# Permanent Forum of Binational Waters

**Discussion Panel: Groundwater Depletion and Water Security in the Rio Grande/Bravo Basin** (Focus of this presentation)


**Antonio Hernández-Espriú**

Full-Time Research-Professor, Engineering School, UNAM

In collaboration with **Saúl Arciniega-Esparza**

Institute of Engineering, UNAM


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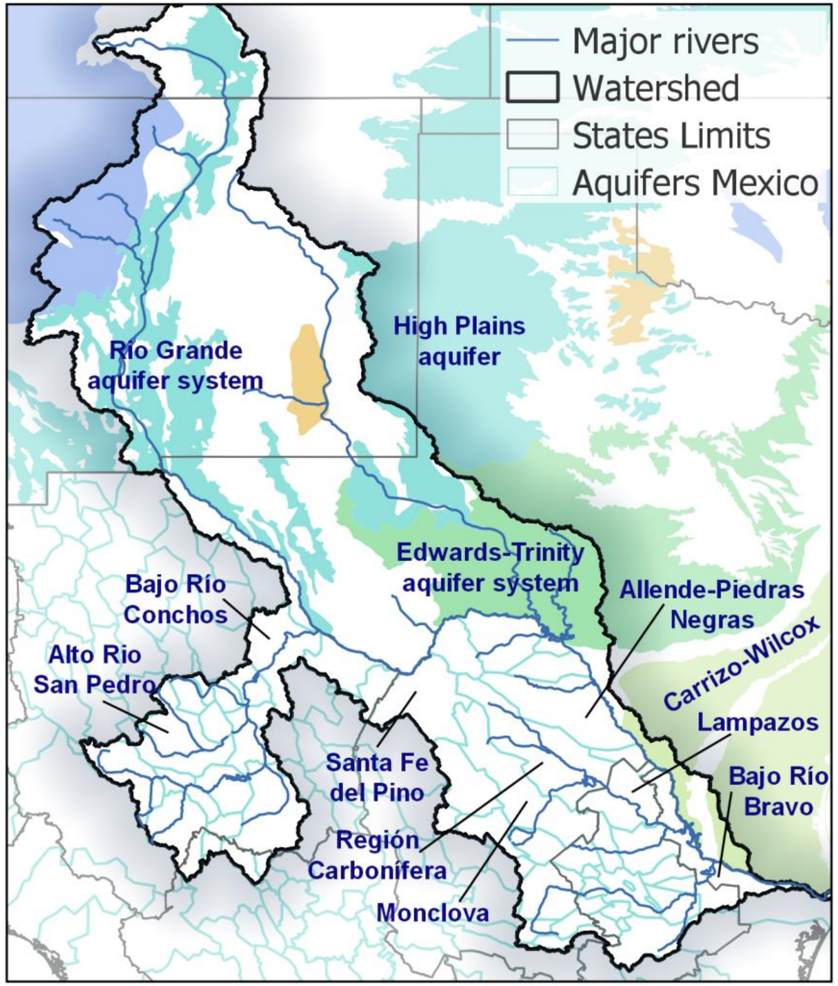
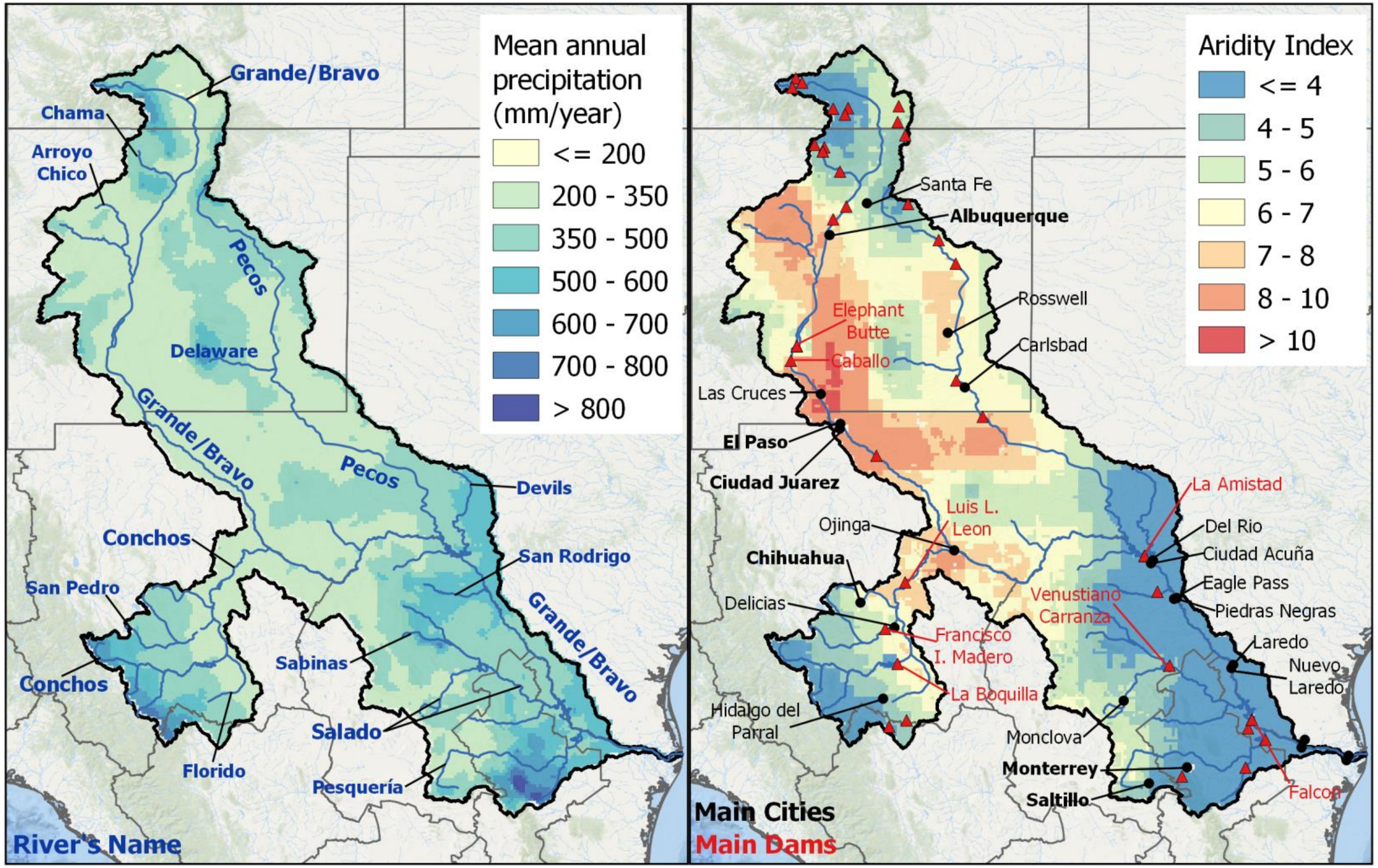
**1. How does climate variability impact groundwater availability (Rio Bravo/Grande river basin vs Rio Colorado basin)?**

¿Cómo afecta la variabilidad climática la disponibilidad de agua subterránea en la cuenca del Río Bravo / Grande en comparación con la cuenca del Río Colorado?

# Aquifers along the Rio Grande/Bravo Basin




# Spatial Variability of long-term climatology

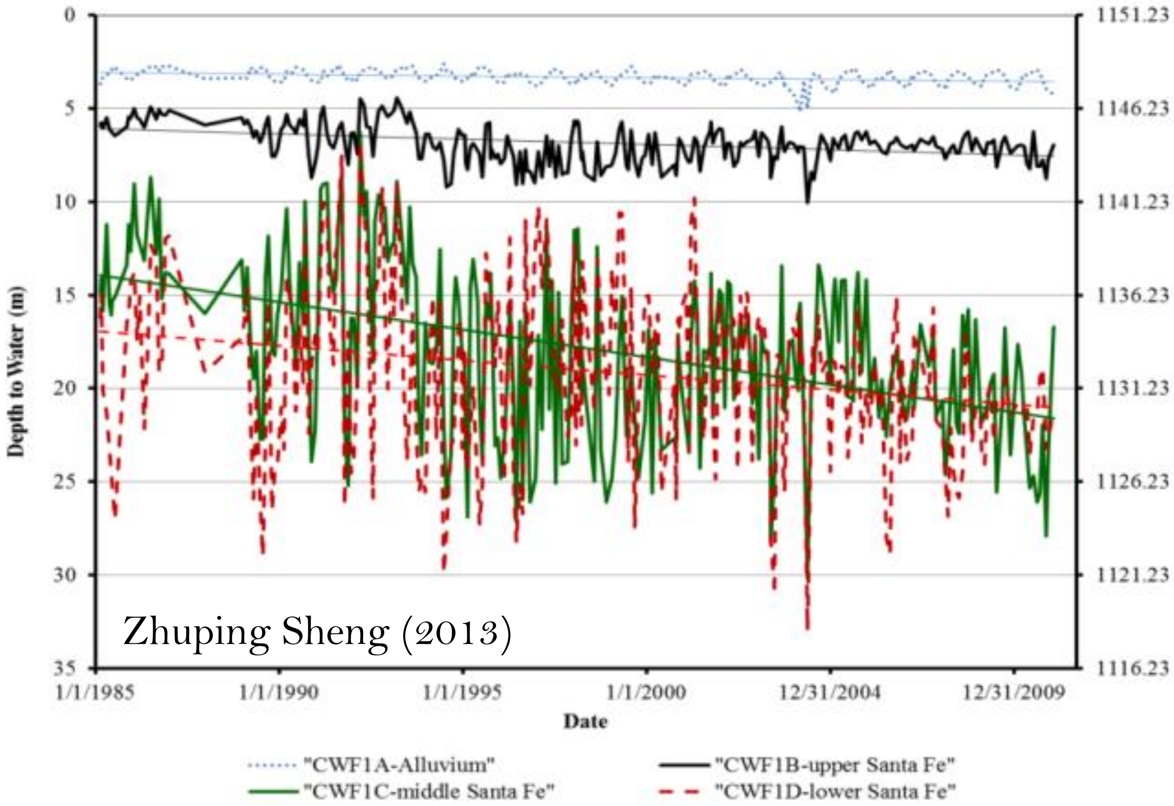



Complex aquifer systems in middle Rio Grande/Bravo Basin and along the Mexican side

Space-time variability

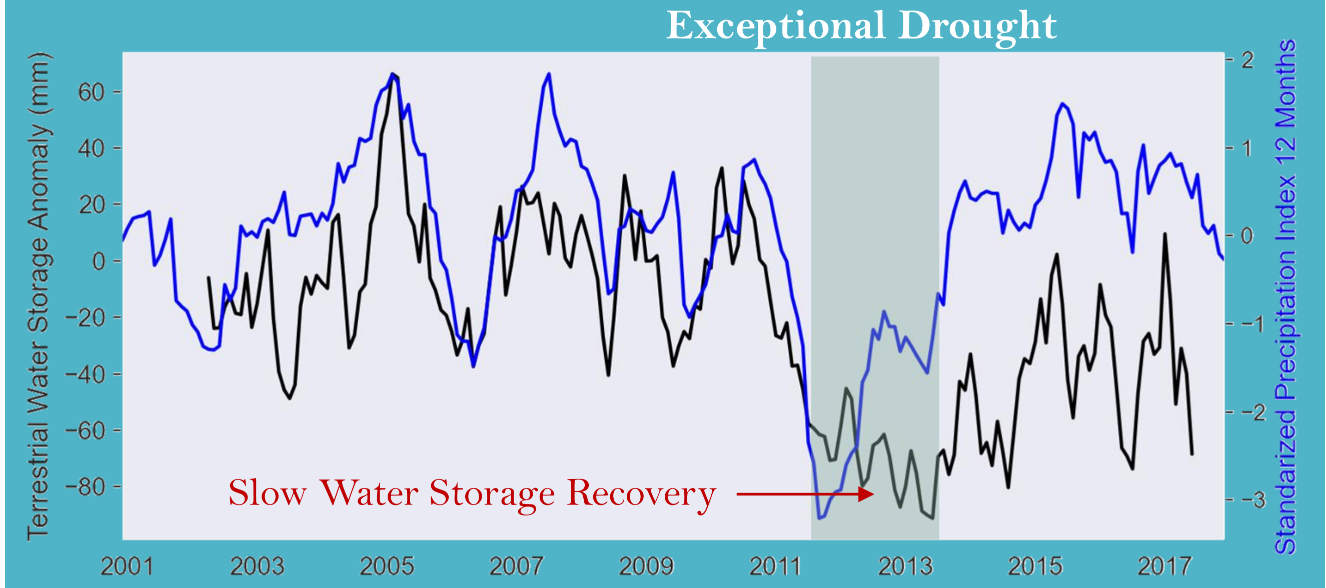
Semiarid to arid conditions in the upper and middle basin

# Water level changes in the Mesilla Basin, Rio Grande (alluvial aquifer)




- Negative trends on GW levels have been observed at local scale.
- GW levels recover during late fall and winter.
- Alluvial unconfined aquifers are more susceptible to climate variability than deep, confined aquifers.

# Extreme Drought and Terrestrial Water Storage Anomalies




- Terrestrial Water Storage (GW+SM+SW+SNOW) is highly influenced by climatology.
- Extreme multiyear droughts (2011-2013) reduce groundwater storage (GWS) since climate controls vertical recharge from seasonal cyclones and rainfall extremes.

# Q1 - Key points

- The Rio Grande/Bravo Basin shows large space-time climate variability, limiting the natural water availability, mainly in the middle basin.

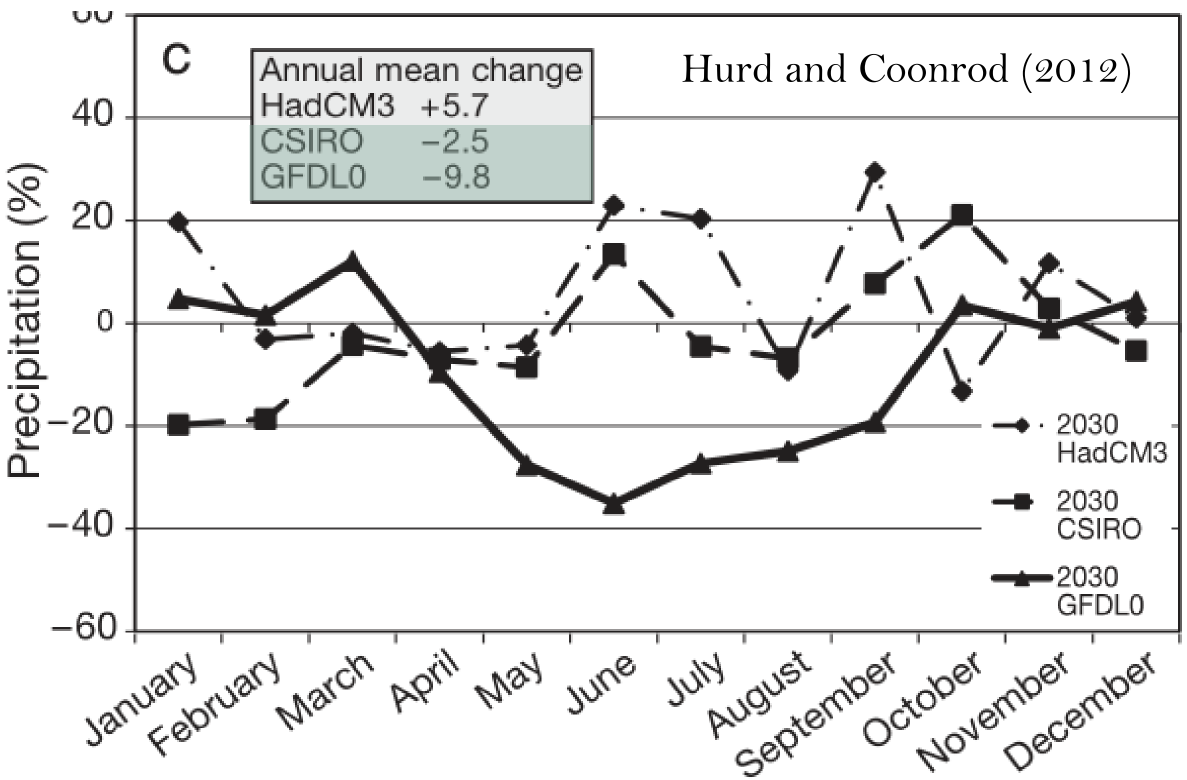
- Alluvial/clastic –unconfined- aquifers (e.g. Sabinas-Reynosa Fm) are largely affected by seasonality of precipitation, i.e., potential vertical recharge. Confined, karstic aquifers related to regional flow systems (e.g. Cupido/Aurora Fm) are more climate-resilient.

- Extreme droughts may affect long-term shallow groundwater flow and storage, which is the main water source in the basin. The hydraulic connection between shallow and deep –confined- aquifer systems remain unclear.

**2. Does the US and Mexico need novel hydro-diplomacy and governance tools under the expected climate change scenarios (any differences between basins Colorado/Rio Grande)?**

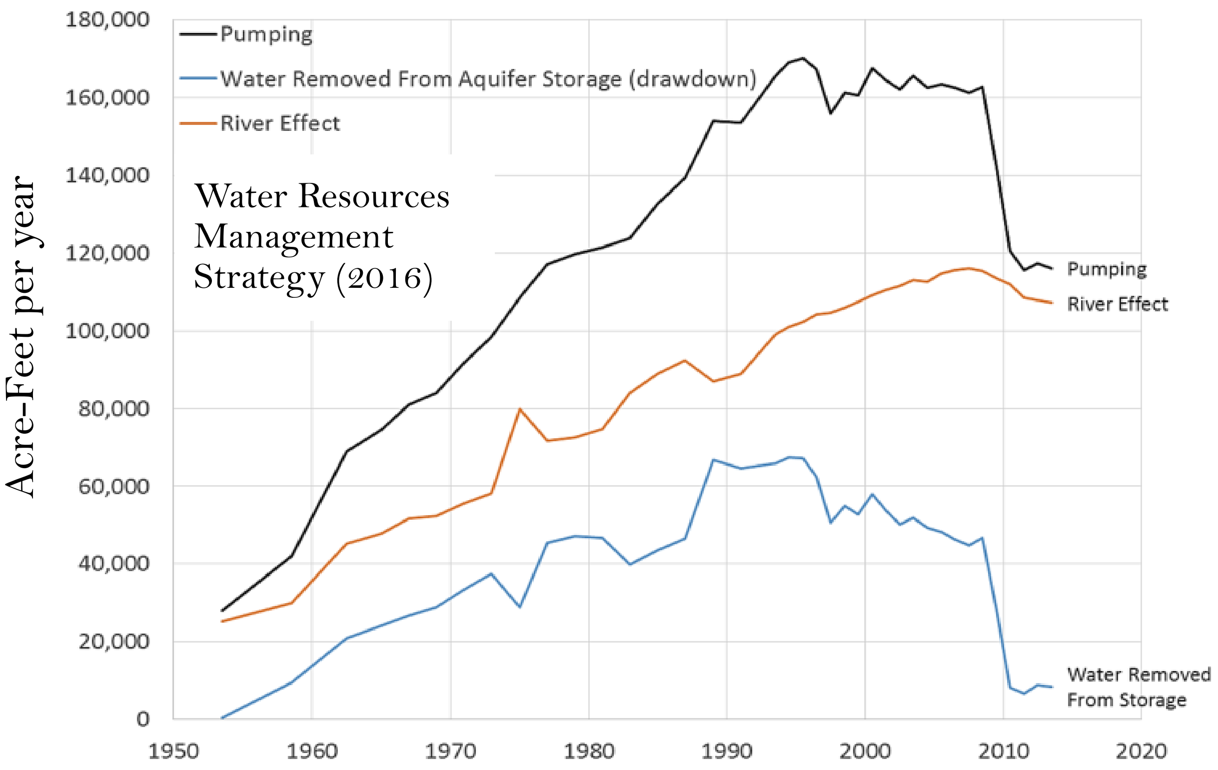
¿Necesitan México y Estados Unidos nuevas herramientas de gobernanza y diplomacia relativas a temas hídricos en los escenarios esperados a causa del cambio climático? Habría diferencias entre las cuencas del Colorado y Río Bravo/ Grande?

# Precipitation change scenarios for Middle Rio Grande Basin (RGB), 2000-2030




- Mean annual precipitation is expected to decrease ~2% by 2030.
- Mean annual temperature is projected to increase in 0.7-1.7 °C by 2030.
- Mean annual runoff is projected to decrease by from 7.3 to 14.4% by 2050.

# Estimated sources of historical GW pumping from wells in the Middle RGB




- GW overdraft has resulted in aquifer depletion.
- Research suggest that GW overpumping may also affect surface water availability.

# Hydrodiplomacy on the Northeast

## Water and Science Diplomacy

**1944 Treaty and IBWC/CILA (Water Diplomacy)**

Creation of a robust treaty and minute process

**1999-2002 Rio Grande water debt crisis (Water Diplomacy)**

Minutes 307 and 308 to define extraordinary drought

**2009 Transboundary Aquifer Assessment Project (TAAP) (Scientific Diplomacy)**

Data-sharing to inventory and harmonize available data

Wilder et al. (2020)

## Water issues

**1951-1978** Drought and short water supplies resulted in development of groundwater supplies.

**2003** Drought

**2010** Groundwater extractions being at Ciudad Juárez water-supply.

**2011-2013** Extraordinary drought resulted in record electricity demand, water demands/consumption and depletion in reservoirs and aquifers.

Hanson et al. (2019) [USGS]

# Q2 - Key points

- **Groundwater pumping** in transboundary aquifers has been **increasing** as water demands increase and surface availability decreases, particularly during droughts.

- No broad bilateral agreement exists on US - Mx border groundwater management and use (**new minutes in 1944 Treaty?**).

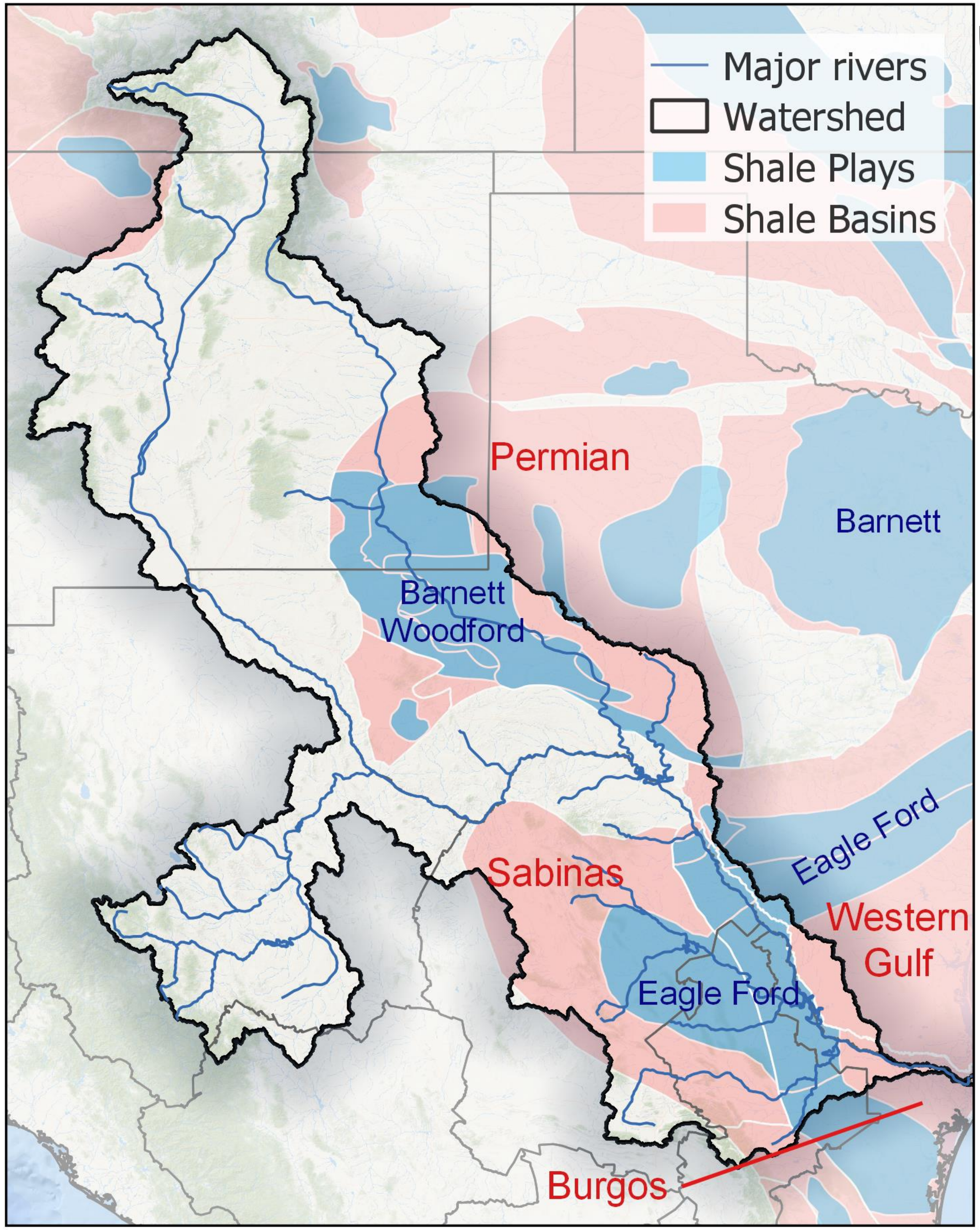
- Knowledge about the extent, depletion rates, and quality of transboundary aquifers is very limited or completely absent (indispensable for **Scientific Diplomacy**), specially in the Mx side.

*Eckstein (2011)*

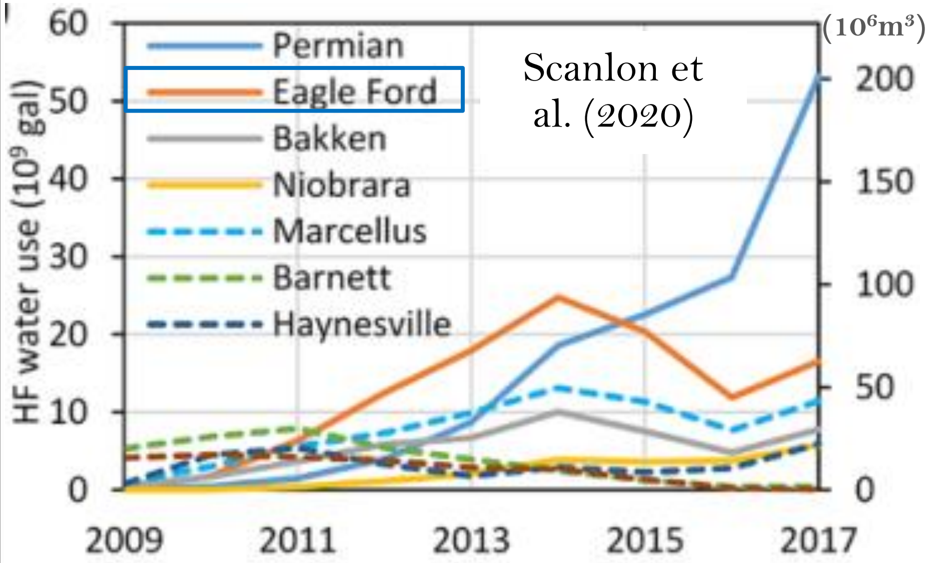
## 3. What is the role of the water-energy-food nexus in transboundary waters?

¿Cuál es el papel del nexo agua-energía-alimentos en el panorama de las aguas transfronterizas?

# Unconventional Oil/Gas Resources

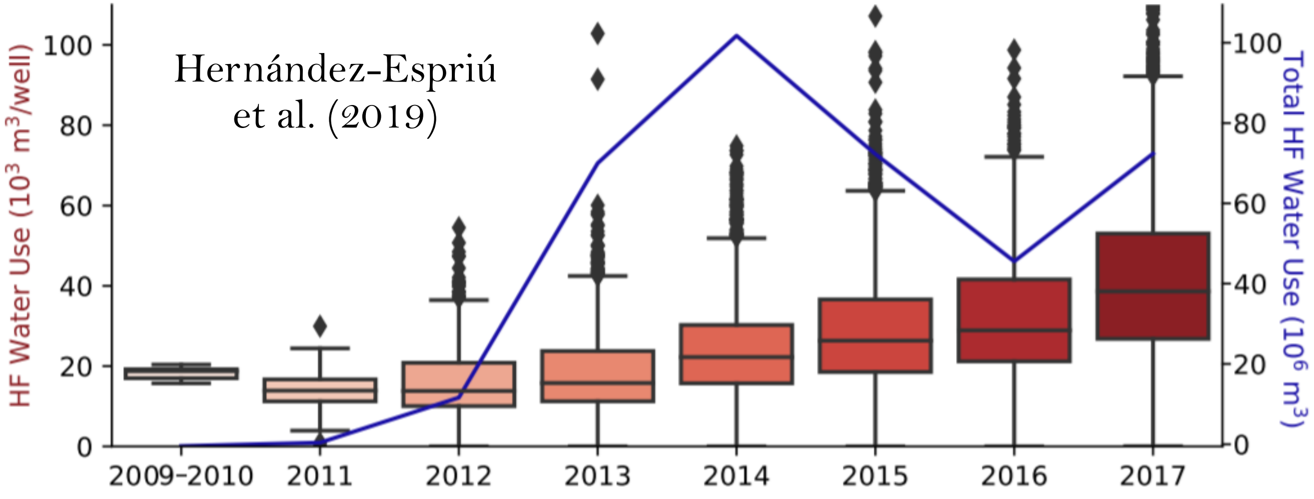



# Water use for HF and energy generation




Water use for HF has been increasing during the last years.

Groundwater from deep aquifers represents the main water source for HF in Permian Basin and TX-Eagle Ford play.



# Q3 - Key points

- Surface water plays an important role for hydropower energy generation in the Rio Grande Basin, but groundwater is the main water source for unconventional oil/gas energy in shale plays across the basin (Eckstein, 2011).

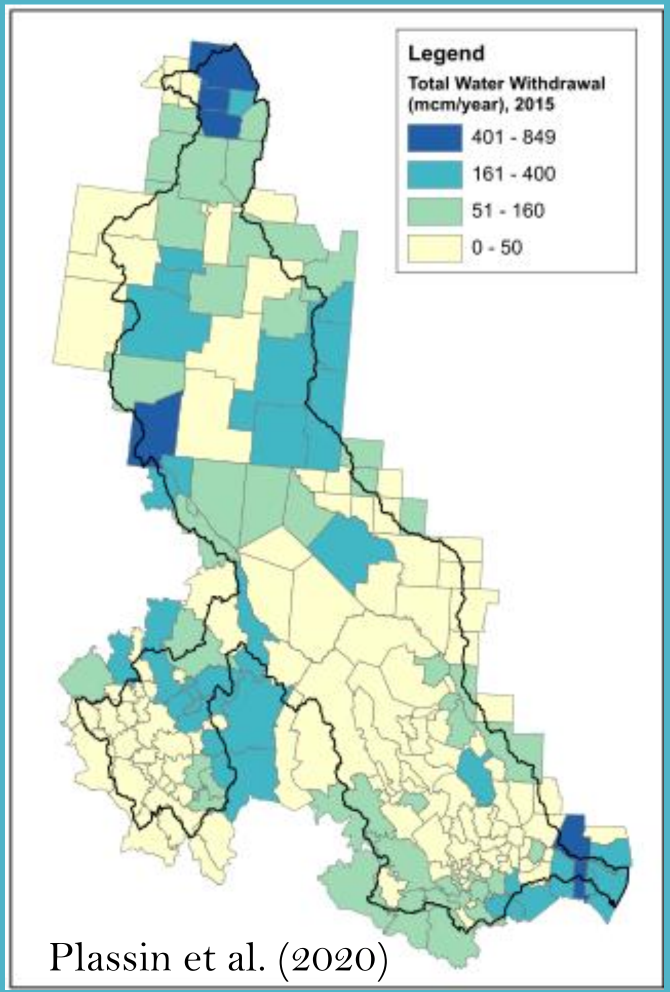
- Energy generation by shale gas has been found to increase the resilience on energy generation in Texas during droughts, where reservoirs storage is depleted (Eckstein, 2011).

- Water use for HF has been increasing over time, in both single use/well and water intensity per horizontal length.

**4. What would you say are the key challenges when it comes to water security in the border region as a whole?**

¿Cuáles diría que son los desafíos generales clave cuando se trata de seguridad hídrica en la región fronteriza?

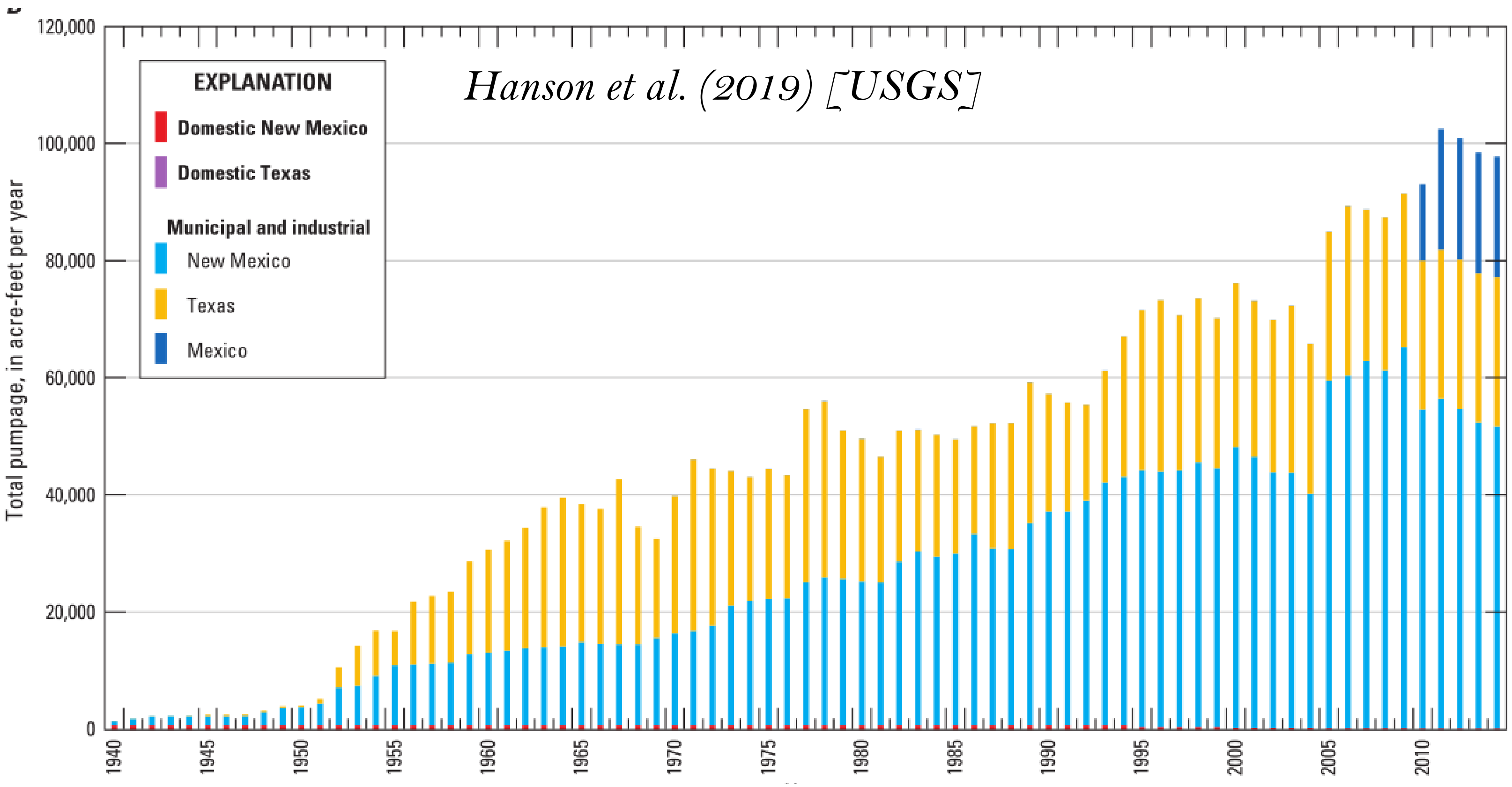
# Rio Grande water withdrawals, 2015




Plassin et al. (2020)

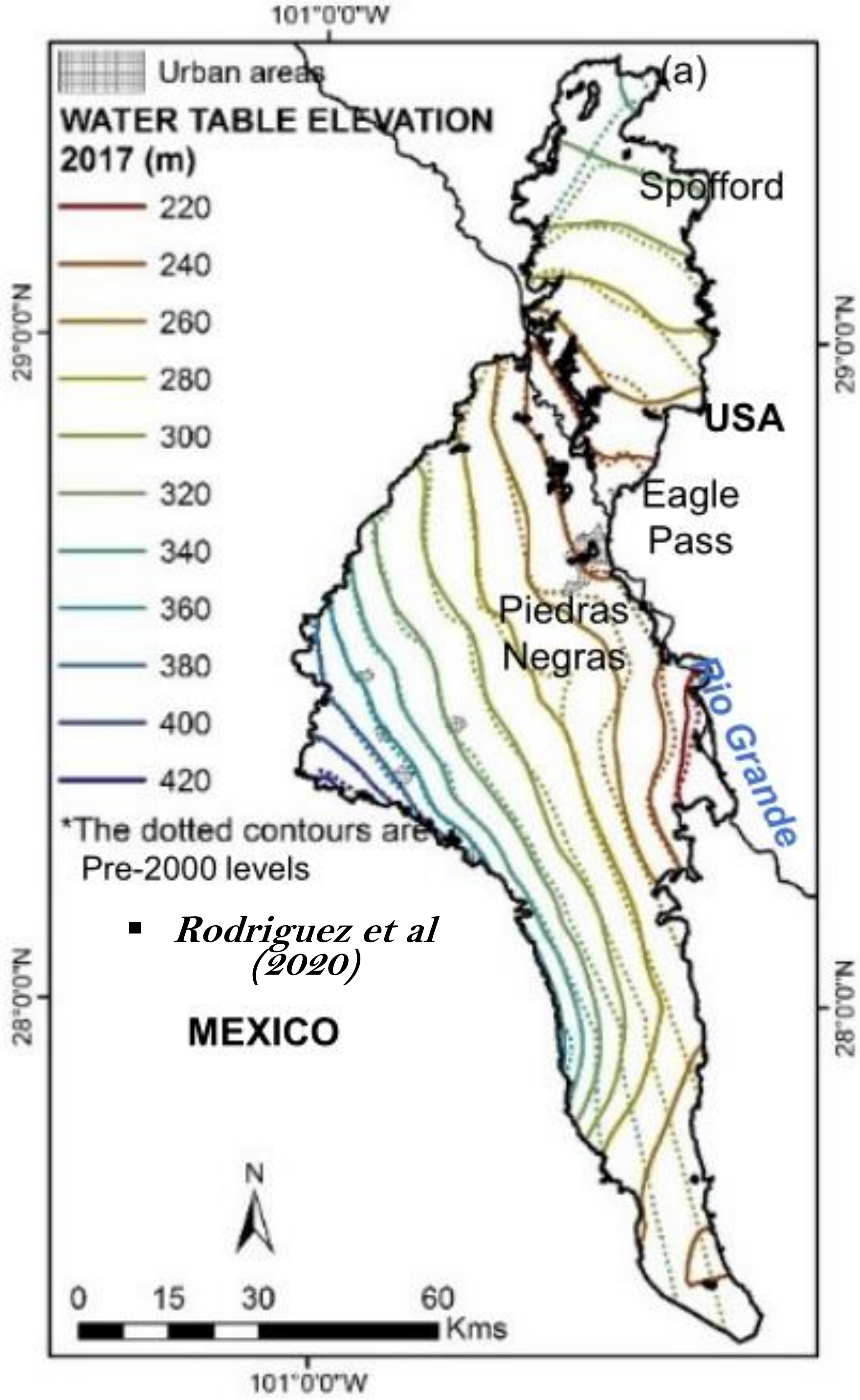
Inequitable water availability and accessibility in the main limitation to achieve water security, i.e., quantity/quality/environment/social peace

# Estimated groundwater pumpage in the Transboundary Rio Grande, New Mexico, Texas, and Mexico




*Hanson et al. (2019) [USGS]*

Increase of population and water demands for different users (irrigation, industrial, municipal, energy generation [HF]) are key factors that limit water security in the Rio Grande/Bravo.




- *Rodriguez et al (2020)*

# Q4 - Key points

- Mexican groundwater management model ignores basic aspects: (1) geological boundaries, (2) connectivity (shallow-deep-surface water) and transboundariness.
- Lack of GW open data (water levels, overall quality, abstraction rates, hydraulic parameters) limits the assessment of regional time-space aquifer resources.
- Severe droughts prevent the US – Mx Treaty compliance and increase GW water stress in the basin.

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