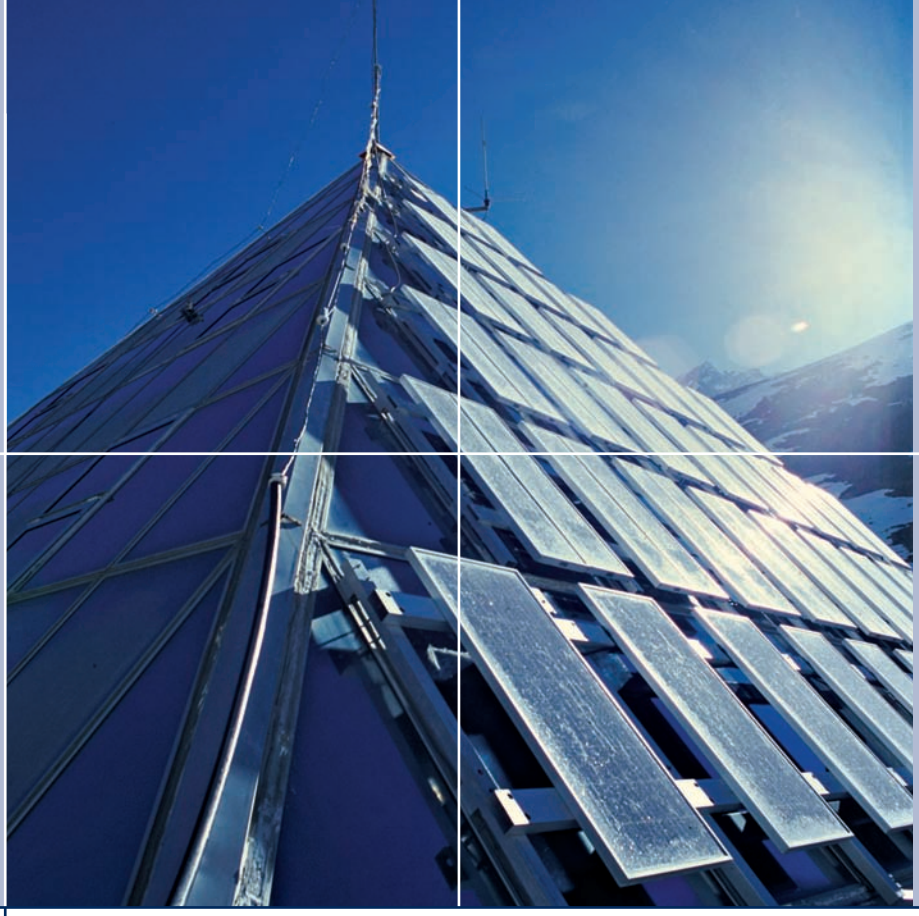


Ev-K2-CNR

Research Project
2008-2010

EvK2CNR

Unità di Ricerca
EvK2CNR

Index

List of **Acronyms**

	Ev-K2-CNR ACTIVITY
EARTH	Ecological Activity for Refuse Treatment at High Altitude
GEMM	Gulf Environmental Monitoring and Management
KT	Karakorum Trust
NATUR*Energy*	New Advanced Turbo Utilization of Renewable Energy
NCO-P	Nepal Climate Observatory - Pyramid
SHARE	Stations at High Altitude for Research on the Environment
	INSTITUTIONS/ORGANIZATONS
ACP	Alpine Club of Pakistan
AKRSP	Aga Khan Rural Support Programme (Pakistan)
CESVI	Cooperation and Development (Italy)
CKNP	Central Karakorum National Park (Pakistan)
CKNPE	Central Karakorum National Park Ecosystem (Pakistan)
CNR	Italian National Research Council
CNR-DTA	Earth and Environment Department - Italian National Research Council
DHM	Department of Hydrology an Meteorology (Nepal)
DNPWC	Department of National Parks and Wildlife Conservation (Nepal)
EPA	Environmental Protection Agency (Kuwait)
GCC	Gulf Cooperation Council
ICIMOD	International Centre for Integrated Mountain Development
IDPA	Institute for the Dynamics of Environmental Processes (CNR)
ISiAO	Italian Institute for Africa and East
IUCN	The World Conservation Union
KANA	Kashmir Affairs and Northern Areas Affairs (Pakistan)
KISR	Kuwait Institute for Scientific Research
KIU	Karakurum International University (Pakistan)
MAE-DGCS	Italian Ministry of Foreign Affairs – Italian Cooperation
MGPO	Mountain and Glacier Protection Organization (Pakistan)
NAST	Nepal Academy of Science and Technology
PMD	Pakistan Meteorological Department
QNP-TAR	Qomolangma Nature Preserve – Tibetan Autonomous Region of China
RSNP	Rural Support Programmes Network (Pakistan)
SNP	Sagarmatha National Park (Nepal)
SPCC	Sagarmatha Pollution Control Committee (Nepal)
UNEP	United Nations Environment Programme
WMO	World Meteorological Organization
WWF	World Wildlife Fund
	PROJECTS / PROGRAMS
ABC	Atmosphere Brown Clouds
CEOP	Coordinated Energy and Water Cycle Observation Project
CEOP-HE	Coordinated Energy and Water Cycle Observation Project – High Elevation
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
GAW	Global Atmosphere Watch
GEWEX	Global Energy and Water cycle Experiment
ILTER	International Long Term Ecological Research – Network
WCRP	World Climate Research Programme
	OTHERS
AWS	Automatic Weather Station
BTC	Bilateral Technical Committee
COPD	Chronic Obstructive Pulmonary Disease
DSS	Decision Support System
GIS	Geographic Information System
GLOF	Glacial Lake Outburst Flood
GPS	Global Positioning System
HKKH	Hindu Kush – Karakorum - Himalaya
KB	Knowledge Base
NGO	National Resources Managing
QA/QC	Quality Assurance / Quality Control
RO KTM	Representative Office – Kathmandu
RO PK	Representative Office – Pakistan
SAR	Synthetic Aperture Radar
WSSD	World Summit on Sustainable Development

Executive **Summary**

Ev-K2-CNR's vision is to be recognized for its contributions to the resolution of complex global problems concerning the environment, health and socio-economic development. The Ev-K2-CNR specialization lies in its capacity to work systemically using knowledge generated within a multidisciplinary framework while promoting the dissemination of science. Years of research have led to the development of a unique expertise in the application of practical solutions in complex situations. Ev-K2-CNR combines lessons learned through science with innovation to promote sustainable strategies for safeguarding the environment and improving the quality of life with a special focus on one of the world's most vulnerable and most valuable resources: ***mountains.***

Ev-K2-CNR is a 20-year old institution of multidisciplinary high altitude scientific and technological research built upon a tradition of Italian exploration in the Karakorum and Himalaya. It was one of the past century's most renowned scientists and explorers, Prof. Ardito Desio, who founded the organization and who, at the age of 90, personally inaugurated the famous International Pyramid Laboratory-Observatory located in Nepal near Mt. Everest (5,050 m a.s.l.) run by Ev-K2-CNR and the Nepal Academy of Science and Technology (NAST).

Research performed by Ev-K2-CNR generally encompasses fields such as: Medicine and Physiology; Environmental Sciences; Earth Sciences; Anthropological Sciences and Clean Technologies. Significant efforts have also been made towards the capacity building of researchers and scientific institutions in the developing countries where Ev-K2-CNR works. Recent years have seen Ev-K2-CNR focusing more on the tangible outputs of its research efforts, moving beyond the generation of knowledge to the application of that knowledge on a management and decision-making level. Thus, contributions can be made to the resolution of major global or local problems, such as the impact of climate change on fragile mountain ecosystems and the urgent need for sustainable management of the world's precious resources like water, energy and food.

Unable to meet such a task alone, Ev-K2-CNR has expanded its national and international collaborative network. Expertise is drawn from numerous institutes of the Italian National Research Council (CNR) and Italian universities, while dozens of international organizations, Non Governmental Organizations (NGOs) and INGOs have chosen to partner with Ev-K2-CNR in recognition of the quality and specificity of the organization's work.

In Italy, Ev-K2-CNR is principally affiliated with CNR. An External Research Unit of CNR, under the Earth and Environment Department has recently been instated at Ev-K2-CNR to consolidate promotion of their activities.

In the coming three-year period 2008-2010, Ev-K2-CNR will continue to promote its main integrated research projects:

- **Stations at High Altitude for Research on the Environment (SHARE)** which generates unique information for helping face the challenges posed by climate change. Interdisciplinary environmental monitoring is carried out in high altitude areas in the fields of Environmental and Earth Sciences (atmosphere and climate changes, glaciology, hydrology and limnology in high altitude areas, geophysics and natural hazards).
- **Karakorum Trust (KT)** which comprises a multi-sectoral intervention to contribute to sustainable economic development and environmental protection in the Northern Areas of Pakistan. Key focus is placed on implementation of the Central Karakorum National Park as a major opportunity for improving the standards of living of the local populations while safeguarding the precious resources of Pakistan's vulnerable Karakorum range.
- **The Hindu Kush - Karakorum - Himalaya (HKKH)** Partnership project, carried out together with the International Centre for Integrated Mountain Development (ICIMOD), the Cooperation and Development – Italy (CESVI) and The World Conservation Union (IUCN), is in the final stages of a three-year program. This project aims to facilitate local, national and regional systemic planning and management, focusing on poverty reduction and biodiversity conservation in the HKKH region. Ev-K2-CNR is particularly proud of the ground being broken in the promotion of management-oriented research and the local institutional capacity being built in this framework.

Executive **Summary**

Given the specificity of its multidisciplinary approach to understanding complex environments and the effects of climate changes, Ev-K2-CNR has been asked to export its expertise for application on a sea-level ecosystem: the Arabian Gulf. In collaboration with the CNR Earth and Environment Department and the Kuwait Institute for Scientific Research (KISR), Ev-K2-CNR is promoting the **Gulf Environmental Monitoring and Management (GEMM) project** for environmental monitoring and research activities in the region.

Ev-K2-CNR is also consolidating its know-how in the development of technological solutions which promote the use of renewable power resources with minimum environmental impact and maximum efficiency. Two such activities include **Ecological Activity for Refuse Treatment at High Altitude (EARTH)** and **New Advanced Turbo Utilization for Renewable Energy (NATUREnergy)**, a prototype for the production of electrical energy and heat from biomass.

In line with its tradition, Ev-K2-CNR will continue to sponsor high quality research "single discipline" projects as long as they are contributing to the organization's objectives. In 2008-2010, investigations are planned in the following fields:

Medicine and Physiology: mechanisms of adaptation to hypoxia and environmental health;
Environmental Sciences: conservation of wildlife and study of tourism impact;
Earth Sciences: study of geological phenomena within the HKKH range;
Anthropological Sciences: knowledge in the fields of anthropology, ethnology and cultural history in the HKKH region.

Introduction

HISTORY AND BACKGROUND

The Ev-K2-CNR project began in 1987, when 90-year-old explorer and geologist Prof. Ardito Desio launched a new research campaign in the Himalayan and Karakorum mountains with the help of climber and businessman Agostino Da Polenza. Just two years later, the Ev-K2-CNR Committee was registered as an independent non-profit association dedicated to technological and scientific research in the Hindu Kush - Karakorum - Himalaya (HKKH) region, with a particular focus on Nepal, Pakistan and the Tibet Autonomous Region of China. In 2006, the association gained national juridical recognition, and in 2007, to formalize Ev-K2-CNR's close collaboration with the Italian National Research Council (CNR) over the previous two decades, an official "External Research Unit" under CNR's Earth and Environment Department (DTA) was opened at Ev-K2-CNR headquarters.

Ev-K2-CNR is probably best known for the Pyramid International Laboratory-Observatory, the high altitude scientific facility located in Nepal's Sagarmatha National Park at 5,050 m a.s.l., installed in 1990 in collaboration with the Nepal Academy of Science and Technology (NAST). What began as a permanent high altitude research base has evolved to become one of the world's most complex and intriguing study sites, at which nearly 600 research missions have been carried out. The Pyramid has a completely self-sufficient renewable energy supply and satellite telecommunications systems. Aside from providing common laboratory space and equipment for researchers, the facilities also offer comfortable accommodations in a temperature-controlled environment. Environmental observation and monitoring equipment installed at the Pyramid continuously collects data that is transmitted to researchers' home institutes in real time.

Since its inception, Ev-K2-CNR has accumulated a wealth of knowledge regarding high altitude in the fields of Medicine and Physiology, Environmental Sciences, Earth Sciences, Anthropological Sciences and New Technologies. Working within a rich network of international institutional collaborations, Ev-K2-CNR plays a strategic role in the exchange and transfer of experiences and of scientific and cultural knowledge. Their increasingly interdisciplinary approach to research has also led to the development of innovative integrated programs for the promotion of socio-economic development and environmental protection in mountain regions. Such projects include: the HKKH Partnership funded by the Italian government and built around Ev-K2-CNR's expertise; Karakorum Trust, which promotes sustainable development in Pakistan's Northern Areas by facilitating implementation of the Central Karakorum National Park (CKNP); and SHARE, the long term study of evolutionary environmental processes at high altitudes with a strong technology transfer and capacity building component.

THE PURPOSE OF THE Ev-K2-CNR 2008-2010 RESEARCH PROGRAM

The main purpose of this document is to illustrate the current priorities and strategies of Ev-K2-CNR and to provide a concise summary of the scientific and technological activities planned for execution in the 3-year period. The program in particular marks a departure for Ev-K2-CNR, as it moves from a multi-disciplinary organization to a more inter-disciplinary, integrated approach.

Researchers reading this document will be able to better orient their current and possible future activities in accordance with Ev-K2-CNR's overall strategy. Institutional readers will be able to appreciate the political and scientific contexts of Ev-K2-CNR's activities and find inspiration regarding ways to support research and reinforce existing or create new collaborations.

The **context**

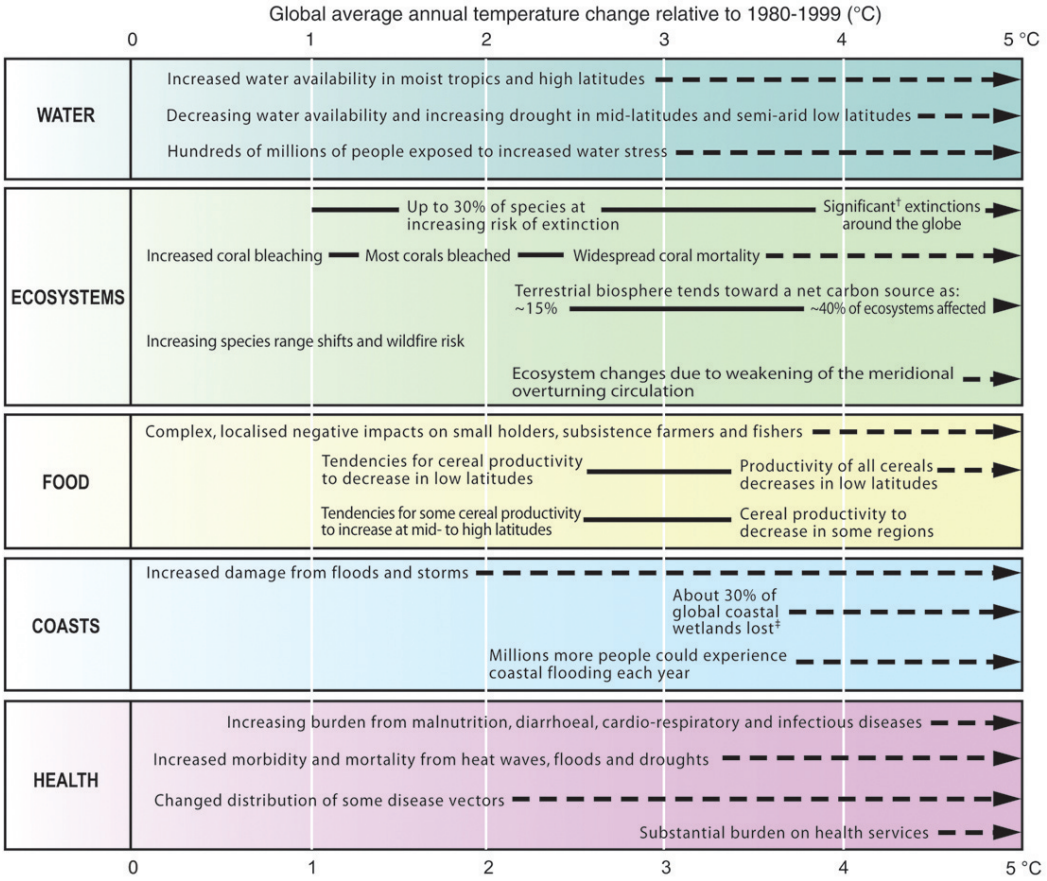
THE WORLD'S PROBLEMS – A FOCUS ON THE ENVIRONMENT

Humans must deal with an increasing variety of extreme phenomena related to climate changes, such as violent storms and drought, rising sea levels and a risk of floods with a possible loss of coastal areas and a potential decrease in the availability of fresh water. Agricultural production will decrease in tropical, subtropical and temperate regions, while desertification will become rampant in Central Asia, the African Sahel and the great plains of America. Such changes in land use will lead to a decrease in food supplies and an increased incidence of epidemics, such as malaria. *Source: UNFCCC website.*

Researchers have observed several changes produced by climate variations in over 420 processes, biological species and communities. For example, some plants and insects are now found living at higher altitudes, where previously cold conditions did not allow them to survive. Climate changes also have complex repercussions on human health, including diseases and death caused by changes in temperature, extreme environmental events, pollution and radiation, and the scarcity of food and water. *Source: UNEP and UNFCCC 2001. Climate Change Information Kit.*

Global warming affects the entire world and has strong implications in terms of poverty, economic development and population growth. Industrialized or industrializing countries in North America, Western Europe and Asia are responsible for past and present greenhouse gases emissions while the greatest victims of climate change will those in developing countries whose already limited resources will be put further at risk.

Fig. 1: *Source: IPCC 2007. Climate change 2007. Synthesis Report. Summary for Policymakers.* Examples of impacts associated with global average temperature change (Impacts will vary by extent of adaptation, rate of temperature change and socio-economic pathway)



The **context**

THE INTERNATIONAL SCIENTIFIC FRAMEWORK

Over the past ten years, several actions aimed at understanding and mitigating climate change phenomena and their impacts on human life have been undertaken. In 1988, the Intergovernmental Panel on Climate Change (IPCC), a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP), was established to provide the decision-makers and other interested parties with an objective source of information about climate change. Its reports immediately become standard works of reference, widely used by policymakers, experts and students. The program interacts closely with the United Nations Framework Convention on Climate Change, which promotes reduction of global warming according to the Kyoto Protocol. The IPCC has most recently recommended attention be placed on energy efficiency and renewable energy, lower greenhouse gas emissions, environmentally sound agricultural techniques and waste management. They also encourage capacity building in economically disadvantaged areas so that these priorities may be addressed.

Other important steps toward mitigation of the effects of climate change are being made through various international bodies and their declarations or reports. Following are some of the most relevant to the current environmental work of Ev-K2-CNR.

- The **European Climate Change Programme**, which deals with carbon dioxide emissions and efficient energy production systems.

- The **Global Climate Observing System Project**, which coordinates ongoing climate research on a global level, studies the physical, chemical and biological properties of climate, as well as the Earth's atmosphere, oceans, hydrology, chryosphere and environmental processes. The information collected supports the evaluation of climate change impacts and provides predictive climate models for research projects.

- The UNEP-**Global Environmental Outlook**, which supports environmental policy management through an integrated analysis of environmental conditions and studies of ecosystem trends, current policies and emerging problems.

- The **Global Earth Observation System of Systems**, approved in 2003 during the G8 in Evian. The aim of this program is to facilitate information dissemination and provide elaboration models through creation of a vast data collection system using the latest hardware and software technologies.

- The UNEP-**Global Environmental Facility**, which promotes environmental projects regarding biodiversity, climate change, international waters, soil degradation, persistent organic pollutants and the hole in ozone layer.

- The **Agenda 21** (1992), which calls for coordination of environmental activities with economic development and poverty reduction. Mountain sustainable development was put on the international agenda thanks to Agenda 21's Chapter 13, where mountain environments are described as one of the world's most important and essential ecosystems, yet fragile and subject to rapid modifications.

- The **Johannesburg Plan of Implementation**, which details the measures required to achieve development that respects the environment, as deliberated at the World Summit on Sustainable Development (2002). Paragraph 42, entitled 'Protecting and managing the natural resource base of economic and social development ', describes specific actions to be taken for the preservation and sustainable development of mountain regions.

- The **United Nations General Assembly resolution** (n. 62/196) on sustainable mountain development which states that mountains provide early indications of global climate change and encourages the scientific community, national governments and inter-governmental organizations to collaborate with mountain communities to jointly study and address the negative effects of global climate change on mountain environments.

- The **World Health Organization**, which analyses the impacts of global environmental risks on human health, included climate change, ozone depletion, biodiversity loss, hydrological system changes, freshwater resource use, soil degradation and food production.

- The **International Strategy for Disaster Reduction** which promotes prevention and reduction of diseases as an integral component of sustainable development, with the aim of decreasing human, social, economic and environmental loss due to natural and environmental and technological disasters.

The **context**

- The declaration of "**International Year of Planet Earth (IYPE)**" to increase awareness of the importance of Earth sciences in achieving sustainable development of society. The 60th UN General Assembly has proclaimed the year 2008 to be the United Nations International Year of Planet Earth. The IYPE activities actually run for a three-year period (2007-2009) so that ambitious science and outreach programs can be carried out.

Assessing the environmental issues characteristic of the new millennium, such as climate change, pollution, energy and industrial development, another challenge of the scientific community is to develop integrated, sustainable cooperation initiatives that take into account such complex issues. The transition from charitable action to a systemic methodology makes inclusion of fundamental features like multiple disciplines, socio-geographic contextualization, specialization, excellence and partnership necessary. These concepts were confirmed in 2002 at the World Summit on Sustainable Development in Johannesburg where the mobilization of applied research and strengthening of institutional capacity building were highlighted and "Type II Outcomes" were foreseen through which multilateral partnerships could be created. One such initiative, the International Partnership for Sustainable Development of Mountain Regions aims to contribute to these objectives for mountains development.

About **Ev-K2-CNR**

OUR VISION

Become recognized for contributions made to the resolution of complex global problems concerning the environment, health and socio-economic development.

OUR SCOPE

The Ev-K2-CNR specialization lies in its capacity to work systemically using knowledge generated within a multidisciplinary framework while promoting the dissemination of science. Ev-K2-CNR combines lessons learned through science with innovation to promote sustainable strategies for safeguarding the environment and improving the quality of life with a special focus on one of the world's most vulnerable and most valuable resources: **mountains**.

The Ev-K2-CNR Committee applies skills, tools, knowledge and methodology to sustainable development within a system of excellence that benefits from strong ties to mountain landscapes and populations, scientific competence and a thorough understanding of local needs.

OUR MISSION

Provide specialized scientific support for sustainable development in high altitude areas, promoting environmental conservation and a better quality of life for local populations.

OUR PRIORITIES

- Further scientific knowledge
- Transfer scientific results so they can be applied to sustainable management of mountain regions
- Build capacity of local scientists and research institutions
- Promote development cooperation that respects local cultures and traditions
- Valorize and preserve mountain environments
- Apply a systemic (social, economic and environmental) approach
- Support decision makers
- Provide qualified expertise
- Transfer technology to bridge the digital divide
- Identify and apply best practices in the application of science to development

Ev-K2-CNR GOVERNING / ADMINISTRATIVE ORGANS

Ev-K2-CNR – CNR External Research Unit Management Committee: Established to regulate execution of the programmatic and financial affairs, it is made up of two members of CNR, one being the Director of the DTA, and two representatives of Ev-K2-CNR. The committee oversees implementation of the "Scientific and Technological Research at High Altitude" project.

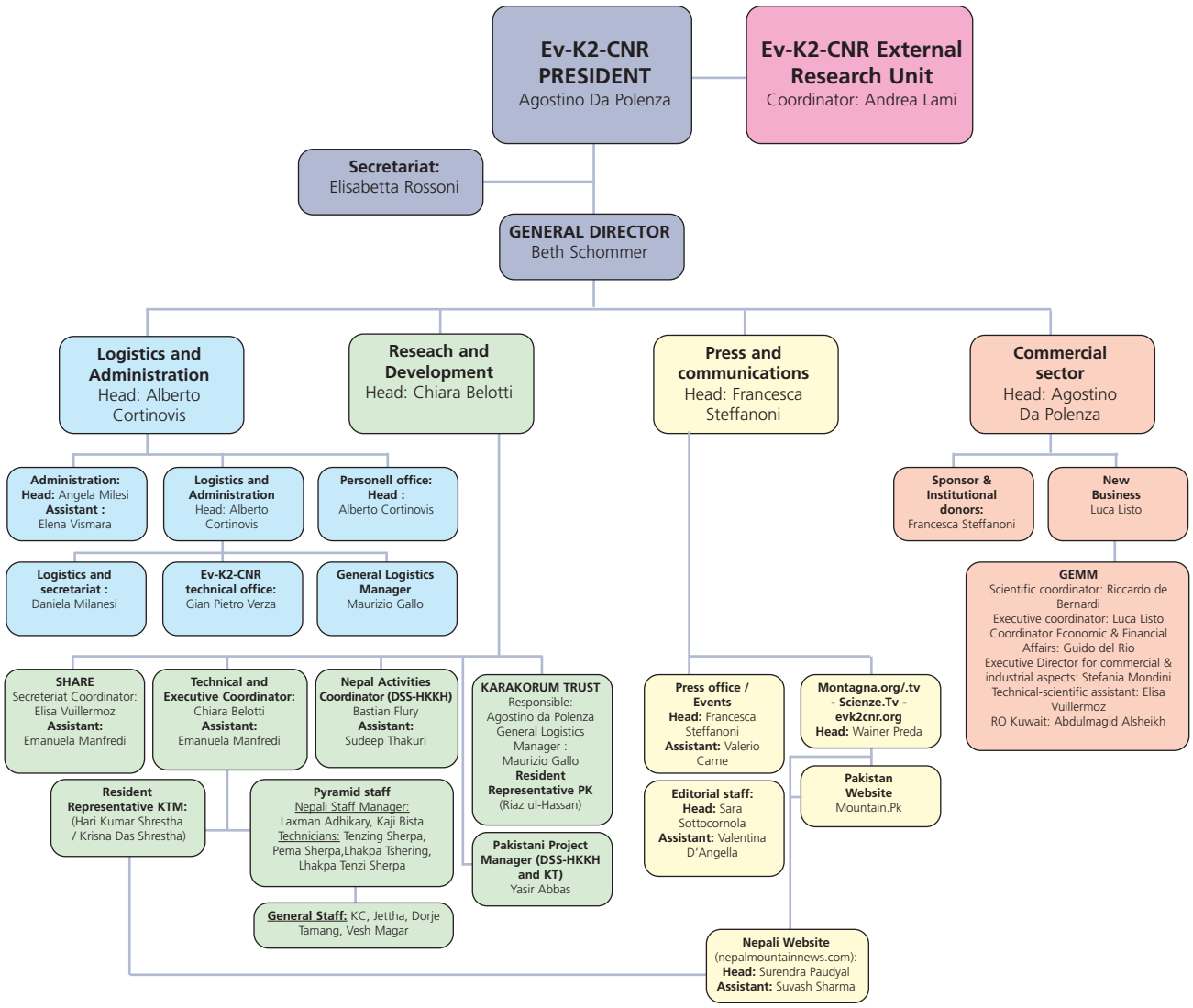
Ev-K2-CNR Executive Committee: Responsible for administration and financial affairs of the Association, it meets periodically to deliberate allocation of funds to research activities, approve the annual financial report, consider inclusion of new members and discuss other administration business.

Ev-K2-CNR Scientific Council: A group of experts representing different research fields, responsible for providing scientific guidance and identifying research priorities. The Council may take part in elaboration of new integrated projects of the Committee. They also provide support and advice on the planning and execution of activities for the Ev-K2-CNR External Research Unit and for the Executive Committee.

The Bilateral Technical Committee (BTC): This group made up of 3 representatives each from Ev-K2-CNR and NAST meets annually to approve research projects proposed for execution at the Pyramid and/or within the "Ev-K2-CNR/NAST High Altitude Scientific and Technological Research Project".

About **Ev-K2-CNR**

Ev-K2-CNR HUMAN AND STRUCTURAL RESOURCES



Since the Association statues do not foresee actual Ev-K2-CNR staff, a private service company, Mountain Equipe S.r.l, provides most project implementation, administration and management assistance in Italy.

A Representative Office was established in Nepal (RO-KTM) in 1990 to oversee management of the Pyramid Laboratory-Observatory, to assist researchers and technicians on the field, to provide local logistic support and maintain local institutional relations. Since 2005, a Pakistani Representative Office (RO-PK) has been running in Skardu, mainly to support implementation of the Karakorum Trust project. With the launch of its GEMM project, Ev-K2-CNR also set up an RO in Kuwait City in 2007, to provide assistance for the implementation of that initiative.

About **Ev-K2-CNR**

OUR PARTNERS

For the execution of its scientific programs, Ev-K2-CNR works through a rich network of national and international collaborators, which includes CNR institutes, Italian and foreign universities, and intergovernmental agencies, NGOs and private companies (*Annex 1*). Ev-K2-CNR however maintains a close and privileged institutional relationship with CNR, which gave rise to the CNR External Research Unit at Ev-K2-CNR.

Ev-K2-CNR has recently been granted Observer status to the UNEP Governing Council/Global Ministerial Environment Forum and is accredited to the UN Economic and Social Council (ECOSOC) with Roster Status. They also collaborate closely with other international and intergovernmental agencies, such as ICIMOD, IUCN, and WWF.

In Nepal, Ev-K2-CNR's main partner has been NAST for nearly 20 years. NAST has an agreement with CNR, to which there is an addendum specifying the collaboration arrangements with Ev-K2-CNR. Ev-K2-CNR has established successful direct collaboration with several local institutions, including the Nepal Ministry of Environment, Science and Technology, the Nepal Ministry of Culture, Tourism and Civil Aviation, the Kathmandu University, the Tribhuvan University, the Department of National Parks and Wildlife Conservation (DNPWC), the Department of Hydrology and Meteorology (DHM), the Sagarmatha National Park, the Sagarmatha Buffer Zone Management Committee and the Sagarmatha Pollution Control Committee (SPCC).

A rich network of collaborators has been developing in Pakistan as well. Particularly for implementation of the Karakorum Trust Project, but not only, agreements have been signed with several local stakeholders such as: the Karakurum International University (KIU), the Aga Khan Rural Support Program (AKRSP), the Alpine Club of Pakistan (ACP), the Mountain and Glacier Protection Organization (MGPO), the Pakistan Meteorological Department (PMD), the Rural Support Programmes Network (RSNP), and the Word Wildlife Fund (WWF) Pakistan. Ev-K2-CNR is also in the process of signing a Memorandum of Understanding with the Pakistan Ministry of Kashmir Affairs and Northern Areas (KANA), the main authority governing the semi-autonomous Northern Areas region.

Recently, with the expansion of Ev-K2-CNR activities to the Arabian Gulf, collaboration with the KISR has been established.

Our **objectives**

GENERAL OBJECTIVE

Improve understanding of high altitude ecosystems, their processes and interactions with the human component and the effects of global changes on a local level, so as to contribute to sustainable development and enhanced management of natural resources.

SPECIFIC OBJECTIVES

- Further knowledge on natural and anthropogenic processes influencing and influenced by mountain environments
- Help mitigate and reduce anthropogenic impacts
- Perform continuous long-term scientific surveys and compile unique, quality datasets on the research performed
- Protect and valorize the biodiversity of mountain ecosystems
- Promote and protect mountain cultures, in particular those at risk
- Develop clean and sustainable, low-impact technologies for mountain areas in developing countries
- Promote capacity building and technical/scientific training
- Raise awareness regarding mountain research and mountain issues in general
- Make a unique research facility available to the international scientific community
- Provide expert technical, logistic and organizational support in the field of high altitude research

2008-2010 OBJECTIVES

- Improve and expand the SHARE monitoring network in order to develop an integrated system of scientific measurements for improving knowledge in the fields of environmental and Earth sciences.
- Promote the implementation of the CKNP Management Plan, improve the existing knowledgebase and raise awareness on key management issues.
- Promote the preservation and valorization of the environmental, cultural and architectonical heritage of CKNP area.
- Contribute to the consolidation of institutional capacity for systematic planning and management at the local, national and regional levels, focusing on poverty reduction and on biodiversity conservation, thought policy development and implementation programs in the HKKH region and in particular in the CKNP, the Sagarmatha National Park (SNP) and Qomolangma Natural Preserve (QNP).
- Carry out monitoring and environmental research in the Arabian Gulf Area, provide solutions for waste management and improve local scientific capacity.
- Help reduce infant mortality and prevent chronic diseases by studying the environment-health and environment-indoor pollution relationships.
- Improve knowledge in the fields of anthropology, ethnology and cultural history in the HKKH region, paying special attention to threats to cultural identity and outputs of research which benefit the local communities.

2008 - 2010
PROGRAMS

Continued and Improved operation of the **Pyramid International Laboratory-Observatory**

The Pyramid International Laboratory-Observatory has been functional since 1990 while its attached living quarters ("Pyramid Lodge"), which host up to 20 researchers at once, have been operational since 1998. The extreme environmental conditions of the area: 5,050 m a.s.l. in Nepal's remote Khumbu Valley, near the Mt. Everest Base Camp, mean constant supervision, careful maintenance and periodic improvements to ensure the facilities remain a unique resource for the international scientific community.

From 1991 till date, several permanent monitoring stations (see SHARE project below for a description) have been installed at the Pyramid and in the surrounding area. These observatory sites require daily routine checks performed by local personnel, as well as periodic calibration and data management interventions on the part of expert researchers to ensure proper functioning.

In the 2008-2010 period, continued facility management and maintenance campaigns are planned. Below is a summary of the relevant objectives, progress, and activities to this end.

OBJECTIVES

- Provide a high standard of quality service for researchers and technicians from around the world who wish to access the Pyramid International Laboratory-Observatory facilities.
- Guarantee proper continuous functioning of the monitoring stations installed at the Pyramid and in the surrounding area.
- Continue to build the capacity of local Pyramid management staff, moving towards independence from Italian supervision.

PROGRESS TO DATE

From 2004 to 2007 an intensive non-routine maintenance campaign was carried out, involving around 20 Italian and local technicians. The most important results are summarized below:
- remodeling of the Pyramid and lodge electrical systems;
- improvement of the heating system and removal of the wood-burning stove;
- improvement of the photovoltaic system;
- installation of a device for water purification and mineralization;
- remodeling of the external walls, preserving the traditional architecture;
- insulation of lodge rooms and installation of new double glass window panes to reduce the thermal leakage;
- remodeling of the bathroom area and installation of new sanitary fixtures;
- improvement of the bedrooms (installation of carpet, ceiling insulation, closets, etc.);
- improvement of dining room, kitchen and storerooms;
- substitution of Pyramid floor covering;
- creation of an insulated "warm room" in the Pyramid for physiology testing;
- installation of a local computer network in the Pyramid and a satellite (VSAT) internet connection;
- creation of an office space in the Pyramid with internet and phone access;
- reconstruction of the lodge roof destroyed by strong winds.

In early 2006, a new management structure was implemented at the Pyramid International Laboratory-Observatory, entailing a greater involvement of the local staff. A new management manual was drawn up which includes the regulations and the operational protocols for correct management of all activities and systems and for the management of the monitoring stations like the Automatic Weather Stations (AWS), Global Positioning System (GPS) Station, the Nepal Climate Observatory-Pyramid (NCO-P), etc. From 2006, a rotating staff of seven trained local technicians has been working at the Laboratory. Their training has been provided in part locally and in part in Italy. From 2007, the local technicians, under the supervision of a "Manager of Nepali Staff", execute all daily, routine activities independently. Periodic visits from Italian technical personnel are carried out for monitoring and improving the local staff's performance.

Continued and Improved operation of the **Pyramid International Laboratory-Observatory**

PLANNED ACTIVITIES for 2008-2010

- The main activities foreseen for the next three-year period are:
- complete the non-routine maintenance works at the Pyramid and lodge:
  - finalize installation of a sauna (installation of heating element and alarm system)
  - improve the water supply system
  - adaptation of electrical boards
  - adaptation of light fixtures
  - rebuild the heating system
  - add a new photovoltaic (PV) field
  - add a new PV accumulation (battery) base
- perform periodic routine maintenance campaigns to ensure system efficiency
- continue training local technicians in Pyramid management
  - training course in Italy
  - training courses on site
- improve the facility management plan (periodically update the manual)

EXPECTED RESULTS AND INDICATORS

RESULTS	INDICATORS
- High standard quality service for researchers and technicians involved in Ev-K2-CNR/NAST project is consistently provided	- routine maintenance campaigns carried out annually - non-routine maintenance works completed by 2010 - routine maintenance works done as needed - improved performance of local management staff - expression of satisfaction on the part of hosted researchers and technicians
- Efficient and consistent functioning of the monitoring stations ensured	- checks performed by local staff every day for the entire period - number of problems addressed and dealt with promptly by local staff in collaboration with headquarters - number of training / refresher courses provided to local staff
- Pyramid management by local staff is improved	- training courses in Italy completed - periodic training courses on site carried out - local staff involved in updating the Pyramid manual - number of control missions by Italian supervisors reduced

TIME TABLE	2008		2009		2010	
Activities	**1st sem**	**2nd sem**	**1st sem**	**2nd sem**	**1st sem**	**2nd sem**
Training courses in Italy (local staff)	■	■				
Training courses at the Pyramid (local staff)			■		■	
Completion of the non-routine maintenance works					■	
Annual routine maintenance campaigns		■		■		■

SHARE

Stations at High Altitude for Research on the Environment

Originally launched as an integrated system of measurements in environmental and Earth sciences in the Himalaya – Karakorum region, SHARE increasingly responds to an international call for information on the effects of climate change. According to a 2007 IPCC report, worldwide climate change threatens ecosystem balance and, as a consequence, life on Earth. To deal with this situation and ensure sustainable management of our natural resources, policymakers, particularly in developing countries, need an objective source of information describing the current climate conditions and their modifications. Several international agencies are now engaged in the evaluation of actions for reducing global warming and the elaboration of adaptation and mitigation strategies regarding the potential environmental and socioeconomic consequences.

Given the recognized fragility of mountain ecosystems, their influence on global processes, and the significant amount of natural resources (water, energy, wood, food, etc.) coming from mountain areas, environmental data collected there is priceless. Mountains represent 25% of the Earth's surface and they are a unique source of energy, biodiversity, minerals, forests and agriculture – all essential for human survival. Recently, the United Nations General Assembly recognized mountains as ideal and vastly representative locations for the study of climate change, calling for an enhancement of research efforts in these areas. Knowledge accumulated through SHARE in the fields of atmosphere and meteorology, glaciology, hydrology and limnology, geophysics and natural risks, has proven essential to support decision-making processes, which can benefit from a greater understanding of climate change on local, regional and global levels.

Increased time-space knowledge on the whole environmental system, important for detecting climate changes, can be provided through global monitoring. Monitoring networks today need to take into account the complex interactions between the ecosphere components and apply a whole-planet approach. Several monitoring networks already exist which collect climate, atmospheric and terrestrial data, such as:
- Project Atmospheric Brown Clouds (ABC) - UNEP.
- AErosol RObotic NETwork (AERONET) - NASA
- Coordinated Energy and Water Cycle Observations Project (CEOP) -WMO
- Global Atmosphere Watch (GAW) - WMO
- Global Land Ice Measurement from Space (GLIMS) - NASA
- Global Seismographic Network (GSN)
- International GNSS (Global Navigation Satellite Systems) Service (IGS)
- International Long-term Ecological Research Network (ILTER)

The SHARE environmental monitoring system, which specializes in collecting important but otherwise unobtainable data at high altitudes, contributes information to several of the above networks. Particularly requested is information on meteo-climate parameters, atmospheric chemical measurements, limnological and paleolimnological analysis on high altitude lakes, glaciological data and precise measurement of Earth surface coordinates. To better respond to the global environmental problems, SHARE has expanded its network beyond Asia (Nepal and Pakistan) to include stations in Africa (Uganda) and Europe (Italy and other EC Countries), with expansion to South America in the planning stages.

OBJECTIVES
- Contribute to study of climate change impacts and adaptation strategies, with special attention to water resources, biodiversity and ecosystem conservation and food security.
- Make new and more complete information on climate changes and their local, regional and global consequences available to governments and international agencies.

SHARE Stations at High Altitude for Research on the Environment

PROGRESS TO DATE

Following is a list of the sites currently included in the SHARE network:

INSTALLATION SITE	Nation / Continent		Station	Characteristics	Altitude (m a.s.l.)
Mt. Cimone	Italy	Europe	"Ottavio Vittori" Research Station:	Atmospheric monitoring station	2,165
Forni glacier	Italy	Europe	-	Automatic weather station	2,669
Pyramid Laboratory Observatory (Lobuche)	Nepal	Asia	NCO-P (ABC-Pyramid)	Atmospheric monitoring station	5,079
			GPS Master	GPS Station	5,050
			AWS 0, AWS 1; AWS CEOP	Automatic weather stations	5,050
			DORIS	Orbitographic station	5,050
Pheriche (Khumbu Valley)	Nepal	Asia	AWS 2	Automatic weather station	4,258
Namche Bazar (Sagarmatha National Park Head Quarter, Khumbu Valley)	Nepal	Asia	AWS NP	Automatic weather station	3,560
Lukla (Khumbu Valley)	Nepal	Asia	AWS 3	Automatic weather station	2,660
Kala Patthar	Nepal	Asia	AWS-KP	Automatic weather station	5,600
Mt Everest South Col	Nepal	Asia	AWS-CS	Automatic weather station	8,000
Urdukas (Baltoro glacier, Baltistan)	Pakistan	Asia	AWS PK1	Automatic weather station	3,926
Askole (Baltistan, Pakistan)	Pakistan	Asia	AWS PK2	Automatic weather station	3,015
Mt. Rwenzori (Elena Glacier)	Uganda	Africa	-	Automatic weather station	4,700

All stations are functioning continuously, collecting data on various standard meteorological/climate parameters. A multidisciplinary team of researchers elaborates the data for international publication and dissemination.

The Mt. Cimone station is a GAW regional station which also performs measurements of greenhouse gases, trace gases, natural radioactivity, aerosol, bioaerosol (spores and pollens), total NO_2 and O_3, NO_2, vertical profile solar photometry, cosmic radiation.

The NCO-P laboratory also collects data on atmospheric parameters, with data transmitted via satellite to Italy in real time. This site is part of the UNEP Project ABC and the WMO GAW network.

The stations in Nepal and Pakistan are Reference Stations in the CEOP project under the WMO's World Climate Research Programme (WCRP) – Global Energy and Water cycle Experiment (GEWEX) initiative. Ev-K2-CNR recently founded a special interest group called "CEOP-High Elevation" (CEOP-HE), which is dedicated to understanding multi-scale variability and change in hydrological and energy cycles in high elevation regions and studying their role within the climate system on a local and global scale.

Annual glacial and lakes monitoring campaigns are also carried out within the SHARE framework. Two lakes located near the Pyramid have been included in the ILTER program, an international network of sites representing various ecosystems.

SHARE Stations at High Altitude for Research on the Environment

PLANNED ACTIVITIES

Project activities are organized in four main sectors:
1. Scientific research
2. System Technology
3. Electronic Information System
4. Capacity building

1. *Scientific research*
In order to study climate change in mountain ecosystems and better understand ongoing processes and phenomena, an integrated approach based on long-term observations is needed, along with appropriate climate modelling. Elaboration of feasible mitigation strategies can only be based on such information.

Thanks to the excellence and uniqueness of the data collected at its stations in Italy, Asia and Africa, SHARE has become an international point of reference. Italy's contribution to integrated monitoring programs such as **UNEP-ABC, WMO-GAW, WCRP-GEWEX–CEOP, NASA-AERONET, ILTER , EUSAAR, ACCENT** has been made possible mainly because of SHARE.

SHARE Stations at High Altitude for Research on the Environment

Scientific research will be performed within the SHARE framework to:

1. analyze the influence of continental anthropogenic and natural processes, with particular attention on mountain regions
2. study the interaction between mountain ranges and global atmospheric circulation
3. characterize physical, chemical, optical properties of aerosol and their variations
4. study seasonal variability of atmospheric pollutants and climate-altering compounds
5. characterize wet deposition chemistry
6. evaluate glacier energy and mass balance and consequent risks (Glacier Lake Outburst Flood - GLOF) and study debris-covered glaciers and the role of debris in ablative processes
7. monitor surface variations of glaciers, rock glaciers and moraines
8. set up hydro-geological models for analysis of risk factors
9. study lacustrine trophic chains and biomass accumulation in response to natural or disturbance factors
10. identify areas at risk of natural hazards through geodetic environmental monitoring

2. System Technology

One of the main reasons knowledge of climate and environmental processes is so limited in mountain areas is because of the objective difficulties of carrying out continuous high altitude measurements at high altitude, especially in developing countries. Advanced technologies for climate change monitoring in high altitude areas are needed in order to better elaborate adaptation and mitigation strategies. The application of technology in developing countries, when done in collaboration with local scientific institutions, can also contribute to bridging the digital divide.

A sophisticated technological system called 'Nano-SHARE' will be developed to facilitate installation and maintenance of monitoring stations in high altitude locations. Nano-SHARE will be designed to function in extreme environmental conditions, taking into consideration the complex logistics often needed to transport scientific materials to remote, high altitude locations. Known technical difficulties, such as problems related to power supply and the need for real-time data transmission will also be addressed.

This innovative, high-tech, integrated environmental and geophysical monitoring system will be modular and adaptable, making measurements possible where installation of a permanent laboratory or standard station would be too difficult or expensive. The system will also use only renewable energy sources and ensure a low environmental impact.

3. Electronic Information System

Electronic information systems and databases that are accessible to governments and scientific research institutes facilitate the dissemination of knowledge, helping improve understanding of climate change phenomena and mitigation of the effects. To date no such integrated, dedicated system exists regarding information on environmental monitoring in mountains, even in Europe where attention to environmental problems is high.

An electronic information system dedicated to mountain environments will therefore be created within the SHARE framework. Data will be collected and organized in a synergic and integrated system, so that researchers can optimize their investments, harmonize their databases and improve collaboration. The system will also be made accessible to concerned stakeholders, like governments, networks, consultants, scientific research institutions, policy-makers and anyone interested in sustainable development or the environment.

4. Capacity Building

The effects of climate change and the consequences of the unsustainable use of mountain resources must be taken into account on both policy and administrative levels. The capacity to integrate such information in national and international development processes must however be strengthened. Institutions and societies need to become even more engaged in addressing the threat of global change, moving beyond emission reduction policy to the adoption of structures and lifestyles adapted to the ongoing social and environmental changes.

SHARE will continue to support sustainable development of mountain regions and improve local environmental management systems by transferring technology and know-how in the fields of environmental and geophysical sciences. Decision makers and local research institutions, particularly in developing countries and transitioning economies, benefit from capacity building efforts through which awareness-raising, training and technology transfer initiatives are carried out. As indicated in Agenda 21, the scientific capacity of local technicians and researchers is also increased through direct participation in research activities and on the job training.

SHARE Stations at High Altitude for Research on the Environment

EXPECTED RESULTS AND INDICATORS

RESULTS	INDICATORS
- Improved knowledge of climate change's impacts on the environment	- Current station network maintained and optimized - 5 additional stations added to the network - Tools modeling climate patterns implemented - International scientific publications on the influence of the Himalayan range on the Asian monsoon circulation
- Improved understanding of the interactions between mountain ranges and global atmospheric circulation	- Continuous atmospheric monitoring throughout project cycle - Expansion of network monitoring sites to include at least two new atmospheric observatories - Integration of data from atmospheric observations with that from climate study - International scientific publications on physical, optical and chemical properties/variations of aerosols - International scientific publications on seasonal variability of ozone and climate altering gasses - International scientific publications on atmospheric background concentration
- Improved understanding of hydrological and energy cycles in high elevation regions and their local and global role in the climate system	- Establishment of HE Network of monitoring stations within CEOP - Observation and modeling of water and energy cycle variability in selected high elevation areas - Energy and hydrological cycles modeled - Hydrometer stations installed in target areas - Glacier hydrological balance defined in target areas - Meteo-hydrological variations defined in target areas - Calibration of satellite data and evaluation of their contribution to the study - Contributions of CEOP-HE Working Group to CEOP/GEWEX
- Evaluation of air quality conditions over the past decade	- Analysis of chemical composition of wet depositions and comparison with previous characterizations - Integration of wet deposition data with that on aerosol chemical composition - Data on photochemical pollution phenomena - Data on atmospheric processes involving organic compounds
- Analysis of biological and hydrological processes regulating nitrogen in the ecosystem	- Data on nutrient and acidifying species in surface water - Data on incoming and outgoing nitrogen flows - Integration of wet deposition data with data on incoming and outgoing flows of nitrogen - Determination of mass balance to examine the retention of different forms of nitrogen form - Identification of nitrogen export factors - Particular microhabitats with representative vegetation and geomorphologic characteristics selected
- Better definition of the role of glaciers as environmental indicators of climate change	- Glacier, rock glacier and moraine variations monitored throughout the project cycle
- Evaluation of energy and mass balance of glacial environments and of consequent risks to human settlements	- Data on the relationship between debris thickness and ablation - International scientific publications on debris-cover glaciers and the role of debris in ablation processes - Modeling tools developed and used - Data on glacial thickness as an indicator of hydrological resource to help determine possible future freshwater availability - Data on glacier surge-type phenomena and GLOFs - Topographic and geophysical survey data organized in a GIS and mapped to show potential risk factors
- Improved understanding of the response of lake ecosystems to climate change	- Lake water and biota samples taken periodically from key lakes - Continuous measurement of lake water temperature - Data on lake sediments to evaluate long term variability of ecosystem structure - Georeferenced database of lacustrine morphometric, chemical and biological data
- Areas at risk of natural hazard identified through environmental geodetic monitoring	- Maintenance and optimization of existing permanent GPS stations in the SHARE network - GPS data available on line in real time - Hydrogeological risk maps developed
- Himalayan seismotectonic structure better understood	- Installation of one or more seismic stations in key locations - Seismic data collected continuously throughout the project cycle - Data available to scientific community - International scientific publication on Himalayan seismotectonic structure
- Improvement of environmental – geophysical monitoring in mountains regions	- Nano-SHARE prototype developed early in project cycle - Nano-SHARE tested and functioning on the field - Increased availability of grants for Nano-SHARE purchase in developing countries
- Accessible and coordinated electronic information system on environmental-climate research in mountain regions established and available to both the scientific and non-scientific community.	- High altitude environmental research sites identified and contributing data to EIS - EIS publicized and accessed internationally - Data on all stations in the network inserted in the EIS and available on line
- Institutional capacity built and technology transferred to beneficiary institutions in developing/transitioning countries	- 6 training programs for local researchers and technicians carried out during the project - Annual informative and training courses for stakeholders and policymakers carried out - Annual seminars held to disseminate scientific results on an institutional level

SHARE Stations at High Altitude for Research on the Environment

TIME TABLE Activities	2008		2009		2010	
	1st sem	2nd sem	1st sem	2nd sem	1st sem	2nd sem
Maintenance, functioning, development of the operational SHARE stations						
Implementation and functioning of 5 new SHARE Master stations in target areas						
Contribution of SHARE stations to the main international scientific and environmental monitoring networks						
Strengthening of SHARE scientific team						
Nano-SHARE design						
Building of Nano-SHARE components and development of the prototype						
Nano SHARE test in three study areas						
Industrialization of Nano-SHARE						
Actions for increasing the availability of grants for Nano-SHARE purchase by developing countries						
Installation of the high altitude background monitoring network in Italy including 12 stations: 5 in the Alps, 4 in the Appennines, 1+1+1 in the islands						
Long term monitoring program in Italy and in the study areas						
Scientific studies (atmospheric sciences, meteorology, and climate, glaciology, hydrology, limnology and paleolimnology, geophysics and natural risks, topography)						
Interdisciplinary studies of environmental impacts on hydrological resources, biodiversity, agriculture, forests, human health					To be carried out in the following period (2012-2015)	
Annual dissemination of information amongst involved researchers						
Publication of scientific results					To be carried out in the following period (2011-2015)	
Creation of SHARE climate-environmental Electronic Information System (EIS) for Italy						
Creation of SHARE climate-environmental Electronic Information System (EIS) for Europe					To be carried out in the following period (2011-2012)	
International promotional campaign of SHARE - EIS					To be carried out in the following period (2011)	
Application of SHARE-EIS as climate-environmental data archive for the target areas					To be carried out in the following period (2012)	
Implementation of an institutional capacity building and technology transfer strategic plan in the studied areas						
Annual seminars for diffusion of scientific results on an institutional level						

KARAKORUM TRUST

KARAKORUM TRUST was created by Ev-K2-CNR to consolidate Italy's nearly 100-year history of exploration, research and mountaineering in Pakistan's Karakorum Mountains. Building upon the dream of Prof. Desio to see a protected area established around Mount K2, Ev-K2-CNR garnered the support of the Italian government and is coordinating a series of sustainable development initiatives in the area. Working with local communities, NGOs, and local and national government, the capacity to manage the fledgling CKNPE is being reinforced. In line with its other scientific objectives, Ev-K2-CNR is also simultaneously helping communities and institutions understand and adapt to climate change.

OBJECTIVES

The KT project's main goal is to promote sustainable development and help improve the standards of living of the populations in the CKNPE, paying particular attention to the priorities of environmental conservation, protection of biodiversity and water resources, and promotion of sustainable tourism.

Specific objectives pursued through various activities proposed within the program framework include:

- Create a structured and harmonic communication network for development cooperation projects;
- Increase the effectiveness of existing cooperation initiatives, filling identified project gaps with integration projects;
- Improve communication amongst the local stakeholders and actors involved in the implementation of development cooperation projects;
- Improve knowledge of the environmental, architectural and cultural heritage;
- Develop local capacity to manage and coordinate development cooperation projects;
- Raise awareness of CKNPE authorities regarding the implementation of procedures and policies that bear in mind the needs of the populations, ecosystems and cultural heritage of Northern Pakistan.

PROGRESS TO DATE

The first phase of the project focused on identification of existing initiatives in the CKNPE area and creation of a network involving local NGOs and stakeholders. Several medium-to-long term cooperative projects were then developed and implementation begun. Ev-K2-CNR has also drawn up agreements with each of the local partners involved to ensure activities carried out within the Karakorum Trust framework all contributed to the overall goal.

The main milestones achieved so far include (where appropriate local implementing partners are specified in parentheses)

- Ev-K2-CNR named one of the authorities responsible for implementation of CKNPE.
- Participation in the "Participatory management and development of CKNPE" document elaboration
- Clean-up expedition on the Baltoro Glacier in July 2006, where over 3 tons of solid waste left from mountaineering expeditions was collected (ACP);
- Training of 95 trekking guides in three separate courses (December 2006, April and May 2007; ACP);
- "Viva Baltoro" awareness-raising campaign on Baltoro waste management (ACP);
- Publication of a baseline survey report for the Upper Braldo Valley containing data on demographics, natural resources management, infrastructure, social organization and capacity, and housing (AKRSP);
- Training courses on health and hygiene, gender sensitization, forest and fruit management, livestock management and adult literacy for school teachers carried out (AKRSP);
- 22,000 forest and fruit saplings planted in the villages of the Braldo Valley (AKRSP);
- Irrigation channels and link roads started to improve the socio-economic conditions of two villages (AKRSP);
- Analysis of historical architecture in Upper Braldo Villages and a plan to protect this cultural heritage drawn up (Milan Polytechnic);
- Cultural heritage of Shigar and Braldo Valleys studied (Milan Polytechnic and the Italian Institute for Africa and the East (ISiAO));
- Plan for creation of a center for analyzing, processing and distributing local gemstones and 10 future trainers trained at the Italian Gemology Institute in Milan (KIU);
- Publication of the first Italian-Urdu dictionary;
- New material donated to the Italian K2 Museum of Skardu (books, photographs and multimedia materials)
- Creation of a public internet point at the Italian K2 Museum of Skardu.

KARAKORUM TRUST

PLANNED ACTIVITIES

- Census and analysis of the existing initiatives concerned with systemic management of the CKNPE
- Identify key stakeholders, projects and cooperation initiatives in the CKNPE concerned with systemic management
- Organize a local consultation workshop to assess the priorities and needs, best practices and traditional knowledge in the CKNPE
- Identify pilot projects and implementation agencies in consultation with local government and communities for the management of the CKNPE
- Finalize the project implementation plan with inputs from national and local government and park management authority
- Develop a strategy for networking among the existing development cooperation and the concerned stakeholders
- Organize training workshops to local government authority, park management staffs and representative of communities on sustainable park management
- Implement activities on pilot projects in close consultation with local governments, park authorities, experts and local communities (eg. community forestry, ecotourism, waste management, organic farming, renewable energy) for park management
- Install environment monitoring stations (environment, ecology, weather, indoor air quality) for the CKNPE
- Develop and disseminate awareness raising materials on adaptation to climate change and integrated park management
- Organize courses, expert exchange, and internships, to benefit the local institutions and authorities of CKNPE

EXPECTED RESULTS AND INDICATORS

RESULTS	INDICATORS
- Sustainable development promoted and standards of living of the CKNPE populations improved	- Awareness package distributed to local decision makers, communities, and other concerned stakeholders - Reports on training on natural resource management and adaptation to climate change for local authorities and local communities - Partnership established amongst local and international organizations
- Institutional CKNPE management improved	- Interactive knowledge base for decision makers containing economic, social and environmental data - Communication network amongst existing and new CKNPE-related projects created and used by at least 80% of projects - All new policies take into consideration needs of the CKNPE populations, ecosystems and cultural heritage - Decision support system for the CKNPE authorities enhanced with contributions from KT project activities - New sustainable development master plan for the CKNPE - Reports on capacity building initiatives for 15 CKNPE management staff and 15 local authorities
- Participatory natural resource management mechanisms foreseeing climate change adaptation strategies in place in CKNPE	- Inventory of economy, social and environmental resources - Reports from 3 participatory workshops - 30 community representatives trained in sustainable natural resource management and community forestry - Reports on seminars held for local communities on climate change and adaptation strategies - Network of local institutions and stakeholders established and functioning - Reports from 4 partnership projects on ecosystem management (forestry, tourism, agriculture, waste, disposal, etc) - Environmental, ecological, climate and indoor air quality monitoring stations installed and 10 local technical staff trained - Reports on 3 training and awareness programs for local communities on GLOF and water availability - Assessment report on impacts of climate change on glaciers, GLOF risks, water security and regional vulnerability - Disseminate information to key decision makers and at least 10 vulnerable local communities

KARAKORUM TRUST

TIME TABLE	2008		2009		2010	
Activities	**1st sem**	**2nd sem**	**1st sem**	**2nd sem**	**1st sem**	**2nd sem**
Census and analysis of the existing initiatives concerned with systemic management of the CKNPE	■					
Identify key stakeholders, projects and cooperation existed in the CKNPE concerned with systemic management	■					
Identify pilot projects and implementation agencies in consultation with local government and communities for the management of the CKNPE	■					
Finalize the project implementation plan with inputs from national and local government and park management authority	■					
Develop a strategy for networking among the existing development cooperation and the concerned stakeholders	■	■				
Organize training workshops to local government authority, park management staffs and representative of communities on sustainable park management		■		■		■
Implement activities on pilot projects in close consultation with local governments, park authorities, experts and local communities (eg. community forestry, ecotourism, waste management, organic farming, renewable energy) for park management			■	■	■	■
Install environment monitoring stations (environment, ecology, weather, indoor air quality) for the CKNPE			■	■	■	■
Develop and disseminate awareness raising materials on adaptation to climate change and integrated park management					■	■
Organize courses, expert exchange, and internships, to benefit the local institutions and authorities of CKNPE		■	■	■	■	■

HKKH Partnership
for ecosystem management

The HKKH Partnership project is being carried out in the largest and the youngest mountain region in the world, Hindu Kush - Karakorum – Himalaya (HKKH), which encompasses parts or the entire countries of Afghanistan, Bangladesh, Bhutan, China, India, Nepal, Myanmar and Pakistan. The project was conceived by Ev-K2-CNR and funded by the Italian Cooperation (MAE-DGCS) through IUCN. The Executing Partners are Ev-K2-CNR, ICIMOD, CESVI and IUCN, along with several local stakeholder institutions in Nepal, Pakistan and China. Activities have been underway since July 2006 and will conclude in June 2009.

OBJECTIVES

Bearing in mind the priorities defined in the World Summit on Sustainable Development (WSSD) Draft Plan of Implementation and considering the recommendations made for achieving successful implementation of Agenda 21, the project aims to contribute to the consolidation of institutional capacity for systemic planning and management at the local, national and regional levels, focusing on poverty reduction and on biodiversity conservation, through policy development and implementation programs in the HKKH region.

Specific Objectives:

1): Provide tools and instruments to facilitate the consistency of various national-level actions in area based planning and management, within the framework of regional level systemic planning and monitoring.

2): Establish a process of application of the acquired capacities and a Decision Support System (DSS) by individual countries in systemic planning and management of mountain areas at a local/ national or transboundary level, within the framework of sustainable mountain development.

PROGRESS TO DATE

Ev-K2-CNR accomplishments in progress/ to date:
- Contributions to the conceptual framework and approach
- Scoping and assessment missions carried out in SNP - Nepal, CKNP - Pakistan and QNP - TAR of China
- On the basis of desk studies and stakeholder consultations, a preliminary analysis and conceptual modeling of the dynamics of key socio-ecosystem processes has been completed, including identification of key indicators and selection of priority research themes for supporting the management processes
- Preliminary analysis of management systems of selected target ecosystems carried out through review of relevant bibliography
- Formulation of technical requirements of the DSS toolbox
- Innovative and collaborative management-oriented research carried out in SNP based on priority research themes: water quality, solid waste management, energy, forestry and climate change.
- Assessment of the natural resource management capacities of local institutions
- Contribute to Knowledge Base aimed at supporting systemic management of target ecosystems
- Production of new basic data sets
- Setting up and coordination of data sharing mechanism
- Capacity building in environmental monitoring (training, lectures, seminars, workshops with local scientific partners)
- Implementation of sustainable improvements of existing scientific monitoring schemes of target ecosystems
- Contribution of information on research made to CD/DVD to distribute the spatial data base and knowledge base
- Contribution to the development of DSS computer based modules: modeling and simulation of key ecosystem dynamics
- Presentation and promotion of the project, dissemination of results

PLANNED ACTIVITIES

(Independently or in collaboration with other partners)
- Development of outreach material and participation in a regional event on tools and methods for ecosystem management
- Finalization of qualitative model for SNP, presentation and validation of the model with stakeholders
- Launch and promote the idea of the "Research gateway for SNP" within the research community and local Government bodies
- Collection of data and metadata required for the SNP quantitative model
- Field work, data collection and training in research activities with local stakeholders
- Development of the climate change qualitative diagram
- Technical assistance and support during operational implementation of DSS toolbox by key stakeholders
- Integration of data sets and knowledge developed in the management plans
- Support in the development of base data sets and in the application of DSS to define management options

HKKH Partnership Project

EXPECTED RESULTS AND INDICATORS

RESULTS	INDICATORS
- A systemic planning and management conceptual framework is developed and promoted	- bibliographic review completed - conceptual framework finalized and documented - outreach strategy for the conceptual framework
- An improved understanding of the dynamics of target socio-ecosystems is developed through scientific and participatory research	- target socio-ecosystem delimited and key processes identified - research priorities identified and research proposals developed and approved - baseline data collected and analyses carried out according to specific standards and technical specifications - % of data sets included in the DSS - models developed according to technical specifications - number of scientific publications produced and published number of formal agreements signed with scientific partner institutions
- The management system and the decision making process in place are analyzed and the entry points for improvements through systemic management are identified with key stakeholders	- key management issues identified - list of indigenous management best practices - assessment of National Resources Management (NRM) capacity completed - no. of meetings, list of stakeholder groups involved
- A system to support the management of mountain areas and the related decision making process is developed and available to key stakeholders	- data sharing protocols designed, tested and applied - knowledge base developed and records input - number of data sets stored in the filing system - data quality and structure assessed - map layouts produced - Knowledge Base (KB) and GIS integrated and distributed - graphic interfaces designed and validated - software tested and validated - multimedia contents developed - interactive web maps integrated/published
- The capacities of key stakeholders/institutions required for the systemic management of mountain areas are built	- list of stakeholders and their training needs compiled and training program developed and approved - list of training materials, manuals, CDs/DVDs published - list of exchange visits/participants and reports - extranet developed and maintained - outreach strategy developed, outreach and communication material produced and distributed
- A monitoring scheme integrated with the DSS is set up for the target socio-ecosystem	- data standards and protocols identified and followed - sampling procedures identified and documented - list and type equipment purchased and operational, transferred to national beneficiaries - person/days spent to provide support and training - document detailing a continuous learning strategy developed - list of data sets regularly collected - % of data sets regularly imported in GIS and DSS
- The conceptual framework, the GIS and the decision support tools developed are used by beneficiaries to manage selected protected areas (project level application)	- manual of procedures prepared - list of thresholds for indicators - list of management options defined - % of management options selected operationally implemented - learning and meeting platforms defined
- A contribution towards the development/update of the management plans of selected protected areas sites is provided and the integration of the DSS in the planning process is promoted	- list and type of data sets provided; availability of data sets to local partners - list of research outcomes provided - management plan draft development status
- A process to promote and apply the conceptual framework, the GIS and the decision support tools developed for systemic mountain areas management at national and regional scale is initiated	- GIS set up - no. of partnerships established - no. number of exchange visits organized - list of policy briefs

HKKH Partnership Project

TIMELINE	2008		2009		2010	
	1st sem	2nd sem	1st sem	2nd sem	1st sem	2nd sem
Development of outreach material and promotion of the approach and methodology developed						
Finalisation of conceptual and functional design of DSS modular toolbox						
Capacity building in environmental monitoring						
Implementation of sustainable improvements of existing scientific monitoring schemes of target ecosystems						
Operational implementation of DSS toolbox by key stakeholders						
Integration of data sets and understanding developed research integrated in the management plans						
Development of a strategy and process to upscale the application of DSS at national and regional levels based on the experience developed on pilot protected areas						

Gulf Environmental Monitoring and Management

Ev-K2-CNR was intrigued by the challenging opportunity to replicate their expertise in integrated, multidisciplinary environmental monitoring in a non-mountainous environment. Stimulated by the need for environmental protection in the Gulf region, Ev-K2-CNR accepted the challenge and now leads and coordinates a group of CNR researchers who will collaborate with local scientific institutions promoting the application of systemic research. The team of Italian researchers will work closely with the existing local scientific institutions to exchange experiences and promote a more networked approach to efficient, coordinated, quality research.

OBJECTIVES

GEMM aims to provide instrumental scientific support in solving the Arabian Gulf's major environmental problems. GEMM's contributions will be characterized by excellence in integrated environmental research and monitoring, becoming a point of reference for research in region.

Specific objectives of GEMM include:

- Sustainably pursue environmental and technological development goals
- Carry out long-term integrated environmental monitoring activities
- Install environmental monitoring stations with a specific calibration and Quality Assurance / Quality Control (QA/QC) procedures
- Coordinate integrated research and monitoring programs
- Provide education and training in scientific research
- Create a framework for exchange of expertise and technology transfer
- Provide solutions for waste management and remediation
- Raise institutional awareness of environmental issues
- Promote the advancement of Gulf area scientists in the international scientific community

PROGRESS TO DATE

The implementation framework has been established, with the CNR Earth and Environment Department (DTA) as principal investigator for the GEMM integrated environment monitoring program and 12 DTA institutes participating. GEMM also received strong institutional backing at the Italian Foreign Ministry Gulf Desk workshop held in December 2006, where Minister D'Alema encouraged the initiative. CNR and Ev-K2-CNR subsequently became members of the Gulf Desk and opened a Foreign Ministry working group on environmental issues (the Environment Group).

In Kuwait, GEMM met with the enthusiasm of KISR, which signed on as the project's main local partner, with active participation of the Environmental Protection Agency (EPA) of Kuwait. Several meetings and visits to Kuwait have ensued to formalize these arrangements. A workshop titled "Environmental management: issues, solutions, tools and business prospects" was held in Italy involving over 100 Italian participants and diplomatic representatives of all Gulf Cooperation Council (GCC) Countries. An Ev-K2-CNR Representative Office has also been established in Kuwait City.

PLANNED ACTIVITIES

The first six GEMM research projects will be implemented with KISR. EPA will be also involved in the waste management component of the program. An institutional workshop will be held in Kuwait to launch the GEMM implementation phase. 1. The six projects are:

1. The oceanography of the Arabian Gulf and its coastal environment: the events of the last 50 years and the present forecasting capabilities
2. Modeling the behaviour of dangerous chemicals in the coastal environment (speciation, input-output, distribution, bioaccumulation, toxicity and applicability of remediation techniques
3. Radiochemical approach for the monitoring and management of the environment
4. Remote sensing techniques for monitoring topographic stability through interferometric synthetic aperture radar
5. Air pollution monitoring network
6. Waste management to increase recovery of valuable resources and to minimize environmental impact

GEMM Gulf Environmental Monitoring and Management

EXPECTED RESULTS AND INDICATORS

RESULTS	INDICATORS
- Improved understanding of local air pollution and elaboration of possible mitigation strategies	- Evaluation report on Kuwait's existing air quality monitoring needs - Analysis report on local specific pollution-related problems - 2 new mobile stations for "hot spot" monitoring installed - Existing stations improved and 10 new automatic stations installed - Existing and new technical personnel trained
- Improved knowledge and constant monitoring of the Arabian Gulf marine environment	- Results of high-resolution geophysical survey of the Gulf - Data from quality, comprehensive monitoring of sediment contamination of the Kuwait coastal marine area (100 sedimentary cores, 10 samples/core) - Results of oceanographic study of the Arabian Gulf, including: - Seawater, particulates and biota (4 marine organisms) for 2 years at intervals of 2 months - Numerical modeling of the environmental system - Production of an interactive atlas with wind, wave frequency and height - Accurate definition of coastal wave climate in specific locations. Multivariate statistics of Hs, Tp, T01 and direction
- Capacity of local scientific community (researchers and institutions) in remote sensing improved	- Report on complete analysis of surface stability in Kuwait using advanced InSAR techniques - Terrain displacement maps of the Kuwait territory - State of Kuwait SAR images acquired - Complete historical time series of ENVISAT data over the Kuwait urban and oil field areas acquired and data availability from other sensors (e.g. Radarsat-1) and use of new sensors (ALOS, TerraSAR-X, COSMO/SkyMed, Radarsat 2) evaluated - Natural and anthropogenic ground control points identified - Differential GPS data validation system set up - Integrated GIS developed for Kuwait - Software technology transferred - 15 scientists trained in advanced SAR data processing - International scientific publications on innovative scientific research by local scientists
- Improve waste management systems and institutional capacity for waste management	- 30 % of waste sorted and recycled by end of project cycle - Assessment report on types of urban and industrial waste, waste distribution and landfills in the region - Laboratory classification and testing of waste to assess possibilities for treatment or recycling - Awareness-raising materials and seminars for local decision makers and municipalities on waste management, remediation techniques and pollution control

GEMM Gulf Environmental Monitoring and Management

TIMETABLE	2008		2009		2010	
	1st sem	2nd sem	1st sem	2nd sem	1st sem	2nd sem
1. The oceanography of the Arabian Gulf and its coastal environment: the events of the last 50 years and the present forecasting capabilities						
Wind and wind climatology						
Waves and Wave climatology						
Statistics						
Atlas						
Wave forecast system & Coastal areas and climatology						
Circulation of pollutant and T&S climatology						Until 2011
Circulation of pollutant forecast						Until 2011
Coastal models						Until 2011
Training						
2. Modeling the behavior of dangerous chemicals in the coastal environment (speciation, input-output, distribution, bioaccumulation, toxicity and applicability of remediation techniques						
Start-up phase						
Geophysics						
Analysis of marine food-web						Until 2011
Sampling of Sedimentary cores						
Geochemical Analysis						Until 2011
Modeling						Until 2011
Final report and publication of results						
3. Radiochemical approach for the monitoring and management of the Environment						
Radio nuclides (gamma emitting) analyses						
Plutonium isotopes and uranium isotopes (140 samples)						
Elemental and Physical Analyses: 20 Major and Minor elements; Loss of water and L.O.I; Apparent density & Granulometry. (860 samples)						Until 2011
QA & QC and intercalibration						
4. Remote sensing techniques for monitoring topographic stability through interferometric synthetic aperture radar						
Mobilization						
SAR processing						
Ground truth						
Validation						Until 2011
Report and maps						on 2011
5. Air Pollution Monitoring network						
Preliminary assessment						
Source inventory and recognition						
Details pollution monitoring in hotspots sites (automated, mobiles and conventional units)						
Atmospheric Modelling						Until 2011
Evaluation of the Background level						Until 2011
Training and technology transfer						
6. Waste management to increase recovery of valuable resources and to minimize environmental impact						
Identification of different types of wastes						
Data gathering						Until 2011
Laboratory characterization						Until 2011
Laboratory experimental tests						Until 2011
Identification of BAT						Until 2011
Scenarios						Until 2011
Design and cost analysis						in 2011

Earth
Ecological Activity for
Refuse Treatment at High-altitude

EARTH is an innovative example of applied research patented by Ev-K2-CNR and designed in collaboration with the private company Actelios / Falck. The EARTH system thermally treats waste with an extremely low emissions rate and is intended for use high mountain parks, where the waste produced by trekking and expedition groups, as well as that of the local populations, is difficult to dispose of without dire environmental impacts. The first EARTH prototype was developed and tested in 2006.

OBJECTIVES
Contribute to the protection of remote high altitude environments.

The specific objectives of the current phase of the EARTH project are:
- Improve the existing prototype and create a new machine able to generate energy, recuperating heat during waste disposal;
- Introduce the new prototype on the industrial market.
- Promote sustainable waste management, providing specific training for local populations where EARTH is installed.

PROGRESS TO DATE
The existing prototype has been designed for use in extreme environments, where the lack of oxygen and absence of electrical power make innovative technological solutions necessary. The actual system is modular, to facilitate transportation in rough terrain, even by porters (no single piece weighs more than approx. 20 kg).

After preliminary tests in laboratory, the system was tested in July 2006 on Plateau Rosà in Italy at 3,400 m a.s.l. Another prototype has been shipped to Pakistan where it will be installed in the framework of Karakorum Trust project and operated in conjunction with the CKNP clean-up campaigns already being carried out as soon as required authorization is issued.

PLANNED ACTIVITIES
The main activities foreseen for the new phase of EARTH are:
- Install the existing prototype in Pakistan within a waste management framework. Considering limited local infrastructure, the optimal location for EARTH has been identified near the village of Askole (the last settlement reachable by jeep)
- Develop an energy-producing component for the current EARTH prototype
- Install the new prototype at the Pyramid in Nepal
- Train local technicians in the use of EARTH in Pakistan and Nepal
- Write and implement an industrial plan for the new prototype.

EARTH Ecological Activity for Refuse Treatment at High-altitude

EXPECTED RESULTS AND INDICATORS

RESULTS	INDICATORS
- New prototype able to produce energy from waste burning	- EARTH II prototype patented
- Waste in SNP and CKNP more efficiently managed and disposed of with the lowest possible environmental impact in the areas where EARTH is installed	- EARTH I and EARTH II installed in Pakistan and Nepal, respectively - X local technicians trained in the use of EARTH in each country Reports on waste management before and after the installation of the EARTH units

TIMETABLE	2008		2009		2010	
	1st sem	2nd sem	1st sem	2nd sem	1st sem	2nd sem
EARTH II						
New prototype design (Italy)		■				
Construction (Italy)			■			
Preliminary laboratory test (Italy)			■			
Shipment to Sagarmatha National Park (Nepal)				■		
High altitude test (Pyramid)				■		
Training courses for local technicians (Pyramid)					■	■
Starting of disposal activity (Pyramid)					■	■
EARTH I						
Assembly of the system in Pakistan (Askole)				■		
Final on site test and any needed adjustments				■		
Training courses for local technicians (Askole)				■	■	■
Starting of disposal activity (Askole)				■	■	■
Industrialization of the new prototype						
Preliminary design					■	
Implementation of industrial plan						■

NATURenergy New Advanced Turbo Utilization of Renewable Energy

Ev-K2-CNR's experience with the EARTH technology has given rise to an opportunity for a technological/industrial spin-off, a thermodynamic system that produces electrical energy and heat from biomass combustion. The project is particularly interesting and innovative for the thermodynamic cycle used, which allows very high efficiencies while using reduced powers.
NATUREnergy will also be compact and could be installed wherever biomass disposal is a problem, such as on farms or in public or private parks, where the remains of pruning and woods upkeep would power the system. The project will be carried out in collaboration with the Bergamo University Center for Territorial Studies, the Bergamo Colli Park (Parco dei Colli) and CNR-Institute for the Dynamics of Environmental Processes (IDPA).

OBJECTIVES

The project aims to improve management of biomass waste in protected areas simultaneously creating a renewable energy source.
The specific objective of this initiative is to develop a marketable NATUREnergy prototype able to process a large enough amount of biomass so as to obtain an economic profit. The pilot system will produce 360 kWe/hour, of which 20 kWe will be used for the machine itself. The remaining 340 kWe can be sold for 7,800 hours a year, for an annual total of 2.652.000 kWh.

The prototype will need to have the following parameters:

PARAMETERS	VALUE
Power production	360 kWe (per hour)
Efficiency	30%
Biomass consumption	415 kg / hour (it means 3100ton a year)
Reliability / availability	>= 7.800 hours a year
Maintenance costs	< 5% of the investment cost per year

PLANNED ACTIVITIES

The main activities foreseen are:
- Finalize the technical design;
- Construction of the mechanical parts of the prototype;
- Indoor assembly and testing of the prototype;
- Dismantling and reassembly of the prototype for testing outdoors in a target area with available biomass.
- Execution of a two-year test, where the system runs 24 hours a day, expect for two maintenance breaks (40 days total) for cleaning of filters and heat exchanger.
- Sale of energy produced to ENEL electric company.

EXPECTED RESULTS AND INDICATORS

RESULTS	INDICATORS
- The use of a new innovative thermodynamic system.	- Electrical efficiency superior to 25 % - The system needs no human management - Low running costs - Prototype patented
- Low environmental impact	- No fuels used to run the machine

NATURenergy New Advanced Turbo Utilization of Renewable Energy

TIMETABLE	2008		2009		2010	
	1st sem	2nd sem	1st sem	2nd sem	1st sem	2nd sem
Prototype design		■				
Construction			■			
Laboratory preliminary test				■		
Outdoor installation				■		
Test					■	■
Industrialization						■

Ev-K2-CNR Scientific and Technological Project

Besides the integrated sustainable development/research projects described above, Ev-K2-CNR continues to promote scientific investigations on specific topics to improve our knowledge in mountain and altitude related fields. For the most part, these studies are self-financed but are promoted through the Ev-K2-CNR network and carried out in collaboration with institutions and researchers in the host countries. Researchers interested in doing studies in the Ev-K2-CNR project or at the Pyramid International Laboratory-Observatory need to submit a proposal for evaluation by the Scientific Council and by the BTC (for projects to be executed in Nepal).

PROGRESS TO DATE

Since 1990, over 550 research missions have been carried out at the Pyramid Laboratory. Hundreds of researchers from around the world have performed studies in the fields of

- Medicine and Physiology
- Environmental Sciences
- Earth Sciences
- Anthropological Sciences
- New Technologies

Just a few of our significant achievements so far:

- Prof. Desio's patrimony of geodetic, geophysical and geological data in the K2 region;
- The discovery of the Snow Leopard's return to SNP and unique data on the numbers and habits of these endangered cats there;
- A model evaluating the impact of tourism in SNP;
- A confirmation of genetic adaptation to high altitude by native Tibetan populations (data concerns the expenditure of less energy while walking or running when compared to low altitude natives);
- Greater understanding of mechanisms which determine the variability in maximum aerobic power at various altitudes;
- Identification of the "lactate paradox" in the Tibetan population;
- Precise to-the-millimeter quantification of a gradual shift of Mount Everest to the north;
- Precise measurement of the heights of the following mountains: Everest (including the exact depth of the snow cap), K2, - Aconcagua, Rosa and Cervino;
- Discovery and translation of a 15th century's Tibetan manuscript telling of the life of Chokyi Dronma, Princess of Gunthang in Western Tibet;
- Recording of the songs of the last Kulunge Rai nomadic hunters;
- Publication of "Guidelines for Eco-compatible Expeditions".

PROPOSALS APPROVED FOR EXECUTION IN 2008-2010

1. MEDICINE AND PHYSIOLOGY

1.1 Respiratory health in high altitude residents exposed to indoor pollution

Principal investigator: Dr. Valter Fasano – University of Milan, Institute for Respiratory Diseases

Indoor pollution is a risk factor for Chronic Obstructive Pulmonary Disease (COPD). The aim of this study is to assess lung function, exercise capability, level of lung inflammation and oxidative stress in representative samples of population of villages at high altitude with no roads and industries so that the only effect of indoor pollution/smoking habits can be studied. At the beginning the study will be performed in Nepal, and the study may be expanded to Pakistan. A preliminary expedition was carried out in 2007.

The study will improve our understanding of the relationship between indoor pollution and respiratory health, to contribute to decreasing the morbidity and mortality from COPD in local populations. Study methods foresee non-invasive respiratory tests and exhaled CO measurements and a collection and analysis of sputum and exhaled air condensate from local subjects. The indoor pollution will be assessed through measurements of carbon monoxide. Following the analysis of the data, programs to prevent, diagnose and manage COPD will be proposed and implemented.

Ev-K2-CNR Scientific and Technological Project

1.2 Mechanics and energetics of heavy load carrying on slopes: resource management in extreme conditions
Principal investigator: Prof. Alberto Minetti – University of Milan, Institute of Human Physiology
The aim of the project is to test the locomotor strategies in carrying high loads while walking on steep slopes in extreme hypoxia. It is hypothesized that Nepalese porters developed a sensibility allowing them to choose speed/gradient pairs which keep the muscular effort as constant as possible. Their ability in this task will be compared with professional Caucasian mountaineers who are expected not to have developed such skills. Two research expeditions have been already carried out and they unveiled that porters displayed better performances, better economy and better efficiency then Caucasian mountaineers. A last expedition will be necessary to further our understanding of one final topic: is the porters' better economy associated with their higher speed of ascent, assumedly permitted by a higher aerobic power? During the study, the performance of 5-6 Nepalese porters and 5-6 Caucasian mountaineers will be analyzed through collection of data on oxygen consumption, heart rate and bodily parameters when the subjects are loaded with 60% of their body mass.

1.3 Mechanisms of central sleep apnea at high altitude
Principal investigator: Prof. Keith Burgess – University of Sidney, Department of Medicine
Abnormal periodic breathing commonly occurs when healthy humans sleep at high-altitude, in patients with heart failure, and typically precedes death. Breathing-induced changes in carbon dioxide and brain blood flow during sleep may underpin the condition. By combining sophisticated gold-standard sleep monitoring and imaging techniques with pharmacological intervention, this project aims to examine the mechanisms by which abnormal breathing develops at high-altitude. Data will be collected at sea-level and following ascent to high-altitude (Pyramid). Likely mechanisms underlying the development of periodic breathing at high-altitude will be examined, namely:
- elevation in ventilatory sensitivity to CO2;
- reduction in cerebrovascular reactivity to CO2;
- destabilizing influence of changes in cardiac output during sleep.

The outcomes of this integrative research study will have important implications for the understanding of periodic breathing in all contexts, including chronic heart failure. In particular, the study aims to test the following hypotheses:
- Indomethacin will reduce cerebrovascular reactivity to CO2, thereby reducing the buffering capacity to H+ provided by changes in cerebral blood flow and increasing the susceptibility for central sleep apnea;
- Acetazolamide will provide an effective means to treat central sleep apnea due to improvement in brain oxygenation mediated via a metabolic acidosis-induced rise in ventilation and cerebral blood flow.l

1.4 Effects of pulmonary hypertension on aerobic capacity in high-altitude
Principal investigator: Dr. Robert Naeije – Free University of Brussels, Department of Pathophysiology
The purpose of the study is to investigate the effects of endothelin receptor antagonist-induced decrease in pulmonary vascular resistance on exercise capacity, and to document concomitant changes in right ventricular and renal function. The results will contribute to understand the pathophysiology of decreased aerobic exercise capacity in hypoxia, and thereby provide background and rationale for innovative anti-pulmonary hypertensive therapies in hypoxic patients. The study aims ultimately to contribute to a better understanding of exercise limitation in hypoxia and maybe provide a rational for the treatment of hypoxic pulmonary hypertension at high altitude.

Specifically, the researchers will:
- study the effects of selective ETA receptor antagonist sitaxsentan on exercise capacity, using a cardiopulmonary exercise test (CPET) protocol including pulmonary artery pressure and flow measurements, ventilatory variables, workload, blood pressure, pulse rate and O2 saturation.
- study the effects of selective ETA receptor antagonist sitaxsentan on renal function as measured by diuresis, plasma and urinary urea, creatinine, uric acid, sodium, potassium and osmolality concentrations for the calculations of creatinine and urea clearances, free water clearance, and fractional excretions of sodium and potassium.

Ev-K2-CNR Scientific and Technological Project

1.5 Hypoxic animal model to characterize the hypoxia exposure effects. Proteomic investigation of brain, heart, liver, skeletal muscle , blood of hypoxic rats
Principal investigator: Prof. Cecilia Gelfi – CNR-Institute of Molecular Bioimmaging and Physiology
Hypoxia-induced changes in rat organs (brain, heart, liver, skeletal muscle, blood) exposed to 10 and 6.5% oxygen (corresponding to 5000 m and 8000 m altitude), will be investigated. This project will provide a list of protein changes induced by hypoxia in different organs, a mechanism for hypoxia adaptation and knowledge for treatment of hypoxia in a number of human disease such as stroke, cancer and respiratory disease. The project began in 2007 and aims ultimately to improve our understanding of the mechanisms for hypoxia adaptation, so as to transfer this information to human pathologies at sea level. Proteomic investigations will be performed on rats exposed to hypoxia.

2. ENVIRONMENTAL SCIENCES

2.1 Conservation of biodiversity: the large mammal community and the structure of bird community of Sagarmatha National Park (Solu Khumbu, Nepal) – Vanishing Tracks on the Roof of the World
Principal investigator: Prof. Sandro Lovari – University of Siena, Department of Environmental Sciences
This project is aimed at understanding the dynamics of certain key populations in SNP, placing a particular focus on the endangered snow leopard and its main prey species. In particular, analyses will be carried out on the population dynamics and reproductive biology of the Himalayan tahr and on the food habits, ranging movements and conservation of the snow leopard. Efforts will also be made to understand patterns of livestock depredation by the snow leopard in the SNP. Communities of SNP birds will also be studied.

Researchers will carry out the following activities:
- Point counts at dawn and playback counts on 3 species
- Study the habitat features (vegetation cover, slope, hydrography, etc.)
- Monitor the ear-tagged specimens darted in 2004-2005
- Tag other specimens (25 males and 10 females)
- Carry out monthly counts on: birth rate, death rate and immigration
- Study the climatic effects on population dynamic
- Scat analysis
- Non-invasive genetic analysis for DNA
- Satellite radio-tagging of 2 or 3 snow leopards
- Questionnaire surveys for the local populations

2.2 Habitat use and overlap of Himalayan musk deer 'Moschus chrysogaster' with reference to habitat quality and human use in Sagarmatha National Park, Nepal
Principal investigator: Achyut Aryal – Albert-Ludwigs University, Faculty of Forest and Environment
The study will investigate habitat use of musk deer with reference to habitat quality and human use. The current status, distribution and possible population of musk deer in the SNP and Buffer Zone will be assessed and differences in diet conditions of Himalayan musk deer in disturbed and undisturbed areas will be analyzed. To do so, biological analysis of vegetation and dung and pellets, and an analysis of pellets/dung distribution will be carried out. Understanding habitat overlap and resource competition of musk deer with other ungulates is another aim of this study and a GIS habitat overlap map will be produced. The general goal of this research is to assist the Government of Nepal in the long-term conservation and management of its endangered animal populations.

2.3 Demogenetic and demoecologic analysis of the Sherpa population from Khumbu Valley (Sagarmatha National Park)
Principal investigator: Prof. Gianumberto Caravello - University of Padova, Department of Environmental Medicine and Public Health, Hygiene Division
The goal of this research is to reconstruct the biological origin and history of the Sherpa population presently living in the Khumbu Valley and in the neighboring areas. A genealogical study based on pedigree drawing of selected subjects, coupled with the analysis of family name distribution in the entire population will be complemented with a population genetic analysis of Y-chromosome STR polymorphisms and other autosomal markers. This study could significantly increase the strength of cultural affiliation and identification of these people. The expected results should provide a coherent picture of the demogenetic dynamic of the population and could serve as a model for improving the approach to the demoecologic studies of human communities. In addition, the collected data could serve to refine the evolutionary tree of the human Y-chromosome.

Ev-K2-CNR Scientific and Technological Project

2.4 Natural resource evaluation and sustainable development in Nepal: health, tourism and the environment
Principal investigator: Prof. Alberto Baroni - University of Padova, Department of Environmental Medicine and Public Health, Hygiene Division
The study team intends to expand their studies, carried out in SNP in past years, in the Manang Valley in order to evaluate the ecosystem health of the area in pretext of growing tourism and human impact. The study will mainly focus on the sustainability and quality of tourism in the area, and will evaluate various environmental and social parameters such as pollution, biodiversity, cultural contamination, etc. by integrated indicators and descriptors.
The following activities will be carried out during this study:
- Examination of water samples quality through "Extended Biotic Index";
- Quantitative measurements of plants in quadrates laid at different altitudes and major tourist sites;
- Examination of socio-economic conditions through interviews and secondary data (reciprocity, politics, demography and emigration as well as income, profits, from many other economic action).

2.5 Research, study and the evaluation of environmental impact as a consequence of farming, zootechnical and tourist activity in the National Park of Sagarmatha (Himalayas)
Principal investigator: Prof. Fabrizio Luciani - University of Perugia, Department of Economy, Finance and Statistics
The purpose of this research is to construct a model to evaluate the impact of human activity applied to similar environmental and territorial realities, in order to indicate the correct measures needed to maintain a correct and on-going process of development. The conclusions to be obtained from this study will further enrich the scientific knowledge regarding the economic and environmental planning and management of the territory, in turn contributing to advanced research in economic and political agriculture, at both the national and international level.

3. EARTH SCIENCES

3.1 Tectonic collisional and post-collisional phases in the Himalayan chain
Principal investigator: Prof. Rodolfo Carosi - University of Pisa, Department of Earth Sciences
Within the framework of this study, the sin and post-collisional tectonic evolution of the Himalayan chain will be reconstructed along representative structural sections located in Nepal, Bhutan and Sikkim. The main objective of the research is to better understand the tectonic and structural evolution of the belt, mainly focused on the comprehension of exhumation mechanisms and modalities of the different metamorphic units and the geometry and kinematics of the main tectonic discontinuities (Main Central Thrust, South Tibetan Detachment System and localized shear zones in the core of the crystalline units).

To better define the role and meaning of the shear zones in the core of the higher Himalayan crystallines, probably extendable both west and east of lower Dolpo, a geological field study will be carried out in western and central Nepal. New geological observations will be performed, structural elements measured and more rock samples collected. In particular, geological observations will be combined with an analysis of geological-structural cartography, a meso-structural analysis and an analysis of metamorphic rocks. Structural, mineralogical, petrographic and geochronological analyses of the rocks collected in 2007 will also be completed. The new geological data combined with the data acquired by the researchers during past expeditions will provide insight into the possible mechanisms of the building up and exhumation of the chain.

3.2 Contribution to the study of geological setting and continental collision process in northwest Himalaya and Karakorum
Principal investigator: Prof. Franco Rolfo - University of Torino, Department of Mineralogical and Petrologic Sciences
The project aims to complete the already available geologic data in key areas of NW Himalaya and Karakorum, and to better describe the tectonometamorphic and magmatic evolution of basement units. Geologic, structural and petrographic data were collected in Shaksgam Valley, south Sinkiang (Xinjiang) in 2006, while selected rock samples have been studied in the laboratory in order to obtain petrographic, petrologic, geochemical and geochronological data. In order to complete the research another expedition in the south tributaries of Shaksgam Valley up to Sarpo Laggo glacier and Mustang Pass is necessary to collect metamorphic rocks for laboratory analysis.

Ev-K2-CNR Scientific and Technological Project

4. ANTHROPOLOGICAL SCIENCES

4.1 Tradition and Modernity in Tibet and the Himalayas

Principal investigator: Prof. Hildegard Diemberger – University of Cambridge, Mongolian and Inner Asia Studies Unit

The project aims to make a detailed study on the tradition and modernity concept, through the analysis of the social, cultural and environmental life in the remote areas of Tibet and Himalaya. The project focuses on two strands of work: the study of a Tibetan woman-lama (Samding Dorje Phagmo) and her reincarnations, and the preservation of Tibetan-Mongolian rare books and manuscripts. Both projects address key aspects of the preservation of Tibetan cultural heritage. In 2007 Hildegard Diemberger carried out two research campaigns in Tibet and Bhutan that led to the acquisition of new materials concerning the Dorje Phagmo tradition and also published a monograph on the Dorje Phagmo female reincarnation line. She now envisages a new publication on the life of Chokyi Dronma (1422-1455), the first of the female reincarnations, focused on unique and unknown sources of the Bodongpa tradition and on the reproduction of ancient mural paintings. To this, a study on the relationship between sacred landscape and mountaineering (Chinese and Tibetan) linked to the Samding Dorje Pagmo project has been added, since the deity Dorje Phagmo has been identified in many different elements of the sacred landscape in Tibet.

4.2 Aesthetics and ritual in the Himalayas

Principal investigator: Dr. Martino Nicoletti

The project has, since 2006, launched several research linked to the following fields: publication of 3 works in the collection Cinnabaris – Series of Oriental Studies, launch of the new series Liminalia – Sketches of Visual Anthropology and Aesthetics and research aimed to the publication of the first two works, launch of the ethnomusicological project Sound's Seeds and printing of the first CD of the series: The Path of Light: The Ritual Music of the Tibetan Bon. Research activity will be aimed to the realization of a second CD devoted to the Newari liturgical musical tradition of charya and professional recording of songs belonging to the musical traditions of the Chitral (Pakistan), editing and publication of the fourth volume of the "Cinnabaris" by Gisele Krauskopff (CNRS Paris) devoted to the Tharu civilisation.

4.3 Aesthetics of body. Performance and religion in Himalaya

Principal investigator: Dr. Alessandra Campoli

Literature research will be performed on iconography and rituals connected to divinities in the Dolpo region to back up and complete testimonies collected on the field in 2007. The Tibetan language texts Klu Bum and Klum Chod are particularly interesting in this sense. A new book set for publication in 2008, A. Campoli, Ritual Art oh the Kingdom of Mithila. Traditional Paintings by Janakpur Women in Nepal, will receive final editing. Finally, research on traditional music begun in 2007 will be continued, and specific data and artifacts will be collected for exhibition of the results of these studies to the public.

4.4 Intimate glance through the sacred Himalayan path

Principal investigator: Dr. Riccardo Vrech

The aim of the project is to complete the collection of data regarding the Bon tradition and the publication of the results in a book. The data will be collected during meetings with some of the most important masters of the Bon tradition, sacred pre-Buddhist doctrine, concerning the historical nexus of the Gcod ritual.

4.5 Gender Identity, Agri-cultures and Development in Uttarakhand

Principal investigator: Dr. Federica Riva

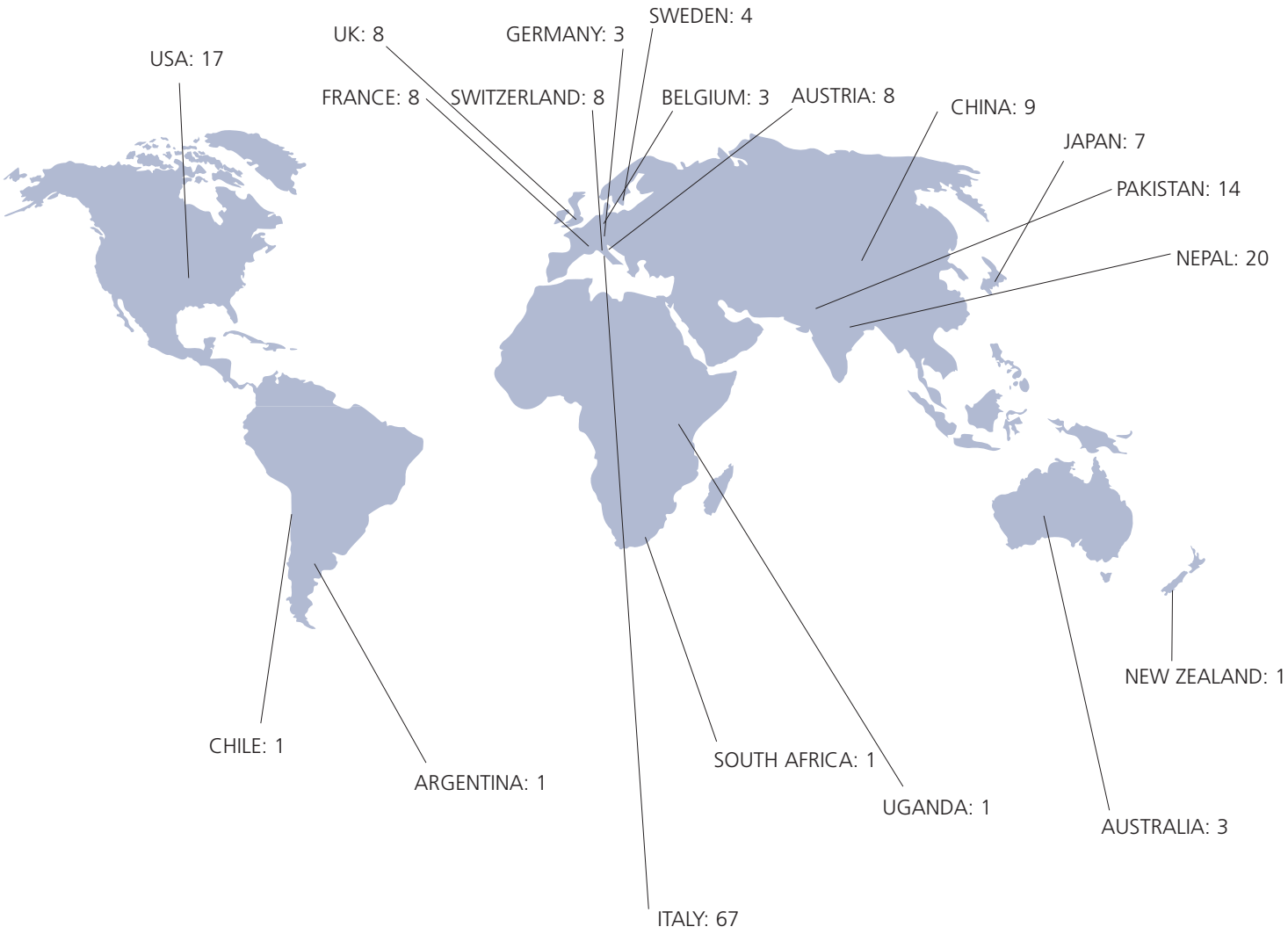
The research, which begins with an anthropological analysis of agricultural rituals, is focused on the symbolic meaning linked to gender roles in the Himalayan rural environment: spaces, images, taboo that define the social values and cultural restriction to the female intervention in agriculture. In fact, a deeper comprehension of the social and cultural dimension of the agricultural practices in the mountainous environment could be useful in order to better understand the material and symbolic gender dynamics at the local level that restrict female participation to the process of agricultural transformation in the Himalaya. Indeed, it will help in identifying the socio-cultural constraints which prevent women's access to control and/or ownership of the means of agricultural production.

Ev-K2-CNR Scientific and Technological Project

TIME TABLE	2008		2009		2010	
Activities	**1st sem**	**2nd sem**	**1st sem**	**2nd sem**	**1st sem**	**2nd sem**
Respiratory health in high altitude residents exposed to indoor pollution			■	■	■	■
Mechanics and energetics of heavy load carrying on slopes: resource management in extreme conditions			■	■		
Mechanisms of central sleep apnea at high altitude	■	■				
Effects of pulmonary hypertension on aerobic capacity in high-altitude	■	■				
Hypoxic animal model to characterize the hypoxia exposure effects. Proteomic investigation of brain, heart, liver, skeletal muscle , blood of hypoxic rats	■	■	■	■	■	■
Conservation of biodiversity: the large mammal community and the structure of bird community of Sagarmatha National Park (Solu Khumbu, Nepal) – Vanishing Tracks on the Roof of the World	■	■	■	■	■	■
Habitat use and overlap of Himalayan musk deer 'Moschus chrysogaster' with reference to habitat quality and human use in Sagarmatha National Park, Nepal		■	■			
Demogenetic and demoecologic analysis of the Sherpa population from Khumbu Valley (Sagarmatha National Park)			■	■	■	
Natural resource evaluation and sustainable development in Nepal: health, tourism and the environment			■	■		
Research, study and the evaluation of environmental impact as a consequence of farming, zootechnical and tourist activity in the National Park of Sagarmatha (Himalayas)	■	■				
Tectonic collisional and post-collisional phases in the Himalayan chain	■	■	■	■		
Contribution to the study of geological setting and continental collision process in northwest Himalaya and Karakorum	■	■	■	■		
Tradition and Modernity in Tibet and the Himalayas	■	■				
Aestethics and ritual in the Himalayas	■	■				
Intimate glance through the sacred Himalayan path	■	■				
Gender Identity, Agri-cultures and Development in Uttarakhand	■	■				
Aesthetics of body. Performance and religion in Himalaya	■	■				

Annex 1 - **Collaborating organizations**

Since 1990, over 180 national and international institutes have collaborated with Ev-K2-CNR:



For implementation of the 2008-2010 program, Ev-K2-CNR will collaborate with the following organizations:

Annex 1 - **Collaborating organizations**

Management of the PYRAMID INTERNATIONAL LABORATORY-OBSERVATORY
- Italian National Research Council – Italy
- Nepal Academy of Science & Technology – Nepal

SHARE – Stations at High Altitude for Research on the Environment
- CNR - Institute for Atmospheric and Climate Sciences – Italy
- CNR - Water Research Institute – Italy
- CNR - Institute of Ecosystem Study – Italy
- CNR - Institute for Electromagnetic Sensing of the Environment – Italy
- National Institute of Oceanography and Applied Geophysics – Italy
- National Metrological Research Institute – Italy
- University of Brescia - Department of Civil Engineering, Architecture, Land and Environment – Italy
- University of Milan - Department of Earth Sciences "Ardito Desio" – Italy
- University of Milan - Department of vegetable production - Italy
- University of Trieste - Department of Mathematics – Italy
- University of Urbino - Department of Chemical Sciences – Italy
- LSI Lastem – Italy
- Italian Glaciological Committee – Italy
- Environmentalist Association "Umana Dimora" – Italy
- CNRS, Laboratorie de Glaciologie et de Géophysique de l'Enviroment – Grenoble, France
- CNRS, Laboratoire de Météorologie Physique - Clermont-Ferrand, France
- Université Joseph Fourrier, Grenoble, France
- University of Innsbruck - Institute of Zoology and Limnology - Austria
- CNES, Service DORIS – France
- Nepal Academy of Science & Technology – Nepal
- Department of Hydrology and Meteorology – Nepal
- Pakistan Meteorological Department – Pakistan
- Uganda Wildlife Authority, Kampala – Uganda
- University of the Witwatersrand - School of Geography, Arch. & Environment Studies – South Africa
- University of Chile, Department of Geophysics, Santiago – Chile
- NASA Commercial Space Center – Washington D.C., USA
- NOAA, Surface Radiation Research Branch, Air Resources Laboratory – Boulder, CO, USA
- Department of Geography, College of Science, University of Idaho, Moscow, ID - USA
- Climate Prediction Program for the Americas (CPPA) NOAA Climate Program Office, Silver Spring, Maryland, MD - USA
- NCAR/Earth Observing Laboratory (EOL) – USA
- Scripps Institution of Oceanography (SIO), La Jolla, CA – USA
- Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing - China
- Institute of Geographical Sciences and Natural Resources Resource, Chinese Academy of Sciences, Beijing - China
- University of Tokyo, Department of Civil Engineering - Japan
- University of Tsukuba, Graduate School of Life and Environmental Science – Japan
- World Meteorological Organization
- United Nations Environment Programme

Annex 1 - **Collaborating organizations**

KARAKORUM TRUST
- Polytechnic of Milan - Department of Architecture – Italy
- University of Padova – Department of Human Geography – Italy
- Friends of Lorenzo Fellowship - Italy
- Italian Institute for Africa and East (ISiAO) - Italy
- Ministry of Environment - Pakistan
- Ministry of Kashmir Affairs and Northern Areas – Pakistan
- Ministry of Minorities, Culture, Sports, Tourism and Youth Affairs – Pakistan
- Northern Areas Department of Forests – Pakistan
- Karakurum International University, Gilgit – Pakistan
- Aga Khan Rural Support Programme - Pakistan
- Rural Support Programmes Network - Pakistan
- Alpine Club of Pakistan
- Mountain Glacier Protection Organization - Pakistan
- Pakistan Meteorological Department - Pakistan
- WWF Pakistan
- United Nations Environment Programme
- The World Conservation Union

HKKH Partnership project
- The World Conservation Union
- International Centre for Integrated Mountain Development– Nepal
- CESVI - Italy
- University of Cagliari - Department of Earth Sciences - Italy
- University of Milan "Bicocca" - Department of Environment and Earth Sciences - Italy
- University of Milan - Department of Earth Sciences "Ardito Desio" - Italy
- University of Napoli "Federico II" - Department of Arboriculture, Botany and Plant Pathology - Italy
- University of Padova - Terrestrial and Agro-Forestry Systems Department - Italy
- University of Padova - Department of Environmental Medicine and Public Health, Hygiene Division - Italy
- Sagarmatha National Park – Nepal
- Sagarmatha Pollution Control Committee - Nepal
- Tribhuvan University – Nepal
- Kathmandu University – Nepal
- Resources Himalaya Foundation – Nepal
- WWF Pakistan

GEMM - Gulf Environmental Monitoring and Management
- CNR - Water Research Institute - Italy
- CNR - Institute of Ecosystem Study - Italy
- CNR - Institute of Marine Sciences - Italy
- CNR - Institute of Atmospheric Pollution - Italy
- CNR - Institute of Intelligent System for Automation - Italy
- CNR - Institute of Inorganic Chemistry and of the Surfaces - Italy
- CNR - Methodological Chemistry Institute - Italy
- CNR - Institute for the Dynamics of Environmental Processes - Italy
- CNR - Institute for Coastal Marine Environment - Italy
- Kuwait Institute for Scientific Research – Kuwait
- Al-Arfaj Group of Companies – Kuwait
- Environment Public Authority - Kuwait

Annex 1 - **Collaborating organizations**

EARTH – Ecological Activity for Refuse Treatment at High-Altitude
- Actelios - Italy

NATUREnergy – New Advanced Turbo Utilisation of Renewable Energy
- University of Bergamo - Centro Studi sul Territorio "Lelio Pagani" - Italy
- CNR - Institute for the Dynamics of Environmental Processes - Italy
- Consortium Regional Park "Dei Colli", Bergamo - Italy
- CO.S.IDR.A S.p.A - Italy
- ABM Valorizzazione Srl - Italy

Ev-K2-CNR SCIENTIFIC AND TECHNOLOGICAL PROJECT
- CNR - Institute of Molecular Bioimaging and Physiology - Italy
- University of Ferrara - Department of Respiratory Diseases - Italy
- University of Milan - Department of Biomedical Sciences and Technologies - Italy
- University of Milan - Institute of Respiratory Diseases - Italy
- University of Milan - Institute of Human Physiology – Italy
- University of Padova - Department of Environmental Medicine and Public Health, Hygiene Division - Italy
- University of Pavia - Department Geographic History; Medical Clinic 1 - Italy
- University of Perugia - Department of Economy, Finance and Statistics - Italy
- University of Pisa - Department of Earth Sciences - Italy
- University of Siena - Department of Environmental Sciences - Italy
- University of Torino - Department of Mineralogical and Petrologic Sciences - Italy
- Mongolia and Inner Asia Studies Unit, University of Cambridge– UK
- University College London, London - UK
- Nepal Academy of Science & Technology – Nepal
- Ministry of Culture, Tourism and Civil Aviation – Nepal
- Ministry of Environment, Science & Technology – Nepal
- Ministry of Forest and Soil Conservation – Nepal
- Department of National Parks and Wildlife Conservation – Nepal
- WWF Nepal
- Manly Hospital, Department of Critical Care, Manly - Australia
- School of Chemistry, University of Melbourne, Melbourne - Australia
- University of Sydney, Department of Medicine - Sydney
- University of Otago, Department of Physiology, Dunedin - New Zealand
- Erasme Academic Hospital, Department of Cardiology - Belgium
- Free University of Brussels, Faculty of Medicine, Department of Pathophysiology - Belgium
- St-Elisabeth Hospital, Department of Pneumology- Belgium
- Albert-Ludwigs University, Faculty of Forest and Environment - Germany

Annex 2 - **Collaborating researchers** (*Ev-K2-CNR Scientific Council member)

For implementation of the 2008-2010 program, Ev-K2-CNR will collaborate with the following researchers:

Prof. Allegrini Ivo	CNR – Institute for Atmospheric Pollution
Prof. Anfodillo Tommaso (*)	University of Padova Terrestrial and Agro-Forestry Systems Department
Dr. Angelini Fabio	CNR - Institute of Atmospheric Sciences and Climate
Prof. Antignani Luigi	S. Camillo Forlanini Hospital, Rome
Dr. Antoninetti Massimo	CNR - Institute for Electromagnetic Sensing of the Environment
Dr. Ardigò Luca Paolo	University of Verona Faculty of Motor Sciences
Dr. Arduini Jgor	University of Urbino Institute of Chemical Sciences
Dr. Balestrini Raffaella	CNR - Water Research Institute
Dr. Barbante Carlo	University of Venice Department of Environmental Sciences
Prof. Baroni Alberto	University of Padova Department of Environmental Medicine and Public Health, Hygiene Division
Dr. Bergamaschi Luigi	National Metrological Research Institute
Dr. Bernardi Luciano	University of Pavia Medical Clinic 1
Dr. Bertolani Laura	Epson Meteo Centre - Climate Research Division
Dr. Bocci Anna	University of Siena Department of Environmental Sciences, Ethology Section, Behavioral Ecology and Wildlife Management
Dr. Boesi Roberto	University of Milan Department of Biology
Dr. Bonacina Costante	University of Brescia Department of Civil Engineering, Architecture, Land and Environment
Dr. Bonafè Ubaldo	CNR - Institute of Atmospheric Sciences and Climate
Dr. Bonasoni Paolo (*)	CNR - Institute of Atmospheric Sciences and Climate
Dr. Bosello Francesco (*)	Foundation ENI Enrico Mattei University of Milan Department of Economics, Business and Statistics
Prof. Boselli Anna Milvia	University of Padova Department of Environmental Medicine and Public Health, Hygiene Division
Dr. Burgess Keith	University of Sidney Department of Medicine
Dr. Calzolari Francescopiero	CNR - Institute of Atmospheric Sciences and Climate
Dr. Campoli Alessandra	"La Sapienza" University of Rome
Prof. Caravello Gianumberto	University of Padova Department of Environmental Medicine and Public Health, Hygiene Division
Dr. Carosi Rodolfo	University of Pisa Department of Earth Sciences
Prof. Carrer Marco	University of Padova Terrestrial and Agro-Forestry Systems Department
Dr. Cavaleri Luigi	CNR - Institute of Marine Sciences

Annex 2 - **Collaborating researchers** (*Ev-K2-CNR Scientific Council member)

Dr. Cavalli Silvano (*)	DIONEX Spa
Prof. Cerretelli Paolo	University of Milan Department of Technological and Biomedical Sciences
Prof. Cescon Paolo	University of Venice Department of Environmental Sciences
Dr. Chiesa Sergio (*)	CNR - Institute for the Dynamics of Environmental Processes
Prof. Cogo Annalisa (*)	University of Ferrara Department of Respiratory Diseases
Dr. Coppo Lucio	University of Padova Department of Environmental Medicine and Public Health, Hygiene Division
Dr. Cozzi Giulio	University of Venice Department of Environmental Sciences
Dr. Cristofanelli Paolo	CNR - Institute of Atmospheric Sciences and Climate
Dr. de Bernardi Riccardo (*)	CNR – Institute of Ecosystem Study
Dr. Della Valle Elena	University of Padova Terrestrial and Agro-Forestry Systems Department
Dr. Dematteis Andrea	Wildlife Management Research Center – CERIGEFAS University Foundation
Dr. Decesari Stefano	CNR - Institute of Atmospheric Sciences and Climate
Dr. Degetto Sandro	CNR - Institute of Inorganic Chemistry and of the Surfaces
Dr. De Paolis Adolfo	CNR – Water Research Institute
Prof. Diemberger Hildegard (*)	Cambridge University Mongolia and Inner Asia Studies Unit
Dr. Facchini Maria Cristina	CNR - Institute of Atmospheric Sciences and Climate
Dr. Fasano Valter	University of Milan Institute of Respiratory Diseases
Dr. Ficetola Francesco	University of Milan "Bicocca" Department of Environment and Earth Sciences
Dr. Formenti Federico	University of Oxford Department of Physiology, Anatomy and Genetics
Dr. Frassi Chiara	University of Pisa Department of Earth Sciences
Dr. Fuzzi Sandro	CNR - Institute of Atmospheric Sciences and Climate
Eng. Gallo Maurizio (*)	Ev-K2-CNR Committee
Dr. Gastaldi Leonardo (*)	Italian National Research Council
Prof. Gelfi Cecilia	CNR – Institute of Molecular Bioimaging and Physiology
Dr. Giannino Francesco	University of Napoli "Federico II" Department of Arboriculture, Botany and Plant Pathology
Dr. Giaveri Giuseppe	National Metrological Research Institute
Dr. Gobbi Gian Paolo	CNR - Institute of Atmospheric Sciences and Climate
Dr. Groppo Chiara	University of Torino Department of Mineralogical and Petrologic Sciences
Dr. Guzzella Licia	CNR – Water Research Institute
Dr. Laj Paolo	CNRS - Laboratoire de Météorologie Physique - Clérmont-Férrand, France / Université Joseph Fourrier, Grenoble, France
Dr. Lami Andrea	CNR – Institute of Ecosystem Study
Dr. Lanzi Carlo	University of Brescia Department of Civil Engineering, Architecture, Land and Environment
Dr. Latella Leonardo	Natural History Civic Museum of Verona

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Prof. Legnani Delfino	University of Milan Institute of Respiratory Diseases
Dr. Lencioni Valeria	Natural Science Museum of Trento
Dr. Loreto Francesco (*)	CNR - Institute of Agro-Environmental and Forest Biology
Prof. Lovari Sandro	University of Siena Department of Environmental Sciences, Ethology Section, Behavioral Ecology and Wildlife Management
Prof. Luciani Fabrizio	University of Perugia
	Economy Faculty, Department of Economy, Finance and Statistics
Dr. Mabilia Rosanna	CNR – Institute for Atmospheric Pollution
Dr. Maione Michela	University of Urbino Institute of Chemical Sciences
Dr. Marchetto Aldo	CNR – Institute of Ecosystem Study
Dr. Marconi Claudio	CNR - Institute of Molecular Bioimaging and Physiology
Prof. Mariani Luigi	University of Milan Department of Vegetable Production
Dr. Marinoni Angela	CNR - Institute of Atmospheric Sciences and Climate
Dr. Marsella Ennio	CNR- Institute for Coastal Marine Environment
Dr. Mayer Christoph	Bavarian Academy of Sciences, Glaciological Commission, Munich, Germany
Prof. Mazzoleni Stefano	University of Napoli "Federico II" Department of Arboriculture, Botany and Plant Pathology
Dr. Melis Maria Teresa (*)	University of Cagliari Department of Earth Sciences - TeleGis Laboratory
Dr. Micheletti Carlo	University of Brescia Department of Civil Engineering, Architecture, Land and Environment
Dr. Migliozzi Antonello	University of Napoli "Federico II" Department of Arboriculture, Botany and Plant Pathology
Dr. Minder Isabelle	University of Siena Department of Environmental Sciences, Ethology Section, Behavioral Ecology and Wildlife Management
Prof. Minetti Alberto	University of Milan Institute of Human Physiology, Faculty of Medicine
Dr. Mininni Giuseppe	CNR – Water Research Institute
Dr. Montomoli Chiara	University of Pisa Department of Earth Sciences
Dr. Naeije Robert	Free University of Brussels Department of Pathophysiology
Dr. Nicoletti Martino	Ev-K2-CNR Committee
Dr. Nodari Maria Luisa	University of Cambridge Department of Social Anthropology
Dr. Oggioni Alessandro	CNR – Institute of Ecosystem Study
Dr. Padoa Schioppa Emilio	University of Milan "Bicocca" Department of Environment and Earth Sciences
Dr. Pellizzi Bernardo	University of Siena Department of Environmental Sciences, Ethology Section, Behavioral Ecology and Wildlife Management
Prof. Pertusati Piero	University of Pisa Department of Earth Sciences

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Dr. Pezzo Francesco	University of Siena Department of Environmental Sciences, Ethology Section, Behavioral Ecology and Wildlife Management
Prof. Piqué Vazquez Javier	Universidad de Huelva (Spain) Dpto. de Ciencias Agroforestales
Dr. Polesello Stefano	CNR – Water Research Institute
Prof. Poretti Giorgio	University of Trieste Department of Mathematics
Dr. Refice Alberto	CNR - Institute of Intelligent System for Automation
Dr. Riva Federica	University of Milan "Bicocca"
Dr. Rizzio Enrico	National Metrological Research Institute
Dr. Roccato Fabrizio	CNR - Institute of Atmospheric Sciences and Climate
Prof. Rolfo Franco	University of Torino Department of Mineralogical and Petrologic Sciences
Dr. Salerno Franco	CNR – Water Research Institute
Dr. Samaja Michele	S. Paolo Hospital Department of Medicine and Surgery
Dr. Sironi Maria Antonia	Eco-Himal Italy
Prof. Smiraglia Claudio (*)	University of Milan Department of Earth Sciences "Ardito Desio"
Dr. Sommaruga Ruben	University of Innsbruck Institute of Zoology and Limnology
Dr. Soraruf Luca	University of Padova Terrestrial and Agro-Forestry Systems Department
Dr. Sprovieri Mario	CNR- Institute for Coastal Marine Environment
Dr. Tarolli Paolo	University of Padova Land and Agro-Forest Environment Department
Dr. Tartari Gabriele	CNR – Institute of Ecosystem Study
Dr. Tartari Gianni (*)	CNR – Water Research Institute
Prof. Tenca Alessandro	University of Padova Terrestrial and Agro-Forestry Systems Department
Prof. Tomasi Claudio	CNR - Institute of Atmospheric Sciences and Climate
Dr. Valsecchi Sara	CNR – Water Research Institute
Prof. Vassena Giorgio	University of Brescia Department of Civil Engineering, Architecture, Land and Environment
Dr. Viganò Agnese	University of Milan Department of Technological and Biomedical Sciences
Dr. Villani Paolo	CNRS - Laboratoire de Météorologie Physique - Clérmont-Férrand, France
Dr. Vrech Riccardo	University of Bergamo Research Centre on the Anthropology and the Epistemology of Complexity
Dr. Vuillermoz Elisa (*)	Ev-K2-CNR Committee

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