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The transition toward resilient water management regime: where are we now?

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Eco-system Resilience

- “Science of Surprise”: ecological systems are complex and self-organizing, permeated by uncertainty and discontinuities. With this multi-equilibrium non-linear view of ecology and environmental sciences, the causal effects and predictions are not simple matters (Holling 1986)
- Resilience in this context is a measure of robustness and buffering capacity of the Social-Ecological System to changing conditions (Folke Berkes 1998; Gunderson 2000; Folke 2003)
- Erosion of resilience manifests itself when long periods of seemingly stable conditions are followed by periods of abrupt, non-linear change, reflected in critical transitions from one stability domain to another when thresholds are crossed (Rockstrom 2009)
- Resilience can be eroded and the self-repairing capacity of ecosystems should no longer be taken for granted (Folke 2003, Gunderson 2000)



Description of the Social-Ecological System (SES)

Berkes and Folke (1998) extended the concept of Resilience to the social realm developing the concept of “SES” defined as “nested, multilevel systems that provide essential services to society”

The SES concept still lacks a more unifying definition

Berkes and Folke developed the first and most influential analytical framework drawing on Ostrom’s work on common property analysis (1992) and Ostrom’s Institutional analysis (1990)

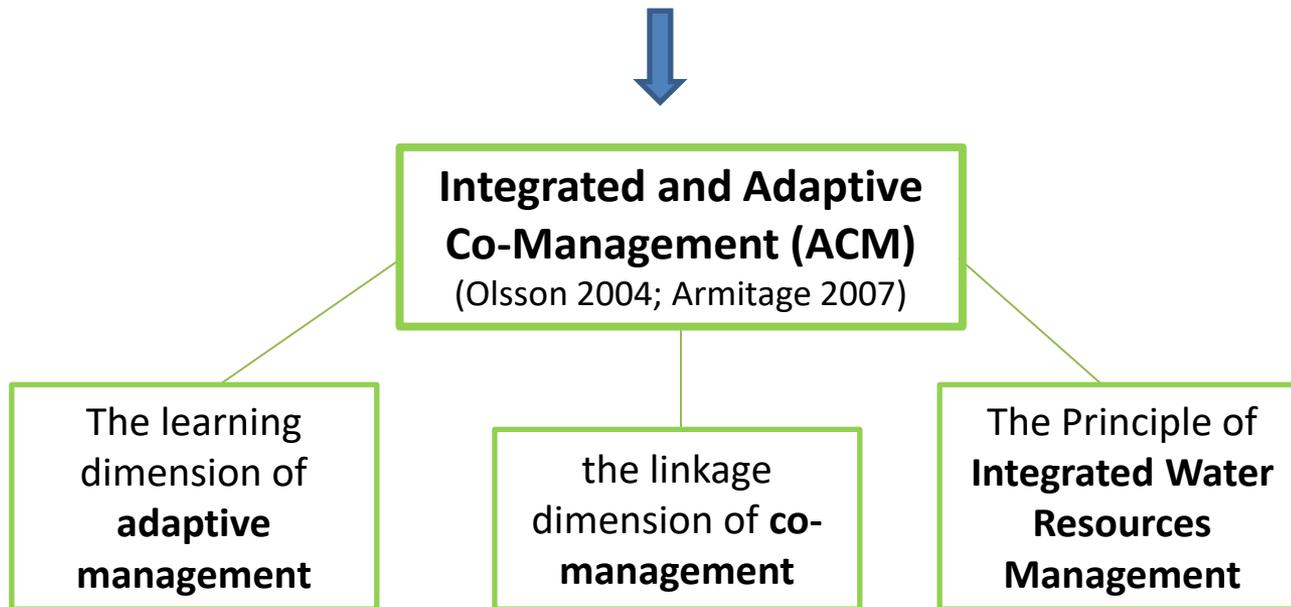
Since the 2000 many analytical frameworks have emerged (e.g. SESF, MTF, ES, HES) and differ for the following characteristics (Binder 2013):

- the conceptualization of both the social and ecological system and their dynamics (e.g. the relation between macro and micro level, anthropocentric vs ecocentric perspective;
- the interaction between the two sub-system and the feedback loops dynamics;
- degree to which the social and ecological systems are treated in depth;
- the main goal of the framework (action vs analysis oriented)



Paradigm shift in water management

Despite theoretical and analytical divergencies, scholars mostly agreed that the complexity and unpredictability of the SES should be managed with **holistic, trans-disciplinary, and flexible approach** in contrast with the traditional «Command and Control regime» (Holling 1996, Pahl-Wostl 2010)



Main features: collaboration in a polycentric governance system, public participation, an experimental and stepwise approach to resource management, management at the bioregional scale (Huitema 2009) and integrated planning



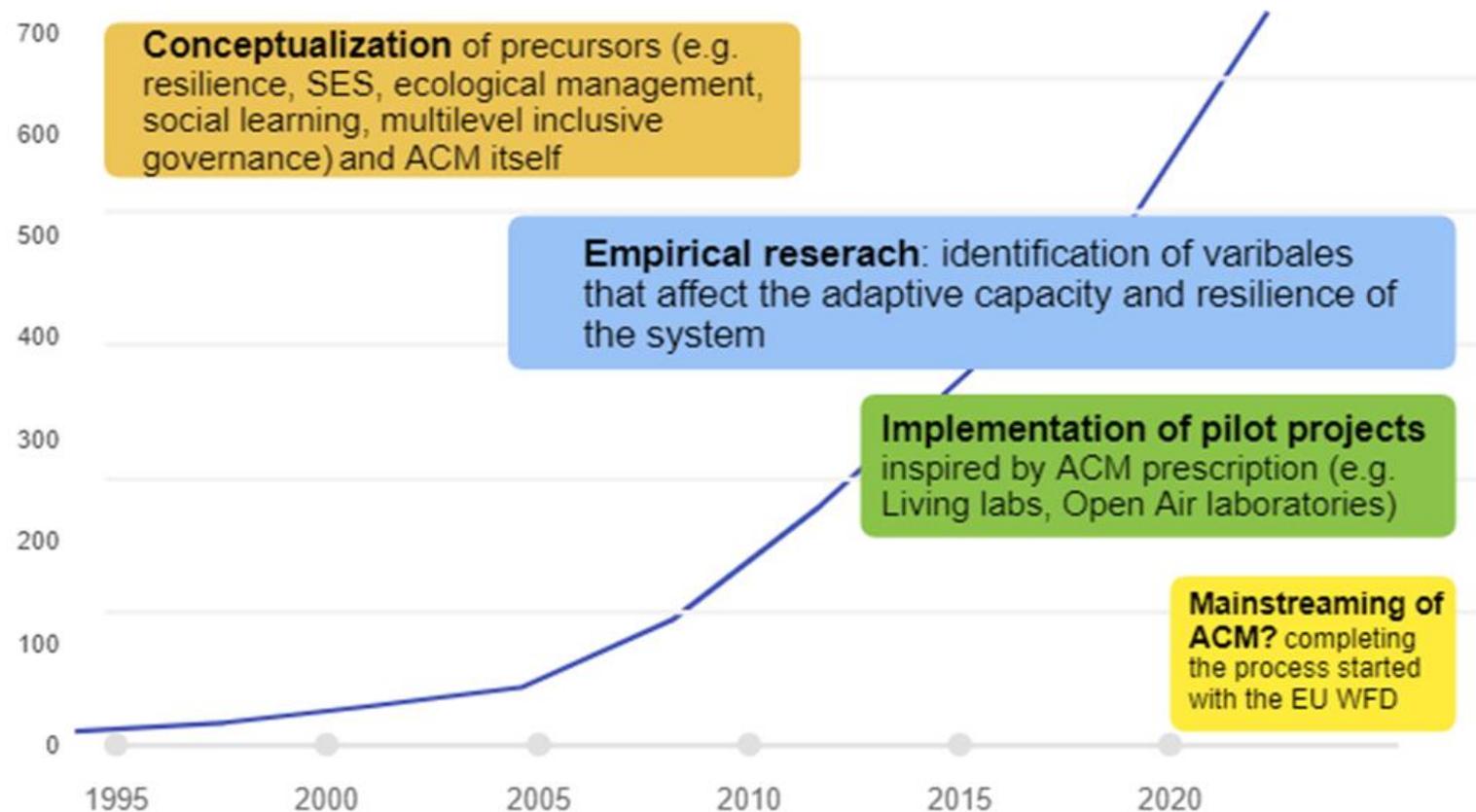
	Prediction/Command and Control	Integrated/Adaptive Co-Management
Governance structure	Hierarchical, centralized, static, formal, top-down decision-making.	Polycentric, decentralized, dynamic network management (Bodin & Crona 2009), sectoral integration (Biswas 2004), vertical and horizontal coordination (Pahl-Wostl 2007)
Management scale	Administrative boundaries (municipal, regional)	Ecological boundaries (eg. river basin), eco-region (Huitema 2009)
Knowledge management	Reductionist approach, high level of specialization, sectorialization of environmental issue, few or absent inter and trans-disciplinary interaction	Trans-disciplinary, holistic approach (Holling 1986); social learning (Pahl-Wostl 2007); integration and sharing of scientific, local (Olsson Folke 2001) and traditional (Berkes 1999) knowledge
Information management	Closed, poor public access, secrecy	Transparent, open, shared; inclusive monitoring (Cundill 2009)



	Prediction/Command and Control	Adaptive management
Decision-making (Expert-policy maker-citizen relation)	Technocratic, monodirectional	Multidirectional, consensus oriented, legitimate (Lang 2012), co-creation (Clarke 2016), deliberative (Dryzeck 1996)
Social learning	Single loop, limited to few actors	Double or triple loop (Pahl-Wostle 2007); distributed cognition (Roling 2002), iterative, development of shared meaning, values and practices (Webler 1995)
Technical infrastructure	Grey, grand scale, single sources of design	Green, smaller and distributed, co-designed
Economy and finance	Sunk cost, disregard of externalities and environmental cost. Pursue of efficiency and low transaction cost (Imperial & Hennessey 1999)	Diversification of financial resources. Attention to natural capital and ecosystem services, internalization of environmental costs (Guerry 2015); acceptance of higher transaction costs for participatory practices



Number of I/ACM publications and the evolution of the literature and practices related to I/ACM



Conclusions - I/ACM in the Academia

- I/ACM has had a constantly growing attention in the last two decades and it is dominant in the literature
- Most defining work, conceptualization and theory building took place before 2010
- Empirical reseraches and theory and hypothesis testing further highlighted structural, macro-contextual variables that enable higher resilience as well as the benefit, barriers and shortcomings of collabaration, coordination, participation, learning and integration.
- Now, increasing focus is needed on the activities, practices and/or other factors that underpin and enable these processes and outcomes in specific context. For instance, we are assisting to more cases of co-creation and co-production in water and land management (e.g. Living Lab and Open Air Laboratories)



Conclusions- I/ACM in practice

- International Organizations are promoting I/ACM through binding legislation (EU Water Framework Directive, Flood Directive, UNECE Aarhus convention), soft laws (UNDP good governance principle; Sendai Framework), and funding programs (e.g. H2020, LIFE)
- National government in EU adopted such principles. If some improvements from an institutional, legislative and economic perspective are clear, other issues of I/ACM (e.g. knowledge integration, adaptive capacity and participation) are still not fully realized. I/ACM approach co-exist with others.
- For instance, very few experts, public authorities, and citizens had ever been involved in participative practices and co-creation processes. Coordination, cooperation and social learning has to be improved and scaled up
- More focus to network creation and management is needed





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Thank you for your attention!

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