Evaluating the impact of land use changes on the behaviour of shallow aquifers by quantifying the groundwater mean residence times distribution

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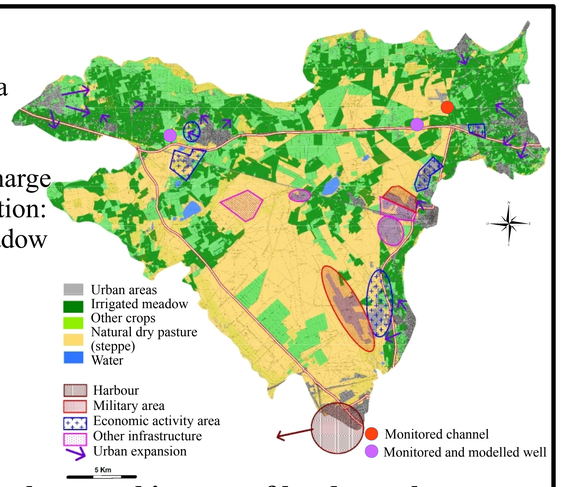
Crau
Mediterranean area
Agriculture

Crau aquifer: Recharge mostly from irrigation: 80-85% under meadow
Major drinking water resource

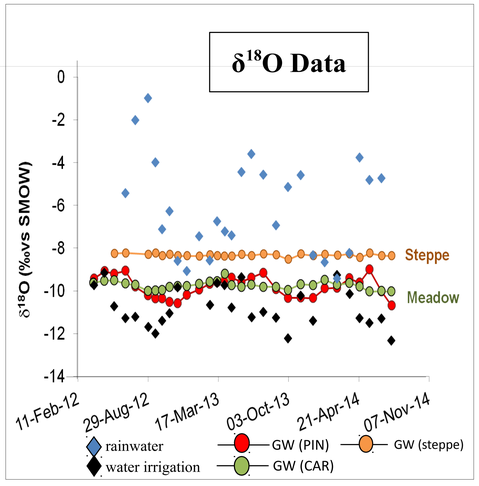
Expected changes: climate change, irrigation patterns, urban expansion



How to evaluate the actual impact of land use changes on the Crau aquifer resource? Refine the quantification of the groundwater behaviour.

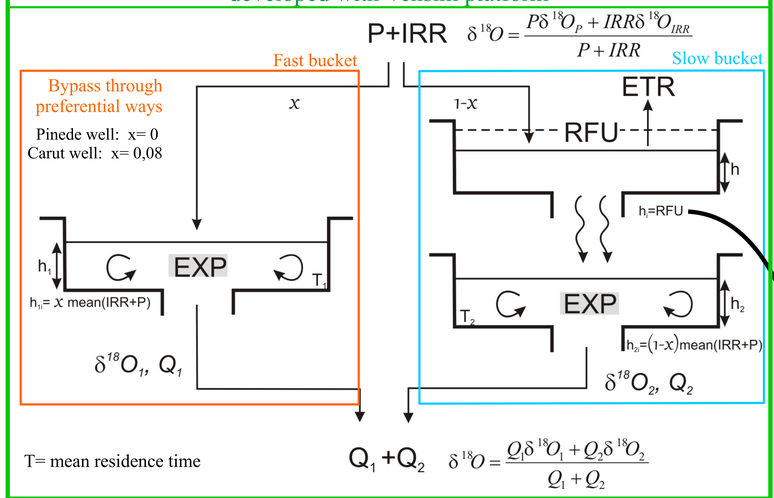
Methodology

Isotopic data (monthly field samplings, 2012-2016)
+
Hydrogeological modelling (lumped and physical models)
=
Mean residence time

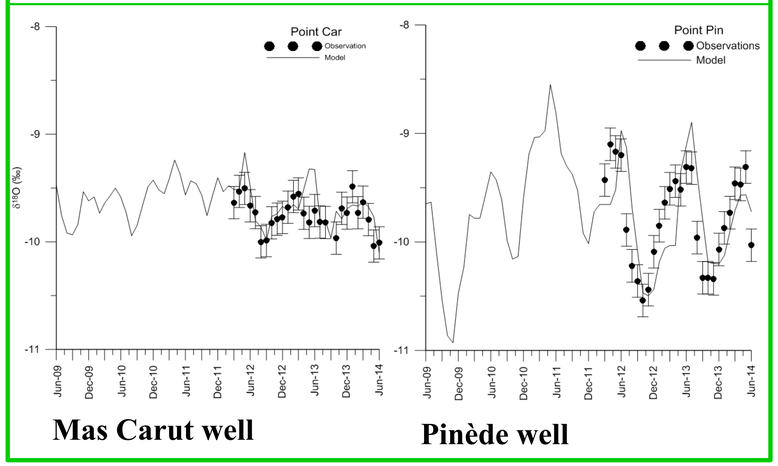


Lumped parameters model

developed with Vensim platform



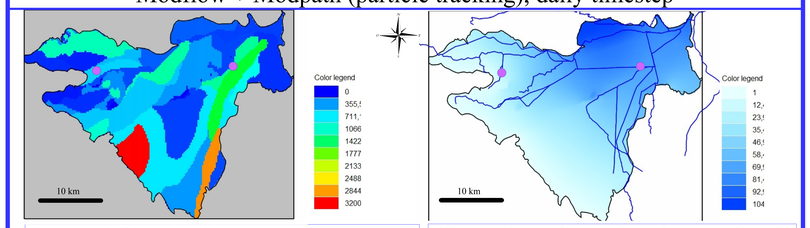
Lumped parameters model results



Mas Carut well **Pinède well**

ModelMuse model

Modflow + Modpath (particle tracking), daily timestep

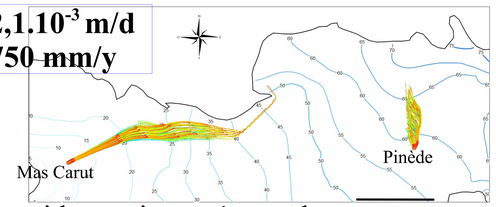


Permeability (m/d) (from Baillieux et al. 2015) | Channels and simulated water levels

Transient runs, 2010-2014, monthly recharge values

ModelMuse results, **spatially homogeneous recharge**

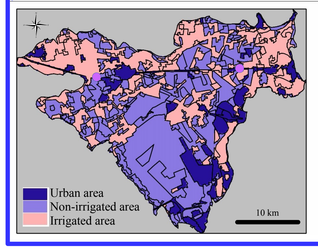
Average Recharge = 2,1.10^{-3} m/d = 750 mm/y

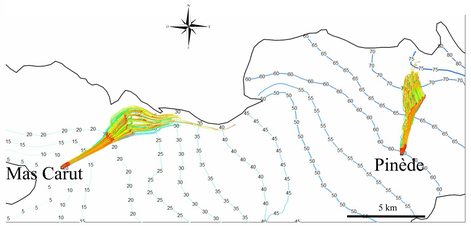


Sensisivity tests
Recharge +10%: mean residence time – 1 month
Recharge -10%: mean residence time + 1 month

ModelMuse results, **3 zones recharge**

Average recharge: Irrigated meadows: 3,8.10^{-3} m/d
Non-irrigated areas: 3,8.10^{-4} m/d; Urbanised areas: 0 m/d





Perspectives

Fully spatially discretised recharge
Mean residence time depending on the particle depth
Analyses of July 2014- September 2016 field samples
Chemical transport
Integration of alternative aquifer geometry (Séraphin et al. 2016)
Sensivity tests on porosity value(s)

Main results

MEAN RESIDENCE TIME	**Mas Carut well**	**Pinede well**
Lumped model	20 months (1 month)	3 months
ModelMuse, homogenous recharge	19 months	13 months
ModelMuse, 3 zones recharge	14 months	18 months
ModelMuse, discretised recharge	*Work in progress*	

Ref.: Olioso et al. (2013) Procedia Environmental Sciences 19, 691–700; Baillieux A. et al. (2015) Géologues 187, 85-9221