);
5
6 // A nice EVI palette.
7 var palette = [
8   'FFFFFF', 'CE7E45', 'DF923D', 'F18555', 'FCD163', '998718',
9   '74A901', '66A000', '529400', '3E8601', '207401', '056201',
10  '004C00', '023801', '012E01', '011D01', '011301'];
11
12 // Just display the image with the palette.

```

Inspector Console Tasks

Point (-106.0342, 37.7009) at 38m/px

Pixels

- Landsat EVI: Image (1 band)
EVI: 0.8262355695503928
- Kernel Peaks: Image (1 band)
EVI: 1
- Ring centers: Image (1 band)
EVI: 1

Objects

Layers Mapa Satélite

Google

Dados cartográficos ©2017 Google 2 km Termos de Uso Informar erro no mapa

ppc ultima.7z

Exibir todos



Geotecnologias na agricultura

MATLAB R2016a

HOME PLOTS APPS SHORTCUTS EDITOR PUBLISH VIEW

FILE NAVIGATE EDIT BREAKPOINTS RUN

Current Folder: C:\Users\UFSM\Desktop\PROSAIL_5B_MATLAB

Workspace: main_PROSAIL_5B.m

```

19 % ! The specific absorption coefficient corresponding to brown pigment
20 % ! provided by Frederic Baret (EMMAH, INRA Avignon, baret@avignon.inra.fr)
21 % ! and used with his authorization.
22 % ! the model PROSAIL is based on a version provided by
23 % ! Wout Verhoef
24 % ! NLR
25 % ! April/May 2003
26 %
27 % !*
28 % !=====
29 clear all hidden
30 clc
31 nw = 2101;
32
33 %Cab = 40; % chlorophyll content (ug.cm-2) (fixo)
34 %Car = 13; % carotenoid content (ug.cm-2) (fixo)
35 %Cbrown = 0.2; % brown pigment content (arbitrary units) (fixo)
36 %Cw = 0.02; % EWT (cm) (fixo)
37 %Cm = 0.009; % LMA (g.cm-2) (fixo)
38 %N = 1.5; % structure coefficient (soja dicotiledoneas)
39 %lai = 1; % leaf area index
40 %angl = 13; % average leaf angle (°) (Baseado no WINSAIL)
41 %psoil = 1; % soil coefficient (LVA - Campo verde - Medido em lab
42 %skyl = 20; % % diffuse/direct radiation (fixo)
43 %hspot = 0.2; % hot spot (fixo)=> indica a largura do efeito hot sp
44 %ihot = 1.0; % (fixo) (1=use hot spot; 0=for non hot spot position
45 %tts = 30; % solar zenith angle (°) (31° em 8/2/2005
46 %tto = 0; % observer zenith angle (°) (21.478 em 8/2/2005)
47 %psi = 0; % azimuth (°) (-64.75 em 8/2/2005)

```

Command Window

```

Error in printLocalCreatePrintJob (line 216)
handles = checkArgsForHandleToPrint(0, varargin{:});

Error in print (line 38)
[pj, inputargs] = LocalCreatePrintJob(varargin{:});

Error in saveas (line 168)
print(h, name, ['-d' dev{1}])

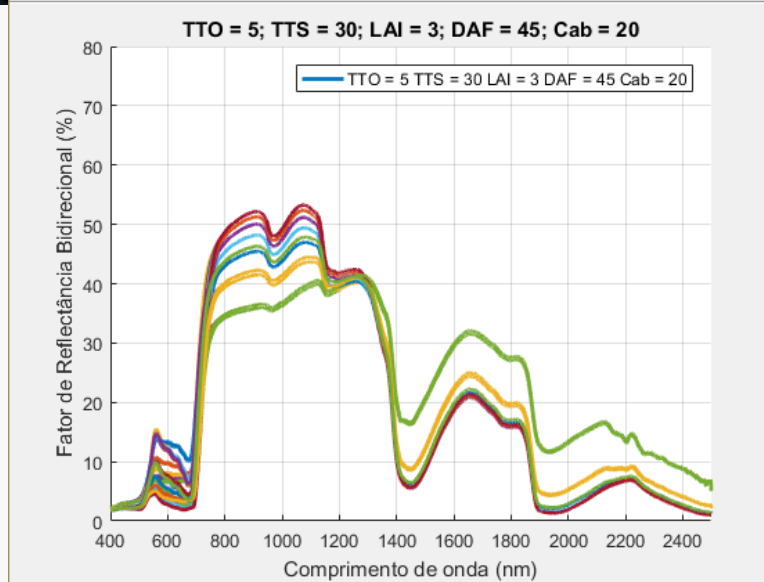
Error in main_PROSAIL_5B (line 90)
saveas(gcf, ['TTO = ', num2str(tto), ' PSI = ', num2str(psi)

```

Figure 1

File Edit View Insert Tools Desktop Window Help

TTO = 5; TTS = 30; LAI = 3; DAF = 45; Cab = 20



Spring 5.4.3 (64Bits) - WINDOWS

Importante: Esta versão roda apenas em sistemas operacionais Windows de 64 Bits

Fonte	Português	Espanhol	Inglês	Francês
DPI - INPE - Brasil	LEAME	LEAME	README	LEAME
	Instalação Completo	Instalación Completo	Install complete	Installation Complet
	Banco Demo	Banco Demo	Database Demo	Banco Demo
	Instalação Símbolos em BMP	Instalación Símbolos em BMP	Symbol installation - BMP	Installation Symboles em BMP

Download dos Conversores de bancos de dados DBase para SQLite:

- Em Português: [Brasil](#) [Espanha](#) [França](#)
- Em Inglês: [Brasil](#) [Espanha](#) [França](#)

Download das versões anteriores:

- SPRING 5.3 (Português) [SPRING 5.3 \(Espanhol\)](#) [SPRING 5.3 \(Inglês\)](#) [SPRING 5.3 \(Francês\)](#)
- SPRING 5.2.7 (Português) [SPRING 5.2.7 \(Espanhol\)](#) [SPRING 5.2.7 \(Inglês\)](#) [SPRING 5.2.7 \(Francês\)](#)
- SPRING 5.1.8 (Português) [SPRING 5.1.8 \(Espanhol\)](#) [SPRING 5.1.8 \(Inglês\)](#) [SPRING 5.1.8 \(Francês\)](#)
- SPRING 5.0.6 (Português) [SPRING 5.0.6 \(Espanhol\)](#) [SPRING 5.0.6 \(Inglês\)](#) [SPRING 5.0.6 \(Francês\)](#)
- SPRING 4.3.3 (Português) [SPRING 4.3.3 \(Espanhol\)](#) [SPRING 4.3.3 \(Inglês\)](#) [SPRING 4.3.3 \(Francês\)](#)
- SPRING 4.2.7 (Português) [SPRING 4.2.7 \(Espanhol\)](#) [SPRING 4.2.7 \(Inglês\)](#) [SPRING 4.2.7 \(Francês\)](#)
- SPRING 4.1.1 (Português)
- SPRING 4.0 (Português)

Download do Data Access Object (DAO)-JET

Para gerar bancos ACCESS, sem ter o ACCESS instalado em sua máquina, você deve instalar [DAO-JET 3.5](#) (OFFICE 97) ou o [DAO-JET 4.0](#) (OFFICE 2000).

Download do MDA 2.0

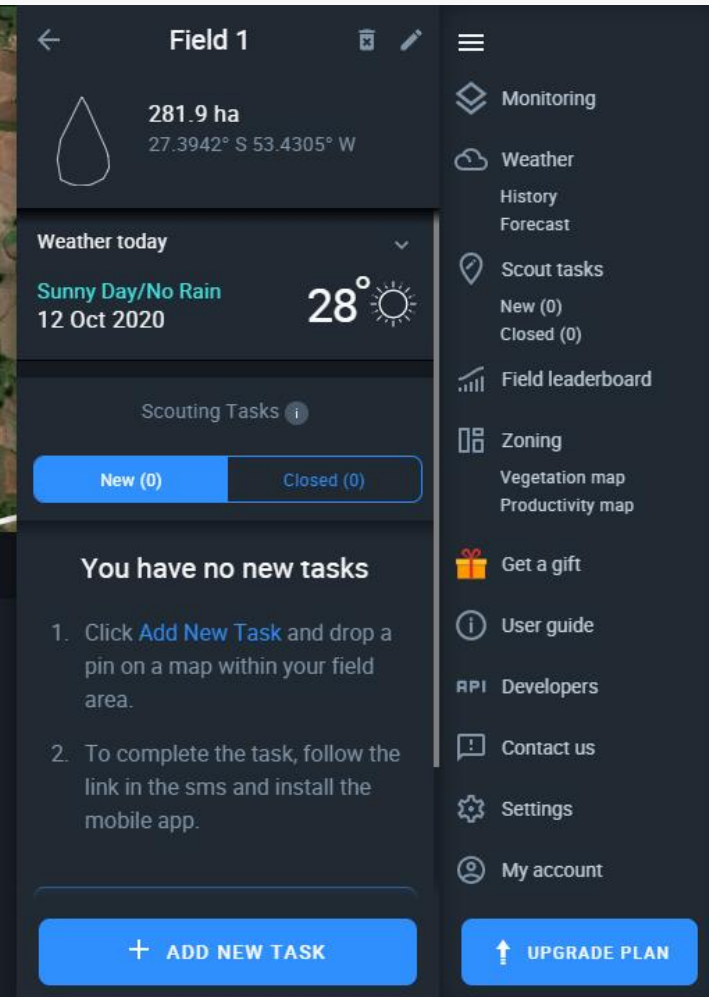
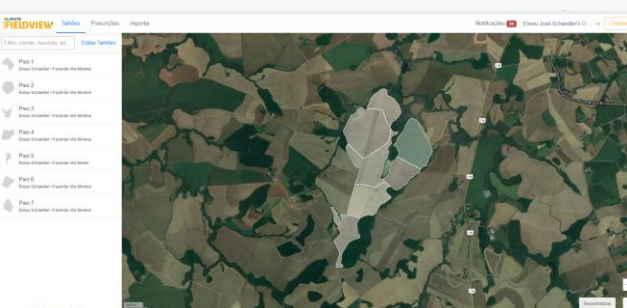
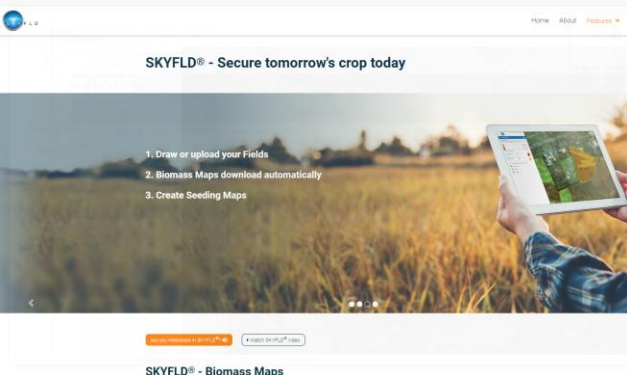
ATENÇÃO: Após instalar o SPRING, tente criar um Banco de Dados com o Gerenciador ACCESS. Caso o SPRING não funcione corretamente com este gerenciador, será necessário atualizar alguns componentes do Microsoft® Data Access Components 2.0. Basta fazer a transferência do arquivo abaixo e executá-lo a partir de qualquer diretório em seu micro.

Obs: As versões mais recentes do Microsoft OFFICE não necessitam desta atualização. PORTANTO, TESTE O SPRING COM GERENCIADOR ACCESS ANTES DE INSTALAR ESTES COMPONENTES.

- [MDA](#)



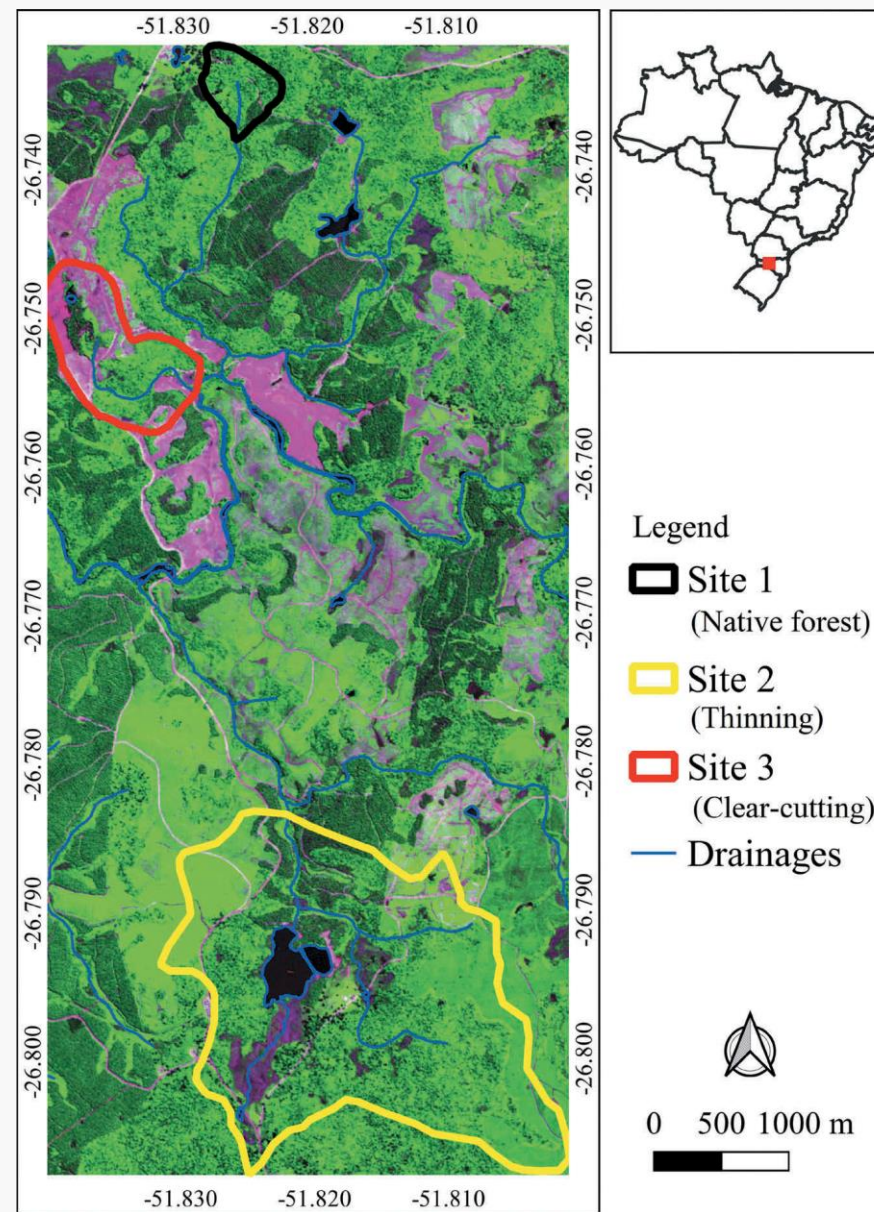
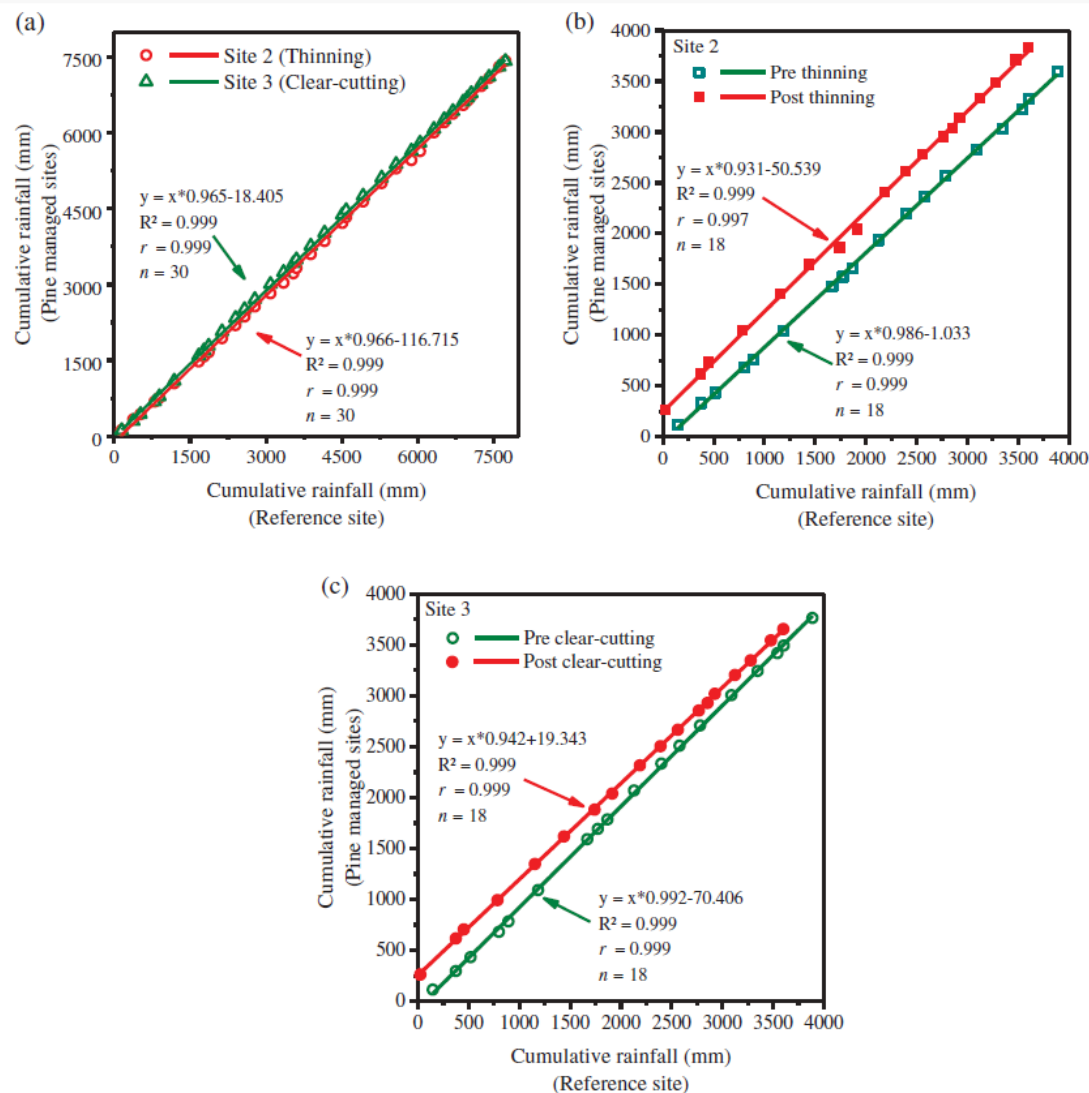
Geotecnologias na agricultura



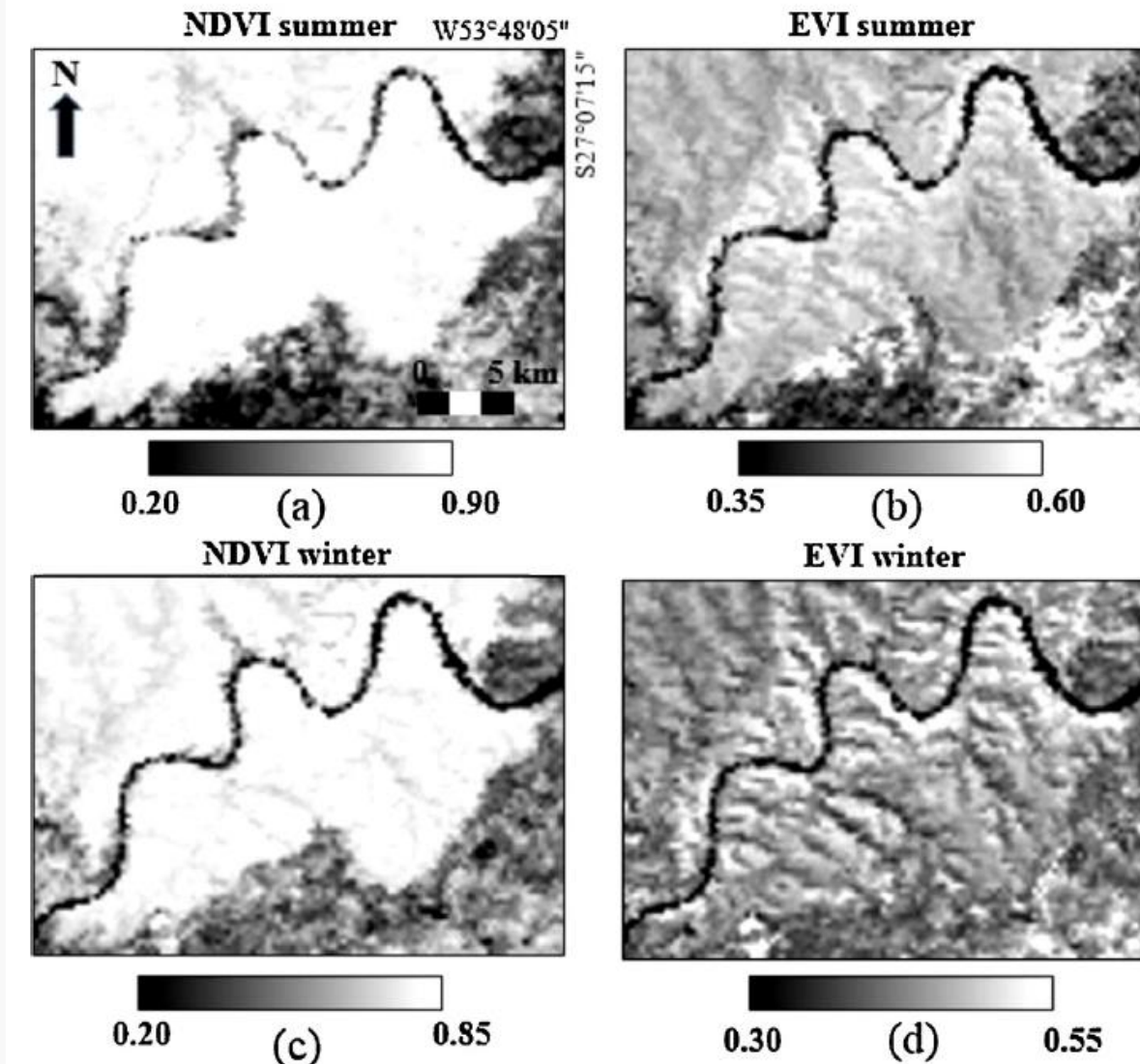
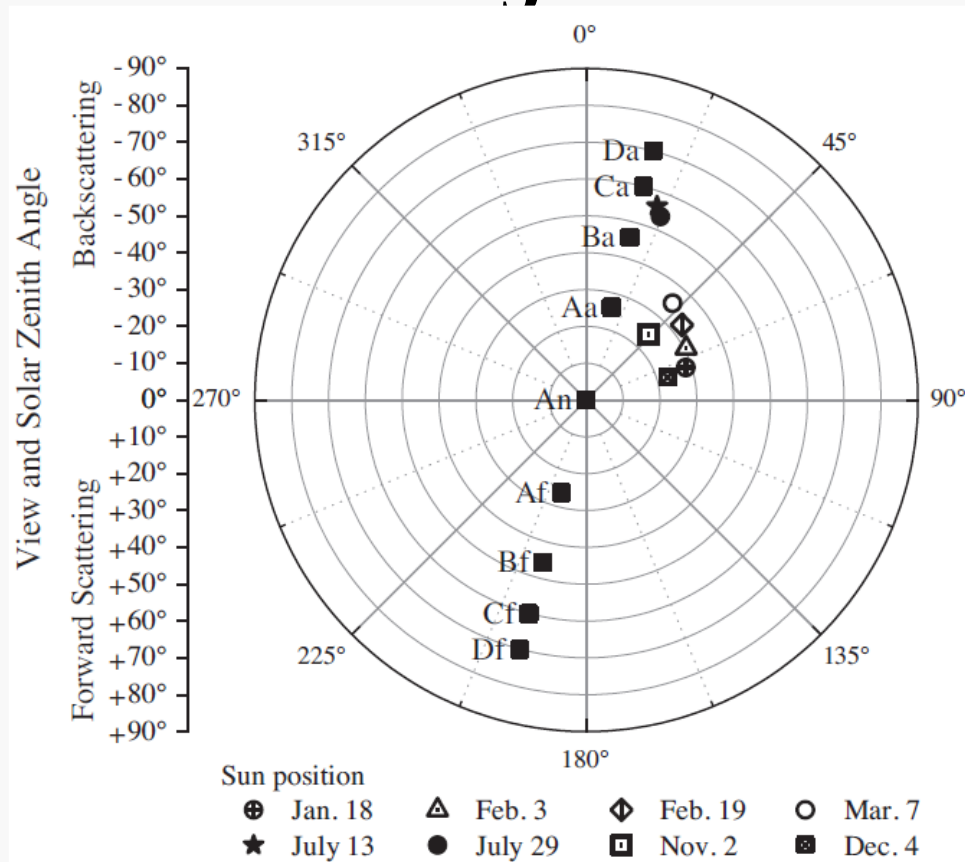


Geotecnologias no setor florestal

Perrando, E. R. *et al.* (2020) 'Evaluation of the effects of Pine Management on the Water Yield and Quality in Southern Brazil', *Journal of Sustainable Forestry*, pp. 1–17. doi: 10.1080/10549811.2020.1746916.



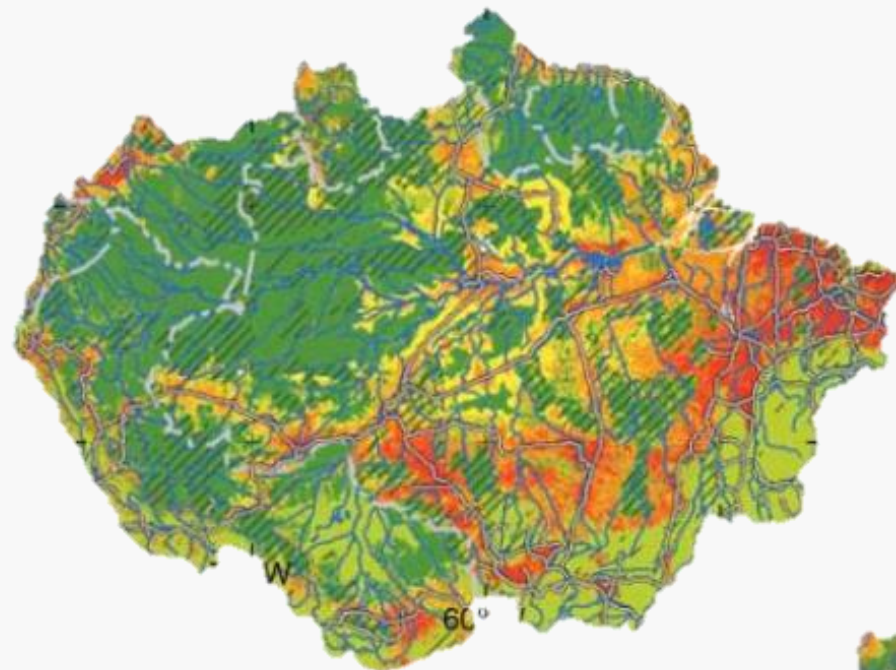
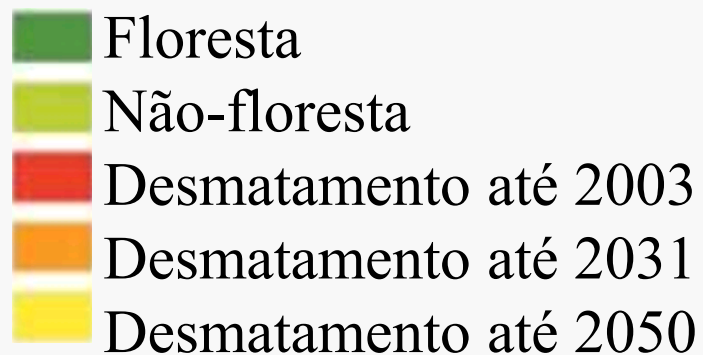
Geotecnologias no setor florestal



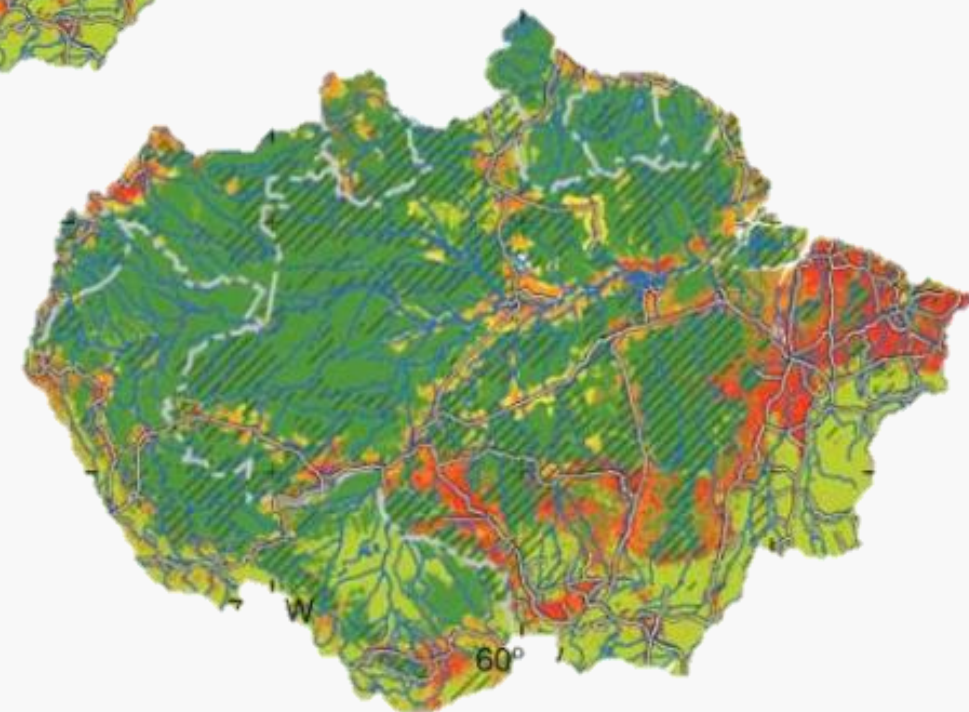
Breunig, F. M. *et al.* (2015) 'Spectral anisotropy of subtropical deciduous forest using MISRand MODIS data acquired under large seasonal variation in solarzenith angle', *International Journal of Applied Earth Observation and Geoinformation*, 35(PB), pp. 294–304. doi: 10.1016/j.jag.2014.09.017.



MODELO ATUAL =>



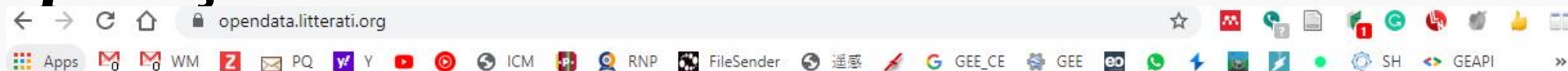
MODELO CONSERVACIONISTA =>



Soares-Filho, B. S. *et al.* (2006) 'Modelling conservation in the Amazon basin', *Nature*. Nature Publishing Group, 440(7083), pp. 520–523. doi: 10.1038/nature04389.

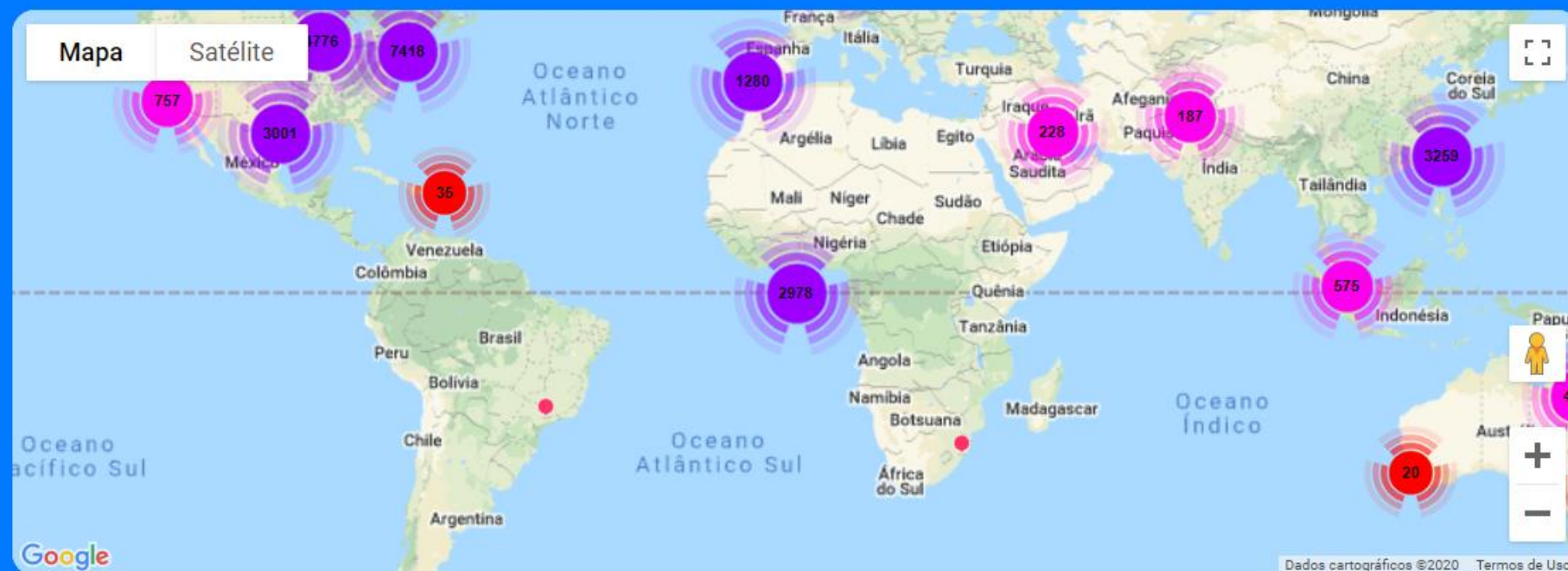


Aplicações – urbana



Map Report

Note: Maximum 50,000 litters can be viewed on map





Aplicações – urbana

Tree Care Activities

There are no activities reported.

[Record Tree Care](#)

Ecological Benefits

💧 **Stormwater intercepted each year**

2,668 gallons

Value: \$26.41

⚡ **Energy conserved each year**

1,670 kWh

Value: \$210.87

🌬️ **Air pollutants removed each year**

3 pounds

Value: \$14.6

🌍 **Carbon dioxide reduced each year**

2,104 tons

Value: \$7.03

💰 **Total Value of Annual Benefits**

Value: \$258.91

Benefits are calculated using formulas from the U.S. Forest Service.

Ginkgo ●

Ginkgo biloba



Tree ID Number 580325

Trunk Diameter 20 inches

Closest Address 47 West 9 Street

[Suggest an Edit](#)

[VIEW ALL GINKGO TREES ON THE MAP](#)



New York City Street Tree Map

Explore and Care For NYC's Urban Forest

[Map](#)

[My Trees](#)

[Learn](#)

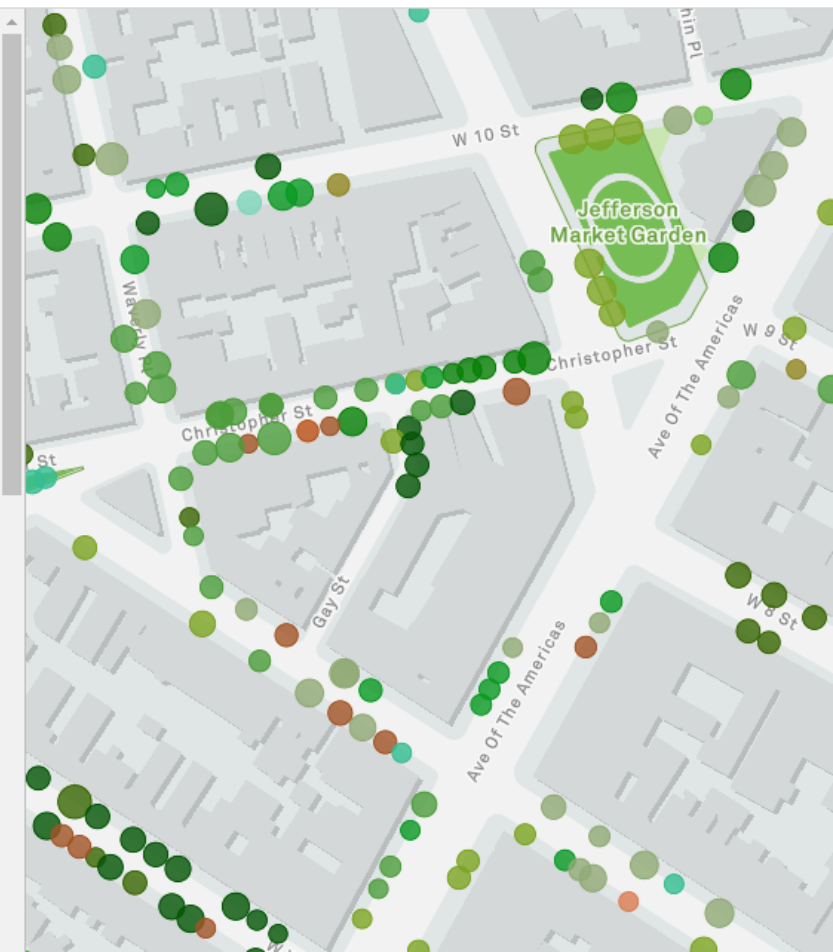
[Groups](#)

[Share](#)

[Tweet](#)

[Favorite](#)

[Report Problem](#)



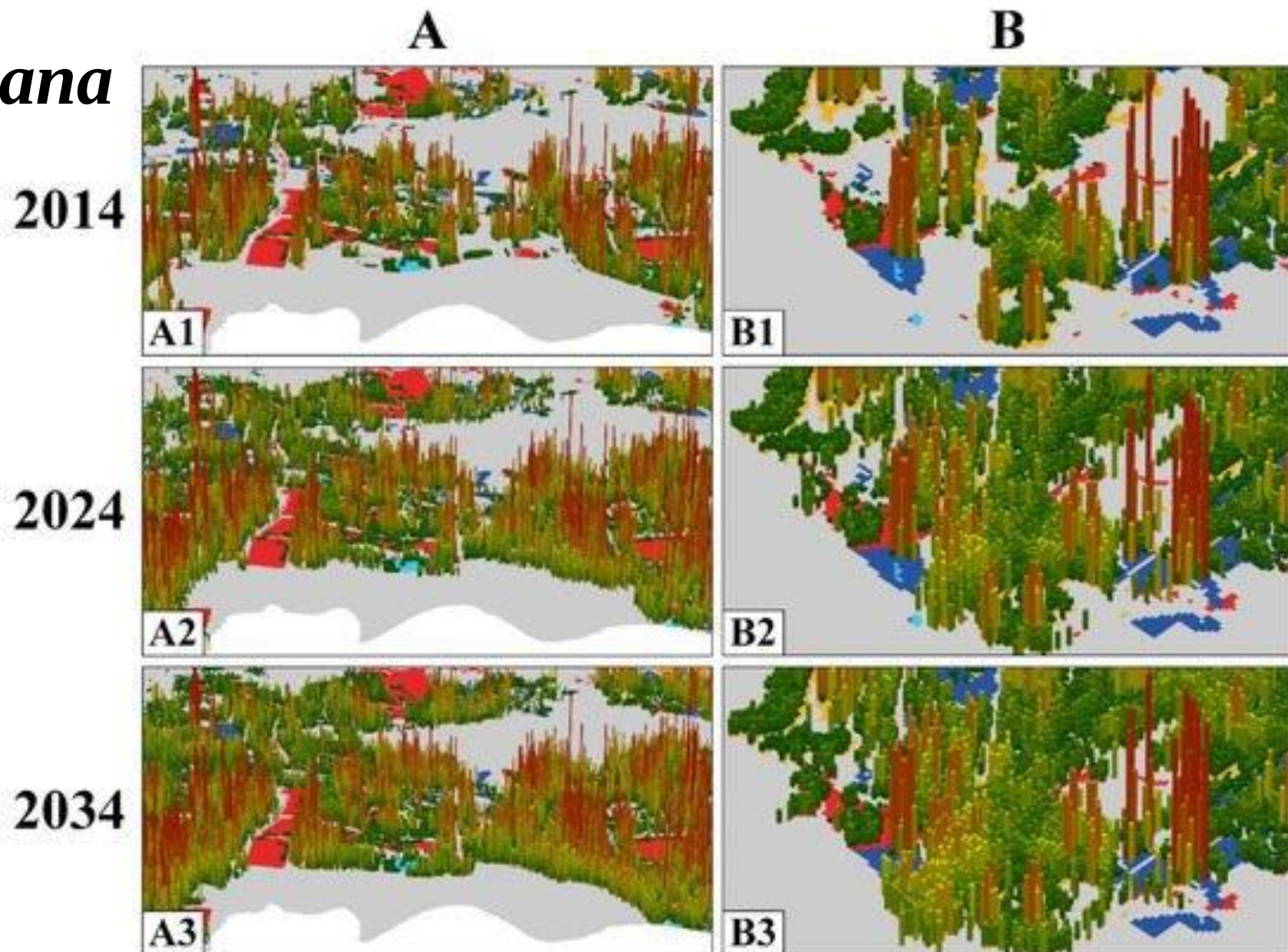
<https://tree-map.nycgovparks.org/tree-map/tree/4640488>



Aplicações – urbana

Predicted results of building height growth of Shenzhen in the vertical direction, 2014–2034. **(A)** The region near Shenzhen Bay; **(B)** The region near the Shenzhen North Railway Station in the south of Longhua District

Zhao, L. *et al.* (2022) 'Three-Dimensional Simulation Model for Synergistically Simulating Urban Horizontal Expansion and Vertical Growth', *Remote Sensing*, 14(6), p. 1503. doi: 10.3390/rs14061503.



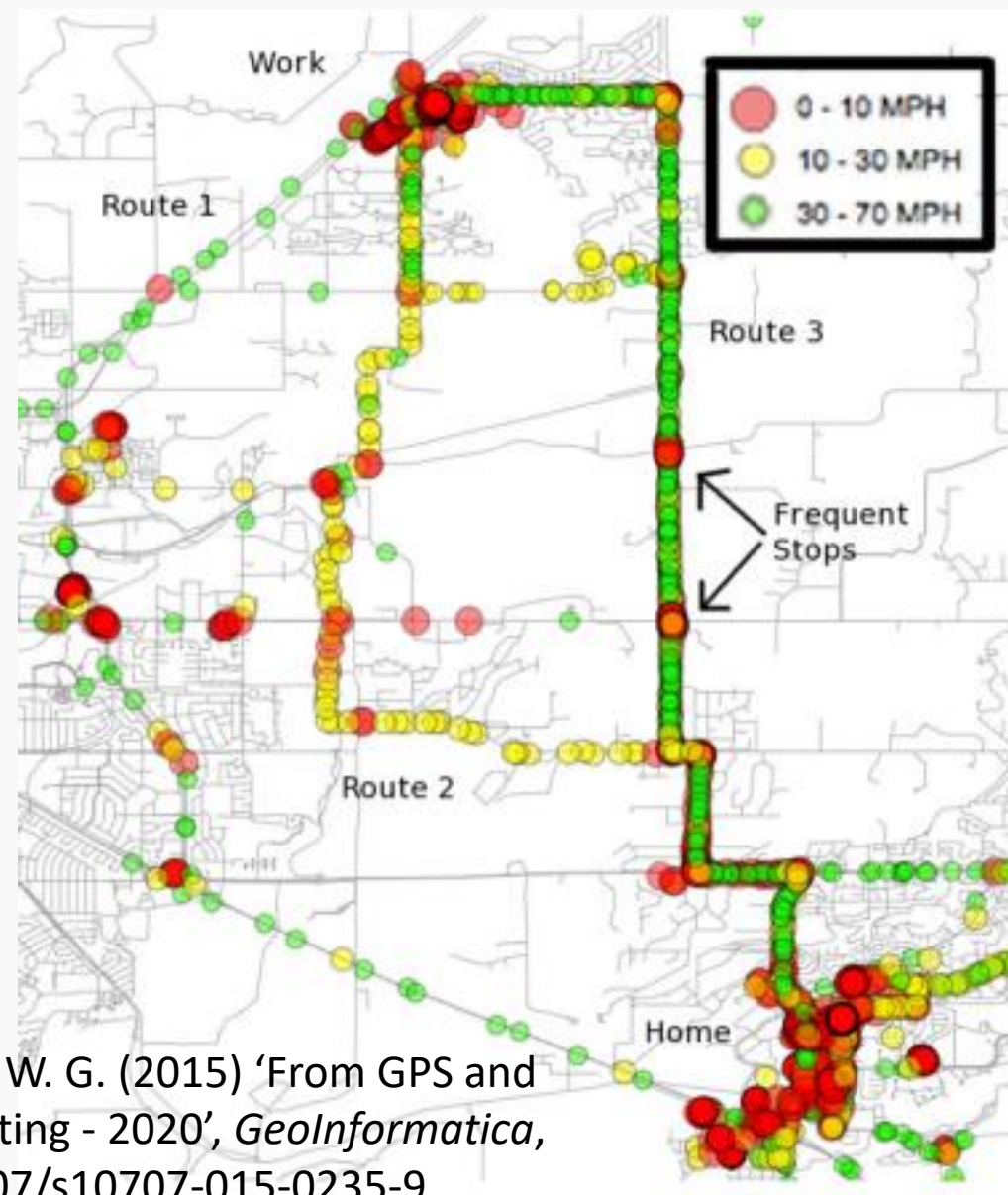
Aplicações urbana



(a) Simulated Crowd



(b) Actual Crowd

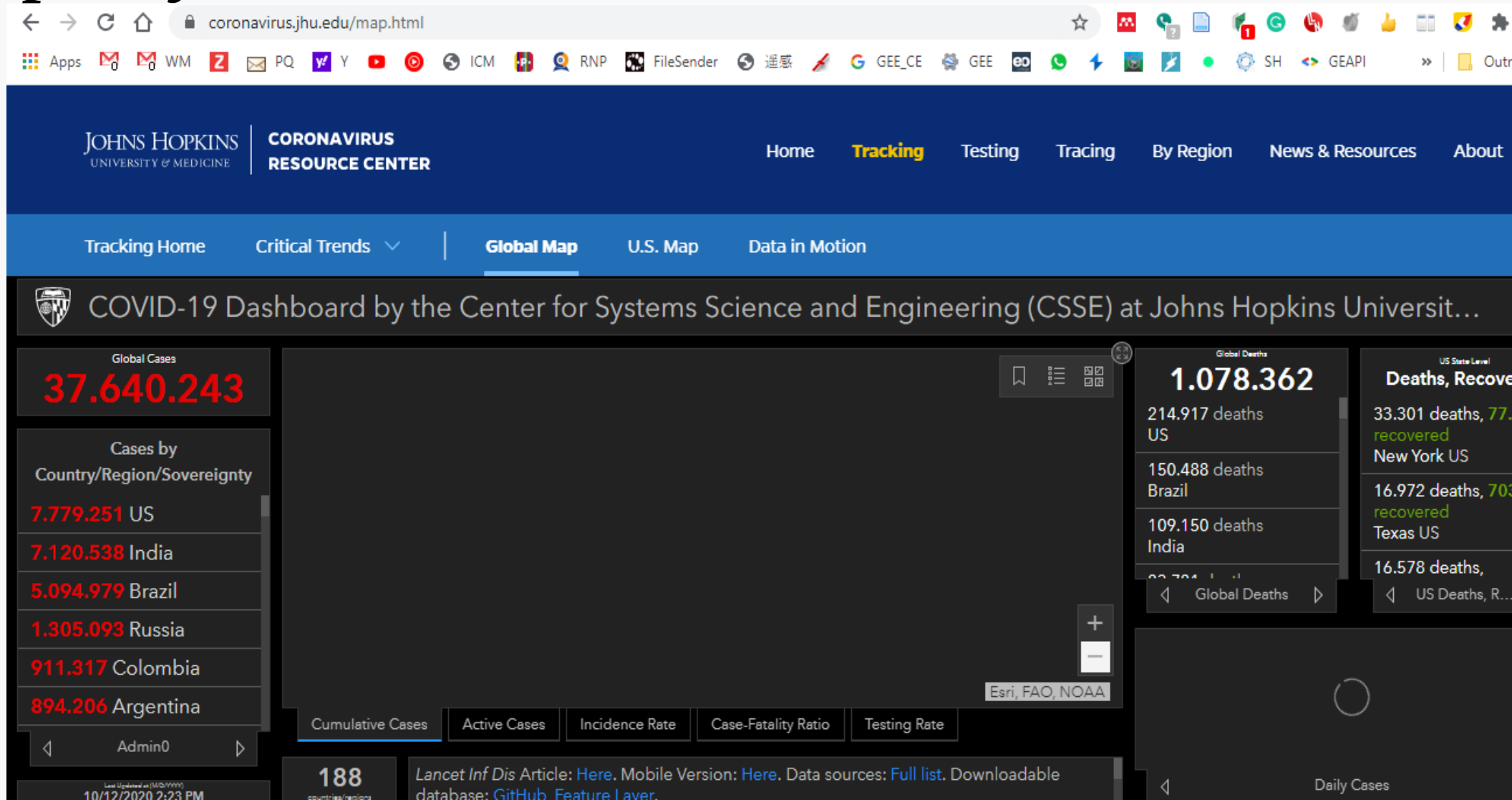


Shekhar, S., Feiner, S. and Aref, W. G. (2015) 'From GPS and virtual globes to spatial computing - 2020', *GeoInformatica*, 19(4), pp. 799–832. doi: 10.1007/s10707-015-0235-9.





Aplicações – Saúde





Considerações finais

Importante eliminar os preconceitos;

Foco na formação de qualidade;

Geotecnologias são um caminho;

Diversidade é muito importante;

Todos vocês são capazes!



Fábio Marcelo Breunig

Prof. Ass. II – DEF/UFSM-FW

<http://ufsmpublica.ufsm.br/docente/15556>

E-mail: breunig@ufsm.br

Telefone: 055 3744-0683 ou 55 9 96405988

Grad. Geografia

Mest. Sensoriamento Remoto

Dout. Sensoriamento Remoto

Pós-doc (2015 e 2019)

Docente Permanente => PPGGEO e PPGCTA (UFSM)

Docente Colaborador => PPGEIO (UFPR) e PGSERE (INPE)

Docente cursos de graduação: Eng. Florestal, Agronomia, Eng. Ambiental, etc.

Coord. Proj. Ext. “Ovo no Alvo” com escolas e “WORKGEO” com emp. e estudantes.

ResearcherID: B-5757-2008

Scopus Author ID: 23968618800

ORCID: 0000-0002-0405-9603

CV lattes: <http://lattes.cnpq.br/5926113161758766>

LGSR: <https://www.ufsm.br/laboratorios/lgsr/> (PQ)

Coord. Lab. Geop. Sensoriamento Remoto (LGSR)

Parcerias/colaborações com empresas e instituições (cartas de apoio)

Editor de periódicos e revisor (nacionais e internacionais).

Coord. Processo de reciclagem (patente)



Importância das geotecnologias na formação acadêmica

Muito obrigado pela oportunidade!

Fábio Marcelo Breunig

Coordenador

E-mail: breunig@ufsm.br

Telefone: 055 3744-0683

Frederico Westphalen, RS

08/04/2022

Sala: