ALLENDE-PIEDRAS NEGRAS TRANSBOUNDARY AQUIFER: AN INITIAL MODELING ASSESSMENT

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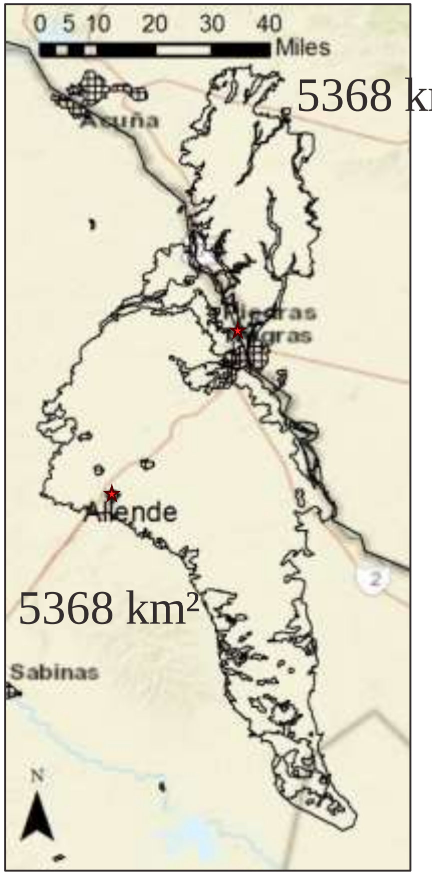
LOCATION AREA



5368 km^2

P=500 mm/yr T=20º C ET=433 mm/yr

BACKGROUND

- 36 potential transboundary aquifers have been identified in the Mexican-U.S border (Sanchez et.al., 2016). 16 aquifers were identified as transboundary. Only 11 aquifers recognized officially as transboundary by Mexico and the United States.

- The Allende-Piedras Negras aquifer between Texas and Mexico, has been identified as transboundary but has not been recognized officially by both countries or at international level.

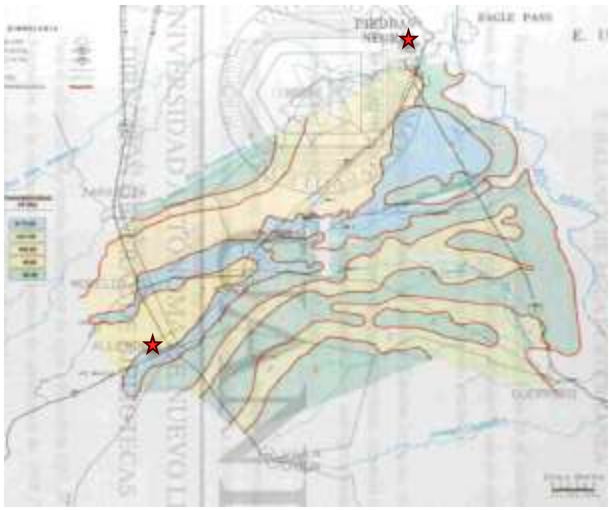
- The purpose of this work is to demonstrate hydrogeological linkages of this aquifer at transboundary level to offer new information that could support its identification and recognition at international level.

BACKGROUND

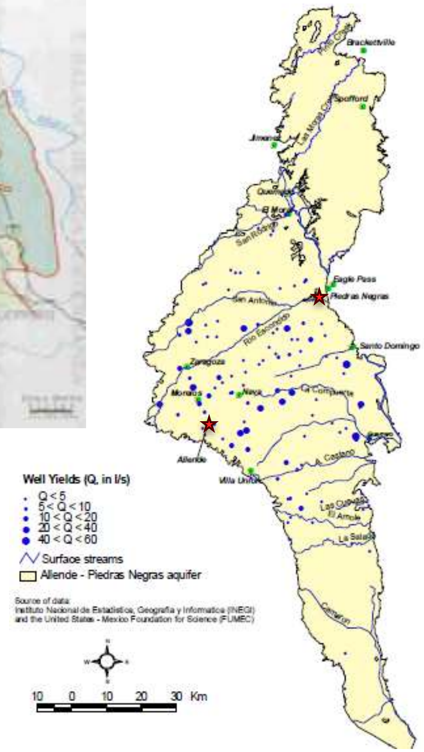
Previous studies:

- Castillo (2000), Boghici (2002), Lesser (2008) and Conagua (2014).
- Mainly focused on the Mexico side.
- Models developed for the central portion of the aquifer.

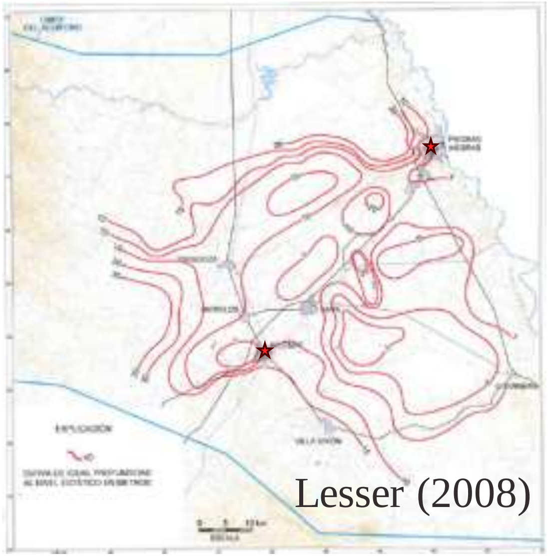
BACKGROUND



Castillo (2000)



Boghici (2002)

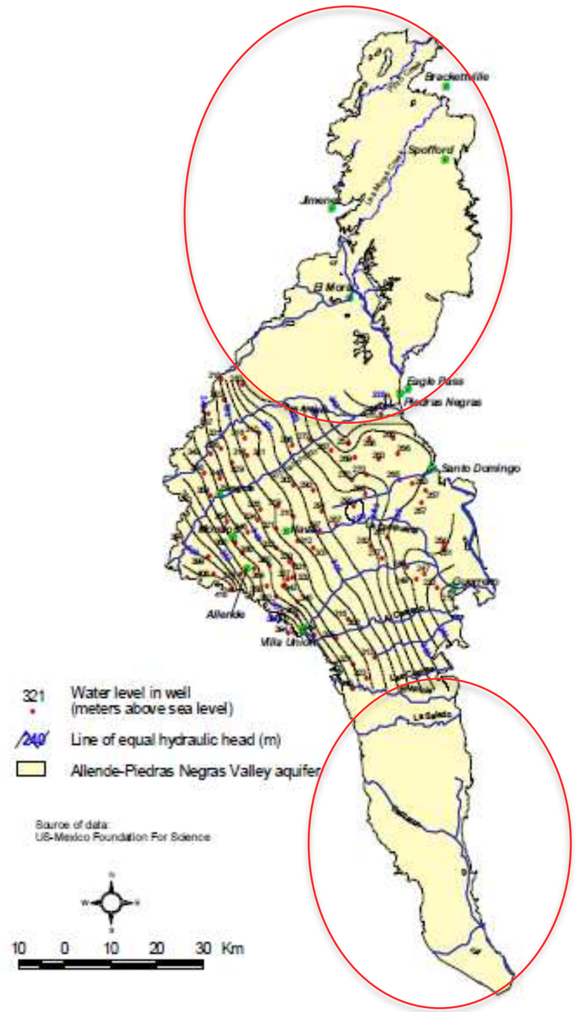


Lesser (2008)

Conagua (2014)

OBJECTIVES

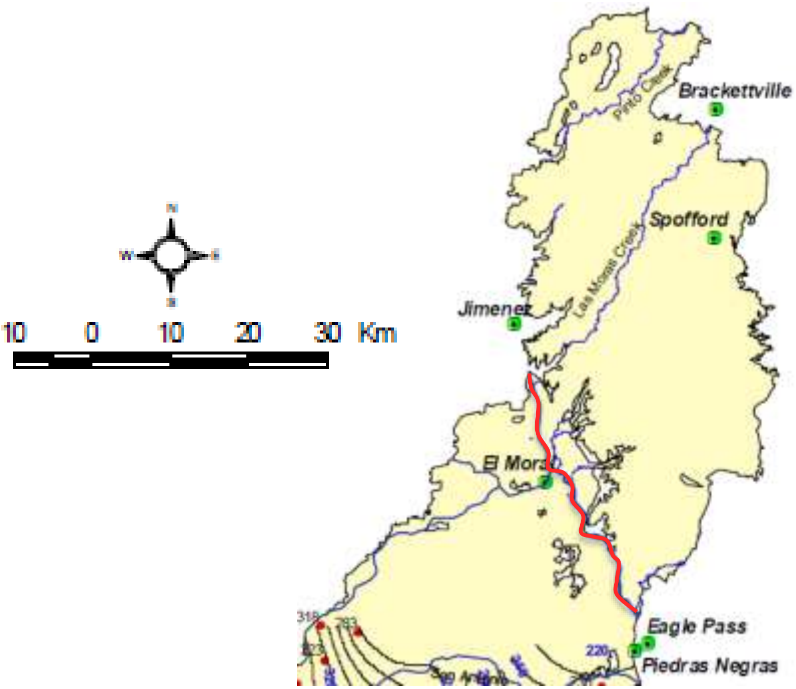
- To include Texas and southern portions of the aquifer to better understand **the transboundary nature of the system**



Boghici (2002)

OBJECTIVES

- To understand how groundwater flow across and near border region and determine significant variables of change



Modified from Boghici (2002)

SPECIFIC OBJECTIVES

- To update the aquifer model with recent information (water wells, remote sensing data)
- Model comparison using remote sensing data (GRACE-Gravity Recovery And Climate Experiment)
- Water budget analysis

SPECIFIC OBJECTIVES

- Forecasting groundwater under different scenarios (pumping rates, droughts)
- Evaluation of the application of the methodology in other transboundary aquifers

HYPOTHESIS

- Groundwater levels are significantly affected by higher pumping rates.
- Severe drought periods affect groundwater levels.
- High pumping rates impacts water quality in the aquifer.

METHODOLOGY

- Aquifer geometry and delineation

- Data collection on:
  - Water levels measured from wells.
  - Annual river flow rates from river gages.
  - Annual precipitation and evapotranspiration from remote sensing images (TMPA and GLDAS).

METHODOLOGY

- Data collection on:
  - GRACE water storativity changes (Gravity Recovery And Climate Experiment-total water storativity changes obtained from gravimetric measurements)

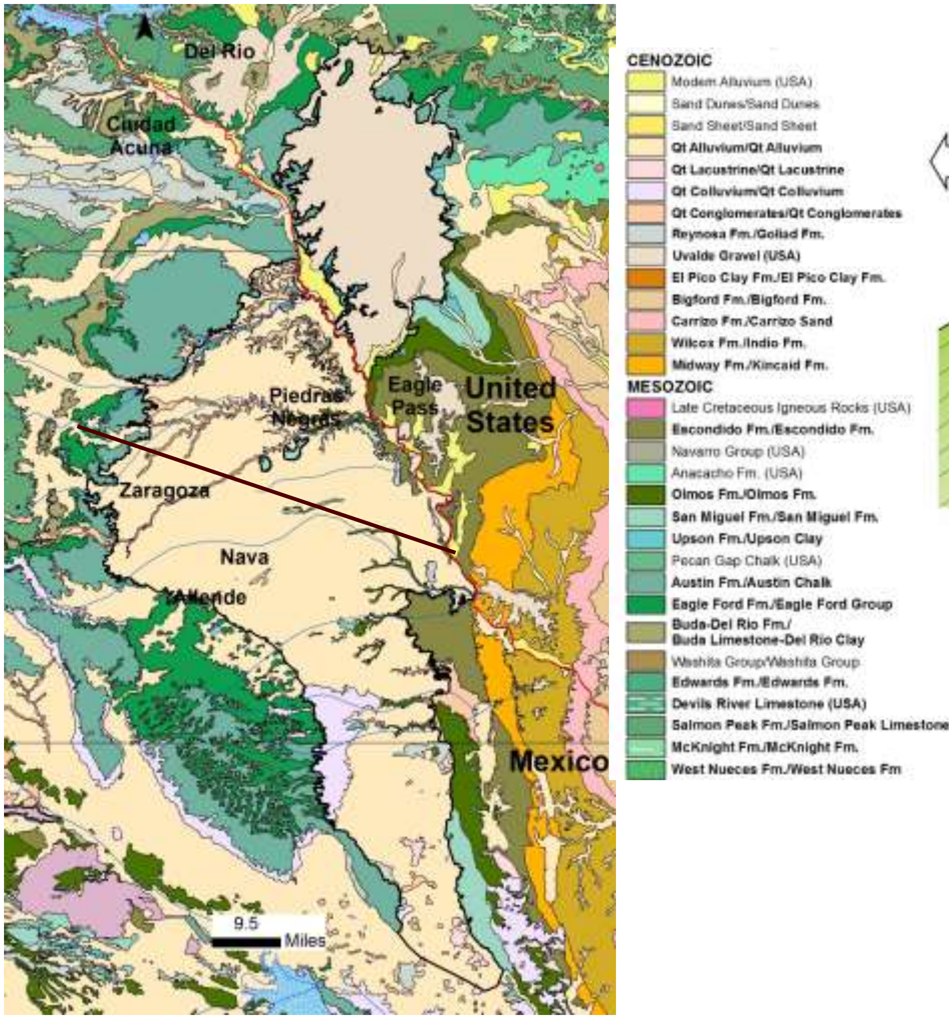
- Hydraulic parameters selection

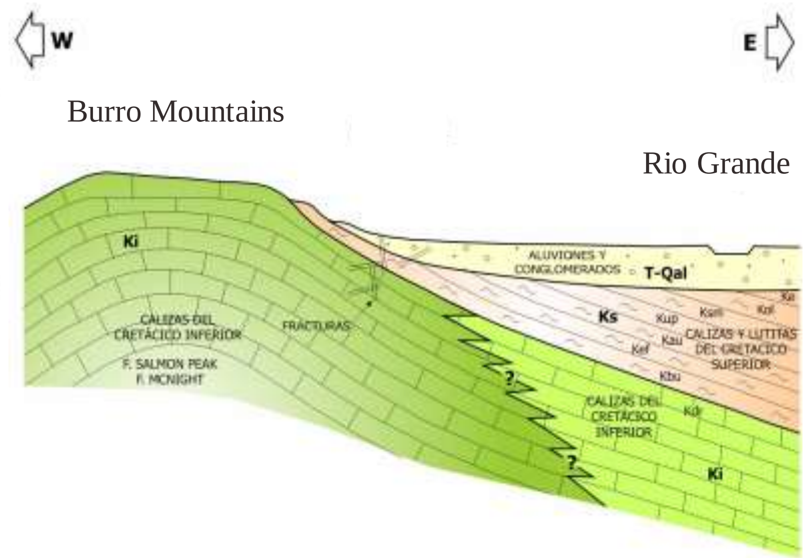
  (n, K, T, S)

METHODOLOGY

- Limitations
  - This research is considering only the modeling on the quaternary and tertiary alluvium deposits (Reynosa-Goliad formations and alluvium deposits)

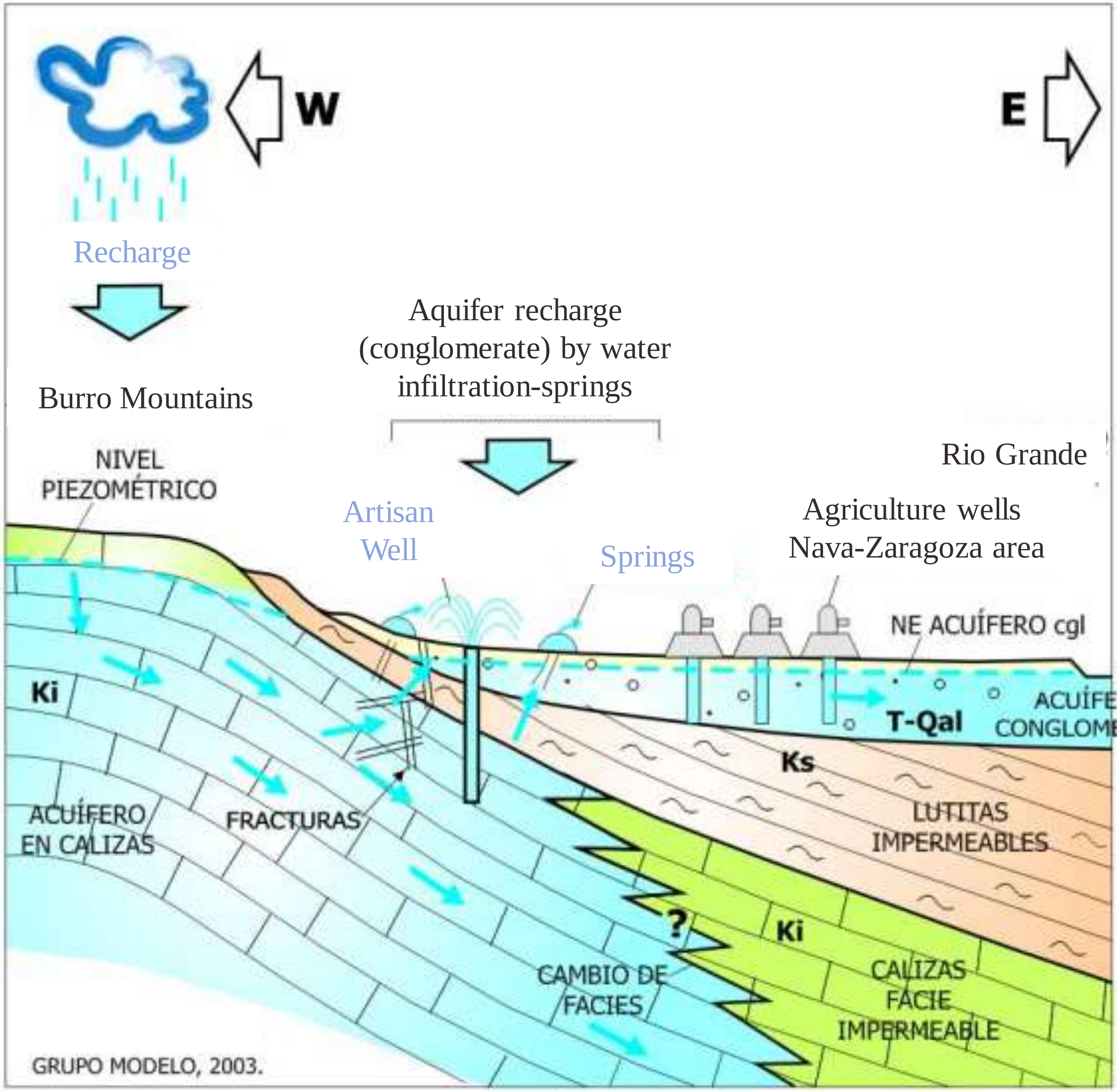
RESULTS



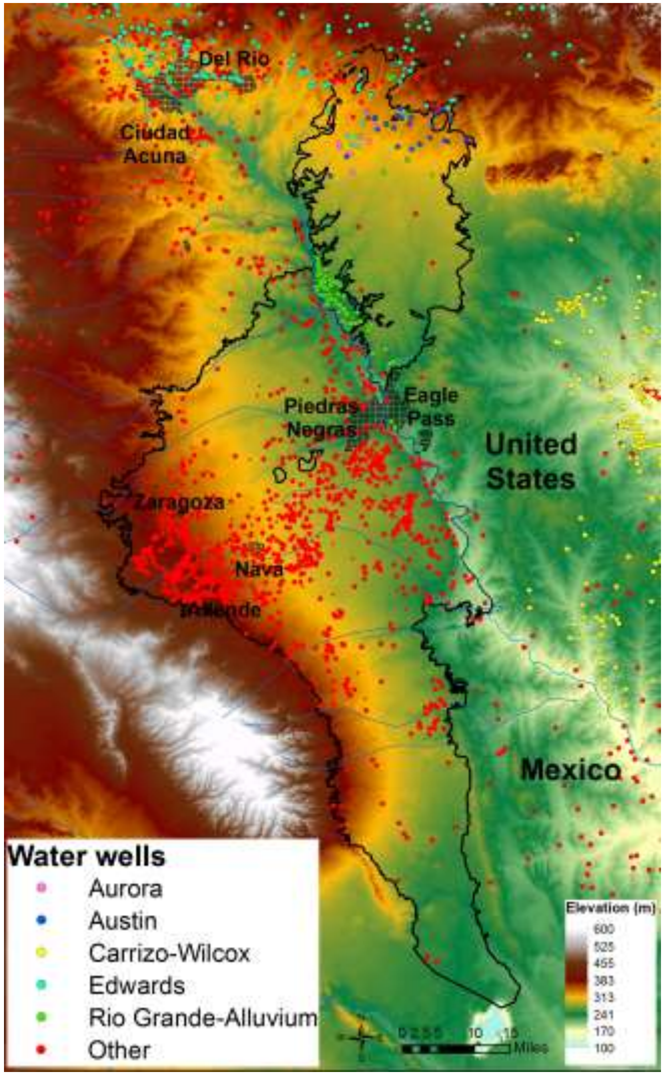


Modified from Grupo Modelo (2003)

RESULTS


W
E
Recharge
Aquifer recharge (conglomerate) by water infiltration-springs
Burro Mountains
Rio Grande
NIVEL PIEZOMÉTRICO
Artisan Well
Springs
Agriculture wells Nava-Zaragoza area
NE ACUÍFERO cgl
Ki
T-Qal
ACUÍFERO CONGLOMERADO
Ks
ACUÍFERO EN CALIZAS
FRACTURAS
LUTITAS IMPERMEABLES
?
Ki
CALIZAS FACIE IMPERMEABLE
CAMBIO DE FACIES
GRUPO MODELO, 2003.

RESULTS



b = 40 m (Mx) – 25 m (Tx)

n = Good (0.25)

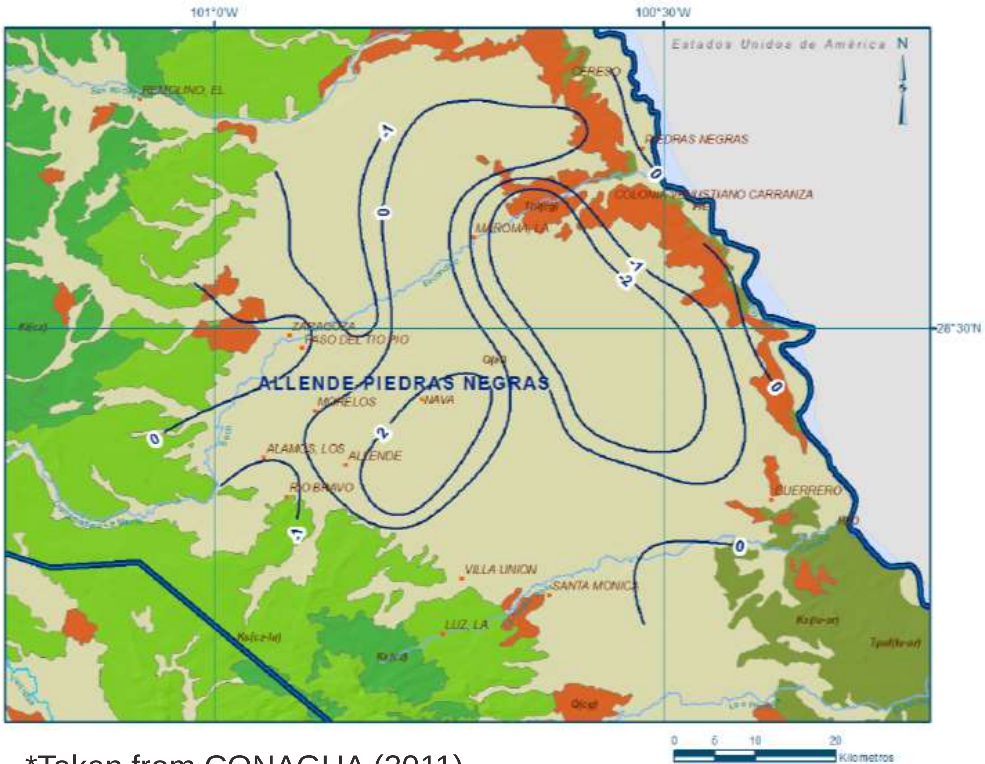
K = 160 – 430 m/day

T = 0.4 m^2/s

Ss = 0.001

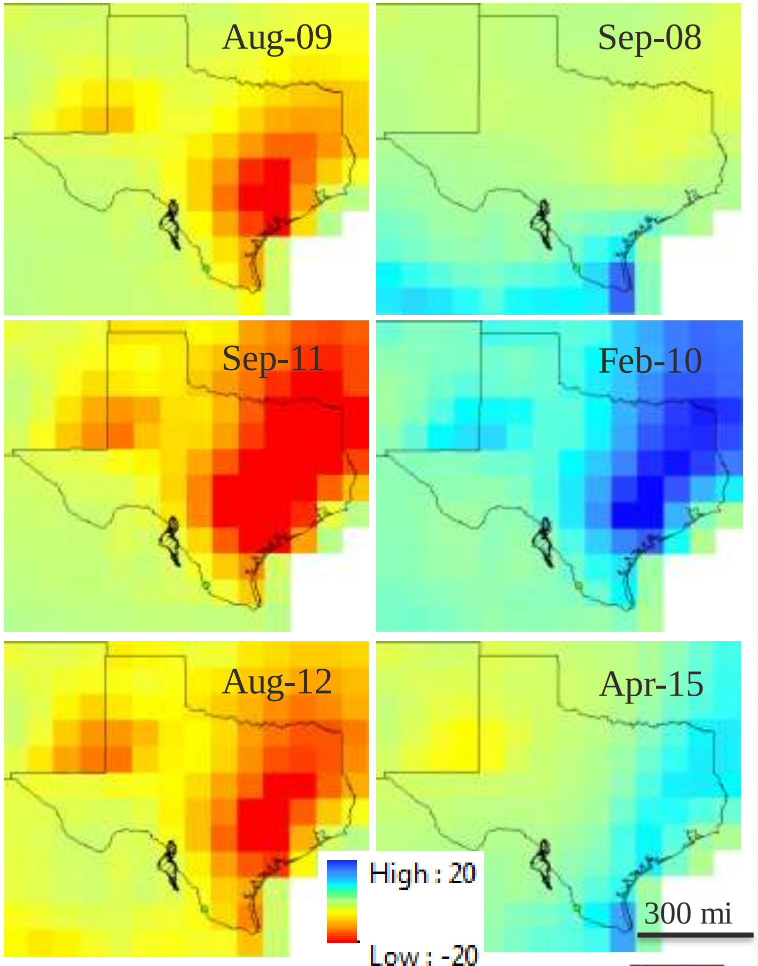
TDS > 1000 ppm

RESULTS

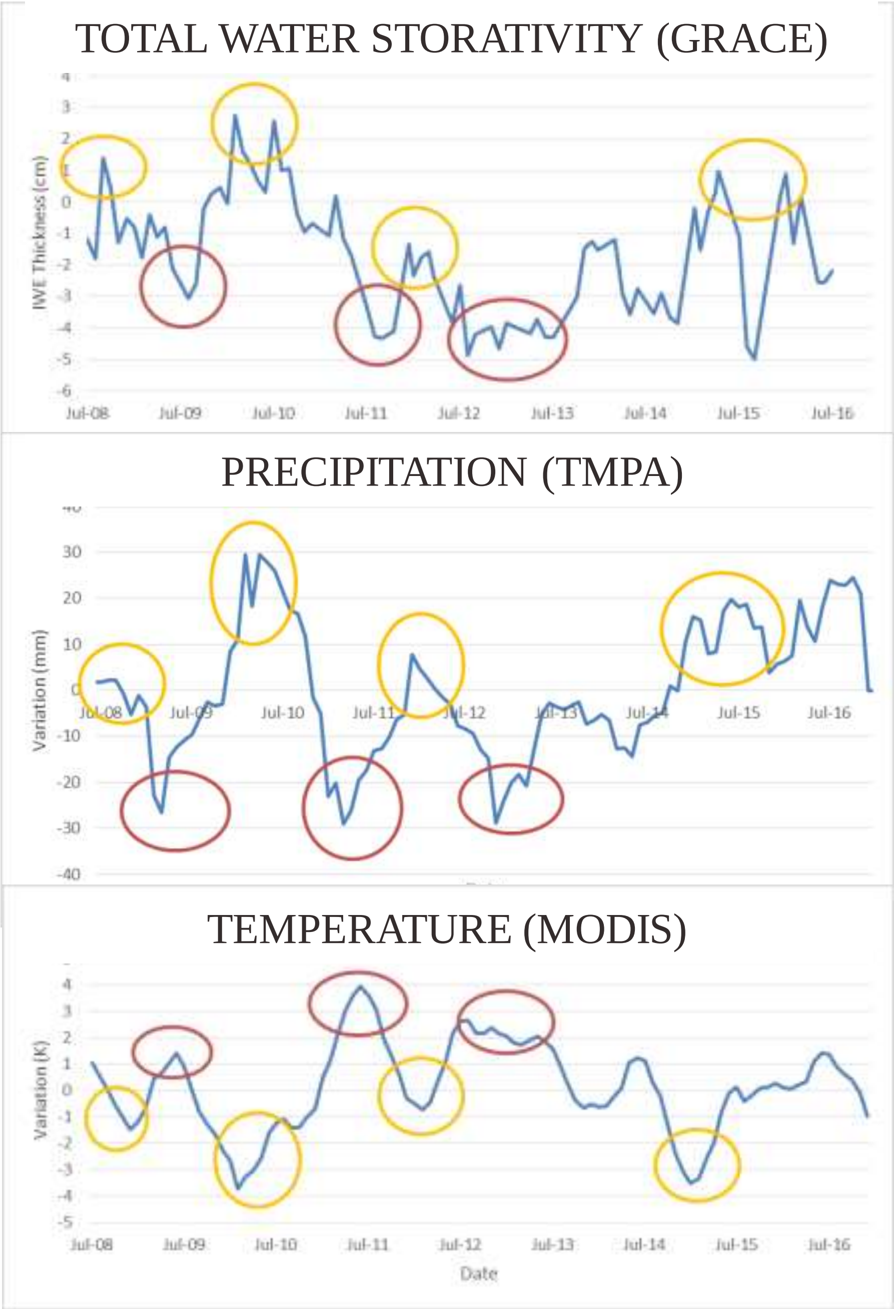


*Taken from CONAGUA (2011)

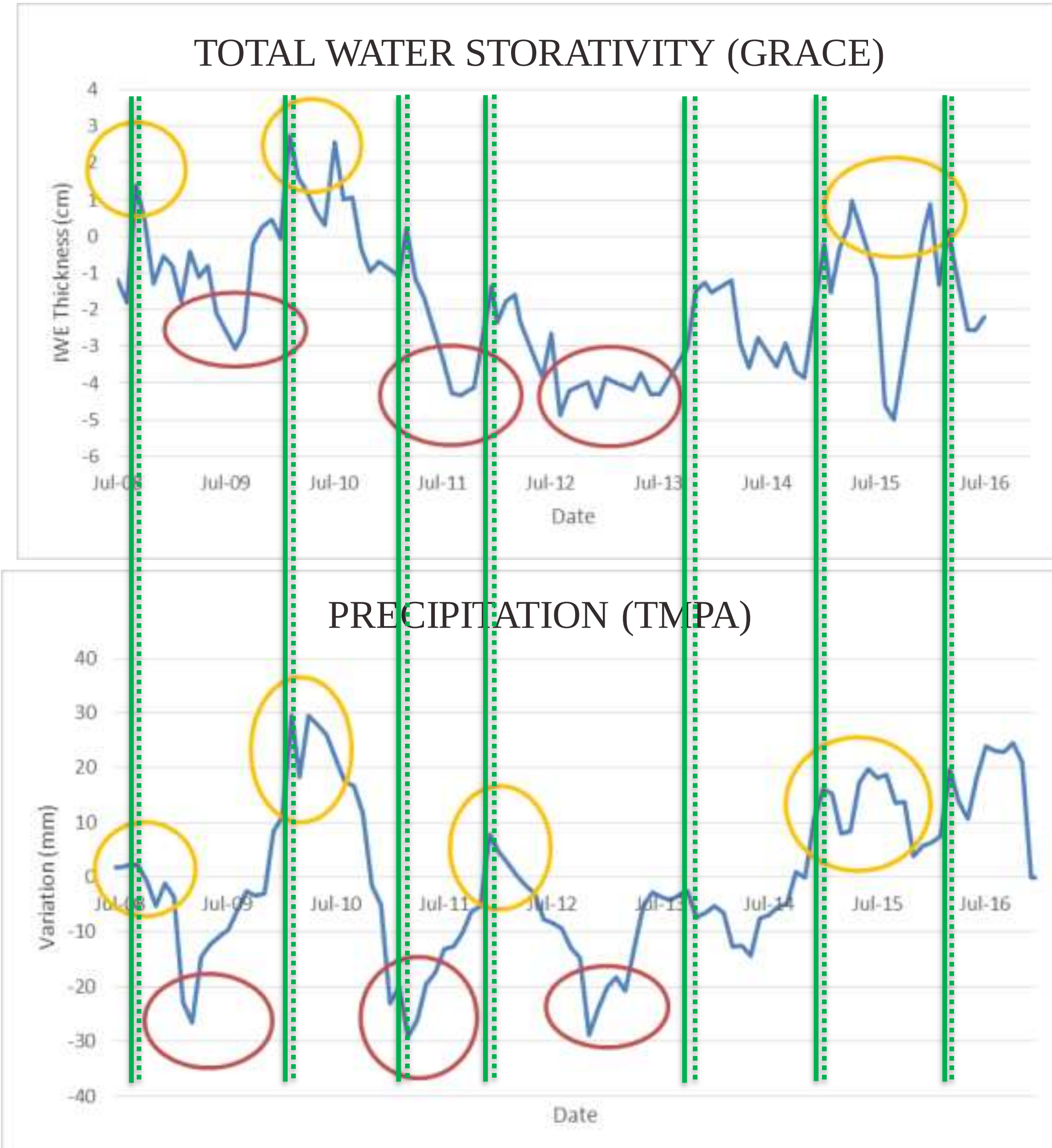
0 to -2 m water levels change from 2008-2011



-0.35 m from GRACE



Identification of droughts from remote sensing data



Infiltration from precipitation takes from 2 to 4 weeks to reach the water table

CONCLUSIONS

- Using remote sensing data to recognize the droughts described by Mexican institutions during past years. Combined parameters help identify dry and wet periods.

- Allende – Piedras Negras aquifer is a small area to attempt an analysis based on GRACE. After comparing water level changes of the period 2008-2011 and GRACE values, differences on water storage are considerable. It could be due to the low spatial resolution of remote sensing data.

- Infiltration takes around 2 to 4 weeks to be reflected on the water table. It will be depending on the lithology of the aquifer, and can be an important feature to explain aquifer vulnerability to droughts and recovery rates.