**📌 Core Theme:**

**"How do elevation-driven climate and soil changes affect nematode biodiversity, ecosystem stability, and carbon cycling?"**

**🌿 Logical Flow of the Study:**

✅ **Climate shapes soil properties** → ✅ **Soil properties determine nematode diversity** → ✅ **Nematode diversity reflects ecosystem stability** → ✅ **Ecosystem stability influences carbon cycling**

**I. Climate-Soil Interactions: The First Step in Understanding Ecosystem Changes**

**To begin, let’s explore how climate properties shape soil characteristics.**

* **Our first heatmap examines the correlation between climate variables (like temperature annual range and precipitation) and soil properties (like pH, moisture, and conductivity).**
* **Key Findings:** 
  + **Temperature annual range has a strong positive correlation with soil temperature and conductivity, meaning regions with higher temperature variability tend to have more extreme soil conditions.**
  + **Moisture negatively correlates with temperature annual range and precipitation seasonality, indicating that more variable climates result in drier soils.**
  + **pH and conductivity show moderate correlations with climatic variables, suggesting that climate shifts can alter soil chemistry over time.**

**Why does this matter?**

* **Soil properties form the foundation of ecosystem health—they determine nutrient availability, microbial activity, and the ability of organisms, like nematodes, to thrive.**
* **As climate variability drives changes in soil moisture, temperature, and conductivity, the biological communities within the soil will inevitably respond.**

**II. Soil Properties and Nematode Biodiversity: Which Trophic Groups are Most Affected?**

**Our second heatmap examines the direct impact of soil conditions on nematode trophic guilds, which are categorized into:**

* **Herbivores (feeding on plant roots)**
* **Bacterivores (feeding on bacteria)**
* **Fungivores (feeding on fungi)**
* **Omnivores and predators (higher-level consumers in the soil food web)**

**Key Patterns in the Data:**

* **Herbivores and omnivores are positively correlated with soil moisture but negatively correlated with conductivity and temperature.**
* **Bacterivores thrive in high-conductivity, low-moisture soils, meaning they dominate in disturbed environments.**
* **Predators and omnivores show weaker correlations, suggesting they may be more resilient to minor soil changes but still affected by extreme conditions.**

**What does this mean?**

* **Climate-driven soil changes alter the balance of nematode communities.**
* **A shift toward bacterivore dominance may indicate ecosystem instability, as bacterivore-heavy environments are associated with rapid nutrient cycling but reduced soil structure and resilience.**
* **Moisture loss, driven by climate variability, threatens higher trophic levels (omnivores and predators), which can disrupt natural predator-prey dynamics in the soil.**

**III. Nematode Functional Diversity: What Does This Mean for Carbon Cycling and Ecosystem Stability?**

**Finally, we turn to how nematode communities influence soil ecosystem function.**

* **Our last heatmap explores the correlation between nematode trophic guilds and functional diversity indices:** 
  + **Bacterivores correlate negatively with ecosystem stability indices, suggesting that their dominance is linked to more disturbed, less mature soils.**
  + **Herbivores and omnivores show positive correlations with indices linked to ecosystem resilience, reinforcing that diverse trophic interactions contribute to long-term soil health and carbon retention.**

**Takeaways:**

1. **Climate influences soil properties, which in turn shapes the composition of nematode communities.**
2. **Moisture loss and increased soil variability favor bacterivores over higher trophic groups, leading to faster but less stable carbon and nutrient cycling.**
3. **Biodiversity loss at the soil level can reduce long-term carbon storage, amplifying climate change effects.**

**IV. Conclusion: Why This Matters and What We Can Do**

 Elevation-driven climate changes in **temperature and precipitation** directly impact soil moisture, temperature, and conductivity.

 These soil shifts **reshape nematode biodiversity**, favoring bacterivores in drier, high-conductivity conditions.

 **Biodiversity loss threatens ecosystem stability and carbon cycling**, with long-term implications for **climate resilience and soil health**.Thank you.

**Key Word:**

precipitation seasonality

The Coefficient of Variation is the standard deviation of the monthly precipitation estimates expressed as a percentage of the mean of those estimates (i.e. the annual mean)