# THE NETHERLANDS AND BRAZIL

20 showcases of collaboration in science, technology and innovation

Netherlands Innovation Network

**COLOPHON**

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# INNOVATION THROUGH COLLABORATION

Over the past decade, the Netherlands and Brazil have been conducting a myriad of joint research and innovation activities in areas such as aerospace, agriculture, biodiversity, high-tech systems and materials, medical technologies and preventing or mitigating the effects of natural disasters. Starting with the signing of the bilateral Memorandum of Understanding (MoU) Science, Technology and Innovation in 2011, Brazilian and Dutch government agencies have invested in multiple joint research and innovation programs, and have promoted bilateral scientific collaboration between the two countries.

The Netherlands Innovation Attaché Network in Brazil, located in São Paulo, works together with public and private research institutions, universities, knowledge-intensive companies, policy makers and other relevant stakeholders in both countries to stimulate international cooperation in the fields of science, technology and innovation. We facilitate contacts, meetings and visits with organizations with appropriate knowledge and expertise. To this end, we for example organize missions to and from the Netherlands, like in 2018 when the Dutch State Secretary of Economic Affairs and Climate Policy, Mona Keijzer, visited Brazil and signed together with the Brazilian Minister for Science, Technology, Innovation and Communications, Gilberto Kassab, an agreement to intensify the bilateral collaboration. Over the years, we have supported and witnessed a vast amount of inspiring projects and collaborations come to fruition. It is my great pleasure to share some of these stories with you.

Stories about Brazilian and Dutch researchers who met during one of our dedicated meetings and decided to apply for a joint research project. About people from both countries who became friends while both pursuing a PhD somewhere in the world and who have been collaborating ever since. About Dutch researchers who fell in love with Brazil and have been either collaborating with Brazilian colleagues for decades, or even relocated to pursue their further academic career in this South American country. And about companies, who found their innovation soulmates all the way across the Atlantic to open up new markets together.

The research and innovation projects described here cover a wide range of topics, from improving the soil to minimize greenhouse gas emissions associated with sugarcane cultivation; combatting citrus cancer, which threatens Brazil's vital orange juice production; and decreasing water consumption by introducing membrane technology to paper pulp mills; to building sophisticated instruments for the largest telescope ever made and using satellite data to set up a new type of climate change related insurance for farmers and mapping biological diversity to preserve the natural riches of our Earth.

We support public and private organizations to realize their international ambitions, we want to inspire you with these stories and show you what becomes possible if people share their dreams and expertise. Whether it is a single project with one shared PhD student, or a large program involving tens of researchers in both countries; and no matter if it is about fundamental research into yeast metabolism or about a commercial collaboration to develop new materials for airplanes, all scientists and companies involved agree on one thing: collaborating across different continents is a life-changing, enriching experience. Not only on a personal level, but even more importantly, also when it comes to the innovation it leads to. Current-day challenges like those concerning ecology, sustainability and global warming cannot be solved by one country alone. A global approach is essential to provide successful solutions for our future world. And this bilateral collaboration is a great support toward global innovation for societal challenges.

I want to express many thanks to all our partners in Brazil and the Netherlands that are dedicated to stimulate this cross border collaboration by means of funding programs, calls for proposals, networking and other opportunities.

In 2021 we celebrate the 10th anniversary of the MoU signed between the Netherlands and Brazil and I hope there will be many more inspiring new stories to come!

***Petra Smits***
*Counsellor for Science, Technology and Innovation / Innovation Attaché for the Netherlands in Brazil*

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# DIVING INTO YEAST'S SUGAR DIET

**Yeast, the single-cell micro-organism mostly known for its role in the production of beer and bread, harvests an enormous potential to convert organic resources into a myriad of chemical building blocks and biofuels. In a joint research project, Andreas Gombert from the University of Campinas, Brazil, and Aljoscha Wahl from Delft University of Technology, the Netherlands, investigated how yeast grows on sucrose and glucose, in order to understand why and how the yeast sometimes grows faster using one or the other sugar.**

Brazil is a major producer of sugarcane. This crop is not only used for the production of sugar, but also as a feedstock for ethanol production. Yeasts can be used to transform the sugar into alcohols like ethanol. Though sucrose is a more complicated sugar than glucose, yeasts are sometimes able to convert sucrose faster than glucose. Until know, it is not understood why this is the case. In their joint project funded by the BE-BASIC consortium, by FAPESP and by the dual degree program of Delft University of Technology, Andreas Gombert and Aljoscha Wahl aimed to solve this mystery by investigating the mechanisms of metabolic regulation and the associated metabolite concentrations and fluxes involved with sucrose fermentation by yeasts.

'We want to understand how nature works to engineer efficient new types of yeasts and achieve a transition in the way we produce our chemicals and fuels,' Wahl explains the motivation for the research. 'We can only do that when we know down to the molecular level how yeast metabolizes sucrose and glucose,' Gombert adds. 'For this project, Aljoscha and I complement each other in a nice way: I have ample expertise in the biology and physiology of yeasts, and Aljoscha knows more about mathematical modelling and the use of -omics data, like metabolomics and fluxomics' (fluxomics describes rates and speeds of metabolism, whereas metabolomics describes which metabolites are involved – ed). The two researchers, who have known each other since

> *It is enriching to see how other people would solve a puzzle, and to discuss data from different angles.*
>
> ***Aljoscha Wahl***
> *Delft University of Technology*

Gombert held a research position at TU Delft from 2006-2009, hired a joint PhD student from Brazil. Carla Soares Rodrigues performed experiments at both Unicamp and at TU Delft, and is currently writing up her thesis.

## COMPARING DIFFERENT YEAST STRAINS

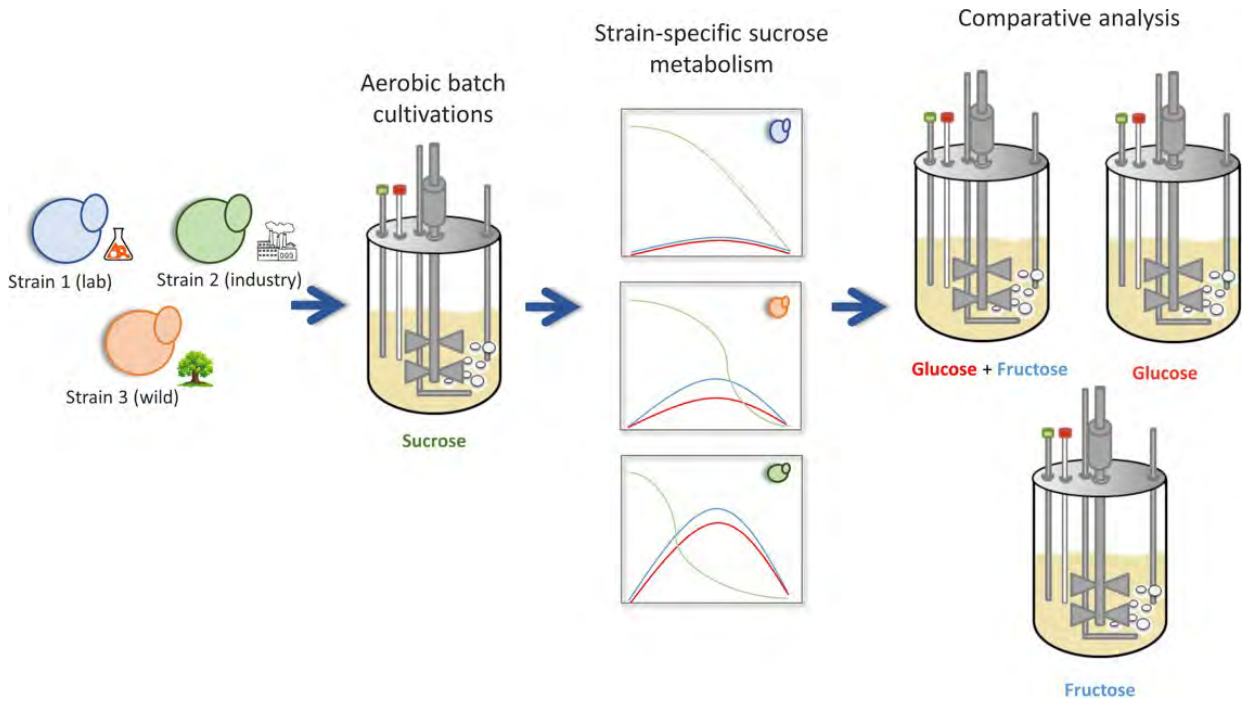
'A lot of knowhow about yeast is based on only a handful of different strains,' Gombert says. But in nature, over 1,500 of different species are known to exist. Since different strains display different behavior, the more diverse strains you study, the more options you discover to engineer new strains to fit your purpose. Wahl: 'Carla compared different strains to see which properties are universal and which are distinctive. The idea was that we would find some interesting features when we would study the different strains under varying conditions. Surprisingly, there was no clear metabolic or proteomic difference found.' Gombert: 'Indeed, we have not been able to identify the cause for the difference in speed of metabolization between glucose and sucrose. But we did rule out some of the possible answers. These types of negative results also advance science, though perhaps in a somewhat less visible way than in case of a positive result.'

## ENRICHING EXPERIENCE

Even though the research did not lead to the outcome they hoped for, Gombert and Wahl valued the collaboration. Sure, it is much easier to collaborate locally, they say. 'With international cooperation, bureaucracy is three times higher. It would help if funding agencies would decrease the bureaucratic hurdles. For example, with the dual degree program, the PhD student needs to fulfill rules of both universities in terms of reports, education, formal talks and forms to be filled in. At least it was agreed that she only has to do one defense,' they laugh.

Still, both would highly recommend their colleagues to search for opportunities to cooperate across the continents. 'Working with people who think differently is fundamental to science,' Gombert says. 'Besides, it has been demonstrated more than once that articles published with international collaborators get cited more often. That is true for any of the involved countries.' Wahl: 'Science is about finding solutions to fundamental questions. It is enriching to see how other people would solve a puzzle, and to discuss data from different angles.'

> *It has been demonstrated more than once that articles published with international collaborators get cited more often.*
>
> ***Andreas Gombert***
> *University of Campinas*




## READ MORE

**Page about the project:**
https://bv.fapesp.br/en/bolsas/166388/why-does-not-saccharomyces-cerevisiae-grow-faster-on-glucose-than-on-sucrose/

**Page about related scholarship for PhD student involved:**
https://bv.fapesp.br/en/auxilios/101228/sucrose-metabolism-in-saccharomyces-cerevisiae-towards-synthetic-yeasts-with-faster-glycolytic-rate/

# BALANCING AGRICULTURE AND NATURE

**How can we combine agriculture with nature in a mutually beneficial way? That is the main question Irene Cardoso, professor of Soil Science at the Brazilian Federal University of Viçosa (UFV), and Thomas Kuyper, Personal Professor of Fungal Ecology and Diversity of the Dutch Wageningen University (WUR) have cooperated on for over twenty years. 'This collaboration goes beyond science. We have become friends.'**

Throughout the tropics, forested landscapes are converted into landscapes dominated by agriculture. Irene Cardoso and Thomas Kuyper have been cooperating in the FOREFRONT program to understand the mechanisms that underlie and drive the changes in these social-ecological systems to reconcile the maintenance of biodiversity with meeting the needs of local actors.

## BRINGING BIOLOGY INTO SOIL FERTILITY

'We've been cooperating for over twenty years now,' the researchers say. 'I did my PhD in Wageningen under co-supervision of Thom,' Cardoso tells. 'From then on, we have stayed in contact and exchanged students. Since my husband is Dutch, I travel to the Netherlands at least once a year. When I am there, I also give lectures at Wageningen University.' 'Irene came here to work on soil fertility and plant growth,' Kuyper says. 'Traditionally, WUR had a strong focus on the chemical approach, using fertilizer. Irene brings in a more biological approach to soil management. Brazil is a frontrunner in this field.'

The University of Viçosa, located in the Brazilian state of Minas Gerais, has been working together with local farmers on agricultural challenges since the eighties, says Cardoso. 'Our agroecology approach is about working toward sustainable practices that are more related with nature. This way of working captured the attention of Thom, who was in fact one of the first in Europe to recognize its advantages. Bit by bit, this idea is now getting through to Europe as well.'

## SHARING LAND INSTEAD OF SPARING IT

The agroecology approach is about sharing land with nature to make optimal use of its benefits. The forest aids climate

> *Our agroecology approach is about working toward sustainable practices that are more related with nature. Bit by bit, this idea is now getting through to Europe as well.*
>
> ***Irene Cardoso***
> *Federal University of Viçosa*

adaptation, for example by retaining water that can be used during the dry season. Some crops grow better under a canopy. And wood products can be used in the agricultural practice, for example to make fences. Cardoso: 'We do not need to convince the farmers of these benefits. They already know that the forest benefits the agroecosystem, and that it is in their own interest to preserve it.'

The multinational cooperation on this topic is mutually beneficial, both say. Kuyper: 'Brazil has a long-standing history in collaborating with local family farmers. The extent to which local farmers there interact with researchers is unprecedented for Dutch standards.' Cardoso: 'WUR helps us theorize our experience with the farmers and put it in a more general framework. And through our cooperation with the Netherlands, we gain European attention for our work.'

Both researchers are proud of the outcome of the program so far. 'We made good progress in understanding the underlying mechanisms of agricultural processes, and the role institutions play in this,' Cardoso says. 'The first four PhD students, two from Viçosa and two from Wageningen,

> *The extent to which local farmers in Brazil interact with researchers is unprecedented for Dutch standards.*
>
> ***Thomas Kuyper***
> *Wageningen University*

obtained double PhD degrees recognized by both institutions and countries, a further demonstration of the equality between both partners,' adds Kuyper.

## STIMULATING EQUALITY

'I do have some suggestions to improve the double degree process though,' Cardoso responds. 'Wageningen only recognizes our students' PhD titles when they defend their thesis in the Netherlands before they do the same in Brazil. In Brazil, we recognize the Dutch students' titles regardless of the order of both defenses. This demonstrates that we still are not perceived as equal partners by WUR.' Also Kuyper has some remarks when it comes to the topic of equality. 'It is hard for Brazilian researchers to find funding, for example to send their MSc students here, whereas we have always been able to send our MSc students there.'

Despite these suggestions for improvement, both Cardoso and Kuyper warmly recommend transcontinental scientific collaboration. Kuyper: 'Engaging with colleagues from other continents changes your perspective on your views and practices. It helps you balance scientific credibility with political tensions, and gives you a broader view on how science can contribute to a better world.' Cardoso: 'Dutch people are nice, respectful, and open to criticism. That is what is needed to make a cooperation work: listen to and respect each other's opinions and viewpoints, even if you don't always agree with them.'

### FOREFRONT

The FOREFRONT program is a collaboration between Wageningen University, the Netherlands, Federal University of Viçosa, Brazil, and two universities in Mexico: IIES (Instituto de Investigaciones en Ecosistemas y Sustentabilidad) and Ecosur (El Colegio de la Frontera Sur). It is funded by the Interdisciplinary Research and Education Fund (INREF) of WUR, which subsidizes the Dutch, Mexican and Brazilian PhDs involved. Additional funding through Brazilian and Mexican institutions has been instrumental for the success of the program. 25 researchers, 5 post-doctoral researchers, 11 PhD candidates and several MSc students from these 4 institutions study the dynamic borders between forested and agricultural land. In Brazil, the studied landscape is located at the Atlantic Forest domain, at the Zona da Mata region of Minas Gerais. The program started in 2015 and ends in 2021. Due to scarcity of funds, no formal new collaboration project has been established yet.

### READ MORE

https://www.wur.nl/Landingspagina-redacteuren-29/en/Value-Creation-Cooperation/FOREFRONT-Program.htm

https://www.youtube.com/watch?v=ZnNxNttpTNQ

https://www.ileia.org/2017/04/18/agroecology-food-sovereignty/

https://edepot.wur.nl/399512

# JOINING FORCES AGAINST CITRUS CANKER

**Brazilian biologist Henrique Ferreira and his Dutch colleague Dirk-Jan Scheffers are working toward an environmentally safe way to combat citrus canker. This highly contagious, endemic disease is a great threat to Brazil's multibillion dollar orange juice industry.**

The culture of citrus fruits is one of the most important agricultural economic activities in Brazil, which is responsible for the production of eighty percent of the orange juice consumed worldwide. However, citrus culture is threatened by several diseases, one of the worst being citrus canker. This disease is caused by a bacterial pathogen named Xanthomonas citri. The bacterium attacks stems, leaves and fruits, leading to lesions and eventually death of the entire tree.

Copper-based bactericides are the most commonly used pesticides to combat this disease. Though effective, these pesticides are not very environmentally friendly. Since copper is not biodegradable, it accumulates in the soil where it affects soil organisms and decreases soil quality. In a series of collaborative projects Henrique Ferreira and Dirk-Jan Scheffers are developing nature-based pest control alternatives which are better for the environment and for human health.

Ferreira and Scheffers go way back, they explain in a joint interview during which they effortless finish each other's sentences. Scheffers: 'We met in 2002 at the University of Oxford, where I was doing a postdoc', 'and I was working on my PhD research,' Ferreira adds. After Ferreira went back to Brazil where he works at the Universidade Estadual Paulista in São Paulo, and Scheffers returned to the Netherlands, where he holds a position at the University of Groningen, they stayed in touch. 'When FAPESP and NWO announced a collaborative call on Biobased Economy back in 2012, we jumped on the occasion to apply for a jointly funded project,' Scheffers says. In the second Biobased Economy call from FAPESP/NWO , they also succeeded in obtaining funds for a follow-up project, which runs until later this year.

## SEAMLESS COLLABORATION

'Henrique was working on the biology of the bacterium that causes citrus canker. He had reported some fascinating results on its cell division processes. Together we wanted to study how we can perturb these cellular processes by targeting specific traits with nature-based compounds,' Scheffers explains. Though far apart, both groups collaborate rather seamlessly. Ferreira: 'My lab works on understanding the biology of the bacteria to find targets for pesticides. Dirk-Jan focuses more on the biochemical analysis of potentially useful compounds. In practice, this translates into me producing different mutants of the bacteria and sending them to Dirk-Jan, who then analyzes how different compounds affect for example the cell division processes or cell walls.'

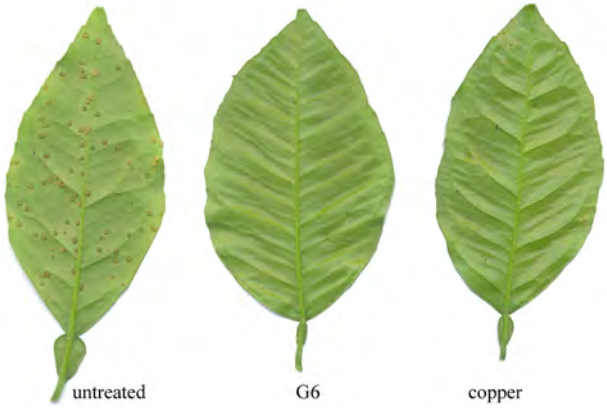
> *We now know what does and does not work, and which of the effective compounds are easy to synthesize and scale up.*
>
> ***Dirk-Jan Scheffers***
> *University of Groningen*

Besides the groups of Ferreira and Scheffers, also other groups in Brazil and the Netherlands are involved in the research. Ferreira: 'For example, we recently involved an agronomist, Dr Behlau, who has access to field experiments through Fundecitrus.' Fundecitrus is an organization funded by orange producers/growers, that monitors citrus diseases and performs applied research on their mitigation. 'They have their own fields we might use for experiments,' Scheffers says. 'That is very valuable, since the bacterium is a restricted organism, and outside of their test fields, we are not allowed to infect trees on purpose.'

## FROM INDIVIDUAL LEAVES TO TREES

So far, both joint projects have been very successful, Ferreira and Scheffers say. Scheffers: 'We have tested many different compounds. We now know what does and does not work, and which of the effective compounds are easy to synthesize and scale up. In the lab, the level of protection from our compounds is similar to that of copper-based pesticides. And the toxicity studies are promising as well; we've shown that our compounds are not harmful to mammalian cells. The next step is to scale up. So far, we have only tested the compounds on small scales, using seedlings in controlled greenhouse experiments in Henrique's lab. We need field experiments to answer questions like: How long is the protective effect when we spray our compounds on the trees? What happens if it rains? What happens to the soil, are our compounds indeed degrading over time? And is it possible to synthesize these compounds from agricultural waste, such as bagasse produced by Brazil's giant sugar cane industry?'

Unfortunately, it is not so easy to find funds for these types of experiments, the scientists experienced. Ferreira: 'Our work is perceived as developing yet another type of pesticide, whilst many of the funding programs are aimed at finding new biological forms of pest control. And we have shifted from purely fundamental research toward more applied questions, leaving us in somewhat of a vacuum when it comes to traditional research funds. It would be great if we would for example be able to capture the attention of a company that can help us work toward actual implementation.'




https://onlinelibrary.wiley.com/doi/10.1002/mbo3.1104

> *It would be great if we would for example be able to capture the attention of a company that can help us work toward actual implementation.*
>
> ***Henrique Ferreira***
> *São Paulo State University*

## READ MORE

**Summary and list of publications from the first project:**
**Research Grants 13/50367-8 - Agronomical Sciences, Agronomy - BV FAPESP**
https://bv.fapesp.br/en/auxilios/84124/new-environmental-friendly-compounds-to-combat-citrus-canker/

**Information on the current joint project:**
**Research Grants 17/50216-0 - Agronomical Sciences, Agronomy - BV FAPESP**
https://bv.fapesp.br/en/auxilios/100824/using-agricultural-waste-to-combat-plant-pathogens-environmental-friendly-ways-to-combat-xanthomonas/

# SECURING SUSTAINABLE SOY SUPPLY

**Build a consortium consisting of twelve public and private partners from two continents and immediately acquire funding. That is what Brazilian and Dutch parties accomplished during the tough pandemic year 2020. The aim: more sustainable soybean production with less agro-chemical use and less adverse environmental side-effects.**

Soybean is a top crop in Brazil. It is also of strategic value to the Dutch economy, which imports nearly 50 percent of its soy from Brazil. That is one of the reasons why forming the consortium went this smoothly despite all travel restrictions, says programme leader Corné Kempenaar, senior scientist at Wageningen University & Research (WUR).

The Brazilian private partner that stepped in first was Stara, Brazil's largest agricultural machinery manufacturer. 'We provide smart solutions for agribusiness, such as planters, seeders, spreaders and sprayers,' tells Stara's R&D Director Cristiano Paim Buss. Another important private partner is the Dutch company Rometron, which provides sensors and other technology for precision agriculture for the market. 'I first met with people from Stara in 2019, when I was invited to give a lecture at the South American Precision Agriculture Conference in Brazil,' the latter recalls. 'Together with Rometron, which I had been connected to before, the three of us applied for a so-called seed money project funded by the Dutch Ministry of Agriculture, Nature and Food Quality. This budget was meant to build a consortium of Dutch and Brazilian public and private partners.'

## INVOLVING THE ENTIRE CHAIN

The seed money project ran in 2020. 'Despite the pandemic we got 12 partners to agree on a proposal for a four-year joint project to develop high precision, cost-effective, circular and robust solutions for data-driven management of arable crops. The project was granted in December 2020,' Kempenaar says with pride. 'The consortium now consists of the private and public parties you need to develop new precision agriculture technology and smart soybean production that can really make it to the market,' he says. 'Besides Stara and Rometron, on the private side also Syngenta and Oro Agri joined us, two companies that are specialised in crop protection products. GDM provides expertise and materials on disease resistant soybean varieties for example. Dutch start-ups Hiber and Agri-dataservices Bioscope joined us with expertise and technology on connectivity and remote sensing. And on the public side, we have besides WUR, the Brazilian Agricultural Research Coperation Embrapa, the Federal University of Santa Maria (Rio Grande do Sul), three Brazilian knowledge institutes on board, plus support of the Dutch Embassy in Brazil.'

> *In our experience, engaging with universities and end users is a powerful way of developing new, marketable technology.*
>
> ***Cristiano Paim Buss***
> *Stara*

The ultimate aim of the project is to develop new business opportunities together, Buss says. 'For Stara, any research we conduct needs to become a product. In our experience, engaging with universities and end users is a powerful way of developing new, marketable technology.' 'This specific collaboration creates an ecosystem of openness,' his colleague Guilherme Silva de Oliveira adds. 'Via the involvement of neutral universities, companies are working together more easily.'

The project started in March 2021. 'It is divided into four different work packages, each involving three to five consortium partners,' Kempenaar explains. Every work package is aimed at a different part of the soybean production process. For example, one of the work packages is looking into the possibilities of developing smart, automated weed control.

The researchers and companies want to use sensors to automatically detect weeds in emerging soy crops, and develop methods to only spray pesticides where needed. Other work packages look into airborne and soilborne disease control, and into smart use of all available crop data to build better crop management models.

## ADD INTELLIGENCE

'We want to add more intelligence to our machines,' Buss says. 'Producing soy beans in Brazil is not easy. We have good weather, but challenging soil, and lots of weeds and bugs to deal with. The use of technology is essential to both increase the yield of the crops, and at the same time lower the environmental burden of crop cultivation by reducing the use of fertilizers and pesticides.' 'About one quarter of Brazil's GDP is generated by agricultural production. If we are able to sustainably increase the yield, that would be of tremendous help for our economy as a whole,' Oliveira adds. 'And with technology, we hope to solve another issue as well,' Buss complements. 'It is hard for farmers to find successors. Technology that increases yield and saves manual labour can open an opportunity and make farming attractive again with the aim to convince farmers' children to reconsider taking over their parents' business.'

Public Private Partnership R&D Smart Soybean Production

Kempenaar enjoys working with the Brazilians on this project. 'The enthusiasm of Brazilian partners like Stara is catching. Precision agriculture is something you cannot develop on your own. You need enthusiastic partners who are willing to invest and share knowledge.' Buss: 'We would like to expand our network to other partners outside Brazil as well. This consortium with Dutch partners is our first step to work closer to Western Europe and get a better understanding of their needs.' 'This collaboration truly brings a new vibe to Brazil,' Oliveira concludes.

> *The consortium consists of the private and public parties you need to develop new precision agriculture technology and smart sustainable soybean production that is ready for the market.*
>
> ***Corné Kempenaar***
> *Wageningen University & Research*

## READ MORE

**Summary of the seed money project: Smarter soybean production through Dutch and Brazilian technology and know how integration - WUR**
https://www.wur.nl/nl/Onderzoek-Resultaten/Onderzoeksprojecten-LNV/Expertisegebieden/kennisonline/Smarter-soybean-production-through-Dutch-and-Brazilian-technology-and-know-how-integration-.htm

**Presentation about the four-year innovation project:**
https://topsectoragrifood.nl/wp-content/uploads/2020/12/Brazilie-Pitch-Soybean-project-dec.-2020-v1.0.pdf

# 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.

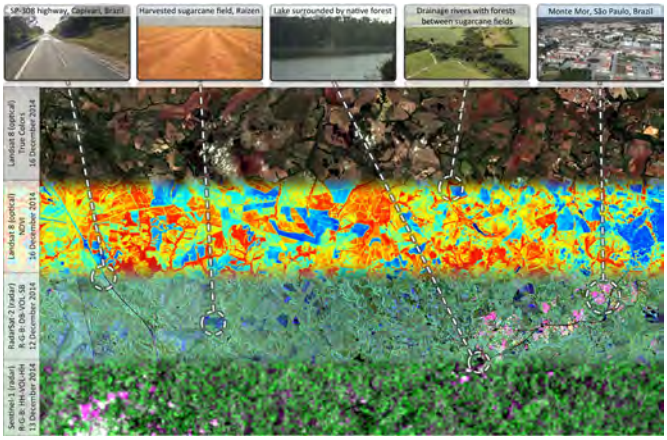
## NATURAL COLLABORATION

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.'

> *To validate our models, we needed the knowledge of the Brazilian team about the growth cycle of sugarcane.*
>
> ***Ramon Hanssen***
> *Delft University of Technology*




## READ MORE

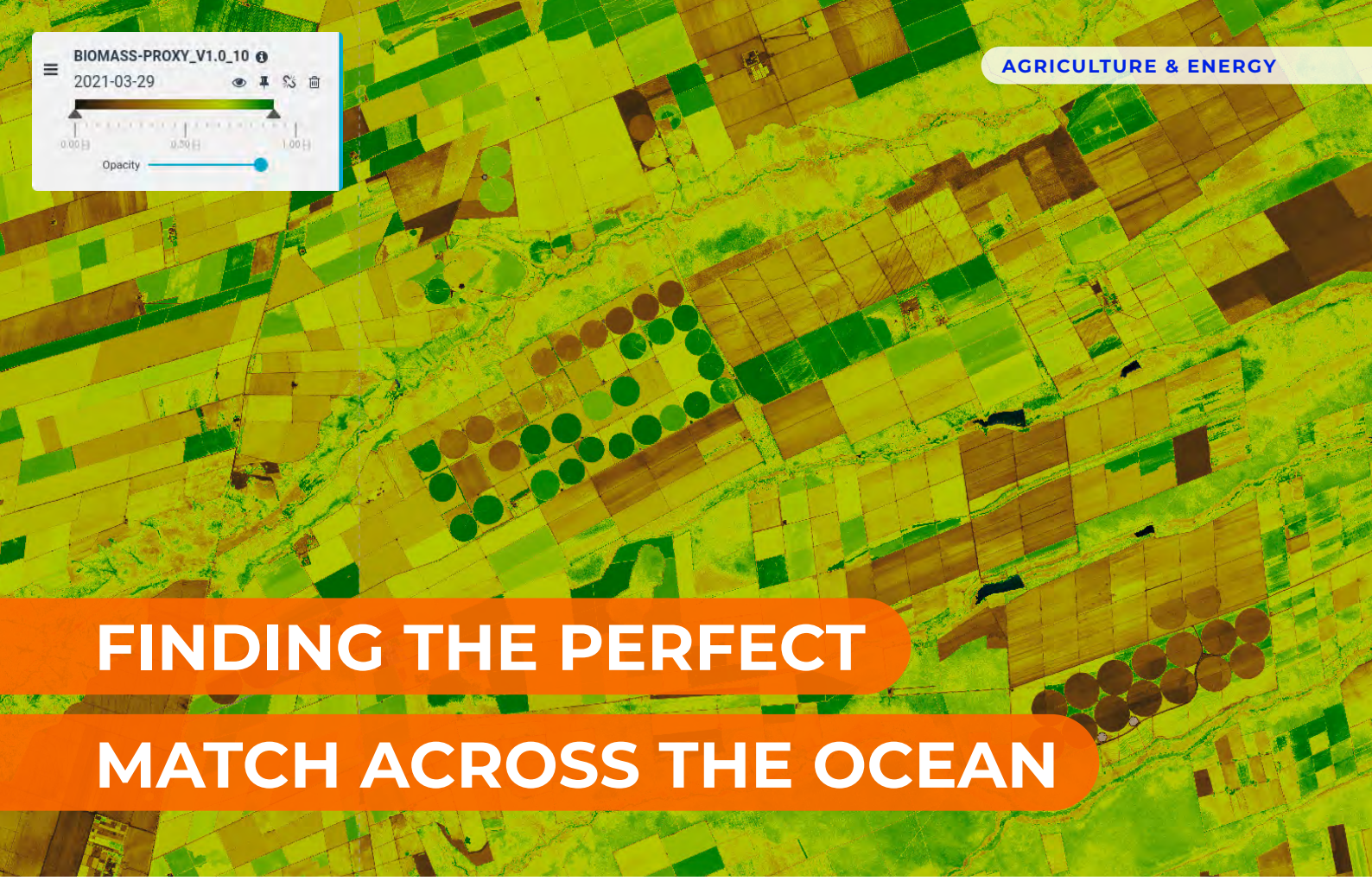
**Information about the project:**
https://bv.fapesp.br/en/auxilios/86785/improved-space-based-remote-sensing-for-land-use-mapping-towards-a-sustainable-expansion-of-the-bioe/

**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/




# FINDING THE PERFECT MATCH ACROSS THE OCEAN

**Only rarely one comes across a commercial collaboration that is so natural and smooth-running as the one between the Brazilian company SpaceTime Labs and its Dutch partner VanderSat. 'It is as though we've found our twin,' respective front men Juan Carlos Castilla-Rubio and Thijs van Leeuwen smile.**

Whoever speaks to SpaceTime Labs' Executive Chairman Juan Carlos Castilla-Rubio and VanderSat's CEO Thijs van Leeuwen, might easily think they are dealing with two colleagues who have been working together at the same company for decades. Nothing could be further from the truth though: they only met two years ago, and where Van Leeuwen's company is located in the Netherlands, Castilla-Rubio's is some 10.000 kilometers away in Brazil.

'At VanderSat, we deliver high-quality data about climate variables based on satellite remote sensing. A couple of years ago we decided that we were missing one key step to transform our data into intelligence that can be used to base decisions on. So we started scouting for leading partners and soon found SpaceTime Labs, which provides exactly the expertise we lack,' Van Leeuwen tells the story of how the collaboration started. 'At SpaceTime Labs we are focused on the "predict" side developing industrial scale automated machine learning, computer vision and advanced analytics platforms that solve complex operational planning, optimization and risk management problems of resource-intensive sectors which are exposed to climate and water risk. So we wanted to partner with a lead player in remote sensing,' complements Castilla-Rubio. He continues: 'During our first conversation we immediately recognized that we share a joint vision. We independently thought of climate change as the topic where it would be critical to make intelligence about natural resources and their associated water and climate risks actionable.'

> *We started scouting for leading partners and soon found SpaceTime Labs, which provides exactly the expertise we lack.*
>
> ***Thijs van Leeuwen***
> *VanderSat*

## SHARING IDEAS AND IDEALS

Besides sharing a vision about a new, interesting business opportunity, both companies also share the same ideal when it comes to the required approach. Castilla-Rubio: 'Trust is the name of the game. So our approach is a science-based one.' Van Leeuwen: 'Both of our teams consist of people with a scientific background. At VanderSat, we employ multiple people with a PhD degree and with a background at ESA or NASA.' 'Add to that our world-class computer scientists and software developers, and there you have it: a very powerful team that is able to make a real impact,' Castilla-Rubio adds.


With the aid of a GlobalStars grant, funded by both the Brazilian (FINEP) and the Dutch governments (RVO), both companies are currently working on a joint project to apply SpaceTime Labs industry-leading artificial intelligence and deep learning technologies to VanderSat's global data service for the energy system in Brazil. 'By combining our expertise, we are able to close the entire chain sense-predict-act. Satellites sense the planet and measure variables to understand water and energy supply. Our two companies together are able to use these data in applications that help companies make better risk management decisions,' Castilla-Rubio explains. 'To be clear, this collaboration goes way beyond the GlobalStars project, with a major focus on making agricultural risk intelligence actionable,' he says. 'Since 2019, we have brought our operations under a joint venture going by the name of RIPPLES.'

## PASSIONATE PITCH

Both men have great ambitions for this joint venture. With a passionate pitch, during which they seamlessly complement each other, Castilla-Rubio and Van Leeuwen sketch an opportunity to fundamentally alter the world of agricultural index insurance. 'As a result of climate change, an insurance gap is arising. Due to weather extremes like droughts or floods, the risk of crop failure is increasing. But there is no capacity to insure all of those risks. We use satellite derived mathematical models of expected and actual quality of crop productivity, such as the amount of sugar in sugarcane per hectare, to both develop an index for the insurance policy, and to monitor if the insurance company should pay out or not, and if so, how much. This way we are able to provide a uniquely neutral, science-based, worldwide scalable service, both to the provider and to the buyer of the insurance.'

When asked about the main added value of their collaboration, both men again demonstrate to work from shared values and beliefs. 'This joint venture helps us in developing new business cases and new markets to address the growing gaps in risk management and risk transfer intelligence. We find each other in wanting to scale a sustainable business by translating sound scientific insights into products that really make an impact on the world,' Van Leeuwen says. 'This is a gigantic opportunity to make impact on a global scale,' Castilla-Rubio agrees. 'Both the severeness and the frequency of climate change related events will only increase. The business world is unprepared for the risks involved. There is an ocean of opportunities we can explore with our combined expertise. I am convinced that we are not only going to disrupt existing markets, but that we will also create entirely new ones. The biggest problems of our time are of a global public goods nature. It is critical for the future of mankind that we develop solutions to those in advanced science and technology focused global collaborations.'

> *There is an ocean of opportunities we can explore with our combined expertise.*
>
> ***Juan Carlos Castilla-Rubio***
> *SpaceTime Labs*

**READ MORE**

**About the GlobalStars project:**
http://vandersat.com/blog/spacetimelabs-and-vandersat-announce-partnership-to-deliver-new-ai-services-for-agriculture-hydropower-and-insurance/

**About the joint venture:** https://www.spacetimeventures.com/ecosystem/joint-ventures/vandersat?rq=Ripples

# EDUCATING A GLOBAL GENERATION

**International scientific collaborations play crucial roles in the education of the next generation of scientists, Brazilian researcher Heitor Cantarella and his Netherlands-based colleague Eiko Kuramae say. 'Current-day challenges concerning ecology, sustainability and global warming require open-minded, well-informed scientists who work on solutions in multidisciplinary teams. International collaboration widens people's views, enriches their judgements and improves the quality of their research.'**

Heitor Cantarella, Director of the Soils and Environmental Resources Center at the Agronomic Institute of Campinas in Brazil, and Eiko Kuramae, Professor of Microbial Community Ecology & Environmental Genomics at Utrecht University and senior researcher at the Netherlands Institute of Ecology (NIOO-KNAW), have known each other for a long time. 'We have cooperated before, for example in projects funded by the Dutch organizations NUFFIC and BE-Basic,' Cantarella explains. 'Our most recent joint project is funded both by Brazil, through FAPESP, and by the Netherlands, through NWO. Such funding from both sides results in a huge joint commitment,' Kuramae adds.

> *People from my lab specialized in soil fertility came back from their stay in the Netherlands with a lot of knowledge on and enthusiasm for soil microbiology.*
>
> ***Heitor Cantarella***
> *Agronomic Institute of Campinas*

## MORE SUSTAINABLE SUGARCANE CULTIVATION

The project is aimed at minimizing greenhouse gas emissions associated with sugarcane cultivation. Currently, over ten million hectares of the Brazilian soil is used to grow sugarcane on. Forty percent of this sugarcane is meant for the production of ethanol, which is supposed to be a green alternative for fossil fuels. But to make this alternative more sustainable, the amount of greenhouse gases emitted during the growth of the sugarcane should be decreased.

Cantarella: 'We wanted to know how the greenhouse gas emission takes place, and what role fertilizers play in this. As an agronomist, I am interested in plant nutrition and soil. For this

project, we were looking for partners who had expertise in soil microbiology and biochemistry. And that is exactly the expertise Eiko brings in. Kuramae: 'I am interested in the soil microbial processes related to transformation of nitrogen into nitrous oxide ($N_2O$). Before we started this project, not much was known about sugarcane-related processes in the tropical soil that contribute to climate change.'

## EXCELLENT SCIENCE CRUCIAL FOR PRACTICAL RECOMMENDATIONS

The research project has been very successful so far, Cantarella states. 'The quality of the science was recognized within the BE-Basic and NWO-FAPESP programs, and multiple PhDs and postdocs were awarded prizes for their PhD theses, papers and poster presentations at international conferences. I myself got awarded the IFA Norman Borlaug Award in 2017. The jury report explicitly mentioned the outcomes of this project as a highlight in my career.'

The project allowed the researchers to produce recommendations for agricultural practice as well. For example, they proved that by adding nitrification inhibitors, it is possible to reduce the emission of nitrous oxide up to 95 percent. 'We also showed that a simple change in daily practice can lead to significant emission reductions,' Kuramae adds. 'Brazilian legislation requires the recycling of vinasse, an organic residue from the ethanol production process, as sugarcane fertilizer. If you apply this vinasse separate from the nitrogen fertilizer you can reach emission reductions of about 30 percent.' An additional advantage of using and recycling these different types of fertilizers is that it increases soil biodiversity in terms of microorganisms and improves soil quality and health.

Though at the moment there is no funding available for a joint follow up project, both researchers are still collaborating and exchanging master students, PhDs and postdocs. 'Brazilian research fits Dutch interests well,' Kuramae says. 'Practices like intercropping (growing different crops together) are common in Brazil, but fairly new to the Dutch agricultural system. We can learn from Brazil how biodiversity above ground can steer and increase the biodiversity below ground. And consequently, how it can increase the ecosystem services delivered by microbes.' Cantarella: 'People from my lab specialized in soil fertility came back from their stay in the Netherlands with a lot of knowledge on and enthusiasm for soil microbiology. And they got a much broader view on various cultural and scientific approaches.'

## BUILDING A CAPABLE COMMUNITY

International collaboration is an enriching experience for all those involved, both researchers agree. 'In international collaboration, 1 and 1 is so much more than 2. The benefits are immense for everyone, especially for young scientists. Exchange programs add to their creativity, and build experiences they will carry with them throughout their lives and carriers. And the publications that result from the research are much better since they have a wider scope. These types of joint projects act as breeding ground for international networks. Our young scientists will remain connected, and will form a global generation of scientists with the right expertise and mindset to work on global challenges.'

> *Before we started this project, not much was known about sugarcane-related processes in the tropical soil that contribute to climate change'*
>
> ***Eiko Kuramae***
> *Netherlands Institute of Ecology*

## READ MORE

**Article on the joint project:**
https://agencia.fapesp.br/novel-nitrogen-management-method-helps-mitigate-ghg-emissions-of-sugarcane-fields/26640/

**Personal page of Eiko Kuramae:**
https://nioo.knaw.nl/nl/employees/Eiko-Kuramae

**Overview of research by Heitor Cantarella:**
https://bv.fapesp.br/en/pesquisador/983/heitor-cantarella

# WIN-WIN IN WATER TREATMENT

**If there is one thing the Netherlands are famous for, besides the traditional wooden clogs and windmills, it is for their knowledge of water technology. That is a perfect match with Brazil's large and still growing pulp and paper mill industry, which consumes huge amounts of water. Brazilian and Dutch researchers are jointly investigating the possibilities of using membrane technology to decrease the water consumption of a pulp mill in the Brazilian State of Minas Gerais.**

'Brazil is a big player in pulp and paper industry, which converts wood chips into pulp and paper,' project leader Cláudio Mudadu Silva from Brazil's Federal University of Viçosa explains. 'These mills use huge amounts of water and generate high volumes of effluents. In this project, funded by the Research Support Foundation of the State of Minas Gerais (FAPEMIG), in partnership with the Task Force for Applied Research (SIA) of the Dutch Organization for Scientific Research (NWO), we are focusing on one particular mill of the company CENIBRA. That mill takes its water from the Rio Doce basin. In 2015, this river in southeast Brazil faced an ecological disaster, when a mining dam collapse resulted in highly contaminated water being released into the river. Our study aims to propose solutions to decrease the total water consumption of the mill and, thus, decrease the total stress on the Rio Doce basin.'

Co-leader Luewton Agostinho, who originates from Brazil and has been living in the Netherlands since 2008, recollects how the project came about: 'My research institution, NHL Stenden University of Applied Sciences, has different collaborations with Brazil. We were active participants in Brazil's Science Without Borders Program, and still receive about 5 to 6 Brazilian students to the Netherlands each year. We also participate in the BRANETEC exchange program which facilitates exchange of both professors and students between both countries. Cláudio came to my group within the scope of this program, and we got to know each other's work rather well.'

## JOINT PROGRAM

After several years of exchanging students and organizing courses together, Agostinho took a next step. 'In the Netherlands, we have "universities of applied sciences", HBO's. These institutions perform application oriented research in tight collaborations with industries and companies. Since an increasing number of these HBO's were interested in collaborating with Brazil, we involved SIA, an organization dedicated to HBO research funding. Ultimately, this resulted in a joint program between SIA and FAPEMIG, the research funding agency of the State of Minas Gerais, which funded our joint WatMin project.'

The scientists had to involve at least one company from each country in their project. In Brazil, CENIBRA showed a lot of interest. Also SENAI got involved, a state agency that monitors the river's water quality. In the Netherlands, Berghof Membranes joined the project. Agostinho: 'Berghof is specialized in membrane technology for ultrafiltration. Together with them we tested what types of membrane separation technology we could use in the pulp mill to recover

> *Our study aims to propose solutions to decrease the total water consumption of a particular pulp mill and, thus, decrease the total stress on the Rio Doce basin.*
>
> ***Cláudio Mudadu Silva***
> *Federal University of Viçosa*

some of the water and useful products, and decrease the net water consumption.' Mudadu Silva: 'First, we had to understand the water balance in the mill. What parts of the process requires what water quality, and where can excess water be recovered? What kind of effluents does the water contain after the different process steps, and is it possible to recover some of the valuable components? For a pulp mill, it is common to lose 1 percent of fiber production in the wastewater. These mills produce 3500 tons of pulp each day. So if you are able to recover even only a fraction of that production from the effluents, it would be a great advantage.'

The researchers built a pilot plant in the lab in the Netherlands, and transported it to the pulp mill in Brazil. Mudadu Silva: 'We now have a picture where and how we can use the membranes, and what the associated costs and benefits are in terms of water conservation and recovery of valuable components from the wastewater. Now it is up to industry to decide if and how, they want to use this technology. The pulp mills in Brazil are what we call fast followers: if one mill puts a novel process in practice and proves its advantages, others will follow quickly.'

## CONNECTING SOLUTIONS TO NEW MARKETS

'The Netherlands has a tradition in water technology and has ample companies offering good solutions to markets,' Agostinho comments when asked about the added value of this transnational collaboration. 'Brazil has a huge end user cluster, consisting both of companies and municipalities. However, to implement wastewater treatments elsewhere, the technology has to be adapted to local circumstances, like climate, the knowledge level of operators and acceptable level of costs. These types of questions can be tackled by scientific research.' Mudadu Silva adds: 'The Netherlands doesn't have pulp mills. For them, this collaboration opens up giant new markets. And for Brazil, membrane technology still is rather new, in spite of being an important technology worldwide for water and wastewater treatment. If we prove this technology is also applicable in such context, this rather small investment in research might lead to giant revenues, both in terms of commercial and of environmental gain.'

> *The Netherlands has a tradition in water technology and has ample companies offering good solutions to markets. Brazil has a huge end user cluster, consisting both of companies and municipalities.*
>
> ***Luewton Agostinho***
> *NHL Stenden University of Applied Sciences*

## READ MORE

**Description of the project: Application of wastewater treatment systems to minimize the water consumption of a pulp mill located in the Rio Doce basin (WatMin). | NWO**
https://www.nwo.nl/en/projects/bbbwt01001

**News articles on the launch and granting of the call (in Portuguese):**
https://ufla.br/arquivo-de-noticias/10527-fapemig-lanca-chamada-conjunta-sobre-biobased-water-technology

https://confap.org.br/news/fapemig-divulga-resultado-de-manifestacao-de-interesse-de-chamada-fapemig-sia/

# RECIPE FOR FOREST RESTORATION

**In the joint Brazilian/Dutch research program 'Ecosystem restoration: the Brazilian Atlantic Forest as a case study', four teams of researchers from both countries are investigating successful recipes for the restoration of forests. 'If you are working on biodiversity, Brazil is the place to be,' Dutch researcher Hans ter Steege states.**

The Atlantic Forest covers 17 Brazilian states and extends along the Atlantic coast of Brazil from the Piauí state in the north to the Rio Grande do Sul state in the south, and inland as far as Paraguay and the Misiones Province of Argentina. It once covered 1.5 million square kilometers. Nowadays, only sixteen percent of the forest is left, spread out in small and larger fragments. Current Brazilian governmental policies are aiming to recover thousands of hectares of the original forest biome. The main question of the joint Brazilian-Dutch research program, funded both by FAPESP from the State São Paulo and NWO in the Netherlands, is how the forest can be restored in such a way that the biodiversity and ecosystem services of this unique ecosystem are conserved and recovered where needed and possible.

## EXTENSIVE PREPARATIONS

'The formal joint call was published in 2018,' Carlos Joly, Professor of Plant Ecology of the University of Campinas and chairman of the BIOTA-FAPESP research program (FAPESP Research Program on Biodiversity Characterization, Conservation, Restoration and Sustainable Use), recalls. 'FAPESP and NWO decided to fund projects of large teams that involve many students and early career researchers. The teams consist of six to seven researchers, including two principal investigators from both countries.' The call was the result of extensive discussions between representatives of the BIOTA-FAPESP program and Dutch researchers representing the Dutch national Nature4Life knowledge agenda. Among the latter were Johan Mols, research policy officer at research institute Naturalis Biodiversity Center, and his colleague, senior researcher Hans ter Steege. 'Biodiversity is globally under pressure. While we were writing the Nature4Life knowledge agenda, we knew that we needed to also strive for international collaborations on this topic,' Mols says. 'We went to Brazil and visited the different ministries and institutes involved in biodiversity research. The BIOTA-FAPESP program in the State São Paulo really impressed us. Apart from its long duration – the program has been running for over two decades now – the research results are also adopted by the state's government and translated into preservation policies. We were very pleased that NWO and FAPESP ended up joining forces in this exciting new research program.'

> *Brazil has a very high level of ambition when it comes to reforestation. In the Netherlands we can learn a lot from the Brazilian approach.*
>
> ***Hans ter Steege***
> *Naturalis Biodiversity Center*

## MUTUALLY BENEFICIAL

The collaboration is mutually beneficial the three men say. Ter Steege: 'Brazil has a very high level of ambition when it comes to reforestation. I have seen forests where over a hundred different species have been reintroduced, and they are doing well. In the Netherlands we can learn a lot from that approach. Especially since the Atlantic Forest has some striking similarities with the Dutch situation in the sense that the forest fragments occur in a landscape with intensive agriculture.' Joly: 'Dutch research labs have access to analytic

tools we lack here, because either they are too expensive or they require an infrastructure that is not available in Brazil. Combining our different expertise leads to higher quality papers and groundbreaking science.'

The program kicked off with a large meeting in Brazil where Dutch and Brazilian researchers presented their work. Joly: 'Most of these people were already collaborating. But not yet in a formal way, and almost always in a one-to-one setting. This joint program has enabled them to step up the cooperation and formalize these existing relationships.' Eventually, four projects received funding from FAPESP and NWO. Ter Steege: 'NWO and FAPESP chose to grant four interlinked, complementary projects that touch upon all relevant aspects of reforestation. The projects address topics from soil quality and interactions between flora and fauna to the social and ecological costs and benefits of reforestation projects.'

> *This joint program has enabled researchers to step up the cooperation and formalize existing relationships.*
>
> ***Carlos Joly***
> *University of Campinas*

### MANAGING FOREST LANDSCAPE TO OPTIMIZE ECOSYSTEM SERVICES

*Prof. dr. R.G.A. Boot and Dr. R.W. Verburg (Utrecht University), Dr. A. Camargo Martensen (Federal University of São Carlos, Natural Science Centre – Lagoa do Sino, UFSCar), Dr. P.A. Verweij (Utrecht University), A. Duden, MSc. (Utrecht University), Dr. A. Uezu (Ecological Research Institute IPÊ).*

This project addresses the question how the multi-functional Atlantic Forest landscape can be effectively managed in order to optimize and distribute its goods and services among the local actors who live and work there. The project seeks to better understand the socio-ecological systems that drive forest change and the spatial distribution of ecosystem services in the landscape, including political and economic trends and the balance among social and ecological costs and benefits. Integrating these types of knowledge will allow for more effective upscaling of restoration and conservation efforts. The enabling policy environments are assessed to develop proper incentives for forest restoration and provision of ecosystem services.

### WIDE VARIETY OF QUESTIONS

Reforestation is not a matter of simply planting a number of trees and waiting for them to grow, Joly explains. 'The result might look as a forest, but rarely functions as one. When young trees grow older, they need to start reproducing. How do you facilitate the dispersal of seeds? How do you bring back animals? How do you make sure the forest can deliver all of its ecosystem services, such as retaining water or capture and store carbon dioxide?' 'Reforestation poses challenges at different scales,' Mols adds. 'That ranges from climate change to how reforestation should be balanced with agricultural land-use. These challenges are too big for one research group to solve. You have to combine different datasets that describe all aspects of the entire forest. But how do you couple different types of data? Which techniques can you use? What socio-economic issues play a role? How can you include all stakeholders, ranging from nature conservation organizations to farmers and municipalities? All of these aspects are crucial to drafting useful policy recommendations.'

Because that is the ultimate aim of the research, the three men agree. 'Eventually, we hope to come to some sort of a menu for public policy, describing which ingredients you should use in which situation to rebuild a forest with the desired ecosystem functionality,' Joly says. Ter Steege adds: 'When you are in the forest, surrounded by the wonders of nature, you immediately know what you are doing it for.' Mols concludes: 'We are happy that this joint program functioned as a stepping stone for the continued formal collaboration between both countries on biodiversity, as this topic is now also officially included in the Governmental Joint Program of Cooperation between the Netherlands and Brazil for the period of 2020 to 2023.'

> *Biodiversity is globally under pressure. We knew that we needed to strive for international collaborations on this topic.*
>
> ***Johan Mols***
> *Naturalis Biodiversity Center*

### READ MORE

**About the joint program:**
https://www.nwo.nl/en/news/four-projects-funded-within-nwo-fapesp-joint-call-ecosystem-restoration-brazilian-atlantic

**About the BIOTA program:**
https://fapesp.br/en/biota

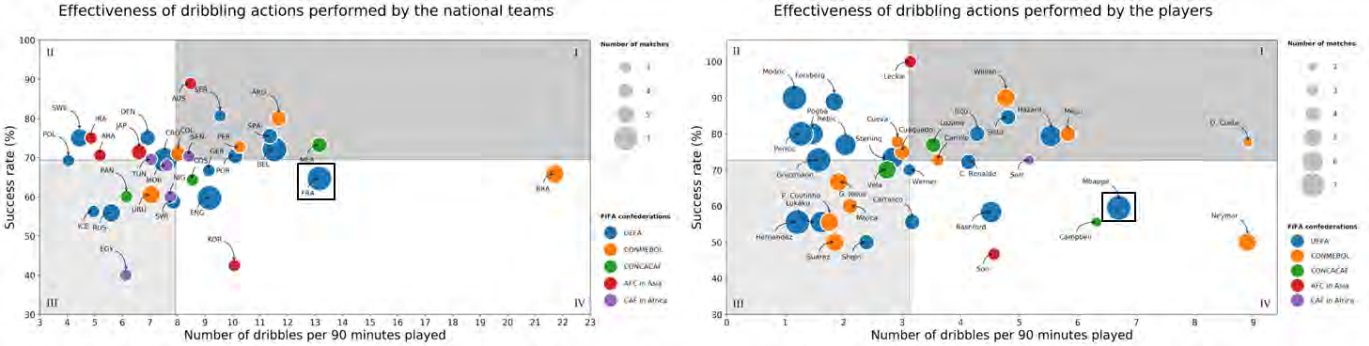
# CAPTURE SUCCESS IN SOCCER

**Combine data science and sport science to help soccer teams become successful. Researchers from the Brazilian University of Campinas (UNICAMP) and the Dutch University of Groningen (RUG) are taking the first steps toward this goal in their project 'The secret of playing football: Brazil versus the Netherlands'.**

Pelé, Neymar, Cruijff, and Van Basten. These surnames refer to some of the greatest Brazilian and Dutch soccer players of all time. Is it possible to quantify what makes a soccer player successful and how this talent develops over the years? And could a combination of data science and sports science lead to the development of a coach's cockpit to optimize the team's performance during the match? To answer these questions, sport scientists Koen Lemmink (RUG) and Sergio Cunha (UNICAMP) joined forces with computer scientist Ricardo da Silva Torres, who in 2019 transferred from UNICAMP to the Norwegian University of Science and Technology.

The collaboration started with Dutch researcher Koen Lemmink taking part in a delegation to Brazil organized in 2016 by the Dutch Ministry of Foreign Affairs. 'I did not know Sergio and Ricardo before. But when I asked European colleagues whom I should be talking to in Brazil, theirs were the names they mentioned. When in Brazil I first met Felipe Moura, whose name I knew from scientific papers.' 'I had been working with Felipe before,' Brazilian scientist Sergio Cunha adds. 'He connected all of us. Very soon after, we started to write this proposal for a FAPESP/NWO project together.'

> *We use data about velocities, accelerations, passes and other tactical moves to study practical and tactical elements of football.*
>
> ***Sergio Cunha***
> *University of Campinas*




Kleber Leal , Allan Pinto, Ricardo da Silva Torres, Marije Elferink-Gemser, Sergio Augusto Cunha. Characterization and analyses of dribbling actions in soccer: a novel definition and effectiveness of dribbles in the 2018 FIFA World Cup Russia™. (HUMMOV-00513-2020-03)

> *It is my hope that we will eventually build a worldwide network of collaborating sports and computer scientists.*
>
> ***Ricardo da Silva Torres***
> *Former UNICAMP and since 2019 Norwegian University of Science and Technology*

## COLLECTING DYNAMIC DATA

In their joint project, the scientists are developing new ways to quantify and then characterize what is going on during soccer matches. They collect data about the match itself, the tactics, and movements and physiological properties of individual players. Cunha: 'Through a video surveillance system and radiofrequency antenna's, we track the ball's and players' movements with great accuracy. We use these data about velocities, accelerations, passes and other tactical moves to study practical and tactical elements of the play.' Lemmink: 'We also used data with information from videotaped matches from the Dutch premier league. All in all, we have a vast amount of data both on the level of individual players, on the interactions between them in subgroups or teams, and on how those affect the play and lead to success. Now we are looking for deeper ways to use these dynamic data to quantify what is happening on the field, and how a coach could influence that.'

The project focusses both on physical and tactical parameters of soccer. The researchers not only study how fatigue influences the performance of individual players, but also how players cooperate on the field and how that affects their opponents' behavior. In the end, the project aims to compare playing styles between the two countries. Cunha: 'Brazilian soccer players tend to play based on intuition, whereas in Dutch teams, often predefined tactics are key. Determining what variables are needed to describe the differences adequately is one of the first major challenges to overcome.'

## USING NETWORK THEORY TO SCORE A GOAL

Both Torres and Cunha spent a year in the Netherlands as part of this collaboration. Cunha: 'In Groningen I studied the concept of dribbling. For our models to distinguish dribbling from running or walking, we need an accurate definition of what dribbling actually is in physical and technical terms.' 'From a computer science point of view, we want to know how we can advance the state of the art in computer science in order to help advance the state of the art in sport science,' Torres explains. 'We are for example looking at different ways of encoding the relationship between players over time. We use complex network theory where the relationships are represented by so called graphs, and players are characterized as nodes. Now we need to determine which network indicators are most useful to describe the dynamics between the players. Eventually, we want to use this network description to deduce how certain tactical decisions can lead to desired actions in the field, such as getting close to scoring a goal.'

This project is one of the first worldwide to truly integrate sports science with data science and computer science. 'This is a very promising approach with major potential for other sports as well. We can for example easily extend our method to futsal or handball,' says Cunha. Lemmink: 'The funny thing is that I needed to go to Brazil to discover the possibilities of involving computer scientists in my work, also in the Netherlands. As a result of this project, the department of Human Movement Sciences in Groningen recently even hired a full-time data scientist. This project undoubtedly is the start of something bigger.' 'It is my hope that we will eventually build a worldwide network of collaborating sports and computer scientists. That combination opens up so many other opportunities for interesting studies,' Torres concludes.

> *The funny thing is that I needed to go to Brazil to discover the possibilities of involving computer scientists in my work, also in the Netherlands.*
>
> ***Koen Lemmink***
> *University of Groningen*

## READ MORE

**Description of the project on the website of FAPESP:**
https://bv.fapesp.br/en/auxilios/97539/the-secret-of-playing-football-brazil-versus-the-netherlands/

**Jointly written review:**
https://read.qxmd.com/read/32297547/unlocking-the-potential-of-big-data-to-support-tactical-performance-analysis-in-professional-soccer-a-systematic-review

# SETTING PEOPLE IN MOTION

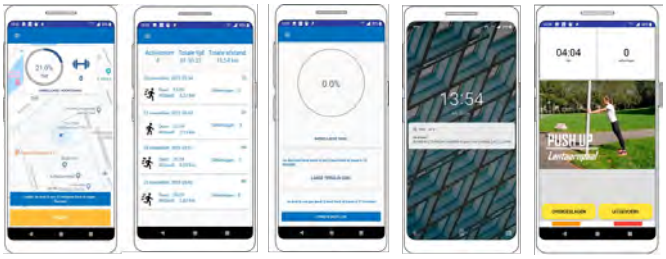
**How can we use technology to increase physical activity of city dwellers? That was the central theme of the project 'Playful data-driven Active Urban Living'. In this recently finished project, Brazilian and Dutch researchers have been working on a science-based app that adapts to the user's physical activity level, health, personality and residential context.**

'Many of the currently available exercise apps are aimed at highly educated, healthy people who want to improve their physical condition even more. In our project, we explicitly aimed for a different target group: we wanted to reach lower fitness city dwellers with a lower socio-economic status, who face higher cardiovascular risks,' Brazilian project coordinator Victor Dourado, Associate Professor at the Federal University of São Paulo, explains. 'The unique feature of our app is that it is highly personalized, and can engage in tailormade conversations with individual users.'

## PERFECT TIMING

'From a previous project with the municipality of Amsterdam we had some beacons left,' Dutch coordinator Ben Kröse, emeritus professor of the University of Amsterdam and the Hogeschool van Amsterdam adds. 'These beacons are small sensors that can be implemented in the urban landscape, and can be used to send app users a location-specific message when they are in the vicinity of a beacon. Then the call for research proposals came in the "Data-driven research on Sports and Healthy Living" program funded by FAPESP, NWO and the Taskforce for Applied Research (SIA). This was a perfect opportunity for us to exploit our expertise in combining sports, health and ICT.'

Also for Dourado, this joint call came at the perfect time. 'I have a background in human movement sciences and was in the final stage of obtaining an additional degree in computer




engineering when I was approached by Dutch professor Marije Deutekom to join this project. This was the ultimate opportunity for me to shift my academic career toward integrating my two fields of interest.'

## VARIED TEAM

The project team combined a myriad of different backgrounds. In Brazil, besides Dourado and his group of human movement researchers, also behavioral scientists and gerontologists from the Federal University of São Carlos were

> *We wanted to combine insights from behavioral science, machine learning, data science and gamification in an app, which we would then test on users in Brazil.*
>
> ***Ben Kröse***
> *University of Amsterdam*

> *When I was approached by the Dutch to join this project, it was the ultimate opportunity for me to shift my academic career toward integrating my two fields of interest: human movement sciences and computer engineering.*
>
> ***Victor Dourado***
> *Federal University of São Paulo*

involved. In the Netherlands, machine learning and data management specialists in Kröse's group teamed up with gamification experts from Utrecht University and sports scientists from the Hogeschool van Amsterdam, which is a university of applied sciences.

'We wanted to combine insights from behavioral science, machine learning, data science and gamification in an app, which we would then test on users in Brazil,' Kröse says. 'But that turned out to be a bit overambitious,' Dutch PhD student Karlijn Sporrel says with regret. 'We indeed built a prototype of the app, which combines proven strategies to change behavior with state-of-the-art machine learning techniques to make it context dependent and personalized. But unfortunately, the app appeared not stable enough for most Android phones. So we haven't been able to get to the large user test we had planned at the beginning.'

## DIFFERENT DEMANDS

That posed a problem for the Brazilian researchers involved, Dourado says. 'One of the lessons I learnt from this project, is that it is wise to inform your partners head on about the demands made by your funding agency. In the Netherlands, researchers are allowed to deviate from the route they described in their proposal, as long as they justify this choice in their reports. In Brazil, at least with FAPESP, people are checking if you deliver on your promise. And since FAPESP is about the only agency we can turn to for research funding, it is crucial for your career not to be associated with failure. We did publish some nice papers on the research we did here with focus groups and questionnaires to determine the requirements for the app, and we conducted a field study with a different, commercially available app. But still, we didn't tick all the boxes of our promised deliverables.'

The project has led to a very promising prototype that deserves to be developed further, all three researchers agree. However, in the Netherlands, the app has landed in somewhat of a vacuum, Sporrel says. 'Ben Kröse retired. And Marije Deutekom has accepted a new position at another institution. As a result, no one is coordinating any follow up initiatives.' 'I am searching in Brazil for additional funding,' Dourado says. 'It would be a pity if we leave this on a shelf while so much of the preparatory work has been finished.'

## INVEST IN EXCHANGE

'In hindsight, both this call and our project plan perhaps were too ambitious,' Kröse concludes. 'We not only brought together researchers from two continents and from very different backgrounds, but within the Netherlands we also combined two different types of higher education institutes, which each have their own dynamics and demands. International collaboration is challenging enough as it is. Perhaps for funding agencies who want to stimulate international collaborations, it would be best to keep it simple. Invest in scholarships to stimulate exchange of students and staff.' Dourado agrees. 'Exchange of students and staff is essential for the scientific upbringing of the next generation of researchers.'

> *We built a prototype of an exercise app, which combines proven strategies to change behavior with state-of-the-art machine learning techniques to make it context dependent and personalized.*
>
> ***Karlijn Sporrel***
> *Dutch PhD student Utrecht University*

## READ MORE

**FAPESP website on the project:** https://bv.fapesp.br/en/auxilios/98295/playful-data-driven-active-urban-living/

**Article on how to tailor apps to older people in low-income communities:** https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0242192

**Article describing the framework for the app:** https://www.frontiersin.org/articles/10.3389/fpubh.2020.528472/full

# AGEING HEALTHY ACROSS THE GLOBE

**The world population is ageing at fast pace, leading to an increasing occurrence of chronic diseases. Brazilian and Dutch researchers jointly study the biological factors that underly the ageing process, in order to develop interventions that maximize the functional capacity, independence, and quality of life of the elderly anywhere in the world.**

Over the past ten years the technology for genetic research has improved significantly. By combining molecular epidemiology and genetics researchers are able to define risk profiles for ageing-related disorders like cardiovascular disease or dementia. But ageing processes are not only determined by genetic traits. The factors that determine how and when you will die, are also related to one's living conditions. Comparing different backgrounds and differences in socio-economic status is therefore vital to really get a grip on the heterogeneity of ageing processes, explains Professor of Molecular Epidemiology at Leiden University Eline Slagboom, who is leading the Dutch public-private multidisciplinary program on healthy ageing, called 'Vitality Oriented Innovations for the Life course of the Ageing Society (Voila)'.

Together with Edson Amaro, neuroradiologist at Albert Einstein Hospital and Head of Big Data Analysis at the University of São Paulo, she stimulates the research collaboration between the two countries on Healthy Ageing. Amaro and Slagboom have known each other for several years, Slagboom tells. 'After I had started the Dutch Society for Healthy Ageing (DuSRA) in 2015, which connected the rather fragmented research on healthy ageing in the Netherlands, I

> *By only focusing on western worlds, many of the possible causes for genetic diseases are outside our field of vision.*
>
> ***Eline Slagboom***
> *Leiden University*

was invited to give a lecture at the Albert Einstein hospital in São Paulo where Edson works. Both our countries are facing a growing population of elderly people. As researchers, we want to determine until which point ageing effects are reversible. What can be done when someone is in his thirties to prevent physiological problems from occurring in his sixties?'

One way of joining and enjoying each other's expertise is by the online summer school Amaro and Slagboom organized in June 2021 together with others in Leiden, São Paulo and Rio on big data analytics in molecular epidemiology, infectious disease and clinical management. The summer school was attended by 30 Brazilian and 20 Dutch master students.

## LARGE-SCALE LONGITUDINAL STUDY

'In Brazil, the population is ageing at an even faster pace than in European countries,' Amaro adds. 'Brazil and the

Netherlands present interesting differences in socio-economic status, lifestyles, nutrition, culture and genetics. All of these affect the ageing process.' Amaro is one of the lead researchers participating in Brazil's longitudinal SABE study, which has been monitoring elderly people in the city of São Paulo since 2000. 'This study encompasses 1,600 subjects followed over 20 years,' he explains. 'This epidemiologically based study has active follow-up in many dimensions, including but not limited to frailty, genomics, behavior and social determinants of health. Dutch studies typically reflect western high-income populations. In contrast, the SABE cohort contains a high rate of illiteracy and low education subjects. Also, the genomes of Brazilians are very informative for unraveling the genetics of ageing and disease, since each individual carries varying proportions of all three major continental ancestries.'

This collaboration between two vastly different countries at two different continents has a major added value for the healthy ageing research field as a whole, both scientists agree. 'We are looking for biomarkers that can distinct between healthy and non-healthy developments, to eventually be able to intervene in ageing processes. But by only focusing on western worlds, many of the possible causes for genetic diseases are outside our field of vision,' Slagboom says. Amaro: 'Understanding the metabolomics and social determinants of health in the two populations can generate knowledge that is applicable to any country. And it provides an opportunity to better determine the roles of genetic, social and health policies contexts in promoting wellbeing during the ageing process.'

In ageing research, differences between individuals are of huge importance, Slagboom concludes. 'To find out which intervention is most suitable for whom, we need to include as many different populations in our research as possible. Healthy ageing is relevant for the entire world population.' Amaro: 'Ultimately, we hope this program can help improve health conditions in any country, and particularly in the poorest areas.'

> *Understanding the metabolomics and social determinants of health in the two populations can generate knowledge that is applicable to any country.*
>
> ***Edson Amaro***
> *Albert Einstein Hospital*

### JOINT BRAZILIAN-DUTCH PROGRAM ON HEALTHY AGEING

Recently a joint program on Healthy Ageing was funded by the Dutch Research Council NWO and the São Paulo Research Foundation FAPESP. In a first round, two projects were granted.

The first project is focused on vascular ageing. Vascular ageing is caused by an accumulation of unrepaired DNA damage and mitochondrial dysfunction in the vessel wall, which both increase with age. In their joint project, Professor Hoeijmakers of the Dutch Erasmus Medical Center and Professor Menck of the Brazilian University of São Paulo aim to better understand the mechanisms involved, to prevent age-related diseases and thereby promote healthy ageing.

In the second project, Professor Andrade of the University of São Paulo cooperates with Dr Roelofs from the Amsterdam Medical Center to determine how air pollution induces molecular and biological changes in the kidney and how it influences premature renal ageing. Premature renal ageing is a risk factor for cardio-vascular adverse events, development of chronic kidney disease and progression towards end stage renal disease.

### READ MORE

**The SABE study:** http://hygeia3.fsp.usp.br/sabe/

**The Dutch Society for Research on Ageing:** https://dusra.nl/?lang=en

**Dutch public private collaboration in VOILA; Vitality Oriented Innovations for the Life course of the Ageing Society (Voila):** https://www.health-holland.com/public-private-partnerships/voila

**News item on the granted projects:** https://www.nwo.nl/en/news/joint-research-brazil-healthy-ageing

# MONITORING DISPARITIES IN METROPOLES

**Sending a researcher around the world with a sensor kit to measure exposure to air pollution while commuting in London, São Paulo and the Dutch Randstad area. Or developing a survey to be relevant in the context of any metropole, ranging from Brazilian favelas to posh neighborhoods in the City of London: The ASTRID project went to great lengths to enable a unique international comparison of disparity and social injustice in job accessibility and exposure to air pollution in metropolitan areas.**

Adding hedges between a bike lane and a busy road significantly decreases the cyclists' exposure to air pollution. Introducing electric buses at the most busy bus stops in São Paulo benefits the health of its lower income inhabitants. These are some of the very practical recommendations that came out of the ASTRID project, in which the Brazilian University of São Paulo, the English University of Surrey and the Dutch University of Twente cooperated.

## SAME RESEARCH METHODS

'We already had a collaboration with Dr Prashant Kumar of the University of Surrey, when in 2015, the FAPESP-ESRC-NWO joint call for Transnational Collaborative Research Projects was issued. To prepare for the ASTRID project, Dr Kumar invited researchers from the Netherlands to join,' Maria de Fátima Andrade and Adalgiza Fornaro from the University of São Paulo recollect. 'The novelty of this project was that we used the same research methods at all three different locations,' Karst Geurs from the University of Twente says. That translated for example in a sensor kit that was physically shipped from one place to the other to measure air pollution in the same way in London, São Paulo and the southern regions of the Dutch Randstad area.

A particular challenging part was to develop surveys that could be used in all three metropoles under study, Brazilian postdoc researcher Anne Dorothée Slovic explains. 'To be able to identify best practices and determine which measures to reduce social injustice work where and why, we needed to come up with questions that made sense in all three different contexts.' Another challenge was how to conduct the surveys, Fornaro adds. 'In São Paulo, the survey was carried out in paper and with a team making home visits in all regions of the city, while in London and Amsterdam the questionnaire was sent online.'


In São Paulo, the exposure to air pollution is both the highest and the most unequally distributed, principal investigator Maria de Fátima Andrade explains. 'People here spend much more time commuting between work and home than in London or Amsterdam. Higher income workers live in the city center, where the jobs are. Low-income workers live in favelas or poor neighborhoods on the periphery. These regions are far away from downtown where there are more job opportunities.

They don't own cars, so they need to use public transport. It is not uncommon to see long lines of people waiting outside bus stops, getting exposed to the exhaust gases for longer periods of time.'

## TAILORMADE SOLUTIONS

The regions studied are all metropolitan regions, but they are very different in aspects like urban planning, public policies, environment, transport and population. This explains why there is no 'one size fits all' solution when it comes to decreasing social injustice in job accessibility and air quality, the researchers say. 'One of our hypotheses was that integrating bikes and public transport would benefit low income workers. In the Netherlands that is true, since public transport is well organized, bike lanes are abundantly available, and high and low income workers live in each other's vicinity. But in São Paulo, investing in cycling facilities in fact turned out to mainly benefit high and medium-income workers in the already job rich center of São Paulo which is well connected by public transport and not low-income workers in the favelas and periphery where there is hardly public transport available,' Geurs illustrates.

The project has formally finished, and the last PhD is writing up her thesis. All four researchers consider the project to be extremely successful. Geurs: 'So far, we have published ten articles, and we are working on a special issue for the Journal of Transport Geography on inequalities, accessibility and environmental impacts.' Fornaro: 'We also organized a couple of international congresses at São Paulo city hall office to disseminate the results of this research to policymakers. In São Paulo and also Brazil as a whole, public policies have been vulnerable, since they are not evidence-based. This institutional weakness can be overcome by this type of study, showing the importance of the population perception and its consideration for the success of public policies aimed at transportation, health and environment.'

> *We needed to come up with questions that made sense in all three different contexts.*
>
> ***Anne Dorothée Slovic***
> *University of São Paulo*

## TOWARD LONG TERM COLLABORATION

The ASTRID project marked the start of a long-term collaboration. 'This project benefited from interdisciplinarity, experience and shared commitment to research priorities, enabling the redistribution of resources and global research results,' Fornaro motivates this intention. 'As a result of this project, we have already set up a joint PhD program between the University of Twente and the University of São Paulo,' Geurs adds. 'The first PhD student from Brazil should be starting this program in 2021. The problems in megacities are not over yet. There is so much more we can do. I hope we will be able to find new funds to continue this collaboration in other projects as well.'

> *The novelty of this project was that we used the same research methods at all three different locations.*
>
> ***Karst Geurs***
> *University of Twente*

### ASTRID PROJECT

The ASTRID (Accessibility, Social justice and TRansport emission Impacts of TOD strategies) project seeks to investigate the causal mechanisms underlying disparity and social injustice in job accessibility and air quality in metropolitan areas, and the potential of transit-oriented development to promote social justice. This project is a joint collaboration between the University of São Paulo (Brazil), the University of Twente (the Netherlands) and the University of Surrey (United Kingdom).

## READ MORE

**Final Publication - Sustainable Urban Development_0.pdf (nwo.nl)**
https://www.nwo.nl/sites/nwo/files/media-files/Final Publication - Sustainable Urban Development_0.pdf

**Home Page - ASTRID:** https://www.astridproject.com/

**Exposure to pollution is uneven in the city of São Paulo | AGÊNCIA FAPESP**
https://agencia.fapesp.br/exposure-to-pollution-is-uneven-in-the-city-of-sao-paulo/29315/

# RESEARCHING APART TOGETHER

**The provisioning of food, water and energy services in urban areas involves infrastructures and resource flows which are heavily dependent on each other and on the natural environment. Interventions aimed at improving one, often negatively influence the others. In the ResNexus project, which ran from 2016-2018, an international team of researchers studied this so-called urban Nexus in three different mid-size cities in Brazil, East Africa, and Eastern Europe.**

'We investigated the vulnerability and resilience of people in poor neighborhoods, and how these are related to access to energy, food and water. Energy and water are crucial for people's ability to cook healthy meals. So when you want to improve the availability of healthy food or water, you will have to make sure there is enough energy available as well,' Dutch project coordinator Bas van Vliet, Associate Professor Environmental Sociology at Wageningen University, explains. 'In this project, we demonstrated that the Nexus must be treated as a social-political issue, and that its governance must be organized in a trans-sectoral way,' Brazilian coordinator Leandro Luiz Giatti, Professor at the University of São Paulo's School of Public Health, adds.

> *As a result of this project, I have become a reference in this field in Brazil.*
>
> ***Leandro Luiz Giatti***
> *School of Public Health, University of São Paulo*

In the ResNexus overall project three universities came together, each funded by a different agency and studying a different city leading to descriptions of three separate local practices. The University of São Paulo was funded by FAPESP and focused on Guarulhos in Brazil. The University of Sussex obtained funds from the ESRC to investigate Sofia in Bulgaria. And Wageningen University in the Netherlands received funding from NWO to focus on Kampala, Uganda.

## CHARCOAL FOR COOKING MATOOKE

'We went to vulnerable districts in Kampala', Van Vliet tells, 'to study how individual households use resources and handle bottlenecks in accessing those.' The availability of resources has a great influence on daily practices, Van Vliet observed. 'Take cooking. In Kampala charcoal is a crucial source of energy, especially for cooking the traditional Ugandan matooke (steamed and mashed green banana, ed). This is a very nutritious meal. When there is no charcoal, people resort to less nutritious foods.'

In Brazil, the researchers also found a direct relation between

energy, food and water, Giatti says. 'In Guarulhos, fresh and healthy food is hard to find. Especially for poor people it is much easier to come across ultra-processed products, like snacks and sausages. The production of these types of food consumes a lot more water and energy than the preparation of fresh food. So for that specific region, growing fresh crops closer to the community would solve multiple scarcity problems at once.'

In Sofia the researchers studied yet another situation, Van Vliet tells. 'Our UK colleagues went to a district filled with the grey, high rise tenements which are so typical for Eastern Europe. During Bulgaria's cold winters, inhabitants of these buildings are faced with high energy bills. People grow and pickle their own vegetables in the summer to save money they would otherwise have spent on food to pay for energy during winter.'

## AMBITIOUS

Though the project led to a successful final conference in Wageningen in 2018, and a well-received special issue of the Journal of Integrative Environmental Sciences, it has been a somewhat bumpy ride, both coordinators say. Giatti: 'Because the three partners all had different backgrounds, it took some time to align our research methods and theories.' 'Also, being new partners, we had to get to know each other first. Perhaps it was a bit too ambitious in a three-year project for such a new group of people with such different backgrounds to really work as a team,' Van Vliet adds. 'But still, it was fascinating to study this universal topic of the Nexus in three different contexts. It forced us to think out of the box, and we have produced some useful generic results to base new governance policies on.

'For me personally, this project has opened many new doors,' Giatti states. 'This was the first time I coordinated an international project, and my first introduction to the topic of the Nexus. As a result of this project, I have become a reference in this field. Not only am I currently taking part in a think tank at my university on food systems and sustainability, I also got involved in a huge study into socio-environmental governance of the São Paulo metropolitan region, funded by FAPESP.'

> *It was fascinating to study this universal topic of the Nexus in three different contexts. It forced us to think out of the box.*
>
> ***Bas van Vliet***
> *Wageningen University*

## READ MORE

**Project page: Resilience and vulnerability at the urban Nexus of food, water, energy and the environment (ResNexus) - WUR**
https://www.wur.nl/en/project/Resilience-and-vulnerability-at-the-urban-Nexus-of-food-water-energy-and-the-environment-ResNexus.htm

**Article on the Brazilian part of the project: Investigating social and environmental problems in Brazil, Africa and Eastern Europe | AGÊNCIA FAPESP**
https://agencia.fapesp.br/investigating-social-and-environmental-problems-in-brazil-africa-and-eastern-europe/27915/

**Resulting special Issue Journal of integrative environmental sciences (open access): Journal of Integrative Environmental Sciences: Vol 17, No 2 (tandfonline.com)**
https://www.tandfonline.com/toc/nens20/17/2

**Article 'Nexus of exclusion and challenges for sustainability and health in an urban periphery in Brazil':**
https://www.scielosp.org/article/csp/2019.v35n7/e00007918/en/

**Article 'What could go wrong with cooking? Exploring vulnerability at the water, energy and food Nexus in Kampala through a social practices lens':** https://doi.org/10.1016/j.gloenvcha.2020.102086


# CHALLENGING PERSPECTIVES ON RELIGIOUS MOVEMENTS

**Academically speaking they grew up together, simultaneously conducting their respective PhD projects in the same research group in Amsterdam. And although they live on two different continents, anthropologists Carly Machado and Martijn Oosterbaan keep each other close.**

'When Martijn first came to Brazil some twenty years ago, we met through our respective supervisors and merely said hello,' Carly Machado from the Brazilian Universidade Federal Rural do Rio de Janeiro recollects their first encounter. 'In 2005, I received a scholarship to travel to Europe and study Raëlism, an international religious movement that originates from France. I joined the group of Birgit Meyer at the University of Amsterdam, where I met Martijn again. We have been collaborating ever since.'

While Brazilian-born Machado was focusing her PhD research on Europe, Dutch researcher Martijn Oosterbaan, who nowadays works at Utrecht University, focused his attention on Brazil. 'I study urban and religious transformations, both in Brazil and in Europe,' Oosterbaan says. 'Funnily enough, the initial PhD proposal that got me admitted to the Amsterdam School of Social science Research was aimed at studying Guatamala, not Brazil. Somehow Brazil remained as a vacant spot in the research portfolio of the institute, which made me change my focus.' After her return to Brazil, Machado also started studying her homeland. 'Brazil has a strong community of anthropologists who study Brazil itself. Before joining that community, I wanted to broaden my horizon first. That is why, after my stay in the Netherlands, I took up a successive postdoc position in Canada. Additionally, by going to Amsterdam, I was exploring a new route for Brazilian anthropologists, who traditionally had not been well-connected to the Netherlands.'

## FROM CATHOLICS TO EVANGELICALS

Both anthropologists study the role evangelical religions play in the daily lives of urban territory dwellers. Brazil used to be a Catholic country. Since the nineties, evangelical movements have become increasingly important in the public life. 'We study how evangelical religious movements, such as Pentecostalism, are present in people's lives. How they are expressed in governance, esthetics, and music, but also in violence and conflict,' Machado says. 'Our niche is that we do not study huge movements like the Universal Church of the Kingdom of God, but instead we focus on churches at the local scale. And we take a positive perspective, starting from what these people, who often face difficult circumstances, do have, not from what they are lacking. We want to highlight how religion acts as a source of musicality and creativity and how it provides people in the poorer districts of Rio de Janeiro with strategies to cope with a tough life.'

One tangible result of their collaboration is the book chapter they wrote together on contemporary power and rule in Rio

> *For anthropology, the only way forward is to research Brazil together with Brazilian researchers and challenge each other's views and perspectives.*
>
> ***Martijn Oosterbaan***
> *Utrecht University*

de Janeiro. The chapter argues how a combination of military interventions on the one hand and religious modes of governing urban territories on the other hand formed the key ingredients of the Pacification Policy in Rio de Janeiro in the years leading up to the Summer Olympics of 2016.

Both researchers not only share a fascination for their study objects, but also a belief on how international cooperation within anthropology should be stimulated to advance the field. Oosterbaan: 'There is a persistent debate on why it is important to have cultural anthropologists that operate from within their own society collaborate with colleagues who originate from elsewhere. As a researcher, I am probably projecting my own Dutch protestant cultural heritage on the cultures I study. And for Carly, it might be harder to maintain a professional distance to the subject, since she is immersed in it in her daily life. The only way forward is to research Brazil together with Brazilian researchers and challenge each other's views and perspectives.'

## MAKING NEW CONNECTIONS

Another aspect of their collaboration both researchers value, is that it establishes a novel connection between their individual universities. Oosterbaan: 'It is easy to make a link between well-known universities in Brazil and well-known universities in Europe. But what does it mean when it is always the same institutions that are connected to each other? My connection with Carly has taught me a lot about how universities work in Brazil, which is rather different than in the Netherlands. For example, PhD students in Brazil often come in with their own research proposals, whereas in the Netherlands, as a PhD student you are usually working on a project that has been predefined by your supervisor.' Machado: 'I am not part of a central university in Rio de Janeiro. My university is in a rural area. Between 2010 and 2016, Brazil had the opportunity to expand its public higher education. As a result of this financial impulse, social sciences departments were created in different cities, and I got my job here in this region where I grew up. My collaboration with Martijn and other Dutch researchers has helped establish the reputation of my department. This has now become a new spot for Brazilian anthropology, with a very successful postgraduate program.'

The landscape of anthropology is changing, they observe. Oosterbaan: 'What we need now is more funding schemes that provide equal funding to the Brazilian and Dutch partners in a project. There used to be a joint PhD program funded by the Brazilian government which worked very well. To advance the field, we need opportunities to truly establish transnational partnerships with a critical eye on historic inequalities.'

> *My collaboration with Martijn and other Dutch researchers has helped establish the reputation of my department. This has now become a new spot for Brazilian anthropology, with a very successful postgraduate program.*
>
> ***Carly Machado***
> *Federal Rural University of Rio de Janeiro*

**READ MORE**

**Machado and Oosterbaan wrote a joint book chapter on Pentecostalism and its relation with military urbanism:**
https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9780429198588-7/postsecular-pacification-martijn-oosterbaan-carly-machado

# POLAROIDS FOR THE BIGGEST EYE ON THE SKY

**In Cerro Armazones, in the Atacama Desert of northern Chile, the European Southern Observatory (ESO) is currently building the largest ever optical telescope. Brazilian astrophysicist Beatriz Barbuy and her Dutch colleague Lex Kaper contribute to the multi-object spectrometer that will act as the workhorse instrument of this Extremely Large Telescope (ELT).**

A stunning 39 meters in diameter, almost half the length of a soccer field. That is the size of the ELT's main mirror that is going to collect light from even the most distant, faint stars. The telescope will probe the furthest reaches of the cosmos, revealing the properties of the very earliest galaxies and the nature of the dark universe. The telescope is planned to start operations in 2025.

Beatriz Barbuy, Professor at the University of São Paulo, and Lex Kaper, Professor at the University of Amsterdam, work on what can be perceived as polaroids for the telescope: an instrument that splits the detected light into its component wavelengths to provide a clear view on the chemical composition of astronomical objects. This instrument, called MOSAIC, will ultimately be able to measure the motions of gas on the outskirts of young galaxies and determine the mass of invisible matter that makes up the largest part of our universe.

## ENTERING NEW REGIMES OF ASTRONOMY

'The instrument is very complex and sophisticated,' Barbuy says. 'It will be able to observe hundreds of objects simultaneously, with an unprecedented sensitivity and spatial resolution. To make this possible, we need fiber optic technology with a micrometer precision. That is where my group comes in. My Dutch partners are working on the design of one of the six spectrographs that eventually will make up the instrument.' 'With the ELT we will enter a new regime of astronomy,' Kaper adds. 'The bigger the mirror, the weaker the signals you can detect. With current large telescopes like the Very Large Telescope, which is also located in the Atacama Desert, we can see about 6 percent of the universe. The ELT will see 60 percent.' Barbuy clarifies: 'Now, we can only see the giant red stars in the center of our galaxy. With the ELT, we will also be able to see the dwarfs.'

> *Since the instrumentation for the Very Large Telescope has been partly developed in Brazil, it was a logical choice for us to also seek collaborations with Brazil for its successor.*
>
> ***Lex Kaper***
> *University of Amsterdam*

Though ESO started out as a European initiative, it is open to

> *The Netherlands has a huge density of famous astronomers.*
>
> ***Beatriz Barbuy***
> *University of São Paulo*

collaboration with countries from other continents as well. 'Since the instrumentation for the Very Large Telescope has been partly developed in Brazil, it was a logical choice for us to also seek collaborations with Brazil for its successor,' Kaper says. The São Paulo Research Foundation FAPESP joined forces with the Dutch funding agency NWO, and together they have supported the Brazilian-Dutch collaboration on instrument development for the ELT since 2015.

## MAKING THE CONNECTION

The connection between Brazil and ESO was easily made, Barbuy says, since in the eighties, she pursued her PhD at the Paris Observatory in France and has been collaborating with her former colleagues ever since. 'Through collaboration with the Europeans we got access to the Very Large Telescope, which we used for measurements on low mass stars and supernova bursts,' she explains. 'The ultimate aim was that Brazil would become a full partner of ESO,' Kaper says. 'Unfortunately, that hasn't worked out as planned yet.' 'However, I am still hopeful that in a few years' time things will change and we will indeed become full partners,' Barbuy adds.

'The Netherlands has a huge density of famous astronomers,' she says. 'The nice thing about cooperating with Europeans in general is that they tend to treat our work as an integral part of their projects, and not as some sort of add on. Dutch people are very open to foreigners. And it helps that most people in the Netherlands are multilingual.' Kaper: 'Brazil is an interesting partner for us. They have the same technical facilities we have and a large population of well-trained young people. Within ESO, we are building top notch instrumentation. This provides young people from Brazil and the Netherlands with a unique opportunity to work on an instrument that will undoubtedly convey groundbreaking new insights about our universe.'

## COLLABORATIONS TO COMPREHEND THE COSMOS

Astronomy is the perfect field to promote international collaborations in science, both stress. 'Astronomy is the most international branch of science. Our countries have complementary expertise in this field, the research subject attracts people from all ages, and the field provides clear links between very fundamental research and down to earth applications like memory foam for pillows and infrared ear thermometers. To understand our universe we need large surveys and instruments, which are impossible for one nation to achieve on its own. Collaborations are fundamental to advance our knowledge about the cosmos.'

> *The nice thing about cooperating with Europeans in general is that they tend to treat our work as an integral part of their projects, and not as some sort of add on.*
>
> ***Beatriz Barbuy***
> *University of São Paulo*

## READ MORE

**Summary of the joint project:**
https://bv.fapesp.br/en/auxilios/92688/mosaic-the-multi-object-spectrograph-for-the-eso-extremely-large-telescope/

**Website on the MOSAIC instrument:** http://www.mosaic-elt.eu/

**Additional website on the instrument:** https://elt.eso.org/instrument/MOSAIC/

**Video on ESO:** https://www.youtube.com/watch?v=MCdle7rbte8&feature=emb_logo

# BUILDING A SCIENTIFIC CAREER IN BRAZIL

**Having worked at the Observatório Nacional in Rio de Janeiro for over eight years now, Dutch astrophysicist Roderik Overzier has a clear view on the similarities and differences in the ways both countries approach scientific research. 'Brazil offers huge opportunities for fundamental scientists to build a scientific career, as long as they are able to do a lot with a little.'**

## HOW DOES A DUTCH SCIENTIST END UP AT AN OBSERVATORY IN RIO DE JANEIRO?

'After obtaining my MSc and PhD degrees in Astrophysics at Leiden University in the Netherlands, I held several postdoc positions in Germany and the US. Around 2012 the Brazilian government started investing heavily in scientific research. As a result many interesting permanent staff positions opened up. At that same time Brazil was planning to become a full member of the European Southern Observatory. The fact that my wife originates from Brazil made it easier for us to move here.'

## ARE THERE ANY DIFFERENCES BETWEEN BEING A SCIENTIST IN BRAZIL AND IN THE NETHERLANDS?

'For an astrophysicist like myself, in principle, it doesn't matter where on earth you are located. All you need is a computer and access to telescope observations, and you're off. Having said that, of course every country organizes science in their own way. Take research staff hiring as an example. In the Netherlands, the informal circuit plays a significant role. Often someone is invited to apply for a vacancy coming up which is never officially published. In Brazil, the process is meant to be more transparent. For every vacancy, an external committee is established which determines who is best fitted for the job. Every candidate has to take the same tests and exams, and is supposed to be evaluated on the same terms. One of the advantages of this process is that here about 30 percent of all astrophysics staff is female. That is a number the Netherlands can only dream of.'

> *If you want to start a career as a fundamental researcher, Brazil offers huge opportunities.*
>
> ***Roderik Overzier***
> *Observatório Nacional of Rio de Janeiro*

## THAT SOUNDS LIKE A PERFECT SCENARIO.

'Unfortunately, this approach does have some unwanted side

effects. For example, the involvement of external committees leaves little room for an institute or university to control what direction the research will take, and whether or not the new colleague fits in the existing team.'

### AND HOW IS FUNDING FOR SCIENTIFIC RESEARCH ARRANGED?

'I am a government employee who is tenured, and don't have to worry about my salary. Also, I have free access to as many students as I want. But anything else I need, I have to acquire additional funds for. Unfortunately, at the moment, funds are scarce, both at the level of my state and at that of the national government. In general, as a scientist in Brazil you have to be creative and achieve a lot with a little. Foreigners like me benefit from the many international connections we already built before moving here. In 2016 we set up an exchange agreement with NOVA, the very successful Netherlands Research School for Astronomy, which has since resulted in the exchange of several MSc/PhD students and postdocs between our institutes and joint projects between senior researchers. In April 2021 it was announced that a team led by myself and a former Leiden graduate student, and including other Dutch scientists, was chosen to be among the first to use the NASA/ESA James Webb Space Telescope. In general, I also benefit from colleagues from all over the world that invite me to join their research projects as a partner, and there are even a few mega-projects in which Brazil participates but Europe does not, such as the US-led Giant Magellan Telescope and the Japanese Subaru Telescope.'

### WHAT IS THE MOST IMPORTANT LESSON YOU HAVE LEARNT AS A FOREIGNER LIVING IN BRAZIL?

'To be aware of the white savior complex. As someone coming to Brazil from a developed country, it is tempting to think you know better. The first PhDs programs in astronomy were founded only in the early 1970s in Brazil, so the community has had a lot less time to organize itself compared to, for example, our long, rich tradition in astronomy in The Netherlands. However, that doesn't mean my colleagues in Brazil aren't entitled to their own solutions, matching their own needs, preferences and circumstances.'

### DO YOU HAVE A MESSAGE FOR PEOPLE INTERESTED IN BECOMING A SCIENTIST IN BRAZIL?

'If you want to start a career as a fundamental researcher, Brazil offers huge opportunities. The road for scientists is not entirely paved yet, and it is easier to make an impact as an individual since you don't have to follow into the footsteps of some established group. Even after eight years, there still are more interesting projects coming along than I can handle.'

### GRASPING GALAXY EVOLUTION

Roderik Overzier focuses on the evolution of galaxies as seen through telescopes and as modeled using computer simulations. Among other things he studies black holes, the large scale structure of the Universe, and the formation and evolution of galaxies and galaxy clusters. To do so, Overzier analyzes observations in wavelengths ranging from X-rays to radio waves from the world's main ground- and space based observatories like the Very Large Telescope, the Hubble Space Telescope, and the Subaru Telescope. Next to that he also uses detailed theoretical predictions and cosmological simulations in order to better understand the observational results and to create better models.

Overzier takes part in many international collaborations. For example, he is a member of the Scientific Advisory Committee of the Giant Magellan Telescope project for Brazil, and of the collaboration to build a revolutionary new multi-object spectrograph for the Japanese Subaru Telescope.

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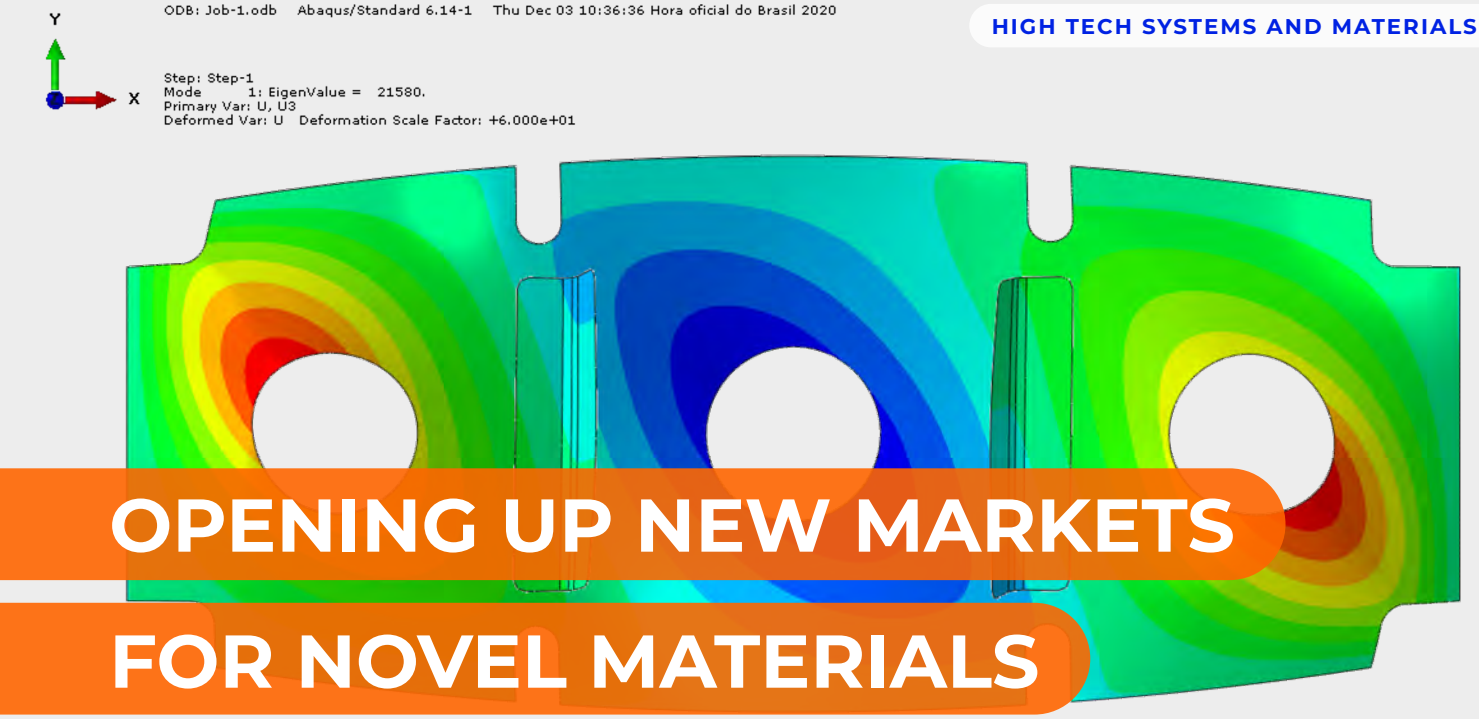
https://roderikoverzier.wordpress.com/




# OPENING UP NEW MARKETS FOR NOVEL MATERIALS

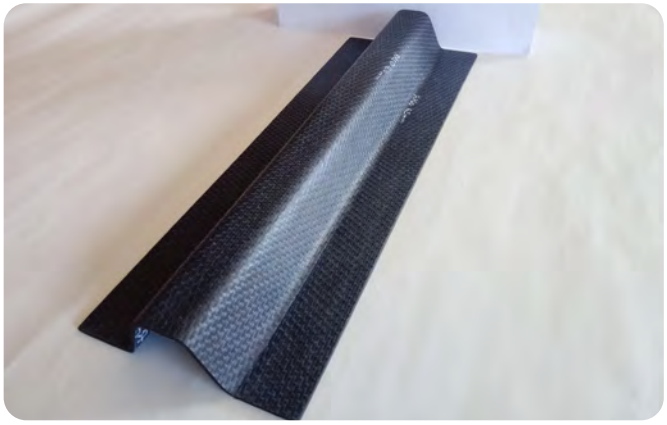
**Collaborate to become more competitive. That is in a nutshell what the two companies Toray Advanced Composites and Alltec Materiais Compostos aim for in their joint SPIRIT FLY project assisted by the GlobalStars program. 'Together, we combine all required expertise to use novel materials for the development of innovative components.'**

For the outsider, it sounds like an unlikely way of working: two commercial companies from two different continents collaborating without the involvement of a team of legal aids guarding a contract about who is allowed to know what and when. 'We deliberately went for an open collaboration model,' Toray's Netherlands-based Director Expert Services Winand Kok says. 'It is just us technicians, there are no lawyers involved. Our motto here is: Let's walk before we run and invest in building relationships and trust before we bring in legal contracts and big ambitions.'

Toray Advanced Composites, formerly known as TenCate

> *We invest in building relationships and trust before we bring in legal contracts and big ambitions.*
>
> ***Winand Kok***
> *Toray Advanced Composites*

Advanced Composites, is a recognized global leader in the design and production of structural fibre-reinforced thermoplastic laminates. These materials, made up of layers of fibre-reinforced polymers, are mouldable at elevated temperatures and solidify upon cooling. Alltec Materiais Compostos is a Brazil-based company that uses these



thermoplastics to build components, for example for the Brazilian airplane manufacturer Embraer.

## GEARING UP

'We had been working with Embraer for two decades,' Kok explains, 'but we wanted to gear that collaboration up a notch and persuade them to use our thermoplastics for components in their next generation airplanes. Thermoplastics have many advantages over the thermoset materials that are currently most used in aviation applications. First of all, they are much more robust against impact damage, for example caused by big hail stones, tool drop, bird strike, or runway debris. Secondly, production cycle times are much shorter. Thermoset materials need typically 8 hours to cure. Thermoplastics only need minutes. And since you can melt thermoplastics locally, you can weld them together, where thermoset materials need to be bonded.' 'On top of that, because of their robustness, thermoplastics enable the production of thinner, more light-weight and cheaper components,' adds his Toray colleague Marlie Koekenberg, Director Commercial Aerospace Programs.

'At Alltec, we develop and produce component parts for Embraer,' Development Engineer Orestes Ferro says. 'Around 2017, Dutch companies came to Brazil and presented their ideas about possible collaborations between the two countries. There the foundations were laid for the SPIRIT consortium, a large consortium of Brazilian and Dutch companies that were interested in understanding the possibilities of thermoplastic components.' 'At that event, the GlobalStars program was presented as well,' Koekenberg recollects. That program, funded by FINEP and EMBRAPII of Brazil and RVO.nl of the Netherlands, supplies grants for collaborative industry-led R&D projects between Brazilian and Dutch companies. 'The involvement of the Dutch government, represented by the Netherlands Innovation Attaché in Brazil, certainly helped open doors for us,' Kok comments. 'And after some pleasant meetings, we decided to take the next step with Alltec,' Koekenberg rounds up the story of how the SPIRIT FLY project came about.

> *In this collaboration, everyone involved is aimed at helping each other, generating new ideas, and creating a fruitful network.*
>
> ***Marlie Koekenberg***
> *Toray Advanced Composites*

## DIVIDING ACTIVITIES

The aim of the project is to develop a thermoplastic-based demonstrator component that meets Embraer's functional, technical, production and financial requirements. Toray supplies the materials, and Alltec comes up with new applications. Ferro: 'We divide the activities over both companies. At Alltec we are the experts when it comes to making designs and developing new fabrication processes. Toray has control over the material properties. In Brazil, supported by universities and institutes, we can use a special technique called resistance welding to join the different parts together. The Dutch dedicated ThermoPlastic composites Research Center (TPRC) that Toray has strong ties with, uses a different technique called induction welding.'

> *With this partnership, we are jointly exploring new opportunities for the benefits of both companies and both countries.*
>
> ***Orestes Ferro***
> *Alltec Materiais Compostos*

Both companies see this collaboration not only as an efficient, but also as a pleasant way of exploring new markets. Koekenberg: 'The Netherlands is a small country with many thermoplastic composites resources. Brazil has a small but growing thermoplastic ecosystem. Collaboration is key to optimize our strengths. In this collaboration, everyone involved is aimed at helping each other, generating new ideas, and creating a fruitful network.' Kok adds: 'With this partnership, we have ample opportunities to bring innovations to aviation through Alltec's strong bonds with Embraer and its local knowledge partners like ITA, UNESP and LEL IPT.' Ferro concludes: 'Alltec is a developer and supplier of parts. For us to stay competitive in this market, it is important to stay up to date with the latest materials and processes. Though our current focus is on applications in aviation, with a certain level of knowledge we hope to be able to open up new markets for these materials as well. Thermoplastics can just as well be used for the oil and gas markets for example. With this partnership, we are jointly exploring new opportunities for the benefits of both companies and both countries.'

# TURNING BRAZIL INTO A COOL PLACE TO GO

**'Too often, Brazil is regarded as a poor country without any significant research. That is a wrong image. The State of São Paulo for example resembles European countries like France and Spain when it comes to the quality of science and the presence of high-tech facilities,' Dutch researcher and UK/Brazilian resident Marin van Heel states.**

**YOU HAVE BEEN WORKING AS A RESEARCHER IN THE NETHERLANDS, GERMANY AND THE UNITED KINGDOM. HOW DID YOU END UP LIVING IN BRAZIL?**

'Perhaps the short answer would be: to give something back. Born in Switzerland from Dutch parents I moved to Brazil with my family when I was nine months old, and I grew up in the interior of the state of São Paulo with Portuguese as my first language. In 1960, we returned to the Netherlands, where I went to high school and university. Around 2003, as a Professor at Imperial College London, I met a Brazilian researcher at a conference in Durban, who invited me to present the opening lecture at the national microscopy meeting in Caxambu, Brazil. A year later I returned to Brazil as a visiting Professor in the Physics department of USP-São Carlos. While there, with the help of the then PhD student Rodrigo Portugal, I organized the first international School for Single Particle cryo-electron microscopy in Brazil. After retiring as Full Professor from the London and Leiden universities, I accepted an invitation to help the now staff researcher Rodrigo Portugal set up the first Latin-American cryogenic transmission electron microscopes (cryo-EM center in Latin America.') centrum, at CNPEM.'

**WHAT DO YOUR ACTIVITIES AT CNPEM ENTAIL?**

'Campinas is a "Silicon Valley" environment in Brazil, including the renowned University of Campinas, the CNPEM Laboratories and many high-tech spin-off companies. The CNPEM now houses one of the very few fourth-generation synchrotrons in the world. We have added a suite of cryogenic transmission electron microscopes (Cryo-EMs) to this center, making it the first cryo-EM facility in Latin America. My reputation as one of the main developers of the field helped to

> *In Brazil, you can get a lot more done for your money than in Europe or the United States. The funds required for one PhD student in the Netherlands are enough to employ some five students here, leading to vastly more output.*
>
> ***Marin van Heel***
> *National Center for Research in Energy and Materials*

put this facility on the map as an international center of excellence. Cryo-microscopes are essential for studying biological complexes such as viruses in atomic detail. Solving and understanding the structure of the SARS-CoV-2 virus largely depends on these newly developed Cyro-EM methodologies, and thus keeps us very busy at present.'

### TO WHAT EXTENT DOES BEING A SCIENTIST DIFFER IN THE VARIOUS COUNTRIES YOU HAVE BEEN ACTIVE IN?

'What most countries have in common, is that as a researcher, you have to deal with massive loads of administration and bureaucracy. Science is an international activity, but most of the procedures at universities or funding agencies are still oriented nationally. In Germany for example, 30 years ago, you could not become a professor unless you had completed your "habilitation", an additional degree obtained in a process similar to that of a doctoral PhD. Here in Brazil, people seem to have taken bureaucracy to the next level. For example: for every 100 euros you want to spend from your grant, you personally need to go to the bank, and often wait for hours to be attended. The bureaucracy hoops you have to jump through to appoint foreigners on research positions here, are just jaw dropping.'

### WHY SHOULD RESEARCHERS FROM ABROAD NEED TO CONSIDER BRAZIL AS AN INTERESTING CAREER OPTION?

'Because Brazil, and especially the state of São Paulo, has excellent researchers and facilities; the best brains, from a country the size a whole continent, are eager to do research in our top institutions. UNICAMP ranks among the top 3 universities in Latin America and among the top 200 universities in the world. The great thing about Brazil is that here you can get a lot more done for your money than in Europe or the United States. The funds required for one PhD student in the Netherlands are enough to employ some five students here, leading to vastly more output. However, it is hard for us to attract foreign PhD students and postdocs. Unfortunately, they tend to compare the salaries we offer here to those in Europe and the United States to decide against us. But they forget that the cost of living here is way lower. With a good postdoc salary in Brazil you are able to save enough to buy a plane ticket to Europe almost every month. Try that in the US! It is my ambition to attract more PhD students and postdocs from abroad, who can further advocate Brazil's great potential to advance international science.'

### PIONEERING TECHNIQUES TO MAKE VIRUSES VISIBLE

Marin van Heel is a senior researcher at LNNano/CNPEM in Campinas, Brazil. He is one of the main developers of the 2017 Nobel Prize winning single-particle cryogenic Electron Microscopy (cryo-EM) technique, that generates 3D images of large biological complexes such as viruses at nearly atomic resolution. After obtaining his PhD from the University of Groningen, the Netherlands, in 1981, he became head of interdisciplinary methodology group at the Fritz Haber Institute of the Max Planck Society in Berlin. In 1995 he moved to the United Kingdom, as a Professor of Structural Biology, where he was the founder and first Director of the Imperial College Centre for Structural Biology and of the Imperial College Centre for Biomolecular Electron Microscopy. In 2011, Van Heel moved to the University of Leiden, the Netherlands, where he held the position of Professor of Cryo-EM Data Processing until his retirement in 2017. He initiated a series of international cryo-EM schools/workshops in Brazil which have become a biannual event with participants from all continents. Marin van Heel is the recipient of the 1987 Ernst-Ruska Award of the DGE and of the 2017 Wiley Award in Biomedical Sciences, both for 'Pioneering Developments in Electron Microscopy'.

## READ MORE

**Latin American Structural Biologists Gain Access to Cryo-EM Capabilities - CNPEM**
https://cnpem.br/latin-american-structural-biologists-gain-access-to-cryo-em-capabilities/

**Democratizing cryo-EM: Broadening access to an expanding field | Science | AAAS (sciencemag.org)**
https://www.sciencemag.org/features/2020/03/democratizing-cryo-em-broadening-access-expanding-field

# CONTACTING EXPERTS ACROSS THE GLOBE FOR THE DEVELOPMENT OF NEW MATERIALS



**Dutch Professor of Photonics and Semiconductor NanoPhysics Paul Koenraad has been collaborating with Brazilian researchers for over three decades. 'The quality of research in Brazil is very good. The country harbors excellent people and facilities. And the Brazilians I've met were all extremely open to collaboration. Brazil can be proud.'**

'I am longing for the moment we can meet in person again and share a caipirinha in the Brazilian sun,' Paul Koenraad from Eindhoven University of Technology tells his Brazilian colleague Alain Quivy through the videoconferencing app. 'I am done meeting people from behind a screen. Things go so much smoother when you are able to meet each other in person. And it is a lot more fun as well.' His connection with Brazil dates from the early nineties, when he was giving a talk in Singapore, Koenraad recollects. 'Afterwards, I met with Professor José Roberto Leite from the University of São Paulo. He invited me to come to Brazil and attend a workshop there. That first visit opened my heart to the country, and I have been visiting at least twice a year since. At least, until COVID-19 hit, that is.'

## SEARCHING FOR EXPERTISE

One of his more recent collaborations is with Alain Quivy from the University of São Paulo, who turned to Koenraad in search for help with his samples. 'In my group, we use a technique called Molecular Beam Epitaxy to make new materials. With this technique we made a new type of quantum dots; extremely small structures that can be of use for novel types of photodetectors or solar cells for example. However,

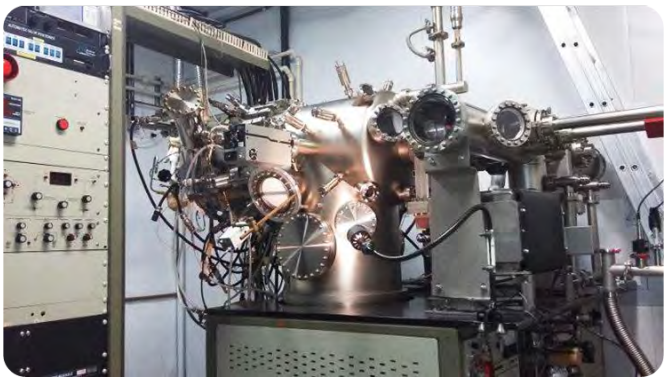
> *Brazil harbors excellent people and facilities. And the Brazilians I've met were all extremely open to collaboration.*
>
> ***Paul Koenraad***
> *Eindhoven University of Technology*

because of their specific properties, you need rather unique equipment to make them visible. My colleague here, Andre Henriques, had contacts with Paul, who is the world specialist in the area of cross-sectional scanning tunneling microscopy I needed. So, through Andre, I made contact with Paul, and now we are conducting very nice experiments together.'

Brazilian researchers should be aware that there are many ways of starting collaborations with Europeans, Quivy says. 'There is no need to wait for one of the rare joint calls. Just use the internet and send an email to link up with good groups that possess the expertise you are looking for. My lab is known as a provider of good samples of new materials. Therefore I receive requests to make specific structures.'

## MUTUAL LEARNING

'I have a long history of intensive collaborations with Brazilian colleagues, without any dedicated funding involved,' says Koenraad. 'For me, the most important prerequisite of engaging in a collaboration is that both partners need to learn something from it. In case of Alain's samples, through conducting the measurements I learn how the material is formed and how it functions. By understanding the processes involved, we can come up with new ideas to make novel materials. That makes this interesting for me.' 'And in return, we get to see exactly what our materials look like. We can use this information to adjust our production processes to optimize the electrical and optical properties of the structures we made and increase the light yield of our devices,' Quivy adds.



## FUNDING AS GREASE

Though in this particular case the collaboration so far has been restricted to sending samples back and forth and writing papers together, both hope that, in the near future, more will be possible. 'It is a fact that funding acts as grease for these types of partnerships,' Koenraad says. 'In our field, there is a lot you can do from a distance. But if you want to step things up a notch and create a true win-win situation, you need to be able to exchange students at the least. Though both our techniques are too hard to learn in a couple of months, it is really helpful when students come over and see how things work with their own eyes. Only then they can get a clear understanding of the possibilities and limitations of the techniques, which enables them to optimize their own experiments toward those.'

'Sending students abroad is essential to create the open minded mentality you need to be a good researcher,' says Quivy. 'You cannot do science alone. You need to engage the expertise and facilities of others in your work. And there is no need to restrict yourself to searching for those in your immediate vicinity. When you have something interesting in mind, just start contacting people. You'll be surprised what one email can lead to.'

> *There is no need to wait for one of the rare joint calls. Just use the internet and send an email to link up with good groups that possess the expertise you are looking for.*
>
> ***Alain Quivy***
> *University of São Paulo*

**READ MORE**

**Joint paper on the quantum dot material:**
https://journals.aps.org/prmaterials/abstract/10.1103/PhysRevMaterials.4.114601

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