Abrupt spreading transitions in populations and infrastructures

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Social contacts and infrastructures can be described through complex networks, which in practice are functionally coupled to each other. Spreading of e.g. an epidemic, traffic or energy on such networks can exhibit critical behavior and under specific conditions also first order transitions. I will present various mechanisms that can lead to catastrophic spreading and also discuss ways of making networks more robust. In particular, I will show how a global budget for disease treatment can induce a pandemic. In another model I will study the role of dam building on flooding and its critical dependence on the roughness of the landscape. Here again global information tends to induce mega-events. Finally I will show in a third model how cascading can produce a sudden blackout in energy supply due to the coupling to a communication network and discuss various ways to make networks more robust against such event.