Responses to Referee #2's comments

Major problem of the present paper is the English language. Needs specific attention.

Thank you for the constructive and helpful comments. We will go through the manuscript carefully to improve the written English.

I believe the main contribution of the present paper is the saltwater intrusion phenomenon regarding the geometry of the aquifer.

Yes, we agree with the referee.

The paper is based on analytical solutions and as it is mentioned in the paper analytical solutions for saltwater intrusion problems cannot incorporate complex factors.

Although analytical solutions cannot incorporate complex factors, its advantages are that (1) they are rapidly and easily computed, and (2) they give explicit relationships between parameters that influence seawater intrusion. We have mentioned these advantages in Lines 69-71.

Page 7, lines 122-124 need more explanation

As mentioned in the manuscript in Lines 121-122, this is because the longitudinal length is much longer than the lateral length for an atoll island in reality. This is also consistent with previous studies where seawater intrusion from lateral side is ignored (Ayers & Vacher, 1986; Underwood et al., 1992; Bailey et al., 2009; Werner et al., 2017).

page 8, lines 149-153. assumption (5) needs more explanation

If recharge is larger than the saturated hydraulic conductivity, overland flow (ponding) will happen and hence analytical solutions don't apply to anymore. This explanation will be added to the revised manuscript.

page 9, $\omega = \theta(L_0+l_2-x)$ what is θ???? You used this symbol for the angle in previous text.

θ is the angle as shown in Figure 2a and then ω is the arc length.

page 10, Eq. 6 needs more explanation. You mentioned substitution of Eq. 5 into Eq. 4. But Eq. 4 does not contain h. Did you solve Eq. 5 for φ??

To obtain equation (6), the Dupuit-Forchheimer approximation and Ghijben-Herzberg equation are used.

Based on Dupuit-Forchheimer approximation, equation (4) becomes,

$$-\frac{1}{2}\left[\left(L_0+l_2-x\right)^2-\left(L_0+l_2\right)^2\right]N=-\left(L_0+l_2-x\right)\int_{h_c}^{\phi}K_s\frac{d\phi}{dx}dz$$
$$=-\left(L_0+l_2-x\right)K_s\left(\phi-h_c\right)\frac{d\phi}{dx} \quad \text{(R1)}$$

Based on Ghijben-Herzberg equation, we have,

$$h=\phi-h_c=\left(1+\alpha\right)\left(\phi-H_s\right) \quad \text{(R2)}$$

Combining equation (R2) with equation (R1) gives equation (6). We will make this clearer in the revision.

page 14, the experimental scale is very small.

When conducting seawater intrusion experiments, small scale is usually adopted to better control the experiments. For example, Badaruddin et al. (2015) conducted seawater intrusion experiments using a sand flume with dimensions of 1.17 m (length) × 0.6 m (height); Lu et al. (2019) conducted seawater intrusion experiments using a sand flume with dimensions of 0.55 m (length) × 0.32 m (height); Wu et al. conducted intrusion experiments using a sand flume with dimensions of 1.3 m (length) × 0.339 m (height). Nevertheless, we recognize this limitation of the small experimental scale and will mention that future experiments and filed data are needed to further validate our analytical solutions in Conclusion of the revised manuscript.

The authors have not considered important publications on saltwater intrusion such as:

Pool, M., & Carrera, J. 2011 A correction factor to account for mixing in Ghyben-Herzberg critical pumping rate approximations of seawater intrusion in coastal aquifers. Water Resources Research 47 (5), 1–9.

Mantoglou, A. 2003 Pumping management of coastal aquifers using analytical models of saltwater intrusion. Water Resources Research 39 (12), 1–12.

We will mention these important publications in the revision.

References:

Ayers, J. F., & Vacher, H. L. (1986). Hydrogeology of an atoll island: A conceptual model from detailed study of a Micronesian example. *Groundwater*, *24*(2), 185-198. https://doi.org/10.1111/j.1745-6584.1986.tb00994.x

Badaruddin, S., Werner, A. D., & Morgan, L. K. (2015). Water table salinization due to seawater intrusion. *Water Resources Research*, *51*(10), 8397–8408. https://doi.org/10.1002/2015WR017098

Bailey, R. T., Jenson, J. W., & Olsen, A. E. (2009). Numerical modeling of atoll island hydrogeology. *Groundwater*, *47*(2), 184-196. https://doi.org/10.1111/j.1745-6584.2008.00520.x

Lu, C., Cao, H., Ma, J., Shi, W., Rathore, S. S., Wu, J., & Luo, J. (2019). A proof-of-concept study of using a less permeable slice along the shoreline to increase fresh groundwater storage of oceanic islands: Analytical and experimental validation. *Water Resources Research*, *55*(8), 6450–6463. https://doi.org/10.1029/2018WR024529

Underwood, M. R., Peterson, F. L., & Voss, C. I. (1992). Groundwater lens dynamics of atoll islands. *Water Resources Research*, *28*(11), 2889-2902. https://doi.org/10.1029/92WR01723

Werner, A. D., Sharp, H. K., Galvis, S. C., Post, V. E., & Sinclair, P. (2017). Hydrogeology and management of freshwater lenses on atoll islands: Review of current knowledge and research needs. *Journal of Hydrology*, *551*, 819-844. https://doi.org/10.1016/j.jhydrol.2017.02.047

Wu, H., Lu, C., Yan, M., & Werner, A. D. (2020). Expanding freshwater lenses adjacent to gaining rivers through vertical low-hydraulic-conductivity barriers: Analytical and experimental validation. *Water Resources Research*, *56*(2), e2019WR025750. https://doi.org/10.1029/2019WR025750