Macroecology of microbial abundance in soil and aquatic ecosystems across US

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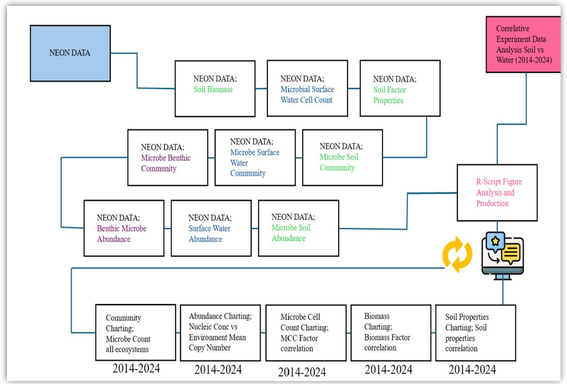
Background

- Microbes drive and indicate climate change by influencing **biomechanical feedback loops**. This study explores the relationship between microorganisms and **environmental factors** like temperature, soil composition, pH, and moisture, using NEON Laboratories data to advance Green Microbiology for climate sustainability.

Methodology



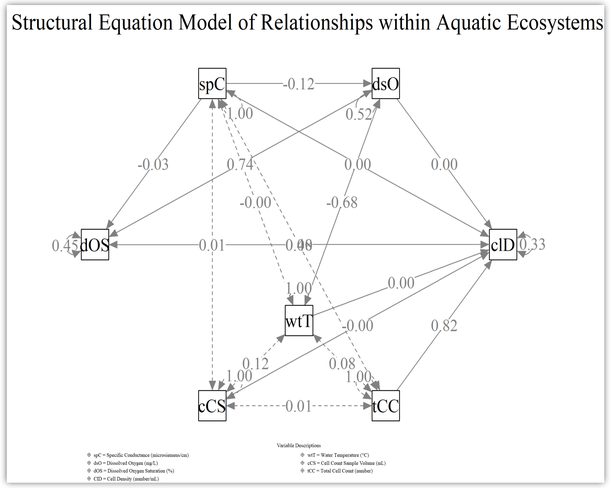
Questions

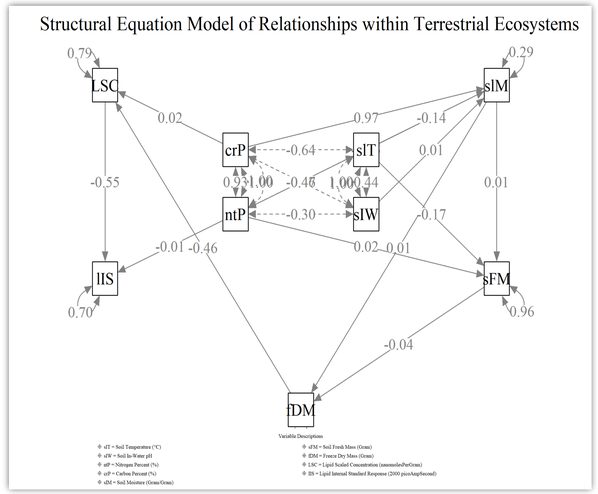
- How are microbial communities similarly affected in aquatic and terrestrial ecosystems?
- Which ecosystem has the most diverse microbial communities in the US?
- Which ecosystem plays a dominant role in climate change, and what is the main contributing factor?

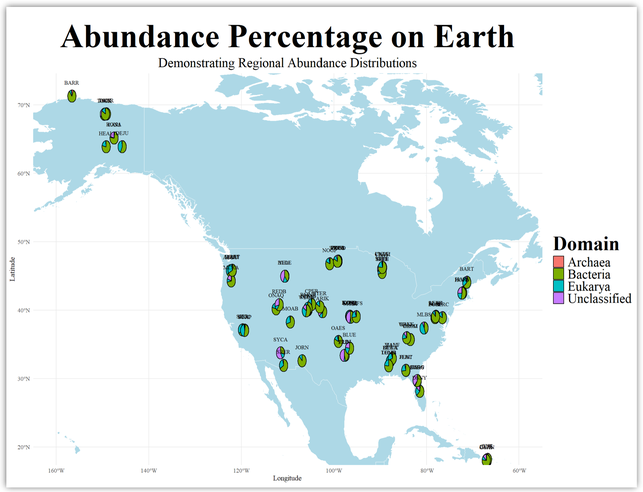
Future Directions

- Further studies should **examine seasonal changes** in microorganism abundance across the US and their impact on environmental factors to enhance sustainability through Green Microbiology.

Results







- In the terrestrial ecosystem, a strong correlations between SFM and CRP (0.97) and CRP and NTP (0.93), indicating a **strong relationship** between carbon percentage, soil fresh mass, and nitrogen percentage, offering insight into the carbon and nitrogen cycles.
- In the aquatic ecosystem, a **strong negative relationship** between **water temperature** (WtT) and **dissolved oxygen** (dsO) (-0.68), and a **positive relationship** between **dissolved oxygen** (dsO) and **oxygen saturation** (DOS) (0.74).

Comparison	Mean_Difference	t_Statistic	df	p_Value
t Archaea vs Bacteria	-66.601266	-45.961787	78.56258	1.520826e-58
t1 Archaea vs Eukarya	-17.670886	-13.415037	78.68132	4.972351e-22
t2 Archaea vs Unclassified	-13.493671	-8.531159	78.47191	8.406254e-13
t3 Bacteria vs Eukarya	48.930380	25.035582	154.59131	2.904033e-56
t4 Bacteria vs Unclassified	53.107595	24.798153	154.81076	8.657563e-56
t5 Eukarya vs Unclassified	4.177215	2.033004	151.02035	4.380367e-02

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            Df Sum Sq Mean Sq F value   Pr(>F)
ecosystem    1   9200    9200    75.7 3.72e-16 ***
Residuals  262  31841     122
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
240 observations deleted due to missingness
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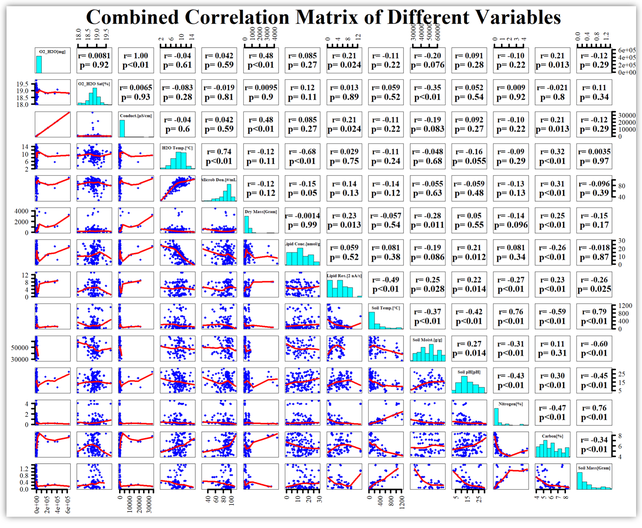

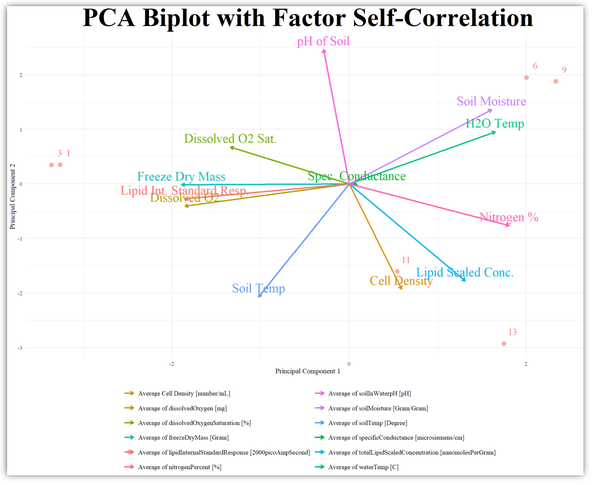


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Variance Explained by Each Principal Component:
> print(pca_variance_ratio)
 [1] 3.110427e-01 1.995366e-01 1.357032e-01 9.597154e-02 7.543015e-02 5.354592e-02
 [7] 3.896555e-02 3.106128e-02 2.256404e-02 1.602098e-02 1.021986e-02 5.860364e-03
[13] 4.075974e-03 1.831957e-06
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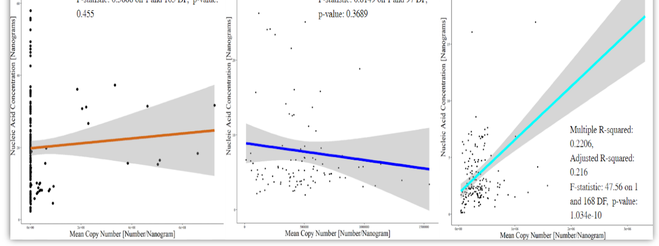

- However, MCD, Spec Conductance, and H2O temp are the primary factors influencing the microbial communities across ecosystems.

Conclusion

- Microorganisms play a key role in biomechanical processes **affecting climate change**, with significant declines in diversity across aquatic and terrestrial ecosystems.
- **Water temperature** and **specific conductance** drive the carbon cycle, while **soil moisture** and **temperature** impact the nitrogen cycle, influencing microbial activity and ecosystem processes.

References and Acknowledgments

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