

Press release

12 January, 2022

In the Climate Change category

# The Frontiers of Knowledge Award goes to Ellen Mosley-Thompson and Lonnie Thompson for glacier ice studies that show our climate is changing at unprecedented speed

- **The awardee researchers** have “advanced the knowledge and understanding of past and current climate change through persistent, dedicated ice-core research in the vanishing high mountain glaciers of the tropics and mid latitudes,” in the words of the selection committee
- **The paleoclimatologist couple** have built an extensive library of past climate histories by analyzing the air trapped in the depths of the ice on both polar and high mountain glaciers, documenting “tropical climatic variability and its impacts on ecosystems and societies”
- **The long time series they obtained** evidence the unprecedented speed of today’ human-induced climate change set against the natural variability of past climate
- **Their research has documented** the rapid loss of high mountain glaciers and its consequences for the local communities that depend on them for water, and in terms of global sea-level rise

The BBVA Foundation Frontiers of Knowledge Award in the Climate Change category has gone in this fourteenth edition to the U.S. glaciologists Ellen Mosley-Thompson and Lonnie Thompson, “for advancing the knowledge and understanding of past and current climate change through persistent, dedicated ice-core research in the vanishing high mountain glaciers of the tropics and mid latitudes,” said the committee in its citation.

The paleoclimatologist couple Ellen Mosley-Thompson and Lonnie Thompson – nominated for

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the award by Dr. Claire Parkinson, Senior Climate Change Scientist at NASA's Goddard Space Flight Center – have built an extensive library of past climate histories by analyzing the air trapped in the depths of Earth's ice fields, with samples obtained by drilling and extracting cylindrical ice cores. The resulting ice record extends back 800,000 years at the poles – the case of samples taken in Antarctica from 3,200-meter boreholes - and up to 20,000 years in high mountain glaciers. And analysis of the cores confirms that current atmospheric concentrations of greenhouse gases are without precedent in our planet's past.

“The laureates' work puts current climate change in the context of natural climate variability, including in tropical and mid-latitude areas where such long records were not previously available,” explains José Manuel Gutiérrez, Director of the Instituto de Física de Cantabria and a member of the award committee. “Climate has shown to be changeable at geological scales of thousands of years, but as their data show, the current change stands outside any previous range and is characterized by its rapidity. This time, moreover, the change is not natural but human-driven. The most obvious evidence of this shift is that the glaciers they have been working on for four decades now are actually disappearing, so if it were not for their work, we would never have had access to this information.”

Professors in the Byrd Polar Research Center (BPRC) at The Ohio State University (United States), they are pioneers in the study of high mountain ice masses in remote locations that can only be reached by means of logistically complex expeditions. The ice cores they extract there are “of immense value” says committee secretary Carlos Duarte, as they provide the only detailed climate record able to connect climate variability with the rise and fall of ancient civilizations, like that of the Incas.

And it is not only air bubbles that get trapped in ice. The presence of pollen and other impurities within the cores allows to map the evolution of ecosystems like the Amazon rainforest or the duration of key climate system processes like the El Niño and La Niña ocean currents.

In the last four decades, Ellen Mosley-Thompson has led nine expeditions to the Arctic and six to Greenland. Lonnie Thompson, meantime, has led around fifty expeditions to high mountain glaciers in the Himalayas, the Andes and Kilimanjaro. One of the latest, in 2019, was to Huascarán, among the highest peaks in the Peruvian Andes, where he and his team battled extreme high mountain conditions, with perpetual snow and low oxygen levels, to successfully extract an ice core of 471 meters.

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## An “early warning system”

On behalf of himself and Ellen, who is convalescing from an illness, Lonnie Thompson expressed his pleasure at receiving the award during an interview shortly after being informed of the committee’s decision. In it he remarked that a key conclusion he has drawn from his decades of research is that “glaciers are the planet’s early warning system” in view of their high sensitivity to climate variations.

“Glaciers,” he explains, “serve both as recorders of the past climate and indicators of today’s. In the bubbles of their ice we have the history of carbon dioxide, methane, nitrous oxide - all the gases we are concerned about for the next 100 years.”

Thompson recalls that when he and Ellen started their research, back in the 1970s, “climate change was not an issue.” But what their work established was that glaciers “were not only retreating but the retreat was accelerating.”

The committee’s citation hails the laureates’ role as observers and recorders of the world’s vanishing glaciers: “The data they painstakingly obtained through an impressive set of 78 expeditions to high-altitude regions in the Andes, the Himalayans and Kilimanjaro have enriched the interpretation of climate change from global ice core records, and documented tropical climatic variability and its impacts on ecosystems and societies.”

“The ice cores obtained by the Thompsons and their local collaborators over the last half century have been drawn from sites likely never to be visited again and as such have become part of our natural and cultural heritage,” the citation continues. “Their research bears witness to the rapid loss of high mountain glaciers and its consequences.”

## Dramatic shrinkage of glaciers

The Thompsons' expeditions, for instance, have evidenced a dramatic retreat of up to 93% in New Guinea glaciers over a 39-year period (1980-2018), plus losses of up to 71% in Kilimanjaro (1987-2018) and 46% in the Peruvian Quelccaya glacier (1976-2020). “This accelerated melt,” Lonnie Thompson affirms, “indicates a significant impact of human activity.”

Further, the latest report by the Intergovernmental Panel on Climate Change (IPCC), published in August 2021, states that glaciers around the world have been shrinking fast, with satellite images suggesting that they lost more mass between 2010 and 2019 than in any decade since

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records began. Depending on changes in greenhouse gas emissions, it is reckoned that glacier mass shrinkage in the 21st century could range from 18% to 36%. To date, the largest losses have been recorded in the Andes, Central Europe, Alaska and Iceland.

Lonnie Thompson voices concern about the consequences of glacier melt for local communities, who are already seeing their lives and livelihoods affected. The loss of glaciers means water shortages, with serious knock-on effects on the supply of food, drinking water and hydroelectric power.

But he is also worried about “how all this will impact global sea levels.” For it is not just mountain glaciers that are in retreat, we are also seeing a loss of ice mass in Greenland and the Antarctic. “The glaciers are telling us that temperatures are rising, and sea level will continue to climb.”

Sea-level rise, he adds, will inevitably “displace a lot of people.” And “if we do not deal well with immigration in today's world, how are we going to handle millions of displaced people?”

### **Expeditions to the poles and high mountain glaciers**

The climate change the glaciers are proclaiming can also be read in the ice cores retrieved from polar regions. Although Lonnie too began his research in the 1970s with trips to Antarctica and Greenland, it is Ellen who is the polar specialist, the first woman to lead an expedition to the Antarctic, in 1986. And her work there was of such value to science that one of the region's valleys now bears her name.

This first expedition – to Plateau Remote, one of the coldest places on Earth – lasted longer than planned because the plane that was supposed to collect them couldn't find the camp. Mosley-Thompson made the most of the delay and kept on drilling, eventually extracting two cores of 200 meters length containing air bubbles from the last four millennia. Their analysis provided the first ever evidence of the huge volcanic eruption that triggered a global cold snap in the 19th century.

Ellen Mosley-Thompson and Lonnie Thompson met in 1969 at a Christmas party organized by the Geology Department at Marshall University, Virginia, where they were both enrolled – Ellen being only the second woman to study physics there. After graduating, the two got married. Their next expedition, says Lonnie Thompson, will be to the Quelccaya glacier in the Andes of Peru, “as soon as COVID-19 allows.”

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The Quelccaya ice cap marks a milestone in the careers of both. It was there in the 1980s that, after several failed attempts and thanks to the team's development of light-weight solar-powered drilling equipment, Lonnie Thompson became the first scientist to retrieve an ice core outside the poles. "The logistics of the undertaking were so complex that many experts at the time considered it an impossible goal," he relates. "But it has since been proved that this kind of work on high mountain glaciers is key to mapping one of climate change's most profound impacts."

### Lessons of the past

For Lonnie Thompson, one of the big advantages of extracting ice cores from high mountain glaciers rather than the poles is that they come from areas where cities and civilizations have sprung up successively over the past 10,000 years. By analyzing such samples connections can be drawn between the rise and fall of these cultures and past climate change.

"Take the Andes for example," he explains. "If we go back to the days before the arrival of the Spanish, in 1531, there was the Inca empire, and before that the Tihuanaco and Huari cultures. Each of them came to an abrupt end due to severe droughts lasting more than a decade, showing conclusively that past civilizations were strongly impacted by changes in climate."

What the ice cores have revealed about the impact of past climate change holds important lessons, he maintains, for the challenges of our human-induced warming. "Today's climate change is a global phenomenon. Every part of the planet will feel its impact, and we all still rely for our survival on agriculture and livestock farming. All that is imperiled by climate change."

The scientist believes that there is still an alarming gap between the seriousness of climate change as revealed by science, and international political inaction in the face of this great challenge of our time: "We need leaders who work for the public interest, but unfortunately there are lots of economic interests that are embedded in political systems around the world. So it is important to get the message across that climate change will impact all of us, all our economies, very negatively indeed."

Despite the scale of the challenge and the obstacles to getting the right anti climate change measures in place, Thompson is confident in human beings' willingness to cooperate when times get tough: "Our scientific expeditions to remote parts of the world, crewed by people from many countries, including the U.S., Russia and China, prove that it is possible to join forces and accomplish the mission, even in the harshest conditions. And that is exactly what will have to

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happen if we are going to deal effectively with climate change.”

### Laureate bio notes

**Ellen Mosley-Thompson** (Charleston, West Virginia, United States, 1948) earned a BS in Physics in 1970 from Marshall University, and a PhD in Geography (Climatology, Atmospheric Science) in 1979 from The Ohio State University, where she had completed a master’s degree in the same specialty in 1975.

She has spent her entire teaching and research career at Ohio State (OSU), joining the Institute for Polar Studies there in 1973. The Institute would later become the Byrd Polar and Climate Research Center, with Mosley-Thompson at its head from 2009 to 2018. Appointed a full professor in the Department of Geography in 1995, she has held the title of Distinguished University Professor at OSU since 2010.

She has led nine expeditions to Antarctica and six to Greenland to retrieve ice cores, as well as heading 16 projects in the field. Author of over 140 peer-reviewed papers, and the recipient of almost 60 research grants, Mosley-Thompson is a past president of the Global Environmental Change Focus Group of the American Geophysical Union, and has also been honored by having her name given to the Mosley-Thompson Glacier in the Antarctic, among other distinctions.

**Lonnie G. Thompson** (Gassaway, West Virginia, United States, 1948) completed a BS in Geology at Marshall University in 1970. After marrying Ellen Mosley-Thompson, he moved to The Ohio State University (OSU), where he received an MS in Geological Sciences in 1973 and a PhD in the same subject in 1976. He has remained at OSU for the rest of his career, as full professor since 1994 and currently as Distinguished University Professor in the School of Earth Sciences and Senior Research Scientist in the Byrd Polar and Climate Research Center. At the time of writing, he is also Adjunct Professor at the Center for Excellence in Tibetan Plateau Earth Sciences and Co-director of Academics with the Tibetan Plateau Research Institute, both in Beijing (China).

He has led over 60 ice-core drilling expeditions in 16 countries, from China to Peru by way of Russia, Tanzania and Indonesia, in a forty-year career that has seen him receive almost 80 research grants and publish more than 260 peer-reviewed papers. A member of the Advisory Board of *National Science Review* (Oxford Academic), published under the auspices of the Chinese Academy of Sciences, he has also served on advisory committees for the likes of the U.S. National Research Council, the Canadian Foundation for Climate and Atmospheric Sciences, China’s Ministry of Science and Technology and the Max Planck Society (Berlin,



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Germany). Among his many distinctions is the National Medal of Science, the highest honor the U.S. awards to American scientists.

### Climate Change committee and evaluation support panel

The committee in this category was chaired by **Bjorn Stevens**, Director of the Max Planck Institute for Meteorology (Hamburg, Germany), with **Carlos M. Duarte**, holder of the Tarek Ahmed Juffali Research Chair in Red Sea Ecology at King Abdullah University of Science and Technology (Thuwal, Saudi Arabia), acting as secretary. Remaining members were **Sandrine Bony**, Director of Research with the Centre National de la Recherche Scientifique at Sorbonne University (Paris, France); **Miquel Canals**, Director of the Department of Earth and Ocean Dynamics at the University of Barcelona (Spain); **José Manuel Gutiérrez**, Research Professor and Director of the Instituto de Física de Cantabria (IFCA) and Coordinating Lead Author of the Atlas chapter in the IPCC's Sixth Assessment Report; **Martin Heimann**, Director Emeritus in the Department of Biogeochemical Systems at the Max Planck Institute for Biogeochemistry (Jena, Germany); **Edward Rubin**, Alumni Chair Professor of Environmental Engineering and Science at Carnegie Mellon University (Pittsburgh, United States); **Paul Wassmann**, Professor in the Department of Arctic and Marine Biology at UiT The Arctic University of Norway; and **Julie Winkler**, Professor of Geography in the Department of Geography, Environment and Spatial Sciences of Michigan State University (United States).

The **evaluation support panel** of the **Spanish National Research Council (CSIC)** was coordinated by **M. Victoria Moreno**, the Council's Deputy Vice President for Scientific and Technical Areas, and formed by: **Santiago Beguería Portugués**, tenured scientist at the Aula Dei Experimental School (EEAD); **Francisca Martínez Ruiz**, research scientist at the Andalusian Earth Sciences Institute (IACT, CSIC-UGR); **Ángel Ruíz Mantecón**, Deputy Coordinator of the Global Life Area and research professor at the Mountain Stockbreeding Institute (IGM, CSIC-UNLE); and **Blas Valero Garcés**, Deputy Coordinator of the Global Life Area and research professor at the Pyrenean Institute of Ecology (IPE, CSIC).

### About the BBVA Foundation Frontiers of Knowledge Awards

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The BBVA Foundation centers its activity on the promotion of world-class scientific research and cultural creation, and the recognition of talent.

The BBVA Foundation Frontiers of Knowledge Awards, funded with 400,000 euros in each of their eight categories, recognize and reward contributions of singular impact in science, technology, the humanities and music, privileging those that significantly enlarge the stock of knowledge in a discipline, open up new fields, or build bridges between disciplinary areas. The goal of the awards, established in 2008, is to celebrate and promote the value of knowledge as a public good without frontiers, the best instrument at our command to take on the great global challenges of our time and expand the worldviews of individuals in a way that benefits all of humanity. Their eight categories address the knowledge map of the 21st century, from basic knowledge to fields devoted to understanding and interrelating the natural environment by way of closely connected domains such as biology and medicine or economics, information technologies, social sciences and the humanities, and the universal art of music.

The BBVA Foundation has been aided in the evaluation of the 105 nominees for the Frontiers Award in Climate Change by the Spanish National Research Council (CSIC), the country's premier public research organization. CSIC appoints evaluation support panels made up of leading experts in the corresponding knowledge area, who are charged with undertaking an initial assessment of the candidates proposed by numerous institutions across the world, and drawing up a reasoned shortlist for the consideration of the award committees. CSIC is also responsible for designating each committee's chair and participates in the selection of its members, thus helping to ensure objectivity in the recognition of innovation and scientific excellence.

**WINNER INTERVIEWS AND PHOTOGRAPHS CAN BE DOWNLOADED FROM**

<https://www.dropbox.com/t/xnSfaMgeluWFJVAc>

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