BRAZILIAN COALITION

ON CLIMATE FORESTS AND AGRICULTURE

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BRAZIL: LAND USE AND LAND COVER DATA AND INTELLIGENCE

KEY MESSAGES OF THE SEMINAR "AGRICULTURE AND THE DYNAMICS OF LAND USE AND LAND COVER: SCIENTIFIC DATA AND THEIR APPLICATION"

FOREWORD

Revealing deforestation of the Amazon, *Cerrado* and Atlantic Forest or making meteorological predictions are among the best-known usage of images obtained by Earth observation satellites. However, recent advances in artificial intelligence and big data can be used to multiply the applicability of the large database generated by this technology.

For example, using instruments currently available it is possible to follow spatial-temporal changes in Brazilian biomes' vegetation cover patterns, the extension of pastures and crop areas, size of environmental assets[1] in rural properties, agricultural credit applications, the effectiveness of the fight against illegal deforestation, and many other applications.

Scientific data obtained through remote sensing are essential to guide rural business activities. They are also very important tools for public policies aiming at a low carbon economy. The low carbon economy is a model endorsed by the B*razilian Coalition on Climate, Forests and Agriculture*[2] based on low greenhouse gas emission rates, high uptake of carbon dioxide from the atmosphere by forest restoration and increase of soil carbon in agriculture, and the maintenance of ecosystem services. To explore and advance this model, the *Brazilian Coalition*, with over 160 private companies, businesses associations, academia and civil society organizations, promoted the seminar that took place in São Paulo on May 17 th , 2018: "Agriculture and the Dynamics of Land Use and Land Cover: Scientific Data and their Application."

According to the movement's co-facilitator, Marcelo Furtado, asserted during his opening speech that the Seminar represented an important step for building a long-term vision the *Brazilian Coalition* intends to consolidate for Brazil. The goal was to bring to the fore the underlying science regarding data generated by Earth observation satellites to all stakeholders interested in the country's potential with respect to sustainable land use, including the use, communication and impact of this data on risk analysis and investment opportunities. **Good data can generate good intelligence and transparency; bad data and analyses misinform, creates wrong policies and alienates investors.**

In this sense, Brazil is in an advantageous position. Carlos Nobre, a climate scientist, member of the *Brazilian Coalition's* Strategic Group, the Brazilian Academy of Sciences and foreign member of the US National Academy of Sciences, explained that, when the first Earth surface observation satellites were launched in the beginning of the 1970's, the country pioneered developing land use management and forest cover change applications. As a result, **Brazil became internationally recognized as one of the leaders in using remote sensing technologies for a multitude of applications.**

Brazil was the first country to develop a robust technology to monitor forest cover changes in the Amazon. That technology has been disseminated to other tropical regions of the world. Brazilian researchers, members of institutions with long experience on this theme, have been maintaining the leadership in this field despite the economic crisis science is experiencing. Recently, the possibilities of using this data were amplified as the cost to access information dropped substantially. This is due to the emergence of constellations of Earth observations satellites, and algorithm development based on multiple sources of data, big data, artificial intelligence, and data mining.

The diversification of products and continuous increase of the need for qualit information have caused new challenges to emerge. Chiefly amongst them, how to better understand and to interpret this data. Because of this, Roberto Rodrigues, former Minister of Agriculture and Getúlio Vargas Foundation's director of agricultural studies, emphasized the importance of academia to develop and validate methodologies that provide correct data for decision-making in debates about climate and environmental questions. This is especially important in this moment of uncertainty regarding the future, political polarization and economic vulnerabilities.

The *Brazilian Coalition* understands that **any measurement regarding land use and land cover is associated intrinsically with a degree of uncertainty, inherent to the scientific method. Quantifying and clarifying this uncertainty/ accuracy allows these measurements to be more realistic and trustworthy**, enabling at the same time a constant search for improvements to increase accuracy.

It is essential that the country does not ignore the reality that the planet is going through marked climate change, and that two of the most affected sectors are agriculture and provision of environmental services, such as water cycle stabilization and carbon sequestration. **The Seminar showed how science can contribute to the development and improvement of Brazilian agriculture and agribusiness, and to combat wrongful and imprecise interpretations** that have sometimes been published about patterns of change in land use and vegetation cover. The future of food production is not only dependent on productivity, but also on nutritional diversity and quality.

For this reason, the event gathered experienced Brazilian researchers involved with the development of satellite-based methodologies and databases on land use and land cover change, as well as some of their users, investors, communicators and decision-makers. There were approximately 190 attendees from 95 different organizations and another 50 people following the Seminar live online. The main questions raised in each of the panels are summarized in the following topics.


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empresas de tecnologia que se uniram para contribuir com o entendimento das transformações
do território brasileiro a partir do mapeamento anual da cobertura e uso do solo no Brasil.
Coleção 2.3
(2000-2016)
Ane Alencar
Coordenadora Bioma Cerrado
IPAM
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PANEL I:

PRESENTATION AND DISCUSSION OF THE BRAZILIAN LAND USE DATASET

The first Panel, moderated by Ana Albernaz, researcher of the Emilio Goeldi Museum of Pará State, presented the work of scientists who produce and develop satellite data analysis to show the main potential of information sources and examples of the data's reach, methodologies and technologies, such as satellite images' degree of precision and scale. They also pointed out the importance of increasing awareness about the uncertainty associated with each source and possible disagreements among them. The Panel concluded that available data sources provide enough information for diagnostics of land use in Brazil. To advance further, a collective effort is necessary to allow for faster progress and to make data more widely available to and used by the stakeholders who need them.

- **Eduardo Assad**, Embrapa's[3] senior researcher responsible for the coordination within Embrapa of projects on climate change impact on agriculture, showed a concrete example of such differences of interpretation: the recent disclosure of the NASA/USGS's (United States Geological Survey) inventory on the planet's cultivated areas based on Landsat satellite imagery, more specifically in regard to figures pertaining to Brazil. For this, he compared the global data with national estimates obtained by municipal statistical information from the Agricultural Census (IBGE) and the maps produced by TerraClass analysis for the Cerrado (Scaramuzza et al., 2017) and Amazonia (Almeida et al., 2016) regions. By comparing the data, the main conclusion was that global-scale studies have more uncertainties compared to local studies, in which it is possible to make observations in greater detail. It became clear that the figure for the total area in use by agriculture in Brazil in the NASA/USGS study was obtained by the authors directly from IBGE's analysis of the Agricultural Census and satellite observations.

- **Prof. Ricardo Rodrigues**, head of University of São Paulo's School of Agriculture's Ecology and Forest Restoration Laboratory (LERF)[4], showed the importance of the CAR (Rural Environmental Registry), created in 2012 by Federal Law Number 12651 (the new Forest Code) to incorporate the georeferenced environmental information for ensuring legal compliance by rural landholdings. He also prese ted the method adopted to regularize part of the environmental assets in these properties using the PRA (Environmental Recovery Program) and PRADA (Degraded and Altered Areas Restoration Project), and its limitations imposed by technology and lack of legal clarity. Among the applications demonstrated by the researcher, it is possible to observe the evident contribution of the CAR in making property data available, which allows for a more assertive action of public policies targeting farmland.

Prof. Laerte Ferreira, a geologist, creator of LAPIG (Image Processing and Geoprocessing Laboratory)[5] and Dean of Research and Post-Graduated Education of the Federal University of Goiás (UFG), explained how LAPIG developed state-of-the-art methodologies to map pastureland areas in Brazil. The work, which is part of MapBiomas6[6], used Landsat 8 spectoral-temporal metrics as reference, and employed machine learning algorithms combined with training samples generated by automated analysis. A "Pasture Vigor Index", a metric to show the degree of pastureland degradation, was also generated. The following step was to obtain an annual map, with the goal of showing the evolution of the country's pastureland and to substitute the machine learning method with neural network mapping. His analysis indicates a total area of 179 million hectares of pastureland in Brazil in 2015, with 87% of accuracy in the measurements. This high accuracy was a result of the use of an artificial intelligence algorithm constrained by thousands of validation pixels based on accurate field observations.

PANEL II:

HOW TO PRODUCE AND UTILIZE SCIENTIFIC DATA ON BRAZILIAN LAND USE AND LAND COVER CHANGE

Under **Carlos Nobre's** moderation, the second Panel showed in greater detail the methodologies, technologies and applicability of some of the main data sources on land use and land cover change at regional and country-wide scales, with emphasis on PRODES, TerraClass and MapBiomas products. The presentations highlighted inherent difficulties in comparing data from systems that use different scales and automation levels and, therefore, result in quite different accuracies. As part of the effort to obtain higher accuracies, and increasingly make the dataset useful, researchers are looking for more advanced technologies that combine artificial intelligence with the human brain.

The information presented on Panels I and II showed that the Earth observation satellite data available create the possibility of carrying out spatial-temporal analyses of land use dynamics in Brazil. For example, taking LAPIG data presented on Panel I and TerraClass Amazonia data showed on Panel II, it is possible to conclude that areas in the Amazon that LAPIG does not identify as being currently (2015) pastureland, have been identified as regenerating secondary forests after pasture abandonment (TerraClass), pointing out to the ever changing nature of land use change dynamics in the tropics.

Eastern Amazon Embrapa's[7] director, **Adriano Venturieri**, presented TerraClass Amazonia, a project developed jointly by Embrapa and INPE with the goal of gathering detailed information about the spatial-temporal dynamics of Legal Amazon's forest cover changes by quantifying and qualifying data produced by INPE's PRODES system and defining various classes of vegetation cover (forests, secondary forests, different stages of pastures, etc.). Prior to TerraClass, many studies were using insufficient or even incorrect data on Amazon's land use (e.g. studies based on extrapolations from one municipality to a much broader scale).

TerraClass mapping for the years 2004, 2008, 2010, 2012 and 2014 allowed for accurately following the land use history for every polygon depicting forest cover alterations, facilitating the monitoring and establishing of public policies. These analyses revealed that, by 2014, about 173,387 km² of Legal Amazon's deforested areas no longer remained as pastures or agriculture and were classified as secondary forests. The abandonment of pastures helps to elucidate why previous

assessments of the total pastureland extent in Brazil came out with figures of over 200 million hectares in contrast with LAPIG's estimate of 179 million hectares in 2015. Venturieri also presented as an example the Legal Amazon's Ecological-Economic Zoning Standardization project[8], in which an agricultural suitability map based on soil was overlapped with TerraClass' to verify specifically how occupation by agriculture occurs. Overall, TerraClass Amazonia mapping has an accuracy of approximately 90%.

- MapBiomas is a project created in 2015 by the Greenhouse Gas Emissions Estimative System (SEEG), from the Climate Observatory, in partnership with universities, technology companies and non-governamental organizations[9]. According to IPAM's[10] Director for Science, **Ane Alencar**, the project's goal is to understand the changes in Brazilian territory by annually mapping land cover and land use for the whole country. The public and open access maps use Landsat images and the classification is done pixel by pixel using artificial intelligence algorithms. It is then automated in the cloud using Google's Earth Engine's platform (the same one that feeds Google Earth), which multiplies the power of data processing. These images are processed in standard 1:250,000 charts organized by biome and classification themes. They allow differentiation of primary (native) and secondary (regenerated/ reconstituted) vegetation, in addition to reducing uncertainty zones regarding livestock and agricultural use.

The current version 2.3 collection includes annual data from years 2000 through 2016 and is in constant development and improvement. The consolidation of the methodology and production will be finalized in collection 3. This collection is planned to be released this year and covers the timeframe between 1985 and 2017. The online access includes accuracy estimates (the global accuracy of mapping classes of land use and land cover change is 79.5%). MapBiomas mapping made possible the observation of trajectory changes in land use in Brazilian's biomes other than the Amazon, that is, it covers all Brazilian biomes. The current analysis indicates, for example, that the Atlantic Forest, which had its original cover reduced to 12.5% experienced some regeneration from 2001 to 2015, expanding, from 276 thousand km² to 301 thousand km². At the same time, the country lost 20% of its mangrove area, partly destroyed by urban expansion. MapBiomas also indicates that the total area of the Brazilian territory in agricultural use (crops + pastureland) in 2015 was about 2.7 million km², with a margin of error of 20.5%, which means it would be between 2.1 million km² and 3.2 million km².

- An example of a Brazilian crop mapping commercial application was presented by Applied Agro-satellite Geotechnology's[11] executive-director and INPE's former researcher, **Bernardo Rudorff**. His company developed sugarcane mapping from 2003 to the present for São Paulo state and Central and South Brazil, depicting areas of expansion and retraction, and areas available for harvesting and in reform. A suite of different data sources from different satellites was used, namely Landsat 8, Sentinel 2A and 2B, CBERS 4 and Google Street View images (the latter allows visualization of places at ground/soil level). To increase precision, a database developed from INPE's MODIS temporal series images, SATVEGA, was used. Another example

of satellite information application was the mapping of areas converted into soy crops in the Amazon and Cerrado. Due to the degree of accuracy required for commercialapplications(approximately 98%), the method requires that, after an artificial intelligence algorithm generates automated analysis, the final product goes through a thorough visual inspection and improvement by specialists.

- INPE's Remote Sensing Division's head, **Dalton Valeriano**, presented the history of satellite-based data monitoring systems in Brazil over the last 40 years and the importance of making this information publically available. The evolution of knowledge from this data, according to Valeriano, took a reverse "Bandeirantes path", i.e., they started in the Amazon and moved towards other biomes to finally arrive on the coast.

INPE started receiving Landsat images in 1974 and, in 1979, carried out the first mapping of Legal Amazon's deforestation. PRODES database, created in 1988 and made public in 2003, is used by the Brazilian government to establish public policies for the area and is a reference for forest emissions (FREL), from which REDD+ actions results are measured. In 2004 new products were incorporated: DETER (deforestation alert system) and DETEX (surveillance of areas with evidence of timber exploitation). In 2010, a public policy to prevent and control deforestation and wildfires in the Cerrado biome was implemented by the Federal Government (PPCerrado). In response to that policy, in 2014, the FRE Cerrado began. In 2016, the PMABB (Brazilian Biomes Environmental Monitoring Program)[13] and REDD+ National Strategy (ENREDD+)[14] were launched. In 2017, the DETER system was expanded to the Cerrado. PRODES data, a well-established technique to monitor the Amazon, uses semiautomatic analysis techniques that are validated by visual inspections by specialists. Between August 2016 and July 2017, PRODES showed the deforestation of 6,947 km² of the forest biome of Legal Amazonia. Recently, a project to validate PRODES data was created, called PRODES Uncertainty. Initial analysis of uncertainty ranges for land cover change for the State of Mato Grosso showed an accuracy of 94.5% for the deforestation class and 90.5% for the forest class (Adami et al., 2017).


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PAINEL IV – Uso de dados: avaliação de risco e oportunidades de investimentos
Carlos Aguiar – Superintendente executivo de Agronegócios do Santander
Moacir Ferreira Teixeira – Sócio fundador do Grupo Ecoagro
Marco Túlio Costa – Diretor de Agronegócios do Banco do Brasil
Wady Cury – Diretor geral de Habitacional e Rural da BB Mapfre
Moderação:
Ana Toni – Diretora executiva do Instituto Clima e Sociedade
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PANEL III:

DATA USE: COMMUNICATION AND PUBLIC POLICIES

The third panel focused on the difficulty of communicating science generated data on land use to society, as well as on how to interpret information from different sources in order to guarantee consistent decisions that can underpin adequate public policies and conscious society participation. **Rodrigo Lima**, Agroicone's general-director, was the moderator of this panel.

- Journalist **Natália Mazzote**, Open Knowledge Brazil's executive-director and leader of Data School (a network that helps social organizations, journalists and public agents to use data efficiently and in society's favor), presented data journalism trends that developed in the context of ease of access to information through the Internet. People and organizations that so far only received information are now users of databases and information generators. This change in behavior has led information managers and producers to become more transparent and responsible. It has also created the challenge of extracting new information from big data and the need to increase data comprehension and qualification by both journalists and information producers. Another challenge is to search for formats that are accessible to different segments of society, avoiding data noise and biased interpretation.

- Journalist **Herton Escobar**, of the Newspaper "O Estado de S. Paulo", spoke of difficulties the communicator faces when making science-produced data available to society. Among them is the need to adjust scientific language to a language that even those not in the field understand. In this context it is necessary to qualify journalists to be able to accomplish this translation and, at the same time, understand the methodologies used in each source analysis and interpretation. Moreover, in social media times, there is the additional difficulty regarding reader's reduced time dedicated to news and, therefore, the need to produce brief texts that dangerously promote generalizations.

- Brazilian Forest Service's (SFB)[15] general-director, **Raimundo Deusdará**, showed how data published by the scientific community affect public policies and society's 13 mma.gov.br/images/arquivos/gestao_territorial/pmabb/Estrategia programa_monitoramento_am biental_PMABB.pdf 14 REDD+ National Strategy (ENREDD+) is the document that formalizes, for Brazilian society and the countries that are part of the United Nations Framework Convention on Climate Change (UNFCCC), how the federal government structured its efforts and how it intends to improve them by 2020. These efforts focus on coordinated actions regarding the prevention and control of deforestation and forest degradation, the promotion of forest recovery and the stimulation of sustainable development (http://redd.mma.gov.br/pt/estrategia-nacional-para-redd) understanding of the world. He mentioned amongst other examples

SICAR's (Rural Environmental Registry System) management and, federally, the coordination of the CAR, as well as the technical-support of PRA's implementation. The implementation of these actions, under SFB's responsibility, is complex and has increased communicators' searches. SFB's efforts to spread transparent information relevant to the subject, to publish newsletters and reports, and to train the sources of information, have reduced communicators' factual questions and have increased those with an analytical nature, showing they had a better understanding of the subject.

PANEL IV:

DATA USE: RISK EVALUATION AND INVESTMENT OPPORTUNITIES

Agriculture and livestock have historically held an important role in Brazilian economy. Their numbers are impressive both by the diversity of products offered and their leadership in commodities exports. Banks and other financial institutions pump this market with a considerable amount of resources via financing and loans, and, in order to do that, require scientifically based information to identify, evaluate and manage risks related to all of the different agribusiness spheres. **Ana Toni**, executive-director of the Climate and Society Institute was responsible for mediating panel IV.

- Santander Agribusiness' executive-superintendent, **Carlos Aguiar**, observed that currently each bank does its own credit risk analysis for the sector. In his opinion, a common body could do this, with a lower cost and greater technical competence to advise investors. Santander has specialized managers and agronomists on staff to analyze all factors influencing results in the field, for example: climate history, rainfall, soil type, sustainable techniques (practices that reduce greenhouse gas emissions and deforestation), productivity, and the CAR regularization process. Robots are responsible to search by region to perform the social-environmental qualification. All this information is presented in a dashboard (indicators panel) for a daily monitoring of the producers.

- Ecoagro Group's founding partner, **Moacyr Ferreira Teixeira**, emphasized the need for trustworthy information to meet long-term planning to perform financial operations focused on agribusiness. The capital market is an underused path in Brazil, as opposed to other countries, but instruments such as the Agribusiness Receivables Certificate are starting to take off and require guarantees linked to the rural property or to the harvest/production and the monitoring of investors' resources.

- **Marco Túlio Moraes da Costa**, the agribusiness director of Banco do Brasil, and the largest rural producers' funder, disclosed the limitations of granting credit. Among these are the risk limits, managed by the bank's Agricultural Technical Referential (RTA) system, a tool developed by experts (agronomists, zootechnicians, and veterinarians) that crosses statistical data on productivity, climate, soil, market, technology type, etc. Other tools are ZARC (Climatic Risk Agricultural Zoning)[16] and other agricultural policy instruments to identify the region's economic suitability.

- Agricultural insurance is an important tool to develop the sector, since it requires technical planting guidelines and acts as a protection against negative environmental and market effects. According to **Wady Cury**, BBMapfre

Habitation and Rural's general- director, a total of 85 crops are covered by this insurance, but the total planted area remains small (15%). The insurance sector still has difficulty in looking beyond forests' wildfire risk, therefore, it does not incorporate the positive externalities the forest sector can offer with environmental services. One of the difficulties in its expansion is the lack of an organized information system that considers the historical time series and environmental effects on production systems, as well as the cost and variability of prices – both of which are fundamental to have a proper agricultural risk diagnosis and management.

CONCLUSION

Having quality data and information is essential to guiding good investments and economic expansion, creating effective public policies and generating intelligence to fight against illegality. According to the members of the Brazilian Coalition who participated in the seminar's closing remarks– **André Guimarães** (IPAM's executive-director and Brazilian Coalition's co-facilitator), **João Adrien** (Brazilian Rural Society's director), **Plínio Ribeiro** (Biofílica's director), Tasso Azevedo (MapBiomas' coordinator) and **Luana Maia** (Brazilian Coalition's coordinator)– there is already a robust amount of quality primary scientific data. It is public and can validate and consolidate other associated information, such as the CAR, and feed various institutions' work in the Brazilian territory. There are no longer excuses for generalizations. Often times, this data, due to misinformation and the country's political polarization, is spread on the Internet and not used to allow a multi-sectorial dialogue and long-term guideline for the country.

André Guimarães, in his closing remarks, remembered that the movement is making an effort to combat polarization and to harmonize the natural environment and production areas. Brazil requires this to become a prosperous and just country for its population and a good place for business. This is the challenge and the seminar represented the beginning of a mature debate that will support concrete proposals for the use of land across the country. A complete report in Portuguese on this subject will be available for those who would like more information.

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APPENDIX

1 The Forest Code in effect in Brazil defines two categories of environmental assets that rural landholdings must mandatorily possess: "Legal Reserve": a variable fraction of the landholding as a function of biome that has to be set aside and only selected economic activities are allowed and the original vegetation has to be maintained; "Permanent Protected Areas": riparian vegetation, areas surrounding water springs, hill tops, very steep slopes, where it is not only mandatory to maintain original vegetation, but also economic uses are not allowed.
2 Learn more: coalizaobr.com.br/en
3 embrapa.br/en
4 lerf.eco.br
5 lapig.iesa.ufg.br/lapig/
6 mapbiomas.org
7 embrapa.br/amazonia-oriental
8 youtube.com/watch?v=WpbgWd6fjjM
9 mapbiomas.org
10 http://ipam.org.br/en
11 http://agrosatelite.com.br/en
12 REDD+ is an incentive developed in the United Nations Framework Convention on Climate Change (UNFCCC) to financially reward developing countries for their achievements in Reducing greenhouse gas Emissions from Deforestation and forest Degradation, considering forest carbon storage conservation and increase, and sustainable forest management
13mma.gov.br/images/arquivos/gestao_territorial/pmabb/Estrategia_programa_monitoramento_ambiental_PMABB.pdf 14 REDD+National Strategy (ENREDD+) is the document that formalizes, for Brazilian society and the countries that are part of the United Nations Framework Convention on Climate Change (UNFCCC), how the federal government structured its efforts and how it intends to improve them by 2020. These efforts focus on coordinated actions regarding the prevention and control of deforestation and forest degradation, the promotion of forest recovery and the stimulation of sustainable development (http://redd.mma.gov.br/pt estrategia-nacional-para-redd)
15 florestal.gov.br
16 agricultura.gov.br/assuntos/riscos-seguro/risco-agropecuario/zoneamento-agricola

BACK COVER PHOTOS

- **Marcelo Furtado**, Brazilian Coalition's co-facilitator
- **Roberto Rodrigues**, GV Agro Coordinator, FAO Special Ambassador for Cooperatives, and former Minister of Agriculture
- **Carlos Nobre**, member of the Brazilian Academy of Sciences and foreign member of the US National Academy of Sciences
- **Eduardo Assad**, Embrapa's senior researcher
- **Ricardo Rodrigues**, head of University of São Paulo's School of Agriculture's Ecology and Forest Restoration Laboratory (LERF)
- **Laerte Ferreira**, creator of LAPIG (Image Processing and Geoprocessing Laboratory) and Dean of Research and Post-Graduated Education of the Federal University of Goiás (UFG)
- **Ana Albernaz**, researcher of the Emilio Goeldi Museum of Pará State
- **Adriano Venturieri**, Eastern Amazon Embrapa's director
- **Bernardo Rudorff**, Agro-satellite executive-director and INPE's former researcher
- **Dalton Valeriano**, INPE's Remote Sensing Division's head
- **Ane Alencar**, IPAM's Director for Science
- **Rodrigo Lima**, Agroicone's general-director
- **Herton Escobar**, Journalist of the Newspaper O Estado de S. Paulo
- **Natália Mazzote**, Open Knowledge Brazil's executive-director and leader of Data School
- **Raimundo Deusdará**, Brazilian Forest Service's (SFB) general-director
- **Ana Toni**, executive-director of the Climate and Society Institute
- **Carlos Aguiar**, Santander Agribusiness' executive-superintendent
- **Moacyr Ferreira Teixeira**, Ecoagro Group's founding partner
- **Marco Túlio Moraes da Costa**, agribusiness director of Banco do Brasil
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- **Plínio Ribeiro**, Biofílica's director
- **Tasso Azevedo**, MapBiomas' coordinator

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