

SeloVerde uses geospatial big data and AI/ML to monitor deforestation in supply chains, powered by AWS

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Forests are crucial for climate protection. They are important carbon sinks, are home to around 80 percent of the animal species living on land, and form the basis of life for around 1.6 billion people. (Photo credit: SECOM/Agência Pará)

Introduction

Public sector organizations across the globe are seeking to develop solutions to evaluate, monitor, or predict land use and land cover change to identify deforestation trends, future wildfire-risk areas, and potential carbon credit projects. Open source geospatial artificial intelligence (AI) and machine learning (ML) analyses along with Internet of Things (IoT)-connected sensors can power near real-time data built on the cloud and assist in decision-making. Amazon Web Services (AWS) is supporting the Government of Pará, Brazil, in designing and deploying SeloVerde (Green Seal), a cutting-edge tool to address climate change challenges and traceability in deforestation-risk supply chains.

SeloVerde integrates governmental databases, innovative map services, and land-use data from high spatial resolution satellite imagery. It is the first public system able to monitor direct and indirect suppliers and integrate federal and state level environmental and social data

daily. SeloVerde allows industry and other stakeholders access to information on deforestation prior to purchasing cattle and soy to make environmentally responsive evidence-based decisions.

Launching SeloVerde 2.1

The SeloVerde 2.1 project is designed to use geospatial big data and AI/ML to mitigate the impact of deforestation. SeloVerde 2.1 was developed as part of Amazon's efforts to support nature-based solutions across the globe through its [Right Now Climate Fund \(RNCF\)](#), a \$100 million commitment to nature-based solutions. To [protect and restore rainforests](#), Amazon has funded the [Agroforestry and Restoration Accelerator program](#) in the Brazilian Amazon rainforest. Amazon is also a founding member of the [LEAF Coalition](#), a global public-private initiative that has mobilized more than \$1.5 billion to protect the world's tropical rainforests. In Europe, RNCF has allocated funding to nature-based projects, such as a [nature and wildlife restoration fund](#) in France, a [reforestation program](#) in Italy, an [urban greening program](#) in Germany, and [rewilding and tree planting projects](#) in the UK.

Amazon provides grant funding to accelerate sustainability research and innovation through the RNCF and the [Amazon Sustainability Data Initiative's \(ASDI\) Promotional Credit Program](#). The Center for Territorial Intelligence (CIT), an AWS Partner, benefited from this funding, which allowed CIT to design and develop the latest version of SeloVerde 2.1 that it deployed in the AWS Cloud in 2023.

"You don't do anything alone. Without partnerships, whether public or private, we will not reach our goal, which is to reduce deforestation and make the transformation of the economy of Pará to a low-carbon economy," said [Mauro O'de Almeida](#), Pará's Secretary of Environment and Sustainability.

Cloud-based intelligence to monitor deforestation

SeloVerde was developed by the State Secretariat of Environment and Sustainability of the State of Pará (SEMAS-PA) together with CIT and the [Federal University of Minas Gerais \(UFMG\)](#) with support from the [Climate and Land Use Alliance](#). SeloVerde 2.1 monitors deforestation by leveraging AI, ML, and open source data on the AWS Cloud. It is a science-based, open-access, online system that provides transparency in deforestation-risk supply chains by integrating socioenvironmental data from federal and state databases and land-use mapping from high spatial resolution satellite imagery (e.g., post-2008 deforestation). SeloVerde 2.1's geospatial big data analyses provide detailed diagnoses of each rural property's environmental compliance in relation to [Brazil's Forest Code](#), the applicable Brazilian regulation governing conservation of the rain forest.

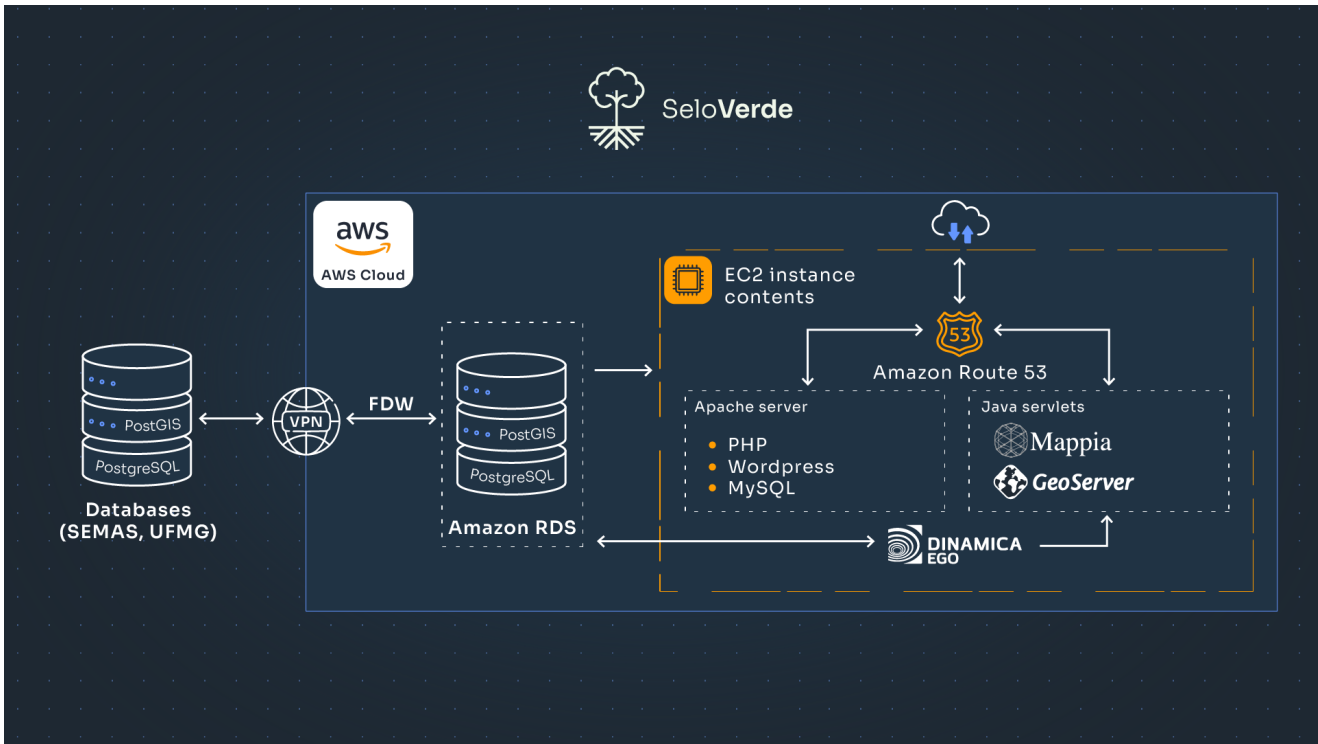
“The vision behind SeloVerde and CAR 2.0 [the Brazilian government’s land registry system] is a thriving agricultural economy in which sustainability and legal compliance are recognized and rewarded by the government and the market,” said Jamey Mulligan, head of carbon neutralization at Amazon. “We believe these tools are critical elements of the solution to deforestation in Pará and across the Brazilian Amazon, and we are pleased to support leadership from the State of Pará.”

How SeloVerde 2.1 maximized the potential of the cloud

SeloVerde 2.1 is run using a combination of services and software in the AWS Cloud which work together to provide a comprehensive online traceability system covering cattle and soy supply chains in Pará. It accesses and analyzes official public environmental and geospatial data sources, including from the UFMG and SEMAS-PA. Each rural environmental registry (CAR) is an entity record; its columns store data which characterizes the farm, including land use, boundaries, environmental licenses, crop area, cattle movement permits, and more. To create a data pipeline between the UFMG and SEMAS-PA databases and the [Amazon Relational Database Service \(Amazon RDS\)](#), SeloVerde uses a foreign data wrapper (FDW) which allows access to external data daily and processes geospatial big data.

[Dinamica EGO](#) freeware is responsible for processing all high-resolution satellite imagery, map algebra, and spatially explicit modelling, handling both raster and vector data in parallel. This is where forest surpluses and deficits for each rural property are calculated. The model also analyzes permanent preservation areas along rivers and other requirements depending on the rural property location.

SeloVerde also uses a geoserver-compatible map service called [Mappia](#). Mappia can be used to access several layers, including a high-resolution land use map yielded by applying AI and patch post-processing to monitor land use change over time. To achieve this, [Sentinel-2](#) images accessed from [ASDI](#) and [PlanetScope](#) are downloaded, processed, merged in parallel, and integrated with Brazilian official deforestation data from the [National Institute for Space Research \(INPE\)](#). With the data processed in Amazon RDS, running on an [Amazon Elastic Compute Cloud \(Amazon EC2\)](#) instance uses an Apache server to generate the content of the system’s website.



Architectural diagram of the solution described in this blog. The major components are an Amazon Simple Storage Service (Amazon S3) bucket and an Amazon RDS instance, using an Apache server, analyzing publicly available data sources including ASDI, and Amazon Route 53 to generate the content of SeloVerde's website. (Image credit: Escada Amarela)

Impact of using data and AI/ML analyses to monitor deforestation

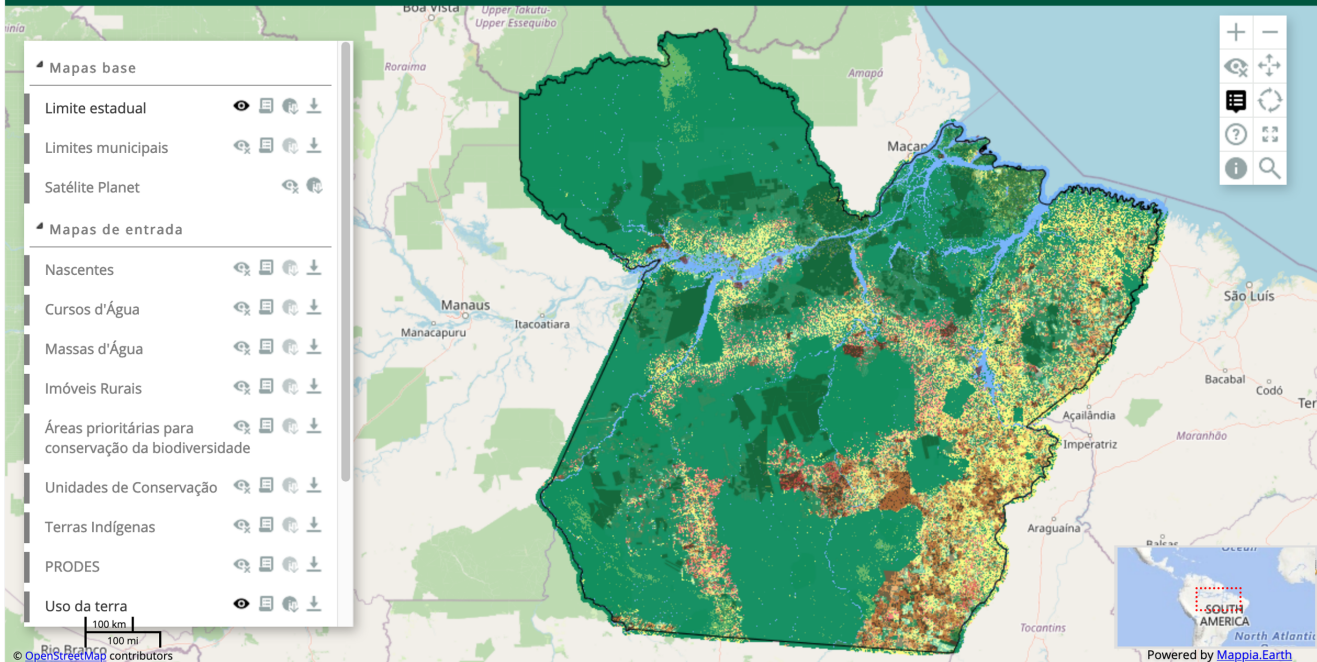
SeloVerde 2.1 automatically monitors 20 million hectares of forest areas. The data, refreshed daily, on transparency and traceability at the property level that SeloVerde provides strongly discourages deforestation by creating an improved monitoring system. Currently, SeloVerde 2.1 tracks approximately 300,000 rural properties in the State of Pará, and with fuller implementation and execution of the Forest Code, it's estimated that 3.4 million hectares of forested areas will be restored within Para. Preliminary projections by CIT and UFMG Center for Remote Sensing indicate that enforcement of the Forest Code and full transparency in supply chains, such as soy and cattle, would avoid the emissions of 739 million tons (MT) of carbon dioxide (CO₂) by 2030, or an average of 123 MT annually.



SeloVerde PA

Science and technology in support of environmental sustainability in agriculture

CONSULT CAR



Screenshot of SeloVerde 2.1, which is currently tracking deforestation and land cover change of about 300,000 rural properties and monitoring an estimated 20 million hectares of forest areas in the State of Pará, Brazil.

Scaling across states and commodities

If use of SeloVerde 2.1 expands beyond Pará to the other eight Legal Amazon states, it may be able to monitor up to 109 million hectares of forested land and could track nearly 1 million separate properties. In the future, SeloVerde's use may expand to include other agricultural deforestation risks commodities such as cocoa, corn, rubber, and palm oil. In addition to supporting Brazilian traceability as a scalable solution running in AWS infrastructure, SeloVerde 2.1 can be expanded at subnational and national levels across the globe.

Experiencing SeloVerde 2.1 at AWS re:Invent 2023

AWS is determined to make the cloud the cleanest and the most energy-efficient way to run all our customers' data infrastructure and business. To help do this, Amazon is committed to reaching net-zero carbon emissions by 2040 as part of [The Climate Pledge](#)—10 years ahead of the [Paris Agreement](#). We are achieving this through innovations and investments, in decarbonizing our own business operations, as well as investing in actions outside our

business to reduce and remove carbon from the atmosphere through nature-based and technological solutions. This is inclusive of solutions, such as SeloVerde 2.1, which will be highlighted during [AWS re:Invent 2023](#). A SeloVerde 2.1 interactive demo will be featured in the Sustainability Showcase located in the Caesars Forum and within two sustainability focused sessions:

For more information on Amazon's commitment to reach net-zero carbon, visit our [AWS Sustainability page](#). And to learn more about sustainability at AWS re:Invent 2023 and how we are working to make re:Invent a more sustainable event, please visit the [AWS re:Invent webpage](#).