

# 地球系统科学中 界面及相互作用研究

**Interfaces and Interactions in  
Earth System Science Studies**

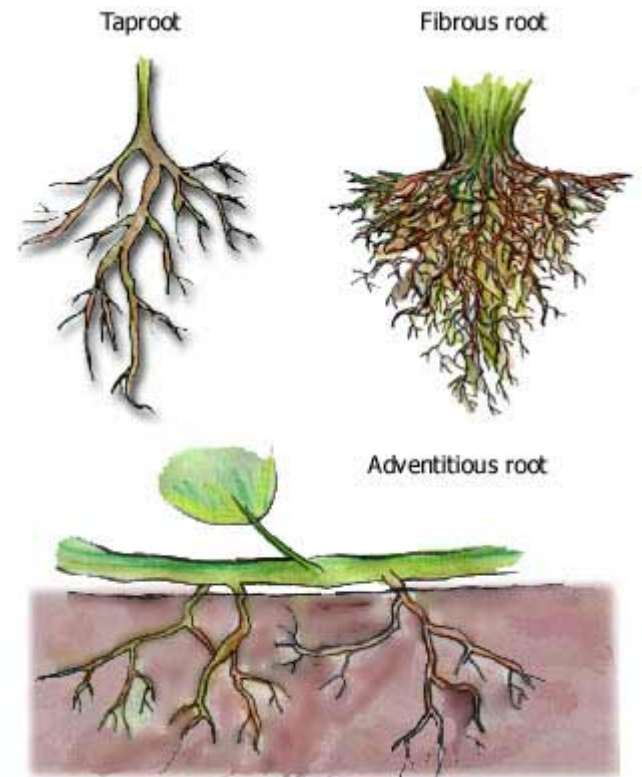
# Major Interfaces in Earth System

- 土-气界面(大气边界层):
- 土-植物界面: 根际土壤( Rhizosphere)
- 土-水界面:湿地与缓冲带:(Wetlands and Riparian zones)
- 土-岩界面: 风化锋 weathering fringe

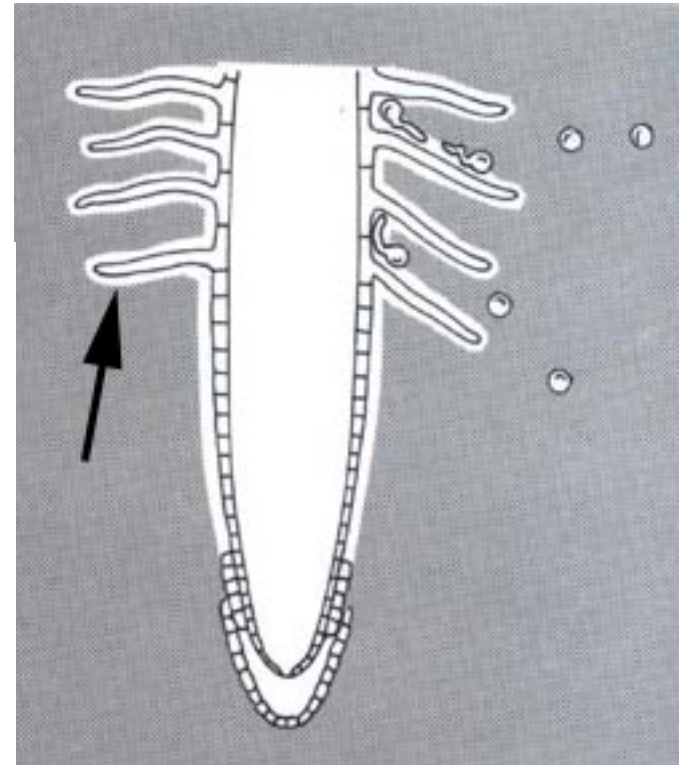
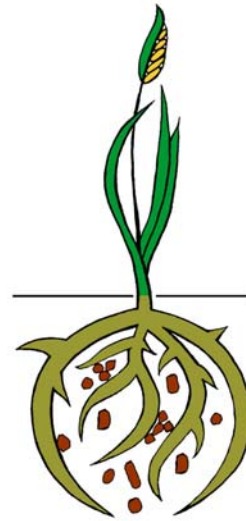


# 根际系统(Rhizosphere)

- A dense and complex environment, in which plants roots negotiate a shifting sea of stimuli, including pathogenic and non-pathogenic microbes, competing plant roots, various invertebrates, and a wide variety of soil conditions.

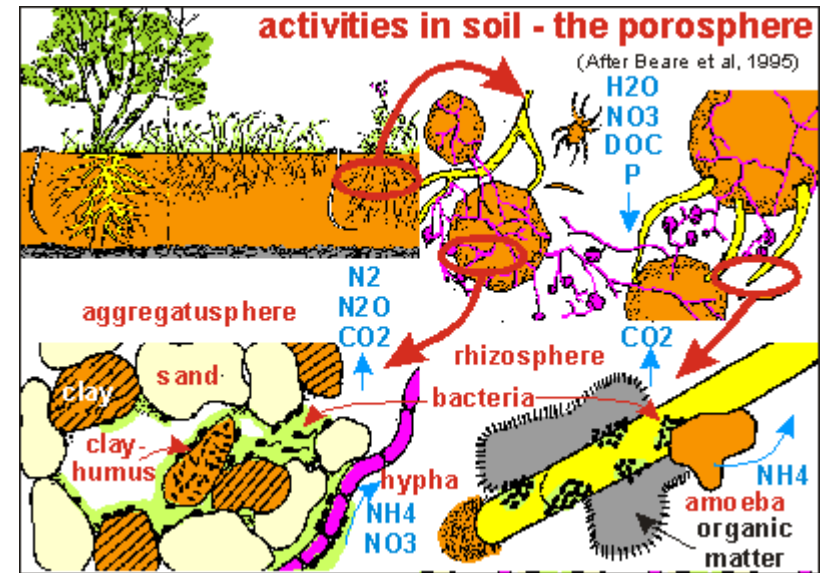


- **Plant roots play an active role in this environment, exuding chemicals that change the soil's pH, encourage symbioses, ward off potential pathogens, and regulate the germination and growth of competing plants, including their own offspring. They in turn are acted upon by various rhizosphere inhabitants.**



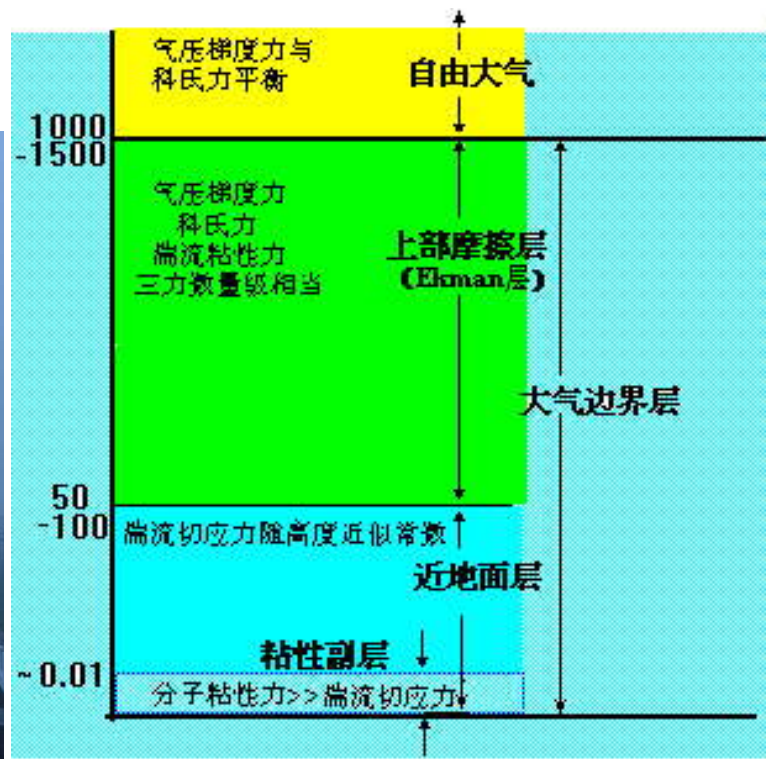
# Music in rhizosphere

- The complexity of these multitrophic interactions is almost impossible to replicate in the laboratory, as studies show that the communication between two organisms within the rhizosphere can be “overheard” and influence the behavior of other organisms.



# 大气边界层

- 上界离地面**500-1000米**;
- 受地面摩擦作用的影响明显, 大气运动呈湍流状态;
- 受地面热力和动力影响深刻, 交换强烈而快速;
- 气象要素的分布和动态易变



# 湿地 Wetlands

- 以水为介质的多环境耦合系统;
- 地球系统的走廊 **earth Corridor**
- 物质的承纳与转化
- 土壤发育弱,
- 季节性
- 



# 海涂 Costal lands

- 特别地:滨海湿地(滩涂)
- 陆海相互作用地带
- 海侵与海退
- ?

LOICZ: A IGBP core project  
Land-Ocean Interactions in the Coastal Zone





# Riparian Zone

- The green ribbon of life alongside a stream or lake. This ribbon is a mixture of vegetation types, which varies greatly from place to place.
- It connects the upland zone to the aquatic zone, controlling the flow of water, sediment, nutrients, and organisms between the two. Without a proper functioning riparian zone, the other zones suffer;
- Riparian vegetation along a desert stream may be small and sparse while the vegetation along a mountain stream may be tall and lush.
- The riparian zone is critical to the health of every stream and its surroundings environment.

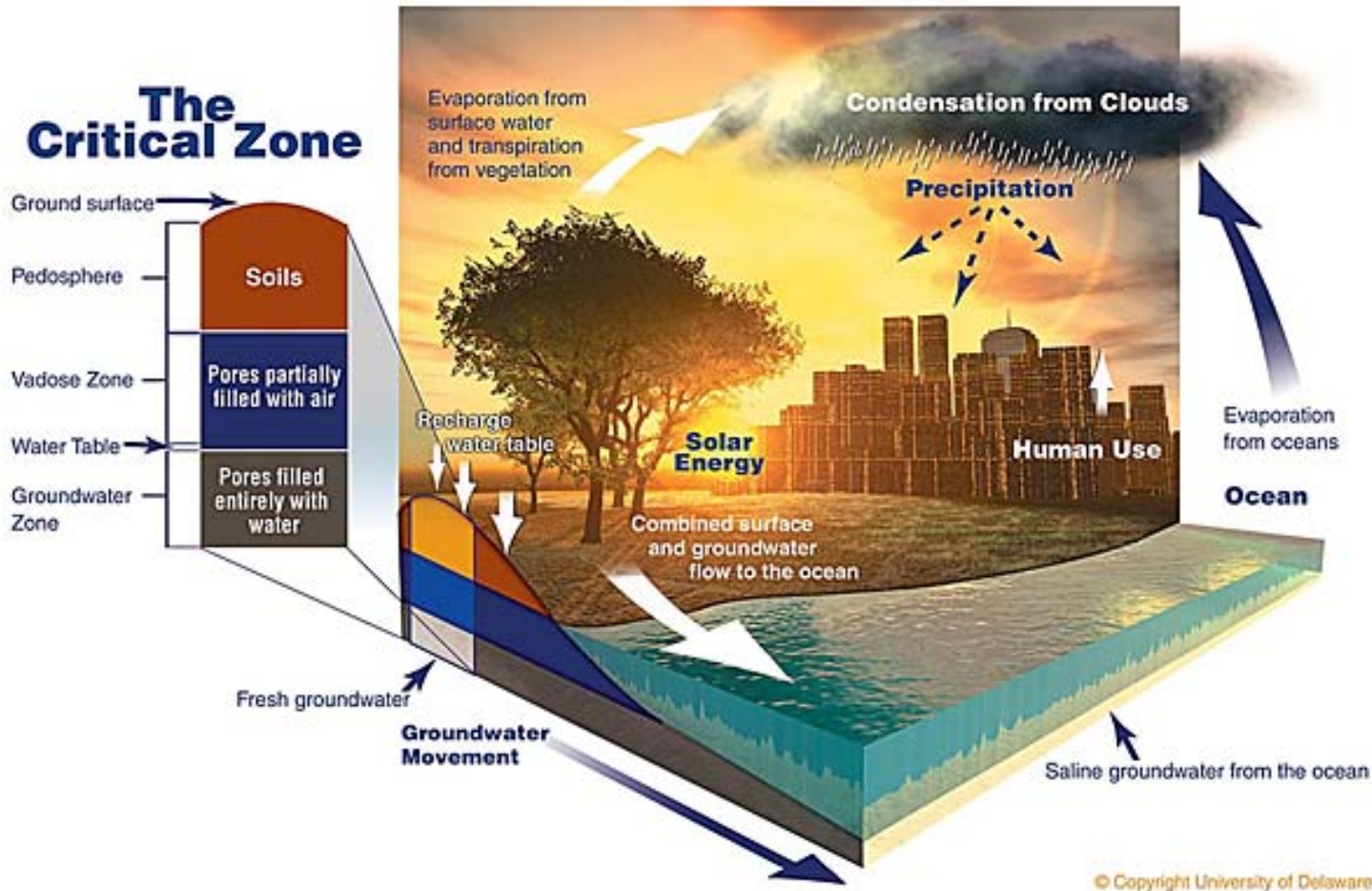


# 大边界层:圈层界面

## 地球临界带(Critical zone):

- 表层系统与深层系统, 生物地球与固体地球的界面;
- **Encompasses the outermost surface of the planet, from the vegetation canopy to groundwater, and is exceptionally vulnerable to human activity;**
- **NSF 地球科学与生命科学的前沿领域;**

# The Earth Critical Zone



# Exploring Complex Environmental Systems & Ecosystem Health

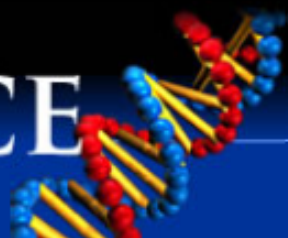
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# SCIENCE

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## ■ The Critical Zone: Where the Action Is



Upon their return from orbit, astronauts have often remarked on their profound sense of the beauty, interconnectedness, and fragility of the planet Earth. From space, human boundaries disappear and the global sweep of natural forces becomes apparent, protected only by the thin blanket of the atmosphere.

Most of the life-sustaining processes on Earth — and, indeed, all living things — exist in a narrow band close to the surface of the planet. Scientists have named this near-surface environment "the Critical Zone." In 2001, the National Research Council defined the Critical Zone as the "heterogeneous, near-surface environment in which complex interactions involving rock, soil, water, air, and living organisms regulate the natural habitat and determine the availability of life-sustaining resources."

# New Center of Critical Zone research in Delaware

- 2006--The University of Delaware has announced the formation of a new Center for Critical Zone Research, designed to conduct basic research concerning the Earth's life-sustaining, near-surface environment, during a ceremony at the **Delaware Biotechnology Institute**.

# Role of Critical Zone research

- The primary mission of the center is to better understand the complex chemical, biological and physical processes that occur in the critical zone and thereby to improve the environmental health;
- The state is located at the center of one of the most heavily populated regions of the United States and is seeing rapid growth in coastal and rural areas.
- That, coupled with industrial pollution and intensive animal agricultural production, is placing increased pressure on already fragile terrestrial and coastal marine environments.

- An international Critical Zone Exploration Network;
- Systematic approach across a broad array of sciences--including geology, soil science, biology, ecology, chemistry, geochemistry, geomorphology and hydrology--to study critical-zone processes;
- Understanding and predicting responses to global and regional change is necessary to mitigate the impacts of humans on complex ecosystems and ultimately sustain food production .

# Interactions: 界面研究的主要内容

- 界面相间的相互作用;**eg:**土壤与植物? 岩石与土壤? 土壤与大气
- 跨界面的不同营力或物质的相互作用: 无机-有机; 物理与化学;
- 人类与地球的相互作用: **A mystery?**
- 土壤中矿质-有机-生物相互作用(**A WG of IUSS**)
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# 界面与相互作用研究

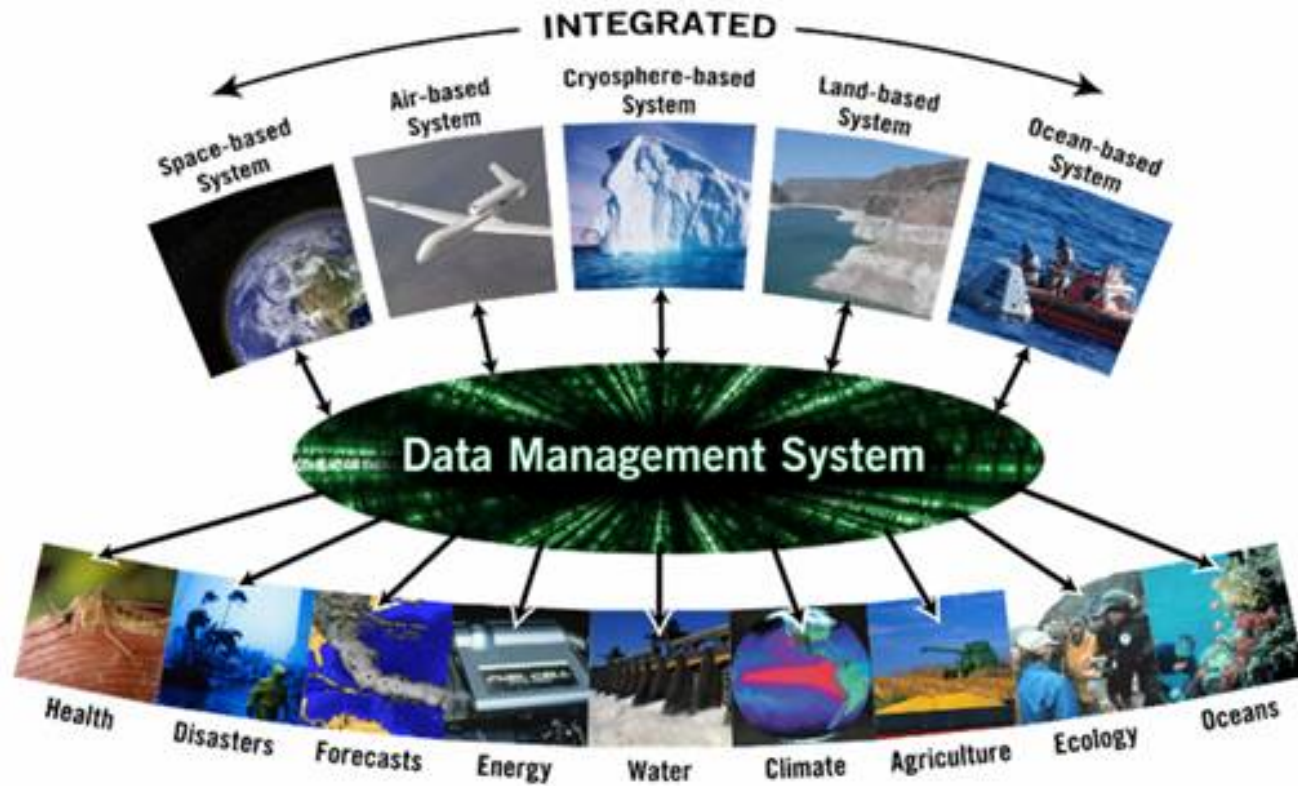
- 多学科认知;
- 多学科技术: 土壤学中分子生态?
- 多途径研究策略
- 多尺度观测系统
- 多边机制: 合作与伙伴关系



# 界面与相互作用研究:全球观测系统

## Observing Systems

### Global Earth Observation System of Systems



# 多功能与多角度管理地球: Earth System Science and Earth System Engineering

- **Earth Bio-geo engineering**
- **Ecological Landscaping**
- **Ecological dam:**

