Space as a tool for mitigation of climate change: multiscale results with Earth Observation technologies in Cerrado biome

Abstract

Brazilian Cerrado biome supports traditional communities' subsistence, biodiversity maintenance, and hydrologic balance of ecosystems. Management and use of this biome are intrinsically related to climate change, mainly due to the deforestation of native vegetation for human occupation and agricultural production. The TerraClass Project, based on satellite images, aims to qualify such deforestation areas and promote low carbon agricultural practices through environmental assessments. To support developing countries' climate actions and commitments, international networks of youth built-in are essential for the exchange of knowledge and experience of space use and are a promising key to strengthening innovation for climate change solutions.

1. Introduction

The impacts of changes in climate patterns occur in many scales, from the rising of ocean temperatures, the alteration in rain seasons, forest fires and floods; to the spatial movement of species out of their original locations and large-scale people migration (Roderick et al., 2014; Konapala, et al., 2020; Sohngen, B. 2020; IOM, 2008). These alterations affect the natural climate balance of many regions of the globe (IPCC, 2014) that shelter important ecosystems, societies, agricultural producers, local and native communities. This is the case of the Cerrado biome in Brazil, the second-largest biome in South America.

The Cerrado domain reaches around 2,036,448 km² (23.92%) of the Brazilian territory and has the most abundant flora of the world's savannas and endemic species (IBGE, 2004; Coutinho, 2002). Due to the coverage of this biome, it serves fundamental roles on different scales: locally, to provide the necessary resources to the traditional community's subsistence, economic and social activities; regionally and globally, to the maintenance of the ecosystems' biodiversity, hydrological balance and agricultural productivity (Sawyer, 2018).

Cerrado biome has been facing deforestation and degradation of lands, an urgent problem in Brazil that has recently worsened (INPE, 2020). To understand the impact of land use and coverage change (LUCC), the initial solution was found in space: monitoring deforestation and land use with earth observation (EO) technologies. EO enables an assessment of LUCC, allowing the understanding of geographic space[1] dynamics and identification of priority regions for preservation and conservation policies.

This essay presents how space can provide vital data to support actions and commitments for climate change mitigation, as well as strengthen the resilience of local communities and agricultural producers. The use of space, science and earth technologies in Cerrado biome can guide projects, assessments, and the decision-makers to mitigate and adapt the impacts of climate change, reaching the main goals of The Paris Agreement (2015) and Sustainable Development Goals – SDGs (United Nations, 2015d).

2. Space as a tool: Earth observation (EO) technologies supporting mitigation effects and climate resilience

Policies, projects and actions which aim at the preservation, conservation and sustainable development of biomes like Cerrado and Amazon in Brazil receive global attention, and many efforts were made to develop these commitments. In 2010, the TerraClass Project was created and designed for qualifying the LUCC, caused by the deforestation of Amazon and Cerrado biomes, and supporting sustainable socioeconomic issues and development (Fig.1) (Brasil, 2018).

[1] Geographic space can be defined as the total area of biosphere interactions, territory configurations, social and cultural areas, as well the socioeconomic relations developed in a determined region, according to Santos (1996).

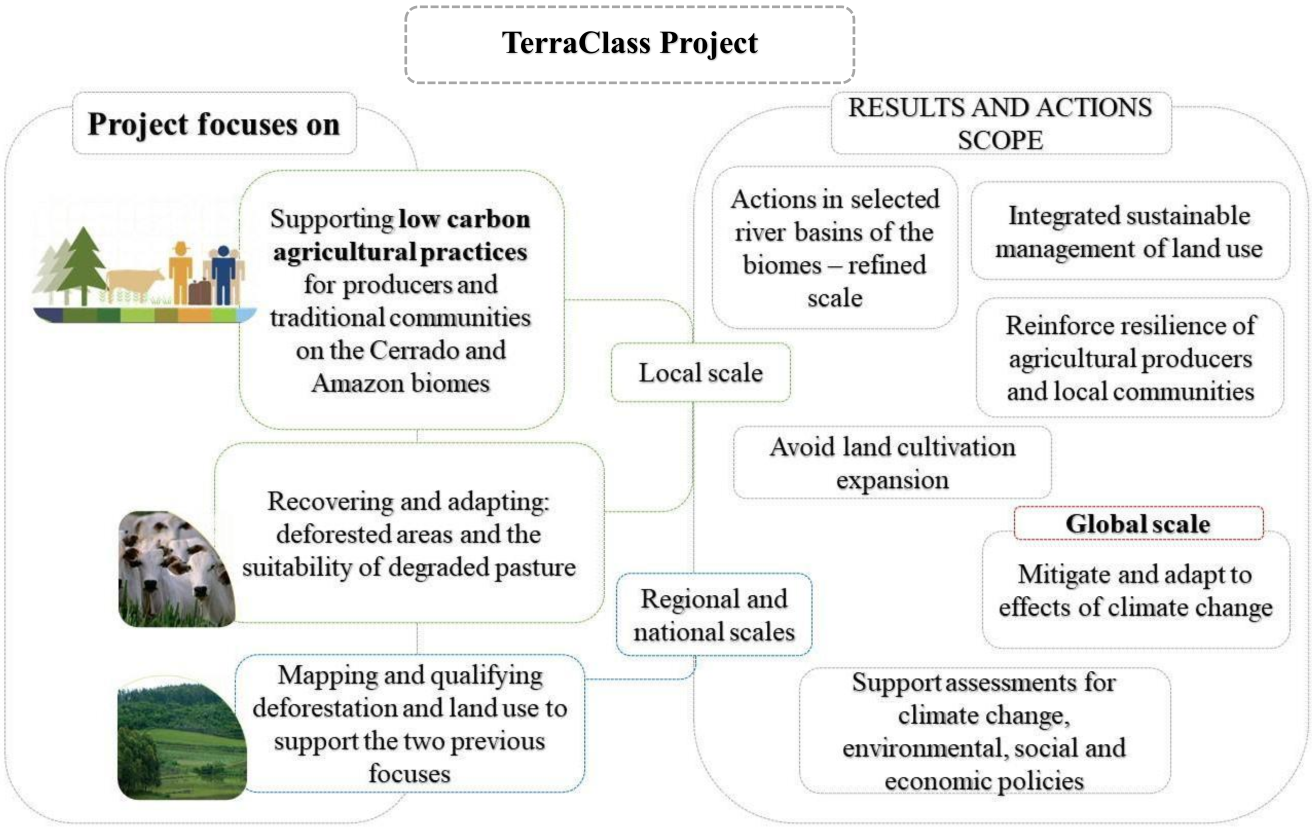

Figure 1: Guidelines and actions scale range of the project (Adapted from: Brasil, 2012; Brasil, 2018)

In order to develop this initiative, a fundamental primary data resource is needed: the space. In TerraClass, the main data used are Satellite Image Time Series of MODIS and LANDSAT satellites combined with computing science data and methods (Fig.2) like machine learning algorithms, implemented in systematic environmental monitoring over the years of analysis.

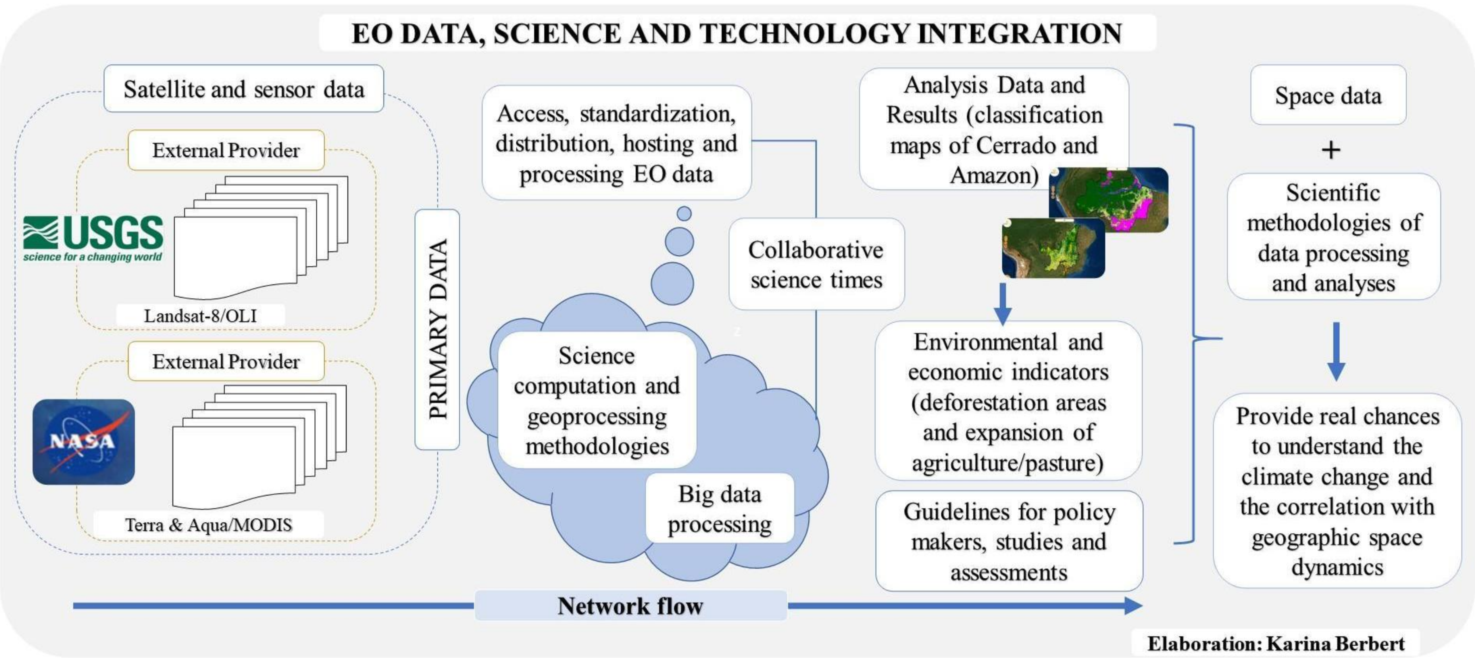

Figure 2: Network flow of EO Data, Science and Technology for project development.

The achievements of the project in monitoring and adapting pasture and agricultural areas (Fig. 3) to better conditions of production, optimization processes of cultivation, and low carbon practices can be transposed to different regions of the planet, on different scales, always considering social and geographical adaptations to local realities. Considering monitoring areas with spatial data and computing science on a regional scale, it is possible to develop a consolidated methodology for the classification of images, advancing it to more detailed scales, such as for river basins.

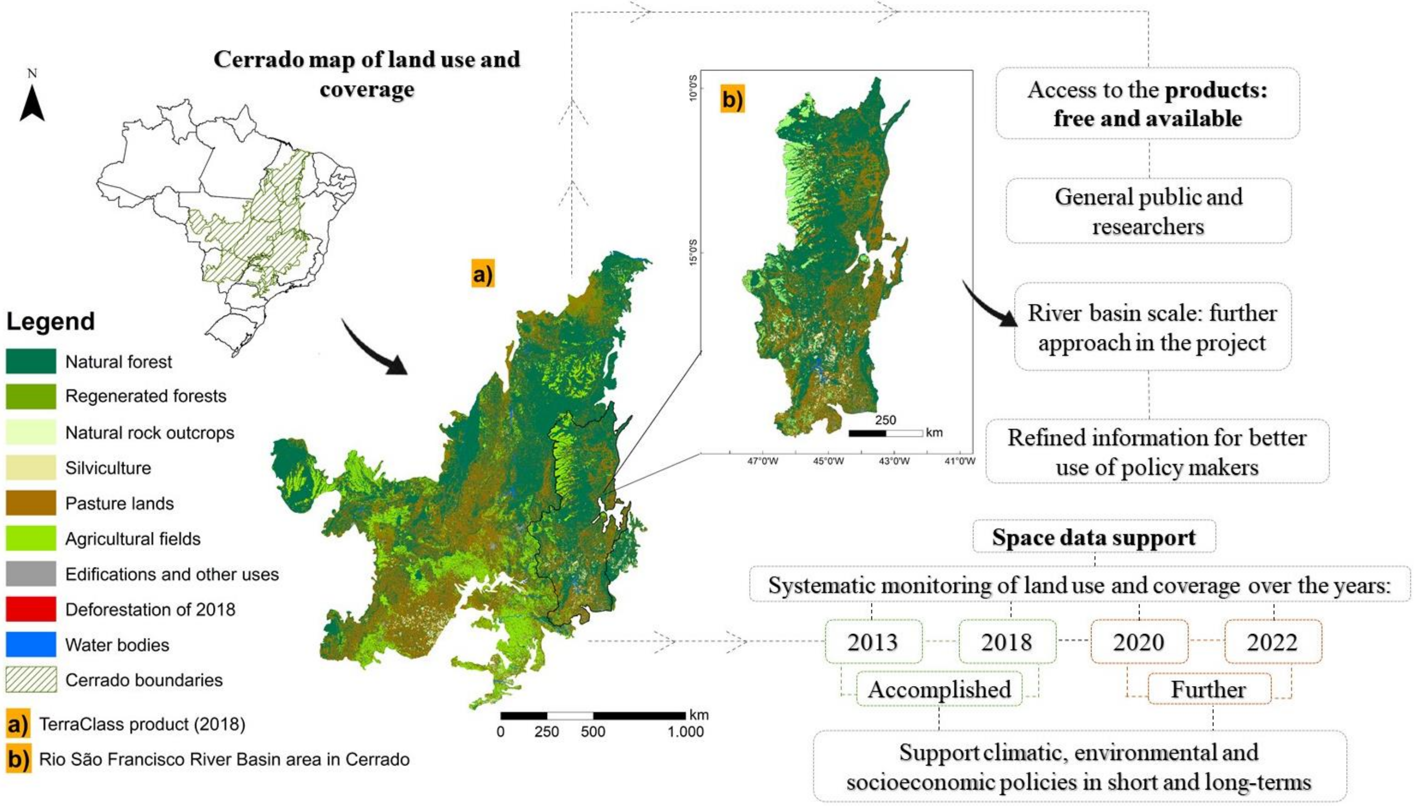

Figure 3: Current results from space products, geoprocessing and computation methodologies

Data source: TerraClass (2018); IBGE (2004). Elaboration map and legend adaptation: Karina Berbert

3. Conclusion

Space can provide answers for what can be considered one of the major challenges for applying a real sustainable policy, embraced by all people and societies: the proximity to their reality and needs, by offering refined scales of analysis and implementation. Using space for describing Earth's resources leads us to understand its importance as a multidimensional tool to promote balance between societies and environments.

One of the main conclusions of climate conferences around the world (Adaptation Futures, 2018), aligned with 12 and 15 SDGs (United Nations, 2015d), is the importance of understanding sustainable management and efficient use of natural resources correlated with the social processes in a geographical context. Using space data as a tool for getting valuable information can allow inclusive governance, putting the climate change policies in synergy with people's lives contexts.

Therefore, the challenges of climate change and the use of space as a tool for seeking solutions are uncountable. The exact refinement of space data is also an actual struggle. The massive amounts of data available from different sources need standardization, methodologies, and processes to allow access for both communities: scientific and societal. This challenge can bring together and expand the international community of data providers, users, and sponsors.

This work and many other initiatives of Space for Youth Competition are an opportunity for the United Nations Office for Outer Space Affairs (UNOOSA) to build a connection between projects in developing countries that aim to reinforce how space can be used as a tool for decision-making and raising awareness on global climate agendas. Such connections can promote partnerships, contacts, and online groups between the S4Y candidates, creating a youth international network.

Also, this network facilitates the exchange of scientific knowledge and experience with spatial data. Sharings about space product usage and methodologies development can be faced together. Such cooperation contributes to better understand, share, and communicate the achievement and progress of the SDGs in developing countries. In this sense, Brazil and many other countries are searching for enhancing their space history and being able to adapt and face the climate change challenges.

Thus, UNOOSA and United Nations international conferences – like COP26 in 2021 – have a key role in reinforcing this union between scientific, governmental, and societal spheres, aiming at the encouragement of youth innovation and cross-disciplinary actions and studies as here proposed for climate change solutions.

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