

BBVA Foundation Frontiers of Knowledge Award in Climate Change

The BBVA Foundation honors the authors of the mathematical models that predicted global warming due to increasing atmospheric CO₂

- The jury has recognized the landmark achievements of **Syukuro Manabe and James Hansen** in developing the first computational models able to simulate climate behavior and project the impact of greenhouse gases on terrestrial temperatures
- Their research, says the jury's citation, "quantified factors controlling the magnitude of the surface temperature response to external perturbation." The methods they developed, it continues, have stood the test of time and "have become central to predictions of future climate change"

Madrid, January 10, 2017.- The BBVA Foundation Frontiers of Knowledge Award in the Climate Change category goes, in this ninth edition, to climatologists Syukuro Manabe and James Hansen, separately responsible for constructing the first computational models with the power to simulate climate behavior. Decades ago, both men correctly predicted how much Earth's temperature would rise due to increasing atmospheric CO₂. The scores of models currently in use to chart climate evolution are "heirs" to those first developed by Manabe and Hansen.

The award is bestowed for Manabe and Hansen's contributions "to the development of mathematical models of the climate system, and their pioneering use of these models to understand and project how Earth's climate responds to changing concentrations of atmospheric CO₂," in the words of the prize jury.

Syukuro Manabe (Japan, 1931) was working on weather prediction in the 1960s, when he set out to build a numerical model to simulate atmospheric behavior. Scientists then had no inkling that CO₂ concentrations were augmenting due to fossil fuel combustion, and none could suspect that a process of this type might end up altering the Earth's climate.

Manabe was doing postdoctoral meteorological research in Japan, when the call came in 1958 to join a colleague at the U.S. Weather Bureau in Washington. It was there that he began using computers in his work to create the first ever model of global atmospheric circulation, including elements like water vapor, winds and atmospheric heat transport. To get a firm grasp on this last variable, greenhouse gases had to be factored into the program. At the end of the 1960s, while engaged in research at the National Oceanic and Atmospheric Administration (NOAA), Manabe completed his model which projected that if CO₂ concentrations doubled, global temperature would rise by two degrees. This was a theoretical prediction based on sparse data, which moreover could not be tested because there was at that time no reliable record of planet-wide temperatures.

In the late 1960s, James Hansen (United States, 1941) had just completed a PhD in Physics at the University of Iowa, where he had taken the space science program led by James Van Allen (a pioneer in the study of the Earth's magnetic field). His training had included a scholarship at NASA and stints as a visiting student in the Astronomy Department at the University of Tokyo, where, he recalls, he became acquainted with Syukuro Manabe's work. In 1967, he joined the staff at NASA's Goddard Institute for Space Studies, researching into planetary atmospheres with a particular focus on Venus. His work there helped establish that the extremely hot temperatures prevailing on Venus were due to an exacerbated greenhouse effect.

As the 1970s advanced, it became increasingly clear that atmospheric CO₂ concentrations were on the rise. There was still no evidence, however, as to what the effect might be on the world's climate. To Hansen, it seemed far more important to study the climate of our own planet as it confronted this change, with unfathomable consequences for many millions of people. He decided to switch to studying the Earth climate, and developed his own model independently of Manabe's. The conclusion he drew was that world temperatures would rise by four degrees centigrade.

"The predictions of Manabe and Hansen's models still hold true," observes jury member Carlos Duarte, since current models point to varying rates of planetary warming as a function of future changes in CO₂ concentrations.

The paper setting out Hansen's conclusions, published in *Science* in 1981, is important for two more reasons: it was the first to incorporate global data for Earth's temperatures, thanks to Hansen's invention of a new method for processing the information gathered from available meteorological stations; and it also predicted how warming would affect other processes, like oceanic circulation, the loss of Arctic ice cover or droughts and flooding.

Hansen's projections, the jury remarks, "have stood the test of time." Hansen and Manabe "quantified factors controlling the magnitude of the surface

temperature response to external perturbations," and developed "analysis methods they have become central to predictions of future climate change."

Manabe, since 2005 Senior Meteorologist on the Program in Atmospheric and Oceanic Sciences at Princeton University (United States), stresses the importance of his colleague's contribution: "I started working with models earlier, but Hansen was the first to use these models to make predictions."

This effort, and his own, have underpinned the pathway to the present juncture, with an international accord in place to combat climate change: "The Paris Agreement sets a very important objective. Whether we can fulfill it is another matter, because the challenge is immense."

For Hansen, Director of the Goddard Institute for Space Studies from 1981 to 2013, and currently an Adjunct Professor at Columbia University's Earth Institute, Manabe "has led the world in global climate models since I started my career."

"The first, crucial conclusion of our work was to show that global climate is very sensitive to humans," affirms Hansen, who also celebrates the fact that "climate models are much more reliable than they were years ago, with a far smaller margin of uncertainty."

Bio notes: Syukuro Manabe

Syukuro Manabe (1931) obtained a PhD in Meteorology from the University of Tokyo in 1958. He was a visiting professor at the universities of Nagoya and Tokyo, in Japan, and worked for the U.S. National Oceanic and Atmospheric Administration (NOAA). From 1997 to 2002, he headed the Global Warming Research Division at Japan's Frontier Research Center for Global Change, before returning to the States to join the staff of Princeton University. He took American nationality in 1975.

Manabe is a pioneer in the study of the terrestrial climate system from the standpoint of fundamental physics, and in the creation of the first ever computational numerical models; technologies that would become essential tools to elucidate the underlying mechanisms of climate variability. This novel approach uncovered the first modern scientific evidence of the increase in CO₂ emissions and its impact on global climate change. Manabe also spoke before the U.S. Senate Committee on Energy and Natural Resources, meeting in 1988, which would prove instrumental in bringing global warming to the attention of policy-makers and the wider public.

An Honorary Member of the American Meteorological Society, the Japan Meteorological Society and the Royal Meteorological Society (United Kingdom), and a Fellow of the American Geophysical Union and the American Association for the Advancement of Science (AAAS), he also belongs to the U.S. National Academy of Sciences, the Academia Europaea, the Royal Society of Canada

and the Japan Academy. His numerous awards and honors include the Benjamin Franklin Medal of the Franklin Institute (2015).

Bio notes: James Hansen

James Hansen (1941) is an Adjunct Professor at Columbia University's Earth Institute, where he has led the Climate Science, Awareness and Solutions program since the year 2013. From 1981 to 2013 he was Director of NASA's Goddard Institute for Space Studies (GISS), where he spent his postdoctoral career after earning a PhD in Physics at the University of Iowa (1967). He also completed a brief research stay at Leiden Observatory.

He was part of the team responsible for the GISS terrestrial atmosphere model, a weather prediction tool that Hansen and his colleagues redesigned to provide long-term climate simulations. This model is being constantly upgraded in line with new findings and technological advances. In 1987, he and Sergej Lebedeff published GISS' first global temperature analysis, which detected an increase in Earth temperatures between 1880 and 1985. In a 1988 paper, Hansen and his co-authors correctly predicted an acceleration in global warming with respect to the 1950s, foreseeing that its effects would be felt in the 1990s.

That same year, his testimony to the United States Senate Committee on Energy and Natural Resources, based on his scientific findings, helped raise broader political and social awareness of the global warming issue, its human origins and the need to act now to mitigate its impact.

A member of the National Academy of Sciences since 1995, his multiple honors include the John Heinz Environment Award, the Roger Revelle Research Medall of the American Geophysical Union and the Leo Szilard Award of the American Physical Society, for Outstanding Promotion and Use of Physics for the Benefit of Society.

About the BBVA Foundation Frontiers of Knowledge Awards

The BBVA Foundation has as its core objectives the promotion of scientific knowledge, the transmission to society of scientific and technological culture, and the recognition of talent and excellence across a broad spectrum of disciplines, from science to the arts and humanities. One of its focus areas is the environment, with particular attention to actions and analyses to conserve biodiversity, along with the scientific study of climate change and strategies for its effective mitigation.

The **BBVA Foundation Frontiers of Knowledge Awards** were established in 2008 to recognize outstanding contributions in a range of scientific, technological and artistic areas, and knowledge-based responses to the central challenges of the 21st century. The areas covered by the Frontiers Awards are congruent with the

knowledge map of the present day, in terms of both the disciplines addressed and acknowledgement of their overlap in diverse interdisciplinary fields.

Their **eight categories** include classical areas like Basic Sciences and Biomedicine, and other, more recent areas characteristic of our time, ranging from Information and Communication Technologies, Ecology and Conservation Biology, Climate Change and Economics, Finance and Management to Development Cooperation and the innovative artistic realm that is Contemporary Music.

The BBVA Foundation is aided in the organization of the awards by the **Spanish National Research Council (CSIC)**, the country's premier public research agency. As well as designating each jury chair, the CSIC is responsible for appointing the technical evaluation committees that undertake an initial assessment of the candidates put forward by numerous institutions across the world, and draw up a reasoned shortlist for the consideration of the juries.

Climate Change jury and technical committee

The jury in this category was chaired by **Bjorn Stevens**, Director of the Max Planck Institute for Meteorology (Hamburg, Germany), where he heads the Atmosphere in the Earth System Department, and also a professor at the University of Hamburg. The secretary was **Carlos Duarte**, Director of the Red Sea Research Center and holder of the Tarek Ahmed Juffali Chair in Marine Biology at the King Abdullah University of Science and Technology (Thuwal, Saudi Arabia). Remaining members were **Scott Barrett**, Lenfest-Earth Institute Professor of Natural Resource Economics at the School of International and Public Affairs and the Earth Institute at Columbia University (USA); **Sandrine Bony**, senior scientist at the Laboratoire de Météorologie Dynamique/Institute Pierre-Simon Laplace (LMD/IPSL) in Paris (France); **Miquel Canals**, Director of the Department of Earth and Ocean Dynamics at the University of Barcelona (Spain); **Martin Heimann**, Director of the Department of Biogeochemical Systems at the Max Planck Institute for Biogeochemistry (Jena, Germany) and a professor at the Friedrich Schiller University, likewise in Jena; **Edward Rubin**, Professor of Engineering and Public Policy and Alumni Chair Professor of Environmental Engineering and Science at Carnegie Mellon University Mellon (Pittsburgh, USA); and **Julie Winkler**, Professor of Geography in the Department of Geography, Environment and Spatial Sciences at Michigan State University (USA).

The **CSIC Technical Evaluation Committee** was coordinated by **Ana Guerrero**, the Council's Deputy Vice President for Scientific and Technical Areas, and formed by: **Gerardo Félix Benito**, Research Professor in the Spanish Museum of Natural Sciences (MNCN); **Antonio Delgado**, Research Professor in the Andalusian Earth Sciences Institute (IACT); **José Luis Pelegrí**, Research Professor in the Institute of Marine Science (ICM); and **Xavier Querol**, Coordinator of the CSIC Natural Resources Area and Research Professor at the Institute of Environmental Assessment and Water Research (IDAEA).

CALENDAR OF UPCOMING AWARD ANNOUNCEMENTS

Information and Communication Technologies (ICT)	Tuesday, January 17, 2017
Basic Sciences	Tuesday, January 24, 2017
Biomedicine	Tuesday, January 31, 2017
Ecology and Conservation Biology	Tuesday, February 7, 2017
Contemporary Music	Tuesday, February 14, 2017
Economics, Finance and Management	Tuesday, February 21, 2017
Development Cooperation	Tuesday, February 28, 2017

Previous awardee in this category

The **Climate Change** award in last year's edition went to climatologist **Veerabhadran Ramanathan**, for discovering that human-produced gases and pollutants other than CO₂ have a huge power to alter the Earth's climate, and that by acting on them it is possible to make a significant short-term dent on the rate of global warming.

A list of remaining laureates in the previous edition can be accessed through the following link:

<http://www.fbbva.es/TLFU/tlfu/ing/microsites/premios/fronteras/index.jsp>

Five of the 79 winners in earlier editions of the BBVA Foundation Frontiers of Knowledge Awards have gone on to win the Nobel Prize. Shinya Yamanaka, the 2010 Biomedicine laureate, won the Nobel Prize in Medicine in 2012; **Robert J. Lefkowitz**, awardee in the same Frontiers category in 2009, won the Chemistry Nobel in 2012. In Economics, Finance and Management, three Frontiers laureates were later honored with the Nobel: **Lars Peter Hansen**, winner of the Frontiers Award in 2010 and the Nobel Prize in 2013; **Jean Tirole**, Frontiers laureate in 2008 and Nobel laureate in 2014; and **Angus Deaton**, 2011 Frontiers laureate and Nobel laureate in 2015.

LAUREATE'S FIRST DECLARATIONS AND IMAGES

A video recording of the new laureate's first interview on receiving news of the award is available from the Atlas FTP with the following coordinates:

Server: **213.0.38.61**

Username: **agenciaatlas5**

Password: **premios**

The name of the video is:

"PREMIO CAMBIO CLIMÁTICO"

In the event of connection difficulties, please contact Alejandro Martín at Atlas:

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Fundación **BBVA**

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