



Hanoi University of Mining and Geology

Proceedings of the ESASGD 2016

Hanoi, November 14, 2016

Session: Geology and Geo-resources (GAG)

ISBN:978-604-76-1171-3

TRANSPORT PUBLISHING HOUSE



INTERNATIONAL CONFERENCES ON EARTH SCIENCES
AND SUSTAINABLE GEO-RESOURCES DEVELOPMENT

ESASGD 2016

ISBN: 978-604-76-1171-3



NOT FOR SALE

TABLE OF CONTENTS

		Page
1	Marek BOROWSKI, Marek CAŁA, Piotr CZAJA. The aspects of educating engineers from vietnam at the agh university of science and technology in cracow	1
2	BUI Hoang Bac, NGO Xuan Thanh, Yungoo SONG, Tetsumaru ITAYA, Koshi YAGI, KHUONG The Hung and NGUYEN Tien Dung. K-ar dating of clay gouges from red river fault zone in Vietnam and its tectonic implication	10
3	Duong Ngoc Tinh, Do Van Nhuan. The metasomatism related lithium ineralization in Ducpho - Sahuynh	19
4	Khoanta Vorlabood, Tran Thanh Hai, Ngo Xuan Thanh, Tran Binh Chu, Pham Thi Chi Subduction related magma in Phakieng-Nambo area, Muang long district, LAOS PDR	25
5	Le Thi Thu Hang. Discussion about regulations on environmental protection charges for mineral exploitation in Vietnam	35
6	Luong Quang Khang, Khuong The Hung. Rare earth element deposit types in Vietnam: distribution features and potential resource	40
7	Lucyna Natkaniec-Nowak, Przemyslaw Drzewicz, Marta Bąk, Jakub Matusik, Joanna Kowalczyk, Maxim Bogdasarov, Antonina V. Ivanina. Fossil resins from jambi province (sumatra, indonesia) - proxy indicators of palaeoenvironment and palaeoclimate of sundaland	45
8	Ęwa Kmiecik, Anna Mika. Silica concentration in geothermal water from banska pgp-1 well - estimation of measurement uncertainty	46
9	Adam Piestrzynski, Chau Nguyen Dinh, Jadwiga Pieczonka, Hao Duong Van, Phon Le Khanh, Pawel Jodlowski. General characteristics of rare earth elements in Dongpao deposit, Laichau, Vietnam	47
10	Ngô Xuan Thanh, Tran Thanh Hai, Vu Manh Hao, Nguyen Quoc Hung, Le Xuan Truong Geodynamic setting and metallogenic potential of ultramafic massifs in Caobang area, NE Vietnam	48
11	Nguyen Hoang Huan, Nguyen Tien Dung, Tran Van Mien. Dip direction of a-a fault in the eastern part of Campha coal mine, Quangninh province: a new hypothesis	55
12	Nguyen Thi Thanh Thao. Hydrothermal alteration of rhyolitic tuff and formation of sericite deposit Sonbinh, Huongson, Hatinh, Vietnam	61
13	Le Duy Dat, Nguyen Thi Le Huyen, Ho Trung Thanh Nguyen Thi Thuy. Some characteristics of surface sediments in the Sam lagoon, Thua thien hue province, Vietnam	70
14	Nguyen Thi Thuy, Hideki Wada, Nguyen Thi Hong Nu. Evidence of crustal material involvement (source contamination) for the south Nam xe carbonatites (northwest Vietnam)	76
15	Ngô Van Hung Tran Thanh Hai. Deformational features of the cenozoic sedimentary assemblage along the northeastern margin of the song hong basin: a preliminary interpretation	86
16	Pham Thi Thanh HienTa Thi Toan. Research results of heat treatment process for semi-gemstones in the Xuan le area, Thuong xuan district, Thanh hoa province	91
17	Nguyen Thi Thuc Anh. Silver (ag) in lead and zinc mineral Chodon and Chodien areas, Backan province, Vietnam	95
18	Tran Van Thanh, Do Van Nhuan, Pham Minh, Pham Trung. A new discovery of an age (145 ma) of rhyolite formations in the north area of Muong lat complex and geological implications	102
19	Vo Tien Dung. U-pb zircon isotopic age of the Nui phao and Da lien intrusives and re-os molybdenite isotopic age, Nui phao mine, Dai tu district, Thai nguyen province, Vietnam	107
20	Amarin Boontun. The study of abrasion resistance of aggregate consisting of limestone and shale	116
21	Hai Thanh Tran, and Khin Zaw. Phanerozoic tectonic evolution of indochina terrane and its significance for metallogeny: the regional perspective and the puzzle	117
22	Changyun Park, Yungoo Song and Woohyun Choi Relation between w-mineralization and w content of skarn garnet: applications for tungsten mineral exploration and its origin	118
23	Xiao-Lei WANG, Xin CHEN, Jin-Hai YU and Ru-Cheng WANG. Geochronology and geochemistry of the volcanic rocks in the tule basin, Northwestern Vietnam	119
24	Moonsup Cho, Wonseok Cheong, Keewook Yi. Paleoproterozoic to triassic crustal evolution of the Korean peninsula: a partisan review	120
25	Yoosup Kim. Bimodal convergence record in the Namco complex, Songma suture zone, NW VIETNAM	121

26	Meng-Wan Yeh, Ai-Ling Haung, and Tung-Yi Lee. Strain pattern of the day Nui Con Voi metamorphic complex: implications on the development of the red river shear zone, Northern Vietnam	122
27	C.A. Arcilla, J. Refran¹, E. Codillo. High-nb lavas from northern Palawan: similarities with non-subduction lavas from vietnam and implications for high field strength enrichment in southern philippine arc	123
28	Junlai Liu, Jiafu Chen, Mydung Tran, Tran Hoang Vu, Wenbin Wu. Mesozoic granitic magmatisms in southeastern tibet: geochronological framework and tectonic implications	124
29	Atsushi Koyam.a, Motoyuki Suzuki, Yoshifumi Kochi, Eiji Matsushita. Dynamic strength characteristics of embankment soils of reservoirs subjected to initial static shear stress	125
30	Bui Truong Son, Chu Tuan Vu. Experimental study of the correlation between ultrasonic velocity and attenuation with porosity for dry, partially and fully saturated samples of mortar	134
31	Dinh Thi Le Ha. Technological measurement process and data processing for measuring deformation along the depth of the construction pit wall by inclinometer sensors	139
32	Do Minh Toan, Nguyen Thi Nu. Assessment the effects of sea level rise due to climate change to geodynamic engineering in the Northern coastal area of Vietnam	146
33	Nguyen Lan, Chau Ngoc Bao. Designing an arduino-microprocessor-and-labview-based system for monitoring wave spreading the ground caused by constructing activities	151
34	Ngoc Dung Nguyen, Ha Viet Nhu, Truong Son Bui, Van Binh Bui, Huu Hai Phung. Simulation of head declination due to groundwater pumping in some areas in Hanoi by using modflow programme	156
35	Motoyuki Suzuki, Inoue Yuho , Nguyen Thanh Duong. Effect of shear rate on residual shear strength of over-consolidated cohesive soils	164
36	Nguyen Van Phong Le Trong Thang. Research on liquefaction resistance of fine sand distributing in hanoi by density	174
37	Nguyen Viet Tinh, Do Minh Toan, Nguyen Thi Nu, Ho Tan Tai. The shore line erosion feature at ganh cape area, an bien district, an giang province in the climate change and current sea level rise conditions	179
38	Nguyen Quang Tuan, Heinz Konietzky. Dem in geomechanics: applications and respects	188
39	Nguyen Thi Nu, Nguyen Ngoc Dung, Pham Thi Ngoc Ha. Evaluation of the liquefaction characteristic of sand distributed in tra vinh province by the cone penetration test and standard penetration test	198
40	Thi Thu Nga Nguyen, Ngoc Quan Vu. Three multi-scale approaches for micro-cracked viscoelastic masonry computations	206
41	Long Nguyen Tuan, Trong Thang Le. Effects of the degree of water saturation on the stability of the slopes: modeling and numerical simulation	214
42	Pham Quang Tu, Dang Quoc Tuan, Nhu Viet Ha, Dang Cong Huong. Reliability - based assessment of the red river dike of Hanoi, Vietnam	222
43	Ta Duc Thinh. Basis of methodology for quantitative assessment of engineering geological conditions	227
44	Nam Hung Tran. An analytical hydro-mechanical solution for deep tunnels in elastic transversely isotropic ground	232
45	Nguyen Bach Thao, Olivier Banton, Adriano Mayer, Nguyen Quang Tuan and Salah Nofa. Coupling geophysical and isotopic approaches to better simulate saltwater intrusion into coastal aquifers: a case study in Crau (France)	239
46	Hoang Van Hoan, Nguyen Van Lam, Tran Thi Luu, Pham Binh Thuan. The mechanism of saltwater intrusion into freshwater lens in pleistocene aquifer in Namdinh region	247
47	PHAM Van, H., VAN GEER, F.C., BUI, T.V., OUDE ESSINK, G.H.P. And Van P.D.T. paleo-hydrogeological reconstruction of the fresh-saline distribution in the Vietnamese mekong delta since the late pleistocene	256
48	Vu V. Hung, and Broder J. Merkel. Calculation of potential evaporation and actual evapotranspiration in Hanoi city, Vietnam	262
49	Salah Nofal, Yves Travi, Anne-Laure Cognard-Plancq, Vincent Marc, Michel Daniel, Bach Thao Nguyen, Gihan Mohammed. The influence of urbanization on groundwater level of the alluvial aquifer in avignon-France	273
50	Trieu Duc Huy Tong Ngoc Thanh, Nguyen Van Lam. Methods to determine groundwater flow through boundary to abstraction wells located near boundary	279
51	Mohammed Gihan, Trolard Fabienne, Bourrié Guilhem, Nofal Salah, Nguyen Bach Thao. Geochemical modeling of the system "water-soil-plant "case study: Crau south France	290

52	Trung Dang Tran, Le Tran Thanh , Nhan Pham Quy. Assessment of groundwater recharge and the hydraulic relationship between the quaternary sedimentary aquifers in the Thach that- Dan phuong locality, Hanoi by isotopes techniques	294
53	Nguyen Dieu Trinh. Water resources zoning in dry season in Binhtrithien, Vietnam	301
54	Long Tran Vu, Flemming Larsen, Hoan Hoang Van, Luu Tran Thi, Nhan Pham Quy. Couple geology evolution and groundwater modeling to simulation of paleo salt intrusion in red river delta	305
55	Patthana BOUNLIYONG, My Dung Tran. Mineral characteristic in Thengkham intrusion, sepon gold-copper mine, middle part of LAOS PDR	307



International Conference on Geology and Geo-resources (GAG)

The influence of urbanization on groundwater level of the alluvial aquifer in Avignon-France

Salah Nofal^{a,*}, Yves Travi^b, Anne-Laure Cognard-Plancq^b, Vincent Marc^b, Michel Daniel^b, Bach Thao Nguyen^c, Gihan Mohammed^d

^aUniversity of Lille, 59655 Villeneuve d'Ascq, France

^bUniversity of Avignon, BP 21 23984 916 Avignon Cedex 09, France

^cHanoi University of Mining and Geology, Hanoi, Vietnam

^dINRA, Site Agroparc, 84914 Avignon, France

Abstract

The alluvial aquifer constitutes the main source for drinking and irrigation purposes in the city of Avignon. The occurrence of groundwater in this aquifer is controlled by surface water. In fact, Durance River could recharge the aquifer directly and indirectly by the irrigation via infiltration. Piezometric measurements show that irrigation leads to rise up locally the piezometric head during irrigation's period in summer. Different factors and processes taking place on surface of soil could impact this aquifer which is near to the surface. Especially if we know that natural and irrigated lands are progressively being reduced by an urban development. Thus, a decrease of recharge could happen in future. Temporal hydraulic head and the areal extent of the urbanized area over 50 years were compared to urban development in order to determine the influence of urbanization of groundwater level. A numerical model was built to predict future consequences.

Keywords: urbanization; irrigation; alluvial aquifer; groundwater level; Avignon

1. Introduction

The city of Avignon lies at the confluence of the Rhone and Durance in a quaternary plain. This plain has natural limits. The Rhone from the north-west, the Durance from the south and tertiary hills from the east (Fig. 1). This area is characterized by smooth landscape with an elevation ranges from 16 m in the west to 40 m in the east. The urbanized area is the dominant land use, while the agricultural lands occupy only 30% of the total surface (Nofal, 2009). This is a result of gradual urban extension (Alkhalifeh, 2008). A network of irrigation canals derived from Durance River is used by the farmers to ensure an optimal growing of corps during summer. The only source of drinking water of the city comes from municipal wells field (La Saignonne), situated 1 km away from the Durance River at the south east of the city. The daily production from this field averaging 40 000 m³.

* Corresponding author.

E-mail address: salah.nofal@univ-lille1.fr

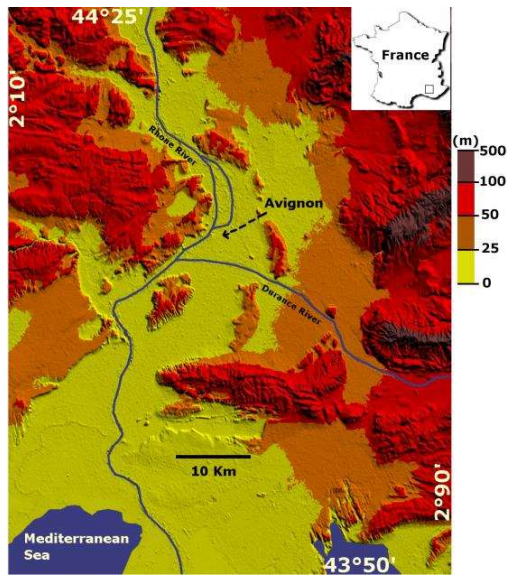


Fig. 1. Location of Avignon city and elevation in meters

2. Hydrogeological settings

The aquifer formation in the study area is made of unconsolidated sedimentary materials of quaternary age. The average thickness of the alluvial formations varies between 15 m and 23 m (Putallaz, 1972). The aquifer formation is characterized with high hydraulic conductivities comprise between 10^{-2} m/s and 10^{-3} m/s (Ciron, 1992; Durozoy et al., 1964; Garnier, 1987; Mallessard, 1983). The storage coefficient of this aquifer is about 10^{-4} , and the porosity is about 5% (Burgeap, 1995). The bedrock of the alluvium deposits, recognized by many drilling, consists essentially of Miocene marls which outcrops east (Fig. 2)

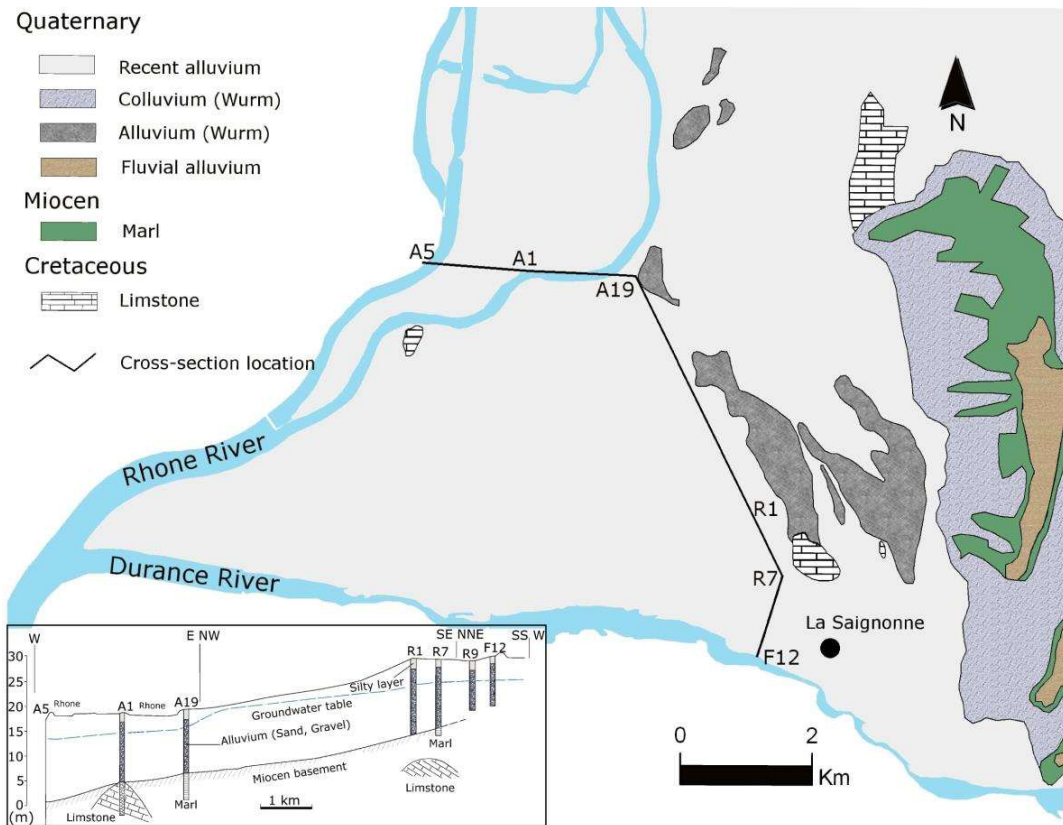


Fig. 2. Geological map and cross-section of the study area

3. Groundwater recharge

The recharge of the alluvial aquifer of Avignon by surplus of irrigation is highlighting by the piezometric measurements (Fig. 3). The piezometric variations show that the high level of groundwater is observed during summer (July) with the absence of effective rainfall when irrigation is at its maximum. While low groundwater level is observed during winter (February) when irrigation channels are unemployed.

Many studies conducted on the plain show that 25% of water brought by gravity irrigation reach the aquifer (Blavoux, 2003). This assessment was first achieved globally using natural isotopic tracing (O^{18} of water's molecule) (Lacroix, 1991). It has been confirmed and refined by water balances (Clementz, 1999). The irrigation provides an average annual volume of 19 millions m^3 which is 7 times more than annual recharge by the rainfall (Nofal, 2014).

Beside the Durance River, we should consider that the main source of recharge of the alluvial aquifer is from the Durance River (Nofal, 2014).

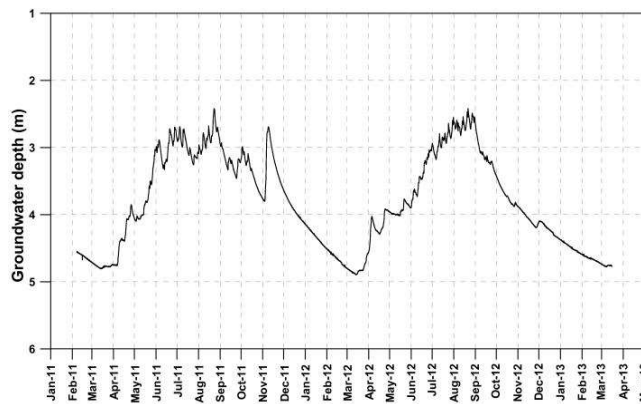


Fig. 3. Groundwater level variations in irrigated land

4. Impact of urbanization on groundwater level

The cumulative areal extent of the urbanized area for approximately 50 years is summarized in Fig. 4. The urban area blocked by the Rhone River has been quickly extended eastward. In the 1940s, urban area was limited in the western part of the city. The period between 1970-1980 has known the largest spread in terms of space consumed by the agglomeration, while from 1990s this trend has been slowed considerably. This evolution largely coincides with changing demographics of the study area (INSEE). Consequently, the morphology of the city has multiplied its surface six times during 60 years (487 ha in 1954 to 2820 ha in 2005).

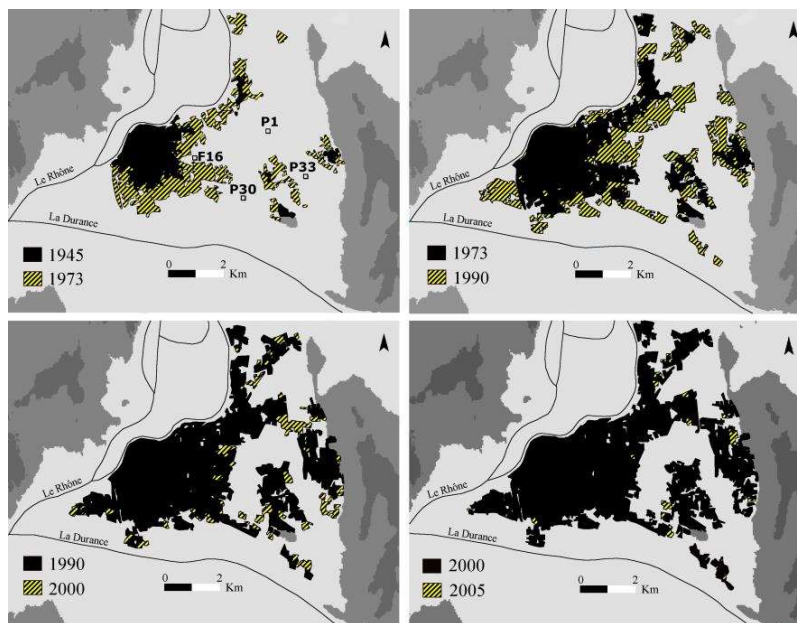


Fig. 4. The cumulative areal extent of the urbanized area (Alkhalifeh, 2008)

The urbanization led to a decrease in irrigated areas in alluvial plain of Avignon (Alkalifeh, 2008) (Fig. 5). Piezometric measurements for three piezometers (P30, P33, F16) distributed over the alluvial plain (Fig. 4), are available for about half of century (Fig. 6). These measurements show that the water table has markedly dropped. This drop was about 1.5 m in piezometer F16 and about 1 m in piezometer P30. However, water table declined mainly during 60's and seem relatively stable from the 80's.

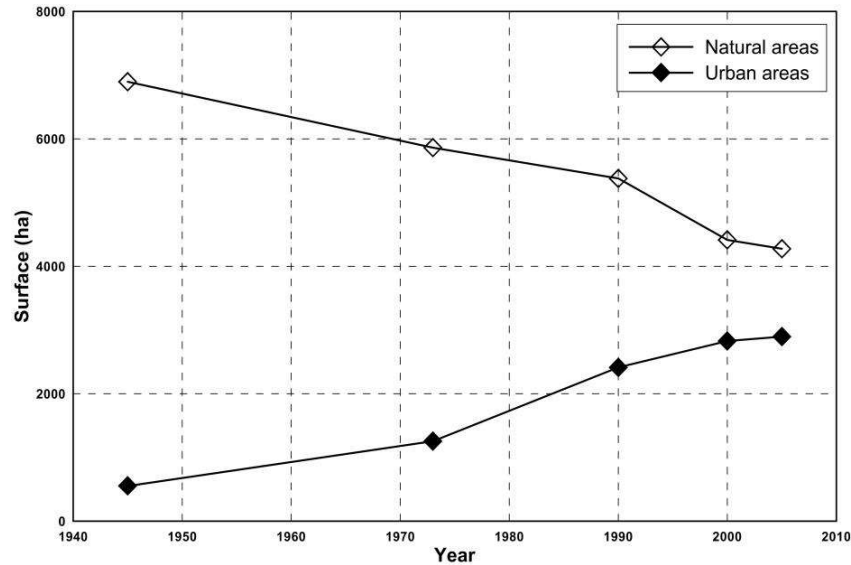


Fig. 5. Evolution of urban and natural surfaces in Avignon (1945-2005)

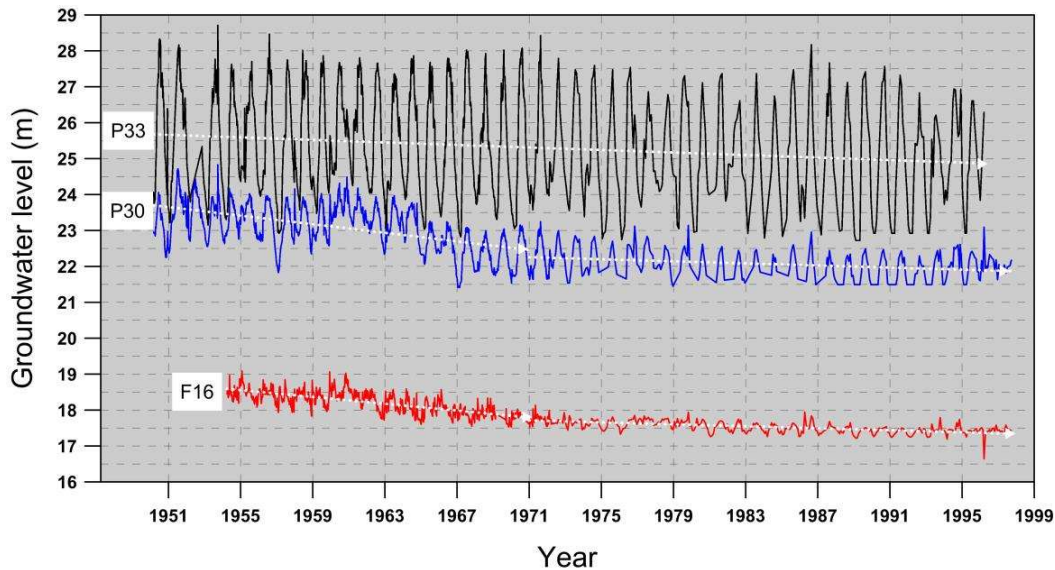


Fig. 6. Groundwater level evolution (1950-1999)

The decline of water table can be explained by various factors. The increase of water needs associated with population growth could affect the groundwater level. But this still a minor effect since the only source of pumping for drinking water is the municipal well fields (La Saïgonne) and the aquifer in this area is recharged mostly by the Durance River (Nofal, 2014). Durance River's regime also could play on the groundwater level especially near the river's bank. The main reason behind the groundwater level drop seems to be the decrease in the surface of irrigated lands around. In fact, ground water level shows a good relationship with the total natural surface's evolution ($R^2 = 78\%$ and 91%) (Fig. 7). While in piezometer P33 situated in irrigated lands, the piezometric measurements show that the water table is more or less stable.

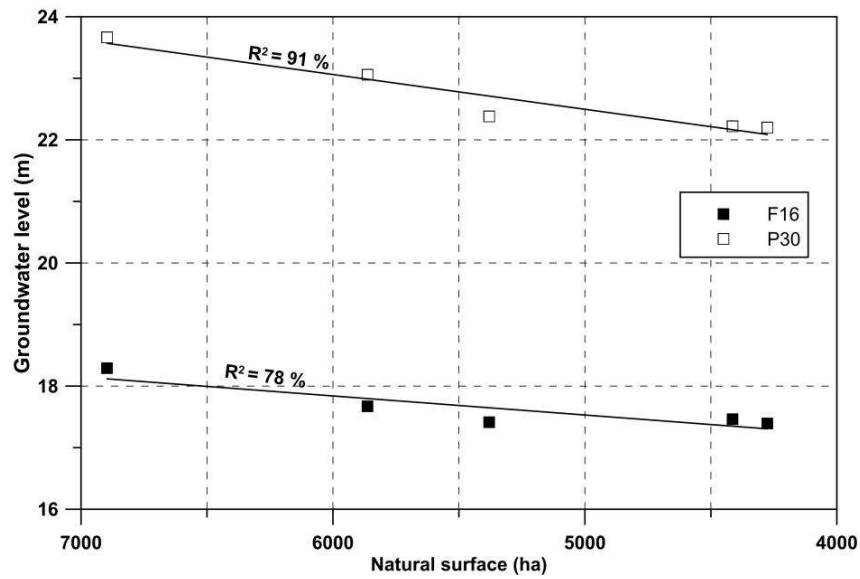


Fig. 7. Relationship between the evolution of natural surface groundwater level in F16 and P30 (1950-1999)

The results of the numerical model built for Avignon aquifer (Nofal, 2014), showed that in case of irrigated lands had to be disappeared and replaced by urban areas, water table would drop about 3 m in the irrigated areas (Fig. 8).

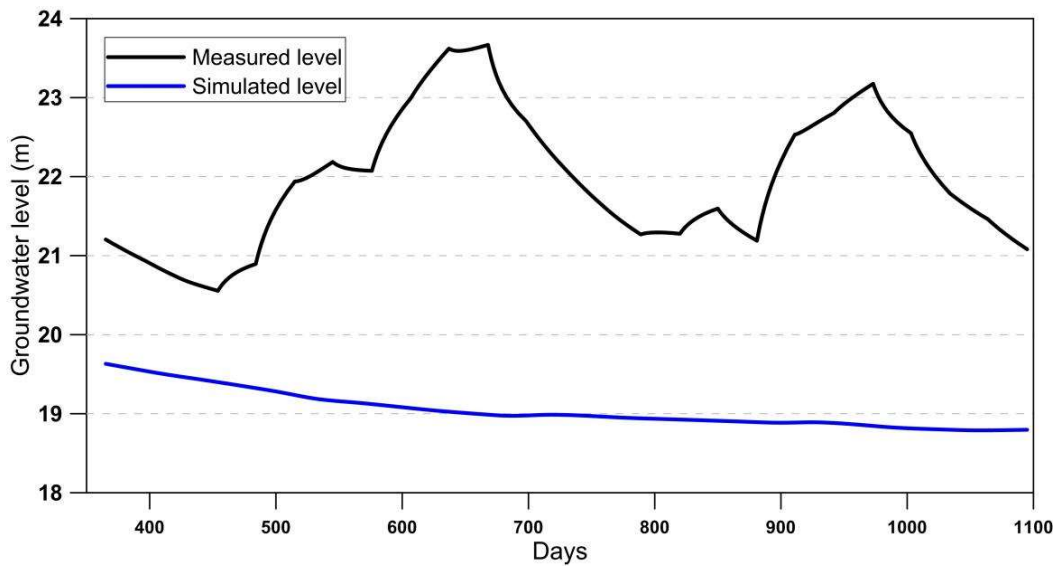


Fig. 8. Comparison between measured level and simulated (P1)

5. Conclusions

The groundwater system of the alluvial plain of Avignon, located between the Rhone and the Durance rivers, is characterized by an expanded agricultural area, whose surface is rapidly shrinking due to urban sprawl and economic development. This shallow aquifer is directly under the influence of surface water. In particular, the Durance water is heavily involved in the recharge process either directly or indirectly via irrigation. Land use, particularly urbanization, plays an important role on the hydrodynamic occurrence. The loss of agricultural land would reduce the irrigation volumes and tend to reduce the groundwater recharge.

References

- Nofal, S., 2009. Étude hydrodynamique à la confluence Rhône-Durance, Mémoire de Master 2, Université d'Avignon, 46 p.
- Alkhalifeh, S., 2008. L'apport de la télédétection dans l'observation de l'étalement urbain. L'exemple de l'agglomération d'Avignon-France, Thèse de doctorat en Géographie, Université d'Avignon, 421 p.
- Putallaz, J., 1972. Recherches hydrogéologiques dans la région d'Avignon, Rapport B.R.G.M, 72 SGN 405 PRC.
- Ciron, P., 1992. Appréciation des effets de la voie nouvelle sur le champ captant d'Avignon. Rapport B.R.G.M, R35747.
- Durozoy, G., Gouvernet, C., Margat, J., 1964. Recherches hydrogéologiques dans la zone Avignon Sorgues, Rapport B.R.G.M, DSGR.64.A22, 59p.
- Garnier, J., 1987. Propagation des pollutions accidentelles et protection des ouvrages de captage en nappe alluviale-Site experimental d'Avignon (84), nappe de la Durance, Rapport B.R.G.M ,87 SGN 839 PAC.
- Mallessard, G., 1983. Sur la présence de fer et de manganèse dans l'aquifère alluvial de plaine d'Avignon : relations avec l'hydrochimie et l'hydrogéologie, Thèse de doctorat, Université d'Avignon, 131 p.
- Burgeap, 1995. Etat de référence des eaux souterraines et proposition de suivi des impacts - confluence Rhône/Durance-Bonpas. Rapport R/Av.422 A.4607-C795.221.
- Blavoux, B., 2003. La réalimentation de l'aquifère alluvial par l'irrigation gravitaire en Basse Durance. Etudes Vauclusiennes n°70, juillet-décembre 2003.
- Lacroix, M., 1991. Impact de l'irrigation sur un aquifère alluvial. Dynamique du système basse Durance, Thèse de doctorat, Université de Besançon, 161 p.
- Clementz, M., 1999. Les effets induits de l'irrigation gravitaire sur la nappe alluviale et le système hydrographique naturel. Etude dans le périmètre irrigué du canal Saint-Julien. Mémoire de DESS Hydrogéologie et Environnement, Université d'Avignon , 111p.
- Nofal, S., 2014. Étude du fonctionnement hydrodynamique de la nappe alluviale d'Avignon; impact de l'usage du sol sur les mécanismes de recharge, Thèse de doctorat, Université d'Avignon, 188 p.

Tên sách: **PROCEEDING OF INTERNATIONAL CONFERENCES ON
EARTH SCIENCES AND SUSTAINABLE GEO-RESOURCES
DEVELOPMENT**

Tên tác giả: **Nhiều tác giả**

NHÀ XUẤT BẢN GIAO THÔNG VẬN TẢI

80B Trần Hưng Đạo – Hà Nội

ĐT: 04.39423345- Fax: 04.38224784

Website: WWW.nxbgtvt.vn – Email: nxbgtvt@fpt.vn

Chịu trách nhiệm xuất bản:

Lê Tử Giang

Chịu trách nhiệm nội dung:

Tổng biên tập Nguyễn Hồng Kỳ

Biên tập:

Nguyễn Ngọc Sâm

Trình bày:

Trường đại học Mỏ-Địa chất

Bìa:

Trường đại học Mỏ-Địa chất

Số xác nhận đăng ký xuất bản: 3799-2016/CXBIPH/2-175/GTVT

Mã số sách chuẩn quốc tế - ISBN: 978-604-76-1171-3

Số quyết định xuất bản: 243/QĐ-GTVT ngày 7/11/2016

Nộp lưu chiều: Tháng 11/2016