MONITORING SUGARCANE EXPANSION FROM SPACE

Cost-effective ways to map the expansion of sugarcane cultivation in Brazil over long times and large areas. That is in short what Brazilian researcher Rubens Lamparelli and his Dutch colleague Ramon Hanssen have been developing in their joint project. They based their solution on a smart combination of Earth observation data collected by satellites.

Brazil is the world's biggest producer of sugarcane, which is used as a resource for the production of sustainable bio-fuels and bio renewable resources. In the State of São Paulo alone, over the past 15 years the land use for sugarcane has expanded with over 2 million hectares. To ensure proper assessments of land use changes and related environmental and socio-economic impacts, policymakers need accurate maps of agricultural land use. In their joint project, Dutch Professor at TU Delft Ramon Hanssen and Professor Rubens Lamparelli from the Brazilian Universidade Estadual de Campinas combined optical and radar data from satellites to develop reliable, high resolution, discriminative land use maps.

ADDITIONAL EYE FROM THE SKY

'Economic impulses such as the price of oil are putting land use under pressure. Satellite observations can be of great help in monitoring crop productivity and land covering,' Hanssen says. 'Unfortunately, due to the rainy seasons in Brazil, the sky is often very cloudy, which makes it impossible to only rely on optical sensors. In this project, we developed new algorithms to derive information about land use from Synthetic Aperture Radar (SAR) satellite observations, to complement the insights gained with optical data.'

> *We have combined our monitoring system using optical technology with the Dutch knowledge on how to use radar data, leading to a system that comprises different spectral, temporal, and spatial resolutions.*
>
> ***Rubens Lamparelli***
> *University of Campinas*

'I first met Ramon and his research team during a technical trip to the Netherlands in May 2013,' Lamparelli recollects. 'They had been developing a system to monitor land use in agriculture, which could also be interesting for Brazilian conditions.' The researchers decided to join forces and wrote a proposal for a call organized by FAPESP and Be-Basic. 'In this project, besides UNICAMP and TU Delft, also Embrapa and Utrecht University were involved,' Lamparelli says.

The researchers combined radar images taken by the SAR satellites Sentinel-1, Radarsat-2 and ALOS-2, with data

acquired by the optical satellites Landsat-8 and Worldview-2. Hanssen: 'The most important challenge for this project was to determine which radar signal represents what kind of vegetation. We solved this by inserting contextual information into the detection algorithms used to decipher the radar signals.' Dutch PhD student Ramses Molijn stayed with Lamparelli's group in Brazil for a year to collect biophysical measurements that could aid in distinguishing between the different types of vegetation.

NATURAL COLLABORATION

This was a very natural collaboration, both researchers say. Hanssen: 'To validate our models, we needed the knowledge of Rubens and his team about the growth cycle of sugarcane. Sugarcane is a fast growing crop: within a year a plant grows up to four meters high, and after being chopped down during the harvesting season, it regrows equally fast. After some five cycles, the plant is no longer profitable, and the soil gets rest for a year. And then the entire cycle starts over again. For us to recognize sugarcane fields, it is important to know about these different stages in the lifetime of the plants.' Lamparelli: 'In Brazil, we had been trying to build a monitoring system using optical technology. That attempt was terminated due to a lack of funds and time. When TU Delft provided us with deep knowledge on how to use radar data, we were able to combine the two, leading to a complementary system that comprises different spectral, temporal, and spatial resolutions.'

Besides a dual PhD degree for Ramses Molijn from both TU Delft and UNICAMP, and a series of publications in scientific journals, the project led to a system that is not only able to recognize sugarcane, but also other types of land use like (harvested) eucalyptus, forest, annual crops, water or urban use. By providing the algorithms with data series taken at different points in time, it is possible to map how the land use is changing over time.

'I hope this collaboration can pave the way to a long term partnership,' Lamparelli concludes. 'Currently, we are working on a follow-up project to use remote sensing data to compare integrated crop-livestock-forestry to conventional croplands and pastures.' 'And I see ample possibilities for other types of follow up research,' Hanssen adds. 'In this specific project, we focused on the amplitude of the radar signal, but we can also look at phase shifts, which contain information about movements of the earth's surface. This can for example be used to determine subsidence effects resulting from climate change. Recently, Brazil has experienced some disasters with collapsing dams. It would be interesting to investigate if it would be possible to use remote radar data from satellites to monitor the state of dams by measuring how they respond to precipitation, heat, or changing water levels.'

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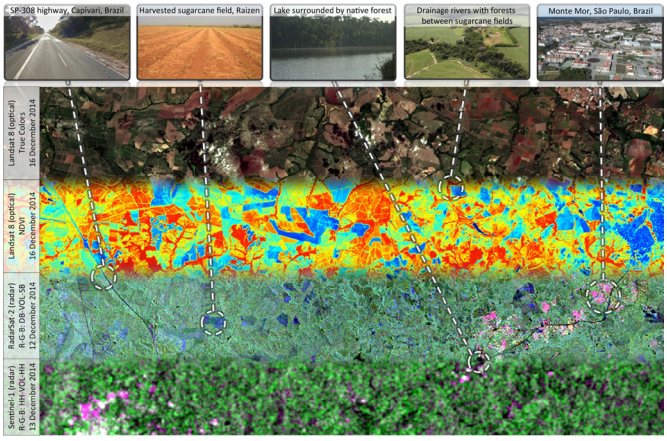
>
> ***Ramon Hanssen***
> *Delft University of Technology*



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Information about the project:
https://bv.fapesp.br/en/auxilios/86785/improved-space-based-remote-sensing-for-land-use-mapping-towards-a-sustainable-expansion-of-the-bioe/

Final presentation by researcher Ramses Molijn:
https://prezi.com/wmohvam0s0ny/20200304-unicamp/?utm_campaign=share&utm_medium=copy

Article about his research: https://www.tudelft.nl/en/ceg/research/stories-of-science/searching-for-sugarcane/

The resulting maps are available online at: http://be-basic.grs.tudelft.nl/maps/316/view

Information on a joint follow-up project:
https://bv.fapesp.br/en/auxilios/100529/monitoring-integrated-crop-livestock-systems-through-remote-sensing-and-precision-agriculture-for-mo/