

Review of: Technical note: Novel analytical solution for groundwater response to atmospheric tides.

The authors present a new analytical solution for modelling flow between a subsurface-well system caused by harmonic atmospheric loading. They integrate this into a comprehensive workflow that also estimates subsurface properties using a well-established Earth tide method. The method is applied to two wells in Australia to estimate hydraulics parameters and compare with the results calculated in the literature.

General comments:

1. Uncertainties of the calculated hydraulic parameters are missing.
 - (a) HALS in Figure 4 showed the best value, is there any consideration of uncertainty or range of error?
 - (b) Table 2, Table 3, Table A1 and Table A2 do not take into account the uncertainty and error range values, these values should be presented as a range value.
 - (c) Figure 5 calculation results do not reflect the error range.
2. Oceanic tides could have a large influence on the results. Amplitudes (and phases) can be computed using SPOTL to check whether they are negligible or not.
3. In section 3.2, the ET parameters are calculated using M2 and S2. S2 waves are affected not only by earth tide but also by barometric pressure. Is the effect of barometric pressure on the Earth tide response considered when using S2 waves to calculate Earth tide, and is its effect on the tidal response removed?
4. There is Biot coefficient α in equation 1, but the solution equation 8 does not contain the Biot coefficient, so is the biotech coefficient eliminated in the calculation or is it assumed to be 1 to represent the consolidation system? Is mean stress solution the method to find the parameters of the consolidation system?
5. In some articles (Acworth *et al.*, 2016; McMillan *et al.*, 2021), porosity can be calculated by this equation $n = \frac{S_s K_f}{\rho g} BE$, compared to equation 33 $n = \frac{S_e K_f}{\rho g}$, of the article, is it possible to get the relationship between specific storage at constant strain and specific storage is $S_e = S_s * BE$? then Equation 24 and the calculated G can be further improved.

Minor comments:

1. The statement in L28-31 is not accurate. The tidal component of O1 is also very large, S1 is not a major component of Earth tide. It's a little weird to mention S1 here.
2. L37-39: Negative skin effects could also be associated to positive phase lag (Valois et al, 2022).

Valois, R., Rau, G. C., Vouillamoz, J. M., & Derode, B. (2022). Estimating hydraulic properties of the shallow subsurface using the groundwater response to Earth and atmospheric tides: a comparison with pumping tests. *Water Resources Research*, 58(5), e2021WR031666.
3. What is the t in equation 1?
4. L86 should be changed to "r is the radius".
5. L176-179: What is the sampling frequency of water level and barometric pressure sensor

records, and what is the time interval used for air barometric, water level, and strain data?

6. The title of Figure 2(b) should emphasize that it is only the geological unit between the AB, as well B1 is not represented in this figure.
7. What does ρ and g stand for in equation 17 and 22, and what are the values used for each?
8. The method description in Section 3.2 is not very clear, it is not very clear what wave components are used in which method, it should be explained. And what is the study time period used for AT and ET respectively should be explained.
9. What is the black line in Figure 5? It should be reflected in the title of the figure.
10. L296-297 need to add references.
11. It needs to be clarified whether the values calculated in L334-336 are the best fitting parameters.
12. The conclusion should include the proposal of future research.