

# Cryosphere and Atmosphere



**T**he Hindu Kush Himalayas contain the largest concentration of snow, glaciers, and permafrost outside the Polar Regions. This vast accumulation of snow and ice is a natural reserve of water and is the source of ten major river systems in Asia that supply water to more than 1.3 billion people downstream. Changes in the cryosphere of the Hindu Kush Himalayas have the potential to directly impact millions of people,

especially those who are dependent on water supplies fed by snow and glacier melt. However, there is lack of long-term, consistent cryosphere monitoring, which is central to understanding the effects and potential impacts of the changing climate on the cryosphere. ICIMOD is working to enhance understanding of complex cryospheric processes, including rising threats of glacial lake outburst floods, to better understand how changes

“Glacier retreat and its impact on water resources are of interest to India. The cryosphere group should work toward generating higher quality hydromet data in the Himalayan cryosphere for water discharge and security in lean periods, for vulnerability assessment, and for eco-sustainability.”

– Alagappan Ramanathan, Jawaharlal Nehru University, New Delhi

Yala Glacier, Langtang, Nepal



in the contribution of snow and glacier melt to runoff will affect people living downstream.

Climate change is driven by changes in the atmospheric concentration of substances that absorb incoming light or outgoing infrared radiation. While warming temperatures, a phenomenon that is more acute at higher elevations, play a role in accelerated melting, there is growing evidence of the role of black carbon

in the region’s cryosphere. Black carbon particles resulting from incomplete combustion are deposited on the glacier and snow and contribute to increased snow and ice melt in the upper reaches of the Hindu Kush Himalayas. Because of the intrinsic link between the emission of black carbon and other short-lived air pollutants and changes in the cryosphere, the two initiatives of cryosphere and atmosphere are housed together within the new organizational structure.

## Building Regional Capacity for Glacier Monitoring

In 2012, ICIMOD focused efforts to improve monitoring of the region's cryosphere on building the capacity of partner institutions and students from the region. Scientists from partner institutions and students from the Master's programme in Glaciology at Kathmandu University, a degree programme that ICIMOD helped establish in 2011, joined monitoring expeditions to glaciers in the Langtang Valley of Nepal. ICIMOD experts trained participants on taking glacier mass balance measurements, meteorological measurements, and hydrological measurements and the use of geodetic measurement techniques and GPS and Total Station surveying equipment.

Another critical part of strengthening cryospheric research in the Hindu Kush Himalayas is improving regional cooperation. ICIMOD hosted an international conference in May 2012 where scientists and partners from the region came together to share knowledge and discuss paths for cooperation in cryosphere research. A web-based cryosphere knowledge hub was initiated at ICIMOD, cementing the Centre's role in facilitating regional cooperation and knowledge sharing on the region's cryosphere.

“Through this collaboration between ICIMOD and Kathmandu University, we get more opportunities and hands-on glaciology training. We have access to computers and software that we would not have otherwise.”

– Achut Parajuli, Kathmandu University

“The training provided by ICIMOD, especially in Matlab, has helped us learn about programming and modelling hydrology. As a beginner, the training was a great way to build my knowledge.”

– Sonika Shahi, Kathmandu University

Yala Glacier, Langtang, Nepal





Sonika Shahi, a student of Glaciology at Kathmandu University, measures ice melt from a stake on Yala Glacier, Langtang, Nepal.

“The students had information sharing sessions every evening to discuss what we observed throughout the day. In the earlier part of the trek these sessions were very useful, and the comments and feedback from the experts were very encouraging.”

– Sanjaya Guring, Kathmandu University

“I attended the Glacier Mass Balance Measurement Training in May 2012 with other regional participants. The theoretical training before the field visit was useful during practical demonstrations. The literature and data analysis provided helped us better understand the results of mass balance experiments.

“This training led us to replicate mass balance experiments on Pakistan’s glaciers. Mass balance experiments were done on Baltoro Glacier in collaboration with German and Italian scientists and on Passu Glacier by our own team.”

– Adnan Shafiq Rana,  
Meteorologist, Research and Development Division,  
Pakistan Meteorological Department

## Pakistan and UN Seek to Cut Risk of Glacial Lake Floods

One major achievement at ICIMOD to address the threat of glacial outburst floods has been the creation of an inventory system for glacial lakes in the Hindu Kush Himalayan (HKH) region using improved data and methodologies. In 2005, ICIMOD compiled an inventory of Pakistan’s 5,000 glaciers across an area covering 15,000 km<sup>2</sup>. It found that 52 glacial lakes were in a potentially dangerous condition.

In 2012, an outcome of this long-term work is a project designed by the United Nations Development Programme (UNDP) and Pakistan’s Ministry of Climate Change based on this earlier work. The project has chosen two sites to reduce the risks of glacial lake flooding in northern Pakistan. The project will develop the ability of public institutions and vulnerable communities to understand and address the risks of glacial lake floods. It plans to work with local people to draft disaster management plans and install early warning systems.

This is one of the first initiatives to be funded by the UN Adaptation Fund, which finances programmes that help developing countries adapt to the negative effects of climate change. This project, whose initial design is based off of ICIMOD research, could serve as a model for other GLOF projects in the mountains of the region.



## Partnering for Cleaner Air

There is broad scientific consensus that short-lived climate pollutants such as black carbon, methane, and many hydrofluorocarbons are the number two driver of global climate change behind greenhouse gases and pose a urgent and collective challenge. In 2012, ICIMOD joined the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants, the first global effort to address short-lived climate pollutants, as a non-state partner.

ICIMOD's current work on the atmosphere has a special focus on black carbon: improving science, exploring mitigation measures, sharing knowledge, and influencing policy. Prior to joining the coalition, ICIMOD made substantial contributions in this field through UNEP's Atmospheric Brown Cloud project and the Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia.

### The health costs of air pollution

In 2012, ICIMOD published a peer-reviewed study, *Rapid Urban Assessment of Air Quality for Kathmandu, Nepal*, the first to collect data on different types of emissions in both wet and dry seasons in the increasingly polluted Kathmandu Valley.

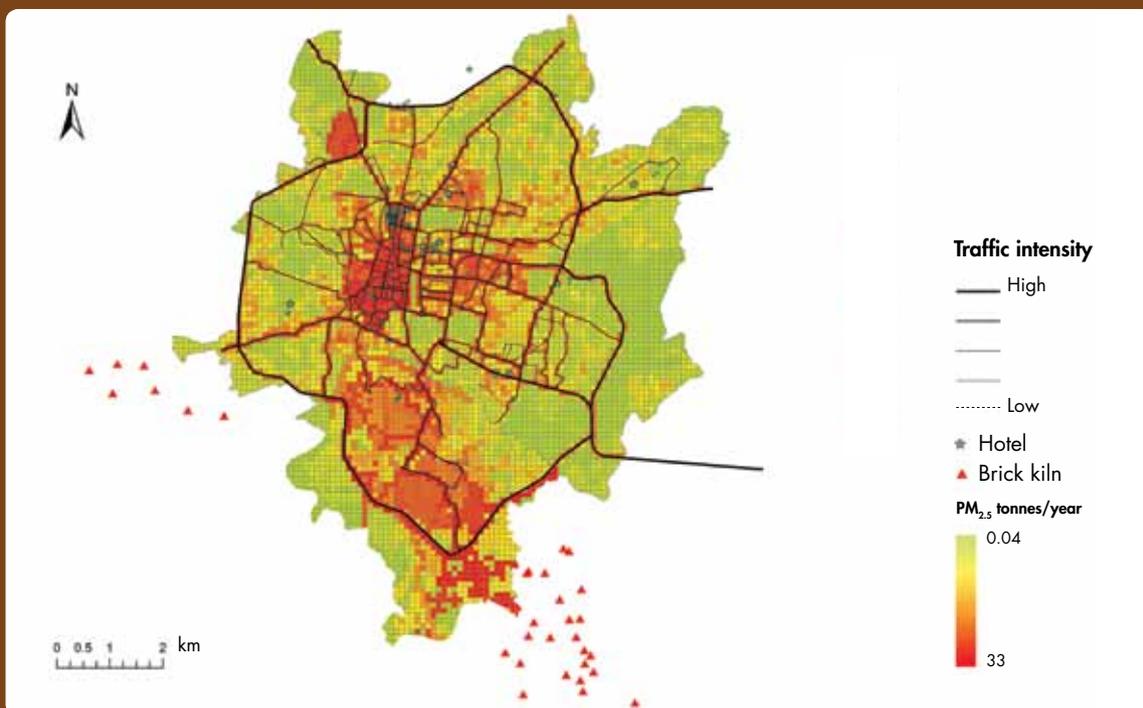
*"An estimated 30 million rupees (USD 400,000) in hospital costs could be saved every year by reducing the level of airborne pollutants to meet World Health Organisation guidelines,"* the study suggested.

The study has an emission database for Kathmandu and offers information on hot spot areas of the city, which the government could use in plans or mitigation measures. It utilizes a template based on measures outlined in the Malé Declaration that were tested in Hyderabad as a pilot for future studies in South Asia.

*"Many congratulations on the publication 'Rapid Urban Air Quality Assessment of Kathmandu Valley'. I hope it will generate public pressure to make the ministry take action. I am currently in Afghanistan working to develop a National Strategy for Air Quality Management. I would greatly appreciate if you could send me the Malé Emissions Inventory Workbook Template - Version 2.4 used in developing the emission inventory."*

– Chiranjibi Gautam, ESIA Adviser,  
National Environmental Protection Agency of  
Afghanistan, World Bank-SDNRP II

A map from an ICIMOD study shows the concentration of particulate matter less than 2.5 micrometres in diameter in Kathmandu, Nepal. Particulate pollution – especially fine particles – can get deep into the lungs and cause serious health problems and can cause reduced visibility and affect a diversity of ecosystems.





Kathmandu Valley, Nepal

## **Developing local and regional solutions to reduce black carbon**

ICIMOD has identified black carbon and other short-lived climate pollutants as a major area of focus in the next five years. Working to reduce the emission of black carbon in the region has the potential to create considerable impacts, both in terms of air quality and the wellbeing of people living in the Hindu Kush Himalayas.

Unlike greenhouse gases, black carbon is very short-lived in the atmosphere, disappearing within days to weeks after the emission sources are shut down. Reducing black carbon aerosols have multiple benefits, including reduction of climate impacts, benefits to human health, and improved agricultural productivity. Improved technologies can help

reduce black carbon emissions, including the use of alternative and cleaner fuels for cooking and cleaner burning stoves; reducing emissions from industries using coal, especially brick kilns; improving vehicle emissions, especially diesel-powered, through refined fuel and improved filters; and reducing the open burning of agricultural residue and other waste.

ICIMOD has planned activities to study the health and climate benefits of various types of improved cookstoves through a pilot programme beginning in 2013 and is working to identify and build awareness of improved technologies for brick kiln operators and policy makers to help reduce black carbon in the region.