



Caapiranga,  
in the state  
of Amazonas,  
October 2005:  
lake turns into  
arid expanse



ENVIRONMENT

# Bringing people together

**FAPESP launches program and summons  
researchers from many fields, from natural sciences  
to the humanities, to increase Brazil's contribution  
in the study of global climate change**

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**B**razil's largest and most collaborative multidisciplinary effort ever was released at the end of last month, to increase understanding of global climate change. Scientists from several areas in São Paulo State, ranging from the physical and natural sciences to the humanities, were summoned to take part in the FAPESP Program of Research into Global Climate Change, officially launched on August 28 in the morning. R\$ 100 million will be invested over the next ten years – or some R\$ 10 million a year – in the bringing together of basic and applied studies into the causes of global warming and its effects on people's lives. "The aim is to increase the quantity and quality of São Paulo researchers' contributions into the progress of our understanding of this complex subject; we expect the program to foster further studies into subjects that are of specific interest to Brazil," stated FAPESP's scientific director, Carlos Henrique de Brito Cruz. "We hope that the growth of Brazil's scientific output in this field

earns it more room in the global debate on climate change," he said.

Two calls for proposals were released, totaling R\$ 16 million in grants. This amount is to be funded equally by FAPESP and by CNPq (Brazil's National Scientific and Technological Development Council), through Pronex, the Aid Program for Centers of Excellence. One of the calls will provide R\$ 13.4 million in grants for projects in six different subjects. The first is how ecosystems work, with emphasis on biodiversity and the carbon and nitrogen cycles. The second is the atmosphere radiation balance, in particular studies on aerosols, the so-called trace-gases (carbon monoxide, ozone, nitrogen oxides and volatile organic compounds, among others); and the change in the use of the soil. The third concerns the effects of climate change on crop and livestock farming. The fourth deals with energy and the greenhouse gas effects. The fifth covers effects on health, and the sixth, the human dimensions of global environmental change. Since the program's initial stage aims to es-

tablish and link researchers' networks, FAPESP chose to fund theme projects, but future calls for proposals may provide other types of grants, such as Aid to Young Researchers. Agreements with research aid foundations in three states (Amazonas, Pará and Rio de Janeiro) will be taken into account in the public notices that are to be released in coming weeks.

The reason for having this program goes beyond the pressing need to get Brazilian knowledge of this subject to advance, at a time when scientists worldwide are being marshaled to understand climate change and to face its consequences. There are a number of effects and aspects linked to global warming that affect or will come to affect Brazil in a unique manner. It is therefore up to its researchers to investigate them and to find answers about how to face them. "Developed countries want to involve all developing nations in the same major global struggle to cut greenhouse gas emissions. They're concerned with adaptation to climate changes, but not with our adaptation,"



RAIMUNDO VALENTIM/DIÁRIO DA AMAZONIA/AE

stated Carlos Nobre, who coordinates the FAPESP Program of Research into Global Climate Change as well as the newly created CCST (Center for Terrestrial System Science) of Inpe, the National Space Research Institute.

As most scientists agree, human activities are contributing hugely to climate change due to gas emissions and aerosols, all of which cause the greenhouse effect. The ongoing changes in Brazil's patterns of greenery, for instance, are a key regional factor reflecting this. The slash burning of forests, in addition to deteriorating air quality, is a major source of aerosols and trace gases. Changes in the rainfall regime, to which the rising frequency of natural disasters such as floods and droughts are ascribed, may have a financial impact on the output of hydroelectric power stations, on soil erosion or on the water supply. Rising temperatures are likely to affect biodiversity, particularly in areas where the original vegetation has already become fragmented, or agriculture, by making it possible for new pests to appear, or by making it no longer feasible to maintain existing plantations that demand mild temperatures. The probable rise in the sea level poses a risk both for the millions of Brazilians who live along the coast and for the coastal ecosystems. As for health, illnesses such as dengue fever and malaria may increase in areas of rising rainfall, while the atmosphere's pollution may spur an increase in heart and respiratory conditions. This glum outlook raises countless issues for researchers.

Carlos Nobre lists some of the aims of this investigative effort, such as reducing uncertainties as to what is driving Brazil's climate change. "We see the changes, but find it difficult to determine if they're due to global warming or deforestation. A significant change in Brazil's vegetation is occurring at the same time as climate phenomena, so that sometimes the signs get confused," stated Nobre. "As public policies demand sound scientific knowledge, one must invest in studies capable of finding the causes," he said. Another focus will be

**Drought  
in Manaus and  
tornado in  
Florianópolis:  
extreme events**



to measure the country's vulnerability to climate change in fields such as health, agriculture, water resources and renewable energy. "We know little about the future impact [of this] on people's lives and society. Surveying our vulnerability will enable us to design policies for the necessary adaptations."

Yet another of the program's objectives is to achieve closer international collaboration, by putting Brazilian researchers in contact with the best climate change study centers in the world. Cooperation is essential and IGBP (the International Geosphere-Biosphere Program) or the IPCC (the Intergovernmental Panel on Climate Changes), among others, are targeted in the FAPESP program. Another aim is to become familiar with and develop new technologies for mitigating the effects greenhouse gases emissions, in the fields such as renewable energy, and to make it possible for society to adapt to the changes, including the establishment of partnerships with the private sector. Agriculture faces a series of technological challenges, such as adapting crops to higher temperatures. "There are

good ideas that merit research efforts, such as forest husbandry and crop and livestock farming systems that bring together high-productivity ranching, agricultural crops and the planting of trees, or techniques such as growing trees in coffee plantations," said Eduardo Assad, a researcher from Embrapa (the Brazilian Crop and Livestock Farming Research Company), who is also involved with coordinating the FAPESP program. "We also need to improve our measuring of agriculture's capacity to capture carbon," he said.

A second call for proposals, granting R\$ 2.6 million, aims at choosing a group of researchers to create the first Brazilian climate model: a software program to produce sophisticated climate simulations. The need to develop domestic competence in this field can be explained as follows: at present, to estimate climate change effects, one employs non-specific computing tools that are actually segments of worldwide forecasts. "Achieving this autonomy is strategic for the country," said Carlos Nobre. "Brazil is large, diverse and has a large range of climates. Economic exploitation is heavily tied to natural resources and depends substantially



on climate. The ability to make simulations that are of greater interest to Brazil and South America will give us the assurance of good quality forecasts.” According to him, Brazil will join a select group of countries that have a climate model, such as the United States, Japan and England. As a result, the importance of the scientific community in this field will increase.

**T**he researcher explains that to develop and refine the climate model, Brazil will not start from scratch. “We’ll establish partnerships with two or three world-class centers and we’ll be able to choose certain modules of their model to add to our own,” said Nobre; he believes this will take at least four years. Brito Cruz, FAPESP’s scientific director, explains the foundation’s expectations of this model. “We hope that, at some point in time, a climate scenario generated by São Paulo re-

The flooding Tocantins River spills into Marabá: likely impact of rainfall regime

searchers will be used as the basis for IPCC analyses,” he said, referring to the United Nations’ collegiate of scientists that update knowledge of global change every five years. “One good thing about

the call for proposals is that it will provide grants for masters’ degrees, doctorates and post-doc work. Thus, we’ll be able to plan the training of PhDs in very complex fields,” said Nobre.

The creation of a Brazilian climate model will be possible thanks to R\$ 48 million in investments, announced about two months ago. Inpe will house one of the world’s most powerful supercomputers, with a processing capacity of 15 trillion mathematical operations per second, for research into climate change. Out of the total of R\$ 48 million, R\$ 35 million will come from the Ministry of Science and Technology (MST) and R\$ 13 million from FAPESP. The investment combines the MST’s priority in the study of climate change

with FAPESP's program. "With this kind of supercomputer, we'll be able to coordinate climate in a way nobody could have dreamt of 60 years ago," stated Sérgio Rezende, the Science and Technology minister.

Inpe has volunteered to house the new program's executive office and is already preparing to get the supercomputer, scheduled to go into operation in 2009. The machine will be installed at CPTEC, the Weather Forecasting and Climate Studies Center in the town of Cachoeira Paulista, in the Vale do Paraíba area of the state. Thirty percent of the supercomputer's time will be earmarked for the program's research networks, for them to simulate the effects of climate on human health, biodiversity, crop and livestock farming, etc. The FAPESP scientific director highlights Inpe's aid to the program: besides housing the supercomputer, it will also second expert staff to help in using the machine. Five researchers will be hired for this task, under the coordination of a head-scientist. "It's a special level of institutional aid, which we have seldom achieved in our programs," stated Brito Cruz.

The program's multidisciplinary nature also raises other challenges. One of its aims is to ensure the bringing together and communication of all the researchers involved. "The results of some must further the results of others," said Brito Cruz. This strategy reiterates the experiences of the Biota-FAPESP Program, which led to a description of more than 500 species of plants and animals distributed across São Paulo State's 250 sq km, and which resorted to project integration protocols to enable researchers from different areas to produce and share access to the data collected on São Paulo biodiversity. "One of our main challenges is to create biodiversity modeling competence," said Carlos Alfredo Joly, a professor at the State University of Campinas (Unicamp) who coordinated Biota-FAPESP and who is also involved in coordinating the Climate Changes Program where biodiversity is concerned. "We have the competence to take inventories and to characterize landscapes and the loss of habitats. Now we must integrate this data into models that can simulate the impact of

climate change upon ecosystems and species," he stated.

Joly provides practical examples of how modeling can leverage the understanding of the impact of climate change. "Climate change can alter the period when a given species flowers or yields fruit. Mathematical modeling will allow us to work out a detailed forecast of the effects of change: whether the pollinating insect or bird will be present at the time of flowering, whether the number of fruit produced will drop and what effect this will have on the survival of species whose diets depend on the fruit," he explained. Other possible simulation targets are invading insects or plants, which may benefit from the ecosystem changes that climate change may bring about.

In Brazil, biodiversity interacts sharply and complexly with climate changes: it both affects and is affected by the latter. "Biodiversity certainly suffers as a result of climate change, as it alters habitats and can lead to species being lost in fragmented landscapes," said Joly. "On the other hand, biodiversity also absorbs the shock of the changes. Forests and marine plankton, for example, account for a large stock of carbon. If the forest were to disappear, the consequences would be major. Moisture in the midwest and in the southeast comes from the Amazon region. If the forest vanishes, these regions' entire agricultural area will be affected," said the researcher. Among the biodiversity themes the program will study, some issues stand out, such as reconstructing the patterns of the flora and fauna of the past and their connections to climate change; the effects of more CO<sub>2</sub> on the physiology of native plants; the impact of deforestation on economic and environmental systems; and an increase in the wealth of studies about water systems, among others.

The idea of introducing a program to integrate various aspects of climate change arose from the fact that the complexity of the problems in question is incompatible with the unchanging and conventional point of view of single disciplines. Moreover, adding humanities to efforts led by the physical and natural sciences is considered crucial in order to understand the causes and consequences of phenomena that are caused by man,

after all. "To discuss the program's format, we brought together people from several areas, like economics, health, biology and engineering, to make sure the program would be coordinated, inclusive and cross-sectional," said Pedro Leite da Silva Dias, a professor at the Astronomy, Geophysics and Atmospheric Sciences of the University of São Paulo (USP) and director of the National Laboratory for Scientific Computing, also involved in coordinating the program.

**A**nother diagnosis shows even though Brazil has a critical mass of people in the natural sciences, it lacks the coordinated effort required to bring its scientists together and produce broader results. "Brazil doesn't do modest research in this field. It's one of the leaders, but there's a lack of coordination among the researchers," said Paulo Artaxo, a professor at the Physics Institute of the University of São Paulo (USP) and coordinator of the program that focuses on the atmosphere's radiation balance and the role of aerosols. He refers, for instance, to Brazilian researchers' active involvement in the IPCC – both he and Carlos Nobre are examples of this. Nobre also stresses the relevance of Brazilian research. "In the 20 main international journals, 1.5% of the articles on climate science or interdisciplinary themes connected to it are by Brazilians, and two thirds of them were conducted in São Paulo. This ratio is a little below the average Brazilian academic production in internationally indexed journals, which is 2% of the total, but it's significant," stated Nobre. Biota-FAPESP is of the few exceptions to the 'lack of coordination' rule, as it integrated researchers from several fields, as LBA (the Large Scale Project on the Biosphere and Atmosphere of the Amazon Region), which generated a huge amount of data on the interaction between the Amazon region and the global climate system. "We will have the opportunity to use data collected by LBA and other programs and to use this in computer simulations that will allow us to study the interaction between the Amazon Forest, the Pantanal swamplands and climate, for instance," said Pedro Leite da Silva Dias.

One of the program's innovations is to invite researchers in humanities to

join the effort. “We’re very curious to see what proposals will come up,” said demographer Daniel Joseph Hogan, a professor at Unicamp who works at the university’s Center for Population Studies and for Environmental Studies and Research and who also coordinates the effort’s segment concerning the human dimensions of climate change. He guesses some of the themes that may arise. “It would be interesting for us to get international relations researchers, for instance, to submit projects about treaties and supranational entities involved in climate change and how they challenge the established notions of national sovereignty,” he stated. The issues of food security, urbanization and technological transformation of industry in the pursuit of sustainability are other subjects that may arise.

**H**ogan reminds us that social scientists took a long time to become interested in the effects of global warming and were awakened thanks to the warnings of their colleagues in the natural sciences. “Sociologists and anthropologists have difficulty dealing with phenomena that are still to come true from the long-term perspective. They are used to doing this with past phenomena,” he stated. One of the references of the Program of Research into Global Climate Changes is the IHDP (International Human Dimensions Program), established in 1990 to research critical topics for the understanding of man’s influence on global change and the implications of global change for human society.

Though other countries are far ahead of Brazil in the study of human aspects, Hogan notes that the sophistication of these studies is not on a par with that of the research into areas like physics or meteorology, for example. “Suffice it to compare the four reports released by the IPCC last year. The first, which covers the subject’s accrued scientific basis, had the greatest repercussion, as it determined the causes and future effects of climate change with a high degree of certainty. The others, which dealt with the human dimensions, were less incisive,” he stated. According to him, there are commonsensical generalizations that demand further studies, such as the

idea that climate change will tend to be more harmful to the poor. “Heat peaks mainly affect small children and the elderly. One must create public policy strategies to face such extreme events. This means preparing to act before and after the event. Brazil is still very much a beginner in this,” said the professor.

Where human health is concerned, the challenge of building research networks will be complex, foresees the area’s coordinator, Paulo Saldiva, a professor of medicine at USP. “The approach is very different from traditional research into health. We aren’t just interested in surveying epidemiological data or evaluating risks, but also in integrating experts in anthropology, healthcare management

and urbanization,” said Saldiva. “We’re talking about complex phenomena. The temperature increase will also affect health by changing the dynamics of cities. People from the countryside may have to move to the cities, causing shantytowns to grow and healthcare costs to rise. I compare this challenge to facing the diseases resulting from pollution in São Paulo. Medicine provides incomplete tools for dealing with the problem, which has become an urban planning issue,” he stated. The professor expects projects

on several of these issues to appear. “If they’re isolated proposals, we’ll integrate them and make the researchers work in networks,” he stated.

Carlos Nobre, the program’s coordinator,

CAIO GUATELLI/FOLHA IMAGEM



**Pollution  
in São Paulo:  
rising risk  
of respiratory  
diseases**



believes that the project will take off faster if most of the proposals submitted incorporate the interdisciplinary spirit that permeates the program. “There are no boundaries for the proposals. They can freely focus on basic or applied research. The challenge is to get the groups to talk to each other. The more cross-institutional the projects, the greater the likelihood of it all working out,” stated Nobre.

**A**t the program’s launch, the São Paulo State secretary for the Environment, Xico Graziano, announced that the state government will submit to the state congress a bill on climate change, proposing actions to reduce the state’s emission of gases. Fernando Henrique Cardoso, former president of Brazil, who attended the ceremony,

recalled that scientists’ efforts must also target informing and involving society so that the knowledge created may turn into concrete actions. “Without social pressure, there are no demands and it becomes harder for things to happen. Even in the United States, whose posture is reactionary, states, cities and companies decided to control the emissions of greenhouse gases, going against Washington’s direction, because the base of society takes part in the process of understanding the effects of global warming,” stated the former president. Fernando Henrique delivered a copy of FAPESP’s program to Ricardo Lagos, former president of Chile and currently United Nations representative on climate change issues, in order to divulge the initiative and encourage international partnership agreements. ■