Climate change and tropical Andean glacier retreat – Update and perspectives for adaptation

Mathias Vuille

Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York

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Under the umbrella of

Energy and Climate Partnership of the Americas
ECPA

With funding from

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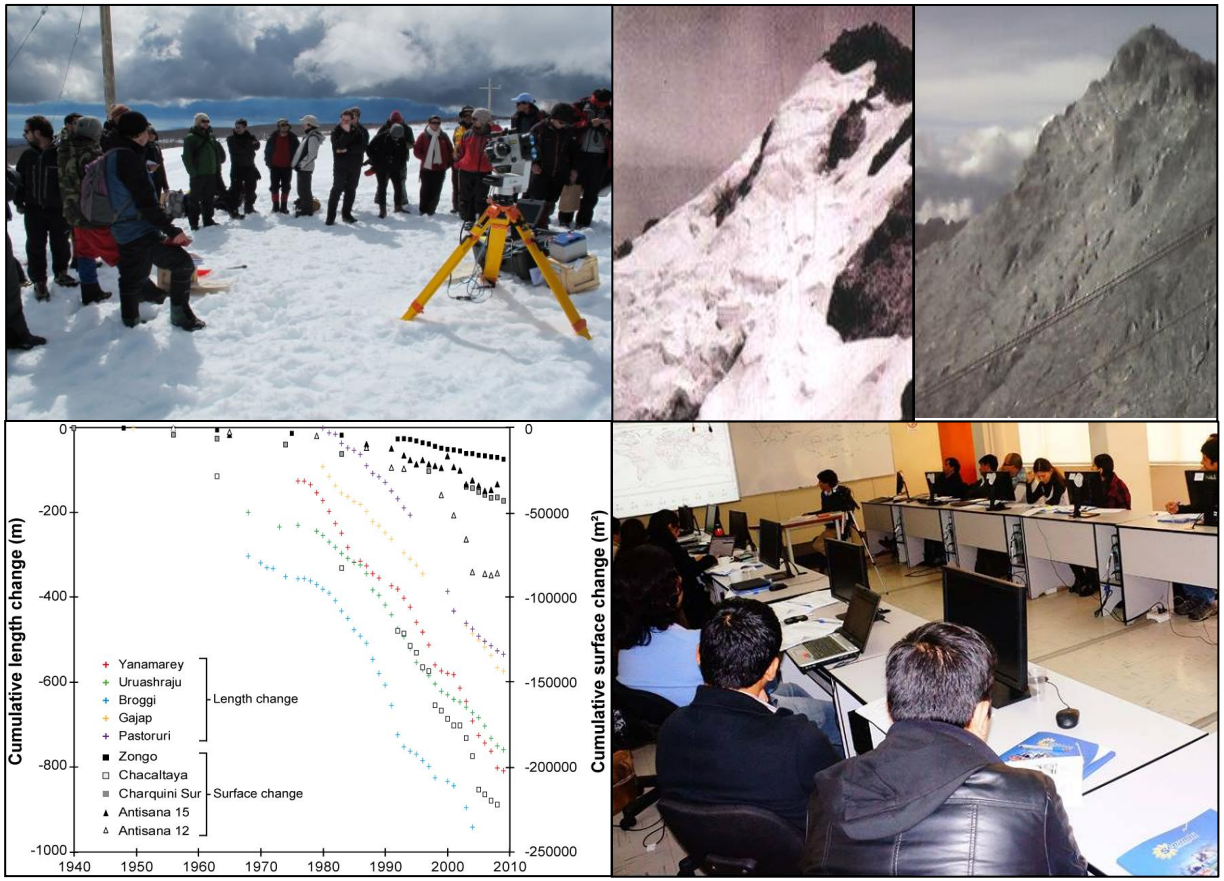

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Glacier retreat in the tropical Andes threatens sustainable water supply

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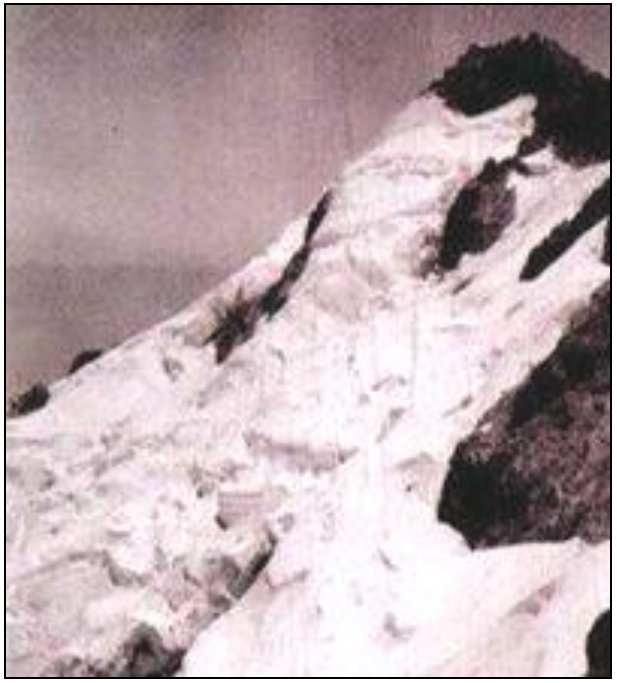
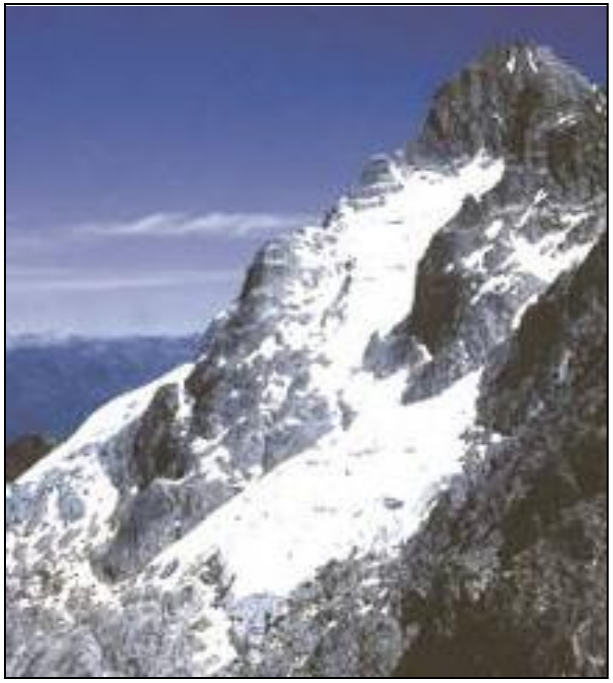
Glacier Espejo, Pico Bolivar (5002 m), Venezuela

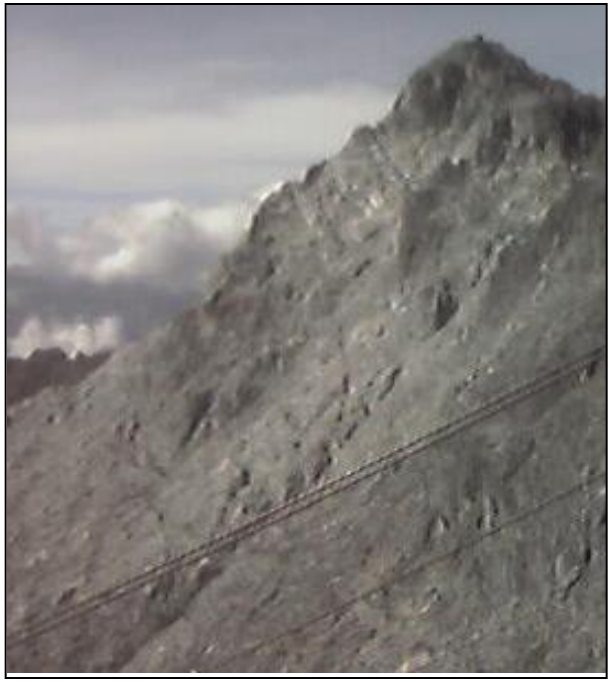
1910



1988



2008



Jahn [1931]; Schubert [1992, 1999]

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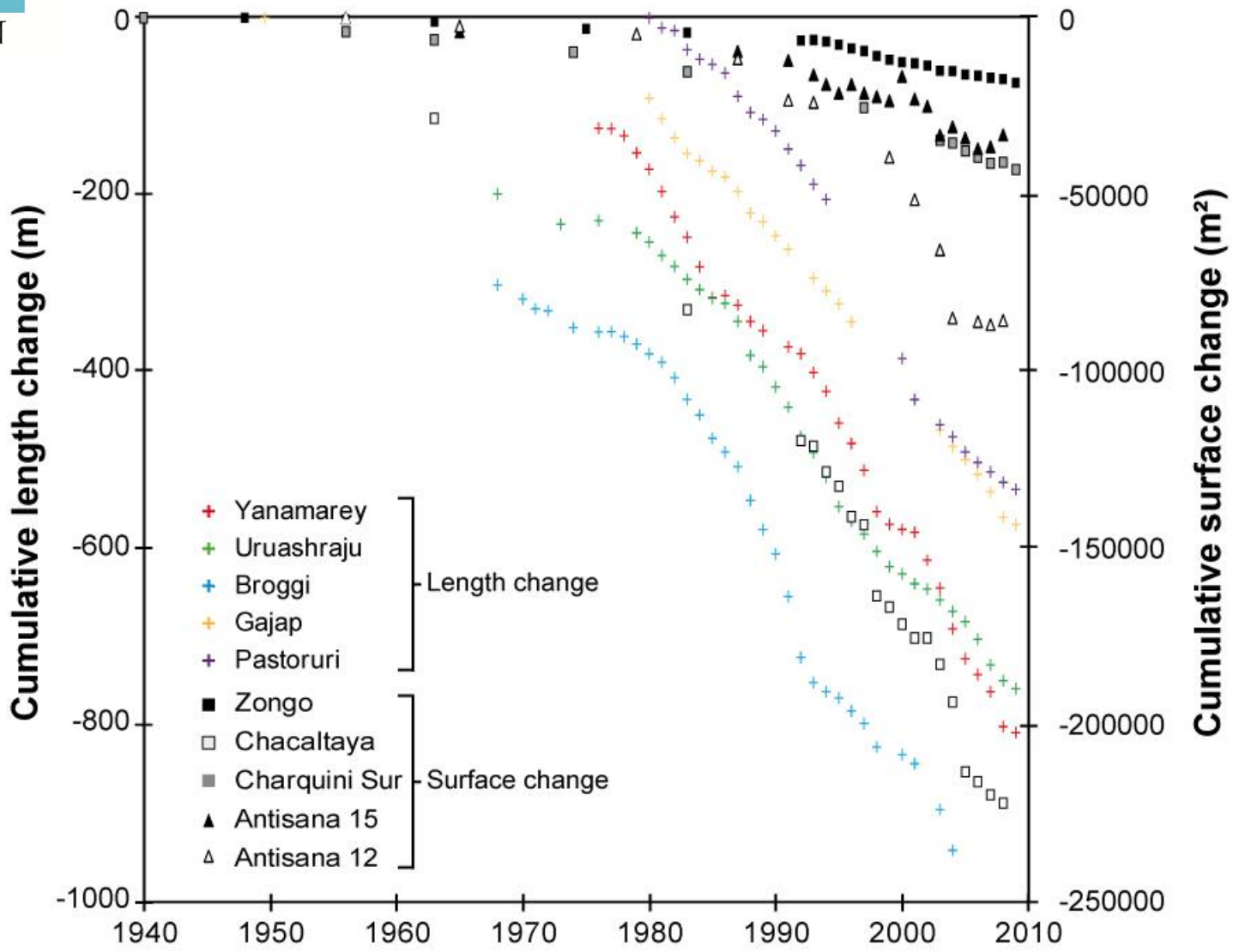
Length change and surface area loss of 10 glaciers in Ecuador, Peru and Bolivia



Rabatel et al., *The Cryosphere* [2013]

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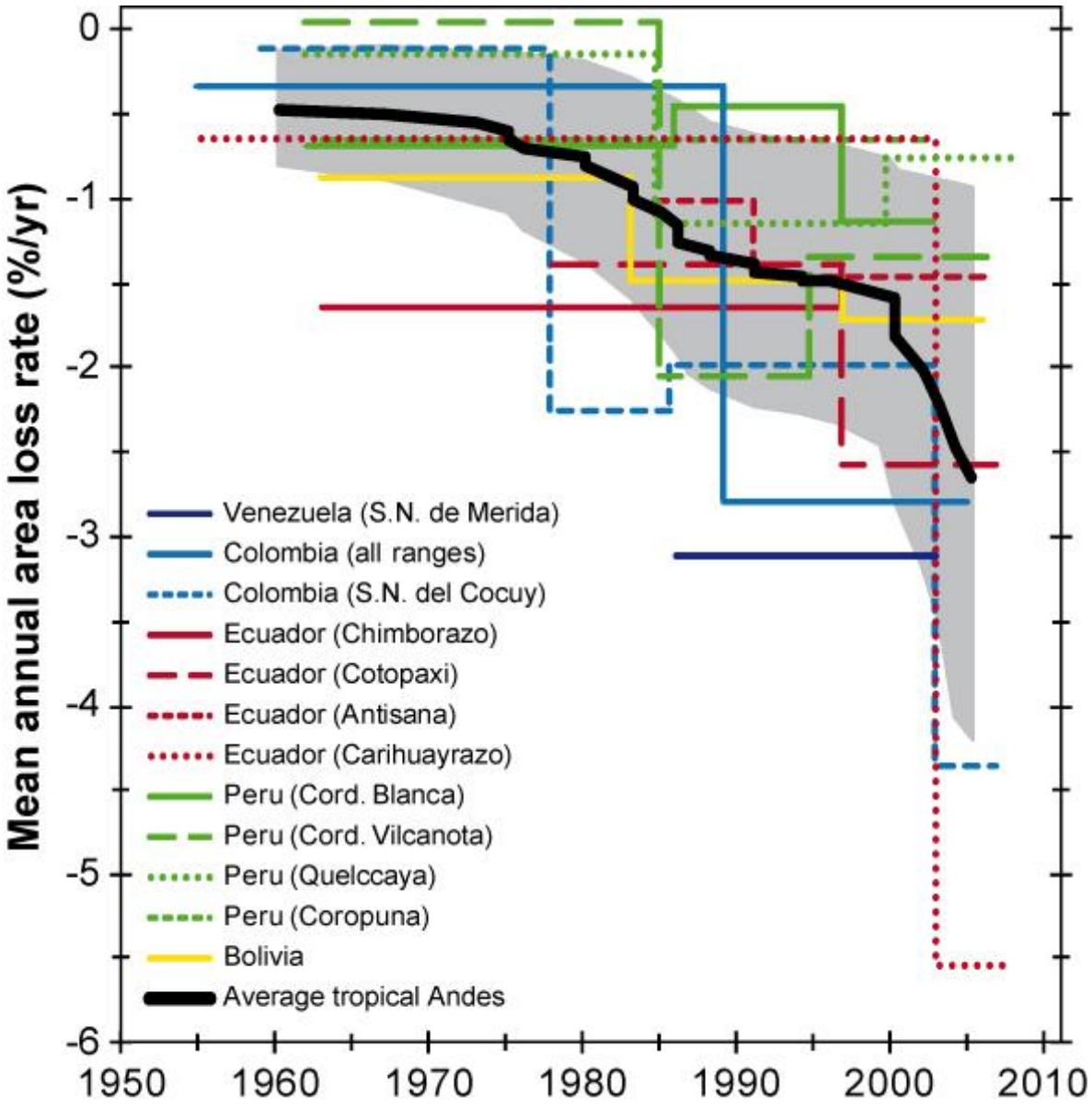
Mean annual area loss



Rabatel et al., *The Cryosphere* [2013]

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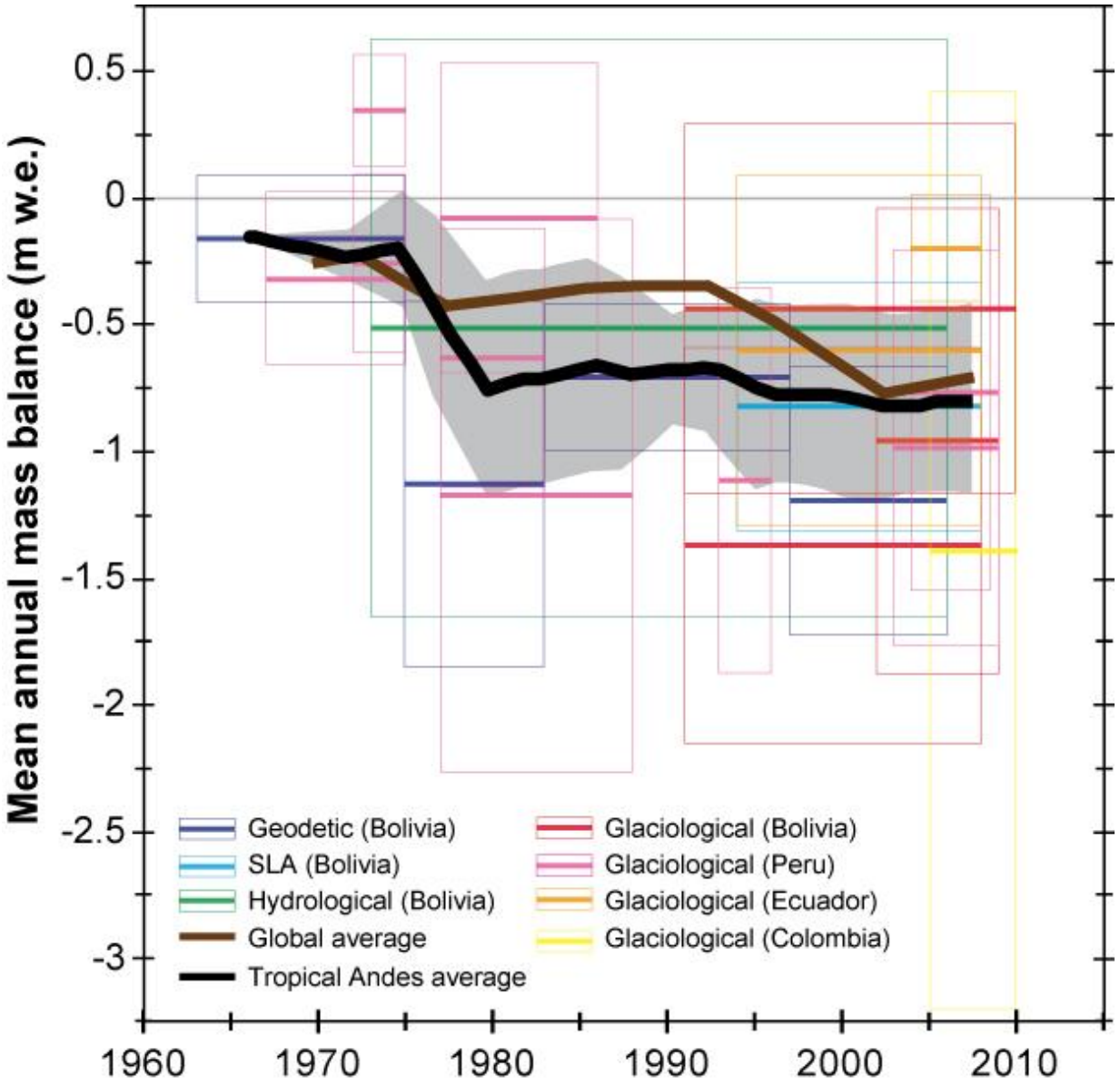
Mean annual mass balance



Rabatel et al., *The Cryosphere* [2013]

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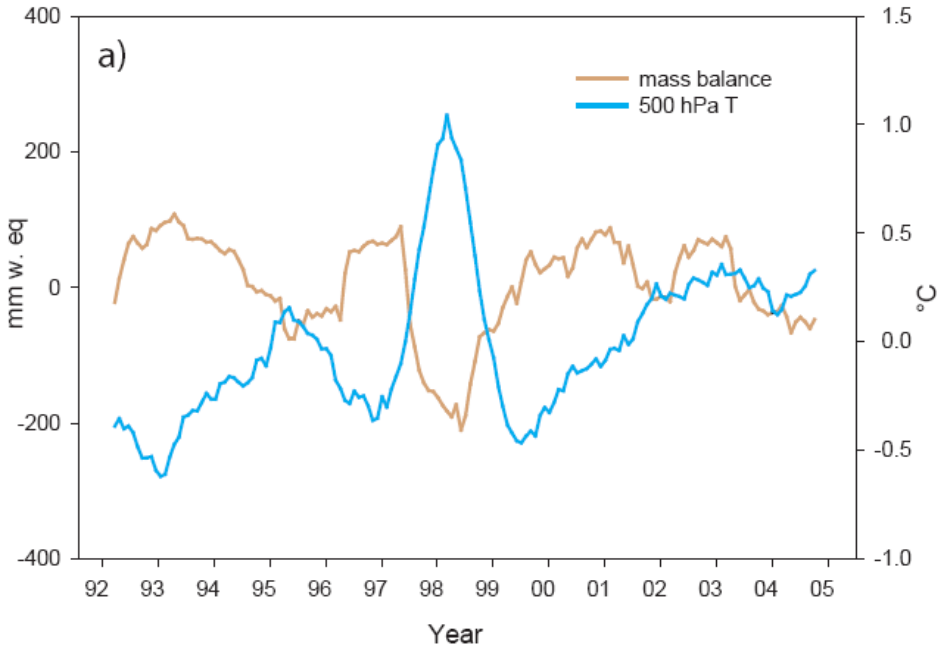
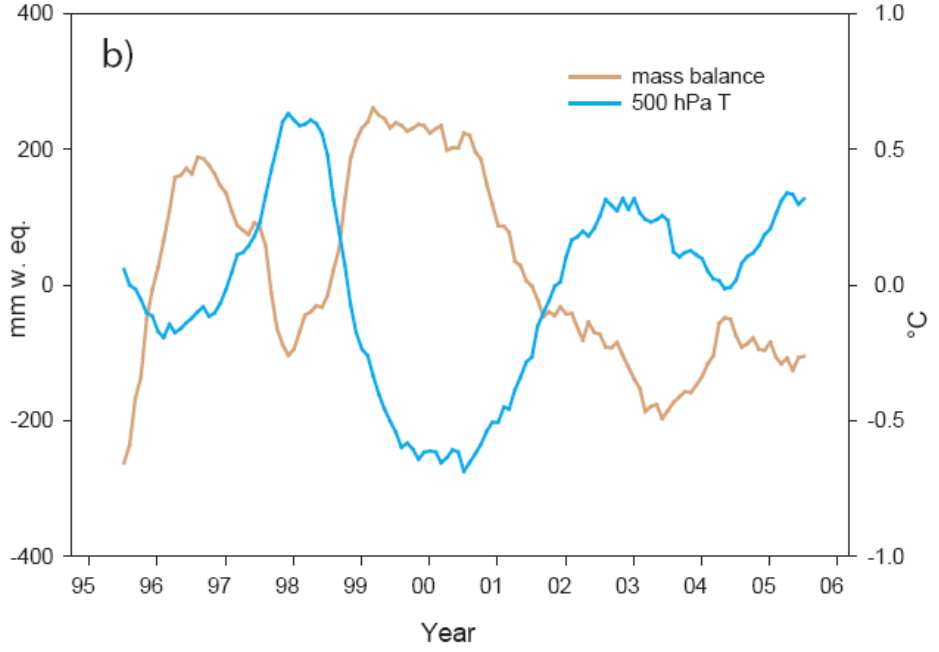
Temperature control on Andean glacier mass balance



Chacaltaya, Bolivia



Antizana, Ecuador

Vuille et al., *Earth Sci. Rev.*, [2008]

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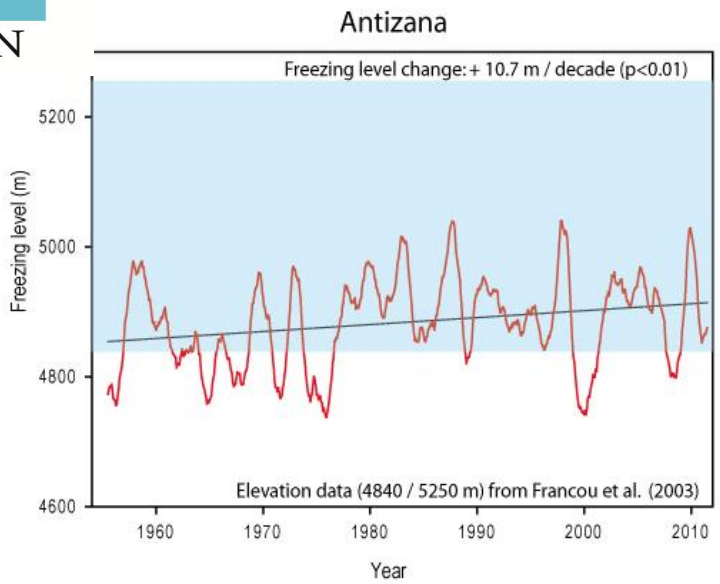
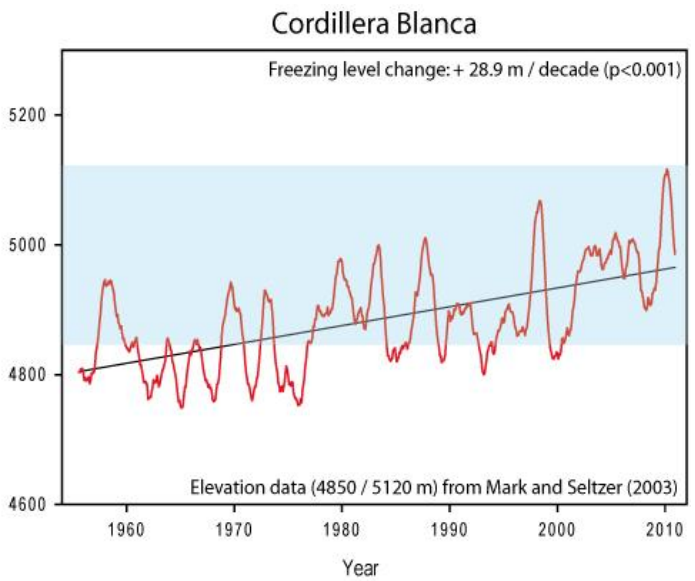
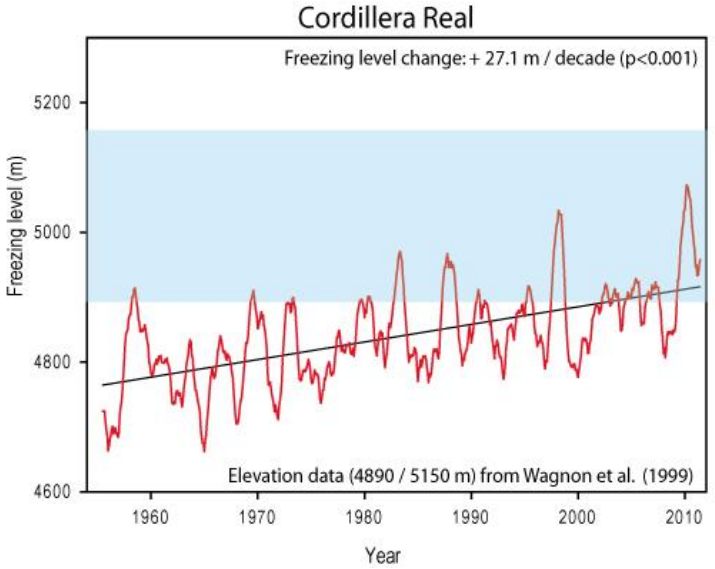
The rising freezing line altitude in the tropical Andes





Blue shading indicates glacier ablation area (zone between ELA and glacier tongue)



Rabatel et al., *The Cryosphere* [2013]

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Differences in temperature trends between tropical and extra-tropical Andes

Vuille et al., *J. Geophys. Res.* [2015]

LA TERCERA

Tendencias

Temperatura en la cordillera sigue aumentando por cambio climático

Según estudio, desde los 60 ha subido 0,25 °C por década, mientras en la costa baja 0,2 °C por década desde los años 80.

Cristina Espinoza
/ 22/06/2015 - 03:54

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Dos fenómenos relativos a la temperatura se presentan en la actualidad en el país. En la cordillera, sin interrupción desde -al menos- 1960, la temperatura ha subido sobre los dos mil metros de altura, a razón de 0,25 °C por década. Pero en la costa del norte y centro de Chile, el fenómeno es opuesto: aunque la temperatura también seguía una tendencia positiva desde hace 50 años, a partir de los 80 se revirtió y ha bajado 0,2 °C por década.

Así lo señala una revisión de datos meteorológicos liderada por Mathias Vuille, de la U. de Albany, Nueva York, en la que participó el chileno René Garreaud, subdirector del Centro de Ciencia del Clima y la Resiliencia (CR2). El estudio, que incluye datos de Bolivia, Perú y Chile, constata que -a

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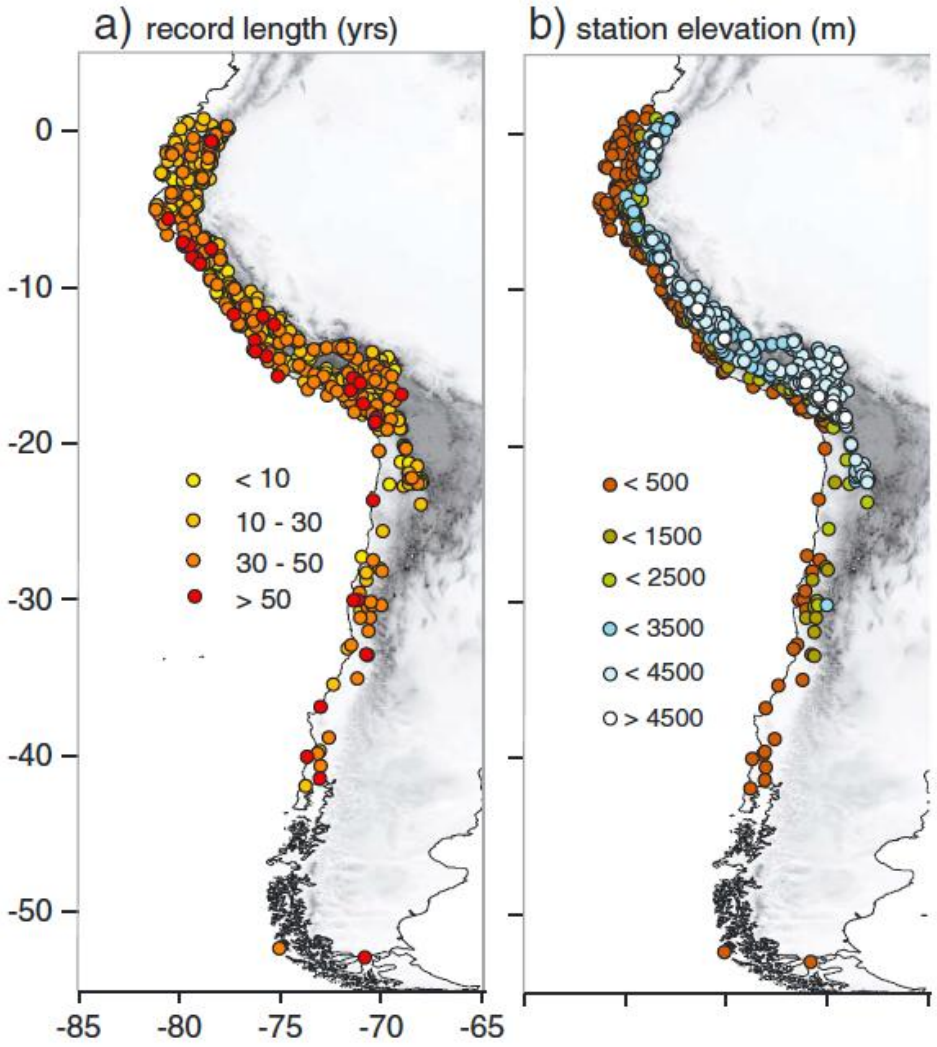
Temperature trends in the Andes (1950-2010)



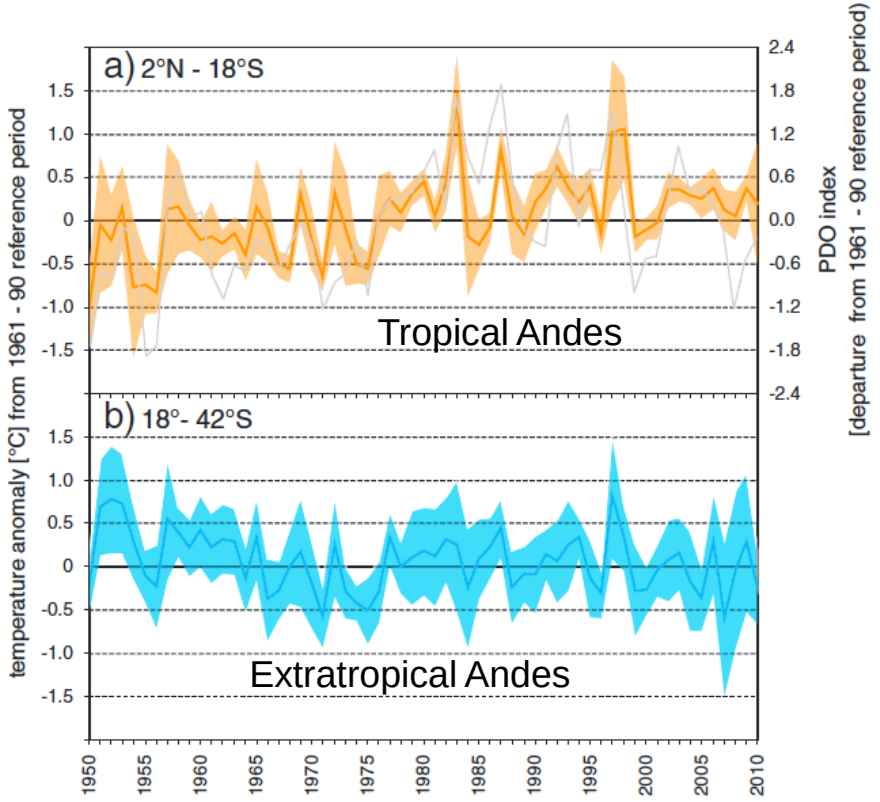


Figure 2. Annual mean temperature departures from 1961 to 1990 reference period for (a) tropical (2°N–18°S) and (b) extratropical region (18°S–42°S). The gray line in Figure 1a indicates PDO. The color shading represents two standard errors of estimate (2 standard deviations of the gridded temperature deviations divided by the square root of the number of grid boxes on either side of the estimate).

Vuille et al., *J. Geophys. Res.* [2015]

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Temperature trends in the Andes (1950-2010)

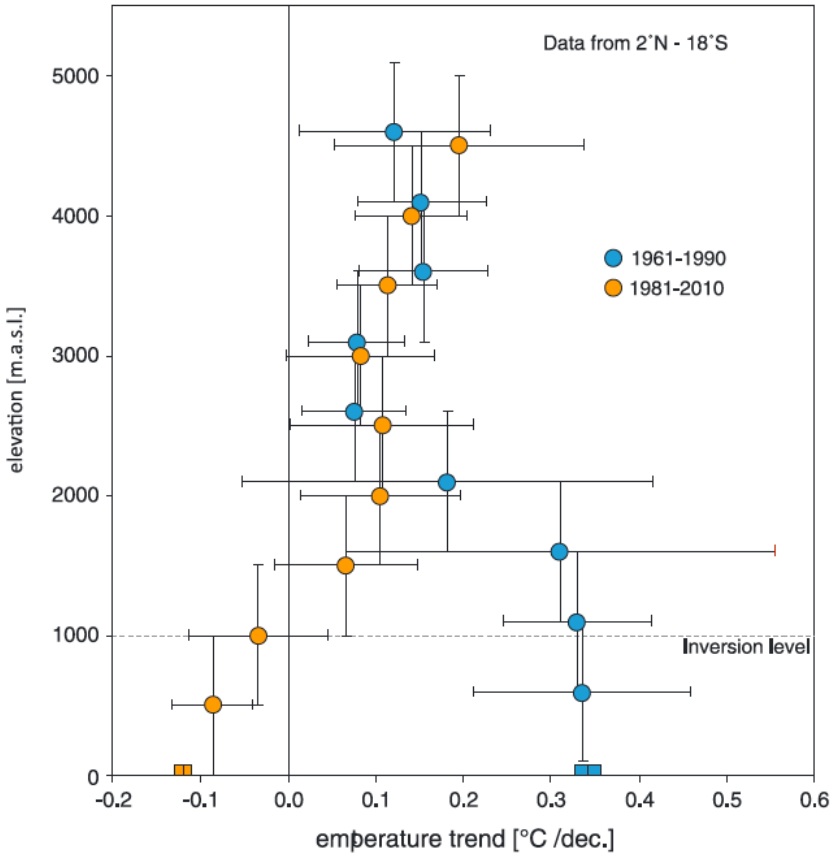

Figure 5. Temperature trends versus altitude along western tropical Andean slopes (2°N–18°S) for 1961–1990 (blue circle) and 1981–2010 (orange circle). The horizontal bars represent 95% confidence limits based on one sample *t* test. Trends are significant at 95% level if horizontal bars do not intersect 0°C/decade vertical line. The vertical bars indicate 1000 m elevation range used to calculate trends. For clarity, trends for 1961–1990 are offset by 100 m. The color bars at 0 m indicate trend (black vertical line) ±95% confidence limits for SST-WSA index for 1961–1990 (blue bar) and 1981–2010 (orange bar), respectively.

Vuille et al., *J. Geophys. Res.* [2015]

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Temperature trends in the Andes (1950-2010) – the role of the PDO

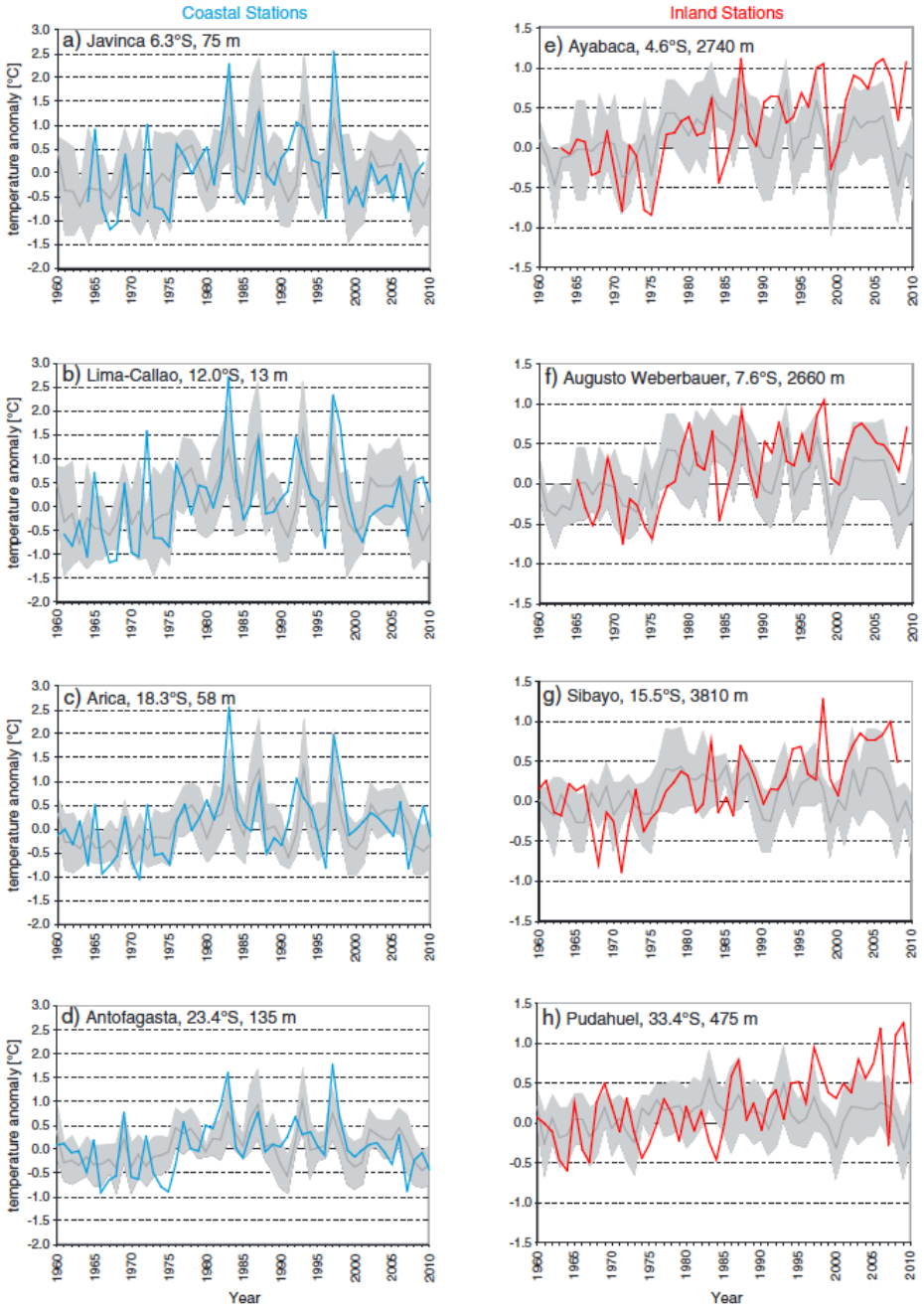


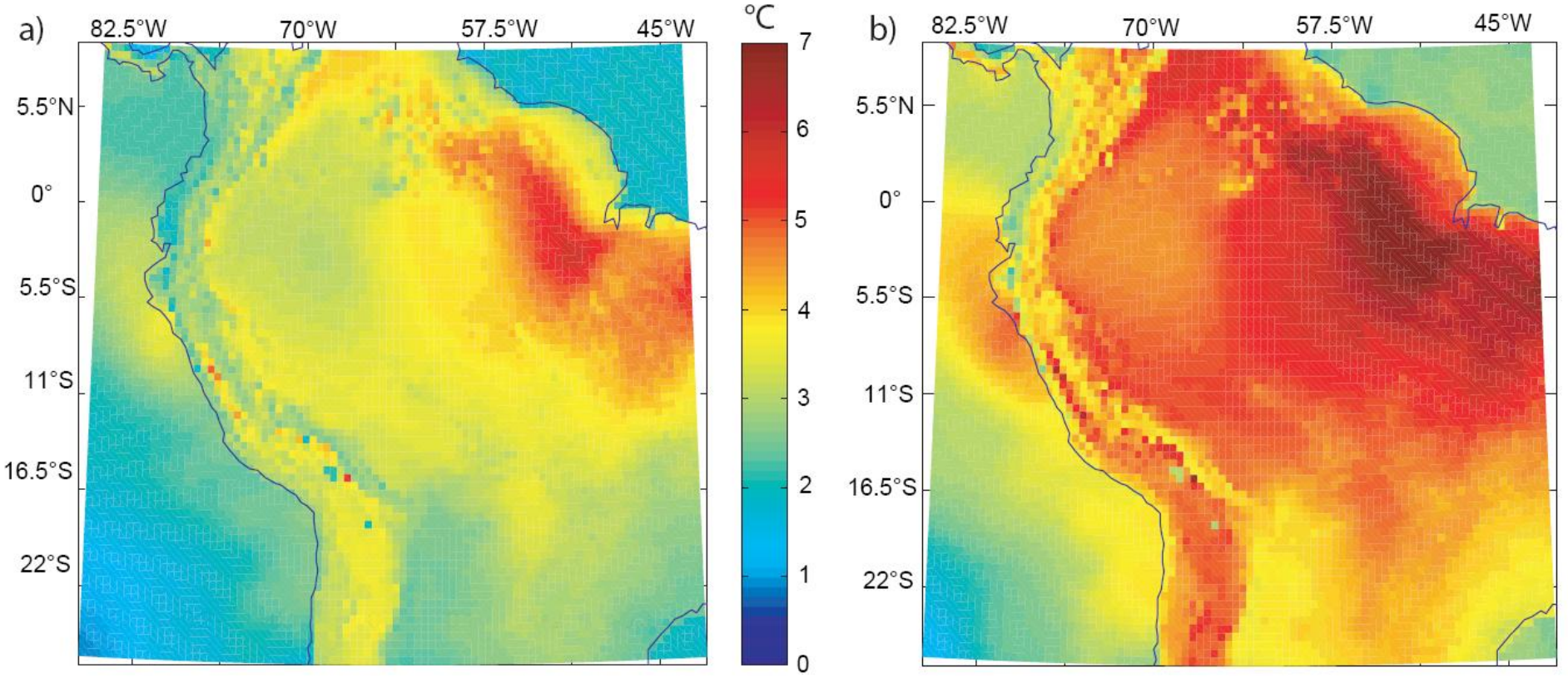
Figure 7. Annual mean observed and PDO-analog temperature anomalies for (a–d) four lowland/coastal stations and (e–h) four inland/high-elevation stations between 1960 and 2010. Anomalies are with respect to the 1961–1990 mean. Observed temperature is shown by blue (red) line for coastal (inland) stations. PDO-analog temperature anomaly (gray line) and its spread (gray shading) represent average temperature anomaly calculated from 5 years with most similar PDO value, ±1 standard deviation.

Vuille et al., *J. Geophys. Res.* [2015]

Projections: Annual mean temperature change for the end of the 21st century

B2

A2



Urrutia & Vuille, *J. Geophys. Res.*, [2009]

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Best practices in Adaptation (Research Component)

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Adaptation requires:

- improving climate change resilience

- strengthening of local research institutions and enhanced capacity building

- better networking in the region between scientists, policy- and decision-makers, water managers and affected segments of the local population

- improved capacity for glacier monitoring & water resources management

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Capacity Building: Fellowships for South American students to study at UAlbany

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Graduate students from Chile, Peru and Ecuador study at UAlbany with an ACCIÓN fellowship

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More outreach: better dissemination and communication of scientific results

Public display and workshops in Huaraz, Peru during ANA Foro Glaciares

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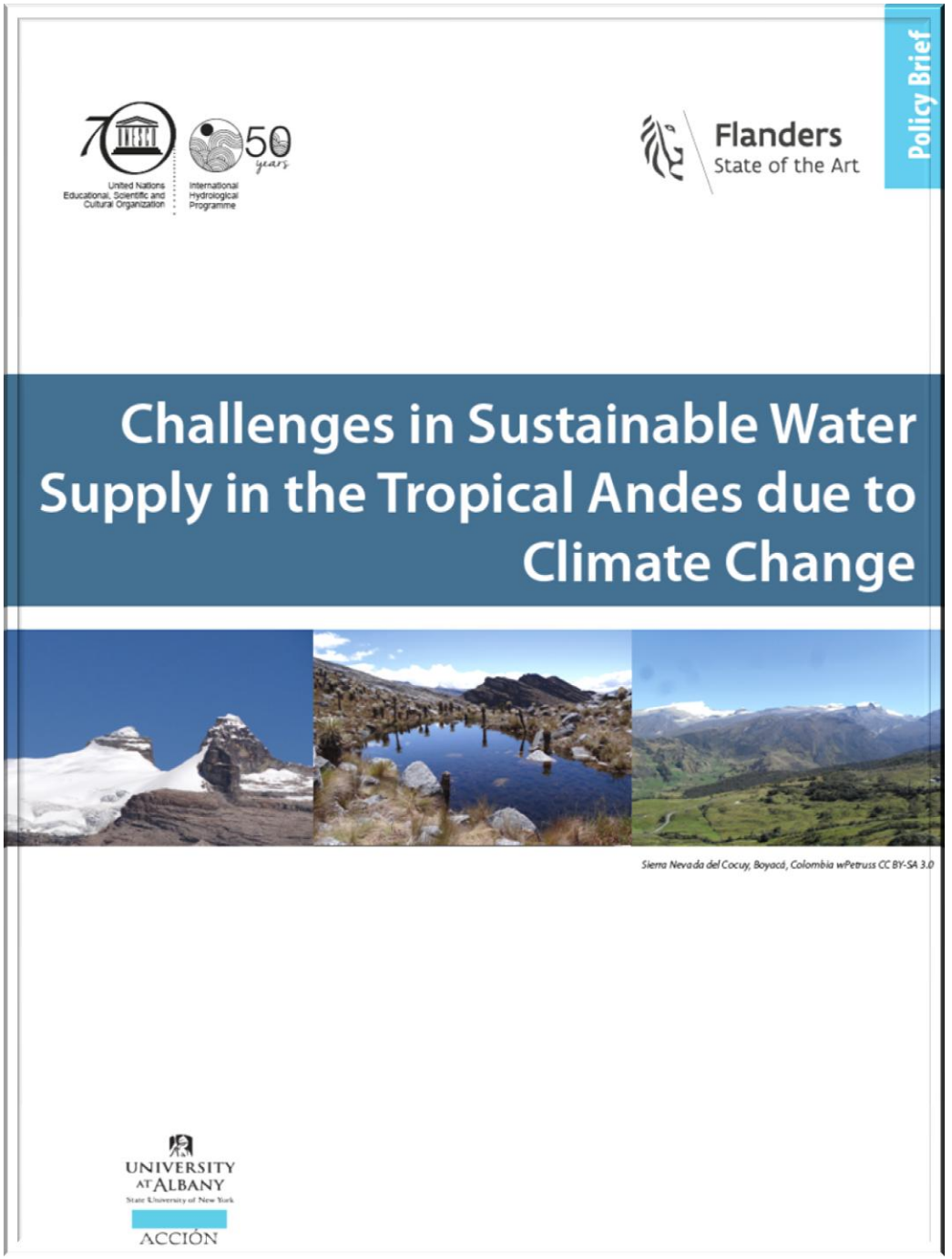
ACCIÓN / UNESCO
Policy brief

‘In press’



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ACCIÓN / CECS / UNESCO Mass balance manual (in Spanish)

'In press'

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Research needs tropical Andes (Outcomes from ACCION/UNESCO meetings 2011-2015)

- Better monitoring
  (lack of data (and access to data) is impediment for research and modeling)

- Monitoring needs to be comparable and have interchangeable standards (design, quality, efficiency)

- Climate modeling and scenario analysis remain a challenge
  (large uncertainties, inadequate resolution, model dependency)

- Challenge of communicating uncertainties to decision makers
  (pursuit of no-regret strategies in light of uncertainties should be encouraged)

- Better visualization and communication of scientific results

Best practices – lessons learned 2011-2015

- Adaptation works best when it responds to actual needs of local population
- Strengthen citizen involvement / local actors in adaptation prioritization
- Adaptation needs to be socially an culturally viable / recover local knowledge
- Incorporate local community experience into adaptation design
- Needs to quantify benefits of adaptation vs. non-adaptation

- Align international cooperation with national and regional needs
- Strengthen cooperation between various Govt. units working on CC adaptation
- Formation of required human resources
- Avoid brain drain

- Establish effective mechanisms of communication / create platforms of exchange
- Strengthen communication between scientific community and policy makers
- Access of public to information needs to be improved