Shallow injection wells: Outstanding questions and research needs

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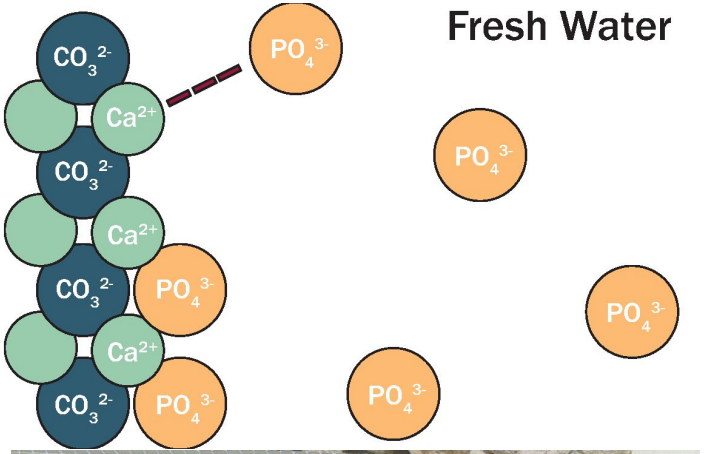
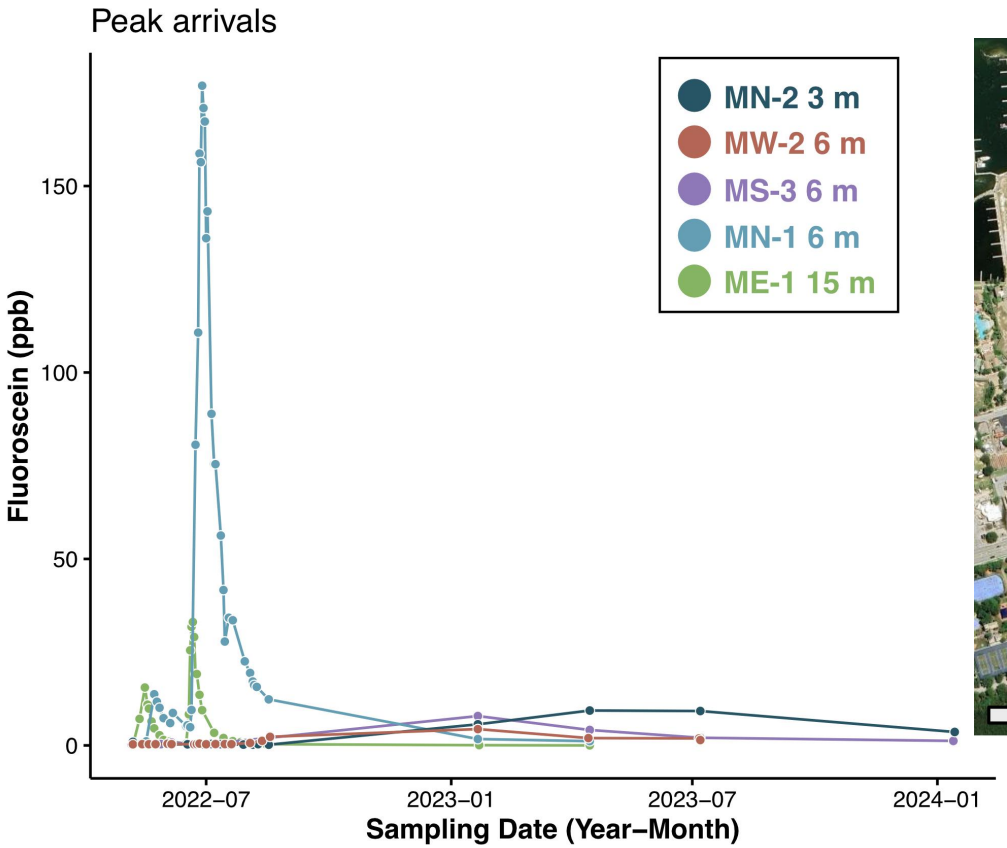
Phosphorus is removed by chemical reactions

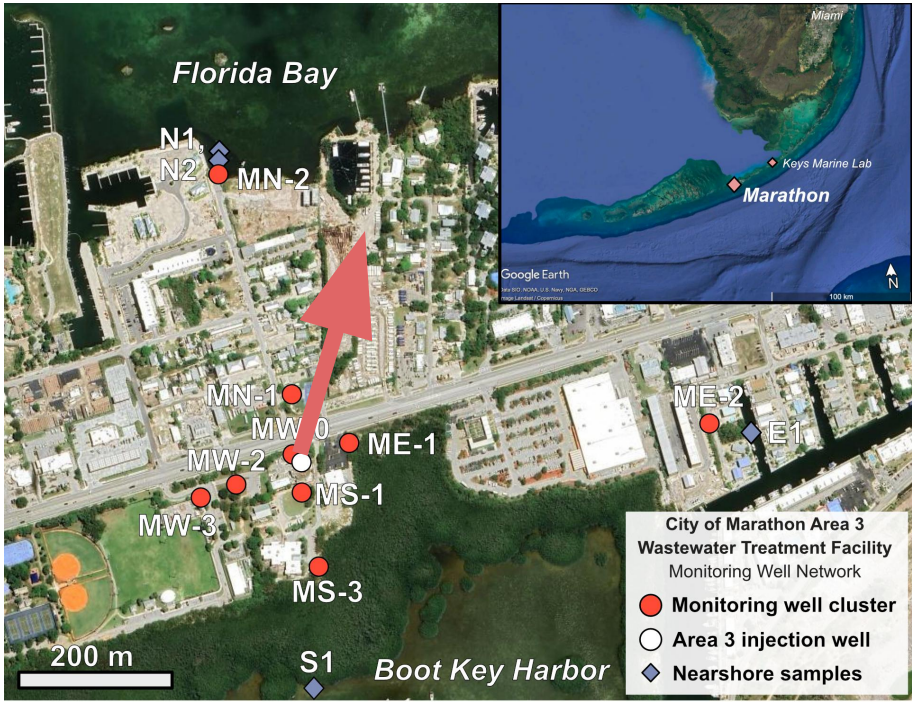
Expectations: Efficient abiotic **adsorption of phosphate onto the carbonate bedrock** will remove phosphate from the effluent plume prior to emergence into the nearshore waters of the halo zone.

Remaining question: Is adsorption an efficient and permanent solution to wastewater-derived phosphate from shallow injection in the Florida Keys?

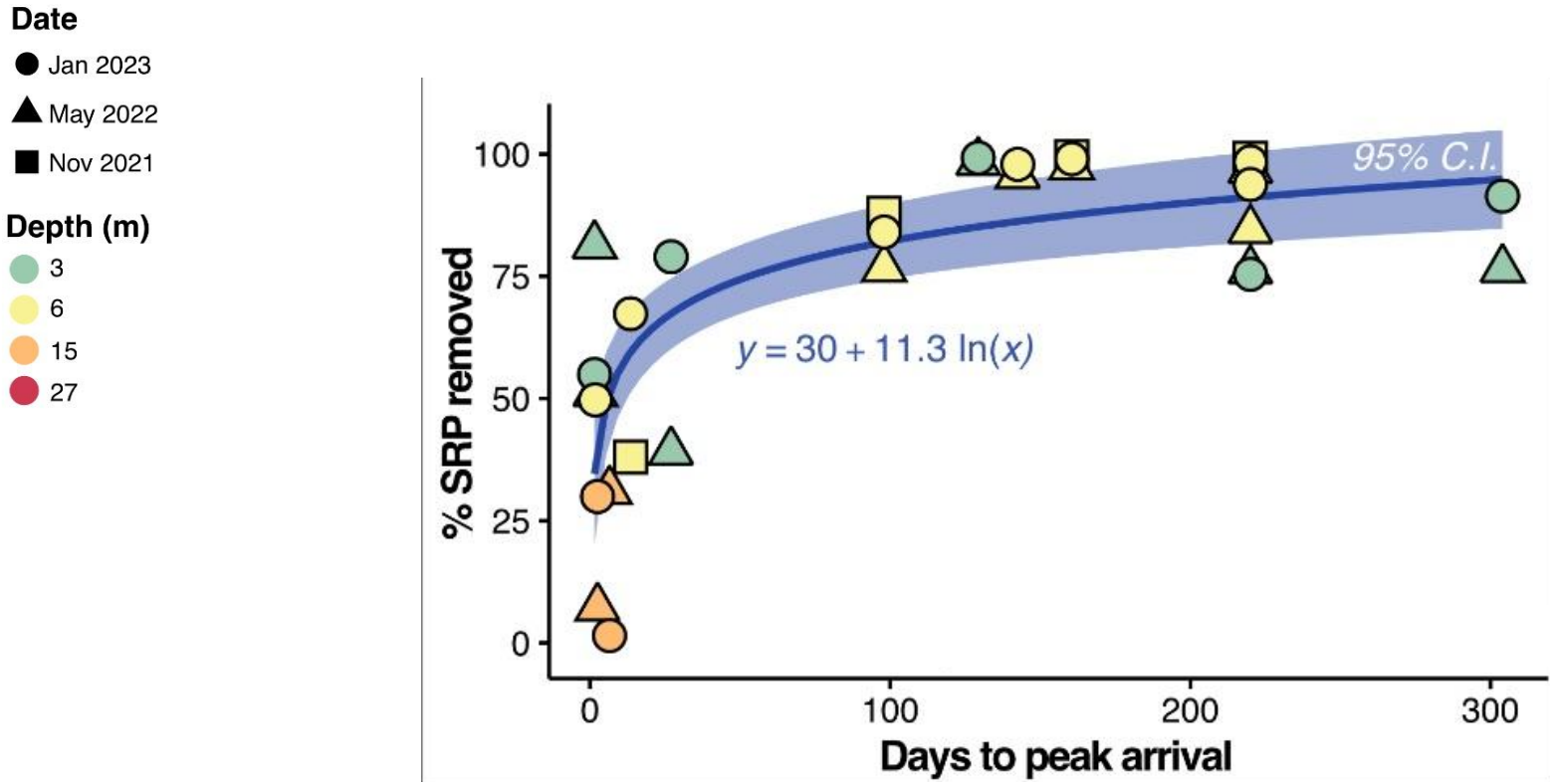


Effluent travel times and direction confirmed by dye tracer experiment



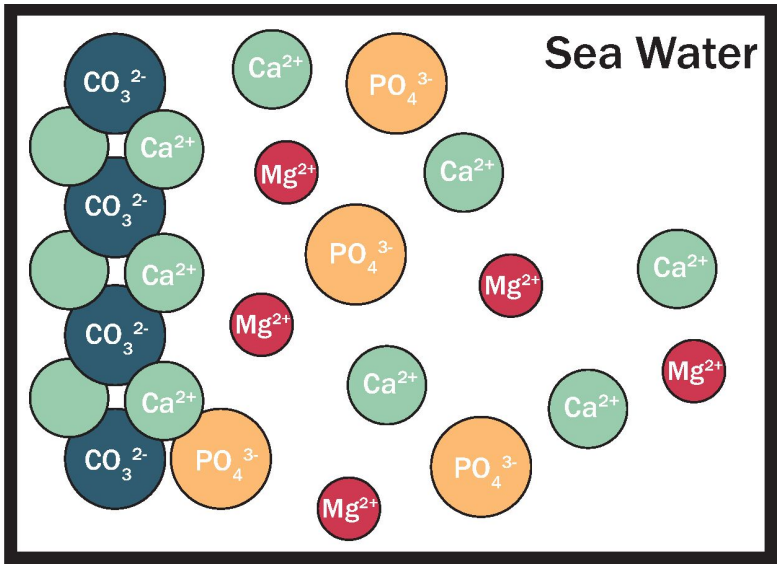


Most wastewater-derived P is efficiently removed in the subsurface



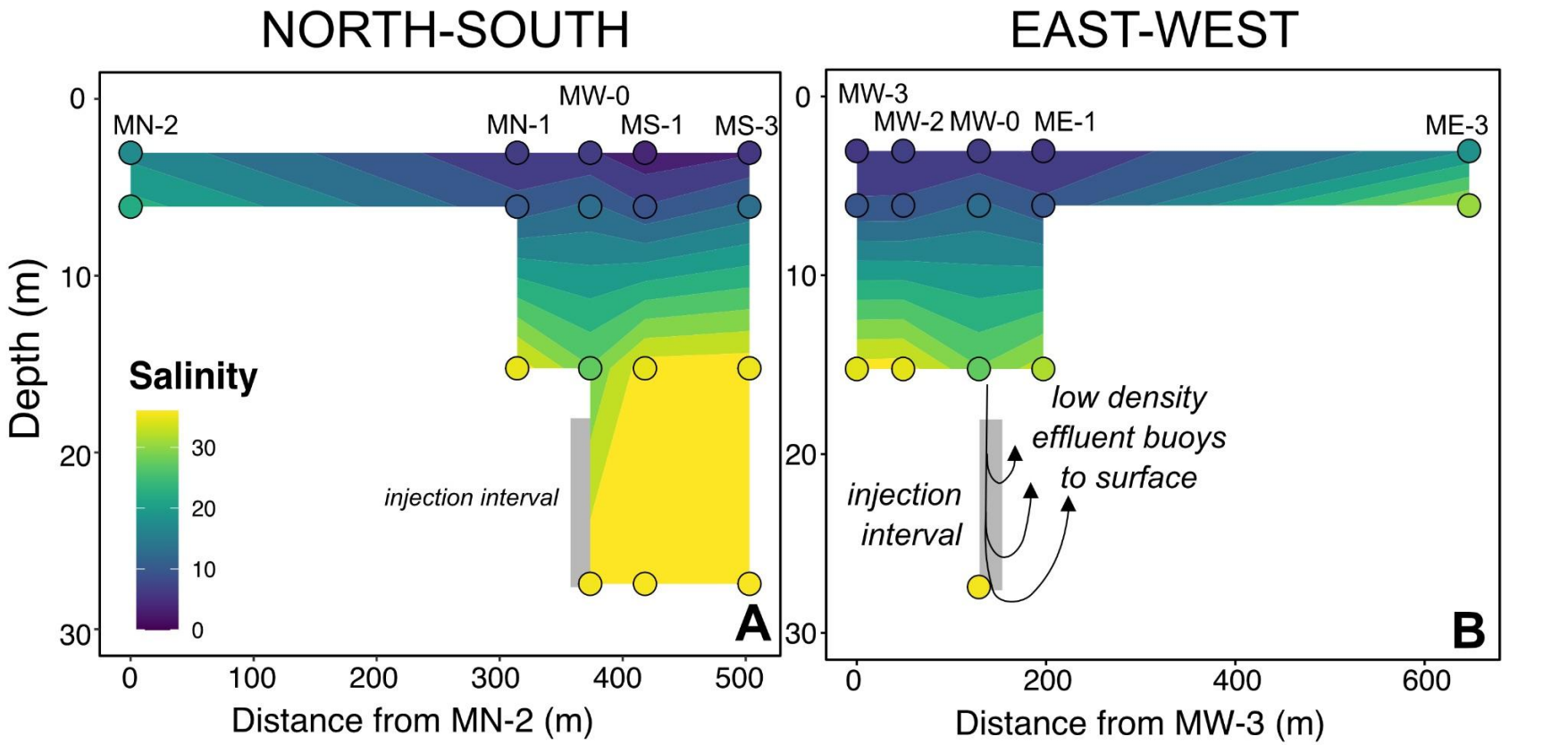
Hypothesis: Increasing the residence time of the effluent plume in the subsurface will increase the efficiency of P removal

Open questions: Does the Key Largo Limestone bedrock have a capacity or limit that will be reached (e.g. open mineral lattice sites)? Will approaches to increasing residence time lead to **desorption**?



Phosphate desorption due to kinetic inhibition from seawater-derived ions is possible

Groundwater-wastewater density contrast expedites transport of nutrients to the surface



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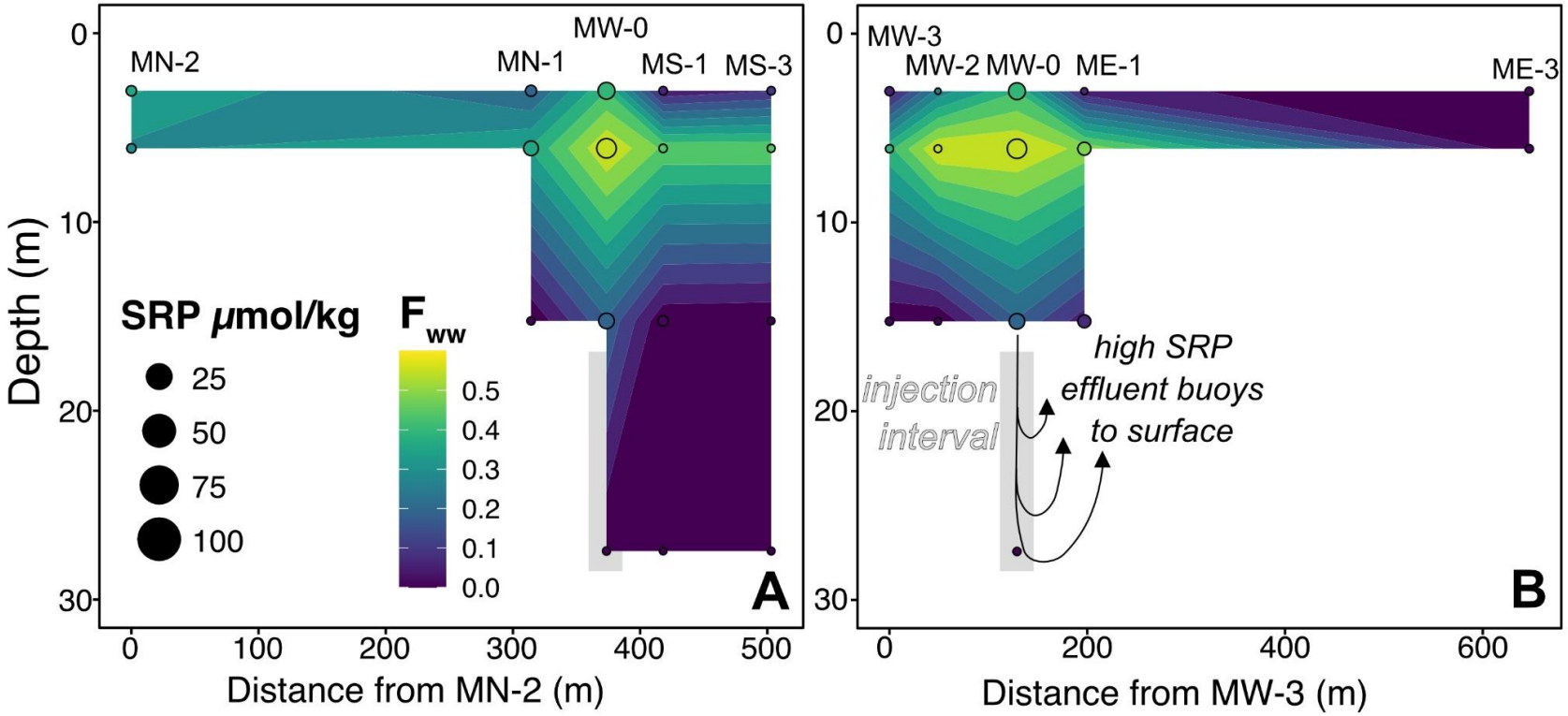
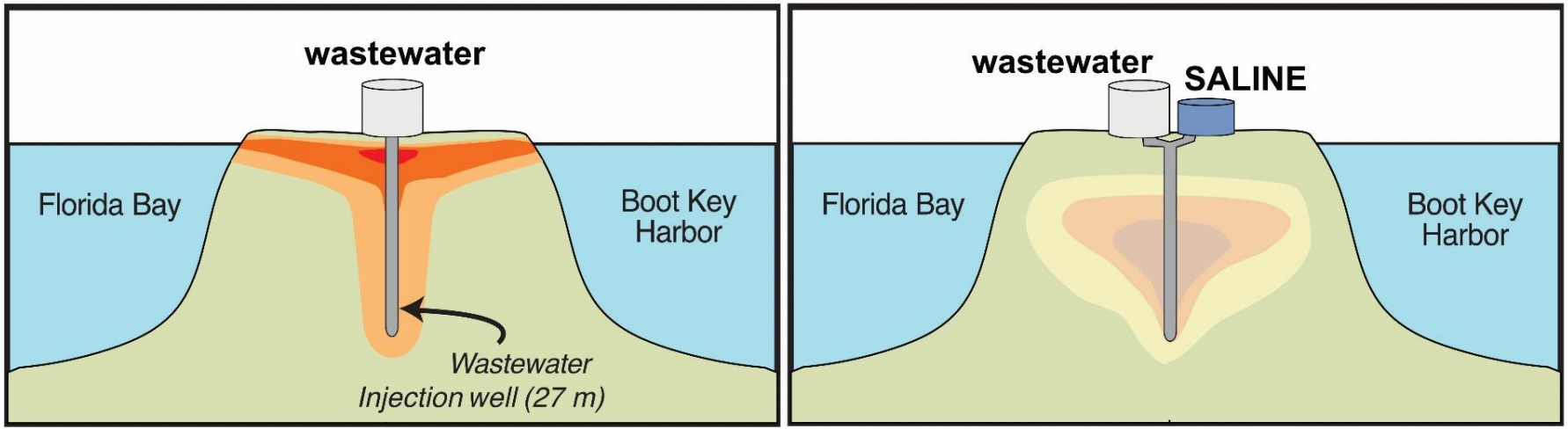


Proposal: wastewater-seawater blending experiments

Increase residence time by decreasing density contrast by blending low-density effluent with saline groundwater or seawater



Challenges: Where to derive the saline water and how to transport to the injection well

Other remaining needs

- Our work on the fate of wastewater nitrogen is nearing completion. General picture the same, with the removal process for nitrate being denitrification. Time in subsurface again a factor.
- Progressing on modeling efforts for generalizability.
- Assessment of other wastewater-derived contaminants: e.g. broader collection of pharmaceuticals, pesticides, sunscreens, etc. could be performed using existing wells.

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