



United Nations  
Educational, Scientific and  
Cultural Organization



International  
Hydrological  
Programme



Flanders  
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# THE IMPACT OF GLACIER RETREAT IN THE ANDES

International Multidisciplinary Network  
for Adaptation Strategies



## THE CONTEXT

The Andes – the world longest continental mountain range – extends in South America through seven different countries, namely Venezuela, Colombia, Ecuador, Peru, Bolivia, Chile and Argentina. The population of these countries accounts for more than 160 million people representing more than 40% of the continent's total population. Many Andean valleys are seasonally dry and glacier runoff is crucial to maintain a more constant flow of fresh water throughout the year. In fact, much of the snow falling is initially stored as ice in mountain glaciers before being gradually released over time. Therefore, glaciers act as critical buffers against highly seasonal precipitation and provide water for domestic, agricultural and industrial use during the dry season.

However, climate change over the 20<sup>th</sup> century, especially global warming, has led to Andean glaciers increasingly being out of equilibrium with their current climate. As a result, rapid glacier retreat has been observed in every country of the Andean region. The trend has intensified since the 1990s, as temperature rise has accelerated and projections for the 21<sup>st</sup> century confirm this tendency. Several studies indicate that for the end of the century, Andean temperature will be significantly warmer and exhibits a much larger interannual variability. These climate changes will affect environmental services, biodiversity and socioeconomic activity in every country of the region.

It is clear that adaptation strategies should be implemented without delay from a multidisciplinary approach, yet at the same time the scientific knowledge is not really sufficiently advanced to adequately guide such implementations.

This network was initiated during the UNESCO International Hydrological Programme IHP-VII (2008-2013) *Water Dependencies*, and its activities and findings will continue helping to build the scientific knowledge base to support involved countries to sustainably manage their water resources as part as the new phase of IHP-VIII *Water Security, responses to local regional and Global Challenges* (2014-2021).



# ACTIVITIES

## INCEPTION WORKSHOP

An initial workshop was organized in Lima, Peru on May 29-30, 2012, involving glaciologists, hydrologists, water resources experts, mountain biosphere managers, policymakers, social scientists, local stakeholders and experts from UNESCO's International Hydrological Programme (IHP) and Man and the Biosphere (MAB) networks. The objective was to ensure that local stakeholders understand the global context of the project and could present, discuss and bring in their own knowledge, needs and expectations.

**The workshop came up with key recommendations for policy advisers and decision makers of Andean countries:**

- Evaluate the regulatory role of glaciers in the region;
- Raise awareness through education, training and dissemination of information;
- Promote dialogue and collaboration among scientists, decision makers and affected communities, as well as coordinate existing initiatives in the region.

**Based on these recommendations, a set of project activities were defined:**

## FIELD COURSE ON GLACIER MONITORING AND MASS BALANCE

A field course on glacier monitoring and mass balance was organized in Valdivia, Chile, in August 2012, in cooperation with the UNESCO Working Group on Snow and Ice of (GTNH-IHP) and the Andean Climate Change Inter-American Observatory Network (ACCION).

During the field course, 35 participants from seven Andean countries gathered to discuss advances on glacier mass balance assessment in each country and to receive further capacitation in the more recent measuring methods.



## VULNERABILITY ASSESSMENT OF GLACIER MELT CONTRIBUTION TO WATER RESOURCES IN THE ANDES

Glaciers are retreating worldwide due to global warming and the melting rate of Andean glaciers has increased considerably since 1970. To identify the vulnerability of Andean countries to the reduction in glacier mass, the contribution of melting glaciers to water resources in the Andean Countries was estimated.

Although large seasonal and interannual variations are observed, a significant portion of the population in Andean Countries is dependent on glacier melt water

for personal consumption, agricultural and energy production. The produced country maps enable the identification of this vulnerability and of appropriate adaptation measures for vulnerable communities.

## CLIMATE SCHOOL ON "ANDEAN CLIMATE VARIABILITY AND CHANGE"

The Climate School held in Lima in September 2013 addressed the topic of "Climate Variability and Change in the Andes region" to identify the consequences of climate change for the Andean environment and society. The Climate School focused both on the

uncertainties in our current understanding of the climate system as well as on the scientific challenges associated with future climate projections.

The course fostered cross-disciplinary connections and collaborations covering a broad spectrum of climate change aspects. The school provided a platform where the next generation of scientists from the Andes gained professional experience and connections beyond their countries' borders.





### SCIENCE POLICY WORKSHOP ON “IMPACTS OF GLOBAL CLIMATE CHANGE ON SNOW, GLACIER AND WATER RESOURCES IN THE ANDES: POLICY RECOMMENDATIONS FOR ADAPTATION STRATEGIES”

The Andean Climate Change Interamerican Observatory Network (ACCIÓN) and CONDESAN jointly organized the Science Policy workshop from 20-21 November 2013 in Quito, Ecuador. The meeting brought together the scientific and policy fields communities, already working on global change impacts on snow, glaciers and water resources in order to formulate policy recommendations for adaptation strategies.

The workshop resulted in recommendations for scientists, policy advisers and decision makers from Member States of the region which included research agendas and strategies for climate change adaptation.

### SCIENCE POLICY BRIEFS FOR DECISION MAKERS

Outreach will involve dissemination of scientific results to policy and decision makers, water managers, stakeholders and affected local populations. The objective of these policy briefs is to raise awareness among policymakers in order to enhance capacities to assess, monitor and communicate the impacts of and responses to climate change on natural and socio-economic environments at local, national and regional levels.



Five policy briefs are currently being finalized:

1. Existing climate change adaptation policies and challenges/opportunities for their implementation;
2. Vulnerability and threats to snow and glaciers in the Andes;
3. Status of education on climate change, water issues and glaciers;
4. Prioritizing scientific research for developing adaptation policies;
5. Climate change adaptation practices in the Andean Region.

### EXHIBITION “CLIMATE CHANGE IMPACTS ON MOUNTAIN REGIONS OF THE WORLD”

UNESCO International Hydrological Programme (IHP) and the Man and the Biosphere (MAB) programme, organized the exhibition ‘Climate change impacts on mountain regions of the world’ within the framework of the World Mountain Forum (WMF). The exhibition was opened on 22 May 2014 at Cusipata Square, in Cusco.

The exhibition uses satellite images, provided mainly by the Japan Aerospace Exploration Agency (JAXA), to highlight the critical functions of mountains and the implications of climate change for mountain ecosystems, water resources and livelihoods.



### SPECIAL EVENT IN THE FRAMEWORK OF COP20

The above mentioned exhibition was also presented at the COP20 of the United Nations Framework Convention on Climate Change (UNFCCC) in Lima in December 2014.

During a special session at the Municipal Palace of Lima, the “Mountains Ecosystem Services and Climate Change” Policy Brief was launched. This publication aims to transform scientific information and experience into action by answering local and regional needs for tools to improve adaptation to global changes and build capacity to address and meet today’s global water challenges.

The Policy Brief is an outcome of discussions based on an overview paper presented at regional workshops in Africa, Asia, Latin America (2013) and a workshop held in Paris (2014) in the context of “Climate Change Impacts in Major Mountainous Regions of the World: Multidisciplinary Network for Adaptation Strategies (Africa, Asia, Latin America and Europe)”.



### GLACIER MASS BALANCE MANUAL

The Manual is the result of the effort of glaciology researches in Latin America with the aim of building capacity of students, technicians and professionals working on glacier monitoring by means of field techniques.

This initiative is led by University of Albany, USA, and is executed in Latin America by Centro de Estudios Científicos (CECs) from Valdivia, Chile. The main objective is to train a broad spectrum of personnel involved in glaciological research, allowing generation of new scientific knowledge, contributing to public decision making, water resources administration, public dissemination and awareness building on current and future water resources. Because on-going climate changes are gaining concern for snow and ice-covered surfaces in Andean countries, this encourages local science groups to pursue glaciological programmes and improve monitoring capacities via qualified personnel and modern measurement techniques accompanied by appropriate infrastructure and financing.



# OBJECTIVES

1

## RAISE AWARENESS AND ENHANCE CAPACITIES

to assess, monitor and communicate the impacts of and responses to climate change on natural and socio-economic environments at local, national and regional levels in the Andean regions.

2

## DEVELOP STRATEGIES AND POLICY GUIDELINES

considering vulnerabilities, opportunities and potentials for adaptation with particular reference to strengthening the role of local communities.

3

## FACILITATE AND STRENGTHEN ON-GOING RESEARCH

4

activities in the region.  
**PROVIDE EDUCATION AND TRAINING** at tertiary level, middle technical level and review and strengthen community education.

# EXPECTED RESULTS

→ **HUMAN AND INSTITUTIONAL CAPACITIES STRENGTHENED** to cope with climate change impacts in the Andean region.

→ **DISTRIBUTION OF CLIMATE SCENARIOS AND ASSESSMENT OF WATER AVAILABILITY** and demand for current/future scenarios of water stress.

→ **IDENTIFICATION OF MOST VULNERABLE COMMUNITIES** in the region, studies on drivers of vulnerability and development of adaptation strategies at the local and regional level to improve livelihoods.

## PARTICIPATING INSTITUTIONS

- + **International Association of Cryospheric Science (IACS)**
- + **Consortio para el Desarrollo Sostenible de la Ecorregión Andina (CONDESAN)**
- + **Adaptive governance of mountain ecosystem services for poverty alleviation enabled by environmental virtual observatories (MOUNTAIN-EVO)** funded by ESPA (Ecosystem Services for Poverty Alleviation) coordinated by Imperial College
- + **The International Network for Alpine Research Catchment Hydrology (INARCH) of the Global Energy and Water Exchanges Project (GEWEX)**
- + **Andean Climate Change inter-American Observatory Network (ACCION)**, University of Albany

## PARTICIPATING COUNTRIES

Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Venezuela and partners from the region.

## COORDINATION

### INTERNATIONAL HYDROLOGICAL PROGRAMME (IHP)

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The Project is funded by Flanders UNESCO Science Trust Fund (FUST).