Uso de información climática y satelital para el manejo ganadero sustentable en pastizales

Dr. CARLOS M. DI BELLA

Director del Instituto de Clima y Agua – **INTA**
Investigador independiente **CONICET**
Profesor adjunto **FAUBA**

Ministerio de Agroindustria
Presidencia de la Nación


Sensores Remotos
Información climática
Pastizales & Pasturas

ÉCOSCIENCE, 2017
https://doi.org/10.1080/11956860.2017.1376262

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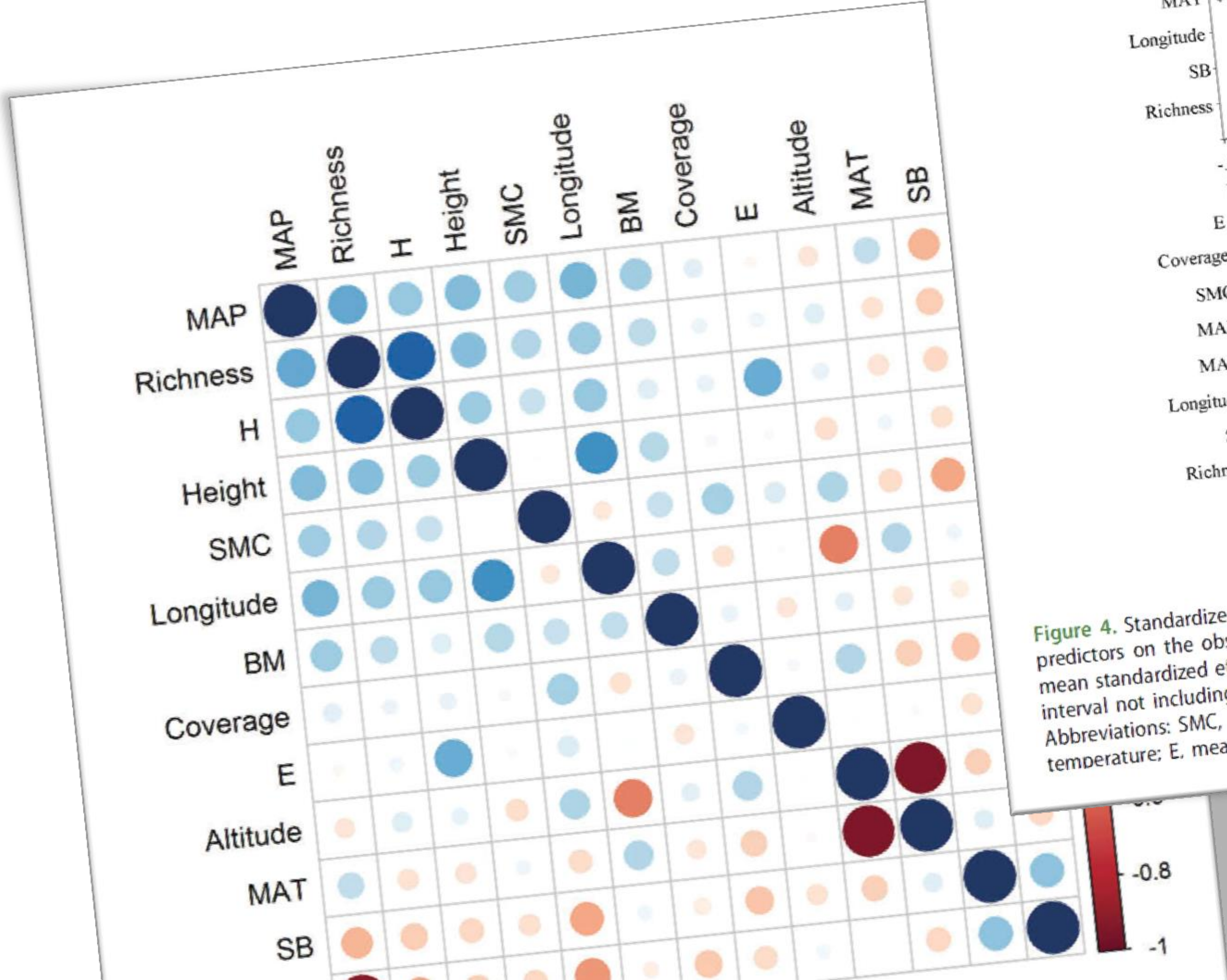
ARTICLE

Bayesian method predicts belowground biomass of natural grasslands

Zhuangsheng Tang [a], Lei Deng[a], Hui An [b] and Zhouping Shangguan[a]



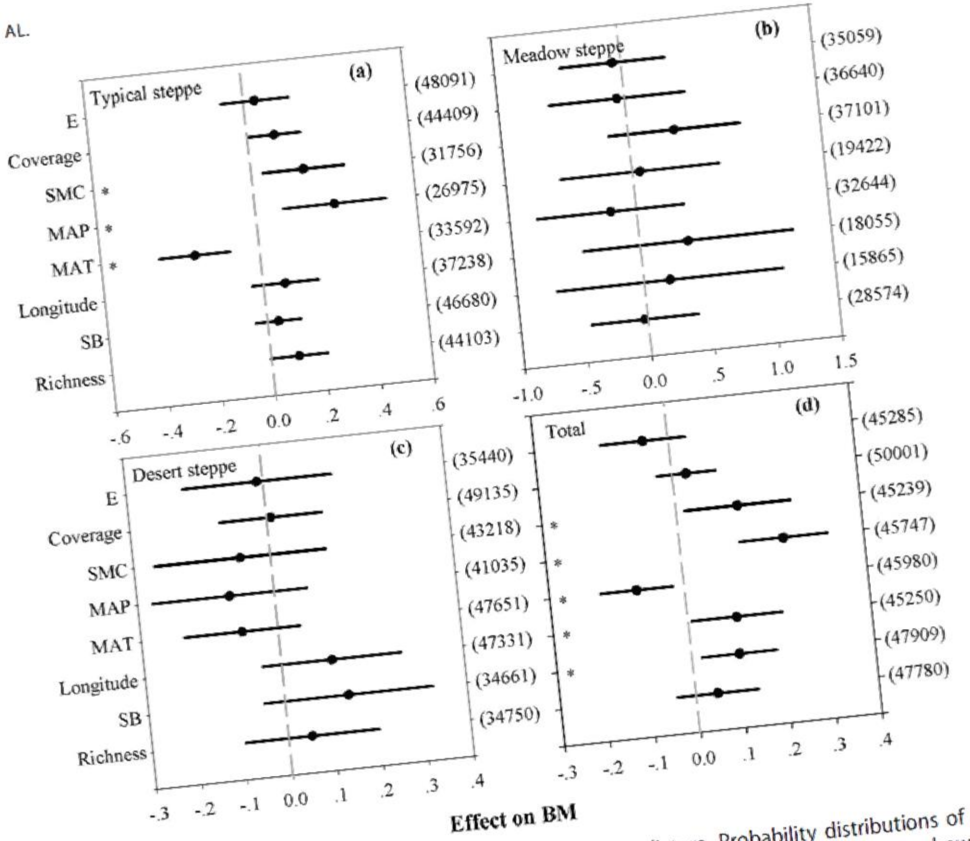
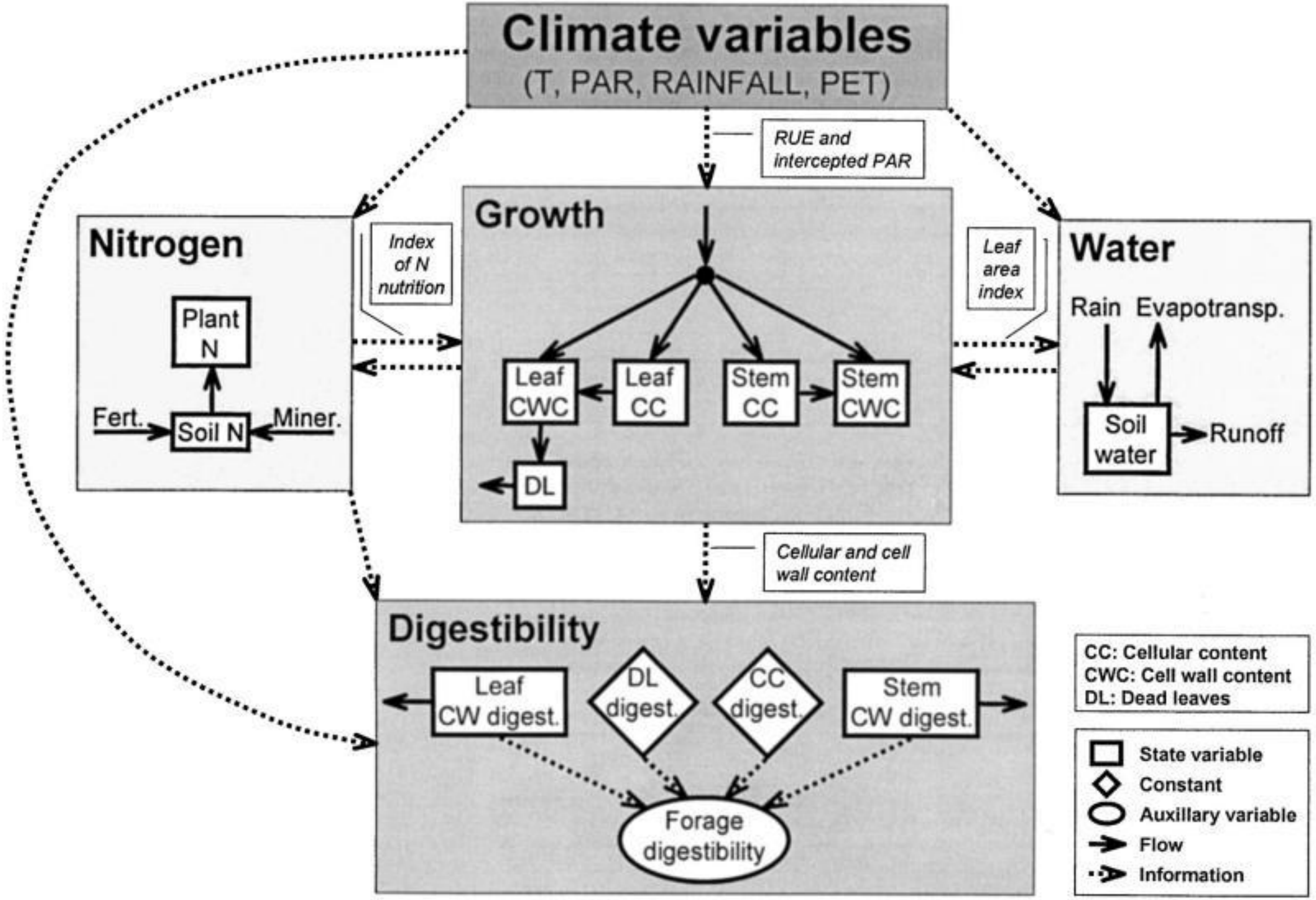


Figure 4. Standardized effect size estimates of the belowground biomass predictors. Probability distributions of the effect of the predictors on the observed production drawn from the posterior distribution of the multilevel model are shown. Points are the mean standardized effect estimates, and thin bars indicate the 95% highest density interval. Predictors with a 95% highest density interval not including zero are considered to have significant effects. The number inside parentheses is the effective sample size. Abbreviations: SMC, mean soil moisture content; SB, mean soil bulk density; MAP, mean annual precipitation; MAT, mean annual temperature; E, mean Pielou index; BM, belowground biomass; *significant.

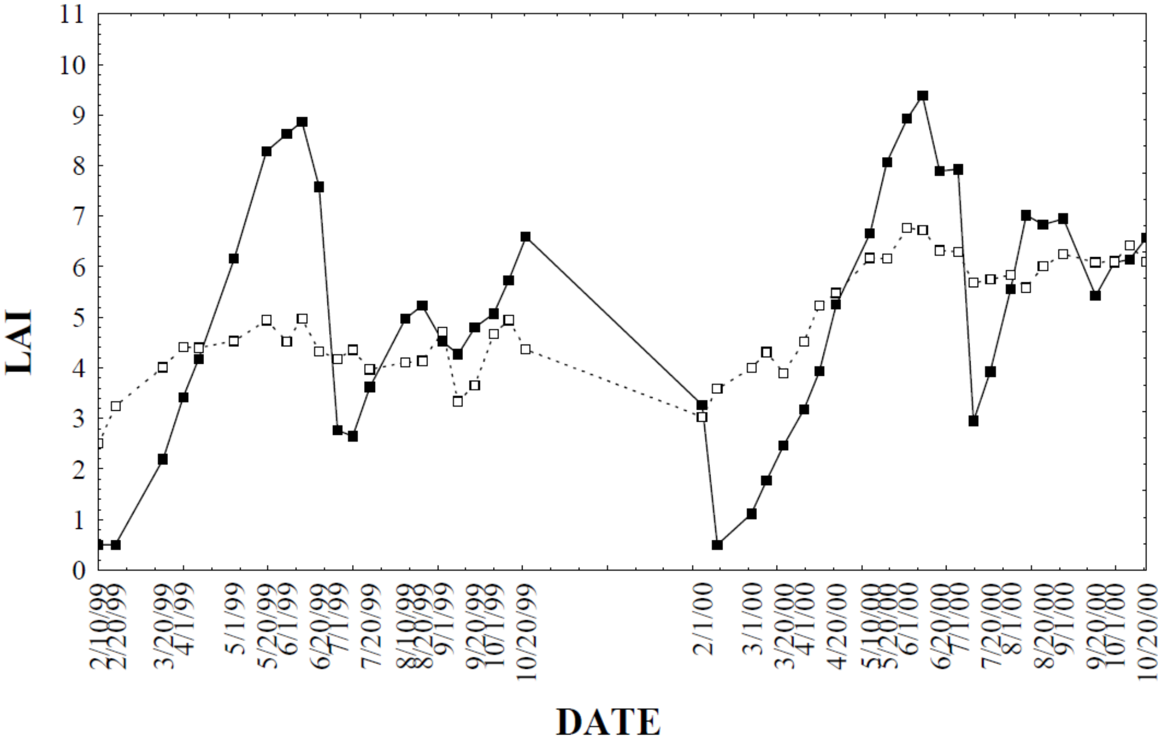
INRA SCIENCE & IMPACT

stics

Qui sommes-nous ? Téléchargement Support Rencontres scientifiques Ressources Partenaires et projets


Climate variables
(T, PAR, RAINFALL, PET)
RUE and intercepted PAR
Growth
Nitrogen
Index of N nutrition
Plant N
Fert.
Soil N
Miner.
Leaf CWC
Leaf CC
Stem CC
Stem CWC
DL
Leaf area index
Water
Rain
Evapotransp.
Soil water
Runoff
Cellular and cell wall content
Digestibility
Leaf CW digest.
DL digest.
CC digest.
Stem CW digest.
Forage digestibility
CC: Cellular content
CWC: Cell wall content
DL: Dead leaves
State variable
Constant
Auxillary variable
Flow
Information

RF 2503



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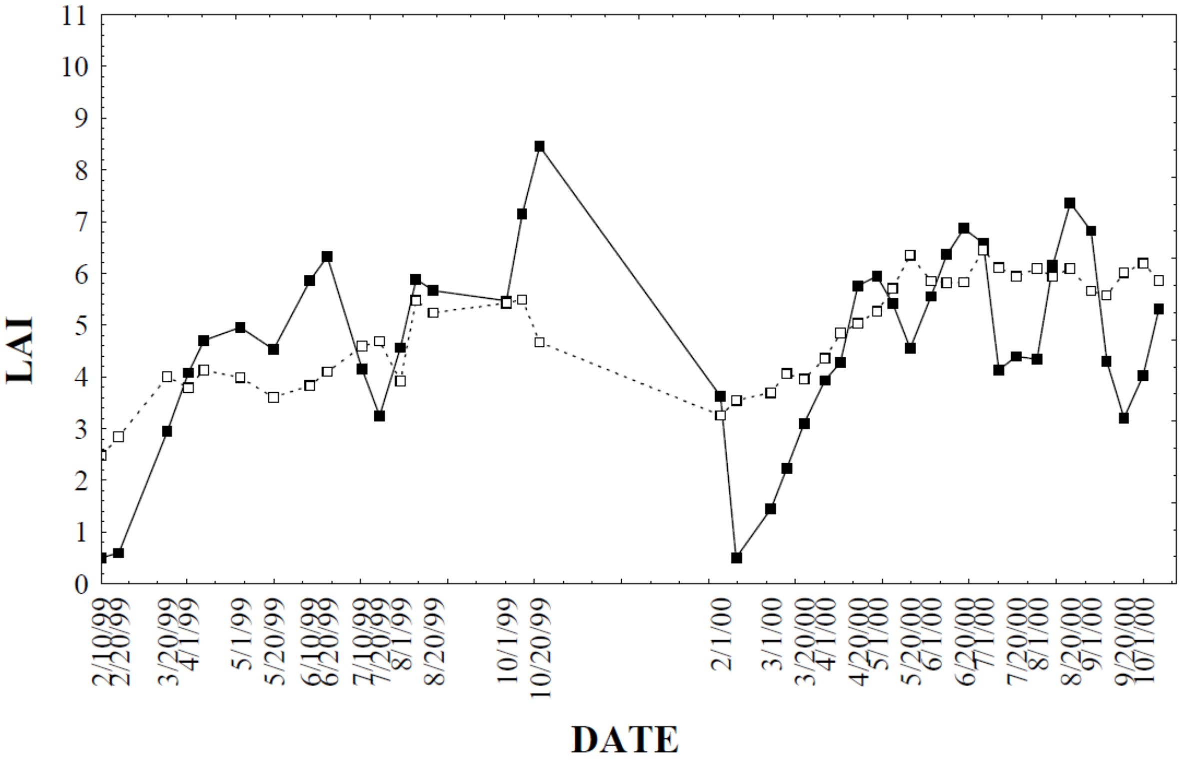

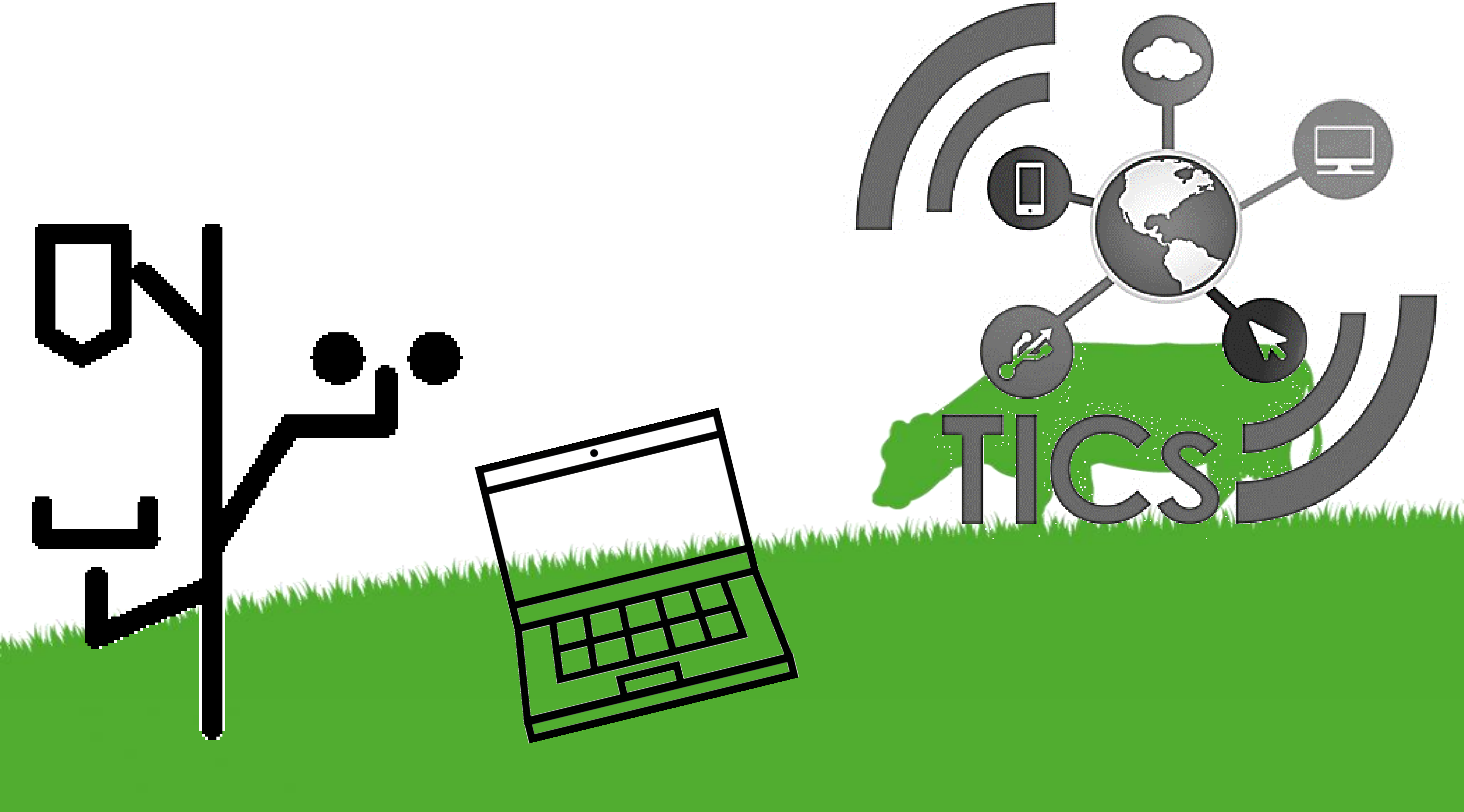
TICs

PORTAL | DATOS | PRODUCTOS | AYUDA

SISTEMA DE INFORMACIÓN Y GESTIÓN AGROMETEOROLÓGICA INTA

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INTA — Ministerio de Agroindustria, Presidencia de la Nación

Estimación de precipitación

del 30 de Abril al 07 de Mayo de 2018

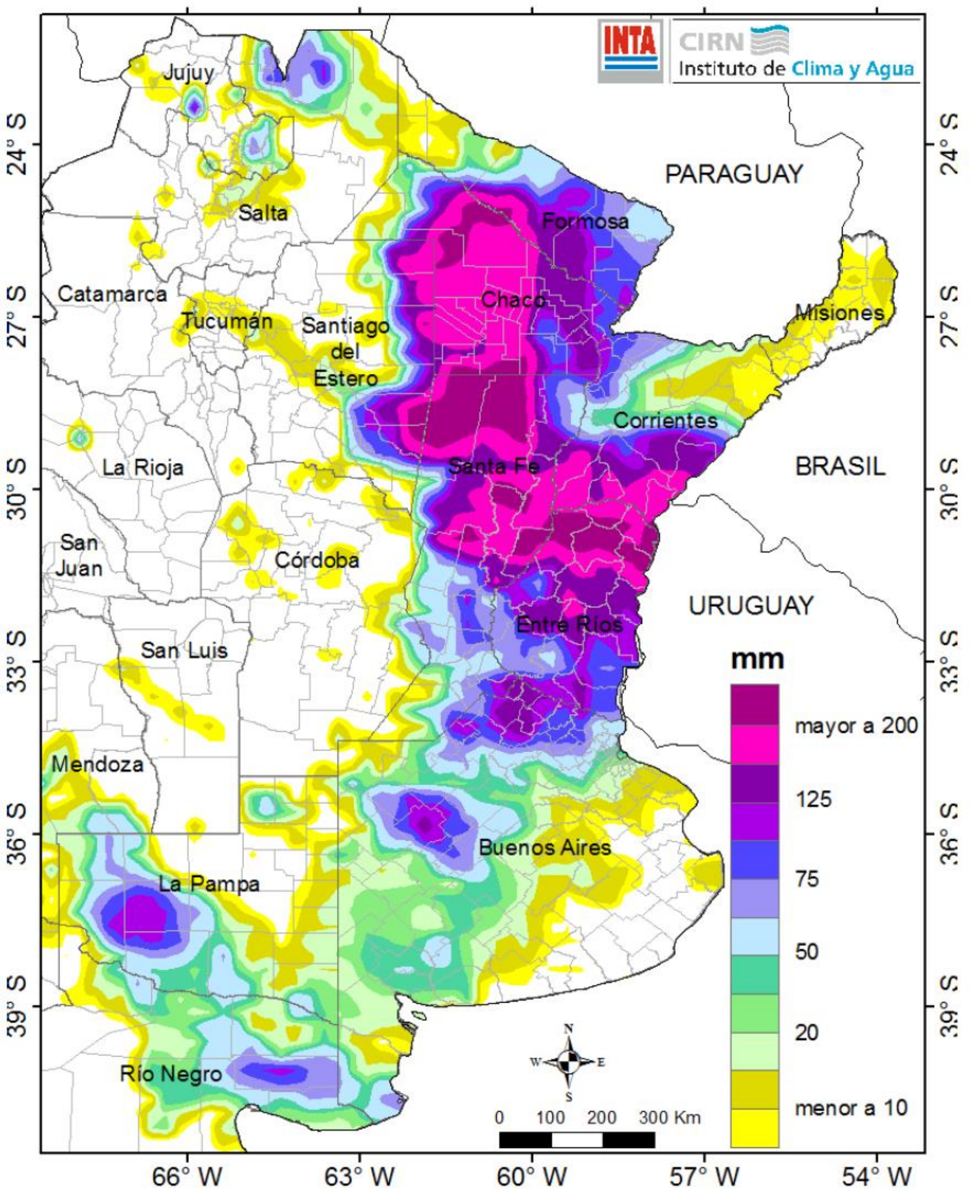


Fig.25: Estimación de precipitación (mm) basada en datos satelitales.

Balance de agua en el suelo

al 07 de Mayo de 2018

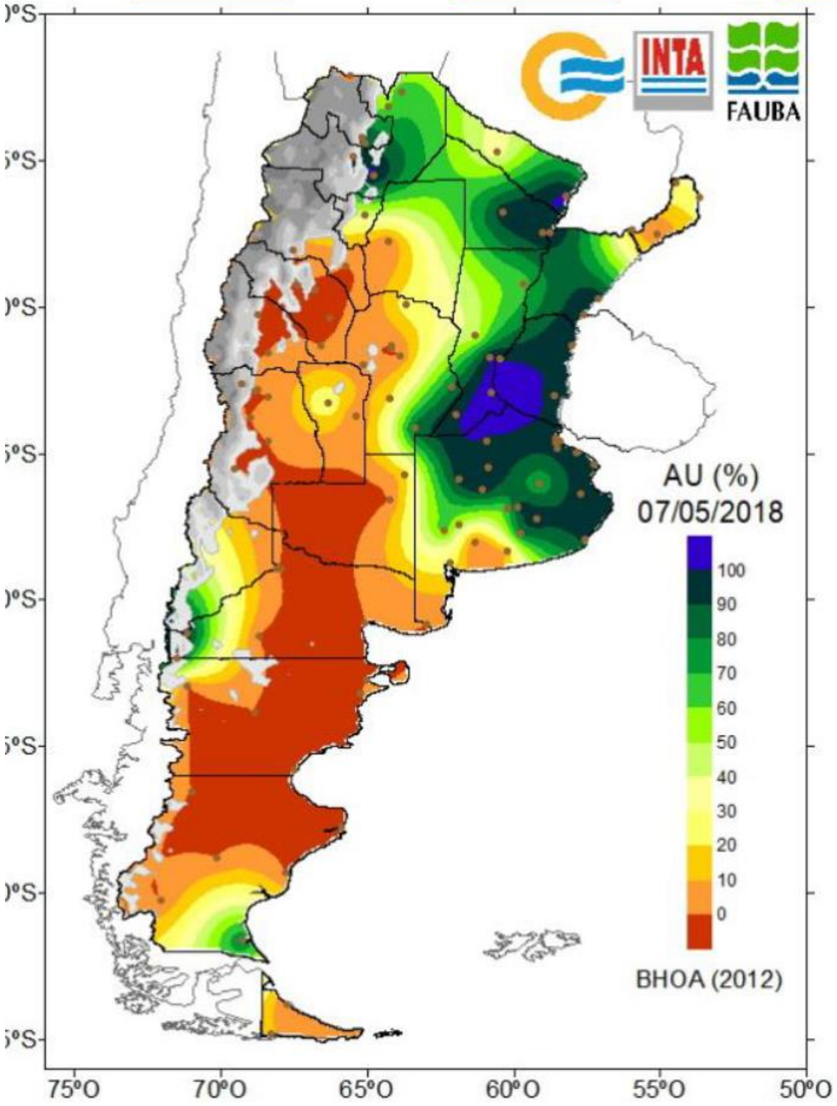


Fig. 26: Agua útil (%) en el perfil del suelo al 07/05/18.

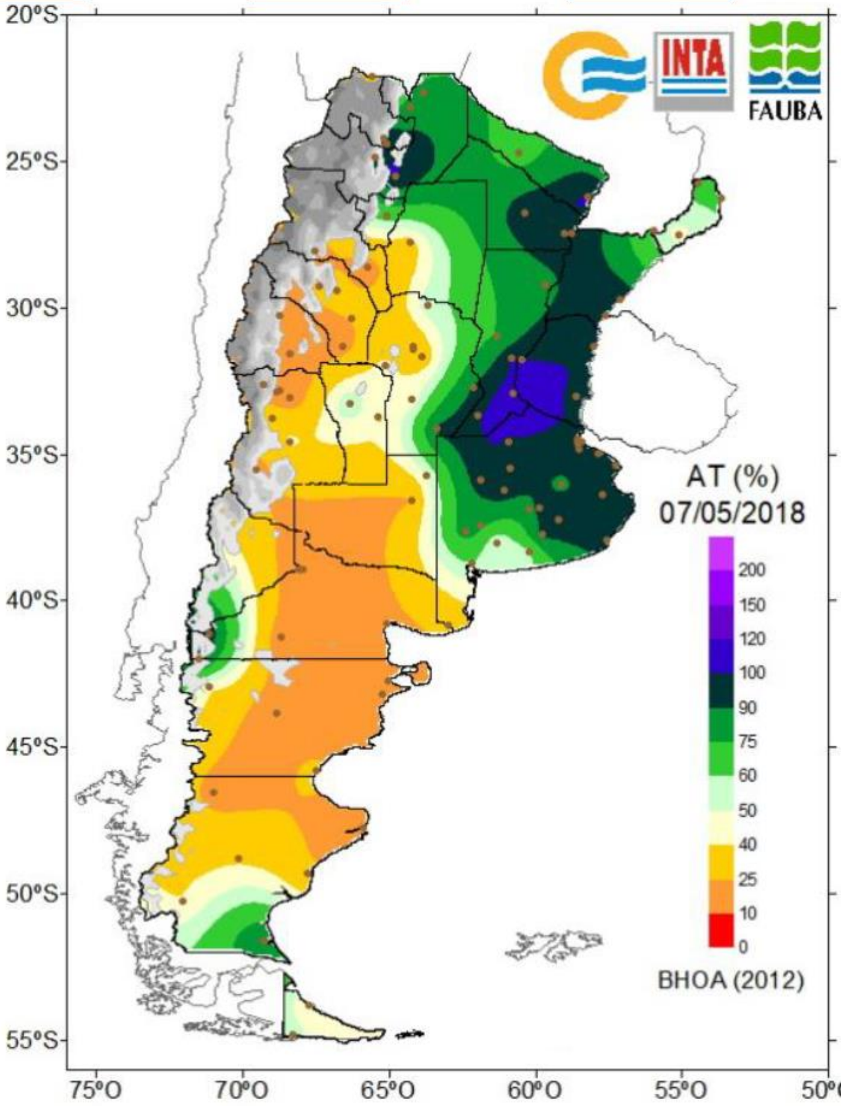


Fig. 27: Agua Total (%) en el perfil del suelo al 07/05/18.

Pronóstico de lluvias de corto a mediano plazo

del 07 al 14 de Mayo de 2018

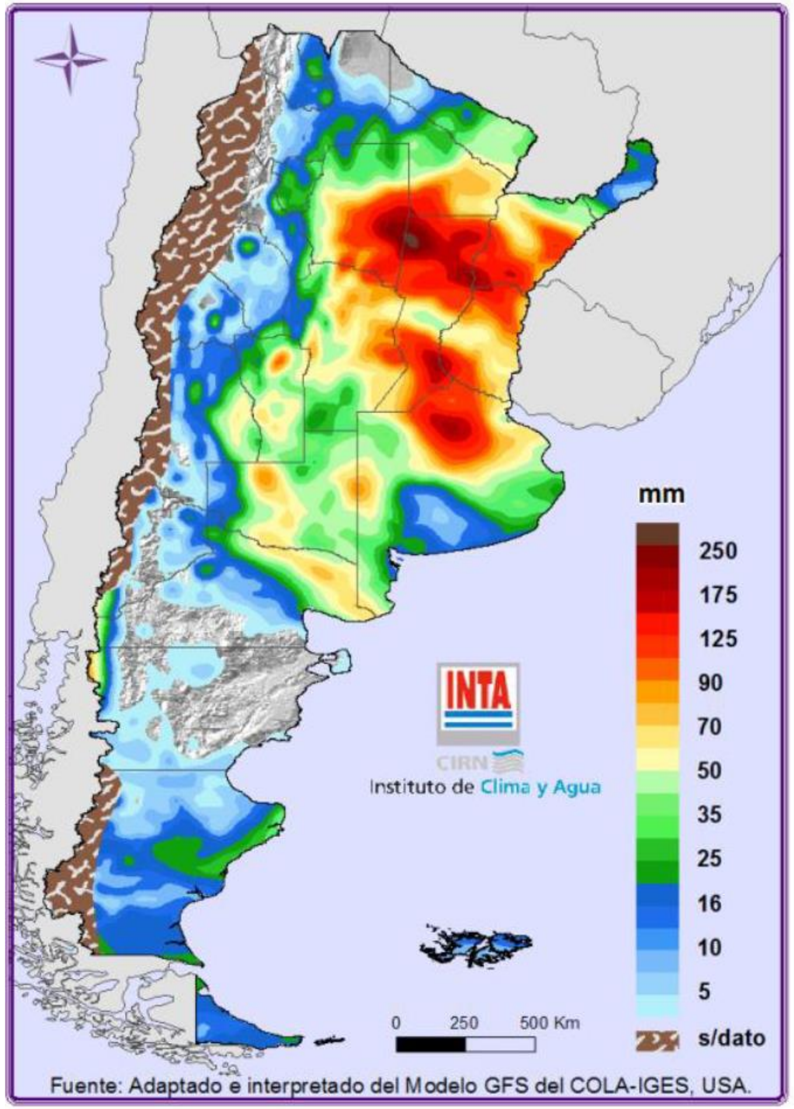


Fig. 31: Precipitación acumulada (mm) pronosticada para la semana del 07 al 14 de Mayo de 2018.

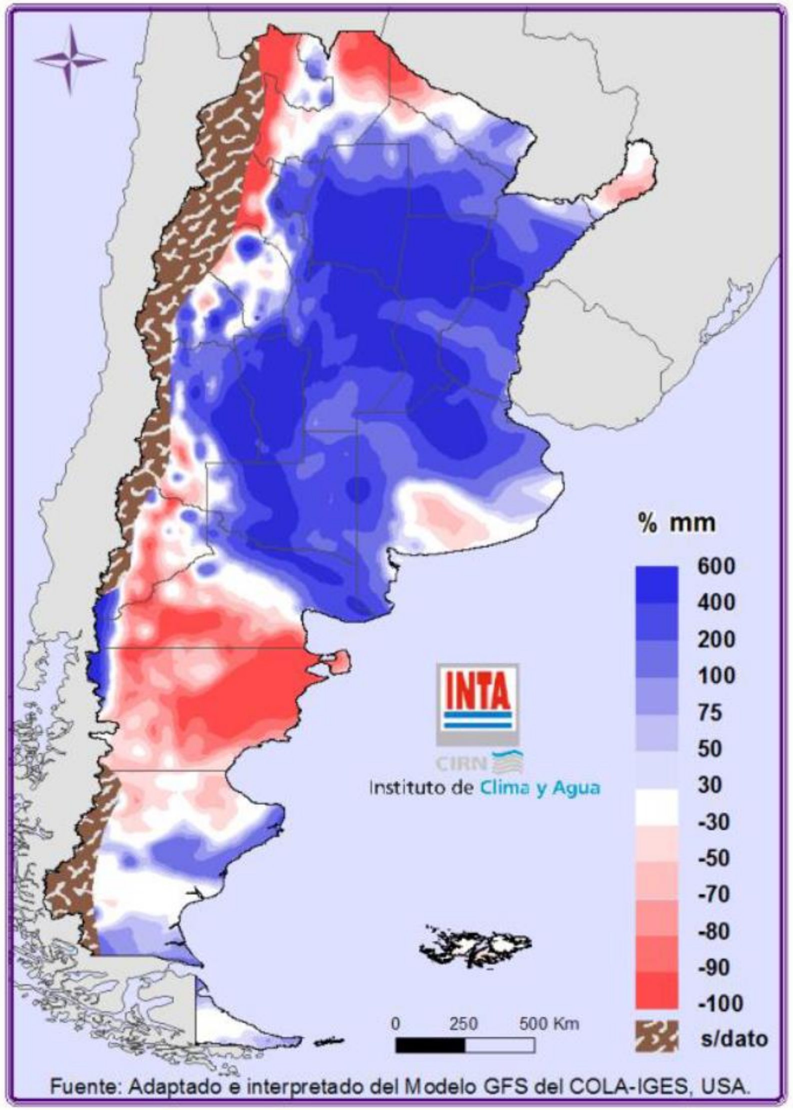


Fig. 32: Anomalía de precipitación acumulada (porcentaje de lo normal) pronosticada para la semana del 07 al 14 de Mayo de 2018.

Pronóstico de lluvias de corto a mediano plazo

del 15 al 22 de Mayo de 2018

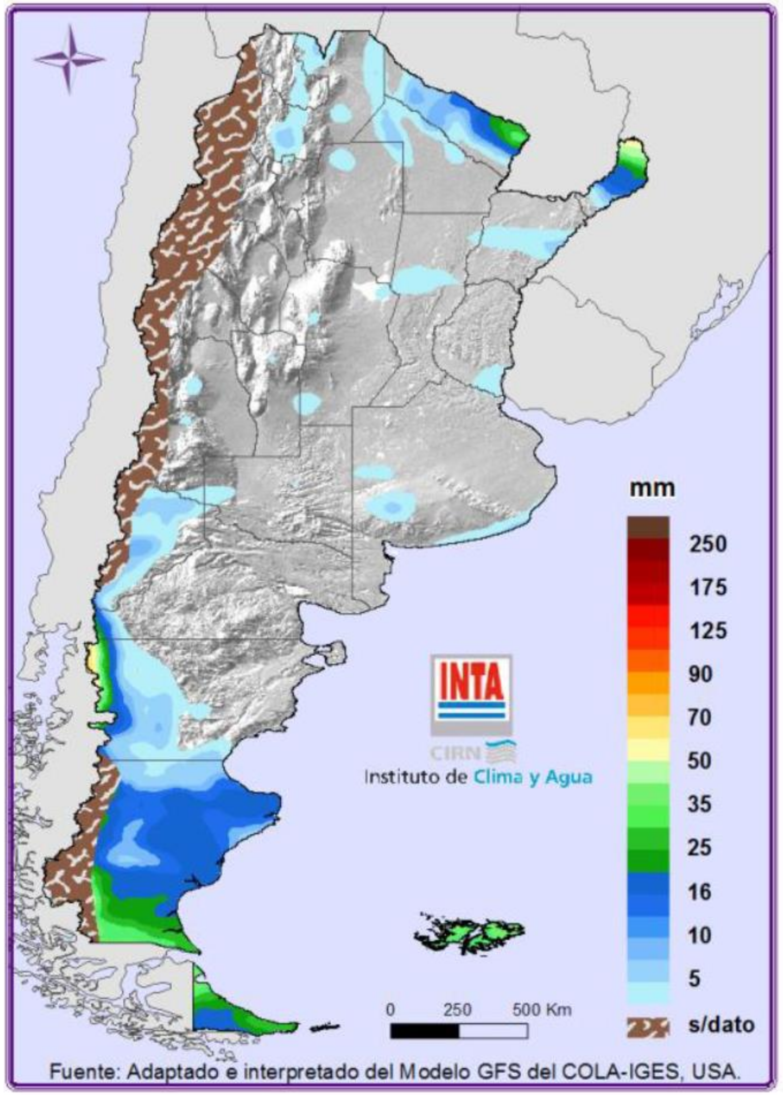


Fig. 33: Precipitación acumulada (mm) pronosticada para la semana del 15 al 22 de Mayo de 2018.

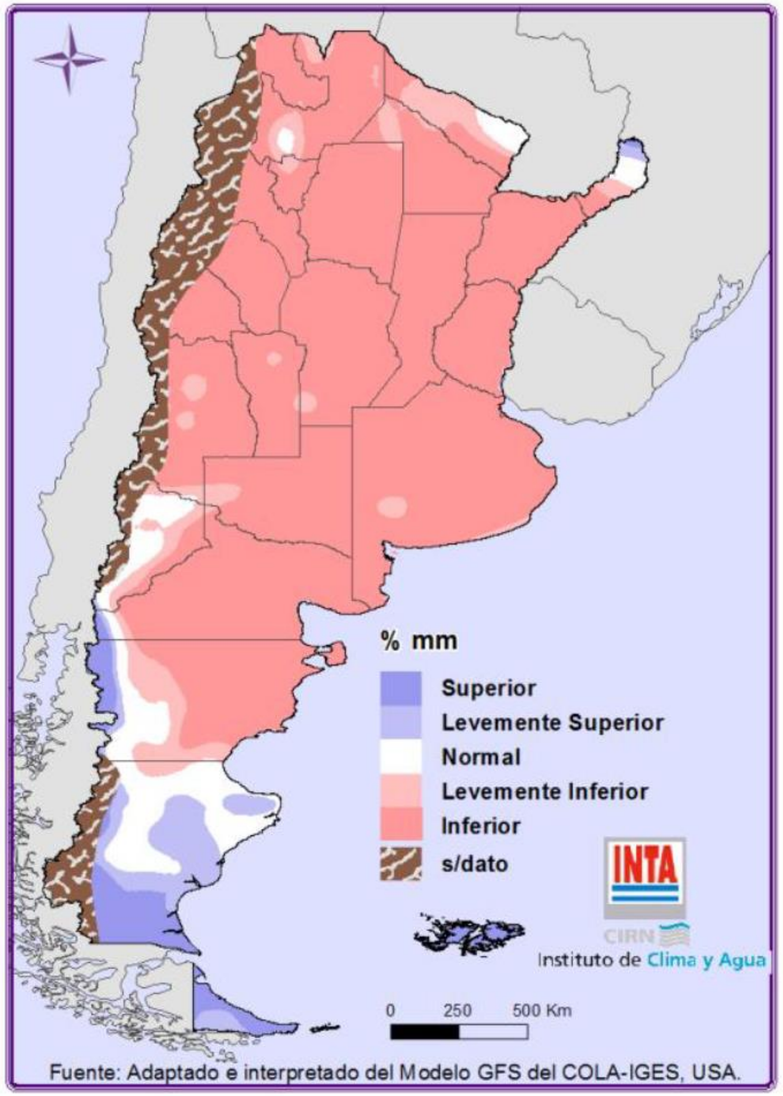
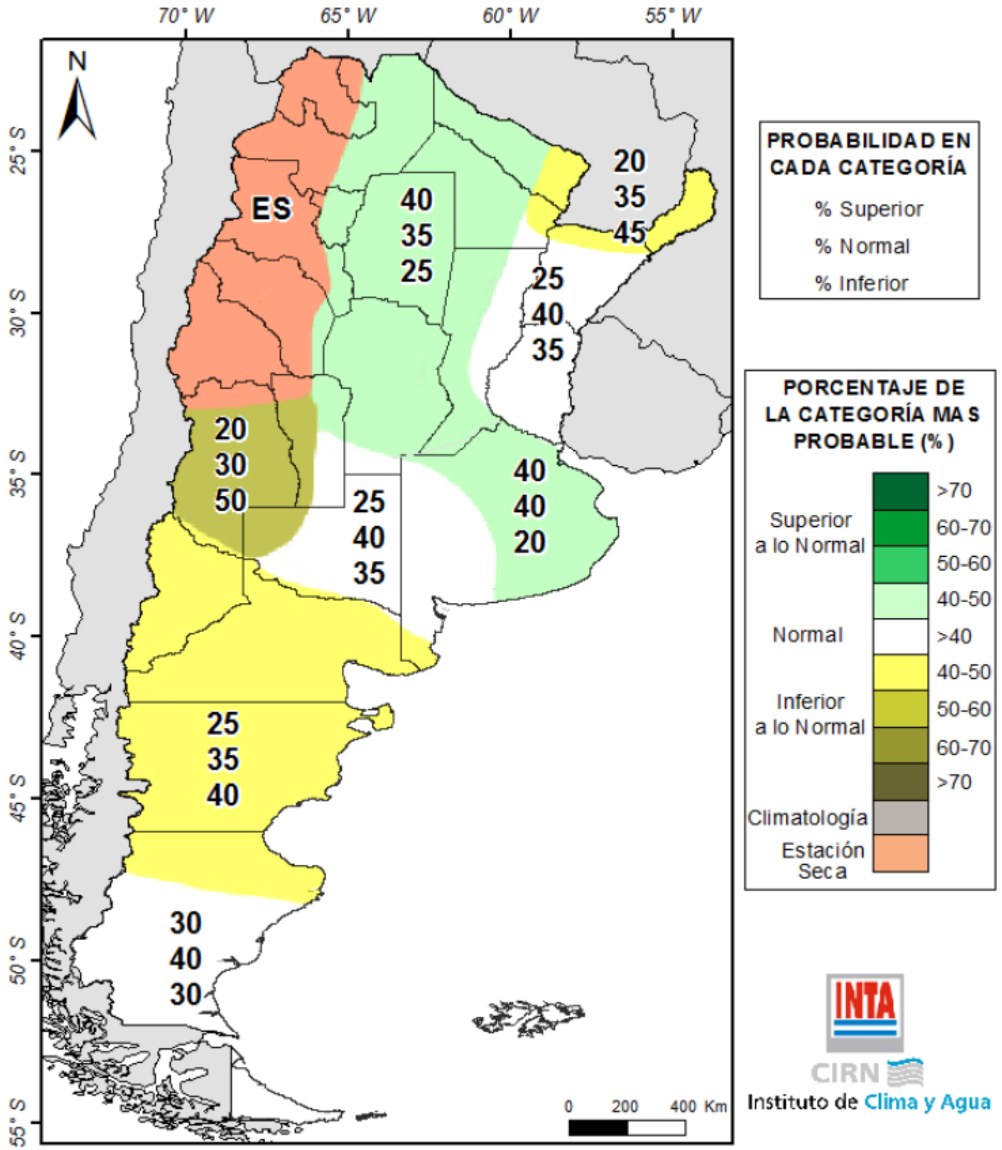


Fig. 34: Precipitación acumulada (%) pronosticada para la semana del 15 al 22 de Mayo de 2018.

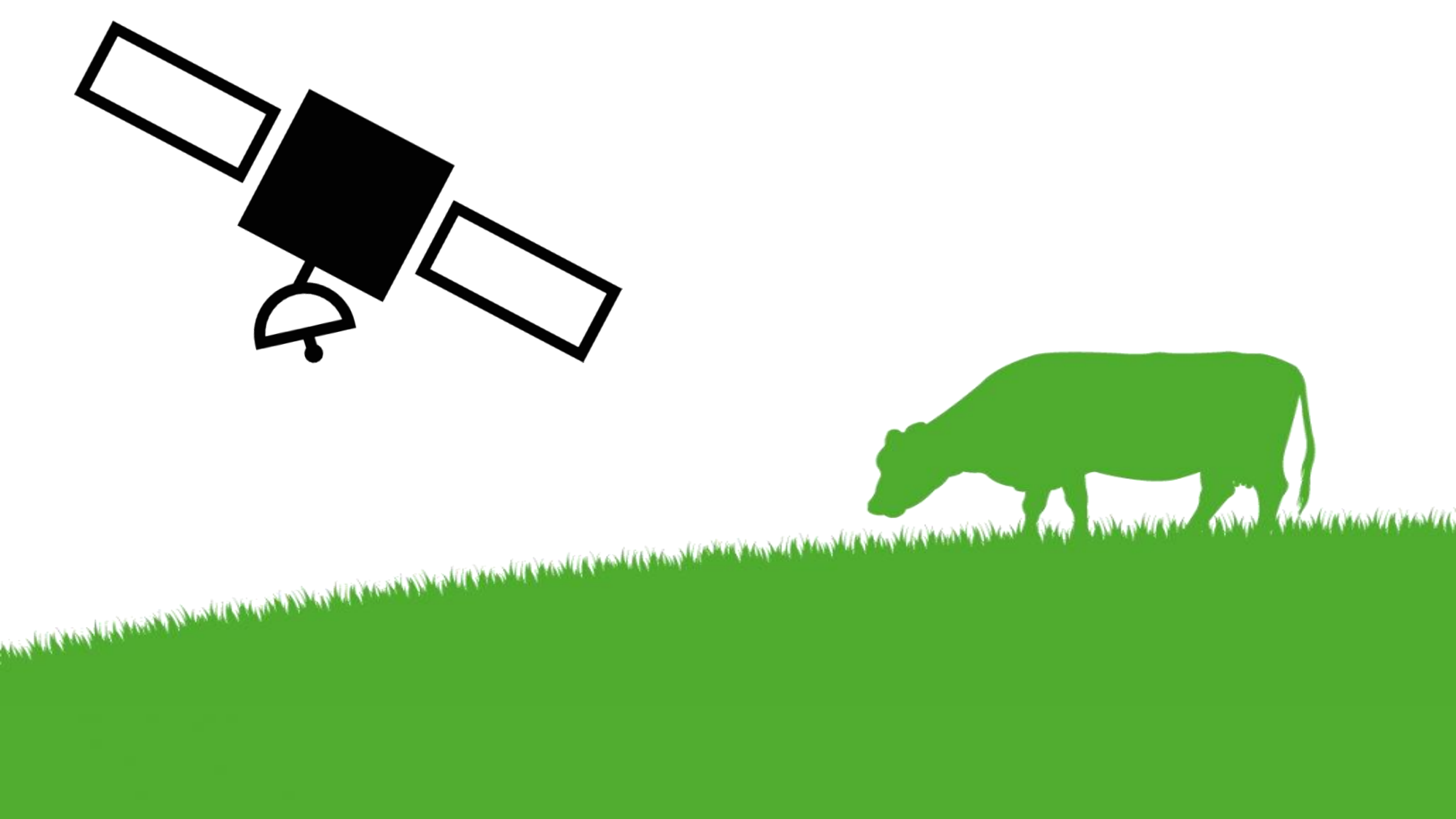
Tendencia climática trimestral: precipitación

Mayo, Junio y Julio de 2018



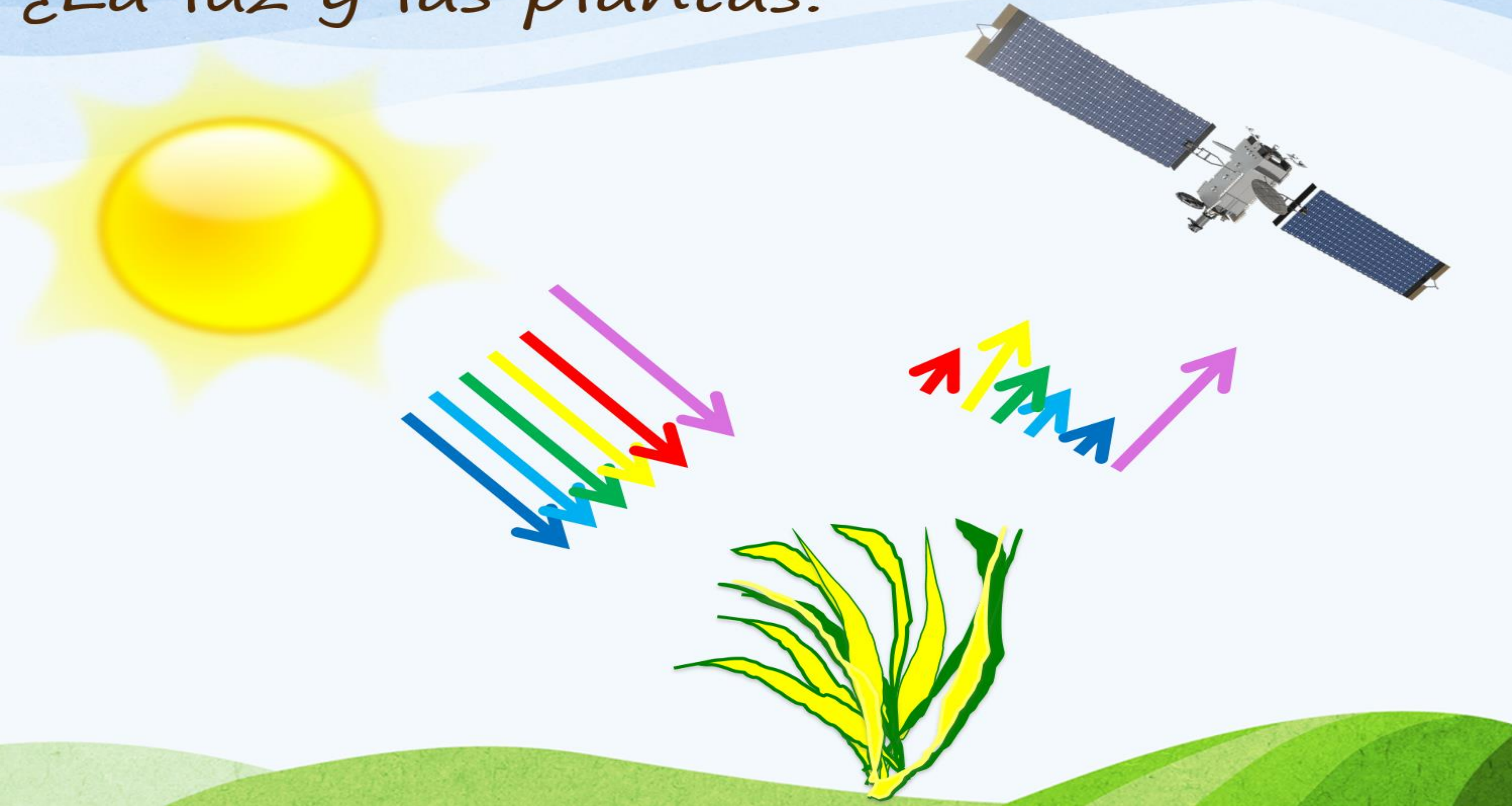
Fuente: Adaptación del Pronóstico Climático Trimestral—SMN

Fig. 35: Previsión trimestral Mayo—Julio de 2018 para precipitación.

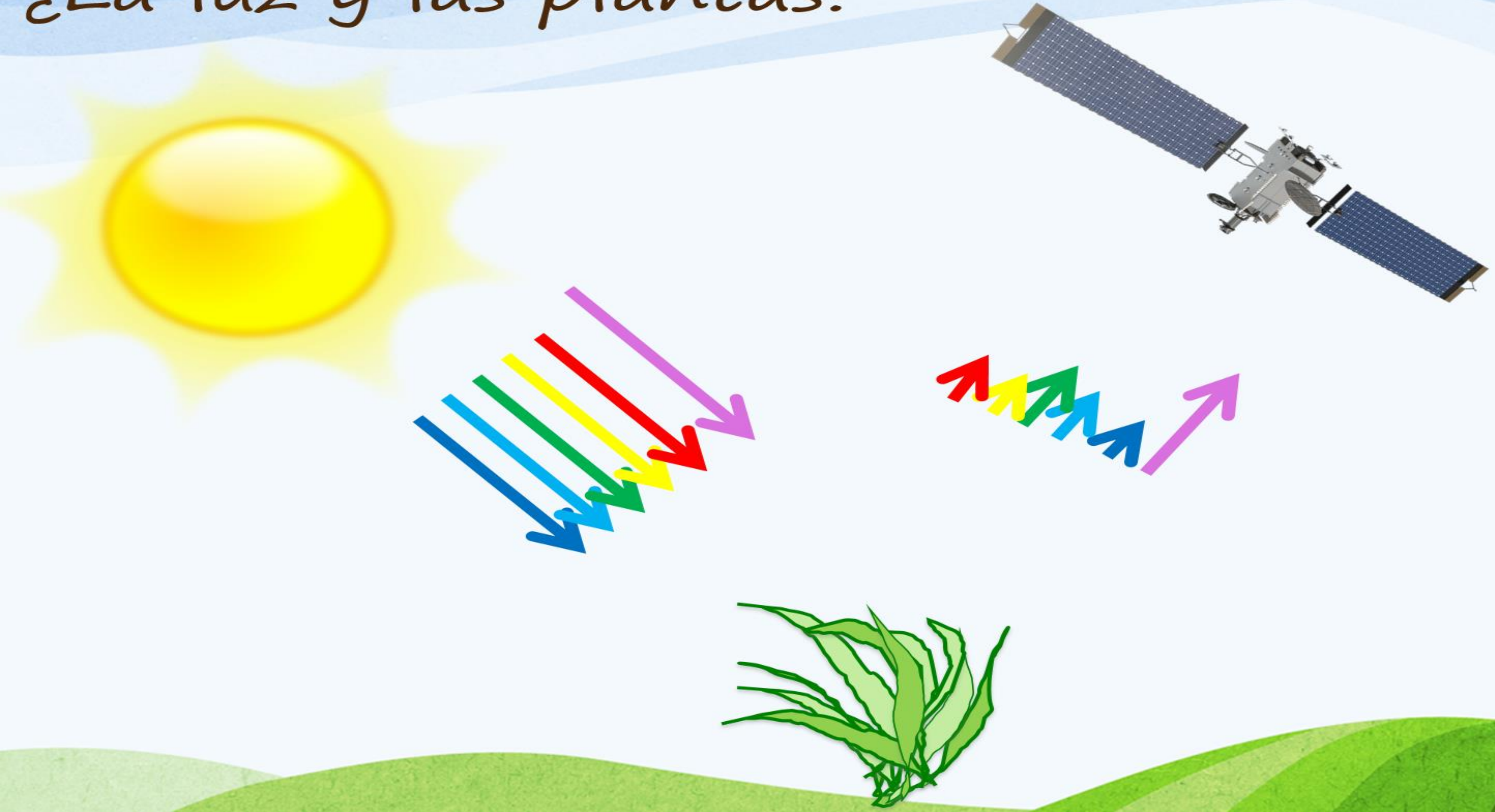


¿La luz y las plantas?

¿La luz y las plantas?

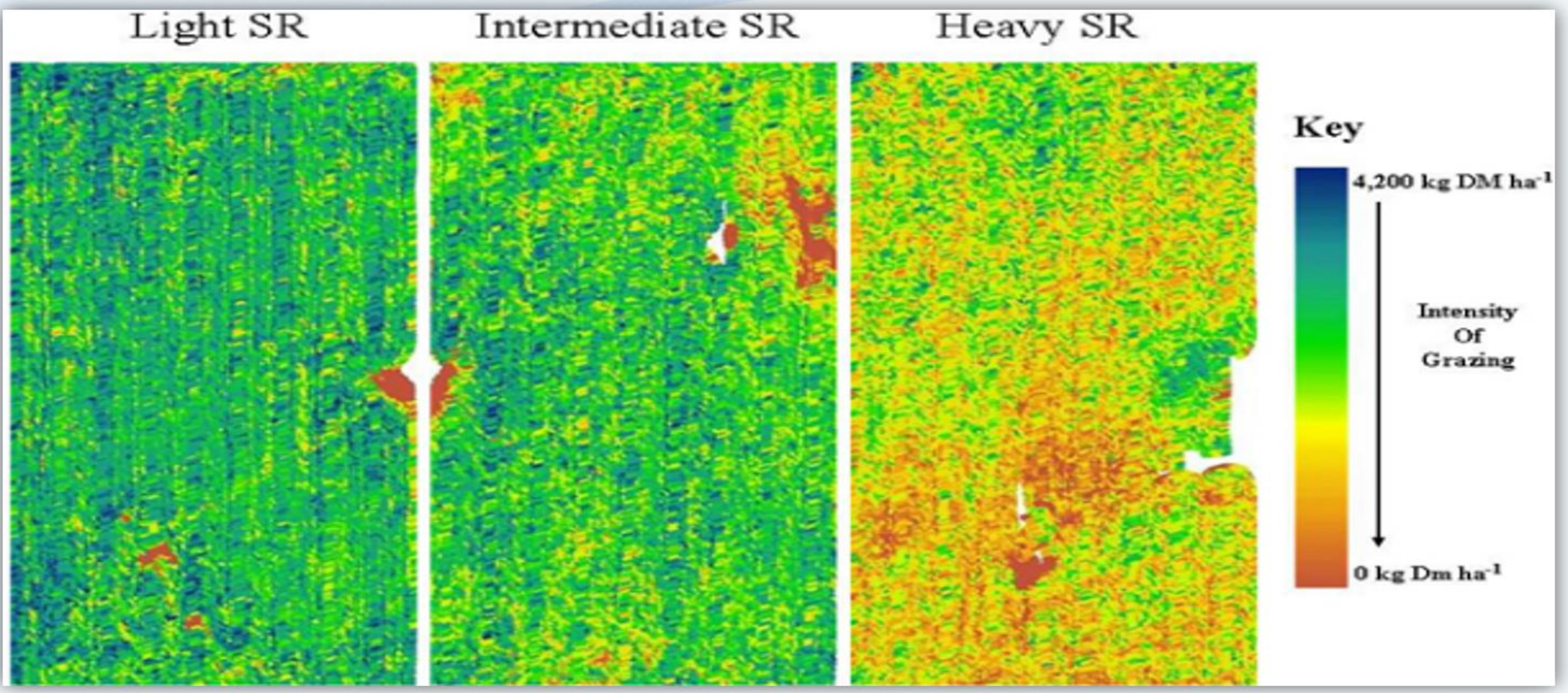


¿La luz y las plantas?

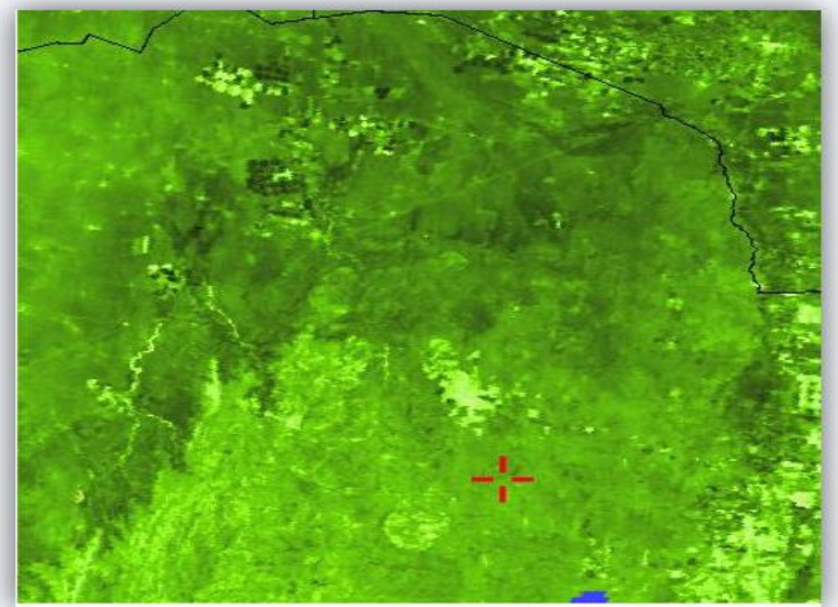


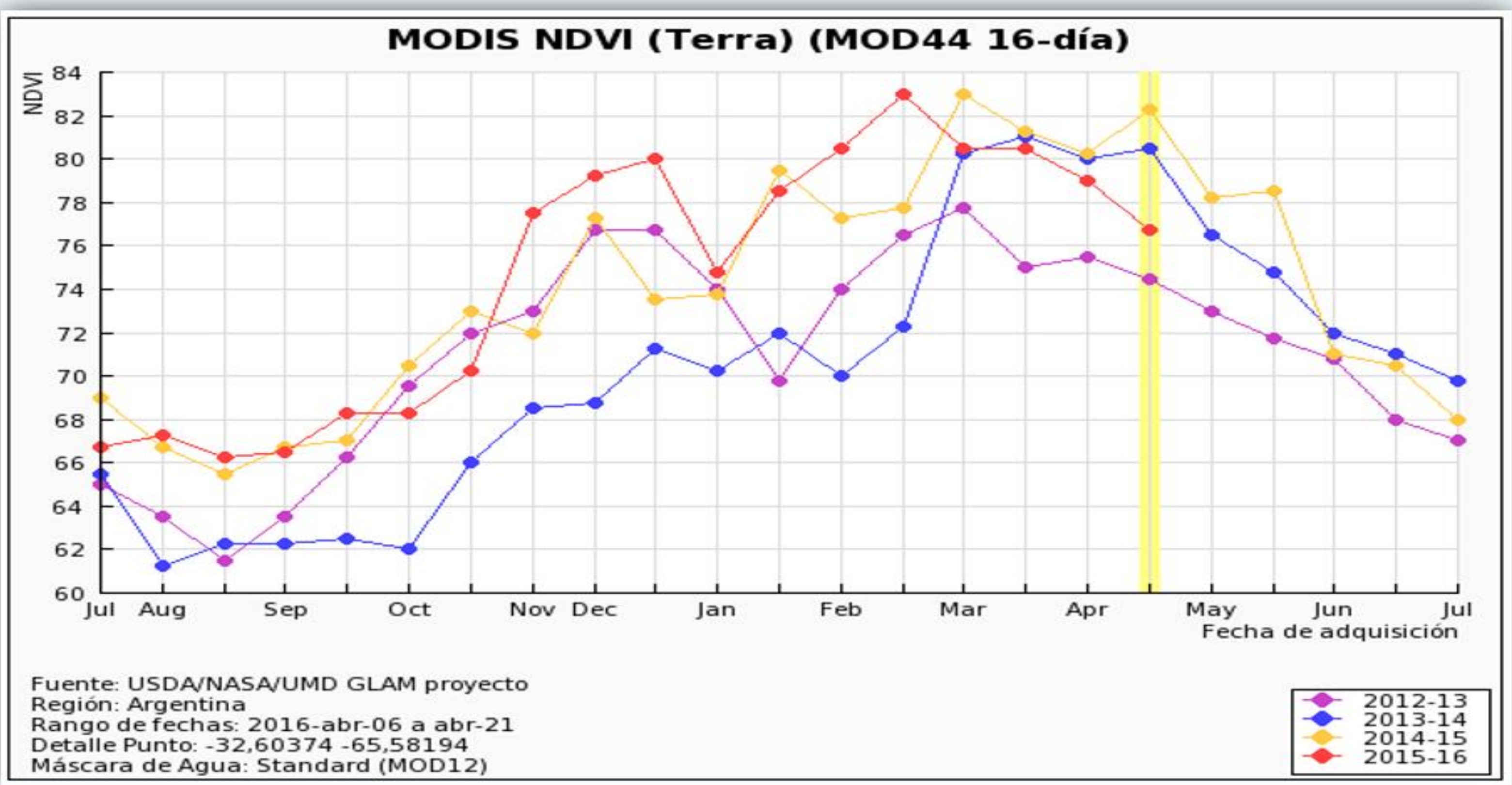
¿Índices de vegetación ?

¿Estimación de la productividad?



¿Seguimiento forrajero?





...plications, 8(1), 1998, pp. 207–212
...e Ecological Society of America

RELATION BETWEEN NOAA-AVHRR SATELLITE DATA AND STOCKING RATE OF RANGELANDS

M. OESTERHELD,[1] C. M. DIBELLA,[2] AND H. KERDILES[2]

[1]IFEVA, Department of Ecology, Faculty of Agronomy, University of Buenos Aires, Avenue San Martín 4453, Buenos Aires 1417, Argentina
[2]Weather and Climate Institute, Natural Resources Investigation Center (INTA), Los Reseros y Las Cabañas s/n, Castelar 1712, Argentina

Abstract. Biomass of both wild herbivores and livestock in rangelan... with rainfall at a regional scale. Thus, rainfall may be a good predictor o... rates. However, rainfall data are scarce in many regions, and their s... usually much coarser than needed to set or to evaluate wildlife or live... We here show a relationship between livestock biomass and an an... (normalized-difference vegetation index-integrated value, NDVI... motely sensed data on spectral properties of rangelands of Arg... as strong or even stronger than previously reported correlation... and rainfall. This, together with the greater availability an... satellite data, makes remote sensing a potentially valuabl... for regions, landscapes, and different portions of a landsc... between stocking rate and average NDVI-I was expon... indicates an increasing herbivore load per unit of p... ductivity increases. This may be at least partially... interannual variation and seasonality were negati... stocking rate may increase exponentially becau... of the forage resource and a more even distri...

Key words: Argentine rangelands; herbivore... vs. rainfall; land-use management; livestock... NDVI; primary productivity; remote sensing...

INTRODUCTION

...important variable i... ...000), is p...

...ied Vegetation Science 3: 189-195, 2000
© IAVS; Opulus Press Uppsala. Printed in Sweden

Estimation of primary production of subhumid rangelands from remote sensing data

Paruelo, José M.[1*]; Oesterheld, Martín[1]; Di Bella, Carlos M.[2]; Arzadum, Martín[3]; Lafontaine, Juan[4]; Cahuepé, Miguel[5] & Rebella, César M.[2]

[1]IFEVA, Departamento de Ecologia, Facultad de Agronomia, Universidad de Buenos Aires, Av. San Martín 4453, 1417 Buenos Aires, Argentina; [2]Instituto de Clima y Agua, CIRN - Instituto Nacional de Tecnología Agropecuaria (INTA), Los Reseros y Las Cabañas s/n, Castelar (1712), Buenos Aires, Argentina; [3]Campo Experimental Pass-man, CC204, Coronel Suárez (7540) Buenos Aires, Argentina; [4]AACREA, Sarmiento 1236, 1041Buenos Aires, Argentina; [5]Facultad de Ciencias Agrarias, Universidad Nacional de Mar del Plata, CC276, 7620 Balcarce, Buenos Aires, Argentina; *Corresponding author; Fax +541145148730; E-mail paruelo@ifeva.edu.ar

Abstract. Above-ground Net Primary Production (ANPP) is the main determinant of forage availability and hence of stocking density. A tool to track the seasonal and interannual changes in ANPP at the paddock level will be very important for livestock management. We studied the relationship between field ANPP data and the Normalized Difference Vegetation Index (NDVI) for rangelands of the Flooding Pampa of Argentina using spectral data provided by sensors on board of two satellites: NOAA/AVHRR and Landsat TM. The relationship between NDVI and ANPP was linear both for data derived from NOAA/AVHRR and Landsat TM. Changes in ANPP accounted for a large proportion of the temporal and spatial variation of NDVI: 71% of NOAA/AVHRR data and 74% of Landsat TM data. By inverting these models, ANPP may be inferred from NDVI data at a seasonal and paddock scale. NOAA/AVHRR data captured better the seasonal variation in ANPP and were less sensitive to local variations than Landsat TM data. In contrast, Landsat TM data were more sensitive to inter-site differences in primary production... cept for the winter months. Thus, combining infor... these two sources offers a good altern... rangeland production at high te...

Keyw...

Introduction

Primary production, the rate of biomass production per area and time, is an important attribute of the ecosystem. It determines, for instance, the total amount of energy available for upper trophic levels. Herbivore biomass is tightly related to primary production both for natural (McNaughton et al. 1989) and human-modified ecosystems (Oesterheld et al. 1992). In rangelands, Above-ground Net Primary Production (ANPP) is the main determinant of stocking density ba... (Oesterheld et al. 1992; 1998) or l... et al. 1998). In order ... movements an... densiti...

Agrociencia Uruguay vol.15 no.2 Montevideo dic. 2011

Eficiencia en el uso de la radiación y productividad primaria en recursos forrajeros del este de Uruguay

Baeza Santiago [1], Paruelo José [2] , Ayala Walter [3]

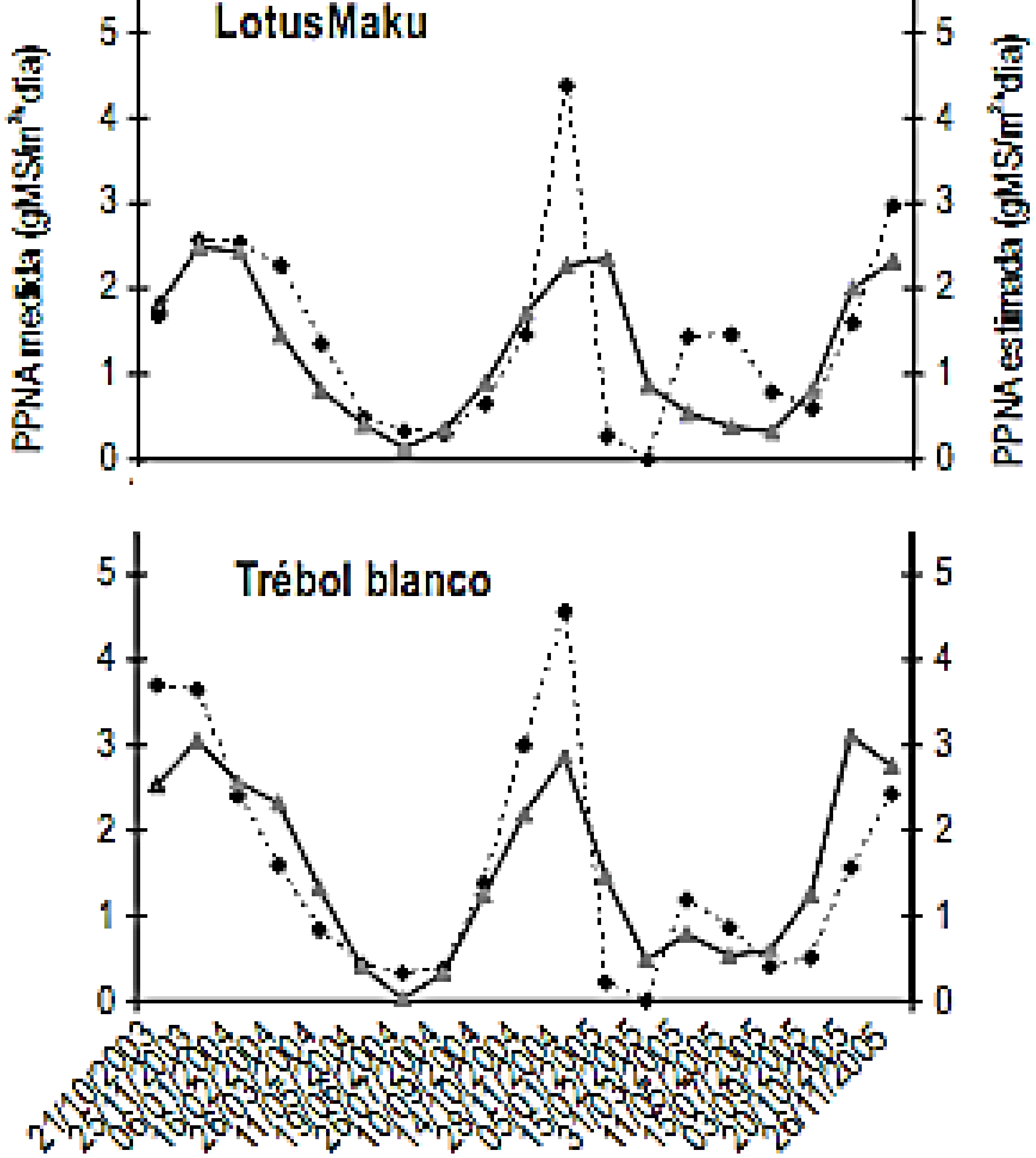
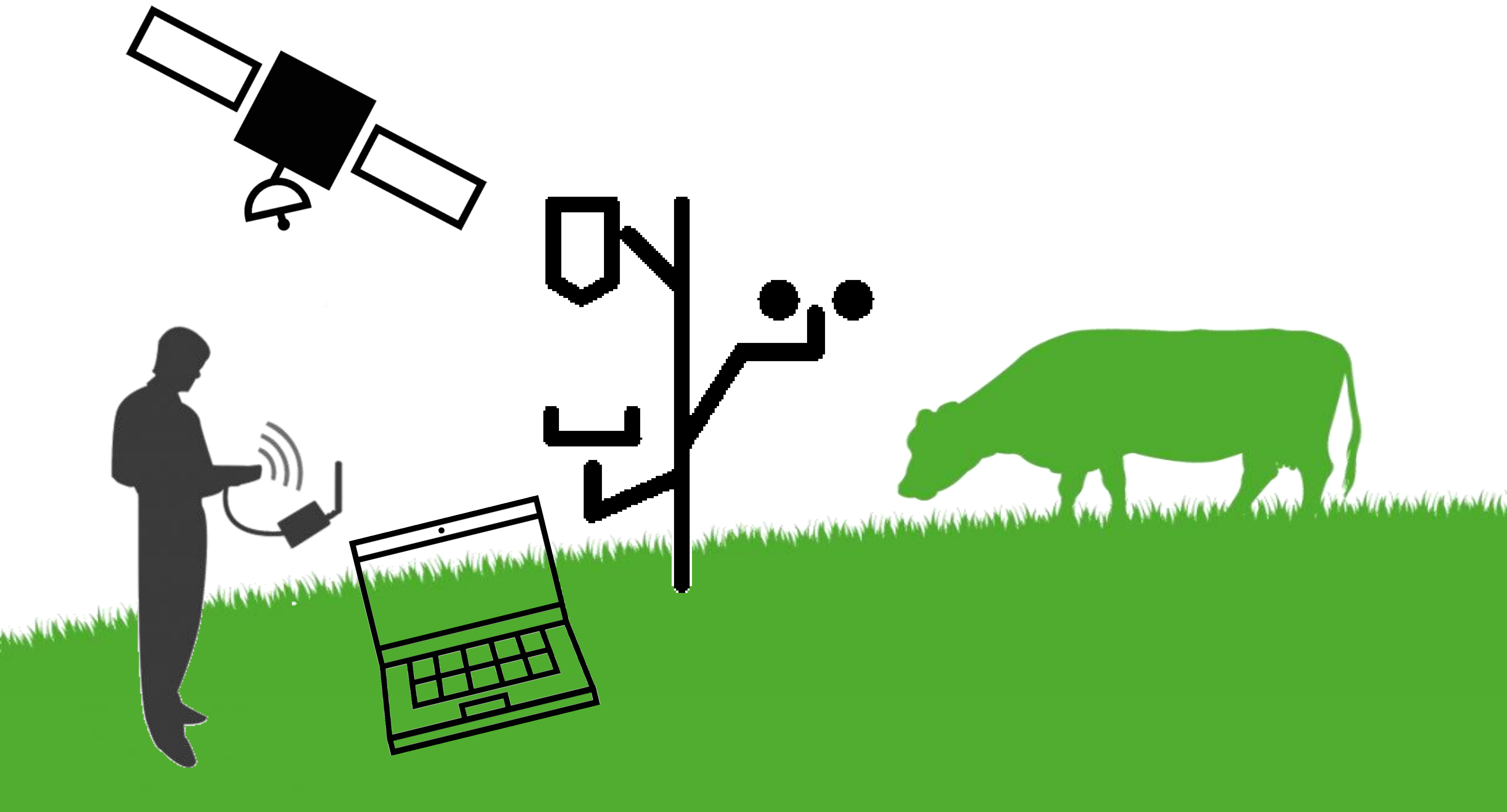


Figura 7. Marcha estacional de la Productividad Primaria Neta Aérea (PPNA) para tres tipos de mejora-



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...NT. J. REMOTE SENSING, 10 DECEMBER, 2004,
...OL. 25, NO. 23, 5359–5372

Remote sensing capabilities to estimate pasture production in France

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M. GUÉRIF‡, B. COMBAL‡, M. WEISS‡ and C. REBELLA†

†Instituto de Clima y Agua—CIRN–INTA, Los Reseros y Las Cabañas S/N,
Castelar 1712, Buenos Aires, Argentina
‡CSE, Bâtiment Climat, INRA–Avignon, Site Agroparc, 84914 Avignon
Cedex 9, France
§Biométrie et IA, INRA–Toulouse, BP 27, 31326 Castanet-Tolosan Cedex,
France

(*Received 17 September 2002; in final form 9 April 2004*)

Abstract. Pastures constitute an important terrestrial ecosystem. In France, pastures occupy 21% of the total area. A big effort is being made to develop a real-time systematic approach to estimate biomass production at a national level, focusing on spatial and seasonal variability in relation to drought. The absence of indirect low-cost methods that could be applied to large areas contributes to this situation. Advances in remote sensing and crop models offer new methodological and operative possibilities to solve this problem. In this pap... 13 forage regions (FR) in France were selected on the basis of their diffe... geomorphologic, climatic and soil conditions with regard to pastoral produ... Images from Système Probatoire de l'Observation de la Terre (SP... VEGETATION were used to forecast productive variables estimate... STICS-Prairie simulation model. In general terms, both satellite and ... data agreed properly. Particularly, the relationship between the mid... based vegetation index (SWVI) and the Leaf Area Index (LAI) dem... best results whatever the FR. Results obtained confirm the capabi... sensing data as an accurate predictor of productive variables e... simulation models. Differences between satellite inform... estimations of pasture systems, especially during the harve... be good indicators to improve model estimations at a re...

...t of view, pastures represent the most im... extensive and intensive conditions... ...re both an important biodiversity... ...ersity of rural landscapes. ... they occupy 50% of th... ...tures represent 21% ...erent French

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Physics and Chemistry of the Earth 30 (2005) 3–9

PHYSICS and CHEMISTRY of the EARTH
www.elsevier.com/locate/pce

Using VEGETATION satellite data and the crop model STICS-Prairie to estimate pasture production at the national level in France

C. Di Bella [a,c,*], R. Faivre [b], F. Ruget [c], B. Seguin [c]

[a] Instituto de Clima y Agua – CIRN INTA, Los Reseros y Las Cabañas S/N, Castelar, Buenos Aires 1712, Argentina
[b] Unité de Biométrie et Intelligence Artificielle (UBIA), INRA – Toulouse, BP 27, 31326 Castanet-Tolosan Cedex, France
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Accepted 24 August 2004

Abstract

In France, pastures constitute an important land cover type, sustaining principally husbandry production. The absence of low-cost methods applicable to large regions has conducted to the use of simulation models, as in the ISOP system. Remote sensing data may be considered as a potential tool to improve a correct diagnosis in a real time framework. Thirteen forage regions (FR) of France, differing in their soil, climatic and productive characteristics were selected for this purpose. SPOT4-VEGETATION images have been used to provide, using subpixel estimation models, the spectral signature corresponding to pure pasture conditions. This information has been related with some growth variables estimated by STICS-Prairie model (inside ISOP system). Beyond the good general agreement between the two types of data, we found that the best relations were observed between NDVI middle infrared based index (SWVI) and leaf area index. The results confirm the capacities of the satellite data to provide complementary information, mainly during the harvesting periods. This could contribute to improve the evaluations of the model on a regional scale.

Keywords: Pastures; Remote sensing; Vegetation index; Biomass production; STICS; Regional scale

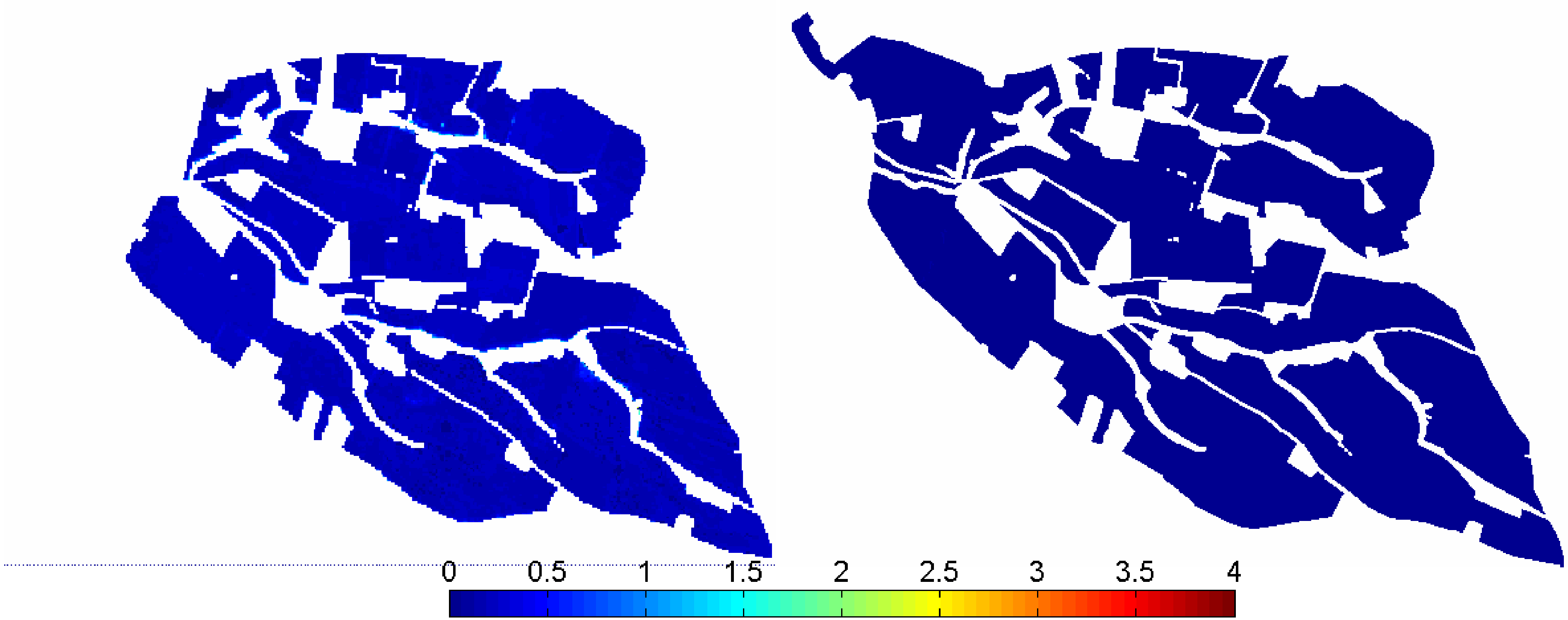
1. Introduction

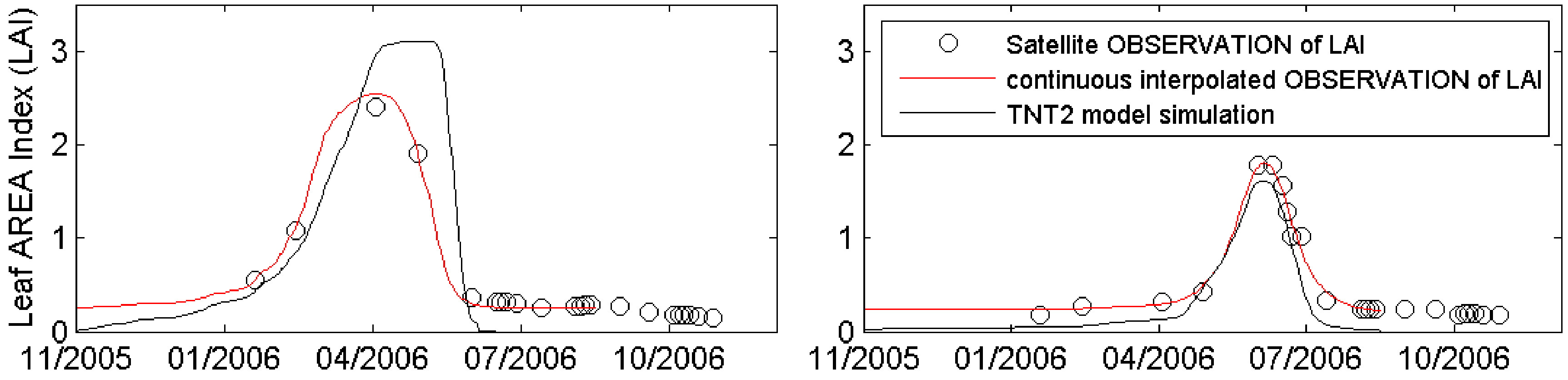
Pastures constitute an important component of terrestrial ecosystems. From a productive point of view, pastures represent an essential component of livestock. In economical terms, France has the most important agricultural sector of the European Union (23% of the total European agriculture production). Within this sector, animal production represents 40% of the total agriculture activities on 21% of the French territory. In this context, the monitoring of pasture conditions on a regional scale represents a very important tool at the national scale.

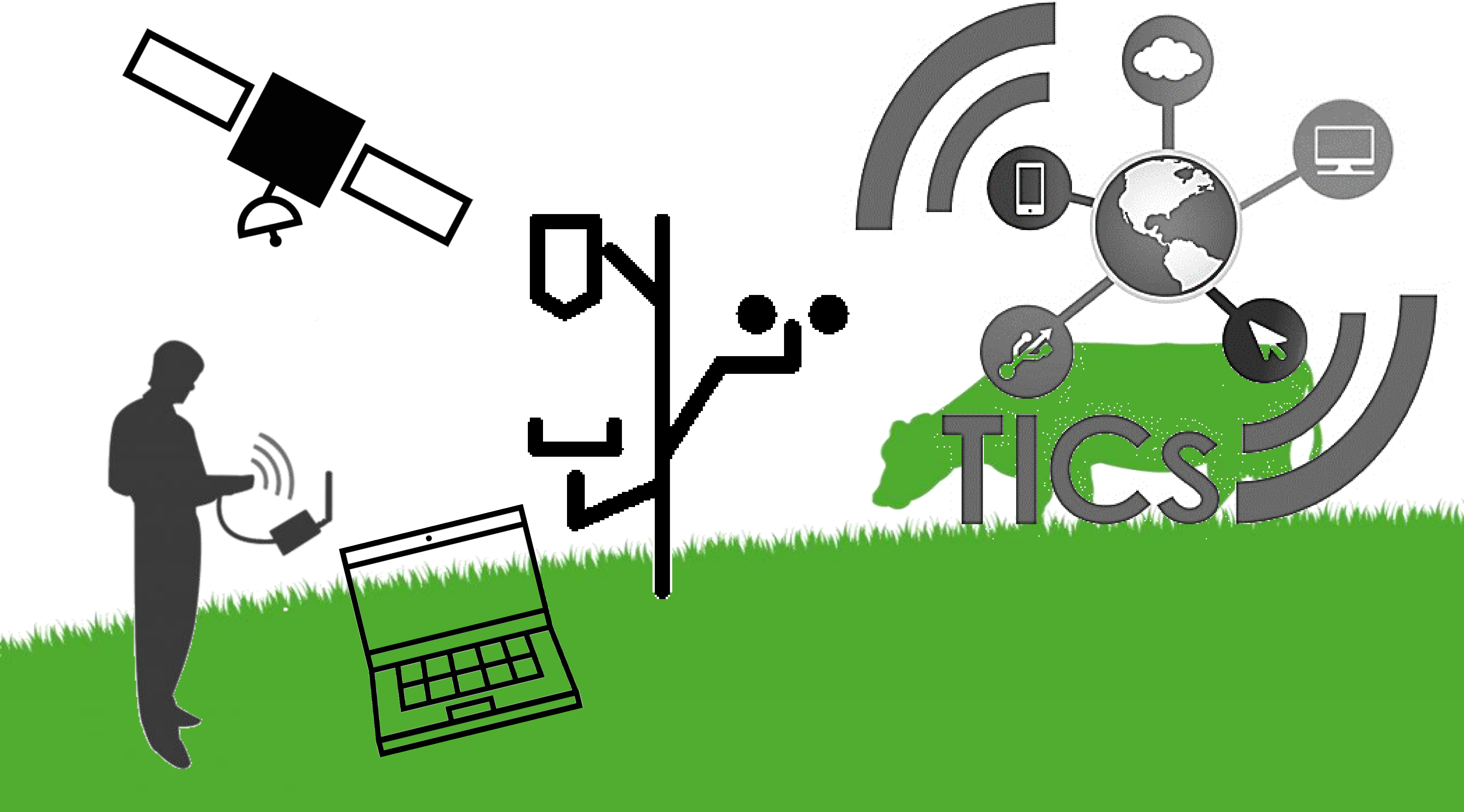
Some research groups are developing different methods to establish in a precise, economic and fast way biomass production of pastures. If biomass cuts constitute a simple method to estimate biomass production (e.g. Sims et al., 1978; Sala et al., 1988) this techni...

12-Sep-2006

Satellite OBSERVATION of LAI TNT2 model SIMULATION of LAI






TICs

PRODUCTOS QUE HACEN MÁS FÁCIL TOMAR DECISIONES DIFÍCILES.

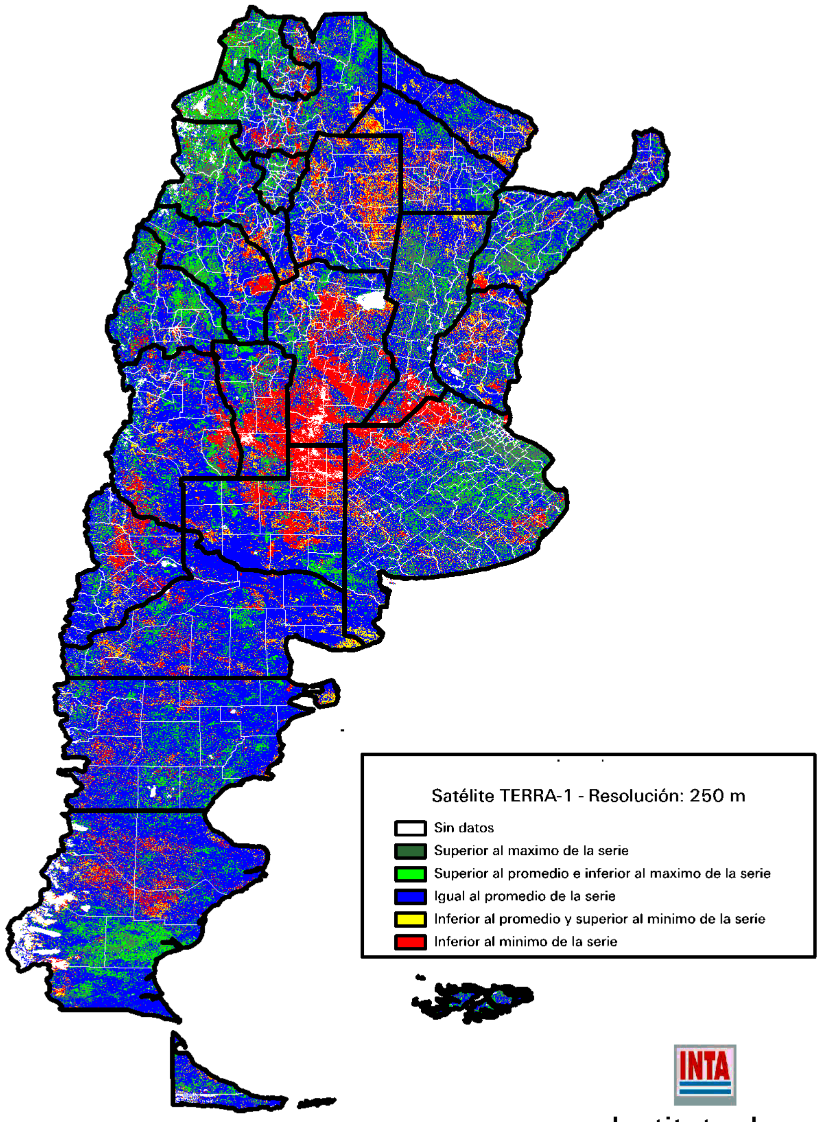
El conocimiento y seguimiento temporal de la cobertura vegetal, la información de pronósticos evolutivos de la vegetación, los pronósticos meteorológicos y la zonificación de eventos destacables resultan fundamentales en el proceso de toma de decisiones para el manejo adecuado y sustentable de los agroecosistemas y los recursos naturales.

Índices de vegetación

Agrometeorología

Escenarios evolutivos

SITUACIÓN RELATIVA DE LA VEGETACIÓN - NDVI
23-Abril al 08-Mayo de 2018 vs 23-Abril al 08-Mayol de 2000-2017



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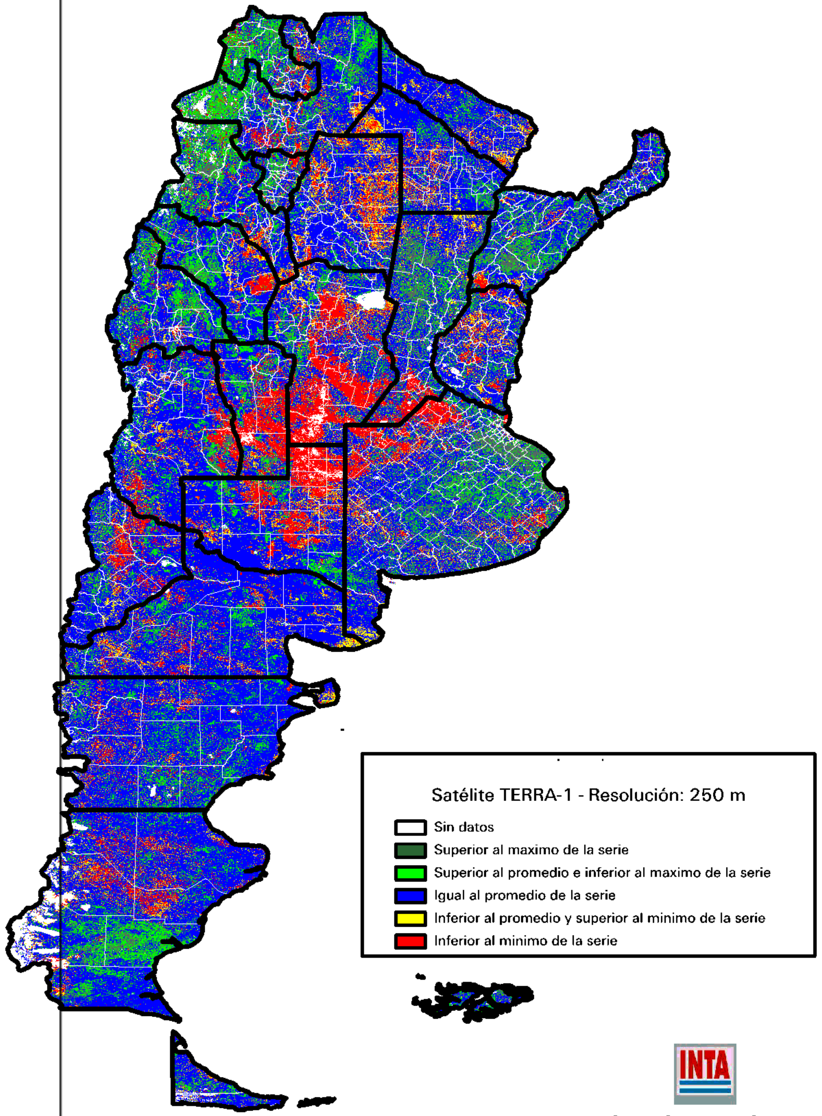
SITUACIÓN RELATIVA DE LA VEGETACIÓN - NDVI
23-Abril al 08-Mayo de 2018 vs 23-Abril al 08-Mayol de 2000-2017



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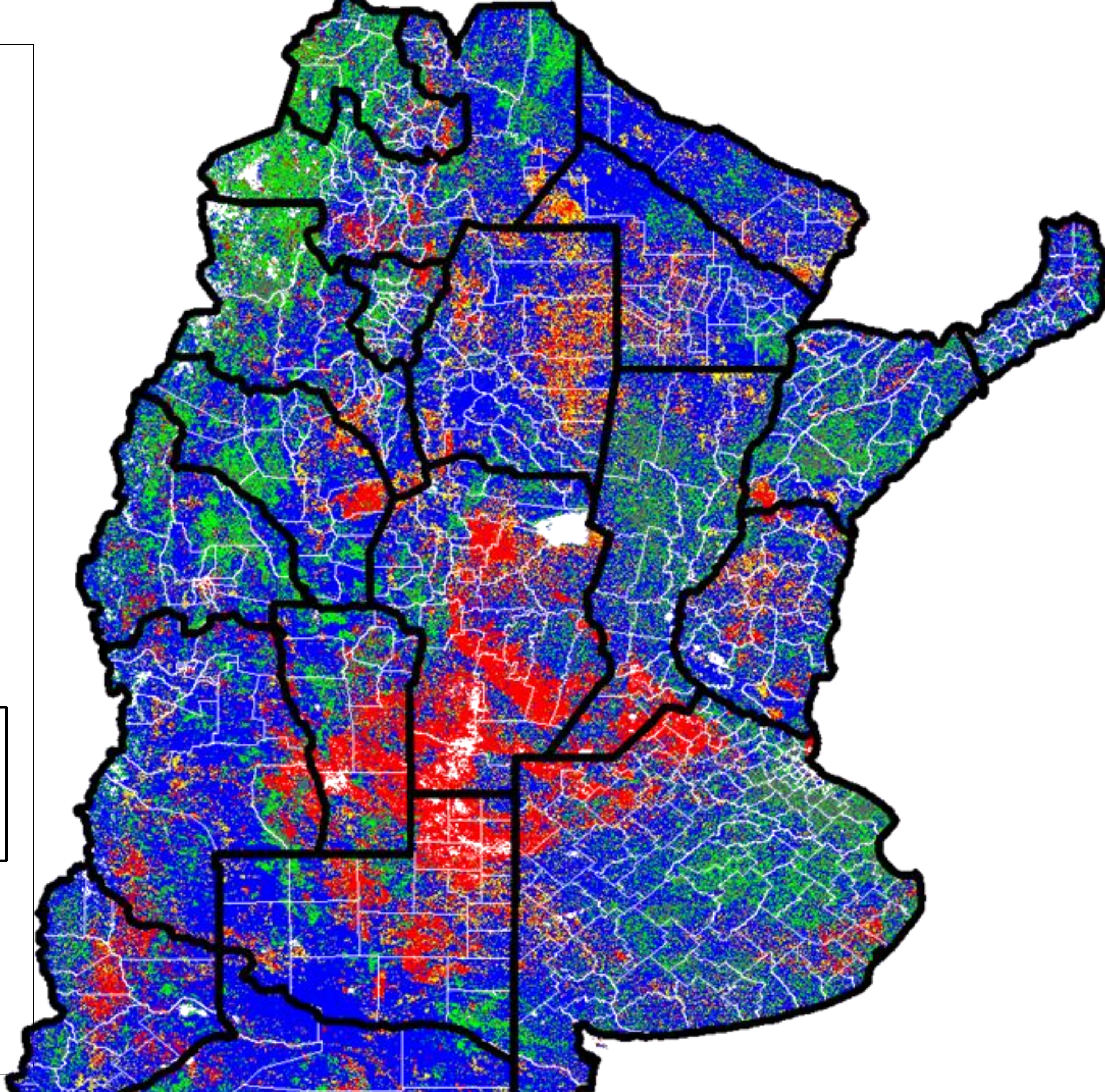
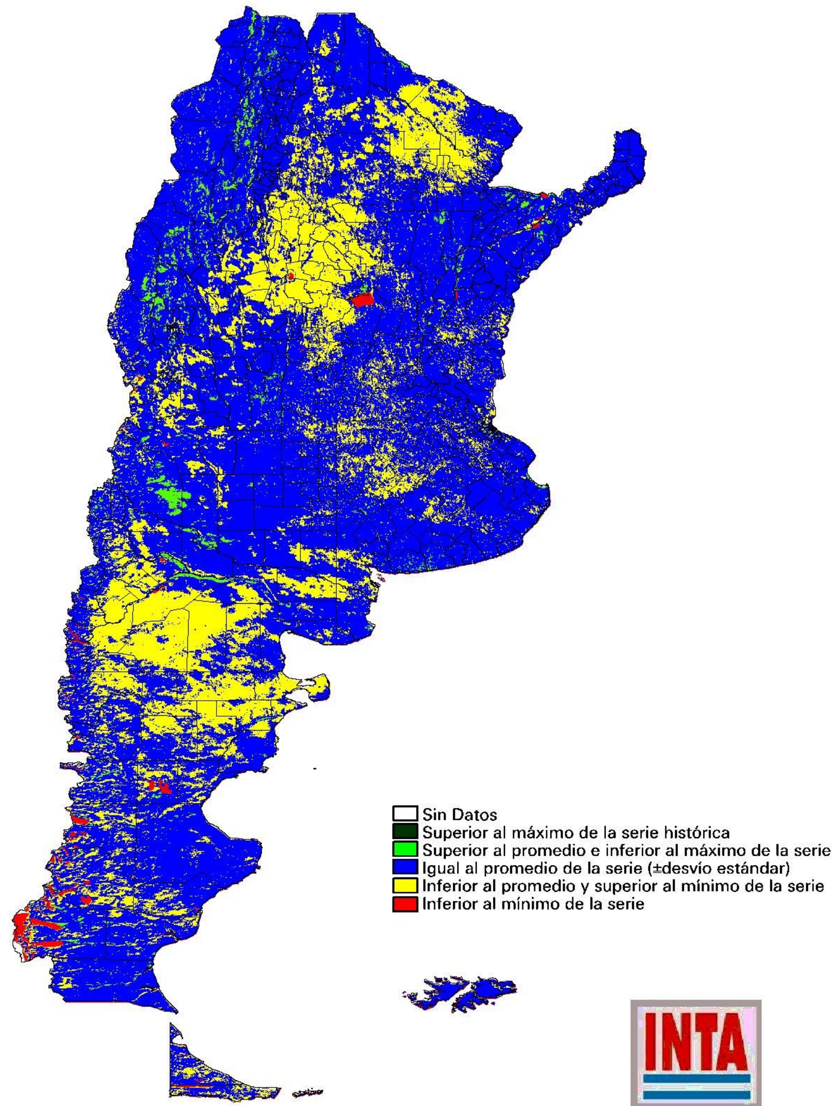


Evolución del IVN de julio de 2017 a junio de 2018 (Escenario de media)
Meses de campaña actual: julio'17 - abril'18
Meses de datos históricos: mayo'18 - junio'18



Actualizado al 30 de abril de 2018

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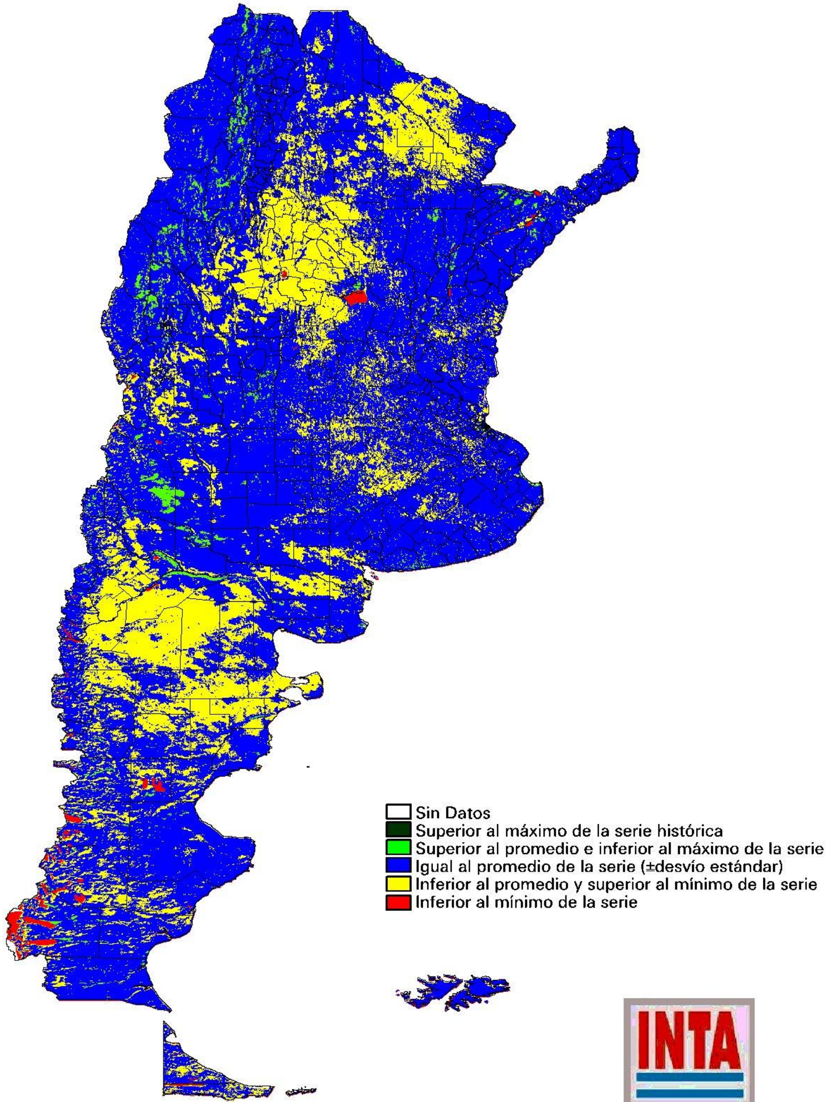
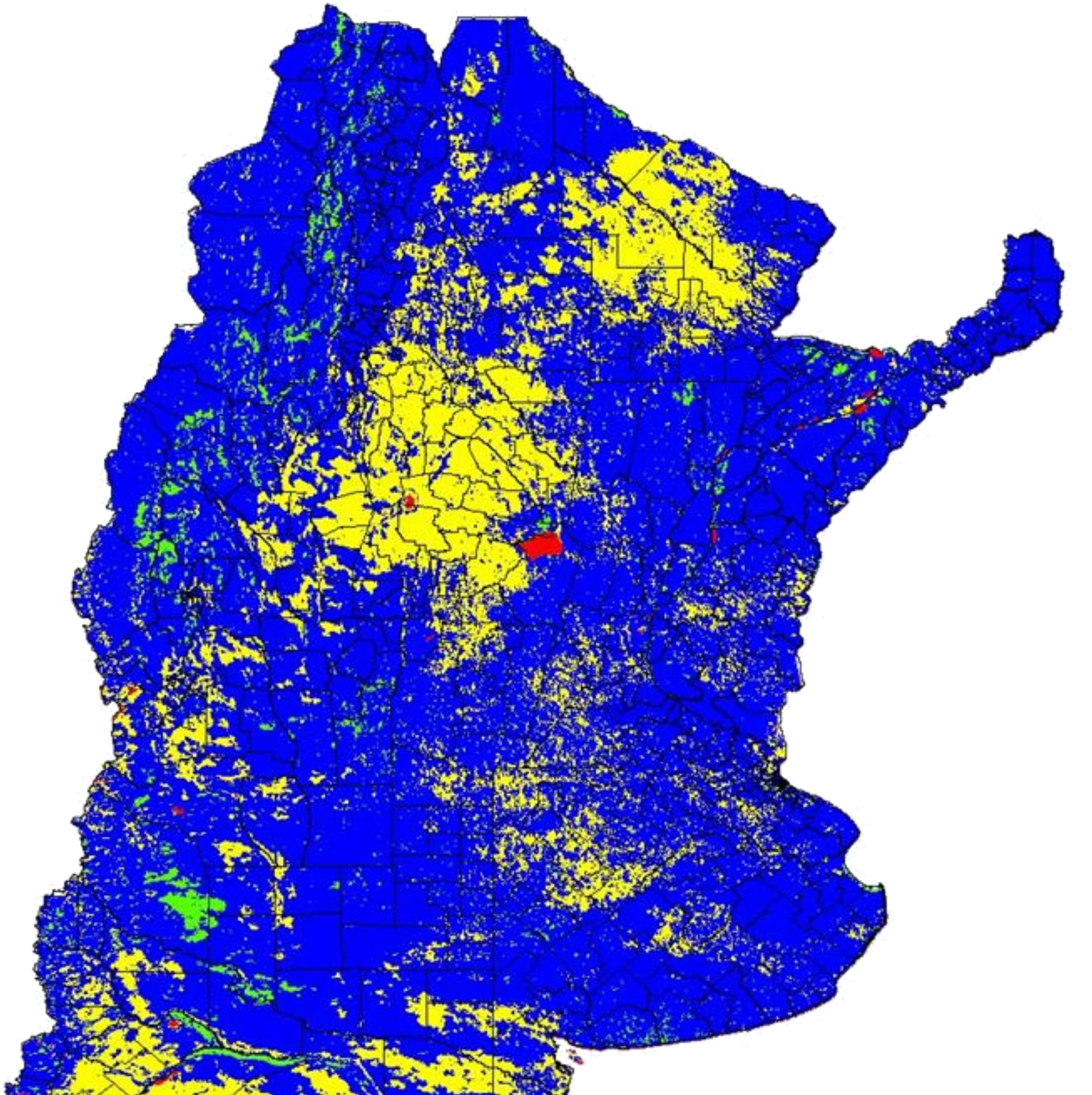
Evolución del IVN de julio de 2017 a junio de 2018 (Escenario de media)
Meses de campaña actual: julio'17 - abril'18
Meses de datos históricos: mayo'18 - junio'18





Actualizado al 30 de abril de 2018

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dry season RUE (autumn-winter) and wet season RUE (spring-summer). Nutrient availability for the RUE maps was derived from the soil types given by the Soil Atlas of Argentina (Soil Institute of CIRN/INTA et al, 1995).

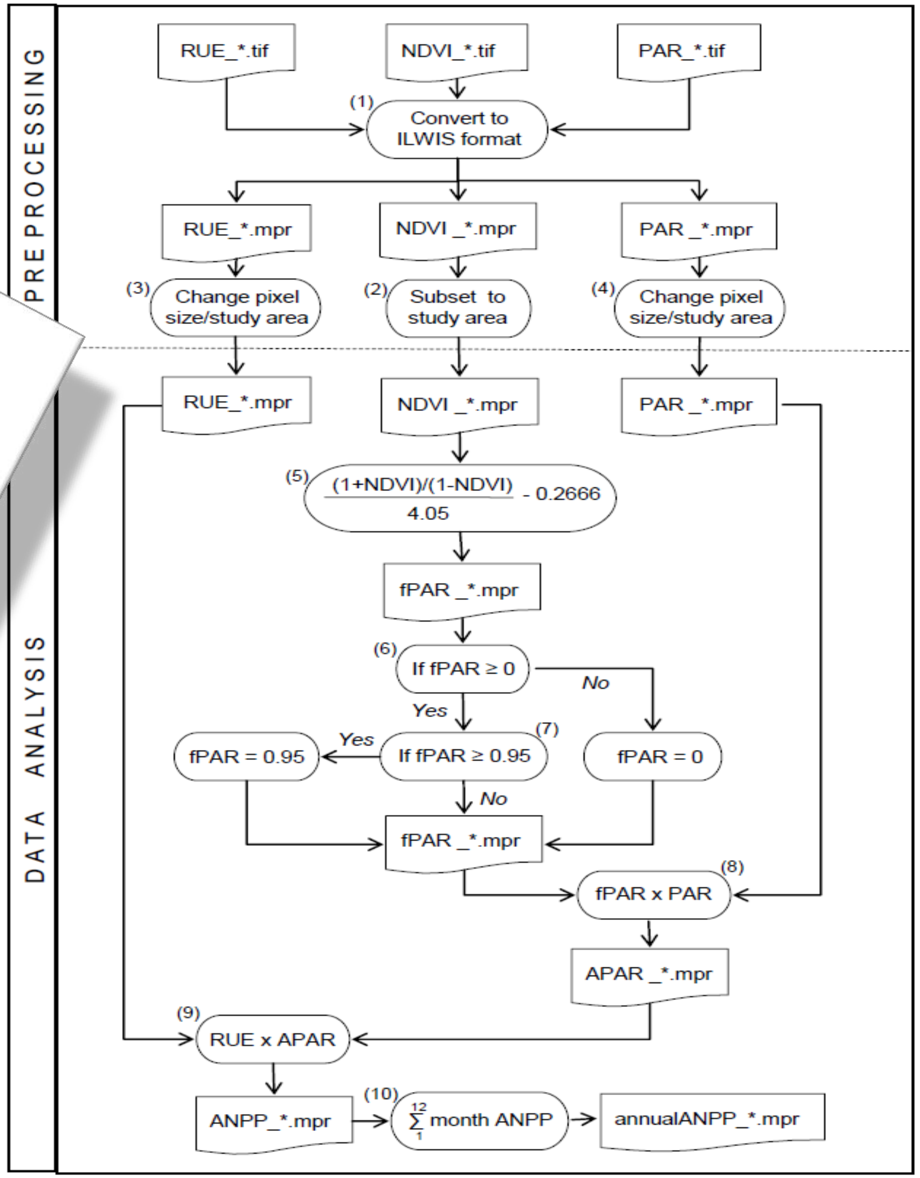
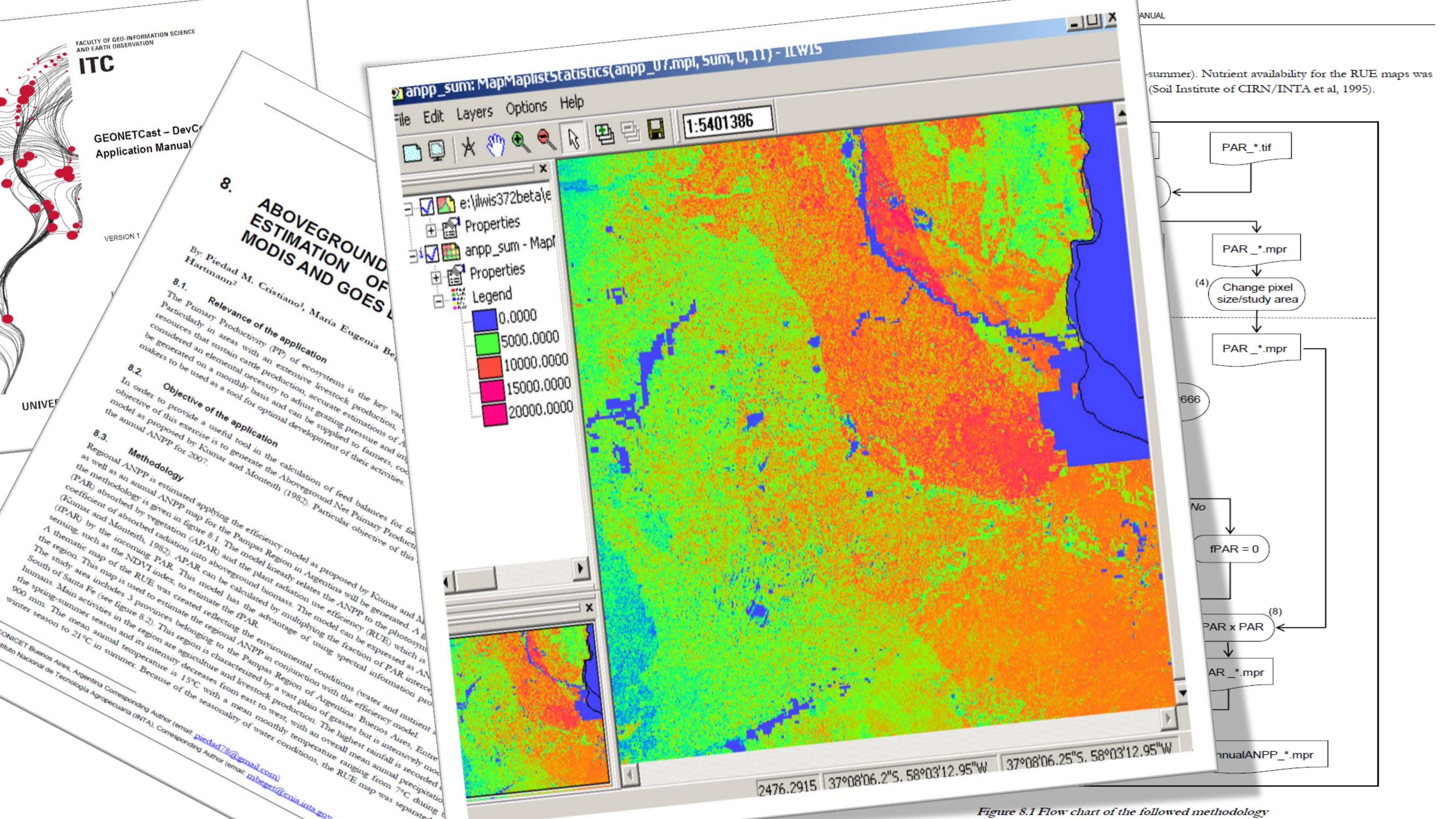


Figure 8.1 Flow chart of the followed methodology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ITC
Application Manual
8.
ABOVEGROUND
MODIS AND GOES
anpp_sum: MapMaplistStatistics(anpp_07.mpl, Sum, 0, 11) - ILWIS
File Edit Layers Options Help
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Properties
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15000.0000
20000.0000
37°08'06.2"S, 58°03'12.95"W
37°08'06.25"S, 58°03'12.95"W
PAR_*.tif
PAR_*.mpr
Change pixel size/study area
fPAR = 0
Figure 8.1 Flow chart of the followed methodology

Seguimiento Global de la Agricultura -- GLAM VI Time Series Database
Argentina -- 2018-abr-23 a abr-30

Lenguaje: Español

Imagen Regional [Ver]

Haga click para mayor detalle. El cuadro rojo indica los límites de la imagen detallada. Cada píxel representa 2,5 km.

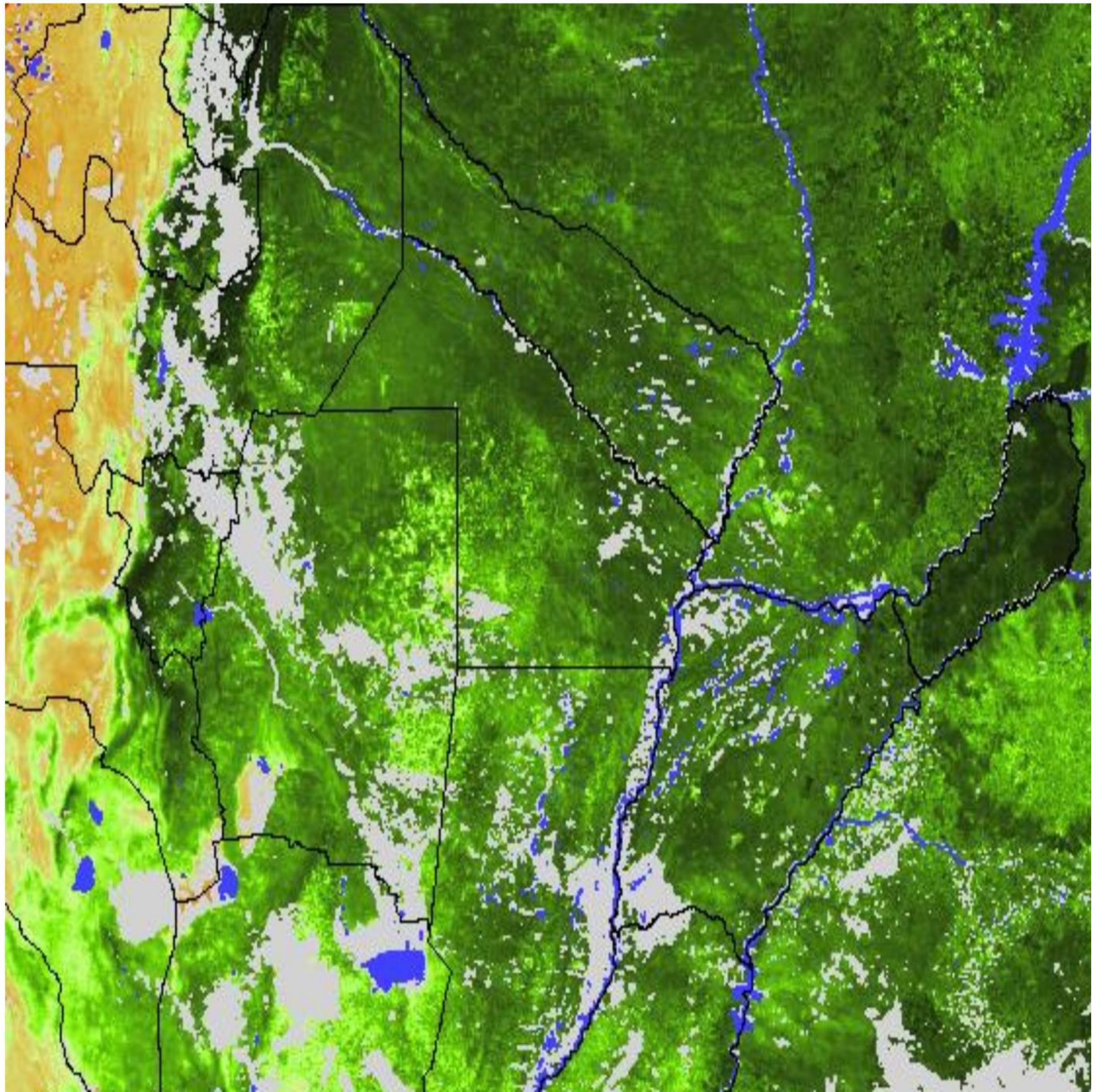
Opciones

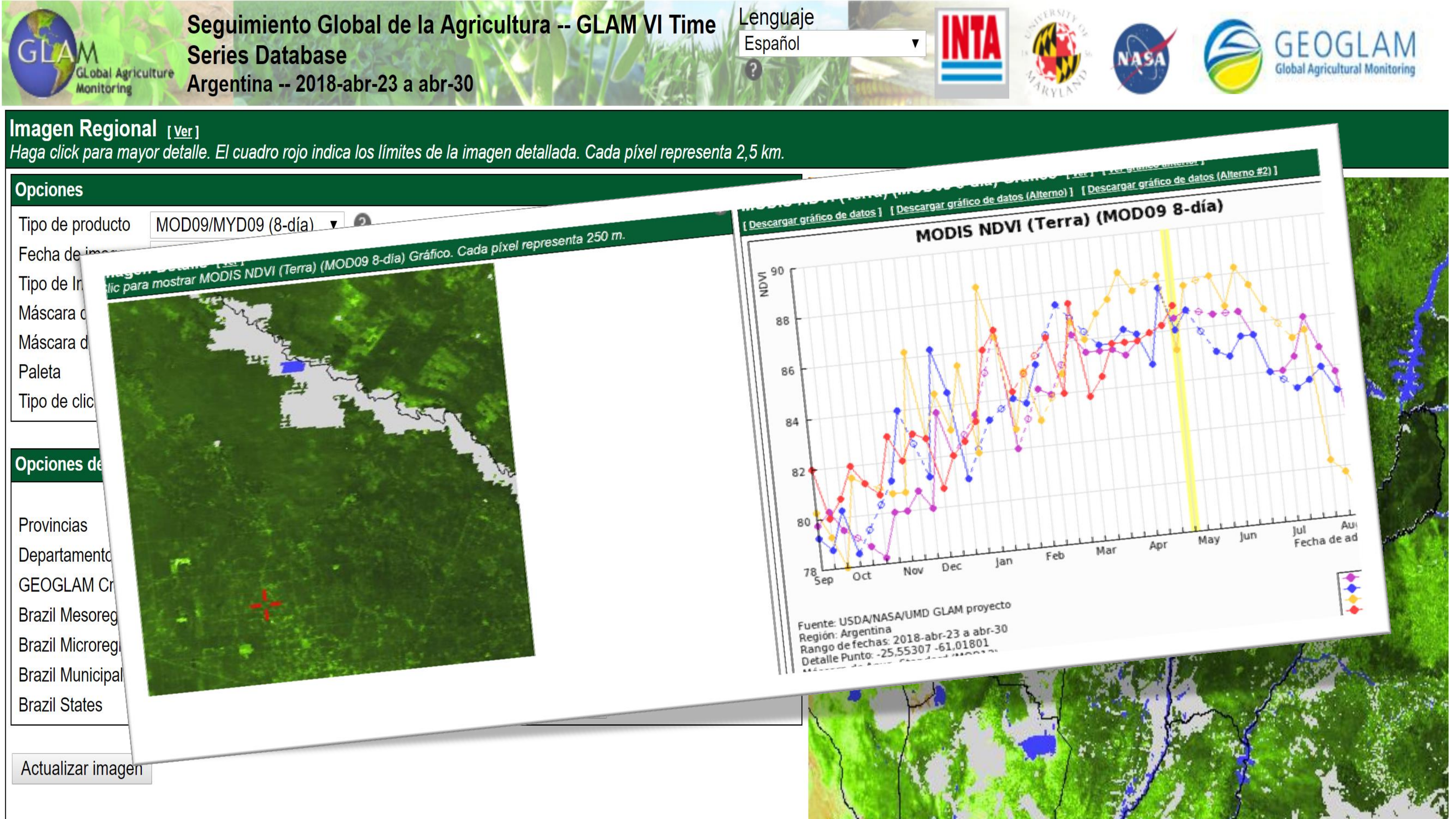
Tipo de producto	MOD09/MYD09 (8-día)
Fecha de imagen	2018-abr-23 a abr-30
Tipo de Imagen	Imagen actual
Máscara de Agua	Standard (MOD12)
Máscara de cultivo	None
Paleta	Color (Ramp)
Tipo de click	Box

Opciones de polígono

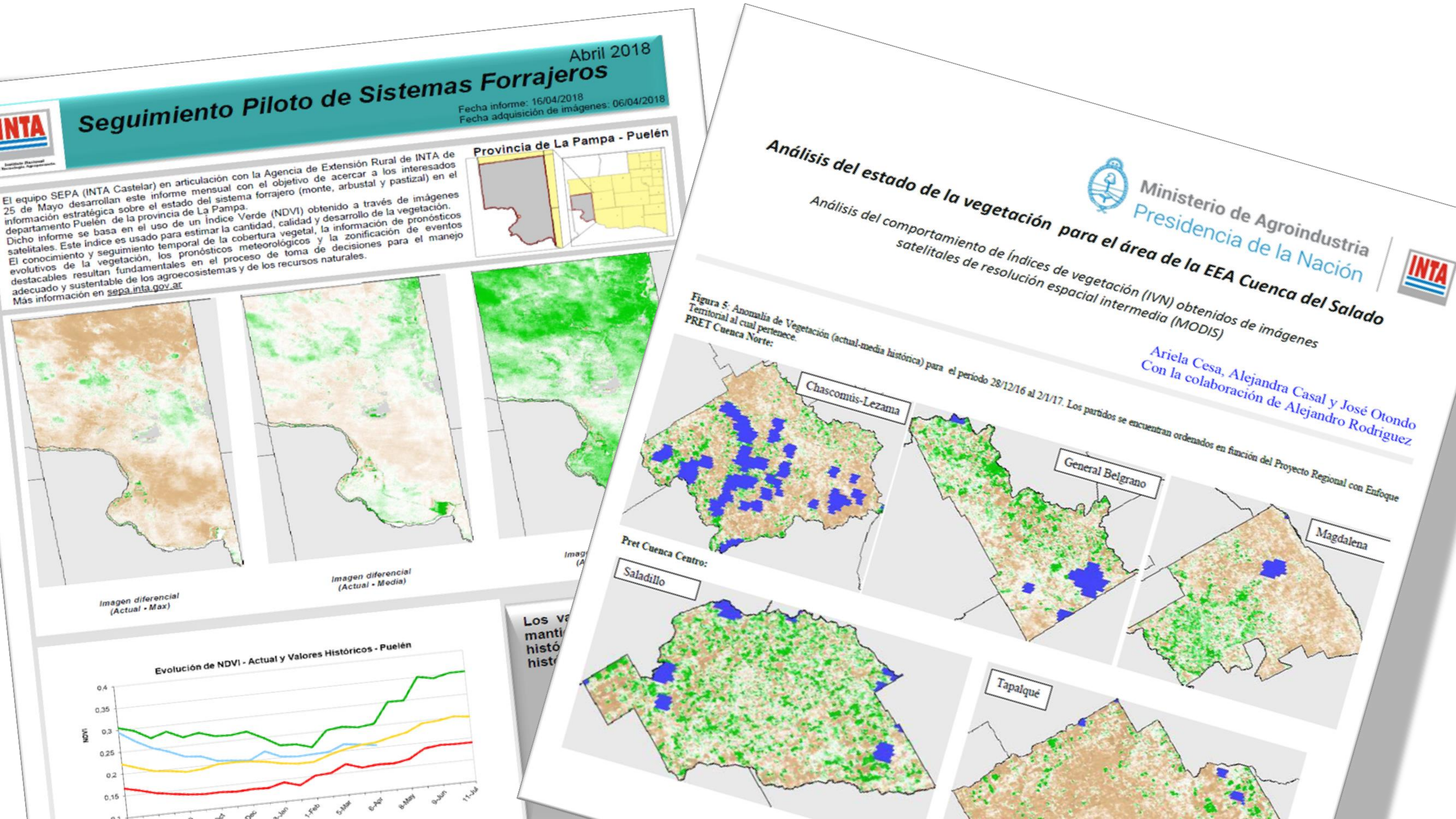
	¿Dibujar?	*¿Etiqueta?*	*Zoom*
Provincias	☑	☐	
Departamentos	☐	☐	
GEOGLAM Crop Monitor Regions	☐	☐	
Brazil Mesoregion	☐	☐	
Brazil Microregion	☐	☐	
Brazil Municipality County	☐	☐	
Brazil States	☐	☐	

Actualizar imagen





Seguimiento Global de la Agricultura -- GLAM VI Time Series Database
Argentina -- 2018-abr-23 a abr-30
GLAM GLobal Agriculture Monitoring
Lenguaje
Español
INTA
NASA
GEOGLAM Global Agricultural Monitoring
Imagen Regional [Ver]
Haga click para mayor detalle. El cuadro rojo indica los límites de la imagen detallada. Cada píxel representa 2,5 km.
Opciones
Tipo de producto
MOD09/MYD09 (8-día)
Paleta
Provincias
Brazil Mesoreg
Brazil Microregi
Brazil Municipal
Brazil States
Actualizar imagen
MODIS NDVI (Terra) (MOD09 8-día) Gráfico. Cada píxel representa 250 m.
[Descargar gráfico de datos] [Descargar gráfico de datos (Alterno)] [Descargar gráfico de datos (Alterno #2)]
MODIS NDVI (Terra) (MOD09 8-día)
NDVI
90
88
86
84
82
80
78
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Fuente: USDA/NASA/UMD GLAM proyecto
Región: Argentina
Rango de fechas: 2018-abr-23 a abr-30
Detalle Punto: -25,55307 -61,01801


Abril 2018

Seguimiento Piloto de Sistemas Forrajeros

Fecha informe: 16/04/2018
Fecha adquisición de imágenes: 06/04/2018

Provincia de La Pampa - Puelén

El equipo SEPA (INTA Castelar) en articulación con la Agencia de Extensión Rural de INTA de 25 de Mayo desarrollan este informe mensual con el objetivo de acercar a los interesados información estratégica sobre el estado del sistema forrajero (monte, arbustal y pastizal) en el departamento Puelén de la provincia de La Pampa.
Dicho informe se basa en el uso de un Índice Verde (NDVI) obtenido a través de imágenes satelitales. Este índice es usado para estimar la cantidad, calidad y desarrollo de la vegetación.
El conocimiento y seguimiento temporal de la cobertura vegetal, la información de pronósticos evolutivos de la vegetación, los pronósticos meteorológicos y la zonificación de eventos destacables resultan fundamentales en el proceso de toma de decisiones para el manejo adecuado y sustentable de los agroecosistemas y de los recursos naturales.
Más información en sepa.inta.gov.ar

Ministerio de Agroindustria
Presidencia de la Nación

Análisis del estado de la vegetación para el área de la EEA Cuenca del Salado

Análisis del comportamiento de Índices de vegetación (IVN) obtenidos de imágenes satelitales de resolución espacial intermedia (MODIS)

Ariela Cesa, Alejandra Casal y José Otondo
Con la colaboración de Alejandro Rodriguez

Figura 5: Anomalía de Vegetación (actual-media histórica) para el período 28/12/16 al 2/1/17. Los partidos se encuentran ordenados en función del Proyecto Regional con Enfoque Territorial al cual pertenece.

PRET Cuenca Norte:

Pret Cuenca Centro:

- Hay sólo Herramientas Oparativas Parciales a Nivel Nacional (Clima o Vegetación)

- Los productores las conocen?

- De conocerlas, saben como usarlas o sacar provecho de ellas?

- Están integradas estas herramientas dentro de un modelo de balance forrajero?

- Hay sólo Herramientas Oparativas Parciales a Nivel Nacional (Clima o Vegetación)

- Los productores las conocen?

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- Los productores las conocen?

- De conocerlas, saben como usarlas o sacar provecho de ellas?

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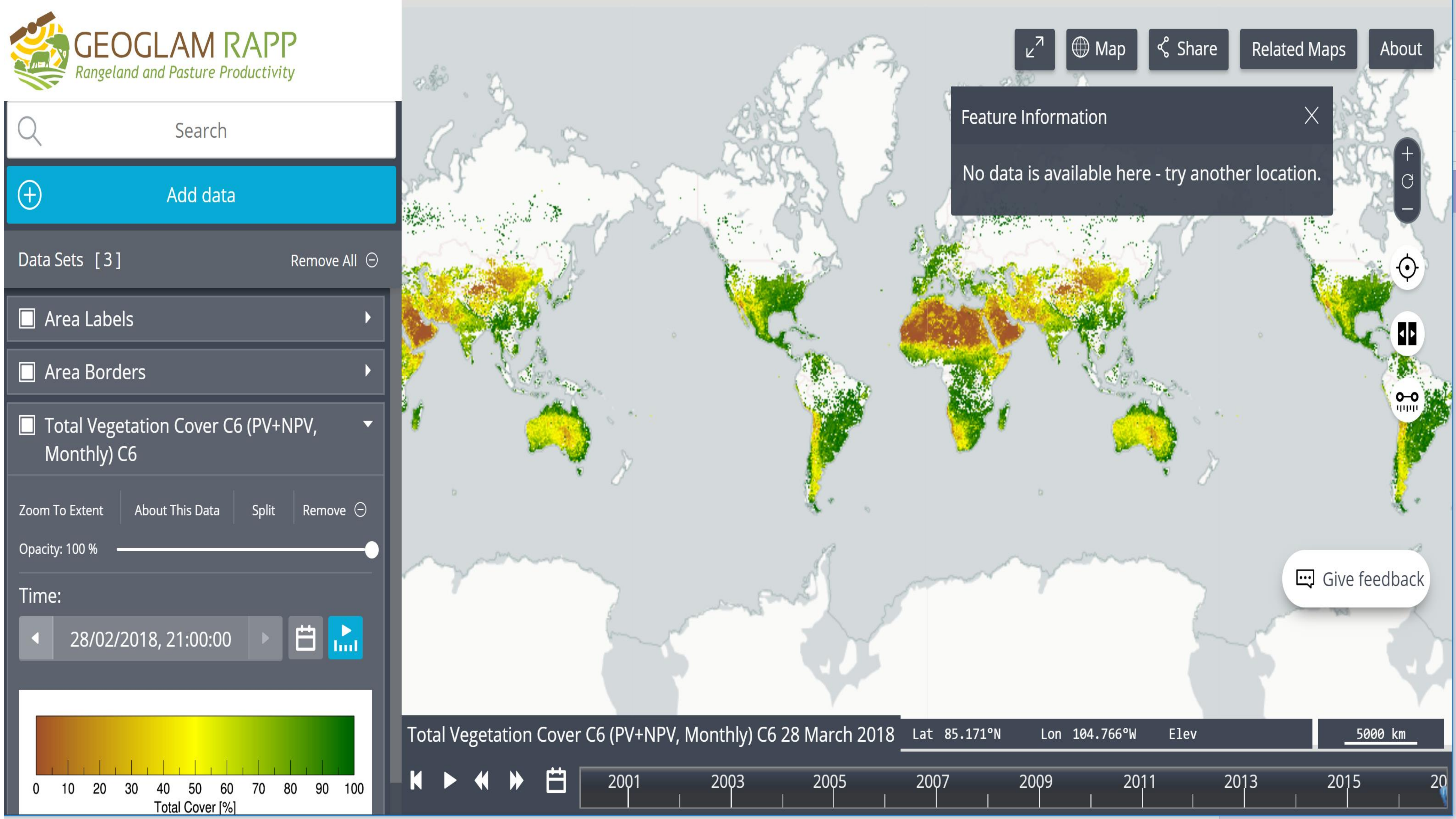
- Los productores las conocen?

- De conocerlas, saben como usarlas o sacar provecho de ellas?

- Están integradas estas herramientas dentro de un modelo de balance forrajero?


GEOGLAM RAPP
Rangeland and Pasture Productivity
Search
Add data
Data Sets [3]
Remove All
Area Labels
Area Borders
Total Vegetation Cover C6 (PV+NPV, Monthly) C6
Zoom To Extent
About This Data
Split
Remove
Opacity: 100 %
Time:
28/02/2018, 21:00:00
0 10 20 30 40 50 60 70 80 90 100
Total Cover [%]
Map
Share
Related Maps
About
Feature Information
No data is available here - try another location.
Give feedback
Total Vegetation Cover C6 (PV+NPV, Monthly) C6 28 March 2018
Lat 85.171°N
Lon 104.766°W
Elev
5000 km
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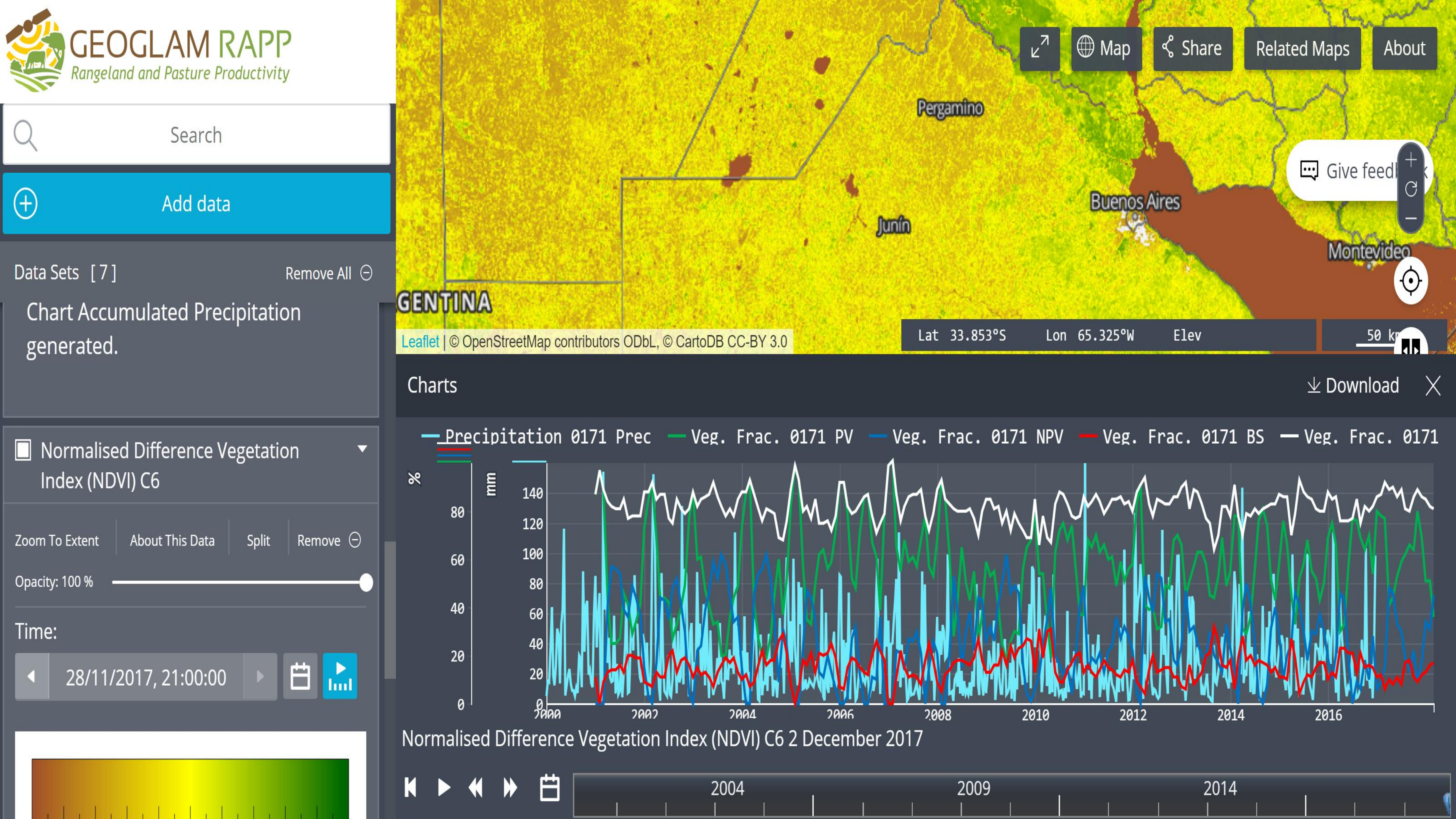
GEOGLAM RAPP
Rangeland and Pasture Productivity
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Chart Accumulated Precipitation generated.
Normalised Difference Vegetation Index (NDVI) C6
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Remove
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28/11/2017, 21:00:00
Map
Share
Related Maps
About
Pergamino
Buenos Aires
Junín
Montevideo
GENTINA
Leaflet | © OpenStreetMap contributors ODbL, © CartoDB CC-BY 3.0
Lat 33.853°S
Lon 65.325°W
Elev
50 km
Charts
Download
Precipitation 0171 Prec
Veg. Frac. 0171 PV
Veg. Frac. 0171 NPV
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Veg. Frac. 0171
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Normalised Difference Vegetation Index (NDVI) C6 2 December 2017
2004
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GEOGLAM RAPP
Rangeland and Pasture Productivity
Operacional
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Map
Share
Related Maps
About
Data Sets
Remove All
Area Labels
Area Borders
Opacity: 100 %
Time:
28/02/2018, 21:00:00
0 10 20 30 40 50 60 70 80 90 100
Total Cover [%]
Total Vegetation Cover C6 (PV+NPV, Monthly) C6 28 March 2018
Lat 85.171°N
Lon 104.766°W
Elev
5000 km
2001 2003 2005 2007 2009 2011 2013 2015

DE los productores,

POR los productores,

y **PARA** los productores

MUCHAS GRACIAS

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@dibella_carlos

Ecological Indicators 88 (2018) 134–143

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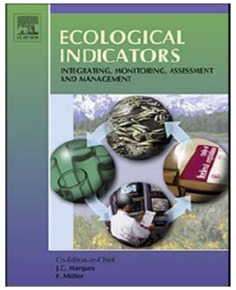


Original Articles

Uncertainty in simulating regional gross primary productivity from satellite-based models over northern China grassland

Wenxiao Jia[a,b], Min Liu[b,*], Duoduo Wang[b], Honglin He[c], Peili Shi[c], Yingnian Li[d], Yanfen Wang[e]

Table 1
The satellite-based models for GPP estimation.

Model	Model structure	References
TG	$GPP = m \times (EVI_S \times LST_S)$	Sims et al. (2008)
GR	$GPP = m \times EVI \times PAR + b$	Gitelson et al. (2006)
VPM	$GPP = PAR \times fPAR \times LUE_{\max} \times T_s \times W_s \times P_s$	Xiao et al. (2004)
VI	$GPP = m \times (EVI)^2 \times PAR$	Wu et al. (2010)
CFIX	$GPP = PAR \times fPAR \times LUE_w \times T_s \times (CO_2)fert$	Veroustraete et al. (2002)
ECLUE	$GPP = PAR \times fPAR \times LUE_{\max} \times \min(T_s, W_s)$	Yuan et al. (2007)
VPRM	$GPP = PAR \times fPAR \times \frac{1}{(1 + PAR / PAR_0)} \times LUE_{\max} \times T_s \times W_s \times P_s$	Mahadevan et al. (2008)
MODIS-GPP	$GPP = PAR \times fPAR \times LUE_{\max} \times T_s \times W_s$	Running et al. (2000)

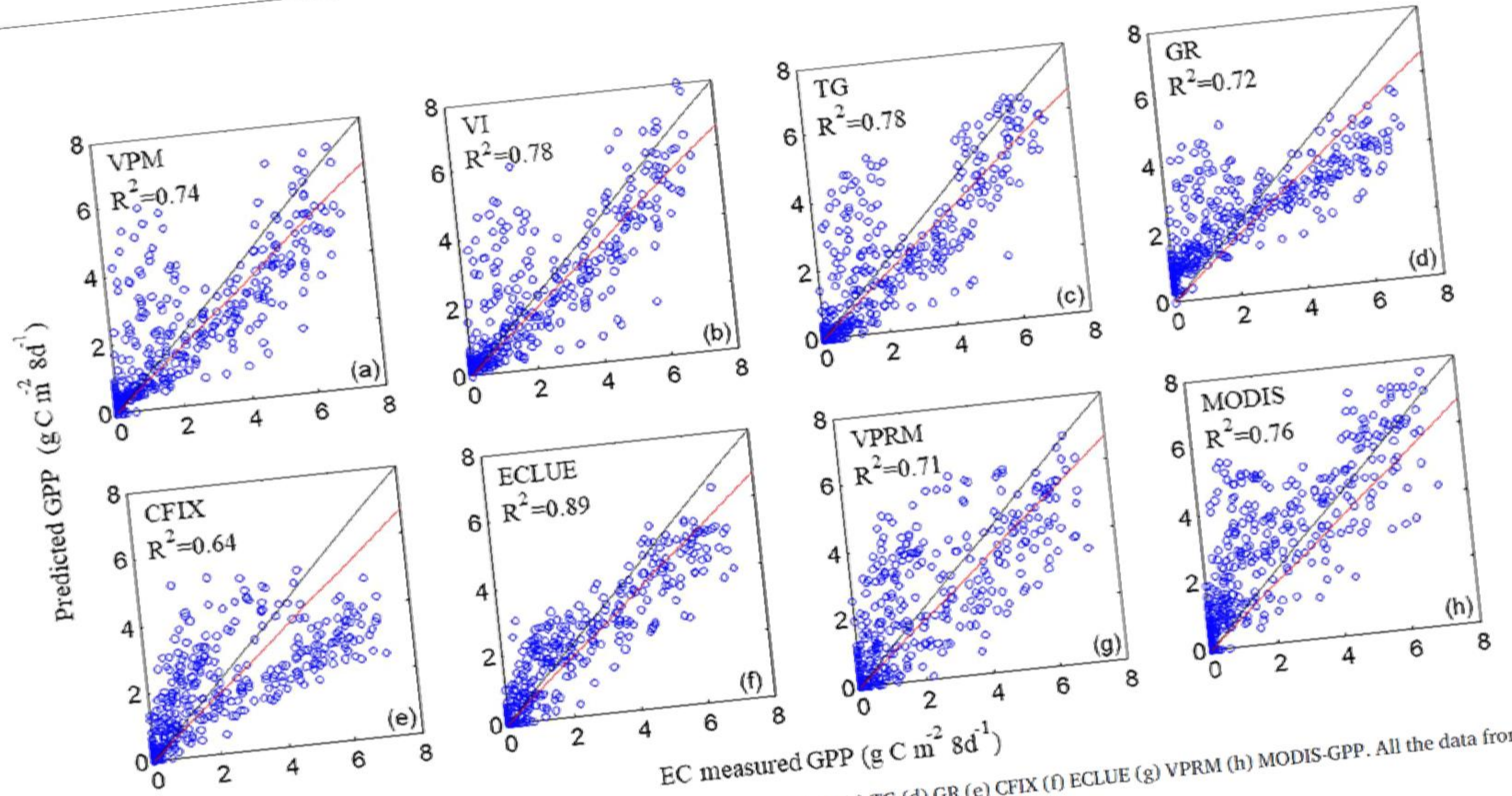


Fig. 2. Comparison between the EC measured GPP and simulated GPP derived from (a) VPM (b) VI (c) TG (d) GR (e) CFIX (f) ECLUE (g) VPRM (h) MODIS-GPP. All the data from different sites were put in the plots together.

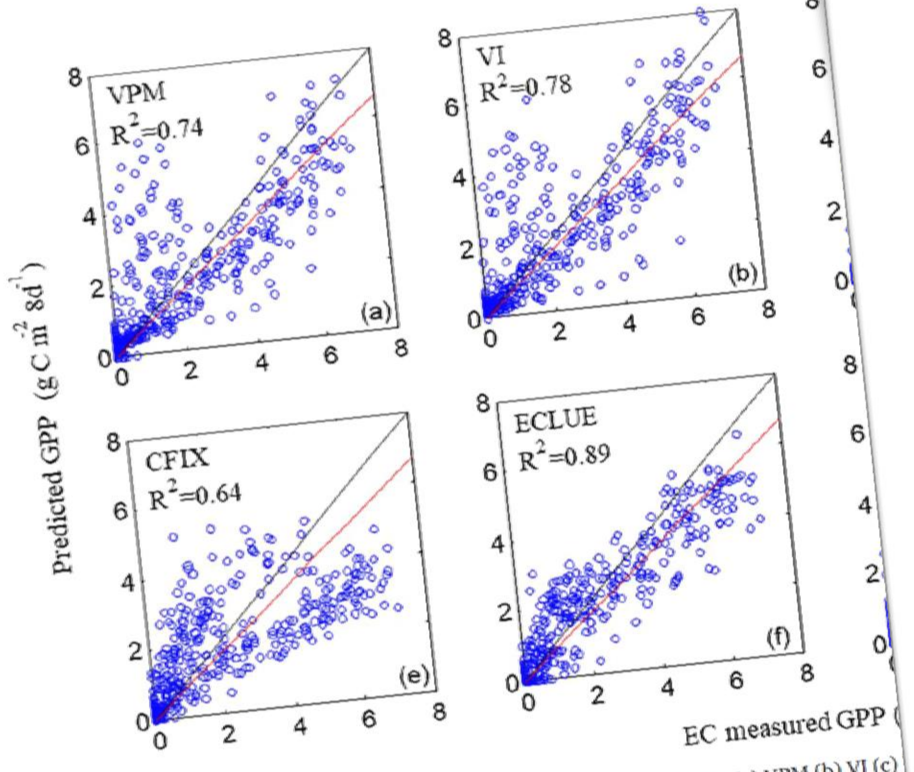


Fig. 2. Comparison between the EC measured GPP and simulated GPP derived from (a) VPM (b) VI (c) sites were put in the plots together.

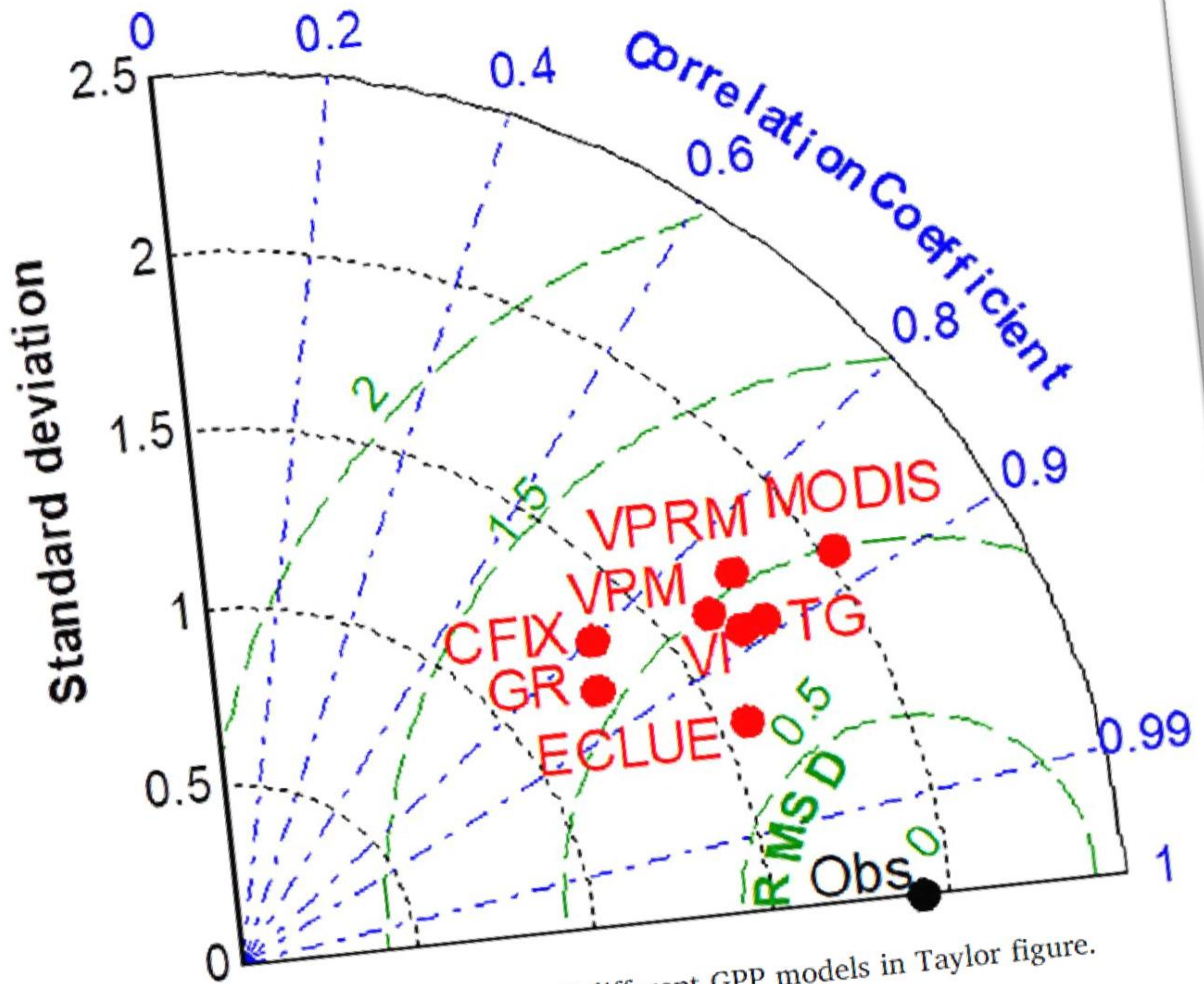
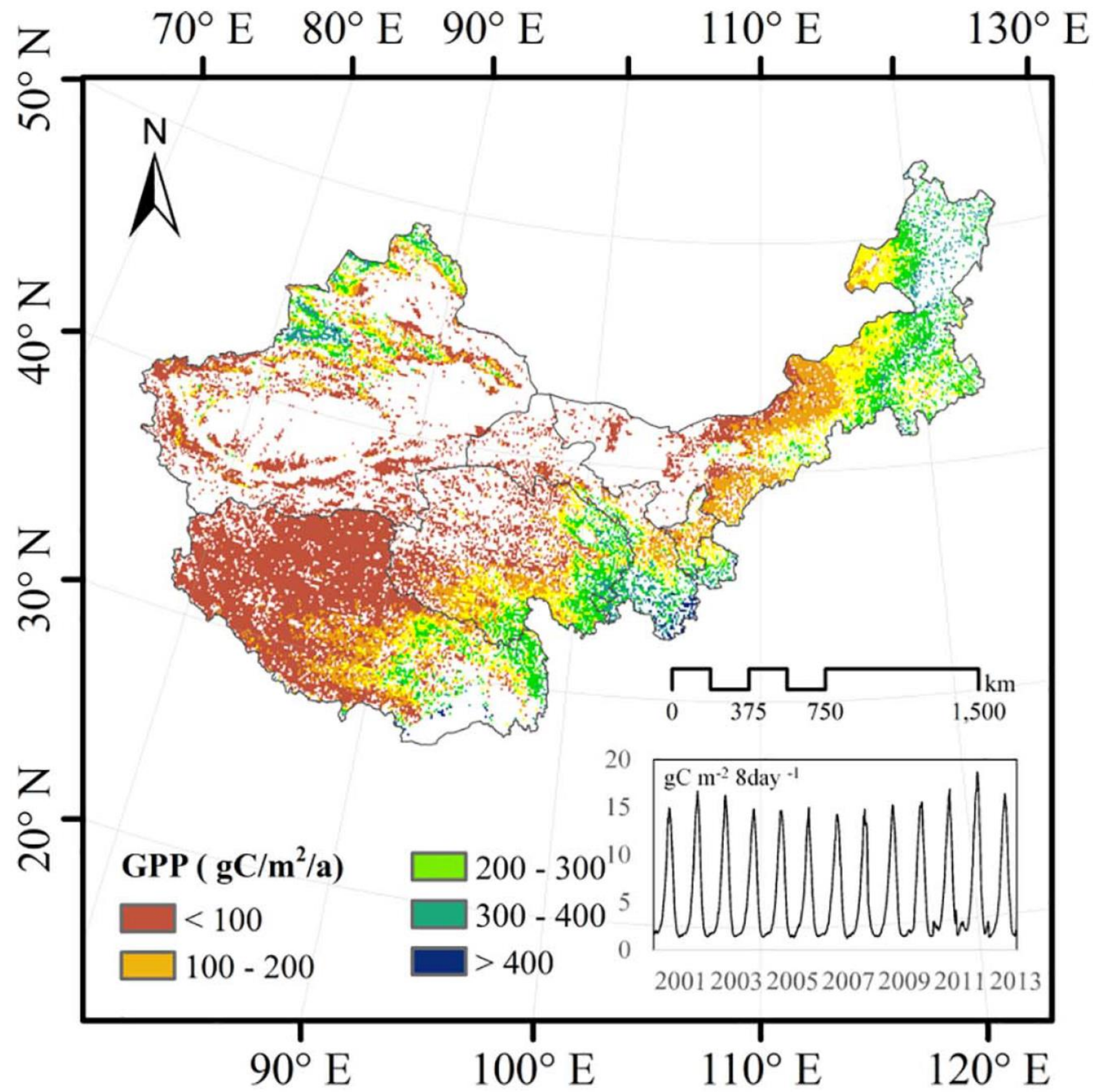


Fig. 3. The performances of different GPP models in Taylor figure.



70° E
80° E
90° E
110° E
130° E
50° N
40° N
30° N
20° N
N
0
375
750
1,500
km
GPP (gC/m²/a)
< 100
100 - 200
200 - 300
300 - 400
> 400
gC m-2 8day -1
20
15
10
5
0
2001
2003
2005
2007
2009
2011
2013
90° E
100° E
110° E
120° E

Remote Sensing of Environment 209 (2018) 181–194

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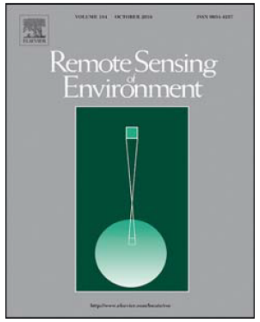
journal homepage: www.elsevier.com/locate/rse



Quantifying grazing patterns using a new growth function based on MODIS Leaf Area Index

Rui Yu*, A.J. Evans, N. Malleson

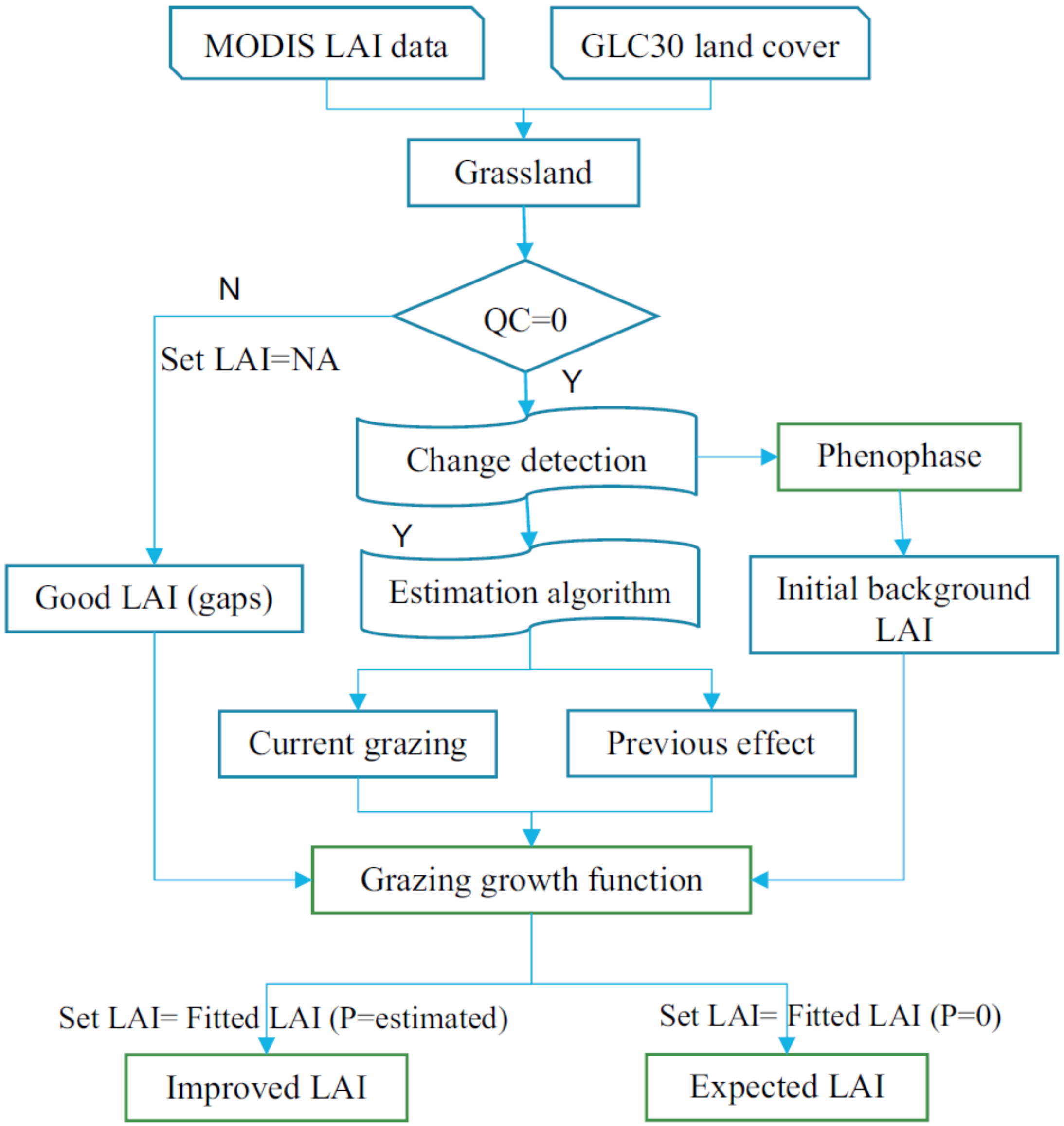
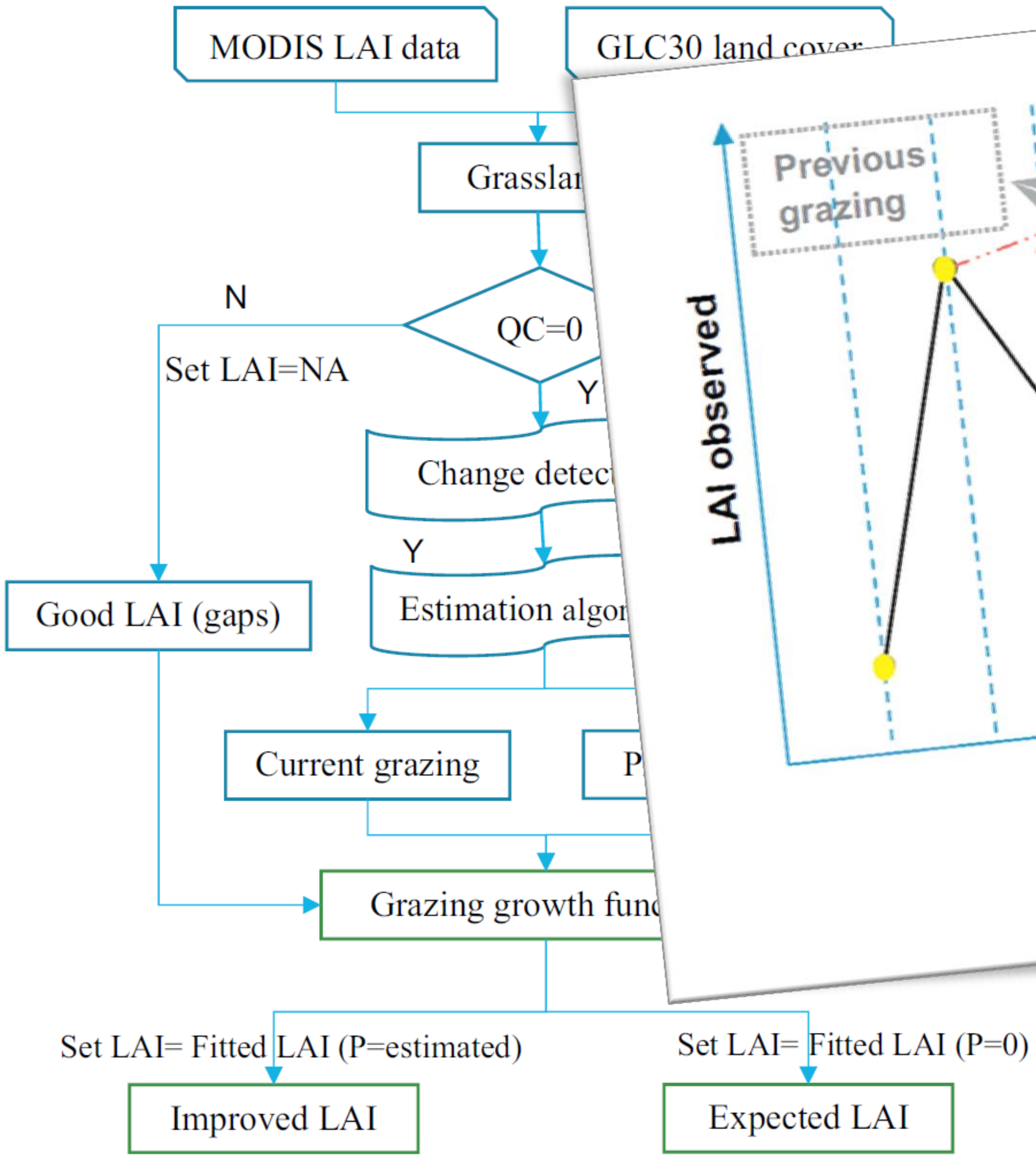


Fig. 3. Conceptual framework for quantifying grazing based on LAI data.



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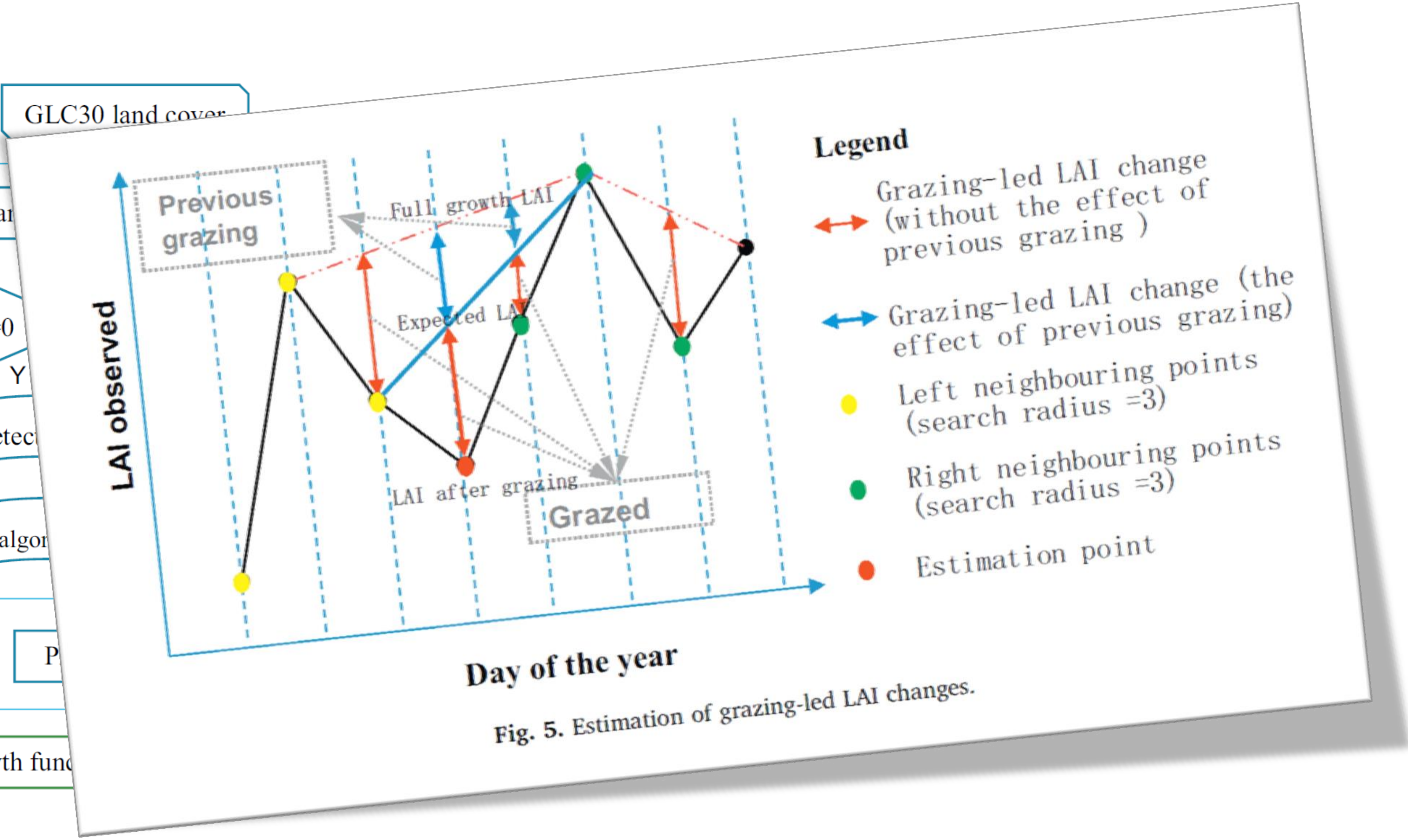
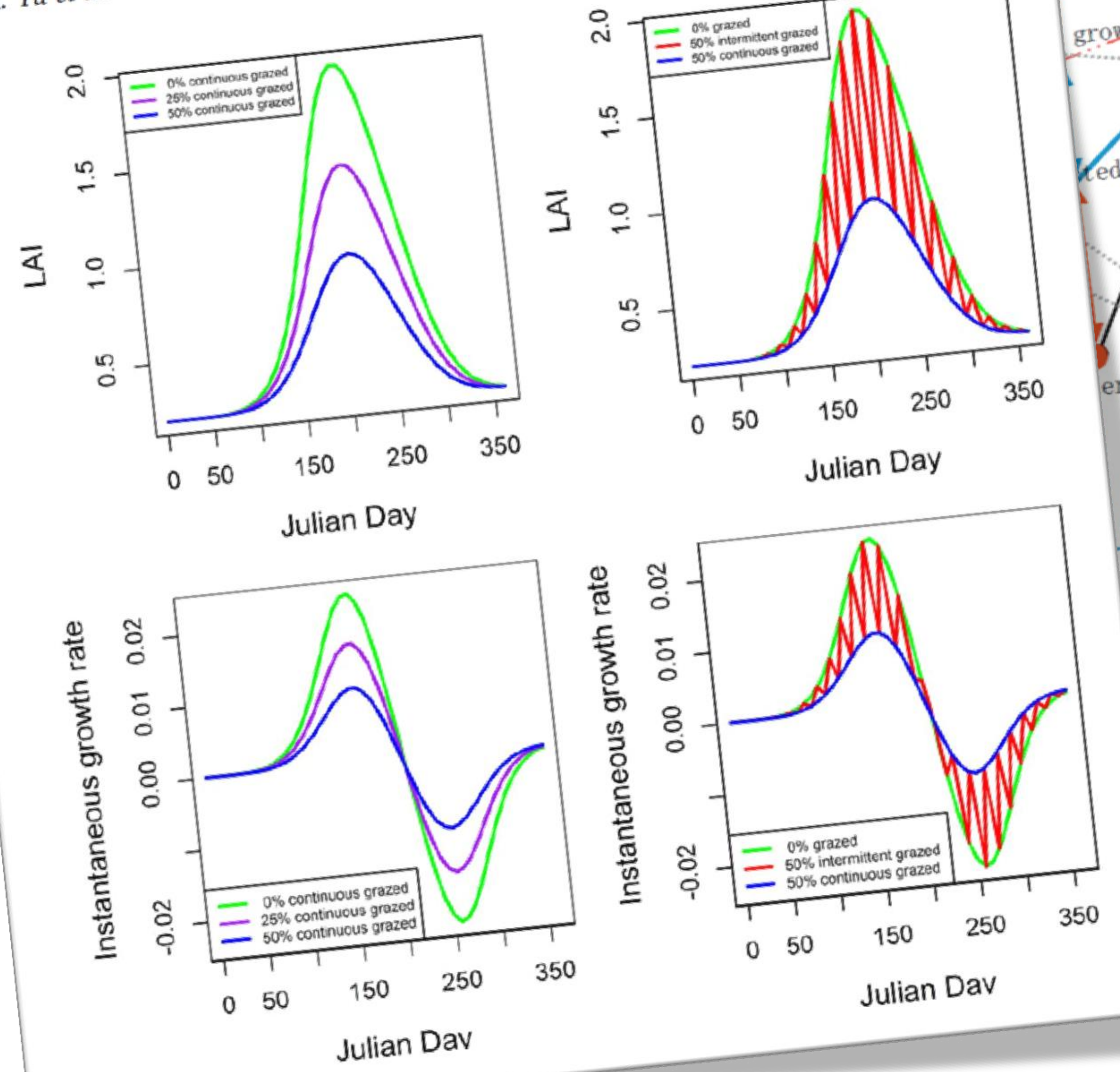


Fig. 5. Estimation of grazing-led LAI changes.



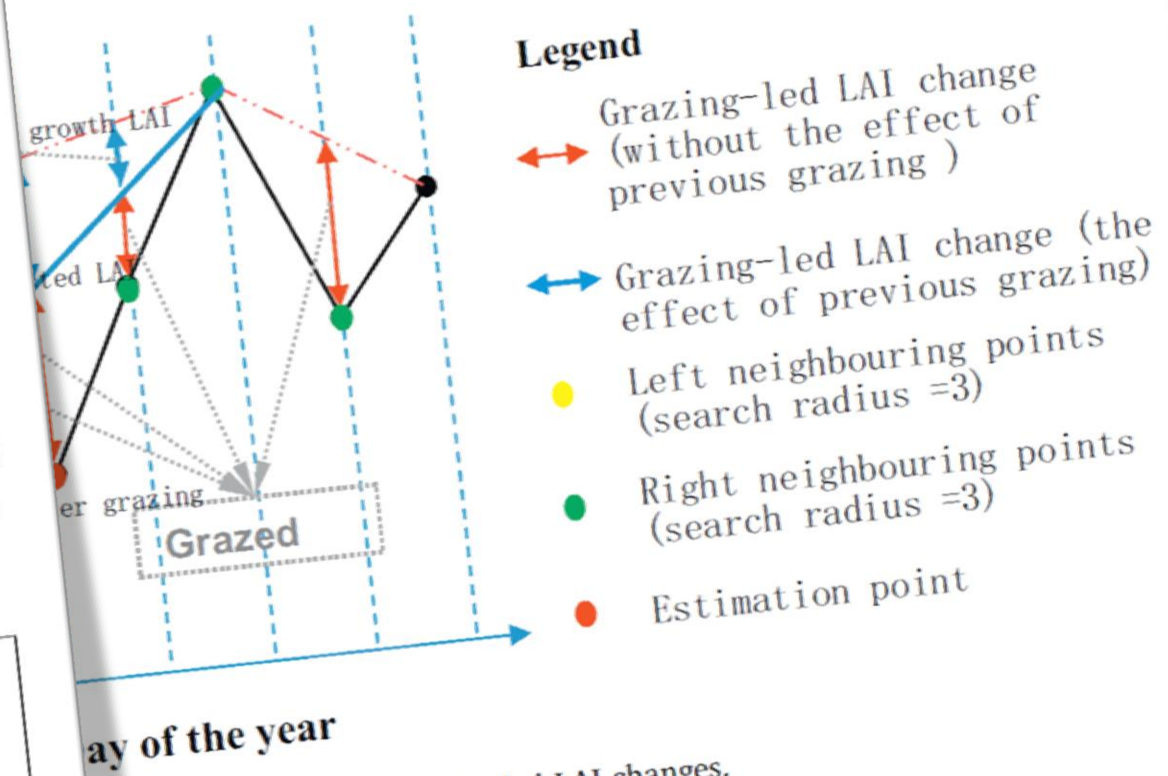


Fig. 5. Estimation of grazing-led LAI changes.