

Detecting groundwater anthropogenic extraction with cyclicity results of wavelet models

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Almonte-Marismas aquifer

It hosts both Doñana National and Natural Parks. It was declared UNESCO World Heritage in 1995.



Overview

Groundwater as the main source for crop irrigation

Anthropogenic effects increased because of unauthorized extractions wells

Illegal groundwater extractions are not controlled

Prison for two Spanish berry producers for illegal extraction of water from Doñana

Two administrators of an agricultural company in Almonte, in the Spanish province of Huelva, have been sentenced by the Criminal Court 4 of Huelva to 1 year and 6 months in jail for illegally extracting groundwater from aquifer 27, which supplies water to Doñana, for the irrigation of their berry plantations. They had been doing this for years without the authorization of the Guadalquivir Hydrographic Confederation (CHG).

GOAL

The aims of this study are to identify complex hydrological processes in groundwater levels (GWL) series during the last four decades, to evaluate possible latent factors, and finally to detect cyclic behaviors in the GWL.

DATA BASE

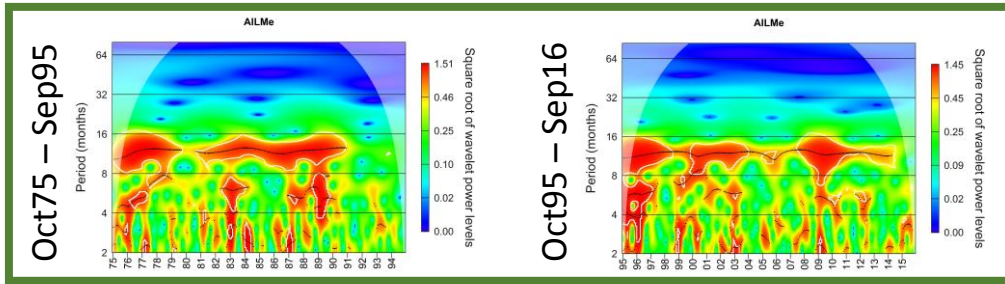
GWL records from 1975 to 2016 of Almonte-Marismas aquifer.

METHODOLOGY

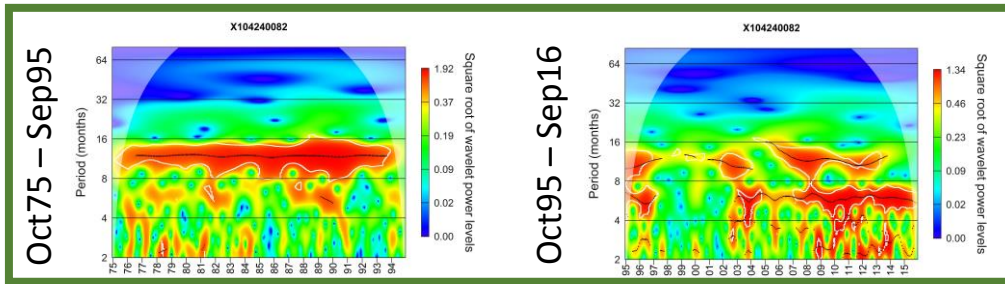
Missing data were imputed monthly with missforest R package.

Wavelet analysis and cyclicity graphs, made with [waveletComp](#) R package, have been applied to detect unfavorable effects of extractions on the GWL.

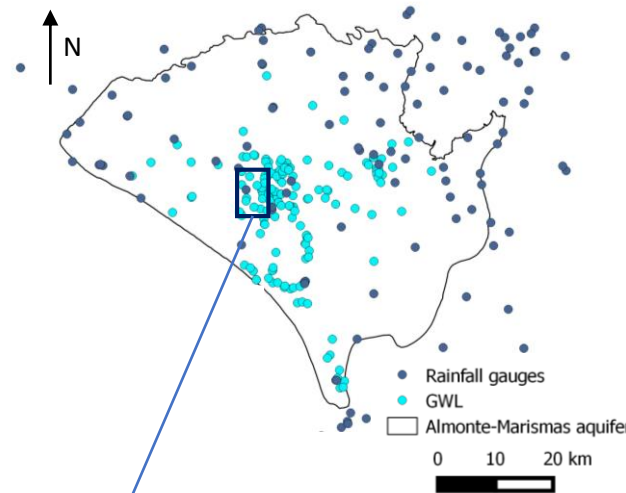
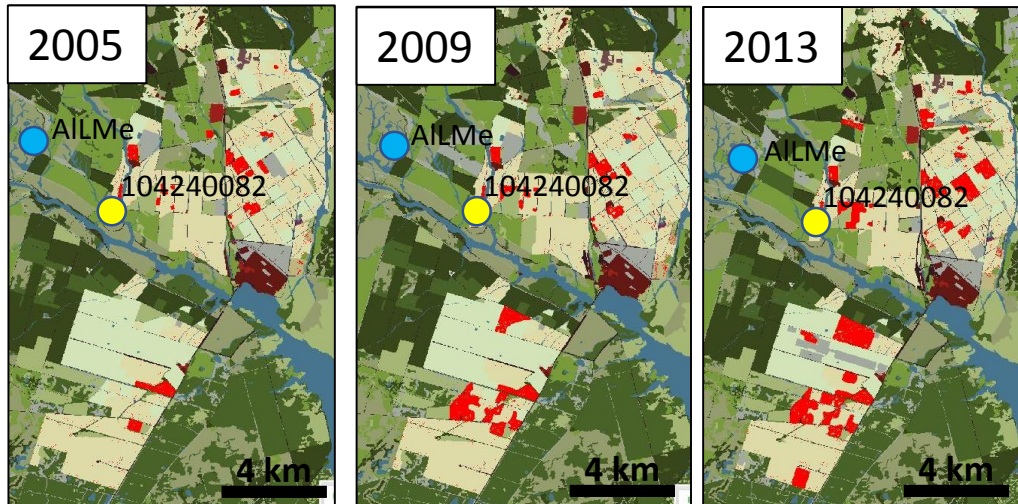
Rainfall – ALLMe



Groundwater levels - 104240082



Greenhouse crops evolution ([SIOSE - J. Andalucía](#))



Oct 1975 – Sep 1995

- Cyclicality of GWL until 1995 was 12 months following the natural cycle of rainfall.
- It could show low anthropogenic pressure or small quantities of groundwater exploitation.

Oct 1995 – Sep 2016

- 12 month cyclicality of GWL following natural cycle of rainfall is almost lost.
- It could show changes in the groundwater exploitation cycle due to changes in land uses.
- **Greenhouse agriculture** has increased since 2000 for berry production ([WWF 2016](#)). GWL wavelet shows particular change from 12 month to 3 and 6 month cycle.

- Wavelet analysis in most of GWL time series analyzed showed periodicities between 11-12 months, which correspond to the typical hydrological cycles of the aquifer recharge and discharge.
- In some areas close to crop fields, periodicities of 3 and 6 months in the GWL have been detected. Changes on land uses from citrus to berry production could be the main reason for these changes in the cyclicities and thus in the hydrogeological dynamics.
- These areas could be the focus of the administration managers to increase a deeper legal control. A thorough control of groundwater extractions in these sites is advisable.

These are preliminary results; any discussion is highly appreciated.
Thank you in advance!



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References are hyperlinked.



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