



Groundwater level fluctuation Of Alluvial Aquifer Of Tamanrasset Southern Algeria

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Key-Words—

I. INTRODUCTION

La région de Tamanrasset est située au sud de l'Algérie. La rareté des ressources en eau dans cette région amène les utilisateurs à optimiser l'exploitation de cette ressource en recherchant les formations susceptibles de fournir les moindres débits a même de satisfaire un tant soit peu les différents besoins de la population. Les formations géologiques en présence sont caractérisées par de larges affleurements de roches métamorphiques, qui en mode de gisement normal non tectonisé, sont réputées imperméables.

Par contre, les formations alluvionnaires déposées le long des lits des oueds de la région forment des réservoirs non négligeables d'eau souterraine.

L'objectif de ce travail est la détermination des caractéristiques du fonctionnement hydrogéologiques des aquifères d'infléflux du bassin versant de Tamanrasset à travers une étude piézométrique basée sur des données provenant des travaux antérieurs et des archives de la direction de l'hydraulique de la Wilaya de Tamanrasset et les travaux réalisés dans le cadre

du projet Tassili 16MDU961 agréé en 2016, intitulé : «*étude des relations entre les eaux de surface intermittentes (oueds) et les aquifères alluviaux en régions arides du Sahara algérien : approche hydrodynamiques et géochimiques et gestion de la ressources*»

II. CONTEXT OF THE STUDY AREA

The wilaya of Tamanrasset represents the capital of Hoggar and represents a vast territory located in the extreme south of Algeria and limited by the parallels 22 ° 30 and 23 ° of latitude North and by the meridians 4 ° 30 and 6 ° 30 of East longitude (Fig. 1). It covers an area of 557,906 square kilometers with an estimated population of 205,220 inhabitants residing in 10 municipalities [3]. In the study area, the geological formations are crystallophylic and volcanic. The northern part of the watershed of Tamanrasset consists of basaltic materials covering most of the Assekrem at 2000 m altitude, which are themselves crossed by trachytic points (Adouada, Akar Akar) and phonolitic effusions of Neogene age [4]. The south consists of the alternation of granitic formations attributed to the Pharusien [5], [6] found on about twenty kilometers along Tamanrasset wadi and a set of schistose gneiss of Suggarian age covering most of the study area. Gneiss and shale have a variable weathered zone thickness of up to 10 to 20 m in depressions [7]. The alluvial surface becomes important only downstream the watershed (13 km² upstream and 4 km² downstream the town of Tamanrasset) where the minor bed is several hundred meters wide. The



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city of Tamanrasset, capital of the wilaya, is located at an altitude of 1400 m and has an arid climate influenced by two different rainfall patterns: The South Sudan Saharan monsoon rains and the northern Mediterranean rains. The arid character is confirmed by the annual rainfall average calculated over a period of 40 years (from 1976 to 2015) which does not exceed 55 mm at Tamanrasset station and a more than 140 mm at the Askerem station. The rainfall pattern is characterized by the frequency of summer storms that cause heavy floods of wadis including Oued Tamanrasset and Oued Outoul which take their sources from the southern flank of the Attakor.

III. PIÉZOMÉTRIE

Les données piézométriques sont notamment requises pour définir les directions et la vitesse d'écoulement des eaux souterraines tant en condition naturelle, que durant le pompage et d'identifier les zones de recharge et d'émergence. L'inventaire des points d'eau (sources, puits, forages, piézomètres) est basé sur l'exploitation des données fournies par la direction de l'hydraulique de Tamanrasset, et aussi par les points recensés lors des campagnes piézométriques. Dans le bassin versant de l'oued Tamanrasset les points de mesure du niveau statique de la nappe comprennent les forages recoupant les deux unités hydrogéologiques (les dépôts meubles et la formation de socle) qui sont hydrauliquement liées et forment un seul système hydrogéologique.

IV. LES ENREGISTREMENTS CONTINUS

Place figure captions below the figures; place table titles above the tables. If your figure has two parts, include the labels "(a)" and "(b)" as part of the artwork. Please verify that the figures and tables you mention in the text actually exist. **Please do not include captions as part of the figures. Do not put captions in "text boxes" linked to the figures. Do not put borders**

around the outside of your figures. Use the abbreviation "Fig." even at the beginning of a sentence. Do not abbreviate "Table." Tables are numbered with Roman numerals.

Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity "electric conductivity," or "electric conductivity C," not just "C." Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write "electric conductivity ($\mu\text{S}/\text{cm}$)" or "electric conductivity ($\mu\text{S}\cdot\text{cm}^{-1}$)," not just " $\mu\text{S}/\text{cm}$." Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)," not "Temperature/K."

Figure labels should be legible, approximately 8 to 12 point type.

A. References

Number citations consecutively in square brackets [1]. The sentence punctuation follows the brackets [2]. Multiple references [2], [3] are each numbered with separate brackets [1]–[3]. When citing a section in a book, please give the relevant page numbers [2]. In sentences, refer simply to the reference number, as in [3]. Do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] shows"

Number footnotes separately in superscripts (Insert | Footnote).¹ Place the actual footnote at the bottom of the column in which it is cited; do not put footnotes in the reference list (endnotes). Use letters for table footnotes (see Table I).

Please note that the references at the end of this document are in the preferred referencing style. Give all authors' names; do not use "*et al.*" unless there are six authors or more. Use a space after authors' initials. Papers that have not been published should be cited as "unpublished" [4]. Papers that have been submitted for publication should be cited as "submitted for publication" [5].

¹It is recommended that footnotes be avoided (except for the unnumbered footnote with the receipt date on the first page). Instead, try to integrate the footnote information into the text.



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Papers that have been accepted for publication, but not yet specified for an issue should be cited as “to be published” [6]. Please give affiliations and addresses for private communications [7].

Capitalize only the first word in a paper title, except for proper nouns and element symbols. If you are short of space, you may omit paper titles. However, paper titles are helpful to your readers and are strongly recommended. For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [8].

B. Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have already been defined in the abstract. Abbreviations such as SI, ac, and dc do not have to be defined. Abbreviations that incorporate periods should not have spaces: write “C.N.R.S.,” not “C. N. R. S.” Do not use abbreviations in the title unless they are unavoidable.

C. Equations

Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). First use the equation editor to create the equation. Then select the “Equation” markup style. Press the tab key and write the equation number in parentheses. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

$$\int_0^{r_2} F(r, \xi) dr d\xi = [\dagger r_2 / (2r_0)] \cdot \int_0^\infty \exp(-\xi |z_j - z_i|) \xi^{-1} J_1(\xi r_2) J_0(\xi r_i) d\xi. \quad (1)$$

Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Italicize symbols (*T* might refer to temperature, but *T* is the unit tesla). Refer

to “(1),” not “Eq. (1)” or “equation (1),” except at the beginning of a sentence: “Equation (1) is”

D. Other Recommendations

Use one space after periods and colons. Hyphenate complex modifiers: “zero-field-cooled magnetization.” Avoid dangling participles, such as, “Using (1), the potential was calculated.” [It is not clear who or what used (1).] Write instead, “The potential was calculated by using (1),” or “Using (1), we calculated the potential.”

Use a zero before decimal points: “0.25,” not “.25.” Use “cm³,” not “cc.” Indicate sample dimensions as “0.1 cm × 0.2 cm,” not “0.1 × 0.2 cm².” The abbreviation for “seconds” is “s,” not “sec.” Do not mix complete spellings and abbreviations of units: use “Wb/m²” or “webers per square meter,” not “webers/m².” When expressing a range of values, write “7 to 9” or “7-9,” not “7~9.”

A parenthetical statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.) In American English, periods and commas are within quotation marks, like “this period.” Other punctuation is “outside”! Avoid contractions; for example, write “do not” instead of “don’t.” The serial comma is preferred: “A, B, and C” instead of “A, B and C.”

If you wish, you may write in the first person singular or plural and use the active voice (“I observed that ...” or “We observed that ...” instead of “It was observed that ...”). Remember to check spelling. If your native language is not English, please get a native English-speaking colleague to proofread your paper.

V. LES ESSAIS DE POMPAGE

The word “data” is plural, not singular. The subscript for the permeability of vacuum μ_0 is zero, not a lowercase letter “o.” The term for residual magnetization is “remanence”; the adjective is “remanent”; do not write “remnance”



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or “remnant.” Use the word “micrometer” instead of “micron.” A graph within a graph is an “inset,” not an “insert.” The word “alternatively” is preferred to the word “alternately” (unless you really mean something that alternates). Use the word “whereas” instead of “while” (unless you are referring to simultaneous events). Do not use the word “essentially” to mean “approximately” or “effectively.” Do not use the word “issue” as a euphemism for “problem.” When compositions are not specified, separate chemical symbols by en-dashes; for example, “NiMn” indicates the intermetallic compound $Ni_{0.5}Mn_{0.5}$ whereas “Ni–Mn” indicates an alloy of some composition Ni_xMn_{1-x} .

Be aware of the different meanings of the homophones “affect” (usually a verb) and “effect” (usually a noun), “complement” and “compliment,” “discreet” and “discrete,” “principal” (e.g., “principal investigator”) and “principle” (e.g., “principle of measurement”). Do not confuse “imply” and “infer.”

Prefixes such as “non,” “sub,” “micro,” “multi,” and “ultra” are not independent words; they should be joined to the words they modify, usually without a hyphen. There is no period after the “et” in the Latin abbreviation “*et al.*” (it is also italicized). The abbreviation “i.e.,” means “that is,” and the abbreviation “e.g.,” means “for example” (these abbreviations are not italicized).

VI. VARIABILITÉ SPATIALE ET TEMPORELLE DU NIVEAU DE LA NAPPE

VII. RÉPONSE DE LA NAPPE APRÈS LES CRUES DE L'OUED

VIII. CONCLUSION

A conclusion section is required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the

importance of the work or suggest applications and extensions.

APPENDIX

Appendices, if needed, appear before the acknowledgment.

ACKNOWLEDGMENT

The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank” Instead, write “F. A. Author thanks” **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page.**

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