Royal Academy for Overseas Sciences

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中国科学院 CHINESE ACADEMY OF SCIENCES

The Royal Academy for Overseas Sciences (RAOS), the Royal Belgian Institute of Natural Sciences (RBINS) and the Chinese Academy of Sciences (CAS) are organizing a three-day conference and workshops


ECOSYSTEMS IN A CHANGING WORLD


PROGRAMME

8-10 Sept 2025

Palace of the Academies & Institute of Natural Sciences (Brussels, Belgium)

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PROGRAMME

1ST DAY – MONDAY SEPTEMBER 8, 2025

Venue: Ilya Prigogine conference room, Palace of the Academies, Rue Ducale/ Hertogstraat 1, 1000 Brussels (Belgium)

13.30 – 14.00 *Welcome Coffee/Tea*

14.00 – 14.05 Welcome Address by Philippe De Maeyer, Permanent Secretary of the Royal Academy for Overseas Sciences & Ghent University, Belgium

14.05 – 14.15 Wei Gao, Counselor of the Embassy of the People's Republic of China in the Kingdom of Belgium

14.15 – 14.25 Brigitte Decadt, Senior advisor, International coordination and cooperation Unit (BELSPO), Belgium

14.25 – 14.35 Weidong Liu, Director General, Bureau of International Cooperation, Chinese Academy of Sciences, China

14.35 – 15.05 Bolun Ning, Director, Office of European Affairs, Bureau of International Cooperation, Chinese Academy of Sciences, China

Presentation of the Chinese institutes, coordinated by Bolun Ning:

Bojie Fu, Research Center for Eco-environmental Sciences, Chinese Academy of Sciences, China

Yanfen Wang, Vice-Rector, University of the Chinese Academy of Sciences, China

Yuanming Zhang, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China

Xuliang Zhuang, Acting Director, Professor, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, China

Bohua Yu, Director, Division Cooperation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, China

Oral communication

Chairman: Yuanming Zhang

15.05 – 15.20 **Industrial ecosystems and their relationship with natural ecosystems (decontamination, decarbonisation, circular economy, etc.): The need for industrial diplomacy**
Christophe Yvetot, United Nations Industrial Development Organization

15.20 – 15.35 **Ecological restoration for sustainable development in China**
Bojie Fu, Research Center for Eco-environmental Sciences, Chinese Academy of Sciences, China

15.35 – 16.05 *Coffee/Tea Break & Group Photo*

Oral communication

Chairman: Pierre Meerts

16.05 – 16.20 **Global-scale responses of the Blue Planet to climate and environmental changes: Implications for Earth's greenhouse gas budgets and the climate system**
Pierre Regnier, Free University of Brussels, Belgium

16.20 – 16.35 **Ecosystems, biodiversity, and climate displacement: The human factor**
Bart Dessein, Royal Academy for Overseas Sciences & Ghent University & Egmont, Belgium

16.35 – 16.50 **Grassland changes over 40 years on the Qinghai–Tibetan Plateau**
Yanfen Wang, University of the Chinese Academy of Sciences, China

16.50 – 17.05 **How to address climate change in dryland ecosystems? Some examples from the field**
Patrick Van Damme, Royal Academy for Overseas Sciences & Ghent University, Belgium & Czech University of Life Sciences Prague, Czech Republic

17.05 – 17.20 **Testimony of twenty years collaborative research between a CAS institute and a Belgian University**
Philippe De Maeyer, Permanent Secretary of the Royal Academy for Overseas Sciences & Ghent University, Belgium

17.20 – 19.30 *Reception*

2ND DAY – TUESDAY SEPTEMBER 9, 2025

Venue: Grand Auditorium, Royal Belgian Institute of Natural Sciences, Rue Vautier/Vautierstraat 29, 1000 Brussels (Belgium)

09.30 – 09.50 *Registration*

09.50 – 10.00 Welcome Address by Michel Van Camp, Director General, Royal Belgian Institute of Natural Sciences, Belgium

Oral communication

Chairman: Pierre Meerts

10.00 – 10.15 **Anthropogenic disturbances and climate change in the eastern tropical Pacific**
Virginie Tilot, Royal Academy for Overseas Sciences & Catholic University of Louvain, Belgium

10.15 – 10.30 **Bioresource of Central Asia and its utilization on ecological restoration of damaged desert ecosystems**
Yuanming Zhang, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China

10.30 – 10.50 *Coffee/Tea Break*

Oral communication

Chairman: Christine Cocquyt

10.50 –11.05 **On the use of ALARO-SURFEX for investigating regional climate of Central Asia regions**
Rafiq Hamdi, Royal Meteorological Institute of Belgium & Ghent University, Belgium

11.05 – 11.20 **Anthropogenic impacts on high-altitude aquatic ecosystems**
Wout Van Echelpoel, Ghent University, Belgium

11.20 – 11.35 **Strong-wind events control barchan dune migration**
Honjing Ren, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China

11.35 – 11.50	**The role of crop wild relatives in generating climate resilience in tropical agriculture** Steven JANSSENS, Meise Botanic Garden & Catholic University of Leuven, Belgium
11.50 – 12.05	**Multi Source Geographic Information for arid land research** Alishir KURBAN, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China
12.05 – 12.20	**Numerical models to assess the effects of anthropic pressures on marine ecosystems** Stéphanie PONSAR & Geneviève LACROIX, Royal Belgian Institute of Natural Sciences, Belgium
12.20 – 13.50	*Lunch Break & Free visit of the Museum of the Royal Belgian Institute of Natural Sciences*

ORAL COMMUNICATION

Chairman: Alishir KURBAN

13.50 – 14.05	**Microbial roles in regulating ecosystem feedback to climate change** Kai XUE, University of the Chinese Academy of Sciences, China
14.05 – 14.20	**Emerging human fascioliasis in Southeast Asia, the role of climate change** Pierre DORNY, Royal Academy for Overseas Sciences & Institute of tropical Medecine, Belgium
14.20 – 14.35	**Tipping points and resilient agriculture: How climate-smart agriculture can meet small-scale farmers** Hossein AZADI, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China
14.35 – 14.50	**Climate-driven thermophilisation reduces carabid beetle richness across scales** San Yin LEEMANS, Royal Belgian Institute of Natural Sciences & Ghent University, Belgium
14.50 – 15.10	*Coffee/Tea Break*

ORAL COMMUNICATION

Chairman: Thierry SMITH

15.10 – 15.25	**Changing biodiversity in Antarctica: From observations to action** Anton VAN DE PUTTE, Royal Belgian Institute of Natural Sciences & Free University of Brussels, Belgium
15.25 – 15.40	**Can One Health help vulnerable communities face climate change?** Nicolas ANTOINE-MOUSSIAUX, Royal Academy for Overseas Sciences & University of Liege, Belgium
15.40 – 15.55	**Multi-scale aeolian sand dynamic processes** Xin GAO, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China
15.55 – 16.10	**Canopy structure and biomass dynamics in tropical forest ecosystems: Climate change, forest resilience, remote sensing and AI for ecological monitoring** Nadine BAHIZIRE AKOKO, Catholic University of Louvain, Belgium
16.10 – 16.25	**Identification of dominant atmospheric pollutants and their sensitivity to soil moisture in urban agglomerations of Northwest China** Jinglong LI, Xinjiang Normal University, China

3RD DAY – WEDNESDAY SEPTEMBER 10, 2025

Venue: Ilya Prigogine conference room, Palace of the Academies, Rue Ducale/ Hertogstraat 1, 1000 Brussels (Belgium)

09.00 – 09.30	*Welcome Coffee/Tea*
	ORAL COMMUNICATION
	Chairman: Virginie TILOT
09.30 – 09.45	**Digital twin technologies to study Ecosystems in a changing world** Stef LHERMITTE, Catholic University of Leuven, Belgium
09.45 – 10.00	**Technological Innovation and Application in Ecological Conservation in Xinjiang, China** Jiaqiang LEI, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China
10.00 – 10.15	**Modeling the carbon and water cycle of Congo Basin forests** Hans VERBEECK, Ghent University, Belgium
10.15 – 10.30	**Refining carbon and water fluxes at the weather station scale** Haiyang SHI, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China
10.30 – 10.50	*Coffee/Tea break*
	ORAL COMMUNICATION
	Chairman: Kai XUE
10.50 – 11.05	**Applications of plant diversity: From desert botanical gardens to the 3046 km Edge - locking project around the Taklimakan desert** Jinglong FAN, Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China
11.05 – 11.20	**Intensive aquaculture at a turning point: From monoculture to integrated systems, or ecological aquaculture** Patrick SORGELOOS, Royal Academy for Overseas Sciences & Ghent University, Belgium
11.20 – 11.35	**Peatlands as climate allies: Pathways to climate resilience and biodiversity** Maud RAMAN, Research Institute for Nature and Forest, Belgium
11.35 – 11.50	**Global climate impacts of methane seeps (CliMetS)** Pei-Yuan QIAN, Hong Kong University of Science and Technology, China
11.50 – 12.05	**Global alternatives in natural vegetation cover** Jean-François BASTIN, University of Liege, Belgium
12.05 – 13.30	*Lunch & Discussions*

ABSTRACT BOOK

1ST DAY

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MONDAY SEPTEMBER 8, 2025

Ecosystems in a changing world
Royal Academy for Overseas Sciences,
Royal Belgian Institute of Natural Sciences
Chinese Academy of Sciences
Brussels, 8-10 September 2025

Industrial ecosystems and their relationship with natural ecosystems (decontamination, decarbonisation, circular economy, etc.): The need for industrial diplomacy

Christophe Yvetot[1,*]

KEYWORDS. — Clean Industrial Eco-Systems; Decontamination; Decarbonization; Circular Economy; Industrial Diplomacy.

ABSTRACT. — In our changing world, the relationship between industrial and natural ecosystems stands at the heart of the global sustainability challenge. Industry has long been a source of progress, jobs, and innovation, but it has also placed heavy pressure on the planet through pollution, carbon emissions, and resource depletion. The crucial question today is how to transform industry from part of the problem into part of the solution.

Industrial ecosystems are evolving. They are becoming laboratories of sustainability, offering pathways to reconcile human prosperity with planetary boundaries. Three transformative trends are particularly significant:

- Decontamination: advanced industrial processes are reducing pollutants and enabling the cleaning of air, water, and soils.
- Decarbonisation: industries are transitioning to low-carbon energy sources, adopting clean hydrogen, electrification, and carbon capture.
- Circular economy: the shift from linear production to closed loops is turning waste into resources, easing the pressure on natural ecosystems.

Yet, these transformations cannot occur in isolation. They require international cooperation, aligned standards, shared technologies, and innovative financing. This is where industrial diplomacy becomes indispensable.

Industrial diplomacy is a new approach that seeks to reconcile economic growth, environmental protection, and geopolitical stability. It builds bridges between governments, businesses, investors, researchers, and citizens. It ensures that the green transition is not fragmented but inclusive, giving developing countries access to clean technologies and opportunities for industrial transformation.

By embedding sustainability into the fabric of industrial ecosystems, and by embedding diplomacy into the governance of industry, we can foster a new form of multilateralism. One where industry is not the adversary of nature but a partner in its regeneration.

The imperative is clear: only by reconciling industrial and natural ecosystems can we build a future where prosperity and sustainability advance together.

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Ecosystems in a changing world
Royal Academy for Overseas Sciences,
Royal Belgian Institute of Natural Sciences
Chinese Academy of Sciences
Brussels, 8-10 September 2025

Ecological restoration for sustainable development in China

Bojie Fu[1,*]

KEYWORDS. — Social-Ecological System; Landscape Pattern; Ecological Process; Ecosystem Services; Sustainable Livelihoods.

ABSTRACT. — Facing the need for transdisciplinary research to promote ecological restoration that achieves both social and ecological benefits, past restoration efforts that have directly or indirectly contributed to regional or national sustainable development warrants reassessment. Using China as an example, we address three basic research questions that can be summarized as follows: ecological restoration — of what, for whom and to what purpose? China's ecological restoration has evolved toward greater spatial integration, from the strategic pattern of national ecological security to the pattern of major projects to protect and restore major national ecosystems. From major function-oriented zoning to systematic ecological protection and restoration, and for the purpose of achieving the Beautiful China Initiative, there are three stages of ecosystem services management: classification, synergy and integration, respectively. We then analyze the benefits and challenges of ecological restoration in China. Findings indicate that restoration programs have greatly influenced ecosystem services, especially carbon sequestration, soil conservation, sand fixation, and water yield, and their interactions, and it is clear that some spatiotemporal trade-off relationships need to be considered. To summarize successful practices and lessons, we propose a 'landscape pattern — ecosystem service — sustainable development' framework to evaluate landscape-scale ecological restoration and its impact on landscape patterns and ecological processes, ecosystem services for human well-being, and sustainable livelihoods and socioeconomic development. Applied to China's Loess Plateau, a region historically plagued by severe soil erosion but achieving successful restoration in recent decades, the framework identifies three pathways to escape the social-ecological trap in the 21st century: (1) implementing site-specific engineering measures (*e.g.* terraces and check dams in the Loess Plateau), (2) investing in ecological restoration programs, and (3) promoting urbanization and livelihood diversity.

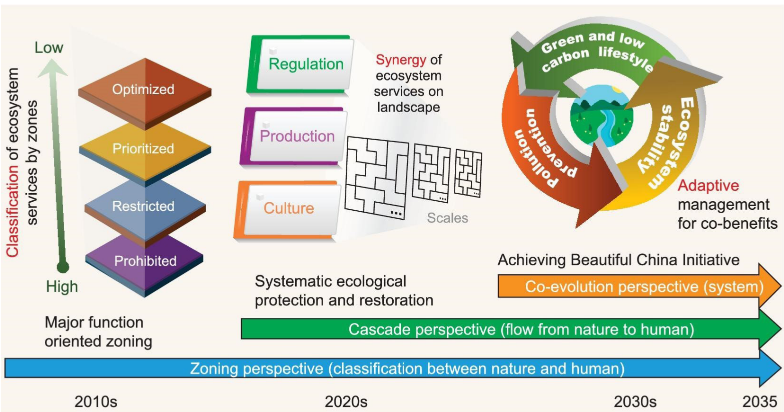

Fig. 1. — Ecological restoration at different stages.

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Ecosystems in a changing world
Royal Academy for Overseas Sciences,
Royal Belgian Institute of Natural Sciences
Chinese Academy of Sciences
Brussels, 8-10 September 2025

Global-scale responses of the Blue Planet to climate and environmental changes: Implications for Earth's greenhouse gas budgets and the climate system

Pierre Regnier[1,*]

KEYWORDS. — Climate-Carbon Cycle Feedbacks; Greenhouse Gases; Inland Waters; Coastal Ocean; Earth System Science; Data Science & AI; Process-Based Modelling.

ABSTRACT. — The need to improve the representation of the variability and trends in the transport of carbon (and nutrients) through the land-to-ocean aquatic continuum (LOAC) has been identified as a major knowledge gap in the 6th assessment report of the IPCC (Canadell *et al.*, 2021). This incomplete knowledge limits our ability to quantitatively constrain the global budgets of anthropogenic greenhouse gases (GHG: CO_2, CH_4, N_2O) and, ultimately, climate projections. We here briefly review the role of the LOAC in the Earth's GHG budgets, not only for the present-day fluxes, but also for their anthropogenic perturbations, which result from complex interactions between global change factors (climate and atmospheric composition change) and direct human alterations (*e.g.*, land-use change, hydraulic management). We highlight some major progress recently achieved through combination of data-science, Earth observations and machine-learning, as well as the emerging role of Earth system modeling in the field of LOAC research. Using CO_2 as a blueprint, we advocate for a new view of the global carbon cycle that explicitly accounts for LOAC processes, from canopy to open ocean (Regnier *et al.*, 2022). The need for community-based ensemble assessments relying on multi-methodological approaches to constrain uncertainties is also stressed, and major remaining knowledge gaps in LOAC science are identified.

REFERENCES

CANADELL, J.G., MONTEIRO, P.M.S., *et al*. (2021) Global Carbon and other Biogeochemical Cycles and Feedbacks. IPCC AR6 WGI, Chapter 5.

REGNIER, P., RESPLANDY, L., NAJJAR, R. G., & CIAIS, P. (2022). The land-to-ocean loops of the global carbon cycle. Nature, 603(7901), 401–410. https://doi.org/10.1038/s41586-021-04339-9.

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Ecosystems in a changing world
Royal Academy for Overseas Sciences,
Royal Belgian Institute of Natural Sciences
Chinese Academy of Sciences
Brussels, 8-10 September 2025

Ecosystems, biodiversity, and climate displacement: The human factor

Bart Dessein[1,*]

KEYWORDS. — Climate Refugees; Global Warming; China; European Union.

ABSTRACT. — Our current world is facing major changes of natural environments due to human-invoked activities: global warming, deforestation, flooding, and contamination of air, water and soil. These have unprecedented effects on biodiversity and are jeopardizing the sustainability of human life. According to figures released by the European Parliamentary Research Service in 2023, since 2008, over 376 million people have been displaced as a result of climate disasters. This is the equivalent of one person being displaced every second. A record high of 'climate refugees' was reached in 2022, which, for that year, reached the number of 32.6 million individuals. Since 2020, the number of 'climate refugees' has increased at an annual average rate of 41 %. This phenomenon does not only apply to countries of the so-called 'Global South', but its effects are increasingly felt worldwide. It is clear that the interconnected phenomena of changes in natural ecosystems and biodiversity on the one hand, and human displacement on the other hand, are becoming an increasingly global phenomenon. It is therefore necessary that the major global actors join forces to prevent further natural degradation.

This contribution will focus on the fight against global warming and the possibilities of the European Union and China, two of the world's largest emitters of greenhouse gasses, to collaborate in the domain of climate change governance.

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Ecosystems in a changing world
Royal Academy for Overseas Sciences,
Royal Belgian Institute of Natural Sciences
Chinese Academy of Sciences
Brussels, 8-10 September 2025

Grassland changes over 40 years on the Qinghai–Tibetan Plateau

Yanfen WANG[1,*]

KEYWORDS. — Grassland; Historical Change; Plant Community Structure; Qinghai-Tibetan Plateau.

ABSTRACT. — The grasslands of the Qinghai–Tibetan Plateau (QTP) serve critical functions, *e.g.* sustaining biodiversity, acting as vital carbon sinks, maintaining ecological productivity, and supporting pastoral economies. These fragile systems face transformative pressures from concurrent climate change and human interventions, though the relative dominance of these drivers remains contested. We examined four decades of grassland evolution (post-1980s) and evaluated global change impacts on vegetative community productivity (Wang *et al.*, 2022) and structure (Wang *et al.*, 2023). 1) Satellite-derived normalized difference vegetation index (NDVI) data — a proxy for photosynthetic activity — revealed overall greening trends since the 1980s, yet with marked spatial heterogeneity and localized declines. While rising temperatures emerge as the primary driver of NDVI increases, thermal amplification has paradoxically intensified water stress in arid regions (<100 mm annual precipitation), partially explaining geographic disparities in vegetation responses. 2) Structural information of grassland changes on the Tibetan Plateau is essential for understanding alterations in critical ecosystem functioning and their underlying drivers that may reflect environmental changes. However, such information at the regional scale is still lacking due to methodological limitations. Beyond remote sensing indicators only recognizing vegetation productivity, we utilized multivariate data fusion and deep learning to characterize formation-based plant community structure in alpine grasslands at the regional scale of the Tibetan Plateau for the first time and compared it with the earlier version of Vegetation Map of China for historical changes.

REFERENCES

WANG Y.F., LV, W.W., XUE, K., WANG, S.P., ZHANG, L.R., HU, R.H., ZENG, H., XU, X.L., LI, Y.M., JIANG, L.L., HAO, Y.B., DU, J.Q., SUN, J.P., DORJI, T., PIAO, S.L., WANG, C.H., LUO, C.Y., ZHANG, Z.H., CHANG, X.F., ZHANG, M.M., HU, Y.G., WU, T.H., WANG, J.Z., LI, B.W., LIU, P.P., ZHOU, Y., WANG, A., DONG, S.K., ZHANG, X.Z., GAO, Q.Z., ZHOU, H.K., SHEN, M.G., WILKES, A., MIEHE, G., ZHAO, X.Q. & NIU, H.S. (2022). Grassland changes and adaptive management on the Qinghai-Tibetan Plateau. *Nature Reviews | Earth & Environment*, 3, 668-683.

WANG, Y.F., XUE, K., HU, R.H., DING, B.Y., ZENG, H., LI, R.J., XU, B., PANG, Z., SONG, X.N., LI, C.J., DU, J.Q., YANG, X.C., ZHANG, Z.L., HAO, Y.B., CUI, X.Y., GUO, K., GAO, Q.Z., ZHANG, Y.J., ZHU, J.T., SUN, J., LI, Y.M., JIANG, L.L., ZHOU, H.K., LUO, C.Y., ZHANG, Z.H., GAO, Q.B., CHEN, S.L., JI, B.M., XU, X.L., CHEN, H., LI, Q., ZHAO, L., XU, S.X., LIU, Y.L., HU, L.Y., WU, J.S., YANG, Q., DONG, S.K., HE, J.S., ZHAO, X.Q., WANG, S.P., PIAO, S.L., YU, G.R., FU, B.J. (2023). Vegetation structural shift tells environmental changes on the Tibetan Plateau over 40 years. *Science Bullutin,* 68(17), 1928-1937.

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Ecosystems in a changing world
Royal Academy for Overseas Sciences,
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Brussels, 8-10 September 2025

How to address climate change in dryland ecosystems? Some examples from the field

Patrick Van Damme[1,*] & Wouter Vanhove[2]

KEYWORDS. — Climate Change; Water Harvesting Techniques; Sahel; Dryland Areas; Africa.

ABSTRACT. — Although models – that often use different assumptions – predict different scenarios of climate change (CC) impact on local climates and weather conditions, it is only fair to assume that the climate in dry areas will become harsher, i.e. hotter and drier with less frequent but heavier rains that may in some areas result in higher annual rainfall figures. At the level of natural resources, this will negatively impact natural vegetation, and crop and animal production. Interventions should increase natural vegetation resilience, and will involve compensatory planting (re- or afforestation) in areas where the original vegetation has (all but) disappeared (through direct seeding or planting of nursery-grown plants) or assisted natural regeneration (ANR; leverages existing natural regeneration already occurring on degraded lands by protecting young trees from threats such as fire, grazing animals, or human disturbance rather than actively planting new trees) in combination with water harvesting techniques (WHT) to catch run-off rain water (harvest) for direct use or (deep-) soil storage. Whatever approach is selected it is our contention that these technical solutions will remain unsuccessful unless applied with the commitment and buy-in of the local communities in whose areas they are implemented. Instilling a feeling of ownership is a *conditio sine qua non* for successful re/afforestation. Or: planting trees is not about… planting trees, but about active beneficiaries' involvement.

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Ecosystems in a changing world
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Testimony of twenty years collaborative research between a CAS institute and a Belgian University

Philippe De Maeyer[1,*]

KEYWORDS. — Sino-Belgian Joint Laboratory for Geo-Information; XIEG; UGent; UCAS; PIFI.

ABSTRACT. — The Ghent University's geography department and the Xinjiang Institute of Ecology and Geography have been working together for 20 years in various areas of research. What began as a chance meeting at a summer school has since led to the promotion of more than thirty five co-supervised PhDs and the publication of more than 170 articles referenced on the Web of Science with authors from both institutes.

A large part of the research was carried out within the framework of a structure called Sino-Belgian Joint Laboratory for Geo-Information. Research topics mainly cover the evolution of ecosystems and climate change, but also include landscape evolution, geoarchaeology and urban issues. During this twenty-year period of joint work, we have seen a shift in the regions studied towards the west (from Xinjiang to Central Asia).

All these researches have only been possible thanks to funding from the Chinese side from the CSC on the one hand, and the CAS on the other hand, specifically in recent years through the Presidents' International Fellowship Initiative (PIFI). The second part of the presentation will look at Belgo-Chinese funding opportunities.

[1] Ghent University (UGent); Royal Academy for Overseas Sciences (RAOS); University of the Chinese Academy of Sciences (UCAS).

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2ND DAY

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TUESDAY SEPTEMBER 9, 2025

Ecosystems in a changing world
Royal Academy for Overseas Sciences,
Royal Belgian Institute of Natural Sciences
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Brussels, 8-10 September 2025

Anthropogenic disturbances and climate change in the eastern tropical Pacific

Virginie TILOT[1,*]

KEYWORDS. — Eastern Tropical Pacific; Global Change; Anthropogenic Impacts; Marine Mammal Communities and Distribution; Temporal and Spatial Megafauna Migrations; Pelagic Eco-Systems; Biodiversity Conservation and Management; Ocean Governance; Ecosystem Approach.

ABSTRACT. — There is growing evidence that marine mammal communities and other apex predators play a critical role in the provision of numerous ecosystem services, ranging from climate regulation and nutrient cycling to globally healthy oceans and services to human societies, Their vulnerablity to natural and anthropogenic impacts, in particular to navigation, by-catch fishing, plastic pollution, deep-sea mining… and climate change, needs to be assessed and mitigation measures proposed.

As these apex communities migrate on varying patterns over great distances, conservation measures should *be flexible in space and time and actions and initiatives should be coordinated* on regional basis with an ecosystem approach, (Hoyt, 2011).

We then propose adapted conservation strategies and domains of research to enhance to ensure their well-being and the continuity of the ecosystem services they provide to the oceans and human societies in integration with other fields of ocean management.

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Ecosystems in a changing world
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Bioresource of Central Asia and its utilization on ecological restoration of damaged desert ecosystems

Yuanming ZHANG[1,*]

KEYWORDS. — Central Asia; Desert Ecosystems; Biological Resources; Ecological Restoration; International Cooperation.

ABSTRACT. — Central Asia is a region with distinct biological and geographical features, abundant in biological resources. It encompasses approximately 9520 species of higher plants, a large number of endemic species, and diverse ecosystems such as deserts, semi - deserts, and steppes. It serves as a global biodiversity hotspot and the origin and differentiation center for numerous species. However, the ecological environment in Central Asia has degraded severely, facing issues like soil salinization, sand encroachment, aeolian desertification, and grassland degradation. To counter these problems, local bioresources are being harnessed for ecological restoration. For instance, the artificial cultivation technique of Cistanche has been developed. Halophytes play a crucial role in improving heavy saline - alkali soil, remediating petroleum - contaminated soil, and managing the ecological problems of the Aral Sea. In sand disaster control projects like the green corridor across the Taklimakan Desert, suitable plant species have been selected, and optimized combination patterns have been established. Additionally, biological soil crusts are significant in the region's ecological restoration. They contribute to the carbon and nitrogen cycle, enhance surface stability, affect the hydrological process, and influence biodiversity.

Looking ahead, international cooperation is of great significance. It involves scientific research, green technology experiment demonstration, and capacity building, aiming to achieve sustainable development and ecological restoration in the region. This study offers a comprehensive overview of Central Asia's biological resources and their utilization in ecological restoration, emphasizing the importance of international collaboration for a better ecological future.

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Ecosystems in a changing world
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On the use of ALARO-SURFEX for investigating regional climate of Central Asia regions

Rafiq HAMDI[1,*]

KEYWORDS. — Climatology; ALARO; SURFEX; Models; Central-Asia.

ABSTRACT. — The ALARO-SURFEX regional climate model is applied for the first time over Central Asia. Two domains have been defined one centred over the Xinjiang region and the second one over the Aral Sea region. A first localization of the regional model has been applied to both regions using updated land use and land cover dataset. A second localization has been applied by implementing the drip irrigation system using mulch plastic. Our results suggest that high resolution climate runs are necessary for the study of regional climate in the north of Tianshan mountains and this presentation will show new finding on (*i*) the impact of agricultural intensification on the local water cycle, (*ii*) on the impact of the irrigation practice on the regional climate around Xinjiang and, (*iii*) on the impact of the Aral Sea shrinking on the summer climate.

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Ecosystems in a changing world
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Royal Belgian Institute of Natural Sciences
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Brussels, 8-10 September 2025

Anthropogenic impacts on high-altitude aquatic ecosystems

Wout Van Echelpoel[1,*], Peter L.M. Goethals[1] & Henrietta Hampel[2]

KEYWORDS. — Freshwater; Assessment; Impact; Ecuador; Andes.

ABSTRACT. — Climate change is rapidly reshaping freshwater systems around the world through the acceleration of glacial retreat and the alteration of precipitation patterns, causing disruptions of the hydrological cycle. These transformations threaten water security and ecological integrity worldwide, causing concern for human and environmental health. In addition, local changes due to alterations in land use (including deforestation, agricultural expansion, and urbanization) affect sedimentation and nutrient dynamics, which further impact water quality downstream. In high-altitude freshwater systems, these impacts are particularly acute due to the potential destabilization of the prevailing delicate balance of alpine aquatic ecosystems. Monitoring and understanding the state of these high-altitude systems is therefore of utmost importance to implement responsible water resource policies. This study examines the impact of two anthropogenic pressures on the high-altitude Paute river in the province of Azuay, Ecuador. Over the course of two years, eight sampling campaigns were conducted to monitor the impact of (1) the city of Cuenca and (2) the downstream hydropower-based reservoir on (1) the abiotic water quality and (2) the associated greenhouse gas (GHG) emissions of the Paute river. The observed conditions were assessed visually to infer differences in river water quality in space (upstream versus downstream) and/or time (normal versus dry conditions). The obtained results show that (1) the study region experienced unprecedented dry periods, (2) the urban area of Cuenca causes elevated nutrient concentrations and GHG emissions in the river Paute, and (3) the downstream reservoir supports a reduction in nutrient levels and GHG emissions. Moreover, periods of drought showed to increase both nutrient levels and GHG emissions. Additional investments to improve treatment efficiency and extend treatment capacity are essential factors to safeguard human and environmental health, while studies on substance balances and the development of ecological models are needed to support environmental decision-making that underlies such management.

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Ecosystems in a changing world
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Strong-wind events control barchan dune migration

Honjing REN[1], Xin GAO[1,2,*], Jiaqiang LEI[1,2], Philippe DE MAEYER[3] & Alain DE WULF[3]

KEYWORDS. — Barchan Dunes; Strong Wind Events; Aeolian Dynamic Process; Contribution Rate.

ABSTRACT. — Wind is the most important external force in shaping aeolian landforms. Yet, it remains unclear what role the strong-wind events will play in the development of aeolian landforms compared with the effect of regular winds. A fundamental question is, what are the contributions of different wind speed levels to the deformation of aeolian landforms.

Here, through *in situ* measurements of high-sampling-rate wind data and high-resolution topographic data, we analyzed short-term strong-wind events at different levels and monitored the rapid migration of barchan dunes, enabling us to provide a first report on the contribution rate of short-term strong winds to dune migration. Leveraging the linear relationship between sand flux and the migration distance of barchans, we found that the ratio of sand flux generated by short-term strong winds to the total sand flux is equal to the ratio of barchan migration distance caused by strong winds to the total migration distance in the same period. Moreover, a global analysis of three typical barchan fields confirmed the relationship.

This study demonstrates that the development of aeolian landforms is dominantly controlled by short-term strong-wind events rather than the traditionally emphasized time-averaged winds. Such strong winds are also the primary drivers of frequent aeolian disasters in arid and semi-arid regions, where the protective effect of conventional sand control projects often falls short, as severe sandstorms can rapidly mobilize dunes and bury sand barriers. These findings highlight the need to pay closer attention to the turbulence processes of strong-wind events and their dynamic role in shaping aeolian landforms. Advancing this line of research will be crucial not only for deepening our understanding of aeolian geomorphology but also for improving strategies to mitigate wind-blown sand hazards in vulnerable desert regions.

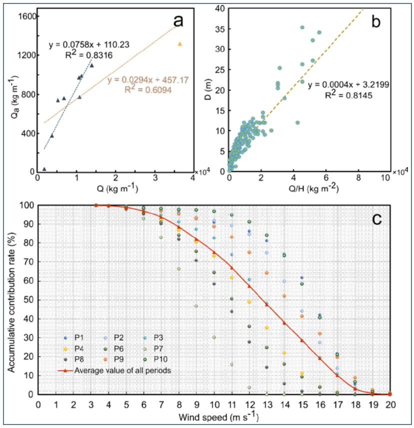

Fig. 1. — **a** High correlation of sand flux by comparing low-frequency measurements with BSNE traps (*Qa*) to high-frequency model calculations (*Q*). **b** Significant linear correlation between *Q/H* and *D*. **c** The contribution rate of different levels of wind speeds to the migration distance during different periods.

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The role of crop wild relatives in generating climate resilience in tropical agriculture

Steven JANSSENS[1,*]

KEYWORDS. — Agrobiodiversity; Crop Wild Relatives; Climate Resilience; Conservation; Genetic resources.

ABSTRACT. — Climate change increasingly threatens tropical agroecosystems due to elevated temperatures, altered rainfall regimes, and intensified biotic pressures. Conventional cultivars of staple and cash crops often lack the genetic variability required to withstand such stressors. Crop wild relatives (CWRs) hold an interesting set of adaptive traits, which have evolved over time under a range of heterogeneous and continuously changing environmental conditions. Their underlying genomic resources can be mobilized to enhance abiotic stress tolerance (drought, heat, salinity) and biotic resistance (pathogens, pests) in domesticated crops. Advances in molecular breeding, introgression strategies, and genome-enabled selection provide unprecedented opportunities to exploit this diversity for climate-resilient agriculture.

Illustrative cases across tropical crops demonstrate this potential. Bananas, coffee, vanilla, and beans are striking examples where each crop has wild counterparts that offer traits vital for coping with stress tolerance, disease resistance, or improved nutritional quality or taste. These cases exemplify how targeted use of crop wild relatives can reinforce both agricultural productivity and food security in the tropics. In this regard it is important to understand the dual urgency of conserving wild genetic diversity in situ and ex situ, and of integrating CWRs into systematic breeding pipelines. Mobilizing this underexploited biodiversity is central to safeguarding productivity, stability, and sustainability of tropical agriculture under accelerating climate change.

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Multi Source Geographic Information for arid land research

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KEYWORDS. — Geographic Information; Remote Sensing; Arid Land; Land Surface Mapping.

ABSTRACT. — Arid lands cover vast regions where scarce water, extreme temperatures, and sparse vegetation complicate observation, monitoring, and management. This presentation demonstrates how integrating multi source geographic information — combining historical documents, satellite remote sensing, in situ measurements, geospatial datasets, and process-based models — enhances land surface mapping and environmental assessment in arid environments. We outline a modular workflow that fuses multi-temporal optical and SAR imagery with climatological, topographic, and soil datasets to derive key indicators of surface conditions, including albedo, land surface temperature, soil moisture proxies, vegetation structure, and surface roughness. Methods include physics-based retrievals, machine learning for gap-filling and data fusion, and uncertainty propagation to quantify confidence in mapped products. Some case studies from representative arid regions illustrate improvements in delineating land cover/land use, detecting vegetation changes, surface dynamics mapping ecohydrological patterns at multiple scales. The approach supports decision-making for rangeland stewardship, desertification control, and water resource management by delivering reproducible, uncertainty-aware land surface maps tailored to arid land research.

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Numerical models to assess the effects of anthropic pressures on marine ecosystems

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KEYWORDS. — Marine ecosystems; Numerical modelling; North Sea; South-China Sea.

ABSTRACT. — Marine ecosystems face growing pressures that disrupt their physical, biological, and chemical processes. Climate change is driving significant shifts -such as rising sea levels, ocean acidification, and increasing water temperatures- which in turn alter biodiversity, species distribution, and biomass. These environmental stresses are further compounded by chemical pollution from plastics, toxic substances, and emerging contaminants.

While observations provide valuable data to quantify these impacts, they often have limited spatial and temporal coverage. Models, on the other hand, offer both high spatial and temporal resolution but are not without limitations, such as numerical inaccuracies or insufficient process detail. Nevertheless, they serve as essential tools for forecasting ecosystem changes and evaluating mitigation strategies based on observed impacts.

The ECOMOD team at the Royal Belgian Institute of Natural Sciences has developed an integrated modeling tool specifically designed for coastal environments. The COHERENS (https://ecomod.be/tools/COHERENS/) model (COupled Hydrodynamic and Ecological model for REgioNal Shelf seas) is a collaborative, open-source numerical model. Built around a hydrodynamic core, it includes multiple compartments to simulate complex marine systems. In this presentation, we will showcase a range of applications of the COHERENS model, from assessing the impacts of offshore infrastructure to studying eutrophication and pollutant transport. These case studies span diverse regions, including the Belgian part of the North Sea and the South China Sea, with a particular focus on eutrophication challenges and nutrient reduction efforts in Halong Bay.

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Microbial roles in regulating ecosystem feedback to climate change

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KEYWORDS. — Grassland; Climate Change; Ecosystem Feedback; Mcirobial Community.

ABSTRACT. — Global climate change has profoundly impacted ecosystems, and in turn, ecosystem responses to climate change can lead feedbacks to influence future climate trajectories. Microorganisms play a critical role in mediating these ecosystem-climate feedbacks, yet their functional contributions remain relatively understudied. Here, I present that climate warming and the resulting permafrost degradation significantly alter microbial functions and the carbon cycle. A long-term warming experiment in a tallgrass prairie revealed that warming increased the abundance of microbial genes involved in labile carbon degradation, while maintaining stable levels of genes associated with recalcitrant carbon decomposition. This suggests a potential negative feedback mechanism that may help stabilize soil carbon pools under warming. In contrast, a short-term warming experiment in a tundra ecosystem showed increased abundance of genes related to recalcitrant carbon degradation, highlighting the vulnerability of this ecosystem to warming and indicating a positive feedback to climate change. Furthermore, an alpine permafrost study in the Qilian Mountains found that permafrost degradation weakens the robustness of microbial co-occurrence networks. Notably, a 10% shift in microbial community dissimilarity correlates with a 0.1–1.5% change in active layer carbon stocks in highly unstable or unstable permafrost regions, providing a quantitative indicator of ecosystem feedback intensity. These findings offer critical scientific insights and practical guidance for grassland ecosystem conservation, restoration of degraded landscapes, and adaptive strategies in response to ongoing climate change.

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Ecosystems in a changing world
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Emerging human fascioliasis in Southeast Asia, the role of climate change

Pierre DORNY[1,*]

KEYWORDS. — Fascioliasis; Southeast Asia; Climate Change.

ABSTRACT. — Fascioliasis is a parasitic disease caused by the flatworms *Fasciola hepatica* and *F. gigantica*. These helminths infect herbivorous mammals and need amphibian/aquatic lymnaeid snails to complete their lifecycle. The parasite develops to an egg laying adult stage in the bile ducts of the mammalian host. Eggs are shed with the hosts' feces in the environment where they embryonate and hatch, releasing a larva that will infect snails. The parasite multiplies in the snail resulting in the release of cercaria larvae that encyst on vegetation to the infective metacercaria stage. Final hosts get infected when consuming contaminated plants. *F. hepatica* occurs in temperate regions, while *F. gigantica* is confined to tropical regions of Asia and Africa.

Fascioliasis is among the most common parasitic infections in ruminants in which it causes liver disease and serious production losses. Sporadic human infections have been reported since long in most endemic areas in the world, including Western Europe. Human infection is characterized by acute or chronic hepatic disease. In the last decades emergence of fascioliasis has been observed in several parts of the world, particularly in the Andean region, Egypt, the middle East and Southeast Asia. Fascioliasis has been included in WHO's list of neglected tropical diseases. Reasons for the observed emergence are not well understood and may differ between regions. In Southeast Asia the habit of eating raw salads made up of aquatic plants is an important risk factor for acquiring fascioliasis. However, other factors such as, hybridization of *Fasciola* spp., drug resistance and climate change have been suggested to contribute to the emergence. Higher temperatures and flooding resulting from tropical storms hitting the region may create better ecological conditions for snails and the development of the parasite in the snail. *In vivo* and *in vitro* studies are required to unravel the epidemiological drivers of the emergence and develop sustainable control options.

REFERENCES

LE, T. H., DE, N. V., AGATSUMA, T., NGUYEN, T.G.T, NGUYEN, Q. D., MCMANUS, D. P. & BLAIR, D. (2008). Human fascioliasis and the presence of hybrid/introgressed forms of *Fasciola hepatica* and *Fasciola gigantica* in Vietnam. *International Journal for Parasitology*, 38, 725-730.

MAS-COMA, S., VALERO, M. A. & BARGUES, M. D. (2009). Climate change effects on trematodiases, with emphasis on zoonotic fascioliasis and schistosomiasis. *Veterinary Parasitology*, 163, 264-280.

MAS-COMA, S., BARGUES, M. D. & VALERO, M. A. (2018). Human fascioliasis infection sources, their diversity, incidence factors, analytical methods and prevention measures. *Parasitology*, 145, 1665-1699.

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Tipping points and resilient agriculture: How climate-smart agriculture can meet small-scale farmers

Hossein AZADI[1,2,*]

KEYWORDS. — Human-Environment Interface; Adaptation and Mitigation; Vulnerability; Early Warning Systems; Livelihood, Small-Scale Farmers.

ABSTRACT. — Agriculture has faced growing risks from climate change, where small environmental shifts can trigger irreversible critical tipping points, threatening productivity, adaptation, and mitigation coping mechanisms. Small-scale farmers, who are particularly vulnerable, often lack timely and accessible early warning mechanisms to mitigate these risks. This discrepancy highlights a significant gap, particularly in aligning Climate-Smart Agriculture (CSA) with the actual capabilities and practices of these poor farmers. To fill this gap, this study introduces, the “Tip-Tap early warning system”, an innovative, proactive monitoring framework designed to anticipate and prevent climate tipping points before they occur, which is defined as a “tapping point” that refers to critical moments when early warning interventions can prevent climate-related tipping points. The Tip-Tap system identifies and responds to these tapping points to enhance climate resilience. By integrating farmers’ livelihood pentagon assets (natural, social, physical, human and financial) with real-time climate data, machine learning, GIS-based spatial analysis, and predictive modeling, this system provides actionable early warnings designed to address the specific needs of small-scale farmers. Unlike traditional reactive systems that respond passively after climate change incidents, the Tip-Tap warning system empowers farmers to implement adaptive strategies actively before these incidents by safeguarding their livelihoods and enhancing the resilience of their farming systems. This early warning system aligns with the concept of Vulnerable-Smart Agriculture (VSA), which prioritizes farmers’ vulnerabilities and adaptive capacities over generic CSA strategies. Through continuous climate risk assessment, threshold mapping, and localized advisory services delivered via mobile apps, SMS, and community networks, the study aims to transform early warning systems into a practical tool for sustainable farming. Accordingly, the study bridges the gap between climate forecasting and real-world decision-making, fostering climate resilience, and assuring long-term agricultural sustainability and food security.

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Ecosystems in a changing world
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Climate-driven thermophilisation reduces carabid beetle richness across scales

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KEYWORDS. — Ecology; Resurvey; Trait-based Analysis; Temperate Forests; Belgium.

ABSTRACT. — Climatic warming is reshaping biodiversity by shifting species distributions and altering community composition, yet its effects on species richness across spatial scales remain unclear. Carabid beetles, a diverse and ecologically important insect group, provide an ideal system to investigate these dynamics. This study addresses how climate-driven thermophilisation—favouring warm-affiliated over cold-affiliated species—affects biodiversity in temperate forests.

We resurveyed 54 forest plots in Belgium after 25 years to quantify changes in carabid beetle communities. Community composition shifted consistently, with a marked decline in cold-affiliated species that drove thermophilisation in 83 % of sites and explained 22 % of total community turnover. Across local and regional scales, species richness declined significantly, driven primarily by the loss of cold-affiliated species without compensatory increases in warm-affiliated species. Rarefied richness of cold-affiliated species also decreased, possibly reflecting local extinctions of poor-dispersing taxa.

These findings demonstrate that recent climatic change is a key driver of arthropod biodiversity loss in temperate forests. By revealing consistent thermophilisation and associated richness declines across spatial scales, this work underscores the vulnerability of cold-affiliated forest species to ongoing warming and highlights the importance of long-term resurveys in detecting biodiversity change.

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Changing biodiversity in Antarctica: From observations to action

Anton Van de Putte[1,2,*], Yi Ming Gan[2], Charlie Plasman[1]
& Pablo Deschepper[1]

KEYWORDS. — Marine Ecology; Biodiversity Informatics; Data Management; Conservation Policy; Southern Ocean.

ABSTRACT. — The unique biodiversity of Antarctica and the Southern Ocean is facing rapid changes due to increasing human pressures and climate change. Effective management and conservation of this fragile ecosystem require a robust, data-driven approach that moves from scientific observation to actionable policy. The core problem is the need for up-to-date and accurate information on the status of species, communities, and habitats to inform decision-makers and support ecosystem-based management.

A critical approach involves building an integrated system that combines and distributes data to provide timely information for decision-making (Van de Putte *et al*. 2021). This system builds upon existing platforms and standards, utilizing a minimal set of variables, such as Essential Ocean, Climate and Biodiversity Variables (EOVs, ECVs, EBVs). At the core is the SCAR Antarctic Biodiversity Portal, the regional node of both OBIS and GBIF. a key platform for managing and sharing biodiversity data. The system relies on shared protocols and international data standards to ensure data is Findable, Accessible, Interoperable, and Reusable (FAIR principles).

Ultimately, the success of this integrated system that enables effective conservation and policy relies not only on technological change but also on cultural change. By embracing open science principles and ensuring data, algorithms, and tools are shared, we can overcome the challenges of remote data collection and high data volumes to produce the timely assessments necessary for the region's conservation.

REFERENCES

VAN DE PUTTE, A. P. *et al.* (2021). 'From Data to Marine Ecosystem Assessments of the Southern Ocean: Achievements, Challenges, and Lessons for the Future', *Front. Mar. Sci.*, vol. 8, p. 637063, Oct. 2021, doi: 10.3389/fmars.2021.637063.

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Can One Health help vulnerable communities face climate change?

Nicolas ANTOINE-MOUSSIAUX[1,*]

KEYWORDS. — Governance; Disaster Management; Indigenous Knowledge; Pastoral Communities.

ABSTRACT. — Under the leadership of international organizations, One Health is an integrative approach to complex health issues that has gained traction worldwide, going through both political and scientific momentum. This approach promotes interdisciplinary, intersectoral and multilevel collaboration across human, animal, plant and ecosystem health. In the Global South, the approach is gradually translated into governance structures, mainly funded by international donors and pushed by the legally binding International Health Regulations. If the One Health concept originates in the challenge of emerging zoonoses, it undergoes a significant widening of its expected applications and virtues. Hence, the current official definition coined in 2022 by the One Health High Level Expert Panel, convened by the Quadripartite, claims that the approach would allow "taking action on climate change, and contributing to sustainable development". This talk proposes to discuss the expectations of One Health implementation in the context of Asian and African pastoralism, the fragile environments and remote communities of which are much exposed to disastrous effects of climate change. Current efforts to promote the One Health approach in these regions raise critical questions about its value added and reasonable expectations, beyond the welcome utopia of a shared health borne by the concept. In particular, capacity-building initiatives aimed at empowering and collaborating with pastoral communities questions the ethics of such interventions, the role of experts and external actors, as well as of indigenous knowledge, in an approach that is often defended by its proponents as paradigm-changing.

REFERENCE

ONE HEALTH HIGH-LEVEL EXPERT PANEL (OHHLEP), ADISASMITO, W. B., ALMUHAIRI, S., BEHRAVESH, C. B., BILIVOGUI, P., BUKACHI, S. A., *et al*. (2022). One Health: A new definition for a sustainable and healthy future. *PLoS Pathogen*, 18(6), e1010537.

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Multi-scale aeolian sand dynamic processes

Xin GAO[1,2,*]

KEYWORDS. — Wind-Blown Sand Dynamics; Multi-Scale Processes; Aeolian Landforms; Sand Disaster Prevention; Scale Nesting and Process Coupling.

ABSTRACT. — The dynamic process of wind-blown sand exhibits a multi-scale characteristic, mainly focusing on the study of wind-blown sand movement laws, the dynamic process of aeolian landforms, and the mechanism of wind-blown sand disasters as well as their prevention and control. It realizes the full-chain research on scientific issues involved in the wind-blown sand dynamic process, which proceeds as follows: sand particle entrainment → dynamics of wind-sand gas-solid two-phase flow → mutual feedback between wind-sand flow and underlying surface → development process of sandy surface morphology → activation of fixed dunes → dune advancement process → mechanism of wind-blown sand disasters → principles of wind-blown sand control engineering and design principles of prevention projects. As a core research field in aeolian sand science, it focuses on the physical mechanisms of interaction between wind and sand materials, the laws of energy transfer, and environmental effects across different spatial and temporal scales. Its core logic is as follows: small-scale processes (such as the movement of individual sand grains) serve as the foundation for mesoscale phenomena (such as dune migration). Meanwhile, large-scale environments (such as climate fluctuations) indirectly affect small/mesoscale processes by regulating factors like wind fields and sand sources, forming a complex system characterized by "scale nesting and process coupling".

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Identification of dominant atmospheric pollutants and their sensitivity to soil moisture in urban agglomerations of Northwest China

Jinglong LI[1,], Jiawen CUI[2] & Qing HE[3,*]

KEYWORDS. — Atmospheric Environmental Science; Particulate Matter Pollution; Soil Moisture Sensitivity; Remote Sensing; "U-Chang-Shi" Urban Agglomeration.

ABSTRACT. — The development of the emerging "Urumqi-Changji-Shihezi" urban agglomeration in Northwest China has led to increasingly severe atmospheric particulate matter pollution, posing potential threats to climate change and human health. However, the three-dimensional distribution characteristics of atmospheric pollutants in this region remain poorly understood, and their interactions with soil moisture (SM) have not been fully explored. This study analyzes the sensitivity of different types of particulates to soil moisture, with sensitivity defined as the rate of change in particulate matter concentration with respect to variations in soil moisture. Meanwhile, Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) data were used to identify the occurrence frequency of different aerosol types and to construct their three-dimensional distribution. The results show that the sensitivity thresholds of $PM_{2.5}$ and PM_{10} to SM fall within the range of 0.2266-0.2389 m^3/m^3 (excluding the direct influence of precipitation), with coarse particles (PM_{10}) exhibiting higher sensitivity, meaning their concentrations are more strongly influenced by changes in SM. Additionally, by analyzing the distribution of threshold contours, differences in sensitivity across ecological units were identified. Specifically, regions with high SM in mountainous areas showed a negative correlation with particulate matter concentrations due to the suppression of dust suspension under moist conditions, while areas with low SM in deserts and plains (including urban areas) showed a positive correlation, indicating that dry conditions promote particulate resuspension and increase concentrations. Moreover, the atmosphere over the study area is primarily dominated by polluted dust, particularly below 4 km, while polluted continental aerosols are widely distributed below 2 km. This research enhances understanding of the characteristics of atmospheric particulate pollution and its complex interactions with soil moisture in the "Urumqi-Changji-Shihezi" urban agglomeration, providing a scientific basis for developing regional air quality management strategies and addressing climate change challenges.

Note: The results of this article are currently unpublished.

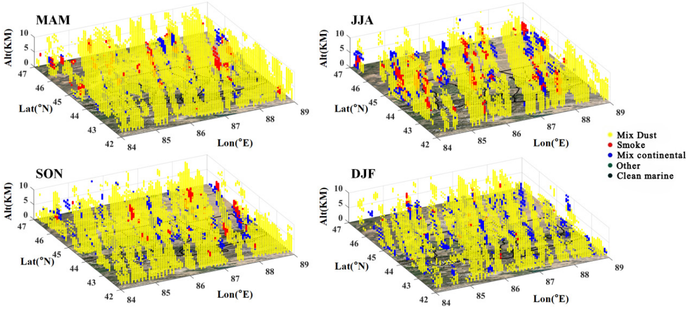

Fig. 1. — Three-dimensional spatial distribution of various aerosol types in the "U-Chang-Shi" region from 2007 to 2022.

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3RD DAY

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WEDNESDAY SEPTEMBER 10, 2025

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Digital twin technologies to study Ecosystems in a changing world

Stef LHERMITTE[1,*]

KEYWORDS. — Digital Twins of the Earth; Ecosystem Modelling; Remote Sensing; Artificial Intelligence.

ABSTRACT. — Digital twin technologies are emerging as a powerful paradigm for studying ecosystems in a rapidly changing world. A digital twin of the Earth — a dynamic, data-driven replica of our planet — offers the potential to simulate, monitor, and predict environmental processes with unprecedented fidelity. As highlighted by Hazeleger *et al*. (2024), these digital twins are not just scientific tools; they are socio-technical systems designed *with and for humans*, enabling participatory decision-making, scenario testing, and adaptive management in the face of climate change and other global challenges.

This presentation explores the role of digital twins in ecosystem science, focusing on their ability to integrate satellite observations, machine learning, and process-based models into interactive platforms. These systems can operate across scales, from global Earth system models to high-resolution twins tailored to specific landscapes. A key strength lies in their capacity to assimilate real-time data and simulate complex interactions between climate, land use, and ecological dynamics.

Dryland ecosystems serve as a compelling example of this approach. These regions are vital for biodiversity, carbon storage, and human livelihoods, yet they are highly vulnerable to climate extremes and land degradation. Traditional monitoring and modeling approaches often fail to capture the fine-scale, dynamic processes that govern dryland resilience. By leveraging very high-resolution satellite imagery, AI-based vegetation mapping, and emulators of land-atmosphere interactions, digital twins can provide detailed insights into tree dynamics, grassland productivity, and causal drivers of ecosystem change.

Through the lens of drylands, this talk will demonstrate how digital twin technologies can support both scientific discovery and societal decision-making. By combining observational data, predictive modeling, and stakeholder engagement, digital twins offer a transformative framework for understanding and managing ecosystems in an uncertain future.

REFERENCES

HAZELEGER, W., AERTS, J.P.M., BAUER, P., …, LHERMITTE, S, … *et al*. (2024) Digital twins of the Earth with and for humans. *Commun Earth Environ*, 5, 463 [https://doi.org/10.1038/s43247-024-01626-x].

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Ecosystems in a changing world
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Technological Innovation and Application in Ecological Conservation in Xinjiang, China

Jiaqiang LEI[1,2,*]

KEYWORDS. — Ecological Conservation; Technological Innovation; Xinjiang, China; Practical Application and Demonstration; Sustainable Land Management.

ABSTRACT. — Ecological construction plays a decisive role in safeguarding environmental stability and promoting sustainable socio-economic development in arid regions. Xinjiang, China, located at the heart of Central Asia's arid belt, has pioneered large-scale ecological practices that integrate desertification control, land restoration, and ecosystem management, providing replicable models for other arid regions.

This report summarizes key innovations, including the Taklimakan Desert Highway Shelterbelt, which uses saline groundwater to sustain vegetation across 436 km of shifting dunes with a survival rate above 85 %. In the Gurbantunggut Desert, non-irrigation afforestation harnessing winter snowmelt has established 3,000 hectares of vegetation at 80 % lower cost. Furthermore, a mountain – oasis – desert integrated management model restores grasslands, improves saline soils, and stabilizes fragile oasis – desert ecotones. These achievements, recognized both nationally and internationally, demonstrate Xinjiang, China's ability to combine scientific breakthroughs with large-scale application.

Building on these successes, Xinjiang, China's ecological technologies have become international models through Belt and Road cooperation. Demonstration projects such as the China–Africa Green Technology Park in Mauritania and the ecological shelterbelt in Kazakhstan have validated the adaptability of Chinese approaches to diverse environments. These cases confirm that adaptive engineering, native species selection, and cost-effective ecological technologies can transform degraded arid landscapes into sustainable ecosystems. The Xinjiang, China experience thus offers not only practical pathways for land restoration and ecological security in arid regions, but also globally transferable solutions to advance the Sustainable Development Goals.

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Modeling the carbon and water cycle of Congo Basin forests

Hans VERBEECK[1,2,*]

KEYWORDS. — Climate Change; Carbon Cycle; Water Cycle; Tropical Forest; Congo Basin.

ABSTRACT. — The Congo Basin hosts the second-largest tropical rainforest and the largest tropical peatland in the World, acting as an engine for the global water cycle, a crucial biodiversity hotspot, and a critical global carbon sink. Nowadays, it faces increasing periods of floods, drought and temperature extremes, resulting in a widespread risk of forest mortality, i leading to changes in its CO_2 uptake and potential fundamental shifts in its ecohydrology. Climate change, together with deforestation, puts the stability of the giant forest carbon stocks and the peatlands it hosts at risk. However, these risks remain poorly quantified. The UGent Congo Basin Center of Expertise (UGent-CBCE) has pioneered in the past decade to collect an unprecedented amount of data on the carbon and water cycle of the Congo Basin. These datasets come from a unique network of monitoring plots in various forest types, from the first eddy covariance station in the region (Congoflux, fig. 1), historical meteorological data, and remote sensing datasets. These data allow us for the first time to parametrize global vegetation models specifically for the Congo Basin. In this presentation, an overview will be given on how these unique datasets and models can shed new light on the past and future of the Congo Basin forests.

Fig. 1. — The Congoflux tower in Yangambi, DR Congo.

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Refining carbon and water fluxes at the weather station scale

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KEYWORDS. — Climate Change; Weather Station; Carbon Flux; Evapotranspiration; Globe.

ABSTRACT. — Coarse-resolution reanalysis datasets such as ERA5-Land often fail to capture fine-scale microclimatic variability, leading to substantial uncertainties in gross primary productivity (GPP) and evapotranspiration (ET) estimates. To address this limitation, we develop a station-scale framework that integrates in-situ meteorological observations, high-resolution remote sensing products, and multi-source geographic data. Using algorithms such as Random Forest, we generate locally refined GPP and ET estimates around global weather stations, replacing coarse reanalysis inputs and significantly improving the representation of spatial heterogeneity while reducing prediction errors. The resulting high-resolution flux products enhance the understanding of how local hydroclimatic conditions influence carbon–water exchange processes and provide improved capability to detect and attribute the impacts of extreme climate events. This approach bridges the gap between coarse climate datasets and the fine-scale information needed for robust ecosystem assessments and effective resource management in heterogeneous landscapes.

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Applications of Plant Diversity: From Desert Botanical Gardens to the 3046 km Edge - locking Project around the Taklimakan Desert

Jinglong FAN[1,2,*], Xinwen XU[1] & Heng ZHANG[1,2]

KEYWORDS. — Plant Sand Control Project; Introduction of Native Plants; Taklimakan Desert.

ABSTRACT. — The Taklimakan Desert, one of the world's most hyper-arid regions and a significant source of sandstorms impacting China, presents formidable environmental challenges through wind erosion and desertification processes. These hazards critically threaten infrastructure, agricultural productivity, and human livelihoods, particularly across southern Xinjiang. To address this, the Chinese government initiated the 3,046-kilometer «perimeter-locking» project, designed to establish a vegetative ecological barrier encircling the desert. This integrated strategy combines aeolian erosion control with sustainable economic development, utilizing indigenous xerophytic species to stabilize dune systems, safeguard critical infrastructure including the Tarim Desert Highway, and enhance ecological resilience. Research conducted at the Turpan and Taklimakan Desert Botanical Gardens has been instrumental in selecting and domesticating appropriate species for this large-scale ecological restoration endeavor.

Our investigation encompassed more than 40 field expeditions conducted between 2000 and 2025, involving the collection and evaluation of over 500 desert plant species. We developed a comprehensive adaptive evaluation framework to quantify survival rates and functional performance under conditions of extreme aridity and high wind stress. Key species — Haloxylon ammodendron, Calligonum caput-medusae, Populus euphratica, and Tamarix hispida — demonstrated survival rates exceeding 80 % and were classified as exhibiting high adaptability. These species were deployed to construct protective shelterbelts, supported by innovative techniques such as photovoltaic-powered irrigation systems. Successful applications include the sustained protection of the Tarim Desert Highway for over two decades, measurable increases in biodiversity within stabilized dune areas, and the incorporation of economically valuable species including Cistanche deserticola, Lycium ruthenicum (black goji), and Ziziphus jujuba (red date), yielding billions in annual economic output.

This integrative methodology demonstrates that ecological restoration within hyper-arid zones is both technically feasible and economically viable. The project underscores the critical importance of employing native species, implementing mixed-planting configurations, and conducting long-term monitoring to achieve sustainable desert greening objectives, thereby providing a transferable model for global arid land management strategies.

REFERENCES

J LEI, X GAO, Y ZHAO, DU HEQIANG, HE QING, H REN, X MENG, HU ZIHAO, Z YANG. (2023). The battle on the edge of Hexi Corridor–Taklimakan Desert: Wind-blown sand situation and prevention tasks of desertification control. — *Journal of African Archaeology*, 4(2), 223-233.

LIU YINGXIN. (1991). Thirty-five years of introduction and planting of sand-fixing plants on moving sand dunes in Shaopotou Area. — *Journal of Desert Research*, 11(1), 13-21.

ZHOU, ZHIBIN, XU, XINWEN, LEI, JIAQIANG, LI, SHENGYU. (2006). Ecological stability of Tarim Desert Highway shelterbelt. — *Chinese Science Bulletin*, 51(supp.1), 153-160.

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Intensive aquaculture at a turning point: From monoculture to integrated systems, or ecological aquaculture

Patrick Sorgeloos[1,*]

KEYWORDS. — Aquaculture; Intensification; Sustainability; Integrated Farming.

ABSTRACT. — Two types of aquaculture can be distinguished: "food aquaculture" as practiced since millennia in China and SE Asia, based on polyculture techniques, and "business aquaculture", pioneered by Japanese researchers in the late sixties by closing the life cycle of different aquatic species allowing the controlled production of fish fingerlings or crustacean post larvae for further ongrowing until marketable size in cages, respectively ponds in monoculture systems (Sorgeloos, 2013).

Although this industrial farming of different fish and crustacean species has contributed to a very significant increase in aquaculture outputs it is becoming clear that we are at turning points in further expansion of aquaculture, *e.g.* the intensification of this monoculture approach has reached levels of maximum environmental carrying capacities and is resulting in increased disease incidences. More focus is needed on disease prevention, on improved biosecurity measures, and taking more into consideration the beneficial role of the wide diversity of bacteria that colonize the aquatic environment. Integration of intensive fish and shrimp farming with 'extractive aquaculture' with molluscs and seaweeds can result in more sustainable production techniques and make aquaculture more environmentally friendly. As our Chinese colleagues are proposing, let's move towards a more ecological aquaculture with already very concrete examples of large-scale applications.

REFERENCES

SORGELOOS, P. (2013). Aquaculture: the blue biotechnology of the future. *World Aquaculture*, 44(3), 18-27.

[1] UGent Aquaculture R&D Consortium, Ghent University, Coupure Links 653, Belgium.
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Peatlands as climate allies: Pathways to climate resilience and biodiversity

Maud Raman[1,*], Tom De Dobbelaer[1], Alexandra Barthelmes[2], Romain Darnajoux[3], Noémie Carles[3], Thomas Crestey[3], Sabine Sauvage[3], Thomas Schindler[4], Silvia Poblador[5], Jyrki Jauhiainen[6], Mauri Heikkinen[6], Sari Juutinen[7], Laure Gandois[3], Laura Escarmena[5], Aldis Butlers[8], Tuula Larmola[6], Ülo Mander[4], Kaido Soosaar[4], Liisa Ukonmaanaho[6], Francesc Sabater[5] & José Miguel Sánchez Pérez[3]

KEYWORDS. — Peatland Restoration; Review; Living Labs; Europe; Northern-Belgium.

ABSTRACT. — Effective peatland restoration is critical for climate change mitigation, biodiversity conservation, and the maintenance of essential ecosystem services.

Within ALFAwetlands, we reviewed past peatland restoration projects, analyzing their objectives, methodologies, and outcomes. Such projects face multiple challenges, including uncertainties about how to define and measure restoration success, and the need to manage obstacles specific to different wetland types (fens, raised bogs, aapa mires). Additional hurdles arise from stress factors and peat degradation, as well as from the need to anticipate side effects of restoration measures and interactions with global climate change.

To overcome these barriers, key recommendations include applying a diverse set of restoration measures — particularly hydrological, vegetation-based, and peat-focused interventions — while establishing robust, long-term monitoring programs covering flora, fauna, hydrology, and carbon. Equally important are strategies for accelerating vegetation recovery, fostering stakeholder engagement, and integrating citizen science to strengthen project effectiveness (De Dobbelaer *et al*. 2025).

The ALFAwetlands project tackles these issues directly through the Belgian living lab. Here, we monitor groundwater levels, vegetation, and greenhouse gas dynamics in degraded peatlands (Zuidleie Valley, Zwarte Beek, and Dijle River Valley) where restoration actions such as mowing, grazing, or rewetting have been implemented. The living lab is part of the Long-Term Ecosystem Research (LTER) network, creating opportunities for sustained data collection, interdisciplinary research, and (inter)national collaboration with researchers and stakeholders.

Looking ahead, wetland restoration requires long-term monitoring of greenhouse gas emissions, hydrology, and vegetation across a range of sites (Convention on Wetlands 2021; Wilson *et al.* 2016). Future efforts should place greater emphasis on eco-hydrological and nutrient dynamics, drought resilience, and peat recovery in order to maximize climate mitigation and biodiversity outcomes (Kemmers 2007; Convention on Wetlands 2021; McCarter *et al*. 2024; Lenaerts *et al*. 2020).

REFERENCES

CONVENTION ON WETLANDS (2021). Global guidelines for peatland rewetting and restoration. Ramsar Technical Report No. 11. Gland, Switzerland: Secretariat of the Convention on Wetlands.

[1] INBO, Brussels, Belgium.
[2] Michael Succow Foundation, Greifswald, Germany.
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DE DOBBELAER T., BARTHELMES A., & M. RAMAN (2025). Recommendations for wetland restoration. Funded by the European Union within ALFAwetlands.

KEMMERS, R.H. (2007). Desorptie en adsorptie van fosfaat na vernatting van veengrond uit het Hunzedal. Alterra-rapport 1575, ISSN 1566-7197.

LENAERTS, B. & VAN SUNDERT, K. & VICCA, S. (2020). The influence of drought and rewetting on plant and soil nutrient dynamics. 10.13140/RG.2.2.26892.18569.

MCCARTER, C. P. R., TUTT, E., MOORE, P. A., FURUKAWA, A. K., VERKAIK, G. J., WILKINSON, S. L., WHITTINGTON, P., & WADDINGTON, J. M. (2024). Hydrophysical properties of peat in undisturbed and smelter-impacted peatlands: implications for moss recovery, drought and wildfire. Hydrological processes, december 2024. DOI: 10.1002/hyp.70034.

WILSON, D., BLAIN, D., COUWENBERG, J., EVANS, C. D., MURDIYARSO, D., PAGE, S. E., RENOU-WILSON, F., RIELEY, J. O., SIRIN, A., STRACK, M., TUITTILA, E.-S. (2016).

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Global climate impacts of methane seeps (CliMetS)

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KEYWORDS. — Methane Seeps; Chemosynthetic Ecosystems; Methane Flux; Global Climate; Biogeography.

ABSTRACT. — Cold seeps (methane seeps) are extreme ocean habitats in which fluxes of methane and other types of carbon released from seafloor serve as energy and carbon sources of chemoautotrophic microbes that form tight symbiosis with marine benthos in the seep fields. The physical setting of seeps can feature massive deposits of metastable gas hydrate, seafloor "lakes" of dense brine, and lush ecological communities. Microbiological productivity at seeps mineralizes vast quantities of antigenic carbonate that would otherwise escape to the ocean and atmosphere as labile carbon. As distribution of cold seeps in global ocean remains largely underestimated and the flux of methane from seep fields has hardly been quantified. The impact of cold seeps on global climate change, biogeography, and ecosystems functionality remain hug knowledge gaps in global ocean science. Global Climate Impacts of Methane Seeps (**CliMetS**) aims to fill up these big knowledge gaps through **1)** capacity sharing in cold seep observation, monitoring, and research in south America, Africa, south Asia, SIDS, LDCs and LLDCs, **2)** discovery of new cold seep ecosystems, **3)** quantifying methane flux, understanding the fate and pathways of methane released from the sea floor, and assessing impact of these gases released from seafloor on global climate changes, biodiversity, function, resilience, and connectivity and global biogeography of different cold seep ecosystems, and **4)** developing innovative technology for *in situ* environmental monitoring, ERA of potential methane release due to gas hydrate degradation and natural and human-induced methane leakage. Our findings will directly contribute to the UN SDGs by providing more accurate methane flux data from ocean to improve global climate prediction models and by supporting marine biodiversity conservation through a better understanding of marine biogeography and mechanisms underlying.

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Global alternatives in natural vegetation cover

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KEYWORDS. — Global Ecosystem Ecology; Restoration and Conservation Ecology; Remote Sensing; Neural Network; Global.

ABSTRACT. — Preserving and restoring terrestrial ecosystems is essential to preventing the decline of life on Earth. To guide global conservation efforts, we present a detailed counterfactual map showing Earth's natural tree, short vegetation, and bare ground cover. This map accounts for environmental filtering along with realistic scenarios of fire frequency and wildlife herbivory. The most likely scenario suggests 43 % (5669 ± 74 Mha) of land could support trees, 39 % (5183 ± 86 Mha) shrubs and grasses, and 18 % (2352 ± 59 Mha) bare ground. Adjustments in fire and herbivory could shift a minimum of 675 Mha of land, stressing the importance of considering alternative outcomes when restoring a landscape. Our findings also suggest that adjustments in fire frequency and wildlife herbivory could have a greater impact on natural vegetation than expected climate changes by 2050, highlighting decision-makers' responsibility to guide conservation and restoration toward a sustainable and biodiverse future.

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