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Newsletter of the European Research Council

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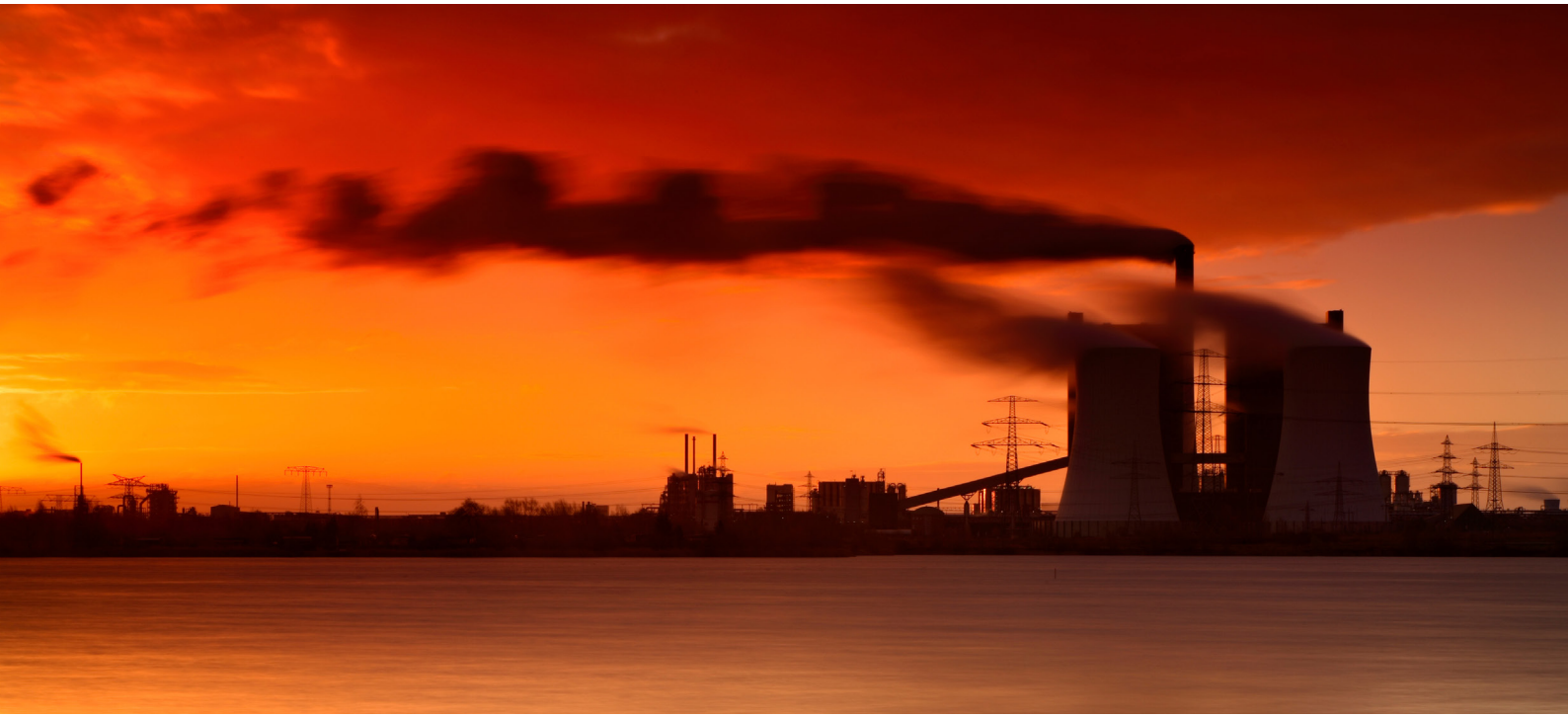

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Over the past years, Europe has become widely recognised as a driving force behind the energy transition and global climate actions. European citizens are highly sensitive to the risks that climate change brings and overwhelmingly demand concrete solutions that are smart and sustainable. Public support has translated into ambitious European climate policies and diplomacy which push and promote a sustainable transition across the world.

But the European Union doesn't exist in a vacuum. In today's political world, there still is a necessity for robust scientific evidence and fact-based decision-making. EU-funded research helps fulfil this need, not least the pioneering science carried out by the European Research Council grantees.

Challenges remain but the Paris climate agreement was a landmark. This agreement presents a huge opportunity and we are encouraged by the global reaction to the US withdrawal.

Fundamental scientific research is vital to uncover new avenues to accelerate a clean energy transition, curb climate change and fight its effects. The ERC-funded projects in these areas provide indispensable evidence to help forge new pathways to mitigate damage from global warming and modernise our economy. Fundamental research helps us identify old beliefs that hold us prisoner, break free from those certitudes, and approach a problem differently to come up with new solutions.

Without curiosity-driven basic science, no research targeted at solving "real problems" would exist and neither would technological progress. The ERC provides important, long-term funding for top researchers with the best ideas to carry out their work in Europe. It funds bottom-up, frontier research, in the belief that there is a need to support and strengthen scientific excellence in Europe without expecting any immediate technological return. The ERC's funding of this type of high-risk/high-gain research creates a foundation from which we can build the science base for future innovation.

We need to ensure that not only our scientists but also our youth and civil society are fully engaged in this challenge. In December 2017, I discussed the challenges of the Energy Union with European youngsters and announced the European Youth for Climate Action initiative to help young people take action for the climate and the local communities they live in.

I was also glad to see that the ERC brought climate change to the forefront at January's World Economic Forum in Davos. In September, we will meet in San Francisco for the Climate Action Summit, and in December, for COP24 in Katowice. We need tangible results to show by then: projects on the grounds that make our economy cleaner and smarter, and our lives better.

I look forward to continue using the results of frontier research to help capitalise on this momentum.

Maroš Šefčovič
European Commission Vice President for Energy Union

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Bottom up climate change research

Climate change – just two words that stand for one of the biggest and most complex challenges humanity faces. Health, safety and the welfare of billions are at stake. Whether it concerns the physics of Earth's atmosphere, ocean chemistry, plant cell biology, or national economics and politics; science is crucial to understand and predict climate change. Ground-breaking research, across virtually all disciplines, is needed if we want to reduce carbon emissions to mitigate the risks of climate change. The solutions can come from unexpected places, for example the research on two-dimensional materials enables the development of high-capacity energy storage devices, while quantum computing can one day help us build better climate models.

The ERC helps top researchers in Europe take on such ambitious challenges and make unexpected scientific and technological discoveries. Here we present the work of two grantees with related research. Dr Lisa Wingate looks down to the soil where the activity of certain enzymes - essential to global carbon storage - has been overlooked. Prof. BernadettWeinzierl looks up to the sky to understand the role of light absorbing aerosols such as mineral dust and black carbon.

From the ground up

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The increase of carbon dioxide (CO_2) in the atmosphere as a result of human activity is impacting the natural carbon cycle, modifying how the element travels between land and atmosphere. How will our future climate impact this exchange? How will ever-growing concentrations of greenhouse gases influence future biosphere CO_2 fluxes? The answer may lie at our feet; in the soil beneath us.

Dr Lisa Wingate studies different soil systems from across Europe, developing models to mimic the functioning of soil micro-organisms, their reaction to changes in climatic events, and how their enzyme activity modifies the atmosphere's chemistry. Integrating this into models can help us understand the complex links between CO_2 increase, biosphere function and climate. Through the ERC project SOLCA, she investigates the role of a previously overlooked enzyme, carbonic anhydrase, in speeding up - or slowing down - the exchange of CO_2 and other greenhouse gases in soil.

This process is not simple. Different environmental conditions, acidity, humidity and temperature, can impact the enzyme's concentrations in soil. This is why Dr Wingate uses data from many different biomes around the world. Soil biodiversity, which includes organisms ranging from bacteria to mosses, and from fungi to liverwort plants, also changes how much carbonic anhydrase is in the ground. This is why she studies and sequences biodiversity in a range of samples, to understand its variability alongside the soil 'community' carbonic anhydrase activity.

With ERC support, Dr Wingate equipped her laboratory with state-of–the–art instruments and established an interdisciplinary team of gas specialists, climate modellers, microbial and plant biologists and geneticists, to tackle these ambitious research questions. The SOLCA project, now in its final year, has developed more realistic models, and tested new measurement techniques to understand soil-atmosphere exchanges of gases such as carbon dioxide and carbonyl sulphide, that play a key role in climate change. The team collaborates with a global network of scientists to investigate the problem on a scale larger than ever before.

Dr Wingate's research could revolutionise environmental ecology by showing that studying organisms at a micro-level can provide important clues about climate change at a global level.

Researcher: Lisa Wingate, Institut National de la Recherche Agronomique (INRA), France

ERC Project: Carbonic anhydrase: where the CO_2COS and H_2O cycles meet (SOLCA)

ERC funding: Starting Grant 2013 €1.7 million for five years

Head and feet in the clouds

© DLR

Fascinated by clouds and planes since childhood, she became a meteorologist and aerosol scientist. Prof. Bernadett Weinzierl looks at the atmosphere but she also flies through it, aiming to understand what happens in the upper layers of the sky. Using an ERC starting grant for her A-Life project, she chases aerosols, those tiny particles suspended in the air which are critically important to the global climate system.

What is the aim of your research project?

We focus on the fundamental physical and chemical properties of aerosol particles and clouds during their atmospheric lifetime. A-LIFE investigates the properties of absorbing aerosol layers, in particular mixtures of mineral dust and black carbon, and studies potential links between the presence of absorbing particles and aerosol layer lifetime.

Both natural and man-made particles contribute to the global aerosol load. Moving through the atmosphere, the physical and chemical properties of particles may change, and aerosols from different sources can mix. Overall, aerosols have a cooling effect because they scatter the sunlight. In addition, aerosols can also change the properties of clouds, for example making clouds appear brighter in a polluted environment and changing the cloud's lifespan. Some aerosols like mineral dust and black carbon (BC) not only scatter but also absorb sunlight, which can lead to a warming of the atmosphere, with important implications for weather and climate.

One of the strengths of the A-LIFE project is its study of such aerosol mixtures and the identification of absorption levels by different aerosol types. According to model simulations, black carbon (BC) is the second or third contributor to current global warming after CO_2. Due to the short lifetime of BC - weeks, compared to hundreds of years for CO_2 - controlling BC emissions has been suggested as a quicker way to provide significant climate benefits, but the uncertainties are high and it is even possible that part of the absorption attributed to BC comes from mineral dust, in particular in mixtures. A-Life addresses a number of questions in this area, including some regarding BC measurements and separating its effects from that of mineral dust, for example.

You measure aerosols from the ground, but also during flights; why?

Although aerosol research is one of the main topics in atmospheric science, most existing measurements were taken from the ground, but aerosol layers often occur at altitudes of several kilometres above. There is only sparse data on aerosols, in all their diversity, at different altitudes and latitudes. Thanks to the ERC, we have equipped the DLR research aircraft Falcon with newly developed instrumentation that allows us to fly through the aerosol layers and to directly observe the aerosols' characteristics in the different environments.

What are the most interesting findings so far?

Developing novel instrumentation and modelling tools, as well as making measurements directly in the aerosol layers is already an innovation and a success. During the field campaign, we managed, for instance, to study a Saharan dust outbreak and dust-impacted clouds during several flights, while the dust outbreak moved eastwards. This gave us the opportunity to assess modification during transport and study aerosol-cloud interaction. Other highlights were the measurements of dust-BC mixtures as well as rare Arabian and Saharan dust layers.

The collected data enable us to assess similarities and differences in mineral dust properties. A strong vertical layering of different aerosol types was observed. We expected to see a lot of pollution, but were surprised to discover so much man-made aerosol, in particular at low altitudes over the sea. We also found mineral dust at a much higher altitudes than recorded previously: up to 9-11 km.

The analysis of the A-LIFE dataset will help to reduce existing uncertainties in the understanding of absorbing aerosols and provide important input towards evidence-based policy-making in the field of climate change.

Researcher: Bernadett Weinzierl, Universität Wien, Austria

ERC Project: Absorbing aerosol layers in a changing climate: ageing, lifetime and dynamics (A-LIFE)

ERC funding: Starting Grant 2014 €1.9 million for five years

Davos: reshaping global systems with frontier science

© World Economic Forum

Against the backdrop of a turbulent world stage, the 48th World Economic Forum (WEF) took place in Davos, Switzerland, from 23 to 26 January, on the theme "Creating a Shared Future in a Fractured World". The ERC had a strong presence at the summit held at the famous alpine resort, which again was a hive of activity, bringing together thought leaders from a range of sectors – from heads of state and business leaders to top academics, philanthropists and figures from civil society.

Participating in the summit for the sixth time, the ERC brought frontier science to the debate during fourteen sessions. ERC President Prof. Jean-Pierre Bourguignon and eleven ERC grantees - including Professors and Nobel Laureates Ben Feringa and Sir Christopher Pissarides - gave insights and inspiration with their latest findings.

Climate change was the focus of many a session at this year's WEF, and also underscored in speeches by French President Macron and Indian Prime Minister Modi. The ERC focused on this theme in its Ideas Lab "Safeguarding our Planet's Assets", with three grantees sharing their research on biodiversity and the fight against climate change.

Prof. Yadvinder Malhi stressed the need for forest conservation. His ERC research has taken him to Amazonia, pinpointing the roots of forest ecosystem instability provoked by climate change. With a biodiversity crisis unfolding before our eyes, Prof. Anne Magurran drew a comparison between our increasingly homogeneous ecosystems - with certain species pushing back others - to big brands dominating shopping centres worldwide. She concluded that there is however still time to restore ecosystems by protecting the environment. Prof. Maja Schlüter gave new perspectives on long-term interactions between natural ecosystems, human behaviour and societal decisions, highlighting the need to understand the influence of these components, for example on the adaptability of societies to developments such as climate change.

The ERC delegation also counted climate change scientist Prof. Johan Rockström amongst its ranks, who pressed for the building of a more sustainable economy. He also joined a related talk with top economist Prof. Hélène Rey: an example of returning European talent, partly thanks to an ERC grant. She also gave her outlook on the 2018 financial year.

In his address "A Journey of Discovery", Ben Feringa recounted the winding path towards his Nobel Prize. The engineering of his nano-cars took around seven years, which he said "wouldn't have been possible without the ERC".

The ERC co-organised a debate with the WEF on "From Frontier Research to Innovation", showcasing speakers Commissioner Carlos Moedas, Prof Bourguignon, ERC grantees Prof. Erika von Mutius and Ben Feringa, and industry leaders. One conclusion from the debate was that academia, industry and governments need more collaboration in order to smooth the path for innovation.

The ERC's President also took part in a highly topical discussion on how a universal code of ethics could help researchers navigate the world of the 4th Industrial Revolution.

Estonian research reflections – kes otsib, see leiab*

With the recent conclusion of the Estonian Presidency of the Council of the EU, we take the opportunity to interview Kristin Kraav, ERC National Contact Point at the Estonian Research Council (ETAg).

How are ERC grants viewed in Estonia?

ERC funding schemes are considered as extremely prestigious and complement our national funding. We don't yet have many grant holders in Estonia, so each time a new successful ERC grantee is added, attention from national press and the scientific community is guaranteed. Of course, country size must be taken into account when looking at the absolute number of ERC grantees based there.

Success in ERC competitions is also to some extent an important indicator of research quality on national level. To help researchers be more successful in ERC calls, ETAg offers a set of support measures. These range from information and training events, to a personal grant that we award to those applicants who get to the second stage, but remain unfunded. The aim of this 1 to 1.5 year grant is to help researchers to further their research and resubmit their proposal, hopefully to be successful in the next ERC call. We hope that this grant motivates more excellent researchers to apply and that it will eventually raise the number of ERC grantees from Estonia.

At an Estonia Presidency conference, the "Tallinn Call for Action on Research and Innovation" made a case for increasing public trust in scientific knowledge and to inform people more about the benefits of research. How does ETAg work in that direction?

ETAg is rather unique among research councils in terms of the weight of research popularisation in our activities. We already have a dedicated department that works with different target groups, from young children to science journalists, having exactly these goals in mind.

A very specific target group are Members of Parliament. To bring research and research policy discussions closer to our parliament, we have initiated a series of annual research policy conferences that gather different stakeholders. Most recently the conference topic was how to increase the role of research-based evidence in policy-making.

Do you also encourage scientists to communicate about their work?

Yes, it is very important to make science communication worthwhile for researchers – to ensure that the research system supports these activities. We have integrated science communication into our national funding instruments. For instance, instead of a traditional report, funding recipients can opt for a summary of popularisation activities related to their research.

The Call for Action also aims to "Ensure the effective use of research results by transitioning to open access of research results". I imagine this is a challenge for all researchers and research organisations. What developments have you seen in this area?

ETAg strives to lead the discussion on open access and open data in Estonia. As a funding agency, we try to help and educate researchers, rather than imposing strict rules. ETAg has an expert group that formulated our basic principles and policy recommendations in 2015. We also organise regular seminars and events on the subject. In 2017, we commissioned two surveys to look in detail on certain aspects of Open Science.

To date, 7 ERC grants have been awarded to researchers based in Estonia; 3 Starting Grants,1 Consolidator Grant , 2 Advanced Grants, and 1 Proof of Concept grant, worth in total about € 9.6 million. There are also 8 Estonian ERC grantees based elsewhere in Europe.
From 2011 to 2016 the Estonian Prof. Mart Saarma was also an influential actor in the ERC, holding the position of Scientific Council Member and then Vice President .

**He who seeks shall find*

Climate change: How on Earth to draw the boundary lines?

© PStockholm Resilience Centre, S-E. Arndt/Azote

Prof. Johan Rockstrom, you have become a well-known figure in climate change science. Tell us about your academic background and how you became interested in this area.

In the early 1990s, my initial field of interest and PhD focus was very down to earth, on sustainable management of freshwater resources, in particular on hydrology and food production. I rapidly realised that I had to connect water management at watershed and river basin scales with the global hydrological cycle and climate change, as I increasingly saw evidence that even local farming systems were impacted by climate change. Through my water research, ranging from local water harvesting to global water demand for food, I increasingly realised that when faced with growing evidence of global environmental change, there could be no such thing as sustainable or resilient development locally unless global challenges were also addressed. So, from the very beginning, I came at climate change research from the bottom up.

> *We work to understand what the processes are that regulate the Earth system.*

I then became head of the Stockholm Environment Institute where we were directly involved in the whole climate science challenge, ranging from climate policy through the COP process and the global science assessments through the IPCC. Through this work, and emerging from the scientific community in general, there was, in the wake of the new Millennium, a rising recognition that the world was moving fast in the wrong direction and taking enormous global risks that could threaten the ability of the Earth system to provide stable environmental conditions for world development. It was in 2002 that Nobel Laureate Prof. Paul Crutzen, a founding member of the ERC, published the seminal paper suggesting (based on the exponential rise in human pressure on Earth since the early 1950s) that humanity may now have entered a completely new geological epoch, the Anthropocene, in which the human world constitutes the largest driver of change on Earth.

In 2007, I co-founded the Stockholm Resilience Center, together with Prof. Carl Folke. We recognised that Earth system science had advanced so far, and evidence of global environmental risks had reached such a magnitude, that the time was ripe to gather scholars across all disciplines with direct links to the functioning of the Earth system - not only climate scientists but oceanographers, glaciologists, atmospheric and biodiversity scientists. The research question we posed was - what are the processes that regulate the stability of the Earth system? For each of these processes and systems, we also attempted to define the boundaries that could provide scientific support for a safe operating space on Earth within which our world, and our social systems, can evolve on a stable Earth system, but beyond which we risk non-linear, irreversible and potentially disastrous trajectories.

Your ERC project "Earth Resilience in the Anthropocene" (ERA) also studies non-linear processes. Can you explain what they are, and how your project will help combat climate change?

Today we understand that Earth is a highly interconnected complex system where all processes – such as the carbon and hydrological cycles, and systems like the atmosphere and biosphere - interact together. The Earth's temperature is not only determined by how much carbon dioxide is released into the atmosphere from fossil-fuel burning and deforestation, but is also a result of how the climate system interacts with forest, soils and oceans, for example. All of these interactions are regulated by feedback mechanisms, which either buffer and dampen stress/pressures (negative feedback) or self-reinforce change (positive feedback), and thereby determine whether it is a desirable or unwanted outcome for humankind.

For the last 12,000 years, since the end of the last Ice Age, Earth has been in an interglacial state of phenomenal stability. This is the geological epoch called the Holocene, in which any shifts or (non-linear) variations to the Earth's natural systems - either as a result of human action such as pollution or a natural event such as a volcanic eruption - have been largely dampened or moderated by the Earth's natural feedback mechanisms. But this predictability and stability can only occur as long as the planet is resilient. When Earth resilience is gradually lost, for example through deforestation and biodiversity loss, feedback mechanisms are prone to change direction from being dampening to self-reinforcing, producing an undesirable situation.

> *"Scientific evidence is fundamental to guide the transformation of the 4th industrial revolution"*

For example the 2015/2016 El Nino event is a form of natural non-linear shift that occurs when the heat normally stored in the Pacific ocean current is abruptly released back into the atmosphere. Oceans absorb some 95 % of the heat caused by our emissions of greenhouse gases, a massive moderating effect. El Nino is an example of a sudden - natural - shift in feedback to self-reinforcing heat, with strong and abrupt effects on weather systems, such as more severe droughts and floods. The aim of our ERC-funded project is to advance the science and better understand where the safe boundaries are, within which the overall mix of feedback on Earth safely remains negative, i.e. that the Earth's resilience level remains sufficient to ensure stable life support systems on our planet.

The science of defining planetary boundaries, within which we have a good chance of maintaining a stable Earth system, emerges from the very worrying and rising scientific recognition that the human race can act to destabilise the entire Earth system. This is, as I see it, perhaps our most important scientific challenge.

Another aim of my ERC research, apart from advancing the planetary boundaries framework, is to analyse at what mean global temperature rise - caused by humans through emissions of greenhouse gases - do we face the risk of pushing the Earth system beyond thresholds and lead to self-reinforced, further global warming, caused by the biosphere rather than humans alone.

You were recently at the WEF Davos summit where you discussed the "4th Industrial Revolution". How can fundamental research help steer us towards the desired prosperous and resilient, zero-carbon future?

My invitation to participate and share research in a number of sessions at Davos is a good indicator of the rise in recognition by the business and political elites that global environmental risks and global sustainability are absolutely central to world economic development. This was also strongly mirrored in the WEF 2018 global risk report that rated global environmental risks at their highest levels ever, in terms of threats to the world economy.

Science is already a generator of innovation and technological advancements and in effect the engine of the 4th Industrial Revolution. Scientific evidence is fundamental to guide the transformation of the 4th Industrial Revolution towards a scientifically defined polestar that would ensure that the next exponential rise in technology and wealth occurs within the safe operating space of a stable planet. My personal hypothesis is that economies and industries that embark on the 4th Industrial Revolution will generate additional gains above and beyond what was originally envisaged, by introducing more and deeper innovations that would be necessary to meet boundaries imposed by sustainability criteria, such as the need to ensure products are carbon neutral. Such innovations would include batteries for self-driving trucks or the next generation of electric jet aircrafts.

Researcher: Johan Rockström
Stockholms universitet, Sweden

ERC Project: Earth Resilience in the Anthropocene (ERA)

ERC funding: Advanced Grant 2016, €2.5 million for five years

ERC - Open to the World

The "ERC – Open to the World" campaign strives to attract worldwide talent, for example through agreements encouraging researchers to join ERC teams in Europe. In October 2017, the tenth such agreement was signed during the EU-India Summit. In December, ERC Vice President Prof. Klaus Bock, ERC grantees and European Commission RTD Director General Robert-Jan Smits participated in the South African Science Forum in Pretoria, focusing on frontier research for inclusive development. February 2018 saw the ERC in the US, taking part in the annual meeting of the AAAS, the MIT Career Fair, and sessions at the University of Texas and Tufts University on ERC funding opportunities.

ERC funds 160 innovation projects

Thanks to the newly awarded ERC Proof of Concept Grants, another 160 researchers are now able to explore the innovation potential of their research findings. The grants, each worth up to €150,000, help to turn research outputs into a commercial or socially valuable proposition. Researchers can use the funding in a number of ways, for example to establish intellectual property rights, investigate business opportunities or conduct technical validation. Funded projects in this latest round of funding include thermo-regulating paint, a new process for quick antibiotic development and an online tool that allows people to evaluate suspicious social media accounts.

Gago Award to ERC President

The first Gago conference on European science policy took place in Porto on 14 February in honour of the late Portuguese particle physicist and former Research Minister Prof. José Mariano Gago, instrumental in setting up the ERC. On this occasion, ERC President Jean-Pierre Bourguignon was awarded a "Gago Award in European Science Policy", designated for inspirational leaders who have contributed to the advancement of European science and technology. Commissioner Carlos Moedas also gave a keynote speech at the conference, which focused on cancer research.

329 Consolidator Grants awarded

The results of the ERC's Consolidator Grant competition were announced at the end of the year. This time, 329 top researchers across Europe received funding worth in total €630 million. Of all grants, 32% were awarded to female applicants, the highest share in this category since the ERC's first grant competition. The new grantees, who hold 39 different nationalities, will carry out their projects at universities and research centres in 22 different countries across Europe.

Calendar of ERC calls

Grants open to researchers from anywhere in the world

Call for proposals*	Publication date	Deadline	Budget	Funding
ERC 2018 Proof of Concept Grant**	6 September 2017	18 April 2018 11 September 2018	EUR 20 million	Up to €150,000 per grant
ERC 2018 Advanced Grant	17 May 2018	30 August 2018	EUR 450 million	Up to €3.5 million per grant

**Researchers who wish to apply to one of the ERC calls can do so through the Participant Portal.

**Call open to ERC grantees only.

For more information regarding ERC Proof of Concept grants, please see the ERC Work Programme 2018.

Candidates should apply with a host institution in an EU Member State or a Horizon 2020 Associated country. See further information on the Participant Portal.

Stay informed on the ERC website and the Participant Portal.

Information on the ongoing selection:

- In the 2018 ERC Starting Grant call, 3,170 applications were submitted (about 3% more than in the 2017 competition). Results will be officially communicated in summer 2018.
- The highest number of applications was submitted in the domain of Physical Sciences and Engineering (1,345 or 42%), followed by Social Science and Humanities (915 or 29%) and Life Sciences (910 or 29%).
- Around 37% of proposals were submitted by women – the same share as in 2017.

Look out for

Global Research Council meeting

On 15 May 2018, ERC President Jean-Pierre Bourguignon will attend the Global Research Council (GRC) in Moscow, Russia. The GRC meets annually, gathering the heads of science and engineering funding agencies to foster discussion about effective high-quality collaboration, and encourage best-practice exchanges. Meeting sessions will focus on the role of science diplomacy as well as exploring the topic of peer review and its role in the advancement of science. This year's meeting is jointly hosted by the Russian Foundation for Basic Research and the National Research Foundation of Korea.

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Liana vine proliferation might be a key adaptation mechanism of tropical forests to climate change. This image is from the webcomic inspired by ERC grantee Prof. Hans Joris Verbeeck's TREECLIMBERS project.

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