Report on identification of priority areas to combat deforestation in Legal Amazon

Monitoring of forest cover loss in the Brazilian Amazon accounts on different systems such as PRODES, Terraclass, DETER-B and DETER Intenso. While the formers operate within the limits of the biome, DETER Intenso works in a more agile and accurate way of providing deforestation or forest degradation alerts for areas considered critical in terms of deforestation. The system began to operate on an experimental basis in February 2020, providing alerts in areas strategically defined by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and state agencies. DETER Intenso is entirely based on the Forest Monitor technology (FM), a webgis platform applied to near-real-time deforestation in the Brazilian Legal Amazon.

With Forest Monitor, it is possible to interactively access images from Landsat 8, Sentinel 2 and CBERS 4 satellites, which have 30, 10 and 20 meters of spatial resolution respectively and are available on the cloud computing services platform provided by Amazon Web Services (AWS). The application allows visualization of images, improvement in contrast and a vector drawing tool for the visual interpretation of areas identified as deforestation by experts in remote sensing and land use change, without the need to download the images on a daily basis. Three Lambdas are used on AWS to make public images available via the Tile Map Service Specification (TMS) service (Figure 1). AWS Lambda allows the execution of code without the need of provision or management of its own servers, running directly on AWS servers and with the computing resources allocated by it. Below, the schematic of the architecture used by Forest Monitor.
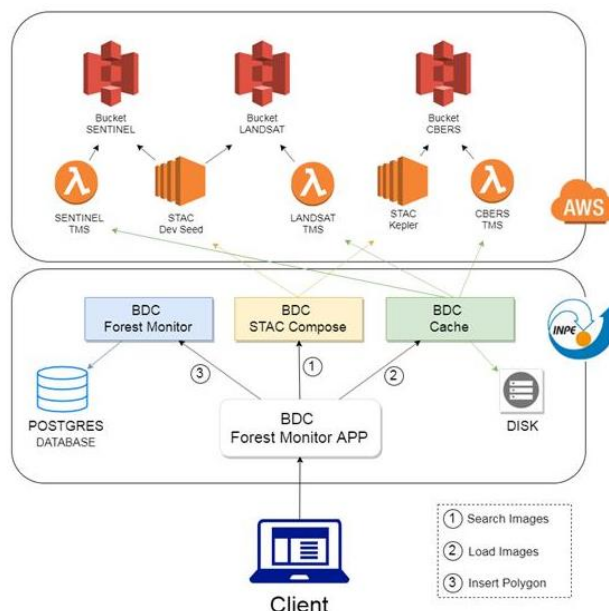

Figure 1- Forest Monitor architecture. Source: Noronha, C.A.; Costa, R.W. 2020

FM is a multi-user platform and requires only an internet connection and a browser. Its interface allows searching for images by period, satellite, cloud cover and region of interest. Functions such as visualization of images in color composition, application of contrast enhancement, gamma and saturation adjustments are also available and are applied at runtime without the need to download images and/or use specific geographic information systems.

DETER Intenso results from the integration of optical images from CBERS-4 (WFI and MUX), Landsat 8 (OLI), Sentinel 2 (MSI) satellites and synthetic aperture radar (SAR) images aboard the Sentinel 1 satellite (C band) to detect land use changes (i.e., changes in forest cover) in specific areas of the Legal Amazon. The imaging technology using SAR satellites is suitable for areas that are subject to intense cloud loads, such as the Amazon at certain times of the year. The detection, based on several sensors, allows reducing the influence of cloud cover on the image interpretation process, as well as the revisit rate to 1 to 2 days. The mapping classes remain identical to DETER and the minimum mappable area is one hectare. DETER Intenso is currently operating in seven priority areas in the regions of Altamira (PA), Apuí (AM), Candeias do Jamari (RO), Extrema (RO), Novo Progresso (PA), BR 163 (PA) and Rurópolis (PA) which together total 642,000 km^2. The figure below shows the main interface of Forest Monitor applied to real-time monitoring of deforestation.
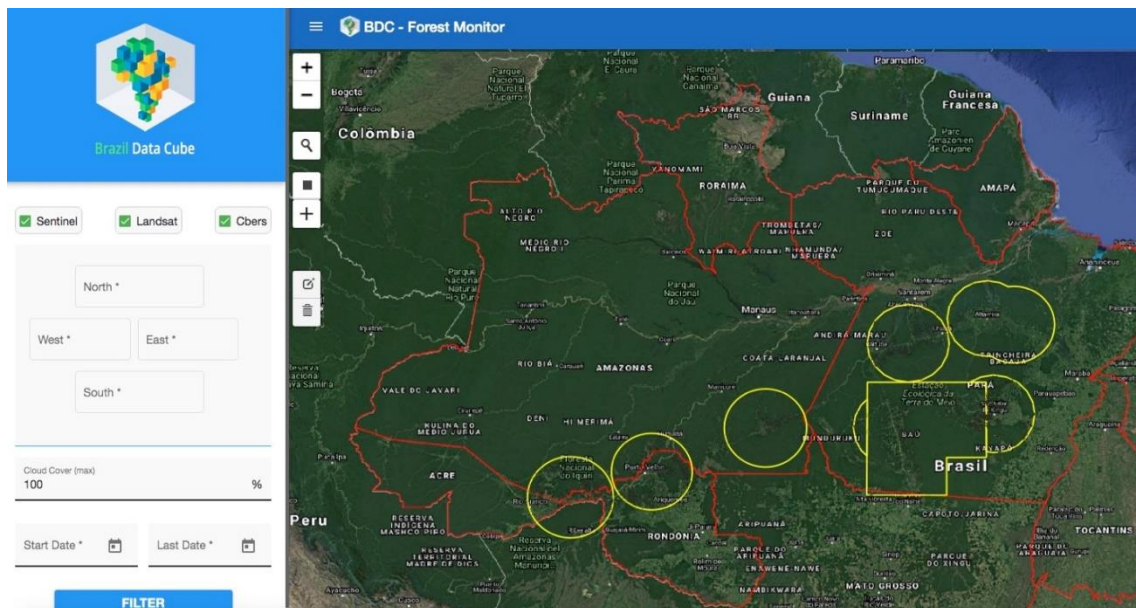

Figure 2: Forest Monitor geographic information system (WebGIS) used to map DETER Intenso alerts, with access to satellite images available on the Brazil Data Cube (BDC) platform. BDC is a INPE project.

Since October 2020, DETER Intenso has detected more than 56,000 deforestation polygons totaling about 10,500 km^2, considering only the use of optical sensors. Deforestation alerts are divided into eight classes (Table 1).

Table 1: Number of alerts and area already mapped by DETER Intenso.

Class	Number of Polygons	Area km^2
Wildfire scar	893	384
Selective cut (SC)	20	21
Disordered SC	121	206
Geometric SC	24	78
Degradation	3.507	1.863
Deforestation with exposed soil	42.937	6.864
Deforestation with vegetation	6.743	1.030
Mining	1.907	147
Total	**56.152**	**10.593**

Considering project's goal of expanding DETER Intenso in the state of Pará and identifying priority areas in the State, INPE trained 15 technicians from the State Secretariat of Environment and Sustainability (SEMAS) by providing courses on the Forest Monitor/DETER. SEMAS technicians were responsible for selecting and mapping the critical area in the region of the BR 163 highway, which totaled 180,000 km^2, accounting for 28% of the total area mapped by DETER Intenso ~~within the project~~ (Figure 3).
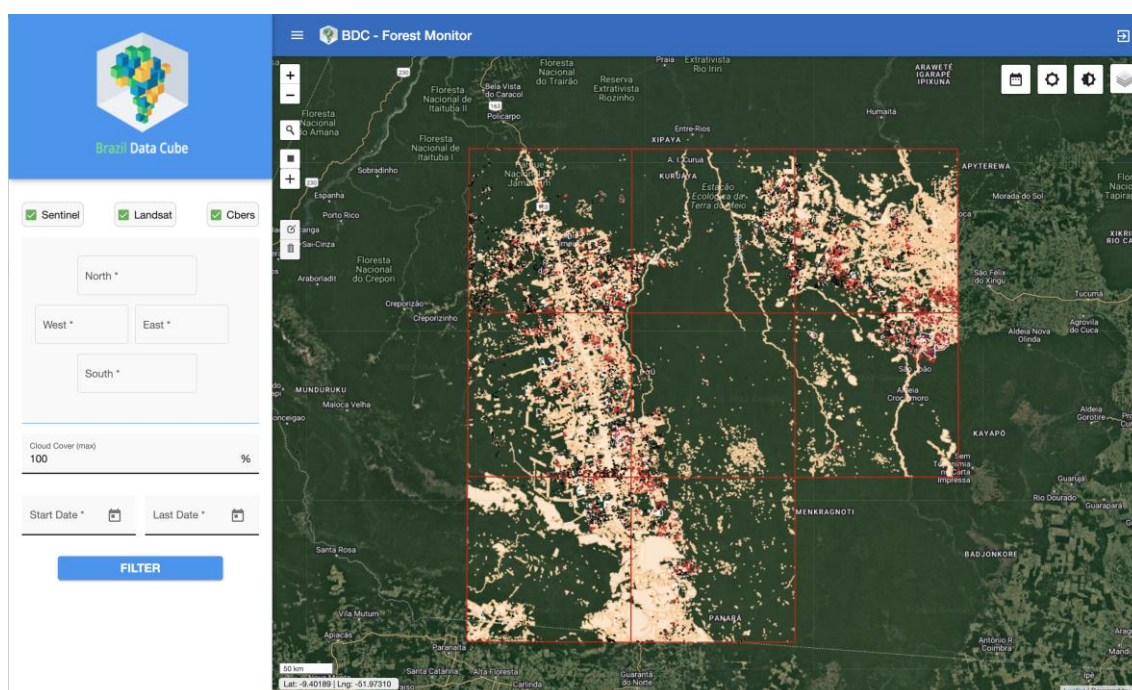

Figure 3: Areas selected by SEMAS in Forest Monitor.

Projeto: Controle do desmatamento e simulação de projetos de infraestrutura na Amazônia

From October 2020 to June 2022, SEMAS mapped approximately 5,100 deforestation or forest degradation polygons totaling 3,200 km^2. The results by deforestation class are shown in Table 2.

Table 2: Number of alerts and area mapped by DETER Intenso in the critical region indicated by SEMAS.

Class	Number of Polygons	Area km^2
Wildfire scar	531	253
Selective cut (SC)	4	6
Disordered SC	45	43
Geometric SC	2	0
Degradation	1.288	1.192
Deforestation with exposed soil	2.479	1.585
Deforestation with vegetation	241	73
Mining	598	92
Total	**5.188**	**3.246**

Projeto: Controle do desmatamento e simulação de projetos de infraestrutura na Amazônia