

# Groundwater Data Analysis as a Tool for Water Resources Management (Amman-Zarqa Basin)

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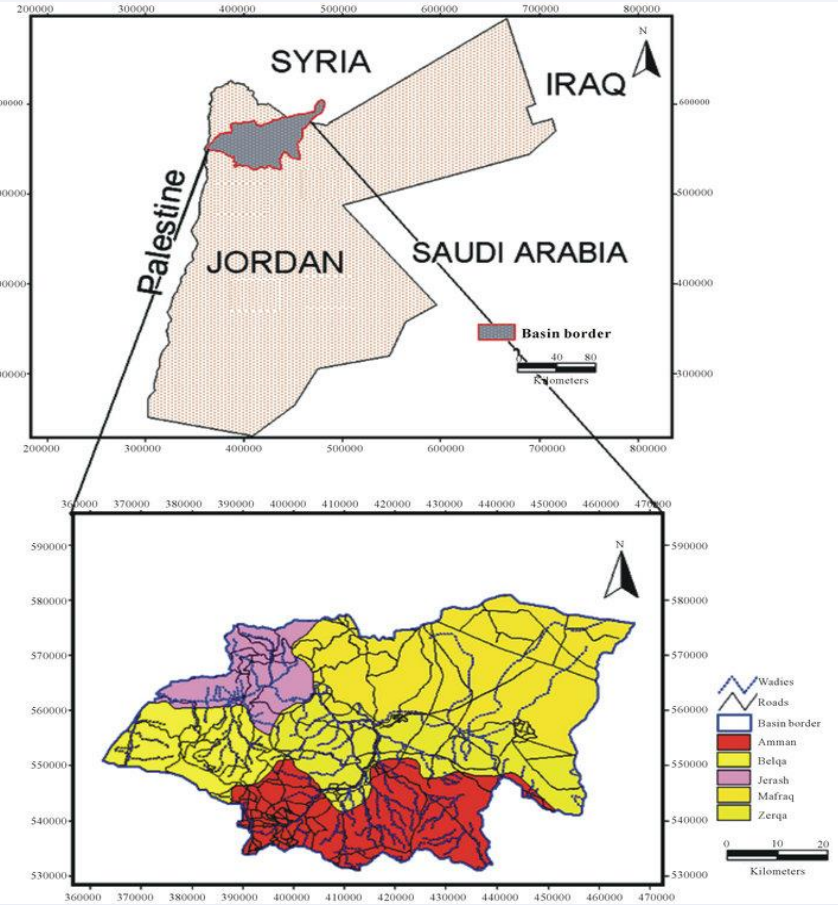
Submitted to Fulfill Big Data Analysis Class Project , Bio539

## Introduction

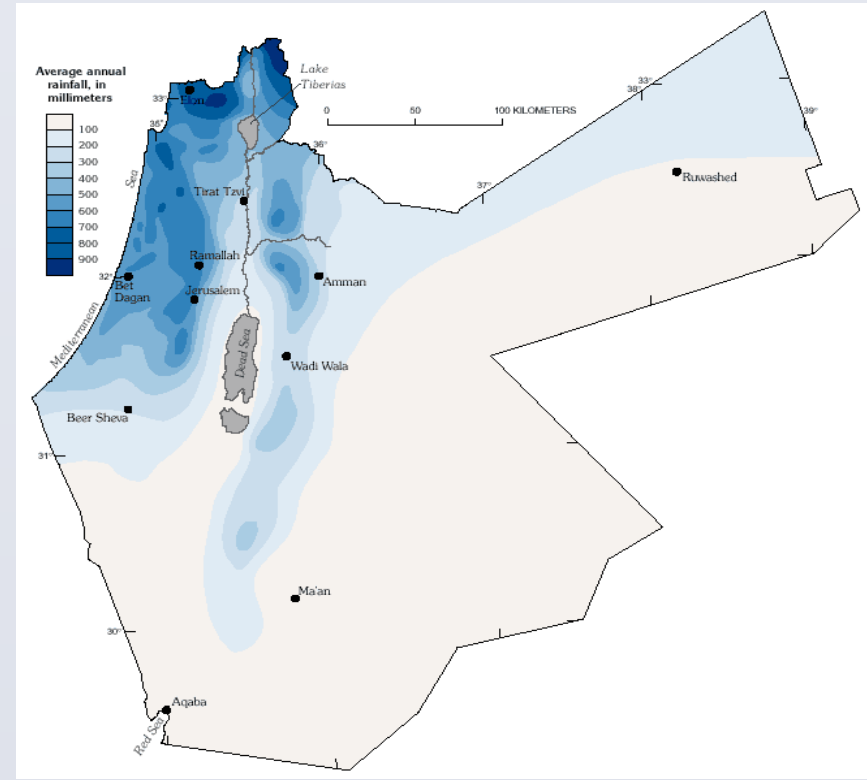
Jordan is the third driest countries in the World and water demand exceeds Jordan's available water resources. Annual per capita water availability has declined from 3600 m<sup>3</sup>/year in 1946 to less than 100 m<sup>3</sup>/year today. Ground water accounts for about 54% of water supply in Jordan from 12 groundwater basins. Abstraction of groundwater is beyond sustainable limits causing water quality deterioration and water-level decline.

The study area comprises one of the most important and exploited basin in Jordan named (Amman-Zarqa Basin).

Groundwater monitoring programs carried provide three types of data; water-level, abstraction rates, and quality



Mediterranean climate prevails west of Jordan to arid and semi-arid to the eastern parts. Precipitation is very low and it ranges from 30 to 600 mm annually. About 93.5% of the country has less than 200 mm of rainfall, and only 0.7% of the country has annual precipitation of more than 500 mm. Most of the country (83%) is composed of desert and desert steppe



## Objectives

Data analysis and manipulation is a vital tool in resources management, different ways and tools are available for data analysis and presentation. The better you present data the better management and decision could be achieved. In this approach we will use R as a powerful tool for;

- Data manipulation
- Data analysis
- And data presentation

## Data Analysis Approach

Three different types of groundwater data is available for analysis;

- Water quality
- Water-levels
- Abstraction rates

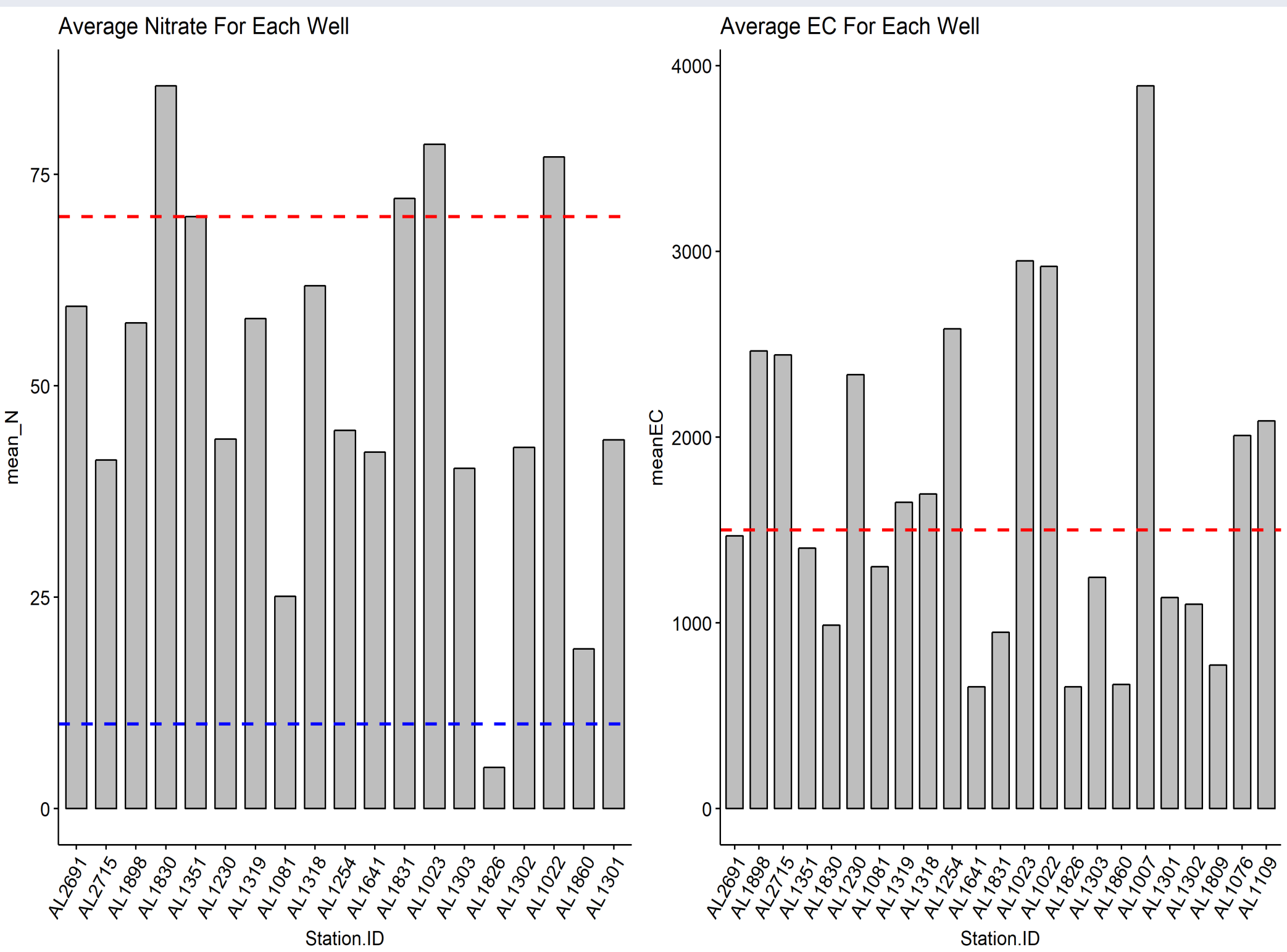
Data was provided in Excel format (multi sheets), in spread and wide format, some data gaps existed and other was not available.

R was used to first manipulate the data, and establish an understanding of data dimension and structure, and then analyze the data and present it in different forms as in the following section (discussion and results)

## Discussion & Results

- Quality data analysis:

Two parameters were considered for analysis; electrical conductivity (EC) and Nitrate (NO<sub>3</sub>) as the following:



Plots show EC and NO<sub>3</sub> values in groundwater and the upper threshold of permissible levels for drinking water

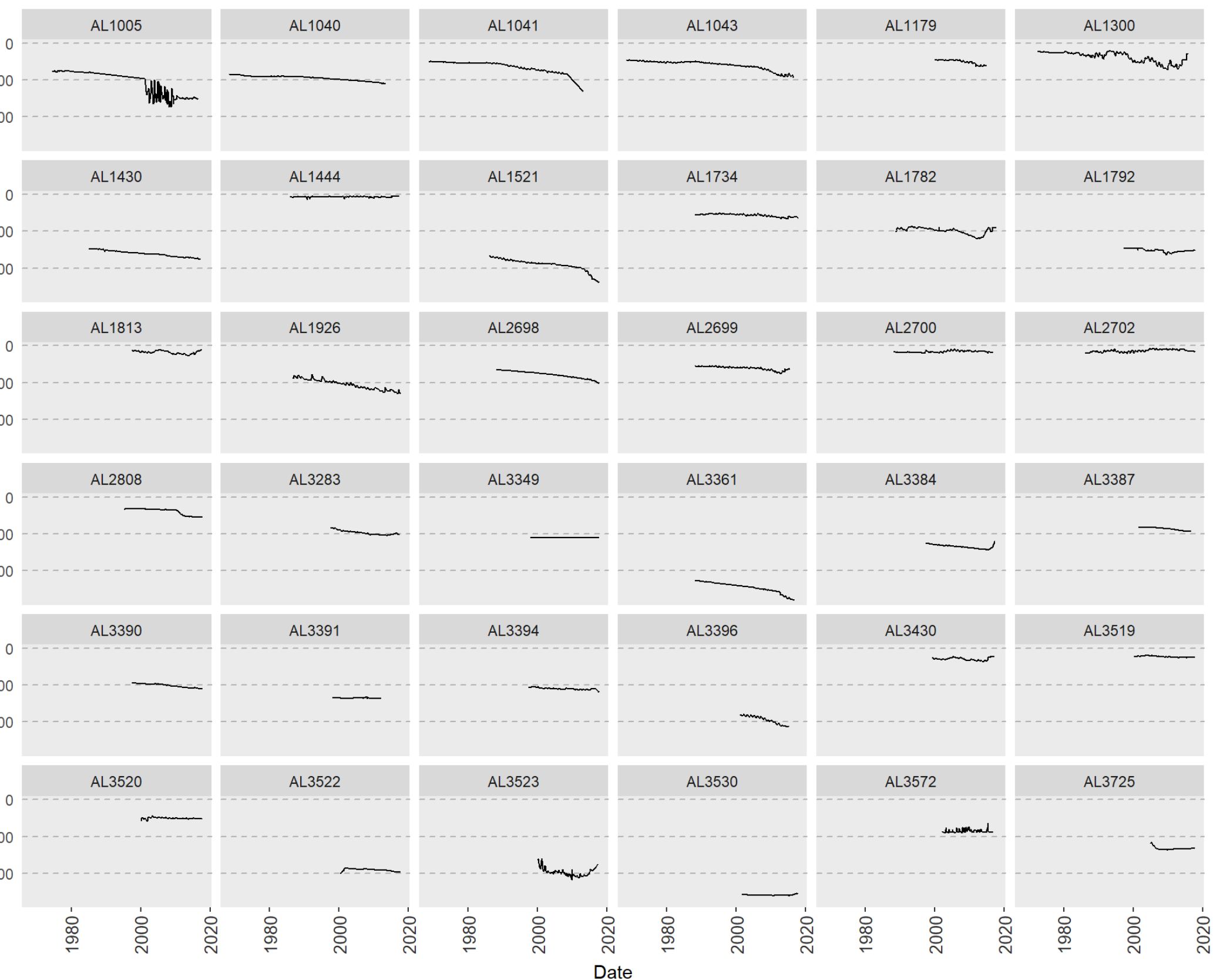


Faceting plot showing time series variation of EC for multiple wells

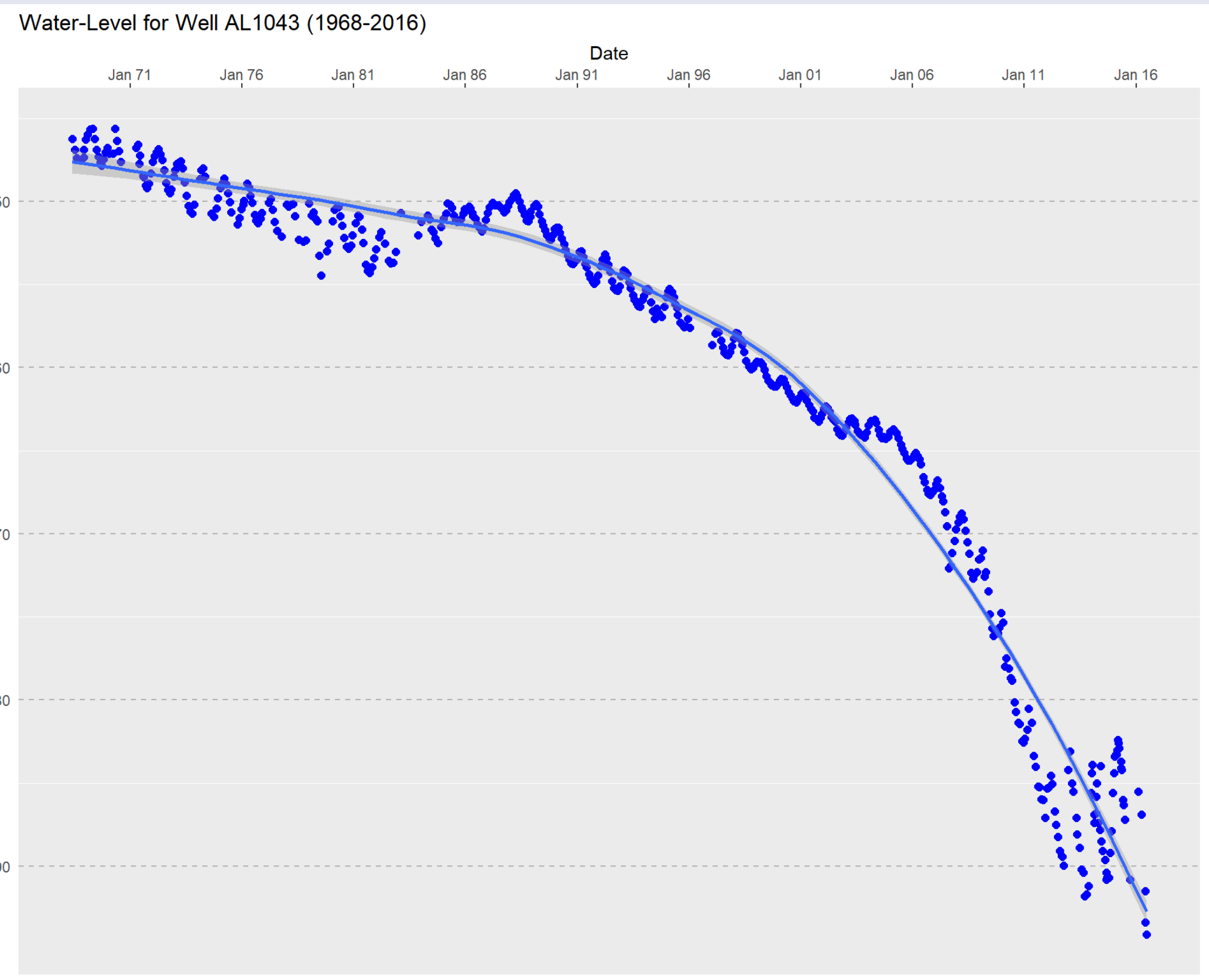
## Discussion & Results Cont.

- Water-level analysis:

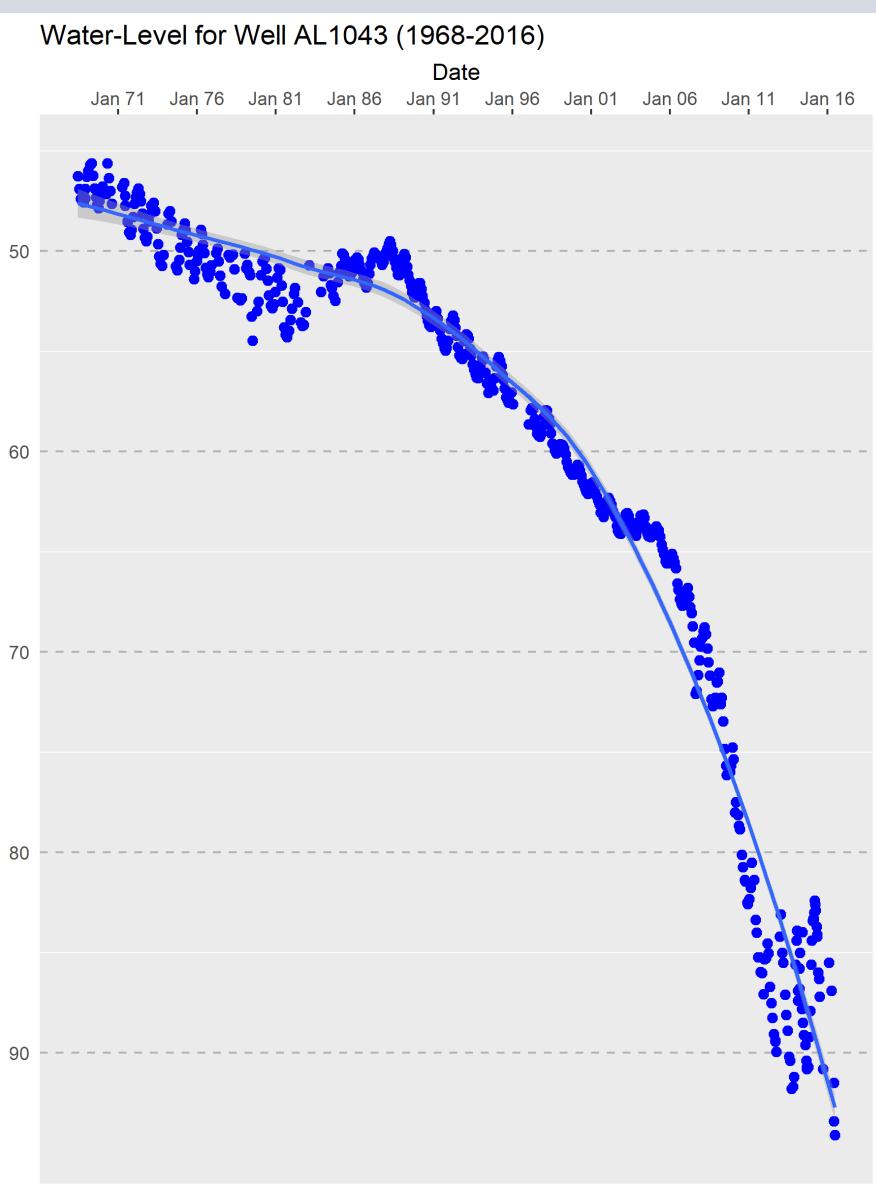
Water-level data provided for many wells and some has long record as shown below



Faceting plot showing water-level series data for monitoring wells of different time frame and variation levels.



The longest record of monitoring well showing three different period of stresses with different response rates.

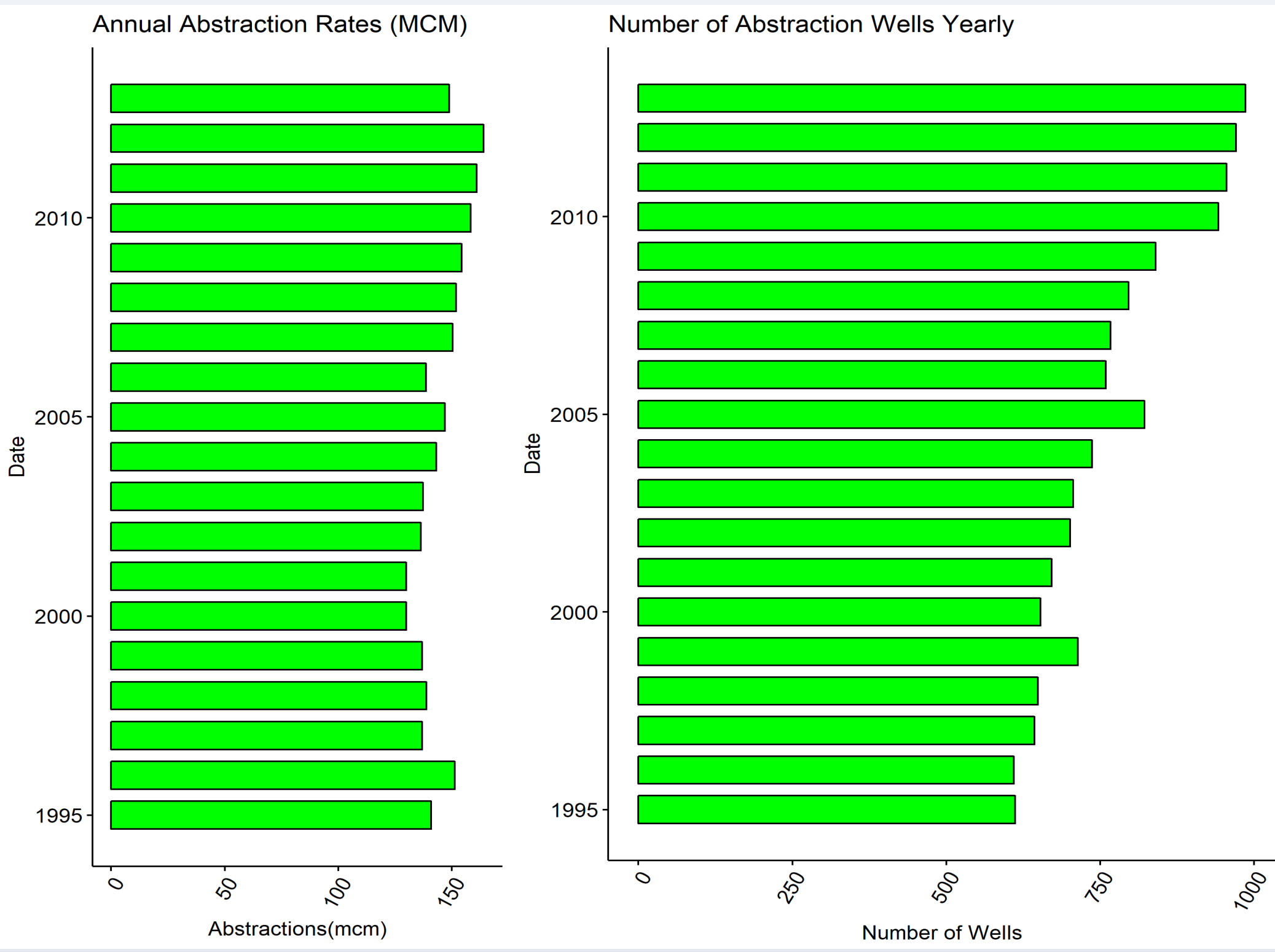


In R you can zoom into any part of that Time series (showing the last 10 years)

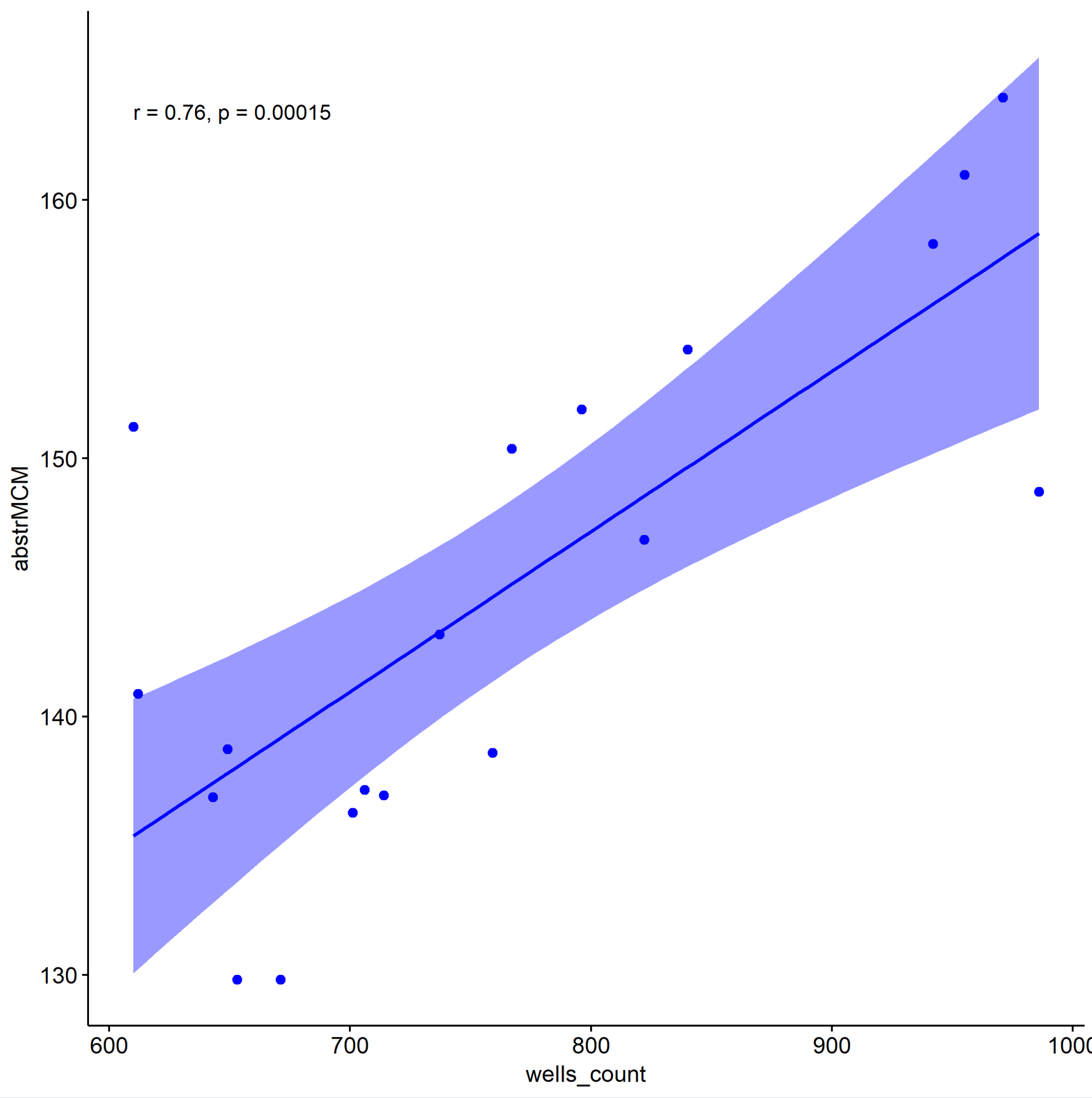
## Discussion & Results Cont.

- Abstraction rates analysis:

Abstraction rates were provided yearly and analyzed as the following:



Plot show a combined bar graphs for abstraction rates and number of wells



Plot showing the relation between abstraction rates and number of wells

## ACKNOWLEDGMENTS

I would like to thank the Ministry of water and irrigation for providing the data for this project, I also would like to thank Dr. Rachel Schwartz the Instructor of the class for her way of teaching and support through the whole semester.