

SENSING THE AMERICAS' FRESHWATER ECOSYSTEM RISK (SAFER) FROM CLIMATE CHANGE

Climate variability imposes a range of regional hydro-meteorologic changes on water fluxes and storages throughout a watershed and, therefore, on freshwater ecosystems and the services they provide to humanity. The severity of the resulting changes to the hydrologic drivers of freshwater systems, manifested as altered baseline flow, the magnitude and timing of flood and lake-turnover and other events is tied to regional sensitivity to changing climate, which is known to be highly variable. Subsequent threats to ecosystem functioning and services will manifest themselves in terms of changes in an array of known threats: eutrophication, pollution by toxic chemicals, acidification, invasive species, overharvesting and habitat destruction and, potentially, in terms of some threats which have yet to be realized. Unfortunately, the connection between climate variation and these threats is poorly understood and difficult to assess because it depends on regional climate responses to global climate change. Furthermore, because the value of ecosystems services will also vary according to regional differences in human needs, assessing (and mitigating) these threats will require a multi-disciplinary approach - one that addresses scientific, socioeconomic and cultural aspects - to a tightly coupled natural-human system

We hypothesize that, within freshwater systems and adjacent watersheds, predicted changes in the global and regional climate will produce an alteration of the hydrological cycle, which can be estimated from the freshwater discharge and waterborne deliverables, i.e., sediment, nutrients, heavy metals. The effects of climate change will also interact with multiple human stressors, potentially in novel ways. As a result of change in geomorphologic, physical, biological and biogeochemical conditions, the ecosystem services provided by freshwater systems will also change significantly, sometimes for the better, sometimes for the worse. We also recognize that weather related sources of short-term variability represent a different problem; but one that also has the potential to dramatically alter freshwater ecosystem services as well.

As such, the objectives of this project are to: 1) employ freshwater ecosystems as sentinels” or “sensors” of climate variability and watershed processes and investigate their interaction with other multiple stressors to assess risks to ecosystem services in the Americas, and 2) determine management and mitigation strategies which are both technically and economically feasible as well as culturally acceptable.

To accomplish these objectives we will include: i) establish the regional distribution of ecosystem services associated to continental waters; ii) estimate how climate variability will affect lakes and their watersheds in different climate regions with varying geomorphologic characteristics using both neo- and paleo-limnological techniques; iii) define the proxies that can be employed to measure the ecosystem services of the lakes and their watersheds; iv) fill gaps in knowledge and methods in order to enable implementation of a harmonized ecosystem-based methodology and database system approach for American lakes and watersheds; v) enable assessments of climate change effects on water quality and quantity as well as sanitation conditions for underprivileged communities as a means to reduce poverty.

The major research outcomes of the proposed project will be: 1) A delineation of freshwater ecosystem service risks in the Americas, 2) Determination of management and mitigation strategies which are both technically feasible and culturally acceptable, and 3) Training of the next generation of scientists and social scientists in terms of international, interdisciplinary research with policy-relevant outcomes.