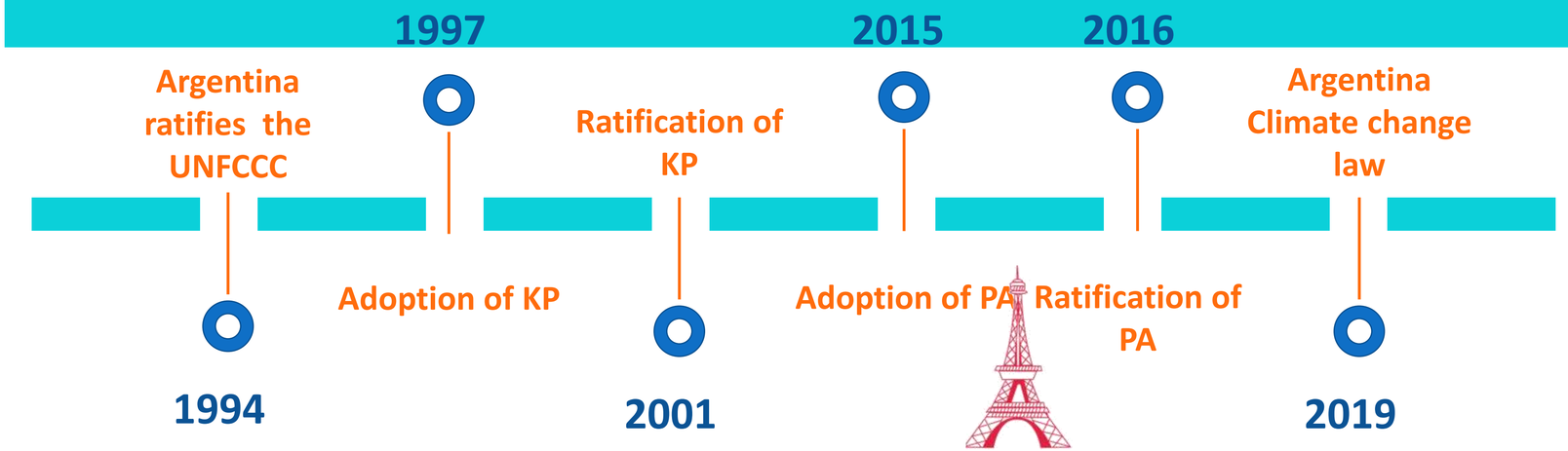
“Nuclear Technologies Contributing to Sustainability”
June 20-23, 2022. Rio de Janeiro, Brasil

Contribution of nuclear technologies to water management in highlands subject to the impact of climate change

Yalguaraz, Mendoza, Argentina. 10/2017

Dr. Daniel S. Cicerone
Argentina

Climate change -National framework



UNFCCC - United Nations Framework Convention on Climate Change

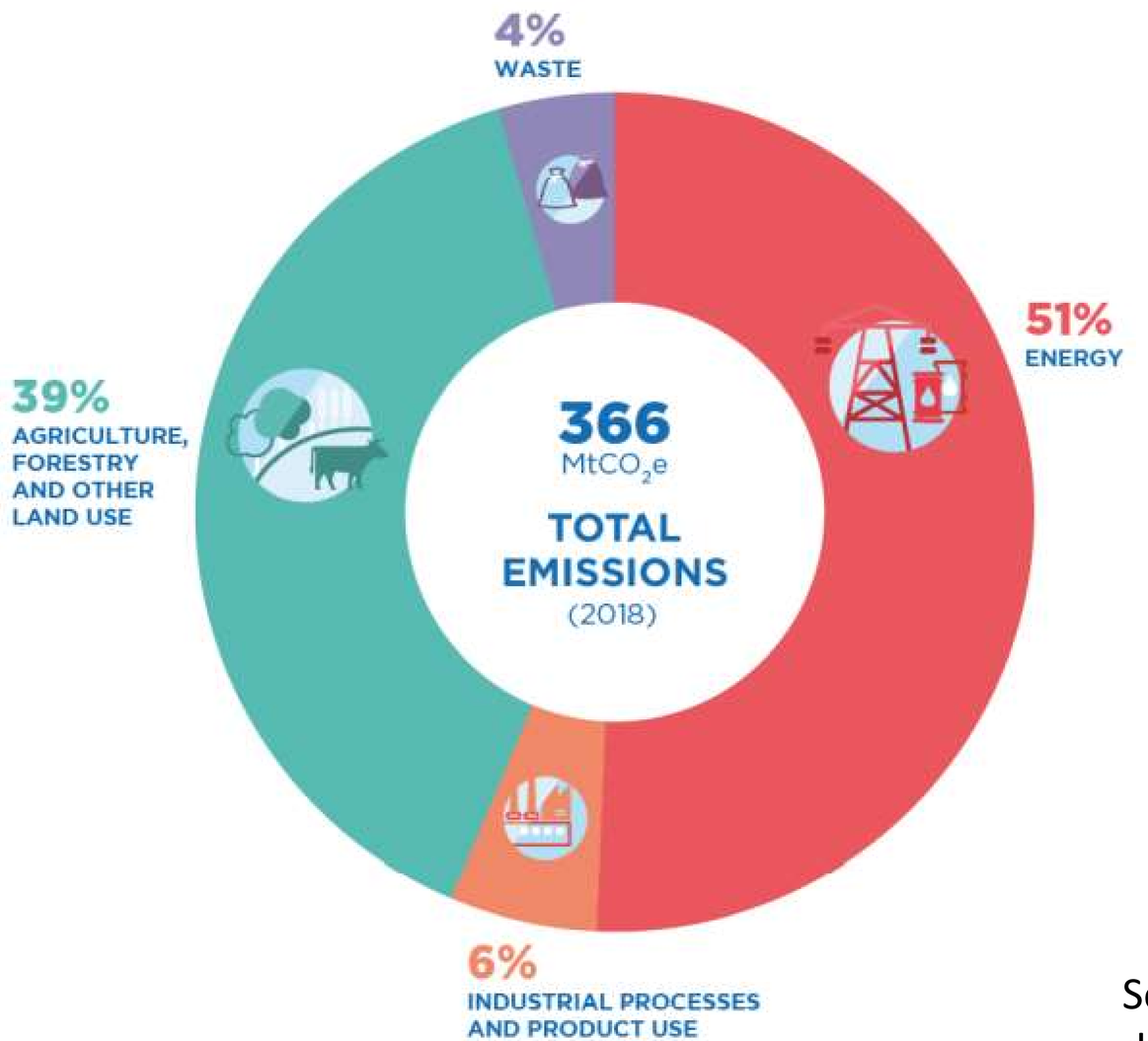
KP -Kyoto protocol

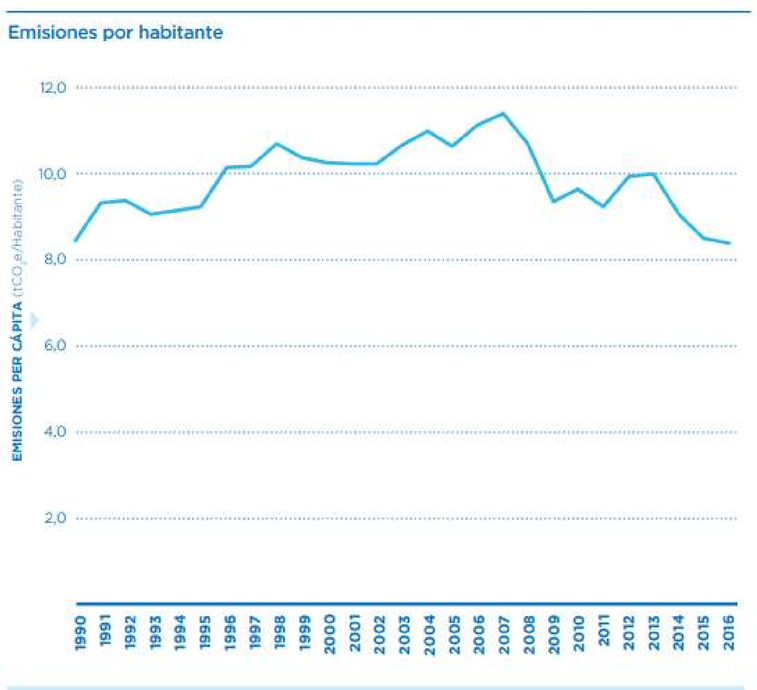
PA -Paris Agreement

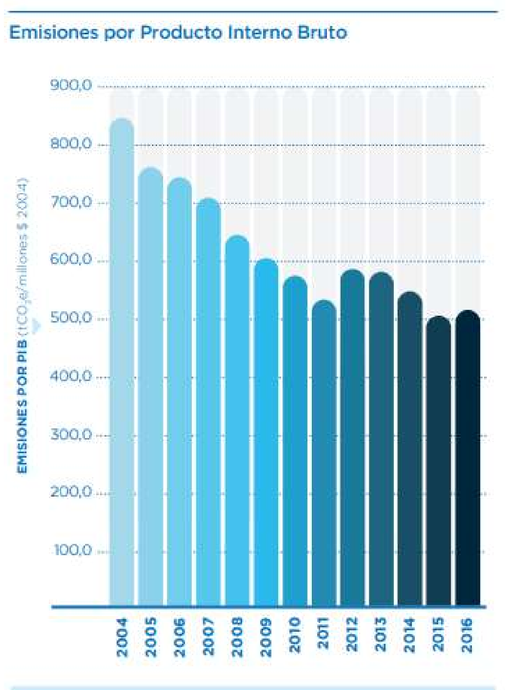
Adapted for the 4th fourth biennial update report of the Argentine to de United Nations framework convention on climate change

Ministries and secretariat	National Climate Change Cabinet
Technical level Focal points	Sectoral level (agriculture, energy, waste, etc.)
Provintial articulation	Federal Environment Council (COFEMA)
Extended thematic roundtables	Civil society (NGOs, workers' associations), private sector, academia, municipalities

Sectoral distribution of GHG emissions in 2018

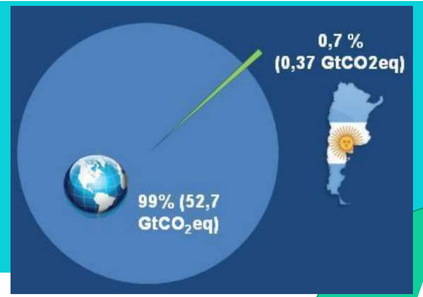






Souce: 4th fourth biennial update report of the Argentine to de United Nations framewor convention on climate change

Mitigation and adaptation



483 $MtCO_2e$

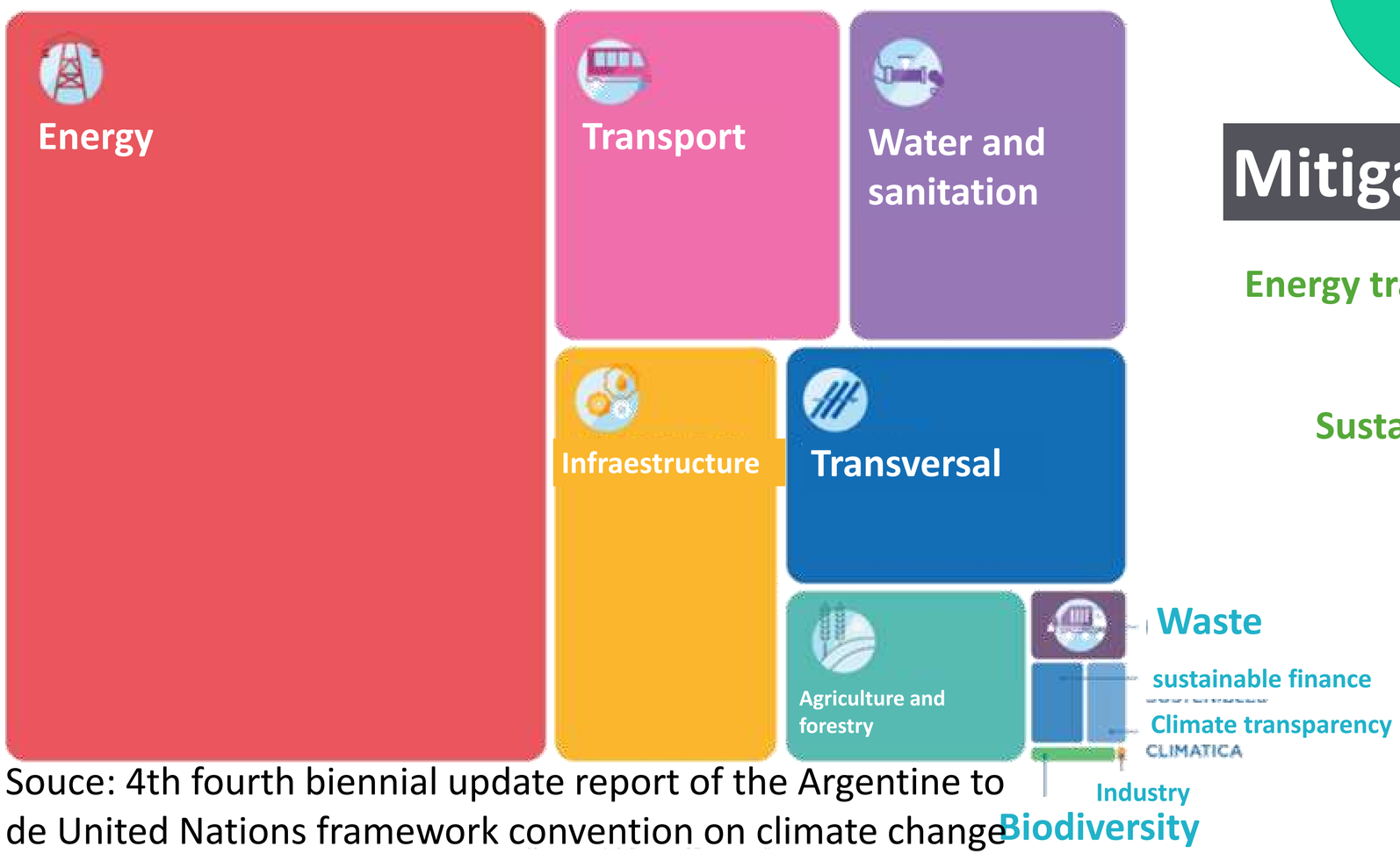
27.7% more ambitious

Aim 2030

Not to exceed

349 $MtCO_2e$

Climate finance by sector



Souce: 4th fourth biennial update report of the Argentine to de United Nations framework convention on climate change

Mitigation

Energy transition

Sustainable transport

sustainable productive transformation

Preservation of natural ecosystems

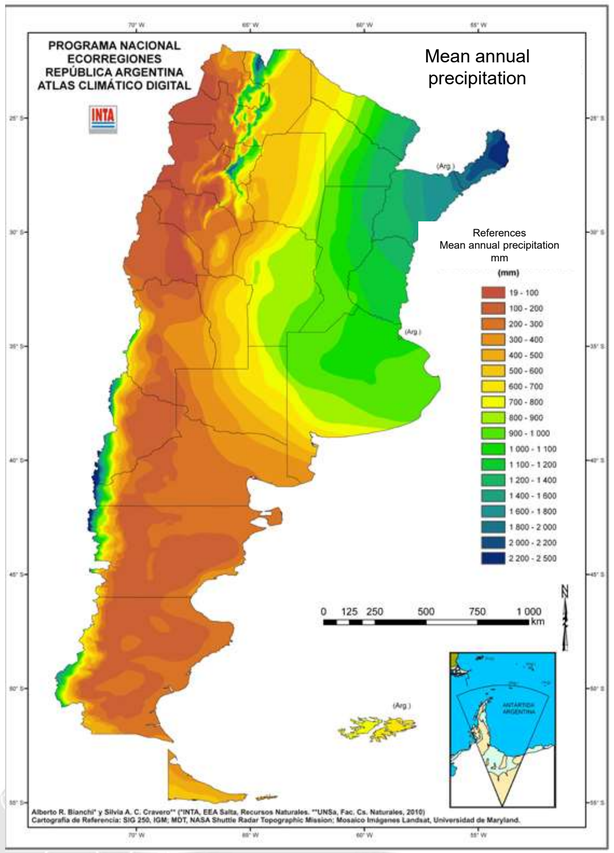
ROAD MAP

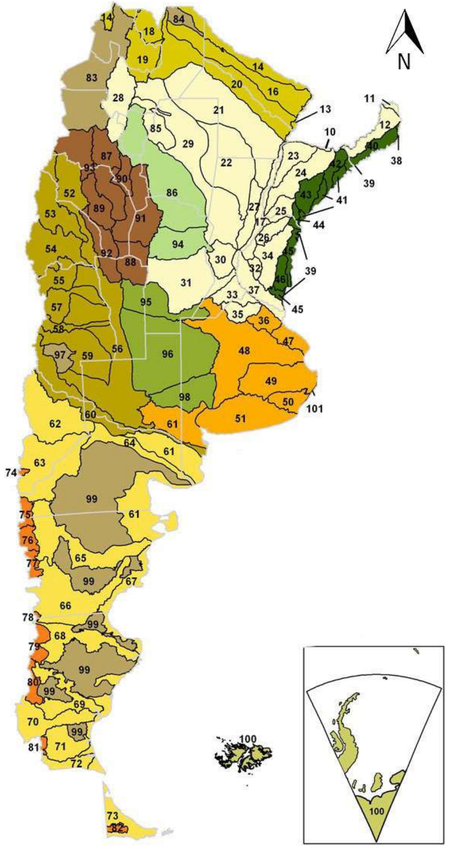
- The Challenge
- Nuclear Techniques
- Benchmark Sites
  - Development (TC – ARG 7/008)
  - Planned activities (TC – INT 5/156)

Yalguaraz, Mendoza, Argentina.
05/2022

- The Challenge
- Nuclear Techniques
- Benchmark Site
  - Development (TC – ARG 7/008)
  - Planned activities (TC – INT 5/156)

THE CHALLENGE





ATLANTIC WATERSHEDS

- Sistema Río Paraná
- Sistema Río Paraguay
- Sistema Río Uruguay
- Sistema Río de la Plata y Provincia de Buenos Aires hasta Río Colorado
- Sistema Río Colorado
- Sistema Río Patagónicos

PACIFIC WATERSHEDS

CLOSED WATERSHEDS

- Sistema Independientes
- Sistema Mar Chiquita
- Sistema Serrano
- Sistema Pampeano

QUANTITY

AVAILABILITY

QUALITY

INFRASTRUCTURE

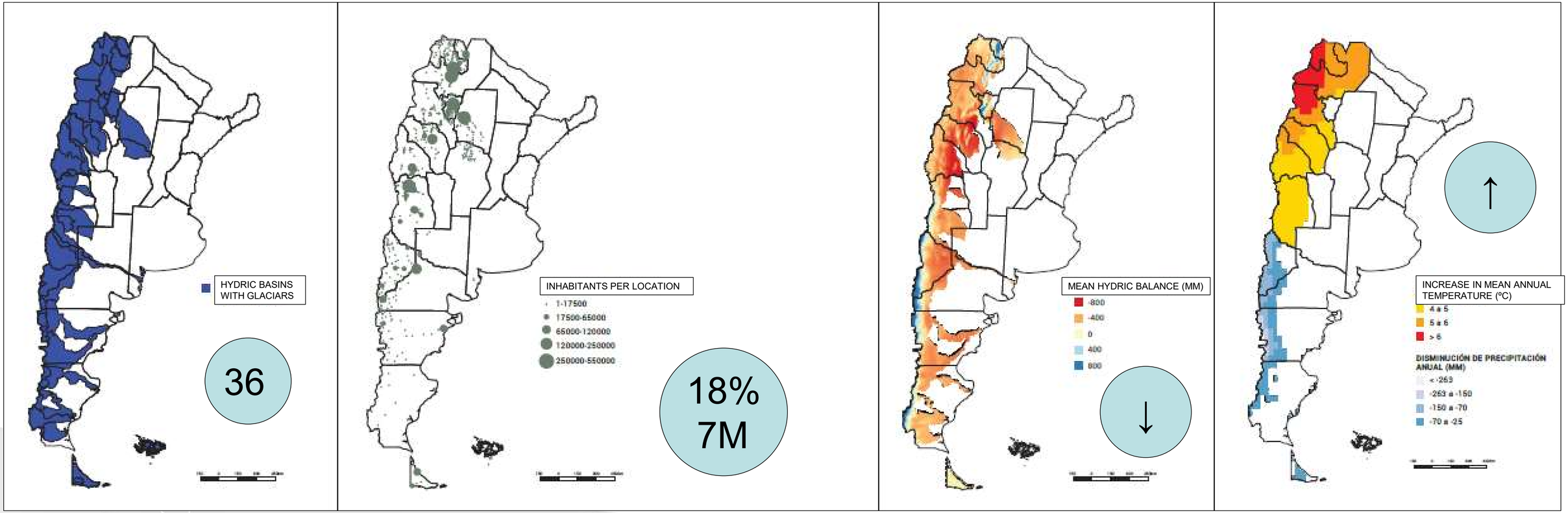
USE

Watersheds and hydrographic systems in Argentina

Source: Secretaria de Recursos Hídricos de La Nación.

THE CHALLENGE

- Water Towers
- Water security
- New Normality

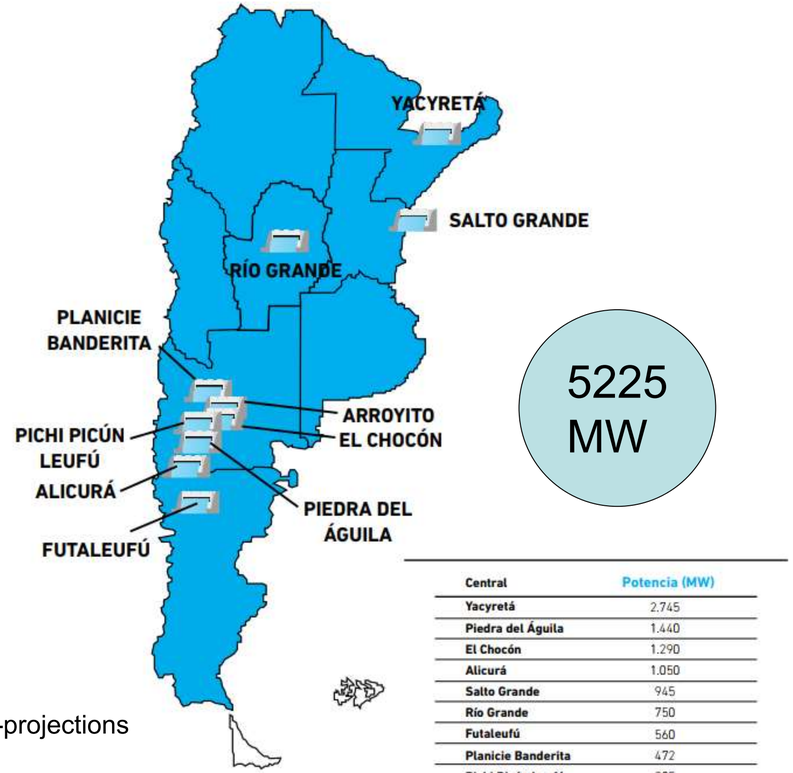


Sources: 1)National Inventory of Glaciers and references therein (https://www.glaciaresargentinos.gob.ar/; SSRR, 2010, INDEC 2010, SAYDS, 2010, SAYDS, 2017);2)Sadof 2007. Sink or swim. Water security for growth and development. https://doi.org/10.2166/wp.2007.021. “the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies.”3) Agua para el Futuro. 2019. Mendoza, Argentina

THE CHALLENGE

Projected Precipitation Percent Change Anomaly for 2020-2039 (Annual) Argentina; (Ref. Period: 1995-2014), Scenario: SSP1-1.9

https://climateknowledgeportal.worldbank.org/country/argentina/climate-data-projections



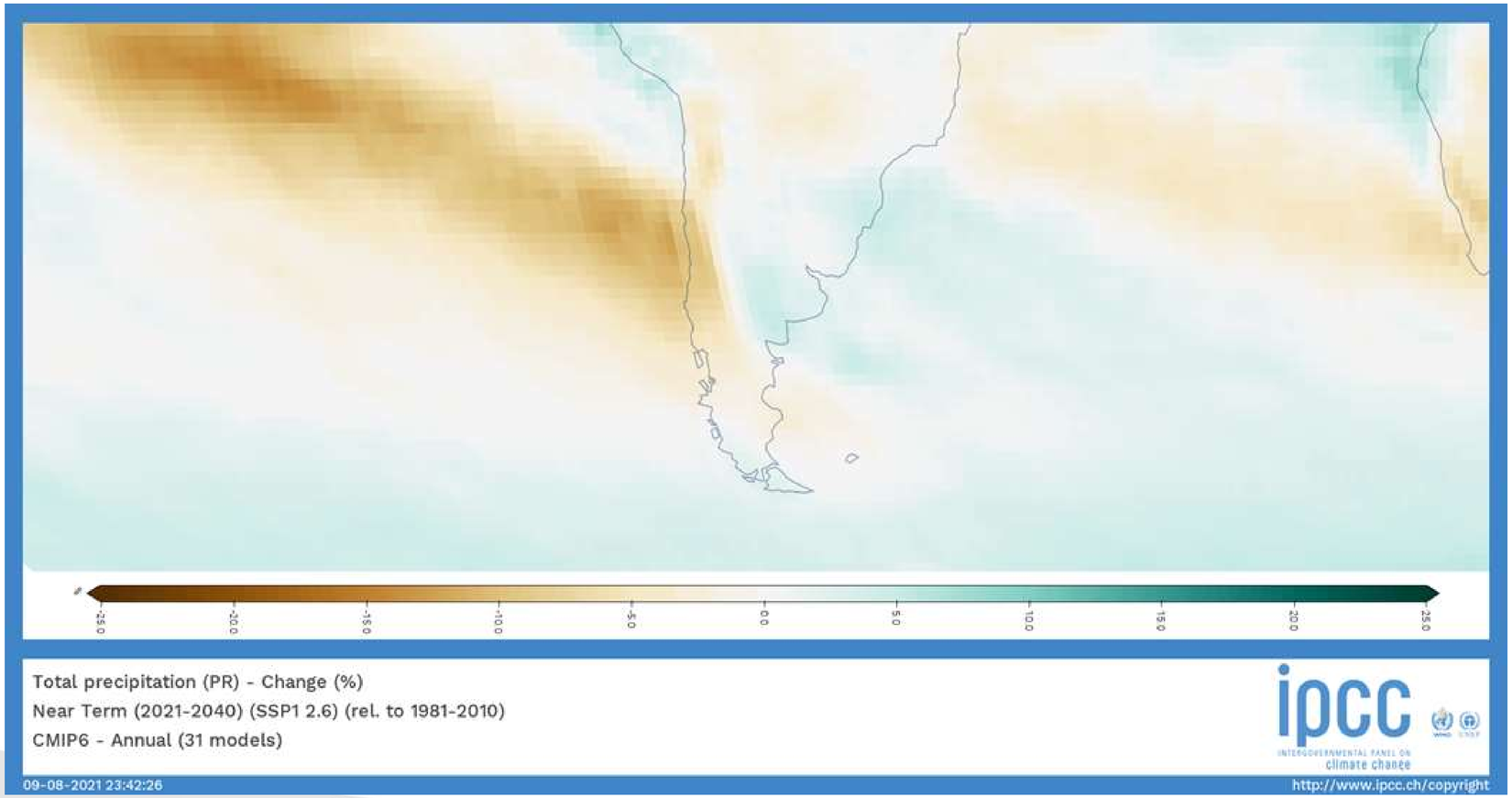
5225 MW

Central	Potencia (MW)
Yacyretá	2.745
Piedra del Águila	1.440
El Chocón	1.290
Alicurá	1.050
Salto Grande	945
Río Grande	750
Futaleufú	560
Planicie Banderita	472
Pichi Picún Leufú	285
Arroyito	128
Total	9.665

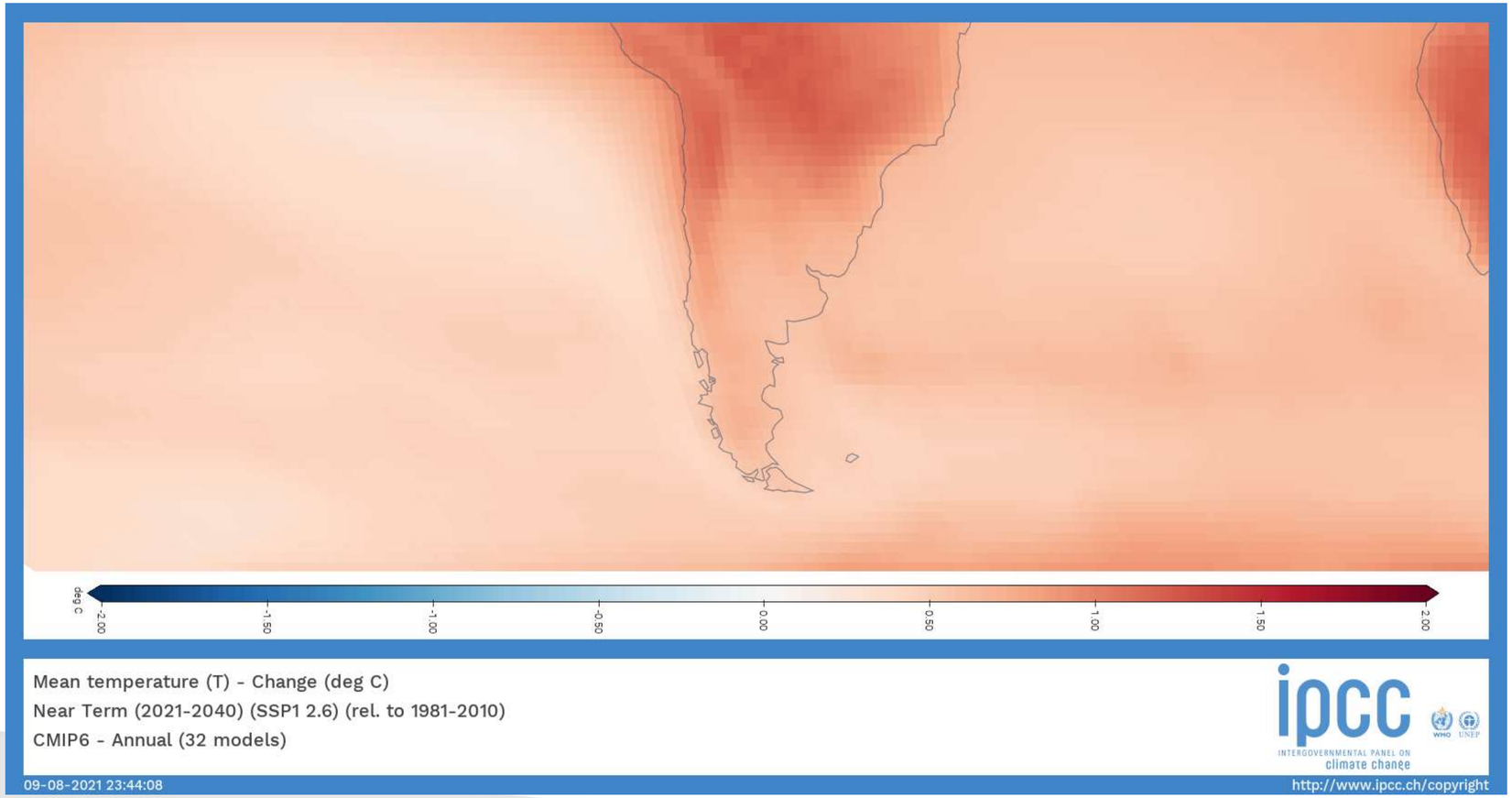
Location of Hydroelectric Power Plants. Source: Síntesis del Mercado Eléctrico Mayorista de la República Argentina. 20 Aniversario.

Location of Dams. Source: Organismo Regulador de Seguridad de Presas, Argentina.

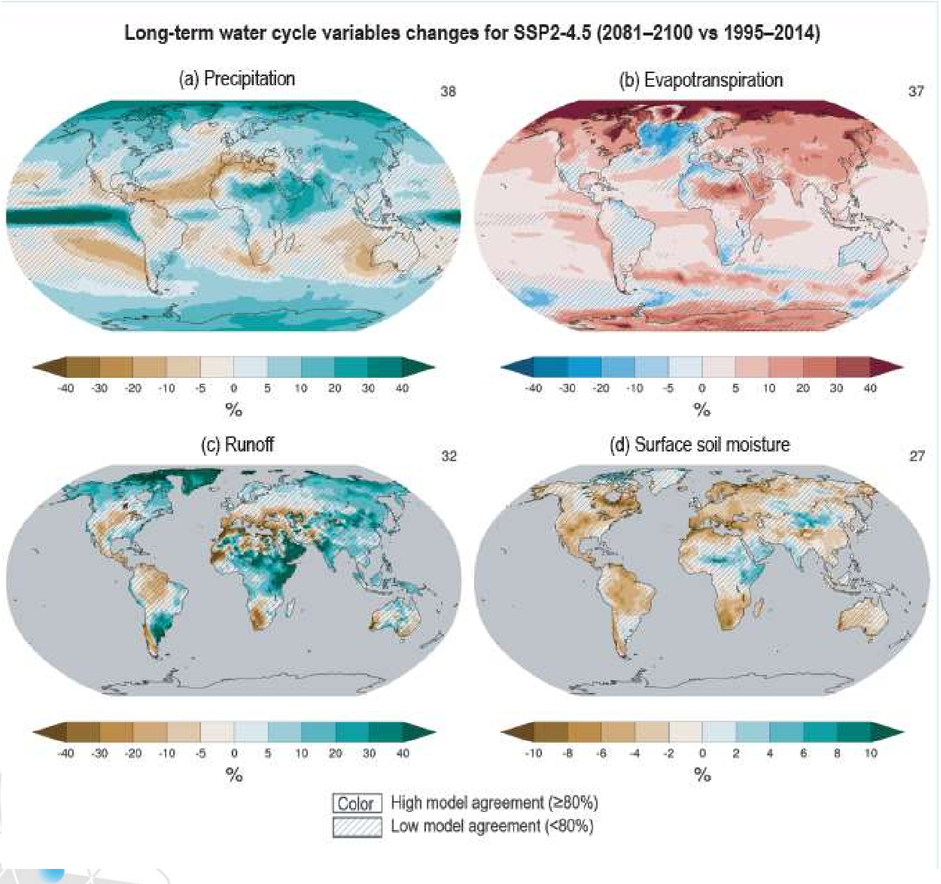
THE CHALLENGE

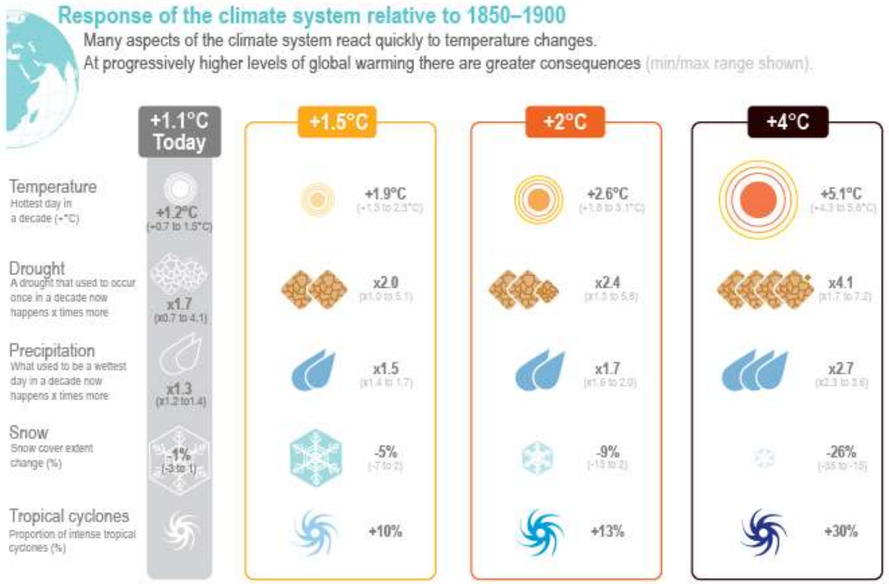


THE CHALLENGE



THE CHALLENGE

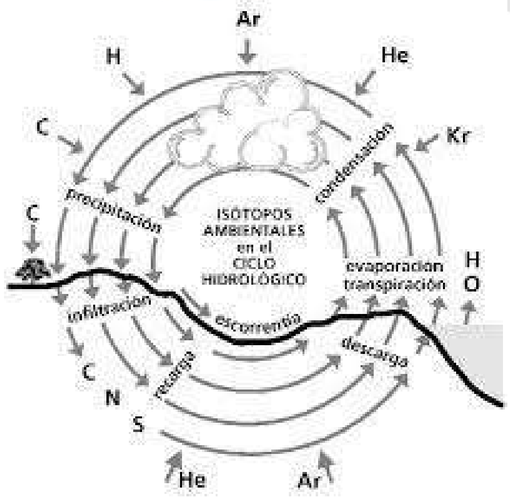




Arias, P.A. et al, 2021: Technical Summary. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 33−144. doi:10.1017/9781009157896.002.

- The Challenge
- Nuclear Techniques
- Benchmark site
  - Development (TC – ARG 7/008)
  - Planned activities (TC – INT 5/156)

- Isotopic Techniques
  - Fallout radionuclides (FRNs). ^{137}Cs, tm = 30.2 y; $^{210}Pb_{ex}$, tm = 22.2 y; and ^{7}Be, tm = 53.3 d. Used to evaluate:
    - Soil erosion and sedimentation rates
  - ^{14}C dating
    - Dynamics of ice masses
    - Soil erosion and sedimentation rates in water bodies



- Isotopic Techniques
  - ^{13}C and ^{15}N analyses
    - Soil organic carbon stability
    - Paleoenvironmental markers of the water cycle
  - ^{18}O, D (^{2}H), T(^{3}H), ^{222}Rn, ^{14}C, noble gases analysis
    - Ice, snow and water for the evaluation of the recharge (sources) and discharge areas in basins, transit time, volume and groundwater-surfacewater interactions

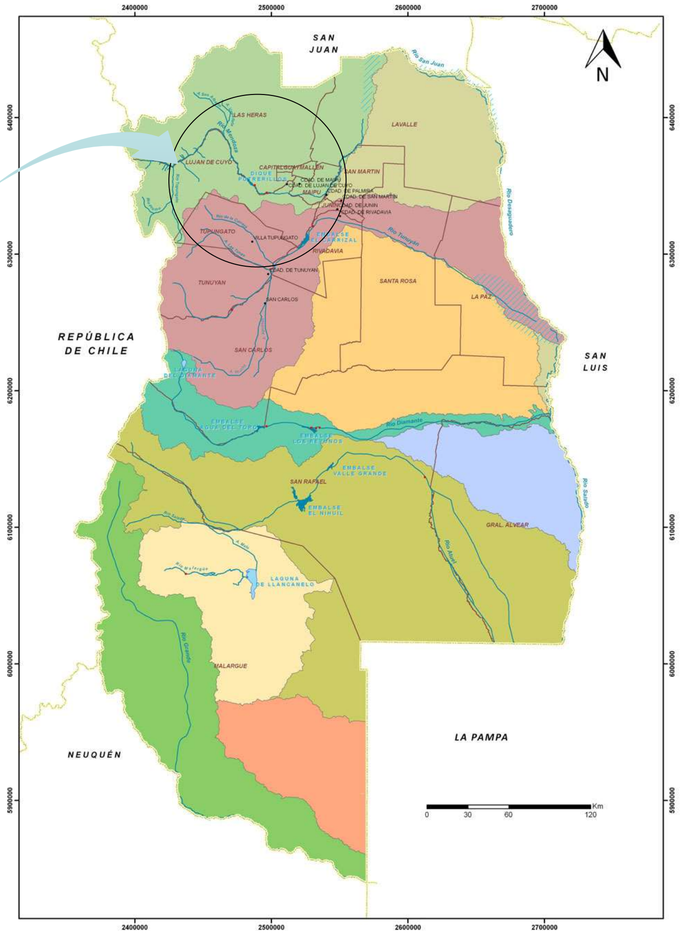
- Cosmic ray neutron sensor technique
  - Soil Water Content (SWC)
  - Snow cover

- The Challenge
- Nuclear Techniques
- Benchmark Site
  - Development (TC – ARG 7/008)
  - Planned activities (TC – INT 5/156)

BENCHMARK SITE

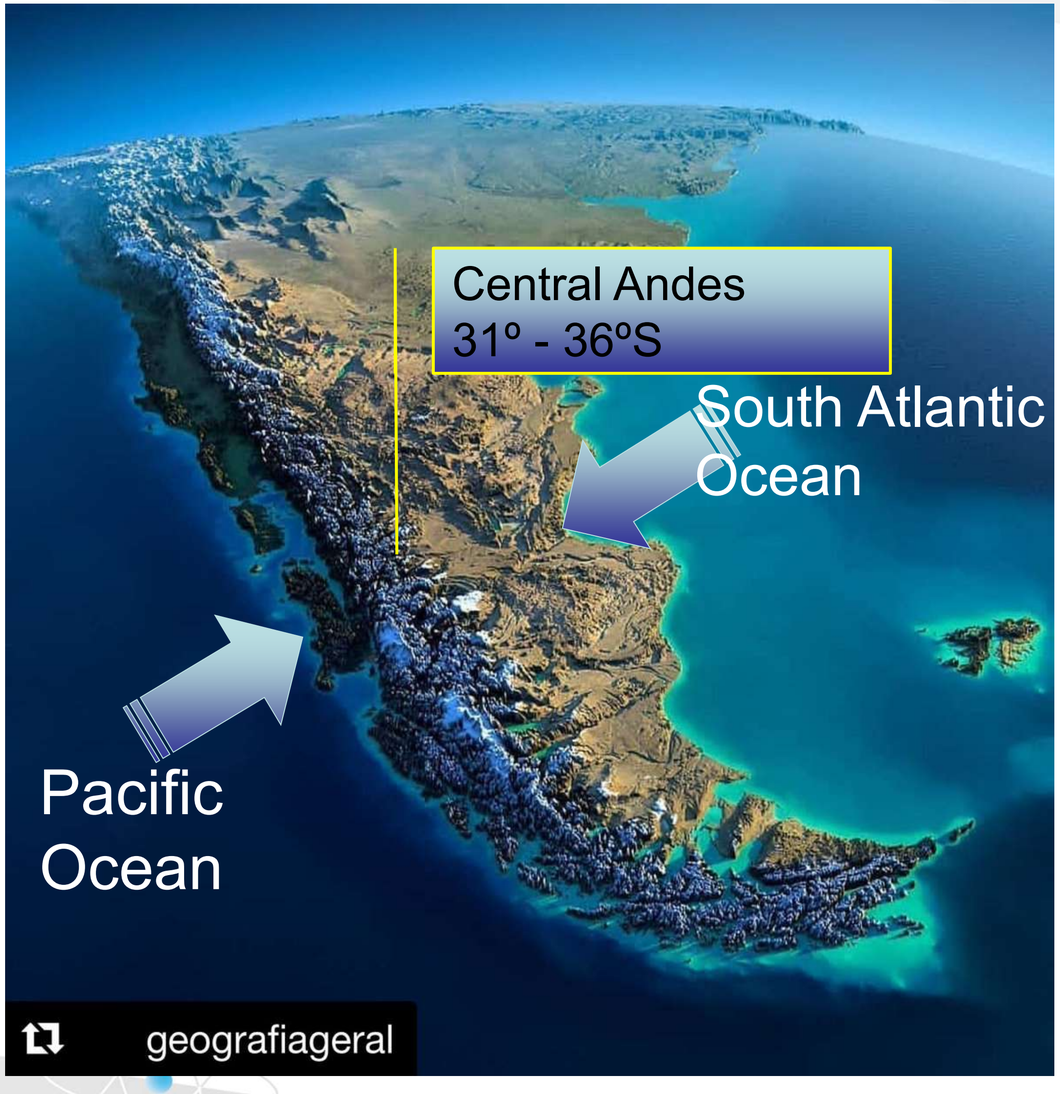
Development: ARG 7/008
Improving Management and Evaluation of Quality and Availability of Water Resources in Certain Regions through the Use of Isotopic Techniques

Case study: Uspallata-Yalguaraz basins.



Partners

CNEA
UNIVERSIDAD NACIONAL DE CUYO
IANIGLA
CONICET
U.N.CUYO
GOBIERNO DE MENDOZA
CONICET
IHLLA
COMISIÓN DE INVESTIGACIONES CIENTÍFICAS
INA Instituto Nacional del Agua
MendozA IRRIGACIÓN
IAEA

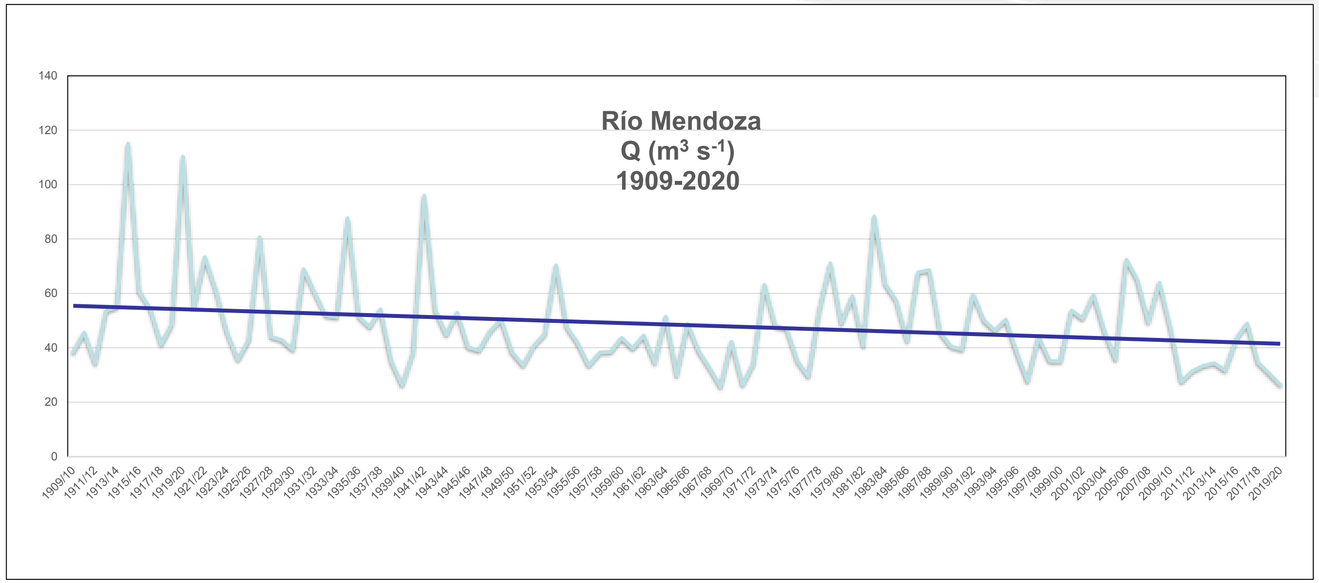


BENCHMARK SITE

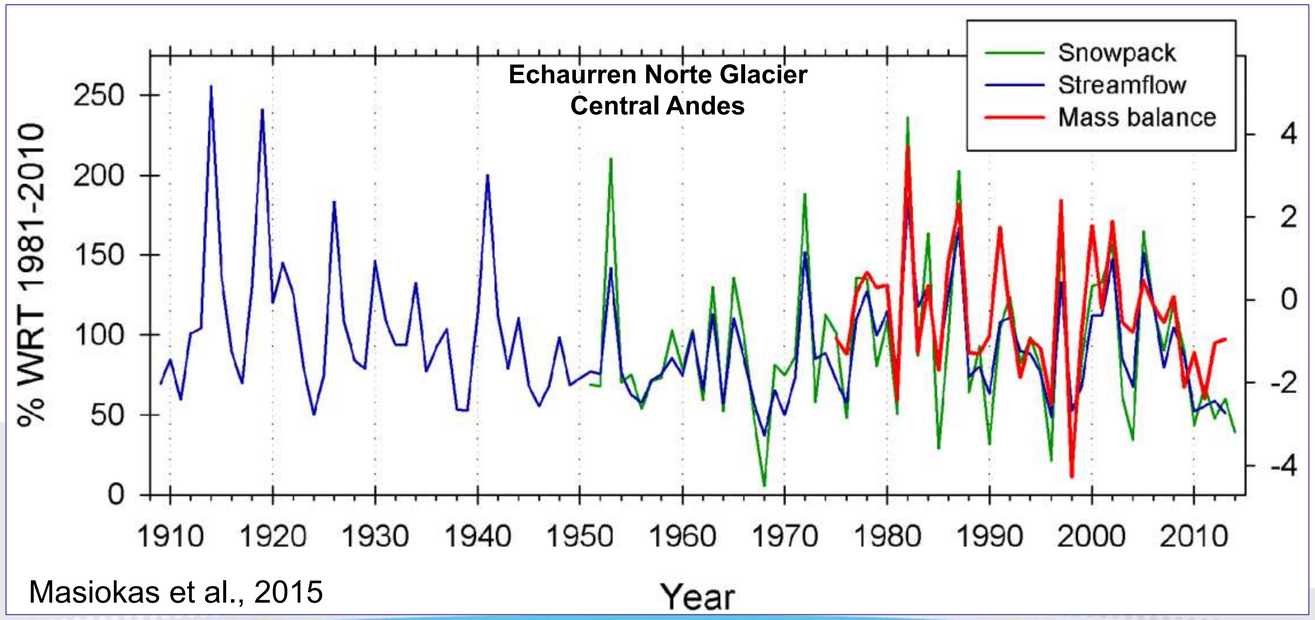
Climate change impacts in Central Andes

1. Arid transition zone (precipitations between 250 and 350 mm)
2. Winter snowfall (Apr- Sep) comes from the Pacific Ocean; Summer rainfall (Oct-Mar) comes from the South Atlantic Ocean.
3. Accumulated snow is the main source of water. More than 10 million people depend on the water resource.
4. Variations in the recharge sources and rising temperatures can:
   - Affect water availability
   - Threaten socio-productive systems at local and regional scale.

BENCHMARK SITE

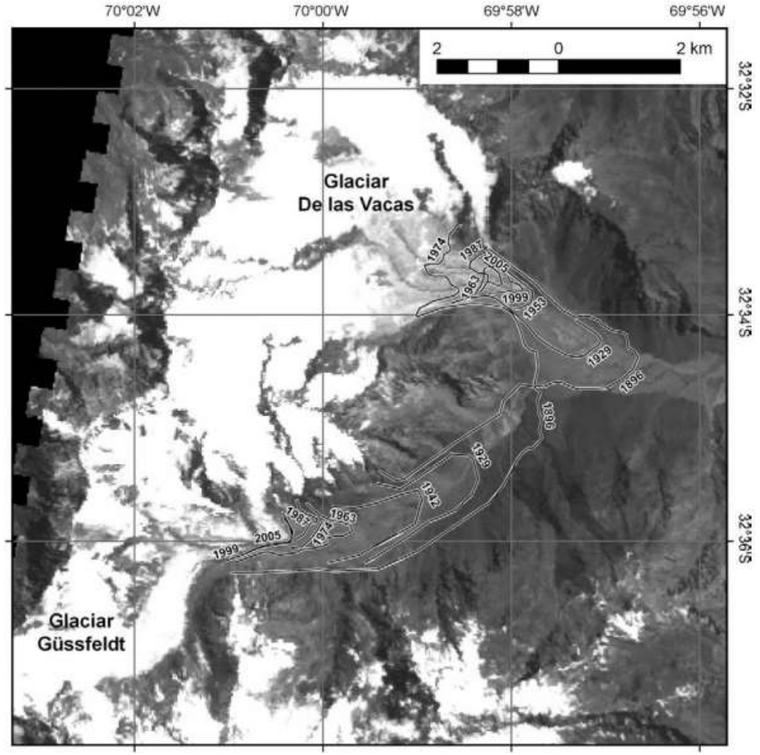


Significant decrease of Río Mendoza mean annual flow.



High correlation between snow series, flow rates and glacier mass balance.

Evidence of climate change impacts in Central Andes



Landsat 5 TM image showing the fluctuations between 1896 and 2005 of Las Vacas and Güssfeldt glaciers, Aconcagua region, Central Argentinean Andes. Masiokas et al.,2009

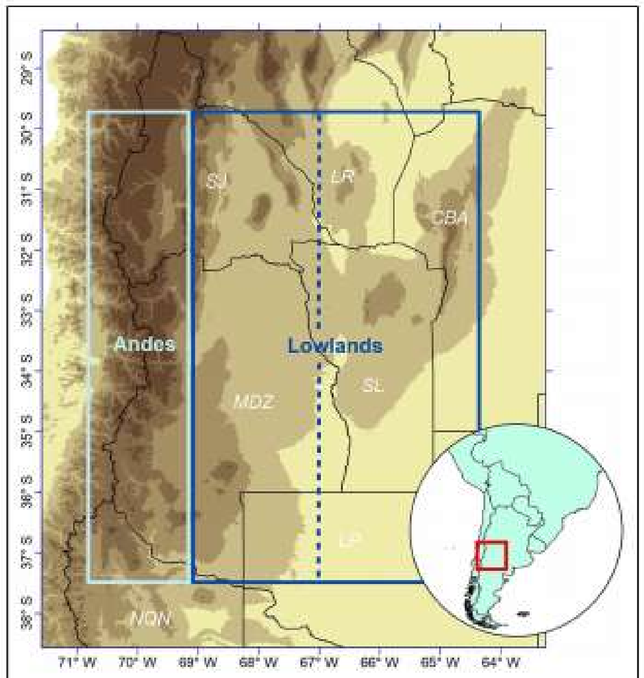
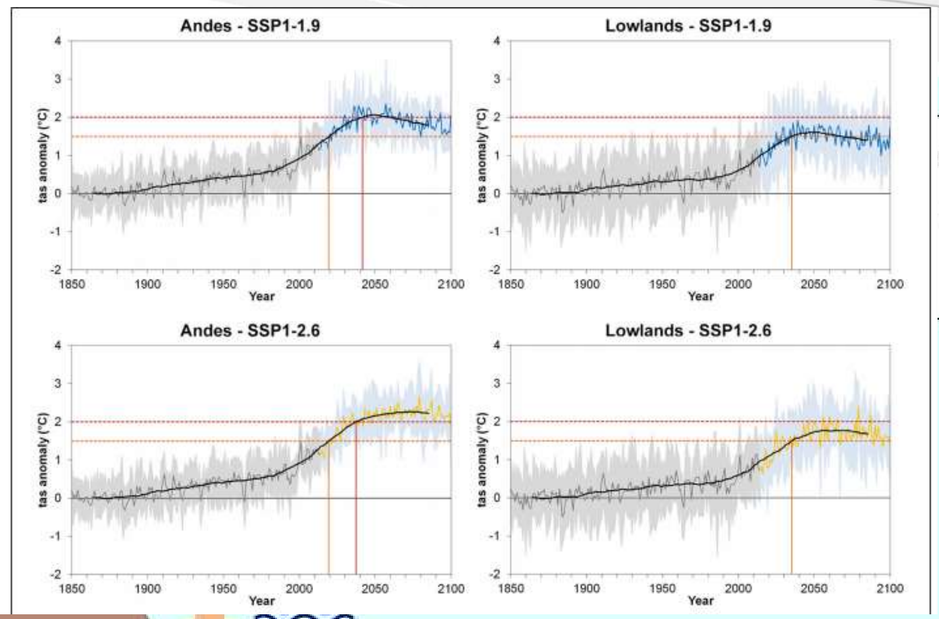
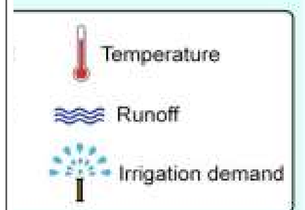
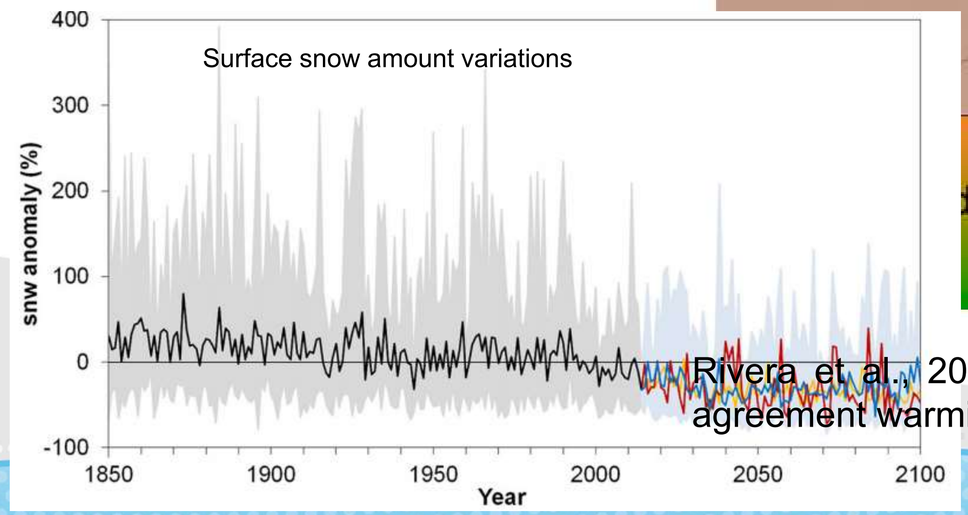


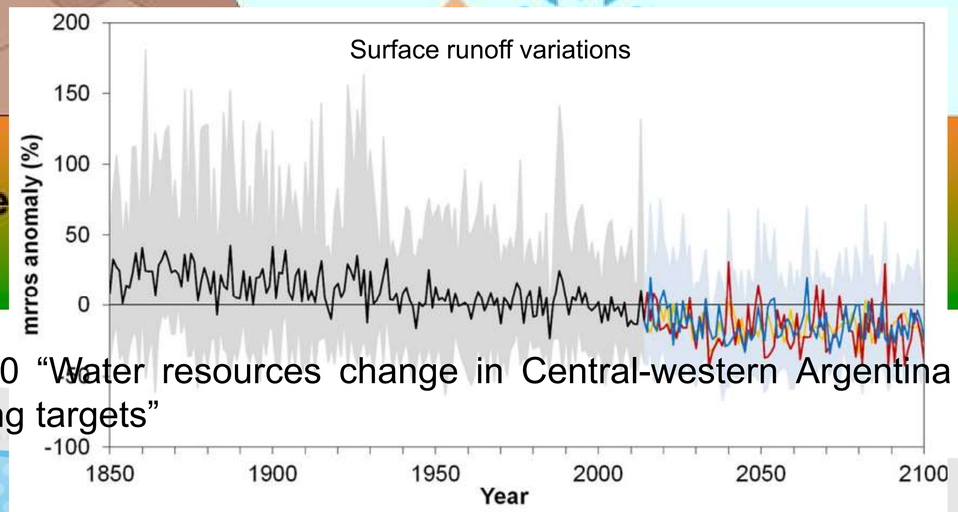
FIGURE 1 | Study area with the delimitation of the main regions analyzed (Andes and Lowlands) and the provinces included in the CWA. CBA, Córdoba; LP, La Pampa; LR, La Rioja; MDZ, Mendoza; NQN, Neuquén; SJ, San Juan; SL, San Luis. The dashed line divides the Eastern and Western portions of the Lowlands region.

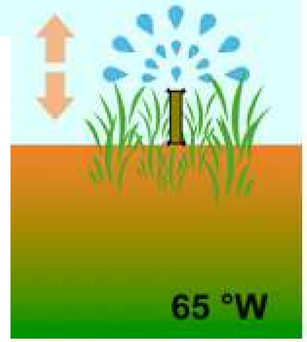




Rivera et al., 2020 “Water resources change in Central-western Argentina under the Paris agreement warming targets”



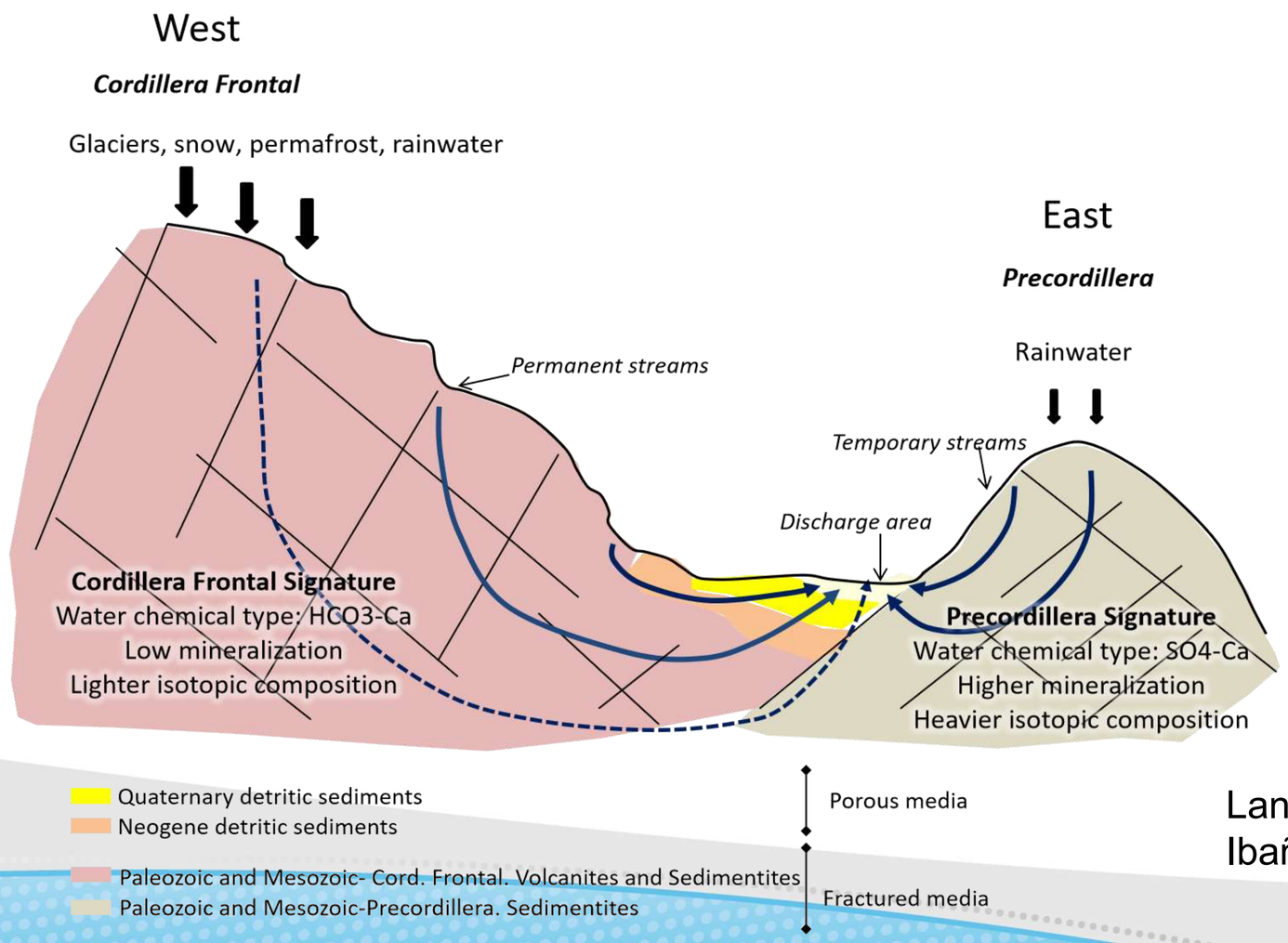




Rivera et al., 2020 “Water resources change in Central-western Argentina under the Paris agreement warming targets”

Hydrogeochemical Conceptual Groundwater Model of the Uspallata Basin

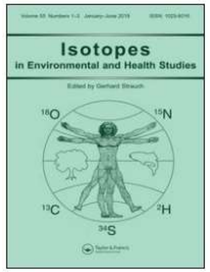
BENCHMARK SITE



- Geology
- Chemistry
- Isotopes

Lana et al 2021
Ibañez et al 2021

Publications (five most relevant)



Taylor & Francis
Taylor & Francis Group

Isotopes in Environmental and Health Studies

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/gieh20

First conceptual hydrogeological model of two intermountain Andean basins based on isotopes and hydrochemistry

Nerina Belén Lana, Sandra Ibañez, Natalia Salvi, Daniel Cicerone & Marisol Manzano

Ibáñez, S.P, et al., 2021.Estudio preliminar del origen del agua del Valle de Uspallata y de su contribución al río Mendoza.... *Boletín Geológico y Minero,* 132 (1-2): 107-114
ISSN: 0366-0176
DOI: 10.21701/bolgeomin.132.1-2.011

Estudio preliminar del origen del agua del Valle de Uspallata y de su contribución al río Mendoza mediante técnicas isotópicas e hidroquímicas. Mendoza, Argentina

Sandra P. Ibáñez[1], Belén Lana[2], Marisol Manzano[3], Susana Rovira[1], Enrique Montero[4], Natalia Salvi[5], Héctor Segal[4], Pabla Tognoli[4], Pablo Grizas[4], Leandro Salvioli[5], Diego Márquez[5], Juan Pina[4] y Daniel Cicerone[6]

BENCHMARK SITE

Ibáñez S, Rovira S, Lana B, Manzano M, et al. 2019 "Development of a conceptual groundwater model in an intermountain andean aquifer with the support of water stable isotopes. Uspallata valley, Argentina" International Symposium on Isotope hydrology: advancing the anderstanding of water cycle processes" Viena, Austria.

IAEA

XIV CONGRESO LATINOAMERICANO DE HIDROGEOLOGÍA
X CONGRESO ARGENTINO DE HIDROGEOLOGÍA
VIII SEMINARIO HISPANO-LATINOAMERICANO
SOBRE TEMAS ACTUALES DE LA HIDROLOGÍA SUBTERRÁNEA

Lana B, Ibañez S, Rodriguez S, Rodríguez M, et al. 2018 "Identificación de la relación agua superficial-agua subterránea en el arroyo San Alberto, Mendoza, Argentina, mediante la técnica de radon-222". "XIV Congreso Latinoamericano de Hidrogeología; X Congreso Argentino de Hidrogeología" Salta, Argentina.

XX CONGRESO GEOLÓGICO ARGENTINO · 2017 · SAN MIGUEL DE TUCUMÁN · PRESENTE Y FUTURO

Lana B, Rovira S, Gomez ML, Tognoli P, et al. "Análisis hidroquímico de las aguas superficiales y subterránea del valle de Uspallata-Mendoza (1970-2015)"."XX CONGRESO GEOLÓGICO ARGENTINO" Tucumán, Argentina.

BENCHMARK SITE

INT 5/156 Building Capacity and Generating Evidence for Climate Change Impacts on Soil, Sediments and Water Resources in Mountainous Regions

BENCHMARK SITE

Objective

- Improve the forecasting of the contribution of the different sources of recharge (glaciers, perennial snow patches, rain and groundwater) to the:
  - Uspallata river flow.
  - Groundwater piezometric levels
  - Groundwater and surface water quality
  - Soil Erosion and sedimentary processes in the Uspallata basin

Stakeholders

- Productive sector
  - Agriculture (Farmers)
  - Tourism
  - Uspallata community
- Federal and local government
- Regulators
- Research and Development Institutions
- Academia

Components and Technologies of the ARG project

- Highland hydrology
- Paleoclimate characterization
- Wetland dynamics
- Cryosphere dynamics
- Water quality in highlands
- Highland erosion and sedimentation processes
- Social

BENCHMARK SITE

- Nuclear techniques
  - ✓ Isotopic Techniques (stable and radioactive isotopes)
  - ✓ AAS, ICPMS, FRX (water, soil, sediments)
  - ✓ Cosmic ray Neutron Sensor Analysis
- Remote sensing techniques (SAOCOM, band L)
- Hydrodynamic techniques
- Chemometric techniques
- Modeling

FINAL REMARKS

- NUCLEAR TECHNIQUES CAN SIGNIFICANTLY CONTRIBUTE TO THE SUSTAINABLE MANAGEMENT OF WATER RESOURCES IN MOUNTAIN REGIONS OF ARGENTINA SUBJECT TO THE IMPACT OF CLIMATE CHANGE.
  - IAEA, through TC and CR projects has contributed to build capacities related to application of nuclear techniques for industry and environment in the Latin American and the Caribbean region.
  - National support allowed training of personnel, build infrastructure and acquire new equipment in Argentina and the region to implement the use of nuclear techniques for environmental applications.
  - Benchmark sites in Argentina and the region allowed their use to show their unique value and contribution for addressing environmental problems (i.e. water security). Last, but not least, these sites offer the possibility to design, implement and validate mitigation and adaptation actions for different stakeholders (including nuclear!).
  - Articulation of institutions (at national, provincial and local level) and countries of the region is needed to tackle global environmental challenges

Comisión Nacional de Energía Atómica

Thank you very much for your attention!

cicerone@cnea.gob.ar