

CZ-Non Newsletter

Updates, publications, and events
from CZ-Non partners around the world

product of the NSF-funded AccelNet: Critical Zone Network of Networks

Collaboration on Display in Paris



On September 30, 2025 as part of the 3rd OZCAR–TERENO Conference in Paris, Drs. Blaize Denfeld and Marcus Wallin presented SITES—Swedish Infrastructure for Ecosystem Science—as a constellation: nine stations linked to eLTER, ICOS, ACTRIS, INTERACT, LIFEPLAN, CZ-Non, AQUACOSM-plus, and GLEON. Water, Spectral, and AquaNet programs sync sensors and mesocosms, converting local observations into global Critical Zone intelligence. Thank you for including the Critical Zone Network of Networks alongside these esteemed observatories and projects.

Scan for more details about the conference and its theme “Advancing Critical Zone Science.”



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12th International Conference on *Ecosystem Behavior*

BIOGEOMON

Theme: Ecosystems in Transition

June 8–11, 2026, Umeå, Sweden

ABSTRACTS

Submission Opens

Sept 17, 2025 — Feb 2026

Co-Chairs: Hjalmar Laudon and Kevin
Bishop

For more information visit:
www.slu.se/BIOGEOMON2026





Upstream Reservoir Cascades Rewire Changjiang Carbon

A staircase of reservoirs on the upper Changjiang has rearranged where river-borne carbon comes to rest. Ke and colleagues follow particulate organic carbon (POC) from mountain headwaters to the tidal limit using grain size, major elements, and dual carbon isotopes ($\delta^{13}\text{C}$, $\delta^{14}\text{C}$) to see what dams change—and what they preserve.

Their verdict: cascade mega-reservoirs now sequester about 6.6 MtC yr^{-1} of POC, including 3.8 MtC yr^{-1} from the modern biosphere. The Three Gorges Dam's POC burial fell from 1.6 to 0.4 MtC yr^{-1} as new upstream reservoirs began storing roughly 0.7 MtC yr^{-1} , relocating burial from the estuary to the Jinshajiang cascade. Faster burial in high-relief reservoirs shortens oxygenated transit, curbing mineralization and boosting preservation.

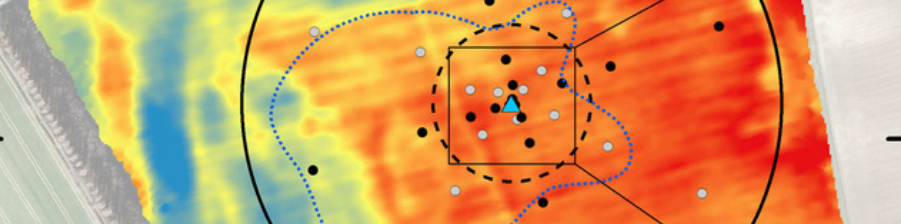
Meanwhile, downstream exports grow relatively richer in biospheric POC but smaller in total load—reshaping the East China Sea's carbon budget and, at times, tipping mid-Changjiang reaches from sink to source.

The study reframes dams as more than sediment traps: they rewire carbon pathways and ages, filtering petrogenic fragments and accelerating storage of terrestrial carbon on land. For Critical Zone science and carbon accounting, the message is clear—engineering choices set the tempo of erosion, transit, and burial across one of Earth's great river systems.

Ke, Y., Calmels, D., Bouchez, J., Noret, A., Massault, M., Chetelat, B., et al. (2025). Regulation of particulate organic carbon by cascade mega-reservoirs in the Changjiang basin: Enhanced sequestration and altered downstream composition. *Global Biogeochemical Cycles*, 39, e2024GB008479.

“Quantifying the long-term impact of dam-induced dynamics on POC preservation and metabolism will be crucial for understanding how human behaviors regulate carbon cycling and climate change.”





“The accuracy of plant traits predicted by the CRNS was lower compared to manual or destructive measurements. However, this can be outweighed by the effortless and continuous nature of CRNS measurements.”

Neutron Eyes on Working Fields

On a gently turning field in Selhausen, Germany, a tube counting neutrons has been quietly watching crops grow. Over a decade, researchers paired a cosmic-ray neutron sensor with an ICOS eddy-covariance tower to see if one instrument could read both soil moisture and the rhythm of vegetation at the field scale. Their answer: yes—usefully so. The sensor’s thermal neutron signal tracked plant development across rotations of winter cereals, potatoes, and sugar beet, correlating with plant height and showing promise for leaf area index and biomass.

Relationships were crop-specific, but precise enough to be practical (median errors: ~ 0.13 m for height, ~ 1.0 m²/m² for LAI, ~ 0.27 kg/m² for dry biomass). Meanwhile, the epithermal signal delivered soil water content that better matched the eddy-covariance footprint than nearby point sensors—without digging, cables, or downtime during field operations.

Crucially, thermal neutrons and gross primary productivity rose and fell together, then diverged during senescence and desiccation—evidence that the signal contains information beyond water alone. That nuance makes the approach valuable for long-term observatories (ICOS, TERENO/eLTER): one, continuous, non-invasive measurement stream supporting flux interpretation, crop monitoring, model evaluation, and eventually decision support for irrigation. Cosmic rays, it turns out, can help ground truth the living, breathing hectare.

Brogi, C., Jakobi, J., Huisman, J. A., Schmidt, M., Montzka, C., Bates, J. S., Akter, S., & Bogaen, H. R. (2025). Cosmic-ray neutron sensors provide scale-appropriate soil water content and vegetation observations for eddy covariance stations in agricultural ecosystems. *Agricultural and Forest Meteorology*, 373, 110731.



Along for the Field Trip: OZCAR-TERENO 2025 at ORACLE–Orgeval

On September 29, 2025, attendees of the OZCAR-TERENO conference stepped out of the lecture hall and into the Orgeval catchment east of Paris, part of France's long-running ORACLE critical zone observatory. ORACLE spans agricultural basins in the Paris region, with the 104 km² Orgeval catchment carrying most of the long-term instruments that track water, soils, and biogeochemical change. The conference itself runs September 29–October 2 in Paris with a dedicated field day at Orgeval.

The morning began at Boissy-le-Châtel, where decades of hydrologic records document how rainfall infiltrates, drains, and re-charges the Brie limestone aquifer beneath intensively farmed landscapes.



Monitoring at Orgeval dates to the 1960s, providing a continuous view of surface–subsurface connections under shifting climate and land use.

The day closed with live geophysics: electrical resistivity profiling and seismic recording using wireless geophones. These methods image subsurface structure and moisture patterns, sharpening the link between soils, aquifers, and stream response from storm to baseflow.

Photos by Critical Zone Network of Networks co-PI Jeff Munroe.

Scan to read more about the site as part of *Critical interfaces in the Critical Zone, from instrumental to modeling approaches* Edited by Fabien Arnaud, Mathieu Dellinger, Jérôme Gaillardet, Damien Jougnot, Pierre Sabatier, Ulrike Werban, Steffen Zacharias





Carbon Ledgers of the North

Ice sheets once pressed a heavy hand across the North, grinding rock to flour and tamping down forests into silence. As the ice thinned and stepped back over millennia, water found new paths, peatlands spread like slow-growing quilts, and soils kept their ledgers—debits of erosion, credits of carbon quietly stored.

Into this long memory comes a map-room you can actually use: “Soil carbon modelling from the Last Glacial Maximum (LGM) to present for the Northern Hemisphere — input data” by Amelie Lindgren, Gustaf Hugelius, Peter Kuhry, Max Holloway, and Zhengyao Lu. Drawer by drawer at $1^\circ \times 1^\circ$ resolution, the collection lays out climate reconstructions from HadCM3 and TraCE-21ka, biomized pollen records tracing vegetation returns, shifting glacial margins, peatland dynamics, permafrost distribution, slope, land mask, and pixel area.

Each layer reads like a different register of the same story. Pollen is the breadcrumb trail of ecosystems reassembling. Peatlands are the patient accountants, recording centuries of surplus. Permafrost is the locked vault, its key turning with temperature. Together, they train a machine-learning model that reconstructs soil carbon storage from 21,000 years ago to the pre-industrial world.

For Critical Zone work, this dataset functions as a time-lapse scaffold: a way to test how soils accrued and released carbon as ice retreated, how wetlands and permafrost shaped storage, how climate and topography set the stage for today’s budgets. It’s reproducible, hemispheric, and ready to slot into model benchmarking, sensitivity analyses, and cross-archive comparisons—from lake sediments to modern SOC inventories. A story told in grids and grains, now organized for the next chapter of carbon-cycle science.

Amelie Lindgren, Gustaf Hugelius, Peter Kuhry, Max Holloway, Zhengyao Lu (2025) Soil carbon modelling from the Last Glacial Maximum (LGM) to present for the Northern Hemisphere — input data. Dataset version 1. Bolin Centre Database.



“These layers were used to train and run a machine learning model estimating soil carbon storage over the last 21,000 years.”





See you at

AGU25

New Orleans, LA | 15–19 December 2025



Terranology: Social Sciences in the Critical Zone



Photo courtesy University of Cape Town

Lesley Green

**Director: Environmental Humanities South,
University of Cape Town & Professor:
Anthropology**

Critical zone sciences have been powerfully brought into dialogue with the social sciences and humanities by Bruno Latour and Peter Weibel in their edited collection *Critical Zones: The Science and Politics of Landing on Earth* (2020). Critical Zone sciences address material, physiochemical, and biogeochemical relations that make for habitability. The focus on relations proposed by CZ is in itself revolutionary in environmental governance for it offers an alternative “big picture” – of habitability (which is a qualitative concern) rather than “social systems” that social-ecological systems research claims to document. The engagement of the social sciences and humanities with CZ, therefore, offers a welcome and vital opportunity to exit the script of studying “social systems” and instead focus on the material and inter-species relations that constitute liveability. This is a welcome convergence of the material humanities with multi-species research – and, crucially, offers an escape from an often tempestuous relationship between social and natural sciences in terms of which social sciences are reduced to a source of numerical data to be harvested for the algorithms that inform environmental governance in, for example, fisheries management, or decisions on mining.

continues...



In order to advance engagement with CZ sciences, however, the environmental humanities must engage in ways that strengthen two aspects of its current research prospectus. First, let us bring into the dialogue what some geographers have called “anthromes” (Ellis et al 2008), for CZ studies have so far focused on the analysis of relations in biomes which, to the exclusion of the human, replicate the nature-society divide. Second, an humanities engagement with what we mean by “the relevant facts” opens up space for an ontological critique. In this, social sciences and humanities do not only expand the available data sets (such as the application of demographics to resource use and discards), but more specifically work to expand the notions of relation beyond those currently conceptualised by the CZ paradigm.

What do I mean by this? An example: Relations with soil in Africa, for example, are framed in discourse of kinship: to be a son or daughter of the soil offers a foundational concept of earthly relations. Such a terranology, I suggest, offers a means to rethink not only the observables and measurables, but also our account of their relations: that is, to tell a different story of the relations in which human collective choices unfold in partnership with planetary processes. It is this focus on the constitutive work that notions of relations do, I propose, that offers a means to unite the humanities and social sciences with the earth and life sciences and public health engineering, in the study of earthly relations. This is crucial because the urgent task facing researchers is account for the depredations of the anthropocene in concepts other than those that have given it birth.

Keynote presented to the Forum for Critical Theory, Goa, India, February 26 2022

Building on the conceptualisation of “terrans” by Deborah Danowski and Eduardo Viveiros de Castro (2014), and drawing on Isabelle Stengers’ Cosmopolitics (2010), this essay composes a field that I tentatively call “Terranology”: a field that, I suggest, encompasses not only the study of “the facts of earthly relations” but the study of “relations” themselves (De la Cadena 2016; Strathern 2020).







CZ-N₂O DEEP LOOK: Alpine soils entered a “pedological Anthropocene” 3,800 years ago

A blue Alpine lake has kept a 9,500-year diary of the land around it—and it pinpoints the moment people, not climate, began writing the ending. In an open-access study, Rapuc, Guinoiseau, Arnaud, Bouchez and colleagues read that diary by measuring lithium isotopes ($\delta^7\text{Li}$) in Lake Bourget’s fine sediments and tracing their sources with neodymium fingerprints.

The early chapters are calm. After deglaciation, warm, dry Holocene decades nurtured steady pedogenesis: soils thickened, clays formed, $\delta^7\text{Li}$ fell as weathering intensified. A cooler, wetter Neoglacial ($\approx 5.8\text{--}3.8$ ka BP) cut channels and gullies yet left hillslopes mostly intact—an incision more than a scouring.

Then the handwriting changes. Around 3.8 ka BP, herders pushed into high pastures; later, lowlands felt the iron of the plow. The record shows three erosive surges (3.8–3.0, 2.8–1.6, and 1.6 ka BP to present) that first shaved off living topsoil, then bit into older, deeper horizons.

Each surge begins with more negative $\delta^7\text{Li}$ —surface clays on the move—followed by rebounds toward bedrock values as erosion mines the subsurface. Human-driven loss ran three to ten times faster than natural soil production.

Because neodymium apportionment separates glaciated granite from inhabited, sedimentary terrain, the team can unbraids climate from culture. Climate’s push acts broadly across elevations; agropastoral pressure decouples the mountain belt, top to valley, in staggered waves. High-elevation meadows go first; centuries later, tilled footslopes follow.

Picture that slope above a village path: grass cropped a little shorter each summer, rills sharpening after a hard rain, the stream running milk-brown by harvest. Down in the lake, thin annual laminations thicken; carbon that would have rested in soil is hurried into water and mud. A generation later the same field yields a little less and needs a little more. Across a catchment, multiplied by centuries, those small shifts add up to the arc this core records: soils nudged back toward their youthful, post-ice-age state.

The authors call this turn a “pedological Anthropocene.” The lake doesn’t lecture; it shows. Read closely, its pages make the costs of careless land use feel immediate—and the benefits of restraint, rotation, and recovery newly within reach.

W. Rapuc, D. Guinoiseau, F. Arnaud, M. Dellinger, P. Sabatier, J. Gaillardet, J. Poulénard, & J. Bouchez, Human and climate impacts on the alpine Critical Zone over the past 10,000 y, *Proc. Natl. Acad. Sci. U.S.A.* 122 (29) e2506030122, <https://doi.org/10.1073/pnas.2506030122> (2025).

“Our findings highlight how long-term lake sediment records can reveal the cumulative impacts of agriculture on the Critical Zone, insights that are likely relevant to other mountain regions worldwide and vital for guiding sustainable land-use strategies.”



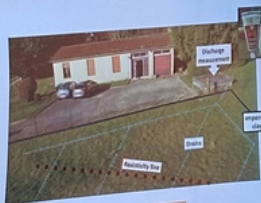
Boissy-le-Châtel Plot : A Long-Term experiment for Drainage and Infiltration Studies

H. Henine¹, M. Kanate¹, A. Blanchouin¹, R. Clement¹, C. Chaumont¹, & J. Tournebise¹
¹ INRAE, UR HYCAR-Armenhy, Université de Paris-Saclay, Antony 92160, France e-mail : hocine.henine@paris-saclay.fr
² INRAE-RIVERSAAL, Lyon.

Boissy-le-Châtel experimental plot : In 1975, a subsurface drainage system composed of clay tile drains was installed to fold down the perched Water Table (WT) and investigate the hydrological and biogeochemical impacts of artificial drainage.

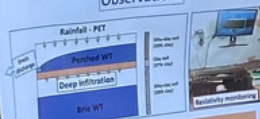


To minimize lateral exchanges with the surrounding soil, the plot was isolated by a 60-cm deep impermeable clay wall.

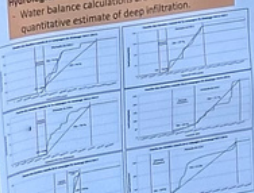


Dynamic of deep infiltration : quantification approaches

Observations

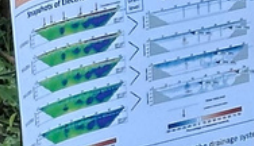


Hydrological monitoring :
Water balance calculations are used to provide a quantitative estimate of deep infiltration.



Average coefficient of restitution (CR) of 64% corresponding to 30% of deep infiltration.
Average refill of Brw water table of 97.5 mm.

Geophysical monitoring :
Resistivity monitoring from recharge periods to wet conditions.

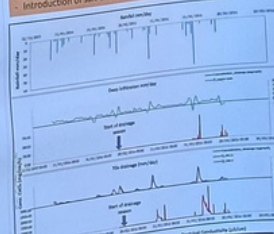


Good characterization of recharge from the soil to the drainage system.
A significant resistivity contrast to highlight deep recharge.

Simulations

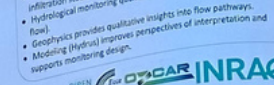
Hydrus 2D/3D Software

Hydrology & Geophysics :
Fitting on 2014-2015 campaign and validation on 2015-2016 with Nash criteria of 0.64
Introduction of salt tracer (CaCl₂) to improve resistivity contrast.



Deep infiltration accounts for approximately 40% of the drainage flow according to hydrological approach.
Simulating tracer injection creates a clear contrast below the drain line, enabling better monitoring with geophysical tracking.

Conclusions :
• The Boissy-le-Châtel plot is a long-term experiment for drainage and infiltration studies.
• Hydrological monitoring quantifies deep infiltration (~40% of drainage flow).
• Geophysics provides qualitative insights into flow pathways.
• Modeling (Hydrus) improves perspectives of interpretation and supports monitoring design.



Good characterization of recharge from the soil to the drainage system.
A significant resistivity contrast to highlight deep recharge.