“Mountains, witnesses of global changes. Research in the Himalaya and Karakoram: SHARE-Asia Project”
From an environmental point of view, mountains are particularly sensitive and important for monitoring the state of health of our planet. Only through distribution of meteo-climatic and atmospheric composition monitoring points in mountain regions, coupled with modelling simulations, will we be able to thoroughly analyze complex pollutant transport mechanisms and better understand imminent global changes.

The Himalayan - Karakoram range, for its elevation and geographic location, represents one of the ideal places for studying long-range pollutant transport systems on a regional scale and for monitoring changes induced by mechanisms that act on a global scale through monsoon circulation.

The Ev-K²-CNR Committee promotes interdisciplinary remote area research in environmental and earth sciences. Recently it launched the project SHAREASIA (Stations at High Altitude for Research on the Environment in Asia) for development of an integrated system of measurements which will contribute to increasing general scientific knowledge on climatic and pollution-related processes while helping build local capacity for monitoring the relevant phenomena. SHARE – Asia currently includes the Pyramid Meteo Network (PMN), a climate monitoring network founded in 1990 by the Ev-K²-CNR Committee, comprising six stations installed in Nepal’s Sagarmatha National Park (SNP), and a station in Pakistan on the Baltoro glacier.

The meeting, organized by the Ev-K²-CNR Committee and promoted by the Italian National Research Council (CNR) in collaboration with the Italian National Mountain Institute (IMONT), aims to highlight the uniqueness of the scientific work of Ev-K²-CNR in important international projects like CEOP (Coordinated Enhanced Observing Period), Atmospheric Brown Clouds (ABC) and, potentially, IGAC (International Global Atmospheric Chemistry), GAW (Global Atmospheric Watch) and GLIMS (Global Land Ice Measurements from Space).

The Ev-K²-CNR Committee thus aims to create a unique opportunity for dialogue between major environmental scientists and experts, highlighting the close relationship between diverse themes with a common underlying thread: in-depth comprehension of the environmental phenomena which are determining the health of our planet.
SESSION 1

ABC Atmospheric Brown Clouds

V. Ramanathan (ABC) - Global and regional climate change: the next few decades

W. Lau (NASA - GSFC) - Aerosol-water cycle interaction: a new challenge in monsoon climate research

C. Hsu (NASA - GSFC) - Global retrieval of aerosol properties from sources to sinks by MODIS

S. Tsay (NASA - GSFC) - Radiation, aerosol joint observations - Monsoon experiment in Gangetic - Himalayan Area (RAJO-MEGHA): Synergy of satellite-surface observations

L. Barrie (GAW - WMO) - Contribution of the WMO Global Atmosphere Watch(GAW) to high mountain observations and ABC

SESSION 2

Ev-K²-CNR in Project ABC

R. Baudo (CNR-ISE/Ev-K²-CNR) - From Himalaya to Karakorum: the spreading of the Project Ev-K²-CNR

G. Tartari (CNR-IRSA/Ev-K²-CNR) - SHARE-Asia contributions to ABC research

S. Fuzzi (IGAC) - Merging regional and global chemistry, air quality & global change

P. Bonasoni (CNR-ISAC) / P. Laj (CNRS) - The ABC-Pyr: a scientific laboratory at 5079 m asl for the study of atmospheric composition change and climate

G. Gobbi (AERONET) - The ABC Pyramid and the AERONET network (“Atmospheric Brown Cloud” Characterization via Sunphotometer Observations)
SHARE-Asia Scientific Fields: Atmospheric Physics and Chemistry & Global Change

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S. Benedict (CEOP - GEWEX) - Integrated data systems CEOP - GEWEX in the study of the water cycle in Asia  pg. 30
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R. Sommaruga (Innsbruck University) - Interactions between solar UV radiation and climatic warming in alpine lakes

J. Shroder (GLIMS) - Global Land Ice Monitoring From Space (GLIMS) Project regional center for southwest Asia (Afghanistan and Pakistan)

M. Bishop (GLIMS) - Assessing glacial fluctuations in the Karakoram Himalaya using remote sensing and geographic information science

C. Smiraglia (Uni MI) - Recent variations of Himalayan and Karakoram glaciers as witness of global changes

A. Byers - Changing climates, changing lives: strengthening adaptive response capacities to climate change in the Huascarán Biosphere Reserve, Peru and Sagarmatha (Mt. Everest) National Park, Nepal

SESSION 5 - SHARE-Asia partners: Commitments to high altitude environmental monitoring in Asia

G. Greenwood (MRI) Global Change in Mountain Regions (GLOCHAMORE)

B. Banmali Pradhan (ICIMOD) - Climate change and sustainable development in the Hindu Kush - Himalaya

S. Baidya (HMG/N – DHM) - Climate Research in Nepal Himalayas

G. Rasul (PMD) - Development of a meso-scale convective system over the foot-hills of Himalayas into a severe storm

Y. Ma (ITPCAS) - Study on land surface heat fluxes and water cycle over the Tibetan plateau

R. Roohi (WRRI-NARC) - Research on global changes in Pakistan
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G. Tartari (CNR-IRSA / Ev-K²-CNR)

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Speaker Biographies & Abstracts
Veerabhadran Ramanathan graduated with a bachelor’s degree in engineering from the Annamalai University in Bangalore in 1965 and attended graduate school at the Indian Institute of Science, also in Bangalore. From 1970 to 1973, he worked on a doctoral thesis in atmospheric sciences at State University of New York at Stony Brook, which led him to innovative discoveries on how CFCs compare with carbon dioxide in their greenhouse effect on Earth’s climate, in collaboration with scientists of NASA and the National Center for Atmospheric Research (NCAR). In 1976, Ramanathan joined NCAR as a postdoctoral fellow. In 1980, with Roland Madden, he published a study which concluded that global warming would become large enough to be detected as early as 2000, a suspicion confirmed in 2001 by the Intergovernmental Panel of Climate Change. In 1993, he joined the Scripps Institution of Oceanography at University of California, San Diego and there, together with Paul J. Crutzen, designed the Indian Ocean Experiment (INDOEX) in 1995. In 2001, the United Nations Environment Program initiated the Atmospheric Brown Clouds (ABC) research program, led by Ramanathan and Crutzen, aimed at understanding the impact of air pollution worldwide, especially on monsoons, agriculture, and public health.

Elected to the National Academy of sciences in 2002, Ramanathan is a distinguished professor of atmospheric sciences and the director of the Center for Atmospheric Sciences at the Scripps Institution of Oceanography. He is a fellow of the American Academy of Arts and Sciences, American Association for the Advancement of Science, American Meteorological Society, and American Geophysical Union. In 2004, he was elected to the Pontifical Academy of Sciences at the Vatican by Pope John Paul II. He is also current co-chief scientist of the Atmospheric Brown Cloud Project, past co-chief scientist of the Indian Ocean Experiment, past chief scientist of the Central Equatorial Pacific Experiment, and the principal investigator of the National Aeronautics and Space Administration (NASA) Earth Radiation Budget Experiment.

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Global and regional climate change: the next few decades

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About 25 years ago, scientists predicted that global warming due to manmade greenhouse gases will be detectable by the year 2000 and that this warming will be accompanied by a large amplification of the warming at the high altitudes and rise in sea level. There is now a general scientific consensus about the veracity of these predictions and a growing societal awareness that global warming is the most vexing environmental issue facing the planet. What is less recognized, however, is a comparably major global problem dealing with air pollution. New data have revealed that, due to fast long range transport, trans-oceanic plumes of atmospheric brown clouds (ABCs) containing tiny particles intercept sunlight, cause surface dimming, cool the surface, warm the air and disrupt regional rainfall patterns and lead to large scale drying. GHGs on the other hand, warm the surface and the atmosphere and make the planet wetter with correlative effects such as melting of glaciers, altering the strengths of storm, among others.

It now seems that the surface cooling effect of ABCs may have masked as much 50% of the global warming due to GHGs. This presents a dilemma for the global community because efforts to curb air pollution may unmask the ABC cooling effect and lead to a large amplification of the surface warming in the coming decades. On the other hand, if GHGs are curbed due to concerns about global warming, ABCs from air pollution may weaken the monsoon rainfall in parts of South and East Asia, thus presenting conflicting options between those regions that are negatively impacted by global warming and those that are negatively impacted by air pollution. The uncertainties in our understanding of these effects are large, but the deeper we delve into the science we are discovering new ways in which human activities are changing the environment during the Anthropocene, and the ethical and scientific dilemmas are becoming more formidable.
WILLIAM K.M. LAU

PRESENT POSITION: Chief, Laboratory for Atmospheres, NASA/Goddard Space Flight Center.; Goddard Senior Fellow, Adjunct Professor, Department of Meteorology, University of Maryland, Adjunct Professor of Mathematics, Hong Kong University of Science and Technology.

RESEARCH AREA EXPERIENCE: Climate dynamics, tropical and monsoon meteorology, ocean-atmosphere interaction, climate variability and global change.


SPECIAL EXPERIENCE: Chair, CEOP Working Group on Monsoon, Senior author of text book on "Intraseasonal Variability in the tropical ocean-atmosphere system", Praxis Book Publisher; Co-, 2005, Member, Organizing Committee of GEWEX, and WCRP Pan-Monsoon Workshops, 2005; Co-Chair, CLIVAR Monsoon Panel, 1995-2001; Chair, CLIVAR US Monsoon Panel, 2001-2003; Editorial Board, Encyclopedia of Atmospheric Sciences; Guest Editor, J.Climate Special Issue on TRMM; Editor, Adv. Atmospheric Science; member of Advisory Panel, Climate Dynamics Group, NCAR, member of review panel, National Oceanographic Center, Taiwan; Science Advisor, Hong Kong Observatory; Co-Convenor: US Japan Global Change Workshop, 1999; Convenor, I GARSS’97; Co-Chair, GAME/SCSMEX Implementation Committee; Member, Science Steering Committee, WMO/M1 Project, 1994-present; Chief Scientist, SCSMEX Science Working Group, 1994-present; Member, Editorial Committee, Chinese Academy of Meteorological Sciences, 1995- present; Chairman, AMS Committee on Climate Variations, 1990-1992; Organizing Committee Chairman, AMS Climate Variations Conference, Denver, 1991; Science Working Group for TOGA/COARE; Chairman, Atmospheric Circulation and Wave Subgroup, 1988-1994, Chief Scientist, US-People’s Republic of China Monsoon
Program, 1987-present; Director, Experimental Climate Forecasting Center at Goddard, 1987-1991; Convenor, Special Session on Ocean-Atmosphere Interaction, AGU, San Francisco, 1990; Co-Convenor International TOGA Symposium, Hawaii, 1990; International Symposium on Climate Change, Beijing, 1990; member, EOS Payload Panel; Member, Goddard Earth Science Seminar Committee; Tropical Rainfall Measuring Mission (TRMM), science team member; member, Organizing Committee of International Conference on Meteorology and Climate of East Asia, Hong Kong, July, 1989.

REFEREED PUBLICATIONS: Dr. Lau has published over 175 refereed publications in scientific journals, book chapters, encyclopedia, on topics ranging from monsoon dynamics, air-sea interaction, hydrologic cycle and radiation interactions, seasonal-to-interannual variability, decadal variations and global change.

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Aerosol-water cycle interaction: a new challenge in monsoon climate research

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Long recognized as a major environmental hazard, aerosol is now known to have strong impacts on both regional and global climate. It has been estimated that aerosol may reduce by up to 10% of the seasonal mean solar radiation reaching the earth surface, producing a global cooling effect that opposes global warming (Climate Change 2001). This means that the potential perils that humans have committed to global warming may be far greater than what we can detect at the present. As a key component of the Earth climate system, the water cycle is profoundly affected by the presence of aerosols in the atmosphere. Through the so-called “direct effect”, aerosol scatters and/or absorbs solar radiation, thus cooling the earth surface and changing the horizontal and vertical radiational heating contrast in the atmosphere. The heating contrast drives anomalous atmospheric circulation, resulting in changes in convection, clouds, and rainfall. Another way aerosol can affect the water cycle is through the so-called “indirect effects”, whereby aerosol increases the number of cloud condensation nuclei, prolongs life time of clouds, and inhibits the growth of cloud drops to raindrops. This leads to more clouds, and increased reflection of solar radiation, and further cooling at the earth surface. In monsoon regions, the response of the water cycle to aerosol forcing is especially complex, not only because of presence of diverse mix of aerosol species with vastly different radiative properties, but also because the monsoon is strongly influenced by ocean and land surface processes, land use, land change, as well as regional and global greenhouse warming effects. Thus, sorting out the impacts of aerosol forcing, and interaction with the monsoon water cycle is a very challenging problem. In this talk, I will offer some insights into how aerosols may impact the Asian monsoon based on preliminary results from satellite observations and climate model experiments. Specifically, I will discuss the “elevated heat pump” hypothesis, involving atmospheric heating by absorbing aerosols (dust and black carbon) over the southern slopes of the Himalayas, and feedback with the deep convection, in modifying monsoon water cycle over South and East Asia. The role of aerosol forcing relative to those due to sea surface temperature and land surface processes, as well as observation requirements to verify such a hypothesis will also be discussed.
N. Christina Hsu received the B.S. degree in atmospheric Sciences from the National Taiwan University in Taipei, Taiwan in 1984, and the Ph.D. degree in atmospheric sciences from the Georgia Institute of Technology in Atlanta, Georgia, USA in 1991. She is currently a Physical Scientist in the Climate and Radiation branch at NASA/ Goddard Space Flight Center in Greenbelt, Maryland. She is a member of the MODIS, CERES, and OMI Science Team where her focus is on the properties of aerosols in the UV-visible spectrum and determination of the radiative forcing due to tropospheric aerosols. Her research experience includes development of near-real time satellite retrieval of aerosols using MODIS and SeaWiFS measurements over ocean and over bright-reflecting dust source regions for field campaigns; and aerosol-climate interaction studies.

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Global retrieval of aerosol properties from sources to sinks by MODIS

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Mineral dust and smoke aerosols play an important role in both climate forcing and oceanic productivity throughout the entire year. Due to the relatively short lifetime (a few hours to about a week), the distributions of these airborne particles vary extensively in both space and time. Consequently, satellite observations are needed over both source and sink regions for continuous temporal and spatial sampling of dust and smoke properties. However, despite their importance, the high spatial resolution satellite measurements of these aerosols near their sources have been lacking.

In this paper, we will demonstrate the capability of a new satellite algorithm to retrieve aerosol optical thickness and single scattering albedo over bright-reflecting surfaces such as urban areas and deserts. Such retrievals have been difficult to perform using previously available algorithms that use wavelengths from the mid-visible to the near IR because they have trouble separating the aerosol signal from the contribution due to the bright surface reflectance. The new algorithm, called Deep Blue, utilizes blue-wavelength measurements from instruments such as MODIS and SeaWiFS to infer the properties of aerosols, since the surface reflectance over land in the blue part of the spectrum is much lower than for longer wavelength channels.

We have validated the satellite retrieved aerosol optical thickness with data from AERONET sunphotometers over land, including desert and semi-desert regions. The comparisons show reasonable agreements between these two. Our results show that the dust plumes lifted from the deserts near India/Pakistan border, and over Afghanistan, and the Arabian Peninsula are often observed by MODIS to be transported along the Indo-Gangetic Basin and mixed with the fine mode pollution particles generated by anthropogenic activities in this region, particularly during the pre-monsoon season (April-May). These new satellite products will allow scientists to determine quantitatively the aerosol properties near sources using high spatial resolution measurements from SeaWiFS and MODIS-like instruments.
Si-Chee Tsay has a B.S. in Atmospheric Sciences from the National Taiwan University (Taipei, Taiwan) in 1977, and M.S. and Ph.D. in Atmospheric Sciences from the University of Alaska in 1982 and 1986, respectively. Joined Goddard Space Flight Center as a Physical Scientist in the Climate and Radiation Branch, Laboratory for Atmospheres, in August 1994. Visiting Scientist in the Universities Space Research Association, Goddard Space Flight Center, between 1990 and 1994, and Research Scientist in the Department of Atmospheric Science, Colorado State University (Fort Collins, Colorado) from 1986 to 1990. Appointed Adjunct Research Associate Professor at the Geophysical Institute, University of Alaska, 1992-1998, and Adjunct Professor at the Earth Systems Science Interdisciplinary Center, University of Maryland since 2002 and actively involved in M.S. and Ph.D. thesis advising. Member of FIRE/CRYSTAL-FACE, EOS/MODIS/CERES, DOE/ARM Science Team, NASA/ESTO Spectrometry/Data-Compressing Team and EPA, ONR & NASA Aerosol Science Teams, and currently, EOS/Terra deputy project scientist.

Authored over 60 papers published in refereed scientific journals, in addition to six scientific and technical reports. One paper has received frequent citations since its publication in 1990 for the review of absorption of solar radiation by clouds. Another heavily cited paper is the 1988 theoretical radiative transfer algorithm in multiple scattering and emitting layered media. It was also selected in the SPIE Milestone Series on “Scattering in the Atmosphere.” This radiative transfer code (DisORT) and other (e.g., STRATS, AeroMie, etc.) first-class computer codes are freely distributed and widely used by the scientific communities.

Besides theoretical developments in radiative transfer (1-D and 2-D), recent research experience includes science planning and operating spectroradiometers from aircraft platforms in field experiments to study aerosol, cloud and surface properties, and to aid in the development of atmospheric and land remote sensing and retrieval algorithms under NASA’s Earth Science Enterprise and Earth Observing System projects. Developing Leonardo concept and airborne simulator: a fleet of microsat clusters, each equipped with a compact, low-power, low-cost, Earth-viewing spectrometer, for formation flight in space. Deployed a suite of surface remote-sensing and in-situ instrumentation (SMART-COMMIT, http://smart-commit.gsfc.nasa.gov/) for comparing/validating satellite measurements. Actively participated in many national and international field experiments, to name a few: ASTEX (Atlantic Stratocumulus Transition Experiment) at Azores, Portugal, June 1992; SCAR-A[B] (Sulfate [Smoke], Cloud And Radiation - Atlantic[Brazil]) at Wallops Island, Virginia [Brazil], July 1993 [Aug-Sep 1995]; MAST (Monterey Area Ship Track experiment) at Monterey, California, June 1994; FIRE-ACE (FIRE-Arctic Cloud Experiment) at Beaufort Sea, Alaska, May-June 1998; SAFARI (Southern Africa Fire-Atmosphere Research Initiative), southern Africa, Aug-Sep 2000; ACE-Asia (Aerosol Characterization Experiment –Asia), eastern Asia, March-May 2001; CRYSTAL-FACE (Cirrus Regional Study of Tropical Anvils and Cirrus Layers – Florida Area Cirrus Experiment), southern Florida, July 2002; UAE2 (United Arab Emirates United Aerosol Experiment), Arabian Gulf, Aug-Sep 2004; EAST-AIRE (East Asian Study of Tropospheric Aerosols: an International Regional Experiment), eastern China, Feb-July 2005.

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Monsoon rainfalls sustain the livelihood of more than half of the world’s population. Understanding the mechanism that drives the water cycle and fresh water distribution is highlighted as one of the major near-term goals in NASA’s Earth Science Enterprise Strategy, and the interaction between natural/anthropogenic aerosols, clouds, and precipitation is a critical component of that mechanism. In Asia, sheer population density presents a major environmental stress. In addition, economic expansion in this region is accompanied by increases in biomass/biofuel burning, industrial pollution, and land cover and land use changes. With a growth rate of ~8% per year for Indian economy, more than 600-million people from Lahore, Pakistan to Calcutta, India over the Indo-Gangetic Basin have particularly witnessed increased frequencies of floods and droughts, as well as a dramatic increase in atmospheric loading of aerosols (i.e., anthropogenic and natural aerosol) in recent decades. Continuous sunphotometry observations (2001-2004) at Kanpur, India also reveal high values of monthly mean aerosol optical thickness of 0.4-0.8 year-round. The Asian monsoon is a dominant component of the global water and energy cycle, and provides the critical fresh-water supply to the Indo-Gangetic Basin. Melt-water from the Himalayas sustains the regional agriculture throughout the dry season. However, recent observations indicate that glaciers are rapidly shrinking, jeopardizing the long-term water supply over the region.

The A-Train satellite constellation, Aqua, CALIPSO, CloudSat and Aura are (will be) deliberately placed in orbit to take synergistic measurements to help provide a better understanding of climate forcing due to trace gases, aerosols and clouds. As a complement to these satellite capabilities, an initiative to deploy NASA SMART-COMMIT facilities and an array of AERONET sunphotometers, in concert with the A-Train/Terra, will be presented. The GSFC SMART-COMMIT facilities will provide aerosol and radiation measurements from a suite of radiometers, micro-pulse lidar, trace-gas concentration analyzers, particle sizers, mass analyzers, nephelometers, aethalometer, and standard meteorological probes. These valuable observations will be utilized to address the following scientific questions:

What are the spatial and temporal distributions of aerosol properties (e.g., chemical, microphysical, optical and radiative) in the RAJO-MEGHA region during the pre-monsoon and monsoon season?

What are anthropogenic aerosols in the regions and can they be remotely sensed?

How accurate can we determine aerosol radiative forcing over the regions?

How do the cloud properties evolve as a result of interaction with anthropogenic and natural (or aggregate) aerosols?

What are the impacts of aerosol-cloud interactions on the regional hydrological cycle during the pre-monsoon season and break period?

The expected close collaboration of RAJO-MEGHA with various research projects in the region (e.g., ABC, CLIVAR, GEWEX, and CEOP) will definitely provide a better understanding of the role that absorbing aerosols (dust and black carbon) play in affecting interannual and intraseasonal variability of the Indian monsoon, in particular, and of global water cycle, in general.
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Key Activity In Atmospheric Chemistry And Meteorology
- Atmospheric aerosols
- Long range transport of air pollutants
- Polar region air chemistry process
- Large scale cycles of toxic atmospheric substances
- Application of network observations to study of chemical cycling.
- Evaluation of large scale climate and air quality models with observations
- Integrating global atmospheric chemistry observations

Career Highlights
- 1970 Joined the Meteorological Service of Canada (formerly Atmospheric Environment Service)
- Ph.D. 1975 Atmospheric Science Johann Wolfgang von Goethe University, Institute of Meteorology and Geophysics, Frankfurt
- 136 peer-reviewed journal publications or book chapters
- 1970s, Studies of the fate of emissions from Alberta oils sands plants
- 1980s, Lead scientist in Canada's acid rain research; involved in U.S. DOE MAP3S peer review
- 1987, Nature paper on Aerosol Pb isotope apportionment of total Pb to Canadian and U.S. sources
- 1988, Nature Paper with P. Crutzen on Arctic boundary layer ozone depletion linked to halogen chemistry and aerosols
- 1989-1992, Led Canadian government researchers in a joint study with NASA/ABLE scientists of the methane emissions from northern boreal wetlands
- 1991-1993, Led and participated in a major international study of arctic tropospheric ozone depletion (Polar Sunrise Experiment 1992) and associated aerosols
- 1998-2002 Vice-president of the Commission for Atmospheric Chemistry and Global Pollution (CACGP). Had served two terms, the last as general-secretary
- 1997-2000, Scientific leader of a three-year, 20 scientist Canadian government /university project to put size-distributed aerosols into climate models as active constituents
- 1998-2000, Chaired and organized an international project of WCRP/IGAC on Comparison of Large Scale Sulphate Aerosol Models (COSAM)
- 1999, elected member at large of the Executive Committee of the International Association of Meteorology and Atmospheric Science (IAMAS) and reconfirmed in 2003 for another
Contribution of the WMO Global Atmosphere Watch (GAW) to high mountain observations and ABC

Leonard A. Barrie,  
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The GAW programme of the World Meteorological Organization (WMO) focuses upon the role of atmospheric chemistry in global change issues. It consists of a partnership of managers, scientists and technical expertise from approximately 80 countries. Recognizing the need to bring scientific data and information to bear in the formulation of national and international policy, the GAW mission is threefold: (i) systematic monitoring of atmospheric chemical composition and related physical parameters on a global to regional scale; (ii) analysis and assessment in support of environmental conventions and future policy development and (iii) development of a predictive capability for future atmospheric states. High Mountain Observatories are an important subset of the 24 station Global observatories and approximately 300 Regional stations that comprise the GAW network. The focus of GAW is on six variable groups related to air chemistry’s role in climate, weather, air quality and long range transport/deposition of air pollution. These are: greenhouse gases, ozone, ultra violet radiation, aerosols, selected reactive gases and precipitation chemistry. For each group, there are science advisory groups maintaining measurement guidelines and data quality objectives as well as WMO Member-supported quality assurance, calibration and training centres, observatories and data integration/analysis centres (World Data Centres). Observational programmes and results at GAW high mountain observatories are reviewed and the role of GAW in ABC high mountain activities discussed.
Renato Baudo  was born in Maccagno (VA, Italy) on August 1, 1950. In 1969 he got a diploma as Chemist Engineer (ITIS Cobianchi High School, Verbania, Italy) and in 1971 started working at the Italian Institute of Hydrobiology (National Research Council, Verbania, Italy). In 1975, he graduates in Biological Science at Milan University, becoming Researcher at CNR Italian Institute of Hydrobiology (actually renamed Institute of Ecosystem Studies), where he still works to date as Senior Scientist in charge of the Freshwater Ecotoxicology laboratory. In 1989-1991 he was appointed Funzionario Nazionale Distaccato (Visiting Scientist) at the Environment Institute, Joint Research Centre of Ispra, Commission of the European Communities. In 1994, he graduates a second time in Natural Science, at Milan University. In 2002 and 2003 he read Ecotoxicology at Sassari University, Environmental Sciences Faculty. Since 1993, he has acted as scientific coordinator of Ev-K²-CNR Committee, and since 1999 he is Chairman of the Bilateral Technical Committee CNR-RONAST (Nepal). He is author or co-author of 293 publications, and of more than 1000 reviews of Italian and foreign books and publications on ecology topics (chemistry, biology, geology, zoology, botany, economy, etc.).

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From Himalaya to Karakorum: the spreading of the Project Ev-K²-CNR

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The International Laboratory – Observatory Pyramid is the symbol of the Project Ev-K²-CNR. Actually, the project started in 1987, when Prof. Ardito Desio, 90 years old at the time, with great enthusiasm launched a new geological and geodetic research campaign in the Himalayan area.

However, it is only with the building of the International Laboratory – Observatory Pyramid, inaugurated by Prof. Desio in 1990, that the Project gained a unique “logistic base” for its scientific research. The laboratory, located at 5050 m a.s.l. in the Khumbu valley, Nepali side of Mount Everest, is in fact the first semi-permanent high altitude scientific research centre, energetically self-sufficient and furnished of the usual scientific instrumentation, suitable for the study of climatic and environmental changes, of medicine and human physiology in extreme conditions, of geology, geodesy and seismic phenomena.

In time, a wealth of knowledge, initiatives and international relationships has been acquired, allowing the Ev-K²-CNR Committee to play a strategic role in the frame of a collaboration among institutions, governments and organizations for the exchange and transfer of experiences, technologies, scientific and cultural knowledge.

Thanks to the Italian Government, the International Partnership "Institutional Consolidation for Systemic Planning and Management Toward Poverty Alleviation and Environmental Conservation in a Framework of Sustainable Regional Development in the Hindu Kush-Karakorum-Himalaya Mountain Complex" has been funded. This Partnership foresees a collaboration with International Institutions such as IUCN, ICIMOD, and CESVI, and has the main objectives of promoting the socio-economic development of the local populations and the environmental safeguard of the area. The project initially foresees some pilot study in three Countries (Nepal, Pakistan, and Tibet AR, PCR), and later on a possible extension to the whole region.

An integral part of this Partnership is the Project SHARE-Asia (Stations at High Altitude for Research on the Environment in Asia), aiming to the establishment of a net of research and monitoring stations for the long term study of the evolutionary environmental process in Himalaya-Karakorum. It must be stressed that this is not a purely scientific research, since the Project main aim is the transfer of advanced technologies by means of an active involvement of local populations, research institutes and institutions.
Gianni Tartari
Italian National Research Council at the Water Research Institute (CNR-IRSA)
Born in 1949, graduate at University of Milan, he is a head of research for the Italian National Research Council at the Water Research Institute (CNR-IRSA). He is working in the field of environmental chemistry since 1975. His research is mainly concerned with atmospheric deposition chemistry, pollutant cycling in lacustrine and rivers environments, in eutrophication and sedimentation processes in lakes and in analytical real-time instrumentation.
He works on pollutant circulation study in the Himalaya-Karakoram region, studying the presence of acidifying species and nutrients in rain, snow and lake waters. In that areas he has carried out research on high altitude aquatic environments for over 15 years.
Since 1992, he is a member of the Ev-K2-CNR Committee and President of the Committee's Scientific Council as well as member of the Bilateral Technical Committee which regulates Italian.
He participated in the activities of Bureau Communitaire of Reference and as EU consultants. He is involved as scientific responsible in several national and European Projects and other international researches (CEOP, ABC, etc.).

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SHARE-Asia contributions to ABC research

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The Himalaya and Karakoram regions represent an interesting area to investigate the air pollutants transport and depositions (wet and dry). Located fairly far from industrialised zones, these chains strongly influence the global atmospheric circulation and have been also considered to study the influence of aerosols vertical distribution to the monsoons regime.

The Ev-K²-CNR Project promotes and develops researches at high altitude (>2500 m a.sl.) in Himalaya-Karakoram since 1987. Recently the activities are focused on developing a monitoring network (Stations at High Altitude for Research on the Environment in Asia-SHARE-Asia) to increase the environmental and geophysical scientific knowledge in these mountain regions. The installation of monitoring stations (automatic weather stations, aerosol monitoring instruments, global positioning system-GPS and seismic monitors) will aid in understanding local impacts of global climate change and earth phenomena.

The expertise of Ev-K²-CNR is based on the study of snow chemistry at high altitude carried out in the past decade to identify different sources of ions in connection with the air mass circulation. More recently these researches have been focused on how snow chemistry represents the atmospheric chemistry. This approach claims an interdisciplinary strategy between chemistry of atmospheric depositions and aerosol chemistry and can also contribute on the recording the Atmospheric Brown Cloud’s tracers distribution, as sulphate, nitrate, organics and black carbon.

The research and monitoring activity at high altitude require a particular experience and a well-organized network. Ev-K²-CNR has developed a wide experience in managing an high altitude network of automatic weather stations along the Khumbu Valley (Nepal) and in the Northern Pakistan (Baltistan region) in the framework of CEOP Project (Coordinated Enhanced Observing Period). In this context, SHARE-Asia is moving to install in the early 2006 an ABC monitoring station, as “Exploratory Site”, at the Pyramid Laboratory-Observatory located at 5000 m at the foot of the Mount Everest. The ABC-Pyramid is the first of a network of stations that is planned to install at altitudes between 2500 and 5000 m along the Himalaya-Karakoram chains. These station will operate under an active co-operation with the local scientific reality, creating a wide co-operation between western countries and developing countries of the region.
Sandro Fuzzi holds a doctoral degree in Physical Chemistry from the University of Bologna, Italy. He is currently Research Director at the Institute of Atmospheric Sciences and Climate of C.N.R. in Bologna and Head of the Group "Atmospheric Chemistry". His main research interest is in the physical and chemical processes of multiphase atmospheric systems (aerosols and clouds) and their effects on atmospheric composition change, climate, ecosystems and human health.

Dr. Fuzzi was Visiting Scientist at the Atmospheric Sciences Research Center of the State University of New York at Albany, USA (1982-83). He is also currently Contract Professor of Atmospheric Chemistry at the Department of Environmental Sciences of the University of Urbino.

Dr. Fuzzi is/has been a member of several International Committees and Panels among which:
- Commission on Atmospheric Chemistry and Global Pollution, CACGP (1990-1994)
- Scientific Steering Committee of the EUREKA project EUROTRAC-1 (1992-1995)
- Scientific Steering Committee of the EUREKA project EUROTRAC-2 (1998-2000)
- Scientific Steering Committee of the International Global Atmospheric Chemistry Project, IGAC (2000-present)
- International Geosphere-Biosphere Program, IGBP (2003-present)
- Managing Committee of the European COST Action 633 “Particulated matter: Properties related to health effects” (2003-present)
- ESFRI (European Strategy Forum on Research Infrastructures) expert-group on Environmental Monitoring (2005-present)

Dr. Fuzzi is currently Co-chair of the International Global Atmospheric Chemistry Project (IGAC) and Coordinator of the European Network of Excellence “Atmospheric Composition Change, the European Network” (ACCENT) which includes 43 major European Institutions in the field of global change research.

Dr. Fuzzi has published over 120 scientific papers and has presented more than 160 contributions at national and international conferences. He is also a member of the Editorial Board of the following scientific Journals:
- Tellus B
- Journal of Geophysical Research-Atmospheres Aerobiologia

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Merging regional and global chemistry, air quality & global change

SHARE-Asia in the context of the International Global Atmospheric Chemistry (IGAC) Project

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The International Global Atmospheric Chemistry (IGAC) Project, under joint sponsorship of the Commission on Atmospheric Chemistry and Global Pollution (CACGP) of the International Association of Meteorology and Atmospheric Sciences (IAMAS) and the International Geosphere-Biosphere Programme (IGBP), was created in the late 1980s to address growing international concerns over rapid changes observed in Earth’s atmosphere. The past decade of international research, much of which was initiated and coordinated within IGAC, has greatly increased our understanding of the chemical composition of the troposphere, the fluxes of chemical components into and out of the troposphere, and the processes controlling the transport and transformation of chemical components within the troposphere. Through a large number of projects and activities, IGAC has created a worldwide community of scientists, enhancing international cooperation towards understanding global atmospheric chemistry.

Much of IGAC’s research efforts during its first decade were directed towards assessing the effects of anthropogenic emissions on the background atmosphere. While questions remain concerning the point at which observed global/regional mean trends in component concentrations (signal) unambiguously rise above background natural variability (noise), it is now well recognized that human activities have perturbed the chemical composition of the atmosphere on local, regional, and global scales. These perturbations arise from i) emissions from fossil fuel/biofuel combustion and other industrial processes, ii) anthropogenic enhancements of biomass burning, and iii) increases in the lofting and transport of mineral dust through human-induced land-use changes. On regional scales, air pollution is a serious and growing problem in many parts of the world.

The past decade of international research has clearly revealed a large number of atmospheric chemistry issues facing society as well as the challenges of studying and managing an integrated Earth System. Two overarching questions have emerged which constitute the basis for the IGAC action plan over the next decade:

What is the role of atmospheric chemistry in amplifying or damping climate change?
Within the Earth System, what effects do changing regional emissions and depositions, long-range transport, and chemical transformations have on air quality and the chemical composition of the planetary boundary layer?

Within the context of the larger ABC-Asia project, a proposal was put forward for the activation of an ABC-IGAC Task focusing on the monitoring of aerosol and trace gases over the Asia Pacific region and on estimating their impact on atmospheric chemistry and the radiation budget. The activities currently in progress to include the Ev-K²-CNR Pyramid observatory in the ABC monitoring network under the SHARE-Asia project aim at providing an important contribution to ABC Asia and, at the same time, will undoubtedly be an opportunity for the Italian global change research community.
Paolo Bonasoni: Doctoral degree in Physics at the University of Bologna. Research scientist at the Institute of Atmospheric Sciences and Climate of C.N.R. and Head of the “Ottavio Vittori” GAW Mt. Cimone Station. Devoted to scientific and experimental research activities. His main research interests concern the study of physical and chemical processes of ozone and other atmospheric compounds in background conditions. He participated to several international projects and has authored over 90 international and national scientific publications.

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Paolo Laj is a physicist at the Laboratoire de Météorologie Physique (LaMP) /Observatoire de Physique du Globe (OPGC Clermont-Ferrand-France). He is specialized in the interaction between aerosols and clouds and the indirect effect of aerosol on climate. He is in charge of the coordination of the integrated aerosol project within the national program for atmospheric chemistry (CNRS-PNCA) as well as of the national network for free-tropospheric monitoring stations. He is the leader of the aerosol group at . He participated in several EU projects within FP4 and FP5 and is coordinating the access to infrastructure activity within the NoE ACCENT (FP6). He is the scientific manager of the new I3-FP6 program EUSAAR. He is author or co-author of more than 40 peer-reviewed scientific papers.

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The ABC-Pyr: a scientific laboratory at 5079 m asl for the study of atmospheric composition change and climate

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Tropospheric aerosols are of great importance because of their impact on human health, visibility, continental and maritime ecosystems, or the Earth’s climate. Increasing anthropogenic emission over the Asian continent is causing significant changes to the atmospheric composition, not only in the urban areas but also at the regional and continental scales. In addition to creating potential threats to human health, elevated concentrations of particles and gases
in the atmosphere contribute to regional climate change by changing the radiative budget of the atmosphere and modifying the hydrological cycle.

Most Asian countries have now organized monitoring of air quality within the large urban centers but yet, monitoring of background atmospheric composition and concentrations in the natural atmosphere remains limited. For this reason, knowledge of both the physical and chemical properties of aerosols and the concentration of selected gases is of great importance. This information is a key step to better constrain global and regional climate models. Implementation of continuous measurements at the CNR-Pyramide in the Himalayas will therefore contribute to better quantifying the impact of anthropogenic activities over the Asian continent, in a region between India and China influenced by the Monsoon circulation and where very little information is presently available.

Our contribution to the Share Asia project concerns the realization of a laboratory for continuous atmospheric measurements at the CNR-Pyramid. A skilled team of researchers and technicians, already engaged in scientific activities at high mountain research stations such as Mt. Cimone (Italy), Puy de Dôme (France) and Dome C (Antarctica) and belonging to the ISAC-CNR, CNRS, DLR and EV-K2-CNR Committee, are working jointly to conceive a permanent laboratory for continuous monitoring of aerosols and gases at more than 5000 m asl. This will be realized using renewable energy from 112 photovoltaic panels and 120 electric storage cells and state-of-the-art data acquisition and satellite communication systems. The laboratory has been first mounted and tested with full instrumentation at ISAC-CNR in Bologna, in October 2005.

The instrumental set up has been defined in accordance to the ABC project and concerns measurement of atmospheric aerosol properties, ozone and other greenhouse gases. Measurements of the particle properties will provide the basic information required to detect any long-term change in aerosol source emissions and assess possible climatic effects of aerosols that may result from these changes. It includes monitoring of aerosol size distribution between 10 nm up to a few µm using a combination of SMPS (Scanning Mobility Particle Sizer) and OPC (Optical Particle Sizer), aerosol scattering and absorption coefficients (Nephelometer and Multi Angle Absorption Photometer) and Aerosol Optical depth (Cimel sunphotometer). In addition, aerosols will be collected using High-Volume samplers and the chemical composition characterized by subsequent analyses performed at ISAC-CNR (inorganic and organic components).

As regard to the trace gases, continuative measurements of tropospheric ozone will be carried out together with more than thirty greenhouse gases (CFCs, HFCs, HCFCs, SF6) that will be measured once a week using air canisters which will be subsequently analysed in Italy. Ozone is considered a strong pollutant in low troposphere and an important greenhouse gas in the middle and high troposphere, where high ozone concentration can be due to stratospheric intrusion episodes or to air mass transported from the polluted lower troposphere. This area of the Asian continent constitutes a large reservoir of primary pollutants than can significantly contribute to large scale increase of ozone concentration. This joint CNR ISAC – CNRS OPGC – Urbino University and DLR project contributing to SHARE-ASIA will therefore provide a very original data set with the objective of improving our understanding of the continental-scale modification of atmospheric composition and climate due to anthropogenic emissions.
Gian Paolo Gobbi received his degree in Physics from the University of Rome La Sapienza in 1978. He became permanent Research Scientist of the National Research Council (CNR) Institute of Atmospheric Physics in 1984. Since 2000 he is “First Research Scientist” of the CNR Institute of Atmospheric Sciences and Climate in Rome. His initial activity focused on lidar (laser radar) remote sensing of stratospheric aerosols and polar stratospheric clouds (formation, radiative, chemical, and climatic implications, and effects on the ozone layer), modeling of aerosol microphysics and light scattering, and middle atmosphere temperature trends. Since 1994 he has been working at the observation of tropospheric aerosols and at the definition of their role in the Earth’s climate and environment. To this goal he developed and operated both mobile and fixed lidar (laser radar) systems for various European Union projects, and set up the Rome AERONET sunphotometer station. Currently he is running the ISAC Rome aerosol lidar and sunphotometer long-term observations and he is PI in two national research projects on aerosol effects on climate (AEROCLOUDS, of the education Ministry MIUR) and air quality (QUITSAT, of the Italian Space Agency ASI).

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The ABC Pyramid and the AERONET network ("Atmospheric Brown Cloud" Characterization via Sunphotometer Observations)

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Atmospheric aerosols are micron-sized particles which can be made of sulfates, nitrates, mineral dust, black carbon, hundreds of organic compounds and ash. When sunlight hits absorbing aerosols, it reveals a brown colored haze, the Atmospheric Brown Cloud (ABC). All clouds prevent some sunlight from reaching the Earth’s surface by mainly reflecting it to space. In addition to that, brown clouds absorb about 25% of the solar radiation they intercept, heating up the atmosphere around them. Furthermore, these aerosols reduce water cloud's ability to turn into rain and dissipate. Overall, ABC prevent sunlight from reaching the surface and reduce the amount of rainfall in a region. ABC can then have significant impacts on regional and global climate, such as temperature changes, rainfall changes and crops growing season alterations. Furthermore, air pollution (and ABC is pollution) is a cause of premature death.

Satellite data reveal thick, polluted haze layers scattered all over the globe, from populated regions to the Alps, the Himalayas, and the Pacific and Atlantic Oceans. Atmospheric brown clouds form across the USA, southern Europe, the Amazon, southern Africa, and most of Southeast Asia. Findings from the INDOEX experiment revealed that the so-called “brown cloud phenomenon” in Asia is spreading from the Himalayas over the North Indian Ocean region, spanning an entire continent and an ocean basin.

In the year 2006, we plan to install at the Ev-K2-CNR Pyramid a Cimel sunphotometer operating in the framework of the AERONET project. This will provide a characterization of the optical and microphysical properties of the ABC in the Himalayan region. In particular, these measurements will allow to follow the time evolution of the aerosol optical thickness (AOT) and other columnar properties of the cloud as single scattering albedo (SSA, fundamental in computing the cloud effects on solar radiation), particle size distribution (SD, fundamental in assessing the ABC effects on formation and lifetime of water vapor clouds) and refractive index. This presentation will introduce the AERONET program, will describe the Cimel sunphotometer measurement technique and will evaluate the contribution of the proposed EvK2 AERONET site to the study of the Asian ABC.
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Professor, Department of Civil Engineering, the University of Tokyo. He is Lead of Coordinated Enhanced Observing Period (CEOP) under the framework of the World Climate Research Programme (WCRP) and worked as a member of the Implementation Plan Task Team (IPTT) of GEOSS 10-year Implementation Planning. He is leading an intensive field experiment on the water and energy cycle in the Tibetan Plateau and scientific activities on satellite remote sensing of hydrology.

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GEOSS and the CEOP high altitude observatories

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The CEOP Phase 2 science framework, based on these new tools, is constructed for making maximum use of this opportunity and for addressing the CEOP guiding goal, by modifying and adding to the Phase 1 overall science objectives established in, WESP and CIMS. In addition to the monsoonal region study, that CIMS is undertaking, the water and energy cycle in semi-arid regions and cold regions, both of which are vulnerable and sensitive to climate change and global warming, are now being targeted in the framework of WESP. To address the natural and human-induced effects on the water cycle, aerosol-water cycle interaction in the monsoonal regions will now be investigated in the framework of CIMS. It is important to aggregate from information at a reference site scale and downscale from global and regional scales to a watershed scale for making usable information. To address these issues, a watershed hydrology study including a down-scaling study is being established in Phase 2 as a focused activity that spans WESP and CIMS and provides linkage to water resources studies. Two cross-cutting activities, namely a CEOP analyses intercomparison project, and an extreme events impact analysis project for increased understanding of hydroclimate processes and improving model predictability, are being introduced to address certain basic aspects and to synthesize other elements, respectively, that are common to the CEOP objectives.

During the first two years of CEOP Phase 2, 2005-2006, CEOP will make efforts for accomplishing data collection and science targets for the CEOP Phase 1 and will prepare for establishment of a reference basin network in addition to reference site upgrading, improvement of the CEOP data system, and preliminary studies on the additional science targets. During the next four years, 2007-2010, CEOP will implement its Phase 2 enhanced observation period and address the CEOP Phase 2 science targets, simultaneously. CEOP will also take steps toward the establishment of the GEOSS in-situ observation network and data integration and information fusion system for the water cycle, in an experimental way. At the same time, CEOP will receive benefits from GEOSS for accomplishing its own science objectives. In this manner, the CEOP Phase 2 observation and data integration system will make the transition into an element of the GEOSS operational framework.

This holistic approach will generate shared scientific targets with existing scientific projects and programs in due course. CEOP will cooperate with and support these activities by contributing the two unique functions established in Phase 1 and working jointly to exploit the opportunity these tools provide.
Curriculum vitae

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BA Math SDSU, 1964
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1974-1990; Caltech/Jet Propulsion Laboratory
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Concerns about the availability of fresh water, in terms of both quantity and quality, to sustain and meet the requirements of our planet and its inhabitants are perhaps one of the most urgent issues for the 21st century. Therefore, understanding of the mechanisms of the global energy and water cycle as one of the most important elements of the earth climate system, particularly in the context of the current concerns about global climate change and variability (floods and droughts) is one of the highest research priorities. The talk will focus on the attention being given in CEOP/GEWEX to the development of specialized tools that have provided the various stakeholders including science and policy groups at regional/local, national and international levels with methodologies to enhance prediction of the global energy and water cycle variation based on integrated observation systems and data management and processing capabilities. Examples of the results of applying these tools in Asia and other regions will be provided.
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Educational Background:
1986-1992: D.Sci. in Natural Sciences, University of Milan, Italy, "cum laude".
Title of the Thesis: "Analysis of meteorological features recorded during 1987-1989 in Lombardy".

Professional Experience:
From March 2001 also employed in the Research and Development Division as researcher.
Main work field: evaluation and verification of forecasts from operational NWP models.


1992, Sep – 1994, Dec: Meteorologist Assistant at "Osservatorio Meteorologico Milano-Duomo".

Qualified Collaboration:

1997, Apr - present: Co-Investigator of the Project: "Study of meteorological and climatological characteristics of the Himalayas and relation to long-range transport and dispersion of pollutants", approved by the Italian Ministry of University, Scientific and Technological Research (MURST) within the framework of the Ev-K2-CNR Project.

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Verification of numerical model forecast of precipitation and satellite-derived rainfall estimates over the Indian region Monsoon 2004

Laura Bertolani
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Precipitation is one of the most difficult weather elements to predict. It depends on many physical and dynamical processes, such as large-scale motion of moist air, orographic lifting, convection. Since all these processes are represented in NWP models, the quality of the model predicted precipitation is often used as a critical indicator of the overall model skill. Near real-time satellite-derived estimates of precipitation, which are becoming available these years, provide a valuable tool to the scientific community for analysing and investigating the physical processes associated with the water cycle, due to the availability of data at increasingly higher spatial and temporal resolution over large areas. There are many fields of application of these measurements, such as flood warning, nowcasting techniques, water resources monitoring, data assimilation and verification of NWP forecasts in regions where other observing systems are not available.

This work describes the preliminary results of a study aimed at:
- assessing the ability of a general circulation model (1°x1° horizontal resolution) routinely run at the Epson Meteo Centre (CEM) in predicting daily rainfall;
- evaluating the performance of satellite-derived precipitation estimates (namely, NOAA CPC CMORPH).

In doing this, the CPC daily rain gauge analysis is used as reference for validation.

The study focuses on the Indian Monsoon during summer 2004. Important thermal and dynamical processes over large areas characterize the phenomenon, and thus can provide interesting hints on model physics and precipitation processes.
Giuseppe Calori has a degree in Electronic Engineering and PhD in Automatica, both from Politecnico di Milano. Research scholar at IIASA (International Institute for Applied System Analysis) in 1995. Post-doc at Politecnico di Milano in 1995-96. Visiting scholar at CGRER (Center for Global and Regional Environmental Research, Univ. of Iowa) in 1999. In ARIANET, since year 2000 (co-founder).

Contributor and coordinator of applied studies and R&D projects on air pollution modeling and environmental impact assessment on various scales and regions, with special focus on design, development and use of air quality simulation and decision support systems.

Relevant activities related to air pollution in Asia (mostly within RAINS-Asia II project, at CGRER and IIASA): development of a ten-year source-receptor matrix for sulfur; study of the combined effects of the emissions trends and the interannual meteorological variability on sulfur deposition; estimation of the effects of future scenarios on sulfur and black carbon; screening modelling of pollutants diffusion over Asian megacities.

Other relevant activities related to long-range and mesoscale air pollution: development of an atmospheric simulation system to support the integrated assessment of emission abatement strategies over Italy (RAINS-Italy project); episodic and long-term 3D photochemical modeling over a number of regional basins and urban areas, for policy support (evaluation of current air quality and future emission scenarios); development of air quality forecast systems (EU FP5 FUMAPEX project and others).

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Circulation and relationship between pollutant sources and atmospheric composition in the Himalayan region

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Estimating past, present and future levels of deposition, ambient levels of concentration, and aerosol column loading are central to the evaluation of risks to ecosystems and human health, and net changes in radiative forcing and resulting changes in climate. This is particularly true in Asia and in Indian subcontinent, where the pressing environmental problems of urban pollution, acid deposition and climate change are already extensively documented and are expected to intensify. Population increase accompanied by expanding economies and change of lifestyles during the last two decades have in fact boosted energy demand throughout the area. The primary energy demand in Asia is currently doubling every twelve years, a pace much more rapid than the world average of every twenty-eight years. Presently ~80% of the demand is satisfied by fossil fuels, with coal being the primary energy source. Most of the energy scenarios up to 2020 are characterized by a further increase in energy use, with fossil fuels remaining the dominant source. There is also increased scientific interest and political concern regarding the long range transport and fate of these pollutants because countries are receiving increasing amounts of pollutants from neighboring and even distant countries. This growth in emissions has stimulated various atmospheric modeling studies, investigating different aspects of transport, transformation and deposition mechanisms of pollutants compounds (mostly sulfur and particulate matter) throughout the region. Integrated assessment models can help to better understand the consequences of future scenarios and emission abatement strategies, by coupling atmospheric models with consistent energy projections, related control technologies information and environmental impacts. This has been the main focus of the RAINS-Asia Project. Within its framework, source-receptor relationships have also been developed, together with multi-years sulfur trends and assessment of inter-annual variability. The results of these studies for the Himalayan region will be illustrated, with a focus on relationships between sulfur deposition and emission sources and their changes during time.
Major Fabio Malaspina has graduated in Physics at the University “La Sapienza” of Rome and currently he is “Head of Observations and Special Measurements Section” of the Department for Aeronautical Meteorology Experimentations of the Italian Air Force Meteorological Service situated in Vigna di Valle (Rome).
Previously he has developed his activity of meteorologist as member of the Analysis and Forecasts Section in the “National Center for Aeronautical Meteorology and Climatology” (Rome) and in the 5° Stormo of Cervia (Ravenna). He has been delegated of the Italian Permanent Representative to the World Meteorology Organization as point of national contact for the program “Global Atmosphere Watch” from August the 9th 2002 to ???.
Since 2004 he has been teacher and coordinator in the course “The man and the climate” included in the “Master in Environmental Sciences” organized by the European University in Rome.
He has given several lectures in seminars in the Specialistic Degree in “monitoring and control of environmental alterations” of the Course of Degree in environmental Sciences of the University “La Sapienza” of Rome. It collaborates with the Department of Physics of Roma Tre University, the “European Centre of Studies on Population, Environment and Development” of Milan and the Bruno Leoni Institute of Turin.
During the National Congress in September 2005, he has won a reward by the “Italian Society of Physics” for a study on the impact of the substitution of the type of radiosondes for the measure of the profile of the meteorological greatness.
He has been designated as “Site Manager” for the World Rain Gauges Intercomparison promoted by the World Meteorology Organization and planned to develop in Vigna di Valle for two years from 2006.

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Italian Air Force observatory network for environmental and meteorological monitoring: from the data control to the quality assurance

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"We will prepare for our future generations a well orderly and precious material to edify the complex building of the Climatology" Father Francesco Denza, 1876 Italian Meteorological Society

The interest for the atmospheric phenomenons is born with the man. They were the Greek to interrupt the long tradition of stars-meteorology and empiric-meteorology of the past, to pick up in organic form the knowledges on the atmosphere until then acquired and to raise them to the dignity of natural philosophy. At least two thousand years had however to pass before meteorology lost its qualitative character and became quantitative. It has been in the ’600 with the invention in Italy of the principals measuring instruments that we find meteorology as science. Fundamental purpose of a observatory network is to try to describe, in the way most complete possible, the natural phenomenons and to leave traces in the time of them. The importance of the recordings increases more and more with years entering to make part of a patrimony of knowledge unique and unrepeatable useful to the whole humanity for the scientific searches, our choices and those that will have to also effect our children. Especially in the last decades, a part of the information can also be used for initializing and verifying some mathematical models. The phenomenons to be described can have different characteristics, for instance global or local, and according to their typology it needs the net to be projected, to be fixed the specifications of the instrumentation and the fit procedures. To study the global scale phenomenons is fundamental to effect measures for long periods in the place away from sources of human pollution, for such purpose they are particularly suitable the tall mountains. Ideally continuing the initiated job in 1654 from the first net in the world wanted by the Granduca in Tuscany at that epoch already worried by the climatic changes, the Meteorological Service of the Italian Air Force has an own national network that effects special measures and participates with its own personnel to the activity of survey in Antarctica too. The problems found in the management of such stations are mainly due to: change of technology, measure of least quantity, necessity of high specialized personnel, remote and often uncomfortable location of the site of measure, not much omogeneity of the net (instrumentation, calibration, methods of measure, exposure). In the epoch of the telecommunications the observative part is more and more distant from who elaborates the data; this last can often read only the encoded messages or the numerical files without knowing the limits and the different characteristics of instrumentation used in the stations of survey. Data of quality are those that guarantee in the time the requisite dictated by the purpose for which they have been produced. The climatic system is mainly characterized by oneness and variability: a post elaborated "Quality Control" based on the past statistic descriptions is not enough, but it is necessary “Quality Assurance” system activation, in order to give to present and future consumers information about measurements has been effected and in order to mark out limits towards which we can implement data elaboration. Only the information “well defined” turn the uncertainty into measurable risk and they can engrave in the decisional trials.
Raffaele Salerno, physicist, has nearly twenty years of experience in mathematical models applied to atmospheric physics and fluidodynamics. He has been professor at the University and has wrote papers in referred journals, conferences, and a few books. At the present, he is the vice-director of the Epson Meteo Center, an applied research private organisation, which was established in 1995 by himself together with dr. M. Giuliani, a well-known and important Italian meteorologist. He is a member of AMS, EGU and other associations.

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Re-analysis models and climate change

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Every year climatic problems occur around the globe. It has been recognized that some of these widely dispersed climatic extremes might have common origins, e.g. the general effects of the global warming, the periodic changes of sea surface water temperature in the central and eastern equatorial Pacific Ocean and other modifications in sea surface temperature which influences the sensible and latent heat fluxes across the air-sea interface and the atmospheric circulation at all scales. In the Mediterranean region, some evidences of these changes are almost evident: the modification in temperature distributions and extremes, the droughts in some places and the floods in others, the alteration of alpine glaciers. The models, particularly the reanalysis models, can help us to understand and assess some of these changes and how they are related to the others on the whole Earth.
Giovanni Kappenberger was born and grown up in Lugano, Switzerland. Studies: Natural Sciences at the Swiss Federal Institute of Technology in Zürich (ETHZ), with a diploma thesis in glaciology (mass balance of Laika Glacier in the Canadian Artic). From 1976 working as weather forecaster at the Federal Office of Meteorology and Climatology (MeteoSwiss) in Locarno-Monti, Ticino, Switzerland.

Active in: mountain meteorology, snow and avalanches, glaciology, permafrost. Several expeditions, mainly of glaciological interests. Research in LangTang, (snow hydrology and environmental goals) in 1992 for the Ev-K²-CNR Project. Responsible for the mass balance measurements of Clariden and Basodino glaciers in the Swiss Alps. Former member of the Swiss Glaciological Commission, actual member of the “Comitato glaciologico Italiano”. Several publications, the most relevant a manual of mountain meteorology:

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Climate changes and mountains

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Global warming concerns most of the mountains areas. Glaciers are one of the best climate indicator of ongoing changes. A few glaciological experiences are presented from three different places: the mountains of the Canadian Artic, the Swiss Alps and the Nepal Himalaya. For a better understanding of the ice loss due to the atmospheric warming, a simple evaluation has been done using the summer zero degree level in the free atmosphere, based on radiosonde data. With the help on the radiosonde data of New Delhi and assuming a constant precipitation amount and intensity during the monsoon months (June to September), it has been found that along the southern slopes of the Himalaya the zero degree and snowfall line have risen at least by some 100 to 200 m in the last decades. A similar change has also been observed for the Swiss Alps, using the radiosonde of Milan.
Ivo Allegrini graduated with a degree in Chemistry in 1970 from the University of Rome and began his career as a researcher at the Italian National Research Council – Institute of Atmospheric Pollution (CNR-IIA). He has been Director of that Institute since 1987. Allegrini is a CNR chief researcher, as well as Consortium President of the Geographic Information System Innovation Research Consortium and Vice-Present of the Executing Consortium for the National Antarctic Research Program.

Allegrini has led several CNR research projects within EU programs and is head of CNR polar research. He has launched significant research in the fields of urban pollution and advanced techniques of remote sensing. His contributions to the creation of scientific structures for environmental studies are considerable, including the CNR artic base “Dirigibile Italia” and the monitoring networks in Italy and abroad, particularly China.

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Global scale atmospheric pollution – a regional problem

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Atmospheric pollutants, whether man made or naturally occurring but released in greater concentrations due to man’s activities, can now be found at all latitudes and longitudes throughout the boundary layer, and depending on their resistance to photolysis and photo-oxidants within both the free troposphere and stratosphere. The key to pollutant transport is longevity of the compound concerned and the circulation patterns of the atmosphere. Pollutants which are relatively unreactive and volatile will, with time be spread across the globe eventually reaching even the most remote areas. Even semi-volatile pollutants can be transported by successive phases of volatilisation and deposition (multi-hop) until they too are spread around the globe. One of the implications of this world-wide distribution is that pollutants may reach areas where specific climatic, physical or chemical conditions occur which result in increased deposition fluxes to marine and terrestrial surfaces with the consequence that pollution hot spots may be created at vast distances from the original pollution source. The polar regions, particularly the Arctic because it is in the same hemisphere as the major industrialised nations, are a good example. Levels of Persistent Organic Pollutants (POPs) and mercury (Hg) in polar wildlife, particularly larger predators, have been known for some time to be higher than is the norm at lower latitudes. Hg deposits in the Arctic not just because of its reduced volatility due to low temperatures but also as a result specific atmospheric chemical conditions related to the tropospheric ozone depletion events. These events, prompted by the so-called ‘Bromine Explosion’ which releases reactive halogen compounds to the troposphere create conditions in which the atmospheric oxidation of HgO(g) occurs with such rapidity that its concentration can fall below detectable limits in a matter of hours. The oxidation products which are much more soluble than elemental Hg are deposited along with particulate matter or dry deposited, and at a time (around polar dawn) when the Arctic ecosystem is entering an active phase with the return of sunlight. Still focussing on Hg, there is evidence that Hg released by coal burning power stations in China can be deposited in rain along the Pacific coast of the U.S. Hg released in the U.S. could potentially be transported with other atmospheric pollutants across the Atlantic to Europe and the Mediterranean. Industrial emissions in northern Europe due to the general north to south flow of boundary layer air in the summer months have a negative effect on Mediterranean air quality (high O3 concentrations) and it seems, on atmospheric Hg deposition to the Mediterranean Sea. If the description above seems rather qualitative it is because as yet the tools with which to model (and to a certain extent measure) atmospheric transport, transformation, deposition and re-emission on such a scale are in their infancy. There is a great need for strategically situated monitoring stations, creating a network to sample within the major air mass trajectories, at ground level but also at altitude. This would allow models and the emission inventories of pollutant fluxes to be validated in a far more comprehensive manner than isolate measurement campaigns permit. From validated models it would then be possible to evaluate the potential effects of changing emissions resulting from legislation or changes in for example the power generation industry towards renewable energy sources. Finally it would be possible also to investigate changes in pollution transport and deposition which occur with changing atmospheric transport patterns resulting from climate change.
**PAOLO CESCON**  
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**Paolo Cescon** is Full professor of Analytical Chemistry at the University Ca’ Foscari of Venice; Director of the National Research Council’s Institute for the Dynamics of Environmental Processes – CNR;  
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Present research field deals with the study of environmental contamination on a regional and global scale by the analytical determination of micro-components in areas subjected to different anthropogenic stresses, such as the polar areas of the Arctic and Antarctica, the Mediterranean Sea, the Venice Lagoon, the Pacific Ocean, etc. etc.  

Among the very interesting results obtained, the global contamination of metals of platinum group (PGEs), resulting from the usage of catalytic converters, is particularly relevant.  
 Furthermore, present activities deal with the development of analytical methodologies for trace and sub trace analyses in environmental matrices and the study of chemical speciation.  

He is the author of several articles published in qualified scientific journals and he takes part in projects with important international Scientific Institutions, such as the British Antarctic Survey of Cambridge, UK, and the Massachusetts Institute of Technology of Boston, USA.  

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**Carlo Barbante** is Professor of Analytical Chemistry at the Department of Environmental Sciences of the University of Venice. His main research of interest is addressed to the study of archives of atmospheric trace element deposition and environmental changes. The investigation of various trace elements in Greenland, Antarctic and Alpine snow and ice has provided a wealth of fascinating information on recent and past changes in the atmospheric cycles of several trace elements. These investigations have so far enabled: 1) the recognition of the sources, geographical origins and transport pathways of aerosols reaching the polar regions; 2) the assessment of human impact on the large-scale atmospheric cycles of various metals, especially Pb, Cu, Zn, Cd, Hg and, more recently, platinum group elements (Pt, Pd, Rh) in both hemispheres; 3) the acquisition of data on the natural changes during the last climatic cycle. 4) the geochemical characterization of the accreted ice of Lake Vostok, Antarctica.  

The research activity is testified by several research articles appeared in qualified international journal with peer review, such as Analytical Chemistry, Environmental Science and Technology, Geophysical Research Letters, Earth and Planetary Science Letters and Journal of Analytical Atomic Spectroscopy, Nature. In the last five years is author of 40 publications in international journals with peer review. He also published as first author or co-author 4 book chapters.  

**In the last five years**

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PGEs and other trace elements in high altitude snow and ice

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Atmospheric pollution by heavy metals is an important problem in Europe. Considerable efforts have been made to assess it, especially through extensive monitoring programs and emission inventories. A major difficulty with such approaches is that they provide information only for recent decades and do not allow us to go back in time to the pre-industrial period, which is necessary to put recent changes in proper perspective. Information on past changes in atmospheric pollution for heavy metals can only be obtained from atmospheric archives such as peat bogs, lake sediments or high-altitude Alpine snow/ice cores.

As an example, only published data for heavy metals in Alpine snow/ice cores are those which were recently obtained from the analysis of a 140 m snow/ice core, drilled in 1994 on the Eastern slope of Dome du Goûter (45°50'N; 6°51'E, 4250 m asl) in the Mont Blanc massif. Although the ice at the bottom of the core was at least 200 years old, only for the upper 110 m were dated with a good precision. They correspond to a ~60 year period from the early 1940s to the early 1990s. Various metals were analysed in this core.

A very interesting opportunity to get longer time series with good quality dating arose from the availability of snow/ice cores drilled at Colle Gnifetti (45°53'33''N; 7°51'5''E, 4450 m asl, see picture), a glacier saddle between two summits of Monte Rosa at the Italian-Swiss border. Systematic investigations of possible drilling sites in the Alps have shown that Colle Gnifetti is probably the place where the longest Alpine time series could be obtained.

Here we present time series for various metals (Pb, Pb isotopes, Cr, Mn, Cu, Zn, Co, Ni, Mo, Rh, Pd, Ag, Cd, Sb, Bi, Pt, Au, U), obtained from the analysis of two well-dated snow/ice cores from Colle Gnifetti, which cover a ~350 year period from the 1650s to the mid 1990s. These elements were chosen because they are emitted by human activities to the atmosphere and might pose a threat to the environment, especially in populated areas such as Europe. The data are compared with those obtain in areas subject to different anthropic influence, such as the Andes and the Himalaya, where we recently obtained an ice core extending back in time to the 400 A.D. PGEs have also been successfully determined in Greenland ice cores, showing how the pollution from these new elements is a global scale process.
Andrea Lami

Education: 1985, Degree, Biology, University of Milan
1990, Ph. D., Ecology, University of Parma

Foreign languages: English (good knowledge)

Position: 1986-1989 Doctoral grant at the University of Parma
1989-present Researcher at the CNR Istituto Italiano di Idrobiologia,
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Experience: Phytoplankton analysis and ecology in eutrophic lakes;
Thin layer and high-performance liquid chromatography (TLC and HPLC) of vegetal pigments;
Elemental analysis of lake sediment (Si and P speciation, C, N, S)
Palaeolimnology of alpine and volcanic lakes;
National leader scientist of the European projects “ALPE 2, Acidification of mountain Lakes,
Palaeolimnology and Ecology (1993-94)” and “MOLAR -Measuring and modelling the
dynamic response of remote mountain lake ecosystem to environmental change“;
Participation to the CNR strategic projects “Ev-K²-CNR, Global circulation of pollutants”,
“PALICLAS, Palaeoenvironmental analysis of Italian Crater Lake Sediments”, “Italian Research
in Antarctica - project Glaciology and Palaeoclimate“;
Participation to the 1994 and 1997 field campaigns at the Ev-K²-CNR high altitude laborato-
ry “The Pyramid”, in Nepal (5050 m a.s.l.);
National leader scientist of the European projects “European Mountain lakes Ecosystems
Regionalization, diaGnostics and socio-economics Evaluation (EMERGE 1999-2002);
In 2003 he was nominated as Scientific Responsible for Environmental Sciences within the
Ev-K²-CNR Committee; this Committee is an organization leading research in Himalayas area
(Nepal);
From 2001-2004 he was the responsible for the research contract with Museo Tridentino di
Scienze naturali for a research on Lake Tovel, Trento, Italia;
Teaching activity at the doctoral course organised by the Regional University Centre of
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Limnological and paleolimnological research in high altitude lakes in Himalayas

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The most remote regions of globe represent some of the least disturbed ecosystem in Europe, yet they are threatened by air pollution and by climatic change. The 2500 km long Himalayas is one of the most isolated regions in the world and least explored wildernesses outside the polar regions and it is for this reason that the Tibetan Plateau is often referred to as the ‘Third Pole’.

Despite their remoteness, the area is threatened by an increasing human pressure in connection with economic development of the Asiatic area. Asia, in contrast with the tendency shown in Western Europe and North America, have a positive trend in air pollutant emission. Lake ecosystems in this region are especially important since they are vulnerable to air pollution, and thus their vulnerability allows them to be used as excellent sensors of environmental change.

After a summary of the main results obtained form the work carried out in the framework of the Ev-K2-CNR project the rationale and objectives for the future research will be presented.
Mario Gallorini (date of birth October, 6 1944; Domodossola Italy) is Ph.D. in Chemistry and works as Research Manager at the Italian National Research Council. As visiting scientist and as expert worked in different international laboratories: (NIST- National Institute of Standards and Technology, USA from 1977 to 1979); (JRC- Joint Research Centre – EURATOM of the European Union, in 1985 and in 1987-1989). From 1994 to 2000 was the director of the CNR Center of Radiochemistry and Activation Analysis at the University of Pavia (Italy). From 2001 Dr. Gallorini is the Head of the Unit of Radiochemistry and Spectroscopy of the Institute of Metrology “G.Colonnetti”. Dr. Gallorini is a specialist in the field of trace elements studies. In particular, has matured great expertise in the radioanalytical as well as conventional techniques for trace metals analysis and certification of reference materials. His researches are applied to the study of the environment and the human health. Dr. Gallorini is author/co-author of more than 120 international scientific publications.

1969 : PhD in Chemistry at University of Pavia
1970 - 73 Fellowships at the CNR Center of Radiochemistry- University of Pavia
1974 - 77 Appointed Professor at University of Pavia teaching the course: Chemistry of metallo-organic compounds. (years: 1974/75; 75/76 ; 76/77)
1977 - 79 Visiting Scientist at NIST (Nat. Inst. of Standard and Technology ) Gaithersburg - MD - USA
1984 Italian member in the “Subcommittee of Selenium”. Commission of Toxicology della IUPAC.
1986 - 87 Visiting Scientist at CCR- EURATOM of the European Union (Ispra, Italy)
1988 - 89 Visiting Expert at CCR- EURATOM of the European Union (Ispra, Italy)
1989 position of National Expert at Cyclotron Laboratory of CCR- EURATOM of the EU (Ispra)
1992 becomes Research Manager of the CNR
1994-2000 Director of the CNR Centro di Radiochimica e Analisi per Attivazione of Pavia from 1999 is Appointed Professor at the Post-doctoral School of “Superior Studies” of the University of Pavia teaching a course on “Radioanalytical techniques for trace elements studies”
from 2000 Head of the Unit of Radiochemistry and Spectroscopy of the CNR Institute of Metrology

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Trace elements pollution at high altitude:  
the AER and RATEAP projects  

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In the framework of the CNR scientific program Ev-K²-CNR two research projects aiming to investigate the trace metals pollution in high elevated areas have been initiated since the 1999. The task project AER-BIONUCLEAR (Air Quality Biomonitoring by Nuclear Analytical Techniques) has been focused on the possibility of using lichens as biomonitor of trace elements atmospheric pollution. Lichen samples collected at high elevation areas in Himalayas (Nepal), Mt. Kenya (Kenya) and the Alps (Italy) have been analyzed for their trace element content. The results of a survey gives important information about the baseline element composition of lichens from unpolluted or very low polluted areas. The elemental composition of lichen samples is essentially influenced by natural occurrence, mainly airborne soil dust. However, also anthropogenic input determined by long-distance atmospheric transport of pollutants can be involved for some highly volatile elements such as Br, Cd and Sb.

The second project RATEAP (Remote Areas Trace Elements Atmospheric Pollution) started in 2001 and still in progress, aims at obtaining information about the elemental characterization and composition of the airborne particulate matter of high altitude remote areas of the Himalayan region.

The airborne particulate was collected at the Ev-K²-CNR Pyramid Laboratory-Observatory (5,100 m of altitude in the Khumbu Valley, Nepal). Samples of total suspended particles as well as of the particle size fractions PM10 and PM 2.5, collected by pump aspiration onto filters, have been analyzed for the determination in ng/m3 of more than 30 trace elements. Samplings were carried out in the pre-monsoon period of March – May 2002 and the post-monsoon period of October 2003 in order to observe a seasonal variation of the amount and the composition of the airborne particulates. In addition, by the analysis of the local soils, the Enrichment Factors of many elements have been also calculated. The analyses have been mostly performed by neutron activation analysis that was found irreplaceable for the multi-elemental determination at extremely low levels. The preliminary results allowed the knowledge of the actual trace metals concentration ranges and identified those trace metals that may be considered of non local origin and deriving from distant natural and/or anthropogenic sources. Furthermore, the RATEAP project can furnish information on the possible origin and direction of long distance transport phenomena and their variation with seasonal/meteorological conditions. This may provide additional information to the studies of the Asian Brown Cloud (ABC).
Stefano Polesello received his Ph.D. in Analytical Chemistry from the University of Milano in 1994, discussing a thesis about in situ spectroscopic studies of atmospheric reactions. After 2 years, spent as a post-doc fellow in the University of Milano and University of Verona, where he studied the effects of atmospheric pollution on cultural heritage, he joined the Water Research Institute (CNR-IRSA) as an associate researcher in 1996.

His main interests are the development and validation of analytical methods of water analysis by spectroscopic and chromatographic techniques. Furthermore he is spending part of his research efforts on studying chemical composition of deposition in high altitude and remote areas (Everest region and Antarctica).

He also coordinated expert groups for the development of Italian official analytical methods for water and was the Italian delegate in the Expert Group on Analysis and Monitoring of Priority Substances (AMPS) for the implementation of Water Framework Directive (Directive 2000/60/EC).

He published more than 40 research and review papers on international journals devoted to analytical and environmental chemistry.

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Chemical composition of fresh snow in Hymalayas and Karakorum

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The interpretation of firn and ice core in high altitude sites in central Asia requires more data on freshsnow chemistry, especially in extra-monsoon season. Since 1992 the Water Research Institute of the CNR has been involving in sampling and analysis of wet and snow deposition in the Himalayan area. The first campaigns, which were based at the Ev-K²-CNR Pyramid site in Khumbu valley, has been focused on the southern side of Everest group in monsoon season with the aim to evaluate the long range transport of inorganic pollutants from Indian subcontinent to Himalayan range. In the following years, involving climbing expeditions, we extended our researches to other regions also on extra-monsoon season. This approach allowed to get a better knowledge of spatial and temporal distribution of major ions in snow deposition of the Himalayan region.

Freshsnow sampling on the northern slope of central Himalayas confirmed that no significant differences can be evidenced between data collected on the northern and the southern slopes of the same range and that the chemical composition of snow mainly depends on monsoon alternation.

As it was found in snowpits and ice cores of this region, freshsnow data showed an alternation between a summer monsoon season, with values not substantially influenced by anthropogenic inputs, and an extra-monsoon season characterised by the influence of dust from central Asia. Although this data set needs further confirmation, it suggests that in pre-monsoon season the Himalayas are not an effective barrier for dust storm transportation. In a similar way, the monsoon and late monsoon concentrations, which are one order of magnitude lower than the pre-monsoon one, are similar on the two slopes of Himalayas, and comparable to those measured in internal Antarctic snowfall. This comparison proves that summer depositions in high elevation sites in central Asia are not substantially influenced by anthropogenic inputs and may be useful for the investigation of the composition of the remote continental troposphere.

Furthermore, our results show that nitrate and ammonium concentrations can be biased by post-depositional gas absorption. In fact the interpretation of nitrate values in glaciochemical is rather difficult because nitrate concentrations in snow is affected by post-depositional exchange with the atmosphere over a broad range of environmental conditions.

Finally, preliminary results obtained during the scientific Project K2-2004, 50 Years Later on both slopes of Everest group and on K2 southern slope in Karakoram are presented.
Ruben Sommaruga is Head of the Laboratory of Aquatic Photobiology and Plankton Ecology at the University of Innsbruck. Dr. Sommaruga studied Biological Oceanography and Biology and in 1993 received his doctor degree from the University of Innsbruck. His interest for aquatic ecology brought him to several research institutes in Europe, USA, and South America. In 2000, he was awarded the International Prize on Recognition of Professional Excellence (IRPE) in Limnetic Ecology by the International Ecology Institute.

His primary general research interests are photobiology and (micro)plankton ecology of different aquatic ecosystems including high-mountain lakes, hypertrophic lakes, and coastal systems. In particular, he is interested in the role that sunlight plays in modulating biogenic and abiogenic processes that transform the carbon pool, as well as in the strategies that different aquatic taxa evolved to minimize UV damage. He has published extensively in top journals on plankton ecology, UV effects, and UV optical physics. He is regular reviewer for several scientific panels and journals, as well as Associate Editor of Photochemical and Photobiological Sciences and member of the editorial board of FEMS Microbiology Ecology, thus, reflecting his interest for both fields. In 2004 he took part of the scientific expedition supported by Ev-K2-CNR to the lakes in Himalaya.

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Interactions between solar UV radiation and climatic warming in alpine lakes

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Solar UV radiation has been a crucial environmental factor since the origin of alpine lakes (i.e., lakes above treeline) ca. 10,000 years ago, because those ecosystems receive high solar UV fluxes due to a thinner ozone column and usually lower aerosol scattering. Another important change that takes place with increasing elevation is the reduction of in-lake colored dissolved organic carbon (cDOC) concentrations, which reflect the dominance of small, sparsely vegetated watersheds at high altitude. Concomitantly with the reduction in cDOC concentrations, there is a significant decrease in the UV absorption capacity of this carbon pool (i.e., reduced content in humic substances). The consequence of these qualitative and quantitative changes of cDOC is that most high-mountain lakes (with exception of those fed by glacier streams) rank among the most UV-transparent aquatic systems, with UVB penetration depths of up to ca. 30 m.

Climatic warming has been particularly pronounced in mountain regions. For example, in the northern Alps, the mean air temperature has increased by 1°C since 1985. Several environmental changes associated to climatic warming such as glacier retreat, and the timing, extent and duration of ice and snow cover, are taking already place in several mountainous regions. Alpine lakes are particularly sensitive to climatic variability because several crucial ecosystem processes are directly affected by those changes. Based on observational analysis, possible changes in alpine lakes will be presented. On a short-time scale, the decrease in the snow- and ice-cover duration will lead to an increase in UV stress on the ecosystem. However, on a longer time scale, the increase in mean air temperature could favor the development of terrestrial vegetation in the catchment, and result in an increase of cDOC export to alpine lakes, particularly to those located near the treeline. As a consequence, underwater UV transparency and UV stress on these ecosystems will be reduced. This scenario is supported by the finding that the alpine-nival flora in some mountainous regions like in the western Austrian and eastern Swiss Alps has moved upward in recent years. On the other hand, glacier retreat may cause turbid lakes to become more UV transparent. The magnitude of these changes will be more important for underwater UVB exposure levels than those expected from ozone reduction at mid-latitudes.
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Recent Professional Honors
Regents Professorship of Geography & Geology, 1995 to date.
Fellow American Association for Advancement of Science, 1992.
UNOmaha Award for Distinguished Research & Creative Activity, 1988.

Relevant Professional Experience
Editor-in-Chief, Developments in Earth Surface Processes, Elsevier Book Series, 2002 to date.
Editor, Geomorphology, Elsevier journal, 1997 to date.
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Global Land Ice Monitoring From Space (GLIMS) Project regional center for southwest Asia (Afghanistan and Pakistan)

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Concerns over world-wide loss of ice have resulted in the GLIMS (global land ice measurements from space) Project wherein glaciers are being mapped and monitored from space with the ASTER satellite sensor system. A combined American and Japanese satellite system launched in 1999 on the Terra rocket, allowed all countries with glaciers to receive free large-scale (15 m - resolution) satellite imagery. The Governments of Afghanistan and Pakistan expressed little initial interest to the U.S. Geological Survey (USGS) or the U.S. Aeronautics and Space Administration (NASA) who were funding GLIMS. The University of Nebraska at Omaha (UNOmaha), with its three decades of research association in both countries, became the Southwest Asia (Afghanistan and Pakistan) GLIMS Regional Center for the Hindu Kush and Western Himalaya.

In the Hindu Kush and Pamir ranges of Afghanistan we selected a transect of glaciers from west to east, that include; (1) Foladi Glacier in Koh-i-Baba Range; (2) Mir Samir glaciers in central Hindu Kush; (3) Sakhi Glacier in Koh-i-Bandakha range in north-central Hindu Kush; (4) Keshnikhan Glacier at the mouth of Wakhan Corridor; and (5) Little Pamirs in Wakhan Corridor. All glaciers were mapped by geoscientists in the past half century and are now being reassessed for change detection. In general smaller, lower-altitude glaciers were already below the climatic equilibrium line forty years ago when first mapped, but were protected in shadowed cirques; many are now wasting away, although deconvoluting cartographic error from real change is problematic. Nonetheless, evidence of serious glacial retreat has major implications for downstream melt-water irrigation in this chronically drought-torn region. In Pakistan focus is primarily upon five main areas in a west to east transect, starting with: (1) glaciers of Tirich Mir in the northwest; (2) Gorshai Glacier in Swat; (3) Batura Glacier and others in Hunza; (4) glaciers of the Nanga Parbat Himalaya; and (5) Biafo and Baltoro Glacier in the northeast. Because these glaciers are all from higher altitude areas than most of those in Afghanistan, they receive more nourishment but are still undergoing significant downwasting, and some termini are backwasting. Most significant related events, however, are the debuttressing of valley walls that can cause massive landslides, and glacier lake outburst floods (GLOF) which threaten much of the Himalaya. Overall between Afghanistan and Pakistan we can say that the loss of significant glacier ice in coming decades is becoming progressively more serious.

The GLIMS Project will continue monitoring glaciers but the task must be passed on to newly trained specialists from Afghanistan and Pakistan. New satellite systems, perhaps even the new European cryosat system, must also be deployed for this purpose. World-wide glacier monitoring underway for decades is at last capable of achieving significant results with high resolution, stereographic satellite imagery in the GLIMS Project.
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Employment
1996- Associate Professor of Physical Geography - Department of Geography and Geology,
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1992-1996 Assistant Professor of Physical Geography - Department of Geography and
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1987-1992 Assistant Professor of Physical Geography - Department of Geography, University
  of Wisconsin at Eau Claire, Eau Claire, Wisconsin.
1986-1987 Instructor of Physical Geography - Department of Geography and Geology,
  Indiana State University, Terre Haute, Indiana.
1985-1986 Technical Coordinator - Indiana State University Remote Sensing Laboratory
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1984-1985 Senior Computer Programmer - Indiana State University Remote Sensing
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1982-1984 Research Laboratory Assistant - Indiana State University Remote Sensing
  Laboratory (ISURSL), Department of Geography and Geology, Indiana State University, Terre
  Haute, Indiana.
1981 Cartographer - Geological Research Center, Department of Geology, Western Michigan
  University, Kalamazoo, Michigan.

Awards
2005 Most Outstanding Recent Contribution for the book entitled Geographic Information
  Science and Mountain Geomorphology, Mountain Geography Specialty Group, Association of
  American Geographers.

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Assessing glacial fluctuations in the Karakoram Himalaya using remote sensing and geographic information science

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Alpine glaciers are retreating and downwasting in many mountain environments. In the Karakoram, the regional mass balance is not known with certainty, although a negative mass balance trend is suspected. Remote sensing and field studies of glacier fluctuations in the Karakoram reveal significant changes including surging, geometry (area coverage and length changes), suprafluvial patterns, outburst flooding, meltwater production and supraglacial debris. Although many factors such as the topography, lithology, climate, and glacier dynamics control glacier fluctuations, climate forcing strongly regulates geometry, downwasting and meltwater production. The occurrence and development of ablation valley, supraglacial, and proglacial lakes are related to climate change, although dynamic processes affecting lake development are complex and highly variable. Alpine glacier characteristics can also be highly variable, and many supraglacial features disappear before we can assess their morphology and evolution. For example, an increase in lake frequency, growth and coalescence is occurring in some areas in response to climatic warming. Consequently, it is imperative to assess glacier fluctuations via satellite imagery. This urgency dictates remote sensing and GIS-based studies to automate the process of mapping and quantitative assessment of supraglacial characteristics in sensitive mountain environments. This research is part of the Global Land Ice Measurements from Space (GLIMS) project, and is designed to evaluate the extraction of information from satellite imagery and digital elevation models (DEMs). Issues of radiometric calibration, analysis of topography and glacier mapping are addressed in the context of producing reliable scientific information on glacier changes.

A multistage processing strategy is presented. Research indicates that object-oriented and geomorphometric analyses are required to obtain reliable information from satellite imagery and DEMs. The results indicate that traditional approaches to information extraction do not work for complex glacier features, and that spectral, size, shape, topological and topographic information is required for accurate glacier mapping. The methodology facilitates the production of reliable quantitative information on glacier changes.
Claudio Smiraglia is a full Professor of Physical Geography-Geomorphology at the University of Milano, Italy; President of Italian Glaciological Committee, Member of AIGEO (Italian Association of Physical Geography and Geomorphology) central council; Italian correspondent for the International Glaciological Society; Vice-President of Central Scientific Committee of Italian Alpine Club; Chairman of the Working Group on Debris Covered Glacier - AIGEO; Leader of the Glaciology Research Group in the frame of Ev-K²-CNR; His main research topics regard the recent environmental changes occurring at World’s high mountain chains, in particular Alps, Himalaya-Karakoram, Andes and Antarctica. His studies deal with the geometry variations of mountain glaciers and the relations with climate driving factors.

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Recent variations of Himalayan and Karakoram glaciers as witness of global changes

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The glaciers located in Himalayan and Karakoram constitute the largest ice masses in the World apart from the two polar caps. Their runoff feeds rivers (e.g.: Indus, Ganges, etc..) whose tributaries carry precious water for several hundreds million people. Since the last decades the scientific community is debating about global glacier shrinkage and its consequences on sea level rising and mountain landscape. In Himalayan and Karakoram the question is not only if ice is melting, but also how fast the ice is melting and how much meltwater and for how much time can be produced. To analyse the recent and historical variations of Himalayan and Karakoram glaciers are particularly indicated remote sensing techniques and the use of historical sources as iconography and maps which permit to evaluate the geometry changes occurred. To drive this choice are the large size of the glaciers here located (e.g.: Baltoro glacier in Pakistan is 62 km long allowing the use of indirect sources without loosing the accuracy of the measurements) and the remote location of Himalayan and Karakoram glaciers that makes impossible to manage for all of them direct and accurate field surveys. Nevertheless, direct field measurements on selected glaciers need for improving and testing satellite images and resolve climatological and other causes of glacial changes.

On the highest Asian chains (Pamir, Karakoram and Himalaya) the type of glaciers more frequent and largely present is Debris Covered Glacier (DCG), a landform characterized by supraglacial debris on the largest part of its ablation zone, which seems actually spreading in the World's mountain regions due to the feedback between ice thinning and supra-glacial sediment accumulation.

To contribute to a better understanding of the complex relations between debris covered glaciers and climate and to forecast on a decadal scale the glacier-response to Climate Change and its impacts on the runoff of high mountain regions, different studies have been carried out by Italian researchers of the Ev-K’-CNR Committee on some selected glaciers located both in Karakoram (Baltoro and Liligo in the K2 region) and in Nepal-Himalaya (Khumbu and Chungri Nup in the Everest region). On them the researchers had performed field campaigns to collect direct data to be compared with those ones obtained by indirect techniques. The data analysis permitted to evaluate the geometry changes occurred on long time frame (100 and 50 years), to calculate their energy and mass balances on short time frame (1-3 months) useful for modelling their runoff and to forecast their evolutions according to the present climate scenarios (IPCC data source). Baltoro Glacier, for instance, the largest DCG chosen as main field test site, seems to be only slightly changed in respect to its past dimensions. Liligo is clearly advancing, but it might be misleading to interpret this advance in term of a direct response to regional climate change, rather than due to an oscillatory change (i.d. surge). On the contrary the signs of a strong shrinkage of the Changri Nup debris free terminus are indisputable (more than 10 m per year of retreat).
Alton C. Byers, Ph.D. is a mountain geographer specializing in integrated conservation and development programs, applied research, and the development of mountain-based educational courses and materials. He received his doctorate from the University of Colorado in 1987, focusing on landscape change, soil erosion, and vegetation dynamics in the Sagarmatha (Mt. Everest) National Park, Khumbu, Nepal. Following two years of integrated conservation and development work in Ruhengeri Prefecture, Rwanda, he joined The Mountain Institute (TMI) in 1990 as Environmental Advisor. Between 1993-94, he and his family were based in Khandbari, Nepal to help establish Nepal’s newest national park, the Makalu-Barun National Park and Conservation Area. During 1994-1996, he worked as founder and Director of Andean Programs in the Huascarán National Park, Peru, funded in part by TMI’s first Matching Grant from USAID. He directed TMI’s Appalachian Program and 400-acre Spruce Knob Mountain Center (SKMC) in West Virginia between 1998-2000, establishing a range of conservation, teacher training, and demonstration projects. Since 2001 he has directed TMI’s Research and Education Programs that promotes the use of applied research, mountain education, publications, and exploration as institutional strengthening, learning, and sustainable development tools. Dr. Byers has worked and continues to publish on a variety of research, field managerial, and program development initiatives in the U.S., China, Nepal, India, Africa, South America, and the Caribbean. Current initiatives include the study of human and cattle impacts on alpine regions worldwide; human dimensions of climate change in Nepal (Everest region) and Peru (Huascarán region); co-editing of a new mountain geography textbook; and coordination of a new multi-year program designed to strengthen TMI’s institutional effectiveness, monitoring and evaluation capacities, and field-based impacts. In 2004, Dr. Byers received the Association of American Geographer’s Distinguished Career Award from the Mountain Geographer Specialty Group.

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Changing climates, changing lives: strengthening adaptive response capacities to climate change in the Huascarán Biosphere Reserve, Peru and Sagarmatha (Mt. Everest) National Park, Nepal

Alton C. Byers, Ph.D.
The Mountain Institute, Elkins, USA

Mountains are particularly sensitive to changes in climate because of their slope, aspect, verticality, mass, and altitude. Global climate change over the past century has resulted in the dramatic recession of glaciers throughout the world, most noticeably in the subtropical Andean ranges of South America. The rapid melting of snow and ice has resulted in an increase in the formation of high altitude glacial lakes, sometimes too fast to monitor accurately, accelerating the potential for catastrophic down-valley floods that can destroy everything in their paths. The likelihood of other high magnitude/low frequency events such as debris flows and landslides has increased, exacerbated by the very nature of the dynamic mountain environment that is naturally predisposed to earthquakes and mass wasting processes. Less understood, however, are the human dimensions of climate change that are already impacting water supplies (irrigation, drinking, power), agriculture systems, high altitude vegetation dynamics, conflicts over irrigation rights, local economies, adventure tourism (climbing, trekking), and other highland/lowland interactions. Likewise, an understanding of how institutional capacities and partnerships can be strengthened to effectively deal with, and adapt to, these changes is lacking.

The mission of The Mountain Institute (TMI) is to conserve high priority mountain ecosystems, improve mountain livelihoods, and promote the well-being of mountain people through research, education, and outreach. The paper discusses an evolving program within TMI that plans to conduct a detailed analysis of the human dimensions of climate change within two of its work regions: the Huascarán Biosphere Reserve, Peru, and Sagarmatha (Mt. Everest) National Park, Nepal. The goal of the project is to better manage natural resources and improve human livelihoods within these regions through:

- the better understanding of climate change impacts in the Huascarán Biosphere Reserve and Sagarmatha National Park on peoples lives, livelihoods, safety, and environments,
- the strengthened integration of the social and physical sciences within the climate change research, analysis, project design, and implementation processes, and
- strengthened stakeholder capacities to access and use scientific information to better adapt and respond to the risks and vulnerabilities associated with contemporary changes in climate, land use patterns, and tropical high mountain environments.
GREGORY B. GREENWOOD

Gregory B. Greenwood
June 2004 to present: Executive Director, Mountain Research Initiative. Develop strategy to increase and focus global change research in mountain regions through the world as part of IHDP and IGBP programs and as a policy objective of the Swiss National Science Foundation. Manage MRI Coordination Office and staff in Bern. Develop worldwide database of global change mountain researchers. Maintain and enhance program website and other communication materials. Collaborate with consortium of European research institutions on the development of a global change research strategy applicable to mountain biosphere reserves. Collaborate with consortium of US researchers on the development of climate sciences in mountains of western North America. Develop funding proposals, frame necessary research and maintain the community of mountain researchers worldwide.

January, 2004 to May 2004: Bioenergy and Climate Science Advisor, California Department of Forestry and Fire Protection, Sacramento, California. Develop a $40 million program to reduce wildland fuel hazards in key watersheds and near settlements in the Sierra Nevada as part of the Proposition 40 watershed protection bond. Develop GIS data needed to prioritize sites. Organize discussions with field staff to assess personnel and program requirements. Initiate discussions with field staff on Environmental Impact Report for fuels management programs. Provide testimony and information to legislative staff.

September 2000 to December 2003: Deputy Assistant Secretary for Resources/Science Advisor, California Resources Agency, Sacramento. Advise the Resources Secretary of the scientific dimensions of resources policy issues. Chair the Joint Agency Climate Team (consisting of representatives from Resources Agency, Cal Environmental Protection Agency, Business, Transportation and Housing Agency, State and Consumer Services Agency, Department of Food and Agriculture and the Governor’s Office of Planning and Research) and lead the development of proposed climate change policy for the state, including both mitigation and adaptation options. Ensure consideration of climate change in state transportation, land use and energy planning. Maintain relations with major academic and federal climate and global change research agencies, especially on the development of guidance to the federal Climate Change Science Program. Lead technical evaluation of federal and state forest policy, particularly related to timber, fire and fuels management. Assist the Secretary in the design and implementation of the California Legacy Program, particularly in the oversight of development of conservation investment methodology by the National Center for Ecological Analysis and Synthesis.

January, 1990 to August 2000: Research Manager, Assessment and Evaluation, Fire and Resource Assessment Program, California Department of Forestry and Fire Protection, Sacramento, California. Manage Assessment and Evaluation program staff to achieve the Program’s mandate for a periodic assessment of the condition and trends of California’s 35 million hectares of wildland, the nature and scale of benefits produced by these lands and the efficacy and cost of programs aimed at their management. Plan and execute an on-going assessment that surfaces key strategic questions facing the Department and its sister Departments within the California Resources Agency, gathers or develops data pertinent to those questions, analyzes and interprets the data and proposes strategic options for executive managers. Develop modeling approaches.
Global Change in Mountain Regions (GLOCHAMORE)

Greg Greenwood
Mountain Research Initiative (MRI), Bern, Switzerland

The GLOCHAMORE project aimed at the development of a global change research strategy for mountain regions, in particular, for protected areas such as UNESCO MAB Biosphere Reserves. The first version of the research strategy was developed in the course of a two-years’ EU-funded GLOCHAMORE project which contained a series of thematic workshops dedicated to: (1) long-term monitoring and analysis of indicators of environmental change in mountain regions; (2) integrated model-based studies of environmental change in different mountain regions; (3) process studies along altitudinal gradients and in associated headwater basins; and (4) sustainable land use and natural resource management in mountain regions. The concepts developed in these four thematic workshops were revisited, refined and synthesized during the final Open Science Conference on Global Change in Mountain Regions in Perth, Scotland, UK (Oct. 2-6, 2005). The strategy presented at the OSC was organized according to the current understanding of the main axes of causality. It focused first on drivers of global change, then on the impacts of global change on ecosystems, then on the subsequent impacts on ecosystem goods and services, regional economies, and health, and concluded with institutional arrangements. The inputs from the conference will be considered for the elaborated version of the strategy, which will be available by the end of November 2005 (http://mri.scnatweb.ch). This presentation will present the current version of the strategy and emphasize implications for the SHARE-Asia program.
BIDYA BANMALI PRADHAN

Bidya Banmali Pradhan

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**Academic Records**:
MS (Environmental Engineering) – Asian Institute of Technology (AIT), Thailand; 1996-97
M.Sc. (Biotechnology/Genetic Engineering) – Indian Institute of Technology, Bombay (IITB), Mumbai, India; 1991-93

**Major Professional Engagements**:
Since 1999, working in International Center for Integrated Mountain Development (ICI-MOD) coordinating projects:
Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effect for South Asia (1999-to date)
Project Atmospheric Brown Cloud (ABC) (2001 – to date)

**Professional Skills/ Expertise**:
Environmental management and technology, Air pollution and Atmospheric science, Environmental database management, Environmental project management and research design, Report reviewing on related subjects.

**Awards**:
AIT & USAID/Nepal Fellowship
Colombo Plan
Asahi Shimbun Scholarship Award (Japan).

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Climate change and sustainable development in the Hindu Kush – Himalaya

Bidya Banmali Pradhan, ICIMOD, Kathmandu, Nepal

The Hindu Kush-Himalayan region, stretching 3,500 km over eight countries, from Afghanistan in the west to Mynamar in the east, is home to more than 150 million people and affects the lives of three times as many in the plains and river basins below. The region is not only the world’s highest mountain region, but also its most populous. The wealth of the HKH lies in an immense diversity of flora and fauna and ethnic groups and languages. It is also an important source of water, energy and Biological diversity. Yet despite this rich diversity, in reality, the HKKH regions are exceedingly fragile. Each day, climate change, pollution, as well as exploitative mining and unsound agriculture practices, take a toll on mountain environments and the most vulnerable to these changes are the inhabitants of this region. Already, they are among the world’s poorest, hungriest and most marginalized people.

Sustainable development of these mountain regions is a challenging task because these areas have highly diverse and fragile ecosystems. The HKH region is geologically the youngest mountain range giving rise to a high degree of natural hazards. Specific information on ecology, natural resource potential and socio-economic activities is essential for sustainable development of this region. There is, however, a lack of sufficient knowledge of mountain ecosystems for the reasons of understanding of mountain specificities, ICIMOD’s effort has been to establish itself as a hub for mountain specific knowledge which will help in sustainable development. Among, several programmes ICIMOD is contributing to two important programmes related to climate change – i. Glacier and glacial lakes ii. Transboundary Air Pollution.

Glaciers and glacial lakes are the repositories of information for exploring quaternary climate changes, as they remain sensitive to global temperature conditions. Rising trend with the climate change much more pronounced in the higher altitude causing the net shrinkage and retreat of glaciers and the increase in size and number of glacial lakes. A number of Glacial Lake Outburst Floods (GLOFs) have been reported in the region in the last few decades and many number of potential threat of GLOF in the HKH region has been identified, which may pose death tolls in downstream populations as well as destruction of property and infrastructure.

Though, mountains are often associated with clean air, it can receive pollution due to transport of pollution by winds. Malè Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia and Project Atmospheric Brown Cloud (ABC) focuses to find the nature of transport of pollution for informed decision making to tackle transboundary air pollution through regional cooperation. Initial study has shown that aerosols have led to a large reduction of surface solar radiation during winter. This may affect agriculture, health and the hydrological cycle; eventually contribute to climate change.
Saraju K. Baidya

Qualification:

Training:
Regional Workshop on Climate Scenarios for South Asia 15-19 August 2005, Kathmandu, Nepal
BIMSTEC Workshop on Weather & Climate 21-23 July, 2005, Noida, India
International Workshop on Satellite Rainfall Estimation and Associated Technologies for the HKH Region 6-10 June 2005, Kathmandu, Nepal
Regional Training Course on Application of Geo-Informatics for Water Resources Management 17-28 March 2003, Kathmandu, Nepal
Training Seminar on Summer Monsoon and Prediction Techniques 17-20 December 2002, Kathmandu, Nepal
Training Programme on Vulnerability and Adaptation Assessment April 23-29, 2002, Bombay, India
Symposium on “Socio-Economic Impact of Meteorology”, 27-28 December, 1999, Dhaka, Bangladesh
Roving seminar on “Crop Yield Weather Modelling”, 19-30 July, 1999, Poona, India
Agro Meteorological Training (Post Graduate Diploma) 12 Jan 1997 – 13 Feb 1997, Bet Dagan, Israel
Workshop/ Seminar on Metropolitan Area Network (24 - 28 October 1994), Kathmandu, Nepal

Job Experience:
Working as a Senior Devisional Meteorologist and Chief of Meteorological Data Section, Dept. of Hydrology and Meteorology since July 2005 till now.
Worked as a Meteorologist in Central Data Processing and Computer Unit, Dept. of Hydrology and Meteorology since 1994 till July 2005.

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Climate Research in Nepal Himalayas

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Nepal is one of the mountainous countries of the world, with high topographical variation (varying from 60 m. to 8848 m. within 200 Km of horizontal span). This paper discusses some climatic research works in Nepal, mainly focusing on climate change and its impact and monsoon in Nepal.

Studies have indicated increasing trend of maximum temperature in most parts of the country with high warming trends in the Himalayan and middle mountain regions compared to lower altitudes and plains. This result is also supported by the retreating glacier trend in the Nepal Himalayas. The glaciological and meteorological observations of the glaciers and climate in Nepal Himalayas started in 1974 as the "Glaciological Expedition to Nepal (GEN)". The studies show that these glaciers are retreating at an alarming rate. Many researches in this field highlight the impacts on water resource management and Glacier lake outburst Floods (GLOF).

Nepal ratified the June 1992 Rio Earth Summit, committing to the objective of UNFCCC to take necessary steps and measures to reduce GHG emission in the atmosphere for mitigating the climatic change process and adopt national policies. Nepal Himalayas being most vulnerable to the climate change and its impact on water resources and agriculture, His Majesty's Government (HMG) of Nepal instituted a Country Study program on Climate Change in 1994. For the first time in Nepal, General Circulation Models (GCMs) were used and climate change scenarios were developed.

The application of climate models in mountainous region is even very challenging. Department of Hydrology and Meteorology (DHM), Nepal has started experiments on Regional Climate Model (RCM), the RegCM3 to study the impact of climate change and to assess the vulnerability. But Nepal being a mountainous region the model results highly deviates from the observation. This highlights the importance of the incorporation of topography and the need of high resolution regional models.

The role of Himalayas on Asian Summer Monsoon (ASM) has been well recognized by many modeling studies. Therefore, a project was developed in 1999 and number of meteorological stations ranging from 500 m to 4400 m were installed in the Marsyangdi river basin in central Nepal and Monsoon Himalayan Precipitation Experiment (MOHPREX) was carried out to study the interaction of the Himalayas and the Asian summer monsoon.
Ghulam Rasul

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Academic Qualifications: Ph. D. (Meteorology)
Professional Experience: 18 years experience working in National Meteorological Service of Pakistan in different capacities.

Dissertations:
2. Ph.D. Diagnosis and Numerical Simulation of Disastrous weather in South Asian Summer Monsoon. Supervised by Acad/Prof Zeng QingCun & Prof. Zhao Sixiong

Distinctions
SAARC Young Scientist Research Award (1994) by South Asian Association for regional Cooperation.

Publications: (Over 20 research papers published in national and international journals)

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Development of a meso-scale convective system over the foot-hills of Himalayas into a severe storm

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Diagnostic analysis has been carried out using NCEP reanalysis data along with radar and satellite images for the development of an MCS and resulting into a severe storm. It has been revealed that the sudden evolution of MCS was the direct result of strong surface convection in the moist and unstable lower layers of atmosphere. The subsequent rapid development was the combined effect the mid-latitude westerly’s trough in the north and moisture supply through monsoonal flow along the Himalayas. The westward drift of the Sub-Tropical High (STH) and the strong divergence zone on its eastern edge played a significant role in developing the upward motion. Movement of the system was controlled by the steering current in the mid-troposphere. The scale analysis shows that the MCS was the combination of $\alpha$, $\beta$ and $\gamma$ meso-scale systems.
Yaoming Ma got his PhD from Okayama University, Japan in 2000. In March 2002, he became a professor of Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI), Chinese Academy of Sciences (CAS). In April 2004, he became a professor of Institute of Tibetan Plateau Research (ITP), CAS. He is the leading scientist of the study on land surface and atmospheric processes at ITP/CAS. He is also Chinese overall coordinator of GEWEX Asia Monsoon Experiment on the Tibetan Plateau (GAME/Tibet) and Coordinated Enhanced Observing Period (CEOP) Asian-Australian Monsoon Project (CAMP) on the Tibetan Plateau (CAMP/Tibet). At same time, he is the director of Comprehensive Observation and Research Station on Mt.Qomolangma (Mt.Everest), Chinese Academy of Sciences.

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Study on land surface heat fluxes and water cycle over the Tibetan plateau

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As the most prominent and complicated terrain on the global, the Tibetan Plateau, with an elevation of more than 4000 m on average above mean sea level, makes up approximately one fourth of the land area of China. Long-term operation and research on the Tibetan Plateau have shown that the giant prominence expert thermal effects on the atmosphere, thus greatly influencing circulations over China, Asia and even the global. Due to its topographic character, the plateau surface absorbs a large amount of solar radiation energy and undergoes dramatic seasonal changes of surface heat and water fluxes. The lack of quantitative understanding of interactions between the land surface and atmosphere makes it difficult to understand the complete energy and water cycles over the Tibetan Plateau and their effects on the Asian Monsoon system by numerical models. Therefore, the study on energy exchange and water cycle are regarded as the main task in the GEWEX (Global Energy and Water cycle Experiment) Asian Monsoon Experiment on the Tibetan Plateau (GAME/Tibet, 1996-2000) and CEOP (Coordinated Enhanced Observing Period) Asia-Australia Monsoon Project (CAMP) on the Tibetan Plateau (CAMP/Tibet, 2001-2005). The intensive observation and long-term observation of the GAME/Tibet and the CAMP/Tibet have been done successfully in the past 8 years. A large amount of data has been collected, which is the best data set so far for the study of land surface heat flux and water cycle over the Tibetan Plateau. Firstly, the field experiments and some results on the local land surface fluxes partitioning (“imbalance”, diurnal variation, inter-monthly variation, inter-yearly variation and vertical variation etc) will be presented.

The study on the regional distribution of land surface heat fluxes is of paramount importance over heterogeneous landscape of the Tibetan Plateau and it is also one of the main scientific objectives of GAME/Tibet and CAMP/Tibet. Therefore, the derived regional distribution and seasonal variation of surface variables, vegetation variables and land surface heat fluxes are also presented by combining three NOAA/AVHRR images and two Landsat-7 ETM images with field observations.

In order to upscale the land surface heat fluxes to the whole Tibetan Plateau area, the Institute of Tibetan Plateau Research (ITP) of the Chinese Academy of Sciences (CAS) is establishing a Monitoring and Research Platform (MORP) for land surface and atmospheric processes on the Tibetan Plateau. The establishing and monitoring plan of long-term scale (5-10 years) of the MORP and three new comprehensive observation and study stations (Mt.Qomolangma, Nam Cuo and Linzhi) will also be introduced.
Rakshan Roohi was born in Lahore and completed M. Sc. in Botany from the University of Punjab, Lahore in 1978. Joined PARC 1981 and since then involved in various research activities. The first assignment was the development of a range management model. The innovative techniques like eyebrow terraces for plantation, alternate pits for reseeding the degraded patches, stock water development, etc. were developed which were adopted by the Pakistan Forest Department and even by some of the international agencies like JICA. This project also served as a model for teaching institutions like Pakistan Forest Institute and Agriculture Universities for Range Science and Forestry students.

The second project involved in was the Agro-Ecological Characterization and Classification of Pakistan. Since Pakistan is a long strip running from north with snow-covered peaks to south touching the Arabian Sea, there is a high variability in climate and resource base. Furthermore, most of the terrain falls in semi-arid to hyper-arid zone and at the top of that country is heavily dependent upon agriculture. To account for this natural variability, this project was initiated. Based on the performance, awarded a competitive scholarship for foreign training in 1985. I was the first lady scientist in Pakistan who completed higher studies in the field of Range Science. After successfully completing M.S. and Ph. D. from Colorado State University, Fort Collins, USA rejoined the duties at PARC in 1989. The assignment was to establish a Geoinformatics facility for agricultural planning and natural resource management. In collaboration with various national and international organizations like JIRCAS (Japan), ICIMOD (Nepal), Imperial College (UK), US Science Foundation, ICARDA (Syria), IUCN, NDP, etc. a fully functional and well equipped with latest hardware and software, a Geographic Information System/Remote Sensing facility was established. It is the first type of facility in the country particularly in agriculture sector. Besides, a multidisciplinary and well-trained team in the application of GIS/RS is developed. Under this programme, the GIS/RS application methodologies are established. A comprehensive database is developed which is used for resource inventory, planning and monitoring. Several case studies were completed under various projects, which have proved the potential of GIS/RS in agricultural planning and natural resource management in the country.

The northern areas of Pakistan comprising parts of Hindukush, Karakoram and Himalayan (HKH) region are blessed with numerous glaciers and glacial lakes. Since the total number of glaciers, glacial lakes and potential GLOF hazards in the region was unknown, in collaboration with ICIMOD, APN, UNEP and START initiated a study in the major basins of the glaciated area of Pakistan. A comprehensive database was developed on these resources for future monitoring of GLOFs in the region.

As an Adjunct Faculty, teaching courses on Remote Sensing and GIS to master level class of Fatima Jinnah Women University and National University of Science and technology besides supervising M.Sc. theses in RS/GIS applications.

Have more than 30 publications in various disciplines covering range management, crop production, resource use planning, sustainability, agro-climatic characterization, remote sensing and GIS applications.
Member of various technical committees, societies and boards. For the achievements so far, awarded the highest women achievement certificate “Mohtarma Fatima Jinnah Certificate” in 2004.

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Research on global changes in Pakistan

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Pakistan lies between 24° and 37° N latitude and 61° and 75° longitude covering an area of 88.2 million hectares including northern areas. Inherently the country has highly variable topography, climate and culture. The three major mountain ranges namely Hindu Kush, Karakoram and Himalaya border in the north followed by plateaus, plains and coastal areas. The climatic variability is expressed by humid zones in the north-east to hyper-arid in south-west and west. The major part of the country could be classified as arid to hyper-arid. Under such circumstances the climate change impacts could be more visible.

The research on climate change in Pakistan is in its initial stages and has just started with the commencement of the century. Realizing the importance and potential impact of climate change on natural resources and population and their sustainable development, several activities have been initiated and a Global Change Impact Study Center has been established under the Ministry of Science and Technology. In collaboration with international institutions like Asia pacific Network for Global Change Research, ICIMOD, UNEP, START, etc. several projects has been launched to undertake research on the impact of climate change on various components of the complex system like water resources, ecology, agriculture, socio-economics, etc. The basic theme is to do the resource inventories/vulnerability assessment and identify potential threats based on which coping mechanisms could be identified and policy recommendations could be made. The information generated under such studies could be coupled with the similar studies in the other countries of the region and regional impacts could be studied. To reach at a conclusion about the climate change there is a need to do the spatial and temporal analysis. For such analysis the historical data is the key element. Using historical climatic data it has been concluded that since 1931 in general the extreme temperatures in the arid environments have increased while in sub-humid and humid environments these have been decreased. The extreme annual rainfall in hot humid, sub-humid and semi-arid environments has increased while in cool-humid and sub-humid, dry mountain coastal zones there is a decreasing trend. In a similar study the impact of climate change on agriculture particularly in the mountain environment was studied and it was observed that especially on the lower elevation the growing season length has been increased. Several studies have been carried out to use the simulation model for climate change impact on water resources, forest ecosystems and socioeconomic conditions. The snow and glaciers are sort of barometers of climate change. Recently a comprehensive inventory of glaciers and glacial lakes in the HKH region of Pakistan has been completed. This comprehensive database will provide baseline information for future climate change studies.