

Earth system governance

World politics in the post-environmental age

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Earth system governance is a new paradigm in the social sciences to better understand politics in times of socio-ecological system changes at planetary scale. It shares with traditional concepts, such as “global environmental politics,” the focus on governance as the collective steering of societal behavior by political actors (see Chapters 1 and 2). Earth system governance radically breaks, however, with traditional notions of environmental policy by replacing their dichotomies of human–nature and human–environment with a decisive socio-ecological systems perspective and by a more explicit focus on planetary interdependence.

This shift from traditional environmental policy to a novel earth system perspective, as reflected in the new paradigm of “earth system” governance, resulted from a new understanding of both global complexity and the rapidly growing planetary role of the human species. Scientific advances of the last decades showed the non-linearity of earth system processes, the threat of rapid system shifts and the complex interrelationships between system components, including the now dominant role of humans. The relative stability of the earth system during the Holocene – the last 12,000 years that brought about the development of human civilization – now seems almost a fortunate exception. This development has been aptly captured in Paul Crutzen and Eugene Stoermer’s (2000) call to declare the Holocene ended and to recognize the beginning of a new epoch in planetary history: the “Anthropocene.” The Anthropocene, the “age of humans,” has become shorthand for the current epoch in our planet’s history in which humans are no longer passive elements in planetary evolution but a driving force at earth system scale, comparable in significance to ice ages (Zalasiewicz et al. 2011; see Chapter 15). The Anthropocene notion is not unproblematic and has been criticized by scholars from the humanities and social sciences for what it lacks or tends to blur (Biermann and Löwbrand 2019; Löwbrand, Möbjörk and Söder 2020). For example, the Anthropocene has been critiqued for its universal one-humankind narrative that hides from view centuries of colonialism, patriarchy, exploitation and postcolonial injustices. Yet any alternative terms remain fixated on one aspect only (e.g., Capitalocene, Andropocene or Plantationocene) and fail to fully grasp the breadth of the novel role of people on earth. In short, as a new concept the Anthropocene has caught on (see Chapter 15).

The core argument of the earth system governance approach here is that the traditional mainstream idea of global environmental politics, shaped in the 1970s and 1980s

(see Chapter 2), falls short when dealing with the novel challenges of the Anthropocene. To give just two examples: scientists have suggested a set of “planetary boundaries” as threshold values that would, if transgressed, shift parts of the earth system into a new state (Rockström et al. 2009; Steffen et al. 2015; critically reviewed in Biermann and Kim 2020b). Most of these boundaries, however, fall outside the realm of traditional environmental policy and are understandable only from a complex global-system perspective. Planetary boundaries for the emission of phosphorus and nitrogen (both linked to global food production), the human use of freshwater or global land use can no longer be described as purely “environmental” policy given their huge economic, social and distributive complexities at planetary scale. Global environmental politics is not a useful concept to shape political responses for protecting such complex, interdependent planetary concerns. As a second example, global environmental politics deemphasizes, with its focus on problem-solving and policy effectiveness, important questions of planetary justice, global democracy and postcolonialism. Global environmental politics does not provide much conceptual guidance to study the many novel societal challenges of the Anthropocene, such as providing food, water and energy to 9 billion people while guaranteeing climate stability (see Chapter 32), preserving biological diversity (see Chapter 41) and ensuring intragenerational, intergenerational and interspecies justice (see Chapters 25 and 26). Politically, framing major earth system transformations such as climate change as merely “environmental problems” – to be dealt with by second-tier environmental ministries and agencies – might even have harmed their standing in the policy system and politically marginalized central planetary concerns, which new discourses, such as calls for “climate emergencies,” now seek to revert.

As a consequence, several discursive interventions have suggested new framings of governance in the Anthropocene beyond traditional global environmental politics, such as “new earth politics” (Nicholson and Jinnah 2016), “earth governance” (Bosselmann 2015), “planet politics” (Burke et al. 2016), “politics of the Anthropocene” (Dryzek and Pickering 2018), “Anthropocene geopolitics” (Dalby 2020) or, from a legal perspective, “earth system law” (Kotzé and Kim 2019, Stephens 2019) and *lex Anthropocenae* (Kotzé and French 2018).

The emergence of earth system governance

Earth system governance is an alternative concept that was advanced two decades ago to integrate the new scholarly focus on *integrated socio-ecological systems* at *planetary scale* with an explicit perspective of *governance, institutions and politics* (Biermann 2002 and 2007). The concept of earth system governance is integrative by opening to different disciplines, such as political science, sociology and law. It is conceptually scalable as it allows the study of local- or regional-scale systems within a planetary or earth system perspective. Some scholars have in fact come to use the term in its plural and more scalable version as “earth systems” governance.

Earth system governance relates to other novel concepts of scientific integration, such as earth system analysis, earth system science, sustainability science or resilience theory (Biermann 2014). All these research lines share core characteristics. First, all focus on analyzing interlinked *systems*. Their eventual unit of analysis is the earth as an interdependent system shaped by human and nonhuman agency. Second, all approaches study the *co-evolution* of humans and nature. Boundaries between natural and social systems are broken down by focusing on coupled socio-ecological systems. Third, all approaches break down *disciplinary boundaries* through working toward a new integrating science that combines existing disciplines in joint research. Fourth, all these approaches seek to integrate research *on all scales*. Boundaries between local and global become blurred in both theory and research practice.

Earth system governance stands in the tradition of these novel approaches, with a focus on the study of the political and institutional dimensions.

Importantly, the key concern of earth system governance is not “governing the earth” or the management of the entire process of planetary evolution. Earth system governance is different from technocratic visions of what is referred to as “earth system management” or “geo-engineering.” Earth system governance is about the *human impact on planetary systems*. It is about the societal steering of human activities regarding the long-term stability of geobio-physical systems and the flourishing of all species. It is about global stewardship for the planet based on non-hierarchical processes of cooperation and coordination at multiple levels.

Earth system governance is hence not a shorthand for world government but part of a larger academic interest in processes of governance. Governance differs from government and is not confined to states and governments. Governance is marked instead by participation of myriad state and nonstate actors at all levels of decision-making, ranging from networks of scientists and experts, civil society actors and environmentalists to intergovernmental organizations. Governance also often implies the self-regulation by societal actors, private–public cooperation and of new forms of multilevel policy. Governance transcends the more narrow concept of institutions through a dynamic perspective that looks at processes of governing, that focuses on governance systems beyond single institutions, and that brings a stronger emphasis on actors and especially on nonstate actors (see Chapters 13 and 14). In short, governance covers a wide set of phenomena that are all crucial for a complete understanding of politics in coupled socio-ecological systems at planetary scale.

Analytical practice, normative critique and transformative visioning

In the practice of earth system governance research, there are three ways of theorizing about it: earth system governance as analytical practice, earth system governance as normative critique and earth system governance as transformative visioning. The *analytical theory* of earth system governance seeks to explain current politics. This is traditional social science. It is about institutions and regimes, their interlinkages, and the diagnostics of specific institutional designs. It is also about core problems of the social sciences, such as the role of power, ideas, norms, different claims to legitimacy, or about the distributive outcomes of governance and their normative evaluation in terms of justice. Here, earth system governance research can draw on a productive tradition in earlier research on national and international institutions (Young, King and Schroeder 2008).

The *normative theory* of earth system governance, on the other hand, is the critique of current systems of governance. The normative theory does not ask what is, but what should be. It juxtaposes the findings and insights from analytical theory – for instance on the effectiveness of international regimes or national policy – with both the necessities of earth system stability and the needs of social justice. The normative theory is essentially critical theory, focusing on the reform and reorganization of human activity in a way that guarantees to effectively and fairly “navigate the Anthropocene” (Biermann et al. 2012, Biermann 2014).

This combination of analytical theory and normative critique turns earth system governance into a transformative approach in the social sciences. Business-as-usual will not prevent critical transitions in the earth system, and technological revolutions and efficiency gains alone will not suffice. Instead, effective earth system governance must directly address key concerns of societal change. For one, in a highly divided world, earth system governance poses fundamental questions of justice within and among nations. It raises important queries about the legitimacy and accountability of public action and about effective and fair

mechanisms of democratic earth system governance. Earth system governance is therefore as much about environmental parameters as about social practices and neoliberal capitalist systems. Its normative goal is not purely environmental protection on a planetary scale – this would make earth system governance devoid of its societal context. Planetary targets – such as control of greenhouse gases – could theoretically be reached through hugely different political means with different costs for actors in different geographies. Earth system governance is about social welfare as well as environmental protection; it is about effectiveness as well as global and local justice.

This foregrounding of normative concerns in earth system governance theory raises new and difficult questions also for scholars and students as agents of change. How do today's universities function as thought leaders, thought provokers, critics and co-creators of transformative normative discourses and novel paradigmatic understandings? Are universities ready for a more active, political role? How can we support engaged scholarship in academia and the generation of novel insights into how to solve the key planetary challenges of the Anthropocene? University communities must critically reflect on their own practices – not the least on the consumption levels of the research community itself. Such discussions about the political and personal roles of scholars in the Anthropocene must undoubtedly become more prominent in the years ahead.

Earth system governance as a research field

Earth system governance as a research field is interdisciplinary, global and complexity-oriented. For one, it transcends traditional concepts of environmental policy and nature conservation and their narrower approaches and questions. The anthropogenic perturbation of the earth system brings research problems that are qualitatively different from those that have traditionally been examined in environmental policy studies. Key questions of earth system governance are, to name a few, the institutional architectures, decision-making procedures and distributive policy impacts in areas as diverse as global adaptation to rising sea levels, the halting of global soil deterioration, the protection of climate migrants or the global implications of speculative carbon dioxide removal technologies – all issues that have barely been covered by traditional environmental policy research.

As a consequence, earth system governance research transcends levels of analysis, from a planetary problem analysis down to national policies and local governance. Earth system governance is more than a problem of global regulation through international agreements. It is first and foremost about people who take decisions in their daily lives and their political struggles. Earth system transformations affect individuals as much as it is driven by individual decisions within social, political and economic structures. As such, earth system governance is informed by planetary complexity while being concerned with local institutions, policies and contestations as well.

Because of this complexity, earth system governance research draws on insights from the full range of the social sciences across the scales, from anthropology to international law. Earth system governance research covers local policies on problems ranging from the preservation of local waters to desertification and soil degradation. At the same time, it includes the study of the hundreds of international regimes that seek to regulate governments and corporations. Earth system governance requires the integration of all these strands of research and bridges scales from global to local.

Importantly, earth system governance research reaches beyond the social sciences. Its problem definition makes it part of the overarching context of integrated sustainability

science and earth system science, where social scientists work with natural scientists to advance the integrated understanding of the coupled socio-ecological system that our planet has become (Leemans et al. 2009; Clark and Harley 2020). Both social and natural scientists must collaborate, including in integrated assessments of the state of knowledge. Typical for such global cooperation across disciplinary silos are interdisciplinary research programs, such as the Global Land Programme, the Global Carbon Project, Future Earth Coasts, or the Programme on Ecosystem Change and Society. These global research programs are not unproblematic: often they are driven by frames and problem definitions derived from the natural sciences, lack financial resources and impact, and are dominated by science organizations from the Global North. Yet there is hardly an alternative to global cooperation. Critical social science is called upon to engage and transform such networks to make them more relevant for global sustainability and social justice. Earth system governance serves here as a boundary concept that allows political scientists and institutional analysts to easily operate within larger interdisciplinary research environments.

In short, earth system governance is broader than traditional global environmental politics in its emphasis on the complexity of integrated socio-ecological systems at planetary scale. Key concerns of earth system governance are vast and interdependent challenges, such as ocean acidification, land use change, food system disruptions, climate change, environment-induced migration, species extinction, changing regional water cycles, as well as more traditional environmental concerns. Yet while earth system governance is a broad area of scholarly inquiry, it also has its conceptual boundaries. For instance, global political questions of international security, global communication and digitalization or terrorism are less studied within the earth system governance research community unless there are clear links to the functioning of socio-ecological systems, for example in the nexus of climate disruptions and local conflicts.

The global network of earth system governance researchers

The transformative force of the earth system governance paradigm has given rise to the creation of a global network of scholars working in this field, the “Earth System Governance Project.” This network originated in 2008 as a core project of the former International Human Dimensions Programme on Global Environmental Change, based on a ten-year science and implementation plan agreed upon in 2008 (Biermann et al. 2009). After over a decade of operation, the Earth System Governance Project has matured into a global, self-sustaining network of over thousand scientists, with conferences, taskforces, affiliated research centers, regional fellow networks, an affiliated foundation, and a lively presence in social media (see in more detail Biermann et al. 2019). Research fellows organize their own activities, including summer schools, research visits, online training sites and in some regions elect their own representatives. Mid-level and full professors are affiliated with the Project as “senior research fellows.” In addition, the Project launched early on its “Lead Faculty,” a small globally diverse community of the most influential scholars in the field of earth system governance. This community of people thrives through the annual open science conferences that the Earth System Governance Project organizes. These annual conferences rotate between continents and have ranged from Amsterdam to Fort Collins, Lund, Tokyo, Norwich, Canberra, Nairobi, Utrecht, Oaxaca and in 2021 Bratislava. These conferences are important gathering venues for the earth system governance research community, with many discussions being carried on from conference to conference over the years. As a network organization the Earth System Governance Project has also invested in global community outreach

from the outset, with an extensive website, a Facebook presence, several Twitter accounts, a LinkedIn group, a newsletter, the hosting of receptions and dinners at partner alliances, and various other means. Overall, this has allowed the network to further grow and to cumulatively reach several thousand scientists, practitioners and increasingly the public.

Even though the Earth System Governance Project has evolved with a high degree of informality, consensus approaches and bottom-up initiatives, it also developed a portfolio of institutional structures essential for continued scientific exchange and production. The Project maintains three book series with the world's top academic publishers, notably the *Earth System Governance* series with MIT Press launched in 2009; the more recent *Earth System Governance* series with Cambridge University Press focusing on synthesis volumes from the Project; and the new *Cambridge Elements in Earth System Governance*, which provide an outlet for shorter books. In 2019, the Project launched its flagship journal, *Earth System Governance*, as an open access publication with Elsevier. The choice of open access followed the Project's efforts to decolonialize global science and to strengthen its global outreach in a world where millions of scholars lack access to rich university libraries and traditional paywalled journals. Articles in *Earth System Governance* are always freely accessible to anybody anywhere, making the research insights of the community a free knowledge good available to all.

Applications and insights

As earth system governance research can look back at over ten years, several important areas of study have emerged. With a view to international relations, earth system governance research has, for instance, moved from the study of single institutions toward the study of broader “architectures” of earth system governance. Whereas traditional studies of global environmental politics had focused on single international regimes (see Chapter 9), increasingly it has become clear that such regimes do not operate in a void but within complex webs of larger governance settings (Young 2017; Zelli, Gerrits and Möller 2020). Earth system governance research has conceptualized such complex institutional settings as “governance architectures,” using the metaphor of buildings with copious rooms, lavish apartments, winding staircases, and meandering corridors. The concept of governance architectures has filled a conceptual void in scholarship and shifted the debate to situations in which a governance area is regulated by multiple institutions and norms in highly complex settings at often planetary scale (Biermann and Kim 2020a).

The notion of a governance architecture does not assume an architect. Governance architectures emerge instead incrementally from institutionalization processes that are often decentralized and hardly planned. Many architects shape an architecture, with the resulting configuration then influencing how institutions interact by limiting the choices and opportunities for actors such as governments. A governance architecture is thus in constant flux, evolving through interactions at the micro-level and the dynamic architecture at macro-level. Importantly, the architecture concept allows for structured comparisons between issue areas, regions and over time and to study variant effects of governance architectures. Such architectures have been studied for various socio-ecological systems at planetary scale, including climate governance, ocean governance or biodiversity governance. This research has usually combined analytical and normative debates, theory and practice, scholarly discourse and calls for political reform. Theoretical debates – for instance on the orchestration effects of intergovernmental organizations (see Chapter 8) – go hand in hand with elaborate calls for structural change.

Second, earth system governance research has emphasized from its start the many ways by which *nonstate actors* have gained influence (see Chapter 14). In some areas, such as forest governance, it appears that nonstate actors even play central governing roles. They also often create their own transnational institutions with only a marginal role for governments or without any involvement of governments. All these actors and institutions interact within broader architectures of earth system governance. This new and complex multiplicity of actors in earth system governance has led researchers to emphasize the theoretical question of *agency in earth system governance*. All 11 global conferences on earth system governance that were held so far included a dedicated stream of panels on agency; and many publications have referred to this concept and the detailed research questions that were laid down in the first science plan of the Earth System Governance Project. Earth system governance research advanced here a novel conceptual frame on how state and nonstate actors engage in making decisions from local to global levels, how structure and agency are related and interact, and how governance and agency differs across societies and scales of governance (Betsill, Benney and Gerlak 2020).

Third, the *adaptiveness of earth system governance* has been a core concept in this research community since its very beginning as well. The concept of adaptiveness brings together communities of scholars that have often operated under different conceptual terms, such as resilience, adaptive governance, adaptive management, anticipatory governance or adaptation, as well as scholars of social learning, institutional dynamics or what is known as governance for transformation (Linnér and Wibeck 2019). In earth system governance research, adaptiveness is now an umbrella concept to bring these communities together for a fruitful research program on how societies and governance systems can adapt to a dynamic environment, can anticipate future changes, and learn (Djalante and Siebenhüner 2021).

Fourth, earth system governance research has opened a new debate on the foundations of law, turning from traditional notions of national or international law to a new conceptualization of “earth system law” (see Chapter 10). Earth system law is defined as a new overarching legal phenomenon that accommodates and encapsulates the juridical aspects of earth system governance better than traditional “environmental” law and that can more comprehensively respond to the regulatory challenges presented by a changing earth system (Kotzé and Kim 2019). One important discussion has, for example, been about the legal status of nonhumans in the Anthropocene and the need to “broaden the universe of entities capable of qualifying as legal subjects eligible for legal rights to include both natural and artefactual non-humans, a move integral to obtaining socio-ecological justice under Earth system law” (Gellers 2020).

Fifth, earth system governance research has brought in important questions of *justice, equity and fairness* (see also Chapters 25 and 26). While the problem-solving effectiveness of global environmental policy has been at the center of scholarly attention for long, earth system governance research emphasizes questions of the allocation of the risks and benefits, of power and disempowerment, and more generally on the normative foundations of governance at planetary scale. Earth system governance research seeks here to expand more traditional concepts of “environmental justice” toward a planetary perspective and “planetary justice” (Biermann and Kalfagianni 2020; Hickey and Robeyns 2020). The term planetary justice marks a fundamental departure from traditional approaches toward justice in twentieth-century “Holocene terms.” Planetary justice foregrounds that the entire human and nonhuman world is now at stake, not merely a locality. Planetary justice is concerned with justice among humans as well as between humans and the natural world. Planetary justice also transforms older notions of global justice with their focus on international institutions, international relations and global order. Planetary justice instead is equally concerned with

the global and the local, with state and nonstate actors, and with individuals and collectives. The notion of planetary justice opens the often localized environmental justice discourse to a more systematic interrogation of its planetary dimensions and the earth system challenges that humanity is facing. It also strengthens the normative critique of the grand designs in earth system science, from planetary boundaries to earth system targets, by questioning their assumptions and the forgotten injustices that are hidden in these meta-narratives.

Sixth, earth system governance research has opened new debates about *global democracy* and about how earth systems could be governed democratically. Much of this work has been linked to theories of deliberative democracy (e.g., Dryzek et al. 2019), with added emphasis on novel ways to strengthen “ecological reflexivity” at planetary scale – the capacity to question and change core commitments while listening and responding to signals from the earth system (Dryzek and Pickering 2018). Yet, the debate on democracy in earth system governance goes further than deliberative democracy (see, e.g., Mert 2019; Schlossberg, Bäckstrand and Pickering 2019). Important debates have addressed the role of human rights in earth system governance (Baber and Bartlett 2020) or representative models of global democracy such as a new “world parliament” within the United Nations (Leinen and Bummel 2018). More specific questions of legitimate and democratic decision-making have been studied by earth system governance scholars as well, including explorations of governance accountability (Park and Kramarz 2019) and transparency (Gupta and Mason 2014).

Seventh, earth system governance research has studied not only global but also local politics. Many studies used frameworks of the Earth System Governance Project to investigate local governance, from floodplain management in Hungary (Werners et al. 2009) to urban climate governance (Van der Heijden 2019; Van der Heijden, Bulkeley and Certomà 2019) or how domestic institutions in climate governance can be (re)made in complex settings (Patterson 2020). At the regional level, a group of African researchers has studied the specific governance implications of earth system transformations in Africa, arguing that the earth system governance approach is useful to guide knowledge generation in this critical area of research. These scholars also underscored the need for robust research capacity and a strong pan-African knowledge network on earth system governance (Habtezion et al. 2015).

After the first ten years of earth system governance research, in 2018 an international group of scholars wrote a new science plan to guide research in the ten-year period until 2028 (Earth System Governance Project 2018; summarized in Burch et al. 2019). This exciting plan develops new approaches to further stimulate a pluralistic, vibrant and relevant research community and advances a new framework with five pairs of research lenses that each offer a distinct perspective on earth system governance, such as “architecture and agency,” “democracy and power,” “justice and allocation,” “anticipation and imagination” and “adaptiveness and reflexivity.”

Policy impact

As a novel conceptualization of politics in the post-environmental age, earth system governance is still largely located in the realm of academic discourse. Yet the notion of earth system governance has slowly found its inroad into the public debate as well. For example, in the run-up to the 2012 United Nations Conference on Sustainable Development in Rio de Janeiro, a group of 20 Nobel laureates called for “strengthening of earth system governance” as a priority for coherent global action. Also in reports by the United Nations, references to earth system governance have been made (UNGA 2014).

Moreover, groups of scholars affiliated with the Earth System Governance Project have regularly engaged with policy debates, for example with assessments of the state of knowledge on key policy issues such as the reform of the intergovernmental system (Biermann et al. 2012), better ocean governance (De Santo et al. 2019), the governance implications of the North American Free Trade Agreement (Tienhaara 2019), a proposal for a coal elimination treaty (Burke and Fishel 2020) or, most recently, a collective assessment by over 60 scholars of the political impact of the Sustainable Development Goals (Biermann, Hickmann, and S  nit 2022).

Critique

Earth system governance has met several lines of critique as well over the last years. For one, the conceptual focus on “earth system” governance initially created a misunderstanding that this community would study only global institutions. Among those who follow the Earth System Governance Project only from afar, and hence base their assessment only on their reading of its title, misleading associations are sometimes drawn with planetary engineering, a “proto bio-political regime” (Salleh 2013), technocratic imaginaries (Stirling 2014), and an alleged tunnel vision of global “cockpit-ism” (Hajer et al. 2015). A more recent line of critique has linked earth system governance research with dangers of universal, Northern-based intellectual dominance that marginalizes different epistemologies and in particular actors from the Global South.

The empirical reality of the Earth System Governance Project tells a different story, with much scholarship by the community studying local, national or multi-level governance and often with emphasis on polycentric, networked or experimental governance as opposed to central steering – yet all typically with a planetary concern and a global perspective. Most scholarship in the Earth System Governance Project also is far from top-down managerial approaches but rather focuses on key social concerns or processes, such as justice, power, democracy and legitimacy, and this often from a critical, emancipatory perspective. This position of the community is also extensively reflected in the two science plans of the project from 2009 (Biermann et al. 2009) and 2018 (Burch et al. 2019). Much research on earth system governance has directly criticized ecomodernism, technocracy and postcolonialism, for instance by prioritizing work on “planetary justice,” epistemic diversity, decolonializing Western science, or by engaging with ecosocialist and other progressive lines of thinking. In 2017, for example, the (late) Marxist sociologist Erik Olin Wright was invited as the opening keynote speaker at the annual conference of the Earth System Governance Project to lay out his critical insights on capitalism and earth system governance.

Conclusion

The traditional notion of global environmental politics is no longer able to allow for a complete and theoretically satisfying understanding of the human predicament in the Anthropocene. A global environment is impossible to define, and key concerns of global governance cut across traditional binaries of humans versus the environment, or human versus nature. In the twenty-first century, we can understand societies and nature only as integrated socio-ecological systems at planetary scale – systems that are dynamic and instable, interconnected and interdependent, and utterly complex when approached from a global governance perspective. To explore answers to these novel challenges in political science and international relations studies, the earth system governance paradigm has been developed over the

past decade as part of a larger family of novel and not mutually exclusive conceptual innovations. Earth system governance brings a new perspective for the theory of global politics that is system-focused as opposed to binary human–environment; integrated across levels instead of being merely inter-governmental or local; and progressive as a research approach by moving from positivist institutional analysis to critical theory and transformative global change.

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