

ANDEX: A Regional Hydrology Program for the Andes

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Rationale (1)



✓ Geographical issues

- The Andes are the world's longest mountain range: 7,242 km.
- It runs through seven countries: Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina and Chile.
- From the northern Caribbean coast (12°N) to southern South America (50°S).
- About 200 to 700 km wide (widest between 18°S - 20°S), and average height 4,000 m.
- Due to long north-south extent it exhibits strong hydroclimatic variability associated with Latitudinal and Hemispheric location, but also with aspect, slope and elevation.
- It contains glaciers, volcanoes, deserts, high plateaus, lakes, *páramos*, *yungas*, *punas*, cloud forests, wet forests, tropical rainforests, dry forests, savannas, and intra-mountainous valleys.

Rationale (2)



- ✓ Socioeconomic and biodiversity issues
 - A major center of biodiversity and source for adjacent areas in birds, reptiles, insects, and plants, and a major driver of diversification.
 - The Andes harbor major cities like Bogotá, Quito, La Paz, Santiago, Medellín, Cali, Cajamarca, Cuzco, Arequipa, San Cristobal, Riobamba, Ambato, Ayacucho, Huancayo, Oruro, Cochabamba, Mendoza, and hundreds of medium and small sized towns and villages demanding an ever increasing supply of natural and socio-economic resources and services.

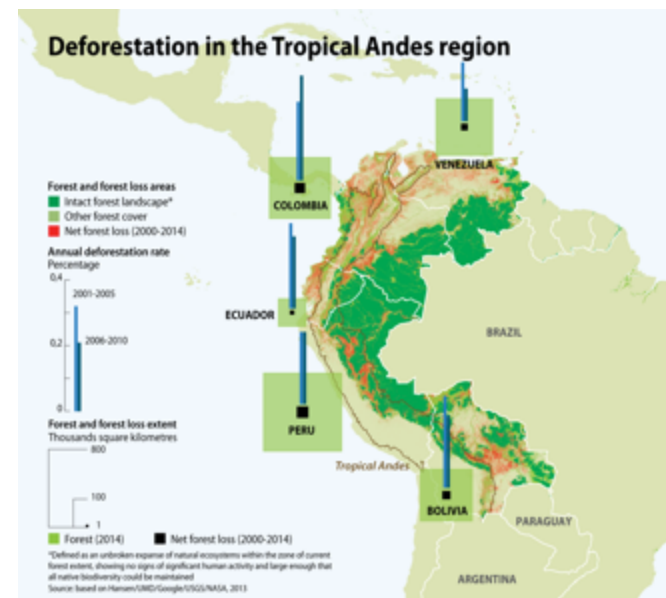


Rationale (3)

✓ Vulnerability issues

- Increasing poverty
- Disappearance of native and ancestral cultures
- Large scale deforestation, erosion and land degradation
- Landslides
- Accelerated loss of biodiversity and soils degradation
- Large-scale pollution of water sources owing to mining activities, oil industry activities, agriculture, cattle dwellers

→ Increasing vulnerability and risk of human populations and settlements
→ Need for a better understanding of hydroclimatic variability and change



<https://www.grida.no/resources/8094>

GRID-Arendal and Cartografare il Presente/
Riccardo Pravettoni

Threats from Climate Change and Hydroclimatic Variability

All Andean Glaciers are Rapidly Receding (From Colombia to Chile)

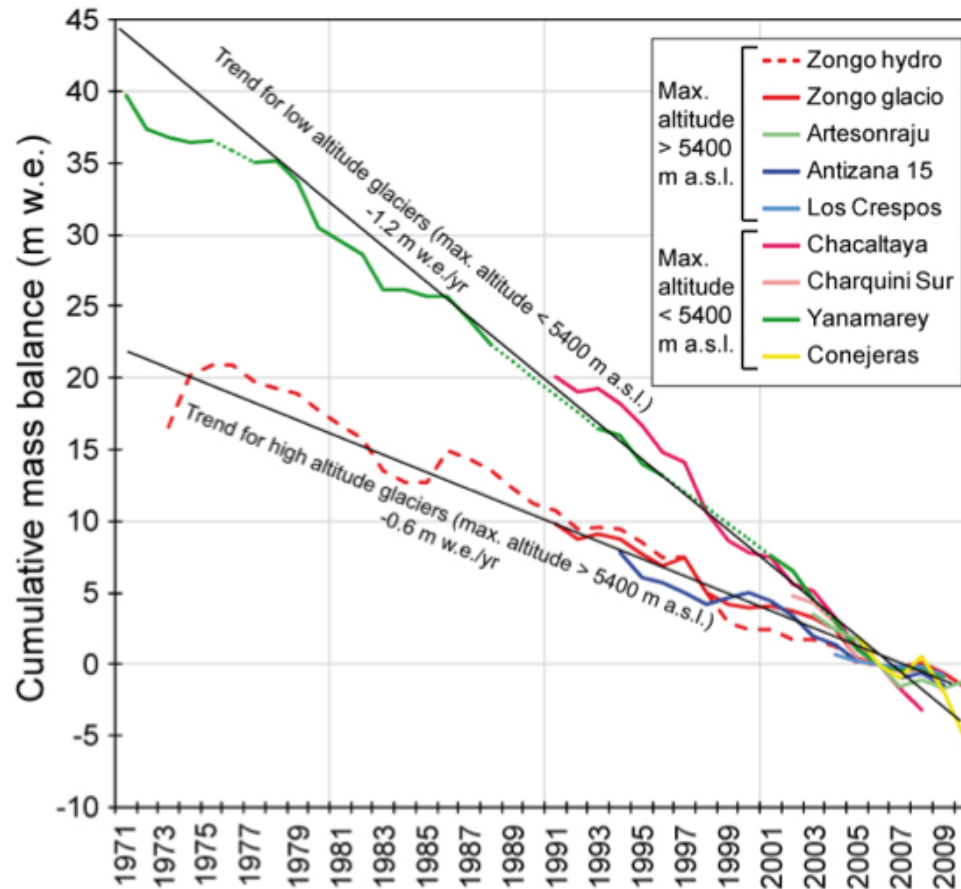


Fig. 6. Cumulative annual mass balance series computed for eight glaciers in the tropical Andes. 2006 was chosen as the common reference.

Fate of Paramos, Yungas, Punas, & Cloud Forests?

Vanishing glaciers in the Colombian Andes^{47 48}



1946



2006



2021?

Photos: (from left to right): Erwin Kraus (1946, reprinted with permission from Diego Samper Editores); Oliver Hill / Roberto Ariano (2006), and; Photoshop editing courtesy of John French (2006).

Threats from Climate Change and Hydroclimatic Variability and Deforestation

Intensification of Storms and Floods

Changes in the Andes Cause Flood Risks for South American Cities



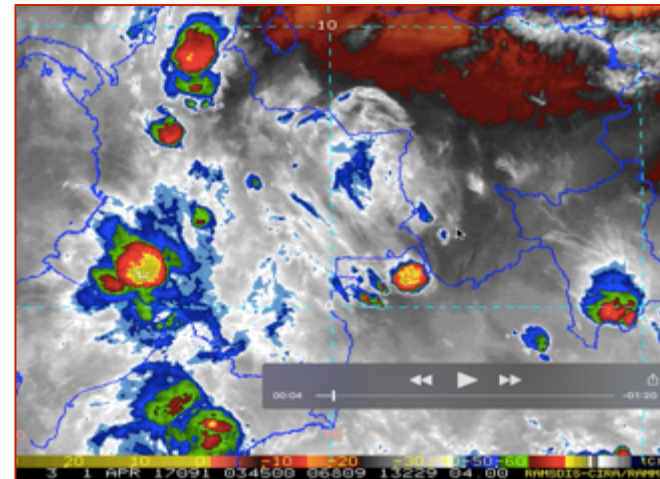
TOPICS: Climate Change Cloud Forest Colombia Ecology Forest Paramos Urbanization

DECEMBER 8, 2012



Deforestation and a changing climate high in the Andes can adversely impact Colombia's cities far below. Credit: Flickr/Matthew Rutledge

Mesoscale Convective System triggered the flooding of Mocoa, Colombia, on April 1st, 2017: 350 dead

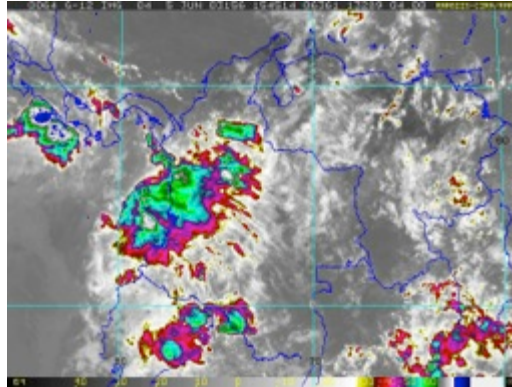


Deforestation in the Andes: Socio-Environmental Risks and Vulnerability



Deforestation in Andes
photo Paul Salaman

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Two RHPs on South America: (1) LBA

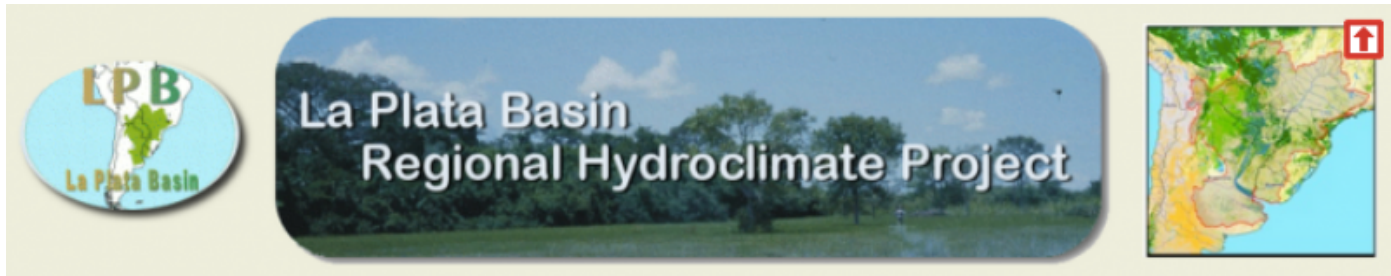
The two overarching questions of LBA



★ **How Amazonia functions currently as a regional entity with respect to the natural cycles of water, energy, carbon, nutrient and trace-gases?**

★ **How will changes in land use and climate affect the biological, chemical and physical functioning of Amazonia, including its sustainability and influence on global climate?**

Two RHPs on South America – (2) La Plata Basin



Project Description:

CLIVAR/VAMOS and GEWEX/GHP identified the Rio La Plata Basin as a climate-hydrology system with components that are potentially predictable with useful skill from seasons in advance, and whose variability has important impacts on human activities.

LPB provides a framework for integration of regional projects leading to improved predictions of the climate and hydrology system, and the coordination of those projects at the highest international level (WMO/WCRP).

LPB can act as an advocacy group to agencies that provide funding for science projects and the strengthening of the scientific infrastructure.

LPB aims to enhance the scientific infrastructure in the Plata Basin in agreement with producers and users of climate information.

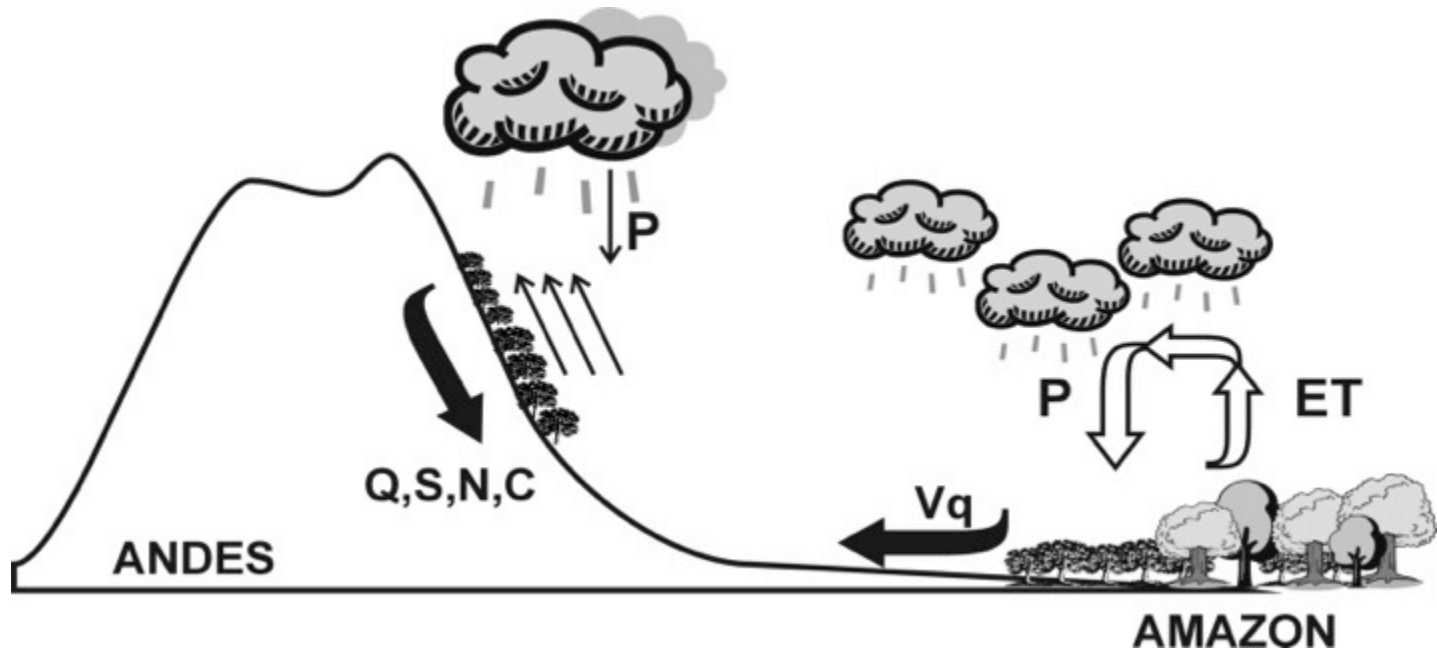
https://www.eol.ucar.edu/field_projects/lpb

None of these previous RHPs on South America have investigated their connections with the Andes

Feedbacks between the low-lying Amazon and the upper Andean Amazon:

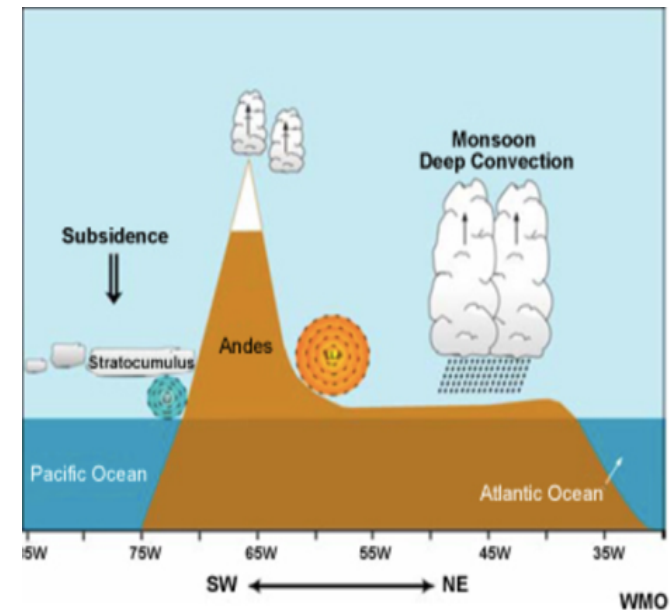
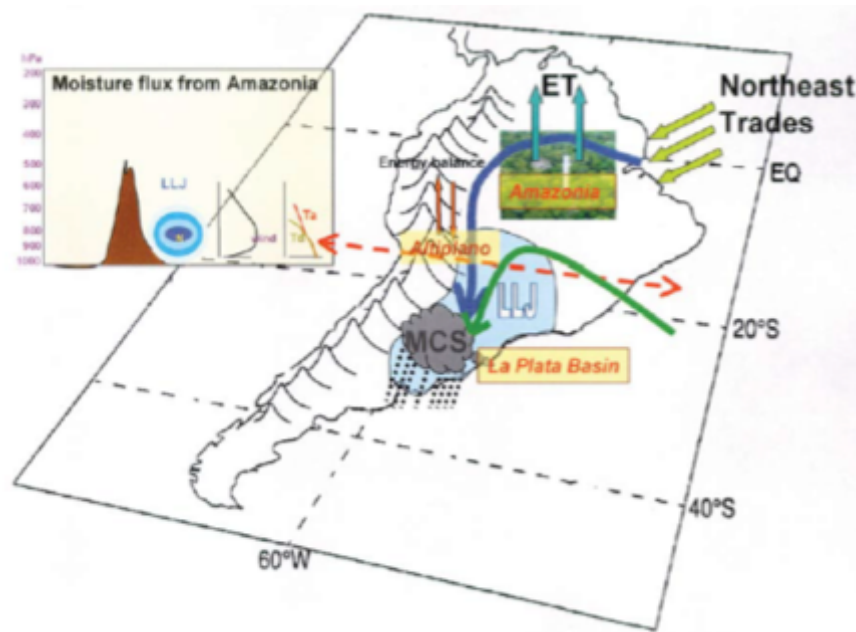
Low-lying Amazon exports atmospheric water to the Andes

The Andes export surface water (sediments, nutrients, soil) to the low-lying Amazon



The Andes and La Plata Basin

Schematics of the winds connecting the Atlantic Ocean with the Andes across the Amazon and Orinoco River basin with the Andes and to La Plata River basin.



Marengo et al. (2004)

Research Topics

- Climate change impacts on Andean glaciers, paramos, punas, and cloud forests and their impact on the hydrologic cycle and water supply.
- Risk, Vulnerability, Environmental Degradation in and caused by Andean cities.
- Water, energy and carbon budgets along the Andes-Amazon gradients, their feedbacks at a wide range of space-time scales and the effects of climate variability and change.
- Socio-environmental vulnerability of the Andes/Amazon region and the impacts of climate change and land use-land cover change.
- Mechanisms to prevent further deforestation and environmental degradation of the Andean region through sustainable and rational exploitation of natural resources including water, biodiversity, forests, fisheries, and agriculture to improve the livelihoods of the region's inhabitants.

ANDEX

Proposed Main Scientific Questions

1. What are the main physical processes driving the hydroclimatology of the Andes at a broad range of spatial and temporal scales, and their interactions with the neighboring oceans and major river basins of South America?
2. How climate change, deforestation and land use changes are affecting the hydroclimatological functioning of the Andes across the altitudinal gradients, from glaciers, to paramos, punas, cloud forests, rainforests, dry forests, etc.?
3. What are the major processes driving the coupling between the Andes and the low-lying river basins east of the Andes (Amazon, Parana, La Plata) at a wide range of spatiotemporal scales?

First Concrete Activity

A Workshop will take place in Medellín, Colombia, in December 4th-7th, 2017, convened by Prof. Germán Poveda, National University of Colombia at Medellín.

Confirmed participants:

- Peter van Oevelen (GEWEX director).
- Joan Cuxart Rodamilans (RHP, GEWEX)
- Silvina Solman (UBA, Argentina).
- René Garreaud (UCh, Chile).
- Jhan Carlo Espinoza (IGP, Peru).
- Rodney Martinez (CIIFEN, Ecuador).
- A representative from Bolivia (TBD).