Urban Water Management for Climate Resilience

Morgenstadt Smart Cities Global – Expertise Building Webinar 04

Friday, 18th of November 2021, Moderation: Sophie Mok, Fraunhofer IAO

University of Stuttgart
Institute for Human Factors and Technology Management IAT

Fraunhofer

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Supported by:

Federal Ministry
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ABOUT MGI

Funding

INTERNATIONAL CLIMATE INITIATIVE (IKI)

On behalf of
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

Coordination

University of Stuttgart
Institute of Human Factors and Technology Management IAT

in cooperation with
Fraunhofer IAO

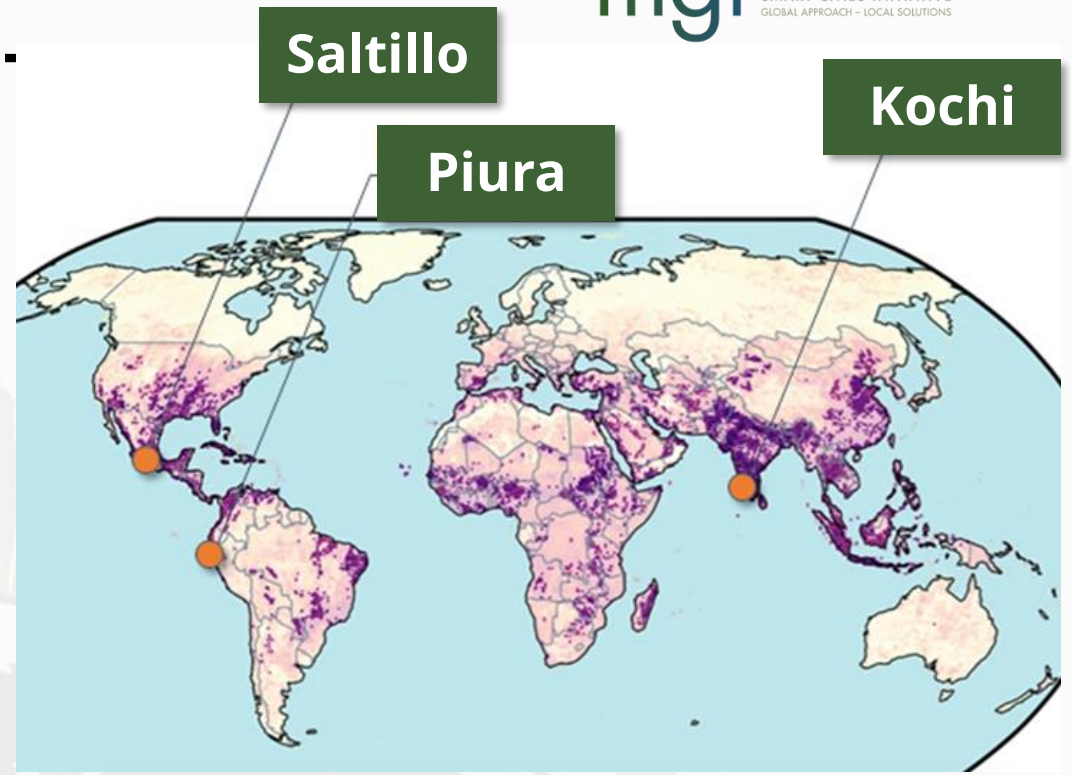
Implementation

Fraunhofer
Frankfurt School of Finance & Management
German Excellence. Global Relevance.
PIURA MUNICIPALIDAD PROVINCIAL
National Institute of Urban Affairs
Tecnológico de Monterrey
IMPLAN INSTITUTO MUNICIPAL DE PLANEACIÓN SALTILLO
UNIVERSIDAD DE PIURA

MORGENSTADT SMART CITIES GLOBAL INI

Mission

- Mitigation of and adaptation to climate change impacts
- Low-emission, environmentally conscious and innovative urban development (Sustainable Development Goals (SDG 11))
- Replicable and affordable solutions for the resilient and livable city of tomorrow



www.mgi-iki.com

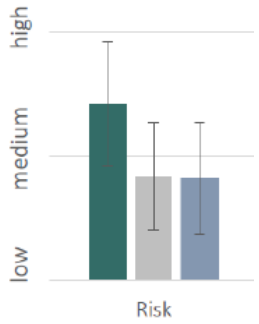
Climate change adaptation

- water related risks and cha

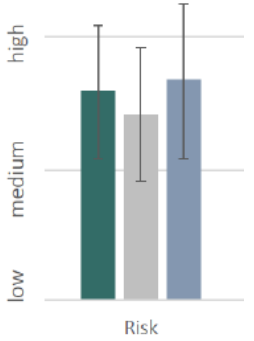
- Saltillo
- Kochi
- Piura

https://mgi-iki.com/en/library/

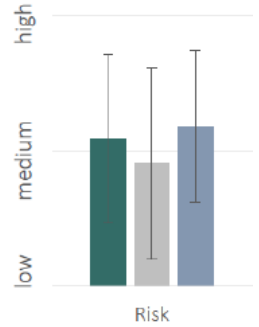
Heavy rainfall & stormwater



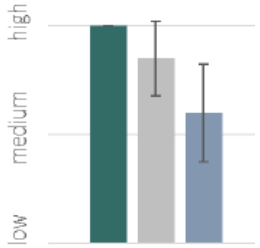
Water scarcity & droughts



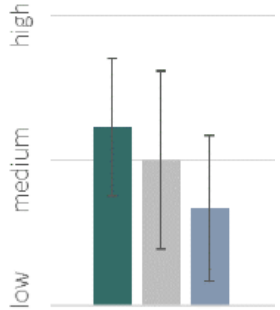
Snowfall & Frost



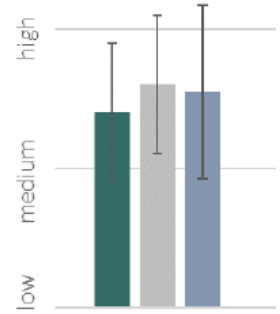
Heavy rainfall & stormwater



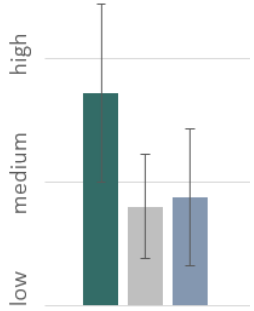
Water scarcity



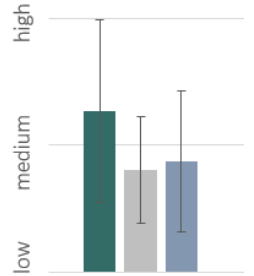
Sea level rise & coastal erosion



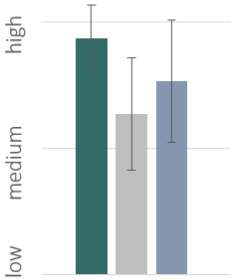
River overflow, heavy rainfall & stormwater

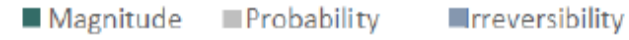


La Niña, Water scarcity & droughts



El Niño Phenomenon, ENSO





Agenda

MORGENSTADT GLOBAL SMART CITIES INITIATIVE
GLOBAL APPROACH – LOCAL SOLUTIONS

University of Stuttgart
Institute of Human Factors and Technology Management

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On behalf of
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

MGI WEBINAR, NOVEMBER 19 (15:00-17:00 CET): URBAN WATER MANAGEMENT

OPENING AND MODERATION
Sophie Mok,
Fraunhofer IAO, Stuttgart

URBAN WATER MANAGEMENT FOR IMPROVING CLIMATE RESILIENCE
Dr.-Ing. Marius Mohr,
Fraunhofer-Institute for Interfacial Engineering and Biotechnology IGB

EVALUATION OF LONG-TERM PRECIPITATION DATASETS FOR WATER BUDGET ESTIMATION AT NATIONAL LEVEL IN PERU
Mechthild Becker and
Carlos Fernandez Palomino,
Potsdam Institute for Climate Impact Research

WATER SECURITY AND CLIMATE: THE SITUATION OF THE MONTERREY METROPOLITAN AREA
Prof. Jürgen Mahlknecht,
Tecnológico de Monterrey

Urban Water Management for Climate Resilience

Break

University of Stuttgart
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Please help us improve by sharing your feedback!

- General impression and competences gained
- Highlights and possible improvements
- Technical Set-up
- Any other comments, suggestions, wishes

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The MGI Webinar Series (tentative schedule)

- Linking COVID-19 response to climate action (January 2021)
- Smart city policies (March 2021)
- Integrated planning for resilient cities – tools and approaches (May/June 2021)
- Adapting to climate change – urban water management (November 2021)
- Climate mitigation in the mobility sector (February/March 2022)
- Ecosystem services and nature-based solutions (May 2021)
- Smart city finance & procurement (September/October 2022)

Stay updated!

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/morgenstadt-global-smart-cities-initiative

/morgenstadtglobalsmartcitiesinitiative

Contact: Sophie Mok (sophie.mok@iao.fraunhofer.de)

URBAN WATER MANAGEMENT TO IMPROVE CLIMATE RESILIENCE

Dr. Marius Mohr
Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB

Fraunhofer IGB

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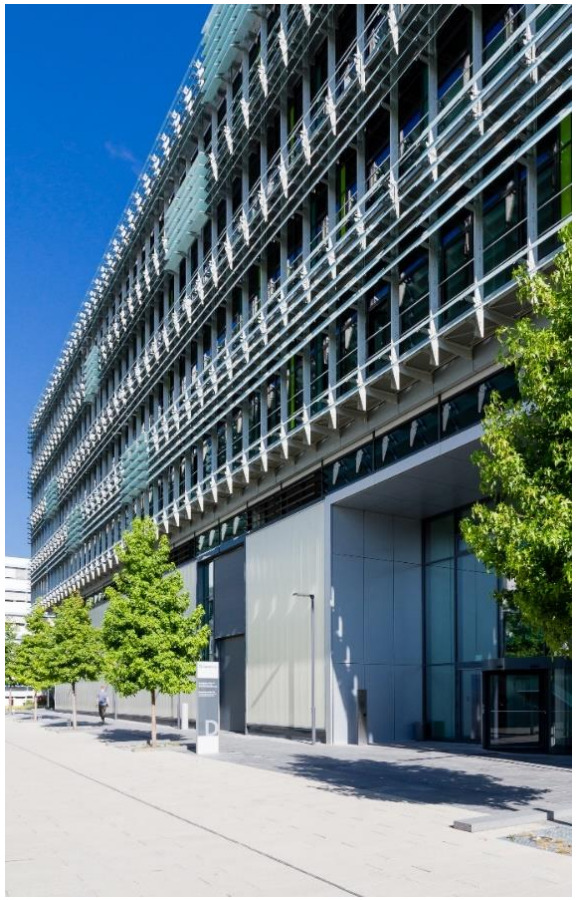
Facts and figures

founded in **1953**, since **1962**
within the Fraunhofer-Gesellschaft

8300 m² infrastructure area –
for the operation of plants up to
demonstration scale



€ 26.5 million
operational budget (2020)

3
locations

368
employees

Effects of Cilmate Change

- Extreme weather patterns
- Heavy rain – flooding
- No rain – water scarcity

Source: http://www.meteoprog.at

Source: Marccophoto / Getty Images / iStock (Ausschnitt)

Global Smart Cities – Kochi (Kerala)

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

based on a decision of the German Bundestag

- Cooperation project funded by German Federal Ministry of Environment
- Focus: climate change adaptation
- 04/2019 – 12/2022
- Exemplary cities:
  - Kochi (India)
  - Saltillo (Mexico)
  - Piura (Peru)
- Assessment and development of measures in 2-3 sectors of each city
- Exemplary implementation of pilot projects for climate change mitigation and adaptation

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Street of the Future-project

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STRASSE DER ZUKUNFT

- Implementations in 2 German cities (Ludwigsburg and Erlangen)
- How can road runoff be utilized?
- Measurement of air and water quality

Road runoff

intern

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Leipziger BlauGrün

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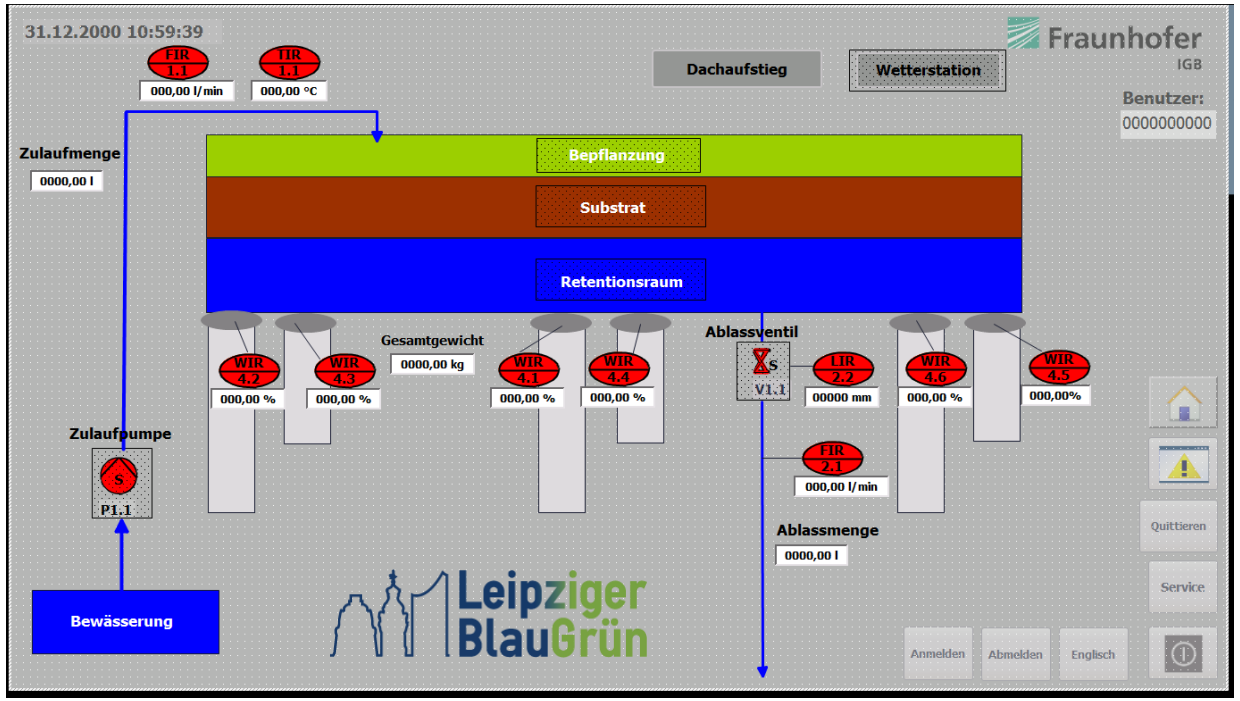
Leipziger BlauGrün

- Blue-Green Infrastructure in a development area in central Leipzig
- Automated Green Roofs for storage of stormwater and cooling of cities



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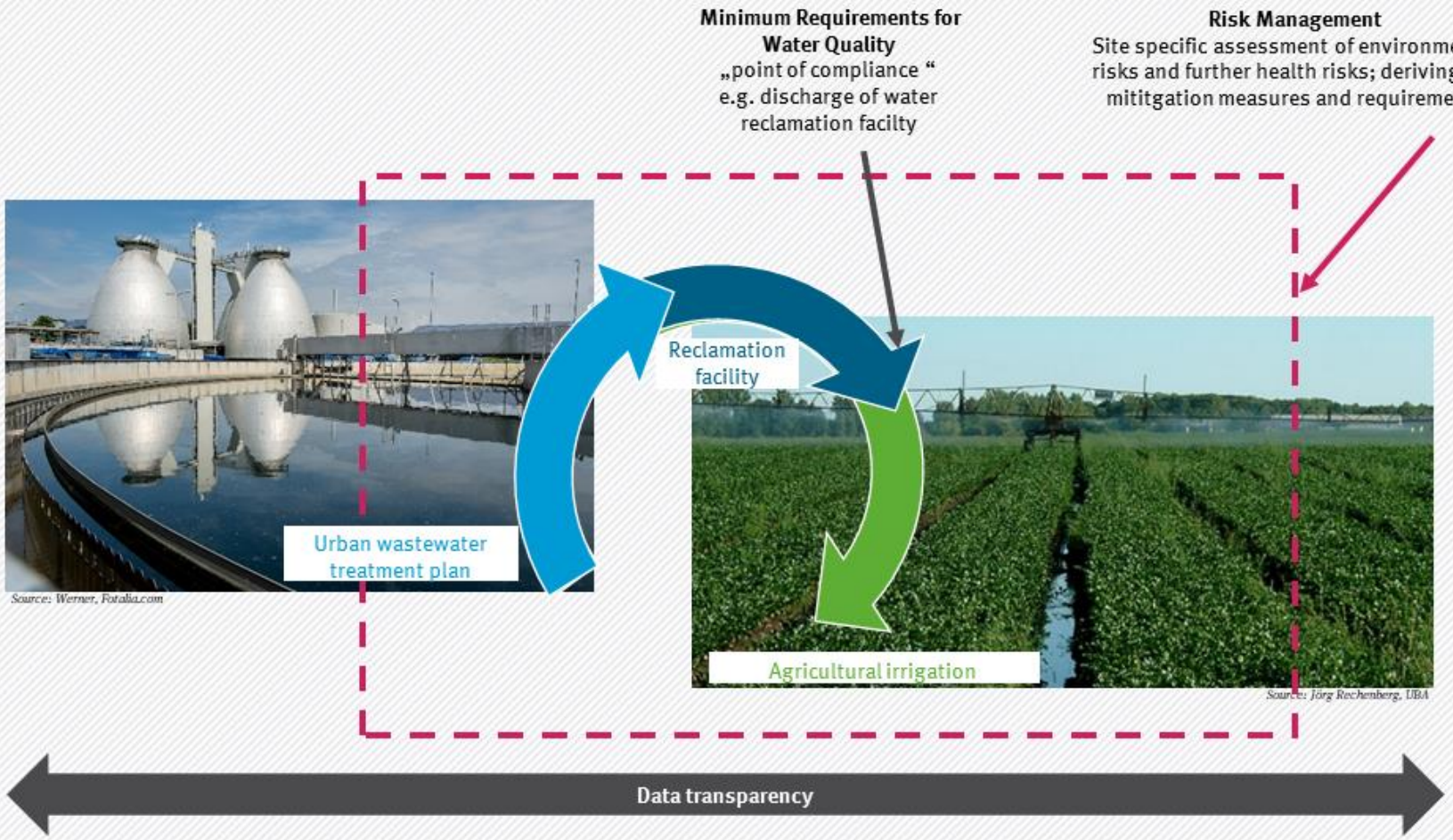
Scope of the EU Regulation on Water Reuse



Source: German Environment Agency (UBA)

HypoWave - Reuse in hydroponic systems

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HYPOWAVE

- Hydroponic systems for a resource efficient agricultural reuse of wastewater
- System with multiple barriers and protection of water and soil from contaminants

- BMBF (German research ministry) funding: 2016 – 2019
- 13 partners from Germany: research, industry, utilities

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Challenges

- Use of nutrients in wastewater
- No contamination of product with heavy metals, pathogenic or antibiotic-resistant microorganisms, micro-pollutants
- Discharge of effluent into environment without further treatment
- Economically feasible system solution

Source: Aquatectura

Pilot plant in Wolfsburg-Hattorf

- Operation between April 2017 and November 2019 at municipal WWTP Wolfsburg-Hattorf
- Different wastewater treatment processes in parallel
- Growing lettuce in hydroponic greenhouse in parallel lines

Results of piloting

- The hydroponic system can be operated efficiently with irrigation water with low concentrations (N,P)*
- Concentrations of heavy metals in lettuce were very low
- Ozonation and activated carbon filtration achieved removal efficiencies of > 90% also for persistent micropollutants
- Main focus should be on microbiological parameters – microbial risk assessment and quality management of whole chain is recommended**

More details:

*Alexa Bliedung, Thomas Dockhorn, Jörn Germer, Claudia Mayerl, Marius Mohr; Experiences of running a hydroponic system in a pilot scale for resource-efficient water reuse. *Journal of Water Reuse and Desalination* (2020)

**Marius Mohr, Thomas Dockhorn, Jörg E. Drewes, Sybille Karwat, Susanne Lackner, Bryan Lotz, Andreas Nahrstedt, Andreas Nocker, Engelbert Schramm, Martin Zimmermann; Assuring water quality along multi-barrier treatment systems for agricultural water reuse. Journal of Water Reuse and Desalination (2020)

Implemetation in Weißenberge

- Weißenberge: 500 inh. connected to pond system
- Economically feasible if connection to WWTP not necessary due to post-treatment in hydroponic system
- Pre-treatment of effluent of ponds necessary, as nitrogen present as ammonium
- Contract between operator of hydroponic system and utility needed

Nutrient recovery

Waste as raw material source and our technologies

ePhos®

- Magnesium-ammonium-phosphate (MAP, struvite)

BioEcoSIM

- Inorganic phosphorus salts
- Ammonium-sulfate
- Organic solids

Pretreatment

- Leaching, P solubilization
- Thermal pressure treatment
- Solid / liquid separation

Product winning

- Electrolytic and chemical precipitation

Product conditioning

- Superheated steam drying
- Hygienization
- Pelletization
- Formulation

Applications

- Production of recycled liquid and solid fertilizers
- Plant protectors for ecological agriculture

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Co-utilization of organic waste and sewage sludge in Paris

Project example

Demand

- Joint treatment of sewage sludge (wastewater) and biowaste (oils and fats, manure) - Co-utilization
- Technologies for material and energy utilization

Results

- Complete process consisting of pretreatment, methanization, solid phase and liquid phase treatment
- Module for drying of HTC coal with superheated steam
- Module for nutrient recovery (magnesium ammonium phosphate)

Benefit

- New contract model – innovation partnership
- Phase I: Development of digestion, co-fermentation, nutrient recovery
- Phase II: Construction of a pilot plant – thermal digestion, drying of HTC coal and nutrient recovery
- Phase III: Will include construction of a large industrial plant

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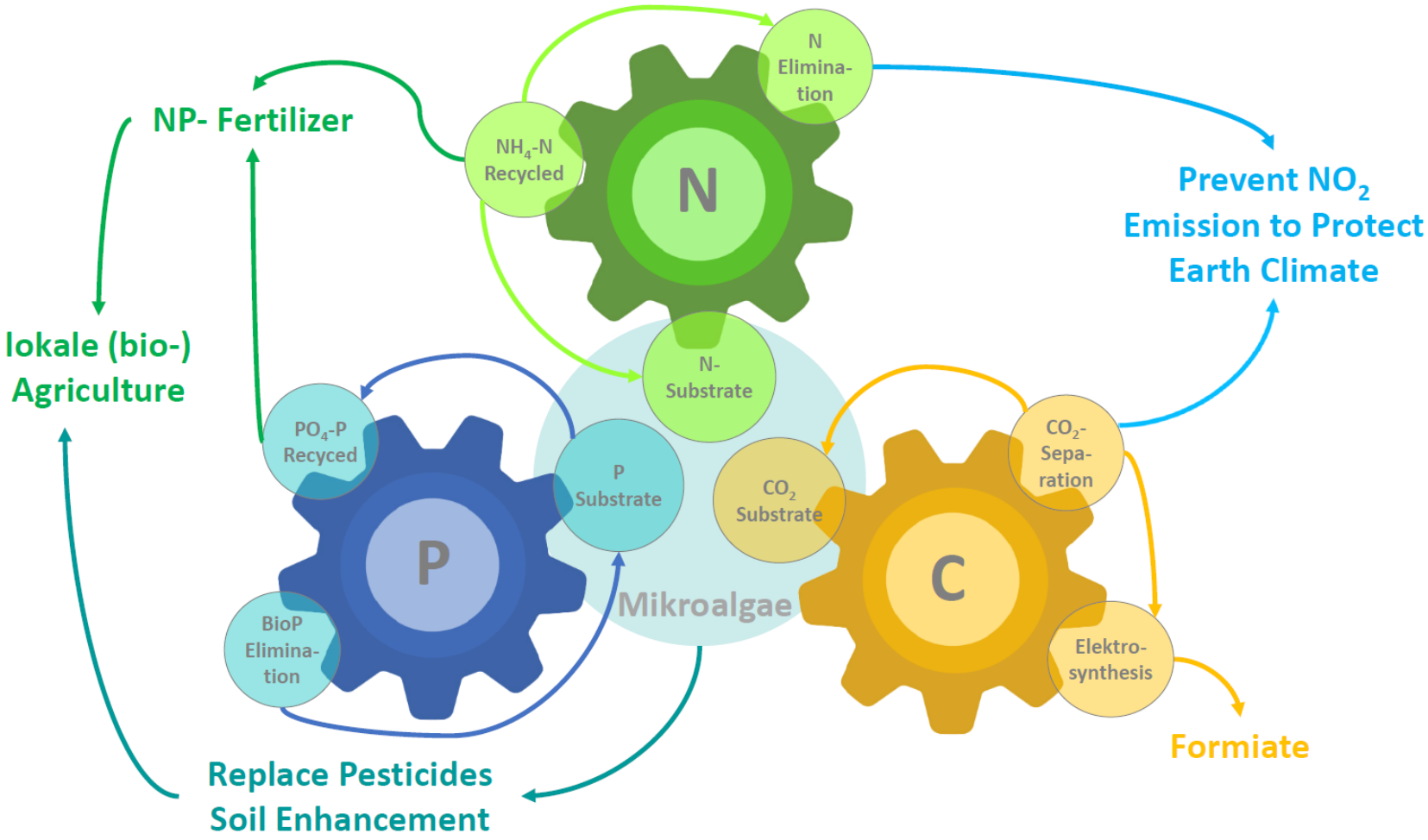
Wastewater treatment plant as biorefinery

Suggested to be realized in Ulm, Germany

- Sources: Anaerobic Digester Filtrate Water (1 m^3/h) & Biogas
- Products: Fertilizer, Plant Stimulants and Soil Enhancers for agriculture, Formiate for (Bio)Industry
- Climate Protection by reduced NO_2 Emission
- Pilot Plant to be built near Ulm



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Thank you for your attention

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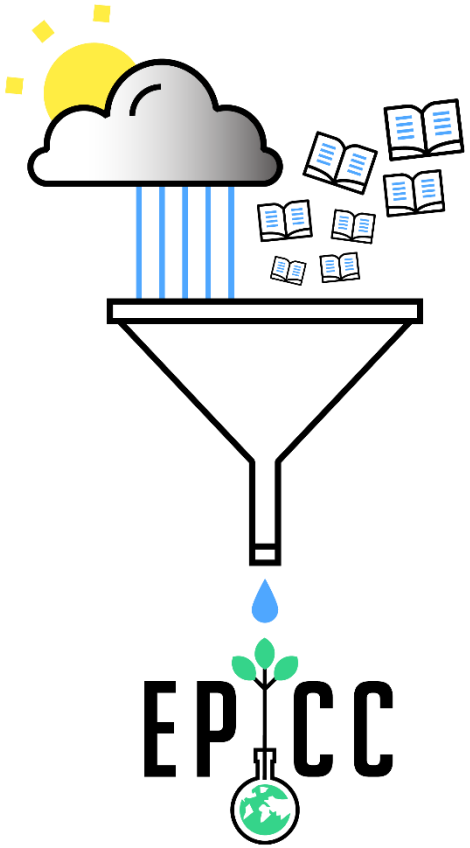

EAST AFRICA PERU INDIA
CLIMATE CAPACITIES

Evaluation of long-term precipitation datasets for water budget estimation at national level in Peru

November 19, 2021

Carlos Fernandez Palomino

Mechthild Anna Becker

Potsdam Institute for Climate Impact Research

IKI INTERNATIONALE KLIMASCHUTZ INITIATIVE

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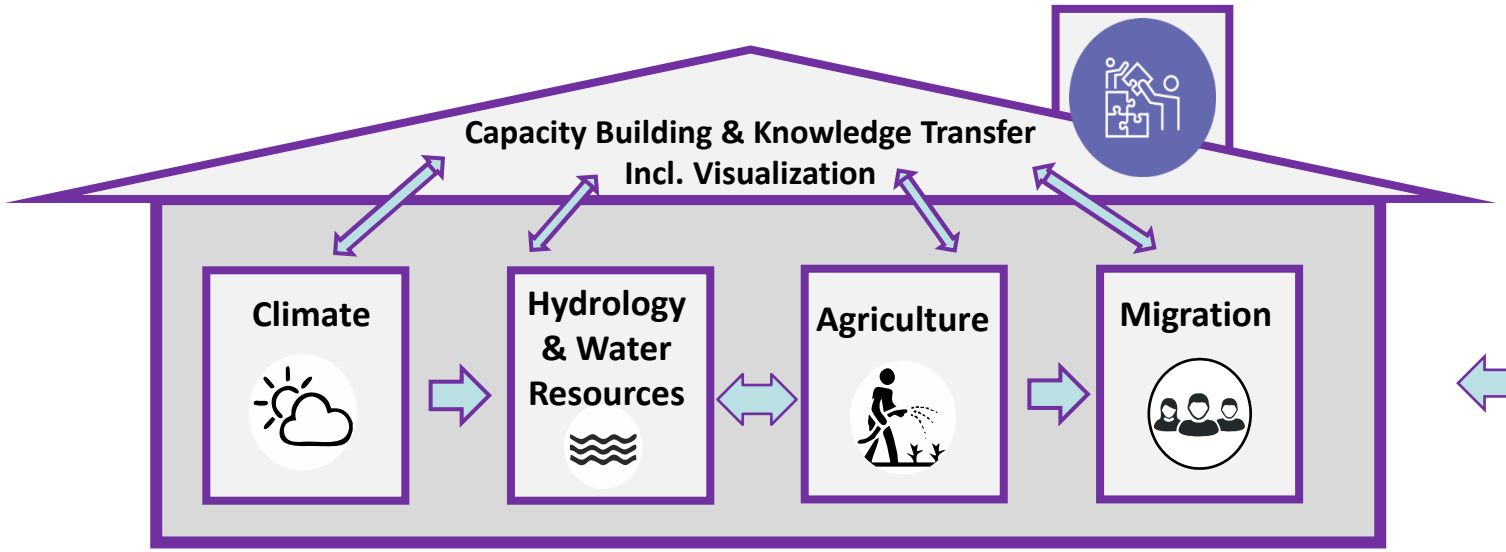
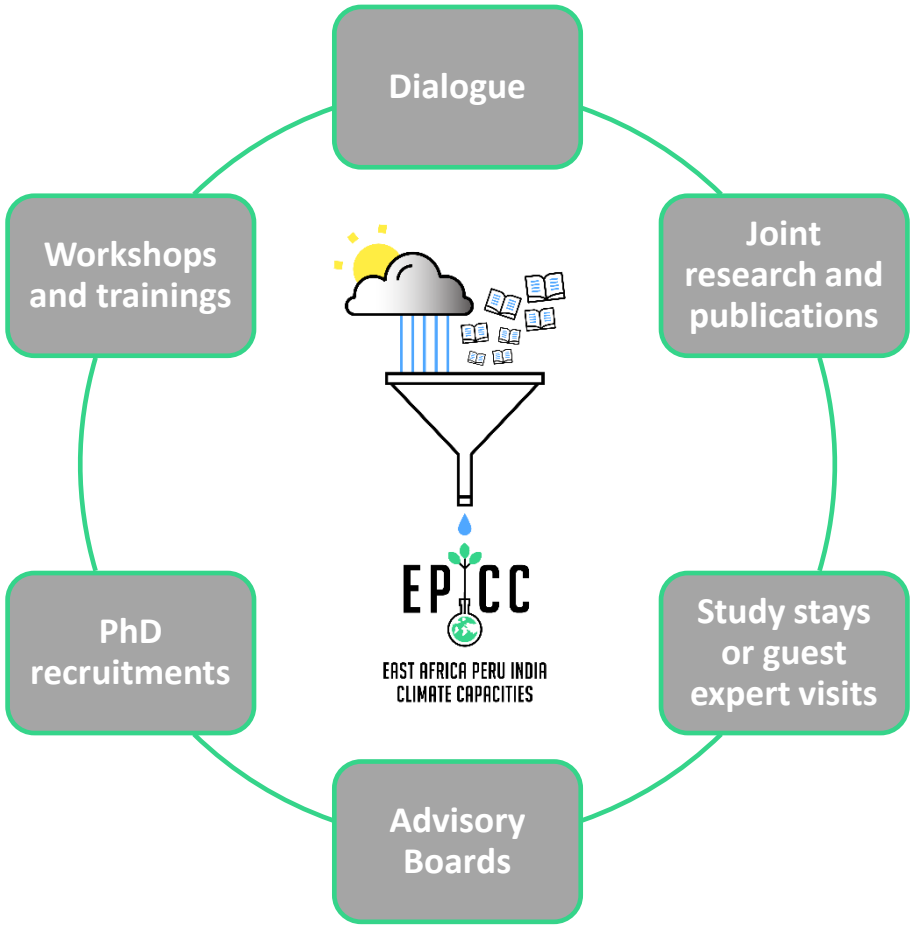
The East Africa Peru India Climate Capacities Project

>> Co-production of user-oriented climate services to better adapt to climate change <<



- Cooperation with research institutes and universities
- Local partners Exchange with political decision-makers

Capacity Building and Knowledge Transfer



Outreach & Exchange

- Co-production of knowledge
- Translation of scientific results into policy relevant information (e.g. National Adaptation Plans)
- Making information free and accessible

PIK

Events and Stakeholder Exchange in Peru

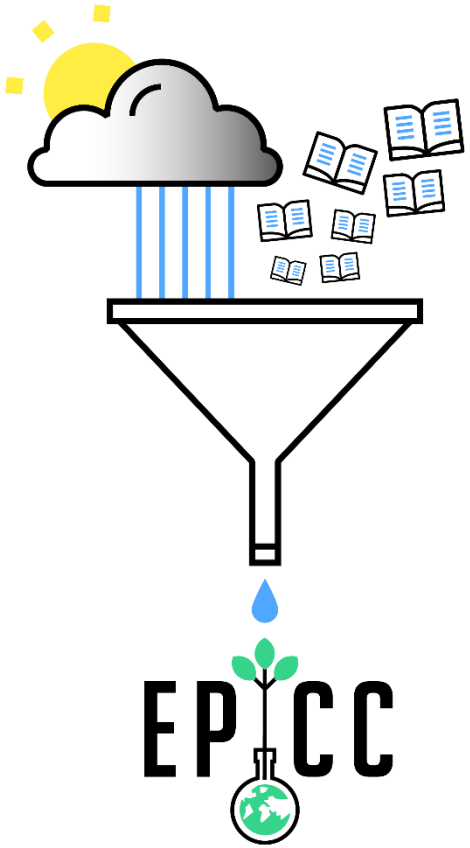
2019: Senamhi, Lima, Peru

Participation in the **Participatory Process of the NAP Development**: Webinar (07.05.2020)

DIALOGUEMOS sobre Cambio Climático

Source: MINAM

PIK



EAST AFRICA PERU INDIA
CLIMATE CAPACITIES

Evaluation of long-term precipitation datasets for water budget estimation at national level in Peru

Carlos Fernandez Palomino (cafpxl@gmail.com)

Potsdam Institute for Climate Impact Research

IKI INTERNATIONALE KLIMASCHUTZ INITIATIVE

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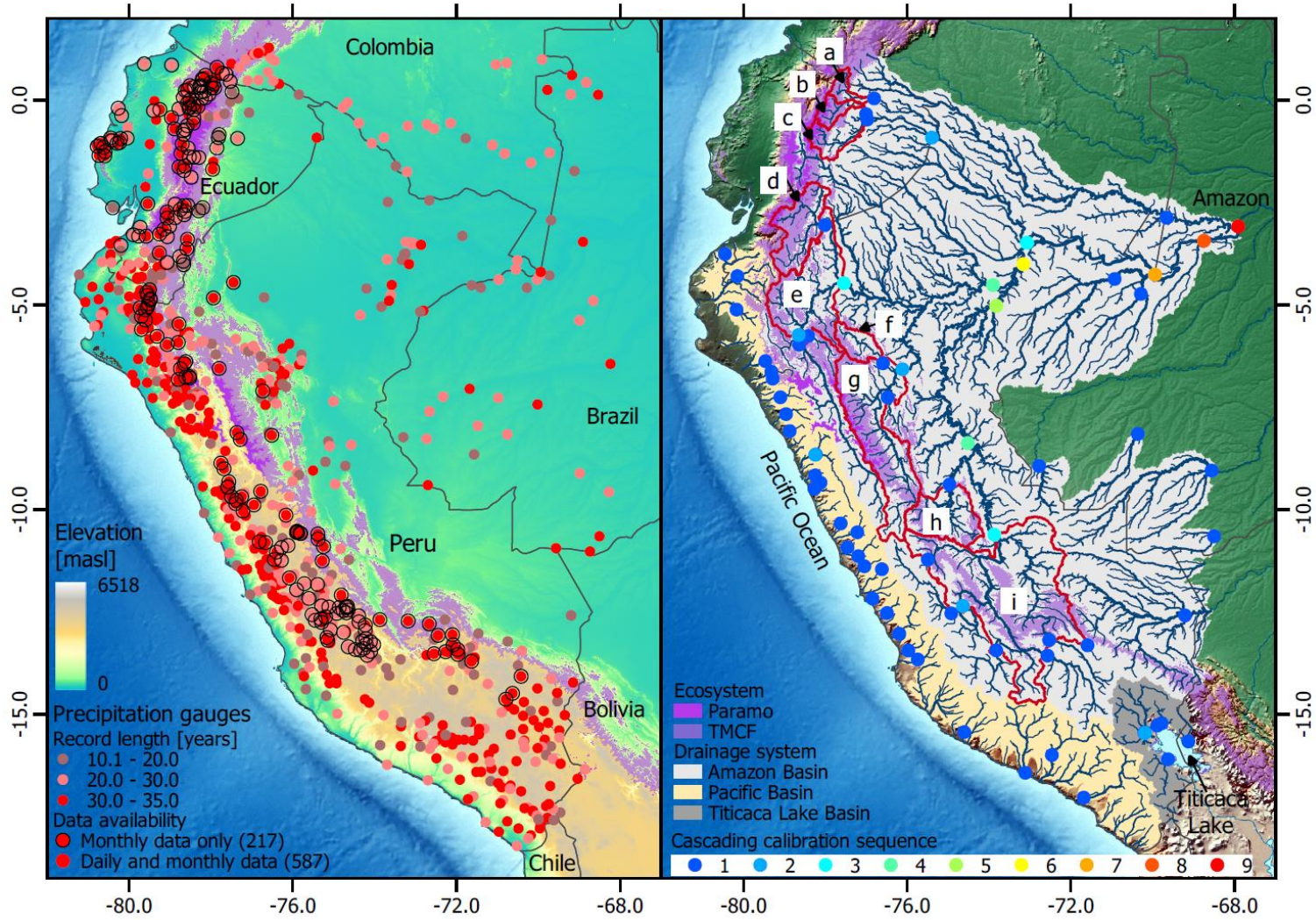
Which precipitation dataset is appropriate to estimate the water budget components at national scale of Peru?

- Evaluation of reliability of different precipitation datasets using precipitation gauge observations and through hydrological modeling

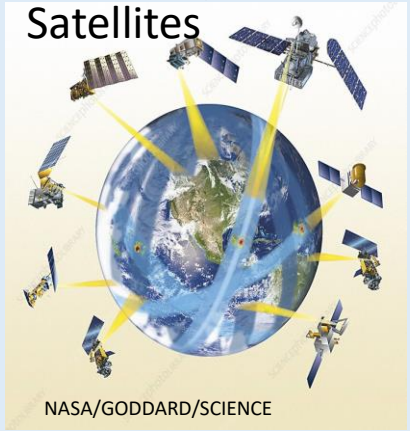
Study Area

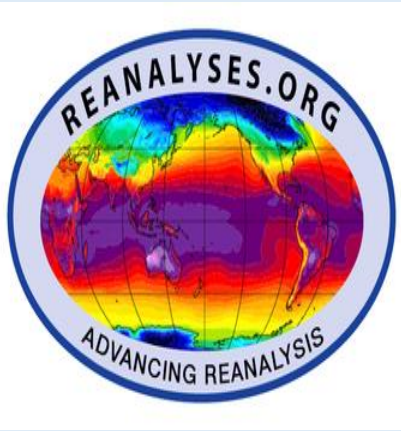


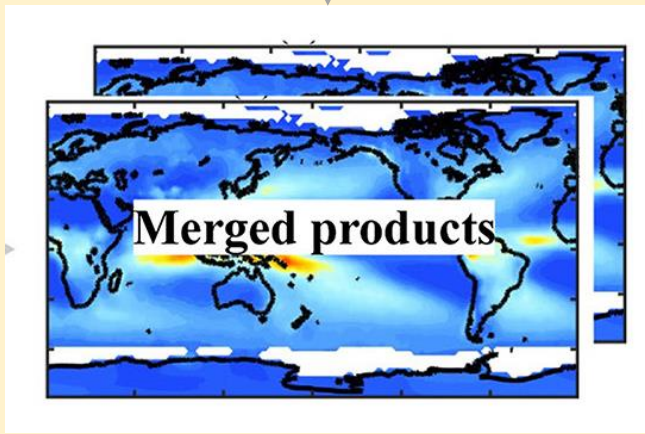
Precipitation gauges

Streamflow stations

Precipitation datasets







- CRU (Harris et al. 2014)
- GPCC (Rudolf et al. 2009)
- HYBAM (Guimberteau et al. 2012)

Gauge-based P datasets

- **CHIRP** (Funk et al. 2015)
- CMORPH (Joyce et al. 2004)
- TMPA (Huffman et al. 2007)
- IMERG (Huffman et al. 2019)

- ERA-Interim (Dee et al. 2011)
- MERRA (Reichle et al. 2017)
- **ERA5** (Hersbach et al. 2020).

non-gauge corrected P datasets

- **CHIRPS** (Funk et al. 2015a)
- **MSWEP** (Beck et al. 2019b, 2017)
- **PISCO**-prec (Aybar et al. 2020)
- **RAIN4PE** (Fernandez et al. 2021) (In Review)

Gauge-corrected P datasets

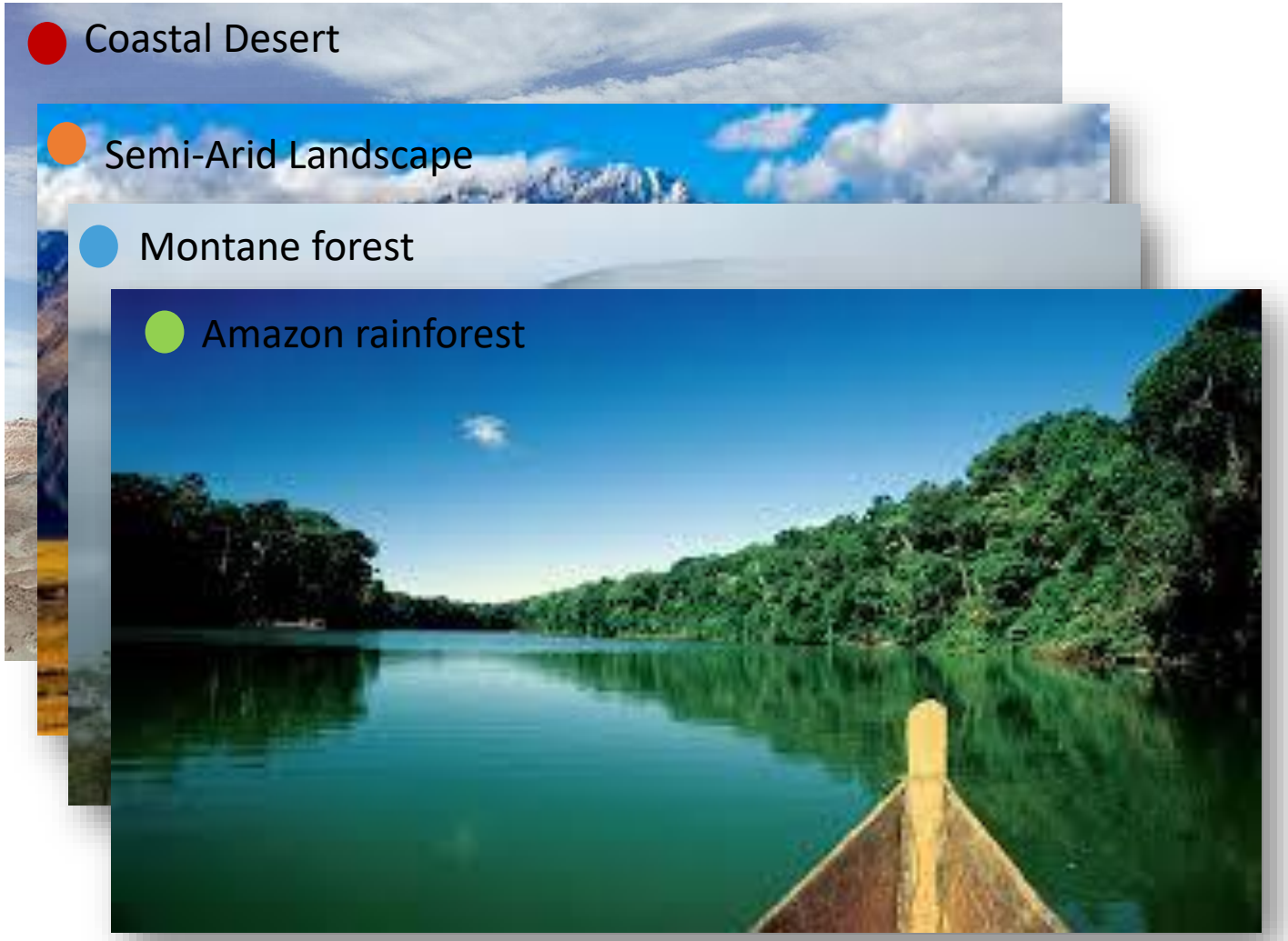
RAIN4PE (Rain for Peru and Ecuador) is the only gridded precipitation product for Peru and Ecuador, which benefits from maximum available in-situ observations, multiple precipitation sources, environmental variable (elevation data), and is supplemented by streamflow data to correct the precipitation underestimation over páramo and montane catchments. RAIN4PE is available at the daily resolution and 0.1° (~10 km) spatial resolution for the period 1981-2015.

Fernandez et al. (2021) (In Review)

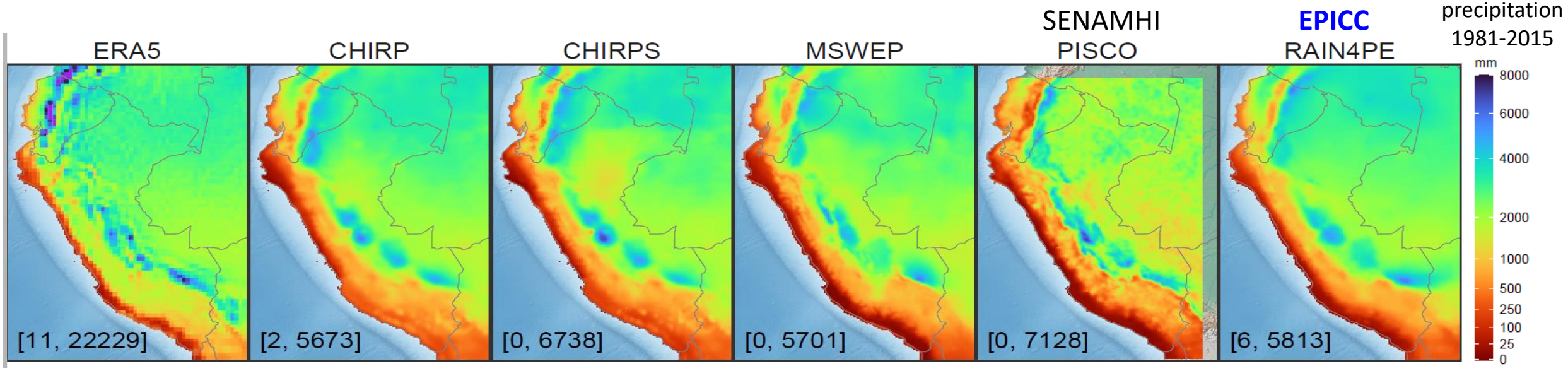
RAIN4PE dataset will be available for users once the manuscript (in review) is accepted

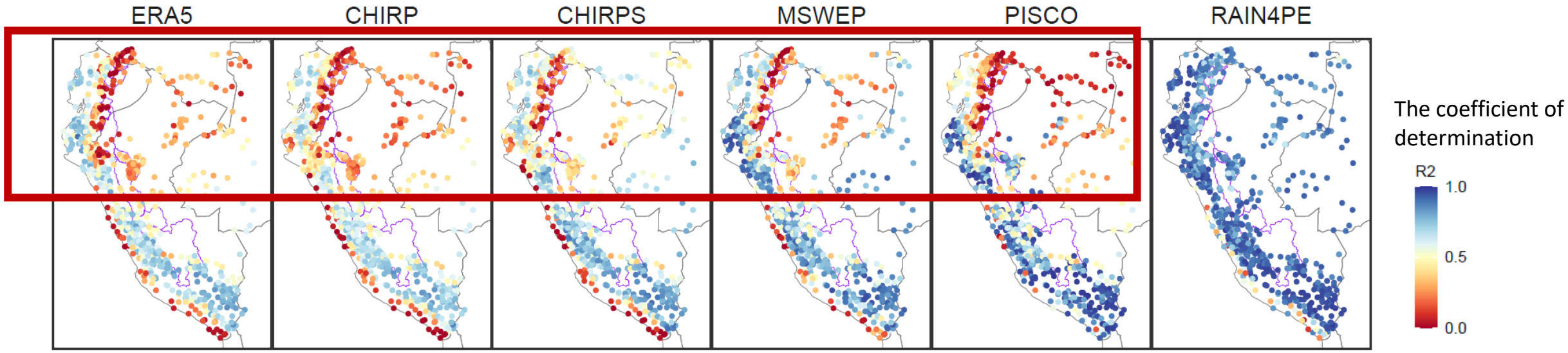
Complex topography and landscapes of Peru to be considered in the hydrological model setting up

Elevation ranging from 0 to 6518 m a.s.l.



Which precipitation data is appropriate?

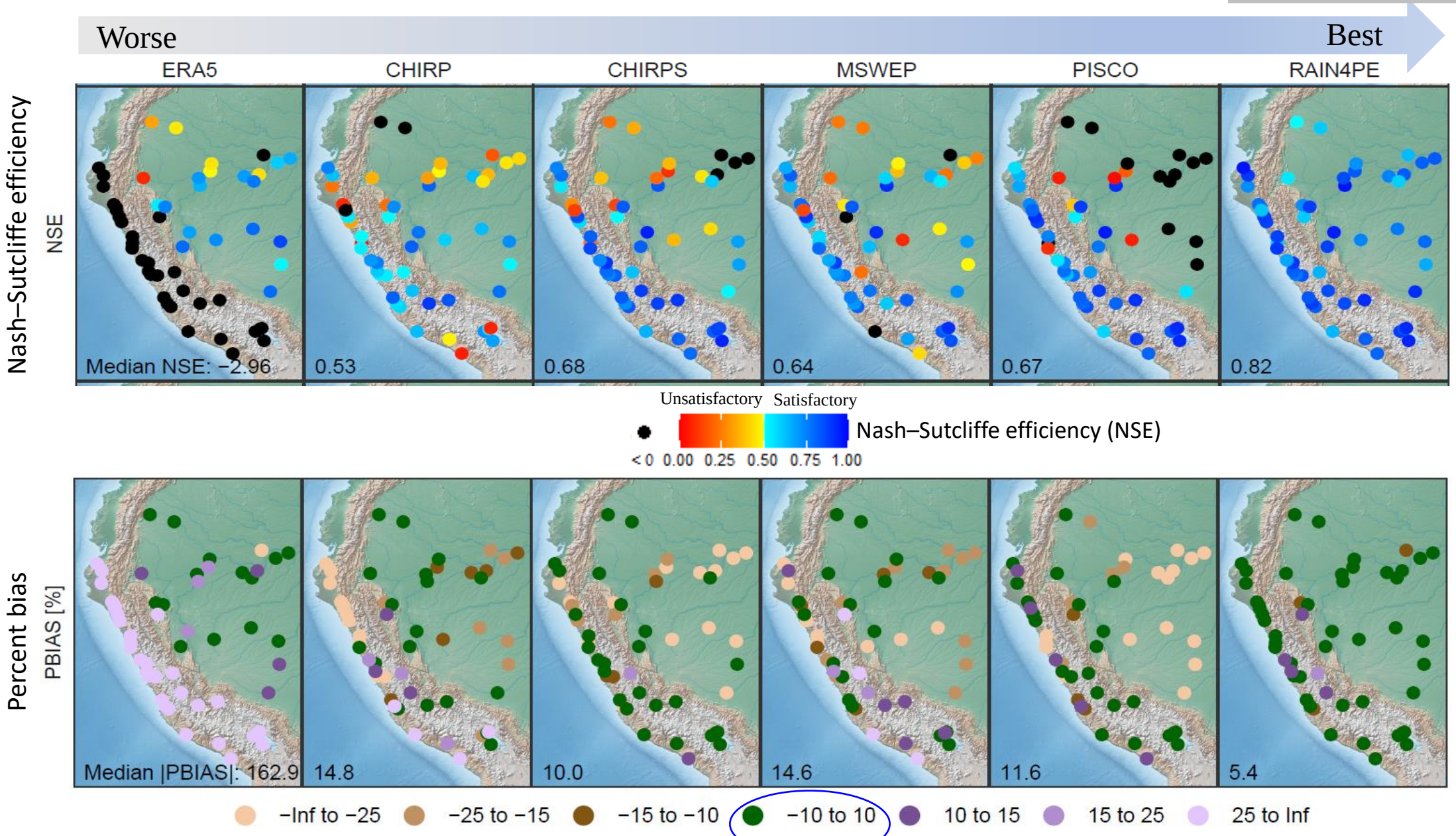




Comparison of precipitation datasets using gauge observations at monthly scale for 1981-2015

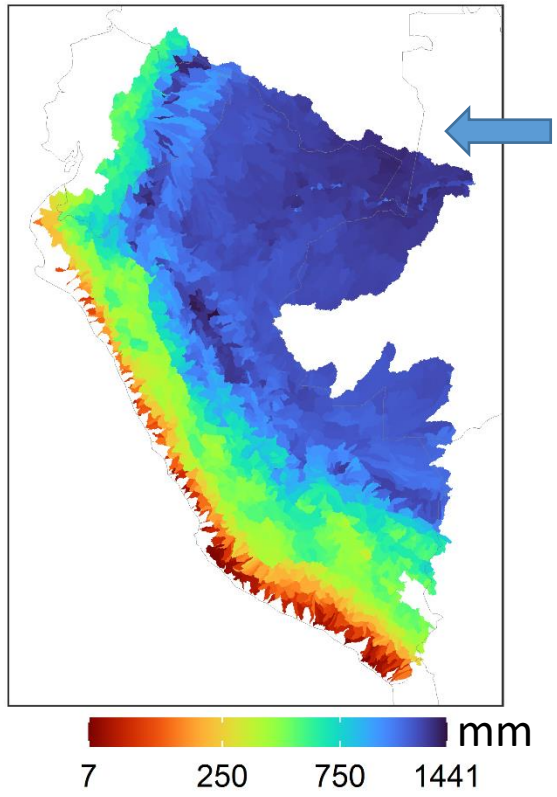
Hydrological model performance using six precipitation datasets for monthly streamflow simulation for 1983-2015

Hydrological model: The Soil and Water Assessment Tool (**SWAT**)

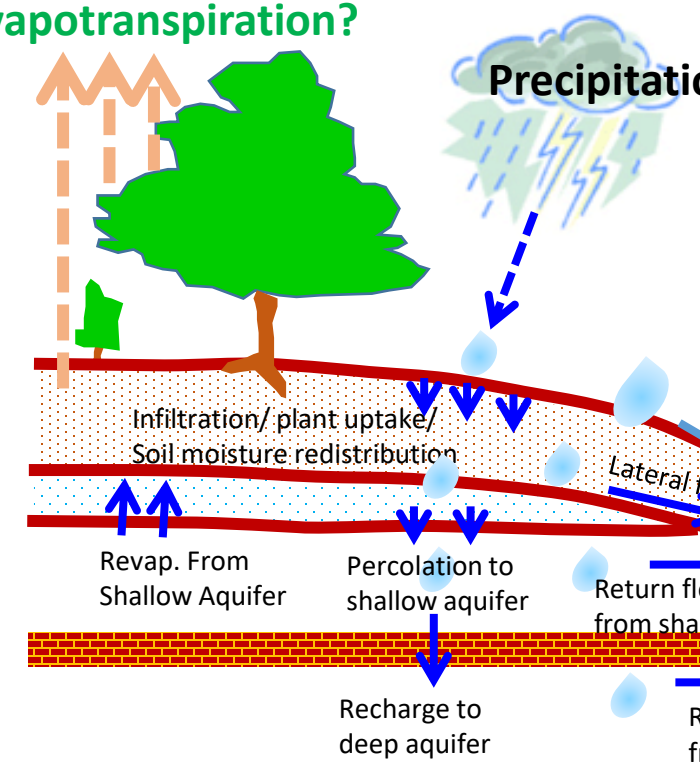


Spatial variability of the water budget components

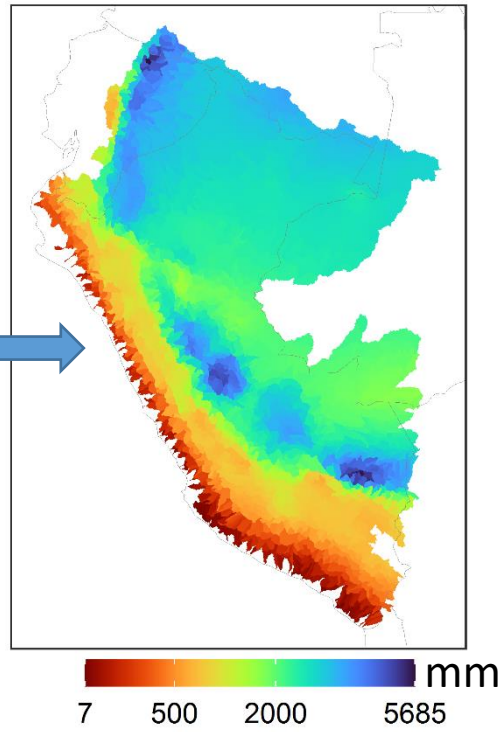
using SWAT driven by RAIN4PE precipitation data



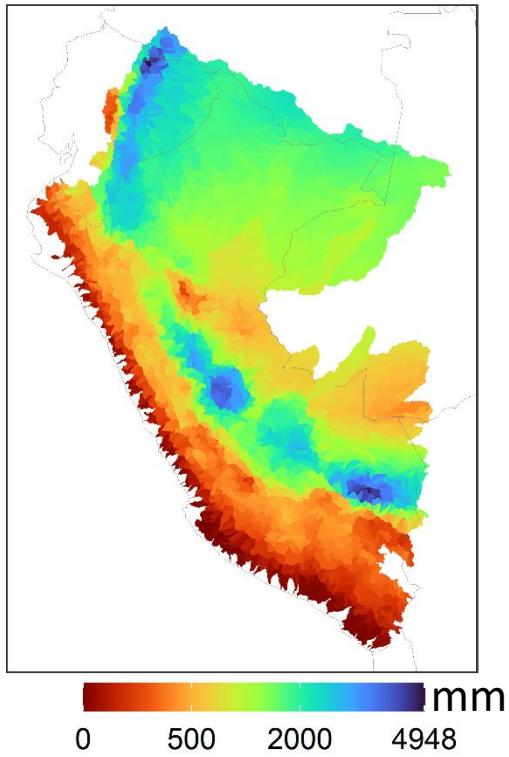
Evapotranspiration?



Precipitation



Water yield?



Fernandez et al (in preparation)

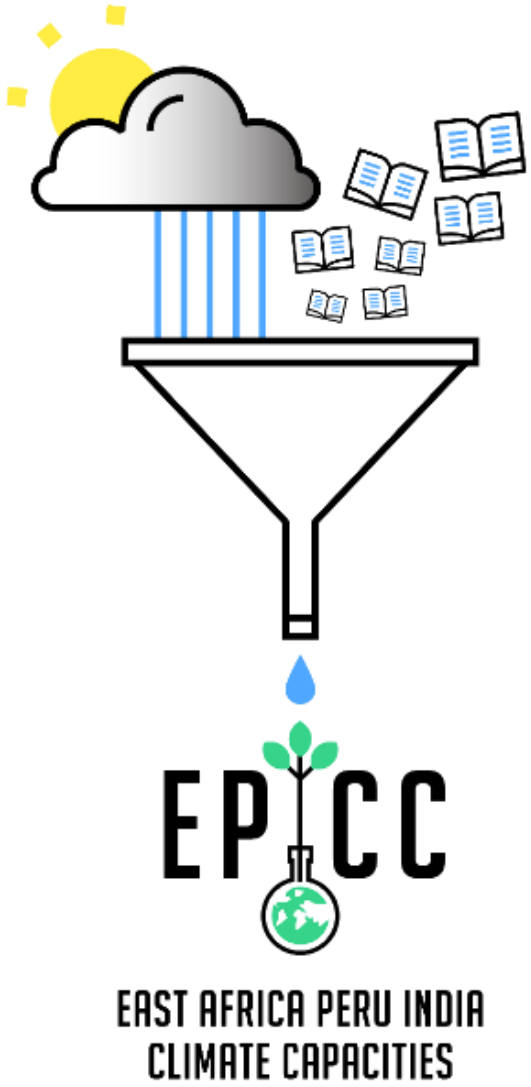
Conclusions

- ✓ Our new gridded precipitation dataset **RAIN4PE** resulted to be more reliable and accurate than existing precipitation products (PISCO, MSWEP, CHIRPS, CHIRP and ERA5).

- ✓ The water budget at national scale of Peru was estimated for the first time which is a big step and will benefit the water resources management

Next steps

- Analyze climate change impact on Peruvian water resources



Thank you!

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Get in touch:

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mechthild.becker@pik-potsdam.de

Water Security and Climate: the Situation of Monterrey Metropolitan Area (MMA)

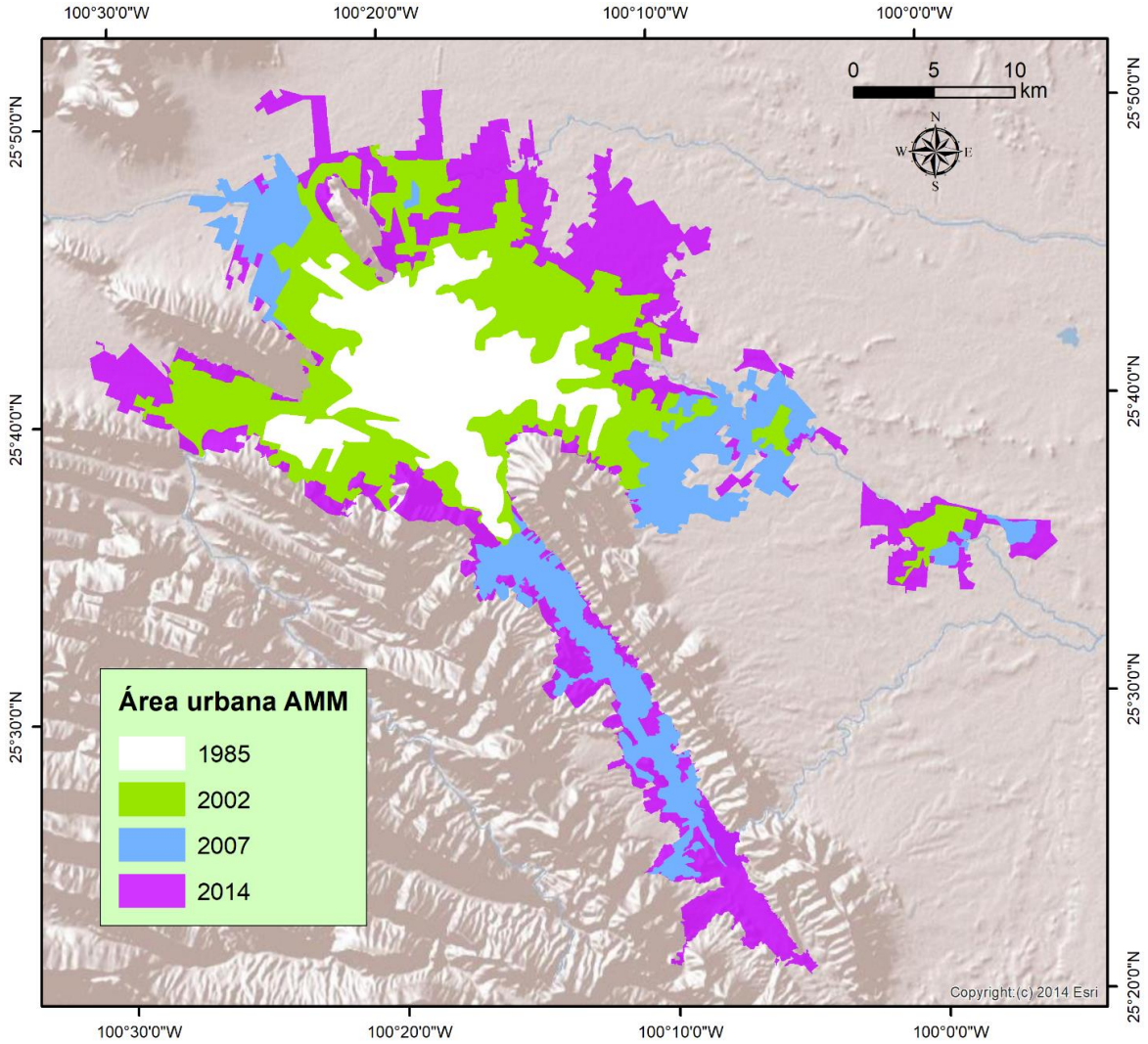
Dr. Jürgen Mahlknecht · Dr. Edmundo Molina
Dr. Ismael Aguilar · Dr. Aldo Ramírez
Tecnologico de Monterrey

MORGENSTADT GLOBAL SMART CITIES INITIATIVE
GLOBAL APPROACH – LOCAL SOLUTIONS

Webinar / 19. November 2021, 15:00 - 17:00 Uhr
Urban Water Management for Climate Resilience
4th Public Expertise Building Webinar

1 Introduction

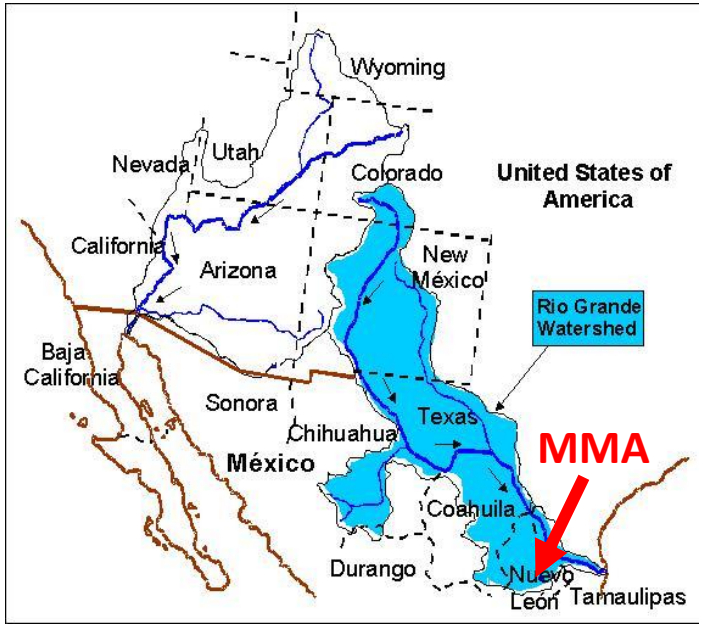
Monterrey Context



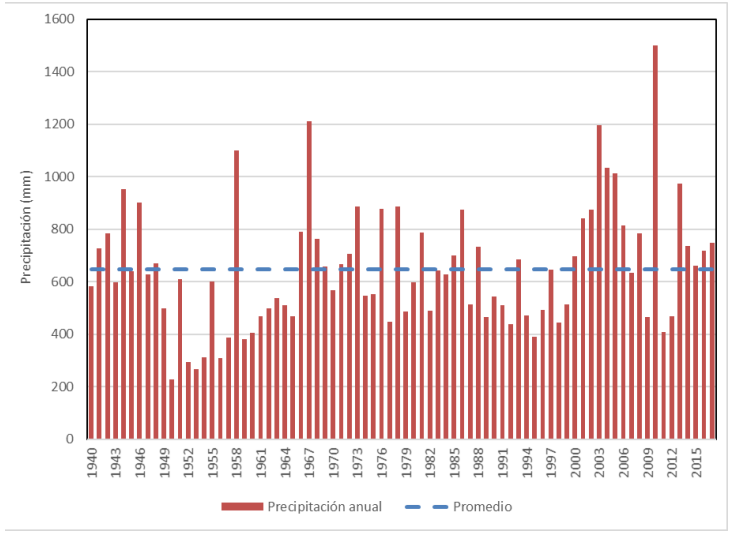
Urbanization

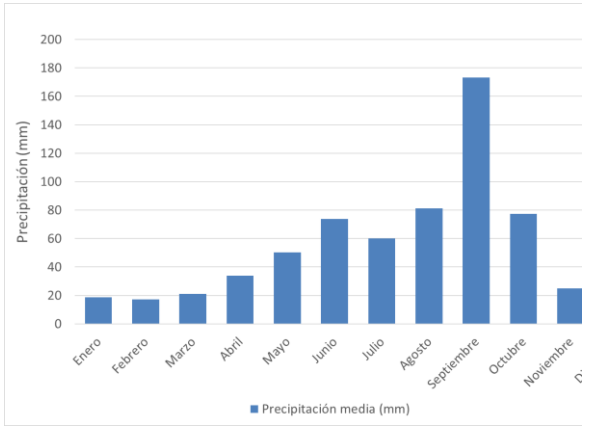
2
Physical framework

Climate



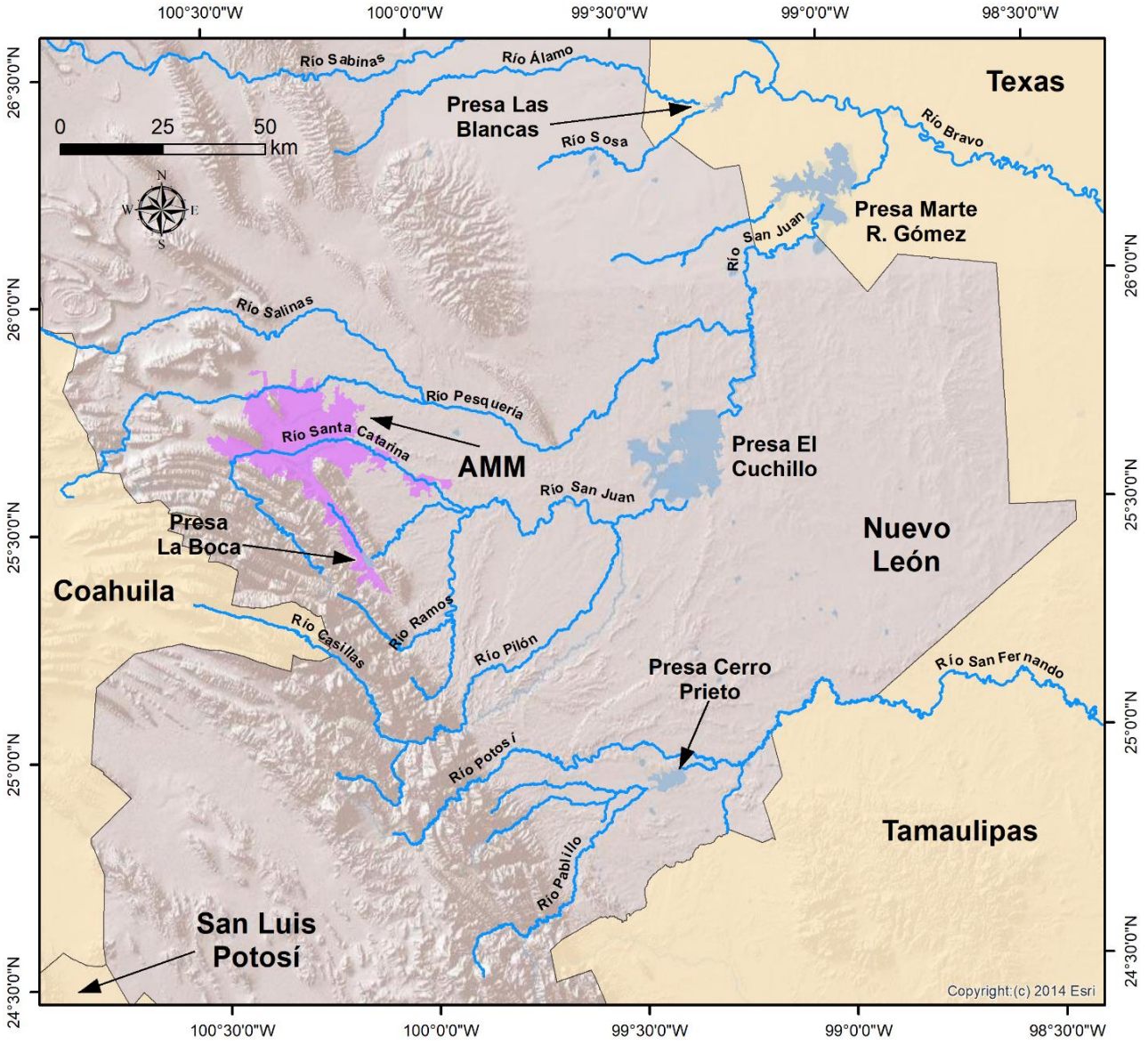
Source: nadb.org



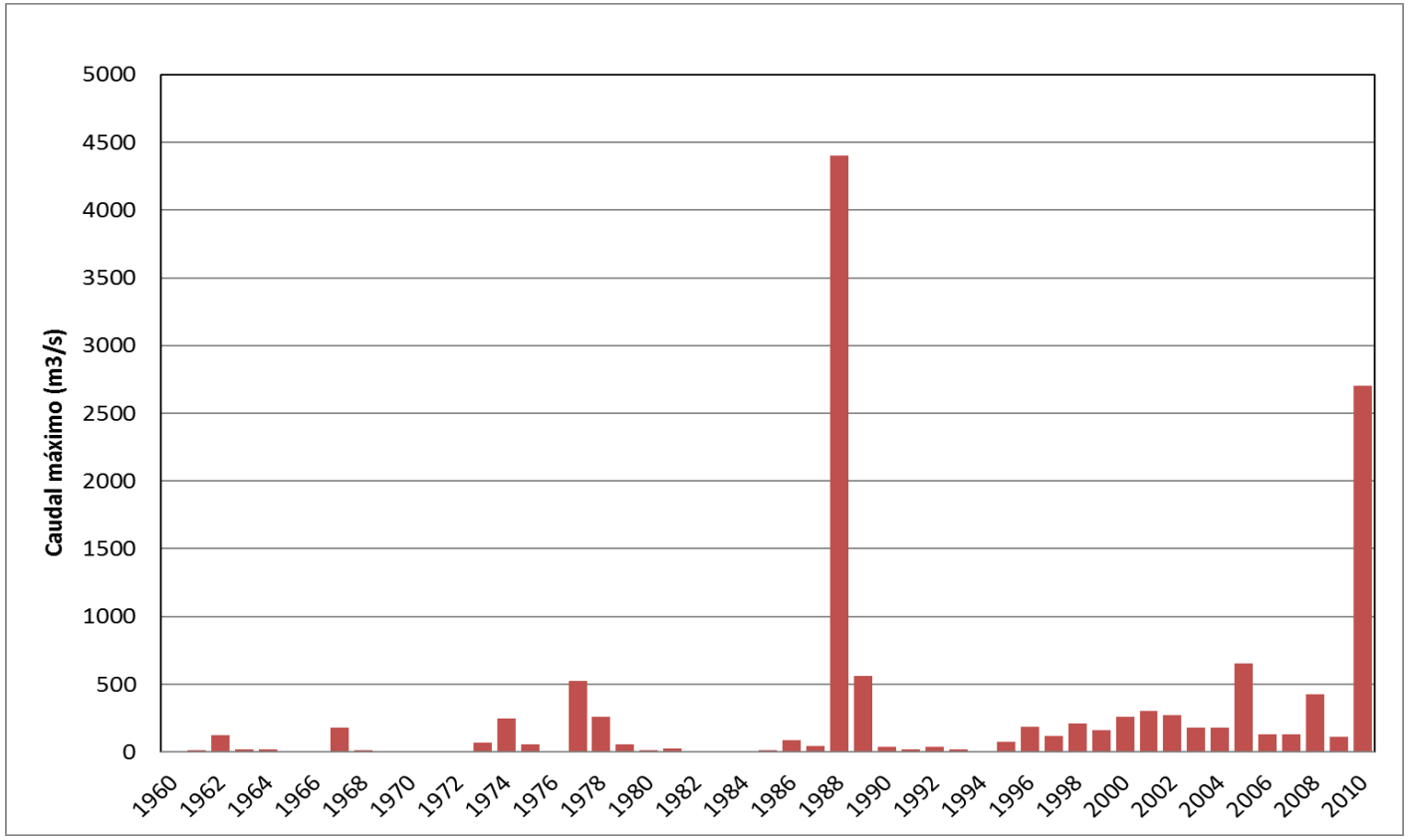


Source: wateractionhub.org

Hydrography



Río Santa Catarina



3 Institutional Framework

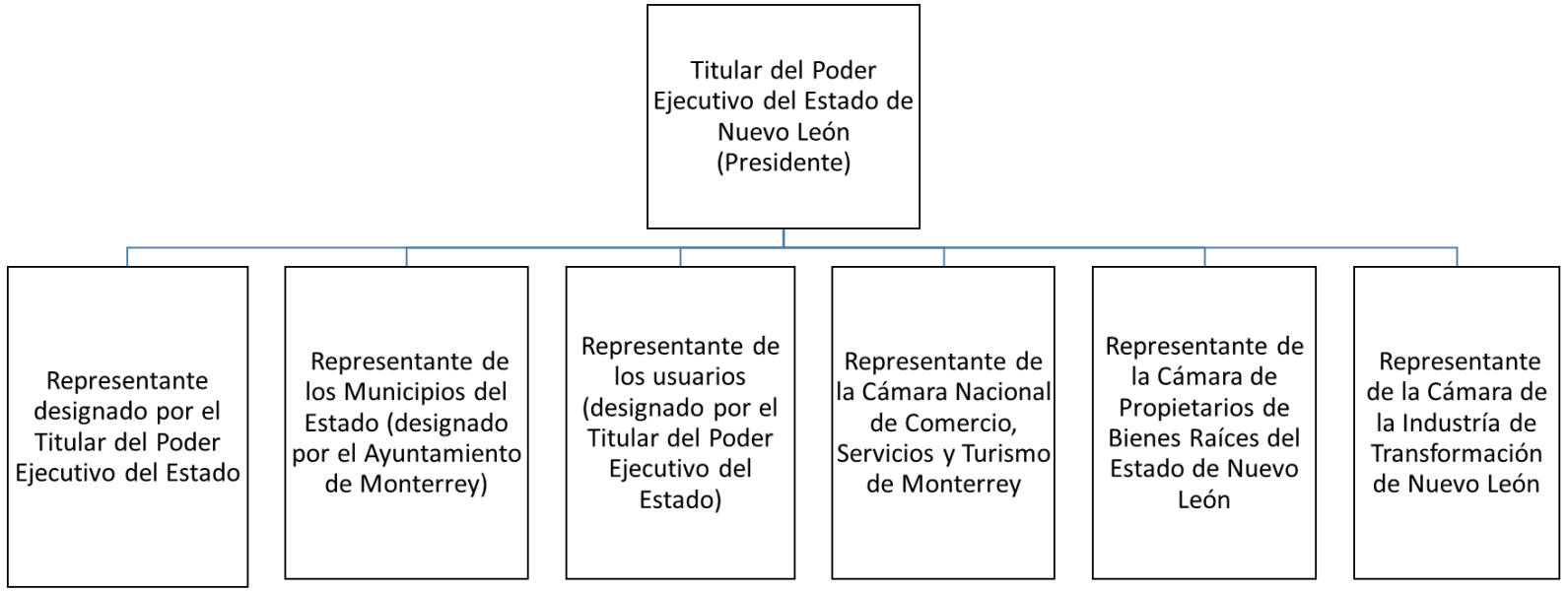
Servicio de Agua y Drenaje de Monterrey (**SADM**)

Decentralized Public Institution of the State Government of Nuevo León with legal personality and its own assets

1.77 million users

5,700 employees

35,122 km drinking water/drainage pipeline



Structure of the water and sanitation operator Board of Directors

4
Water Services of SADM

Drinking Water

Drinking water service coverage> 99%

Drinking water supply: 12,600 l/s

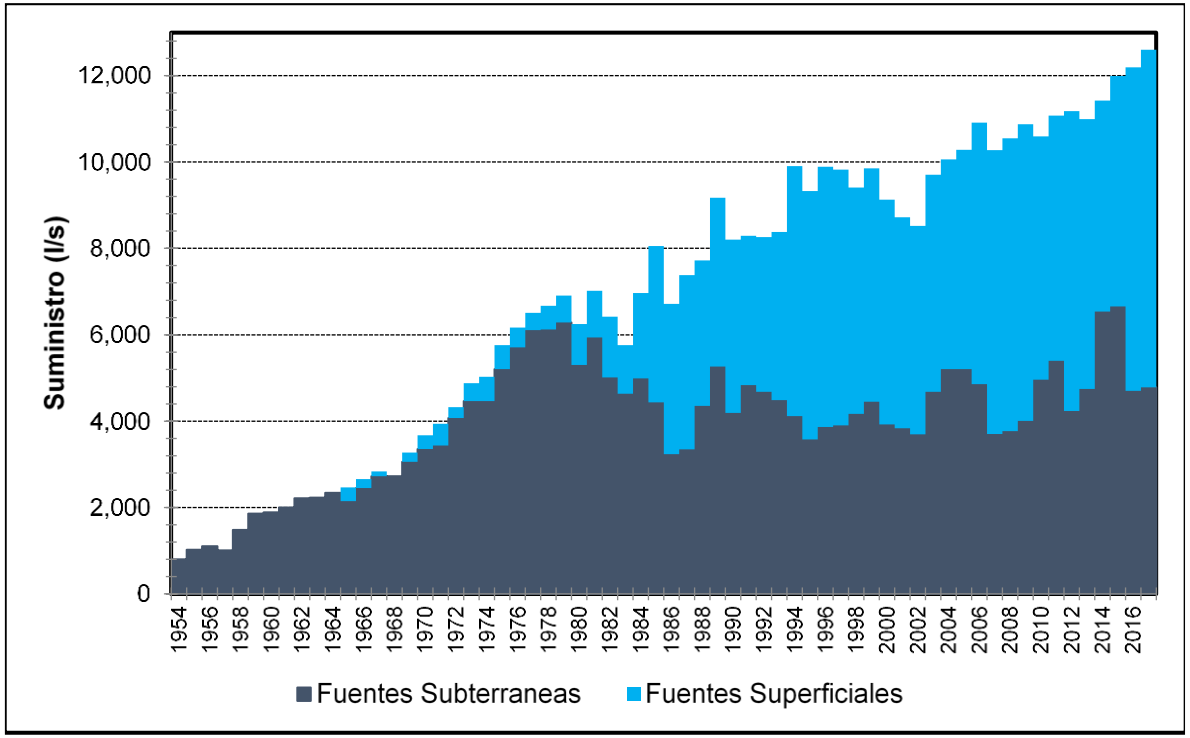
Drinking water network pressure: 2.5 kg / cm2

Continuity of service: 24/365

Several international accreditations

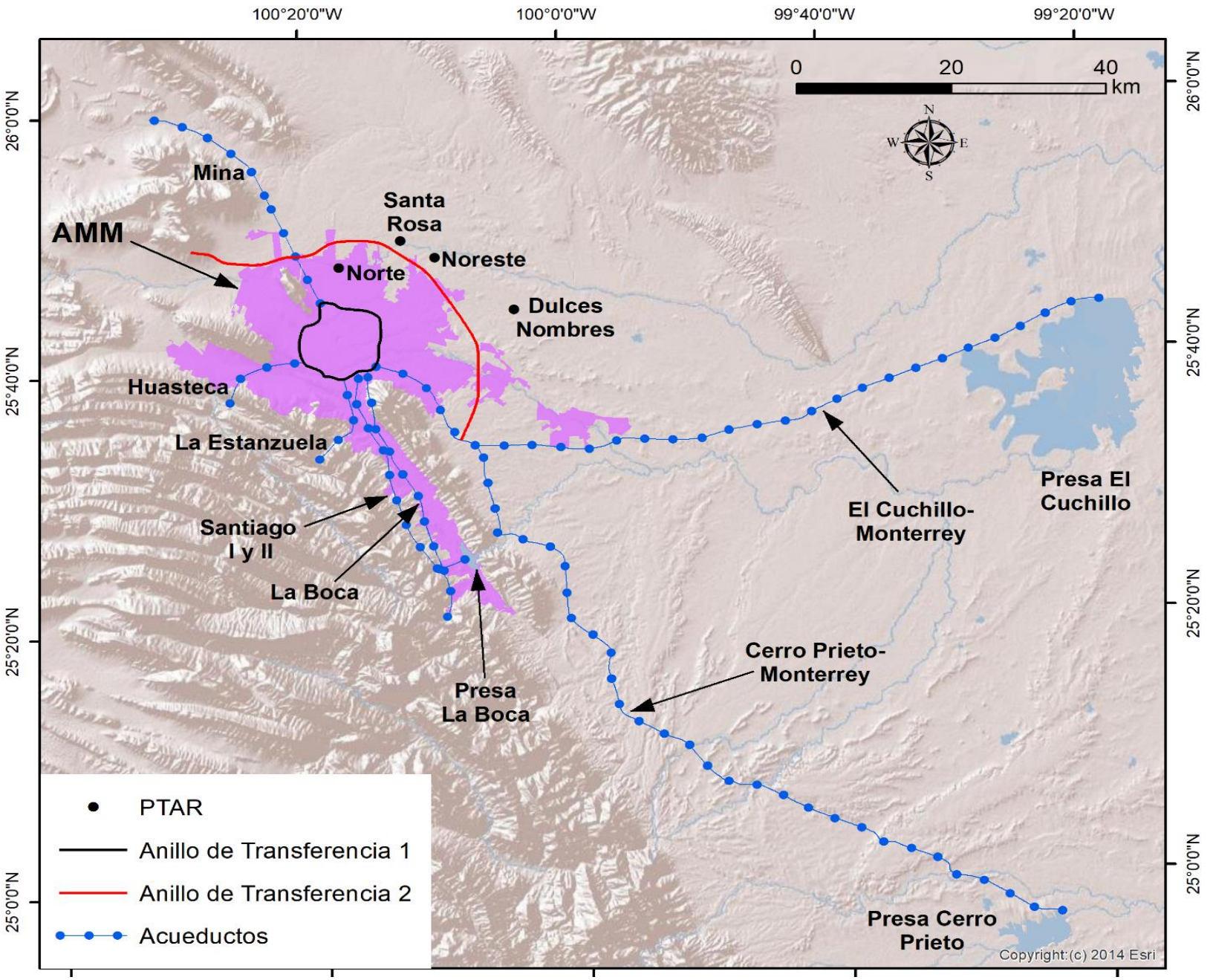
Non-revenue water: 25.7%

Drinking Water



Source: Prepared by the authors based on information from SADM (2017)

Hydraulic Infrastructure

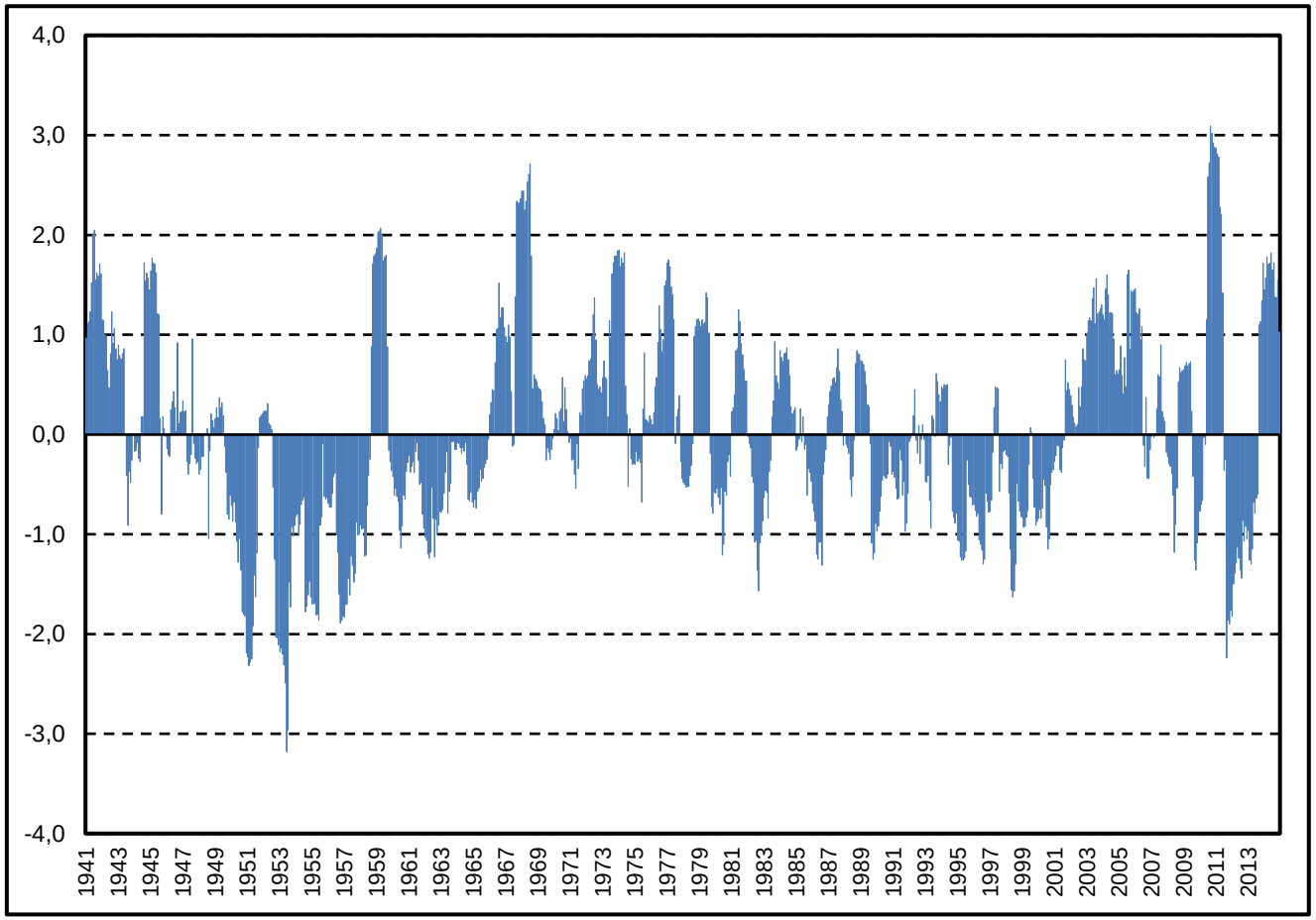


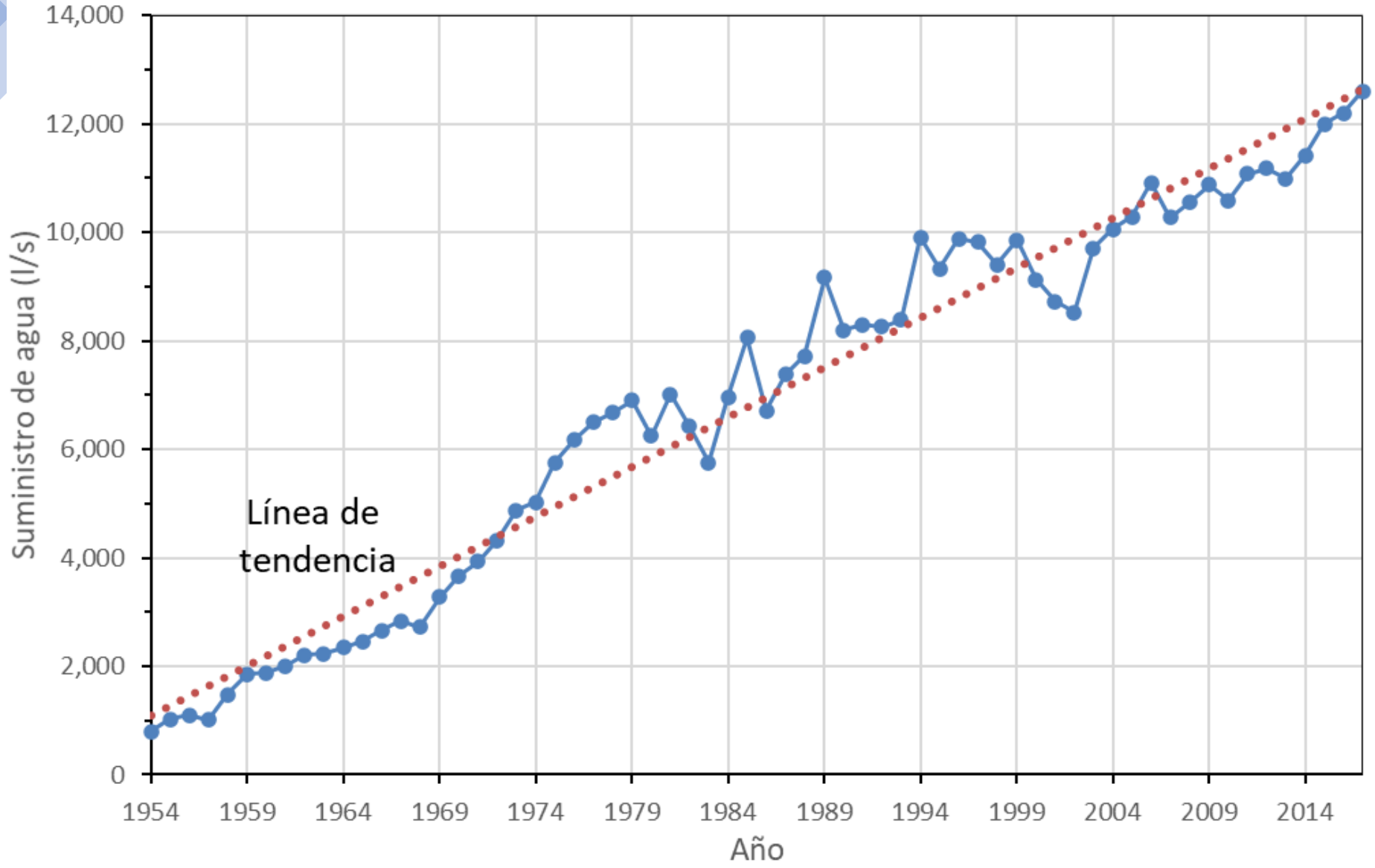
5
Extreme hydrometeorological phenomena and their relationship with the water supply in the MMA

Monthly SPI, central region of Nuevo León, January 1941-December 2014

Source: Prepared by authors based on data from Organismo de Cuenca Río Bravo, CONAGUA, and Ortega-Gaucin (2012)

SPI Value	Interpretation
>+2.0	Extremely humid
[+1.99 ... +1.50]	Very humid
[+1.49 ... +1.00]	Moderately humid
[+0.99 ... -0.99]	Near to normal
[-1.00 ... -1.49]	Moderate dry
[-1.50 ... -1.99]	Very dry
<-2.0	Severly dry





Soruce: Prepared by the authors based en data from SADM

6 Challenges

- AMM, with a geostrategic position in northeastern Mexico, is a fundamental contributor to the country's economy.
- Availability of water must be treated as a matter of national interest of the first order.
- Coverage and quality of service achieved to date will be a major challenge.
- The climate regime will remain highly variable and probably even more extreme.
- The conservation efforts of the basin in which the AMM is located are of absolute necessity

- Aquifers can provide water for a long time, even during very long droughts.
- But an important effect of climate change would be a general decrease in the water table.
- It is foreseeable that new sources of supply are needed in the long term, with a more effective management of demand from current sources (surface and groundwater).

7
Research studies

Water Research 182 (2020) 115962

Contents lists available at ScienceDirect

Water Research

journal homepage: www.elsevier.com/locate/watres

Tracking nitrate and sulfate sources in groundwater of an urbanized valley using a multi-tracer approach combined with a Bayesian isotope mixing model

Juan Antonio Torres-Martínez [a], Abrahan Mora [b], Peter S.K. Knappett [c], Nancy Ornelas-Soto [a], Jürgen Mahlknecht [a, *]

[a] Escuela de Ingeniería y Ciencias, Tecnologico de Monterrey, Campus Monterrey, Eugenio Garza Sada 2501, Monterrey, 64149, Nuevo León, M
[b] Escuela de Ingeniería y Ciencias, Tecnologico de Monterrey, Campus Puebla, Atlixcáyotl 5718, Puebla de Zaragoza, 72453, Puebla, Mexico
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Keywords:

ABSTRACT

Over the past decades, groundwater quality has deteriorated
intensive use of fertilizers in agriculture, release of untreat
and atmospheric deposition. Likewise, groundwater is incr
of domestic, municipal and industrial wastewaters, as w
intrusion, atmospheric deposition, mineral dissolution
Monterrey valley has a long record of elevated nitra
multiple potential pollution sources. This study a

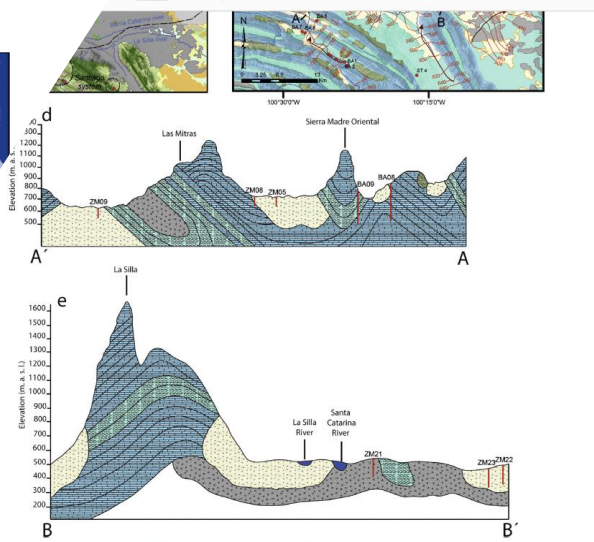
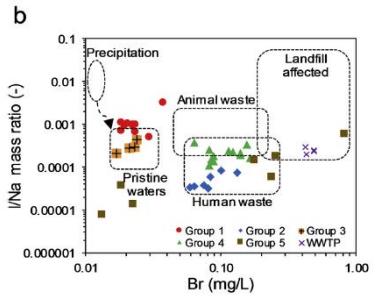
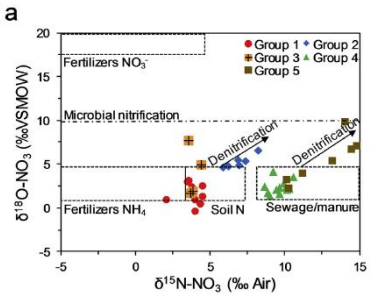
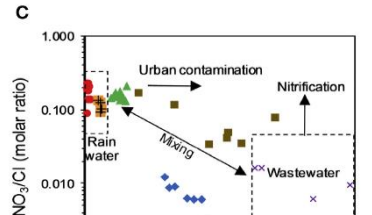
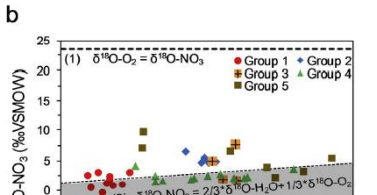


Fig. 1. (a) location of the Monterrey Metropolitan Area (MMA) and the State of Nuevo Leon within Mexico, (b) land use and land cover, (c) surficial geology, and (d, e) hydrogeological cross-sections. Panels b and c include the locations of wells sampled for chemical and isotopic analysis.









Clean Technologies and Environmental Policy (2020) 22:2145–2161
https://doi.org/10.1007/s10098-020-01964-2

ORIGINAL PAPER

Water, energy, and food security assessment in regions with semiarid climates

Xaté Geraldine Sánchez-Zarco[1] · Edgar Geovanni Mora-Jacobo[1] · Ramón González-Bravo[2] · Jurgen Mahlknecht[2] · José María Ponce-Ortega[1]

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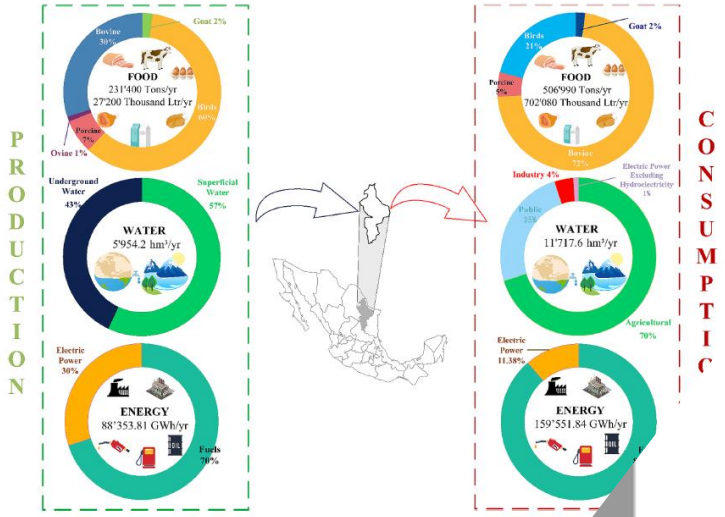


Fig. 4 Water, energy, and food security for the State of Nuevo León in México 2019

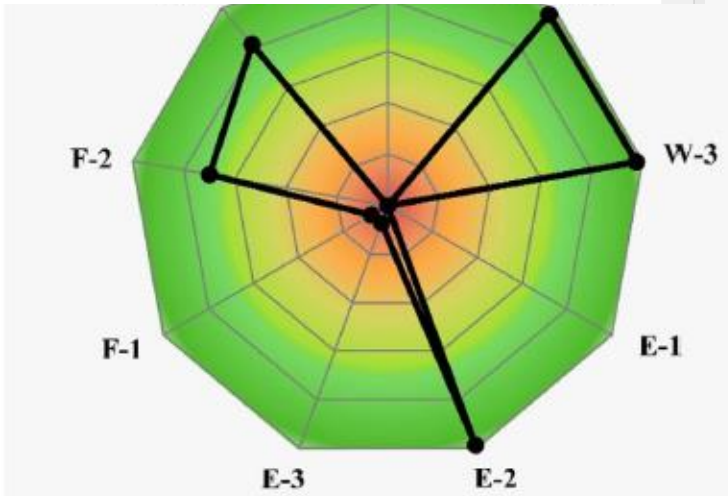
Assessment of the water–energy–food

Table 3 Water requirements for

...ssued by SIAP (2018b).

...esults of the evaluation of the water–energy–food security indices

To analyze the WEF security in Nuevo León, a radar chart with nine vertices was developed for the last year of available data (2019). Fig. 8 shows the evaluation of the indices presented in Eqs. 1–9. This graph shows a value of cero regarding water availability (W-1) due to the existing water balance deficit, while water accessibility (W-2) and water sustainability (W-3) are close to 1. Similarly, energy avail-



frontiers in Environmental Science

ORIGINAL RESEARCH
published: 05 November 2019
doi: 10.3389/fenvs.2019.00163

Recovering of the Monterrey Metropolitan Area, Mexico, After Hurricane Alex (2010): The Role of the Nuevo Leon State Reconstruction Council

Ismael Aguilar-Barajas and Aldo I. Ramirez*

Tecnologico de Monterrey, Monterrey, Mexico

The Monterrey Metropolitan Area (MMA), strategically located in Northeaster
has a population of over 4.5 million people. The metropolis is the secc
economic center in the country, only after Mexico City, and maintains a ke
Mexico-US trade corridor. Thus, the issue of urban resilience to extreme weat
a matter of national security and not only a local concern. In July 2010, Hurr
the Monterrey Metropolitan Area (MMA). It is estimated that 15 human lives
hurricane generated severe damages to the metropolis's infrastructure ar
the aftermath of Hurricane Alex, the Nuevo Leon State Reconstruction C
in Spanish) was established, with the participation of government ager
from the local community (universities, non-governmental organizations
This paper analyses the role played by the CERNL in the reconstruc
In 2013, the CERNL ended its mission. Most basic services and i
re-established, some of them within a few days and weeks after
The relative good work of the Council, in spite of a fragmented
institutional framework, has to do with a local enabling environme

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Environmental Science and Policy 99 (2019) 37–47

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Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Building urban resilience and knowledge co-production in the face of weather hazards: flash floods in the Monterrey Metropolitan Area (Mexico)

Ismael Aguilar-Barajas[a,*], Nicholas P. Sisto[b], Aldo I. Ramirez[c], Víctor Magaña-Rueda[d]

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[b] CISE (Centro de Investigaciones Socioeconómicas), Universidad Autonoma de Coahuila, Saltillo, Coahuila, Mexico
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[d] Instituto de Geografia, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico

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knowledge co-production
floods
Monterrey
Mexico

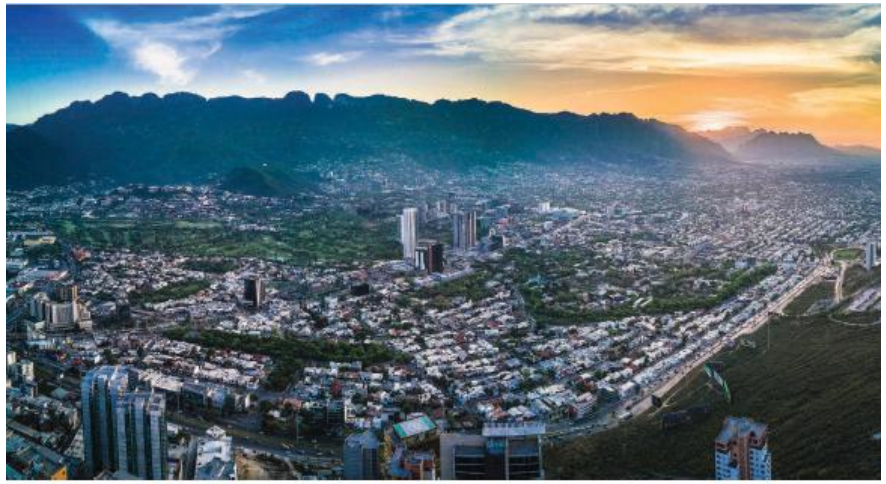
ABSTRACT

In 2010, flash floods triggered by Hurricane Alex caused fifteen fatalities in the Monterrey Metropolitan Area (MMA). In contrast, an estimated 225 people died in the 1988 Hurricane Gilbert disaster and reputedly, over 5,000 in the historical flood of 1909. The magnitude of hurricane-related impacts thus appears to be decreasing, indicating higher resilience to this hazard. This paper analyses the process of building resilience to flash floods in the MMA over the last several decades. Knowledge co-production plays a significant role in that process, particularly through the Nuevo Leon State Reconstruction Council, the multi-institutional, public-private-civil group of stakeholders established to guide and coordinate reconstruction efforts following the Hurricane Alex disaster. Findings reveal a complex, protracted and incremental resilience building process, conditioned by the nature of the hazard (infrequent but liable to cause significant damages) and contingent upon the city's socioeconomic and institutional local context. This local context is embedded in a highly fragmented national water governance architecture that lacks inter-institutional co-ordination and has limited the city's adaptive responses. Despite definite gains in building resilience, the city faces challenges notably in terms of the conservation and continuing development of knowledge co-produced in the aftermath of disasters.

Water Plan Nuevo León 2050

With participation of

Tecnológico de Monterrey



Developing a Robust Water Strategy for Monterrey, Mexico

Diversification and Adaptation for Coping with Climate, Economic, and Technological Uncertainties

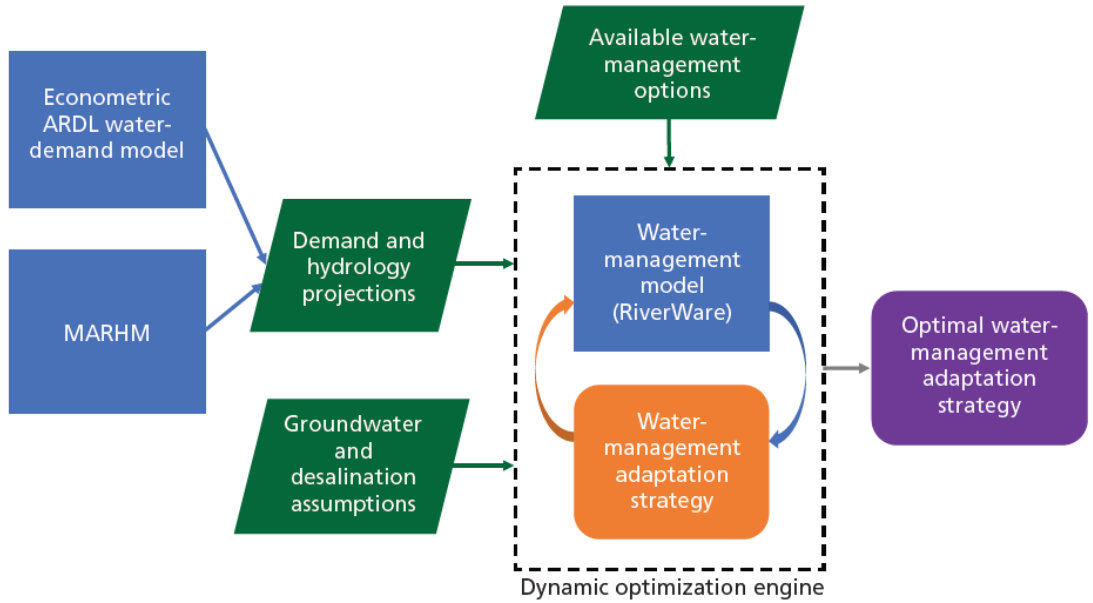
Edmundo Molina-Perez, David G. Groves, Steven W. Popper,
Aldo I. Ramirez, Rodrigo Crespo-Elizondo

RAND CORPORATION

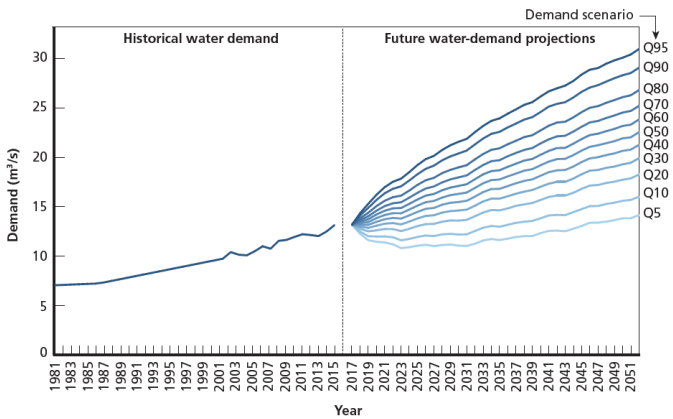
Tecnológico de Monterrey

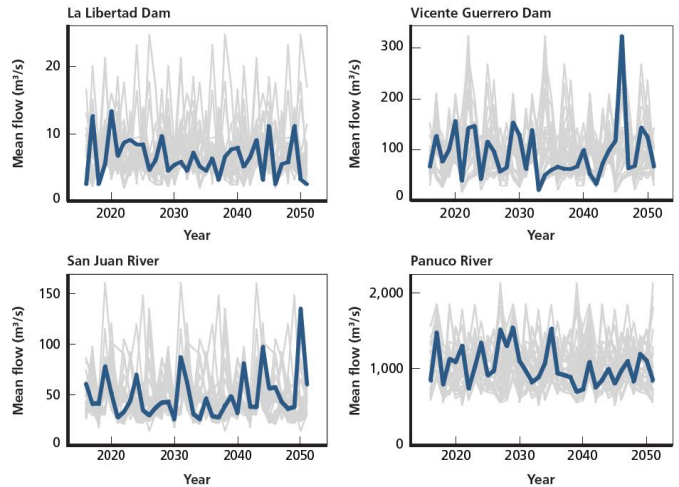
https://www.rand.org/pubs/tools/TL338.html

Figure 2.6
Integrated Assessment Model to Estimate System Performance and Define Optimal Adaptation Pathways



NOTES: IAM architecture. Arrows denote data flow. Blocks denote model components and outputs.





Escuela de Gobierno y Transformación Pública
Tecnológico de Monterrey

FAMM funded Tecnológico de Monterrey and RAND to support Monterrey Water Plan

Take a diversified water planning approach

Develop a water planning model w/ best available scientific information

Use RDM to develop adaptive plan

Evaluate different portfolios that ensure reliability at lowest possible cost

Explore vulnerabilities of current system

MONTERREY

Plan Hídrico de NL costará 6 mil mdp

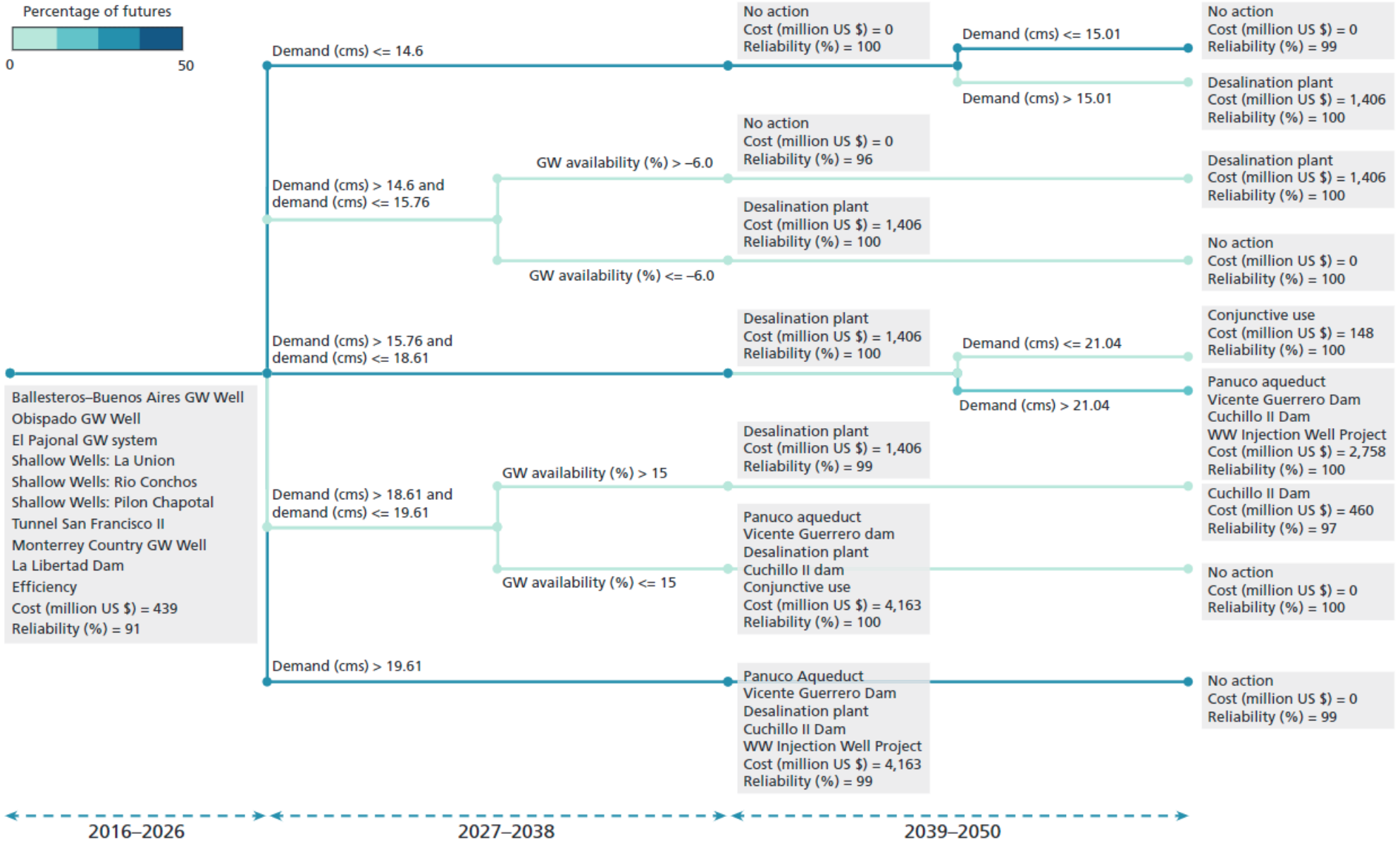
Nuevo proyecto sustituye a Monterrey VI, el cual valía 62 mil millones de pesos.

Alejandra Mendoza
amendoza@elfinanciero.com.mx 24.05.2017
Última actualización 24.05.2017
ETIQUETAS: Monterrey, agua, Nuevo León, Presa, Monterrey VI, Fonadin, mty, Plan Hídrico,

ARTICULO 0 Comentarios A+ A-

Escuela de Gobierno y Transformación Pública
Tecnológico de Monterrey

Successive optimizations (4.9 million runs) used to define long-term adaptive strategy



"El éxito en la prestación de los servicios de agua potable y saneamiento en el Área Metropolitana de Monterrey se debe, como describe el libro, a la cooperación entre los tres niveles de gobierno y la participación de la sociedad. Sin duda, esta obra puede convertirse en un referente para los interesados en la gobernanza del agua y una guía de acción para los tomadores de decisiones que buscan transitar hacia entornos de seguridad hídrica".

- Fernando J. González Villarreal, Director, Centro Regional de Seguridad Hídrica bajo los auspicios de UNESCO y Ex Director General de la Comisión Nacional del Agua.

"A partir de una redacción precisa y amena, el libro desarrolla con claridad conceptual y rigor científico los retos y oportunidades del Área Metropolitana de Monterrey relacionados con los servicios de agua y saneamiento, aportando propuestas superadoras y sustentables. Sin duda se constituirá en una referencia obligada para los actores del sector".

- Óscar Pintos, Presidente, Asociación de Entes Reguladores de Agua Potable y Saneamiento de las Américas.

"Monterrey se ubica en una región con una baja disponibilidad de agua, y el cambio climático incrementará este problema. Ello obliga a que los mejores científicos pongan en su verdadera dimensión los retos y las propuestas de solución al abastecimiento de agua. Esta obra, en la que priva el compromiso de la verdad con la investigación y la academia, es un gran aporte regional y nacional, dada la importancia de esta metrópoli para la economía de México".

- Felipe I. Arreguín, Ex Director General, Instituto Mexicano de Tecnología del Agua.

"Este libro recopila la historia de la provisión de los servicios de agua y saneamiento del área metropolitana de Monterrey y da un contexto amplio de la gestión del agua en Nuevo León. Es una lectura obligada para quien quiera conocer a profundidad el sistema de agua de Monterrey".

- Alfonso Garza Garza, Presidente, Fondo Ambiental Metropolitano de Monterrey, A.C.

Este libro llena un vacío en la literatura sobre el abastecimiento de agua al Área Metropolitana de Monterrey (AMM), de poco más de 35 años. Iniciando con el reconocimiento de un contexto regional complejo y geoestratégico para México, en sus páginas se encuentra una historia rica en lecciones y experiencias sobre como esta metrópoli se ha adaptado a entornos adversos para proporcionar servicios de agua y saneamiento de calidad, reconocidos en el ámbito nacional y latinoamericano. Se demuestra que los retos actuales y potenciales en materia de mayor seguridad hídrica para el AMM, requieren de una gobernanza más proactiva e integrada, traducida en decisiones informadas y responsables.

Ismael Aguilar Barajas es Profesor Titular de la Escuela de Ciencias Sociales y Gobierno del Tecnológico de Monterrey y miembro del Sistema Nacional de Investigadores.

Aldo Iván Ramírez Orozco es Profesor Titular de la Escuela de Ingeniería y Ciencias del Tecnológico de Monterrey y miembro del Sistema Nacional de Investigadores.

Nicholas P. Sisto es Profesor-Investigador del Centro de Investigaciones Socioeconómicas de la Universidad Autónoma de Coahuila y miembro del Sistema Nacional de Investigadores.

Segunda edición

Agua para Monterrey

Logros, retos y oportunidades para Nuevo León y México

Agua para Monterrey

Logros, retos y oportunidades para Nuevo León y México

Con el apoyo de: Servicios de Agua y Drenaje de Monterrey, I.P.D.

Tecnológico de Monterrey

Ismael Aguilar Barajas
Aldo Iván Ramírez Orozco
con la colaboración de Nicholas P. Sisto

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Gobierno de Nuevo León



¡ Muchas Gracias !
jurgen@tec.mx