

Understanding the Effect of Coastal Water Conditions on Bio-Based Ground Improvement Strategies for Mitigating Earthquake Hazards

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Background & Motivation



- Structures are at risk of bearing failure and flow slides by **earthquake-induced liquefaction**
- Our goal is to develop a cost-effective, sustainable solution for existing facilities

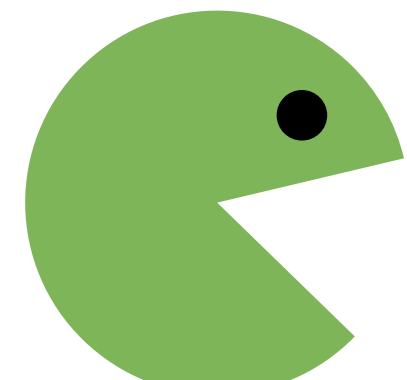
- Microbially induced desaturation and precipitation (MIDP) via denitrification (dissimilatory nitrate reduction) has shown potential for liquefaction mitigation in the lab

How might the MIDP product and by-product formation change in the field?

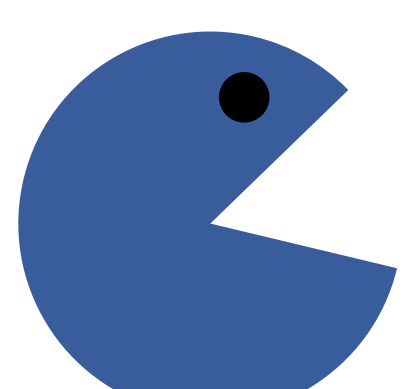
Can we optimize our treatment recipe as we consider...

... competing biochemical processes?

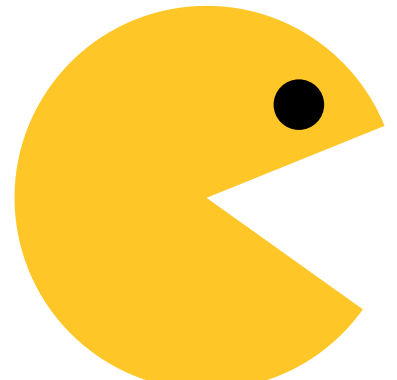
Iron reducer



Sulfate reducer



Denitrifier

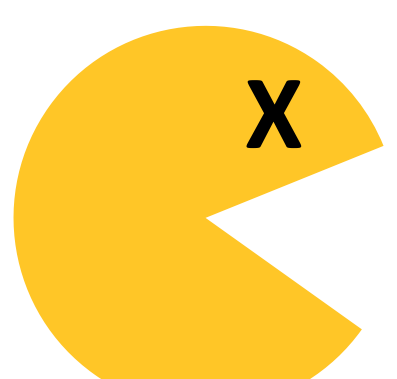


Electron Donor
(Microbe
"Food" Source)

... potentially inhibitory compounds?



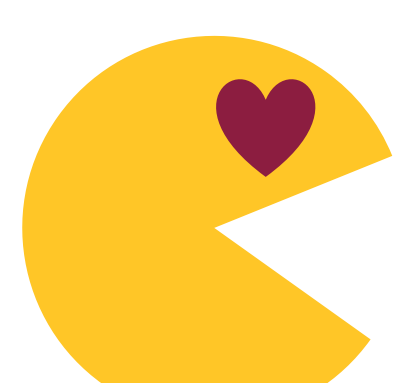
Denitrifier



...alternative electron donors
and nitrogen sources?

Nitrate

Denitrifier



Ammonium

Molasses

Acetate

Glucose

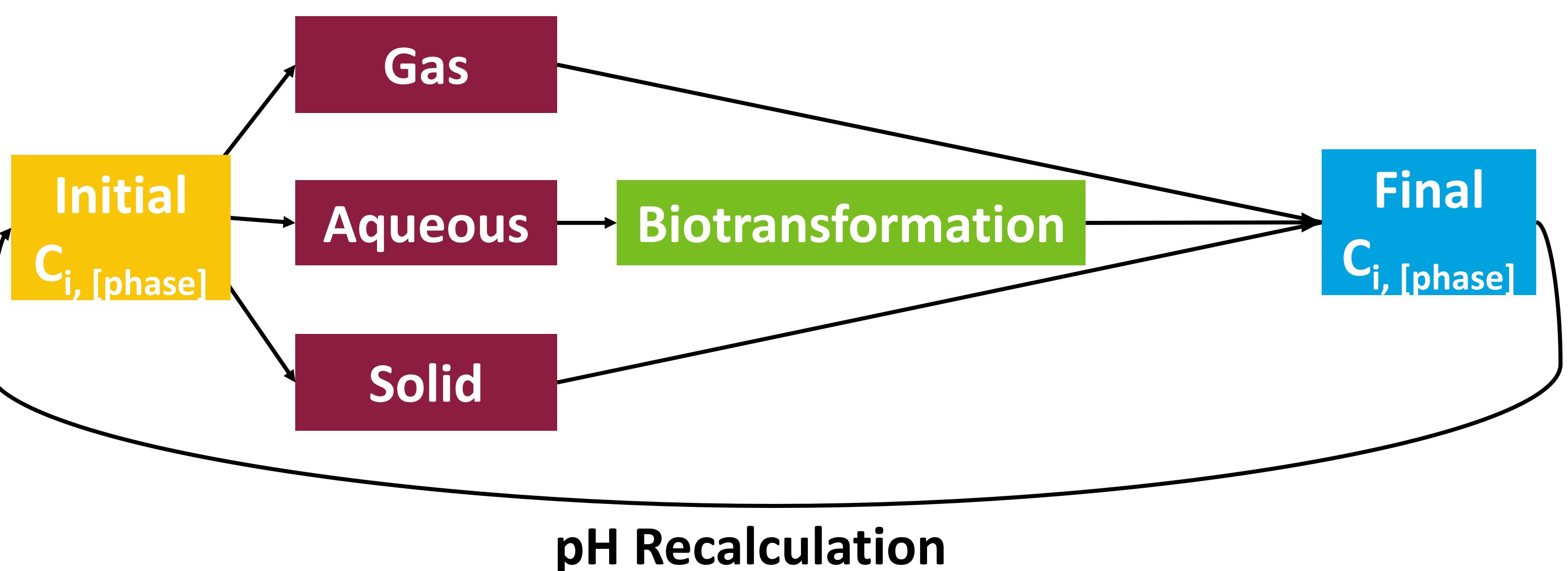
Batch Model Development and Evaluation

Model considers:

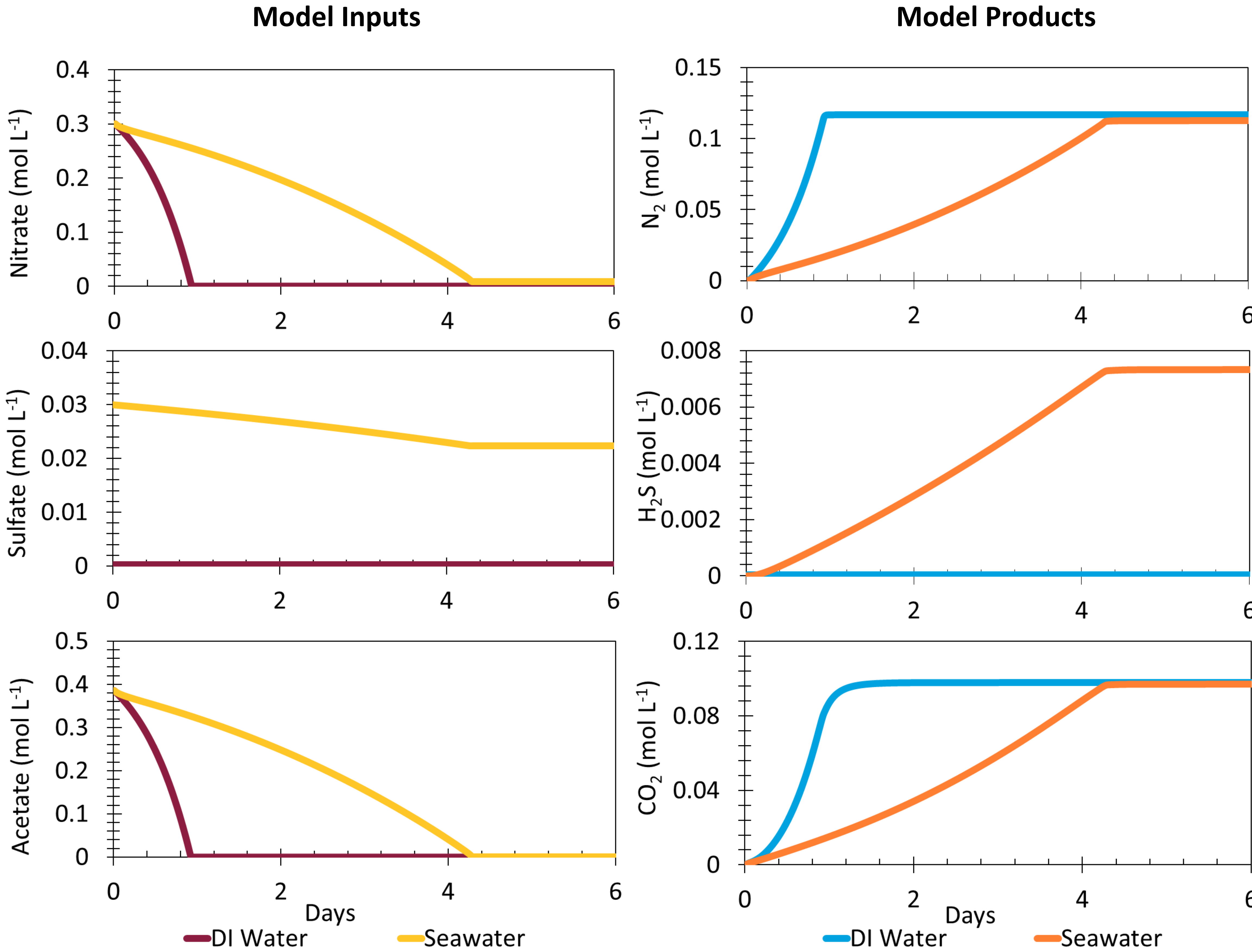
- Gas-phase mass transfer
- Mineral precipitation
- Compound speciation
- Mixed microbial community
- Inhibition by H_2S

Speciation and Phase Transfer

Drivers: pH and kinetics



Preliminary Model Results and Insights



- The model can represent all major processes occurring in MIDP
- The presence of sulfate in the environment promotes H_2S production - which inhibits MIDP
- Sulfate reducers compete with denitrifiers, but consume electron donor more slowly

Next Steps

- Include additional inhibition mechanisms
- Consider alternative electron donors and nitrogen sources
- Use model to conduct a life cycle sustainability assessment to develop a framework for applying MIDP in the field

Want to connect? caitlyn.hall@asu.edu and @CaitlynAHall

Acknowledgements

This material is based upon work primarily supported by the Engineering Research Center Program of the National Science Foundation under NSF Cooperative Agreement No. EEC-1449501. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect those of the National Science Foundation.