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Editorial: Ecological links between aboveground and underground ecosystems under global change

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Editorial on the Research Topic
Ecological links between aboveground and underground ecosystems under global change

Introduction

In the intricate tapestry of ecological study, the interconnections between aboveground and underground systems are profoundly intertwined and inseparable. Traditional ecological research has predominantly focused on aboveground phenomena, including the lush expanse of forests, the undulating grasslands, and the diverse flora and fauna visible to our senses. However, a hidden world teems beneath our feet, encompassing the soil, intricate root networks, and subterranean microbial realms. This Research Topic in "*Frontiers in Ecology and Evolution*" endeavors to illuminate this often-overlooked subterranean domain, shedding light on the critical interactions between the Earth's surface and its hidden depths.

These interactions transcend mere academic curiosity; they serve as fundamental components in the intricate machinery of life, governing processes ranging from nutrient cycling to plant growth and from carbon sequestration to water purification. The study of aboveground-underground interactions assumes particular significance in an era characterized by rapid environmental changes and global ecological challenges. Comprehensive comprehension of these interplays is paramount to unraveling the enigmas surrounding ecosystem resilience, biodiversity preservation, and ecological restoration.

This compilation of six articles represents a diverse spectrum of research endeavors, each contributing distinctive insights into the dynamic dialogues between aboveground and underground ecosystems (Figure 1). From examining the effects of low-dose ionizing radiation on soil microorganisms to exploring the phenotypic adaptability of Canadian maples in the context of climate change, these studies not only advance our scientific understanding but also compel us to reevaluate our relationship with the natural world.

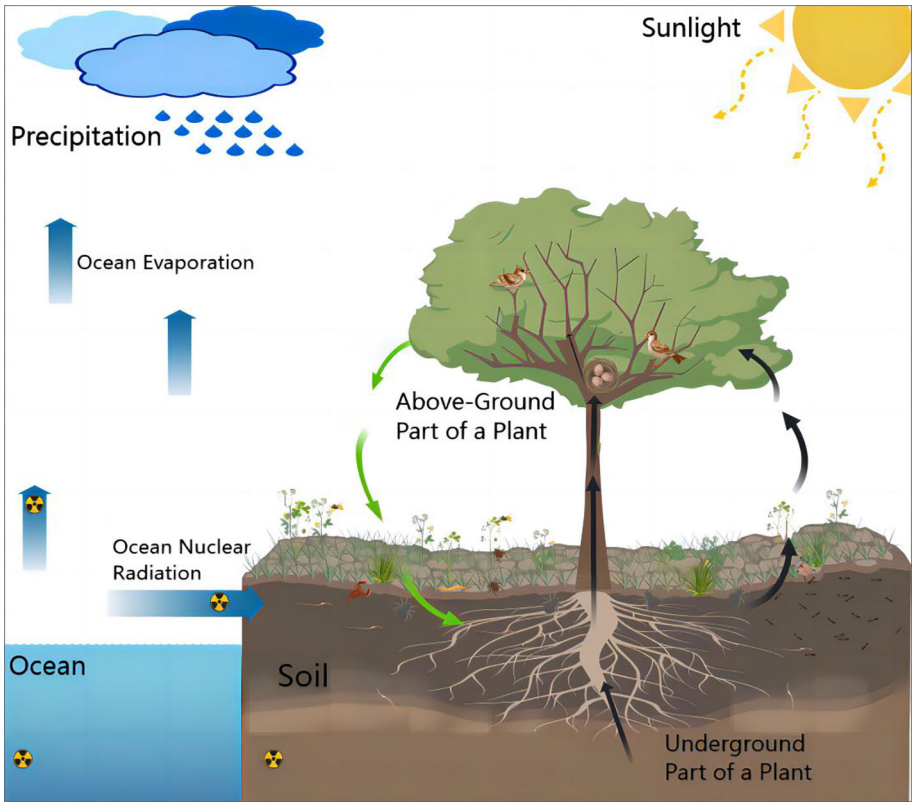

FIGURE 1
Summary picture of the research topic.

Long-term low-dose ionizing radiation on soil microbial communities

The inaugural article transports us to the outskirts of Chengdu, China, where diligent researchers have delved into the repercussions of thorium-232 ionizing radiation on subterranean microbial communities. This investigation assumes paramount importance in deciphering the intricate effects of persistent, low-dose radiation—a byproduct of human activities such as nuclear power generation—on the intricate web of life thriving beneath the soil.

Remarkably, the research unveils a remarkable resilience among bacterial communities, which constitute the bedrock of soil ecosystems, in the face of radiation exposure. In stark contrast, fungal populations, equally pivotal for nutrient cycling and soil health, exhibit significant shifts in diversity and function. This dichotomy in their response underscores the intricate and adaptive mechanisms at play within soil microbes and emphasizes the imperative of considering these minuscule yet influential organisms in environmental risk assessments (Cheng et al.).

Relationship between leaf dry mass and leaf age

Our second article delves into the nuanced relationship between leaf dry mass (LDM) and leaf age, focusing on *Photinia serratifolia*, a common shrub in East Asian gardens. This study elegantly bridges the gap between plant physiology and ecological modeling, offering insights into how leaf traits adapt over time.

The research reveals a proportionality between LDM and fresh mass across different leaf age groups, a finding that challenges existing assumptions in plant ecology. It shows that, while older leaves tend to have a higher LDM due to moisture loss and cell wall thickening, this increase is not linear, but rather modulated by the leaf's lifespan. This nuanced understanding of leaf mass dynamics is crucial for predicting plant responses to environmental changes, particularly in urban and managed landscapes (Yan et al.).

Impact of black locust on native ecosystems

The invasion of non-native species and their impact on local ecosystems is a critical concern in conservation biology. The third article addresses this issue through a study on the black locust (*Robinia pseudoacacia*), a North American tree species introduced to China's Loess Plateau. This study provides a comprehensive view of how a non-native species can influence native biodiversity and soil ecology.

Remarkably, the introduction of black locust was found to enhance local biodiversity initially, but long-term effects included a decline in native species richness and alterations in soil properties. This research

highlights the complex and often unpredictable nature of ecological invasions, emphasizing the need for careful management strategies in forestry and conservation practices (Zhang et al.).

Phenotypic plasticity in Canadian maple populations

Climate change poses unprecedented challenges to plant species, especially long-lived ones like trees. The fourth article explores this theme by studying the phenotypic plasticity of Canadian maple (Acer saccharum) populations across varying climatic regions. This research sheds light on the ability of trees to adapt to rapid climatic shifts, focusing on the timing of bud development as a key adaptive trait.

The findings underscore the importance of phenotypic plasticity over genetic variation in determining the tree's response to climatic changes. This insight is pivotal for understanding how tree populations might cope with the accelerating pace of global warming, and for developing conservation strategies that preserve the genetic diversity and adaptive potential of forest ecosystems (Guo et al.).

Nesting site selection of birds in urban greenspaces

The fifth article transports us to the urban jungles, exploring the nesting behaviors of birds in the greenspaces of Nanjing, China. This study focuses on two bird species, the magpie (*Pica pica*) and the azure-winged magpie (*Cyanopica cyana*), examining how urban landscape elements influence their nesting site selection.

Using a combination of field surveys and generalized additive models (GAMs), researchers found that factors such as tree height, proximity to central lawns, and tree cover significantly impact nesting site choices. This study is a testament to the resilience and adaptability of urban wildlife. It also emphasizes the critical role of urban planning and greenspace management in preserving avian biodiversity in metropolitan areas, offering practical insights for urban ecologists and city planners (Ding et al.).

Plant diversity and root biomass increase in rainfall and grassland diversity manipulations

The final article in our series is a compelling exploration of how plant diversity influences root biomass in response to varying rainfall patterns. Conducted as a multifactorial manipulation experiment, this study provides valuable insights into the belowground responses of grassland ecosystems to environmental changes.

The results reveal a strong positive correlation between species richness and both aboveground and underground biomass, underscoring the significance of plant diversity in ecosystem productivity. Furthermore, the study demonstrates that root biomass increases significantly with diversity, especially in herbaceous plant communities. These findings have profound implications for understanding the resilience of grasslands to global change factors like drought and highlight the importance of preserving plant diversity for ecosystem sustainability (Podzikowski et al.).

Conclusions and future directions

As we conclude this journey through the aboveground and underground realms of ecological science, several themes emerge. First and foremost is the complexity and interconnectedness of these two worlds. Each article, in its way, has illuminated aspects of this intricate dance between the soil and the sky, the roots and the leaves, the microbe and the mammoth.

The resilience of ecosystems to environmental changes, a thread running through all these studies, stands out as a key area of focus. The adaptability of soil microbes to radiation, the phenotypic plasticity of trees in the face of climate change, the impact of non-native species on native ecosystems, the nesting strategies of urban birds, and the response of grassland root biomass to diversity and rainfall variations – all these phenomena underscore a single truth: our ecosystems are dynamic, adaptable entities.

Looking ahead, the path is clear. We must continue to explore these interactions with a sense of urgency and purpose. The need for multidisciplinary research is more pressing than ever, as is the need for innovative conservation strategies that take into account the holistic nature of our ecosystems. As we face the challenges of climate change, habitat loss, and biodiversity decline, the lessons learned from these studies will be invaluable.

In closing, this Research Topic not only expands our knowledge but also deepens our appreciation for the intricate web of life that sustains our planet. It is a call to action for ecologists, conservationists, policymakers, and every citizen of the Earth to work towards a deeper understanding and a more harmonious coexistence with the natural world.

Author contributions

JG: Writing – original draft, Writing – review & editing. BY: Conceptualization, Writing – review & editing. SB: Writing – review & editing.

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Conflict of interest

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