Spotlight on ERC grantees

AAAS Annual Meeting 2015

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Introduction

Every year, the American Association for the Advancement of Science (AAAS) organises the world's largest general scientific meeting which brings together thousands of scientists, policy makers, educators, journalists and students. This year's AAAS Annual Meeting takes place from 12 to 16 February in San Jose, California, and focuses on the theme of *Innovations, Information, and Imaging*. The objective is to debate the impact on science and technology of the novel ways used nowadays to collect and explore information and data.

The European Research Council (ERC) participates in this meeting with three sessions in which its grant holders will present their innovative research in different fields. This brochure gives an overview of the **eight ERC-funded projects** presented during the three sessions.

Set up in 2007, the ERC is the first pan-European funding body designed to support investigator-driven frontier research and stimulate scientific excellence across Europe. It aims to help the best and most creative scientists to identify and explore new directions in any field of research (Physical Sciences and Engineering, Life Sciences and Social Sciences and Humanities) with no thematic priorities. In particular, the ERC encourages proposals which cross disciplinary boundaries; address new and emerging fields and introduce unconventional and innovative approaches.

The ERC awards long-term grants to individual researchers of any nationality and age who wish to carry out their research projects in Europe. Excellence is the sole criterion for evaluation. So far, over 4,500 researchers have benefited from ERC funding.

ERC Sessions (San Jose Convention Center)

Visualizing the Experience and Use of Space in the Built Environment

Friday 13 February, 8:00 am - 9:30 am - Room LL21E

Ann Heylighen, University of Leuven, Belgium
Challenging Prevailing Ways of Understanding and Visualizing Space

Yehuda Kalay, Israel Institute of Technology, Haifa, Israel
Simulating Human Behavior in Built Environments

Steven Vertovec, Max Planck Institute for the Study of Religious and Ethnic Diversity, Göttingen, Germany
The Diversification of Migration: Visualization Across Scales

Imaging the Past: Using New Information Technologies To Nurture Historical Analysis

Friday 13 February, 10:00 am - 11:30 am - Room LL21E

David Mattingly, University of Leicester, United Kingdom
Tracing History in the Saharan Desert Landscapes

Niclas Burenhult, Lund University, Sweden, and Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands
Mapping Categories of the Past and Present for the Future: Hunter-Gatherer Motion

José Iriarte, University of Exeter, United Kingdom
Using UAV LIDAR and Spectral Technology To Detect Human Landscape Changes in Amazonia

Imaging the Future of Cancer Research

Friday 13 February, 3:00 pm - 4:30 pm - Room 230B

David Scadden, Harvard University, Cambridge, MA
Tracking Cancer Stem Cells: The Intestine Paradigm

Danijela Vignjevic, Curie Institute, Paris, France
Cancer in 3D: In-Depth Research To Uncover Its Secrets

Cristina Lo Celso, Imperial College London, United Kingdom
In Vivo Imaging of Stem Cells: Deciphering the Dynamics Regulating Self-Renewal

ERC Workshop (San Jose Convention Center)

Top European Grants for Brilliant Minds from Across the World

Saturday 14 February, 9:15 am - 10:15 am - Room 210H

Speakers: Jose Labastida (ERC), **Elena Gabriela Chira** (REA) and **Viktoria Bodnarova** (Euraxess)

How disability can pioneer architectural innovation

Disability is often associated with access legislation rather than a source of creativity for architects. With her ERC grant, Prof. Ann Heylighen wanted to reverse this perspective. Her findings suggest that disability can be a valuable source of innovative solutions in architecture by extending prevailing ways of understanding space and designing buildings.

Through their interaction with the environment, disabled people are able to detect obstacles and appreciate spatial qualities in the environment that most architects are not attuned to. The experience and insights of people who are visually impaired or who are diagnosed with autism or dementia can complement and enrich the professional expertise in this field. They can draw attention to features we may all sense but never can formulate as well: for instance the non-visual qualities of a room (temperature, sound, air displacement); or features that (dis)connect or regroup people in a building.

In her project, Prof. Heylighen explored a new multisensory design approach in architecture, with the view to improve the quality of buildings and develop innovative design concepts. Working with visually impaired people, her team developed visuo-haptic design models to represent space taking their experience into account. The dialogue they initiated between disabled people and architects contributed to the overall discussion on inclusive design.

Prof. Heylighen also used her ERC Proof of Concept grant to enable disabled people to "rent out" their spatial experience to inform architects' design process. This service – in line with the concept of social innovation – will help architects design more inclusive buildings (e.g. museums, shops, restaurants), respectful of the diversity in people's abilities and conditions. This will become even more important as the population ages and more and more Europeans will experience some form of disability.

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Entrance of Museum M, Leuven (Belgium)

© Caroline Van Doren

The designer's tool for more people-friendly buildings

Our physical surroundings have a great impact on our lives. We live and work in buildings designed to meet a variety of purposes – but how well do these buildings meet the needs of the people who occupy them? Prof. Yehuda Kalay has received an ERC Advanced Grant to develop a method that will enable architects to design buildings that better accommodate people's physical and social needs.

In the process of designing a new building, considerations of user experience are sometimes lost in the need to focus on the material and physical aspects of the building, such as energy and structure. Prof. Kalay's research will extend current Building Information Modelling (BIM) systems to enable architects to predict and evaluate how well a proposed building will perform according to its users' point of view. The system will highlight how a building functions in light of the different types of users – for instance, whether a proposed new hospital is designed to optimally suit the needs of doctors and nurses, as well as patients and their visitors, or which compromises have been made to prefer one user community over another, and at what cost.

To develop the Next Generation BIM system, Prof. Kalay will take a new approach to represent the multitude of data relating to the form, function and use of a building. Rather than focusing on data that represents the form of the building alone (as current Building Information Modelling systems do), or information concerning the actions of individual users (as current game engines do), the research will employ a 'distributed' approach, representing all data as interconnected pieces in a larger puzzle.

By improving the design process of buildings, this research will help make buildings more user-friendly, reduce the operating costs in terms of physical infrastructure, as well as in terms of lost productivity and need for future structural adaptations, and minimise stress levels of users.

Comparing urban diversification in today's global cities

Global migration flows show a profound diversification of migrants groups in recent years. Their patterns of nationality, ethnicity, language, age, gender and legal status are growing ever more complex and migrants with 'new diversity' traits live in cities alongside people from previous immigration waves.

The dynamics of diversification and patterns of encounter in urban public space are at the core of Prof. Steven Vertovec's project. Eighteen months of fieldwork have been carried out in three cities undergoing rapid diversification: New York (a classic city of immigration with new global migrants flows in a broadly supportive political context); Singapore (dominated by racial-cultural politics, and wholly dependent on new, highly restricted migrants); and Johannesburg (emerging from Apartheid with tensions around unregulated new, pan-African migrant flows). In these cities, within neighbourhoods studied by the project, new migrants from a wide variety of origins and legal statuses represent more than 40% of the local population.

In public spaces compared across cities, what accounts for similarities and differences in social and spatial patterns that arise under conditions of diversification, when 'new diversity' meets 'old diversity'? Prof. Vertovec and his team use multidisciplinary research methods that span anthropology, sociology and human geography to research the changing nature of diversity and its socio-spatial patterns. Their approach explores how old and new diversities are locally understood ('conceiving diversity'), producing ethnographies of interaction ('observing diversity') and using photography, film and innovative data mapping ('visualizing diversity').

The project is currently in its final phase and the researchers hope the study will provide new social scientific understanding of many global trends connected to urbanization and social diversification.
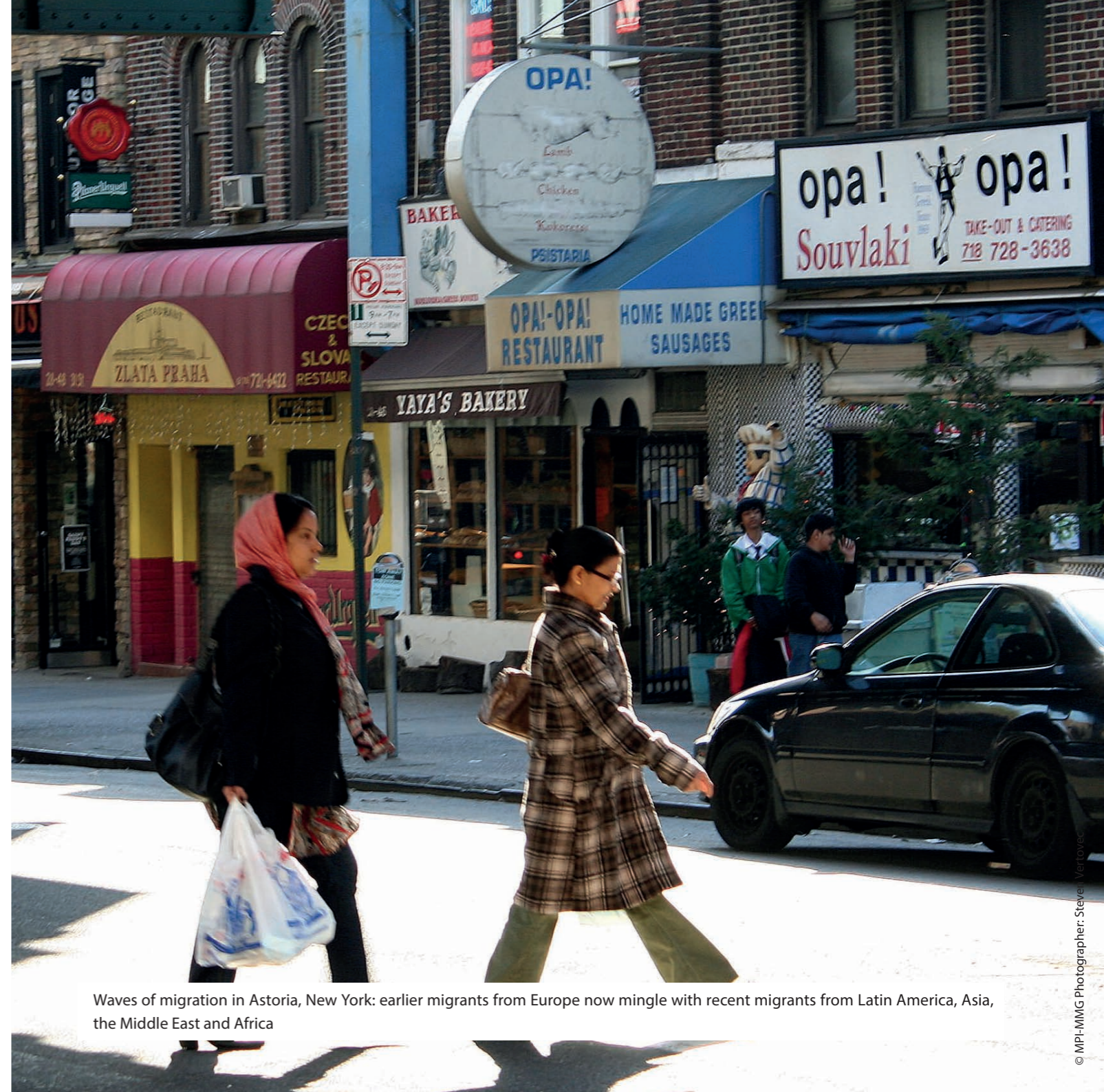
Waves of migration in Astoria, New York: earlier migrants from Europe now mingle with recent migrants from Latin America, Asia, the Middle East and Africa

© MPI-MMG Photographer: Steven Vertovec

The fascinating mysteries of a lost civilization

Funded by an ERC grant, researchers from the University of Leicester are investigating an ancient Saharan population, called the Garamantes, dating back to the period from 500 BC to AD 600. The team's archaeological findings in southern Libya have proved to be crucial in shedding more light on this scarcely-known civilization and the history of pre-Islamic Africa.

Contemporaries of the Roman Empire, the Garamantes have previously been depicted as a nomadic tribe living in scattered camps in a remote area of the Central Sahara. Recent research has suggested, however, that they were a remarkably advanced people, living in permanent villages and urban settlements, practising oasis agriculture, backed up by advanced technologies relating to irrigation and manufacturing (metal working, textile production, etc). They traded with both the Mediterranean and Sub-Saharan zones, playing a leading role in the earliest Trans-Saharan trading network, according to Prof. David Mattingly, one of the recognised leaders of Saharan archaeology.

The aim of this ERC project is to understand more about the Garamantes, their role in Trans-Saharan trade and migration flows and their connections with the neighbouring peoples. Prof. Mattingly, who leads the project, and his team have carried out extensive research work using aerial photography and satellite imagery. Thanks to these sophisticated investigation tools, they have brought to light the existence of an outstanding archaeological heritage, including hundreds of fortified oasis settlements, with advanced water-extraction and irrigation systems, which were exceptionally preserved by their remote setting. The Sahara now emerges as a much more populous place in the pre-Islamic era than previously believed and, rather than being a barrier, the desert appears to have been a much more connected space that put Mediterranean civilisations in regular contact with Sub-Saharan societies from the late first millennium BC onwards.

After four years, the project has achieved significant results that will have profound implications for the scholars' understanding of the historic relationships between the Mediterranean world and the Sub-Saharan area, leading to a reshaping of the history and archaeology of the African continent.

Researcher: David Mattingly

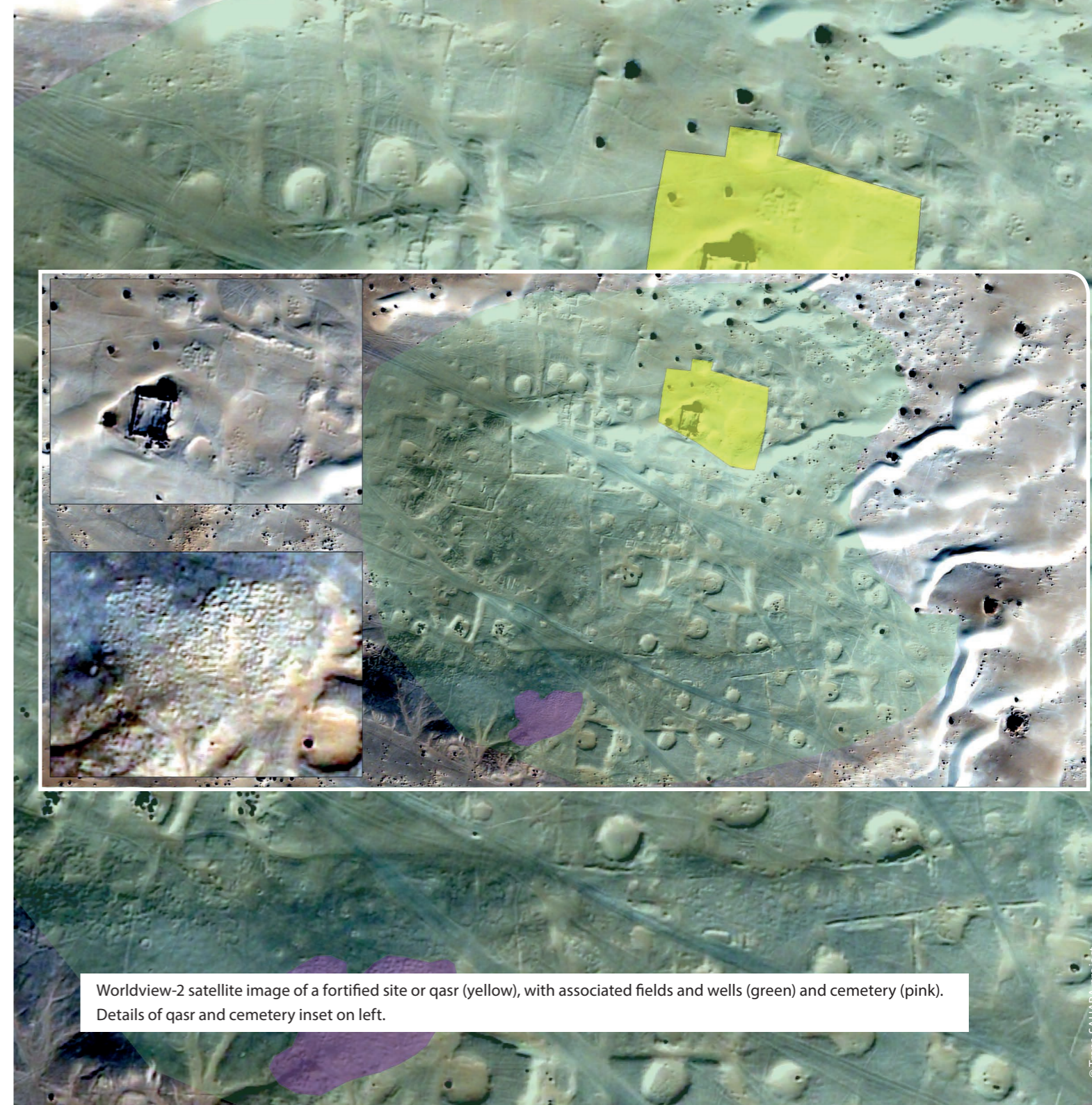**Host institution:** University of Leicester (United Kingdom)

ERC project: State Formation, Migration and Trade in the Central Sahara (1000 BC - AD 1500) (Trans-SAHARA)

ERC call: Advanced Grant 2010

ERC funding: €2.4 million for five years

Project webpage: http://www2.le.ac.uk/departments/archaeology/research/projects/trans-sahara-project/the-trans-sahara-project

Researcher webpage: http://www2.le.ac.uk/departments/archaeology/people/mattingly

Worldview-2 satellite image of a fortified site or qasr (yellow), with associated fields and wells (green) and cemetery (pink). Details of qasr and cemetery inset on left.

Understanding Amazonia's past to ensure its sustainable future

Amazonian forests represent a major reservoir of biodiversity and are of crucial importance for the regulation of earth's climate. Can we learn any lessons for its sustainable future by studying the relationship ancient societies established with the environment? Professor Iriarte believes so and aims to study how Amazonian land was used during the debated pre-Columbian period.

Humans have lived in Amazonia for at least the last 13 000 years. Until recently, the long-accepted paradigm was one of the 'noble savage' living in harmony with these ancient forests and having no impact upon them. Nevertheless, recent archaeological studies suggest the presence in the area of sizeable, regionally-organised, pre-Columbian societies that began to transform the landscape during the Late Holocene (1 AD-present) at a scale not previously recorded.

As this finding is among the most debated topics in New World archaeology, palaeo-ecology and conservation, Prof. Iriarte and his team set out to investigate the influence of the late pre-Columbian land use on Amazonian landscapes, the impact of the 1492 Columbian Encounter and its modern legacy.

They are currently carrying out a comparative study of pre-Columbian land uses in four different regions of Amazonia by applying an approach that integrates archaeology, ethno-history, archaeo-botany, paleo-ecology, soil science, landscape ecology and remote sensing, including the LIDAR technology used for high-resolution maps.

Amazonia, the epicentre of global biodiversity, has long been considered one of the last untamed wilderness areas on the planet. The results of this project will surely have broad implications not only for archaeology and geography but also for this area's conservation and the implementation of future sustainable land-use policies.
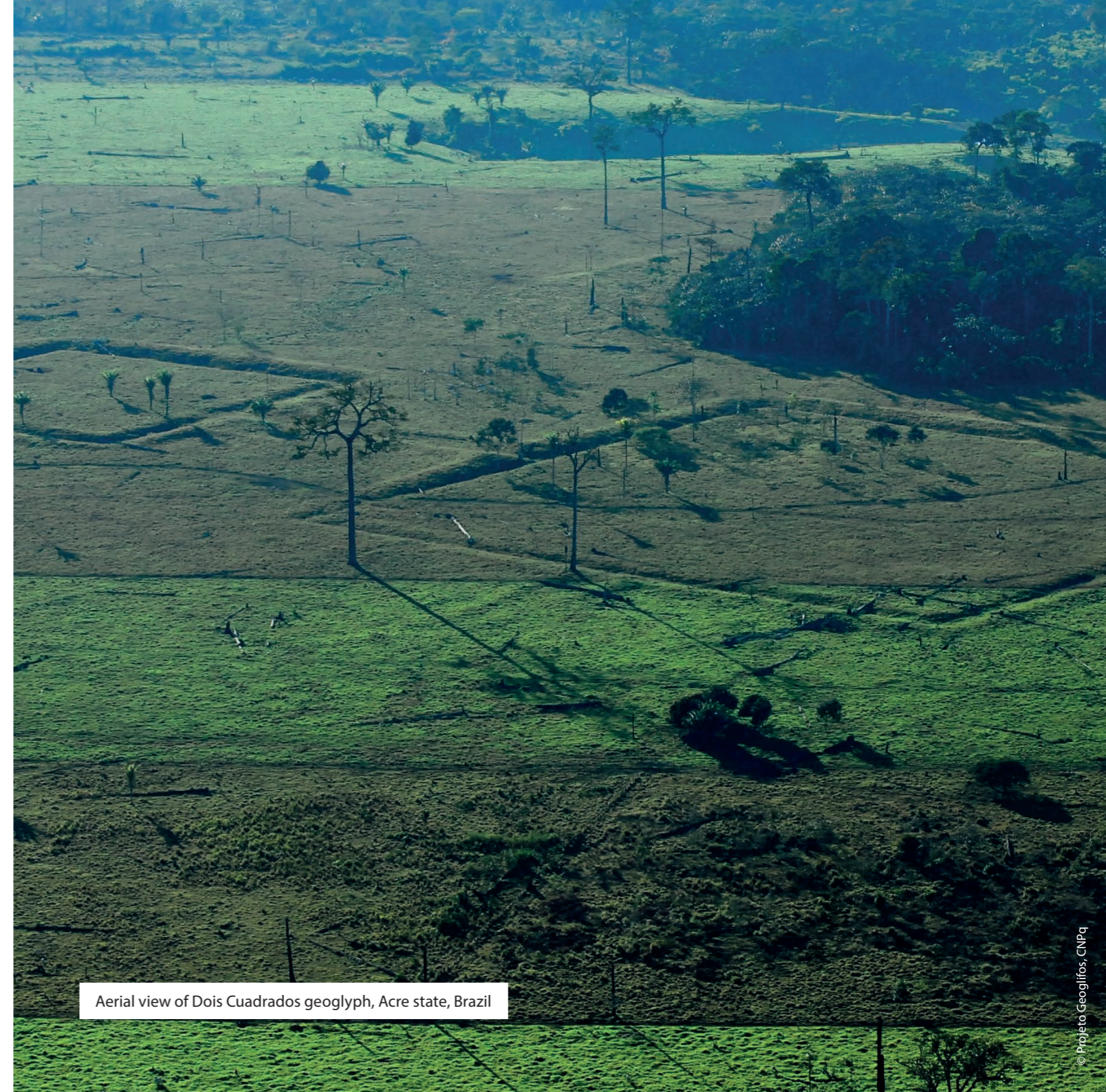
Researcher: José Iriarte

Host institution: University of Exeter (United Kingdom)

ERC project: Pre-Columbian Amazon-Scale Transformations (PAST)

ERC call: Starting Grant 2013

ERC funding: €1.7 million for four years

Researcher website: http://www.joseiriartearchaeology.net/

Aerial view of Dois Cuadrados geoglyph, Acre state, Brazil

© Projeto Geoglifos, CNPq

Does language shape the land?

Landscape influences human existence and experience and it is the spatial backdrop for language, cognition and culture. Dr Niclas Burenhult is working on the relationship between language and landscape in different areas of the planet.

Inspired by current intellectual shifts and technological advances, the project aims to situate our geographical environment within linguistics. With the possible exception of the human body, it is difficult to imagine a domain which is more fundamental to our language. Yet, landscape has hardly been explored from a linguistic point of view.

On the other hand, modern geographic information systems (GIS) are currently being developed at a global scale to map out locations, assist navigation, manage geographical information and deliver emergency services. But do they take into account indigenous names and categories? Or are they developed using a Western perspective only?

How do different languages label geographic features such as 'mountain', 'river', or 'valley'? How and why do categorical strategies vary across languages and speakers? What is the relationship between common nouns (landscape terms) and proper nouns (place names)? These are some of the questions Dr Burenhult's team aims to answer, investigating five diverse small-scale language groups across the globe in the Amazon, the American Southwest, Australia, Europe, and Southeast Asia.

The team collects, analyses, and documents spatially recordable linguistic data with GIS technology, and each language setting offers opportunities to compare closely related languages as well as the use of the same language by several individuals.

The results of the project will have a practical impact: understanding differences in labelling landscape is crucial for fields such as navigation, resource management and international law.

Researcher: Niclas Burenhult

Host institution: Lund University (Sweden)

ERC project: Language, cognition and landscape: understanding cross-cultural and individual variation in geographical ontology (LACOLA)

ERC call: Starting Grant 2010

ERC funding: €1.5 million for five years

Project webpage: http://projekt.ht.lu.se/lacola

Researcher webpage: http://www.sol.lu.se/en/person/NiclasBurenhult

© H. Burenhult

Mount Relay, Perak, Peninsular Malaysia

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Picturing cancer in 3D

In 2012, 2.8 million people in the European Union were diagnosed with cancer. It is the second most common cause of death in the EU. Dr Danijela Matic Vignjevic's STARLIN project is using ERC funding to understand how normal cells become cancerous and spread.

Colorectal cancers, affecting the stomach and intestines, are among the most frequently occurring forms of cancer. Dr Vignjevic's research into these types of cancer is unusual in that it focuses on the cell biology of the very early stages of cancerous development, rather than the later medical issues.

The entire lining of our intestine is renewed every week, thanks to cells dividing and multiplying, and then migrating towards the tips of the 'villi' – the finger-shaped protrusions that line the intestines and absorb nutrients from our food – before dying at the tips. Dr Vignjevic is exploring the possibility that cancer results when cells proliferate more than usual, or do not die, or do not migrate enough or normally. A better understanding of how the cells migrate would give us a better understanding of cancer.

In order to study tumours and see the cells buried deep inside tissue, the team is working on producing 3D imaging systems. Thanks to the ERC grant, the researchers have been able to buy and operate a 'two-photon microscope', which uses fluorescence to produce real-time images while inflicting less 'phototoxicity' damage to cells or tissue than comparative methods.

Although the research is due to run until 2017, good progress has already been made in the study of how cancer cells break through the basement membrane to spread to other organs. By imaging intestinal cells over three days from birth to death, the project has also advanced understanding of cell migration.
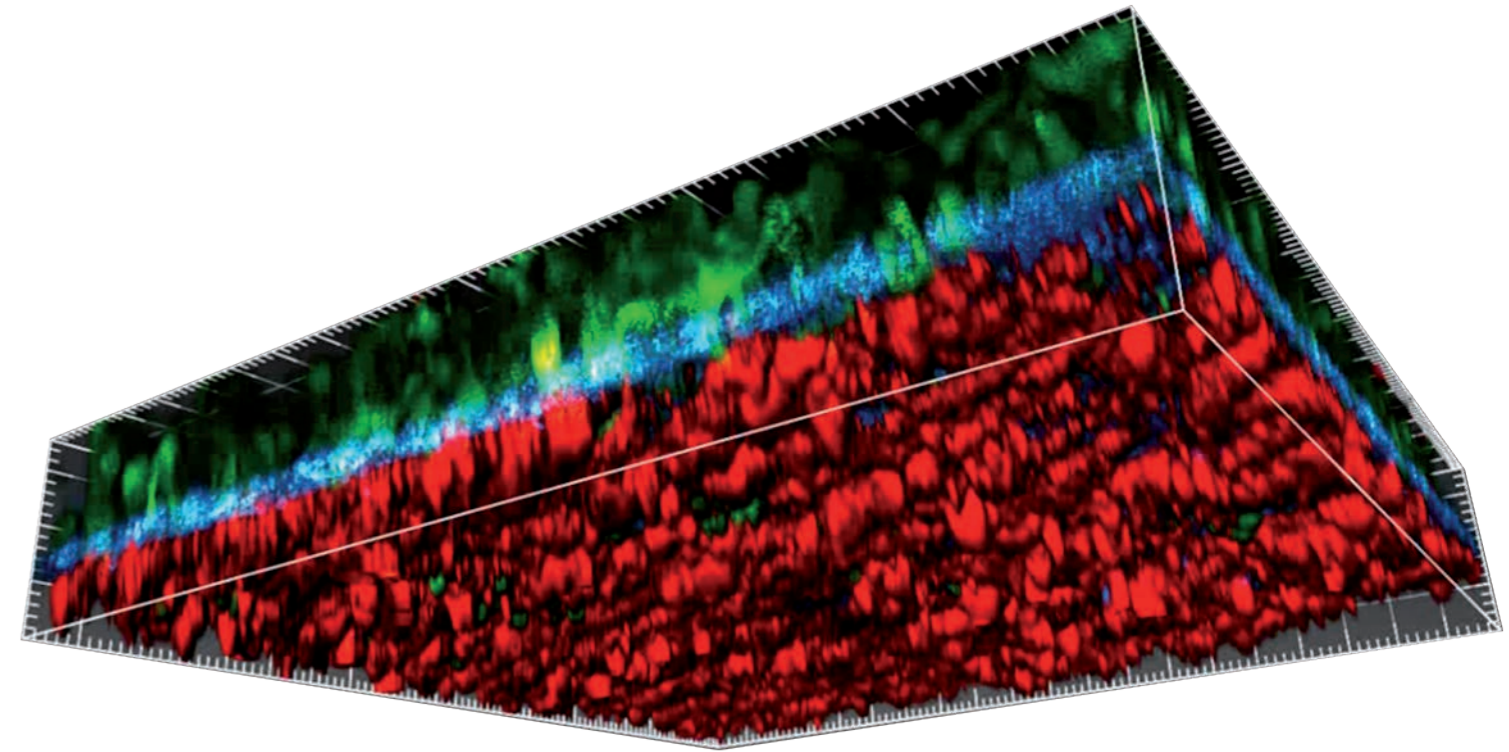
Researcher: Danijela Matic Vignjevic

Host institution: Curie Institut (France)

ERC project: Cell migration in gut homeostasis and cancer invasion – role of microenvironment (STARLIN)

ERC call: Starting Grant 2012

ERC funding: €1.5 million for five years

Researcher webpage: http://umr144.curie.fr/fr/profile/danijela-matic-vignjevic-00481

Cancer cells (green), cancer-associated fibroblasts (red), basement membrane (blue)

New insights into blood stem cells for improved regenerative therapies

Hematopoietic Stem Cells (HSCs) are blood cells that give rise to all the other blood cells. Recent advances in medical research have led to the use of HSCs transplants to treat cancer and autoimmune diseases. Elucidating how these cells work is the challenge of Dr Cristina Lo Celso, with a view to develop their therapeutic applications.

The function of Hematopoietic Stem Cells (HSCs), located in the bone marrow, is to produce and maintain the strains of the other blood cellular components: red blood cells, white blood cells, platelets and immune cells. They adapt their production, responding to the body's needs: developing more immune cells to counteract infections or leukaemia development, for example.

In order to function correctly, HSCs have to reside in the bone marrow within very specific places called "niches". The migration of HSCs to a different location – e.g. during a transplant - or the temporary modification of their niche may alter their function.

Despite numerous investigations, scientists do not currently have full knowledge of the composition and inner dynamics of HSCs niches. In this ERC-funded project, Dr Lo Celso will apply a new experimental approach to observe HSCs niches in physiological and pathological conditions.

Her research team will take advantage of the latest state-of-the-art microscopy techniques to observe, *in vivo*, HSCs of mice, which are very similar to human ones. The objective is to visualise the cellular and molecular components of the niches over time and understand their interactions, in a healthy steady state and in response to infection or leukaemia onset.

This research work will provide new insights into the mechanisms required to support the production of blood cells. A comprehensive picture of these dynamics will also be crucial for the future development of stem cell-based regenerative medicine therapies following injury or cancers such as leukaemia.

Researcher: Cristina Lo Celso

Host institution: Imperial College of Science, Technology and Medicine, London (United Kingdom)

ERC project: In vivo imaging of haematopoietic stem cells in their natural niches to uncover cellular and molecular dynamics regulating self-renewal (HSCNICHEIVM)

ERC call: Starting Grant 2013

ERC funding: €1.7 million for five years

Researcher webpage: http://www.imperial.ac.uk/people/c.lo-celso

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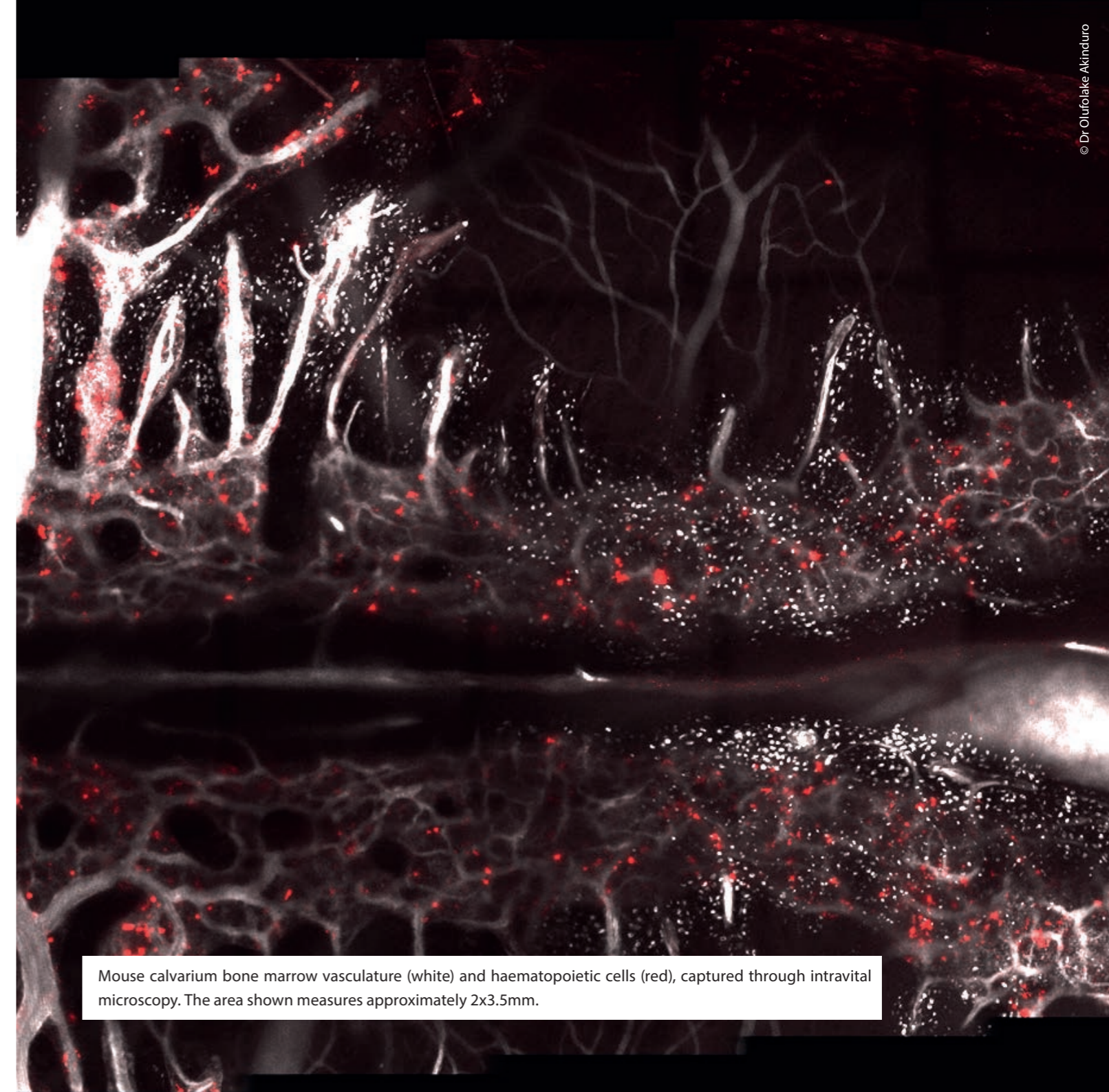
Mouse calvarium bone marrow vasculature (white) and haematopoietic cells (red), captured through intravital microscopy. The area shown measures approximately 2x3.5mm.

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Jean-Pierre Bourguignon
ERC President and Chair of its Scientific Council

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