Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **257** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

SLO/GO Degradation-Loss Sensitivity in Climate-Human System Coupling

Tuesday 10 June 2025 15:15 (15 minutes)

The potential of extreme environmental change driven by a destabilized climate system is an alarming prospect for humanity. But the intricate, subtle ways Earth's climate couples to social and economic systems raise the question of when more incremental climate change signals the need for alarm. Questions about incremental sensitivity are particularly crucial for human systems that are organized by optimization. Optimization is most valuable in resolving complex interactions among multiple factors, however, those interactions can obscure coupling to underlying drivers such as environmental degradation. Here, using Multi-Objective Land Allocation as an example, we show that model features that are common across non-convex optimization problems drive hypersensitivities in climate-induced degradation–loss response. We show that catastrophic losses in human systems can occur well before catastrophic climate collapse. We find punctuated insensitive/hypersensitive degradation–loss response, which we trace to the contrasting effects of environmental degradation on subleading, local versus global optima (SLO/GO). We argue that the SLO/GO response we identify in land-allocation problems traces to features that are common across non-convex optimization problems more broadly. Given the broad range of human systems that rely on non-convex optimization, our results therefore suggest that substantial social and economic risks could be lurking in a broad range in human systems that are coupled to the environment, even in the absence of catastrophic changes to the environment itself.

Keyword-1

Climate Adaptation

Keyword-2

Land-use planning

Keyword-3

Statistical physics

Authors: CABRERA, Sierra (Queen's University); BABAYAN, Irina; ALIAHMADI, Hazhir (Queens University); CHEN, Dongmei (Queen's University); VAN ANDERS, Greg

Presenter: VAN ANDERS, Greg

Session Classification: (DCMMP) T2-4 Special Session - Physics, Climate change, and the transition to sustainability / Physique, changement climatique et transition vers la durabilité (DPMCM)

Track Classification: Special Sessions / Sessions spéciales: Special Session - Physics, Climate change, and the transition to sustainability / Physique, changement climatique et transition vers la durabilité