

COMPLEX SYSTEMS

Rakhyun E. Kim

Utrecht University, The Netherlands

Complex systems are systems that display unique properties such as emergence and self-organization. Their behavior is inherently unpredictable due to nonlinear relationships between interdependent parts and processes. This makes complex systems different from systems that are just complicated by possessing many parts. Diverse types of complex systems exist, but global governance scholars have paid particular attention to complex adaptive systems. These systems operate at the edge of chaos (neither random nor uniform) and display seemingly coordinated and adaptive behavior in the absence of central control.

Two key rationales exist for looking through a complexity lens in **global environmental governance studies**. The first relates to the need to increase the **effectiveness** of governance in complex systems (Young 2017). As humanity is entering the **Anthropocene**, global (environmental) risks are becoming increasingly networked, creating super-wicked problems. The increasing complexity of problems at hand demands critical reflection on the form and function of global governance (Galaz 2019). Here, an emerging view in the literature is that governance needs to be modeled on systems-to-be-governed, which requires a complexity-informed approach to global governance (Kim and Mackey 2014).

The second relates to the idea that global governance systems themselves are complex (Orsini et al. 2019). The proliferation of **regimes**, often articulated in hundreds of multilateral environmental agreements (e.g. **Wetlands Convention**) and administered by treaty **secretariats**, has resulted in a complex web of **institutional interactions** (Oberthür and Stokke 2011). The resultant structures are sometimes described as “regime complexes” (Orsini et al. 2013) or governance “architectures” (Biermann and Kim 2020). These large web-like structures display properties of complex systems such as reflexivity and **adaptation**, and they evolve through a process akin to natural selection (Morin et al. 2017).

These two analytical dimensions—the “governance of complexity” and the “complexity of governance”—together comprise an emerging research agenda on institutional complexity. The two are interrelated: the effective governance of complexity is at least in part a function of certain characteristics of complex governance systems. Key research questions have therefore been both analytical and normative: What makes a global

governance system more or less complex? What are the effects of institutional complexity? How should we govern complex systems and to what end?

A key variable here is the complexity of global governance systems, for which there are two notable approaches to operationalization. An agency-oriented approach, on the one hand, seeks to identify when the complexity of a governance system reaches beyond the cognitive capacity of agents operating therein. Here, perceived rather than objective complexity is what matters. This approach to detecting complexity has been adopted by social scientists interested in the ethical or political dimensions of complexity, for example, by examining who is empowered or disempowered by increasing institutional complexity.

A structure-oriented approach, on the other hand, seeks to measure complexity as a quality inherent in a governance system. So far institutional diversity and multiplicity have been employed as key measures, with recent attempts at detecting complexity using topological signatures such as small-world and scale-free properties (Kim 2019). The expectation is that, by using a quantifiable measure of complexity, we may compare various governance systems, and explain the relationship between institutional complexity and governance outcomes, such as effectiveness, **environmental justice**, and **participation**.

The complex systems approach is generating novel insights on the role of complexity in and for global governance. Paradoxically, however, the enhanced understanding has not and will not necessarily increase our predictive power. A theory of complexity is still far from our reach. What complexity thinking has allowed us, though, is to embrace the complex reality, rather than denying it and thereby coming to misleading conclusions.

References

- Biermann, Frank and Rakhyun E. Kim (Eds.). 2020. *Architectures of Earth System Governance: Institutional Complexity and Structural Transformation*. Cambridge, Cambridge University Press.
- Galaz, Victor (Ed.). 2019. *Global Challenges, Governance, and Complexity: Applications and Frontiers*. Cheltenham, Edward Elgar.
- Kim, Rakhyun E. 2019. "Is Global Governance Fragmented, Polycentric, or Complex? The State of the Art of the Network Approach." *International Studies Review*: 1–29.
- Kim, Rakhyun E. and Brendan Mackey. 2014. "International Environmental Law as a Complex Adaptive System." *International Environmental Agreements: Politics, Law and Economics* 14(1): 5–24.