

**Practice-relevant adaptation science and services across climate timescales:
What is being learned?**

Roger S. Pulwarty

National Oceanic and Atmospheric Administration (NOAA)

Climate variability and change impact nations and communities, within and across sectors, including, water resources and water-sensitive systems. The IPCC Special Report on Climate Extremes (2012), the UN Global Assessment of Disaster Risk Reduction (2011) and the forthcoming IPCC Fifth Assessment (2014) outline the exposure, vulnerabilities and adaptations to extremes (drought, floods, high temperatures) that are underway and proposed in several countries and communities. In recognition of such risks, the international community is developing a Global Framework for Climate Services. Developing and communicating climate and climate impacts information under changing baselines and extremes, represent critical emergent needs. Failure to adapt adequately to existing climate risks largely accounts for what has been called "the adaptation deficit " between the present needs and what is projected for future or emergent conditions. In addition, the large range for different climate model-based scenarios suggests there is no guarantee that the models represent the full range of climates that could be experienced. In this presentation, we map the evolution of adaptation plans and service experiences to date and those needed for improving decision-making processes in a changing climate. The coordination of timely production and delivery of useful climate data, information and knowledge to nations, communities and decision makers is multidimensional. It engages multiple networks and information services infrastructure needed to support these plans and their implementation. While existing "service-type" activities can be identified in many settings (e.g. national, academic, private), we show that the problem is one of crafting effective implementation strategies for improving decision quality (not just meeting "user needs"), coordinating innovation mapping and diffusion, and most importantly highlighting common interests among the different groups. Early warnings of changes in the linked physical-social system and of thresholds or critical points that affect management priorities become important. Effective risk management involves a portfolio of actions to reduce and transfer risk and to respond to climate events and disasters. To develop the necessary procedures and tools requires continued scientific, observational, technical and operational efforts using measures that can be easily revised or are robust to changing conditions. Adaptation practices include developing the entrepreneurship and anticipatory coordination for proactive risk management and early warning information systems across temporal and spatial scales. Specific examples, from the Caribbean, the US, and elsewhere, outlined in the presentation, show that such knowledge and capacity is most effectively acted on during windows of opportunity, and when collaborative frameworks between research and management exist, and deliberate mechanisms to monitor and inform learning are supported and sustained.