Data Article

Data on monthly physicochemical variation of Tropical Island groundwater of Pulau Bidong, South China Sea

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\textbf{A B S T R A C T}

The groundwater samples of Pulau Bidong, Terengganu, Malaysia were collected from five sampling stations from June to October 2016. Physical parameters such as temperature, specific conductivity, dissolved oxygen (DO), pH, salinity, and DO saturation were measured in-situ by using handheld device. Meanwhile, total suspended solid (TSS), total dissolved solid (TDS), nitrate (NO\textsubscript{3}\textsuperscript{−}), nitrite (NO\textsubscript{2}\textsuperscript{−}), ammonium (NH\textsubscript{4}\textsuperscript{+}) and phosphate (PO\textsubscript{4}\textsuperscript{3−}) were analysed and detected using UV–Vis Spectrophotometer. The inorganic nutrients (NO\textsubscript{3}−, NO\textsubscript{2}−, NH\textsubscript{4}+ and PO\textsubscript{4}\textsuperscript{3−}) were ranged from 0.000 to 4.310 mg/L, 0.000 to 0.190 mg/L, 0.000 to 0.807 mg/L and 0.003 to 0.028 mg/L, respectively. The monthly trends of specific conductivity, DO, salinity, DO saturation, NO\textsubscript{3}−, NO\textsubscript{2}− and NH\textsubscript{4}+ demonstrated significant variation in June (the lowest rainfall) compared to other months. Correlation matrix revealed that temperature was associated with the specific conductivity, and NH\textsubscript{4}+ strongly correlated with DO, NO\textsubscript{3}− and NO\textsubscript{2}−. Nevertheless, there is a strong negative correlation between physicochemical parameters and monthly rainfall distribution. Notably, future studies are required for long-term monitoring to ensure the good quality of ground-

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water from Pulau Bidong. The spatial and temporal variability of the present data has been reported by Tan et al. [1].

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### Specifications Table

| Subject | Water Science and Technology, Analytical Chemistry |
|---------|--------------------------------------------------|
| Specific subject area | Monthly groundwater quality |
| Type of data | Table |
| How data were acquired | Physical parameters such as temperature, specific conductivity, dissolved oxygen (DO), pH, salinity, and DO saturation were measured in-situ by using Multiparameter YSI Professional Plus. Chemical parameters such as nitrate (NO₃⁻), nitrite (NO₂⁻), ammonium (NH₄⁺) and phosphate (PO₄³⁻) were measured using ultraviolet spectrophotometric screening method at different wavelengths. Total suspended solid (TSS) and total dissolved solid (TDS) were calculated using gravimetric method. |
| Data format | Raw Analysed |
| Parameters for data collection | Physicochemical parameters such as temperature, specific conductivity, dissolved oxygen (DO), pH, salinity, DO saturation, total dissolved solid (TDS), total suspended solid (TSS), nitrate (NO₃⁻), nitrite (NO₂⁻), ammonium (NH₄⁺) and phosphate (PO₄³⁻) were represented the monthly groundwater variation of Pulau Bidong. |
| Description of data collection | A total of 25 water samples were collected monthly from five sampling stations between June to October 2016. Groundwater samples were collected in triplicates at each sampling stations. The water level was measured followed by pumping the surface water out from the well for 15 min before taking water samples from each sampling stations. This was done to ensure that the samples collected represent the groundwater instead of the stagnant water, which would affect the quality of the samples. Then, physical parameters of groundwater such as temperature, specific conductivity, dissolved oxygen (DO), pH, salinity, and DO saturation were measured in-situ by using Multiparameter YSI Professional Plus. The groundwater samples were later collected using Niskin water sampler and were kept in 1 L and 5 L sampling bottles for nutrients, and total dissolved solid (TDS) and total suspended solid (TSS) analysis. The samples were then preserved in icebox to minimize the changes of nutrients content prior to the laboratory analysis. |
| Data source location | Institution: Universiti Malaysia Terengganu |
| | City/Town/Region: Peninsular Malaysia, Malaysia |
| | Country: Malaysia |
| | Latitude and longitude (and GPS coordinates) for collected samples/data: Latitude and longitude for each station are presented in the article. |
| Data accessibility | Data are presented in the article. |
| Related research article | Author’s name: Tan Jia Xin, Hasrizal Shaari, Adiana Ghazali and Nor Bakhshia Ibrahim. |
| | Title: Monthly Physicochemical Variation of Tropical Island Groundwater of Pulau Bidong, South China Sea. |
| | Journal: Groundwater for Sustainable Development |
| | DOI: In Press |
Value of the data

- The researcher can use these data as a baseline data for further investigation of the groundwater quality in the tropical islands.
- Data on monthly physicochemical variation of tropical island groundwater of Pulau Bidong, South China Sea may provide a better picture on the effect of different seasons on the groundwater quality.
- Researchers and Terengganu’s stakeholders may use these data for a general overview on groundwater in several islands in Malaysia especially in the East Coast Peninsular Malaysia.
- The present data could complete the environmental data gaps in the South China Sea since no data on groundwater quality in East Coast Peninsular Malaysia.

1. Data description

Pulau Bidong is located in the East Coast of Peninsular Malaysia with the total land area of approximately 230km². This island is hilly with steep slope where the maximum elevation is approximately 267 m [1]. The water sources in this island inclusive of small streams in the flat land at the south of the island, which is covered by forest except for the steepest points along the water’s edge which are bare rock [2]. Pulau Bidong is an island with tropical rainforest climate under the influence of Northeast monsoon season from October to March. The study area is exposed to heavy rain spells of ~ 2000mm annually during Northeast monsoon season [3]. Thus, the main source of groundwater recharge in Pulau Bidong is originated from precipitation. The sampling activities were carried out during June to October as represent the transitional period from Southwest Monsoon to Northeast Monsoon. There are few wells present at both beaches of Universiti Malaysia Terengganu (UMT) Marine Research Station and Pantai Pasir Pengkalan. The wells in Pulau Bidong mainly supply freshwater for various activities and purposes. The sampling points were selected based on the criteria of proper well-constructed at the sampling sites. Three sampling points were located at UMT Marine Research Station and two sampling points were located at Pantai Pasir Pengkalan [1]. The well at station 1 is currently active for freshwater usage, the well at station 2 acts as an alternative freshwater supply and the well at station 3 is inactive, whereas the wells at station 4 and station 5 are mainly used by fisherman for bathing and freshwater source.

Table 1(a)–(h) show the variation of groundwater physico-chemical parameters collected in at all sampling stations in Pulau Bidong. The physico-chemical data were in-situ measured using Multiparameter YSI Professional Plus throughout June 2016 to October 2016. The TDS and TSS were measures using gravimetric method after filtration process [1].

The concentration of nutrients namely ammonium (NH₄⁺), nitrate (NO₃⁻), nitrite (NO₂⁻) and phosphate (PO₄³⁻) was measured as recommended by American Public Health Association and Environmental Protection Agency standard methods. The concentration of NO₃⁻ and NO₂⁻ was determined using ultraviolet spectrophotometric screening method at different wavelengths [1]. In the meantime, PO₄³⁻ was determined by ascorbic method and NH₄⁺ was determined by phenate method [1]. Fig. 1 shows the standard calibration curve obtained by ultra violet spectrophotometer throughout the nutrients analysis.

Table 2(a)–(d) show the concentration of nutrients in the groundwater collected at Pulau Bidong during June 2016 to October 2016.

2. Experimental design, materials, and methods

A total of 25 water samples were collected from five sampling stations between June and October 2016. The water level was measured followed by pumping the surface water out from the well for 15 min before taking water samples from each sampling stations [4]. This was done
Table 1
Monthly variation of (a) Temperature, (b) Specific conductivity, (c) DO, (d) pH, (e) Salinity, (f) DO Saturation, (g) TDS, (h) TSS in the groundwater in Pulau Bidong.

| a) Temperature (°C) | June | July | August | September | October |
|---------------------|------|------|--------|-----------|---------|
| Station 1           | 28.7 | 28.4 | 28.2   | 28.1      | 27.7    |
| Station 2           | 28.1 | 28.0 | 28.0   | 27.6      | 27.8    |
| Station 3           | 27.6 | 27.1 | 27.2   | 26.9      | 26.8    |
| Station 4           | 28.0 | 27.6 | 27.6   | 27.2      | 26.8    |
| Station 5           | 27.3 | 27.3 | 27.2   | 26.8      | 27.2    |
| Average             | 27.9 | 27.7 | 27.6   | 27.3      | 27.3    |

| b) Specific Conductivity (S/m) | June | July | August | September | October |
|-------------------------------|------|------|--------|-----------|---------|
| Station 1                    | 0.293| 0.022| 0.025  | 0.010     | 0.013   |
| Station 2                    | 0.452| 0.014| 0.021  | 0.025     | 0.037   |
| Station 3                    | 0.186| 0.009| 0.050  | 0.011     | 0.012   |
| Station 4                    | 0.080| 0.043| 0.017  | 0.015     | 0.022   |
| Station 5                    | 0.029| 0.023| 0.018  | 0.020     | 0.017   |
| Average                      | 0.208| 0.022| 0.026  | 0.016     | 0.020   |

| c) Dissolved oxygen (mg/L)   | June | July | August | September | October |
|-------------------------------|------|------|--------|-----------|---------|
| Station 1                    | 4.79 | 1.04 | 1.11   | 0.87      | 2.20    |
| Station 2                    | 3.02 | 6.40 | 1.04   | 0.76      | 0.32    |
| Station 3                    | 7.45 | 2.48 | 0.77   | 2.27      | 1.06    |
| Station 4                    | 4.24 | 0.29 | 0.26   | 1.07      | 1.13    |
| Station 5                    | 5.94 | 0.48 | 0.39   | 1.64      | 0.27    |
| Average                      | 5.09 | 2.14 | 0.71   | 1.32      | 1.00    |

| d) pH                         | June | July | August | September | October |
|-------------------------------|------|------|--------|-----------|---------|
| Station 1                    | 6.65 | 5.71 | 5.43   | 6.92      | 5.75    |
| Station 2                    | 6.74 | 5.78 | 5.55   | 6.78      | 5.98    |
| Station 3                    | 7.23 | 5.56 | 5.82   | 7.07      | 5.52    |
| Station 4                    | 6.74 | 5.23 | 5.50   | 7.47      | 6.20    |
| Station 5                    | 5.89 | 5.98 | 5.73   | 7.62      | 5.57    |
| Average                      | 6.65 | 5.65 | 5.61   | 7.17      | 5.80    |

| e) Salinity (ppt)             | June | July | August | September | October |
|-------------------------------|------|------|--------|-----------|---------|
| Station 1                    | 1.53 | 0.10 | 0.10   | 0.05      | 0.06    |
| Station 2                    | 2.41 | 0.07 | 0.10   | 0.12      | 0.18    |
| Station 3                    | 0.94 | 0.04 | 0.24   | 0.06      | 0.06    |
| Station 4                    | 0.39 | 0.20 | 0.08   | 0.07      | 0.10    |
| Station 5                    | 0.39 | 0.11 | 0.08   | 0.10      | 0.08    |
| Average                      | 1.13 | 0.10 | 0.12   | 0.08      | 0.10    |

| f) DO saturation (%)          | June | July | August | September | October |
|-------------------------------|------|------|--------|-----------|---------|
| Station 1                    | 48.30| 13.40| 14.30  | 11.00     | 2.20    |
| Station 2                    | 25.90| 6.40 | 13.30  | 9.70      | 4.20    |
| Station 3                    | 0.61 | 31.20| 9.30   | 28.30     | 1.06    |
| Station 4                    | 41.10| 3.60 | 3.30   | 13.00     | 14.20   |
| Station 5                    | 60.60| 6.10 | 4.90   | 23.00     | 3.40    |
| Average                      | 35.30| 12.14| 9.02   | 17.00     | 5.01    |

(continued on next page)
Table 1 (continued)

| Station | June (mg/L) | July (mg/L) | August (mg/L) | September (mg/L) | October (mg/L) |
|---------|-------------|-------------|---------------|------------------|----------------|
| Station 1 | 1.662       | 0.137       | 1.662         | 0.086            | 0.149          |
| Station 2 | 2.451       | 0.149       | 2.451         | 0.170            | 0.337          |
| Station 3 | 1.088       | 0.093       | 1.088         | 0.091            | 0.160          |
| Station 4 | 0.450       | 0.306       | 0.450         | 0.125            | 0.233          |
| Station 5 | 0.173       | 0.168       | 6.840         | 0.098            | 0.208          |
| Average  | 1.165       | 0.170       | 2.498         | 0.114            | 0.217          |

| Station | June (mg/L) | July (mg/L) | August (mg/L) | September (mg/L) | October (mg/L) |
|---------|-------------|-------------|---------------|------------------|----------------|
| Station 1 | 0.011       | 0.002       | 0.003         | 0.002            | 0.002          |
| Station 2 | 0.003       | 0.001       | 0.001         | 0.001            | 0.001          |
| Station 3 | 0.003       | 0.001       | 0.001         | 0.001            | 0.001          |
| Station 4 | 0.002       | 0.003       | 0.002         | 0.006            | 0.002          |
| Station 5 | 0.002       | 0.001       | 0.002         | 0.001            | 0.001          |
| Average  | 0.004       | 0.002       | 0.002         | 0.002            | 0.001          |

Fig. 1. Standard calibration curve for (a) NH$_4^+$, (b) NO$_3^-$, (c) NO$_2^-$ and (d) PO$_4^{3-}$.

to ensure that the collected samples represent the groundwater instead of the stagnant water, which would affect the quality of the samples. Water samples were collected using Niskin water sampler and kept in 1 L and 5 L polyethylene bottles. The samples were then preserved in the icebox loaded with ice to minimize the effect on nutrients content prior to the laboratory analysis. The physical parameters such as temperature, specific conductivity, DO, pH, salinity and DO saturation were measured in-situ using Multiparameter YSI Professional Plus. The Multiparameter was calibrated according to manufacturer’s recommendations to ensure the accuracy of the reading. The concentrations of nitrite (NO$_2^-$), nitrate-nitrogen (NO$_3^-$), ammonium (NH$_4^+$) and phosphate (PO$_4^{3-}$) were measured according to the standard methods recommended by American Public Health Association [5] and Environmental Protection Agency [6]. The standard solutions were prepared to obtain standard curve and reagents were prepared for the determination of nutrients (NO$_3^-$, NO$_2^-$, NH$_4^+$ and PO$_4^{3-}$) concentrations in water samples respectively. The nutrients concentrations were determined using ultraviolet spectrophotometric screening
Table 2
Monthly variation of (a) NH$_4^+$, (b) NO$_3^-$, (c) NO$_2^-$ and (d) PO$_4^{3-}$ in the groundwater in Pulau Bidong.

|          | June     | July    | August  | September | October  |
|----------|----------|---------|---------|-----------|---------|
| Station 1| 0.078    | 0.001   | 0.001   | 0.000     | 0.001   |
| Station 2| 0.078    | 0.005   | 0.001   | 0.000     | 0.004   |
| Station 3| 0.807    | 0.001   | 0.056   | 0.000     | 0.002   |
| Station 4| 0.048    | 0.007   | 0.005   | 0.007     | 0.010   |
| Station 5| 0.083    | 0.025   | 0.005   | 0.000     | 0.040   |
| Average  | 0.219    | 0.008   | 0.014   | 0.001     | 0.011   |

|          | June     | July    | August  | September | October  |
|----------|----------|---------|---------|-----------|---------|
| Station 1| 0.077    | 0.070   | 0.085   | 0.003     | 0.000   |
| Station 2| 0.374    | 0.000   | 0.040   | 0.046     | 0.023   |
| Station 3| 4.192    | 0.198   | 4.310   | 0.421     | 0.122   |
| Station 4| 0.413    | 0.016   | 0.031   | 0.228     | 0.024   |
| Station 5| 0.113    | 0.546   | 0.001   | 0.019     | 0.011   |
| Average  | 1.034    | 0.166   | 0.895   | 0.143     | 0.036   |

|          | June     | July    | August  | September | October  |
|----------|----------|---------|---------|-----------|---------|
| Station 1| 0.006    | 0.006   | 0.005   | 0.000     | 0.001   |
| Station 2| 0.008    | 0.003   | 0.000   | 0.000     | 0.003   |
| Station 3| 0.190    | 0.002   | 0.005   | 0.001     | 0.002   |
| Station 4| 0.031    | 0.001   | 0.004   | 0.000     | 0.002   |
| Station 5| 0.002    | 0.009   | 0.000   | 0.000     | 0.000   |
| Average  | 0.047    | 0.004   | 0.003   | 0.000     | 0.002   |

|          | June     | July    | August  | September | October  |
|----------|----------|---------|---------|-----------|---------|
| Station 1| 0.004    | 0.008   | 0.006   | 0.004     | 0.003   |
| Station 2| 0.005    | 0.011   | 0.008   | 0.006     | 0.006   |
| Station 3| 0.005    | 0.006   | 0.006   | 0.005     | 0.005   |
| Station 4| 0.007    | 0.005   | 0.006   | 0.003     | 0.007   |
| Station 5| 0.006    | 0.013   | 0.006   | 0.009     | 0.010   |
| Average  | 0.005    | 0.009   | 0.010   | 0.010     | 0.006   |

method at the different wavelengths for each nutrient. The absorbance values of NO$_2^-$, NO$_3^-$, NH$_4^+$ and PO$_4^{3-}$ were determined at the wavelengths of 543 nm, 275 nm and 220 nm, 640 nm and 880 nm. There are two wavelength values were used for the NO$_3^-$ analysis (220 and 275 nm) compared to NO$_2^-$, NH$_4^+$ and PO$_4^{3-}$. The absorbance values at the wavelength of 275 nm were subtracted from the absorbance value at the wavelength of 220 nm in order to discard the interference of dissolved organic matter. The TDS and TSS concentrations in the sample were determined using gravimetric method [5]. Water samples were filtered through GF/C filter paper by using filtration set. The filter paper was transferred into the petri dish and dried for an hour at 103°C. Then, the filter paper was cooled down in desiccator for an hour and weighted using analytical balance. The TSS value in samples was calculated based on the following equation [6]:

$$\text{TSS (mg/L)} = (A - B) \times (1000/v)$$

Where,

- \( A \) = Initial weight of filter paper + dried residue (mg)
- \( B \) = Initial weight of filter paper (mg)
- \( v \) = The volume of water sample (mL)
250 mL filtered water samples were transferred into glass beakers in three replicates. The beaker was heated in oven at 103 °C until water samples completely evaporated. The beaker was cooled down in desiccator for an hour, and the weight of beaker was measured using analytical balance. The readings were recorded until weight of the beaker constant. The TDS value in water sample was calculated based on the following equation [5]:

$$\text{TDS (mg/L)} = (A - B) \times \left( \frac{1000}{v} \right)$$

Where,

- $A =$ Initial weight of beaker + dried residue (mg)
- $B =$ Initial weight of beaker (mg)
- $v =$ The volume of water sample (mL)

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**Conflict of interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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