2008

Blue Planet Prize

Dr. Claude Lorius (France)

Director Emeritus of Research, CNRS
Member of the French Academy of Sciences

Professor José Goldemberg (Brazil)

Professor, Institute of Electrotechnics and Energy, University of São Paulo
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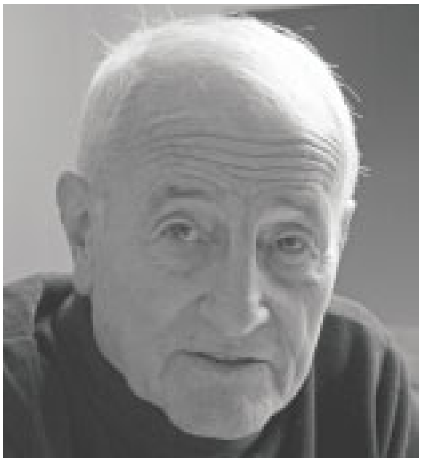
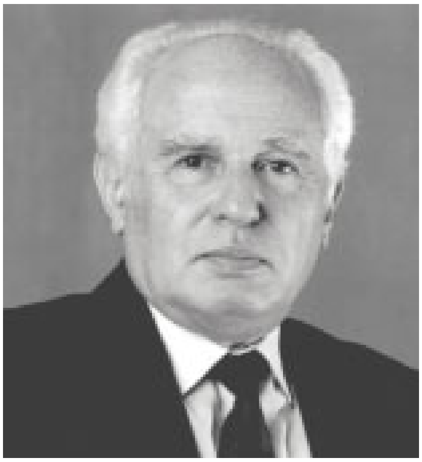




NAVIGATION:
Our Planet
The Blue Planet where all of us live
Carrying life in infinite numbers
Journeying towards the eternal universe

Do we mankind impose ourselves
To deeply think
Of the blue spaceship of life
Where it is going?
Given life on this planet

A tiny life
Although tiny, are we been responsible?
To care for others
Helping each other
For the destination
Of the "Ship of Life" Earth

We sincerely hope
That the film
Helps you
In letting you think
Of the wake of the "Ship of Life" Earth
Of the destination of the Blue Planet

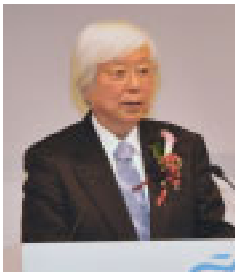
Selected from the Slide Show Presented at the Opening of the Awards Ceremony

His Imperial Highness Prince Akishino congratulates the laureates

Their Imperial Highnesses Prince and Princess Akishino at the Awards Ceremony

Hiromichi Seya, Chairman of the Foundation delivers the opening address

Dr. Jiro Kondo, Chairman of the Presentation Committee makes a toast at the Congratulatory Party



Dr. Hiroyuki Yoshikawa, Chairman of the Selection Committee explains the rationale for the determination of the year's winners

Ambassador Mr. Philippe Faure of the French Republic (left) and Ambassador Mr. Luiz Augusto Castro Neves of the Federative Republic of Brazil, congratulate the laureates

The prizewinners receive their trophies from Chairman Seya

Dr. Claude Lorius

Professor José Goldemberg

Profile

Dr. Claude Lorius

Director Emeritus of Research, CNRS
Member of the French Academy of Sciences

Education and Academic and Professional Activities

1932	Born in Besançon, France
1955	Researcher, Antarctic Committee, National Center for Scientific Research
1957-1958	Participated in the IGY Antarctic Expedition
1961	Researcher, CNRS
1962	Earned doctorate degree from the Sorbonne University
1979-1983	Associate Director, Laboratory of Glaciology and Geophysics of the Environment (LGGE)
1983-1988	Director, LGGE
1984-1986	Chairman, French Polar Expeditions
1986-1990	Chairman, Scientific Committee on Antarctic Research (ICSU)
1987-1994	Corresponding member, French Academy of Sciences
1989	Humbold Prize
1989	Belgica Medal
1992-1998	President, French Institute of Polar Research and Technology
1993-1995	Chairman of EPICA Project
1994-	Member, French Academy of Sciences
1994	Italgas Prize
1996	Tyler Prize for Environmental Achievement
1997	Seligman Crystal (International Glaciological Society)
1998-	Director Emeritus of Research, CNRS
2001	Balzan Prize for climatology
2002	The CNRS Medaille d'Or
2004	Petit Larousse illustré
2006	EGU Vladimir Ivanovich Vernadsky Medal
2008	SCAR medal

(As of June, 2008)

Dr. Lorius was born in Besançon, France in 1932 and received his bachelor's degree in physics in 1953. He began his research career in glaciology and climate change where he later accomplished many outstanding achievements by applying to an ad posted on the walls of the University of Besançon in 1955 which read "Needed: young researchers to join scientific expeditions organized in conjunction with the International Geophysical Year."

In 1957, as a fresh initiate in the emerging science of glaciology, he spent the winter at

Charcot Station, a small base camp perched in Antarctica at 2,400 meters elevation with two colleagues. He returned to Antarctica in 1959, joining the US Victoria Land Traverse Exploration and came up with an idea of obtaining the temperature of the air from the measurement of the oxygen and hydrogen isotopes of 'solid water' ice. Furthering the idea provided means of characterizing the successive seasonal layers of ice and an ice flow tracer, which enabled him to reconstitute past climate change and dating.

Afterwards, while leading the 1965 wintering-over team to the coastal base at Adelie Land, making casual observation of ice cubes melt in a glass of whisky and seeing the air bubbles trapped in the ice burst, Dr. Lorius came up with an idea of analyzing them. He thought that they would hold vital information of the composition of the air. After 1968, he proposed original ideas such as that to use crystal size in the field as an indicator of past climate change, and the information obtained from analyzing the ice sheets disclosed not only the climate but also information on the atmospheric environment.

Since 1974, Dr. Lorius began the hard work lasting several years at Dome Concorde, a high plateau located in central Antarctica, and in 1978 succeeded in drilling to a depth of 900 meters. By analyzing the ice sheet core, it was revealed that the bottom ice was to be about 35,000 years old, that the end of the last ice age was about 20,000 years ago and that the subsequent warm period had now lasted for 10,000 years.

In order to further conduct an analysis, there was a need to obtain older ice samples, and fortunately at the most remote and coldest station on earth Vostok of USSR, another series of core samples obtained by drilling 2,200 meters deep existed. Lucky for Dr. Lorius and his two companions, with the support from the Arctic and Antarctic Institute of Leningrad, the Geographic Institute of Moscow, and the National Science Foundation (USA), they were able to set foot on Vostok station in the midst of the cold war in 1984. Information obtained from the ice core were more than expected and for the first time a series of results undisturbed by any ice flow for over 150,000 years included all the last climatic cycle which took place in the quaternary era. Once back in France, Dr. Lorius gathered a squad of specialists and conducted a thorough study on the samples he brought back. As a result, it was disclosed that a long ice age occurred between the current interglacial period and the interglacial that existed about 120,000 years ago. The close correlation between atmospheric concentration of methane and carbon dioxide and climatic change during glacial and interglacial periods became a hot topic and the results were introduced in the editorial and other articles in *Nature* in 1987, also decorating the cover of the journal.

In 1989, Dr. Lorius was requested to reorganize polar research and established the French Institute of Polar Research and Technology (IFRTP) becoming the first president in 1992. While continuing his own research activities, he put efforts in planning Antarctic ice sheet deep drilling program at the international level.

In 1998, the joint team of Russia-France-USA reached at Vostok the depth of 3,623 meters and obtained a continuous ice sheet record for the past 420,000 years. Dr. Lorius recognized that there were four long cold and relatively shorter warm periods, namely glacial and interglacial periods, along this time scale and disclosed that during those periods atmospheric concentration of carbon dioxide fluctuated between minimum 200ppm (parts per million) and maximum 300ppm; during the last deglaciation carbon dioxide concentration increased by 40% and methane gas level doubled. Current atmospheric concentration of carbon dioxide has now reached almost 390 ppm and is increasing further. Dr. Lorius describes that the results obtained from the research on past glacial records gives credit to those arguments that the earth will continue to warm up through the 21st century and might potentially cause a disastrous effect on water supply, agriculture, health, biodiversity and human living conditions in general.

Dr. Lorius has made a total of 22 summer and winter expeditions to the polar ice sheets in Greenland and particularly in Antarctica, which represents more than six years spent in the Polar Regions. As operations in Antarctica, ice core analysis and interpretation require a lot of people's cooperation and participation, various achievements accomplished could be said to be those of the group he led, but without Dr. Lorius's highly prominent perspective, tenacity and organizational skill in forming international teams as a researcher, such research results could not be achieved so early.

From ice core studies, Dr Lorius believes we now entered in a new era, the "anthropocene", in which humans control the environment of our planet which is now a major and urgent international challenge. He has stated that although alarm raised was heard in case of the ozone layer depletion and some improvement had been noted, for the issue on climate only statements of intention had been heard so far, and that we have to maintain the pressure to ensure new technologies are developed and human attitudes continue to evolve.

Lecture

Climate and Environment
– 50 years of Adventures and Research in Antarctica –

Dr. Claude Lorius

50 years of adventures and research in Antarctica
Fifty years ago, I was first attracted by the human experience in the polar ice areas. My passion for research would come when we made our first discoveries, while exploring the mysteries of ice. Thanks to ice drillings, we aimed at going back in the past so as to discover the climate and environment of old times; a research that led us to the heart of one of the greatest challenges in our modern society. I would like to share with you this path on the field and in our research. I hope I could show you that polar ice are both survivors and guards of the earth climate and environment.

Based on missions, works and thoughts about polar ice, this presentation is three-fold:
Climate: past and future
Global Environment Mankind and Anthropocene
We will thus discover the Anthropocene epoch, a new era in which Mankind is responsible for damaging its own environment.

Slide 1* - The white planet: from pole to pole
Snow and ice spread over huge surfaces. In the Arctic, the pack ice is thin and formed by frozen sea water. It spans over 15 million square kilometres in winter and stays until summer as it is surrounded by a continental belt. However, the ice pack almost totally disappears during the hot season in the widely opened austral ocean. In both poles, huge ice sheets lay on bedrock: Greenland (over 2 million square kilometres) and Antarctica (its surface area is 12.3 million square kilometres which is bigger than Europe and about 30 times that of Japan). While the melting of the ice pack doesn't change the sea level, it is not the case with ice sheets: they contain such great volumes of ice that they would cause a sea level rise of more than 70 metres if they disappear.

Slide 2 - Polar ice "archives"
Ice sheets shelter unique archives, or records, on the history of our climate and atmosphere. Ice is solid water (H_2O) and contains isotopes. Isotope concentration in ice indicates the temperature at the time of ice formation. While filtering it, we collect the minuscule dust which has settled with snow. The dust can have natural origins (continental dust, sea salts, volcanic eruptions...) or can be linked to pollution (lead, radioactive wastes...) and thus measuring its magnitude becomes possible. Concentration of impurities is very low and requires sophisticated equipments for chemical measurements. If other types of archives do

* There are supplement slides *at the back of* the section.

exist on climate and pollution, ice holds a unique treasure with the air bubbles trapped in it: they are the only testimony of the atmosphere composition.

To date the ice, the easiest way is to count the annual layers, but this method quickly reaches its limits. Some events such as nuclear tests and volcanic eruptions can identify certain levels. To go further glaciologists have developed models that can wedge in comparison with better dated marine sediments or from the calendar of astronomers who punctuate climatic variations. Just recently glaciologists were able to detect on EPICA (European Project for Ice Coring in Antarctica) ice cores traces of the reversal of the magnetic field that occurred 780,000 years ago; a godsend to re-schedule the archives.

Slide 3 - Antarctica: 50 years of ice drilling

After the IGY (International Geophysical Year, 1957-58), glaciologists have carried out deep coring across Antarctica: the Americans (Byrd), the French and Europeans (Dome C), the Russians (Vostok) and the Japanese (Dome F). All along the years, as the ice drillings went on, more and more ancient periods began to emerge; core samples of only 10 centimetres in diameter will be our memory from the past.

Mechanical properties of ice and low temperatures require glaciologists to develop a specific technology to get ice cores. This is a complex, delicate craft and which needs constant attention. Engine, pumps, electronics are integrated into a drill suspended on a cable guided from the surface to get samples a few metres long. In it's slow getting down and up in a fluid that will avoid the closure of the hole it will know many failures and sometimes break down.

Slide 4 - Eastern Antarctica: 50 years of missions

Cold sites, with slight slow accumulation and undisturbed ice flow, contain long-term archives but they are situated in central areas hard to reach. Thanks to the logistic support mostly provided by the Americans and Russians, for French and Europeans these areas became reachable. In a white desert spreading over 5 million square kilometres, we used ski-equipped planes and tracked snow tractors to lead the survey. Then, we carried out the ice drillings with heavy means and larger teams were organized. To lead such projects, international collaboration, also based on friendship, was necessary to help us with providing heavy transportation equipment.

1956: Towards《Terra Incognita》

For the IGY, 12 countries, among which were Japan and France, combined their efforts to study the last continent almost entirely virgin: Antarctica. They set up 48 stations, among which 4 were on the ice sheet. The aim was to study the magnetic field and polar lights while the first satellites were launched into space; climatology, glaciology, a new branch of science, and exploration traverses were also planned.

1957: Overwintering at Charcot station

I spent one year with two workmates in a small station of 25 square metre, buried beneath the snow at an elevation of 2,400 metres, where the average temperature is -40°C. At that time, Charcot was then one of the few inland stations that had ever been set up.

1957: Overwintering at Charcot station
On the horizon, nothing but a white desert and for months we would not have any ways of communicating with the coastal station and our far away families. My research concerned the "heat balance", so as to understand why Antarctica is such a cold continent. This overwintering was a beautiful adventure, a physical and a human experience. After adapting myself again to civilization and to viruses contained in our atmosphere, I knew that I would come back.

1959: Victoria Land Traverse
After a year spent in France, I went back to the great South to take part in an American exploration traverse on Victoria Land, east of Adelie Land. Flying from New Zealand, we arrived on October 19th, 1959 at Mac Murdo, overlooked by Mount Erebus volcano. With six American, one New Zealander and one Dutch scientists, we covered 2,500 kilometres in 119 days, using tracked vehicles, thus opening a new track in the discovering of the inland ice.

1959: Victoria Land Traverse
We met with many difficulties and surprises: a hard access to the plateau among crevasses, engine troubles, cold and blizzards but also the discovery of a mountain range with Mount Lorius mentioned in the American atlas. A powerful scene in my memory: the opening of a "mail box" attached to a marker at the furthest southern point that had been reached by my French fellows of the IGY, two years before.

1957-59: Records from decades to centuries
At Charcot station, we dug snow pits of several metres deep to observe the sequence of summer snow, less dense and formed by bigger crystals than winter snow packed down by the wind ; a simple way to get the age of the latest layers and data on snow accumulation. In central regions, where it doesn't snow very much, we can thus sample almost a century of records.

Hand drillings: towards the millennium
During the traverses, we made several stops for a few hours, sheltered from the wind by snow tractors and we carried out hand drillings from 10 to 20 metre deep, leading us further on in the past. Going deeper, we observed a progressive decrease of the range of the seasonal cycle of temperatures. A thermometer put at the bottom of the holes would give us the average annual temperature of the different sites we were exploring. Seismic shots showed that ice could be over 4,000 metres thick.

Slide 5 - The "isotopic thermometer"
The core samples collected during those missions were analyzed as soon as we went back to our laboratories. Snow and ice are solid water (H_2O) which isotopic composition can be measured and expressed by the concentration ratio $^{18}O/^{16}O$ or D/H. Comparing these ratios with temperatures found on the field led to a real discovery: the temperature at the time that

snow precipitation formed, left signs that analyses managed to decipher. This correlation would allow us to describe the climate thanks to samples of deep ancient ice.

At the core of polar ice: depths and ages

The quality of an ice drilling site depends on several elements: snow falls and temperatures, elevation and bedrock relief, thickness and ice flow of ice; these data, integrated into modelling, indicate the ages of ice that we could find in the depths. Cold sites, with low accumulation, deep and undisturbed ice flow, are situated in central areas, thus hard to reach. But this is where we would have to go to extract ancient records of the climate, where it will take hundreds of thousands of years for one tiny snow flake to reach the sea and melt. If more recent times are at stake, we would choose stations with higher accumulation in which it is easier to decipher the environment of our century.

Deep ice drillings

We developed drilling equipment when we carried out coring in the coastal ice of Adelie Land where I overwintered in 1965. One summer evening, our small glaciologist's team gathered in our caravan used as our shelter. We were sharing a relaxing moment, washed down with glasses of lukewarm whisky, in which we put - what a sacrilegious act! - bits of ice samples drilled from about a hundred metre deep. They melted...when we saw the air bubbles exploded in our glasses, released from their pressure; it came to our mind that these gases were perhaps testimonies of ancient atmospheres composition. But many years would be necessary for our team to prove the validity of the idea. Analyzing them would be a technical challenge but would "revolutionize" our understanding of the evolution of the earth climate.

In the last 30 years, deep ice drillings

After the site surveys, the deep ice drillings, that I am to talk about, would be carried out from 1977; firstly at Dome C, then in Vostok, and finally at Dome C again.

1974-1978: Ice drilling at Dome C

Within the context of the International Antarctic Glaciological Program, the American and English radar coverage identified an interesting drilling site at an elevation of 3,250 metres, where ice would be about 3,000 metres thick. We tried to reach this point from the French coastal station of Dumont d'Urville which is located more than 1,100 kilometres away. Two successive missions failed in this attempt but they allowed us to explore new territories.

1974: Leading site survey at Dome C

To obtain data on the spot, the U.S. Air Force embarked from Mac Murdo station a small team with 4 French, one American and one Russian, equipped with tents and snowmobiles. After one week of acclimatization at the South Pole station, we landed in December 1974 at Dome C where it was -35°C in the middle of summer. In a couple of weeks, we were able to gather information on snow accumulation (10 centimetres) and ice flow speed lower than a few metres per year: favourable features for ice drilling.

1974: Leading site surveys at Dome C
The end of the mission happened to be difficult, as two C-130 planes that were supposed to pick us up, crashed one after the other, while taking off. On the chaotic surface of sastrugi, the take-off assist rockets exploded, destroying skis and wings of the planes. After the last flight to assess the damages on the planes, that I well remember as I was petrified with fear, we were all back safe at Mac Murdo. Data confirmed that the site was promising but at that time, we did not expect to come back there. The Americans would manage to get back the damaged planes, and that was a real achievement.

Slide 6 - 1977: 900m deep ice drilling at Dome C
Three years after our first steps at Dome C, the Americans embarked our team of 13 people formed by drillers, technicians, researchers, a doctor and a cook, and tons of equipment. This ice drilling mission was a success as it reached 900 metres deep in two months; the maximum reachable depth without using any fluid. On the spot, we studied ice crystals and we found out that their size is correlated to the climate evolution, their growth being faster during hot periods than cold periods.

When we got back, we were able to describe the end of the last ice age era which took place about 20,000 years ago, and the beginning of the hotter climate of Holocene that we have experienced for ten thousand years now.
Although many other missions may be more fruitful with the drilling at Dome C, the risks and joy of this campaign that I experienced made us stand out in the very closed circle of nations who have carried out deep drilling in polar regions and shown its analyses capacity.

Vostok: the 1980's and 1990's
For a long time, I had been dreaming to go to the Soviet station, at the heart of Antarctica. The Cold War was threatening international relations but it did not prevent encounters and friendships between researchers on Antarctica. On December 31st 1984, a C-130 plane from the US Air Force brought three French glaciologists to Vostok station where Soviets were ice drilling. In ice caves, dug into the snow, they had stored core samples that had been extracted for years. This collaboration would last for years, giving access to samples spanning over 420,000 years.

The cold pole of the Earth
A temperature of -89°C was recorded at Vostok station, where polar night lasts for long months. The station had a Spartan-like comfort, where everyone spoke only Russian, there was no running water and supplies were scarce before the team change-off. But we had everything needed in the trunks that we brought to carry the core samples back. In the small rooms dug in the snow, we spent warm evenings with those who had overwintered and who had left their families for more than a year.

Slide 7 - 1984: Vostok, 150,000-year-old records
We were hoping for it: studying 2,083 metres of ice core revealed a 150,000-year-old history

about climate and atmosphere composition. All along hot and cold periods stretching along the last great natural climatic cycle, we showed, for the first time, the correlation between climate and concentration of greenhouse gases in the atmosphere. On a very large time scale, before human beings presence, natural climatic variations were caused by the earth's path around the sun, during which it receives more or less energy according to its position. The path taken by our planet entails long hot and cold periods, modifying greenhouse gases concentration in the atmosphere in such a way that these gases accentuate significantly climate variations. A breakthrough, to which the Soviets and the Americans were associated, allowed us to announce, 20 years before now, the current global warming, caused by human activities which send out large quantities of greenhouse gases.

The cover of the prestigious *Nature* magazine with a comment describing these archives "cornucopia", was a recognition for our team and me; at this time I was elected as a member of the Academy of Sciences.

Slide 8 - 1998 Vostok: 420,000-year-old records
In 1998, ice drilling reached a depth of 3,623 metres where ice is 420,000 years old. Results are comforting evidence of the three fold correlation between climate, greenhouse gases and sea level and give a coherent explanation on large natural variations in our Quaternary climate. The average temperature change on Earth between ice ages and hot periods is 5°C, leading to sea level variations of 120 metres, caused by expansion or melting of the ice sheets. This testimony of old ice helps us to explain the current climatic warming and estimate the future one.

Dome C, Vostok, Dome Fuji: climate variability
These studies were also successfully led by the Japanese, on the other side of the continent, at Fuji Dome where they got a climatic record of 330,000 years old. On this time scale, comparison with data obtained from Vostok and Dome C gives a consistent picture of climate variability and reinforces the sense of getting a sample core as we hoped at the time of the Dome C and Vostok records.

Dome C- Epica, 800,000-year-old records
Near Dome C where we ice drilled 30 years before, twelve European countries reached the bedrock at a depth of 2,871 metres, in 2004, within the project EPICA. The link climate-greenhouse gases (carbon dioxide and methane) is still striking and show that the earth atmosphere has never known such high concentrations of greenhouse gases as today, for 800,000 years. We notice variations in both duration and amplitude of hot and cold periods, thus opening new paths for research on our future climate.

From 1974 to 2004: Dome C
This image illustrates the progress made in thirty years. We have moved from exploration to 800,000 years of archives. A great satisfaction for us, and I who initiated these two projects.

Slide 9 - 1,000 years: CO_2 and global warming
To come back to our day and age, data on the last millennium show a warming of nearly 1°C, observed for a hundred years comes essentially from CO_2 and other greenhouse gases of anthropic origins. In this context, what of our white planet? Our glaciers will go on declining, or even disappear for the most vulnerable ones.

To go off the tracks of my research field, I would like to present now some images of the consequences, even if they may still be moderate today, of global warming on polar areas, hoping I would heighten your awareness of a less austere side of our expeditions.

Climatic warming and ice pack
Satellite imagery shows the ice pack retreat in the Arctic between the end of summers 1979 and 2005. With climatic warming, new navigation routes thus open between the Atlantic and the Pacific oceans, intensifying commercial transportation and access to new sea fishing areas. The retreat which seems to accelerate will make easier exploitation of the sea bed that treasures significant hydrocarbon and gas resources. This has already aroused clashes of interests between the five bordering countries of the North pole.

Climatic warming and Inuit populations
Ancestral hunting people, Inuit populations suffer from the ice pack fragility which makes it dangerous for them to hunt seals and polar bears on which they live. It also reduces the social contacts in a society already not very numerous and spread over coastal areas, traditionally linked with dog-sledging. In this case, climatic warming is at the source of real cultural changes.

Climatic warming and polar bears
As their silhouettes are an icon of the great North, polar bears need a stable ice pack to reach their preys, i.e. seals, and to ensure the living of their cubs. The 20 to 25,000 polar bears have thus joined the black list of threatened species.

Climatic warming and Emperor penguins
A symbolic figure, with its unsteady gait, of the great South, Emperor penguins depend on the ice pack stability too, as they must ensure the survival of their chicks during winter because the latter won't be able to feed themselves in the sea as long as they keep their fluff. But this is not an urgent concern thanks to the cold temperature in this season in Antarctica.

Slide 10 - Temperature: past and future
The temperature increase predicted at the end of our century can vary from about 2°C to more than 6°C, a large range due to uncertainties concerning our knowledge about how the climatic system works and to our choice of future energies. It is necessary to remind us of the effect of past temperature changes: the average variations of 5°C have shaped quite different landscapes on our planet. It was thus white-coated during the last ice age. In the future, it could be partly covered with water.

Slide 11 - Climatic warming and sea level

Because of continental ice melting, sea level would rise from 10 centimetres to 1 metre at the end of this century. This is not a very accurate estimation because it mostly depends on the future of ice sheets. The first signs of significant melting appeared on Greenland and its expansion is visible through satellite images: a faster increase of melting could be feared. Much colder, Antarctica seems less vulnerable except for its hotter area, the Antarctic peninsula. Threats exist but on a very long-term scale considering the impressive ice masses, unless more sudden variations occur, in relation with the instability of some glaciers of which basis is located under the sea level.

Antarctica: glaciers and mass balance

From space, we can see "ice rivers" in central areas of Antarctica, flowing towards the sea. The mass balance of inland ice, i.e. the difference between snow accumulation and loss, due to glaciers flow and melting in coastal areas, is not yet well known. All the more since a temperature rise could increase snowfalls, thus slowing down the increase of sea level. This is one of several uncertainties for a faraway future, its ice volume representing the equivalent of 70 metres.

Ice and climate, a close link

As we have seen, ice and climate have a common destiny. Spreading over tens of millions of square kilometres, the white planet is both a testimony and a key element of the climate evolution. It is a testimony as ice expands in cold climate and melts in hot climate; it is a key element as it sends back towards space a more or less significant part of its energy received from the sun, according to the size of its surface, and thus it causes a decrease of temperatures or on the contrary in hot season. Thus, polar ice expansion shows and accentuates the climate evolution; a link more or less close according to its fragility which depends on its thickness. Because of the ice pack, Arctic warming is twice or three times more important than anywhere else on earth and, in fact, this foreshadows our tomorrow's climate.

50 years of adventures and research in Antarctica

Thanks to the discovery of secrets deeply buried in the ice records, we changed our views on the future climate. Moreover, polar ice contains many other information about our environment; a topic that I would like to develop now.

North pole - South pole: only one planet

In a few months time, going from pole to pole during my training to become a glaciologist, I discovered aurora polaris. These beautiful coloured veils are created by the collision between solar wind particles and our atmosphere, in a zone defined by the magnetic field that surrounds the earth; without this magnetic field, life would have never grown up on earth. From this time, before I became familiar with our earth and oceans, I realized that we have only one single planet.

North pole - South pole: only one atmosphere

Even before meteorologists scrutinized the atmosphere, early naturalist explorers discovered this fact, just from observing the migration of Arctic stern from the great North to the great South.

Slide 12 - Hemisphere pollution: Greenland 1

Sulphates concentration measured in Greenland snow have significantly increased since the 1900's and are an indicator of pollution at one hemisphere scale. Sulphates, to be blamed for arctic fogs, are naturally produced (sea salts, volcanic eruptions...), but they also come from coal combustion. This latter source is at the origins of the observed increase, whereas the recent decrease is due to the filtration of carbon emission in our biggest cities.

Slide 13 - Hemisphere pollution: Greenland 2

The evolution of the concentration of another polluter is also measured in Greenland snow: lead. It's rise is originally the result of industrial activities; but since the 1930's, it is the lead-based additives in gasoline used in industrialized countries that lead to concentrations of about 200 times the standard natural level of the early 19th century. With the use of unleaded gasoline, the concentration of this short-term life aerosol is in decrease but it will take decades before ice records attest a come-back to a less contaminated air.

Global pollution: radioactivity

In the early 1970's, I got really shocked when I discovered in South pole snow, fallout from radioactive wastes, sent out during nuclear explosions in the northern hemisphere. It was the evidence of a global atmosphere on Earth. For instance, we measured a strong peak in the years 1964-65, caused by tests carried out two or three years before in the other hemisphere. The signal was strong enough to manage to date the layers of recent snow. Radioactive halflife of tagging-agents such as strontium 90 and cesium 137 is around 20 years, which allows time to erase little by little evidence of irresponsible behaviours.

Slide 14 - Global pollution: "the ozone hole"

While ozone in the air that human beings breathe at ground level is dangerous for health, the abundant ozone present in the stratosphere is very crucial. Because it absorbs UV radiation before it reaches the earth surface, ozone protects life on our planet. And again as a proof of a global pollution, Antarctica is the place where researchers discovered the "ozone hole" caused by Chlorofluorocarbons (CFC) emitted by industrialized countries in the northern hemisphere. The "ozone hole" shows the consequences, sometimes unpredictable, of human activities on our global environment. The Montreal Protocol, signed in 1987, then extended to 190 countries in 2007, should lead to a drastic decrease of emissions and, hopefully, to a reduction of the "ozone hole".

North pole - South pole: only one ocean

During their travels around our blue planet, naturalist explorers saw the hump-back whale from North to South, deducing from their observations the idea that there is only one ocean.

Global pollution: sea as a dust-bin

The ocean, cradle of terrestrial life, is now threatened by numerous pollutions. Here, soiling is more localized, oil dumpings reach the beaches and their fauna, while nuclear-powered submarines lying at the bottom of the Arctic water are a danger for the future. It is more difficult to give a global-scale estimation but it seems that more than 40% of the oceans are highly affected by human activities and that few sea areas remain virgin territories.

50 years of adventures and research in Antarctica: Mankind and Anthropocene

Since he first appeared, man has had to protect himself from nature to survive. First, he fed himself with gathering and hunting, then with farming and breeding. Discovering fire, during Holocene, was the starting point of greenhouse gases emissions; then, humans built towns to gather themselves as the population was getting more and more numerous, while the industrial era was beginning to take place. At that time, we entered Anthropocene, characterized by increasing pollutions, man deeply leaving his mark on the natural environment which he lives in. Warning signs came from polar areas, where almost no one lives and very far from the pollution sources.

Global warming challenges: human life conditions, resources, wars and conflicts

Global warming is the most urgent challenge that Anthropocene has given our societies to take up. It is most probable that human life conditions will drastically change, under the pressure of storms and droughts and biodiversity loss.

Vital resources in fresh water and food will become scarce and our current sources of energy will run out. Wars and conflicts already existing will multiply, aroused by migrations of a population looking for food or escaping sea floods. The first victims will be inhabitants of poor countries, those who already have their feet in water or are living in dry deserts.

Climatic warming: what can be done?

City lights of the world seen from space clearly show imbalanced distribution of population, activities and pollutions over our planet, for instance emphasized by the African night on one hand and United States or European lights on the other hand. Obviously, there are possibilities to reduce greenhouse gases emissions as several "Blue Planet" prize-winners proved it, among whom Professor José Goldemberg awarded this year. Among these possibilities, let us quote energy savings, lifestyle changes, research on climate and energies... But above all, people must be made aware that a real international solidarity is essential. But unfortunately, this is not the case today.

Climate and Environment: reactions

We like "burying our heads in the sand". Too often, if politicians, policy-makers and citizens agree on the necessity to protect our planet, they don't dare to make the first move, leading to action. Numerous reasons made them bury their heads in the sand.

Environment: Mankind facing the challenge

On our everyday horizon, and on the one of polar ice, we don't perceive the emergency to protect our planet, and furthermore other issues that are at stake: health, AIDS, famine, ... and we always hope, wrongly I think, that technological progress would make up for our consumption damages. In our private life, the quest of wealth, power and comfort justify our behaviour as citizen; a behaviour that doesn't make easy decisions from politicians and policy-makers, acting under the public judgment.

Anthropocene: our tracks in the ice

Nobel prize-winner Paul J. Crutzen (1995) suggested the word "Anthropocene" to characterize the new era which we entered, with pollutions entailed by human activities damage our environment on a global scale. An era in which dramatic rise is engraved in polar ice.

Slide 15 - CO_2: the birth of Anthropocene

The CO_2 content in atmosphere is an indicator that represents almost all the human activities, as emissions are mostly due to the use of fossil fuels as an energy source. The concentrations, measured during the last millennium in air bubbles trapped in Antarctic ice, are more or less stable until the early 19th century; then, they increased faster and faster until now, reaching levels representing a growth of 40%.

Environment and International Governance

To highly different extents, all citizens and countries are contributing to global warming and to environmental degradation. I think that solutions could be only found in the framework of international governance, but this doesn't seem to be realistic regarding our today's context with many conflicts. Maybe we would have to wait for genuine catastrophes which will lead man at the verge of chaos to make the governance possible; but why don't we dream about a future "Right for Environment"? Fifty years ago, scientists from the International Geophysical Year managed to convince the governments to sign the Antarctic Treaty.

Let us be in Peace with Nature

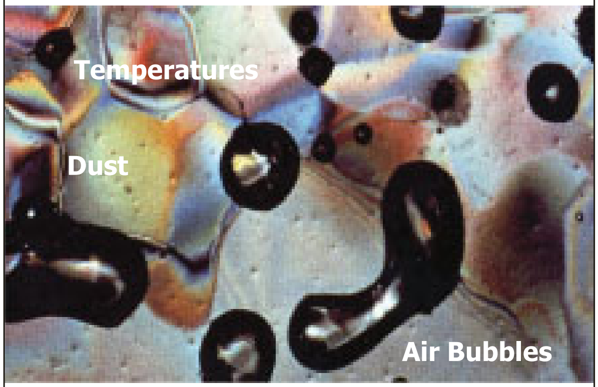
As French hot desert explorer Theodore Monod said "Beyond the exploration and research led to understand the world that surrounds us, it is also important to think of human behaviour towards this small but so fragile sphere going around in the immensity of the Universe". And that is a short message that I would like to pass on, at the end of so many years of research in and about polar ice. It illustrates this drawing by Paul Emile Victor, founder of the French Polar Expeditions, "Let's be in peace with nature".

In our hands, Our planet

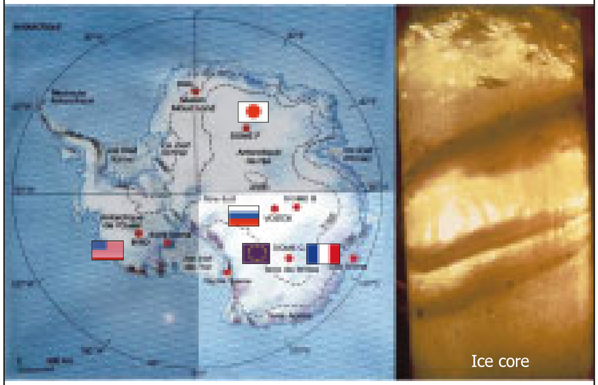
This logo symbolizes our liability in the future of the environment, and thus, in the future of our modern societies. To conclude this presentation, I would like to thank very simply but with much emotion, the "Blue Planet Prize" which aims at preserving our planet; I would like to thank all of you, ladies and gentlemen, who are here today. This gratitude, I am sure, holds in high regard ice researchers and backs them up in their willingness to achieve a “fundamental” research which is at the same time so necessary to our civilization.

Slide 1
The White Planet: from Pole to Pole

Slide 2
Polar Ice "Archives"

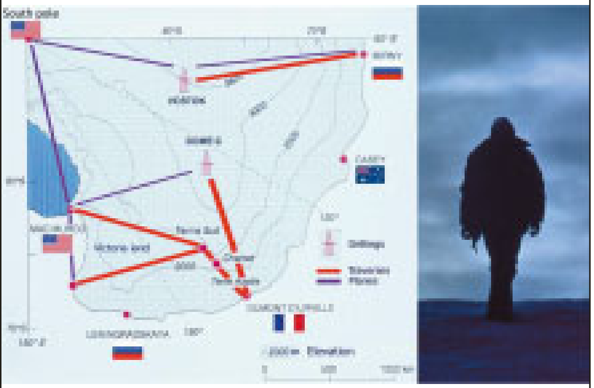


Slide 3
Antarctica: 50 Years of Ice Drilling



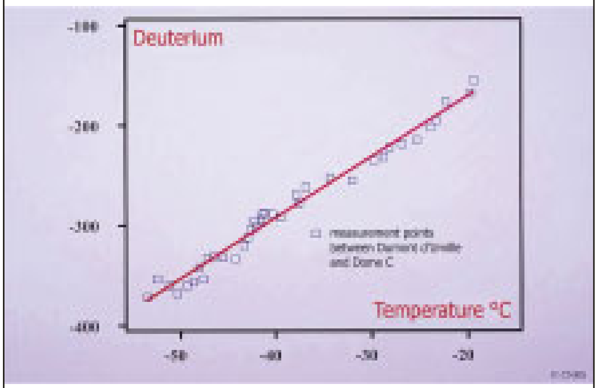
Slide 4

Eastern Antarctica: 50 Years of Missions



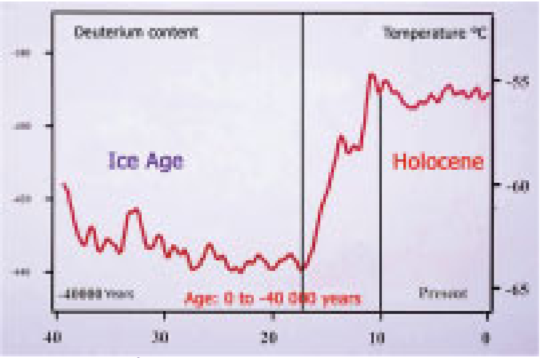
Slide 5

The "Isotopic Thermometer"



Slide 6

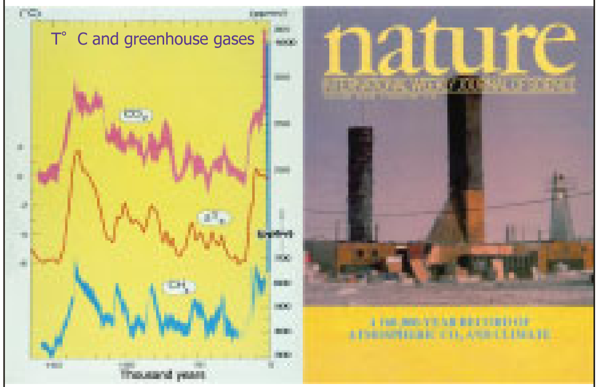
1977: 900m Deep Ice Drilling at Dome C



T° C from today to -40 000 years

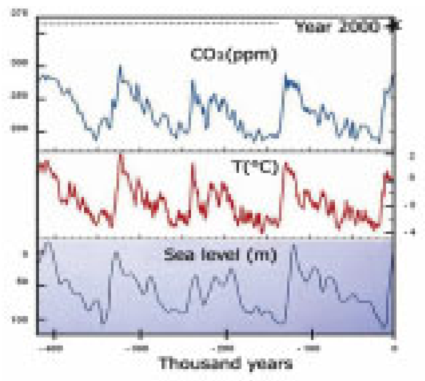
Slide 7

1984: Vostok, 150,000-year-old Records



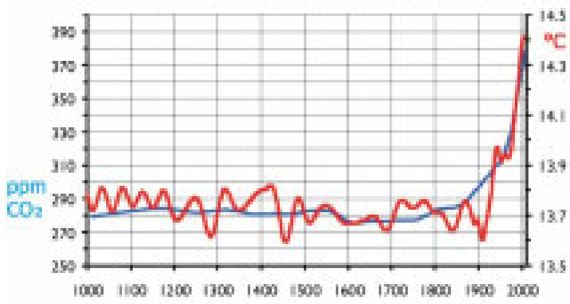
Slide 8

1998: Vostok, 420,000-year-old Records

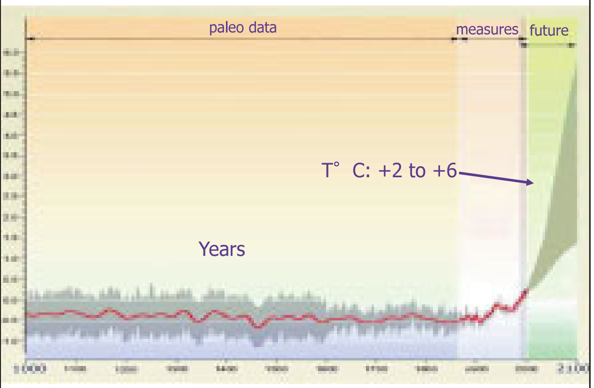


Slide 9

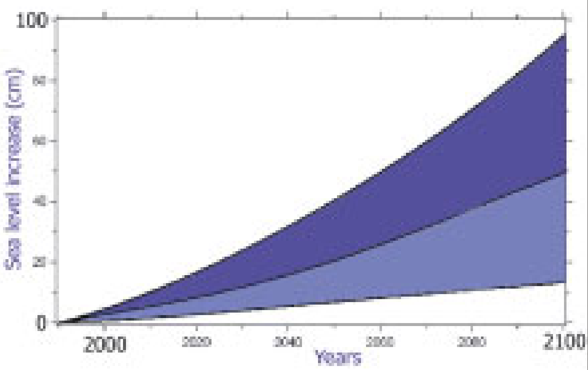
1000 years: CO_2 and Global Warming



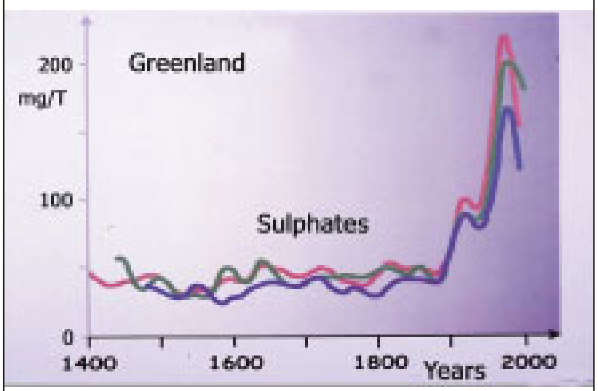
Slide 10
Temperature: Past and Future



Slide 11
Climatic Warming and Sea Level

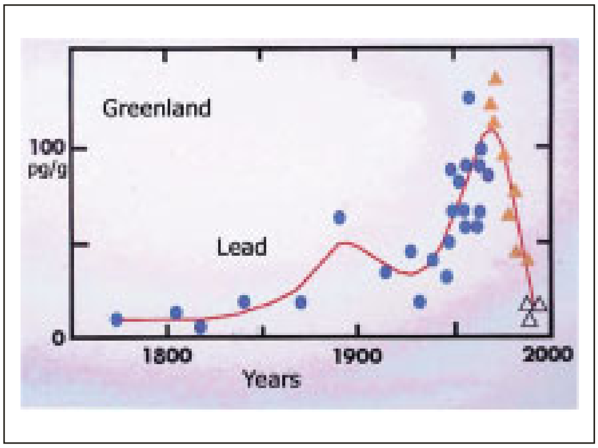


Slide 12
Hemisphere Pollution: Greenland 1



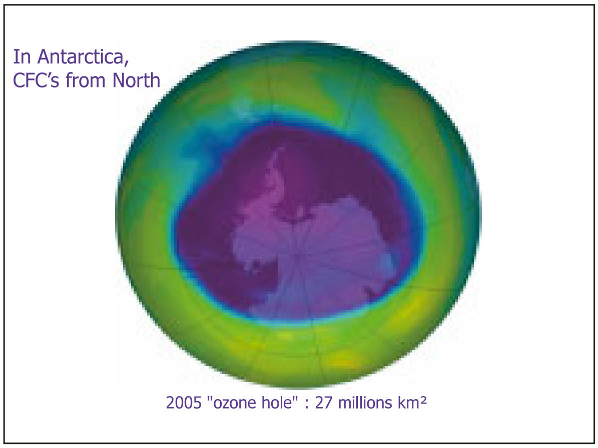
Slide 13

Hemisphere Pollution: Greenland 2



Slide 14

Global Pollution: "the Ozone Hole"



Slide 15

CO_2: the Birth of Anthropocene