



# High Summit

LECCO 2013

INTERNATIONAL CONFERENCE ON  
MOUNTAINS AND CLIMATE CHANGE

October 23•24•25 • 2013

# ABSTRACT BOOK

VENUE

POLITECNICO DI MILANO • POLO TERRITORIALE DI LECCO  
VIA PREVIATI • 23900 LECCO • AULA A01



POLITECNICO DI MILANO



POLO TERRITORIALE  
DI LECCO



Camera di Commercio  
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# TABLE OF CONTENTS

<b>Motivations</b>	<b>p.3</b>
<b>Promoting Committee</b>	<b>p.4</b>
<b>Scientific Committee</b>	<b>p.5</b>
<b>Conference Programme</b>	<b>p.6</b>
<b>Speakers Biographies and Abstracts</b>	<b>p.9</b>
<b>Poster Session Abstracts</b>	<b>p.51</b>
<b>Index of Authors</b>	<b>p.68</b>



# MOTIVATIONS

The final report of the UNCSD Conference held in Rio on June 2012 recognizes that benefits deriving from mountains are essential to sustainable development. Mountains are, in fact, a fundamental source of water and energy for a large number of populations and play a key role in the study and understanding of the impact of climate change.

Moreover, as stated by the Rio Declaration on Environment and Development (United Nations Conference on Environment and Development, 14 June 1992), mountains provide key resources like minerals, forest and agricultural products as well as recreation. However, mountain areas are fragile ecosystems and very sensitive to global climate changes and anthropogenic pressures: as the world heats up, mountain glaciers melt, weather patterns change with rare plants and animals struggling to survive in a decreasingly favorable habitat. Understanding the impact of changing climate conditions on glacier melt is a prerequisite for projections of glacier volume changes which are needed for mountain hydrology studies, for analyzing natural hazard frequency and to forecast sea level rise.

Due to their relative remoteness from highly populated and industrialized regions, mountains are considered ideal locations for investigating the impact of climate changes from regional to global scales, as also recently defined in the UN resolution (UN, A/Res/62/196, 2008).

Mountain issues need to be prioritized in development agendas and processes dealing with poverty reduction, food security, climate change, and other issues that are critical to sustainable development in mountain areas. Regional and global environments, as well as the global economy, strongly depend on mountains, since they are a crucial source of ecosystem services and can also harbor a wide range of important natural resources. Mountains make important contributions to economic development, environmental protection, ecological sustainability and human wellbeing, as well as to economic and ecological resilience in the downstream regions.

Mountains provide a large share of the world's resources for mining, forestry, water for drinking and irrigation, hydropower, and generate an increasing amount of wind power, as well. Mountain products and services form the basis for many economic sectors – food, agriculture, forestry and rangeland production, hydropower generation, tourism, pharmaceuticals, cosmetics and others. Mountain rangeland and forests provide economic benefits to local people and global communities, with their rich store through medicinal plants, nuts, fruits, timber, wood for fuel, and minerals.

Indirect contributions to national, regional, and global economies include the support and regulation of ecological functions and processes, such as carbon sequestration and storage, soil conservation, flood control, climate moderation, and wind and monsoon regulation.

The genetic diversity preserved in mountain ecosystems helps to ensure the world's future food security. Thus a sustained flow of mountain ecosystem services is critical for feeding the growing population.

Finally, it must be recalled that mountain vegetation plays a major role in reducing or mitigating risks from natural hazards. The huge value of mountain ecosystems in protecting against hazards can be deduced from the economic and social costs of natural disasters in the eastern Himalayas and downstream (ICIMOD, 2011).

In this global context, the High Summit Conference 2013 aims at presenting the state of the art of current knowledge on the mountain ecosystem from a scientific and socio-economic points of view. The participation of high-level speakers moderating the various round tables will facilitate discussions among the experts and the conference audience. At the end of the two working days, a document will be produced, summarizing the main outcomes of the meeting. Results will be presented at the next COP19 in Warsaw, where Ev-K2-CNR will promote a side event dedicated to the role of mountain resources and related ecosystem services which need to be prioritized in the international context of the promotion of sustainable development under the impact of climate changes.



# PROMOTING COMMITTEE



The Ev-K2-CNR Committee is an autonomous, non-profit association, which has promoted scientific and technological research projects in high mountain regions for more than 25 years, distinguished by the specificity and the excellence of the results achieved in the international scientific world. With its constant presence on the mountain areas of Hindu Kush – Karakorum – Himalaya region in Nepal, Pakistan, China (Tibetan Autonomous Region), India, and with the creation and management of the Pyramid Laboratory/Observatory located at 5,050 meters a.s.l. in Nepal at the base of Mount Everest, a precious jewel universally recognised and appreciated for the high altitude research and study. Ev-K2-CNR Committee has given a new unique value to the mountain world, a rich basin from which it is possible to have information on the fields of Earth Sciences, Environmental Sciences, Medicine and Physiology, Anthropology, eco-efficient technologies and environmental management systems. Today, Ev-K2-CNR's work is mainly organized via broad-scale integrated multi-disciplinary programs aimed at helping resolve urgent environmental and development issues.

POLITECNICO DI MILANO



POLO TERRITORIALE  
DI LECCO

Polo territoriale di Lecco was founded in 1997 upon collaboration between the University and territorial bodies to satisfy the need for, in a highly industrial area with great employment potential, a university campus able to increase and drive collective growth through research and technological development. The Lecco Campus offers a distinctly high level of education that encourages integration with the territory in terms of both the uniqueness of the entrepreneurial fabric and the campus' own research initiatives. In fact, the study programmes, some of them unique to the Politecnico, have been designed to answer to the needs of local industries as well as to the requests from the global job market. Today, 19% of the entire student population who lives and studies in Lecco, and which amounts to more than 1,600, are foreign students. This constant growth rate seems to predict greater international participation in the near future. Polo territoriale di Lecco is also committed to high quality and innovative research through the development of experimental activities and technological transfer. Close ties between our campus and numerous industries in Lecco permit both sectors to collaborate in didactic and research projects that have as common goal to maximize the potential of regional resources.



Consiglio Nazionale delle Ricerche

University and Research (MIUR).

The CNR, within a framework of European cooperation and integration, has the task to carry out, promote, transfer, assess and enhance research in the major fields of knowledge. And applying the results to the scientific, cultural, technological, economic and social development of the country. The CNR scientific network consists of over 100 institutes, divided into 7 Departments, with approximately 8,000 employees. Its size, its organization and its spread all over the country make the CNR the largest Italian research body, characterized by a high degree of multidisciplinary that distinguishes it from all other bodies and it is one of the most important at international level.



Camera di Commercio  
Lecco

The Camera di Commercio di Lecco was founded in 1993 after the Institution of the Provincia di Lecco and is an "Autonomous institution of public law which in the territorial district carry out function of general interest to the business system taking care of local economies development (Legge di Riforma n. 580/1993 e s.m.i)". The institution – based on subsidiarity – valorizes the autonomy and the entrepreneurial, professional's activities, industrial action, cooperation and consuming activities and other social organizations useful for the development and promotion of the system. The association carries out lots of roles, as companies Public Administration: innovation, research, technological transfer; internationalization; training and professional development; Registry of Businesses; Sportello Unico Attività Produttive (SUAP); market regulation and consumer protection, brands and licences; observers and economic information, access to credit; announcements and incentives, infrastructure and marketing planning and cultural initiatives.



# SCIENTIFIC COMMITTEE

## Chair

**Enrico Brugnoli** - Department of Earth System Science and Environmental Technologies, CNR, Italy

## Members

**Martin Beniston** - Institute for Environmental Sciences, University of Geneva, Switzerland

**Paolo Bonasoni** - ISAC Institute of Atmospheric Sciences and Climate, CNR and Ev-K2-CNR Committee, Italy

**Surendra Raj Kafle** - NAST Nepal Academy of Science and Technology, Nepal

**Najma Najam** - KIU Karakoram International University, Pakistan

**Antonello Provenzale** - ISAC Institute of Atmospheric Sciences and Climate, CNR, and GEO Ecosystems SBA Coordinator, Italy

**Veerabhadran (Ram) Ramanathan** - Scripps Institution of Oceanography, University of California, USA

**Renzo Rosso** - Department of Civil and Environmental Engineering, Politecnico di Milano, Italy

**Surendra Shrestha** - International Environment Technology Centre, UNEP, Japan

**Claudio Smiraglia** - Department of Earth Sciences "Ardito Desio", University of Milan and Italian Glaciological Committee, Italy

**Elisa Vuillermoz** - Ev-K2-CNR Committee, Italy



# CONFERENCE PROGRAMME

## DAY I – OCTOBER, 23

- 08.30 Registration
- 09.15 Welcome Addresses
  - Giovanni Azzone** • Rector of Politecnico di Milano, Italy
  - Vico Valassi** • Senior guest conference, President of Camera di Commercio di Lecco and UniverLecco, Italy
  - Agostino Da Polenza** • President of Ev-K2-CNR Committee, Italy
  - Virginio Brivio** • Major of Lecco
  - Daniele Nava** • President of Province of Lecco
  - Roberto Maroni** • President of Lombardy Region (**invited**)
- 10.00 Opening remarks
  - Maria Cristina Messa** • Vice President of CNR, Italy
  - Surendra Raj Kafle** • Vice Chancellor of NAST Nepal Academy of Science and Technology, Nepal
  - Surendra Shrestha** • Director of International Environment Technology Centre, UNEP, Japan
  - Deon Terblanche** • Director of Atmospheric Research and Environment Branch WMO, Switzerland
  - Barbara J. Ryan** • Secretariat Director of the intergovernmental Group on Earth Observations (GEO), Switzerland
- 10.45 Plenary 1 **CLIMATE**
  - Martin Beniston** • Institute for Environmental Sciences, University of Geneva, Switzerland
- 11.15 Round Table 1 **CLIMATE**
  - Chair: **Martin Beniston**
  - Sandro Fuzzi** • ISAC Institute of Atmospheric Sciences and Climate, CNR and Steering Committee UNEP-ABC, Italy
  - Gregory R. Carmichael** • Center for Global & Regional Environmental Research, University of Iowa, USA
  - Vincenzo Artale** • Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
  - Bhupesh Adhikary** • Ev-K2-CNR Committee, Nepal
  - Thomas Abeli** • Department of Earth and Environmental Sciences, University of Pavia, Italy
  - Raffaella Balestrini** • IRSA Water Research Institute, CNR, Italy

**OPEN DISCUSSION**
- 12.45 Lunch
- 14.00 Plenary 2 **MOUNTAIN ECOSYSTEMS**
  - Antonello Provenzale** • ISAC Institute of Atmospheric Sciences and Climate, CNR, Italy and GEO Ecosystems SBA Coordinator, Italy
- 14.30 Round Table 2 **MOUNTAIN ECOSYSTEMS**
  - Chair: **Antonello Provenzale**
  - Priptal Soorae** • IUCN International Union for Conservation of Nature / SSC Re-introduction Specialist Group, United Arab Emirates
  - Sergio Savoia** • WWF World Wildlife Fund, Switzerland
  - Bhaskar Singh Karky** • ICIMOD International Centre for Integrated Mountain Development Directorate, Nepal
  - Dinesh Bhuju** • NAST Nepal Academy of Science and Technology, Nepal
  - Marino Gatto** • Department of Electronics and Information, Politecnico di Milano, Italy
  - Alberto Basset** • Department of Biological and Environmental Sciences and Technologies, University of Salento, Italy
  - Valerio Sbordoni** • Department of Biology, University of Rome "Tor Vergata", Italy

**Open discussion**
- 16.10 Coffee Break
- 16.30 Plenary 3 **CRYOSPHERE**
  - Claudio Smiraglia** • Department of Earth Sciences "Ardito Desio", University of Milan and Italian Glaciological Committee, Italy
- 17.00 Round Table 3 **CRYOSPHERE**
  - Chair: **Claudio Smiraglia**
  - Frank Paul** • Glaciology, Geomorphodynamics and Geochronology Physical Geography Division, Department of Geography, University of Zurich, Switzerland
  - Valter Maggi** • Department of Earth and Environmental Sciences, University of Milano-Bicocca, Italy
  - Yaoming Ma** • Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China
  - Mauro Guglielmin** • Department of Theoretical and Applied Sciences, University of Insubria, Italy
  - Thomas Painter** • Jet Propulsion Laboratory, NASA, USA
  - Shresth Tayal** • Centre for Himalayan Ecology, Water Resources Division, TERI, India
  - Ethan Gutmann** • National Center for Atmospheric Research, Boulder, USA

**Open discussion**
- 18.30 First day conclusion

DAY II – OCTOBER, 24

- Parallel Session
- 09.15 Plenary 4 **WATER**  
**Renzo Rosso** • Department of Civil and Environmental Engineering, Politecnico di Milano, Italy
  - 09.45 Round Table 4 **WATER**  
Chair: **Renzo Rosso**  
**Daniele Bocchiola** • Department of Civil and Environmental Engineering, Politecnico di Milano, Italy  
**Martin Beniston** • Institute for Environmental Sciences, University of Geneva, Switzerland  
**Andrea Lami** • ISE Institute of Ecosystem Study, CNR and URT Ev-K2-CNR, Italy  
**Bodo Bookhagen** • Geography Department, University of California, Santa Barbara, USA  
**José Tundisi** • International Institute of Ecology, Brazil  
**Open discussion**
  - 09.15 Plenary 5 **MOUNTAIN NATIONAL PARKS ( ROOM A1.1 )**  
**Corrado Clini** • Director General for Sustainable Development, Climate and Energy, Italian Ministry of Environment and Protection of Land and Sea, Italy  
**Franco Mari** • Scientific Advisor SEED Project, Ev-K2-CNR Committee, Italy
  - 10.15 Round Table 5 **MOUNTAIN NATIONAL PARKS**  
Co-Chairs: **Corrado Clini and Franco Mari**  
**Teodoro Andrisano** • Majella National Park, Italy  
**Wolfgang Platter** • Stelvio National Park, Italy  
**Ashiq Ahmad Khan** • Pakistan Scientific Board, Ev-K2-CNR Committee, Pakistan  
**Andrew G. Seguya** • Executive Director/Secretary Board of Trustees, Uganda Wildlife Authority, Uganda  
**Abdulwahid Hussein Haji Said** • Erbil Governorate Board member for Protected areas, Kurdistan Region, Iraq  
**Mukunda Raj Prakash Ghimire** • Joint Secretary, Ministry of Forest and Soil Conservation, Government of Nepal, Nepal  
**Open discussion**
  - 11.15 Coffee Break
  - 11.30 Plenary 6 **ENVIRONMENTAL AND SOCIO ECONOMIC IMPACTS OF CLIMATE CHANGE**  
**Veerabhadran (Ram) Ramanathan** • Scripps Institution of Oceanography, University of California, San Diego, USA  
**Qamar-Uz-Zaman Chaudhry** • Advisor (Climate Affairs) Government of Pakistan, Pakistan
  - 12.30 Round Table 6 **ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS OF CLIMATE CHANGE**  
Co-Chairs: **Veerabhadran (Ram) Ramanathan and Qamar-Uz-Zaman Chaudhry**  
**Hildegard Diemberger** • Social Anthropology, University of Cambridge, UK  
**Pietro Boccardo** • ITHACA Information Technology for Humanitarian Assistance, Cooperation and Action, Italy  
**Annalisa Cogo** • Biomedical Sport Studies Center, University of Ferrara, Italy  
**Mylvakanam lyngararasan** • Division of Environmental Law and Conventions, UNEP, Kenya  
  
**Michael Gatari** • Institute of Nuclear Science & Technology, University of Nairobi, Kenya  
**Rosalaura Romeo** • Mountain Partnership Secretariat - FAO, Italy  
**Open discussion**
  - 14.00 Lunch
  - 15.00 Plenary 7 **THE CARBON CREDITS MECHANISM**  
**Stefania Proietti** • Department of Industrial Engineering, University of Perugia, Italy and Carbon Trader Specialist, Asian Development Bank
  - 15.30 Plenary 8 **MARKET BASED MEASURES FOR ENVIRONMENT**  
**Piero Cipollone** • Executive Director, The World Bank, Washington, USA
  - 16.00 Round Table 8 **MARKET BASED MEASURES FOR ENVIRONMENT**  
Chair: **Piero Cipollone**  
**Fabrizio Acerbis** • PricewaterhouseCoopers  
**Bhaskar Singh Karky** • ICIMOD International Centre for Integrated Mountain Development Directorate, Nepal  
**Giuseppe Vegas** • Consob  
**Ezio Bussoletti** • ASI Italian Space Agency and Geo Focal Point for Italy, Italy  
**Giancarlo Morandi** • President of COBAT, Italy  
**Stefania Proietti** • Department of Industrial Engineering, University of Perugia, Italy and Carbon Trader Specialist, Asian Development Bank  
**Open discussion**
  - 18.00 Second day conclusion

## DAY III – OCTOBER, 25

- 09.00 Poster session
- 09.30 Special Focus I **THE ALPINE CONVENTION**  
**Paolo Angelini** • Italian Focus Point for the Alpine Convention, Ministry of Environment and Protection of Land and Sea, Italy
- 10.00 Special Focus II **THE ROLE OF THE MOUNTAINS IN THE FRAMEWORK OF EXPO 2015**  
**Giuseppe Sala** • Chief Executive Officer of Expo 2015 (**invited**)  
**Amrit Ratna Shakya** • Chairman IEG Implementing Expert Group, Nepal
- 11.00 Coffee Break
- 11.20 Plenary **SHARING OF THE SYNTHESIS REPORT**  
**Paolo Bonasoni** • ISAC Institute of Atmospheric Sciences and Climate, CNR and Ev-K2-CNR Committee, Italy  
**Elisa Vuillermoz** • Ev-K2-CNR Committee, Italy
- 12.00 Closing Remarks and Conclusion  
**Gaetano Leone** • Deputy Secretary, IPCC  
**Maria Chiara Carrozza** • Minister of Education, University and Research, Italy (**invited**)  
**Andrea Orlando** • Minister of Environment and Protection of Land and Sea, Italy (**invited**)  
**Marco Bocciolone** • Vice Rector of Politecnico di Milano - Polo territoriale di Lecco, Italy
- 13.00 Lunch Buffet



# **SPEAKERS BIOGRAPHIES AND ABSTRACTS**

## SESSION - CLIMATE

### **Martin Beniston**

Institute for Environmental Sciences (ISE), University of Geneva, Switzerland  
(Martin.Beniston@unige.ch, +41 22 379 07 69)

**M**artin Beniston was born in the UK in 1953, and holds Swiss, British and French passports. He undertook part of his university education in England (Bachelor and Masters) and his PhD at the École Normale Supérieure in Paris. More recently, he obtained his Habilitation Degree from ETH-Zurich.

He has conducted research on atmospheric and climate issues in Paris, Canada (University of Quebec), Germany (Max-Planck Institute in Hamburg) and, since 1985, in Switzerland. From 1993-1996, he shared his time between a senior scientist position at ETH-Zurich and the vice-chairmanship of one of the «Impacts» working groups of the IPCC (Intergovernmental Panel on Climate Change, that was co-awarded the 2007 Nobel Peace Prize). In 1996, he was appointed full professor at the University of Fribourg, where he headed the Institute of Geography.

In October 2006, he was appointed full professor at the University of Geneva where he holds the Chair for Climate Research and in addition heads the University's Institute for Environmental Sciences. Among his current scientific activities, he is the initiator and coordinator of one of the biggest European environmental projects awarded to Switzerland (the "ACQWA" Project, [www.acqwa.ch](http://www.acqwa.ch)).

He has close to 150 scientific publications, including 4 books with international editors, and a further 9 volumes that he has edited/co-edited. He was appointed Editor-in-Chief of *Advances in Global Change Research* (Springer Publishers), *Environmental Science and Policy* (Elsevier Publishers), and Associate Editor of *Regional Environmental Change* (Springer Publishers) and *Journal of Hydrology* (Elsevier Publishers). He is a member of many international commissions, and is since the year 2000 an elected member of the Academia Europea.

More information at: [www.unige.ch/climate/Team/Beniston.html](http://www.unige.ch/climate/Team/Beniston.html)

### **Mountain water resources in a changing climate: emerging results from the EU "ACQWA" Project**

*M. Beniston, Institute for Environmental Sciences (ISE), University of Geneva, Switzerland*

**T**he European Alps are one region of the world where climate-driven changes are already perceptible, as exemplified by the general retreat of mountain glaciers over past decades. Temperatures have risen by up to 2°C since 1900 particularly at high elevations; a rate that is roughly three times the global-average 20th century warming.

Regional climate models suggest that by 2100, winters in Switzerland may warm by 3-5°C and summers by 6-7°C according to greenhouse-gas emissions scenarios, while precipitation is projected to increase in winter and sharply decrease in summer.

The impacts of these levels of climatic change will affect both the natural environment and a number of economic activities. Alpine glaciers may lose between 50 and 90% of their current volume and the average snowline will rise by 150 m for each degree of warming. Hydrological systems will respond in quantity and seasonality to changing precipitation patterns and to the timing of snow-melt in the Alps, with a greater risk of flooding during the spring and droughts in summer and fall. The direct and indirect impacts of a warming climate will affect key economic sectors such as tourism, hydropower, agriculture and the insurance industry that will be confronted to more frequent natural disasters.

This talk will thus provide an overview of the current state of knowledge on climatic change and its impacts on the Alpine world, based in particular on the results of the EU-FP7 "ACQWA" project currently coordinated by the speaker ([www.acqwa.ch](http://www.acqwa.ch)).

*Key Words: climatic change, Alps, hydrology, climate impacts*

**Sandro Fuzzi**

Institute of Atmospheric Sciences and Climate, Italian National Research Council (CNR),  
Bologna, Italy  
(s.fuzzi@isac.cnr.it, +39 051 6399559)

**S**andro Fuzzi is Research Director at the Institute of Atmospheric Sciences and Climate (ISAC) of the Italian National Research Council (CNR). His main research interests are physical and chemical processes of aerosols and clouds, and their effects on atmospheric composition change and climate. Sandro Fuzzi has coordinated several international projects and has published over 150 papers in refereed journals (h-index = 45). He has been a member of several international panels such as the European Commission Panel on Atmospheric Composition Change, the International Commission on Clouds and Precipitation, the Steering Committee of the Atmospheric Brown Cloud (ABC) project, and has been co-chair of the International Global Atmospheric Chemistry (IGAC) Steering Committee. Sandro Fuzzi has coordinated the European Network of Excellence–Atmospheric Composition Change (ACCENT), which included the major European institutions in the field of global change research, and is currently coordinating a follow-up program aimed at facilitating the transfer of research results into policy-decision making (ACCENT Plus). He has been a Contributing Author for the 4th IPCC Assessment Report and is presently involved as a Review Editor in the preparation of the 5th IPCC Assessment Report. Recently he has been appointed as a member of the Coordination Group on the WMO Integrated Global Observing System (ICG-WIGOS).

**Air quality and climate change: two sides of the same coin?**

*S. Fuzzi, Institute of Atmospheric Sciences and Climate – Italian National Research Council (CNR), Bologna, Italy*

**O**ver the past decade, different studies have addressed the co-benefits of combining the policies for improving air quality and mitigate climate change. In fact, the strategies to contrast air pollution can have significant effects, in both positive and negative directions, on climate change at the regional and global scale. On the other hand, there are convincing scientific evidences that increasing temperatures have detrimental effects on air quality. These scientific evidences call for an integrated approach both for the study of air quality and climate and for developing win-win policies to contrast the two interlinked phenomena.

**Gregory Carmichael**

Center for Global & regional Environmental Research, University of Iowa, Iowa City, USA  
(gcarmich@engineering.uiowa.edu, +319 3353333)

Gregory R. Carmichael is the Karl Kammermeyer professor of chemical and biochemical engineering at the University of Iowa. He also serves as the Associate Dean for Graduate Studies and Research for the college of engineering and as co-director of the Center for Global and Regional Environmental Research (a large interdisciplinary center with 80+ faculties). He is a leader in the development and application of chemical transport models at scales ranging from local to global. He has over 300 journal publications. The majority of his recent papers deal with the development and application of chemical transport models (CTM) to studies in regional atmospheric chemistry, air quality and climate. These research activities include the development of comprehensive air quality models and their application to regional and international air pollution problems. His studies have led to a greater appreciation and understanding of the importance of long range transport of pollutants within Asia and across the Pacific. His work has also explored the importance of dust on atmospheric chemistry, and this work has helped to stimulate laboratory as well as large-scale field experiments. His research has involved the development of innovative modeling tools, including techniques to optimally integrate measurements and models via formal chemical data assimilation. Most recently his work has focused on the role of black carbon (BC) in the atmosphere and its dual role as an air pollutant and climate warming agent. He has published recent papers on the important role of BC in the climate system. He also serves as chair of the Scientific Advisory Group for the World Meteorological Organization Global Atmospheric Watch Urban Meteorology and Environment project, which is focused on building capacity worldwide to improve air quality forecasts and related services.

**Source sector and region contributions to BC and PM2.5 in Central Asia**

G.R. Carmichael (1), S. Kulkarni (1), N. Sobhani (1), B. Adhikary (2)

(1) University of Iowa, USA, (2) EvK2CNR Committee, Nepal

Particulate matter (PM) mass concentrations, seasonal cycles, source sector and source region contributions in Central Asia (CA) are analyzed using the STEM chemical transport model and modeled meteorology from the WRF model. Predicted AOD values (mean value ~0.2) in CA vary seasonally with lowest values in the winter. Dust, from sources within and outside CA, is a significant component of the PM mass and drives the seasonal cycles of PM and AOD. On an annual basis, the power and industrial sectors are found to be the most important contributors to the anthropogenic portion of PM2.5. Residential combustion and transportation are shown to be the most important sectors for BC. Biomass burning within and outside the region also contributes to elevated PM and BC concentrations. The simulated values are compared to surface measurements of Aerosol Optical Depth (AOD), and PM2.5, PM10, black carbon (BC), organic carbon (OC) mass concentrations at two regional sites in the Kyrgyz Republic (Lidar and Bishkek). The analysis of the transport pathways and the variations in particulate matter mass and composition in CA demonstrate that this region is strategically located to characterize regional and intercontinental transport of pollutants. Aerosols at these sites are shown to reflect dust, biomass burning and anthropogenic sources from Europe, South, East and Central Asia, and Russia depending on the time period. Simulations for a reference 2030 emission scenario based on pollution abatement measures already committed to in current legislation show that PM2.5 and BC concentrations in the region increase, with BC growing more than PM2.5 on a relative basis. This suggests that both the health impacts and the climate will increase unless additional control measures are taken. The importance of observations in CA to help characterize the changes that are rapidly taking place in the region are discussed.

*Key Words: black carbon, Central Asia, emission sectors*

**Vincenzo Artale**

Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), Rome, Italy  
(vincenzo.artale@enea.it, +39 06 3048 3096)

**Education**

University Degree in Physics at the University of Rome (1979) with a thesis in Physical Oceanography: "A model of Messina Strait" (grade 110/110).

**Research interests**

Vincenzo Artale has over 30 years extensive experience in the areas of ocean and climate research and he is specialized in ocean circulation and in impact studies of climate change on the ocean, in particular on the Mediterranean Sea.

His scientific interest regards in particular the following research fields:

- Development of Regional Climate Modelling to study the mechanism of climate variability, and projected scenarios analysis
- Numerical Modelling: Ocean General Circulation Model and Ocean Regional Model of the Mediterranean Sea
- Development of analytical linear and non-linear model of the stratified flow, in order to study the generation and the evolution of the internal waves, solitons, overflow and the physics of the straits
- Data analysis and modelling of buoys trajectories and Lagrangian diffusion.

**Work Position at ENEA**

- 2010-today: Director of the Technical Unit Energy and Environment Modelling of ENEA
- 2002-2010: Head of the Oceanographic Modelling Unit of ENEA
- 1999 to 2001: Head of the Climate Section of ENEA
- 1994 to 1999: Director's Assistant of the ENEA Climate Division
- 1984: Permanent position at ENEA, as expert in physical oceanography.

**Climate change, impacts and adaptation in the Mediterranean region**

*V. Artale, Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Rome, Italy*

In the present talk I will discuss the main features and mechanisms of climate variability at a global and a regional scale, using the observation analysis and the numerical results of climate models. I will also discuss the annual sea surface temperature anomaly (SSTA) during the last 150 years, that can be estimated using several datasets. An important characteristic of this mode of SST variability is that the SST anomalies have the same sign across the entire North Atlantic and Mediterranean Sea, resembling the Atlantic Multidecadal Oscillation (AMO).

Moreover, in the Mediterranean case, the numerical results of a fully coupled regional climate models (Protheus Earth System) will be presented and the interactions among the distinct components of the Mediterranean climate system (i.e. ocean, atmosphere, biosphere, etc.) will be analysed. Such models are expected to improve our skills in predicting reliable scenarios in complex regions such as the Mediterranean area, that is subject both to the influence of global scale dynamics (e.g. disturbances in the mid-latitudes, strength and meridional extension of the Hadley circulation), and to the effects of local physical processes.

As a future follow-up of these studies, the role of the Mediterranean Sea on nearby and remote regions will be investigated in the context of present and future climate change and impact on the climate system.

*Key Words: climate variability, Mediterranean Region, climate modelling, impact studies*

**Bupesh Adhikary**

SHARE – Resident Scientific Coordinator, Ev-K2-CNR Committee, Kathmandu, Nepal  
(bhupesh.adhikary@evk2cnr.org, 97714381839)

**Academic Qualification**

The University of Iowa, Chemical Engineering, B.S.E. (1998), M.S. (2007), Ph.D. (2008).  
The College of Wooster, Economics, B.A., (1997).

**Graduate School Adviser and PhD Thesis title**

Professor Gregory R. Carmichael, Characterization of the seasonal cycle, regional distribution and outflow of south Asian aerosols: a three dimensional chemical transport model analysis

**Awards/Recognition**

National Aeronautics and Space Administration (NASA) Group Achievement Award for the Arctic Research with Aircraft and Satellites experiment (ARCTAS), received April 2009.

First Place: American Institute of Chemical Engineers (AIChE), Environmental Division-National Graduate Student Paper Competition (2008).

National Aeronautics and Space Administration (NASA) Group Achievement Award for Intercontinental Chemical Transport Experiment (INTEX-B), received May 2007.

National Aeronautics and Space Administration (NASA) Group Achievement Award for Intercontinental Chemical Transport Experiment (INTEX-A), received April 2005.

The University of Iowa-Graduate Student Assistantship, 2004-2008.

**Employment History**

Resident Scientific Coordinator, Stations at High Altitude for Research on the Environment (SHARE), Ev-K2-CNR Committee, Bergamo, Italy, September 1, 2011 - Present

Assistant Professor, School of Engineering, Kathmandu University, P.O.Box 6250, Dhulikhel, Nepal, April 2009 - July 2011

Graduate Research Assistant, Center for Global and Regional Environmental Research (CGRER), The University of Iowa, IA, USA, June 2004 - December 2008

**Short lived climate forcers over Nepal Himalayas**

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**S**HARE (Stations at High Altitude Research on the Environment) project is promoted by Ev-K2-CNR Committee and funded by the Italian Ministry of Education, University and Research (MIUR) through the Italian National Research Council (CNR). This presentation will include discussion of Short Lived Climate forcers (SLCFs) based on in-situ observations and regional scale numerical modeling analysis from the Nepal Himalayas including data from Nepal Climate Observatory-Pyramid (NCO-P) located in the foothills of Mount Everest at an altitude of 5079 m a.s.l. NCO-P is also one of the Global Atmospheric Watch stations of the World Meteorological Organization (WMO-GAW) and is the only currently operating GAW global station in South Asia and the highest monitoring station of the UNEP ABC (Atmospheric Brown Clouds) project. Results from monitoring of SLCFs such as ozone and black carbon for multi years starting from 2006 will be presented. A regional scale meteorological / chemical transport modeling project has been initiated to help to put the measurements in perspective and provide decision support for policy makers. Using numerically modeled simulations regional and sectoral contribution to the pollutant loading over the Himalayan region will be presented.

*Key Words: SLCFs, South Asia, high altitude, regional scale modeling, long term monitoring*

**Graziano Rossi**

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**M**aster Degree in Natural Sciences, 1985 (University of Bologna, Italy). PhD in Geobotany, 1991 (University of Pavia, Italy). Researcher in Plant Ecology (University of Pavia) since 1991. Currently Associated Professor of Basic and Applied Botany at Pavia University. Plant ecologist and conservation biologist, with research focus mostly on alpine environment (European Alps, Apennines, Himalayas), on climate change effects on plants, seed ecology and plant sociology. Since 2005, scientific responsible of Lombardy Seed Bank, an infrastructure for ex situ conservation of wild flora, part of the Regional Centre for Plant Conservation of Lombardy Region D.G. Environment (CFA; Centro Flora Autoctona), managed by Parco Regionale del Monte Barro (Galbiate, Lecco). Since 2010, involved in SHARE Project in Nepal, working with NAST and different scientific institutions for ex situ conservation of Himalayan flora (HSB, Himalayan Seed Bank). Coordinator of the project for Italian Red Lists for Ministry of Environment (MATTM) and Italian Botanical Society (SBI) and for Guidelines for Wild Plant Translocation, for MATTM again. Author of more than 40 papers on international journals regarding plant ecology. Involved in different European Union projects under research programmes: GLORIA on climate change effects in high mountains, ENSCONET European network of seed banks of wild species, NASSTEC for Initial Training Network for doctoral level education on seed research for the improvement of production and market of seeds of wild plants in habitat restoration.

**Effects of climate change on alpine vegetation: from evidences to action**

G. Rossi (1), T. Abeli (1)

(1) Department of Earth and Environmental Sciences, University of Pavia, Pavia, Italy

**M**ountain areas with cold climate conditions are the more affected by changes in species distribution as a consequence of climate change. Mountain ecosystems are experiencing unprecedented rates of warming during this century, two to three times greater than observed during the last one. For the next about 50 years we expect a significant loss of plant species, especially those taxa with strict climate requirements and limited migration capabilities, mostly if located in mountain areas of low altitude. Therefore, mountain areas provide interesting locations for the early detection and study of the signals of climate change.

Despite the considerable number of studies on the impacts of climate change on alpine plants, there have been few attempts to investigate its effect on regeneration. However, recruitment from seeds is a key event in the life-history of plants, affecting their distribution and evolution and seasonal changes in climate will inevitably affect recruitment success. Here, we present an overview of word literature and some suggestion on how to act against the expected loss of biodiversity, with ex situ and in situ activities.

*Key words: alpine region, climate change, upward migration, extinction risk, plant conservation*

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**R**affaella Balestrini, graduated in Biology from University of Milan, works since 1996 as scientific researcher at the Water Research Institute of the National Research Council, in Brugherio (Italy). Her specific research activities are:

- i) nutrient removal and ecology of riparian wetlands-streams-lakes
- ii) biogeochemical processes at surface-groundwater interfaces
- iii) nitrogen cycling in forested and high elevation watersheds
- iv) role of atmospheric deposition in the element cycling of aquatic and terrestrial ecosystems.

### **Wet deposition chemistry at a high elevation site in the Khumbu Valley (Nepal Himalaya): implications for the nitrogen biogeochemical cycle**

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*(1) Water Research Institute - National Council of Research, Brugherio, Italy, (2) Department of Earth and Environmental Sciences, University of Pavia, Italy, (3) Institute of Arctic and Alpine Research and Department of Geography, University of Colorado Boulder, USA*

**A**mong the alpine environments of the world, the region of Mount Everest is a unique ecosystem with a degree of biodiversity among the highest, but characterized by a recognized fragility and low resilience. There is a growing concern about the potential effects of global warming and other large scale phenomena (e.g. atmospheric brown cloud) on aquatic undisturbed systems in the Himalayan region.

The chemistry of wet deposition was investigated during 2007-2008 at the Pyramid International Laboratory in the northernmost portion of the Khumbu Valley, at 5,050 m. asl, , and since June 2012 until now within the GAW programme. The main hydro-chemical species and the stable isotopes of oxygen ( $\delta^{18}\text{O}$ ) and deuterium ( $\delta^2\text{H}$ ) were determined on precipitation samples.

The obtained results revealed a very low ionic content, also compared to precipitation sampled in remote sites from the Tibetan Plateau. The temporal variations of  $\text{NO}_3$  and  $\text{SO}_4$  exhibited maximum concentrations at the beginning and ending phases of monsoon. A similar trend is observed for the carbonaceous and ionic aerosols at the same site. Also the isotopic composition is strongly influenced by the amount of precipitation, with depleted values characterizing the central monsoon period. Results suggest that during monsoon the air masses reaching the Pyramid site were almost completely depleted of potential contaminants originated from the lower urbanized Asian areas.

The low nitrogen concentrations associated with very modest amounts of precipitation have produced nitrogen loads considerably lower than those measured in high-altitude environments in Europe and North America. Higher N loads were reported for other different ecosystems in the most remote regions of the world, as the Northern Africa dry savannah, and for the Central Amazonia tropical rain forest. These results will be discussed further considering the nitrogen level in the surface water collected in the high Khumbu valley catchment.

*Key words: nitrate, sulphate, precipitation, water isotope*

## SESSION - MOUNTAIN ECOSYSTEMS

### **Antonello Provenzale**

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**B**orn in 1958. Research Doctorate in Physics, University of Turin, in 1987.  
Research Director at the Institute of Atmospheric Sciences and Climate, CNR, Turin.

Research interests: Climate dynamics; climate-biosphere interaction; climate impacts on ecosystems and the hydrologic cycle.

#### **Awards and invitations**

- Golden Badge Award of the European Geophysical Society (EGS) in 1997.
- Dozor Fellowship of the Ben Gurion University in Beer Sheva (Israel) in 1996.
- JILA Visiting Fellowship of the University of Colorado, Boulder (USA) in 1997.
- Member of the Summer Program on Geophysical Fluid Dynamics at the Woods Hole Oceanographic Institution, MA, USA, from 2005.
- Invited professor at the École Normale Supérieure in Paris in 2005, at the Université Pierre et Marie Curie in Paris in 2008 and 2009.

#### **Professional activity**

- Coordinator of the Working Group on "Nonlinear Processes in Geophysics" of the European Geophysical Society (EGS) from 1991 to 1994.
- Vice-president for Europe of the Committee for Mathematical Geophysics of the International Union of Geodesy and Geophysics (IUGG), from 2001 to 2007.
- Member of the GFD Core Faculty Group of the Summer Program on Geophysical Fluid Dynamics at the Woods Hole Oceanographic Institution.
- Coordinator of the CNR section (commessa) on Climate dynamics from 2005.
- Coordinator of the national Italian MIUR project "NextData"
- Coordinator of the ECRA Collaborative Program on "Changes in the Hydrological Cycle"
- Coordinator of the GEO/GEOSS Societal Benefit Area "Ecosystems"

#### **Publications**

Author of more than 120 publications in the peer – reviewed international scientific literature (ISI journals). Editor of four volumes and of two journal special issues.

### **Mountain ecosystems**

*A. Provenzale (1), S. Imperio (1), R. Viterbi (2)*

*(1) Institute of Atmospheric Sciences and Climate, National Research Council of Italy (CNR-ISAC), (2) Gran Paradiso National Park*

**M**ountain landscapes, owing to their physical, topographic and climatic heterogeneity, create a mosaic of habitats along the altitudinal gradient. Such heterogeneity determines high levels of biodiversity, usually higher than those recorded in adjacent lowland areas. Mountain habitats support some of the world's most rare and fragile ecosystems. Populations at high elevations are usually small, isolated and prone to local extinction, are often poor dispersers and are characterized by high levels of endemism. On the other hand, mountains are very sensitive to environmental change and global warming, and high-altitude ecosystems are especially exposed to the negative effects of the temperature rise. In this seminar, we shall discuss some of the changing patterns in mountain ecosystems, both for individual species and at community level, and shall address the interplay between modifications of the physical environment (snow cover and duration, hydrological cycle, temperature) and the response of the biotic components. The role of the GEO/GEOSS Societal Benefit Action "Ecosystems" and of the Italian National Project of Interest "NextData" for the study of mountain ecosystems and the dissemination of observational data and research results will be addressed.

*Key words: mountain ecosystems, climate change, impacts, data dissemination*

### **Priptal Soorae**

IUCN/SSC Re-introduction Specialist Group (RSG), Abu Dhabi, United Arab Emirates  
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#### **Current Position**

- Unit Head, Terrestrial Assessment & Monitoring, Environment Agency - Abu Dhabi
- Program Officer, IUCN/SSC Re-introduction Specialist Group (RSG)

#### **Professional Experience**

Program Officer of the IUCN/SSC Re-introduction Specialist Group (1995-present)

- Developing policy guidelines.
- Review of re-introduction proposals submitted to the RSG Secretariat.
- Published 3 books on re-introduction case-studies - Global Re-introduction Perspectives.

#### **Unit Head, Terrestrial Assessment & Monitoring, Environment Agency - Abu Dhabi**

- Wildlife Assessment & Monitoring within Abu Dhabi Emirate.
- Specialized in reptile and amphibian research and monitoring within the UAE.

### **Guidelines for reintroductions and other conservation translocations and their relation to mountain ecosystems and climate change**

*P.S. Soorae (1), F. Launay (1)*

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The IUCN/SSC Reintroduction Specialist Group (RSG) developed the IUCN Guidelines for Re-introductions in 1995 which had superseded the 1987 IUCN Position Statement on the Translocation of Living Organisms. In 2013 the RSG finalized the Guidelines for Reintroductions and other Conservation Translocations which superseded the 1995 IUCN Guidelines for Re-introductions. The new guidelines were drafted as a response to the present era of accelerating ecological change. There is increasing pressure on the world's biodiversity due to loss of habitats and reduction in their quality, biological invasions, and climate change. The latter is the main force behind the proposition to move organisms deliberately outside their indigenous ranges, an exercise of greater potential risks than a reinforcement or reintroduction. While such 'assisted colonization' is controversial, it is expected to be increasingly used in future biodiversity conservation. Because of such anticipated developments, these Guidelines emphasize the need to consider the alternatives to translocation, to appreciate uncertainty of ecological knowledge, and to understand the risks behind any translocation. Many conservation translocations are long-term commitments, and every case is an opportunity to research the challenges for establishing populations, in order to increase the success rate of these interventions.

*Key words: guidelines, reintroduction, translocation, climate change*

### **Sergio Savoia**

WWF European Alpine Programme  
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1985-2001 – Journalist and author for SSR-SRG Swiss Radio and Television Company

1999-2007 – Director of satirical magazine Il Diavolo

2001-2004 – Freelance consultant

Author of several publications (list available)

Freelancing for several media in Switzerland and Italy (list available)

2004-2006 – Communication Officer for WWF European Alpine Programme

2006-current – Director of WWF European Alpine Programme

#### **Political engagement**

2006 to today: President of Green Party cantonal section

2003 – Member of Parliament

### **Multiple pressures, multiple responses**

*S. Savoia, WWF European Alpine Programme, Bellinzona, Switzerland*

**T**he Alps' ecosystems provide freshwater and energy to the surrounding metropolitan areas, while offering leisure and tourism opportunities for almost 100 million visitors each year. It comes as no surprise that their invaluable natural treasure is under intense and concentric pressure.

On the other hand, the natural wealth characterizing the Alps also reflects the historical influence of human presence in the area. The rich diversity of cultures, languages, and traditions in the Alps has resulted in a unique cultural landscape. That diversity can be used to preserve and enhance the natural diversity.

Traditional farming practices dating back to Neolithic times have in fact added to biodiversity. For instance, extensively farmed Alpine meadows located at 1800 to 2200 metres above sea level support up to 80 species of plants per hundred square metres.

The Alps face a number of major threats – from pollution and habitat loss to mass tourism and the impacts of climate change.

Even as one of Europe's richest natural areas, the Alps are one of the most intensively exploited mountain regions in the world.

Human pressures have already damaged the unique biodiversity characterizing most Alpine valleys through strong urbanization trends and intensified agriculture.

Now, even the most remote natural areas of the Alps are threatened as trends towards mass tourism become more prevalent.

Effective conservation of the Alps at the ecoregional level will require strong collaboration between all Alpine countries.

WWF works for the protection of the Alps at the national level – through its national offices – and at the international level – through the European Alpine Programme.

As it becomes increasingly clear, no permanent conservation success can be achieved without intense and as of yet unprecedented international collaboration. In this instance, the Alps can lead the way towards conservation practices that reach over cultural and administrative or political barriers.

*Key words: Alps, culture, collaboration, ecoregion*

**David Molden**

International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal  
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**D**avid James Molden joined ICIMOD as Director General with effect from December 2011. He is a development specialist with more than 30 years of experience in designing, planning, executing, and monitoring programmes on water management, livelihoods, environment, and ecosystem services. Prior to joining ICIMOD he was the Deputy Director General for Research at the International Water Management Institute (IWMI) based in Sri Lanka. He has worked in several Hindu Kush-Himalayan countries, including China, India, Nepal, and Pakistan, and has experience in projects in the Indus, Ganges, Yellow, Mekong, Yangtze, and Amu and Syr Darya river basins. He has acquired considerable management experience in a number of positions, including Chief of Party for the Irrigation Management Project in Nepal, Chief of Party for a water resources strategic research program in Egypt, and Leader of the multi-institute Comprehensive Assessment of Water Management in Agriculture programme.

Molden was awarded a PhD in Civil Engineering from Colorado State University in 1987 specializing in water resources, and has since developed broader interests in integrating social, technical, and environmental aspects of natural resources management. He has contributed to the publication of nearly 200 works in books, refereed journals, research and project report series, the media, and educational materials. He has received many awards including the Outstanding Scientist Award of the Consultative Group on International Agricultural Research (CGIAR) in 2009.

### **Regional cooperation for management of mountain ecosystem and adaptation in the Hindu Kush Himalayan Region**

*D. Molden (1), B.S. Karky (1), E. Sharma (1), N. Bisht (1)*

*(1) International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal*

**T**he Hindu Kush Himalayan (HKH) mountains are an important global resource, providing goods and services to the people living in the HKH region (210 million) and those living downstream (1.3 billion). The HKH Mountains serve as the “water towers” of Asia, feeding the region’s ten major river basins, connecting upstream and downstream areas in terms of culture, communications, trade, and resource management.

The mountains and mountain communities are increasingly under threat undergoing rapid change due to globalization, environmental, social and climate change. Air pollution and global warming are related to increased snow and glacier melt, more intense floods and droughts, changing ecosystems, and possibly changing monsoon patterns. Key questions arise about mountain communities and ecosystems’ coping capacity to deal with these changes. Mountain communities, while incredibly resourceful, live in areas most vulnerable to negative consequences; and are often impoverished and not primarily responsible for such changes.

Urgent actions are needed at the global, regional, national and local level to address these changes and consequences by firmly placing mountain needs on national, Asian and global agendas, and empowering mountain women, men and children in their role as stewards of mountain ecosystems. This includes regional cooperation, knowledge sharing, innovative means of conserving ecosystems and promoting adaptation through diversifying livelihoods, and compensation and payment for ecosystem services. Integrative and trans-disciplinary research is urgently called for to inform these agendas and to contribute to a substantially improved well being of the mountain communities in a healthy environment.

*Key Words: Hindu Kush Himalayas, ecosystem services, climate change, adaptation*

**Dinesh Raj Bhaju**

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**D**inesh Raj Bhaju is Academician at Nepal Academy of Science and Technology (NAST), and Member of Nepal Scientific Board of EvK2CNR. He is a committed professional dedicated to the promotion of scientific research and popularization of science with over 30 years of experience in teaching ecology and leading research activities mainly in the field of environmental science. In Nepal, Bhaju initiated research studies at landscape level, prepared nationwide ecological data of Chure hills and used dendroclimatological tools to assess the climatic impacts at tree-lines of Everest region. In his early career, he pioneered and conducted much popular science radio programme over Radio Nepal. For three years (2009-2012), he led NAST's Faculty of Science as its chief. In 2010, he took initiative in establishing Nepal Climate Change Knowledge Management Centre and gave leadership to advance its activities including nation-wide campaign of mobile library for climate change awareness and research grants for young scientists. Currently, Bhaju is affiliated with the Central Department of Environmental Science (Tribhuvan University), where he advises climate change and disaster management projects, teaches and supervises graduate and PhD students. He has his education and academic training from Nepal (BSc, MSc), UK (Post graduate) and Japan (PhD). As a visiting faculty, he has experience of teaching at Padua and Pavia universities in Italy. He has authored and edited several books, periodicals including NAST's first scientific journal. To his credit, Bhaju has over 60 publications in national and international journals, supervised over 45 MSc dissertations, and contributed to over 200 popular articles for mass media. In policy thoughts, his recent contributions are policy brief on climate change adaptation and green economy framework, both in Nepal context.

**Saving the Himalaya: Call for International Collaborative Research**

*D.R. Bhaju, NAST Nepal Academy of Science and Technology, Kathmandu, Nepal*

**I**n the context of climate change impact, the IPCC has depicted the Himalaya as a white spot for its serious lack in basic data. Some three billion people live in the region, most of them would be hardest hit by climate change, rely on these natural resources including river waters and forests. Nevertheless, these people have amassed a plethora of knowledge through generations of their living in harmony with nature. In last over a decade, some initiatives have inventoried ecological data and have prepared a baseline of scientific information, thanks to the support of Ev-K2-CNR, NAST and other organizations. A survey on plant species used by the Sherpa of Khumbu in east Nepal listed a total of 130 plant species, 98 of which were used for medicinal purposes. The local people grow staple crops such as barley up to 4.350 m, vegetables like radish, turnip and peas up to 4.359 m and potatoes at 4.700 m. In a short span of Imja valley, 180 species of herbaceous angiosperms were recorded, of which 43 were new, for eastern Himalaya and 32 recorded at higher range than previously reported, indicating anthropogenic and/or climatic influences. The high Himalaya contains tiny area of forests, example the Sagarmatha (Everest) National Park comprises only 1.87% of forested land, however, boasts 150 species of mushroom. With an average annual increase in temperature of 0.06°C per year, climate change is a major concern in the Himalaya. In order to monitor the impact of this warming, two permanent plots at SNP have been established. In Nepal, national academia are making remarkable progress, specifically in environmental science and allied subjects, which produce hundreds of case studies and dissertations every year. With the baseline in place and looming impacts of global warming, it is high time that the international collaborations involve these national academia and their young generation in the research activities, which will find a sustained way of saving the Himalaya and its ecology.

*Key Words: academia, baseline information, climate change, environmental research, Himalaya*

**Marino Gatto**

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**M**arino Gatto, born in 1949, graduated in Electronic Engineering in 1972. In 1976 he joined the Institute of Animal Resource Ecology, University of British Columbia, Vancouver, Canada, for about one year to specialize in applied ecology. He is Professor of Ecology, School of Civil, Environmental and Land Use Engineering, Politecnico di Milano. His cultural background is engineering and mathematical modelling. His research has entirely focussed on ecology and the management of renewable resources since 1974. He's been a visiting Professor at University of Vienna, Austria, École Normale Supérieure, Paris, France, École Polytechnique Fédérale de Lausanne, Switzerland. His current research interests include: ecohydrology, dynamics and management of marine resources, models of fragmented populations, extinction risk assessment of wildlife populations, climate change ecology, disease and parasite ecology, ecological economics.

1991-1999: chair of the Program in Environmental and Land Use Engineering, Politecnico di Milano

2003-2006: president of the Italian Society of Ecology

2007-2010: member of the Academic Senate of the Politecnico di Milano.

Marino Gatto has authored or coauthored about 200 papers, books or book chapters. More than half appeared in peer-review journals, including *Nature*, *Proceedings of the National Academy of Sciences USA*, *Proceedings of the Royal Society*, *Journal of the Royal Society Interface*, *Geophysical Research Letters*, *BioScience*, *The American Naturalist*, *Ecological Applications*, *Water Resources Research*, *Canadian Journal of Fisheries and Aquatic Sciences*, *Ecohydrology*. He is a member of the *Istituto Lombardo*, *Accademia di Scienze e Lettere*, and the *Istituto Veneto di Scienze, Lettere ed Arti*.

A complete list of publications can be downloaded at

<ftp://ftp.elet.polimi.it/outgoing/Marino.Gatto/PublicationListGatto.pdf>

**Effects of Climate on Biodiversity and Faunal Dynamics in the Alps**

*M. Gatto (1), A. Mignatti (1)*

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**V**ariations of meteorological forcings, both in terms of mean and variance of seasonal values and of increase in frequency and intensity of the extreme events act as strong disturbances to many ecosystems. Here we focus on three paradigmatic examples: the population dynamics of the Alpine ibex (*Capra ibex*) in the Gran Paradiso National Park and the Black grouse (*Tetrao tetrix*) in the Piedmont region, and the habitat characteristics of the Alpine marmot (*Marmota marmota*) in a high altitude valley near the Stelvio National Park. The dynamics of ibex is affected by winter snow accumulation, while the Black grouse, because of its peculiar needs, is an umbrella species for the Alpine habitats. We model the dynamics of the two species considering, together with the climatic effect, also the density dependence and sexual structure of the populations. Because of the long life expectancy of the ibex, we also account for the population age structure. For the Black grouse, we introduce a spatial description using the data from several Piedmont sub-populations and suitably downscaling GC models. Our results confirm the strong impact of meteorological conditions on the life cycle: winter survival of ibex is affected by the winter snow depth for both juveniles and adults; the growth rate of the grouse decreases with the increase of the daily temperature range in the breeding period, while the components of fertility are sensitive to the temperatures in the critical post hatching period and in late winter, when the species needs to maintain a shelter in the snow-pack. To build marmot habitat suitability models, we used localization of marmot burrows as the response variable, and a set of habitat characteristics as explanatory variables, including an accurate fine-scale vegetation map of the valley. Our models show that the Alpine marmot prefers south-faced slopes with presence of shrubs or snow valley vegetation, while the areas with pioneer vegetation are avoided.

**Alberto Basset**

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University of Salento  
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**A**lberto Basset is full professor of Ecology at the University of Salento, where he coordinates the PhD programme in Ecology and Climate Change, and is serving as president of the Italian Ecological Society and vice-president of the Ecological European Federation.

His main fields of research are organization, conservation and management of biodiversity and ecosystem functioning, which have been developed with experimental studies and modelling on aquatic ecosystems, along the full range from freshwater to marine ecosystems, as well as from low to high latitude ecosystems. During almost thirty years of career, he has produced over 150 papers, developed a strong network of international collaborations, coordinated national and international research projects, was in the board of journals in the field of ecology, scientific societies and federations and served as advisor in international projects and initiatives. Recently he was invited to contribute to the GEO Ecosystem Task and with to LifeWatch, the European e-Science Infrastructure on Biodiversity and Ecosystem Research of which he is currently member of the Board of Directors.

### **Biodiversity organisation and conservation in mountain ecosystems: challenges and opportunities from the LifeWatch virtual laboratory facilities**

*A. Basset (1), G. Corriero (2), N. Fiore (1)*

*(1) Department of Biological and Environmental Science and Technologies, University of Salento, Lecce, Italy, (2) Department of Biology, University of Bari, Bari, Italy*

**H**igh mountain ecosystems are fragmented habitat islands. Their environmental niche is characterized by severe and in some cases extreme physico-chemical conditions along limiting dimensions, determining very selective filters to species invasion and colonization. On the other hand, ecological communities in high mountain ecosystems contribute to ecosystem services, which are of a crucial importance for all downstream ecosystems. Since the last decades, anthropogenic pressures and climate changes are progressively modifying the environmental niche of those ecosystems, affecting community stability, ecosystem functioning and services. Addressing these issues requires data availability on both abiotic and biotic components of the ecosystems, data on species responses to abiotic and biotic pressures and capabilities for data standardization, integration from different sources, data analysis and modelling, scenario building and decision support systems. Since biotic data are not easy to collect and not always available for high mountain ecosystems, it is also required the capability to mine available and required data from existing international repositories or smaller data providers, access to available data, evaluate data quality, standardise data and merge them eventually with data experimentally collected locally. As a research e-Science infrastructure, LifeWatch is planned to build its virtual laboratory facilities in order to offer fully equipped online laboratories to researchers and different stakeholders to perform these activities and achieve results, which consistency from a scientific point of view, in terms of intrinsic degree of uncertainty, can be evaluated by the users through specific e-training tools developed for every service offered by the infrastructure quantifying the uncertainty degree associated to every component of the research performed. Here, I will present a LifeWatch showcase on ecosystem fragility to alien species.

*Key Words: LifeWatch, biodiversity, virtual laboratory, alien species*

**Valerio Sbordoni**

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**V**alerio Sbordoni has been Full Professor of Zoology up to 2012 at the University of Rome "Tor Vergata", where he is still active teaching Biodiversity and as a member of the PhD School in Evolutionary Biology and Ecology. In his life-long research activity, he dealt with population genetics and evolution of several organisms, with special regard to butterflies and organisms adapted to cave life.

The laboratory so far directed by VS embraces a consistent staff of researchers, post-docs, and PhD students involved in different facets of biodiversity ([www.zeb.uniroma2.it](http://www.zeb.uniroma2.it)). At University of Rome "Tor Vergata", he has served as Vice-President for Cultural Activities (1999-2005). He is a member of the Accademia Nazionale delle Scienze, the so called "Accademia dei XL", and of the Accademia Nazionale di Entomologia. He is the scientific responsible of the Italian Biodiversity Network (NNB), and of the Regional Biodiversity Observatory of Latium (OBL), since when it was established in 2002, and a member of the Coordination Board of LifeWatch-IT biodiversity digital infrastructure.

Prof. Sbordoni is the President of the Società Italiana di Biogeografia (SIB), former President of the Circolo Speleologico Romano and of the Federazione Speleologica del Lazio. He has promoted and led many zoological expeditions in the mountains and caves of Near East, Mexico, Tibet, and in most Himalayan countries. This activity resulted in the discovery of more than 200 taxa new to science. He is the author of some books and of more than 250 scientific papers in several qualified journals in the field of ecology and evolutionary biology. VS has collected several awards, including the G.B.Grassi prize for Zoology by the Accademia Nazionale dei Lincei; the Gold Medal by the Accademia Nazionale delle Scienze; the Rolex Award for Enterprise for his studies on the biodiversity of caves in Chiapas (Mexico).

### **Alpine butterflies: a challenge to understand the effects of climate change on biodiversity and ecosystems**

*V. Sbordoni, Department of Biology, University of Rome "Tor Vergata", Rome, Italy*

**B**utterflies occur in most terrestrial habitat types, and unlike most other groups of insects, their taxonomy is understood and they are easy to recognise. Moreover they are relatively well-recorded in space and time, recognizable by the public, making them a favourite organism for citizen scientists. Butterflies have short life cycles and thus react quickly to environmental changes. Their limited dispersal ability, larval foodplant specialization and close-reliance on the weather and climate make many butterfly species sensitive to fine-scale changes. These reasons emphasize the role of butterflies as reliable indicators of ecosystem changes associated to the impacts of climate change, resulting in habitat loss and fragmentation and local extinctions.

From this viewpoint alpine and mountain butterflies are of special interest since they can respond to climate change in several ways like trends in local abundance, altitudinal range shifts, as well as changes in phenology.

I will briefly overview two research projects currently running at University of Rome "Tor Vergata", dealing with Himalayan butterflies (SHIBU project: "DNA barcoding, molecular systematics and evolution of Sino-Himalayan butterflies"), and *Erebia* butterflies (a PRIN project: "Comparative phylogeography of butterflies from Apennines addressed to the development of descriptive and predictive bioclimatic models").

The general purpose of the SHIBU project is to produce DNA sequences that can be used for identification of species of many endemic butterflies belonging to the Sino-Himalayan Transition Zone. The data obtained will be used as a data source for taxonomy, genetics, and the development of phylogeographic models.

The second project, based on mtDNA and genomic markers, seeks to understand the evolution of the *Erebia tyndarus* species complex and to develop demographic and distributional ranges scenarios over time based on two independent approaches: molecular phylogeography and Ecological Niche models.

## SESSION - CRYOSPHERE

### **Claudio Smiraglia**

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Claudio Smiraglia was born in Milan (Italy) in 1946. From 2001 to present he is Full Professor of Physical Geography-Geomorphology at the University of Milan, Italy; he teaches Physical Geography at the degree course in Natural Sciences and at the degree course in Environmental and Human Sciences (SUA) of the University of Milan where he also developed the courses of Climatology and Glaciology. His main research topic is glacial and periglacial evolution of high mountain environments. In 2011 he received the Laurea Honoris Causa in Geography from the University of Bucarest (Romania).

#### **Main Committees/Councils:**

Italian correspondent for the International Glaciological Society (IGS), 1997-present;  
Member of Scientific Board of the Alpine Glaciology Meeting;  
Member of the Management Committee of the Stelvio National Park;  
President of Central Scientific Committee of Italian Alpine Club 1995-2001;  
Chairman of the Working Group on Debris Covered Glacier - AIGEO - 2003-2007;  
President of Italian Glaciological Committee (CGI), 2002-2007;  
Member of EvK2CNR Committee Central Council 2004-2009.

He managed several national research projects (e.g.: PRIN 2005 and 2008) and organized European conferences, workshops and field trips.

The main purposes of the research he conducted were: analysis of Alpine glaciers for quantifying their historic and recent (XX century) changes and the relations with climate; studying epiglacial morphology; studying debris covered glaciers describing their features and the occurring processes; describing and analysing periglacial morphologies like rock glaciers; analysing Antarctic local glaciers; promotion of Alpine environment by identifying geomorphosites and by detecting geomorphological hazards and risks in relation to human presence.

He enjoyed several field campaigns in the Alps, the Himalayas and the Karakoram; moreover he took part to international field work programs in Antarctica, Alaska, Africa and in the Andean chain.

### **Where are the cryospheric sciences going? Where should they go?**

*C. Smiraglia, Department of Earth Sciences "Ardito Desio", University of Milan, Milan, Italy and Ev-K2-CNR Committee, Bergamo, Italy*

Broadly speaking, cryospheric sciences (or science?) are the scientific study of ice in all its forms and sides, among the others glaciers, snow, ground ice, sea ice, river ice and why not the cubes to cool our whisky glass. Therefore, cryospheric science (or sciences?) could be well defined the science of ice in the environment. Therefore again, cryosphere can attract the interests of a wide range of discipline, e.g. engineering, geology, geography, physics, chemistry, climatology, hydrology, mathematics, ecology and so on. Sometimes the term glaciology is considered being a synonymous of cryospheric sciences, but in the common perception glaciology it is used in a quite narrow way to cover the study of glaciers. Here I will try to state the evolution of the cryospheric sciences, even if out of necessity, taking into account also the contributions of colleagues. The main topics will be glaciers in the high regions and ground ice in the permafrost regions. We have to pay attention to the complex global system of which the cryosphere is only a part. Most of all, I will try to discuss the prospects for the future of cryospheric sciences by emphasizing the contribution of a wide range of approaches (for instance, remote sensing, numerical modelling, ice coring and of course the traditional, but essential, empirical field data collection). Their future and their survival will depend on their capacity first of tightening the conversations between numerical modellers and fieldworkers, then of facing their specific unsolved questions in the context of the community of earth and environment scientists, mainly in the view of applied use of their new finds.

*Key Words: cryosphere, glaciers, permafrost, science evolution*

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1993 Diploma (MSc.) in Meteorology (University of Hamburg, Germany)

2003 PhD in Physical Geography (University of Zurich, Switzerland)

Since 2005: Research Assistant at the Dept. of Geography (University of Zurich)

2007-2010: Project Manager and Lead of the ESA Project GlobGlacier

2010-2013: Lead Author of Working Group I of the 5th Assessment Report (AR5) of the IPCC

since 2011: Science lead of the ESA project Glaciers\_cci

**Research interests**

- Glacier monitoring from multispectral satellite data
- Application of GIS technologies for efficient data processing in glaciology
- Geomorphometric DEM analyses and its application in glaciology
- Distributed glacier mass balance modelling at various levels of sophistication

**5 Most important publications**

- Gardner, A.S., G. Moholdt, J.G. Cogley, B. Wouters, A. A. Arendt, J. Wahr, E. Berthier, R. Hock, W. T. Pfeffer, G. Kaser, S. R. M. Ligtenberg, T. Bolch, M. J. Sharp, J. O. Hagen, M. R. van den Broecke and F. Paul (2013): A reconciled estimate of glacier contributions to sea level rise: 2003 to 2009. *Science*, 340 (6134), 852-857.

- Linsbauer, A., F. Paul and W. Haeberli (2012): Modeling glacier thickness distribution and bed topography over entire mountain ranges with GlabTop: a new, fast and robust approach. *Journal of Geophysical Research - Earth Surface*, 117, F03007.

- Paul, F. and S. Kotlarski (2010): Forcing a distributed mass balance model with the regional climate model REMO, Part II: Downscaling strategy and results for two Swiss glaciers. *Journal of Climate*, 23 (6), 1607-1620.

- Paul, F. and L. M. Andreassen (2009): A new glacier inventory for the Svartisen region, Norway, from Landsat ETM+ data: challenges and change assessment. *Journal of Glaciology*, 55 (192), 607-618.

- Paul, F. and W. Haeberli (2008): Spatial variability of glacier elevation changes in the Swiss Alps obtained from two digital elevation models. *Geophysical Research Letters*, 35, L21502.

**Global glacier inventories and GLIMS: status and applications**

*F. Paul, Department of Geography, University of Zurich, Zurich, Switzerland*

Glacier inventories play a key role in regional to global scale determination of glacier changes (e.g. area and volume). So far, only low accuracy datasets were available on a global scale (e.g. GGHydro from J.G. Cogley or the hydrologic layer in the Digital Chart of the World, DCW). The GLIMS (Global Land Ice Measurements from Space) database on the other hand hosted vector outlines of about 100.000 of the estimated 170.000 glaciers (so it the database is globally not complete) but glacier outlines were derived from satellite data (with about 30 mt spatial resolution) and are much more precise.

In a recent special effort the community has created and provided preliminary glacier outlines to close the gaps in the GLIMS database and establish a globally complete inventory of glacier outlines for the forthcoming 5th Assessment Report (AR5) of IPCC working group I. This dataset has been named Randolph Glacier Inventory (RGI) and was used in numerous applications in support of AR5 (e.g. glacier volume modelling and calculation of the sea level contribution). The presentation is providing a short overview on the various glacier inventories, their accuracy and the various global-scale applications.

*Key Words: Glacier inventory, remote sensing, accuracy, IPCC*

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Geologist with PhD in Earth Sciences, from 1990 to 1992 he participated to the Greenland Ice Core Project (GRIP), for the deep drilling in the central of Greenland Ice Sheet, dealing with the mineral dust characterisation. He participated to the 10 Antarctic field seasons (1992-2008) of Italian Antarctic Expeditions, for firn drillings in the Northern Victoria Land and Dome C. From 1994, he was responsible, with J. R. Petit (LGGE, Grenoble), of the “Dust and Tephra Scientific Group” of the EPICA Project, participating to 4 field seasons in Dome C for EPICA and 4 field seasons at Talos Dome for TALDICE. He has been PI in the UE AlpClim Project on the climatic characterisation from Alpine ice cores, PI of IMONT (Italian Institute for Mountain Research) project CryoAlp and coordinator of 3 ISPEL (Italian Institute for Work Safety) projects on the anthropogenic impact on the European Alps and Mediterranean area. Starting from 2002, he is Italian representative of the EPICA Steering Committee. From 2004 to 2008, he was Chief scientist of TALDICE ice core seasons. He is a member of the International Glaciological Society (IGS) and of the American Geophysical Union (AGU). He is involved in the IPICS (International Partnership for Ice Core Sciences) for the “The oldest ice core”, “40 ky network” and “2ky Arrey” tasks. His main research interests are related to the characterisation atmospheric dust, mainly in Antarctica, Greenland and Alpine areas, for long-term paleoclimatic influences of mineral phases on the atmosphere. Identification of the source areas of mineral dust and evolution of the solid charge in atmosphere in the last 800 ky. He participates to the main European ice core drilling projects for reconstruction of past climate changes and the environmental changes on Antarctica, Greenland and European Alps area. From 2003, he is Assistant Professor at the University of Milano-Bicocca.

**80 Year-Long ice core climate record from Mt. Rosa (Colle Del Lys, 4,250 m a.s.l.)**

V. Maggi (1), B. Delmonte (1)

(1) Department of Earth and Environmental Sciences, University of Milano-Bicocca, Milan, Italy

Mid-latitude glaciers represent key archives for environmental and climate data. Under favourable conditions, the snow layers, progressively accumulated over the years on the uppermost part of high-altitude glaciers, can provide an undisturbed stratigraphic record of climate and environmental information, which can be studied in detail through firn and ice cores. In particular, ice core records from European Alps are essential for the assessment of the anthropogenic contribution to recent climate and environmental change occurred in an area located among the most industrialized countries of the world and close to the Mediterranean sea.

Drilling activities were performed in July 2003 and June 2012 on the topmost part of the Lys Glacier (Mt. Rosa, 4,250 m a.s.l.), a site that former studies (e.g. Maggi et al., 2006) indicated as suitable for ice core and paleoclimate research. We present here a new aeolian mineral dust record obtained from a 106-m + 32 m long firn/ice cores drilled at Colle del Lys (CDL03; CDL12) in the framework of NextData Project (CNR). The aeolian dust stratigraphy in the core shows a well-marked seasonal variability of background dust levels, with the exception of the deepest part of the core, where thinning of the layers is important. Superimposed to the seasonal variability of background levels, some highly-concentrated dust layers, often associated with brownish visible layers in the core, are also present. These ones are mainly related to important atmospheric advection of mineral dust from the arid areas of northern Africa, travelling over the Mediterranean well above the maritime boundary layer and deposited on the Alpine glaciers mainly through wet precipitation events. According to the preliminary dating, based on the occurrence of the 1963 3H peak, historical Saharan dust events and annual layer counting, the CDL03 and CDL12 record extends back to the 30's of the 20th century.

*Key Words: ice cores, paleoclimate, Alps, mineral dust, atmospheric transport*

**Yaoming Ma**

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Yaoming Ma got his PhD in Atmospheric Physics from Okayama University in 2001 and in Environment Science from Wageningen University in 2006. In 2004, he joined the Institute of Tibetan Plateau Research (ITP), the Chinese Academy of Sciences (CAS), and worked as a professor in ITP/CAS. He is also Deputy Director of ITP/CAS and Director of the Qomolangma Station for Atmospheric and Environmental Observation and Research (QOMS), CAS. As an atmospheric boundary layer researcher, he has been actively involved in many land surface experiments in China. He has also been actively involved in the GEWEX Asia Monsoon Experiment on the Tibetan Plateau (GAME/Tibet, 1996-2000) for its entire duration. He was coordinating the participation of Chinese team in the GAME/Tibet. He is also one of the overall coordinators of Coordinated Enhanced Observing Period (CEOP) Asian-Australian Monsoon Project (CAMP) on the Tibetan Plateau (CAMP/Tibet, 2001-2010). He is still in charge of the long term air-land interaction monitoring on the Tibetan Plateau. His 50 papers have been published in international journals. He is also the Winner of Outstanding Young Scientists for Meteorological Sciences and Technology, 2006, by China Meteorological Administration (CMA) and the Winner of Outstanding Young Scientists, 2008, by National Natural Science Foundation of China (NSFC). As a scientific researcher, except his domestic research work, he cooperated with the foreign scientists on atmospheric boundary layer and the application of satellite remote sensing. His cooperative institutions and universities are including Alterra (SC-DLO), Wageningen University and Research Center (WUR), International Institute for Geo-Information Science and Earth Observation (ITC) (The Netherlands), University of Tokyo, Nagoya University, Kyoto University, Tsukuba University and Okayama University (Japan) etc.

### **Using field observations and satellite data for the air-land interaction study over heterogeneous landscape of the Tibetan Plateau**

*Y. Ma, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing, China*

As a unique geological and geographical unit, the Third Pole area (the Tibetan Plateau and nearby surrounding area) dramatically controls climatic and environmental changes in China, Asia and even in the Northern Hemisphere. Supported by the Chinese Academy of Sciences and some international organizations, the Third Pole Environment (TPE) Programme is now implementing. Firstly the background of the establishment of the TPE, the establishing and monitoring plan of long-term scale of the TPE and six comprehensive observation and study stations will be introduced. Then the preliminary observational analysis results on atmosphere-land interaction will also be shown. The study on the regional distribution of land surface heat fluxes of paramount importance over heterogeneous landscape of the Third Pole area. A parameterization methodology based on satellite and in-situ data is described and tested for deriving the regional surface heat fluxes over heterogeneous landscape of the whole Tibetan Plateau area. Eight images of MODIS data and four images of AVHRR data were used in this study for the comparison among winter, spring, summer and autumn and the annual variation analysis. The derived results were also validated by using the "ground truth" measured in the stations of the Tibetan Observation and Research Platform (TORP). The results show that the derived surface heat fluxes in four different seasons over the Tibetan Plateau area is in good agreement with the ground measurements. The results from AVHRR were also in agreement with MODIS, with the latter usually displaying a higher level of accuracy.

*Key words: air-land interaction; heterogeneous landscape; Tibetan Plateau; Third Pole Environment Programme*

**Mauro Guglielmin**

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**M**auro Guglielmin, born in Lissone in 1965, Master Degree in Geology in 1989 and PhD in Earth Sciences in 1994 with a thesis on permafrost and related landforms. Since 2004 he has the permanent position as Associate Professor of Physical Geography and Geomorphology at the University of Insubria. He has been tutor of more than 30 among thesis and 2 Phds on glacial and periglacial geomorphology in the Alps and in Antarctica. His scientific activity was developed in the Alps, in the Arctic region (3 scientific campaigns) and in Antarctica where he participated to 14 Antarctic expeditions. Since 2001, he has been PI of different national Antarctic projects on Permafrost and Global Change in Antarctica. He is now Co-Chairman of the SCAR Expert Group ANTPAS - Antarctic and Sub Antarctic Permafrost, Soils and Periglacial Environments. Since 1996 up to now, he has been Chairman or Co-Chairman at several international conferences. He has been reviewer for several international journals with IF and for international and national research proposals in EU and outside. He has established different international collaborations with several institutions. In 2012, he has been Guest Editor of the special Issue of Geomorphology entitled "Advances of the permafrost and periglacial research in Antarctica". He has been PI or researcher of several international projects and he has been responsible of several projects funded by local administrations or environmental agencies. Recently he started the cooperation with EvK2-CNR both in the Alps and in Pakistan. His research is focused on periglacial processes, on permafrost thermal regime and on ground ice. More recently some papers were focused on the relationships between permafrost, vegetation and climate change. He published more than 100 papers on national and international journals, of which 54 on Journals with IF and he has a h-index of 15.

**Impacts of climate change on mountain permafrost**

*M. Guglielmin, Department of Theoretical and Applied Science, University of Insubria, Varese, Italy*

**P**ermafrost temperature can be a very useful tool to understand recent climate change and its impact on the cryosphere. The latest IPCC assessment stresses the large feedbacks between climate and its impacts on the ecosystems' where permafrost degradation and active layer thickening occur. Among them, there are large hydrological changes at the surface, increased release of methane into the atmosphere, changes in vegetation composition and increasing in slope instability and rock falls. In the mountain permafrost at a middle latitude the distribution is generally patchy or discontinuous and strongly controlled by snow distribution, while permafrost temperature is higher than  $-3^{\circ}\text{C}$  and in many cases it is not so far from the thawing conditions. Here the impacts of climate change may be even stronger and faster than in the Arctic or in Maritime Antarctica. Considering the nature of the substrate that generally is characterized by permafrost (rock or coarse material with a low organic content) the main feedbacks of the permafrost warming or of the thickening of the active layer are the increasing of the slope mass wasting (e.g. rock avalanche like Val Pola in 1987 and Thurwieser Peak in 2004, both in Italy, or several debris flows and rock falls like the Cervino rock falls in 2003) and the changes of vegetation coverage and biodiversity (like the unexpected decrease of the vegetation coverage in the Stelvio area in the permafrost areas). Nevertheless the hydrological changes due to the permafrost areal reduction or to the active layer thickening are potentially more important especially in non glacierized areas but the available data on this challenging topic are too scarce and require further investigations.

*Key Words: permafrost, active layer, climate change, landslide, ecosystems*

**Thomas Painter**

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Thomas H. Painter, PhD, is a Scientist at the Jet Propulsion Laboratory/Caltech and a Research Professor at the University of California, Los Angeles. His areas of interest are snow hydrology, radiative impacts of light-absorbing impurities on snow and glacier melt, multispectral remote sensing and imaging spectroscopy, water resources applied science, and solar system astrobiology. Painter has pioneered our understanding of the impacts of dust emission from land use change and industrial black carbon on snow and ice cover in mountain systems and the hydrologic response. He has also developed cutting edge remote sensing and field models for snow properties from multispectral to imaging spectrometer sensors.

He received the PhD and MA in Geography from the University of California, Santa Barbara and the B.S. in Mathematics from Colorado State University. He was an Assistant Professor of Geography at the University of Utah, and Research Scientist at the National Snow and Ice Data Center. He is a member of the American Geophysical Union, the European Geosciences Union, International Glaciological Society, and Western Snow Conference. Painter is the President of the Cryosphere Focus Group of the American Geophysical Union and member of the AGU Eos Editorial Advisory Board. He is the Principal Investigator on the NASA/JPL Airborne Snow Observatory.

**Mountain snow and ice loss driven by dust and black carbon radiative forcing**

*T. Painter, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA*

Changes in mountain snow and glaciers have been our strongest indicators of the effects of changing climate. Earlier melt of snow and losses of glacier mass have perturbed regional water cycling, regional climate, and ecosystem dynamics, and contributed strongly to sea level rise. Recent studies however have revealed that in some regions the reduction of albedo by light absorbing impurities in snow and ice, such as dust and black carbon, can be distinctly more powerful than regional warming at melting snow and ice.

In the Rocky Mountains, dust deposition has increased 5 to 7 fold in the last 150 years, leading to ~3 weeks earlier loss of snow cover from forced melt. In absolute terms, in some years dust radiative forcing there can shorten snow cover duration by nearly two months. Remote sensing retrievals are beginning to reveal powerful dust and black carbon radiative forcing in the Hindu Kush through Himalaya. In light of recent ice cores that show pronounced increases in loading of dust and BC during the Anthropocene, these forcings may have contributed far more to glacier retreat than previously thought.

For example, we have shown that the paradoxical end of the Little Ice Age in the European Alps beginning around 1850 (when glaciers began to retreat but temperatures continued to decline and precipitation was unchanged) very likely was driven by the massive increases in deposition to snow and ice of black carbon from industrialization in surrounding nations.

A more robust understanding of changes in mountain snow and ice during the Anthropocene requires that we move past simplistic treatments (e.g. temperature-index modeling) to energy balance approaches that assess changes in the individual forcings such as the most powerful component for melt – net solar radiation. Remote sensing retrievals from imaging spectrometers and multispectral sensors are giving us more powerful insights into the time-space variation of snow and ice albedo.

**Shresth Tayal**

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**Education**

Ph.D. (Glacier Hydrology), School of Environmental Science, Jawaharlal Nehru University, New Delhi, 2006

M.Sc. (Geology), Department of Geology, Banaras Hindu University, Varanasi, 2000

**Publications**

- Book

Shresth Tayal and Vinod Garg (2007). Understanding Our Environment, ICON Publication: A text book for Undergraduate Students as per the syllabus prescribed by UGC.

- Articles/Papers

1. Assessment of Volume Change in East Rathong Glacier, Eastern Himalaya (2013). International Journal of Geoinformatics, May 2013

2. S. I. Hasnain, R. Kumar, S. Ahmad and S. Tayal (2010): 'Status of Indian glaciers under the changing climatic regime: type study'. Satellite Image Atlas of Glaciers of the World: ASIA. USGS PP1386-F.

3. Tayal S. (2010). Glaciers of Eastern Himalaya. Annual magazine of Himalayan Mountaineering Institute.

4. Hasnain, S.I. and S. Tayal (2009). Impacts of Global and Regional Warming on Hindu-Kush Himalayan Glaciers. Climate Change, Society & Sustainable Development: Agenda for Action. Times Foundation 2010.

**Teaching Experience**

Teaching Glacier Hydrology to M.Sc. (III) semester students at TERI University, New Delhi, July 2008 to present.

**Ongoing Projects**

1. Water, Energy, and Climate Interactions: Identifying Issues and Assessing Response Capacity at the State Level – as Principal Investigator

2. The response of the Hydrological system in India to climate change (INDICE)

3. Fluxes of Persistent Organic Pollutants (POPs) in the Ganges River, India

4. Conducting a GIS based diagnostic study for assessing availability and quality of water resources to address watershed wide concerns using watershed approach

5. Impacts of climate change on the Himalayan glaciers

Current Research Runoff modeling research for high altitude catchments of Himalayan Rivers based on real time data series for mass balance, energy balance and hydrological balance

**Multiple vulnerability forces to high altitude hydrological patterns**

*S. Tayal, Centre for Himalayan Ecology Water Resources Division, The Energy and Resources Institute (TERI), New Delhi, India*

The coupling of natural as well as anthropogenic factors forces the vulnerability of high altitude hydrological flows, generally dominated by glacier ice/snow melt. The basic scientific and geographical reasoning as well as ground measurements of the date raise serious concerns on the present as well as future stage of Himalayan cryosphere. Considering the role played by these glaciers in regulating the water availability as well as the livelihood of the region's population, it is vital to develop an adaptation framework for future water policy and water management keeping a space for scenarios of glacier vulnerability and seasonal flows in the Indo-Gangetic river systems.

However, to quantify the degree of vulnerability and provide certainty to accomplishments in the policies framed, a network of well-equipped high altitude hydrometeorological observatories, representing various micro-climatic settings, needs to be established for long-term monitoring and to keep a continuous track of changes in the Himalayan cryosphere system.

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**Education**

2008 PhD, 2002 MSc, University of Colorado, Boulder, USA  
1999 BA Williams College, MA

**Appointments**

2010-present: Associate Scientist III, NCAR  
2008-2010: Post-Doc, Advanced Studies Program, NCAR  
2009: Instructor, University of Colorado, Boulder, USA

**Recent Publications**

Rasmussen et al (submitted), Climate Change Impacts on the Water Balance of the Colorado Headwaters: High-Resolution Regional Climate Model Simulations. *Journal of Hydrometeorology*  
Gutmann et al (submitted), An intercomparison of statistical downscaling methods over the contiguous United States. *Journal of Climate*.  
Biederman et al (2013), Multiscale observations of snow accumulation and peak snowpack following widespread, insect-induced lodgepole pine mortality. *Ecohydrology*. doi:10.1002/eco.1342  
Rasmussen et al (2012), How Well Are We Measuring Snow?: The NOAA/FAA/NCAR Winter Precipitation Test Bed. *BAMS*, 93(6):811–829. doi:10.1175/BAMS-D-11-00052.1  
Gutmann et al (2012), Snow measurement by GPS interferometric reflectometry: an evaluation at Niwot Ridge, Colorado. *Hydrologic Processes*, 26(19):2951–2961. doi:10.1002/hyp.8329  
Gutmann et al (2012), A Comparison of Statistical and Dynamical Downscaling of Winter Precipitation Over Complex Terrain. *Journal of Climate*, 25(1):262–281, doi:10.1175/2011JCLI4109.1  
Rasmussen et al (2011), High resolution coupled climate-runoff simulations of seasonal snowfall over Colorado: A process study of current and warmer climate. *Journal of Climate* 24(12) 3015-3048. doi:10.1175/2010JCLI3985.1  
Ikeda et al (2010), Simulation of seasonal snowfall over Colorado. *Atmospheric Research*, 97, 462-477, doi:10.1016/j.atmosres.2010.04.010  
Larson et al (2009), Can we measure snow depth with GPS receivers? *Geophysical Research Letters*, 36, L17502, doi:10.1029/2009GL039430

**The future water balance at high elevations**

*E. Gutmann (1), R. Rasmussen (1)*

*(1) National Center for Atmospheric Research, Boulder, USA*

**S**nowpack is the most important water source in the western U.S., and thus it is critical that water managers be provided an estimate of the likely changes expected of this resource in the future. Previous climate studies have shown that the Headwaters region of the Colorado river to be a particularly difficult area for climate models to handle, with inconsistent snowpack trends in this region from both the 3rd and 4th IPCC reports (2001, 2007), despite consistent prediction of temperature increases from all climate models. In order to provide more realistic estimates of the hydro-climatic changes in this region, a high resolution modeling study has been conducted using the climate version of the NCAR Weather Research and Forecast (WRF) model. This talk will present the current and projected future changes of snowfall, snowpack, evapotranspiration and runoff over the Colorado Headwaters region using a continuous 8 years high resolution WRF simulation at 4 km grid spacing. The model simulations will be verified with SNOTEL data. The future impacts will be estimated by performing a climate sensitive run in which the 8 year current run is perturbed with the boundary conditions of the NCAR CCSM climate model for the mean conditions between 2045 and 2055.

*Key Words: water balance, Colorado Headwaters, winter snowpack, evapotranspiration, precipitation*

## SESSION - WATER

### Renzo Rosso

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**R**enzo Rosso is Full Professor of Water Engineering at the Politecnico di Milano since 1986. He graduated in Civil and Hydraulic Engineering from the University of Genoa. From 1975 to 1986, he worked at the Italian National Research Council (CNR), in the Imperial College of Science and Technology and at the Universities of Florence and Genoa. He also taught at the University of Parma, the University for Foreigners in Perugia, the University of Concepción (Chile), the Colorado State University (Fort Collins, USA) and the Massachusetts Institute of Technology (Cambridge, USA).

He is the author of texts of applied statistics, hydrology and climatology at international level and has published more than 350 scientific works, including more than 90 articles in international peer reviewed journals (SCI), as well as monographs and contributions to conferences and seminars on hydrology, fluvial geomorphology and climatology, glaciology, analysis and planning of water systems, risk analysis and stochastic processes, nonlinear dynamics and fractal geometry. He has contributed to projects on mitigation of hydrogeological risk and planning and designing water systems, coordinating several national and international research programs. He was associate editor of several scientific journals and reviewer for several international journals. He has been a member of several committees and scientific and technical evaluator on behalf of national and international agencies at the European Commission (DGXII and DGXVII), NSF (USA), NERC (United Kingdom), NASA (USA), FNSNF (Suisse), CNRS (France), MIUR and CNR (Italy).

### **Impact of climate change on water resources in the water towers of Asia: the case of Indus River**

*R. Rosso (1), A. Soncini (1), G. Confortola (1), E. Nana (1), A. Bianchi (1), D. Bocchiola (1)*  
(1) Politecnico di Milano, Milan, Italy

**T**he mountain regions of the Hindu Kush, Karakoram and Himalaya (HKKH) are the “third pole” of our planet and the glaciers in this area play the role of “water towers”, delivering significant amounts of melt water, especially in the dry season, essential for food and water security, and hydropower production. The recent dynamics of glaciers in the Karakoram area is also called the “Karakoram anomaly”, characterized by substantially unchanged ice cover during the last decade, against noticeable area loss worldwide, possibly leading to slightly decreasing stream fluxes. Yet, recent major floods occurring in Pakistan and the Karakoram area may represent an effect of modified climate in the area, carrying heavier precipitation in the Monsoon season. We present here results obtained under the umbrella of the Ev-K2-CNR Committee SHARE-Paprika project, aiming at evaluating the impact of recent and prospective climate change on the hydrology of the upper Indus river. We focus here on a specific watershed nested within the upper Indus basin and fed by seasonal melt from two major glaciers (Baltoro and Biafo), at the toe of K2 Peak. We illustrate data gathered during three field campaigns during 2011 and 2012, aimed at investigating ice ablation dynamics, seasonal accumulation, and hydrologic fluxes from the Baltoro-Biafo glaciers area and Shigar river. Based upon these data we approached hydrologic modeling of the area. We then project the hydrological future (until 2100). We further investigate a possible projection of the transient hydrologic regime until the year 2100. This is approached by downscaling state of the art climate scenarios, used as input to the hydrologic model. Scenario simulations are thus obtained, including modified snow cover, ice ablation regime and implications for future water resources and flood regime in the area. The uncertainty of the results is addressed and future research questions are discussed.

*Key Words: climate change, hydrological models, climate models, future water resources, Upper Indus basin*

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**D**aniele Bocchiola, born in 1972, since 2005 is Assistant Professor in Hydrology at the Politecnico di Milano. He gained his degree (Master of Science) in Environmental Engineering in July 1998 and his PhD in Hydrology in June 2003 at Politecnico di Milano, partially fulfilled at MIT. His field of interest in research covers a range of issues, with particular focus upon impact of ongoing and prospective climate change on water resources, natural hazard, agriculture, and cryosphere in the European Alps, the Andes, the Hindu-Kush Karakorum Himalaya, and the Caribbeans.

He is author of over 100 publications, including about 40 papers upon peer reviewed journals. He cooperates with Ev-K2-CNR Committee for high mountain research within several projects under the framework of the SHARE initiative, and has carried a number of field expeditions therein.

He is member of the Italian Glaciological Committee (CGI), the Italian Association for Physical Geography and Geomorphology (AIGEO), and member of AGU, EGU and IGS.

### **Climate change effect upon water resources and hydro-ecology in Northern Italy and the Alps**

*D. Bocchiola (1), A. Soncini (1), G. Confortola (1), E. Nana (1), S. Canobbio (2)*

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**G**lobal warming is affecting the climate of mountain areas in temperate regions and the water resource distribution therein. Within the European and Italian Alps thermal shift since recent climate signals display to substantially unchanged precipitation, but a marked decrease of snowfall, and modification of the hydrological cycle therein, and downstream in the lowlands. Expected hydrological changes within Alpine catchments include modified average in channel discharge, as well as modified incidence of extreme events, either low flows or flood flows, thus impacting water management strategies in the lowlands, as needed for agricultural, and flood mitigation purposes, and ecological status of riverine systems. We provide here case studies of prospectively modified hydrological cycles within Northern Italy and the Alps under climate change, and potential fallout upon water resources management, hydro-ecology, and agriculture, developed in partial fulfillment of I-CARE project, funded by Politecnico di Milano under "5 x mille" scheme during 2011-2013.

*Key words: climate change, Alpine catchments, water and food security, hydro-ecological status*

**Andrea Lami**

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**H**is field of study is paleolimnology and in particular the study of fossil remains biochemicals such as chlorophylls and carotenoids in lake sediments with the use of techniques of chromatography (TLC and HPLC) in order to reconstruct the long scale evolution of algae populations and how they respond to external drivers such as climatic or anthropogenic changes. He has also dealt with the development of methodologies for the measurement of chemical parameters in the sediment such as carbon, nitrogen and sulphur, through the CNS elemental analyzer, phosphorus and biogenic silica. Participation in several fieldworks around the world, including remote areas such as Alps, Himalayas and Patagonia, which allowed him to gain experience with the use of various types of corer, including some able to collect long sediment cores up to 14 meters in deep water, and the use of corer in extreme conditions. He developed experience also as a scientific coordinator of national and international projects. During these years he has been invited as a university level lecturer on topics related to the impact of climatic change on water quality and paleolimnology.

**Mountain waters fragile ecosystem not just water reserve**

*A. Lami (1), M. Rogora (1), A. Boggero (1), S. Musazzi (1), S. Zaupa (1), F. Salerno (2), R. Balestrini (2)*

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**M**ost lakes and rivers located in mountain regions are characterized by high quality waters with low nutrient concentrations. Alpine waters usually have few species of aquatic organisms; however, they often possess rare and sensitive species adapted to extreme conditions that make them vulnerable to environmental change. Even these remote areas are no longer pristine: the environmental changes occurring at high altitudes may have direct and indirect impacts on water quantity and quality, on biodiversity and on the structure and function of freshwater ecosystems as a whole. Because of their physiographic, morphometric, hydrological and edaphic characteristics, high-altitude lakes and rivers are among the most sensitive aquatic ecosystems to air pollution and climate change. They can then be used as early-warning sites to study the effect of anthropogenic stressors, either through extensive surveys of water chemistry or biological populations. High altitude freshwater ecosystems may possibly acquire increasing importance for water management in the future, because they serve as multifunctional tools in the regulation of water balance and because they may represent a secondary source of pollution to ecosystems at lower altitudes, with important implications for water quality and usage. In this contribution, we describe the special nature of high altitude waters, their fragility and vulnerability, to human disturbance. The magnitude and extent of the ecological consequences of climate change in high altitude freshwater ecosystems will depend largely on the rate and magnitude of change in three primary environmental drivers: the runoff regime; temperature; and alterations in water chemistry. Large uncertainties remain in projecting species and system-specific responses and the impact of changes in climate and UV radiation levels on biodiversity at local and regional spatial scales. However, several broad projections can be made and are here presented.

*Key Words: lake, water quality, climate change, freshwater communities*

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**Educational background**

Vordiplom in Computer Science and Geophysics, 1997, Potsdam University, Germany  
Diploma in Geology, 2000, Potsdam University, Germany  
Dr. rer. nat. (summa cum laude), Geology, 2005, Potsdam University, Germany

**Academic honors**

2005: Best PhD-student publication award (Leibniz-Kolleg, Potsdam University)  
2004: Bernd-Rendel-Preis (achievement award by the German Sci. Foundation)  
2001: Socrates Intensive Program participants (EU sponsored)  
1998: selected participant to the ECRC Advanced Study Course (EU sponsored)

**Work experience and appointments**

since 2011: Assoc. Professor, Geography Dept., UC Santa Barbara  
since 2008: Affiliated Faculty, Dept. of Earth Sciences, UC Santa Barbara  
2008 – 2011: Asst. Professor, Geography Dept., UC Santa Barbara  
Jun. 2007 – Sep. 2007: Visiting researcher, Inst. f. Geowiss., Potsdam University  
Jan. 2006 – Dec. 2007: Postdoctoral researcher, GES, Stanford University  
Jan. 2005 – Sep. 2007: Adjunct Researcher at the Inst. f. Geowiss., Potsdam University  
Jan. 2005 – Feb. 2006: Assistant Researcher, Institute for Crustal Studies, UC Santa Barbara  
Jun. 2004 – Nov. 2004: Research Associate at the Space Science Laboratory, UC Berkeley  
May 2003 – Dec. 2003: Research Associate at the University of California, Berkeley  
Oct. 2001 – Jul. 2002: DAAD Stipend at the University of California, Berkeley  
Mar. 2001 – Dec. 2004: DFG (German Sci. Foundation) Graduate Fellow (Potsdam University)  
Mar. 1996 – May 2001: Computer coder at a private computer company in Berlin, Germany

**Research interests**

Understanding Quaternary climate change, geomorphic processes, landscape evolution, and tectonic processes through integrated studies involving cosmogenic radionuclide dating (He, Ne, Be, Al, Cl), recent and past climatic records, remote sensing, numerical modeling, and field observations. Spatial scales range from hillslopes (10 km<sup>2</sup>) to entire mountain ranges.

**Hydrologic contributions and sediment transport in High Mountain Asia**

*B. Bookhagen, Geography Department, University of California, Santa Barbara, USA*

The hydrological budget of rivers through High Mountain Asia (HMA) is dominated by seasonal rainfall and snowmelt, but their relative impact and spatial distribution is not well established because this remote region lacks a dense gauge network. In this presentation, I rely on a combination of validated remotely-sensed climate parameters to characterize the spatiotemporal distribution of rainfall, snowfall, glacial melting, and evapotranspiration in order to quantify their relative contribution to river discharge. In a second step, I will evaluate sediment-transport process linked to hydrometeorologic extreme events. Sediment concentration in rivers throughout HMA plays an important role for sustaining drinking water and hydropower generation. The hydrologic model uses rainfall amounts calculated from calibrated, orbital, high-resolution Tropical Rainfall Measurement Mission data, and snow-water equivalents are taken from passive microwave data, but they are compared to amounts computed by a snowmelt model based on satellite-derived snow cover, surface temperature, and solar radiation. Sediment concentration and their changes through time are determined by gauge data, but also geochemical methods (cosmogenic radionuclides) that allow integrating several hydrometeorologic extreme events. Results indicate large spatiotemporal gradients in the hydrologic components, with >50% of annual discharge contribution through snowmelt in western HMA. The Central and Eastern areas are dominated by seasonal rainfall through the Indian and East Asian Summer monsoon. Sediment transport processes are closely linked to strong rainfall events and significantly impact water quality.

## SESSION - MOUNTAIN NATIONAL PARKS

### *Franco Mari*

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**B**achelor degree in Biological science at Milan University on wildlife management and a PhD at the University of Turin on evolutionist biology and biodiversity conservation.

As a freelance biologist, he has developed and worked as researcher or project manager on different projects in Protected Areas in Europe, Asia, North and South America, mainly focused on conservation on endangered species and park management.

Member of different groups as IUCN (reintroduction specialist group), he is now working for EV-K2-CNR Committee as a scientific advisor for the SEED Project, developing the research programs for the sustainable development of the Central Karakorum National Park – North Pakistan – and the related Management Plan.

He has published several papers and scientific notes.

### **What approach for the management of the mountain protected areas?**

*F. Mari, Ev-K2-CNR Committee, Bergamo, Italy*

**M**any of the Protected Areas in the world are mountain areas, and in many cases the choice of their recognition, in these particular regions, is suggested from the consideration that they are marginal compared to human activities needs of.

This underestimates the importance of these areas both for the conservation of the environment and for their support to the life of communities.

The highly specialized ecosystems, evolved as adaptation to the presence of particular, often extreme, conditions, and the impossibility for many species to “migrate” make these zones particularly fragile and subject to the impact of climate change.

From another point of view, we have to consider their support to human beings, also with an ecosystem approach: the timber products from the forests, but also their capacity of CO<sub>2</sub> sequestration, or the availability of fresh waters from their glaciers and snow fields.

The importance of a Park, especially in high mountain areas, is not to have only a conservation function, but also to support the needs of local communities in a sustainable way, primarily in those geographical areas where people are still living in critical conditions and are mainly depending on natural resources. We discuss the necessity of a multidisciplinary and participative approach for the management of these Parks, using the work developed during the first part of the SEED Project to produce the first draft of the Management Plan for the Central Karakoram National Park.

This is a protected area of 11,000 square kilometres, established in 1993 in Gilgit-Baltistan (North Pakistan), near the China border. Here land is dominated by mountains (K2, Nanga Parbat, Gasherbrum-1, 2, Broad Peak, with an overall of 19 peaks above 7,600 m) and over 700 glaciers interesting the 38% of the Park area, with around 4% forest and rangeland. These last ones constitute important habitats of high altitude plants and animals, many of them endangered, like the snow leopard. Due to the critical conditions of the area, the majority of the population is only engaged in subsistence production, including agricultural, pastoral and silvicultural activities.

*Key words: Mountain Protected Areas, participative management, biodiversity conservation, sustainable development*

**Teodoro Andrisano**

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**T**eodoro Andrisano, born in Bari in 1958, Degree in Forestry Science in 1984 at the University of Bari. He worked in the Società Agricola e Forestale, where he was involved in several forestry improvement planning, forest management plans and regional forest inventories. He has worked for two years at the Protected Areas Technical Secretariat of the Ministry of the Environment - Nature Conservation Service. He has been working at the Majella National Park Authority since 1997 and he was Deputy Director and Coordinator of Services and Offices for thirteen years. Currently, he is Planning and Management Service Manager and Head of the Monitoring and Managing Biodiversity Office. His principal activities: scientific research, wildlife, agriculture and forestry. In particular: promotion of agricultural and livestock activities and authorizations, damage caused by wildlife, wildlife monitoring and annual census for the most important species of the park, monitoring floristic status of rare and endemic species, management of wildlife enclosures and botanic gardens, coordination of veterinary activities on wild animals, prediction and prevention of forest fires. Andrisano is also coordinator of 2 Life Nature projects: WOLFNET "Development of coordinated measures for Wolf in Apennines" and COORNATA, "Development of coordinated protection measures for Apennines Chamois". In the past, he worked on other Life Nature projects. He was also involved in the development of the Park Plan, as a civil work designer and/or construction manager, he worked on several improvement forestry projects, wildlife enclosures, development of the Park's network of paths. From 2003 to 2010, he was professor in "Management of Protected Areas" for the degree course in Science and Technology for the Conservation of Forests and Nature at the Faculty of Agriculture and Forestry Sciences of the University of Tuscia Viterbo. He has published several papers and scientific notes.

**Climate change and sustainable development in a National Park of Apennines**

*T. Andrisano, Planning and Management Service and Monitoring and Managing Biodiversity Office, Majella National Park Authority, Italy*

**M**ajella National Park is a mountain park, in the center of the Apennines and of the Mediterranean basin, just over one hour from Rome. The natural environment and the evolutionary processes that characterize the ecosystems, flora and wildlife of the area came from the massive abandonment of human activities, which took place in the last 60 years, and influenced by the reintroductions of wild ungulates carried out in the '70's.

In its 16 years of existence, the park has developed a system for monitoring and management programs, for the most important wild fauna and flora, innovative in many ways, thanks to the experience carried out under EU Life Projects (e.g. capture of wolves, released with radio collar satellite, etc.). In addition, the Park carries out periodical studies on habitats and species of European interest in order to check their health status, potential problems and to improve management systems.

The system is integrated with a network of service structures: 6 wildlife enclosures (2 for the Apennine chamois reintroduction programs), others are for environmental education (wolf, bear, deer, roe deer); two surgeries and one multi-purpose veterinarian center for the recovery of wildlife; two botanic gardens with an attached herbarium; seed collection, seed bank of rare species of the Park, certified nursery for the production and sale of forest plants, native herbaceous and shrub species, traditional fruit cultivar of the territory. A research carried out has permitted to count more than 50 traditional agricultural cultivars. The structures are integrated in a receptive circuit, formed by visitor or information centers, museums and Park Houses, a net of various kind of paths, over 750 km long, service facilities-assistance (horse shed, bike repair shops, etc.) and rental (mountain and pedal assisted electric bikes), all green infrastructure to promote tourism in the protected area. The park promotes the collaboration with stakeholders of the area to support traditional activities.

*Key Words: national parks, protected areas management, biodiversity*

### **Wolfgang Platter**

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**B**orn in Val Venosta Valley, (Bolzano, Italy). Degree in Natural Sciences at the University of Innsbruck, Austria. He taught mathematics and natural sciences at the compulsory school, he has been mayor of Lasa for 4 administrative periods, vice-chair of Val Venosta district and expert of naturalistic matter. In 1995 he has been designated president of the Management Committee for the Autonomous Province of Bolzano in the Consortium of Stelvio National Park by Autonomous Province of Bolzano and in 2000 he has been re-elected.

Between 2003 and 2006 he has been director of the peripheral office of the Consortium of Stelvio National Park for the Province of Bolzano-Alto Adige. Since 2006, following a publish competition, he is Director of the whole Stelvio National Park.

### **The Stelvio National Park**

*W. Platter, Stelvio National Park, Bormio, Italy*

**T**he presentation will be focused on Stelvio National Park, the unique one of the 24 Italian National Parks administered by a consortium, on its habitats and on an inventory of the Park's vertebrate species. Then the critic aspects of this park, that can be considered a complex mosaic of natural and cultural landscapes, will be shown. In particular, among the critical topics, the attention will be focused on the different forms of water use in the framework of climate change, with the reduction of glaciers or the touristic pressure in sensitive areas with a reduced load capacity. In this context it will be presented the zoning approach with different levels of protection included into the plan of the Park. After all, the different initiatives and the monitoring actions promoted by the Park for the conservation of biodiversity in sensitive habitat and of plant and animal species, with bioindicator function, will be shown.

*Key Words: Stelvio National Park*

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With a Master both in Zoology and Forestry from Pakistan; and Master in Natural Resource Management from Scotland, UK, Ashiq Ahmad Khan has been serving the Pakistan Forest Institute as Wildlife Management Specialist till 1992 and WWF-Pakistan as Chief Technical Advisor till 2010. He is currently engaged with Ev-K2-CNR Committee as Scientific Representative and Member of Scientific Board. Khan has been Chairman of International Steering Committee, elected for Snow Leopard Network, consecutively for 2 tenures, 3 years each. He is Member of the Steering Committee for International Crane Foundation and Wetlands International. Khan has been a member of the Federal Advisory Board for Environment, Government of Pakistan and has been serving on several other professional boards. He is member of 5 specialist groups of IUCN. In addition to being author of about 50 scientific articles and reports, Khan is Associate Editor and Chief of the Journal of Arid Lands, published by the Chinese Academy of Sciences. On the conservation front, Khan has not only been involved in the creation of several protected areas in Pakistan but has authored the management plans of several protected areas and a biosphere reserve. He has pioneered several conservation initiatives in Pakistan, including the use of trophy hunting as a conservation tool, and ethno-botany as a tool for the conservation of medicinal plants.

**Introduction to the session on Biosphere reserves: scope and objectives**

*A. A. Khan, Ev-K2-CNR Committee Scientific Board for Pakistan, Pakistan*

All nations of the world, including Pakistan, do want to arrest the process of degradation of the natural landscapes, and reverse it, as and when possible. To do so, protected areas with different nomenclatures, supported by the legislations of respective countries, are in place.

Since 1974, Pakistan has created a number of protected areas in different ecological zones with nomenclatures such as National Parks, Wildlife Sanctuaries and Game Reserves, that covers +11% of its land mass. Although, like many countries of the world, most of the protected areas in Pakistan are not managed the way they deserve but nevertheless adequate level of protection is available to some of the species of global significance only in such areas. Biosphere Reserve is one category of such protected areas that is nominated and managed by respective countries and designated by UNESCO under its Man and Biosphere Programme. As of 2012, there are 610 Biosphere Reserves in 125 countries of the world, 30 in neighboring China, 9 in India and 10 in Iran. In Pakistan, there are only 2 Biosphere Reserves, the oldest being Lal Suhanra Biosphere Reserve, designated in 1977, while the recent one is Ziarat Juniper Biosphere Reserve, designated in June, 2013.

Since there has been no significant effort to highlight the need for the creation of Biosphere Reserves in the past, a session has been exclusively reserved in the EvK2CNR conference. The session shall be guided by the following objectives:

1. Sharing information about the processes and procedures involved in the creation of Biosphere Reserves;
2. Knowing about the newly created Biosphere Reserve of Pakistan, its issues and management potentials;
3. Sharing information about some of the potential sites in Pakistan that could be designated as Biosphere Reserves under the UNESCO's Man and Biosphere Programme.

*Key Words: protected areas, conservation, Biosphere Reserve*

**Andrew Seguya**

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**Qualifications**

- Postgraduate Diploma in Monitoring and Evaluation Methods, Stellenbosch University, South Africa, 2008. Skills attained: monitoring, evaluation, performance management, impact assessment
- Master of Business Administration, De Montfort University (UK) 2003. Skills attained: Financial Management and control, Business strategy formulation and strategic management, Human resource management, Marketing and international marketing, Organisational development and change, Change management, Project management, Entrepreneurship and innovation, Preparation of business plans/proposals, Customer service and market research, Performance management in the work place
- Master of Veterinary Science, University of Melbourne, Australia 1999. Skills attained: animal health management, disease surveillance techniques, advanced veterinary medicine, surgery, epidemiology and preventive medicine
- Bachelor of Veterinary Medicine, Makerere University (1992). Skills: professional veterinary medicine and surgery.

**Professional Work Experience**

December 6, 2010 to present – Executive Director, Uganda Wildlife Authority (UWA), P.O. Box 3530 Kampala, Uganda, [www.ugandawildlife.org](http://www.ugandawildlife.org) (Area of business - Wildlife Management).

February 2005 - December 2010 – Executive Director, Uganda Wildlife Education Centre (UWEC), P.O. Box 369 Entebbe, Uganda, [www.uweczoo.org](http://www.uweczoo.org) / [www.uwecug.org](http://www.uwecug.org) (Type of business: Wildlife Management and Conservation Education)

March 1991 - February 2000 – Assistant Lecturer, Makerere University, P.O. Box 7062 Kampala, Uganda, [www.mak.ac.ug](http://www.mak.ac.ug) (Type of business: Higher Education)

**Rwenzori Mountains National Park: management and conservation strategies**

*A. Seguya (1), J. Makombo (1), C. Tumwesigye (1), F.K. Kayanja (1)*

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The Crest of the Virika (Rwenzori), the great mountain of Vacongio was divulged to the outer world in April 1888 with the top and sides clothed in white vividly seen by H.M. Stanley indicating snow clad mountain. The mountain ranges identified with the semi-legendary mountain of the moon (1888) as the most important source for River Nile (Ptolemy in 150 AD), about 50 crater lakes that add beauty to the scenic views and contributes large volumes of water to the surrounding communities, lifelines to the Protected areas wildlife, its the largest water catchment area in Uganda. Rising from the rift valley floor to wintry elevation of 5109m, Rwenzori supports large tracks of montane evergreen and bamboo forest (2000m-3500m), while the higher moorland zone 3000m- 4500m is known for its other worldly cover of giant heather and Lobelias with permanent snow, 20km north of the equator. The unique scenery, wildlife and natural sacredness of ranges lead to its international recognition as a World heritage Site (No. 684) since 1994 and RAMSAR site in 2007. Its numerous mineral deposits, potentially extension of Congo copper belt is important for Uganda's economy. The above importance and roles of the Rwenzori, contributes enormously to the social economic development of the local communities and the Nation, sustainable access to the Park Resources, employment as Park staff and / ecotourism staff and revenue sharing with the neighbouring communities. However, climate change is real and it impacts heavily on, rainfall patterns, vegetation zones and subsequently animal distribution and Tourism. This therefore calls for a multipronged approach for effective conservation, through a ten-year management plan was developed in consultation with the local communities and other stakeholders. The conservation of the mystical Rwenzori Mountains water catchment area is crucial for the rain fall based social economic development of the region and the country.

*Key Words: Rwenzori, Mountains of the Moon, conservation, Uganda*

### ***Abdulwahid Hussein Haji Said***

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Date of Birth: 1967-01-05

Education: Law BA degree

Director of Halgurd Sakran National Park

Head of Soran Association Care for Handicapped (volunteer)

Soran Cultural Center Member

Language: Kurdish, Arabic, Persian and English

### **Toward Halgurd Sakran National Park**

*A. H. Haji Said, Halgurd Sakran National Park, Erbil, Kurdistan Region, Iraq*

**T**he area envisaged to become Halgurd-Sakran National Park is situated in Erbil Governorate, 120 km east-north-east of the capital city of Erbil, close to the Iranian border. It is part of the Zagros mountain range located in the Irano-Anatolian sub-region.

Kurdistan represents Upper Mesopotamia since its deep prehistoric era and as the cradle both for mankind and civilization. As the coexistence between the Kurdistan nation and surrounding nature can be traced back deep to prehistory, preservation of the Halgurd-Sakran area as a National Park in modern Kurdistan should merit all attention.

The National Park would be the biggest mountain protected area in Kurdistan. It would comprise an area of more than 1200 km<sup>2</sup> (60,000 ha) (to be fixed in the upcoming planning process) and would stretch across an elevation range from 900 m up to 3,609 m (Halgurd Peak, formerly known as the highest mountain in Iraq).

## SESSION - ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS OF CLIMATE CHANGE

### *Hildegard Diemberger*

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**H**ildegard Diemberger (PhD) is the Director of the Mongolia and Inner Asia Studies Unit and a Fellow of Pembroke College at the University of Cambridge. She was trained as a social anthropologist and Tibetologist at the University of Vienna and has published extensively on the history and culture of the Himalayas and the Tibetan Plateau. Her publications include the monograph "When a woman becomes a Religious Dynasty: the Samding Dorje Phagmo of Tibet" (Columbia University Press 2007) and the English translation of Tibetan historical sources published by the Austrian Academy of Sciences. In the last few years she has become increasingly interested in the impact of the changing climate on the livelihood of the Tibetan rural population and has become part of an international interdisciplinary network focusing on climate histories across the world (her recent publications on the subject include the forum article "Communicating Climate: Proxies, Processes, Politics". *Current Anthropology*, April, 53, 2, 226-244 and the chapter "Deciding the future in the Land of Snow: Tibet as an arena for conflicting forms of knowledge and policies" in the volume *The Social Life of Climate Models* edited by Kristen Hastrup and published in London by Routledge). She is a member of the Cambridge Forum for Sustainability and the Environment and the general secretary of the International Association for Tibetan Studies (IATS).

### **Living with environmental change on the Tibetan plateau**

*H. Diemberger, University of Cambridge, Cambridge, UK*

**T**his paper will focus on the changing climate on the Tibetan plateau as experienced by rural communities in Central Tibet and on the Himalayan slopes. In particular it will explore the ways in which local knowledge has been deployed in understanding environmental transformations, develop strategies to cope with extreme events and achieve a synthesis with other forms of knowledge coming from outside (the state, NGOs and the global debate on climate change).

**Piero Boccardo**

Information Technology for Humanitarian Assistance, Cooperation and Action (ITHACA),  
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**B**orn in Turin in 1964; from 2001 Associate Professor in the field of surveying and mapping at the Politecnico di Torino, Department of Environment, Land and Infrastructure Engineering; from 2006, Director of ITHACA (Information Technology for Humanitarian Assistance, Cooperation and Action), a joint project between Politecnico di Torino, SiTI and WFP (World Food Programme).

Degree at the Politecnico di Torino, Ph.D in “Geodetic and Topographic Sciences” at the Department of Geo-resources and Land of the Engineering Faculty of Politecnico di Torino.

Grant awarded by the Italian Research Council (C.N.R.) for a research activity at the Department of Geography and Anthropology, Louisiana State University, Baton Rouge, USA. Prize awarded by the Italian Research Council (C.N.R.) for research activity carried on in USA.

From 2011 he is President of the Remote Sensing Italian Association (AIT); from 1997 a member of the ASITA Scientific and Steering Committees; chair of the Working Group 1 (Remote Sensing and Disasters) of Commission VIII (Remote Sensing Application) of ISPRS (International Society of Photogrammetry and Remote Sensing) and Director and member of ITHACA (Information Technology for Humanitarian Assistance, Cooperation and Action) Board of Directors.

He is in charge of Remote Sensing University courses at the Politecnico di Torino, and of the “Environmental applications of GNSS Technology” Master organized by the same university. He also participated as lecturer in different public and private training courses. He has been supervisor of more than 70 dissertation thesis both at university and Ph.D. degree.

Author of more than 110 publications, edited at a national and an international level, he has attended as speaker and chairman, more than 75 national and international scientific congresses.

Consultant for several private and public companies and organizations, he is now in charge for more than 10 contracts.

**New perspectives in emergency mapping**

*P. Boccardo (1), F. G. Tonolo (1), A. Ajmar (1)*

*(1) ITHACA, Turin, Italy*

**I**n recent years, a growing attention is paid to remote sensing when used for disaster management applications. This is essentially due to the large availability of different types of remotely acquired imageries, allowing the extraction of geometric and thematic features able to map, delineate and grade the impact of natural disasters. Another key point is represented by the quick availability of the above mentioned images that allow rapid mapping procedures in order to deliver the data (reference and thematic ones) to concerned users.

In this kind of application, different crucial issues should be taken into account:

1. timeliness of the service, in order to guarantee the fast provision of raw and thematic data (both raster and vector);
2. the necessity to set up consolidated procedures allowing the delivery of consistent and generalized products;
3. the overall request to produce certified data, quality checked and stating, in the meantime, geometric and thematic accuracies;
4. the necessity to define a precise data model and all the sets of metadata describing the data itself;
5. the obligation to deliver such data (raw and thematic) using an interoperable schema, allowing maps multiple usage and/or re-usage, and avoiding redundancy and effort duplication.

In this paper, a state-of-the-art is briefly described, paying particular attention, in the second part, to the GIO-EMS new operational service delivered by the European Commission.

*Key Words: remote sensing, GIS, mapping, emergency management*

**Annalisa Cogo**

Biomedical Sport Studies Center, University of Ferrara, Ferrara, Italy  
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**Present position**

Associate Professor in Respiratory Diseases, Director of the Biomedical Sport Study Center, University of Ferrara, Italy.

1969: registered at the Medical School of the University of Milan, Italy.

1975: graduated in Medicine summa cum laude

Specialized in Respiratory Diseases (1978) and Respiratory Pathophysiology and Rehabilitation (1982)

1975-1980: Medical Assistant at the Department of Respiratory Diseases - University of Milan

1980-1993: Assistant Professor of Respiratory Diseases at the University of Milan

1993-2002: Assistant Professor of Respiratory Diseases at the University of Ferrara (Italy)

2002: Associate Professor of Respiratory Diseases at the University of Ferrara (Italy)

2005: Elected Director of Sports Biomedical Studies Centre, University of Ferrara, Italy.

**Professional expertise**

Respiratory pathophysiology, Chronic Obstructive Pulmonary Disease and Pulmonary Rehabilitation, Cardiopulmonary exercise test, High Altitude Medicine

**Research area**

Respiratory Diseases, Hypoxia, High Altitude, Exercise Training for patients suffering from chronic respiratory diseases.

**Teaching, University of Ferrara**

Sport and Exercise Science School, High Altitude Training, Respiratory rehabilitation, Exercise prescription for patients suffering from chronic respiratory diseases, Medical School, Respiratory Pathophysiology

**Impaired lung function due to biomass smoke exposure in non smokers high altitude dwellers**

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(1) Biomedical Sport Studies Center, University of Ferrara, Ferrara, Italy, (2) Department of Experimental Medicine, University of Milano-Bicocca, Milan, Italy, (3) Travel and Mountain Medicine Centre, Nepal International Clinic, Kathmandu, Nepal, (4) Department of Internal Medicine, University of Pisa, Pisa, Italy, (5) Institute Clinical Physiology, CNR-IFC, Pisa, Italy.

**E**xposure to biomass smoke is an additive risk factor for chronic obstructive pulmonary disease and early lung function impairment. We aimed to investigate the effect of biomass smoke exposure on lung function in a peculiar population, not exposed to other noxious particles such as cigarette smoke, traffic and industries pollution.

Respiratory function was assessed in 4 villages of Khumbu Valley (Nepal) where people use biomass fuels for heating and cooking, often without a chimney. We also measured the ventilation inside the houses (Ventilation Index [VI]= window + door surface/kitchen cubic meters), the environmental and exhaled carbon monoxide (ex CO) as a surrogate marker of indoor pollution. A total of 342 subjects performed acceptable and reproducible spirometry. We calculated the percentage of subjects with non-reversible bronchial obstruction (FEV1/FVC <0.70) and the percentage of subjects with an early impairment of lung function (FEF25-75 <65% of predicted). Note that in the last ten years indoor ventilation has been improved in the buildings of Pengboche, the village most frequented by trekkers.

The percentage of subjects with impaired lung function is reported for the 4 villages:

Thame 3900m 154 subjects (76M); Age 41.2 (14-84); FEV1/FVC<0.7 11.8%\*; FEF25-75<65% 25.3%\*; ex-CO na; VI 0.06±0.02. Phakding 2500m 58 subjects (24M); Age 34.8 (16-73); FEV1/FVC<0.7 11.7%\*; FEF25-75%<65% 15%\*; ex-CO 9.1±5.3 ppm; VI 0.08±0.07\* Pengboche, 3900m 92 subjects (43M); Age 32.9(14-70);FEV1/FVC<0.7 2.2%; FEF25-75<65% 8.6%; ex-CO 9.6±7.7 ppm; VI 0.12±0.07 Thamo 3700m 38 subjects (20M); Age 36.4(14-72); FEV1/FVC<0.7 15.7%\*; FEF25-75<65% 42%\*; ex-CO 13±8.1 ppm; VI 0.08±0.08\*

\* = p<0.05 compared to Pengboche

A significant inverse correlation was found between CO and VI (p <0.01). In 3 villages the percentage of subjects with nonreversible bronchial obstruction and early impairment of lung function was higher than expected in a general population. The only exposure to biomass smoke is a risk factor comparable to exposure to many harmful particles. Improvement in inside ventilation and in cooking stoves seems to reduce the lung function impairment.

**lyngararasan Mylvakanam**

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**M**ylvakanam lyngararasan is a project coordinator at United Nations Environment Programme (UNEP), responsible for implementation of UNEP Atmospheric Brown Clouds (ABC) programme and air pollution related activities, which brought the Short-Lived Climate Pollutant issue to the forefront. Prior to joining UNEP, he was heading the emerging environmental issues component of the UNEP Regional Resource Center for Asia and the Pacific (RRCAP).

He holds a Master of Engineering degree from School of Civil Engineering, Asian Institute of Technology, Bangkok, Thailand and a B.Sc. (Agricultural Engineering) from the University of Peradeniya, Sri Lanka.

**Environmental and socioeconomic impacts of climate change***I. Mylvakanam, United Nations Environment Programme, Kenya*

**A**fter more than a century of scientific studies on climate change, we have today a fair understanding of the cause and impacts of greenhouse gases (GHGs). We also have a good understanding on the impacts of Atmospheric Brown Clouds (ABCs) on climate change. Scientific studies suggest that impact of climate change on the three pillars of sustainable development (economy, environment, and society) is one of the greatest challenges facing humanity today. The 4th assessment report of the Intergovernmental Panel on Climate Change (IPCC) states that: "It is very likely that climate change can slow the pace of progress toward sustainable development either directly through increased exposure to adverse impacts or indirectly through erosion of the capacity to adapt." With increased understanding on climate change, linking the understanding and action with environmental and socioeconomic benefits is essential. Project Surya is an example. The improved cook stoves and solar light package, demonstrated by Project Surya, help reduce black carbon and other pollutants. The beneficiaries of Project Surya reported health benefits, while a satisfied user in Kenya reported a 60 percent reduction in expenditure on firewood and kerosene to cook and light her home since using the improved cooking-lighting system. Project Surya's cooking-lighting system has reduced climate forcers, reduced cooking time and provided more time for women to engage in productive activities, acquire new skills, fulfill other domestic responsibilities, or simply rest, and improved the health and financial standing of its users. This is an example for addressing the climate change with environmental and socioeconomic benefits. In order to bridge the gap between understanding and action, there is urgent need to promote Surya like projects with particular attention to environmental and socioeconomic benefits.

**Michael J. Gatari Gichuru**

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Senior Lecturer: Nuclear and Aerosol Science, University of Nairobi, Kenya

**Interests**

physical and chemical properties of atmospheric aerosols in the perspective of human health & climate change, teaching, nuclear safety and nuclear radiation spectroscopy methods in research and education, ionizing and non-ionizing radiation measurements and effects on human health, and scientific and nuclear instrumentation maintenance, principles and applications

**Student supervision**

Three PhD and 15 MSc students

**Education**

PhD, Environmental Science (Physics) at University of Sweden; Diploma: European Research Course on Atmospheres, Joseph Fourier of Grenoble University, France; Licentiate (MPhil) in Environmental Physics, Chalmers University of Technology, Sweden; Diploma in Nuclear Instrumentation, International Atomic Energy Agency, Austria; Higher Diploma in Electrical Engineering (Electronics), Kenya Polytechnic, Nairobi, Kenya; Diploma in Aircraft Electrical & Instruments, Royal Air Force College, United Kingdom.

**Research activities & grants**

UNEP Research Grant to assess Black Carbon levels at North West Slopes of Mt. Kenya (GAW Site Area); Group Leader/Investigator, Use of Nuclear Science in Kenyan Agriculture and Environmental Research, sponsor International Science Programme, Uppsala University, Sweden; Group Leader, Air quality Assessment contract in Nairobi Metropolitan area, Kenya; Co-Location Study, Evaluation of Black Carbon sampled in parallel on Glass Fibre and Teflon Filters.

**Mt Kenya ecosystem and impact of black carbon: implication to poverty and social economic dynamics in Kenya**

*M. J. Gatari Gichuru (1), G. R. Mwaniki (1), K. Thiongo (2)*

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**M**t. Kenya is the second highest mountain in Africa after Mt. Kilimanjaro and is one of three tropical Africa Mountains with glaciers at high altitudes. The ecosystem of this mountain is a major water source in Kenya that sustains a large human and animal population as well as water reservoirs. Its importance is better understood when one considers the dependence of the Kenyan economy on agriculture and tourism and the fact that over 60% of its population depends on small-scale farming and pastoral activities, besides supporting major hydropower generation stations. Sustainable conservation of its ecosystem is an asset to Kenya economic development and a necessity to achieve the Millennium Development Goals (MDGs) and Kenya Vision 2030. However, it continues to suffer environmental degradation through direct and indirect anthropogenic and natural causes. The glacier sizes have been receding since the late 19th century and accelerated in the 20th century by greenhouse forcing (Hastenrath, 2010). The indigenous water preserving the thick mountain forest saw an unprecedented degradation during the colonial era followed by increased deforestation for agriculture and afforestation especially after independence in 1963. The damage is today entrenched in the receding underground water and the reduced water volume in its rivers. Considering that the ecosystem of this mountain remains threatened under the pressure of increasing population (from less than 10 million inhabitant to the current 40 million in 50 years) in a country where less than one eighth of the land is arable and the climate variability induced degradation, studies to facilitate mitigation policies are required. An important study is that of black carbon and short-lived pollutants in the middle troposphere, which ABC-African intends to focus on.

*Key Words: water source, climate variability, short-lived pollutants, environmental degradation, economic development*

## SESSION - THE CARBON CREDITS MECHANISM

### **Stefania Proietti**

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In 2000 she obtained from the University of Perugia a bachelor of mechanical engineering degree, course of study "energy", in 2004 a Ph.D. in Industrial Engineering, in 2003 a II level master's degree in Management of Energy Systems. She was admitted to the Order of the Engineers of the Province of Perugia from 19/10/2000. Since 2000 she works at the University of Perugia about research on distributed generation, energy systems and emissions reduction, energy efficiency, with specialization in energy and carbon markets. Author of 40 scientific publications and patents holder in the energy sector, supervisor of thesis and PhD in engineering, coordinator of research projects and speaker at national and international conferences. Since 2001 she is also a freelancer, founder, owner and CEO of the engineering firm Engineering Service System srl. In 2005 she founded two spin-off of Perugia University. She is currently Chairwoman of the spin-off TREE Technologies for Emission Reduction Engineering srl (company focused on carbon management services, environmental impact reduction, ETS, energy and environmental markets). TREE is trader on European Emissions Markets (NASDAQ, EEX) and broker on the new voluntary market of Beijing Municipality in China (CBEXX platform).

In 2006, 2011 and 2012 she reported for the University of Perugia on technologies for reducing greenhouse gases to the UNFCCC. She was sustainability manager in International events (13th FINA World Championship–Rome 09, Meydan City FEI Open Endurance Championships, Perugia Green Days). Member of the WG GHG of UNI, in 2012 she is appointed national contact point by ISO TC 256 in Carbon Capture and Storage. She is carbon trader specialist for Asian Development Bank since 2012.

In 2010 she was nominated for the preparation of the 5th Assessment Report IPCC, receiving the appointment as peer reviewer of the draft reports of WGII (Impacts, Adaptation and Vulnerability) and of WGIII (Mitigation of Climate Change).

### **The carbon credit mechanism**

*S. Proietti (1), P. Sdringola (1)*

*(1) Department of Industrial Engineering, University of Perugia, Perugia, Italy*

With the Kyoto Protocol the regulatory approach with economic basis becomes an integral part of the strategies for reducing greenhouse gas emissions. The Protocol considers two kinds of actions that each Country decides to implement with its policies: implementation on the territory of measures to drastically cut emissions; the possibility of using some economic instruments (flexible mechanisms) as Joint Implementation, Clean Development Mechanism and the Emissions Trading System, the carbon credits market most developed today. Many countries, for example China and Brazil, are introducing or planning Emissions Trading Schemes and carbon credits markets at national, regional or city level. They are considering the development of carbon markets through cap-and-trade systems at various levels of government as one of the most important climate change mitigation instruments.

In addition to official initiatives carried out by national and international institutions, voluntary actions for the CO<sub>2</sub> emissions offsetting have spread worldwide giving rise to some real Voluntary Markets.

In the framework of policies for climate change mitigation and promotion of a sustainable development, the voluntary carbon credits markets have introduced interesting opportunities. A farmer and/or a forestry contractor and/or a landowner could obtain revenues from the sale of carbon credits, related to specific interventions aimed to increase the carbon stock in the biomass.

A smart agriculture project for carbon credits exchange has been developed. It aims at the definition of a local voluntary market of carbon credits, with the creation of a trading platform and the definition of agreements designed to reduce/offset the emissions through the purchase of credits related to agriculture and forestry sectors. The overall objective is to promote a local market of carbon credits in order to stimulate the virtuous exploitation of soils and the maintenance of the territory against climate changes.

*Key words: carbon credits, carbon market, CO<sub>2</sub> emissions, sustainability, mitigation*

## SESSION - MARKET BASED MEASURES FOR ENVIRONMENT

### **David Molden**

International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal  
(dmolden@icimod.org +977-1-5003222 Ext. 201)

**D**avid James Molden joined ICIMOD as Director General with effect from December 2011. He is a development specialist with more than 30 years of experience in designing, planning, executing, and monitoring programmes on water management, livelihoods, environment, and ecosystem services. Prior to joining ICIMOD he was the Deputy Director General for Research at the International Water Management Institute (IWMI) based in Sri Lanka. He has worked in several Hindu Kush-Himalayan countries, including China, India, Nepal, and Pakistan, and has experience in projects in the Indus, Ganges, Yellow, Mekong, Yangtze, and Amu and Syr Darya river basins. He has acquired considerable management experience in a number of positions, including Chief of Party for the Irrigation Management Project in Nepal, Chief of Party for a water resources strategic research program in Egypt, and Leader of the multi-institute Comprehensive Assessment of Water Management in Agriculture programme.

Molden was awarded a PhD in Civil Engineering from Colorado State University in 1987 specializing in water resources, and has since developed broader interests in integrating social, technical, and environmental aspects of natural resources management. He has contributed to the publication of nearly 200 works in books, refereed journals, research and project report series, the media, and educational materials. He has received many awards including the Outstanding Scientist Award of the Consultative Group on International Agricultural Research (CGIAR) in 2009.

### **Mountain based opportunities in the Hindu Kush Himalayan region**

*D. Molden (1), B.S. Karky (1), N. Bisht (1)*

*(1) International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal*

**T**he Hindu Kush Himalayan (HKH) Mountains are an important global resource, providing goods and services to people living in the HKH region (210 million) and those living downstream (1.3 billion). They are a rich repository of biodiversity and ecosystem services. During recent years, rapid population growth, urbanization, migration induced feminization of the landscape, economic development, and climate change have begun to pose challenges to traditional livelihood strategies and coping mechanisms. Once self-sufficient people now face dire economic poverty. Degradation of forests, wetlands, agricultural lands, and rangelands threatens livelihood and biodiversity contained in these ecosystems.

Faced with this rapid decline, a growing emphasis is placed on finding appropriate economic tools to provide incentives to aid conservation efforts and sustainable use of biodiversity. Introducing market-based mechanisms to ensure the management of ecosystems and delivery of ecosystem services are seen as potential solutions.

Market based choices for the HKH region includes value chain development, niche products and value-added services. The presentation covers ICIMOD's experiences in finding economic incentives for conservation, livelihoods, adaptation and mitigation. These include REDD+ pilots in Nepal and Pakistan, payment for ecosystem services (PES) schemes, benefit sharing programmes in the hydropower sector, and ecotourism approaches that enhance local livelihoods through cultural and environmental conservation. These market based approaches will require testing, documentation, learning, communication and out scaling to reach their potential.

**Stefania Proietti**

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In 2000 she obtained from the University of Perugia a bachelor of mechanical engineering degree, course of study “energy”, in 2004 a Ph.D. in Industrial Engineering, in 2003 a II level master’s degree in Management of Energy Systems. She was admitted to the Order of the Engineers of the Province of Perugia from 19/10/2000. Since 2000 she works at the University of Perugia about research on distributed generation, energy systems and emissions reduction, energy efficiency, with specialization in energy and carbon markets.

Author of 40 scientific publications and patents holder in the energy sector, supervisor of thesis and PhD in engineering, coordinator of research projects and speaker at national and international conferences. Since 2001 she is also a freelancer, founder, owner and CEO of the engineering firm Engineering Service System srl. In 2005 she founded two spin-off of Perugia University. She is currently Chairwoman of the spin-off TREE Technologies for Emission Reduction Engineering srl (company focused on carbon management services, environmental impact reduction, ETS, energy and environmental markets). TREE is trader on European Emissions Markets (NASDAQ, EEX) and broker on the new voluntary market of Beijing Municipality in China (CBEX platform).

In 2006, 2011 and 2012 she reported for the University of Perugia on technologies for reducing greenhouse gases to the UNFCCC. She was sustainability manager in International events (13th FINA World Championship–Rome 09, Meydan City FEI Open Endurance Championships, Perugia Green Days). Member of the WG GHG of UNI, in 2012 she is appointed national contact point by ISO TC 256 in Carbon Capture and Storage. She is carbon trader specialist for Asian Development Bank since 2012.

In 2010 she was nominated for the preparation of the 5th Assessment Report IPCC, receiving the appointment as peer reviewer of the draft reports of WGII (Impacts, Adaptation and Vulnerability) and of WGIII (Mitigation of Climate Change).

**Smart agricultural for carbon credit exchange**

*S. Proietti (1), P. Sdringola (1)*

*(1) Department of Industrial Engineering, University of Perugia, Perugia, Italy*

In the framework of policies for climate change adaptation and for promotion of an integrated sustainable development, the voluntary market for the offsetting of CO<sub>2</sub> emissions introduces interesting opportunities for the primary sector. A farmer and/or a forestry contractor and/or a landowner could obtain revenues from the sale of carbon credits, related to specific interventions aimed to increase the carbon stock in the biomass.

In this context, present project aims at the definition of a local voluntary market of carbon credits, with the creation of a trading platform and the definition of agreements designed to reduce/offset the emissions through the purchase of credits related to agriculture and forestry sectors. The overall objective of the project is to promote, on a voluntary basis, a local market of carbon credits in order to stimulate the virtuous exploitation of soils and the maintenance of the territory in the context of policies against climate changes.

The project idea proposes to structure a local micro-market where:

- Demand is represented by the subjects who want to calculate and reduce their environmental footprint through offsetting transactions.
- Supply is guaranteed by small local farmers, who grow carbon sink crops generating removal units (or RMUs) type credits.

Carbon credits may be enhanced through the recognition in a specific Register of agro-forestry Carbon Sinks and the subsequent sale on a specific IT platform.

Added value will be the involvement of local partners to ensure a high degree of transparency in the mechanisms of recognition, quantification and trading of carbon credits. Farmers and small operators will be directly connected to trading operations by the use of a dedicated ICT application, e.g. every farmer may access to his own “carbon account” through a mobile phone, enhanced with an app for operating into the market; offers could be made for the available RMUs, quantified and verified by specialized technicians.

*Key Words: carbomarket, emissions, resilience, sustainability, adaptation*



# POSTER SESSION

## SESSION CLIMATE

**Farhan Saleem** (*Government College University*) – Prevailing patterns of temperature extremes in the semi-arid regions of Punjab, Pakistan

**Barbara Frigo** (*Politecnico di Torino*) – The influence of extreme snowfall on snow avalanche impact pressure

**Shahid Muhammad Zeeshaan** (*Chinese Academy of Sciences*) – Simulation of the aerosols over Pakistan using WRF/Chem Model

## SESSION MOUNTAIN ECOSYSTEMS

**Simone Orsenigo** (*University of Pavia*) – Effect of the extreme heat-waves on populations of alpine plants in the N-Apennines (Italy)

**Efrem Ferrari** (*University of Padua*) – Forest biomass assessment in isolated mountain areas through remote sensing

**Narayan Prasad Gaire** (*NAST*) – Tree-line dynamics with climate change in Nepal Himalaya

## SESSION CRYOSPHERE

**Danilo Godone** (*University of Turin*) – Recent changes of some selected Chilean glaciers as a contribution to understand Climate Change impacts on the Cryosphere

**Antonella Senese** (*University of Milan*) – Defining the influence of sparse supraglacial debris on ice albedo: an experiment at the Forni Glacier (Central Italian Alps)

**Vittoria Paramithiotti** (*Politecnico di Milano*) – Assessing hydrologic components of a glaciated catchment in the central Himalaya

## SESSION WATER

**Andrea Soncini** (*Politecnico di Milano*) – Future hydrological regimes under climate change scenarios in the Upper Indus Basin: the case study of the Shigar river.

**Silvia Zaupa** (*CNR – ISE*) – Climate change impacts: hypothesis on the role of mountain lakes biology

**Nitesh Shrestha** (*Tribhuvan University*) – Climate change and its impact on the flow regime of rivers of Nepal

## SESSION ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

**Silu Bhochhibhoya** (*University of Padua*) – Potential of reducing greenhouse gas emission through thermally efficient building in high altitude of Nepal

**Amrit Poudel** (*Environment Department*) – Micro/Mini hydro technology as a climate change mitigation strategy in Nepal

**Rodney Garrard** (*University of Bern*) – Land use dynamics in Sagarmatha National Park, Nepal: linking spatial research tools and social science in the study of the driving forces of land use and land cover change

**Michèle Curtaz** (*Fondazione Montagna Sicura, Italy*) – ALPLINKS – Analysis of potential development of a mobility integrated system in the area Cervino – Monte Rosa



# POSTER SESSION ABSTRACTS

## SESSION CLIMATE

### **Prevailing patterns of temperature extremes in the semi-arid regions of Punjab, Pakistan**

*F. Saleem (1), F. Abbas (1), M. Adrees (1)*

*(1) Department of Environmental Sciences, Government College University, Gilgit, Pakistan (saleem\_farhan@gmail.com)*

Global mean temperature have continued to raise over the last decades. The spatial and temporal patterns of temperature extremes were investigated in this study during the historical period of 1981-2010 by collecting the maximum and minimum temperature data on daily basis from the five weather stations (Multan, Bahawalnagar, Faisalabad, Sargodha and Rawalpindi respectively) located across the semi-arid regions of Punjab, Pakistan. RCLimindex software developed by the Expert Team on Climate Change Detection Monitoring and Indices (ETCCDMI) was used for data quality assessment and calculation of temperature indices. Mann-Kendall Test and Sen's Slope Estimates were used to find significance of the temperature patterns. Over the analysis period, the regionally averaged occurrence of extreme cold (10th percentile) nights and days has decreased by – 3.94 nights/decade and – 0.61 days/decade, respectively. Occurrence of extreme hot (90th percentile) nights and days has respectively increased by 4.19 nights/decade and 0.92 days/decade. Summer days have increased for all cities at a regional average of 3.04 days/decade except for Multan; excluding the decreased days for Multan, the summer days increased by almost 5 days/decade for the region. Regionally averaged increase in tropical nights was 8.35 nights/decade. Regional warming will dictate increased crop water requirements in this semi-arid region of Punjab, agriculture of which is already under water scarce conditions especially in Faisalabad district where saline ground water not suitable for crops.

*Key words: regional warming, temperature indices, semi-arid Punjab, RCLimindex*

## The influence of extreme snowfall on snow avalanche impact pressure

*B. Frigo (1), B. Chiaia (1), V. De Biagi (1)*

*(1) DISEG - Politecnico di Torino, Torino, Italy (barbara.frigo@polito.it)*

Any structure, or structural element, shall be designed to perform adequately under expected actions, to withstand extreme actions, but not to be damaged by extreme natural events to an extent disproportionate to the original cause (International Organization for Standardization, 1998). Neglecting the permanent loads, the choice between variable and accidental is related to site conditions. For example, in US tornado are contemplated as variable actions and, similarly in EU, earthquakes are considered as variable actions: for each site, a ground motion intensity is related to the probability of occurrence of the natural event and, thus, a probabilistic approach to the design of the construction is possible. The loads imposed by snow avalanche are considered as accidental; independently from the geographical area the structure is built. Buildings and other structures shall be classified, based on the risk to human life, health, and welfare associated with their damage or failure by nature of their occupancy or use (American Society of Civil Engineers, 2010). This concept is a direct consequence of the risk analysis: the greater the exposure, the higher the risk. For this reason, a temporarily occupied construction has to be designed for load magnitudes lower than the ones of highly occupied building. Regulations to construct buildings in snow avalanche hazardous areas act in the land planning way based on the impact avalanche pressure against an obstacle. The estimated pressure is calculated on an real o probabilistic avalanche originated from a 1000, 300 or 100-years maximum of three days snowfall in the starting zone at different altitudes. In a probabilistic framework, the paper is analyzed the variation of avalanche impact pressure related to the increase of snowfall periods and intensity verified in the last 5 years.

## Simulation of the aerosols over Pakistan using WRF/Chem Model

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Air Pollution and climate change is serious challenge of developing countries like Pakistan. To study the impact of different air pollutants on climate, PM<sub>2.5</sub> (Particles with an aerodynamic diameter of 2.5  $\mu\text{m}$  or less), Black Carbon (BC), Nitrate ( $\text{NO}_3^-$ ) and Sulphate ( $\text{SO}_4^{2-}$ ) are simulated using the Weather Research and Forecasting, Chemistry (WRF/Chem) model over Pakistan. The simulation of the temporal variation and spatial distribution of the concentrations of black carbon (BC), sulfate ( $\text{SO}_4^{2-}$ ), nitrate ( $\text{NO}_3^-$ ) and particles with an aerodynamic diameter of 2.5  $\mu\text{m}$  or less (PM<sub>2.5</sub>) were conducted with weather research forecasting model coupled with chemistry (WRF-Chem model) over Pakistan. The uncertainties of the model were evaluated by comparing with the observed data. The temporal variations and spatial distribution of the concentrations PM<sub>2.5</sub>,  $\text{NO}_3^-$  and BC were significant over north eastern and central Pakistan and less significant in southern Pakistan. We compared simulation results with observed data over two largest cities of Pakistan, Lahore (Lat 31°32'N Lon 74°22'E) and Karachi (Lat 24°53'N Lon 67°00'E). Concentration of PM<sub>2.5</sub>, BC,  $\text{NO}_3^-$  and  $\text{SO}_4$  were much higher over Lahore and lower in Karachi. These two cities have strongly influence by meteorological conditions. Lahore is under the influence of transboundary air pollution that contributes to increase the PM and BC concentration. One of major air pollution sources is Indian coal-based thermal power plants which consume thousands of tons of coal daily and emit tons of sulfur dioxide, black carbon etc which plays a key role in climate change. In Karachi, PM, BC,  $\text{NO}_3^-$  and  $\text{SO}_4^{2-}$ , these four pollutants were mainly from the local sources.

## SESSION MOUNTAIN ECOSYSTEMS

### Effect of the extreme heat-waves on populations of alpine plants in the N-Apennines (Italy)

*S. Orsenigo (1), T. Abeli (1), A. Mondoni (2), P. Cristofanelli (3), M. Gandini (2), P. Bonasoni (3), G. Rossi (1).*

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Future climatic models show an alarming increase in occurrence and severity of extreme climatic events, such as heat waves (HWs) and drought. Studies on climate extremes are still an emerging research field in ecology. First evidences show that plants are heavily damaged by HWs, both directly through the effect of extreme temperature, and indirectly through the effects of drought and exposure to high ozone concentration. Here we investigated the effects of HWs on alpine species from Northern Apennines. In a first study we analysed the impact of extreme summer temperatures on reproductive performance (flowering abundance and biomass) of two orophytic species, *Alopecurus alpinus* and *Vicia cusnae*, during period 1999-2004, focusing on their response to HWs occurred in 2003. We observed a decreasing number of flowering stems and flowers per flowering stem for both species. Extreme weather negatively affects species survival, in particular flower production, while vegetative growth remained unchanged. Hence, HWs may induce changes in species' reproductive strategies. In the second experiment we investigated the effects of HWs on seed germination of 55 species. Freshly collected seeds were exposed to different climatic scenarios in lab, derived from air temperature measurements taken in the field. The incubation conditions simulated 1) the mean weekly T of the study area, 2) HWs occurred in summer 2003 and 3) HWs occurred in autumn 2011. Preliminary results show that, in absence of anomalous heating, most of the species germinated in spring. Conversely, the autumn HWs increased seed germination in almost 50% of the species tested. These preliminary results, demonstrate that even short heating periods in autumn can shift germination from spring to autumn in several alpine species. The extent of this change across species might be driven by seed dormancy status. As a consequence, autumn-germinated seedlings might be exposed to risk of winter frost, affecting their survival.

## Forest biomass assessment in isolated mountain areas through remote sensing

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Even though declining, deforestation and forest degradation are continuously threatening mountain ecosystems especially in the developing countries. Lack of information on forest resource availability, poor management guidelines and illegal logging are posing a serious threat to highly valuable ecosystems (for biodiversity conservation, soil protection, hydrological cycle, subsistence of local communities among others). In remote mountain areas, with limited accessibility and rough morphology, remote sensing techniques represent a precious tool to assess forest resources availability, readily and in a cost efficient manner. Here, an example of its application for the Central Karakorum National Park (Pakistan) is presented. The methodology applied involves the use of Landsat imagery with a 30x30 meters resolution, field surveyed calibration plots and the collection of validation points throughout the entire study region. A topographic correction algorithm for the rough morphology was implemented together with the use of vegetation indices (NDVI) and classification algorithm for the development of land cover. Successively, the assessment of forest Above Ground Biomass and increment at pixel level were performed. The results highlight a strong declining gradient in forest area and biomass by moving from the South Western (partially influenced by the monsoon) to the North Eastern valleys which are characterized by a more continental and relatively drier climate. This general trend is also consistent for forest biomass increment. This information is fundamental for forest management: indeed, only if annual wood harvested by local communities equals or is less than the forest increment, sustainable forest management can be achieved.

## Tree-line dynamics with climate change in Nepal Himalaya

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Climate change has several biological finger prints. The high altitude natural tree lines are sensitive biomonitors of past and recent climate change and variability, and also taken as early warning line to the climatic impacts on high altitude biota. We carried out a dendroecological study at the tree-line ecotones of Mt Everest, Mt Langtang and Mt Manaslu regions of the Nepal Himalaya with the aims to assess the impact of climate change in the tree-line ecotones, and reconstruct the past environmental history of the region. Two to three vertical belt transects plots (20m wide and >100m length) were laid down in each treeline site. Using both ecological and dendrochronological tools, climatic response on radial growth and regeneration, recruitment and dynamics of *Abies spectabilis* D. Don and *Betula utilis* D. Don were analyzed. The tree density, basal area, DBH, height, and age decreased with increasing elevation though with spatial heterogeneity. High regeneration of *Abies* as compare to *Betula* was observed recently. The tree core analysis showed that *B. utilis* was established earlier than *A. spectabilis*. The upper distribution limit shift of *A. spectabilis* at studied sites was found 1.56m to 3.6m per year. Correlation between site chronologies of *Abies* showed a positive relationship indicating some common factors limiting the growth of the tree. Tree growth-climate and regeneration-climate relationship showed that warm winter and moist summer favored the regeneration of *Abies*. Infilling of existing treeline as well as upward shifting of treeline was observed. Population demography and climate growth response indicated that both of the species had species specific response to climate change with much wider differences anticipated in the population status of the species as climate continues to change throughout the century.

## SESSION CRYOSPHERE

### Recent changes of some selected Chilean glaciers as a contribution to understand climate change impacts on the Cryosphere

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In year 2012 a multidisciplinary research group, under the framework of the “Plan de Acción para la Conservación de Glaciares ante el Cambio Climático” project managed by the Ev-K2-CNR Committee and the DGA (General Water Department) of the Chilean Government, carried out several investigations devoted to analysed some representative Chilean glaciers. The main purposes of the project were: i) developing a monitoring strategy and a measurement network to evaluate glacier short term variations, describe supraglacial meteorology and energy fluxes and assess meltwater resource availability ii) giving the fundamental technical and scientific know-how to personnel from DGA to continue these activities over time iii) developing a data base including all the collected data and information. The project team was composed by researchers and technicians giving the different skills needed to perform the program (i.e.: glaciology, mountain hydrology, climatology, remote sensing, geophysics, etc..). The field activities were performed in glacierized areas of the Chilean Patagonia (i.e.: Tyndall, Exploradores and San Rafael glaciers) and of the Andean chain (i.e.: San Francisco, Echaurren Norte and Piramide glaciers). On these glaciers ablation stake networks were installed and the measurements were repeated during the hydrological year; Ground Penetrating Radar and geophysical inspections were performed coupled with GNSS investigations. The EvK2CNR team also gave guidelines and best practices to install and maintain Automatic Weather Stations (AWSs) and hydrological stations on glacierized areas based on the expertise from the SHARE project and from the GEUS Greenland monitoring network. Through AWS data analysis the energy budget (and then the melting amount) of some glaciers was evaluated. Moreover our analysis also took advantage from remote sensing surveys and GIS data processing. Then by comparing LIDAR data (surveyed in 2011 by DGA) with SRTM and/or ASTER DEMs the volume changes of some selected glaciers (i.e.: Juncal Norte, Juncal Sur, Olivares Gamma, Olivares Beta, Olivares Alfa, Palomo, Cipreses, Cortaderal, Universidad glaciers) were assessed. By the employment of MODIS satellite time series (2007-2011) snow cover duration and extent was assessed in 18 mountain basins.

## Defining the influence of sparse supraglacial debris on ice albedo: an experiment at the Forni Glacier (Central Italian Alps)

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Recently, evidence for significant tongue darkening on retreating glaciers has been drawing increasing attention. This peculiar surface phenomenon in part depends on the exposure of ice surface to layers of dust and coarser rock debris. The consequent effect is a remarkably decreasing of albedo, due to the presence of light absorbing particles. In spite of the abundant literature dealing with dust and black carbon deposition on glacier accumulation areas, few studies are available that describe the distribution and properties of fine and discontinuous debris at the melting surface of glaciers. Furthermore, guidelines are needed to standardize field samplings and lab analyses thus permitting comparisons among different glaciers. In this work, we propose a method to describe sparse debris coverage at the glacier melting surface and its relation with ice albedo. For this purpose we developed a protocol to sample fine and sparse supraglacial debris, quantify its surface coverage (through image analyses), describe its sedimentological properties, measure ice albedo (by a portable net radiometer) and identify the relationship between albedo and debris coverage. The procedure was tested at the surface of Forni Glacier (Italian central Alps), in summer 2011 and 2012. The variation of albedo is discussed on the basis of dust distribution, showing an exponential correlation with the percentage of debris-covered ice surface ( $y = 0.22e^{-0.01x}$ ). The origin, grain-size and color of sediments controlled by mineralogical properties and degree of weathering are investigated. Moreover, dust evolution during the melting season was analyzed. It resulted that the presence of water plays a relevant role in determining ice albedo. The fine debris presents marked variability, increasing its surface coverage from the beginning to the end of summer and thus influencing ice albedo. The rock debris has generally a local origin (from nesting rockwalls) and the organic content is high, suggesting that further analyses are required to describe its sources.

This work was conducted in the framework of the SHARE Stelvio Project, funded by Regione Lombardia and managed by FLA (Fondazione Lombardia per l'Ambiente) and Ev-K2-CNR Committee. The AWS1 Forni project is developed under the umbrella of the SHARE (Stations at High Altitude for Research on the Environment) Project, developed and managed by the Ev-K2-CNR Committee.

### **Future hydrological regimes under climate change scenarios in the Upper Indus Basin: the case study of the Shigar river**

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The mountain regions of the Hindu Kush, Karakoram and Himalaya (HKKH) are the “third pole” of our planet. Water from glacier and snow melt especially in the dry season play an essential role for agriculture, human consumption, and hydropower production. Recent dynamics of glaciers in the Karakoram is not clearly assessed hitherto, and in the last decade substantially unchanged ice cover area was seen, against noticeable area loss worldwide, i.e. the so called “Karakoram anomaly”. Thenceforth the great need for assessment of future water resources, and hydrological variability in this area. Our study is carried out under the umbrella of the SHARE-Paprika project, aiming at evaluating the impact of climate change upon hydrology of the upper Indus river. We focus here on a particular watershed, the Shigar river close to Shigar, with an area of about 7000 km<sup>2</sup>, nested within the upper Indus basin, and fed by seasonal melt from two major glaciers (Baltoro and Biafo), with an ice covered area of about 1200 km<sup>2</sup>. In this study we use hydrologic and glaciological data gathered during recent (2011-2013) field campaigns. Based upon these data, plus topographic information, historical climate data and remote sensing data of ice and snow cover, we set up a semi-distributed hydrological model, providing acceptable depiction of in stream flows and snow and ice cover dynamics. We then use this model to assess the potential variation of the hydrological cycle until the end of the century (2100) in this area, by feeding our hydrological model with future precipitation and temperature (locally adjusted using downscaling) from three general circulation models from IPCC AR5: EC-Earth, CCSM4 and EcHam6 (RCP 2.6, 4.5 and 8.5). The projected flow duration curves, some selected flow descriptors, and the significance of modified flow regimes in the Shigar river are then evaluated. We also evaluate possible scenario upon snow cover, ice ablation and implications for future water resources and flood regime.

## Climate change impacts: hypothesis on the role of mountain lakes biology

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Remote lakes are pristine ecosystems able to support a biodiversity specialized to endure prolonged low temperatures, high daily thermal fluctuation, and scarce resources. Freshwater ecosystems in remote regions are particularly important because they are often threatened by pollution and climate change causing biodiversity losses, or significant changes in community composition. Recently, the CNR-ISE has been involved in research conducted within the Stelvio National Park to monitor some lakes using macroinvertebrates and diatoms, two of the major sensitive quality indicators, and chemical characteristics. The final aim of the study is to promote conservation practices of water resources and highlight the related ecosystem services which need to be prioritized in the international context of the promotion of sustainable development under climate change impact. Macroinvertebrates and diatoms live on submerged substrata, and hence are particularly subject to climatic, environmental, but also to sediment variability. For this reason, and for their ability to integrate information from different sources, since the late '70s, they were used in bio-monitoring programs to test the effectiveness of water resources management and of conservation measures. In this context, samples were collected in different areas of the Stelvio National Park on 9 lakes, following a European wide standardized sampling protocol, through littoral handle netting, direct stones brushing, and outflow water sampling. Results on macroinvertebrates showed a clear shift in community composition between very high and less high altitude lakes caused by the recent origin of the first ones, while water chemistry data revealed an extremely high variability of chemical composition, even in very limited areas. Among the many results obtained, two attractive case studies are shown: L. Bianco (Gavia mountain Pass) and L. Rosole (Forni Glacier), both relevant for testing the hypothesis of climate change effects.

## Climate change and its impact on the flow regime of rivers of Nepal

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Climate Change and its impact on the Flow Regime of Rivers of Nepal Climate changes during last decades have found the reflection in increase in frequency and intensity of precipitation along with seasonal change in the flow regime of rivers. This study targets to identify the change in the climate of Nepal and its impact on the river. The daily temperature and rainfall data of seven stations covering different physiographic regions of Nepal were analyzed which covers the period from 1980 to 2009. Trends of temperature and precipitation extremes have been investigated using the temperature and precipitation indices of climate extremes using software Rclimdex developed by CLIVAR under WMO. Blockwise use of TOP model with Muskingum-Cunge method (BTOPMC) was used to simulate daily flows for different climate scenarios. The scenarios comprised of temperature increment of 0.0C to 3.0C and rainfall increment of 0% to 50%. An increasing trend has been observed in temperature extremes. Most of the temperature extremes showed an altitudinal distribution which means the trend of temperature indices were higher in higher altitude. Days and nights were becoming warmer and both cool days and cool nights were found to be less frequent phenomena. Long-term mean and maximum flows were found to be increased with increase in either temperature or rainfall while minimum flows were found to be reduced with increase in temperature. The monthly analysis of the simulated flows with increase in temperature revealed the stream flows decreased in dry season (February to June) while it increased in the remaining seasons. The increase in deficits and surpluses were not in linear with increase in temperature. These impacts are likely to be of concern to water managers to assure access to fresh water in dry season and to safeguard lives and properties from increased floods in wet seasons.

## Assessing hydrologic components of a glaciated catchment in the central Himalaya

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The Hindu-Kush Karakoram and Himalaya (HKKH) mountains are the water towers of Asia, as they deliver water to nearly half of the world's population. Despite so, it is mostly unclear what is the relative contribution of rainfall, snow and ice-melt to hydrological fluxes in this area. Here, we study the Dudh Kosi River catchment (450 to 8848 m asl, ca. 4000 km<sup>2</sup>) in central Nepal, including the Khumbu glacier at Mt. Everest's toe. Two critical components for predicting hydrologic fluxes in steep mountain ranges are: (1) accurate information of energy and mass fluxes, especially at high altitudes, and (2) depiction of rainfall and snowfall amount and dynamics. In this study, we use a combination of unique ground-control data and remote-sensing data to provide realistic hydrologic modeling boundary conditions. We primarily relied on and validated (1) Moderate Resolution Imaging Spectroradiometer (MODIS) product MOD11/MYD11, to calculate day/night land surface temperatures and monthly lapse rates; (2) Tropical Rainfall Measurement Mission (TRMM) 3-hourly rainfall data from TRM M product 3B42 with 0.25\_ x 0.25\_ spatial resolution; and (3) MODIS product MOD10/MYD10 to derive daily snow covered areas. Ground-control data are derived from high altitude stations provided by the Ev-K2-CNR Committee of Italy, as well as from data of the Department of Hydrology and Meteorology (DHM) at lower elevations. We model hydrological run-off processes with a semi-distributed, altitude-belt based model. While the validated remote-sensing data generally provide good agreement with station data, snowfall component is not well depicted. We rely upon a correlation of precipitation with altitude combined with snow depth measurements at the EV-K2-CNR Pyramid (5050 m asl) to evaluate snowfall contribution. We use a degree-day approach and explicitly treat debris coverage on ice and snow. Our preliminary results indicate that approximately 20% of annual discharge is derived from snow and ice melt. Ice melting is highest during the late summer season, when air temperature and solar radiation exert a strong forcing upon snow free ice. Our combined approach of remote-sensing and ground-control stations provide realistic hydrologic-modeling parameters that can be used for predicting water resources in this sparsely-monitored region.

### **Potential of reducing greenhouse gas emission through thermally efficient building in high altitude of Nepal**

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**T**hermally efficient building is one of the significant technologies to conserve energy and cope with climate change. The energy for space heating can be reduced by using thermally efficient insulation tile in the building and thereby huge amount of greenhouse gases could be reduced. Houses in the mountain regions can be built using this principle because the long season of cold weather in these regions demands high amount of energy for space heating. Well insulated energy – efficient building construction methods could be the key mitigation measures to reduce greenhouse gas emission and to improve the quality of life of local people. This help to reduce the heating needs through fire-wood, dung and other fuels. Thus the study has been done on the insulation tile which are made up of locally available material like white soil (Kamero), cow dung and waste product like paper, plastic, wooden grain. The thermal conductivity of bio-tiles with different materials and ratio are tested in Thermo-Box. The comparison of different bio-tiles are made in terms of its thermal efficiency and cost effectiveness. Furthermore, the amount of greenhouse gas emission reduction by using bio-tiles is studied. This research is mainly deals the thermal efficiency of insulation tiles and its efficacy on reducing greenhouse gas emission in the high altitude of Nepal.

## Micro/Mini hydro technology as a climate change mitigation strategy in Nepal

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Decentralized energy technology like micro/mini-hydro is being one of the tools to climate change mitigation strategy and to ensure energy security in developing countries like Nepal. The technology has been one of the most successful models for the production of clean, environmental friendly and cost effective energy in Nepal with the participation of local communities. The ownership of micro/mini-hydro in Nepal is either by small groups of individuals or by communities. In recent years, with micro-hydro being promoted by different agencies, the share of community-owned and-managed micro/mini-hydro is increasing. The success of micro/mini-hydro and interest of communities in it has two underlying implications to mitigation and adaptation to climate change at the local level. The first implication is that micro/mini-hydro, as a source of renewable energy, contributes to replacement of conventional sources of energy that ultimately lead to reduction in greenhouse gases. The second implication is that it provides an opportunity for better livelihoods and improved resiliency to disaster and climate change in rural areas. Micro/mini hydro technology is the second Carbon project for renewable energy technology promoted by the Nepalese government. The government with the Third Year Interim Plan (2007-2010) has initiated the development of micro-hydro schemes as a Clean Development Mechanism (CDM) project activity. The government is able to list the micro/mini-hydro technology as a CDM project by registering in the United Nations Framework Convention on Climate Change. The estimated emission reduction potential of Micro/mini-hydro as a CDM project is 2.3 tones of CO<sub>2</sub> equivalent per kilowatt of generated power per year. This opportunity of carbon market may support in further development and promotion of the technology in the rural areas of the country, which will not only increase access to decentralized energy but also supports in the sustainable development.

**Land use dynamics in Sagarmatha National Park, Nepal: linking spatial research tools and social science in the study of the driving forces of land use and land cover change**

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**T**his landscape-scale study combines multi-temporal satellite imagery spanning 20 years, ground-based repeat photography spanning 60 years, and information from field studies extending over 4 years to assess the extent and causes of land use and land cover change in Sagarmatha National Park and Buffer Zone. Agriculture, livestock herding, forests, settlements, glaciers, culture, and tourism have all experienced rapid change in their structure, extent, and interactions especially over the past 30 years in response to a variety of institutional, economic, political, cultural, climatic, and demographic processes. Land use patterns and processes are explored through a complementary application of interpretation of satellite imagery, photographic monitoring and case study analysis that explicitly addresses local-regional spatial scale change over a time frame appropriate to the identification of fundamental causal processes. The results illustrate that this combination provides an effective basis for describing and explaining patterns of land use and land cover change and their root causes in a UNESCO World Heritage Site with a rapidly evolving socio-economic context.

## **ALPLINKS – Analysis of potential development of a mobility integrated system in the area Cervino – Monte Rosa**

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**T**he region of Cervino (Matterhorn) and Monte Rosa massif is a major and most attractive ski resort in the Alps, thanks to the great mountain landscape: Zermatt (Switzerland), Cervinia (Italy) and Monterosa Ski (that joins the Italian valleys of Ayas, Gressoney and Alagna-Valsesia). Moreover, a great part of this area is covered by glaciers, that affects positively snow distribution. Nevertheless, the connection between these areas is difficult because of the great elevation of the boundary peaks. In order to improve the flow of the skiers and pedestrians between Zermatt and Matterhorn area, a new large cableway is currently under planning, meaning a great financial investment. The project ALPLINKS – Analysis of potential development of a mobility integrated system in the area Cervino – Monte Rosa (cross-border cooperation programme Italy - Switzerland) rises from the needs of the municipalities to assess the new opportunities coming from an extension of the transport connections, including the Monte Rosa resort. The project aims at analyzing the impacts for the territories involved in a complete and integrated way, also considering the sustainability of this development. By the consequence, a multimodal transports master plan will be defined, including a socio-economical analysis and a cost-benefit analysis of investments. The plan will also be supported by an environmental analysis of ice-snow conditions. Recent evolution of glaciers and snow cover will be taken into account in order to define which scenarios could give the best performance as well as implement the value of the areas by means of their integration. Furthermore, as the expected impacts are significant, these studies will be coupled to information and consultation initiatives addressed to population and local stakeholders, in order to raise awareness about this connection project and the possibility of economical increase and development of new activities coming from this link.



# INDEX OF AUTHORS

	pag.
Bhupesh Adhikary	14
Teodoro Adrisano	38
Vincenzo Artale	13
Raffaella Balestrini	16
Alberto Basset	23
Martin Beniston	10
Silu Bhochhibhoya	64
Pietro Boccardo	44
Daniele Bocchiola	34
Bodo Bookhagen	36
Dinesh Bhuju	21
Gregory R. Carmichael	12
Annalisa Cogo	45
Michèle Curtaz	67
Hildegard Diemberger	43
Efrem Ferrari	56
Barbara Frigo	53
Sandro Fuzzi	11
Narayan Prasad Gaire	57
Rodney Garrard	66
Michael Gatari	47
Marino Gatto	22
Danilo Godone	58
Mauro Guglielmin	29
Ethan Gutmann	32
Andrea Lami	35
Mylvakanam lyngararasan	46
Ashiq Ahmad Khan	40
Yaoming Ma	28
Valter Maggi	27
Franco Mari	37
David Molden	20 and 49
Simone Orsenigo	55
Thomas Painter	30
Vittoria Paramithiotti	63
Frank Paul	26
Wolfgang Platter	39
Amrit Poudel	65
Stefania Proietti	48 and 50
Antonello Provenzale	17
Graziano Rossi	15
Renzo Rosso	33
Sergio Savoia	19
Abdulwahid Hussein Haji Said	42
Farhan Saleem	52
Valerio Sbordonni	24
Andrew G. Seguya	41
Antonella Senese	59
Muhammad Zeeshaan Shahid	54
Nitesh Shrestha	62
Claudio Smiraglia	25
Andrea Soncini	60
Priptal Soorae	18
Shresth Tayal	31
Silvia Zaupa	61

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