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Identification and management of climate change induced socio-economic tipping points

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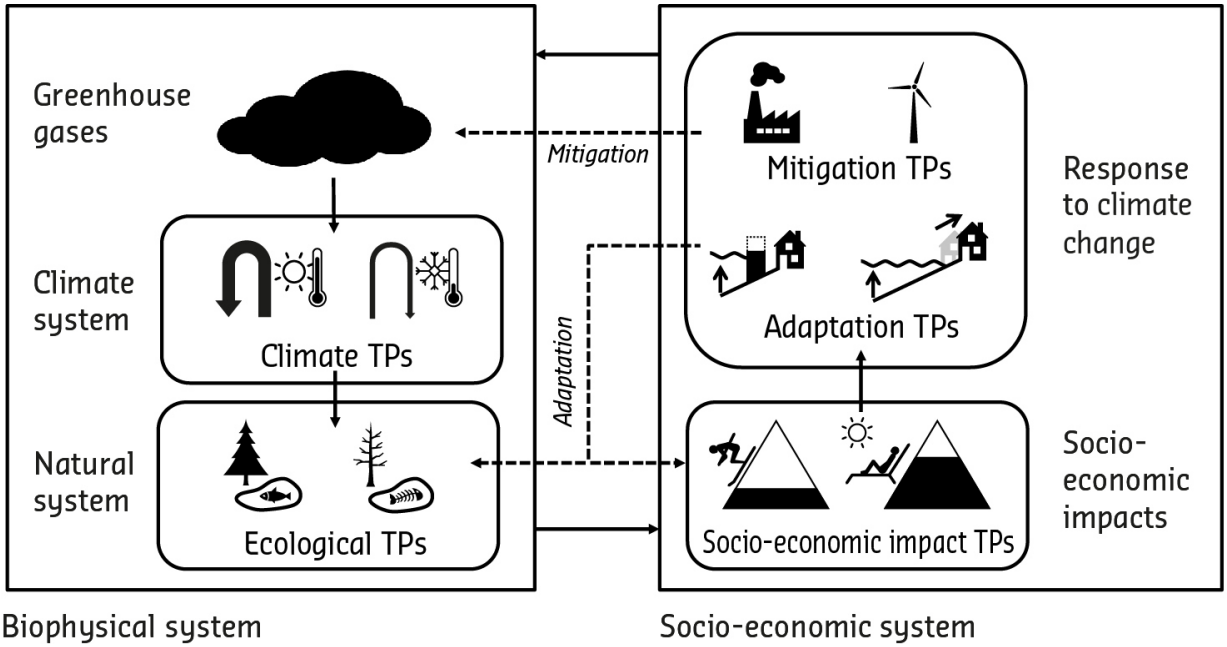
Global warming may cause abrupt and non-linear climate tipping points, with large impacts to established socio-economic systems [1]. The socio-economic system itself also exhibits many non-linear change processes, and therefore may experience manifold unintentional climate-change induced socio-economic tipping points (SETPs) that could already follow from relatively small changes in climatic conditions. Examples are the gentrification of vulnerable groups or abrupt unplanned retreat from areas of increasing climate risk, abrupt transitions in financial markets, large-scale systematic malfunction of critical infrastructure networks during weather extremes, sudden reconfigurations of insurance markets and house price collapses. Such SETPs are defined as 'a climate change induced, abrupt change of a socio-economic system, into a new, fundamentally different state' [2]. It is important for spatial-economic planners and capital investors to know if and under what conditions SETPs may happen, and what can be done to anticipate and manage their causes and effects.

With three model-based case studies we demonstrate a stepwise approach to identify SETPs and to support adaptation and mitigation policy. The first is a house price collapse and radical transformation of long-term flood risk policy in a coastal city like Rotterdam, following rapid sea level rise due to Antarctic ice-sheet instability. Using a model that simulates flood risk, house prices and adaption integrally, we identify abrupt house price collapses in hundred-thousands possible futures spanning the uncertainty in sea level rise, storm surge and house market scenarios. We explicitly explore the long-term impacts of four dynamic adaptive strategies to anticipate flood risk and their successfulness in avoiding a SETP [3]. The second case is the financial collapse of the winter sports industry in the European Alps following a gradually retreating snowline [4]. The third is a large-scale systematic malfunction of national road networks of European countries due to increasing river flood hazards. The focus of our contribution is on showing how decision making can be supported despite the large uncertainties around SETPs. Finally, we discuss how the SETP-concept aligns with socio-ecological regime shifts [5] and deliberate positive social tipping points to achieve large mitigation and adaptation challenges [6,7].



Types of tipping points along the cause-effect chain from increasing GHG, to biophysical changes, to socioeconomic impacts and transformative adaptation and mitigation response. Source [2], CC-BY3.0 license.

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