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Comparison of climate change impacts on the recharge of two karst systems computing different modelling approaches

Caballero Y.*[1], Zerouali, L.[1], Ladouche B. [1], Lanini S. [1], Seguin J.J. [2], Charlier J.B. [1], Cadilhac L. [3], Maréchal J.C. [1] , Pagé C. [4]

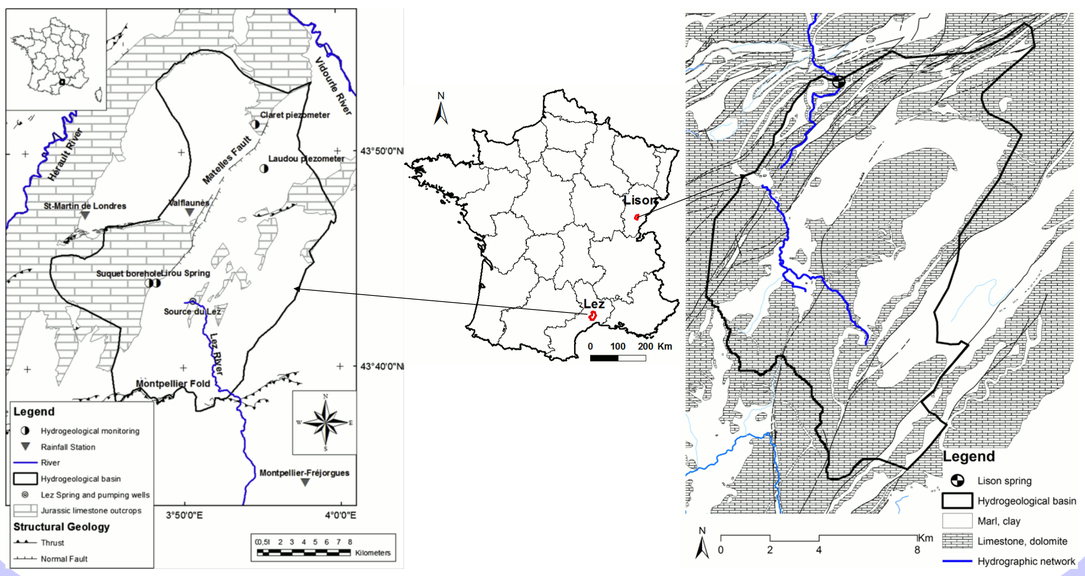
1 – BRGM, D3E/NRE, Montpellier, France ; 2 – BRGM, D3E/GDR, Orléans, France; 3 – RM&C Water Agency, Lyon, France; 4 – CERFACS, Toulouse, France

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The Lez and the Lison karst systems in Southern and Eastern France respectively, provide 2 examples of karst systems of several km² under two contrasted climate conditions, the first one being heavily exploited. Using a multi-method recharge estimation tool a comparative climate change assessment on both karst systems is performed using three IPCC SRES A1B climate scenarios. Results are compared and discussed using the information provided by the application of the multi-method estimation of recharge on both systems.

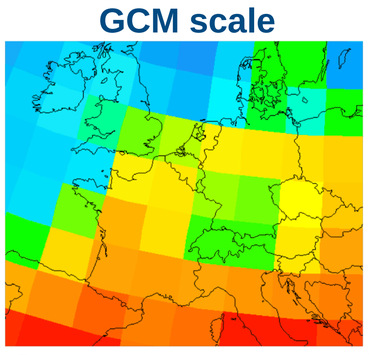
2 contrasted karst systems: The Lez and the Lison springs

The Lez and the Lison karst systems in Southern and Eastern France, respectively, are submitted to contrasted climate conditions. The Lez system is being heavily exploited by pumping boreholes while the Lison is not exploited at all.

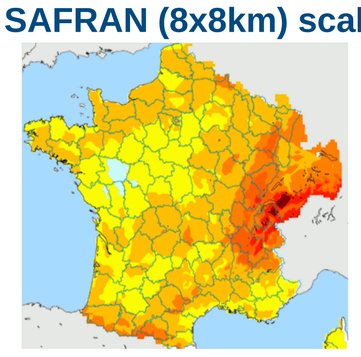


3 climate scenarios (SCRATCH 2010)

GCM scale



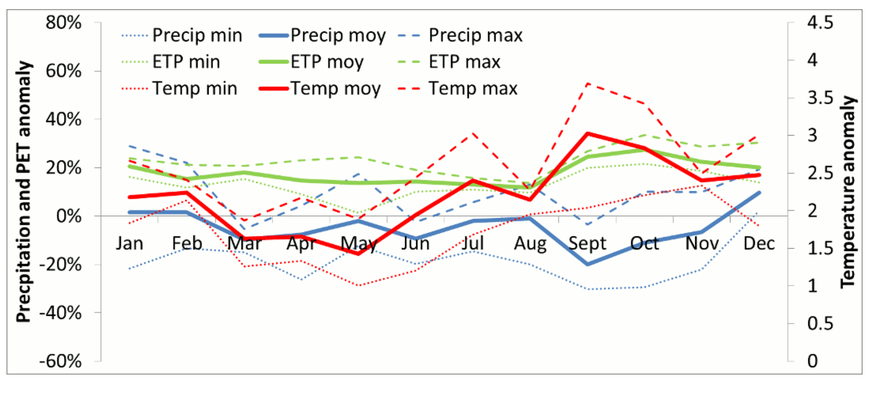
SAFRAN (8x8km) scale



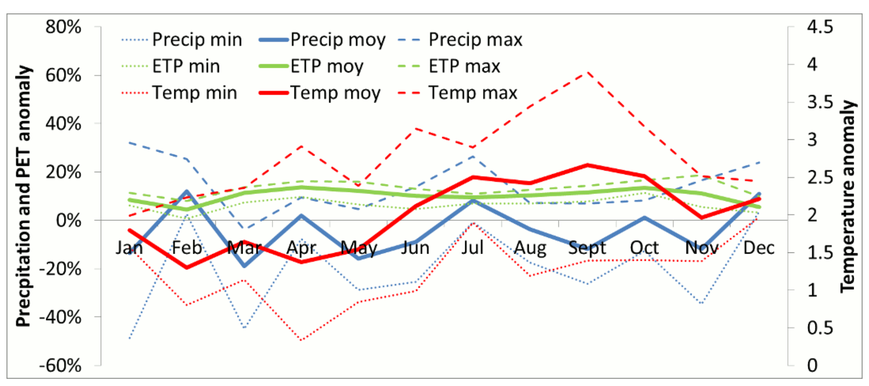
Downscaling using a weather-typing based statistical methodology
Pagé and Terray, (2010)

Temperature and PET increase on both sites, with a higher intensity for the Lison system. Precipitation slightly decreases during the major part of the year for the Lison system while a more variable signal is observed on the Lez karst system

Lison

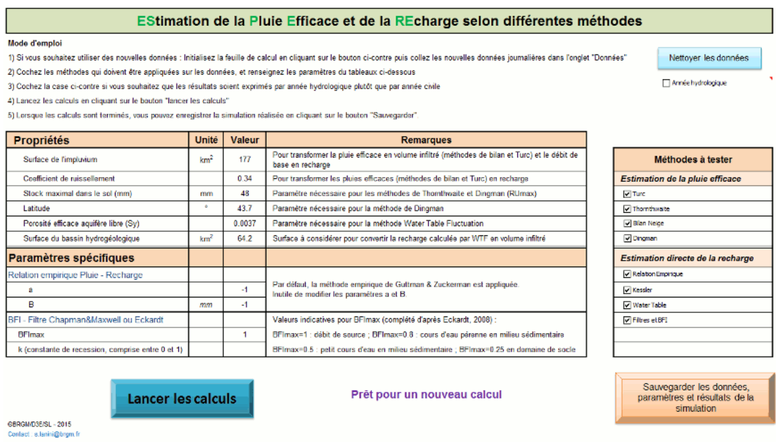


Lez

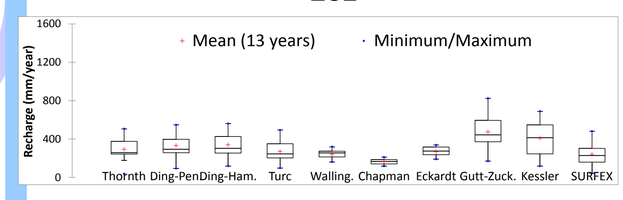


ESPERE a multi-method recharge estimation tool

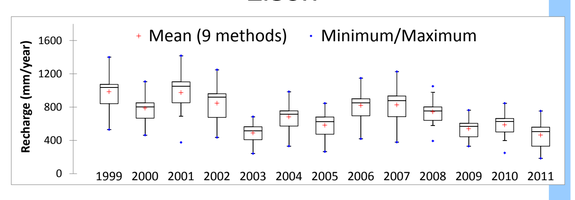
ESPERE applies different commonly-used methods to fast and simultaneously estimate recharge. It allows quantifying recharge with a monthly and annual time step and visualizing related uncertainties (including a comparison with SURFEX (Masson et al., 2013).



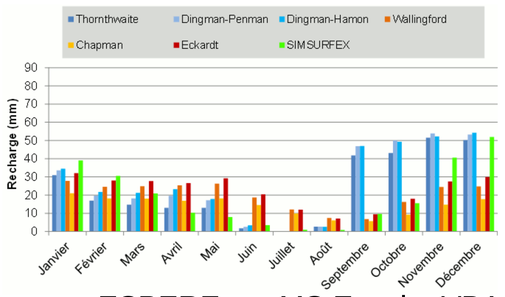
Lez

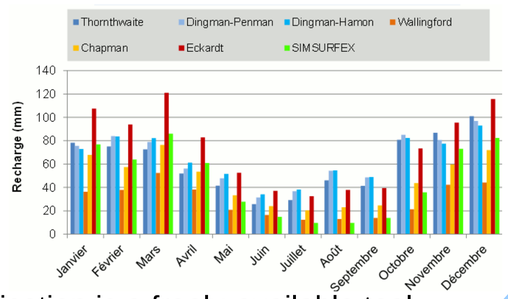


Lison



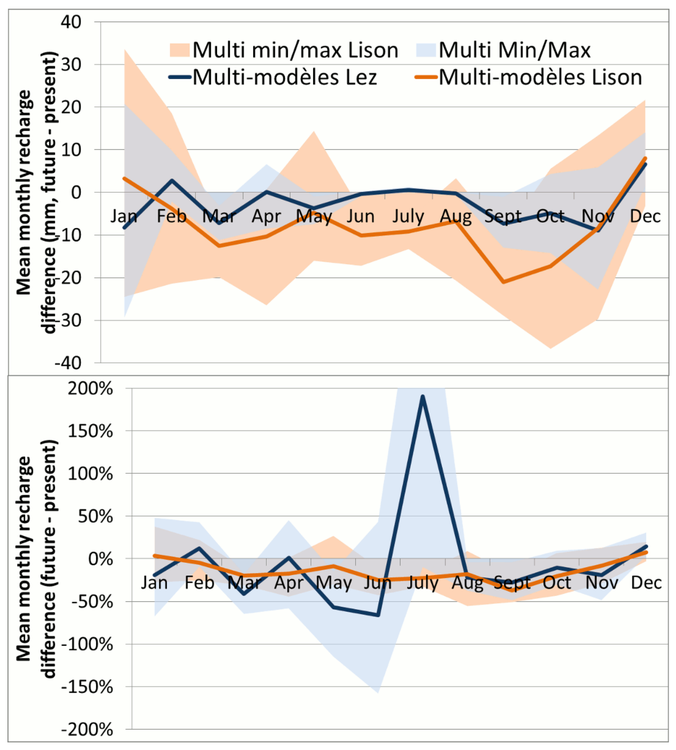
The multi-method estimation Is useful to discuss the aquifer size and its dynamics and to compare different systems with a common framework *(Caballero et al., 2015*)





ESPERE, an MS Excel + VBA application is a freely-available tool
(Lanini et al, submitted to Groundwater)

Results



Future recharge is likely to decrease on both systems and seems to affect the Lez more severely. Due to the importance of the recharge process during autumn, the Lez system should be less sensitive to the strong impact observed during spring. The Lison system should in turn be more sensitive as recharge is quite similar in spring and autumn.

Caballero, Y., Lanini, S., Seguin, J.-J., Charlier, J.-B., Ollivier, C. (2015) – Caractérisation de la recharge des aquifères et évolution future en contexte de changement climatique. Application au bassin RM&C. BRGM/RP-64779-FR, 159 p., in french.
Lanin, S., Caballero, Y., Seguin, J.J. ESPERE, a multi-method computer tool for estimating aquifer recharge, submitted to Groundwater.
Masson, et al., (2013), The SURFEXv7.2 land and ocean surface platform for coupled or offline simulation of earth surface variables and fluxes , Geosci. Model Dev., 6(4), 929-960, doi:10.5194/gmd-6-929-2013
Pagé, C. and Terray, L., (2010) Nouvelles projections climatiques à échelle fine sur la France pour le 21ème siècle: les scénarii SCRATCH2010. Technical Report TR/CMGC/10/58, Toulouse, France (In French).

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