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Extreme Events and What To Do About Them

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Extreme events are a key manifestation of complex systems. Their economic and social consequences are a matter of enormous concern. Due to their rarity, extreme events have been hard to study and even harder to predict. The EU's current Sixth Framework Programme (FP-6) has a novel New and Emerging Science and Technologies (NEST) initiative on "Tackling Complexity in Science." Within this initiative, a highly interdisciplinary proposal on "Extreme Events: Causes and Consequences (E2-C2)" incorporates 17 different scientific institutions in 9 countries. This talk provides a sketch of some of its unifying ideas.

Integrated assessment of economic and climatic changes associated with global warming is an exemplary area of interaction between the natural and socio-economic sciences. The UN's Intergovernmental Panel on Climate Change (IPCC) has separated, so far, between two working groups : WGII has been providing scenarios of CO2 emissions, WGI expected climate changes based on these scenarios. We'll consider a truly dynamic macro-economic model, with " business cycles " and chaotic behavior, and its two-way coupling to a simple climate model. The results show rapid transitions in the economic behavior, rather than gradual adaptation. Extreme events appear therewith likelier than suspected heretofore.

To overcome the limitations due to sample size, one can use a nonlinear, complex-system model that reproduces a known distribution of extreme events. The model can then add reliability to a forecast of events of an already known type by making a verifiable prediction of novel, verifiable phenomena. This idea is applied to colliding-cascade models of stress-and-heal problems. Using a Boolean delay equation (BDE) model of such problems permits the refinement of previous approaches to the prediction of earthquakes, and of several types of socio-economic extreme events (recessions, surges of unemployment or of homicides).