Resilience, Sustainability and Decision Under Uncertainty

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In this talk, I gather previous works related to mathematical methods for the management of natural resources, and present how they can contribute to tackle questions in resilience and sustainability. For this purpose, I will

- scan through the vocabulary of sustainability in the IPCC (climate) and IPBES (biodiversity) international bodies reports: goals, indicators, vulnerability, adaptive capacity, stress, risk, scenarios, models, etc.;
- address theoretical aspects: how can we formalize sustainability and resilience with tools from control theory (optimal control, viability) and decision under uncertainty (multistage stochastic optimization, risk)? for instance, when goals to achieve are formulated as constraints to satisfy — like minimal spawning stock biomass every year in fishery management, or maximal number of infected in epidemics control — we present the notion of viability kernel, and their stochastic and robust variants;
- present methods: how can we tackle the solving of problems, once mathematically formalized? we present stochastic and robust dynamic programming in small state dimension;
- outline examples: biodiversity (fisheries, epidemiology), energy and climate;
- raise open questions and challenges: numerical methods in high dimension, risk measures for random processes, axiomatics for acceptable processes, etc.

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