

ICE MEMORY

PROTECTING ICE MEMORY

Press Kit
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ICE MEMORY: an international scientific programme aimed at preserving climate memory

Collecting ice cores from high-mountain glaciers most at risk from climate change and storing them in Antarctica for future generations of scientists: that is the goal of **ICE MEMORY**, an international programme aimed at preserving the memory of high-mountain glaciers.

Climate archives under threat

Non-polar glacial ice holds a wealth of information about past changes in climate, the environment and especially atmospheric composition, such as variations in temperature, atmospheric concentrations of greenhouse gases and emissions of natural aerosols or man-made pollutants... The glaciers therefore hold the memory of former climates and help to predict future environmental changes.

Over the last few decades, glaciologists have been observing the effect of increased temperatures on the melting of high-mountain glaciers in Europe and especially in the Andes. Time is running out: if global warming continues at its current rate, glaciers at an altitude below 3,500 metres in the Alps and 5,400 metres in the Andes will have disappeared by the end of the end of the 21st century. These are unique pages in the history of our environment which will therefore be lost forever.



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Protecting ice memory

Faced with this alarming observation, French and Italian glaciologists decided to take action and launched the **ICE MEMORY** project in 2015. Backed by the Université Grenoble Alpes Foundation, it unites the following partners: CNRS, IRD, Université Grenoble Alpes, National Research Council of Italy, Ca' Foscari University of Venice, as well as IPEV (French Polar Institute) and the Italian Antarctic research programme (PNRA) as regards the Concordia station (joint French-Italian research facility located in Antarctica).

Their primary goal: create the world's first ice archive sanctuary in Antarctica, using glaciers threatened by global warming. Antarctica is indeed the most reliable – and natural – freezer in the world. Hundreds of ice cores taken from around the world will be stored for several centuries in a snow cave at -54°C in Antarctica, at the Concordia station, which is run by the French Polar Institute (IPEV) and the Italian Antarctic Research Programme (PNRA). These samples will be the property of humanity, with sustainable international governance ensuring their preservation as well as their exceptional and appropriate use, in order to enable future generations of scientists to carry out unprecedented analyses.

Unite glaciologists of the world

As part of the **ICE MEMORY** project, a team of French, Italian, Russian and American researchers carried out the first ice archive drilling operation on the Col du Dôme glacier in the Mont Blanc massif, in August 2016.

This mission represented the first stage in demonstrating the feasibility of the "ice core archive" project. Following successful completion of the operation, the team is set to carry out a second ice archive drilling operation on the Illimani glacier in Bolivia, in June 2017.

The consortium does not intend to stop at that. It hopes to unite the international community of glaciologists in order to carry out at least another ten or so drilling missions at various glaciers around the world, both those of scientific interest and those threatened by climate change.

The inaugural **ICE MEMORY** conference is due to be organised on 8-10 March 2017, under the patronage of the French national commission of UNESCO. It is set to mark the internationalisation of the programme, with fifteen American, Russian, Chinese, Brazilian, Swedish, Japanese, German, Swiss, Italian and French scientists specialising in the study of ice cores due to attend.



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ICE MEMORY, a collaborative model

The project is equally jointly financed by the provision of human resources and equipment from partner scientific organisations and by private sponsorship, through the Université Grenoble Alpes Foundation. Companies, foundations and private individuals are therefore joining forces to ensure that this adventure, this responsibility we all share, can be pursued.

KEY DATES

- 2015:** Launch of the **ICE MEMORY** project
- 2016:** First drilling operation at Col du Dôme, France
- Février 2017:** Patronage of the French national commission of UNESCO and the Italian national commission of UNESCO
- Mars 2017:** International launch at UNESCO Paris
- Mai-Juin 2017:** Illimani mission in Bolivia
- 2018-2019:** Analysis of ice cores and creation of a reference database
- 2020:** Creation of the snow cave at Concordia station, Antarctica
- 2021:** Transport and storage of the first ice cores for archiving

Mission accomplished on the Col du Dôme

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The first drilling operation of the ICE MEMORY project was held on 15-29 August 2016 in the Alps, on the Col du Dôme glacier

This operation, unprecedented in the Mont Blanc massif, called for almost a tonne of equipment to be lifted by helicopter - including 25m³ of specially insulated boxes - from Chamonix. The international team, comprising French, Italian, Russian and American glaciologists and engineers coordinated by Patrick Ginot (IRD) and Jérôme Chappellaz (CNRS), spent two weeks bivouacked in tents at the coring site.

At 4,300 metres above sea level, the scientists drilled down through the glacier to the bedrock to sample, metre by metre, the first three "ice cores for archiving". Measuring 126, 128 and 129 metres in length, these cores were then lowered down and stored in a cold storage facility in Grenoble.

One of them will be analysed in the lab in order to improve current knowledge and build a database available to the entire world scientific community.

The other two will be transported by ship and then by tracked vehicles to the high plateaus of Antarctica, probably in 2020, for storage at the Concordia station.



What can we learn from the Col du Dôme?

Previous drilling operations conducted at the Col du Dôme had already hinted at the exceptional potential of this site in reconstructing the evolution of the climatic and atmospheric environment at European level. Studies had, for example, highlighted a considerable increase in sulphur dioxide emissions between 1925 and 1980 originating from the countries surrounding the Alpine region (sulphur contributing to "acid rain" in Europe).

Similar conclusions have been drawn from nitrate profiles, which indicate an increase in nitrogen oxide emissions related to agricultural activities in those same areas. Using these reconstructions of changes in atmospheric pollution, it has therefore been possible to update emission inventories and generate regional policies aiming to limit certain human-induced pollutant emissions.

Analyses of the ice core samples extracted in August 2016 will shortly supplement this information.



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Illimani glacier: 18,000 years of climatic archives

The next ice archive drilling mission will take place in June 2017

in Bolivia, on the Illimani glacier

Peaking at 6,432 metres above sea level, the Illimani glacier is located between the wet Amazon basin and the dry Bolivian Altiplano, just above the Bolivian capital, La Paz. Depending on the season, Illimani is influenced by air masses mainly stemming from Amazonia, but also from the dry side of the Andes mountains and La Paz. This site records a vast array of information, from various sources: rainfall trends and forest fires (Amazonian side), human-induced emissions and urban pollution (Altiplano side).

Two metres of snow fall each year on the drilling site, which enables this information to be reconstructed in great detail. With a depth of 140 metres and the reduced flow of the glacier, the site preserves up to 18,000 years of climatic and environmental archives. Studying the glacier therefore means the past of this environment can be reconstructed, as far back as the Last Glacial Maximum.

Dangerous and difficult drilling operations

The high altitude of the glacier represents the main difficulty of the drilling site: transporting equipment

to the top of Illimani is impossible by helicopter. All the equipment must therefore be physically carried by around fifteen Bolivian high-mountain guides and porters (each carrying 30kg). To deal with the physiological difficulties related to the high altitude, two teams of six to eight people (French, Russian, Brazilian, American and Bolivian) will take it in turns to perform the drilling operations. Preparation of the mission and the drilling of the three ice cores (approximately 450 metres of ice in total) are expected to last four weeks altogether.

A close Global North/South partnership

IRD researchers have been studying the Illimani glacier for almost 20 years, working with their Bolivian partners from the Universidad Mayor de San Andrés (UMSA) as well as Brazilian and Swiss partners. An initial deep drilling operation was conducted in 1999, demonstrating the considerable potential of this site and tracing the history of the glacier between 18,000 BC and 1999. This drilling operation also helped measure the temperature profile of the glacier, revealing the impact of climate change and the risks of losing information recorded in these ice strata. Since then, other shallow drilling operations (particularly in 2009) have helped specify the evolution of the glacier between 1985 and 2009.

10,000KM IN A REFRIGERATED CONTAINER

6 February 2017, all of the equipment - a core drill, 75 specially insulated boxes, camping gear - was loaded onto a refrigerated container at the Institute of Environmental Geosciences (CNRS/IRD/UGA/Grenoble INP) in Grenoble. The 30m³ of equipment is expected to arrive in La Paz at the end of March, after a 10,000km+ journey by boat. The refrigerated container will be used to store the ice core samples in La Paz during drilling operations, and then to transport the insulated boxes back to France (five- to six-week journey). The equipment will be sent back to France separately in another container.



© IRD/ Patrick Ginot

CONCORDIA: the ICE MEMORY project's snow cave

The ice cores extracted during the ICE MEMORY missions will be stored from 2020 (objective) at the Concordia station, the French-Italian research facility jointly run by French Polar Institute (IPEV) and the Italian Antarctic Research Programme (PNRA).

Concordia is located 3,233 metres above sea level on the High Antarctic Plateau (1,100km from the nearest coastline and 2,500km from the geographic South Pole). The average temperature is -54°C and can drop as low as -84°C in winter. Despite the remoteness and isolation of the site, the logistics chain in place and the highly stable temperature at a depth of 10 metres in the névé (around -54°C, obtained naturally all year round) make it an ideal place for storing ice core samples in order to preserve climate archives.

The first global bank of glacier ice samples

Opened in 2005, Concordia is the third permanent research facility on the Antarctic Plateau besides the Scott-Amundsen (United States) and Vostok (Russia) stations at the South Pole. It is designed to allow 14 people to live in complete isolation from the rest of the world during the nine months of the austral winter. In austral summer (between November and February), the station accommodates 60 people on average.

Supplies are brought to the station mainly over land by traverse, carrying all the food, fuel and other equipment required to live on-site from the French Dumont d'Urville station. Station personnel arrive by air, either from the Italian Mario Zucchelli station or from Dumont d'Urville.

FRENCH-ITALIAN POLAR LOGISTICS

The Concordia station was jointly designed and built, and is run by France and Italy. The French Polar Institute (IPEV, the French agency for resources and skills supporting French scientific research in the polar region) and the Italian Antarctic Research Programme (PNRA, a consortium combining the Italian ministry for Research, ENEA and CNR) operate the station. They are responsible for deployment of scientific programmes at Concordia.

In 1995, the European programme EPICA (European Project for Ice Coring in Antarctica) was run at the Concordia site, reaching a drilling depth of 3,270m, thus tracing some 800,000 years of climate history. The logistics for this large-scale project were provided by both IPEV and PNRA. Thanks to this experience and their knowledge of construction in isolated settings and in extreme conditions, the two agencies are the best placed to create this storage site, whilst the logistics chain already in place will ensure that ice core samples are transported in complete safety, to France and Italy in particular.



300m² of storage in Antarctica

Located close to the Concordia station, the ice memory storage zone will cover a surface area equivalent to approximately twenty 20-foot containers, i.e. about 300m².

It offers solutions to the major challenges of the project:

- ▲ **Temperature stability:** in order to guarantee a stable, substantially negative temperature, the conditions required for optimum preservation of the ice core samples, the cave will be buried in the snow, ten metres below the surface.
- ▲ **Pressure exerted on the cave:** the structure must be able to withstand the pressure caused as it becomes increasingly buried by the accumulation of snow at the surface over a period of at least several decades.
- ▲ **Planned duration of storage:** the cave must be able to support storage over several decades and it must be possible to extend the facility if necessary.
- ▲ **Organisation:** the cave must be organised in such a way as to allow easy access to the ice core samples. Workshops and handling areas will be created outside of the storage zone for sampling and cutting work.
- ▲ **Preservation:** in order to guarantee the stability of the storage environment, future access will be limited because every intervention causes condensation and frost to form.
- ▲ **Personal safety:** working at these very low temperatures in a confined space calls for improved intervention possibilities in case of the need to evacuate person in difficulty.
- ▲ **Sample safety:** the extreme isolation of the site makes it very easy to protect the cave and manage access to the structure.

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Key members

Coordination team

Anne-Catherine Ohlmann



Director General of the Université Grenoble Alpes Foundation, Anne-Catherine Ohlmann is involved in coordination of the project, and especially of its sponsorship. Holder of degree in Biotechnology Engineering and an MBA in Marketing, she worked on international marketing at Hewlett-Packard (HP) for over ten years. She simultaneously coordinated HP's philanthropy activities in Africa. She advised the Enterprise Foundations of leading European companies on implementation of philanthropy projects and PPPs (public-private partnerships) in Western and Northern Africa. She was appointed Director of the Université Grenoble Alpes Foundation when it was set up in 2014.

Jérôme Chappellaz



Founder and joint scientific coordinator of the **ICE** MEMORY project, Jérôme Chappellaz is Research Director at the CNRS (at the Institute of Environmental Geosciences). He is a recognised expert in the evolution of greenhouse gases within the atmosphere on various time scales. He coordinates French research surrounding ice cores drilled in polar regions and represents France in international committees for this scientific field.

He has taken part in nine expeditions in Antarctica and Greenland, and he is currently initiating two ambitious projects for the European Research Council (ERC). He has published more than 160 scientific articles, including 115 in peer-reviewed journals and more than twenty in the prestigious journals, Nature and Science. For more than a decade now, the impact of his publications has placed him in the select category of the most highly cited researchers in geosciences worldwide (<http://www.jerome-chappellaz.com>). A Knight of the French National Order of Merit, Jérôme received the CNRS Bronze Medal in 1993 and the Silver Medal in 2015, the Jaffé Award from the Académie des Sciences in 2001, the Shackleton Medal for scientific innovation from the European Association of Geochemistry in 2013 and the Niels Bohr Institute Medal of Honour in 2014.

Patrick Ginot



Founder and operational coordinator of the **ICE** MEMORY project, Patrick Ginot is Research Engineer, First Class, at IRD. A glaciologist and a geochemist, he is an expert in the reconstruction of our past climate and environment using ice cores extracted from the highest glaciers in the world (the Andes and the Himalayas). He is assigned to Bolivia and attached to the Observatory for Sciences of the Universe, Grenoble (OSUG) and the Institute of Environmental Geosciences (IGE). As a coordinator of French research surrounding non-polar ice cores, he has both coordinated and participated in the majority of French and international drilling missions in the Andes and at other high-altitude sites. Monitoring and understanding glacial retreat, the impact of human activity and the connection between glaciers and the atmosphere are central to his research, conducted in partnership with the institutions and universities of the Global South, especially in Bolivia. His research work strengthens our knowledge of hydrological cycles and the changes in water resources, particularly in the Andes.

Carlo Barbante



Joint scientific coordinator of the **ICE MEMORY** project, Professor of Analytical Chemistry at the Ca' Foscari University of Venice, Carlo Barbante is Director of the CNR Institute for the Dynamics of Environmental Processes in Venice. He has a highly prominent international profile and, over the past fifteen years, has made substantial contributions to environmental and climate sciences. His particular strength is the ability to span fields by contributing to ice core geochemistry, analytical chemistry, palaeoclimatology, environmental contamination, atmospheric chemistry and synthesising findings from across these diverse fields. He is most noted for his contributions to the fields of palaeoclimatology and past biogeochemical cycles. Specifically, these contributions include the reconstruction of past atmospheric pollution through polar and Alpine ice core analysis, as well as the development and use of novel analytical approaches based on inorganic/organic mass spectrometry.

In all of these disciplinary fields, Professor Barbante has played a substantial role in the production and understanding of datasets that have revolutionised our knowledge of Earth system history. He is a European Research Council (ERC) Senior Grant awardee and currently the Italian National Delegate to the EU's Horizon 2020 programme for the Societal Challenge "Climate Action, Environment, Resource Efficiency and Raw Materials". He is also a member of several national academies and received the La Belgica Prize in 2014 for his research in Antarctica.

Some of the international scientists involved

Margit Schwikowski



Margit Schwikowski is head of the Environmental Chemistry Laboratory and head of the Analytical Chemistry Group at the Paul Scherrer Institute in Switzerland, and is also professor at the University of Berne. She is interested in the reconstruction of man-made pollution, environmental conditions and climatic variability in high-mountain glaciers. She has led 20 ice drilling missions on high-mountain glaciers in Argentina, Chile, Mongolia, Russia, Switzerland, Norway and Tanzania. She is jointly responsible, along with Jefferson Simões, for the «non-polar ice drilling» part of the IPICS international consortium, which features scientists working on ice cores. Furthermore, she is currently planning several drilling operations that may contribute to the **ICE MEMORY** project.

Jefferson Simões



Head of the Brazilian National Institute for Cryospheric Sciences in Porto Alegre, Brazil, Jefferson Simões is Professor of Glaciology and Polar Geography at the Federal University of Rio Grande do Sul. He is also Visiting Professor at the University of Maine's Climate Change Institute in the United States and a full member of the Brazilian Academy of Sciences.

Currently, Jefferson Simões is the Brazilian delegate for the Scientific Committee on Antarctic Research of the International Council for Science (ICSU), which makes him the spokesperson for the **ICE MEMORY** project within this programme. His published works have predominantly centred on ice core samples obtained in Antarctica and the Andes, and he is currently interested in the reconstitution of Amazonian environmental history using ice core samples taken from the Andes. Jointly responsible for the "non-polar ice drilling" part of the IPICS consortium, he will be taking part in drilling operations at the Illimani glacier and intends to propose further drilling operations in the Andes, that may contribute to the project.

Stanislav Kutuzov



Head of the Glaciology department at Moscow's Institute of Geography in Russia, Stanislav Kutuzov is a glaciologist, specialised in extraction, glacier ground-based geodetic surveys, analysis of ice cores, mass balance measurements and remote sensing of glaciers. He has taken part in many field work studies in various regions of the world, including Peru, Tibet, the Caucasus, Norway and Russia. He coordinates several international research projects.

Stanislav Kutuzov is a former member of the European Commission's Marie Curie Research programme, and has been working at the University of Reading (UK) for the last two years. Academic Secretary of the Glaciological Association, which unites scientists from the post-Soviet states, he received a prize from the Russian Geography Society in 2014 in recognition of his work on the Caucasus. He is currently working on impacts of atmospheric dust on glaciers in the Middle East, using ice core samples taken from the Caucasus. He is jointly leading a drilling project on Mount Elbrus in the Caucasus, a project supported by **ICE MEMORY**.

Partners and sponsors

Founding members

The **ICE MEMORY** project is jointly financed equally by the founding members (providing human resources and equipment) and by private sponsorship, through the **Université Grenoble Alpes Foundation**.



The French National Centre for Scientific Research (CNRS) is the largest public sector research organisation in France and in Europe. It produces knowledge for the benefit of society as a whole. With close to 32,000 permanent employees, a budget of 3.3 billion Euros (in 2015), 769 million Euros of which is CNRS-generated income and research structures located throughout France, the CNRS works in all fields of knowledge, supported by over 1,100 laboratories. With 21 Nobel prize winners and 12 winners of a Fields Medal, the CNRS has a long tradition of excellence. It conducts research into all scientific, technological and societal disciplines: mathematics, physics, information and communication sciences and technologies, nuclear and particle physics, geosciences, chemistry, life sciences, human and social sciences, environment and engineering.

Co-founder of the project on the French side, the CNRS contributes to the **ICE MEMORY** project in particular through the involvement of several of its researchers, engineers and technicians. These CNRS employees have worked on collecting ice cores for archiving, analysis of the reference ice cores from each site and the set-up of the long-term storage facility in Antarctica.

Furthermore, the CNRS has also allowed use of its National Ice Core Drilling Centre (C2FN), the «glaciology» section of which not only provides personnel skilled and experienced in drilling, but also drilling equipment specifically adapted to high-altitude working conditions. The cold chambers used to conduct reference analyses in Grenoble are also managed by CNRS personnel.

www.cnrs.fr



The French National Research Institute for Sustainable Development (IRD France), an internationally recognised multi-disciplinary organisation, is a French public research establishment. Via its network and presence in fifty or so countries in the intertropical and Mediterranean zone, it takes an original approach to research, expertise, training and knowledge-sharing, to the benefit of countries and regions that make science and innovation key drivers in their development. www.ird.fr

IRD, along with its Bolivian partners, began observation of tropical glaciers in 1991, real climate change indicators and local water resources contributors. These observations began on the Zongo glacier, near La Paz, which takes part in GLACIOCLIM observatory since 2005 and Global Cryosphere Watch network of World Meteorological Organization since 2016.

This strong Global North/South partnership has subsequently been extended to Peru, Ecuador and, more recently, Colombia. It led to the creation in 2011 of the International Combined Laboratory (LMI) Glaciers and water resources in the tropical Andes: indicators of environmental changes (GREAT ICE), which features twelve scientific institutions in France and in the Andes.

IRD also supports the Physics Research Institute at the Universidad Mayor de San Andres (UMSA), as part of the project to strengthen the capacities of CHARME (Climate High Altitude Tropical Atmospheric Experiments, 2016-2019). Within the current context of climate change, the CHARME project aims to better understand the behaviour of aerosols in urban settings and to determine the origin of air pollutants more effectively in one of the largest and most densely-populated cities in Bolivia, La Paz. It also supports the monitoring activities of the Chacaltaya station (Bolivia, 5,240m above sea level), which has been part of the World Meteorological Organization's Global Atmosphere Watch network since 2011.



Created following the merger of the Joseph Fourier, Pierre-Mendès-France and Stendhal universities in 2016, the Université Grenoble Alpes is a leading player in the field of higher education and research in France. In an increasingly competitive world, the aim of the new establishment is to meet more effectively all the challenges for universities posed by the world of today and tomorrow, and to raise its profile and attractiveness internationally.

Through its 80 laboratories and six research centres, research at the Université Grenoble Alpes has adopted an increasingly cross-disciplinary approach as it seeks to be a leader in innovation. Université Grenoble Alpes is one the founding partner of the Ice Memory project, involved since its inception. UGA supervises the Institute of Environmental Geosciences, operator of the project and supports its Foundation, which leads the ICEMEMORY project.

www.univ-grenoble-alpes.fr



The Université Grenoble Alpes Foundation, set up in September 2014, aims to accelerate the creation and sharing on knowledge in order to contribute to societal transformation in the 21st century. It supports projects led by laboratories at the Grenoble site through sponsorship, particularly of heritage preservation projects, research chairs, innovative teaching techniques and assistance and support for students in one-off projects such as high-performance sport.

www.fond.univ-grenoble-alpes.fr



IPEV, the French Polar Institute, provides human, logistical, technical and financial resources, as well as the legal framework required for the development of French scientific research in the polar and sub-polar regions. These regions' isolation and extreme climates make it imperative for operators to have highly specific technical knowledge and skills. The Institute brings together specialist professionals in polar logistics, turning to good use its knowledge of harsh environments and special range of skills to coordinate, support and run an annual 60 to 80 science and technology programmes

in the higher latitudes of the globe, both North and South.

From its headquarters in Brest, IPEV's permanent teams – around fifty people, two thirds of whom are provided by the CNRS – manage the resources required to organize and lead scientific expeditions.

In Antarctica and the Subantarctic islands, around 200 seasonal personnel or winterers, spread across the various stations, enable a force of over 200 researchers to conduct their fieldwork. In the Arctic, a hundred or so scientists go on assignments each year with the support of IPEV.

www.ipev.fr



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Ca' Foscari
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Since its inception in 1868, the Ca' Foscari University of Venice has been a leader in Economics, Econometrics and Modern Languages. Ca' Foscari today is exploring new frontiers of knowledge, focusing on Climate Change, Digital Humanities, Cultural Heritage and Nanosciences.

With a view to enhancing an already world-class scientific profile, Ca' Foscari seeks constantly to engage the best available technological and human resources to consolidate existing areas of expertise while exploring new avenues of interdisciplinary research and challenging current academic paradigms.

Ca' Foscari hosts the Early Human Impact (EHI) Project, funded by the European Research Council and headed by prof. Carlo Barbante. The project aims to reconstruct the history of man-made fires through an analysis of ice cores and lake sediments. These are retrieved from sites which correspond with the centres of the origin of agriculture, across seven continents, and are analyzed by means of a ground-breaking technique pioneered by the EHI research group: a globally present molecular marker called levoglucosan, used for identifying and measuring the history of biomass burning in ice cores and lake sediments.

www.unive.it



National Research Council of Italy

The National Research Council of Italy is represented here by the Institute for the Dynamics of Environmental Processes (IDPA). IDPA-CNR is dedicated to advancing the understanding of the processes of the Earth system and their interactions with the humankind. It pursues this goal through basic and applied research and education, by focussing on monitoring and management of anthropogenic effects. It develops approaches to support problem-solving in earth-sciences and decision-making for sustainable development, and communicates its results to promote understanding and awareness, to the benefit of the wider society.

The main research activities of the CNR-IDPA involve the study of chemical contamination on a global level, the mechanisms of transport and transfer of pollutants between different environmental compartments, the processes and cycles of transformation of chemicals in the environment, and the development of chemical analytical methodologies for the specific study of pollutants in snow, ice, soil and waters.

IDPA-CNR has a large experience in the research on past climate change and in the study of the contamination level from local to global scales, especially in remote and mountainous areas. The Institute's activities take also place in highly populated areas to assess the impact of human activities on the environment, to understand the mechanisms of spread of contamination and to propose the best actions for environmental recovery.

www.cnr.it



The Universidad Mayor de San Andrés (UMSA) in La Paz, Bolivia, is IRD's preferred and longstanding partner in the field of climate and environmental sciences. Several UMSA laboratories take part in the Bolivian component of the ICE MEMORY project. The Institut d'Hydrologie et d'Hydraulique (IHH) is the logistics centre of the operation and will house the refrigerated container. The Instituto de Investigaciones Geológicas y del Medio Ambiente (IGEMA) will coordinate the geophysical measurements on the Illimani glacier. The Laboratorio de Física de la Atmósfera (LFA) will compare current and past data on the composition of the atmosphere.

<http://www.umsa.bo/web/guest>

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https://twitter.com/fond_uga



<https://www.facebook.com/ProtectingIceMemory/>

Relive the Col of Dôme expedition with the Wild Touch Production's film produced with the support of scientific partners



<https://www.youtube.com/watch?v=K8fH7JC6DGg&feature=youtu.be>



<http://ice-memory.imag.fr>

Royalty-free photos and videos available on request

Article "A vault to preserve the world's glaciers", CNRS journal, August 2016



<https://news.cnrs.fr/articles/a-vault-to-preserve-the-worlds-glaciers>

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