Identifying anthropogenic effects into Doñana aquifer (SW Spain) through hydrogram clustering of piezometric database

Carolina Guardiola-Albert; Nuria Naranjo-Fernández; Héctor Aguilera; Esperanza Montero-González

Doñana Natural Park surroundings

It hosts one of the most important wetlands in Europe with high ecological richness.

Pressures

- Anthropogenic overexploitation
- Global changes

GOAL

Identify different hydrogeological behaviours and the relationship with groundwater overexploitation.

DATA BASE

Groundwater levels (GWL) records from 1975 to 2016:

- 160 GWL series available
- 24 GWL points selected

METHODOLOGY

Missing data were imputed and database were standarized. Three clustering methods were applied:

1. Visual clustering
2. k-means clustering
3. Time series clustering

RESULTS

Preprocess 160 GWL points from Oct 1975 to Sept 2016

Imputation 160 GWL points. Missforest R package

Selection of the best 24 time series

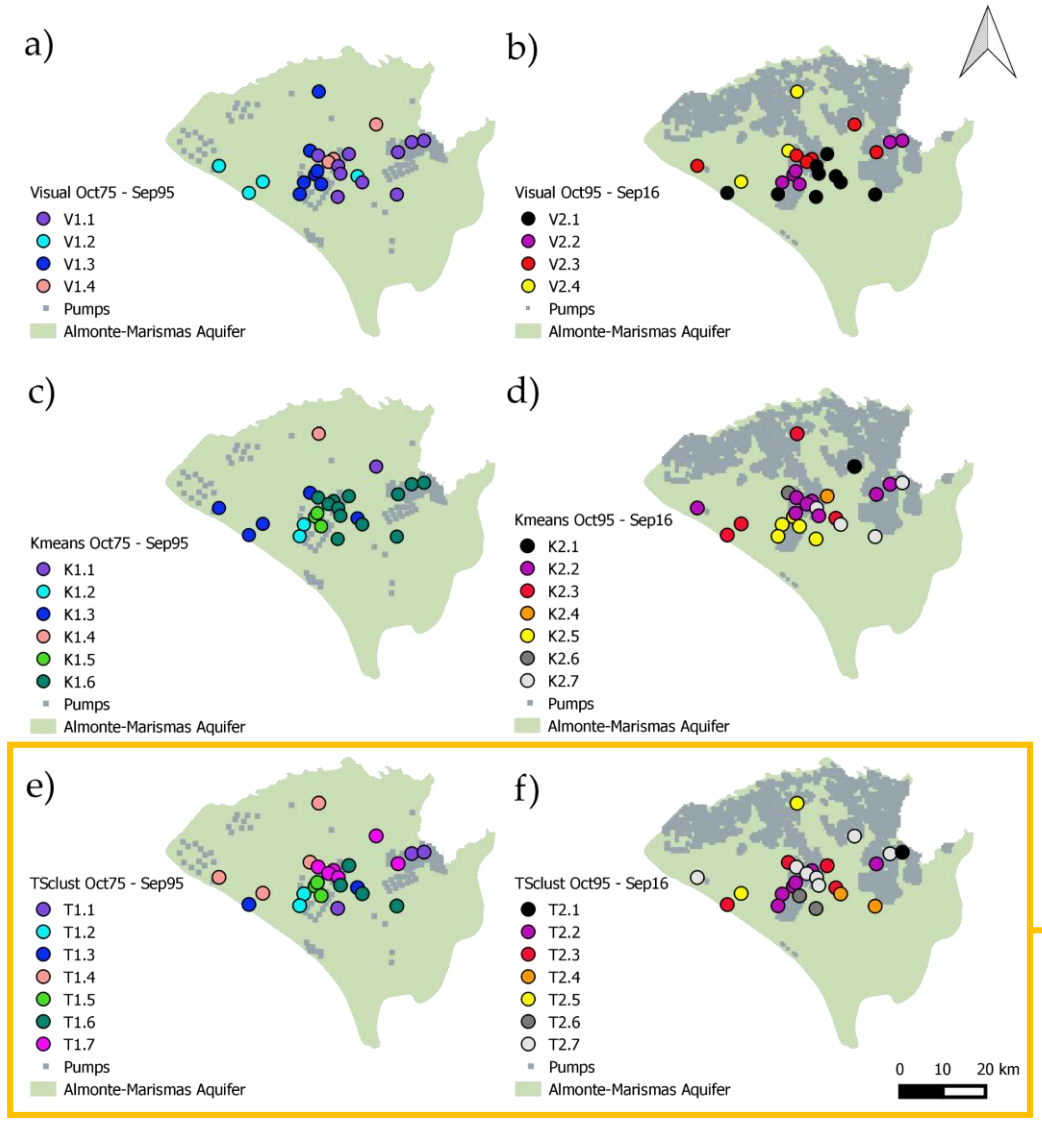
2 Periods:
Oct75 – Sept95
Oct95-Sep16

CLUSTER:
- Visual analysis of patterns
- k-means
- Time series clustering

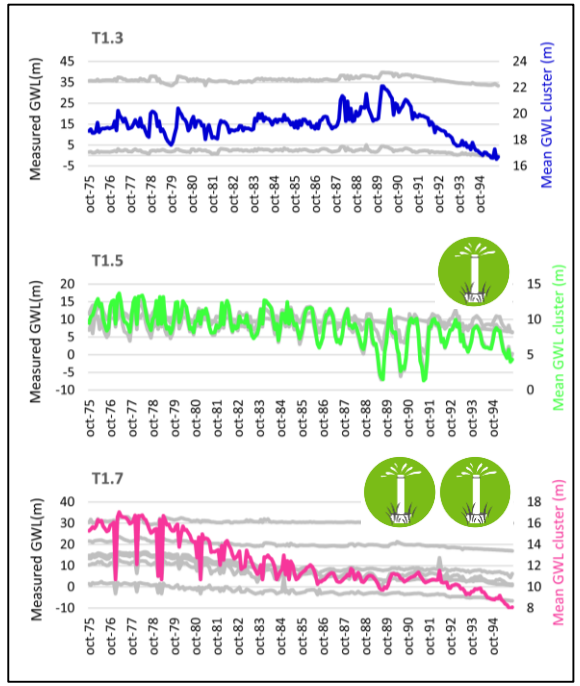
VISUAL

K-MEANS

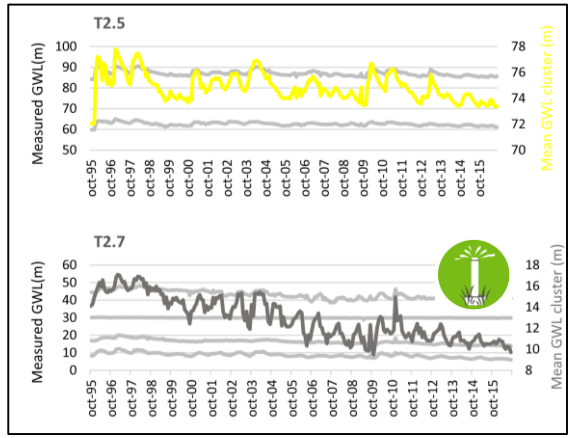
TIME SERIES



e) Oct75-Sept95 anthropic pressure



f) Oct95-Sept16 anthropic pressure



CONCLUSIONS

- Visual classification was very useful as a baseline.
- k-means allows to distinguish diferent GWL oscillations and permits to identify some raw data errors.
- Time series clustering offers better results for studing time series distribution considering the correlation structure of time series.
- The results of this work could be applied in the construction of groundwater models, optimizing the amount of input data and speeding up the modeling execution.
- The methodology applied offers a way to zone overexploitation hot spots in aquifers under anthropogenic pressure.

Research extracted from publised paper:
Naranjo-Fernández, N.; Guardiola-Albert, C.; Aguilera, H.; Serrano-Hidalgo, C.; Montero-González, E. Clustering Groundwater Level Time Series of the Exploited Almonte-Marismas Aquifer in Southwest Spain. *Water* **2020**, *12*, 1063.