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Abstract

A general framework for assessing future impacts of technology on society and environment is presented. The dynamics between agent behaviour and technological systems underpin and impact upon many processes in society and nature. Although this involves diverse phenomena their mathematical description relies on similar dynamical systems models that characterize heterogeneous agent interactions on physical, technological and social networked systems. This involves non-linear dynamics calling for an understanding of how technology and human behaviour influence each other and co-evolve. Conventionally, technological and behavioural systems are analysed as separate entities. Here, we develop an integrated theoretical and methodological approach termed techno-behavioural dynamics focusing on networked interactions between technology and behaviour across multiple system states. We find that positive feedback between technology learning, decision-making and network effects can lead to tipping points in complex sociotechnical systems. We demonstrate how mean-field and agent-based models are complimentary for capturing different analytical resolutions of a common problem domain. Assessing and predicting co-evolutionary dynamics between technology and human behaviour can help avoid systems lock-in and inform a range of adaptive responses to environmental and societal risk.