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(G*) Giving new meaning to ”Physical Geography”: Physics-based approaches to problems in planning

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Land-use decision-making processes have a long history of producing globally pervasive systemic equity and sustainability concerns. Quantitative, optimization-based planning approaches, e.g., Multi-Objective Land Allocation (MOLA), seemingly open the possibility of improving objectivity and transparency by explicitly evaluating planning priorities by land use type, amount, and location. Here, we primary show that optimization-based planning approaches with generic planning criteria generate a series of unstable "flashpoints"whereby tiny changes in planning priorities produce large-scale changes in the amount of land use by type. We give quantitative arguments that the flashpoints we uncover in MOLA models are examples of a more general family of instabilities that occur whenever planning accounts for factors that coordinate use on- and between-sites, regardless of whether these planning factors are formulated explicitly or implicitly. Building on this, our current research extends into the realm of environmental change, revealing that common features across non-convex optimization problems, like MOLA, drive hypersensitivity to climate-induced degradation, resulting in catastrophic losses in human systems well before catastrophic climate collapse. This punctuated insensitive/hypersensitive degradation–loss response, traced to the contrasting effects of environmental degradation on subleading local versus global optima (SLO/GO), suggests substantial social and economic risks across a broad range of human systems reliant on optimization, even in the absence of extreme environmental changes.

Keyword-1

Land-Use planning

Keyword-2

Climate change

Keyword-3

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