

3.20 Description of the Campo de Montiel aquifer case study, Spain

Title of Case Study	Campo de Montiel aquifer
Location (region, Country)	Ciudad Real and Albacete, Castilla la Mancha, España
Other information	

Description of Case Study (background information on the region)

Campo de Montiel aquifer covers an area of near 2200 km² located between Ciudad Real and Albacete provinces in the Mediterranean region of EU. This aquifer is part of the Upper Guadiana Basin. It is mainly composed by limestones and Jurassic carbonated formations. Its altitude varies between 800 and 1000 m.a.s.l. The mean annual temperature is about 14 °C. The annual precipitation varies between 400 and 500 mm. It is a semiarid region where groundwater use has helped to transform a largely poor rural region into a prosperous agricultural area. In Campo de Montiel aquifer strong natural interactions between groundwater and surface water are observed, which gives rise to some of the one hundred wetlands that make up UNESCO's Mancha Húmeda Biosphere Reserve.

Description of problem (why is this location chosen for a Cases Study)

This pilot area highlights the strong conflict between groundwater-dependent ecosystems and groundwater pumping to supply demands (mainly irrigation demands). Also the pumping volumes are not so high (about 9 hm³/year), the wetlands are very sensible to groundwater levels. Moreover, the intense agricultural activity has produced a clear qualitative deterioration of the aquifer.

Methods to be used in the Case Study (analytical and isotope techniques, modelling)

Some studies based on isotopes (³H and ¹⁸O) have been conducted in this area in order to improve the knowledge of the hydrogeological system and to determine groundwater age and the origin of the high nitrate concentration in the aquifer.

Moreover, the River Basin Authority developed a groundwater flow model (MODFLOW) covering eight groundwater bodies in the Upper Guadiana Basin to simulate groundwater levels. This model can be used to determine the groundwater volume and to perform a first assessment of the residence time of the aquifer.

Results from this Case Study

We have performed a preliminary assessment of a distributed map of mean groundwater age distribution from the ³H by applying interpolation techniques.

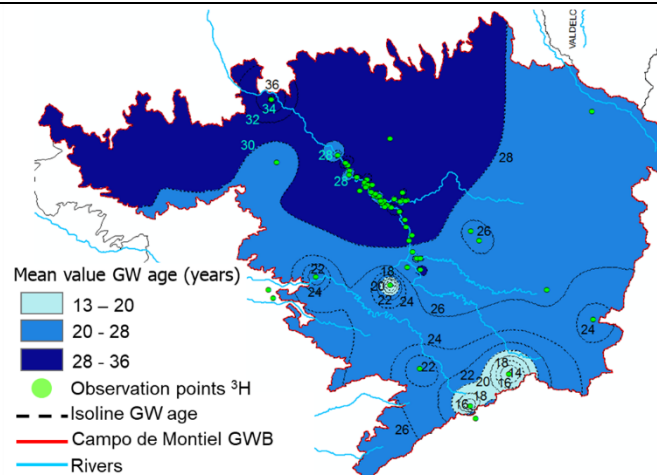


Fig. 1 Distributed groundwater age in Campo de Montiel aquifer.

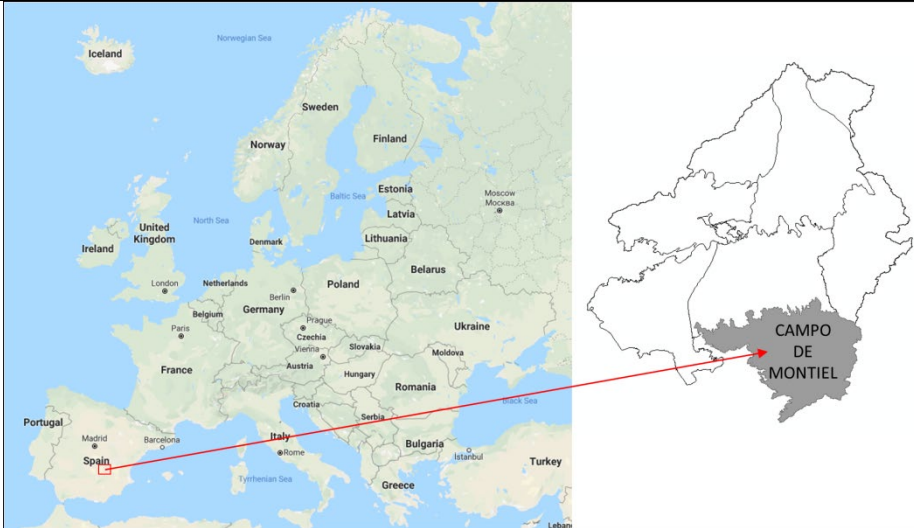
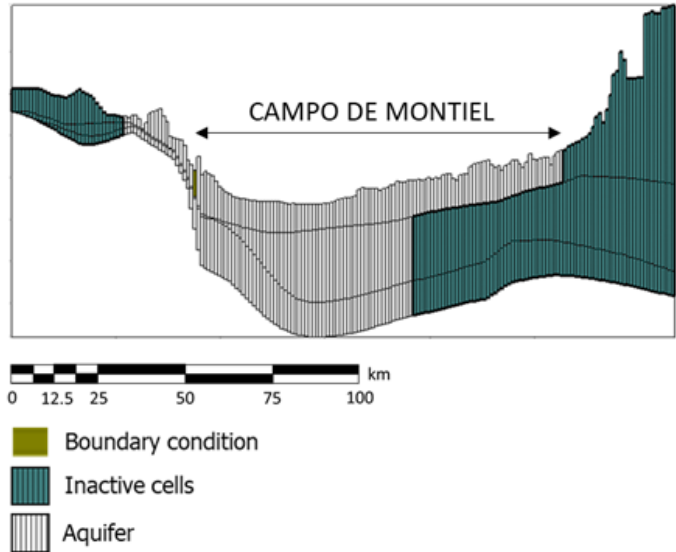
We intend to produce the same map based from the calibrated MODFLOW model by using MODPATH and to compare results.

The lumped mean groundwater age obtained from the map (Figure 1) is 27.8 years. The groundwater age obtained by applying the turn over time index approach (obtained by dividing the aquifer groundwater storage by the mean net aquifer recharge) is 17 years, which is in the range of the values in Figure 1 (13 - 36 years).

We are also studying the correlation between the turn over time index and the lumped vulnerability value to surface pollutant in the eight aquifer bodies located within Alto Guadiana Basin.

Impact - how this Case Study contributes to the overall project aims

It intends to contribute to test different techniques for estimating groundwater age with residence times mainly in the age range of 10 to 1000 years. In our demonstration pilot we will compare mean spatial distribution obtained from a numerical model with those obtained from a numerical model. We also analysed lumped mean values, comparing those obtained from the cited maps with values estimated by applying the simple turn over time index.

Name of pilot area / aquifers / type: Campo de Montiel / Jurassic limestones / carbonated		Country: Spain Region: Campo de Montiel aquifer (Upper Guadiana Basin)	
Study level	Transboundary : ☐	Regional: ☒	Local: ☐
Type of observations <i>(choose one of the options, create separate template if needed for each type if each type need specific information)</i>	Single well(s): ☐ ☐ Short screened observation wells (not pumped) ☐ Long screened observation wells (not pumped) ☒ Pumped wells, long screens in one aquifer ☐ Pumped wells, long screens over multiple aquifers ☐ Springs ☐ Other (eg. research wells; indicate type and information on pumping):		
Approximate location of pilot:			
Geological cross section / conceptual model of the pilot area:	Conceptual flow model 		

Name of Shape- / Geopackage file defining the area: HoverSPPilots.shp		Projection to be used: WGS84 (Epsg4326)		
Hydrological parameters:	Mean annual precipitation (mm or range in mm)	Mean annual groundwater recharge (mm or range in mm)	Mean annual groundwater recharge temperature (°C)	Thickness of unsaturated zone (range in m)
	450-500	50-90		0-180
Pumped wells only		Typical pump discharge of sampled individual well (m ³ /day): 115		Typical pump discharge of complete well field (m ³ /day): 30796
List of aquifers and aquitards in pilot area		No. of confined or semiconfined aquifers in pilot area: 2		No. of unconfined aquifers in pilot area: 1
Aquifer no. (aqf): 1	Aquifer/aquitard type and/or name	Lithology (Resource WP6 terminology)	Depth range (m)	GW age range (yr)
Aqf-1: Campo de Montiel aquifer	Campo de Montiel aquifer	Jurassic carbonated aquifer + Limestones	50 - 200	5 - 100
Porosity type	Porous: X	Fissured: ☐	Karst: ☐	Fissured and porous / dual porosity: X
Applied tracer age indicators (³ H, ³ H/ ³ He, ⁸⁵ Kr, ³⁹ Ar, ¹⁴ C, ³⁶ Cl, ⁸¹ Kr, ⁴ He, CFCs, SF ₆ , etc.) Applied recharge temperature indicators (¹⁸ O, D, noble gases)		Aquifer-1: (A) ³ H (tracer age indicator) + ¹⁸ O (recharge temperature indicator). (B) Applied groundwater distributed model (MODFLOW + MODPATH) (C) Lumped index (turn over time index = total storage/mean recharge)		
Number of sites (wells/springs) with age indicators		Aquifer-1 1-5: ☐ 5-10: ☐ 10-25: ☐ >25: X		
GW age range (GAR) GAR-1: Modern (< 60 yr) GAR-2: Old (> 60 yr and 10 kyr) GAR-3: Paleowaters (> 10 kyr)		Aquifer-1 GAR-1: 1-10%: ☐ 10-25%: ☐ 25-50%: ☐ >50%: X GAR-2: 1-10%: ☐ 10-25%: ☐ 25-50%: ☐ >50%: ☐ GAR-3: 1-10%: ☐ 10-25%: ☐ 25-50%: ☐ >50%: ☐		

Groundwater age ranges (GAR) estimated by:		Tracer based estimates ☐ Flow and age model simulations ☐ Combination of model and tracer estimates X Expert judgement: ☐			
Objective of age dating studies:					
Basic research or General groundwater management	Assessment of pollutant history		Assessment of the efficiency of remediation and mitigation measures		Indication of vulnerability of aquifers and water supply wells
X					X
Water Usage <i>(not relevant for observation wells)</i>	Water supply		Irrigation	Industry	Other
	X		X		
Geoenery related activities <i>(not relevant for observation wells)</i>	Shallow Geo-T	Deep Geo-T	Hydrocarbons		Nuclear waste disp.
Mining activities <i>(not relevant for observation wells)</i>	Construction materials		Minerals / metals	Coal	Other
REFERENCES					
OPEN Access reports and papers (PDF versions made available in EGDI repository making them downloadable via maps and keyword / free text searches):			Reports and papers with restricted access: MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO and CONFEDERACIÓN HIDROGRÁFICA DEL GUADIANA (2009). MEJORA DEL CONOCIMIENTO HIDROLÓGICO E HIDROGEOLOGÍCO DEL ALTO GUADIANA. Clave: 04.803-246/0411. MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO and CEDEX (2008). ESTUDIO HIDROGEOLOGÍCO E ISOTÓPICO EN LA MASA DE AGUA SUBTERRÁNEA CAMPO DE MONTIEL (041.010).		
Remarks / other relevant information:					