

*Between ourselves*

**Share: the colours of research**

BY PAOLO BONASONI

Isac-Cnr, Share Coordinator

Scaling the steep Himalayan paths it is not unusual to come across prayer flags, with their combinations of vivid colours: yellow for the earth, green for water, blue for air and sky, red for fire, white for infinite space. I have been told that they bind the Earth to the Sky thanks to the wind, the rain and the sun, which read and spread the prayer so that it arrives at the farthest corners of the Earth. The multicoloured flags that call to mind the Earth's resources also urge us to share more fairly these resources, today set at serious risks by the climate. Share: this words so pregnant with meaning, was chosen by the EvK2Cnr Committee as the acronym for its project Stations at High Altitude for Research on the Environment (Stazioni di Ricerca in Alta Quota per la Ricerca sull'Ambiente). Share is a scientific and technological research project focusing on mountains, areas that are particularly sensitive to climate changes, first of all that of Everest, where prayer flags flutter in the wind. Share is mainly identified with the Pyramid Laboratory Observatory, operating at over 5000 metres height since 1990, and with the more recent Nepal Climate Observatory, listed in the Gaw programme of the World Meteorological Organization as the 33rd "Global Station". The station is located at 5079 m altitude, and since 2006 it has been making measurements for climate studies, including those related to the so-called SLCFs – Short Lived Climate Forcers. The initials stand for climate-altering compounds, like black carbon (carbonaceous particulate emitted by various combustion processes) and ozone, able to warm the Earth's atmosphere, while surviving only for brief periods, for several days to a few weeks, unlike other greenhouse gases, for example CO<sub>2</sub>, that have far longer atmospheric lifetimes. The increasing interest of the scientific community – and not only this community – for these compounds, lies in the fact that, being polluting and climate-altering compounds that are short-lived in the atmosphere, their substantial reduction would in turn permit a significant reduction of anthropogenic effects on planetary warming more quickly than by limiting ourselves to decreasing CO<sub>2</sub> emissions. Black carbon also can increase the glacier melting rates from Greenland to the Himalayas. In fact, while a "clean" glacier is able to reflect a good portion of the solar radiation that reaches it, when this dark coloured particulate is deposited on the glacier and is warmed by sunlight, it favours the melting of the glacier. That is why, once the impact of these pollutants on the climate have been evaluated and their sources identified, in certain areas of the planet – as in the southern Himalayas – efforts can be made to promote systems to bring about a significant reduction in these emissions – produced, for example, by live fires for cooking or heating. Such intervention will contribute to diminish anthropogenic effects on the climate, and also improve air quality and human health. These small, big steps help to understand the importance of scientific and technological research, but also the role of green economy, in order to ameliorate man's living conditions and that of his surrounding environment.

In mountain environments, it is often difficult to monitor atmospheric pollutants. Therefore, as part of its work on the development of advance technological systems, Share has undertaken the task of realising a self-sufficient transportable system capable of monitoring the atmosphere in these remote areas. This reinforces our commitment to studying the climate and its variations in the mountain regions of Karakorum, the Himalayas, the Alps and, very soon, we will arrive on the Mountains of the Moon in Africa, without forgetting the research performed in Nepal and Pakistan in the framework of Unep's project Abc. The Paprika and Stelvio pilot projects provide a concrete confirmation of EvK2Cnr and the Cnr's keen interest in the study of air-ice-water resources and, more specifically, in the study of the "glacier problem". In many regions, in fact, glaciers and the snows covering them are irreplaceable sources of drinking water and a crucial support to agriculture, energy production and tourism, guaranteeing the livelihood of many people. Water is also essential to guarantee the biodiversity celebrated by the United Nations in the year 2010. In this context, the "Himalayan Seed Bank", the project founded in collaboration with the Nast, is currently taking its first steps towards studying and safeguarding the characteristic flora of the Himalayan mountains, currently under serious threat from climate change effects.

It is therefore my conviction that Share is helping us also to

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**BLACK CARBON**

BY WAINER PEDA

Scientists around the world are increasingly confident. Not only are the so-called greenhouse gases to affect global warming. Deciding factor on increasing the temperature, and consequences of the black carbon, soot, mostly of anthropogenic origin, generated by combustion processes that occur in specific areas of the planet. In recent years, the black carbon that deposited on the glaciers will increase the merger, was not included among the causes of global-change. Recent studies, however, say the opposite

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*Share, sentinel in the high mountains*  
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*Share Paprika Focus on the cryosphere*  
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*Share, observatory privileged on Stelvio*  
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**The "Himalayan Seed Bank" is born**

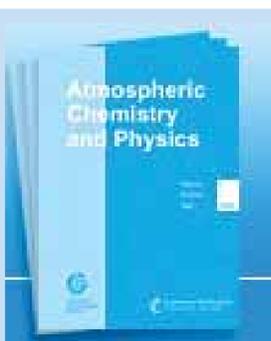
It's the first in the world for flowers and plants. Goal: Preserving biodiversity

The first "seed bank" of Himalayan plants was created today to preserve biodiversity in the Sagarmatha National Park. The great initiative promoted by the Italian EvK2Cnr Committee, Nast (Nepal Academy of Science and Technology) in collaboration with the Italian University of Pavia, is unprecedented in the world. The agreement was signed this morning in Kathmandu, with the

support of Prime Minister of Nepal Madhav Kumar Nepal, who met Agostino Da Polenza and praised the whole work of EvK2Cnr Committee.

The "Himalayan Seed Bank" is the first of the world dedicated to the Himalayan alpine flora and will be hosted in the Nast laboratories. It will shelter seeds of endemic species of the Sagarmatha National

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**Gaw station and Acp double awards for EvK2Cnr researchers**

A dual recognition and prestige. In September Last, the Union World Meteorological Organization (Wmo) has awarded the Nco-p station, located at the Pyramid laboratorio Everest, the status of "total station" of the Global Atmospheric Watch (Gaw). The structure, built and operated by EvK2Cnr, has thus become the 33rd overall station the network and the highest altitude, since it is 5079 m

above mean sea level, on the southern Everest.

Since 2006, from there, the scientists related to the EvK2Cnr collect data on the chemical composition of through continuous measurement. The first results - and this is The second award - were published in an edition Special of the prestigious journal of international studies Atmospheric Chemistry and Physics in 2009, dedicated to the phenomenon of Atmospheric Brown Clouds (Abc) in the Himalayas. The issue is also available at the website: [http://www.atmos-chem-phys.org/special\\_issue162.html](http://www.atmos-chem-phys.org/special_issue162.html)

(at pages 4 and 7)

**New internet Site for Share project**

Data, activities, forms: everything on the web. Share the most important Italian project monitoring and environmental climate, promoted by EvK2Cnr and internationally recognized as a valuable source of information for the study of global warming, has a new internet. It's the new site accessible to the public since last December. In there were collected in a clear and detailed all the activities carried out by researchers from the Himalayas to South America, passing through Pakistan and Italy.

(at page 3)

**Share Paprika and Stelvio studying the effects on glaciers**

Studying the effects of climate change on specific regions of the world to obtain critical data for the development of more accurate forecasting models is the objective of two different but complementary projects, carried out by EvK2Cnr scientists. They both take the glaciers as reference. Why the glaciers? Because the snow and glacial cover is recognized as the most trustful indicator of the ongoing "global change" and of the climate forcing reaction, the experts say. The first project takes the name of Share Paprika. It will analyze the Karakorum glaciers, which are very important because they supply water to the Indo river, essential resource for the entire Central-Asia. The second one, is closer to us. It is the project, called Share Stelvio, which takes the name from the Stelvio National Park, in which it is based. From here, scientists and their stations will be able to precisely study the pollutants effects.

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## GLOBAL CHANGE

## The Lombardy glaciers a 21% surface lost in 10 years

BY DAVIDE ANTINORI

The Lombardy glaciers have lost 21% of their surface during the last 10 years. This is what it is turning out from the research on "Climate and glaciers", ordered by A2A and Lombardy Regional Council, to Claudio Smiraglia, climatologist and contributor of EvK2Cnr Committee, in order to control the consequences of greenhouse effect against the glacial resources of Lombardy.

According to Mr. Claudio Smiraglia's data, ex president of the Italian Glaciological Committee, current representative of our country at the International Glaciological Society and member of the scientific council of EvK2Cnr Committee, it is turning out that even Italian glaciers, as most of the mountain ranges of the world, are losing in thickness and moving to extinction, whilst the permafrost is rapidly melting. By following this rhythm the "criosphere" will surely collapse. According to Smiraglia, the pending climatic crisis has caused the loss of 21% surface to the Lombardy glaciers during the last decade.

This degradation is bringing to reduction, and perhaps to extinction, a fundamental water resource. In order to maintain the glacier intact, scientists are experimenting a special thermal cover, which should reduce its liquefaction of 50%.

This cover has been applied even to Presena and Dosdè glaciers.

### Share, an EXPO-2015 project

The Expo 2015 Scientific Council itself decided to acknowledge Share's exceptional role in the issues of climate and environmental monitoring, by including it among the leading initiatives that will feature in the 2015 Milan Universal Exposition. Being perfectly aligned with the key themes promoted by the Milan Expo, Share has formally received Expo 2015's patronage. "Feed the planet, energy for life" is the theme of the extraordinary universal event, which will give visibility to Italian tradition, creativity, innovation and skills, considered as excellences in the international scenario. Beyond the macro-theme of food, Expo 2015 will be characterized by a series of closely integrated issues: Environmental protection, Sustainable development, Biodiversity safeguard, Renewable energies, Fight against desertification, Landscape defence, Prevention of natural disasters, Access to water for everyone. The problem of food can not be separated from themes like sustainable development, research on climate change, and its inevitable impacts on ecosystems and related human systems. The Expo 2015's themes have long been amongst Share's priorities, in terms of technical and scientific research on the mountains, aiming at improving and widening the knowledge on climate change in mountain environments and of its local and global effects, in order to empower and support decision-making processes. The Share project is therefore devoted to the continuous environmental monitoring in high-altitude and hardly accessible sites, to collect high-quality environmental measurements which, in the frame of the most important international projects, can provide relevant and unique information to estimate climate change impacts and to promote a sustainable development.

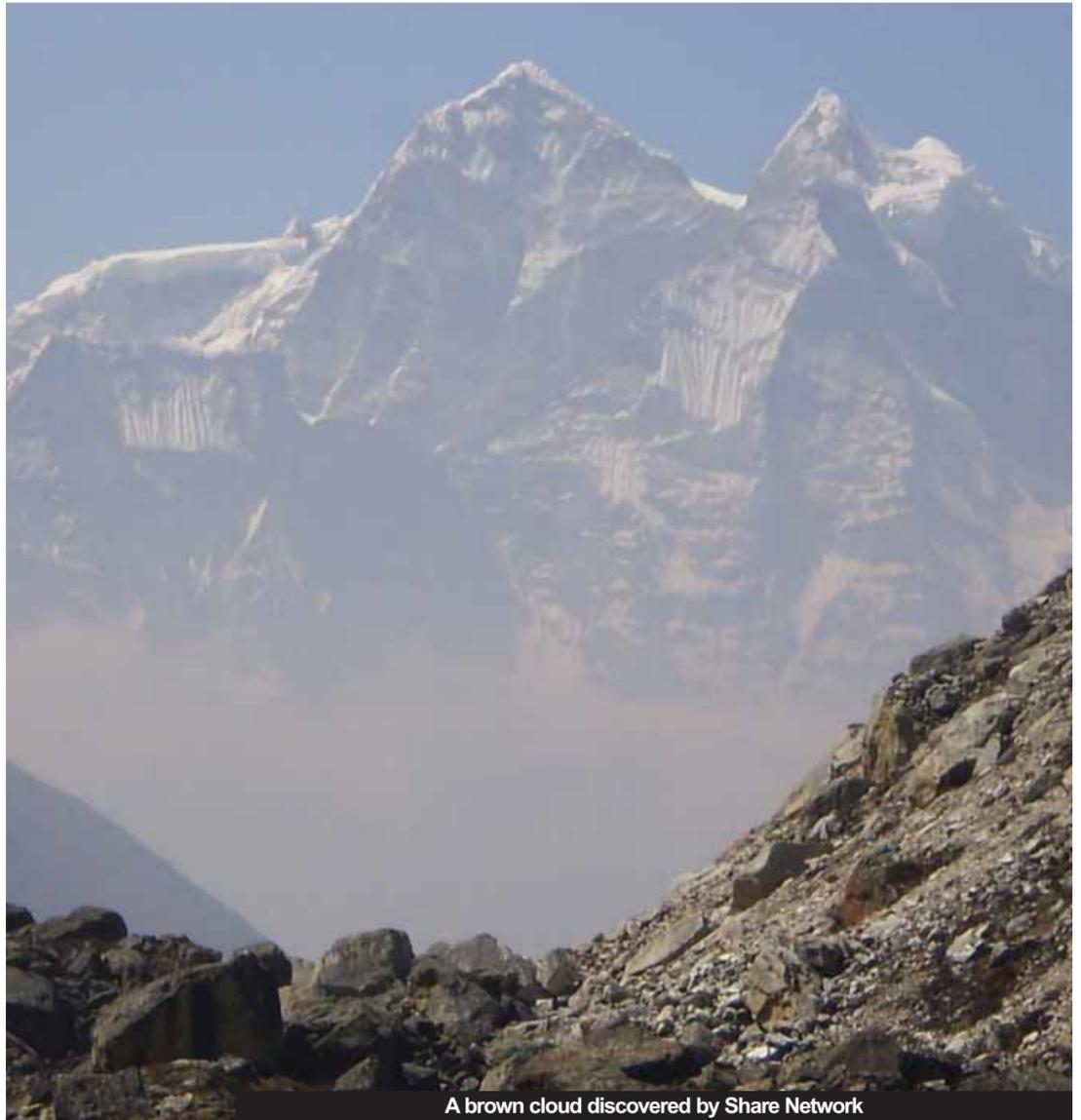
The Share project fully meets all the themes that the Universal Expo is willing to face, over the issues of environment, health, pollution and eco-effective technologies: This is the reason why it has been officially welcomed among the Expo 2015's projects.

Also this year with the development of the pre-monsoon season, Himalayan peaks experience alarming levels of atmospheric pollution. This results from the Share (Stations at High Altitude for Research on the Environment) project, promoted by the EvK2Cnr Committee and pointed out by the studies and observations of the Bologna Isac-Cnr and Grenoble LggeCnrs research group at the Nepal Climate Observatory - Pyramid, the EvK2Cnr station installed at 5079 m a.s.l., on the slopes of Mt. Everest. About a month ago we entered in the pre-monsoon season that favours the transport to Himalayan high altitudes of the pollutants which constitute the Asian Brown Cloud, a mix of pollutants that covers the Indian and South Asian plains. "The values of pollutants observed during the first days of April are over the already high levels reached in the last years. In these days the black carbon was very close to  $6 \mu\text{g m}^{-3}$  - says Angela Marinoni, Isac researcher - while the PM1 (particulate matter mass) exceeded the  $100 \mu\text{g m}^{-3}$ , a never registered value since the Nco-p Observatory started its research activity in the framework of the Atmospheric Brown Clouds Unep project". The presence of these pollutants in the atmosphere darkens the clear view of the Khumbu Glacier, as you can see from the Nco-p webcam (evk2.isac.cnr.it/realtime.html). "These worrying concentrations of particulates - says Paolo Cristofanelli, in charge for the Share atmospheric activities - are coupled with high levels of ozone, a high oxidizing greenhouse gas that forms in the atmosphere in presence of primary pollutants and solar radiation. Thanks to the conditions of extreme drought that

## CLIMATE CHANGE

## The Share - Nco-P station registered a brown cloud

BY VALENTINA D'ANGELLA



A brown cloud discovered by Share Network

characterizes the premonsoon season in Southern Asia, one of the main sources of these high concentrations of pollutants seems to be linked with the frequent forest fires, also connected to agricultural practices, that break out in this period of the year in the areas of Nepal and Northern India, besides Indochina." These observations confirm the alarming results of the first four years study of the Share project that registered in proxi-

city of the Himalayan glaciers concentrations of pollutants similar to those of the urban areas.

Every year during the pre-monsoon season, at the Share Nco-p station the highest values of the year are registered, with 30 minutes averaged concentrations of black carbon that reached the  $5 \mu\text{g m}^{-3}$  and with values of PM1 between 50 and  $70 \mu\text{g m}^{-3}$ , concentrations that exceed also the alarm threshold fixed by

the European Community for the urban air quality. "The observations made at the Nco-p station are worrying - says Paolo Bonasoni, scientific head of the Share project - because the pollutants, through Himalayan valleys, acting as chimneys, may be transported till medium and high troposphere, where they considerably increase their lifetime and may accumulate for being transported even on long distances". Moreover, as

showed by a study performed in collaboration with the NASA Goddard Space Flight Center, an estimation of the deposition processes of these pollutants on Himalayan glaciers may favor a significant increase of their natural melting. This appears even more important because Himalayan glaciers represent one of the main sources of fresh water for Southern Asia, one of the most populated areas of the world.

### MN montagnanews

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Concept: Wainer Preda

www.montagna.tv  
via G.Falcone 13/15 - 24129 Bergamo  
tel. +39 0353230536 - Fax +39 035384589  
email: redazione@montagna.org  
Press: Grafistampa srl - Zanica (BG)

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News: Q&A

### A sky-high eye on climate change

Measuring aerosols and radiation at dizzying altitudes is all in a day's work for Angela Marinoni.

Jane Qiu

Angela Marinoni is a climate scientist who likes to be close to the action — on and among the world's highest mountains. A researcher at the Institute of Atmospheric Sciences and Climate in Bologna, Italy, part of the country's National Research Council, she spends part of her year 5,000 metres above sea level at the Pyramid Laboratory in the Khumbu Valley on Everest's south side. Marinoni has helped to build a series of cutting-edge weather stations in the Nepalese Himalayas, allowing her to witness climate change at first hand.



Angela Marinoni is living

Angela Marinoni, on Nature web site

## EvK2Cnr Share Project appears in Nature

A new distinction for the Pyramid International Laboratory-Observatory and the Share Project, the international climate and atmospheric monitoring network and research in environmental and geophysical sciences, promoted by EvK2Cnr Committee: the global high altitude network of stations, which monitors the atmosphere and pollution on the highest mountains in the world, appeared in the prestigious scientific magazine Nature, in the form of an interview with the Italian researcher of Isac-Cnr Angela Marinoni.

The interview, signed by Jane Qiu and published in the November 2010 edition is

entitled: "A sky-high eye on climate change". The article describes the important climatic findings of Marinoni and the Share Project researchers, coordinated by Paolo Bonasoni, in the Khumbu Valley and near the International Pyramid Laboratory-Observatory, on the Nepalese side of Mt. Everest.

Marinoni, met by Nature in Kathmandu on occasion of the "2nd Third Pole Environment Workshop", relates the research activities at 5,050 m a.s.l. and the climate changes impacting the vulnerable and remote mountain environment: "One of the most remarkable things — said the Italian researcher to

Nature — is the finding of above-zero temperatures at 8,000 m a.s.l. at the South Hill, where we installed the Share-Everest Station, the highest station in the world. The above-zero temperatures have been found to coincide with several collapses of ice and avalanches. Equally surprising was the discovery of pollution at 5,079 m a.s.l., near the Nepal Climate Observatory-Pyramid station, with values as high as the ones typical of urban environments. These are very important data for understanding phenomena like glacier melting, climate evolution and for validating climate models".

"These environments — added

Marinoni —, far from human influence, are very sensitive to climate change, but they are still not completely understood. The Share stations aim at filling this gap through their monitoring activities, which are renowned at an international level, as they are fundamental to understanding climate variability and change at high altitudes".

In fact Share operates in collaboration with several international institutions and it is considered an international point of reference for the collection of precious data for understanding global warming and the circulation of pollutants and for evaluating impacts on glacial, water and biological systems.

## Interview

PAOLO BONASONI  
Share project coordinator

*Recent research reveals that the impact of so-called "black carbon" equals at least that of greenhouse gases in determining climate change in Central Asia and the world.*

Share  
Abc



BY WAINER PREDÀ

Usually shy of TV cameras and microphones, Paolo Bonasoni of Isac - Cnr, and coordinator of the Share project of the EvK2Cnr Committee, rarely gives interviews, engaged as his in his studies on major issues of global warming and the mountain environment. We managed to meet him during a two-day workshop held in Bergamo in mid-December.

**Professor Bonasoni, Share has become one of the world's most important monitoring networks...**

Certainly for mountains it's become a crucial reference point because it is able to acquire multidisciplinary information at high altitudes regarding the atmosphere, cryosphere, hydrology, biodiversity, and human health, while also devoting special attention to issues of technological research and development.

**What point are you at in your research on climate changes?**

A good point, I'd say, considering the scientific results obtained so far, which have been published in specialised reviews. The results achieved by Share researchers stem from specific activities undertaken in high mountain environments, in places that are often difficult to reach, with all the problems and risks this involved. It's an excellent outcome as the acquired data have gone to integrate international databases, available for studies and research, and important for the validation of forecasting models.

**So, is it correct to say they're studies that focus specifically on climate and mountains?**

Yes, among its thematic areas, Share has promoted a series of "pilot projects" geared towards a better understanding of how climate influences man's life and his surrounding environment. It's an undertaking that has already led to important results, in the first place guaranteeing the study of climate-altering compounds, through direct high-mountain observations thanks to the setting up of the Nepal Climate Observatory - Pyramid. Since 2006 this laboratory has been measuring concentrations of black carbon, ozone, PM1, PM10, etc... defining the state of health of the Himalaya region at over 5000 meters altitude. This has also been permitted by our collaboration with Nast and the Unep pro-

ject, Abc - Atmospheric Brown Clouds.

**Speaking of Abc, what is the role of black carbon in climate change?** Black carbon (the strongly absorbent carbon fraction of atmospheric particulate) weighs on climate considerably, as it behaves, in a certain sense, in much the same way as greenhouse gases, absorbing solar radiation and warming the atmosphere. Recent studies suggest that BC has a far stronger capacity to warm the global atmosphere than was hypothesised in the Ipcc 2007 Report. This mechanism is described detail in a report "Clima, cambiamenti climatici globali e loro impatto sul territorio nazionale" (Climate, global climate changes and their impact on the national territory), presented at the end of 2009 by the Institute of Science of the Atmosphere and Climate of the Cnr. By absorbing the sun's radiation, black carbon reduces the amount of radiation reaching the ground, thus producing a negative influence on the hydrological cycle and, in turn, on agriculture, as highlighted by professor Veerabhadran Ramanathan (of the Scripps Institution of Oceanography - California, head of the Abc project) concerning the fall in rice production in the Asiatic region. At the same time black carbon is one of the main atmospheric compounds that, once deposited onto glaciers, favour their melting. However, there is a positive aspect, one that distinguishes it from CO2 (the main climate-altering greenhouse gas), namely, that black carbon remains in the atmosphere only for a few days or weeks.

**Have you found high values of black carbon in Italy as well?**

Yes, at the Cnr "Vittori" field station on Monte Cimone, the highest peak in the northern Apennines. Here, especially in summer, we have recorded high levels of black carbon and other pollutants, originating mainly from the Po Valley, but also from Central Europe, or other regions subject to forest fires, even beyond Europe.

**But also sands arriving from North Africa and dusts from Icelandic volcanoes, responsible for the chaos in European airways nearly a year ago...**

Yes, because of its free horizon, Monte Cimone, allows us to monitor air masses rich in sand that arrive directly from the Sahara desert, and can

This means that if we promote suitable abatement policies, especially in areas strongly influenced by BC emissions, it will be possible to obtain a reduction of atmospheric concentrations of these carbon particles, contributing to an improvement in climate and a decrease in global warming.

**It would seem that global climate change can differ greatly from one area to another...**

The word "global" tells us that this is a situation that involves the entire globe, something that is confirmed when we think, for example, of the melt rate of the majority of glaciers scattered over the planet, or the shrinking of ice packs in the Arctic Sea, allowing ships to pass for more than a month through the legendary Northwest Passage, completely inaccessible up to just a few years ago. There are, in addition, some regions of the planet that are prone to particularly intense meteorological phenomena, or to very high concentrations of pollutants that, emitted into and transported by the atmosphere, end up "destabilising" the conditions of the atmosphere itself. However, it has to be remembered that pollutants have no regional or national frontiers, and that, once emitted into the atmosphere, they can end up anywhere. Confirmation of this has been our five years of measurements at the Nepal Climate Observatory Pyramid (Nco-P), which show extremely high levels of black carbon and ozone originating from areas very distant from the Himalayan peaks of Nepal.

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## The new objective? To study black carbon (but not only)

reach the cities of southern Europe. Each year we record eighteen of these events, some of which are so intense that they are able to influence PM10 concentrations on the plain. In spring 2010, at the Ottavio Vittori station, we were able to watch the arrival of the ash cloud emitted by Eyjafjallajkull, the Icelandic volcano. This gives an idea of the usefulness of high mountain stations, not only in climate studies, but also, thanks to specific activities involved environmental early warning systems, in their support to civil protection services.

**Is it true that Share has extended its observations also to the Lombard Alps?**

Yes, a new pilot project started up last year in the Alpine area of the Stelvio National Park. Ice, water and atmosphere, but also plant and animal biodiversity, are the key words in these climate studies. The important glaciological data from the Forni glacier, in the upper

Valtellina valley, where Milan University has been doing research for years, are now being integrated, since summer 2010, by the atmospheric measurements carried out in a laboratory specially set up near the Guasti shelter, at over 3000 metres altitude.

**To wind up, what is Share's next step going to be?**

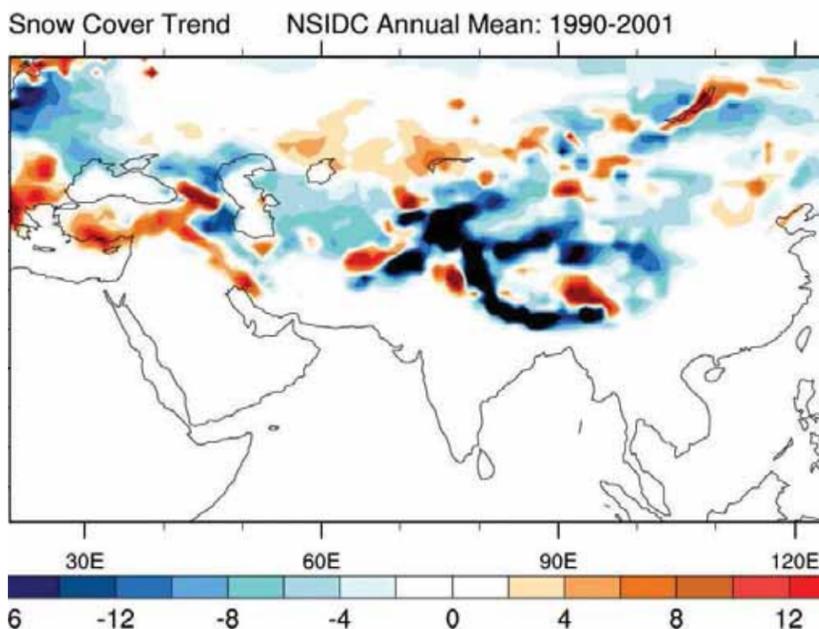
As far as black carbon and other pollutants are concerned, the observations underway in the Himalayas will be extended, in the framework of the projects Abc-Unep and Share-Paprika in Karakorum, in the Northern Areas of Pakistan, also providing scientific support to the project SEED (Social Economic Environment Development in the Central Karakorum National Park, Gilgit Baltistan Region). As for Paprika, it will be entering an important new phase that will link observations on the Baltoro glacier to hydrological, atmospheric and meteo-



climatic data. The goal is to arrive at a modelling system that is able to provide information on the evolution of the region's water resources, in view of the fact that the 60 km-long Baltoro glacier contributes to feeding the Indus river, considered the "jugular vein" of Pakistan's water resources. The Nepal Climate Observatory - Pyramid, now classified as the 33rd global station of the Gaw-Wmo network, will implement the series of measurements required by that programme. As regards other new atmospheric observations, we are due to start those relating to the monitoring of mercury in collaboration with the Cnr Institute of Atmospheric Pollution. Special attention will also be paid to the Himalayan activities on biodi-

versity and to the newly established Seed Bank, a project begun in 2010, International Year of Biodiversity, in collaboration with the University of Pavia. Last but not least is the realization of the first Nano-Share, a specially developed transportable system for self-sufficient monitoring of atmospheric composition at high altitudes, on glaciers and remote areas. I conclude with a word of thanks to all those taking part in the project. Away from the limelight, close to the mountain-tops, and often with considerable hardship, they perform research that is unique in its kind, in the hope that our work can contribute to safeguarding the environment, and therefore guarantee a future for the generations that will follow.

## Share, the jewel of climate monitoring, on the web



There is a newborn in the Share project. The important climate and environmental monitoring project, promoted by EvK2Cnr Committee and renowned at international level as a precious source of data for studies on global warming, appears to the public with a new internet form, that displays in a clear and in-depth way all the activities carried out by researchers and the different declinations of the project. A new section of the [www.evK2cnr.org](http://www.evK2cnr.org) site is dedicated to Share. The public inauguration took place December 13th, in occasion of the meeting of the Paprika project, which is dedicated to the evolution of the cryosphere of the Hindu Kush - Himalaya region, in the context of regional and global climate changes, and their consequences on water resources. During the meeting in Bergamo, the different operational units involved in the project met and discusses their activities and planned future actions. Paprika is one of the Share's pilot projects, Stations at High Altitude for Research on the Environment, a global mountain obser-

national network devoted to research in atmospheric composition, meteorology and glaciology, hydrology and water resources, biodiversity and human health. Specific aims of Share are to improve scientific knowledge on climate variability in mountain regions, by ensuring the availability of long term, high quality data for the design of mitigation and adaptation strategies to oppose the effects of climate change. Mountains represent an important source of water, energy and biological diversity. They provide key resources as minerals, forest and agricultural products as well as recreation. However, mountain areas that cover about a fourth of the Earth's land surface giving hospitality to about 13% of world population, are fragile ecosystems, very sensitive to global climate changes. Moreover, due to their relatively remoteness from highly populated and industrialized regions, mountains are considered ideal locations for investigating the impact of climate changes from regional to global scales.



Paolo Bonasoni

## Atmospheric Brown Clouds

**In March 2011, the Nco-p will celebrate its first five years of activity**

# Abc: five years of observations at the Nco-P

BY PAOLO CRISTOFANELLI

The preparation for this anniversary was bound to occur in a very special way: above all, by welcoming the news that on September 8, 2010, the World Meteorological Organization (Wmo) upgraded the Nco-p to the role of "Global Station" in the frame of the Global Atmospheric Watch (Gaw) programme; then, by preparing a volume encompassing the scientific papers published by EvK2Cnr's researchers in a special issue of Atmospheric Chemistry and Physics, entitled "Atmospheric brown clouds in the Himalayas" ([www.atmos-chemphys.org/special\\_issue162.html](http://www.atmos-chemphys.org/special_issue162.html)). The first continuous observations at the Pyramid started in March 2006, in the frame of EvK2Cnr's project Share, and of Unep's project Abc: in March 2011 the first five years of scientific research will be celebrated. Over the last two decades, measurement campaigns performed in various areas of the planet, together with satellite observations, have highlighted the existence of thick clouds in the lower atmosphere, characterized by high concentrations of pollutants. These huge clouds have been named Abc – Atmospheric Brown Clouds: in 2003 the United Nations, aiming at evaluating their impacts on climate, mankind and environment, started the Abc project in the frame of their Environmental Programme (United Nations Environmental Programme – Unep). Although scientific evidence had already suggested that the huge cloud of pollutants covering South-western Asia could also affect the Himalayas, until now the existence of continuous observations in this high-mountain area, where the logistic and operational difficulties in performing scientific research are remarkable, could not confirm this hypothesis. To face this problem and provide a detailed description of the atmospheric composition over the Himalayas, in March 2006 the Nepal Climate Observatory – Pyramid (Nco-p) was established, in a privileged location for observing the extension of the Brown Cloud from 5079 m of altitude, on the Everest Southern slope, in the upper Khumbu glacier valley.

The first years of observations at the Nco-p are, therefore, the longest historical series concerning the in-situ characterization of the chemical-physical properties of the Himalayan atmosphere. This information has permitted us to define the variability of compounds (such as tropospheric ozone, aerosols, black carbon –BC-, halogenated greenhouse gases) linked to human and natural emissions, also providing a first evaluation of the possible climate impacts linked to the transport of polluting substances up to the Himalayan peaks. The first scientific results concerning the first two years of scientific activity have been presented in several different scientific publications, encompassed in a special issue of Atmospheric Chemistry and Physics, entitled "Atmospheric brown cloud in the Himalayas".

These meteorological and climatological studies, above all, provide a characterization of the Nepalese Himalayas, and describe the important role played by atmospheric circulation and monsoon-related precipitations. They have allowed the definition of the seasons: pre-monsoon, monsoon, post-monsoon and winter, which we can approximately associate to our spring, summer, autumn and winter. It was then found how the pre-monsoonal season is characterized by several transport events of particularly polluted air-masses, which reach the Himalayan summits through the Himalayan valleys acting as actual chimneys, thus pumping polluted air-masses from the plains to the peaks, as has been observed at the Nco-p station. It is in the pre-monsoonal season, as reported in the paper of Bonasoni et al (1), that the influence of the brown cloud (defined by a parameter called the Aerosol Optical Depth, or AOD) is most evident at the Nco-p. The Abc can extend from the Indo-Gangetic plain to the Himalayan foothills, where the pollutants accumulate. During this season, 20% of days have been characterized by a strong influence of the Abc which, during afternoon hours, leads to a 5-fold increase in BC and PM1 with respect to the seasonal means, thus confirming how, particularly during the pre-monsoon, the southern slope of the high Himalayan valleys represent a direct channel of Abc pollutant transport up to 5000 m altitude, thus

strongly influencing local atmospheric conditions. Although during the pre-monsoon the acute episodes of pollution are characterized by black carbon concentrations greater than  $5 \mu\text{g m}^{-3}$ , it should be born in mind that 55% of the time interval covered by the Khumbu valley analysis is characterized by extremely low levels of anthropogenic aerosols, as discussed in the paper of Marinoni et al. (2), which presents particulate and black carbon masses seasonal and daily series. The same conclusion is reached by Sellegri et al. (3), who analysed the variations in the fine and ultrafine particle concentrations and size distributions. As shown by Decesari et al. (4) in the study of the atmospheric particulate (PM1 and PM10) chemical composition, the aerosol reaching the 5000 m of the Nco-p mostly originates from combustion processes (biomass burning and use of fossil fuels) and, when transported to the Himalayan summits, it influences the so-called atmospheric background. In spite of its high altitude, at the Nco-p it has been possible to detect particularly high PM10 concentrations, with a dominating presence of mineral dust, organic compounds, elemental carbon and inorganic ions. In particular, as highlighted by systematic and large-scale atmospheric circulation analysis (Bonasoni et al. (1)), during the pre-monsoonal period high quantities of polluting substances can be transported to the Nco-p also from remarkable distances, such as the Middle East and the Persian Gulf, whereas air-masses rich in mineral dust can be traced to the deserts of Afghanistan, Pakistan, North-west India and even back to the Sahara or, during droughts, to the agricultural areas of the Indo-Gangetic plains (Duchi et al. (5)). In fact, according to Gobbi et al.'s (7) and Duchi et al.'s (5) analyses, in addition to the aerosols resulting from combustion processes, also the particulate originating from natural processes, such as the mobilization of sands of the Northern Hemisphere's deserts, can be transported effectively to the High Himalayas. As discussed by Yasunari et al. (6), mineral dust and above all black carbon, when transported and deposited onto the glaciated areas of the Himalayas, can play an important role in influencing the Himalayan glaciers' snowcover and, therefore, the water quantity resulting from their seasonal melting. Obviously, the climate effect of atmospheric particulate does not concern glaciers and snow-covered areas only, but also the atmosphere itself, as discussed by Marcq et al. (8), who calculated the impact on the radiation in the atmosphere due to particles reaching the High Himalayas as a consequence of pollution transport phenomena at regional and synoptic scales. This study, the first of its kind for the High Himalayas, showed how the polluting aerosols can induce local dimming in this high-mountain area, with the double effect of surface cooling and atmospheric warming. Such atmospheric warming also derives from the effects of gases, like climate-altering halogenated compounds or ozone, if present in excessive concentrations. The ozone concentration, in fact, rose by 14% during pre-monsoonal direct Brown Cloud transports to the Nco-p. As discussed by Cristofanelli et al. (9), the analysis of the variability of Nco-p tropospheric ozone shows another significant aspect: 14% of days were characterized by transport of ozone-rich air-masses coming from the stratosphere, confirming that this natural and non-anthropogenic process can contribute to determining the seasonal variability of this important greenhouse gas. Such effects interact with those connected to halogenated greenhouse gases, as analysed by Maione et al. (10).

In conclusion, the research activities performed at the Nco-p allowed a significant characterization of the Himalayan atmosphere, also singling out some of the key processes that can modify its composition. The results briefly discussed here suggest that the transport of pollutant compounds towards the High Himalayas can have serious repercussions on environmental quality, on the characteristics of regional and global climate, and therefore on the wellbeing of populations, thus confirming the need to promote serious mitigation policies.

More details on the scientific results can be found in the monographic issue "Atmospheric brown clouds in the Himalayas" of the open-access "Atmospheric Chemistry and Physics" journal, accessible at the website [http://www.atmos-chem-phys.org/special\\_issue162.html](http://www.atmos-chem-phys.org/special_issue162.html) and listed in the box on this page.

## ACP (Atmospheric Chemistry and Physics) - Special Issue Atmospheric brown cloud in the Himalayas

Editor(s): G. McFiggans and J. J. Schauer

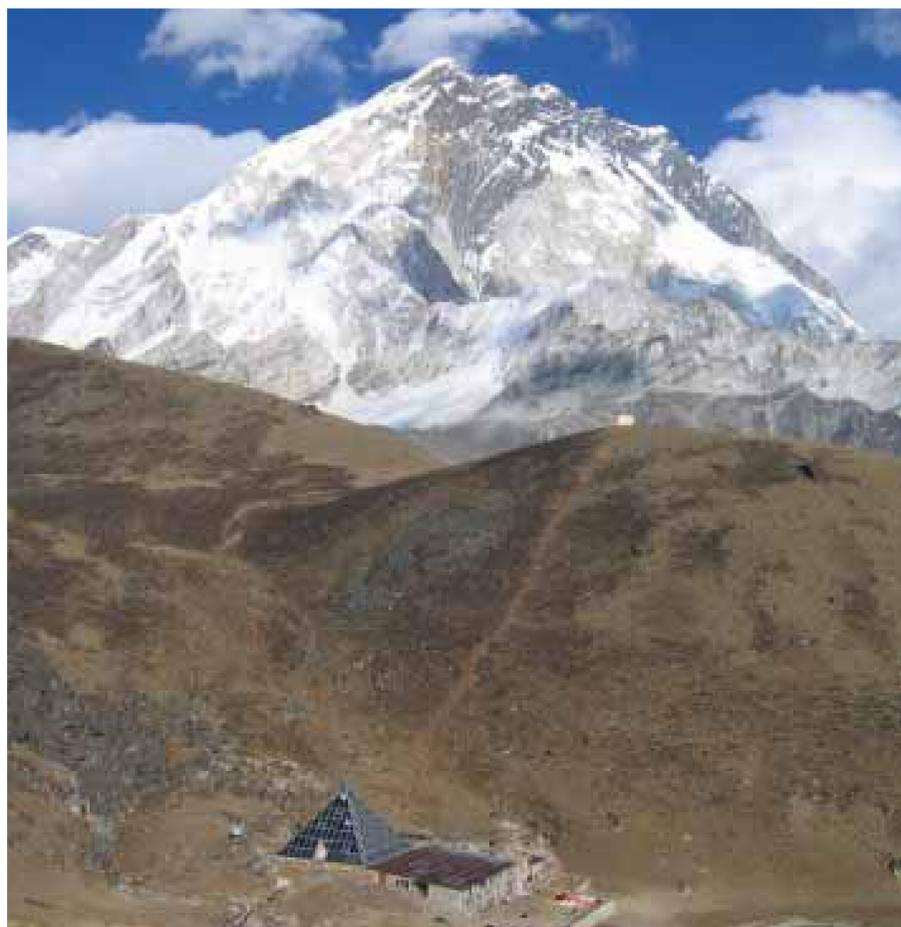
- (1) *Atmospheric Brown Clouds in the Himalayas: first two years of continuous observations at the Nepal Climate Observatory-Pyramid (5079 m)*  
P. Bonasoni, P. Laj, A. Marinoni, M. Sprenger, F. Angelini, J. Arduini, U. Bonafè, F. Calzolari, T. Colombo, S. Decesari, C. Di Biagio, A. G. di Sarra, F. Evangelisti, R. Duchi, MC. Facchini, S. Fuzzi, G. P. Gobbi, M. Maione, A. Panday, F. Roccato, K. Sellegri, H. Venzac, GP. Verza, P. Villani, E. Vuillemoz, and P. Cristofanelli. Atmos. Chem. Phys., 10, 7515-7531, 2010.
- (2) *Aerosol mass and black carbon concentrations, a two year record at Nco-p (5079 m, Southern Himalayas)*  
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Share Network measures

# The first weather station on the Mountains of the Moon

*New Share station on Rwenzori, Africa*



BY GIANLUCA LENTINI

Arround the world trip through meteorological stations. The Share network, collecting data on the atmosphere and pollution over the highest mountains of the planet resembles a modern transposition of a Jules Verne's novel. From Pakistan to Nepal, from the Stelvio to the Rwenzori Mountains National Park, EvK2Cnr's stations collect data that keep us informed on the health of our planet's climate. In this page we take a tour to the Rwenzori, described by the first Share Automatic Weather Station (Aws) installed on June 18, 2006, in cooperation with the Uganda Meteorological Department, on Mt Stanley's crest about 50 m away from the glacier front, in the Rwenzori Mountains. The Rwenzori is a mountain ridge spanning more than 120 km, formed by six mountain massifs, in which 43 glaciers, covering an area of 5 km<sup>2</sup>, are located. The largest of these massifs is Mt Stanley, encompassing several peaks among which the highest, Margherita, reaches 5109 m in altitude, the third highest peak in Africa after Mt Kilimanjaro and Mt Kenya. Mt Stanley was named after Henry Morton Stanley, the first European who visited the Rwenzori during an expedition in 1889, whereas, seven years later, in 1906, the Duke of the Abruzzi, Luigi di Savoia, was the first to reach the

summit. Rwenzori is characterized by permanently snow-covered peaks (at least until now) and it runs along the border between Uganda and the Democratic Republic of the Congo. Already in 150 AD the Alexandrian geographer Claudius Ptolemaeus, in his "Geographia", described "the Mountains of the Moon, the snows of which feed the source lakes of the Nile". The Margherita glacier is nowadays one of the rare equatorial ice caps left. Unfortunately, as reported by Uganda Wildlife Authority (Uwa) researchers, in the spring of 2010 the ice cap at the summit broke into two parts, because of global warming, giving rise to the hypothesis that the Rwenzori Chain's glaciers are going to disappear in 20 years. In fact, the Rwenzori glacier, which 50 years ago measured about 6 km<sup>2</sup>, is now reduced to less than 1 km<sup>2</sup>. This ridge is one of the last areas close to the equator to host glaciers and, although it was declared a UNESCO heritage site in 1994, Rwenzori glacier melting has resulted in a rise in the level of the river Semliki. The river marks the border between Uganda and the Democratic Republic of the Congo which, as a consequence of its increased erosion force, moved by about 1 kilometre, triggering a dangerous territorial dispute. These facts, directly or indirectly linked to the ongoing climate variations, show the importance of quality obser-

vations in these areas of the planet. Despite the adverse environmental and logistic conditions of the site, the Aws Rwenzori allowed a satisfactory analysis of the local meteorological conditions between June 2008 and June 2009. In detail, the principal meteorological parameters are characterized by a scarce seasonal variability, characteristic of Equatorial belt. Only the precipitations show marked seasonality, with a clear influence, in the wet seasons, of the so-called "Inter Tropical Convergence Zone" (ITCZ), whose presence is identified by daily precipitations above 3 mm. At the Rwenzori Aws similar cumulates of rain are found in less than the 34% of the days in the dry seasons (defined as summer and winter) and in more than the 47% of the days in the wet seasons (denominated "short rains" and "long rains"): this points out that the influence of the ITCZ during the wet seasons is rather evident at Rwenzori, although the classical definition of a wet-dry dipole dominated by the ITCZ is less applicable here in comparison to other areas of Equatorial Africa. Analyzing the atmospheric circulation at regional scale, a prevailing eastern regime was found. As shown by the back-trajectories calculated through the NOAA HYSPLIT model, seven principal circulation clusters interest the site of the Aws Rwenzori: from the Arab Peninsula, North Africa, East Africa, the Equatorial

Indian Ocean, the Northern Indian Ocean, the Southern Indian Ocean, and a Regional cluster. On an annual basis the most frequent contribution is linked to the circulation from the Equatorial (22,3% the events) Indian Ocean, even if the contributions of the Arab Peninsula (15.9%), the Region of Central-Eastern Africa in which the station is located (16.9%), the Northern Indian Ocean (16.4%) and Southern Indian Ocean (15%) are not negligible. As a consequence of the different circulatory synoptic patterns, it is likely that atmospheric processes (such as stratospheric

mass intrusions, transport of biomass burning pollutants, and so on) affect the atmospheric properties of the

Aws Rwenzori site.

Due to the interactions between atmospheric circulation at continental scale

and the local topography, the dominant direction of the wind is East-southeast. It is possible to identify a seasonality of the wind speed, with the lowest values for summer, probably connected to the weak winds that characterize Equatorial Africa in this period. Moreover, as displayed by the radiation and relative humidity values, the site of the Aws Rwenzori is often characterized by conditions of immersion in cloud (49% of the hourly observations are constituted by values of relative humidity above 95%).

As it is possible to deduce from the analysis of the diurnal seasonal variations of specific humidity (a tracer for low troposphere air masses) and from wind speed, the site of the Aws Rwenzori is probably influenced by thermally-induced circulation, characterized by the upward transport of wetter air masses coming from the boundary layer during the afternoon-evening. During the night, the measurement site appears more representative of free troposphere conditions, with a strong influence of atmospheric circulation of synoptic type.

## Convention

### Abc: Africa Consultation Meeting, 23-24 August 2010, Nairobi

From 23 to 24 August 2010, the First Abc-Africa Consultation Meeting was organized by Unep (United Nation Environment Programme) to present the Abc Africa Project to the local stakeholders. As Mr. Surendra Shrestha (Unep) mentioned, the Abc (Atmospheric Brown Clouds) project was promoted by Unep in 2002 with the aim to study this atmospheric phenomenon and its impacts, in particular, in Asian region. Based on the findings, Unep has decided to expand the project also in other regions, as like as Africa. During this event, the EvK2Cnr Committee, represented by Dr. Elisa Vuilleumoz (Share Executive Coordinator), showed the activities carried out in the framework of Share project, in particular on Aws (Automatic Weather Station) Rwenzori, installed in 2006, at 4.750 m a.s.l. in Uganda. In fact, that station, thanks its geographical position could supply important information for studying climatic aspects and Abc phenomenon in Africa. Within this context, after the meeting, the drafting of a white paper, concerning the activities that will be carried out in the African land to support the Abc Programme is ongoing.

## Abc project now moves to Africa: which contribution will derive from observations on the African mountains?

The so-called Atmospheric Brown Clouds (Abc) are 2-to-3-km-thick air masses extending over large polluted areas of the planet, of the order of several millions of square kilometers. These polluted clouds, composed of gases and particles produced by industrial emissions and biomass burning affect air quality, climate and its variability and human health in large areas of the Earth.

Within the Unep Abc Project, launched in 2003, South-East Asia is the area in which brown clouds have primarily been studied. Here, countries with a rapid economical growth, such as China and India, produce very high levels of pollutants and remarkably persistent Abcs.

EvK2Cnr has been part of the Abc Project for several years, mostly through the research at the Nepal Climate Observatory, close to the EvK2Cnr Pyramid, located at 5079 m altitude on the Himalayan ridge.

The Abc Project results have led to the preparation of a Unep document on the evaluation of the important effects of Abcs on the climate, water availability, agricultural yield and human health in Asia. The document also underlines that Abcs are a phenomenon which is common to all highly polluted areas.

For this reason, the Unep Abc Project has recently been expanded to include the African continent where, in spite of different situations in terms of climate and pollution, the Abc

phenomenon is relevant and where weather and pollution data are lacking.

EvK2Cnr joined this new phase of the Abc project and is working towards the establishment of a new measurement station next to Mt Stanley, at 4750 m a.s.l. in the Rwenzori Massif of Uganda. From 2006, an Automatic Weather Station (Aws) is in operation on the Rwenzori, next to the glacier, and has allowed for a first climatological analysis of the area. Considering the problematic meteorological and logistic situation, the possibility of installing a sophisticated automatic station for monitoring of the atmospheric composition will be strategic for the project. This automatic station, in the process of being finalized, is intended to be operational in extreme environmental conditions, to be energetically independent and will be provided with a remote data transmission system. The Abc-Africa project will have an important impact for the understanding of the effects of human activities on the environment, climate and human health in this continent, and for the definition of adequate mitigation and adaptation policies. The Italian research will be, once more, leading the way for this new scientific and technological endeavour.

**Sandro Fuzzi**  
Isac-Cnr, Bologna

Member of the Abc Project Scientific Committee



# Share: keeping watch over the high mountain climate

BY PAOLO BONASONI

There is an urgent need for data that give a better understanding of climate variations and the environmental effects they cause. To achieve them, we require information based on increasingly accurate and realistic observations, whose reliability is guaranteed by conformance to international protocols and high-level validation systems. We need high-quality data to provide a precise and reliable validation of forecasting models and scenarios, to produce estimates for use by scientific research bodies, such as the IPCC - Intergovernmental Panel on Climate Change.

We need observations to study our Planet, allowing scientists to diagnose its state of health, present and past, and to predict possible climate scenarios in both the near and far future. The results obtained will then be published in peer reviewed scientific publications. In this way, they become available to those who must decide upon the correct mitigation and adaptation policies to confront the climatic changes that,

already today, are able to condition the life and habitat of mankind.

Against this background, the mountains, being particularly sensitive to climate changes, can be seen as environmental "sentry posts", and high altitude scientific measurement stations have a crucial role to play. For all these reasons, Share (Stations at High Altitude for Research on the Environment), the high-mountain climate monitoring project promoted by the EvK2Cnr Committee, and coordinated by Paolo Bonasoni of Cnr - Isac, is regarded as an international reference point for climate research at high altitudes, necessary for studying global warming and assessing its effects on the glacial, hydrological and biological systems. The project collects information thanks to its network of stations, whose usefulness to climate research increases, the more their location is remote and, therefore, sensitive to climate changes. Share, operates in collaboration with various international bodies, foremost among them, the United Nations Environment Programme (Unep).

The Share network has been present for years in Asia, Africa and Europe and currently includes 16 high altitude stations providing climate data in Nepal, Pakistan, Uganda and Italy. Its "jewel in the crown" is the Nepal Climate Observatory - Pyramid (Nco-p) set up in 2006 by the EvK2Cnr Committee at 5079 m altitude close to the Pyramid Laboratory on Everest as part of the Unep Project Abc - Atmospheric Brown Clouds. The project was launched by the Nobel Prize winner, Paul J. Crutzen, and Prof. V. Ramanathan, to study the "brown clouds" rich in aerosol and gaseous pollutants, which were initially identified in Asia, but are now recognised as a global phenomenon with a strong negative impact on climate and environment.

The collaboration with Unep envisages the extension of the Abc network to Karakorum, to support meteorological observations and studies in the field of glaciology already underway in Pakistan since 2004 on the Baltoro glacier. Unep is also engaged in promoting the implementation of a new phase of the Abc pro-

ject in Africa, where Share plans to extend its monitoring activities. Here, in the area of Rwenzori National Park, EvK2Cnr in collaboration with Uganda Department of Meteorology, started meteorological measurements in 2006 on the western part of Plateau Stanley, at 4750 m height and about 50 m from the front of Glacier Elena. More recently, Share has turned its attention to the South American continent, working with other international agencies in setting up a new Gaw-Wmo (Global Atmosphere Watch - World Meteorological Organization) station on Chacaltaya, situated at over 5000 m altitude in the Bolivian Andes, thus supporting the Atmospheric Physics Laboratory of the Universidad Mayor de San Andres in La Paz.

The value of the Himalayan observation activities has recently received the recognition of the World Meteorological Organization, which in 2010 listed the Italian-Nepalese "Everest-Pyramid" atmospheric observatory among the stations of its global programme (Gaw-Wmo). The Nepal Climate Observatory - Pyramid is now rated the 33rd site for monitoring the Earth's atmospheric composition: it is the network's highest station and the first Italian one to obtain this prestigious recognition, albeit outside the country itself. It bears witness to the high scientific value of the multidisciplinary research activity carried out by Share, from the meteorological measurements performed for years in the Khumbu valley (leading first to the Pyramid and, then, Everest on the Nepalese side), to the more recent measurement of meteorological data at South Hill, at 8000 metres, just a few steps from the summit of Everest. A further important research issue relates to the

study of glaciers and their state of health. It was at the EvK2Cnr Pyramid that, in 1994, a study of the Changri Nup Glacier was launched to monitor the variability of the glacial front and surface dynamics in relation to climate variations. Part of this research is today addressed in the context of the Paprika project, one of Share's important "pilot projects", involving a close collaboration among Italy, France, Nepal and Pakistan. The integration of observations, experimental activities and modelling studies will allow us to assess the impacts of climate changes, and the transport and deposition of absorbent particulate, on the glaciers of Baltoro (Karakorum) and Changri Nup (Himalaya) and on water resources.

The water cycle and energy are central themes of the "pilot project" Share-He in the framework of Gewe - Global Energy and Water Cycle Experiment, which uses the data of Share's meteorological stations to promote studies on water cycle variability on different spatial-temporal scales at high altitudes.

In the Himalayas, the acquisition of limnological data began in 1990 with the monitoring of the "upper Pyramid lake" (5213 m) and "lower Pyramid lake" (5067 m). As part of the scientific cooperation between the EvK2Cnr Committee and Nast, and thanks to the collaboration of Cnr-Ise and Cnr-Irsa, a historic series of data has been obtained that, since March 2006, is part of ILTER (International Long Term Ecological Research Network), one of the most important international programmes of long-term ecological research.

Leaving Nepal and moving to the Alpine peaks of Italy, the monitoring stations on the Giant glacier (Mt. Blanc) and

Dosdè and Forni glaciers (central Alps) have been operative for years. The Forni area, in the upper Valtellina, has recently seen the launch of another "pilot project" called Share-Stelvio, an integrated, interdisciplinary research programme that aims to monitor at high altitudes the climate changes currently underway and their environmental effects on the Alps. The three-year project is funded by the Lombardy regional government through the Lombardy Foundation for the Environment. Experimental activities begun in 2010 in the Stelvio National Park will permit the acquisition of data that, through modelling analyses and processing, will be crucial to a correct assessment of the state of play concerning the four major themes: glaciology, hydrology, biology and atmospheric composition. Moving on again to the highest peak of the northern Apennines, still in the context of the Gaw-Wmo programme, the climate observatory "Ottavio Vittori" of Cnr-Isac has been operating for over fifteen years on the summit of Monte Cimone. It is the only high altitude station south of the Alps and the Po valley that performs climate and atmospheric research. It is a strategic platform for the study of climate conditions in southern Europe and the Mediterranean basin. Also of great interest is the collaboration in Share of the Department of Physics of the University of L'Aquila, with the scheduled launch of climatic measurements on Gran Sasso, an essential site for studying atmospheric processes from the highest point of the central Apennines, watershed between the Balkan region and the western Mediterranean area.

Share also focuses particular attention on biodiversity research, including among its "pilot projects", a historic

research devoted to the snow leopard, a protected mountain species identified in the Park of Sagarmatha, in the Himalayas. The data obtained so far has delineated the structure of snow leopard populations by means of direct counts and genetic analyses, establishing the species' feeding habits and habitat. Share also wished to make a significant contribution to the United Nations' "International Year of Biodiversity", in 2010, by supporting a study on the Himalayan flora, currently threatened by climate change. A new "pilot project" was announced, coordinated by the Department of Earth Sciences and the environment of the University of Pavia, involving the set up of a seed bank for the Park of Sagarmatha (the Park of Everest) in the Himalayan region: "Biodiversity Conservation, the Sagarmatha Seed Bank Feasibility Project". The initiative is the result of a close collaboration with the Nepalese Academy of Science and Technology.

Through Share, EvK2Cnr is providing multidisciplinary support to a host of research and monitoring activities addressing the climate and environment in high mountain areas. The data collected by these high altitude observations are made directly available to the collaborating international projects, as well as being made available on an open source web platform administered by the Bergamo headquarters. Again on the international level, along with the mentioned joint initiatives, EvK2Cnr also takes part in the Operative Plan of the Global Earth Observations (Geo) that coordinates the implementation of a global system for the integration of observation activities aiming at the improvement and optimization of the management of the Earth's environmental resources.

A final aspect of this brief overview of the Share project regards the development of an innovative transportable instrumentation that is able to make meteorological observations in remote high-mountain areas, in an entirely autonomous way, including energy provision. The system, called Nano-Share, has been promoted by EvK2Cnr and developed in collaboration with researchers of Cnr-Isac of Bologna and Cnr-Lgge of Grenoble. After a field test phase, it will be employed in various field campaigns on the mountains and glaciers of the Alps, Karakorum and Rwenzori. Its development is opening up new frontiers, by allowing climate measurements in locations where it is impossible to establish permanent monitoring stations, thus reducing costs and logistical problems. This will facilitate the continual acquisition with high temporal resolution of climate data in remote locations of great meteorological and climatic interest, ones which are particularly difficult to reach. While guaranteeing operation in such problematic areas, Nano-Share will obviously be able to perform measurements also in rural and urban areas, thereby ensuring a continuous monitoring of air quality.

(follows from frontpage)

## Share: the colours of research

understand that scientific research is not so far removed from the realities of everyday life, even if we sometimes prefer to ignore the voice of science when it speaks out strongly about the climate problems afflicting our Planet. More and more, it is becoming essential to look to the future in order to «guarantee environmental sustainability», one of the eight Millennium Development Goals, which all 191 United Nations member states have committed themselves to attaining by 2015. Share is also working

towards this goal! It does so by seeking reliable answers concerning the state of health of the climate and the mountain environment. Its aim is to allow governments and institutions to adopt suitable policies for the safeguard of mountain regions, emblematic places in which actions and intervention must become the expression of development, also thanks to a sustainable economy. In view of the fact that mountain areas are far from marginal - they account for about 25% of emerged land - it is my hope that we will all join together to support

these outstanding places, by correctly interpreting and implementing a "green" economic development that ensures respect of the resources that bind the Earth, or better, the mountain, to the sky. So, as requested during the recent COP16 in Cancun, let us join in with the voices of the mountain people, too often ignored, in calling for a greater attention in their regard and in pointing out that a simple and sober lifestyle is the only recipe possible for a better future for man, the mountains, and, indeed, the entire Planet.



### The Italian Government support Share Project

On the occasion of the passage of the financial law 2011, in a bipartisan way, the MPs Osvaldo Napoli, Lolli, Quartiani, Jannone have presented an Agenda that has been allowed by the Government: "thanks to Share Project, implemented by Cnr through EvK2Cnr Committee, Italy is in the forefront of the international activities related to climatic and environmental monitoring such as researches on climate change" scientific research; this activity fits in the framework of specific projects afferent to the World Meteorological Organization (Wmo), United Nations Environment Programme (Une), United Nations Framework Convention on Climate Change (Unfccc). In these days EvK2Cnr has received, owing to the important results achieved, the recognition as member of the technical expert group (Tec) in the Mountain Initiative, that has been promoted by the mountain countries in order to cope with the effects of climate changes. Another recognition has been the upgrading of the Share NCOP station to the role of global station of the Global Atmospheric Watch Programme".

It is not the first time that the Parliament supports Share through the passages of policy documents: it has thus committed the Government to support the project also in the forthcoming years.

## Global Atmospheric Watch the highest station is Italian

### Min. Gelmini: Share, a beacon of excellence

We have talked on the phone with the Minister of Education and Research, Mariastella Gelmini, who has released this short but significant declaration concerning the Share Project:

"The Share Project is an excellent expression of the cooperation among State and private entities on scientific issues of international importance, such as the ones related to the study of environmental and climate change, which are fundamental for our present and future existence. Such an excellence is testified by Share's participation in the most important atmosphere and water cycle research projects, being launched with remarkable international effort by the United Nations with the World Meteorological Organization. Share developed scientific and technological competences about the mountains, which represent not a marginal place, but a quantitatively-relevant part of our planet, hosting precious sources of water, biodiversity, energy, raw materials, but also of culture and traditions. Tens of Italian and international researchers, and the several Cnr Institutes and Universities involved in Share, stand out surely for their scientific competences, but they are also an excellent example of international scientific cooperation and knowledge transfer to least developed countries, such as the African ones, or developing countries, like Pakistan or India. This is a much needed focus for science, which can represent a pillar for an effective development and for a positive international exchange".

*A new distinction for Italian science. The Share monitoring station, the Pyramid on Mt. Everest, becomes the 33rd "global station" of the World Meteorological Organization*

BY SARA SOTTOCORNOLA

Official recognition for the Italian Observatory Everest-Pyramid which, at more than 5000 metres of altitude, provides precious and unique information on atmospheric composition. It is the confirmation of the Italian excellence in the applied research field of environment protection.

In Geneva, the World Meteorological Organisation (Wmo) conferred the Italian Observatory Everest - Pyramid of the EvK2Cnr Committee, situated at more than 5.000 m of altitude, on the Southern slope of Mount Everest, in Nepal, the role of global station in the Global Atmosphere Watch (Gaw) project. Everest - Pyramid has therefore become the 3rd 'focal' point in the Earth's atmosphere composition monitoring network: it is the highest in the network and the first Italian station, even outside the national territory, to obtain such prestigious recognition.

"It is a prestigious recognition for the Italian scientific community and the National Research Council (Cnr), which carries out forefront scientific and technological activities, as shown by the uninterrupted functioning of the Everest - Pyramid station which, from March 2006, provides precious and unique information on the atmosphere composition from more than 5000 m of altitude", says Giuseppe Cavarretta, director of Cnr's Earth and Environment department. "This observatory on the

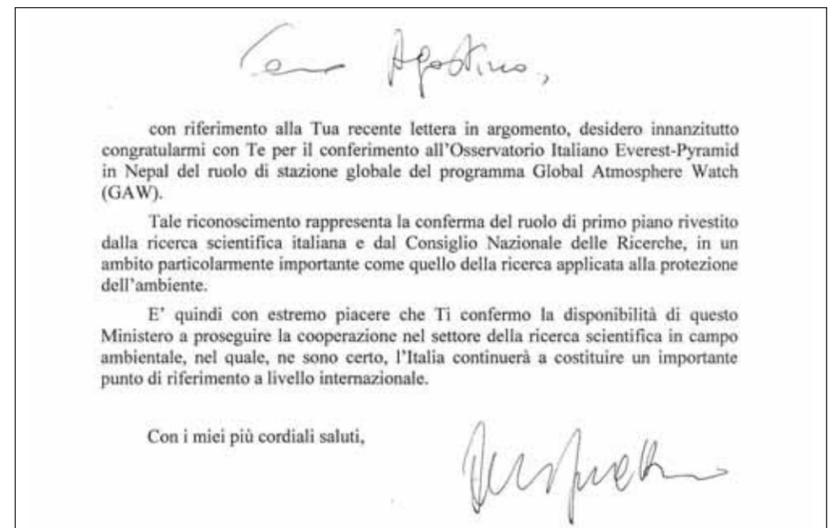
Everest slope was born in the frame of the Share (Stations at High Altitude for Research on the Environment) project, the climate and environmental monitoring station network promoted and managed by EvK2-Cnr", says the Committee president, Agostino da Polenza. "It has achieved the status of climate observatory at an international level and it will assume an even greater scientific importance, if we consider its location, on the edge of the two most populated regions of the planet".

"Everest - Pyramid, or Nepal Climate Observatory - Pyramid (Nco-p) works in the frame of several strategic projects for the monitoring of the chemical-physical composition of the atmosphere and the effects of climate changes in Southern Asia" says Paolo Bonasoni of the Institute of Atmosphere and Climate Sciences (Cnr-Isac), Share coordinator and responsible of the Gaw station.

"This area is, in fact, particularly influenced by the so-called 'Atmospheric Brown Cloud' (Abc), a polluting cloud originating from urban and industrial emissions, together with pollution coming from agricultural and forest biomass burning and from traditional cooking methods. These Abcs, a phenomenon also characterizing other heavily-polluted areas of the planet, form during the winter and pre-monsoonal seasons, and they extend from the Indian Ocean to the Himalayas with consequences on climate, air quality, the monsoon system and agriculture." The Global

Atmosphere Watch (Gaw) is a programme instituted by the Wmo (World Meteorological Organization) involving about eighty countries with the aim of supplying data on the chemical composition and the physical characteristics of the atmosphere, studying natural and anthropogenic changes, so to improve the comprehension of atmospheric interactions with the oceans and the biosphere and the growing influence of human activities on global climate. It is also on the data supplied by this network that the Ipcc (Intergovernmental Panel on Climate Change) reports, which summarize the most updated knowledge on the atmosphere status and the planetary climate processes, are based. Gaw can count on more than 600 regional stations and on 33 'global ones': the vast majority of the latter ones, are situated in remote areas, which are of great importance to evaluate the medium-to-long-term changes in the Earth's atmosphere. This international acknowledgment, received by Cnr and the EvK2Cnr Committee, is also the result of the collaboration with the French Cnrs (Centre National de la Recherche Scientifique), Nast (Nepal Academy of Science and Technology) and the Italian Università di Urbino (Chemistry Institute), as a confirmation of the Italian excellence in the applied research field of environmental protection.

### Italian Foreign affairs minister Frattini congratulates EvK2Cnr Committee



### The new Share-weather station on Changri Nup

From its 5700 meters altitude the new Share meteorological station on Changri Nup gives precious information on the meteorological conditions and on glaciers dynamics. This is a further and precious step forward towards the high altitude science in the environmental framework. That is how the first Italian monitoring station on the Himalayan glacier was defined. It is located on the Changri Nup glacier, at 5.700 metres altitude and it continually registers the winds regime, the temperature values, humidity and the coming and reflected solar energy. It was assembled during a snow storm, at 15° below zero by the EvK2Cnr Committee team guided by Giampietro Verza and Elisa Vuillemoz. The Changri Nup is a small ice pillow set apart between the Lobuche Peak West and the Changri La Pass, a few meters distant from the Himalayan watershed. In February 2010 the EvK2Cnr Committee team assembled the first Italian monitoring station on the Himalaya, even though this glacier had been the centre of attention of the EvK2-Cnr researchers and Università di Milano. In fact, frontal monitoring variations are ongoing since 1994 on Changri Nup, which have shown a continuous backing (150 m circa) of the glacier front. It is surely one of the longest and most continuous data series of frontal variations of an Himalayan glacier, which, with the stake network position, allows also to obtain the apparatus mass balance. This is a study which will continue in the ambit of Share "the Changri Nup station placement surely represents a very important event in the framework of a greater knowledge of the Himalayan glaciers and the water resource that these last represent". - comments Claudio Smiraglia, glaciologist, teacher at Università di

Milano and member of EvK2Cnr Committee -. It must be also underlined that the Changri Nup was chosen because it represents one of the best example of "white Himalayan glacier", a rare typology if compared to the more common "black glaciers" on which the debris cover alters the energetic changes with the atmosphere, making the comprehension of the exact relationship between the glacial and climate dynamics difficult. It is the first network installed on Himalayan ice. A new confirmation of the pioneer role that the EvK2Cnr Committee has held for more than twenty years in the high altitude scientific research. "The measurement station installed yesterday is the first Italian one installed on an Himalayan glacier" - says Guglielmina Diolaiuti, glaciologist at Università di Milano. Its position is not only an amplification of the Share network for the high altitude environmental monitoring, but it also represents one of the first actions, promoted by the EvK2Cnr Committee, in the ambit of the Paprika project. This pilot project wants to study the Himalayan and Karakorum glaciers reaction to climate changes, quantifying, among other things, the energy and mass third pole exchanges, which is how the big glacial masses of the great Asian chains are called, the biggest ones on Earth after Antarctic and Greenland". In fact, the observations and measurements taken directly on the Changri Nup glacier will be very important, in the ambit of the precious information concerning the atmospheric composition, collected in the far-away Gaw station of the Nepal Climate Observatory - Pyramid.



Water sources from glaciers

## The partners who will take part in the project

The Paprika Share project sees the participation of some of the most prestigious authorities of the high altitude scientific research on global level. Paprika Karakorum foresees an International and multidisciplinary collaboration finalised to the study of the mountain environment and the global change. To the project the following participate:

**Isac-Cnr**, Istituto di Scienze dell'Atmosfera e del Clima: A. Provenzale, P. Bonasoni, P. Cristofanelli, S. Decesari, C. Facchini, F. Fierli, S. Fuzzi, J. von Hardenberg, A. Marinoni, R. Duchi.

**Università di Milano**, Dipartimento di Scienze della Terra, Università di Milano: C. Smiraglia, C. D'Agata, G. Diolaiuti, C. Mihalcea.

**Baw**, Bavarian Academy of Sciences and Humanities: C. Mayer and coworkers.

**Ingv**, Istituto Nazionale di Geofisica e Vulcanologia, Roma: A.

Zirizzotti, I. Tabacco, S. Urbini.

Politecnico di Milano, Dipartimento di Ingegneria Idraulica, Ambientale, Infrastrutture Viarie, Rilevamento - Sez. Costruzioni Idrauliche e marittime, Idrologia (DIAR-CIMI): R. Rosso, A. Bianchi, D. Bocchiola, B. Groppelli, M.C. Rulli.

**Ise-Cnr**, Istituto per lo Studio degli Ecosistemi: A. Lami, A. Marchetto.

**Cmcc**, Euro-Mediterranean Center for Climate Change: A. Navarra, C. Cagnazzo, S. Gualdi.

**Ictp**, International Center for Theoretical Physics: F. Giorgi, F. Solmon.

**TU Delft**, Technical University Delft: M. Menenti and coworkers

**EvK2Cnr**: E. Vuillemoz, G. Lentini, F. Steffanoni, C. Belotti.

**Seed project**: F. Mari and coworkers.

Share  
Paprika



## Karakorum, focus on the cryosphere

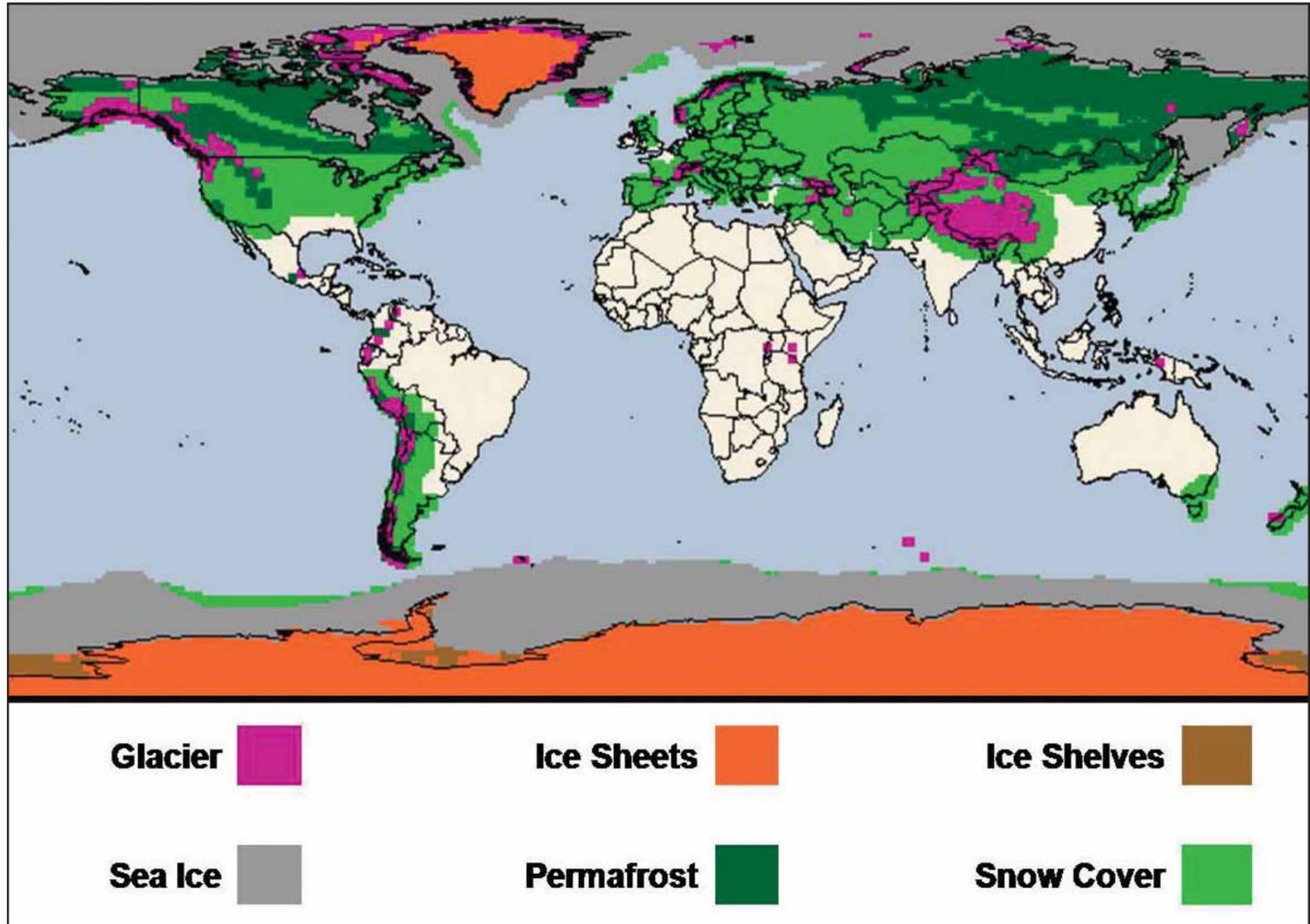
*Studying the effects of aerosols on mountain glaciers and water availability. This is the goal of the Share Paprika project.*

BY ANTONELLO PROVENZALE

Glacier and snow-cover response to climate change and to anthropic pressures in the Hindu Kush - Karakorum - Himalaya region, impact on water resources and on agriculture and adaptatopn measures in Nepal and Pakistan. Ground and satellite observations, global and regional climate modelling and evaluation of future scenarios. These are the goals of Share Paprika, the new pilot project launched by EvK2Cnr in collaboration with the French Cnrs. Paprika is a three-year project (2010-2013) composed of two sub-projects: Paprika-Karakorum, devoted to the upper Indus basin in Pakistan, funded by the EvK2Cnr Committee in Italy, and Paprika-Nepal, devoted to the Nepali Himalaya and funded by the French Cnrs.

The mechanisms by which climate change affects glaciers and snow cover are complex, and they are not univoquely determined by the rising global temperatures. Glacier dynamics is certainly influenced by the large-scale atmospheric circulation, such as the South Asia summer monsoon for the Himalaya region and the western weather patterns coming from the Mediterranean and the Middle East for the Karakorum. However, local meteo-climatic conditions and the properties of individual glaciers also matter. In particular, many glaciers in the Karakorum are covered with debris, a mixture of fragmented rocks and gravel that hides the glacier ice below. Many Himalayan glaciers are

now retreating, while most Karakorum glaciers retreat much less or, in some cases, even advance. Among its goals, the Paprika project is also devoted to understanding the origins of these differences in glacier behavior. The presence of very high concentrations of atmospheric pollutants and aerosols in the most remote regions of the Hindu Kush and the Himalaya further complicates the picture: aerosols can change the atmospheric circulation and they interact with global warming, with an amplification or damping effect which depends on the nature of the aerosol. Darker aerosols, the so-called Black Carbon, can accelerate ice and snow melting once deposited on the snow surface, as their dark color favors absorption of solar radiation, leading to temperature increase and snow melt. The Paprika-Karakorum project is devoted to the study of the effects of atmospheric aerosols, particularly Black Carbon and mineral dust, on glacier dynamics, on the hydrologic cycle and on water availability, using both in-situ and remotely sensed data. The project will also develop an integrated modelling approach, with a focus on the Karakorum area and, more specifically, on Baltoro glacier and on the upper Indus basin. Paprika-Karakorum has specific scientific goals, namely to provide a quantitative assessment of the properties of the atmospheric circulation in the Karakorum area; to estimate the aerosol load, transport and deposition and the aerosol chemical properties; to determine the state



of the glaciers and their mass/energy balance; and to determine the hydrological characteristics of the upper Indus basin. By the use of global and regional

climate models, this information will be used to assess future scenarios and to estimate the quantity and quality of water available in the coming decades. In addition

to the analysis of the physical and chemical processes, of their modifications owing to climate change and of their impact on water resour-

ces, the Paprika-Karakorum project will also consider the effects of climate change and of water availability on economy, agriculture and

society, devising adaptation measures which should take into account the knowledge and the needs of the local populations.

## Paprika Karakorum arrives in Parliament

The Relationship Development Center for Security Studies (TTS), chaired by Senator Joseph Esposito, vice president of the Parliamentary Committee for Security of the Republic, organized the first conference on "Climate, Water and Security" which was held Wednesday, November 3 in the Hall of Mercede Palazzo Marini, the Chamber of Deputies.

In this context, in his presentation Professor Antonello Provenzale explained the problem of climate change, water availability and the retreat of glaciers in mountain regions, illustrating in particular the draft Paprika-Karakorum and research in progress. In this area has also been highlighted by Professor Provenzale the opportunity to develop a national project to assess the state of water resources in Italy and their response to climate and environmental changes.

## At the new library they talk about Share and the Pyramid

The Archimede library, a high level maxi multimedia structure, was inaugurated in Settimo Torinese. During the celebration, Giampietro Verza from EvK2Cnr Committee, explained about the Pyramid laboratory, the research activities and the high altitude monitoring of the Committee. Verza - alpine guide and responsible of the meteo stations of the EvK2Cnr Committee, who held the meeting entitled "Pyramid, a laboratory on the Everest" in which he talked about the Pyramid laboratory which rises at 5.050 meters on the Khumbu valley.

## The researchers' themes

The researchers' themes involved in the Share Paprika Karakorum project are several. The Pakistani mountain chain, in fact, has peculiar characteristics which must be very carefully studied through the data collected by the monitoring stations, to understand which evolutions the climate changes will bring and above all, which will be the most reliable forecast models to establish the potential impacts. The scientists will evaluate, in first place, the aerosol effects on the atmospheric circulation and on the processes associated to the seasonal nival fusion, to the glacial balance mass/energy and to the ice ablation. Consequently they will study the interaction among western meteorological systems, which are particularly important for the Karakorum, and the snow and ice distribution. So, once understood the complex phenomenon which regulate the climate on this zone of the Earth, they will create mathematical models to forecast the dynamics of the glaciers, partially covered by detritus, and quantify how these last respond to climate change. The scientists will develop downscaling procedures for stochastic parameterization in regional climate models. They will therefore try to obtain an average medium representation, on regional scale, of the cryospheric and hydrologic balance through the use of data from remote sensing, validated through measurements taken on the field. In the studies, it is included the construction and validation of an integrated model system, which use global climate models, which includes a regional climate model with interactions with snow and ice, and which supplies the input for hydrologic models to estimate of the water availability in different scenarios of climate change and aerosol emissions. It is a quantitative evaluation on the present state of the atmospheric circulation properties; aerosol loads, deposition and chemical properties; glaciers status, mass/energy balance and flow estimation; hydrologic characteristics, among which water quantity and quality, in the two study areas. The Paprika-Karakorum observational part will be concentrated on the study of the high altitude areas of the Karakorum in Pakistan, with a specific focus on the region of the Baltoro glacier and on the high Indo basin. Moreover, the research aims at supplying a series of integrated model instruments, based and validated on the field and from remote sensing (satellites and air radars), in order to obtain quantity evaluations of water availability and impacts of climate change on agriculture, the environment and the ecosystems in the next decades (2010-2050) and to develop strategies for capacity building, dissemination and information transfer to policy makers..





Karakorum Glaciers

**Interview**

Antonello Provenzale

Share Paprika Karakorum project coordinator

# Hunting for data in the Karakorum

*Paprika is devoted to two climatically-relevant regions Italian researchers will study the Karakorum*

BY WAINER PREDÀ

The Share network is crucial for the study of aerosols and of "black carbon" and its data are important for climate modelling.

**Professor Provenzale, could you tell us more about the Paprika project?**

The Paprika project deals with climate change and the effects of aerosols, pollution and black carbon on snow and ice melt, on the hydrologic cycle and on water availability in mountain areas. Right now, Paprika considers two study areas: the Nepali Himalaya, which is studied mainly by French research groups, and the Karakorum in Pakistan, which is studied by Italian scientists.

**What did you find in the Karakorum and what do you expect?**

We are at the beginning of the project. There are several meteorological measurements available in the last six years and several glaciological data have been collected in the last ten years. Karakorum glaciers differ from Himalayan ones as they are often covered with debris, a mixture of fragmented rocks and gravel which makes them dark. In general,

Karakorum glaciers are retreating less than those of the Himalaya.

**Some glaciers seem even advancing...**

Yes, even though we should understand whether it is a "healthy" advance of glaciers with a positive mass balance or it is the rapid sliding of glaciers which are surging and losing mass. In the framework of Paprika, the Karakorum glaciers are studied by the research group of Professor Smiraglia at the University of Milan. Together with them, and with several other groups, we are developing glacier and snow models to determine the glacier response to different climate scenarios. Snow and ice are particularly important in the Karakorum because they provide a relevant fraction of the water in the Indus river, which brings water to all Pakistan. Understanding whether snow and ice can undergo accelerated melting, how melt water will be seasonally distributed and how the rainfall distribution will be modified is important for predicting the Indus river discharge and estimating the probability of droughts or floods.

**The floods of last summer in**

**Pakistan are a normal event or they indicate a climatic change?**

A single event is never indicative. The drought of summer 2003 in Europe or the flood of last summer in Pakistan, by themselves, are not a proof of anything. Only the repetition of analogous phenomena can be taken as an indication of climate change. Unfortunately, there are few long-term data in this area and it is difficult to assess whether flood events like that of last summer are a cyclic phenomenon. In general, in a warmer world we do expect higher energy in the hydrologic cycle and a larger probability of droughts in some regions and of floods in others. We should also recall that the meteorological characteristics of Pakistan are quite different from those of India or Nepal. The Pakistani region is affected both by the Indian monsoon and by the western weather patterns that come from the Mediterranean, and the climate in this area can vary a lot from one year to another.

**Did you see significant climatic differences between the last few years and the past?**

The data collected by EvK2Cnr refer only to the last 6-7 years and they are not sufficient to answer this question. There are longer records from satellite data and from the European Center for Medium Range Weather Forecast

(ECMWF) which span the last 50 years. We are now collecting the data from the Pakistani Meteorological Department and from the Hydrological Service to address the problem of climate change in the Karakorum region.

**EvK2Cnr provides access to the data of the Share network...**

EvK2Cnr installed two meteorological stations in the area of Baltoro glacier, and a third one will be installed soon, hopefully. The EvK2Cnr Committee also provides important links with several Pakistani research centers and logistic support to the scientific campaigns.

**The Share network is active in several areas of the world. How important is this network for your studies?**

The Share network is crucial. The responsible for the network is Dr. Paolo Bonasoni who works in the same Institute where I work, the Institute of Atmospheric Sciences and Climate of the Italian Cnr (Isac-Cnr). Aerosols like those produced by pollution, the black carbon coming from combustion and the desert dust have a very important climatic role. Perhaps not as much as greenhouse gases, but not much less. **This is a relatively new research topic...**

Yes, it is quite new. In the last IPCC report, the role of black carbon was partially underestimated. The last report of IPCC was released in 2007 and it refers to research results obtained before 2005. In the last five years, we learned a lot on aerosol effects. Black carbon, in particular, is very important because it contributes to global warming and modifies atmospheric stratification, by heating the air and cooling the ground, with possible consequences on the atmospheric circulation and on the properties of precipitation. The study of aerosols, both from an experimental viewpoint, as done by the Share network, and by a

modelling standpoint, as our group is trying to do at Isac-Cnr, is essential to understand climate change.

**A last question. Somebody says that for decreasing the impact of black carbon it would be sufficient to use "ecological" heating and cooking systems. Is it true?**

All measures taken to reduce emissions can be useful. Traditional cooking and heating, when performed by a billion people, can certainly contribute. However, there is also an important component due to industrial activities, transports and energy production which should be carefully estimated.



## Data collected at the Urdukas and Askole Aws

The two Pakistani Aws in the Share network are fundamental to understand how the glaciers of this region of the Earth are reacting to the ongoing climate change. Wind direction and speed clearly show the influence of the extensive Baltoro glacier, displaying a clear distinction, in dynamical and thermal terms, between katabatic and thermal winds.

At Urdukas the katabatic winds drawing from the glacier are evident during the night and in the morning, when cold and dense air masses reach the station. After that, from late morning to the early evening winds coming from valley are dominant, when a warmer and less dense air climb up to the glacier and reach the station from the west; few hours after the sunset the cycle restarts. The same description is valid for Askole, located about 900 m below, but in the same valley. Also in terms of wind speed it is possible to discern clearly this katabatic (or gravity-induced) and anabatic (or thermally induced) cycle, with cold winds slower than warm ones. It is therefore also interesting to observe the good correlation between wind speed and direction. (Gianluca Lentini)

*A high-mountain observatory to study climate change, the transport of atmospheric pollutants and their effects on glaciers*

## Share Stelvio

BY FRANCESCA STEFFANONI

The three-year Share-Stelvio project is devoted to performing technical-scientific activities in the Alpine region, in the context of an open-air high-altitude laboratory for the study of climate change. The Share Stelvio project, born in the framework of Share - Stations at High Altitude for Research on the Environment - managed and coordinated by EvK2Cnr, aims at detecting and quantifying climate change and its effects in a vulnerable area of the Italian Alps: the Lombardy sector of the Stelvio National Park. The project's main aim is to launch a systematic, coordinated and permanent environmental programme, integrating various (and different in methodology, scale, resolution) but synergic monitoring activities. Such a monitoring system represents, for Lombardy and the Alps, an innovative and important interdisciplinary study of European and international value, allowing the quantification of the variations in three geophysical units of the Alpine area, the cryosphere (ice and permafrost), the hydrosphere and the atmosphere, which are very vulnerable to recent and present climate variability and change. The project is funded by the Lombardy Region through an agreement with the Fondazione Lombardia per l'Ambiente (FLA), which is also a scientific partner of the programme. The study area has been selected in order to better evaluate the joint impact of anthropic emissions and climate change on the Alpine ecosystem. This protected area, fragile and vulnerable, encompasses 8 Community Interest Sites (CIS), important glaciers, and a high bio- and geodiversity. It represents an important water source, both in terms of fresh water and hydroelectric power. In fact, over an area of about 600 km<sup>2</sup>, several monitored glaciers can be found, on which information and data are collected for the World Glacier Monitoring Service, the international glaciological database. In this area, the first Italian supra-glacial station of the Share network was installed in 2005 and, in the framework of the EU-Pace project, a 100-m permafrost (i.e. rocks or terrain permanently below 0°C) perforation was performed: permafrost itself is a fundamental, and up to now scarcely known, water source for

# Share: a privileged observatory on Stelvio



## Share, Operational Structure

### WP 1) Scientific Research and Climate (coordinator: Paolo Bonasoni)

Multi-disciplinary and interdisciplinary scientific research is based on observations and sampling activities conducted at high mountain stations. It is declined in 6 thematic areas, divided in the six following sub-WPs:

- **WP 1.1 Atmosphere (coordinator: Paolo Cristofanelli):** study of processes and mechanisms of interaction between mountain ranges and global atmospheric circulation and of physical, chemical and optical properties of aerosol and their variations.
- **WP 1.2 Glaciology (coordinator: Claudio Smiraglia):** Cryospheric researches at high altitude in the Alps, Himalayas and Karakorum carried out with the goal of determining intensity and ablation rates nivo-glacial; quantification of their impact on hydrology of glaciated basins of high altitude and analysis of their relations with the climatic system.
- **WP 1.3 Energy and water cycle (coordinator: Gianni Tartari):** evaluation of water and energy balances due to climate change impacts on the environment in mountain areas, through the observation and the study of regional hydrological regime variations.
- **WP 1.4 Limnology (coordinator: Andrea Lami):** studies of lacustrine trophic chains and of sediment biomass accumulation in response to natural or disturbance factors, including the atmospheric depositions able to influence the chemical and biological conditions of the lake ecosystems.
- **WP 1.5 Biodiversity (coordinators: Sandro Lovari, Graziano Rossi):** Animal Biodiversity: study the effects of global warming on large mammal ungulates and predators in the Sagarmatha National Park (Nepal) and Central Karakorum National Park (Pakistan); Plant biodiversity: study of plant biodiversity in the Italian Alps and Apennines, and in the Sagarmatha National Park (Nepal).
- **WP 1.6 Medicine (coordinator: Annalisa Cogo):** study of human physiology responses to extreme condition and the consequence of indoor pollution on the people living in mountainous areas of developing countries

### WP 2) Technological Research and Climate (coordinator: Paolo Laj)

Development of a sophisticated, innovative, high-tech, integrated environmental and geophysical monitoring system, permitting to carry out measurements even where the installation and maintenance of a permanent laboratory is too difficult or expensive. The system will be equipped with near-real-time data transmission and will use renewable energy sources.

### WP 3) Information System (coordinator: Maria Teresa Melis)

Development of a web-service platform based on GeoNetwork open source architecture, to create an international standard catalogue of data and metadata to be used by the scientific community. Two principal actions are considered: (i) a shared database for the collection, management and access to spatial and non spatial data; (ii) a dedicated thematic portal for the access to distributed databases and to remote high altitude stations.

### WP 4) Capacity Building

The Share project supports the sustainable development of mountain regions and aims at improving local environmental management systems by transferring technology and know-how in the fields of environmental and geophysical sciences. Unep close collaboration with Share will strengthen partnership with developing countries, supporting scientific knowledge and technological expertise for environmental and climate studies. The know-how will be shared locally and with inter-governmental agencies, providing a technology transfer mechanism and supporting decision-making on the environment.



our mountains. Share Stelvio is articulated in four scientific research activities, led by different operational research units. The first activity, led by the University of Milan, the Politecnico of Milan and the University of Insubria, is devoted to the cryosphere and, in particular, to the study of the effects of climate change on snow cover variability and on glacier and permafrost stability in order to quantify the hydrological runoff related to snow and glacial melting, thus contributing to the evaluation of the quantity and variability of the freshwater resource in the Park. The second activity, devoted to the Resource Water, aims at studying the effects of global change and pollution on water quality and quantity in the Stelvio National Park's lakes and rivers; the water resource activity involves the Cnr Institute for Water Research and the Cnr Institute for Ecosystem Studies in Brugherio and Pallanza. The third activity, involving the Cnr Institute for Atmospheric and Climate Science in Bologna and the Cnr Laboratory of Glaciology in Grenoble is devoted to the Resource Air, and it focuses on the study of atmospheric composition variability in order to evaluate the effects of the transport and deposition of pollutants

vio



**SHARE**  
**Stelvio**  
 Stations at High Altitude for Research on the Environment

(such as the black carbon) and of natural compounds (such as the Saharan sands) on the Alpine cryosphere. The fourth activity, led by the Fondazione Lombardia per l'Ambiente with the cooperation of the Politecnico di Milano and the Cattolica University (UCSC), is devoted to climate change and atmospheric pollution, through, on the one side, the studies on pollutants' formation, transport and deposition at a regional scale and, on the other side, the characterization of climate-change-related and pollution-related forcing and impact factors on mountainous ecosystems. The Project has been conceived as a multi-disciplinary programme because of the wide-spectrum interactions and relations among the different systems under examination: atmosphere, cryosphere and hydrosphere. Such interactions are easily exemplified: through the deposition of absorbing material, possible transport events of pollutant-rich air masses or of climate-altering compounds can modify snow and ice ablation rates, thus affecting the glaciers' extension; more, variations on the intensity and ratio of nivoglacial ablation processes can affect water availability in the Stelvio National Park.

#### Hi-Tech

### Forni: a Share station on the largest Italian Glacier

The Forni glacier is the most extensive valley glacier in Italy, with an area of about 12 km<sup>2</sup>, and it is located in the Ortles-Cevedale Group, Stelvio National Park, Lombardy Alps. The glacier has a North exposition and it spans between 2600 m and 3670 m of altitude. The Aws1 Forni WGS84 coordinates are 46° 23' 56.0" N, 10° 35' 25.2" E, 2669 m a.s.l. (ellipsoidal height): it is located on the ablation tongue at the base of the eastern serac zone. This site represents a good compromise between the need of minimizing the effects of local topography while having a low risk of avalanches. The station is located in the lowest part of the glacier, 800 m away from the glacier front. The surrounding mountains are about 3000-3500 m high (the highest is Mt. S. Matteo, 3678 m a.s.l.), thus implying shadow conditions over the southern and eastern sectors of the glacier.

#### Share Network Data

### The August-September 2010 campaign at the Stelvio Aws

Following the August-September 2010 data collection campaign it has been possible to discern two regimes of air masses, a western and an eastern one, clearly distinct in terms of their thermal and hygrometric characteristics. The dominant regime is the western one, leading in terms of number of events and characterized, on average, by higher thermometric values and by a homogeneous interval of relative humidity values. The eastern regime is less common in occurrence and it is characterized by lower thermal and hygrometric values. The clear thermal and hygrometric signals of the eastern regime allow inferring possible stratospheric signals in the air masses coming from East. The stratospheric air is normally identified by lower temperatures, by very low relative humidity and by positive values of variables such as the potential vorticity: weather maps for the area and the period under examination allow to identify stratospheric air which induce cyclogenesis (creation of low pressure vortex) on the Gulf of Genoa and on the Po Valley which, in turn, push cold and dry air coming from the East to the Stelvio. It will be interesting to investigate the possible sign, in terms of ozone and particles, of the two regimes' air masses.





## The great initiative promoted by the Italian EvK2Cnr Committee, Nast (Nepal Academy of Science and Technology) in collaboration with the Italian University of Pavia

(follows from frontpage)

Park, in particular of wild, medicinal plants, but also agricultural ones, in order to save the precious local biodiversity from the effects of anthropization and climate change. Beyond seed conservation "in situ", the project will promote studies on seed germination in different climatic and environmental scenarios, in order to understand the reactions of these vegetables to global change. Local researchers will be trained ad hoc. "The Indian subcontinent is one of the richest areas in the world for biodiversity - Graziano Rossi, University of Pavia, says -. Natural vegetation ranges from tropical rain forests to alpine flora. The Himalayas, considered one of the 20 most important hot spots for biodiversity in the world according to Conservation International, host over 3000 endemic species. But they are in danger: deforestation, fires, pollution, use for medicinal purposes and climate change are causing a loss of biodiversity in the area. We will study Himalayan seeds in order to understand their future reaction to climate change, but also to preserve them from extinction: we hope to let these seeds and their embryos survive outside their environment, ex situ, i.e. in high-tech structures such as seed banks". The agreement for the realization of this project was signed this morning, November 16, 2010 by Surendra Raj Kafle,

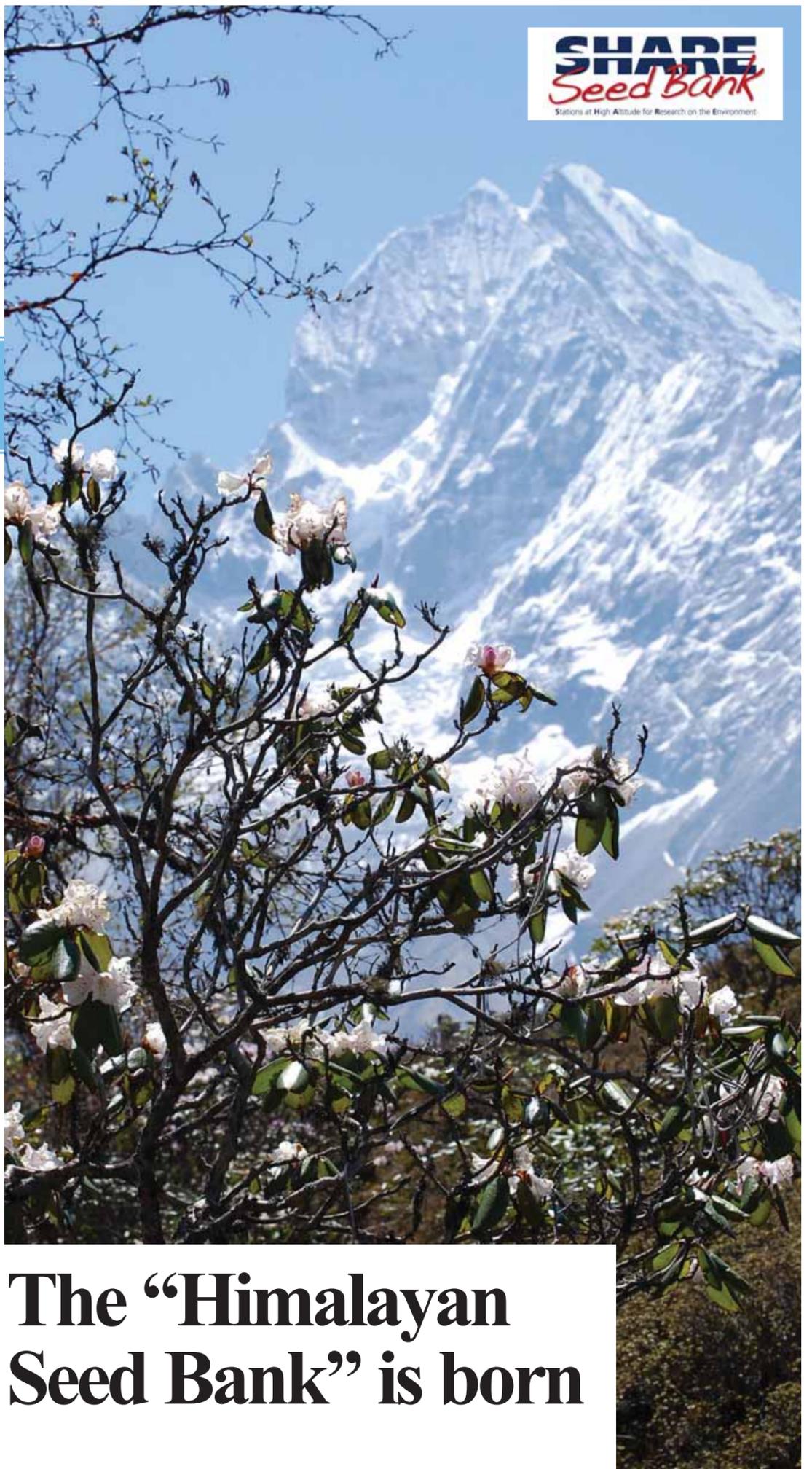
Nast Vice-Chancellor and Agostino Da Polenza, president of EvK2Cnr. "I'm happy to have signed this agreement during the 2010 International Year of Biodiversity - Agostino Da Polenza says from Kathmandu -. The Himalayan Seed Bank has a concrete but also

strengthen the relations with local partners through programs of capacity building and technology transfer". These days, Da Polenza met also the Nepali Minister of Environment Madhav Kumar Nepal, who praised the work of EvK2Cnr in the fields of scientific research at high altitude and climate

### Seed surviving to global changes in a protected shelter

symbolic value for biodiversity preservation in the Himalayas and it will be handled directly by EvK2Cnr". The project, promoted by EvK2Cnr in collaboration with the University of Pavia, is carried out within the Share (Station at High Altitude for Research on the Environment) project. "Share - explains Elisa Vuillemoz, coordinator of EvK2Cnr scientific projects - the main research and monitoring project of EvK2Cnr in the field of climate and environmental studies, was included among the reference projects of the Mountain Initiative for Climate Change, as a fundamental support to define adaptation strategies against climate change in mountain regions. In this context, information and new research activities in the field of biodiversity will have an increasing importance. The Himalayan Seed Bank is a major achievement not only from a scientific point of view but also to

change. EvK2Cnr has been managing for 20 years the Pyramid Laboratory/Observatory located at 5,050 meters a.s.l. in Nepal at the base of Mount Everest. Today, with its Share program, EvK2Cnr is world leader in integrated environmental research, climate change monitoring and sustainable development of mountain ecosystems.



## The "Himalayan Seed Bank" is born



## High elevation (He) programme

(coordinator: Gianni Tartari, Irsa-Cnr)

Since 2007, the EvK2Cnr Committee, in the framework of the Share project, has coordinated the High Elevation Programme, which aims to study multi-scale variability of energy and water cycles in high elevation areas.

He is an initiative within the Gewex Hydroclimatic Panel (Ghp), formerly the "Coordinated Energy and water cycle Observations Project (Ceop)", a project which is encompassed by the "Global Energy and Water cycle Experiment (Gewex)", promoted by the World Climate Research Programme (Wcrp) of the World Meteorological Organization. In this framework, He is identified as "regional study" and it encompasses a series of climate and monitoring reference stations.

He is meant to be a concerted, international and interdisciplinary effort aimed at furthering knowledge on the physical and dynamic processes at high elevations, thus contributing to global climate and water cycle studies, including the effects on the sustainability of the fragile mountain ecosystems.



## Share limnology and water quality

Lakes located in remote areas have typical biotic and abiotic characteristics and are extremely vulnerable and sensitive and thus considered ideal sites for studying long-term environmental changes. In addition, the high quality of their sedimentary records allows inferring with good certainty speed, direction and biological impact of phenomena such as acid depositions, air pollutant transports and climate variations on very long time scales.

Monitoring activities in the more representative lacustrine bodies located in Sagarmatha National Park have been ongoing for the last twenty years whereas, in the framework of Share, the limnological activities are carried out in the lakes near the Pyramid.

The achieved results, in accordance with the Share multidisciplinary approach, allow analyzing and better understanding the responses of lacustrine environments to climate change.

## Snow Leo is back

*Sandro Lovari of EvK2Cnr have studied four individuals in Sagarmatha National Park*

BY ANGELO LOCATELLI

It was Christmas Eve 2003. At 3800 m a.s.l. in the Sagarmatha National Park, an EvK2Cnr team of researchers led by Sandro Lovari had a first encounter with the legendary snow leopard. It was sitting in the shade of a tree, guarding the carcass of a prey captured the day before. The scientists, who were there to study the tahr, a large Himalayan herbivore the males of which reach 130 kg of weight, were awestruck by that big cat. It was a historical encounter, if you consider that the snow leopard had disappeared from the Everest area in the 1960s, for yet unknown reasons.

Some tracks reappeared in the 1980s, after the Everest area was declared National Park. But until 2003 there was no photographic evidence to show it. The snow leopard is a cat of remarkable dimensions (the male weighs up to 80 kg, the female rarely exceeds the 60 kg), but it looks larger because of the thick, grey-spotted white fur, which protects him from the cold.

It rarely moves below the forest's upper limit: it is an elusive predator of the open spaces, the steppes, the barren lands, the cliffs, normally at high altitudes.

Uncia uncia, this is the scientific designation of the cat, lives normally in Central Asia, Southern Russia and Western Mongolia, till the Himalayan region and China. This animal feeds on tahrs, other mountain ungulates and domestic cattle. His average life in captivity is of the order of 17-19 years, whereas it is much shorter in nature.

At global level, the snow leopard is considered "endangered" (severely threatened) in the IUCN classification. Of this superb animal only 2500 breeding mature individuals exist, plus an unknown number of younger individuals.

It is estimated that at least four specimens live in the Sagarmatha National Park.

"After three decades of protection, the hunting ban and the recovery of the wild ungulates' populations, snow leopards are back. The population is composed by 4 specimens" – writes Sandro Lovari, in his last publication on the subject. The EvK2Cnr researcher documented the effects of the snow leopard's return on its main wild preys: tahrs, musks and bovinds. So, "If cattle predation continues, together with the decrease of Himalayan tahrs, the reactions of local populations on the predator will persist and the snow leopard will be again at risk of local extinction", the researcher adds.

Studying an elusive species, living in a harsh environment like that of the Himalayas, represents a challenge. The snow leopard bordered extinction for essentially three reasons; the first is connected to human presence in the territory: through the alteration of the natural habitat and through the excessive hunt of wild preys, mankind has often forced the large predators to replace them with cattle, thus triggering persecution responses. The snow leopard has an additional problem: it lives in source-poor and semi-desert environments, with very delicate ecologies (Central Asian mountains and plateaus). Another problem is global warming, which endangers all animal

species specialized in living in cold environments, and which favours the replacement by competitor species. EvK2Cnr's research project has been centred on counts of snow leopards and common leopards, as well as those of their main/alternative prey. Analyses of food habits, movements and habitat use of snow and common leopards have also been included. The study area lies between Namche (3440 m a.s.l.) and Phortse (3849 m a.s.l.) villages, up to Gokyo Lake (4750 m a.s.l.), encompassing the upper catchment of the Dudh Kosi river, as well as the lower part of the Cho-Oyu Valley. Counts of snow leopards and common leopards

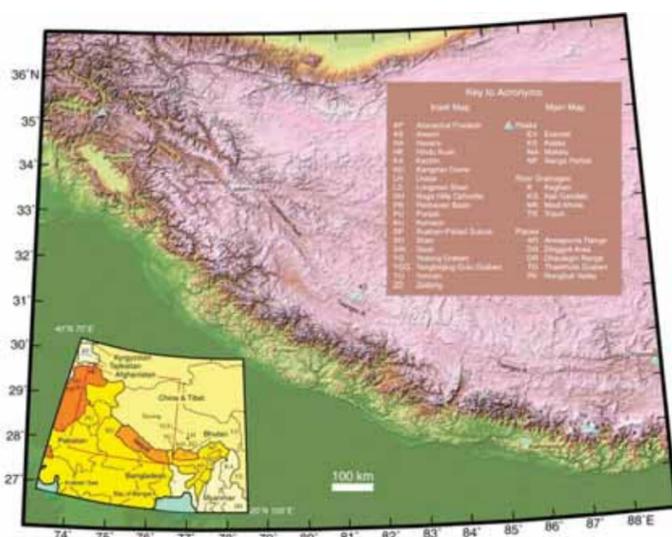
have been carried out through DNA analyses from scats collected monthly along fixed itineraries (nearly 150 km). These analyses may assess species, individual and sex to which the faecal samples belong. Relative prey densities (ungulates/alternative prey, e.g. large pheasants: monal, blood pheasant, snow-cock) have been estimated monthly, by counting individuals along fixed itineraries. Diets of leopards have been studied through scat analysis: preys are identified on the basis of hair micro-characters and other indigestible remains. Prey selection is estimated by comparing the relative abundance (availability) of main prey species

with that found in the diet (use). Information on ranging movements and habitat use of leopards will be obtained through genetic analyses of scats, GIS analyses (satellite imagery, land-use vegetation maps) and, possibly, satellite radio tracking (pending permits). Some 200 scats of snow leopard and 120 of common leopard have been used for DNA and for food habit analyses. In autumn, the young-to-female ratio of Himalayan tahr has fallen from ca. 0.8 to 0.2 (1991-2010), reducing the tahr population by 2/3. Sanitary analyses of blood samples from the tahr population showed that no relevant disease is present. Although the

reproductive rate is close to 1 at the beginning of summer, 75% of kids disappear in the following 4 months. At the same time, the proportion of tahr in the diet of the snow leopard doubles, thus suggesting predation events. The use of the main food resources of the snow leopard and that of the common leopard overlap greatly, although habitat partitioning seems to occur. A population size assessment of large pheasants has also been carried out in the study area. In 2004-05, 38 individuals of tahr (28 males, 10 females) have been darted and individually ear-tagged, to estimate the mortality rate of

the adult segment of the population.

On March 24th 2006, EvK2Cnr signed a cooperation agreement with WWF-Nepal, for the safeguard of species at risk in the Sagarmatha National park. The agreement, endorsed by WWF International, was signed in Kathmandu by EvK2Cnr's President Agostino Da Polenza and by the local representative of WWF Nepal. Following this agreement, the two institutions commit themselves to common research initiatives, and to monitor and protect the snow leopard and its preys from the risk of extinction.



## Himalaya. number increase of the snow leopards

Since farmers are no longer forced to hunt him down to defend themselves, the snow leopards have increased. In the Kanchenjunga Conservation Area, the Himalayan mountains of Nepal, today there are about 45 individuals: according to the calculations of naturalists, the number would have grown thanks to the insurance of livestock against attacks by these animals. First, farmers scatter traps in the woods and mountains around the villages, to capture and kill the predators that were often raided their livestock, reducing them to ruin. Today, however, this cruel practice is no longer needed. A couple of years ago, to protect snow leopards are an endangered species with extinction, the park authorities have introduced a special insurance that reimburses farmers Chiefs lost as a result of attacks by these animals. And apparently, the system is working even better than expected. Last year there were 32 in the area of the Kanchenjunga snow leopard, this year there are about 45. The insurance is initially active only in the district of Ghunsa, was introduced in all areas where snow leopards have been found. And the co-existence between man and this beautiful predator, since then, has improved everywhere. "At this time, no leopard was killed - said Himal Chundak, president of the Snow Leopard Conservation Committee, the Kathmandu Post -. And 'good news for them. ""The idea was very effective - he said Sujit Kumar Shrestha, director of the Kanchenjunga Conservation Area Project. Farmers are excited to be working. This helped us a lot in protecting the species. "

## Interview

PAOLO LAJ

*Scientific responsible Paprika and Nanoshare project*

# Working towards a completely automatic station

BY WAINER PREDA

NanoShare is a project financed by the EvK2Cnr Committee to develop a completely automatic station monitoring the atmospheric composition. It aims to develop a station that can be installed at 4,000 m a.s.l., functioning autonomously and working independently from an energetic point of view. We are the only ones developing this kind of project.

## Are there any other similar experiences in the world?

No, there are not. There is a lack of data coming from high-mountain areas because there are real practical difficulties in developing and elaborating systems that can work in the extreme meteorological conditions found at high altitudes.

## Why are data taken in the mountains so important for climate change research?

We can make projections on future climate change with models, but these models that need data for validation purposes. We have plenty of data collected, for example, in the Po Valley and lowland Europe. On the contrary we don't have many, or any, data from other areas of the world, particularly from mountain areas, and I am thinking especially of the Andes and the Himalayas. When models need data for validation in these areas, researchers are not able to find any or not much data to compare models' results with the observations. With NanoShare we are trying to provide data from areas where, at the moment, there is simply no surveying at all.

## So, if I understand well, you can not make projections on global change without these data...

It is still possible to make projections, but they have, invariably, to be validated with real data. Model validation with observed data is, otherwise projections will lack any correspondence with the natural reality.

## Recently, the topic of black carbon has come up importantly on the agenda of scientific research...

Black carbon has always been important. The aerosol has an effect on climate, this is well-known. In some areas such as India and South America, the black carbon component is essential to understand how the solar energy is transmitted to the atmosphere. So the scientific community is

surely interested in better understanding the spatial distribution of these particles.

## What is the role of mountains in the fight against climate change?

Mountains have an essential role because, basically, those are the areas where water resources come from. Secondly, they are very



Paolo Laj

vulnerable to climate change because there host the cryosphere, in particular in terms of snow and glaciers. Mountains are rapidly changing, rapidly-evolving environments. A temperature rise at high altitudes represents something that is bound to have important impacts on ecosystems, on biodiversity, on people living in these areas. The connection between atmospheric pollution and snow-covered areas is embodied by the black carbon. The black carbon is composed of black particles that absorb the solar radiation thus having a warming effect: if there is absorption there is a warming. And

when these particles settle on snow, they warm and melt it more rapidly.

With the last works we performed with EvK2Cnr, we found that in some areas of the Himalayas there are high black carbon concentrations. According to our first calculations, these concentrations may have an impact almost as high as that of CO<sub>2</sub> on the local warming.

With some American colleagues, we have analyzed and obtained the first results on the impact that this black carbon settled on snow can have and we have seen that this impact can be sufficiently important to melt the snow more rapidly.

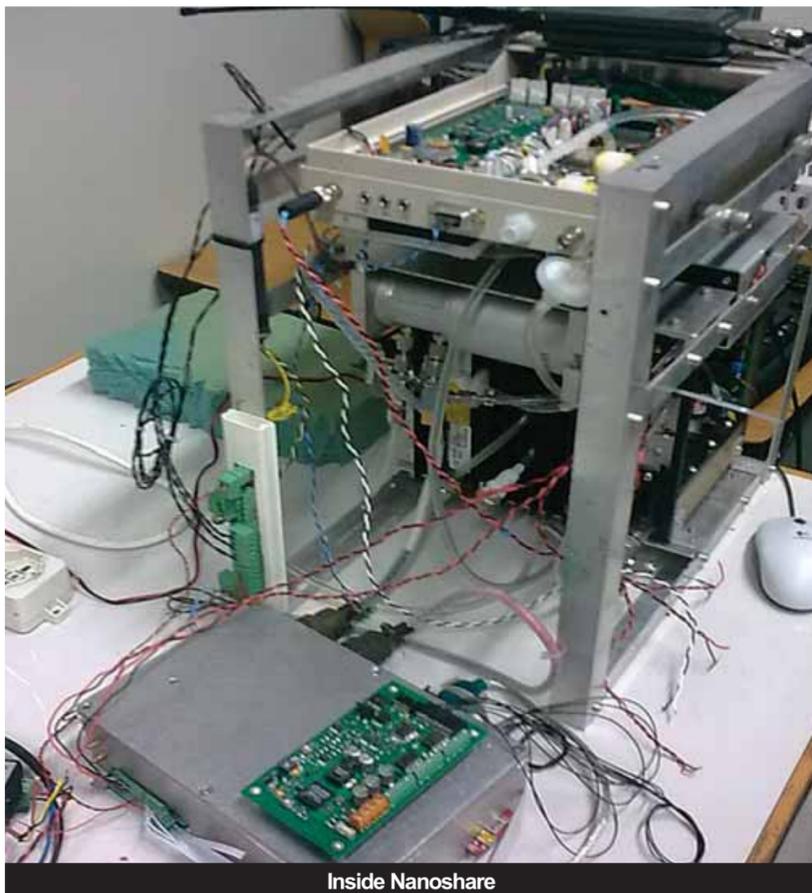
## How quicker can this melting be?

It is difficult to say. We are not able to give an evaluation yet. We can suppose that in 30-40-50 years we can have a shift back, of about a month, of the snow melting peak. It is evident that this will have important consequences for all the people that use water resources in that area. For agriculture and electric energy production these are important facts. But for the moment we are not able to project what the future is going to be. However the objective of the project is to gather researchers working in atmosphere, glaciers, hydrology, impacts, geography, who can study how water is used by populations, to understand if we can get to better projections than the ones we have now.



Testing Nanoshare

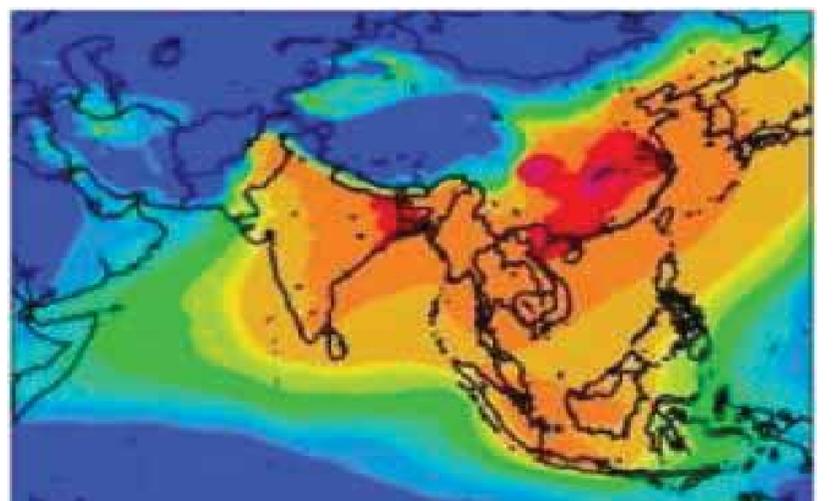
## Nanoshare: inside the next generation hi-tech jewel



Inside Nanoshare

The Share project also includes a component of technological innovation regarding the instrumentation for climate monitoring and atmospheric observations in remote high mountain areas, also in close collaboration with the private sector. The objective difficulty of performing continuous measurements at high altitudes in mountain regions, especially in developing countries, is one of the reasons why knowledge of climate and environmental processes in high mountain regions is thus needed in order to obtain representative quality measurements.

NANO-Share is developing to advance observation capacity in high mountain locations and in remote regions in order to favour the acquisition of meteorological data useful for the study of climate and environmental protection. The main applications of the system include intensive field campaigns for short term measurements as well as long-term monitoring activities. Measurements currently being carried out are surface ozone, aerosol size distribution from ultrafine to coarse particles, aerosol optical properties and meteorological parameters (T, P, RH, WI, WD, PRP).





## Chacaltaya: EvK2Cnr will provide instruments to the laboratory on the Andes

BY ANDREA CHIODI

At 5.230 m a.s.l., the Chacaltaya laboratory is the highest site for astrophysical research and for cosmic rays in the world. For the study of the atmospheric composition it will be necessary to use instrumentation coming directly from Italy: they will be provided by EvK2Cnr and they will carry out researches on climate change from a privileged position for scientific research, a unique position in the world.

For its location, the Chacaltaya laboratory is considered the viewpoint of Cordillera Real, on the Bolivian Andes. Built on the plateau on the Bolivian Andes, this laboratory is surrounded by mountains higher than 5000m a.s.l., such as Illimani (6462 m), Mururata (5775 m), Condoriri (5696 m) and the beautiful Huayna Potosi (6088 m), one of the most scenic mountains in the world.

On this mountain the homonymous glacier was found: it has now completely disappeared, as prof. Edson Ramirez, of La Paz University, announced a couple of years ago. Studying climate evolution in this area of South America appears, therefore, more important than ever. This is the reason why an international programme to promote

researches on atmospheric composition and climate change has been established, thanks to the commitment of Francesco Zaratti, Director of the Laboratorio de Física de la Atmósfera of the University Mayor de San Andrés in La Paz (Lfa-Umsa), of Paolo Bonasoni of

Bologna Cnr-Isac, co-ordinator del of EvK2Cnr's Share project, and of Paolo Laj, Director of Grenoble's Lgge. At Chacaltaya, a project for the implementation of a new Global Atmospheric Watch (Gaw, of the World Meteorological Organization) regional station has

been launched. This activity, co-ordinated by Prof. Zaratti, sees the scientific co-operation of several international institutions and organizations, from the United States to Europe, and it will allow the implementation of scientific instrumentations and research equip-

ment. For the Italian part, this equipment will be provided by EvK2Cnr and will be applied to researches on climate change, also in collaboration with the Institute for Atmospheric and Climate Sciences (Isac-Cnr). The activities will be undertaken

also by the Centre National de la Recherche Scientifique (Cnrs), the Laboratoire de Glaciologie et Géophysique de l'Environnement (Lgge) and the Institut de Recherche et Développement (Ird) in Grenoble and the Laboratoire des Sciences du Climat et de l'Environ-

nement (Lsce) in Gif/Yvette, Météo-France, the Centre National de la Recherche Scientifique (Cnrm) in Toulouse and the Paul-Scherrer Institute - Laboratory for Atmospheric Processes (Psi) in Villigen, Switzerland.

## The Chacaltaya Gaw station on the Andes

DI FRANCESCO ZARATTI\*

Observations of the free troposphere are needed to understand long-range transport, climate change and trends in the oxidizing capacity of the atmosphere, as well as, to provide a 'baseline' for the characterization of atmospheric chemistry and physics. Further analysis of global networks also shows that the Southern Hemisphere is clearly under-sampled in comparison to the Northern Hemisphere.

In this context, a project was started for the implementation of a long-term station at Mount Chacaltaya, Bolivia, operated by the Atmospheric Physics Laboratory ('Laboratorio de Física de la Atmósfera', Lfa-Umsa) that, in January 2010, has become the 3rd Gaw station in South America and the unique high altitude station over the Continent.

The CHC Gaw Station is located at 5.200 m asl, 16.2°S

and 68.1°W, at approximately 25 km, in straight line, from the Lfa-Umsa in downtown La Paz, and is easily reachable within 90 minutes from La Paz city by car.

The CHC Station will provide measurements of three (out of six) Gaw focal areas, namely, greenhouse gases, reactive gases and aerosols. At the moment the station is at the stage of broadening its program in collaboration with a strong international team composed of several partners with extensive experience in the measurements of greenhouse and reactive gases and aerosols.

During the year 2011, the new CHC Gaw Station will receive instruments for aerosols and atmospheric composition measurements by a "consortium" integrated by several Institutes from Italy, France, Switzerland, Germany and Sweden under the coordination of the Bolivian team at Lfa-Umsa.



A strong partnership has been created with EvK2Cnr Foundation, through an Agreement with the

University of San Andrés that will allow a fruitful exchange of scientists, students, instruments and data.

For further information on CHC, please visit the web page: [www.chacaltaya.edu.bo](http://www.chacaltaya.edu.bo)

\* Director of Laboratorio de Física de la Atmósfera', University Mayor de San Andrés, La Paz, Bolivia

# Share Everest Back to 8000 meters



## A new mission for EvK2Cnr Committee Targhet: repairing sensors at Share station Everest South Col

DI ELISA VUILLERMOZ

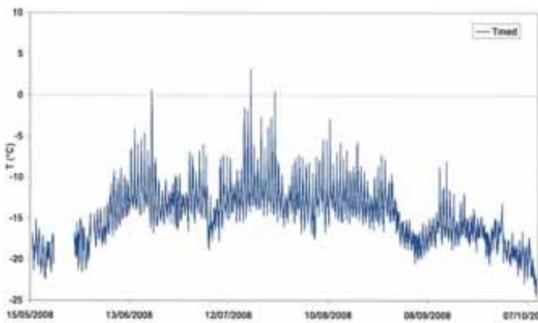
A new campaign to Mt Everest, for the re-establishment of the measurements at South Col, 8000 m a.s.l., has been planned for the spring 2011.

In May 2008, for the first time at such altitude, the sensors were installed by a mountaineering expedition for a feasibility test of continuous measurements and real-time data transmission to Italy. Thanks to the efforts of the Italian and Nepalese mountaineering team, the weather station was installed, and it allowed the continuous collection of T, RH, P, WD, WS, RG, UVA.

Considering the satisfactory outcome of this test, lasted over 6 months, it was then decided to re-establish the weather measurements by organizing a new mission to the Everest to re-position the instrumentation. So, in April 2011, an EvK2Cnr team of mountaineers, researchers and technicians will leave for Nepal to re-activate the South Col measurements.

The new station will be equipped with new, technologically-advanced sensors for the measurements of temperature, humidity, wind speed and direction, whereas the same sensors of the previous installation will be used for measuring pressure and radiation. Support and energy supply systems will be optimized, and the transmission system will be re-established, considering its good function-

ing during the test campaign. The aim of Share Everest 2011 will be to reactivate continuous weather measurements at 8000 m a.s.l., the only measurements at such altitude performed by a weather station on land. These data are of unique importance for both the scientific and the mountaineering communities, coming from a privileged location for weather monitoring and allowing, thanks to the integration of this information with the ones collected by the Khumbu Valley's Share network, the improvement of atmospheric circulation studies. These data will also integrate the forecasting data of Nepal's Department of Hydrology and Meteorology's Meteorological Forecasting Division, in their services for mountaineering expeditions.



Il grafico delle temperature registrate al Colle Sud dell'Everest

### Indoor pollution in the Khumbu Valley: Share-GARD cares for human health

The study of indoor pollution and its effects on the health of Khumbu Valley's populations are the focus of the Share-Gard project, launched by EvK2Cnr in collaboration with Nast (Nepal Academy for Science and Technology), the Kathmandu University and the Global Alliance against Chronic Respiratory Diseases (Gard). The project is coordinated by University of Ferrara's Annalisa Cogo, who has been cooperating in several Evk2Cnr's initiatives in various high-altitude areas in the world. Indoor pollution has been recognized as a pre-eminent health problem at global scale, especially

among rural populations in developing countries, where biomass burning for cooking and house heating is often associated with a bad ventilation of the buildings. Moreover, in developing countries and at high altitudes, the population's exposition to pollution is bigger. The pathologies directly correlated to pollution include some important respiratory, ophthalmological and cardiovascular diseases. Recently, Unep focussed its attention on the issue by promoting "The Global Alliance for Clean Cook Stoves".

Coordinator Annalisa Cogo,  
University of Ferrara

Interview SURENDRA SHRESTHA Director strategic resources Unep Nairobi

## Surya, the indian continent pollution will be defeated by ecological stove

**Abc Project is successfully entering in its second phase. What are the expected outcomes of the expansion of the activities in Africa and Latin South America ?**

Atmospheric Brown Clouds (Abcs) are regional issues with global significance. There is a need to develop the science and capacity in the developing countries to address this emerging issue. Building on the experience from Asia, Project Abc aims to enhance the science and capacity in Africa and Latin America through establishment of observatories, training of young scientists, and impact assessment.

**EvK2Cnr already collaborates with Unep within the Project and this partnership will continue in the second phase too. How relevant is the contribution of EvK2Cnr/Share in the field of high altitude research and monitoring for the Project ?**

Mountains, as one of the most fragile environments on the Earth, are vulnerable to the impacts of climate change and Abcs. Collaboration between EvK2Cnr's and Unep through the Abc / Share projects greatly enhanced the capacity building and availability of scientific information in Karakorum and Himalaya mountain regions. The contribution made by EvK2Cnr is very relevant and significant. This partnership should continue.

**How the collaboration between Unep and EvK2Cnr could contribute to increase the importance of mountain ecosystem as early indicators of climate change within the main international contexts like UNFCCC and Ipcc ?**

Scientific assessments and policy negotiations require time series data and information. The partnership between Unep and EvK2Cnr has already established a sound basis for generation of continues data and information on the mountain environment. Continuation of this partnership with expansion of geographical and temporal coverage together with national level capacity building activities will fill the data gap and contribute to the decision making process. It is likely that the 5th Assessment of Ipcc will focus on aerosols and black carbon making the collaboration even more relevant in the context of mountain ecosystems and climate change.

**Unep recently develop the new Project SURYA. Which have been the main achievement of the project pilot phase?**

Project was initiated, with Prof. Ramanathan as the Principal Investigator, to promote sustainable, pro-environment, pro-poverty, pro-health, pro-women action plan, infrastructure and technologies to switch to cleaner technologies such as efficient cooking stoves. Project Surya has successfully implemented a pilot phase in a rural village in India to field test the approach to cleaner cooking technologies and data collection on climatic and health benefits and socio economic parameters. The results of the pilot phase shows that local fabrication of cleaner cook stoves combined with solar lighting system provides

significant environmental and socio-economic benefits. **How the Project will develop and where?**

Building on the success in the pilot phase in India, project Surya will continue to focus on developing knowledge concerning mitigation measures for Black Carbon and other related substances in the context of health benefits and climate change mitigation. Pilot testing and demonstration phases will be implemented in other developing countries in Asia, Africa, and Latin America.

**Unep with Abc and Surya is concentrating a big effort in black carbon monitoring. Which have been the main results achieved within the impact of BC on the environment?**

Project Abc is an initiative that integrates science, impact assessment, regional capacity building and mitigation measures to address emerging regional atmospheric issues, such as black carbon, and issues related to increasing air pollution. During the last 10 years, project Abc has contributed remarkably to regional capacity building, including much-needed physical infrastructure to monitor a broad range of atmospheric parameters that helped understand the science and likely impacts of Abcs. In addition to enhanced capacity and science to address the issue of Black Carbon under an integrated framework, the project has also greatly contributed to placing the Black Carbon issue on the political agenda in many countries and international negotiations.







Interview ELISA VUILLERMOZ EvK2Cnr Committee research

# Data for new projection models are needed

BY SARA SOTTOCORNOLO

“Mountains are a fundamental source of natural resources, and they represent fragile ecosystems, particularly vulnerable to environmental changes. Here in Cancun there are several events devoted to the high altitudes, an evidence of the ever growing interest of the governments for the mountains, but, for their safeguard, specific initiatives based on reliable data and information are needed”. This is the comment of Elisa Vuillermoz, head of EvK2Cnr scientific projects, about the Cancun COP16, in Mexico, where she was present together with Paolo Bonasoni, Share Project Manager, at the side event “Mountains in Peril – Mainstreaming the sustainable mountain development agenda into climate change agreements”. **Elisa, yesterday the first meeting about the mountains at the COP16: a comment?**

The event, coordinated by Icimod, mostly dealt with adaptation and mitigation strategies in the Hindu Kush Karakorum Himalaya (HKKH) mountain areas, presenting the Nepalese, Indian and Bhutanese governments’ actions and interventions, after the presentations of the scientific results on climate change, in the fields of atmosphere, glaciology and biodiversity. It was an important meeting point, perfect to share information among research

ers and local administrations, which also brought fruitful results also for Central Asian representatives who, at the end of the Icimod side event, presented the results and the initiatives in the countries of Tajikistan and Kyrgyzstan.

**EvK2Cnr took part in the side event presenting its researches on the pollutants over the Himalayas. Why are these researches important?**

Our intervention concerned the threat that black carbon and ozone can have on the mountains. Such polluting compounds are found in high concentrations in the atmosphere and they enhance its warming, thus contributing to ‘global warming’ like the CO<sub>2</sub>, the main greenhouse gas. These two compounds can also be harmful for human health and the environment, agriculture included. More, black carbon plays an important role in the direct impact on glaciers and indirect impact on the precious water resource. In fact, the presence of high concentrations of black carbon at high altitudes, as monitored by EvK2Cnr at the Nco-p Gaw station, close to the Pyramid on the Everest, leads these highly-absorbing particles to deposit on Himalayan glaciers, thus reducing their reflectivity, and causing the higher solar radiation absorbed to hasten the glaciers’ melting. The four years of black carbon and ozone measurements at the Nco-p, presented during yesterday’s side event, represent an important asset for the

Himalayan area, as they prove as high concentrations of pollutants can reach the high altitudes in the so-called “Third Pole”. As opposed to the CO<sub>2</sub>, which remains in the atmosphere for over a century, black carbon and ozone are short-lived compounds which remain in the atmosphere for limited periods, of the order of weeks or months. This is important because, with an effective work for limiting and cutting down these pollutants, it is possible to affect the global warming processes.

**Do you think that this year there is more attention for the mountains, at the COP16?**

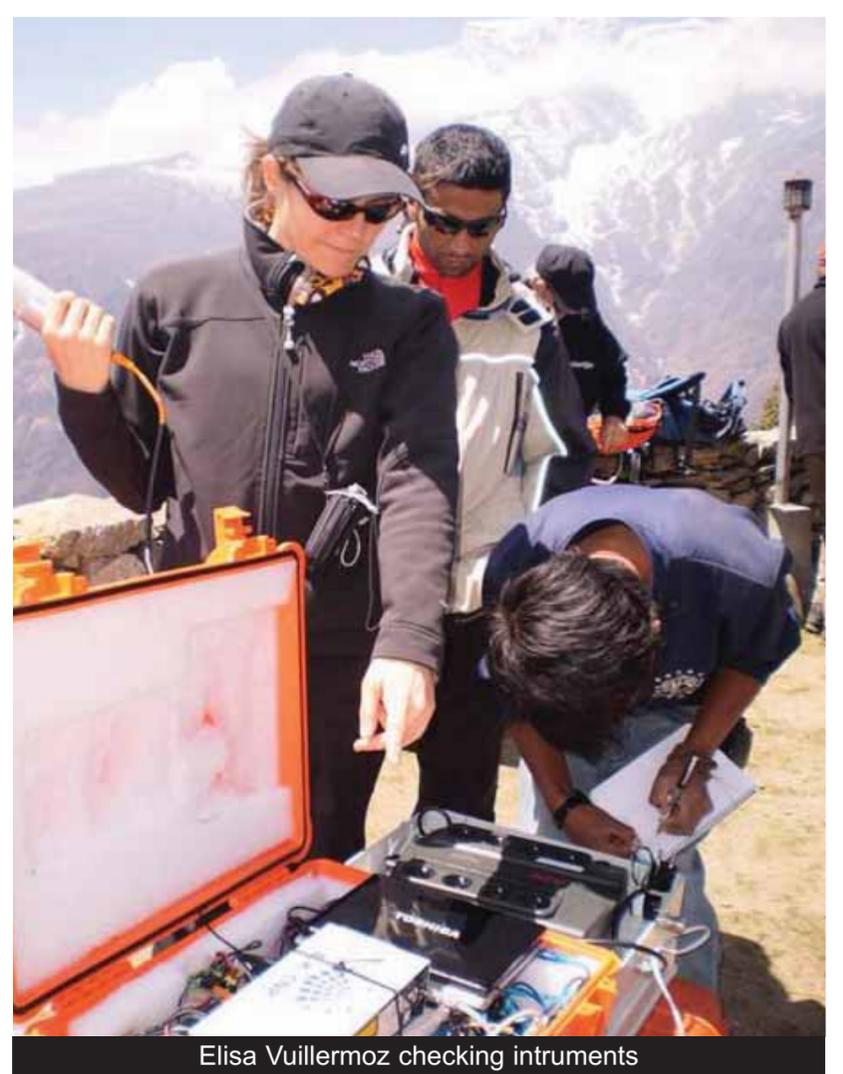
It is difficult to say, for now: it is necessary to wait for the COP16 final decisions, to assess whether the “mountain” topic is included in the final declarations. Surely, here in Cancun there are several side events and exhibits devoted to high-elevation areas, and this is a proof of the growing interest and above all the will of local governments for action, intervention and mitigation plans.

**What role do EvK2Cnr projects play in the fight against climate change? What are Share’s next steps?**

EvK2Cnr has invested a lot in the Share (Stations at High Altitude for Research on the Environment) project, which defines an integrated observational system related to multi-disciplinary researches performed at high altitudes for climate variability and its changes in time. This system is based on cli-

mate observations which, over the last few years, have been performed at the Nepal Climate Observatory – Pyramid, at the Cnr Station Vittori at Monte Cimone, on Baltoro glacier in Pakistan and on the Fomi glacier in the Stelvio National Park, together with the weather information collected throughout the Khumbu valley or close to the Rwenzori glacier in Uganda, water analyses in the Himalayan lakes, but also on the recent investigations for activating a Himalayan seed bank and for studying biodiversity in the Sagarmatha National Park. The Share observation system is structured for collecting precious information in areas where performing measurements is very difficult: this represents an added value to the researches themselves. Among Share’s next steps the start up of Paprika must be mentioned: it is an Italian-French joint project devoted to the study of the cryosphere in HKKH; more steps are the finalization of the Himalayan Seed Bank, the setting up of a climate observatory in Pakistan in the frame of the Unep-Abc project and the start up of the field tests of the Share-box, a platform for the measurement of atmospheric compounds to be used at high altitudes, but not only there. All this is ongoing, but we shall also mention the keeping up of present activities, which are of great importance for national and international climate studies.

**At the COP16 the Mountain**



Elisa Vuillermoz checking instruments

**Initiative has also been presented. Briefly, what is it and what is the importance of such initiatives?**

The Mountain Initiative is a coordination system promoted by the Nepalese Ministry of Environment, with the aim of creating an alliance among the high-altitude countries in the fight to climate change. To reach this objective, the programme has constituted an expert group coordinated by Icimod which contributes both the necessary scientific information for understanding impacts and effects of global warming on mountain ecosystems, and the definition of adequate mitigation and adaptation policies. **Why do the mountains need a specific agenda for climate change and sustainable development?**

Mountains are a fundamental source of natural resources, and they represent fragile ecosystems, particularly vulnerable to environmental changes. The multiplicity of factors affecting dynamics and processes in these areas make it necessary to define sustainable resource plans and the lack of scientific observations at high altitudes make it necessary to design specific and dedicated strategies to safeguard these environments.

**At the COP16 the site “Mountains in the Climate Change Agenda” (<http://cop16.mtnforum.org>) was presented. What’s its role?**

It is a site realized by the Mountain Partnership through the Mountain Forum in order to gather all information related to

COP16 mountain initiative, and to summarize the main results. It will be important, at the end of the conference, to summarise the main results emerged, thus promoting the importance of the mountain in an international environment, also considering next year’s IYM.

**How is EvK2Cnr involved in the Government of Nepal side event of December 4th?**

EvK2Cnr was invited to the event as a member of the scientific expert group of the Mountain Initiative: this will permit to EvK2Cnr to share the results of its scientific researches performed in HKKH, thus consolidating the relationships with the institutional representative of the Nepalese government and of the Ministry of the Environment in particular.



# Side event “Mountains in peril”

BY ANDREA CHIODI

“Mountains are disproportionately vulnerable to climate change, because of the quicker temperature rise at high altitude, a phenomenon which is accelerating glacial melting and which exposes the mountains to even more extreme weather events”. These are the words uttered by Madhav Karki, vice-director general of Icimod (International Centre for Integrated Mountain Development), to introduce the ‘Mountains in Peril: Mainstreaming the Sustainable Mountain Development Agenda into Climate Change Agreements’ side event, held at the Cancun COP16, in Mexico, on December 2nd. All speakers agreed on the need of teaming up to prevent the risk that the mountains remain a marginal issue in international negotiations. The side event organized by Icimod and by the Nepalese Ministry of Environment, gathered experts, from both private and governmental organizations, who work on the issues of climate change in the Himalayas, with the aim of putting the mountains in the agenda of the greats of the Earth for the definition of strategies for sustainable development, risk management and adaptation. All mountain countries are called to take part in the Mountain Initiative promoted by the Nepalese Government. Karki, introducing the side event, discussed the issue of the gap of information about climate change impacts in mountain regions, especially in the Himalayas, and he highlighted how climate change at high altitude should be encompassed by the Rio Conventions, the Convention for Biological Diversity (CBD) and the UNFCCC Climate Convention. Paolo Bonasoni, on behalf of

EvK2Cnr and Nast, discussed about black carbon and ozone, which are considered as two of the most important pollutants contributing to global warming. Matthias Seebauer (Germany) of UNIQUE Consultancy and Nabaraj Dahal (Nepal) talked about the Redd project for the forests, applied to

some Himalayan villages. Bhutani Tashi Jamtsho underlined the need of an immediate action and he talked about ‘The Climate Summit for a Living Himalayas’, scheduled in Bhutan in October, in which he plans to establish a common adaptation strategy for south-eastern Himalayas

countries, such as Bhutan, Bangladesh, India and Nepal. “In the Himalayas climate change impacts are manifesting very rapidly – he said – and the time for reaction is running out”. Karumuri Ashok of the Indian Institute of Tropical Meteorology presented an overview of researches on

the changes in Himalayan climate, summarizing some interventions enclosed in the Indian National Action Plan on Climate Change Himalayan Mission. Batu Krishna Uprety, Ministry of Environment of Nepal explained how his country is working towards initiatives to face climate

change impacts, from the National Adaptation Plan of Action (NAPA), declined in several local plans, to the Mountain Initiative, in which all mountain countries would hopefully be involved, be they developed or less developed countries. “These interventions show

the importance of a common and transboundary approach. – said John Drexhage of IISD – Because of its global approach, the Mountain Initiative, in particular, is fundamental so that the mountains are not relegated to a marginal role in international negotiations”.

Interview Bhaskar Karky and Madhav Karki Icimod

## Mountain Initiative: searching a common front

“Mountains in peril” was the first event dedicated to the mountains in this Cop16. Could you give us a comment?

The objective of this side event was to highlight the heightened risk mountain populations and ecosystems are facing due to emerging challenges brought about by climate change. Mountain specificity and the fragility of mountain environment need more emphasis in the UNFCCC processes. Mountain communities, globally, are exposed to environmental and non-environmental stresses which have serious repercussions not only to the mountain populations, but also downstream populations. The side event was first such opportunity for Icimod to bring global speakers to highlight the specific vulnerability and risks mountain systems are facing due to Climate and global changes in a global forum. It provided a common floor to Icimod partners to reflect on their work and offer solutions and recommendations for reducing the adverse impacts of climate change based on our joint research work and pilot projects to the party and other delegates of the COP16.

What are, in your opinion, the pressing risks and the possible solutions for the mountains in a changing climate?

First and foremost, mountains are characterised by inherent natural hazards and marginal farmers that are dependent on natural resources and subsistence-based biomass economy. They are disproportionately exposed to the vagaries of nature and consequently face higher risk factors. In order to reduce this risk, more emphasis needs to be given to a new development paradigm that considers the mountain specificities – marginality, fragility and inaccessibility. All development endeavours need to be climate proofed or climate risk screened. Sustainable Mountain Development agenda must dovetail with climate resilient development interventions. Local actions must be tailor made keeping in mind the unpredictable changes in precipitation and temperature due to global emissions.

What is the aim of such an initiative, organized by Icimod and Government of Nepal?

ICMOD is providing technical support to the Mountain Initiative started by the Government of Nepal. The purpose of the Mountain Initiative is to generate scientific basis on better understanding of the climate change scenarios and drivers in the mountains and to provide mountain specific measure to mitigate the adverse impacts. There is a dearth of knowledge especially on the tropical mountains including the Glaciers. Mountain Initiative is expected to generate knowledge for the countries to be able to reemphasize the role of mountains not only in the multi-lateral environment agreements, but also at the national and regional levels.

What is the role of EvK2Cnr in this context?

The EvK2Cnr and its contributions in the scientific arena are unequivocal. We have already witnessed the unfounded report on Himalayan glacial melt published by the Intergovernmental panel on Climate Change. The scientific studies conducted by EvK2 on glacial melt and black carbon can assist countries in the Hindu-Kush Himalaya region to rely on data with lower uncertainty levels. As the HKH regions gear towards designing adaptation and climate resilient development pathways, understanding climate changes impacts are a prerequisite. EvK2Cnr’s research work and generated data and information can be very useful to support such goal.

Among the several researches within the Share project, which are the ones you believe more immediately important for the Mountain Initiative?

Based on the first International Expert Consultation meeting for Mountain Initiative held in Kathmandu on 23-24 Sept 2010, the Expert Group has come up with Mountain Initiative Status paper which has identified numerous climate change challenges for the mountains. Revisiting the Mountain Agenda, research related to cryosphere and black carbon, regional cooperation on adaptation are some of the most urgent topics.

Yesterday, EvK2Cnr spoke about black carbon researches and its environmental impacts: what are the MI priorities in this issue?

The effect of black carbon on snow and ice needs to be better understood with higher certainty. Once this relationship is understood, measures to reduce its impact and curbing emission at source can be identified.

Do you believe MI, as the first common initiative of mountain countries, can yield concrete results for mountain people?

The Mountain Initiative is indeed a very timely and important step Nepal has taken being a premier mountain country. It has both technical and strategic objective, but first and foremost getting the foundation from technical and knowledge point of view is very important. Icimod wants to work purely from technical point of view creating a repository of scientific and technical knowledge for better sharing and understanding the science behind climate change in the mountains by the mountain country stakeholders. It is for the countries that are Parties to the multi-lateral environment agreements (MEAs) to use this knowledge in a way that can mainstream the Mountain Agenda for the benefit of mountain environment and populations in the UNFCCC and other processes.

How was the MI born?

During the COP-15 at Copenhagen, the Prime Minister of

### What is the Conference of Parties?

COP, or Conference of Parties, is an occasion where Countries are called to debate about International agreements related to different themes, first of all the issues concerning climate change. Since 1990, Governments of all Member States meet annually at the Conference of Parties in order to analyze and evaluate the adopted strategies to face climate changes, to negotiate the Kyoto Protocols, to establish legally binding actions for developed countries directed towards the reduction of their greenhouse gases emissions.

The Conference of Parties, now is at the sixteenth edition, is celebrated annually between the months of November and December. In 2010, the Conference took place in Cancun, Mexico, and was organized in accordance to the rules that regulate the United Nations meeting. “Parties” refers to all the national states that signed and ratified both the Framework Convention and the Kyoto Protocols, committing to observe and comply with its terms regarding international cooperation against climate change.

The United Nation Framework Convention on Climate Change has been signed by 194 States Parties whereas the Kyoto Protocol has been ratified by 184 States Parties. In accordance to Article 7 of the Convention, the Conference of the Parties, as an authority of the supreme body, has the mandate to adopt the necessary decisions for the promotion of its effective application.

Madhav Karki



Nepal called on all the mountain countries and stakeholders to come together, and form a common platform to ensure that mountain concerns get the due attention in the international deliberations. The PM had said “Let us make sure that our interests are prominently

represented in future COP negotiations and let us make sure that our efforts of adaptation get the required international support”. After COP 15 meeting, GON requested iCIMOD to provide technical support to their Ministry of Environment in taking this concept further into implementation. Icimod in discussion with various local, regional and global stakeholders decided to move this concept further in the form of Mountain Initiative other MI. Was it difficult to gather all the mountain countries of the world? Why?

Yes, it is not an easy task. So far the progress has been encouraging. Icimod and the GON so far have organized two side events – one at Bonn and other in Cancun) and the first International Expert Consultation meeting. More than 20 countries have already participated in these meetings including numerous expert institutions such as the Mountain Partnership Secretariat (FAO) and International Institute of Sustainable Development and the World Bank. A Technical Working Group for the MI has been established. The MI is moving purely as a technical initiative to generate mountain related scientific literature, case studies and knowledge. For formation of an alliance of Mountain countries, it remains the prerogative of the mountain countries.

How do you think this initiative will grow?

For now, this initiative will move forming strong technical forum and doing knowledge networking to review the gaps in knowledge and understanding. Icimod intends to make its knowledge and information base to all the mountainous countries and initiatives for gaining better understanding of different and complex aspects of climate change in the mountains and find solutions on how mountain inhabitants can better adapt to this change. More importantly, the Mountain Initiative aims to educate the global community the importance of mountains of the World as being the Water towers of the World, repository of rich biodiversity, destination of unique landscape and place of adventure and last but not the least, the harbinger of climate change.



# Black carbon and ozone threats for mountains and glaciers

EvK2Cnr took part at COP16 in Cancun, showing the scientific results achieved thanks to the long-term observations carried out at Pyramid Laboratory-Observatory, located at 5.050 m a.s.l. in the Himalayan region of Nepal. Paolo Bonasoni, as Project Manager and Elisa Vuillermoz, as Executive Coordinator of the project, participated at the side event "Mountains in Peril". The intervention, carried out in collaboration with Nast focused its attention on black carbon and ozone effects in mountain regions. In the occasion Paolo Bonasoni stressed that these two pollutants, if present in high concentrations in the atmosphere, favor atmospheric warming, thus contributing to "global warming", as much as CO<sub>2</sub>, the main greenhouse gas. BC and ozone are also able of producing damage to human and environment health.

BC has a direct impact on glaciers and acts indirectly on water. In fact, as observed by researchers at the Nepal Climate Observatory - Pyramid, near the EvK2Cnr Pyramid, the presence of high concentrations of black carbon in mountain regions brings this dark-coloured and highly-absorbing particulate to deposit on the surfa-

ce of Himalayan glaciers, reducing the reflectance conditions and increasing the amount of solar radiation absorbed, thus favouring a precocious melt of them.

The results achieved during the first four years of measurements of BC

and ozone by Nco-p were presented during the "Mountain in Peril" side event: they represent unique information for Himalayan Area, and show as high polluting concentrations can also reach the "Third Pole" peaks.

Moreover, during this

occasion the differences between CO<sub>2</sub> and BC were underlined: in fact, CO<sub>2</sub> remains in atmosphere for about one century, whereas BC and ozone are compounds with a shorter life than CO<sub>2</sub> and so they stay in atmosphere for more limited periods, of the

order of some days or weeks. This aspect is extremely important: if we work together for containing and reducing these pollutants in atmosphere, there is the possibility to produce positive effects and contrast global warming.

**Cop16**  
*The EvK2Cnr Committee and Nast at the Icimod-Gon Side Event*

## Why Mercury?

Mercury is a natural component of the earth's crust. The metal is released into the atmosphere from several natural sources, including volcanic eruptions, geothermal activities, forest fires and weathering of rocks, besides human activities. Among the anthropogenic sources, mercury is released to the atmosphere from fossil fuel-powered plants, primary and secondary smelters for non-ferrous metal production, incinerators of solid wastes, gold mining activities and from a variety of industrial processes, such as chlor-alkali industry, refineries of crude oils and paper production processes. On an annual basis, nearly 7500 Tons of mercury are released to the atmosphere, including 2300 Tons from major anthropogenic sources and 5200 Tons from natural sources and re-emissions processes. On global scale, emission trend is growing, especially in Asiatic countries that represent nearly 40% of global emissions. Once in the atmosphere, having a residence time of 6-12 months, it can be transported for long-distances before it is deposited on terrestrial and aquatic ecosystems, causing a significant impact on food chain.

## Global Mercury Observation System - Gmos: a new international project at the Nepal Climate Observatory - Pyramid

BY NICOLA PIRRONE\*

The Global Mercury Observation System (Gmos) ([www.gmos.eu](http://www.gmos.eu)) is a five year project (2010-2015), funded by the European Commission 7th Framework Programme (DG Research) and involves 24 partners worldwide; it is coordinated by the Division of Rende of the Institute of Atmospheric Pollution Research of the Cnr ([www.iaa.cnr.it](http://www.iaa.cnr.it)). Gmos is aimed to establish a worldwide observation system for the measurement of atmospheric mercury in ambient air and precipitation samples. Gmos will include ground-based monitoring stations, shipboard measurements over the Pacific, Indian and Atlantic Oceans and European Seas, as well as aircraft-based measurements in the UTLS in cooperation with the Caribic program. The understanding of che-

mical and physical processes at different altitudes and latitudes and the improvement of our knowledge related to vertical profiles of mercury concentrations with changing mercury emissions and oxidation potential of the atmosphere is one of the main goals of Gmos. Among the high-altitude ground-based sites, the Cnr Institute of Atmospheric Pollution Research is in charge to establish a permanent site at Nepal Climate Observatory - Pyramid (Nco-p, 27.95 N, 86.82 E) located at 5079m a.s.l. in Sagarmatha National Park, in the eastern Nepal Himalaya, near the Pyramid EvK2Cnr International Laboratory and not too far from base camp area of Mt. Everest ([evk2.isac.cnr.it/](http://evk2.isac.cnr.it/)). The observational data from this high-altitude site part of the Share - Stations at High Altitude for Research on the Environment - network, will

provide a very important contribution to our understanding of chemical and physical processes affecting the dynamic of mercury on hemispheric and global scale and its impact of aquatic and terrestrial ecosystems. This is particularly important for Italy because in addition to the coordinating role of Italy

in Gmos, the European Commission recommended to the European Parliament to consider Gmos as reference infrastructure and program for the implementation of the future international treaty on mercury that is currently under preparation in the framework of the activity of the Unep Mercury

Programme which will be submitted for consideration to the next Governing Council of Unep planned for 2013

(<http://www.unep.org/hazardoussubstances/Mercury/tabid/434/Default.aspx>).

\*Director of Institute of Atmospheric Pollution - Cnr



# Monte Cimone climate studies



BY ANGELA MARINONI

For evaluating the global state of the atmosphere and providing indications about changes in the average concentrations of atmospheric compounds and their variability, it is necessary to carefully investigate the tropospheric background conditions. In fact, only continuous observations in background conditions can provide reliable information on long-term variations of the tropospheric properties, also representing a valuable resource for early-warning purposes. Mountains are often characterised by large "areas of representativeness" and by "clean" conditions, thus these locations are considered useful for studying the background state of the troposphere. Moreover, at these measurement sites the monitoring of trace gases and aerosol properties can also provide reliable information on pollution levels. Similar activities appear to be particularly important for the Mediterranean basin, a region sensitive to climate change and affected by elevated anthropic and natural emissions of aerosol and trace gases as well as to long-range transport of pollutants (even from other continents).

At Monte Cimone (2165m asl), the highest peak of the Italian Northern Apennines, the Institute of Atmospheric Sciences and Climate by the National Research Council of Italy, manages the Italian Climate Observatory "O. Vittori" (ICO-OV). This station, part of the Share network, is hosted within the infrastructures of the Italian Air Force Meteorological Service (IAF-MS) Observatory. The long-term scientific programmes running at ICO-OV are made possible thanks to the collaboration with the Chemistry Institute of Urbino University, the Environmental Radiochemistry Laboratory by

the Bologna University, ARPA Emilia-Romagna, Emilia-Romagna Region, the Joint Research Centre (Ispra), the Cnr - Lgge (Grenoble) and the IAF-MS. Thanks to the high quality of data and the large number of atmospheric observations here carried out, the ICO-OV scientific activities were included within several national and international research projects.

The ICO-OV is the only measurement site in Italy which provides surface ozone data to the Global Atmospheric Watch (Gaw) programme of the World Meteorology Organization (Wmo): this time series, started in 1996, represents the longest ozone record available in background conditions for Italy. Recently, in collaboration with ARPA Emilia-Romagna, SO<sub>2</sub> and NO<sub>x</sub> continuous measurements have been also started at the ICO-OV. This station is one of the 20 "European Supersites" devoted to the study of atmospheric aerosols within the UE-project EUSAAR (European Supersites for Atmospheric Aerosol Research) and, starting from 2001, the ICO-OV will be also part of the EU-project ACTRIS (Aerosols, Clouds, and Trace gases Research Infrastructure Network) that will be focused on integrating a high-quality European research network for the investigation of climatic and environmental issues related with atmospheric aerosols, volatile organic compounds and nitrogen oxides.

At the Mt Cimone station, continuous measurements of a number of climate-altering gases are also carried out, such as those included in the Kyoto Protocol (methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons) and those regulated by the Protocol Montreal, such as CFCs, HFCs, chlorinated

solvents and methyl bromide. Also carbon monoxide, an important tracer of pollution and anthropogenic emissions of fires, and other halogenated compounds are monitored at ICO-OV. These measurements, carried out thanks to the collaboration with the Institute of Chemistry of Urbino University are associated to the global monitoring network AGAGE (Advanced Global Atmospheric Gases Experiment)

An important aspect of the experimental activities at ICO-OV, is related to the development of technology solutions which allow to perform continuous high-quality measurements despite the adverse weather conditions - high wind speed and large ice rimming - often characterizing the

measurement site. Since the station is completely automated, most of the equipment is remotely controlled directly by the Cnr in Bologna by using a satellite broadband connection provided thanks to a synergy with the Emilia-Romagna Region and the Skylogic company. This allows the real-time monitoring of the data, verifying their correctness and allowing timely action in case of malfunctions.

During more than 14 years of activity, the researches performed at the ICO-OV led to a better understating of the role played by different atmospheric processes in determining the background properties of atmospheric aerosol and trace gases over North Italy and the

Mediterranean Basin, a region particularly affected by anthropogenic climate change. In particular, due to several implications in meteorology, air quality and climate change issues, the analysis of the atmospheric aerosol represent a key action. For example, within a study performed in collaboration with APRA-Emilia-Romagna, the 8-year activity of ICO-OV Saharan dust transport monitoring, has recently allowed to point out a possible relationship between the occurrence of such events and health effects on population. The monitoring of the black carbon, an aerosol component able to influence air-quality and regional climate by absorbing solar radiations and changing cloud pro-

erties, is carried out at ICO-OV since 2005.

The assessment of the contributions played by natural and anthropogenic processes in affecting the ozone concentrations over North Italy and the Mediterranean basin (e.g. intrusions of stratospheric air masses, polluted air-mass transport, summer heat waves, biomass burning) is a further key activity conducted at the ICO-OV. In fact, this compound plays a fundamental role in determining the oxidative capacity of the atmosphere and it is also an effective greenhouse gas. Moreover, because of its high oxidizing power, high concentrations of this gas are harmful to ecosystems and can lead reduction of agricultural yields.

Moreover, thanks to the implementation of a near-real time monitoring technology, the observations carried out at the ICO-OV can be profitably used in activities of early-warning. As a recent example, the aerosol physical properties observed at Mt. Cimone allowed the exact detection of the volcanic plume connected with the explosive eruption of Eyjafjallajökull (Iceland) over North Italy during April and May 2010. A more complete overview and the bibliography of the researches conducted at the ICO-OV are available at the web site [www.isac.cnr.it/cimone/](http://www.isac.cnr.it/cimone/), where also on-line data of atmospheric composition, meteorological parameters and solar irradiance are reported.

## It is written 'Share' and it means data sharing

To create an information system where data and metadata could be shared through specific web services, is one of the main objectives of Share Project within its work package dedicated to the spreading of the information.

Gathering and shared initiatives, concerning environmental data, organized in scientific and accessible databases, are multiple and technologically diversified. Currently, there is not a unique access point, able to spread environmental data and information concerning researches on high altitude areas, considering also the growing interest to access data and information collected by high altitude stations and to environmental data acquired and processed by the researchers. The big size of gathered information is distributed over dedicated websites, which support several initiatives, and create relevant thematic networks. In particular the main program are Project Atmospheric Brown Clouds (Abc) of Unep, Aerosol Robotic Network (Aeronet) of Nasa, and both following programs, Coordinated Energy and water cycle Observing Project (Ceop) and Global Atmosphere Watch (Gaw) of Wmo.

Today, without a doubt, the conceptual pattern, which is receiving more consent, is Inspire (Infrastructure for Spatial Information in Europe). Its architecture is rich of multiple services: Registry Service, Discovery Service, View Service, Download Service, Processing Service, etc., which are well adapted to manage geographical data, and service metadata. Thanks to all this, it is

possible to gather and store data safely; share and combine information gathered on a different scale, so to execute specified surveying for preservation and management; make the gathering of a data set easier, know how to use it in order to satisfy a specific need; get available data, which have been spread in a standard way.

The main characteristic of ecological data, even referring to those not gathered within the sphere of EvK2Cnr and Share, is that they do not completely contemplate the standards proposed at European level (long time trend, distribution towards the three dimensions, etc.)

For this reason, different conceptual patterns and architectures are developing new standard spreading systems, at European and International level.

The most important one is the European Gmes program (Global monitoring for environment and security), whose main objective is to get data available.

Further the EvK2Cnr Committee, this initiative is also supported by Cagliari University, L'Aquila University (Cetemps), Unep and Icimod.

The main objective of the information system, Share, is to generate a data sharing web system, based on standardized data, concerning high altitude areas, and including the structured list of information (metadata) and access to them, through specific research and authentication proceedings.

Whilst the operative objective of the project is to install the Geonetwork focal point, on

the premises of EvK2Cnr, in Bergamo, with the concrete possibility for the subscribers to install subsystems based on the same technology, such as the Share focal points, which will include data and metadata linked to the main focal point.

Each Geonetwork focal point will manage a specific area, that is why it is important to lead the inquiry on all focal point, simultaneously, by mean of a "distributed" research through an Internet connection.

The previous experiences show how the use of Geonetwork is definitely difficult into remote areas, such as Africa or Asia, due to the reduced connectivity: this barrier will be partly reduced through a metadata collection process and their local recording, in order to reach a "faster" access.

Within the sphere of Share project, it is required to gather information related to existing data; identify the exigencies of each partner, for data and metadata recording; make the specific recording system for ecological and biological data, by mean of standard languages; realize a recording, spreading and visualization system, standardized to the suggestions of Open geospatial consortium (Ogc) and Gmes, concerning data gathered by sensors, which convert any quantity into a signal, to be translated by an observer or by a tool; implement a Spatial Infrastructure of Data, related to mountain and/or remote environments, where it is possible to carry out all operations foreseen by the directive Inspire, and by other existing initiatives.