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From acid rain to the anthropocene: 37 years of BIOGEOMON part 1—history and impact

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Abstract The 11 BIOGEOMON (International Symposium on Ecosystem Behavior) conferences span 37 years of research in ecosystem science. Here we discuss the history of BIOGEOMON in two parts. In Part 1 we focus on the structure of the conference over the years: its inception, the demographics of attendees, the major biomes and ecosystems studied, and the evolution of dominant topics and themes. We argue that the fundamental goal of understanding the response of ecosystems to perturbations has remained the same over the meetings, but the drivers of change focused upon have evolved over time, reflecting the emergence of new issues and the development of scientific understanding. Each conference is therefore partly a snapshot of the important topics of the day, and partly the core themes that define BIOGEOMON: the cycling and transformations of the major biogeochemical elements on land, and the investigative techniques of monitoring, modelling, and catchment manipulation. We conclude with some reflections on the conference from BIOGEOMON attendees over the years.

Keywords BIOGEOMON · Biogeochemistry · Geochemistry · Catchments · History of science · Conference history

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A pioneering endeavor

The 1970s marked the coming-of-age for ecosystem science. On the one hand, the decade witnessed the widespread scientific recognition of the continental- and global-scale impact of humans on the biosphere through eutrophication, acidification, and climate change (e.g. Landner 1976; Schindler 1974; Likens et al. 1979; Hansen et al. 1981). On the other hand, it saw the flourishing of several catchment monitoring networks designed to understand the causes and impacts of these drivers (summarized in Moldan and Černý, 1994). In 1972, Bedřich Moldan and Tomáš Pačes from the Geological Survey of Prague (Fig. 1) began one such network to quantify the fluxes of elements to and from nine calibrated forested watersheds in the former Czechoslovakia.

In their words today…

'We were already aware in 1969 of the deterioration of surface water quality in

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Bedřich Moldan Tomáš Pačes

Fig. 1 Bedřich Moldan and Tomáš Pačes, the founders of the BIOGEOMON conference series

Czechoslovakia due to extreme eutrophication caused by over-fertilization of agricultural land. So, in 1972 we prepared a project for monitoring nine small watersheds in the upper part of the Trnávka river basin in the rather unpolluted landscape of the Czech-Moravian Highlands, about 80 km SE of Prague. The watersheds had very similar bedrock and climate, but different land use: forestry, agriculture, and inhabitation. Together with our colleagues at the Geological Survey of Prague, we built monitoring devices to measure mass balances of chemical elements, hydrology, atmospheric deposition and runoff, and basic meteorological observations.

The research started in 1974. We soon realized the additional dangerous trend of acidification of forest soils due to extreme emissions of SO_2 and NO_x from local electric powerplants. So, in 1977 we added two more watersheds in the Erzgebirge Mountains along the Czech-German border, where dieback of fir trees was most visible.

The results of our research embarrassed our authorities because we showed that our socialistic system was heavily polluting the environment in central Europe. In spite of this, we were able to invite colleagues from western countries to discuss these problems.'

Tomáš Pačes and Bedřich Moldan, personal recollections, 2023

Thus, through the efforts of a small group of courageous people, The International Workshop on Geochemistry and Monitoring in Representative Basins, or GEOMON, officially opened in the splendid Art Nouveau setting of the Municipal House in Prague, on 18 September 1987. The meeting attracted over 150 scientists from 20 countries to exchange their research findings on catchment geochemistry as a portal to understanding environmental disturbance.

As important as the science, the meeting reinforced the realization that the problem of environmental degradation was not unique to any country or political system—every developed nation faced issues of air, water, and soil pollution stemming from decades or centuries of unregulated industrialization and agriculture combined with poor habitat management. These pollutants were transported over local, regional, or continental scales.

The global nature of the problem was reinforced by the wide geographic range of talks on pollution or acidification, including Scandinavia (e.g. Iverfeldt and Johansson 1987; Ratio and Tikkanen 1987), central and eastern Europe (e.g. Fott et al. 1987, Ungerman 1987, Hillbricht-Ilkowska. 1987, Bashkin. 1987, Pokarzhevskii et al. 1987), western Europe (e.g. Dise and Hauhs. 1987, Dorioz et al. 1987; Mulder 1987), North America: (e.g. Nordstrom 1987; Wieder et al. 1987; Driscoll et al. 1987), South America (Ovalle et al. 1987), and even the Arctic (Ottar 1987). It became clear that the only way to tackle the extreme pollution that does not respect national or political boundaries was to transcend those boundaries through open discussion and exchange.

The success of GEOMON set the stage for BIOGEOMON in 1993, again in Prague. The "BIO" prefix was added to reflect the rapidly ascendent, unifying discipline of biogeochemistry. The name change also signaled a broadening of the scope of the meetings, from the geochemical assessment of catchment behavior to the geochemical, biogeochemical, and biological responses of ecosystems to perturbations, covering scales from molecules to continents. Around 200 delegates attended from 27 countries, the approximate level at which the conference has since remained (Table 1).

The fall of the Iron Curtain in 1989 allowed open exchange across the nations in Europe and beyond for the first time since the Second World War. As with all disciplines, this was of momentous importance

Table 1 The 11 BIOGEOMON conferences to date, and approximate number of attendees and countries represented

No.	Location	Year	Attendees	Countries	Special Issue
1	Prague, Czechoslovakia (GEOMON)	1987	150	20	None
2	Prague, Czech Republic	1993	200	27	Černý et al. (1995)
3	Villanova, Pennsylvania, USA	1997	240	28	Wieder et al. (1998)
4	Reading, England, UK	2002	300	25	Wieder et al. (2004)
5	Santa Cruz, California, USA	2006	300	30	Novák et al. (2008)
6	Helsinki, Finland	2009	450	43	Johnson et al. (2010), Mander and Mitsch (2011)
7	Northport, Maine, USA	2012	200	18	Johnson et al. (2013)
8	Bayreuth, Germany	2014	300	35	None
9	Litomyšl, Czech Republic	2017	300	30	None
10	Tartu, Estonia	2022	170	20	None
11	San Juan, Puerto Rico	2024	140	13	Current volume

in advancing the biogeosciences. At the second BIOGEOMON,[1] Prague 1993(2),[2] researchers of former western- and eastern- bloc countries were, for the first time, unencumbered by political barriers. They could freely compare data, plan visits, collaborate on research, and host students and postgraduates.

Beyond the obvious benefits of the exchange of information and expertise, the opening of borders provided insights into the different ways in which people from diverse cultures and backgrounds approach scientific research. Indeed, a mainstay of BIOGEOMON has been connecting scientists of all ages, backgrounds, and career levels on an equal level. Its relatively small size facilitates close encounters across the career spectrum from internationally prominent scientists to early and mid- career researchers to graduate and undergraduate students. These encounters have led to lasting collaborations and friendships.

Venues and demographics

From 1987 to 2024, there have been 11 BIOGEOMON conferences[3] (Table 1). Five have been hosted in the US (including Puerto Rico) and six in Europe, including three times in the Czech Republic (Czechoslovakia in 1987). The12th BIOGEOMON conference is due to return to Europe: it will be held in Umeå, Sweden, in June 2026 (BIOGEOMON2026). While the number of participants and the number of countries that have attended each meeting has varied, a 'typical' BIOGEOMON has hosted 200–300 participants from 20 to 30 countries.

In total, more than 50 countries from six continents have been represented at BIOGEOMON, and at each meeting, new countries are welcomed. Figure 2 shows the international growth of BIOGEOMON by mapping the 'first appearance' of a country at the conference as represented by a lead speaker in an oral presentation. Although this underestimates the actual first appearance of a country at the conference (as represented by any attendee), the figure gives a good picture of the national makeup of the meetings and how that has changed over time. Prague 1987(1) was mainly attended by representatives of North America (plus Brazil), northern and central Europe (including the then USSR) and Scandinavia. Later meetings brought more delegates from central Europe, and added southern Europe, Australia and parts of Asia. South America, Africa, the middle East and southeast Asia have been largely unrepresented over the years.

[1] The general use of 'BIOGEOMON' in this paper also includes the first GEOMON conference in 1987.

[2] We use the convention 'City year (conference number)' to denote the different meetings.

[3] Although the meetings are officially 'symposia', we refer to them in this paper as 'conferences', in line with their usual designation among participants.

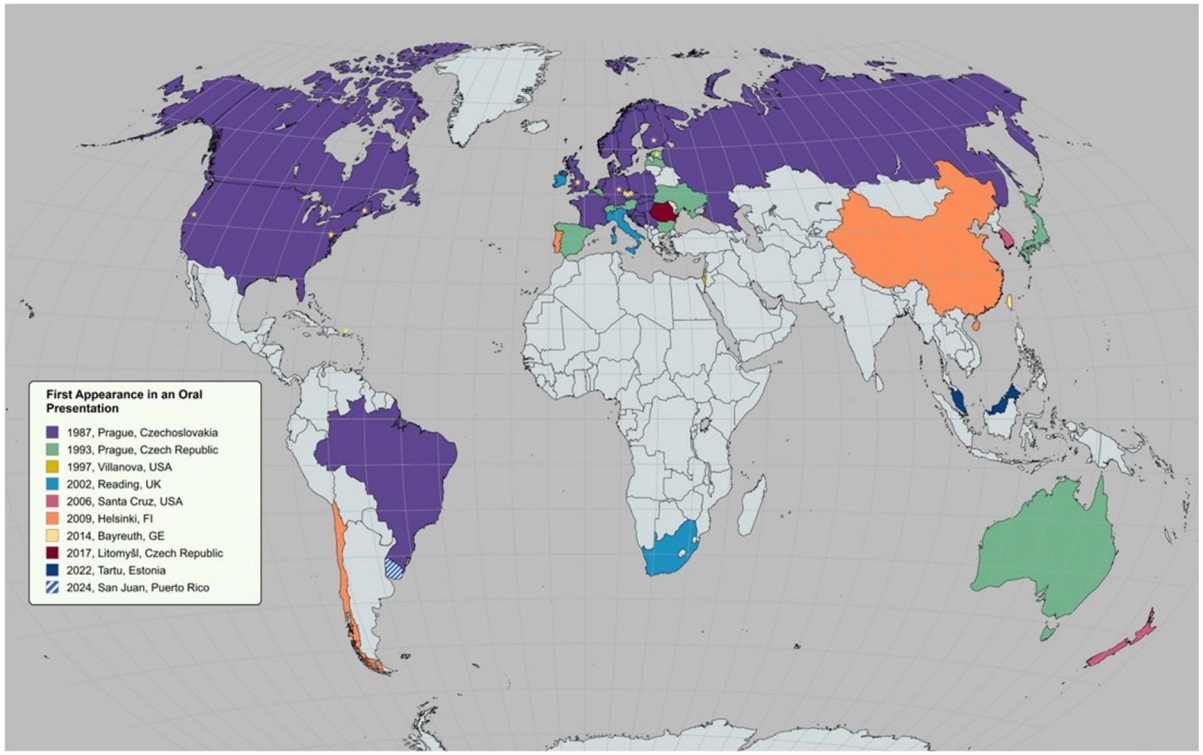


Fig. 2 Countries of delegates at the BIOGEOMON conferences. Countries are color coded according to the first meeting at which they were represented by a lead speaker in an oral presentation. Conference locations are indicated by stars

Despite efforts to create a more balanced picture of global biogeochemical issues, BIOGEOMON is still overwhelmingly a northern hemisphere meeting.

A typical meeting covers four days: three days of scientific sessions, and a one-day field trip, usually in the middle of the conference, to research sites or other locations of interest. Each conference publishes the abstracts of oral and poster presentations, and in most meetings, participants are invited to submit original research to a special issue of a peer-reviewed, high-impact journal in the field (Table 1).

Evolution of topics and themes

Although the research presented at BIOGEOMON has clear management and policy implications, presentations usually focus on the scientific research underlying these applications. The scientific program at BIOGEOMON typically combines (1) core recurring themes, including the fundamental techniques of monitoring, modelling, and ecosystem manipulation, (2) current 'hot' topics in the field, and (3) specialized subjects, often relating to the meeting venue (Fig. 3). So, each conference embodies a continuation of what has come before, and a snapshot of what is to come in the biogeosciences. The foundation of every meeting, however, is the 'fundamental question' posed by Moldan and Pačes in the first GEOMON symposium:

> *Man faces a fundamental question: what are the permissible changes and the acceptable steady state of ecosystems induced by fossil fuel burning, by modern industrial and agricultural development?*

Bedřich Moldan and Tomáš Pačes, Foreword to the GEOMON Book of Abstracts, 1987.

Today we may rephrase this question as a goal: to understand the biogeochemical response of ecosystems to environmental drivers of change, primarily due to human activity.

Fig. 3 Session Themes at the 11 BIOGEOMON conferences to date. Note that the absence of a topic as a Session Theme does not imply that the topic is not discussed at the meeting

Over the history of BIOGEOMON, our awareness of the most important drivers, or stressors, of ecosystems has evolved over time. At Prague(1) 1987, the main ecosystem stressors discussed were extreme eutrophication of surface waters from unregulated agricultural runoff (e.g. Gerds 1987; Dorioz et al. 1987; Ungerman 1987), and ecosystem acidification in response to acidic air or water pollutants (e.g. Nordstrom 1987; Fott et al., 1987; Mulder 1987). Most of the presentations focused on the hydrology and geochemistry of catchments, especially as impacted by these drivers. The catchment was considered the ideal unit of investigation: it allowed quantification of the inputs, outputs, and internal transformations of elements, and the response to changes in these processes. Catchment monitoring, calculating mass balance budgets, and modelling were the primary tools used to quantify the response. In

turn, the catchment response to stress was considered an indicator of the wider impact of pollutants on ecosystems, biomes, and landscapes.

Understanding the processes governing ecosystem responses to acidification and eutrophication, and the techniques of monitoring, calculating hydrochemical budgets, and modelling, remained key topics of focus at Prague 1993(2) (Fig. 3). In addition, new stressors such as increasing atmospheric CO_2 (Johnson and Ball 1993) and tropical deforestation (Forti et al. 1995), and new techniques including whole-catchment manipulation (e.g. Feger 1995; Uddameri et al. 1995; Mörth and Torssander 1995), and GIS / remote sensing (e.g. Zemek et al. 1993) were discussed. Scales of study broke out of the catchment to landscapes (e.g. Semenov 1993a) and national/multinational networks (e.g. Skjelkvåle et al. 1993; Henriksen and Brakke 1993; Dise and Wright 1993; Shaw 1993). The topic of isotopes in biogeochemical research, which featured in only a few talks at Prague 1987(1) (e.g. Herrmann et al. 1987; Silar 1987) rose to a Session Theme in 1993 and remained so for 6 of the subsequent 9 meetings. And finally, the question of 'permissible change and acceptable steady states' posed by Moldan and Pačes in 1987 was quantified by 1993 with the introduction of critical loads to the discussions (Hultberg and Moldan 1993; Lenz and Stary 1993; Hall et al. 1993).

By the late 1990s and early 2000s more topics became established, including nitrogen and carbon cycling and processes (e.g. Chang 1997; Beier et al. 2006; Arvola et al. 2012), linkages across cycles (e.g., Evans et al. 2006; Schimel & Weintraub 2006; Melvin & Goodale 2009), wetland/peatland research (e.g. Hoosbeek et al. 1997; Wieder et al. 2006; Dise 2012), trace elements and metals (e.g. Mander et al. 2004; Nieminen et al. 2006; Krám & Šráček 2012), biosphere–atmosphere interactions (e.g., Neff 2006; Hollinger et al. 2012; Oulehle et al. 2024), global change archives (e.g., Osterberg et al. 2006; Engstrom 2012), and molecular/microbial investigations (e.g., Prosser 2002; Balser 2006; Prša et al. 2012) (Fig. 3). These themes have regularly returned in subsequent conferences.

Some research topics figured prominently in only a few meetings. One reason is that the topic declined in perceived importance over time. For example, research focused on acidification and atmospheric deposition (described in more detail in Part 2: Dise et al. 2025) was highlighted in Session Themes in early conferences, but disappeared by the 2000s (Fig. 3), although the topic continued to appear in individual presentations. This reflects the overriding importance of ecosystem acidification in Europe and North America during the 1980s (e.g., Neal and Whitehead 1987; Fott et al. 1987; Schnoor and Nikolaidis 1987) and 1990s (e.g. Probst et al. 1995; Hruška et al. 1997), with a profusion of monitoring, modelling, and experimental studies, followed by the dramatic decline in sulfur deposition in this part of the world by the 2000s (Lajtha and Jones 2013). Nitrogen also replaced sulfur as the dominant air pollutant over much of North America and Europe by the 1990s (Fowler et al. 2020), and this is seen in the rise of nitrogen as a Session Theme from 1997 through to 2017 (Fig. 3).

Only slightly lagging the acidification wave was the rise in the topics of ecosystem manipulation (e.g. Feger 1995), restoration (e.g. DeGraaf et al. 1997), and recovery from acidification (e.g. Driscoll et al. 1998). We suggest that, rather than disappearing, acid deposition research as reflected at BIOGEOMON has evolved from acquiring an understanding of drivers, effects, and extent of acidification, into the next steps of manipulating those drivers (e.g. Moldan et al. 2006; Navrátil et al. 2006), and documenting the rate and form of recovery (e.g. Lawrence et al. 2012; Akselsson et al. 2014). This shift in focus reflects the primary European and North American origins of BIOGEOMON attendees: in contrast, in many developing countries and emerging economies, acid deposition remains a serious pollutant (Fowler et al. 2020), and ecosystem acidification is a significant environmental problem (e.g. Yu et al. 2017).

Another reason for the prominence of a topic at only a few meetings is that it heralded a new study area in biogeochemistry that was coming into prominence. For instance, there was a Session Theme on bioenergy in Helsinki 2009(6) (e.g. Hazlett 2009) and at the next meeting in Northport 2012(7) (e.g. Morrison et al. 2012), but none before or after these meetings. Similarly, the topic of linking biodiversity with biogeochemistry was a Session Theme in three consecutive meetings only: Bayreuth 2014(8), Litomyšl 2017(9), and Tartu 2022(10) (e.g. Reich 2014; van Dijk et al. 2017; Andrews et al. 2022; Fig. 3). The reduced attention to these topics in later conferences does not mean that they were no longer

important research areas, rather it suggests that they have become more established in the field.

A topic may have also appeared as a Session Theme at only a few meetings because it covered a new technique that attracted widespread attention, meriting sessions devoted to its use and applications. Subsequently, the technique became part of the overall 'toolkit' of researchers and was embedded in a wide range of presentations, no longer requiring a special focus at a meeting. Tools such as GIS (Session Theme at Villanova(3) 1997, e.g. Plant 1998) and remote sensing (Session Theme at Santa Cruz 2006(5), e.g. Albrechtová et al. 2006) are examples (Fig. 3). Sometimes a Session Theme relates to the biogeography of the host site, or the research focus of the host institution. For example, at San Juan 2024(11), the first BIOGEOMON in a tropical setting, tropical biogeochemistry appeared as a Session Theme for the first time (e.g. Canon-Escobar et al. 2024). In more recent years, themes have become more diverse, with, for example, sessions on scaling processes, stoichiometry, the arctic and subarctic, ecosystem services, and extreme events (Fig. 3).

Some topics are under-represented at BIOGEOMON. For example, there have been no Session Themes on ozone pollution and its impacts, and only a few ozone-related presentations at BIOGEOMON. This is surprising since increased tropospheric ozone, a product of combustion reactions, is known to significantly damage vegetation foliage, reproductive success, and seed viability (e.g. BIOGEOMON presentations of Semenov. 1993b, Nakaji et al. 2004, and Karlsson et al. 2017; see also Mills et al. 2011). Ozone can also act synergistically with pollutants that make regular appearances at BIOGEOMON, like nitrogen (e.g. BIOGEOMON presentations above, see also Payne et al. 2011; Hayes et al. 2019). Research focused exclusively on marine or estuarine ecosystems has also been uncommon, reflecting the decision in the early days of the conference series to focus on terrestrial habitats (Kelman Wieder, pers. comm.). The low visibility of some topics does not reflect their actual importance in the biogeosciences, rather, it is at least in part the legacy of those who attended the early meetings. Their research interests and those of their colleagues and students broadly set the tone of subsequent conferences.

Biomes and ecosystems

Every major terrestrial biome and ecosystem has been discussed at BIOGEOMON (Fig. 4). For biomes (Fig. 4A), the temperate zone dominates, featuring in around 50–60% of all oral presentations, but declining over time. The boreal zone is the next most popular biome, accounting for around 20% of talks. The coverage of boreal biomes increased in Helsinki 2009(6) and Tartu 2022(10), the two meetings hosted within the boreal zone, as well as at Villanova 1997(3), with a relatively high proportion of presentations based in Canadian boreal forests and peatlands. Presentations featuring tropical biomes increased from 2–3% at Prague 1987(1) to nearly 20% in San Juan 2024(11). Other biomes have lower representation: arctic, alpine, Mediterranean, and desert biomes account in total for around 5–15% of all talks.

Forests are the most common ecosystem, featuring in approximately 40–50% of oral presentations (Fig. 4B). This reflects in part the dominant concerns of the early conference founders and delegates: surface water acidification and forest decline, predominantly of coniferous forests. Like the temperate biomes with which they are often paired, the focus on forests reduces somewhat over time as other ecosystems, particularly aquatic and wetland, command more attention (Fig. 4B). After forests, aquatic ecosystems, including streams, lakes, groundwater, and karst, are the most featured at BIOGEOMON. Usually these are streams or lakes draining catchments where both the terrestrial and aquatic components are discussed. Only in recent years have aquatic ecosystems on their own become more prominent.

After forests and aquatic systems, agricultural (up to 15%), grassland (up to 10%), and urban ecosystems (up to 5%) have a low but fairly constant presence at the conferences. Interest in wetlands has steadily increased: at Prague 1987(1) fewer than 10% of presentations had a wetland component (and only one, Wieder et al. 1987, was devoted solely to wetlands); this increased to over 30% of talks in Tartu 2022(10). Estuarine and marine ecosystems feature in any significance only in the three conferences at maritime locations—Santa Cruz 2006(5), Northport 2012(7), and San Juan 2024(11)—and even then at less than 5%.

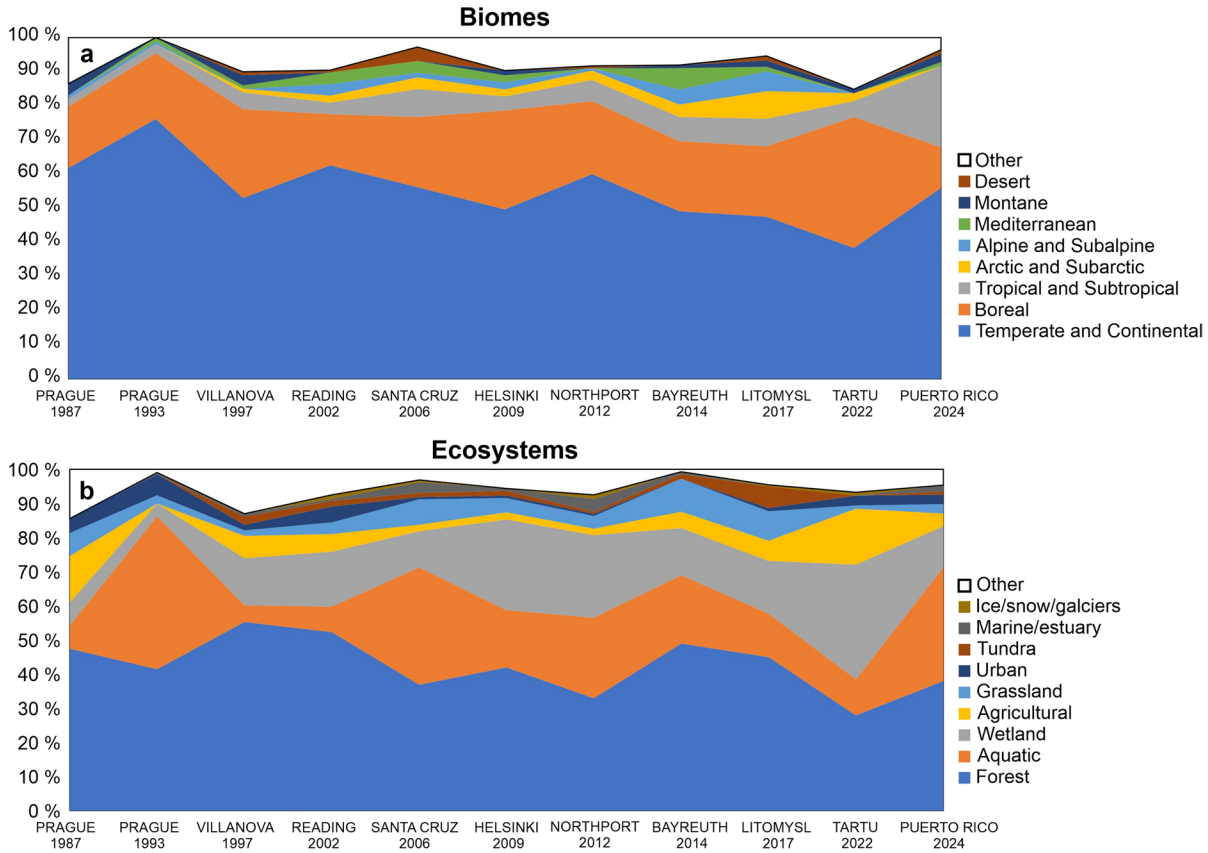


Fig. 4 Cumulative proportion of different (**A**) biomes, and (**B**) ecosystems discussed in oral presentations at BIOGEOMON meetings. Talks covering research on more than one biome or ecosystem received scores for each one

Field trips, culture, and culture shifts

There is a day devoted to field trips in every conference. These may be sites of ecosystem research, restoration, or management, rare or unique habitats, or recreational or cultural expeditions. Over the years, BIOGEOMON attendees have ventured to well-known catchment research sites, large-scale field manipulation experiments, and agricultural research centers. They have taken in redwood forests, glacial lakes, many types of wetlands, management and conservation zones, pollution remediation projects, botanic gardens, karst features, caves, coasts, and tropical cloud forest, to name a few (Table 2).

All of the participants at the Prague 1987(1) conference were invited to an excursion to the skeletal spruce forests of the Krušné hory mountains, decimated by air pollution (Moldan & Dvořáková, 1987). For some, it was their first sobering experience of the impact of extreme acidification. Catchment research, hydrologic engineering, and hydrometeorological observation were on offer in Prague 1993(2), as well as a brewery tour for those wishing to experience this celebrated feature of Czech culture.

When the meeting moved across the Atlantic for the first time, at Villanova(3) 1997, some of the serious environmental problems in the eastern industrial and coal-mining regions of America were demonstrated. Participants could visit a restoration activity where disposal of septic and chemical waste since the 1960s had severely contaminated the soils and local aquifer, and cleaning/containment activities were underway. The conference also featured a trip to the coal mining region of Pennsylvania, with ongoing mining and remediation activities. Visits to the unique ecosystem of the New Jersey Pinelands, the Catoctin Mountains, or the Chesapeake Bay were

Table 2 BIOGEOMON field trips

Location	Field trips
Prague, Czechoslovakia (GEOMON), 1987	• Krušné hory spruce forests (Moldan & Dvořáková 1987; Kupková et al. 2018)
Prague, Czech Republic, 1993	• Želivka dam and waterworks • Košetice hydrometeorological observatory (Fottová & Skořepová 1998; Dvorská et al. 2008) • Salačova Lhota catchment • Brewery tour, Pelhřimov
Villanova, Pennsylvania, USA, 1997	• New Jersey Pinelands (Morgan and Gray 1997; Fertakos & Clement 2021) • Tyson's superfund site • Catoctin Mountains, Maryland • Pennsylvania coal mining region • Chesapeake Bay
Reading, England, UK, 2002	• Plynlimon experimental catchment, Wales (Neal et al. 2004; Robinson et al. 2013) • Hydrological tour of the Roman Baths at Bath • Stonehenge • Post-conference trip to Cornwall
Santa Cruz, California, USA, 2006	• Henry Cowell Redwoods State Park • Watsonville wetlands
Helsinki, Finland, 2009	• Valkea-Kotinen catchment (Vuorenmaa et al. 2020) • Häme castle • Lake Vesijärvi; Sebelius Hall, Lahti • Liesjärvi National Park; Jokioinen Meteorological Observatory • Torronsuo mire; Agrifood Research Finland (MTT), Jokioinen • Sailing cruise through Helsinki Archipelago
Northport, Maine, USA, 2012	• Bear Brook experimental watershed (Patel et al. 2021) • Sargent Mountain Pond: glacial lake • Acadia National Park: wetlands and vernal pools • Acadia National Park: coastline geomorphology • Mount Desert Island; Schoodic peninsula; Gouldsboro Grand Marsh: coastal marshes and shorelines • Maine's Ice Age Trail • Windjammer sailing • Ocean kayaking
Bayreuth, Germany, 2014	• Lehstenbach study catchment, Fichtelgebirge (Gerstberger et al. 2004); Wunsiedel granite block labyrinth • Northwest Bohemian spa region: geological, ecological, and historical-cultural tour • Steigerwald Nature Park: management and conservation in beech-dominated deciduous forests • Forest ecosystem monitoring at Altdorf; tour of Nuremberg • The Jena Experiment and BIOTREE: biodiversity research • Helmholtz Centre for Environmental Research, Leipzig: pollution remediation • Fränkische Schweiz: Northern Jurassic plateau in Franconia. Geology, geomorphology, karst hydrology, vegetation • Fränkische Schweiz: Environmental impacts and visitor management of outdoor sports; kayak tour on river Wiesent • Experimental sites combining climate change, biodiversity and invasion research; Ecological-Botanical Garden • Bayreuth city tour including Wagner Opera House
Litomyšl, Czech Republic, 2017	• Košumberk castle; Luže place of pilgrimage; Velké Dářko Nature Reserve • Nové Hrady country house; castellated rocks of Toulovcovy Maštale; decanal church St.Lawrence Vysoké Mýto • Potštejn castle; Orlické Hory mountains; U Dvou Louček catchment (Petrash et al. 2019; Špulák et al. 2023); Kostelec nad Orlicí country house • Javoříčko caves; Bouzov castle • Pernštejn castle; protected Landscape Unit Žďárské vrchy (Žďár Hills); UNESCO World Cultural Heritage site Zelená Hora

Table 2 (continued)

Location	Field trips
Tartu, Estonia, 2022	• Forest ecosystem study sites in the Järvselja complex (Noe et al. 2011): free air humidity manipulation; experimental drained peatland forest; SMEAR Estonia (Station Measuring Forest-Atmosphere Relations) • The industrial oil-shale region in North-East Estonia: oil-shale open-pit mine and restoration; Lake Peipsi • Emajõgi River; Võrtsjärv lake and limnological station, Vända constructed wetland for buffering agricultural runoff; berry cultivation in former peat extraction area • Protected sites around Otepää and Karula hilly areas; Sangaste castle; forest study station and Soontaga eddy covariance tower. (Soosaar et al. 2022) • Meenikunno raised bog; traditions and culture of Seto people; visit to Piusa-Võmmorski protected area: heathland restoration and habitat creation for Northern crested newt (*Triturus cristatus*) in abandoned quarry • Männikjärve natural raised bog and peatland restoration sites in Laiuse and Endla • Post-conference tour to Saaremaa Island
San Juan, Puerto Rico, 2024	• El Yunque National Forest and Luquillo Research site (Lugo et al. 2021): Sabana warming experiment, Bisley experimental watersheds, Angelitos Trail to Rio Mameyes, high-elevation cloud/dwarf forest

also on offer. The dilemma, which became a feature of BIOGEOMON, was which trip to choose.

Critics sometimes point to the recreation activities of conferences as unnecessary distractions outside the scope of meetings. However, these activities build collaborations and friendships, provide important mid-conference 'down time' to rest and refresh minds, and not least, advance understanding and appreciation of other countries and cultures. BIOGEOMON has always provided a flavor of the local culture to participants. Excursions to castles, stately homes, opera houses, cathedrals, and places of pilgrimage have been interwoven with scientific stops in field trips (Table 2). Participants at different conferences could choose activities like sampling local produce, sailing, kayaking, canoeing, hiking, or sea cruising. Conference dinners in impressive city halls and national museums have featured in some meetings, outdoor barbeques, lobster feasts and seaside picnics in others.

Art also plays a notable part at BIOGEOMON (Fig. 5). Watercolors of forests by conference founder Tom Pačes, as well as by the Czech artists Julius Mařák and Josef Sima, have graced the covers of conference proceedings and abstract books. A seascape by Ava Shanley, daughter of conference co-organizer Jamie Shanley, featured in San Juan 2024(11). Other conference proceedings showcased photography of lakes, peatlands, and mountains.

Music too has featured in the conferences, including Czech country dancing, a concert by Noel Paul Stookey of the iconic 1960s folk group Peter, Paul and Mary, classical chamber music, pop and rock, and Puerto Rican Bomba percussion music. At Villanova 1997(3), delegates could attend a pre-conference baseball game, and the organizers of Bayreuth 2014(8) outdid themselves by providing a World Football Cup victory for Germany during the meeting. And finally, the Czech spirit Becherovka is the official herbal bitter of the meetings, bringing conference participants back to the place where it all started.

As society has changed, so has BIOGEOMON. Female attendance at the conference has increased year on year, echoing the rising presence of women in the field. Even more telling, the proportion of female keynote or plenary speakers has rocketed from zero in 1993 to 80% in 2024 (Fig. 6A). No longer is there a 'ladies' program' as there was in 1987 (Fig. 6B). Now ladies *lead* the program. Clearly this reflects the attainment of more women to senior positions over the three generations that have attended the meetings and, in general, to progress in addressing gender bias in the sciences.

Despite clear progress in the representation of women at BIOGEOMON, equal treatment for all remains as much an issue in the biogeosciences as it does in our wider society. Recognizing the paucity of minority and under-represented groups

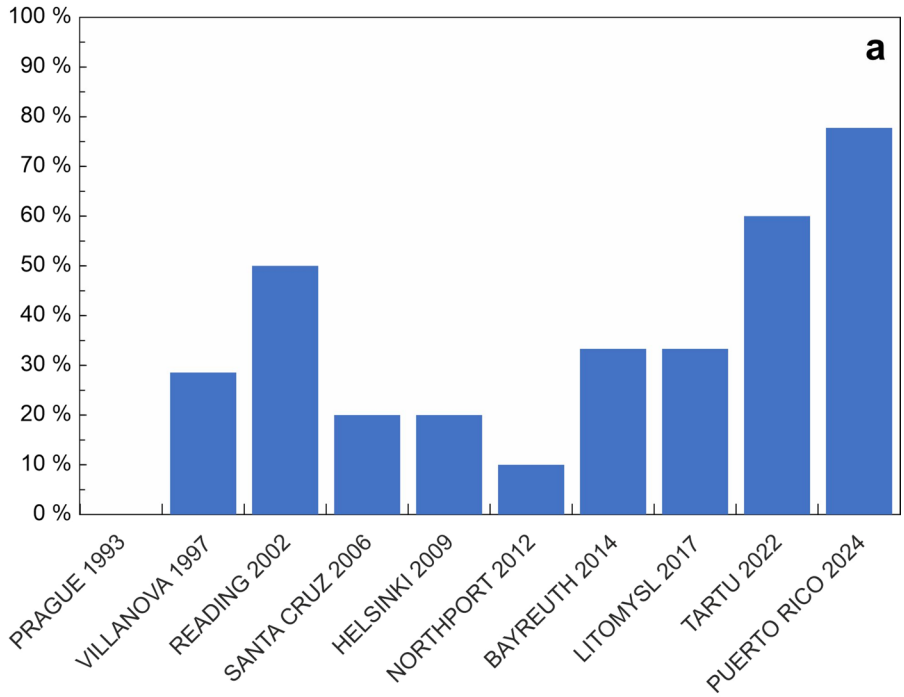
Fig. 5 Some artwork featured on BIOGEOMON conference abstracts and special issues. Clockwise from top left: Julius Mařák, Morning Song (1877), featured in Santa Cruz 2006(5); Erkki Oksanen, Finnish Lake (2008), Helsinki 2009(6); Tomaš Pačes, Recovery (1980s), Villanova 1997(3); Ava Shanley, Luquillo Mountains (2023), San Juan 2024(11); Tomaš Pačes, Forest Decline—Fishbone Trees (1980s), Prague 1993(2); Josef Šima, Landscape (1930), Reading 2002(4). Mařák and Šima artwork reproduced courtesy The National Gallery, Prague. Oksanen, Pačes, and Shanley artwork reproduced by kind permission of the artists

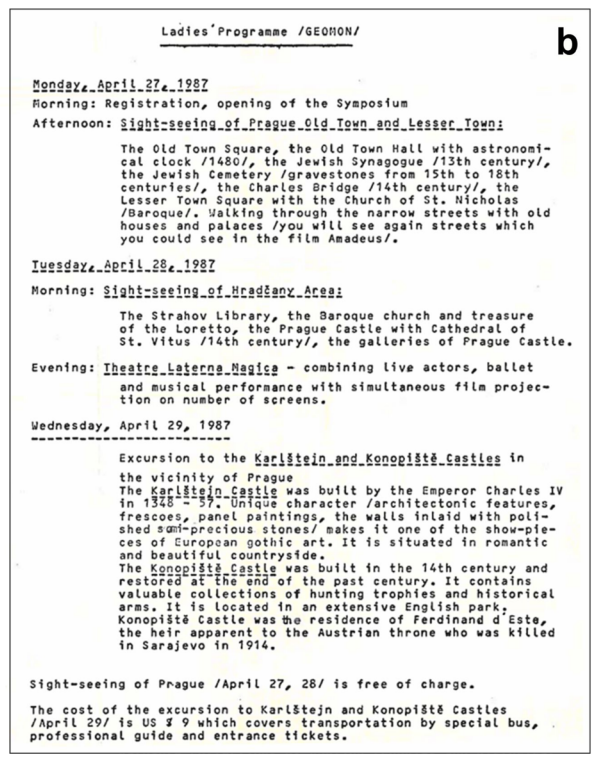
in the natural sciences, San Juan 2024(11) was the first BIOGEOMON conference to host a keynote presentation (Barnes 2024), and several workshops, on making the biogeosciences more welcoming and just for all people. A strong message is that science does not occur in a vacuum: both societal and personal biases influence our perception of the world and, in turn, our professional lives (Barnes et al. 2024). Unconscious bias can cascade through recruitment, hiring, and promotions, ultimately affecting the composition of the professional community (Moss-Racusin et al. 2012; Grogan 2019; Eaton et al. 2020). The need to acknowledge the preconceptions we all hold, and work together to overcome them, may prove as challenging a task over the next years of BIOGEOMON as bridging entrenched geopolitical barriers was in 1987.

Perspectives

In April 1987 an American Master's student (NBD) arrived at the GEOMON meeting in Prague to present her first paper at an international conference. There she met an energetic Czech PhD student (MN), who, a year later, arrived at Villanova University in the USA, having negotiated the pitfalls of an international exchange program with the added complication of the Cold War. He worked together with an enthusiastic undergraduate (MAV), and they presented their work in Prague 1993(2). A few years later, an early career scientist (MŠ) started work at the Czech Geologic Survey, and in turn, presented her research at Reading 2002(4).

Nearly a quarter of a century later, we four friends are now mid-career, late-career, and retired scientists. Like the progression of a career, BIOGEOMON has changed subtly over the years, and it is now almost unrecognizable from its start. But it carries with it the




b

Ladies' Programme /GEOMON/

Monday, April 27, 1987

Morning: Registration, opening of the Symposium

Afternoon: Sight-seeing of Prague Old Town and Lesser Town:

The Old Town Square, the Old Town Hall with astronomical clock /1480/, the Jewish Synagogue /13th century/, the Jewish Cemetery /gravestones from 15th to 18th centuries/, the Charles Bridge /14th century/, the Lesser Town Square with the Church of St. Nicholas /Baroque/. Walking through the narrow streets with old houses and palaces /you will see again streets which you could see in the film Amadeus/.

Tuesday, April 28, 1987

Morning: Sight-seeing of Hradčany Area:

The Strahov Library, the Baroque church and treasure of the Loretto, the Prague Castle with Cathedral of St. Vitus /14th century/, the galleries of Prague Castle.

Evening: Theatre Laterna Magica - combining live actors, ballet and musical performance with simultaneous film projection on number of screens.

Wednesday, April 29, 1987

Excursion to the Karlštejn and Konopiště Castles in the vicinity of Prague
The Karlštejn Castle was built by the Emperor Charles IV in 1348 - 57. Unique character /architectonic features, frescoes, panel paintings, the walls inlaid with polished semi-precious stones/ makes it one of the show-pieces of European gothic art. It is situated in romantic and beautiful countryside.
The Konopiště Castle was built in the 14th century and restored at the end of the past century. It contains valuable collections of hunting trophies and historical arms. It is located in an extensive English park. Konopiště Castle was the residence of Ferdinand d'Este, the heir apparent to the Austrian throne who was killed in Sarajevo in 1914.

Sight-seeing of Prague /April 27, 28/ is free of charge.

The cost of the excursion to Karlštejn and Konopiště Castles /April 29/ is US $ 9 which covers transportation by special bus, professional guide and entrance tickets.

Fig. 6 A. Proportion of female keynote and plenary speakers at the BIOGEOMON conferences. There were no keynote or plenary speakers at Prague 1987. B. Ladies' program at Prague 1987. The three-day program included a tour of the Old Town, ballet performance, and excursion to two castles: total cost US $9!

seeds of its beginning, and the many influences that have shaped it along the way. For the new generation of scientists, we trust that our history has helped to give the meetings new perspectives and added depth. For those who have notched up many attendances (no-one has been at all 11, but a few have attended 10 and counting), we hope our retrospective has done some justice to describing your experience.

We have chosen to end our review with reflections from a few BIOGEOMON veterans:

"My first BIOGEOMON was no. 3 in Villanova, and I participated all but one of the following BIOGEOMONs. All were outstanding conferences, perfectly organized, and with topics and presentations always keeping up with hot pressures of the times. Co-organizing BIOGEOMON no. 8 in Bayreuth was a special pleasure for me. I wish BIOGEOMON a long and prosperous future."

Gerhard Gebauer

"BIOGEOMON, and the Acid Rain conferences, were my very first international conferences when I started out 30 years ago. These conferences were very exciting, of course, and set the scientific frame of our research. Being a young scientist, they helped a lot to meet everybody, being able to present my work and get to know people and get people to know me. I think I can truly say they were a very important part of my scientific career. Apart from that it was great to meet and follow up with colleagues I met over all these years."

Christine Alewell

"My memories of BIOGEOMON are so coloured by the first one in Prague. It was one of joy. Joy in the fact that I met wonderful scientists, some of whom became very dear friends. I also remember those lead scientists, at that time of rapidly changing political and environmental pollution perspectives, who showed bravery, humanity and humility: qualities that will always be so indispensable in our environmental sciences. My work was enriched beyond recognition by the contribution from wonderful scientists that could only be established through international get-togethers such as BIOGEOMON."

Colin Neal

"My first meeting in 1987 convinced me that there was a camaraderie about BIOGEOMON that was comfortable because of the size. The format of oscillating the meeting place from Europe to North America was a great idea. But it was the mixture of the established great scientists and newly minted scientists, or about to be, that was exciting. The small size led to anticipation of seeing friends again every 3+/- years. And the friends turned into colleagues, and colleagues into collaborators. My career has been immeasurably enhanced by new friends that I have been fortunate enough to meet. I am grateful to many people, but particularly the Czech contingent for the vision of GEOMON at the beginning, and the expanded vision to BIOGEOMON brought on by a collective wisdom of the planning committees through time. It has been great fun being part of this journey."

Steve Norton

"BIOGEOMON has always felt like returning home, a family reunion of sorts. My science family."

Melanie Vile

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BIOGEOMON has never been associated with a professional organization, and each organizing committee has had to take on the challenge of supplementing registration fees with external funds. Private, industrial, government, and educational organizations have all helped fund the meetings.

Finally, we would like to thank all those who have participated in the conference over the last 37 years, from BIOGEOMON 'lifers' who attend regularly, to those who have joined only once or twice, to the new generation of scientists who came for the first time in 2024. We hope that future BIOGEOMONs will continue to challenge and enrich you.

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Declarations

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