

Is there a difference between robustness,
stability, and resilience?

Resilience has two dimensions: *a system's capacity to withstand change and recover (adapt)*

Robustness captures the first dimension.

[dynamical] stability: how small perturbations of the equilibrium state affect a dynamical system.

topological robustness: ability to withstand the failure of nodes and links

Q1

How can we unify the different concepts of robustness of complex systems found across disciplines?

We propose as a working definition: Robustness captures a system's capacity to withstand change and represents the structural dimension of resilience.

Key points

How a system responds to **perturbations** given a **reference state [performance]** over a **period of time**

Perturbations: to state variables or parameters

Reference state: qualitative or quantitative

Key points

How a system responds to **perturbations** given a **reference state [performance]** over a **period of time**

1. Less change to a perturbation (Resistance)
2. most quickly return to a reference state (Resilience)
3. withstand large perturbation and return to (remain in) a reference state (Tolerance)

Justus, J. 2013. “[Philosophical Issues in Ecology](#).” In Kampourakis, K. (ed.), *Philosophy of Biology: A Companion for Educators*. New York: Springer, pp. 343–371.

Q2

Can we relate the concept of robustness to existing systemic risk measures? To what extent does this help us to understand the resilience of complex systems?