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Watershed Sustainability Research Group
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Watershed Sustainability in a Changing World

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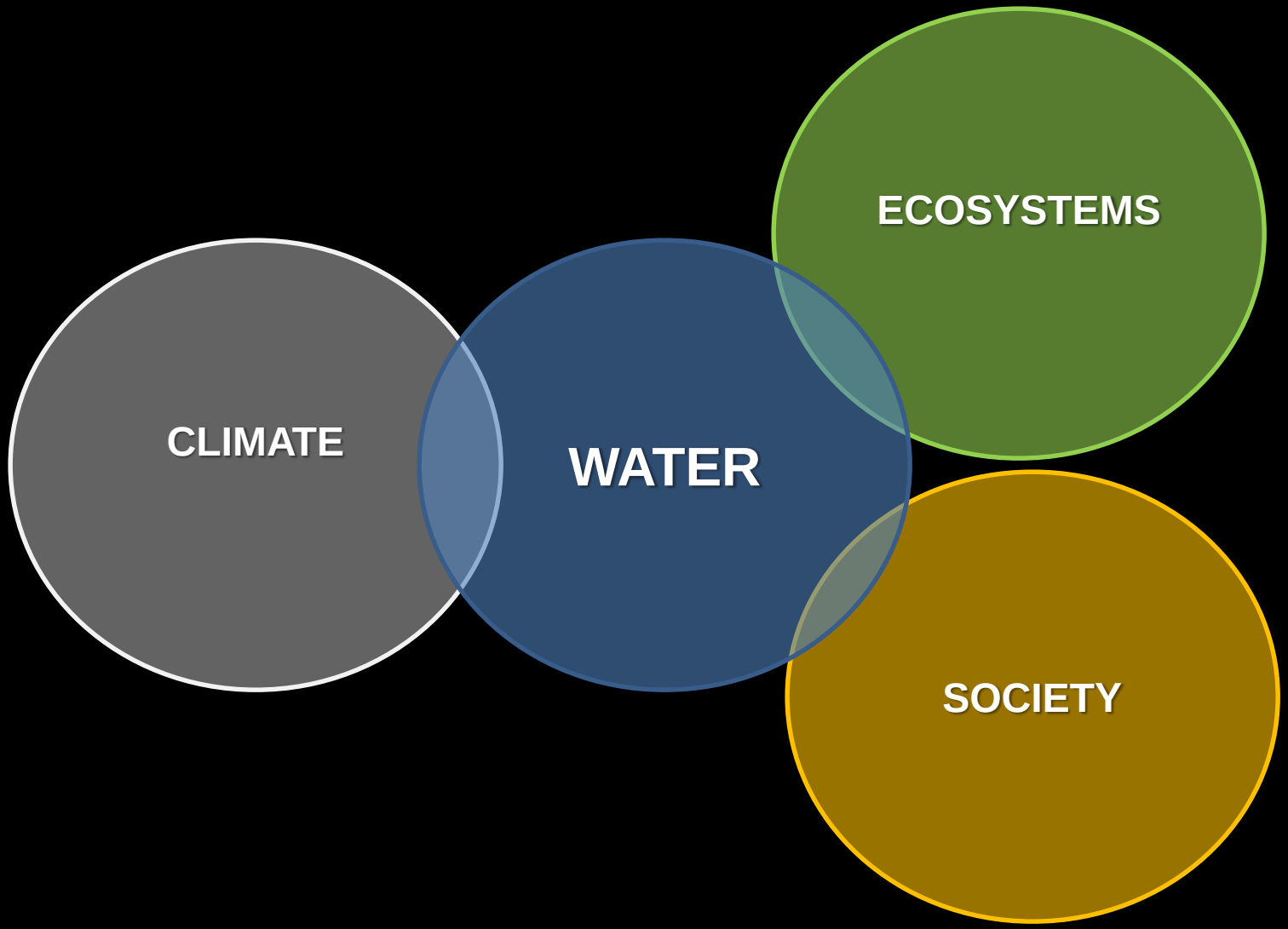
Talk Outline

1. Research overview
2. Showcase of past research in the Mekong River
3. Future directions in Florida: Designing flows for coastal sustainability

Research Overview

Research goal: To identify **solutions** to the world's water problems with regard to the **interactions** between the climate, the environment and development

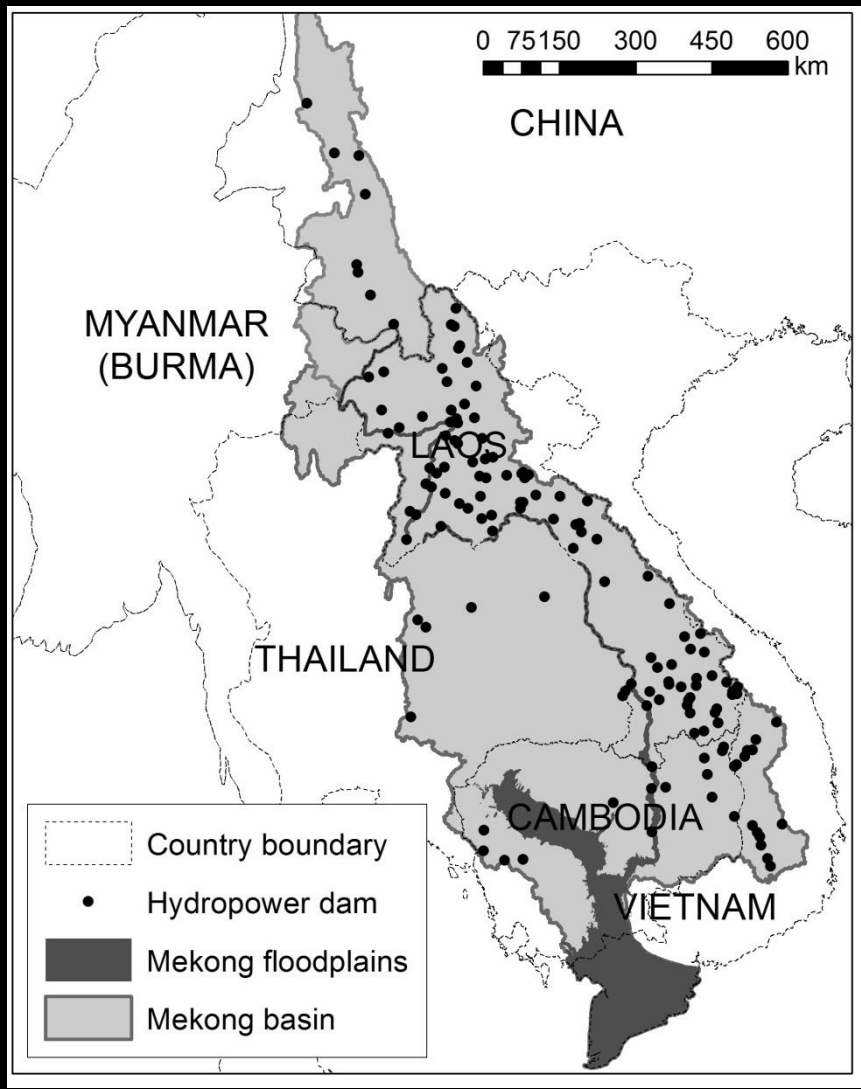


National / State development goals

Local ecological and cultural value

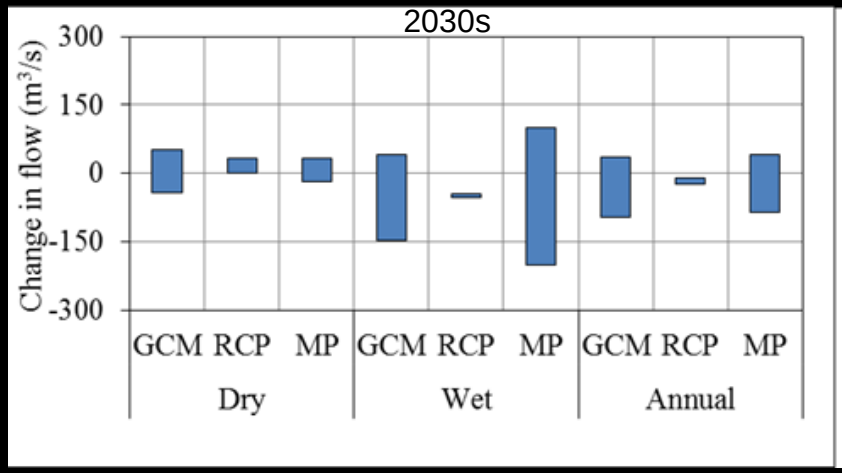
The Mekong: context & challenges

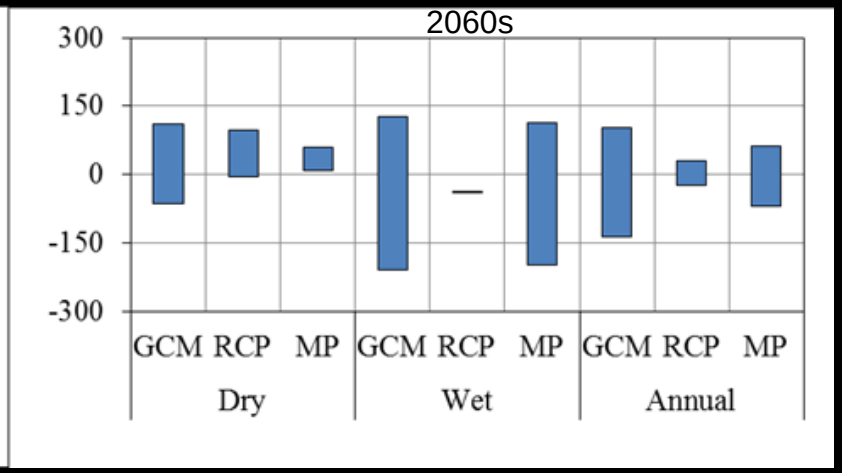
- Largest transnational river in Southeast Asia
  - Livelihoods/ecosystems adapted to unregulated hydrological cycle
  - World's largest inland fishery
  - Food basket of the region
- Mekong challenges
  - Hydropower dams
  - Climate change
  - Land use conversion



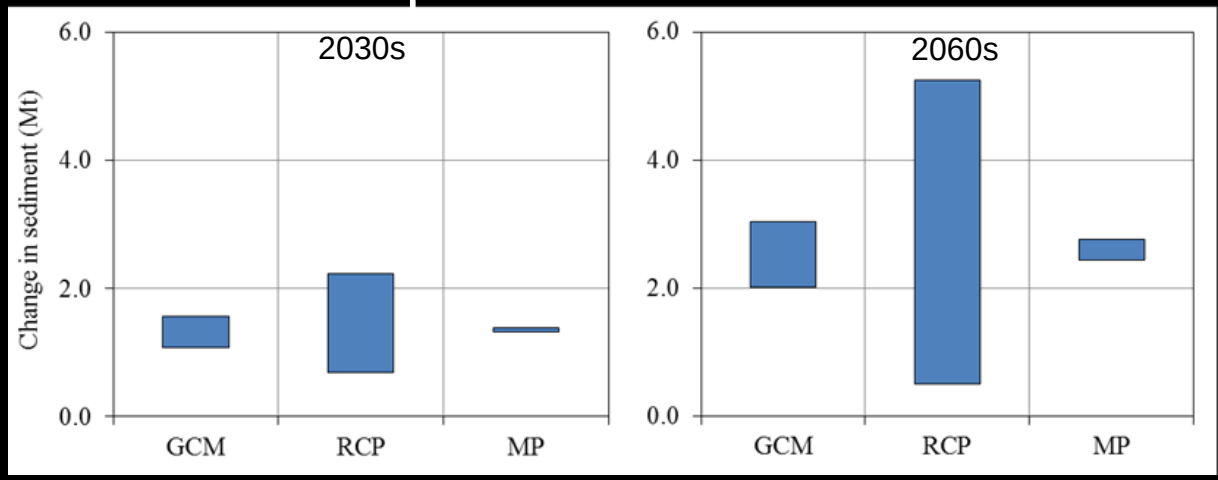
Effects of future climate uncertainty on watershed hydrology

Effects on river flows:





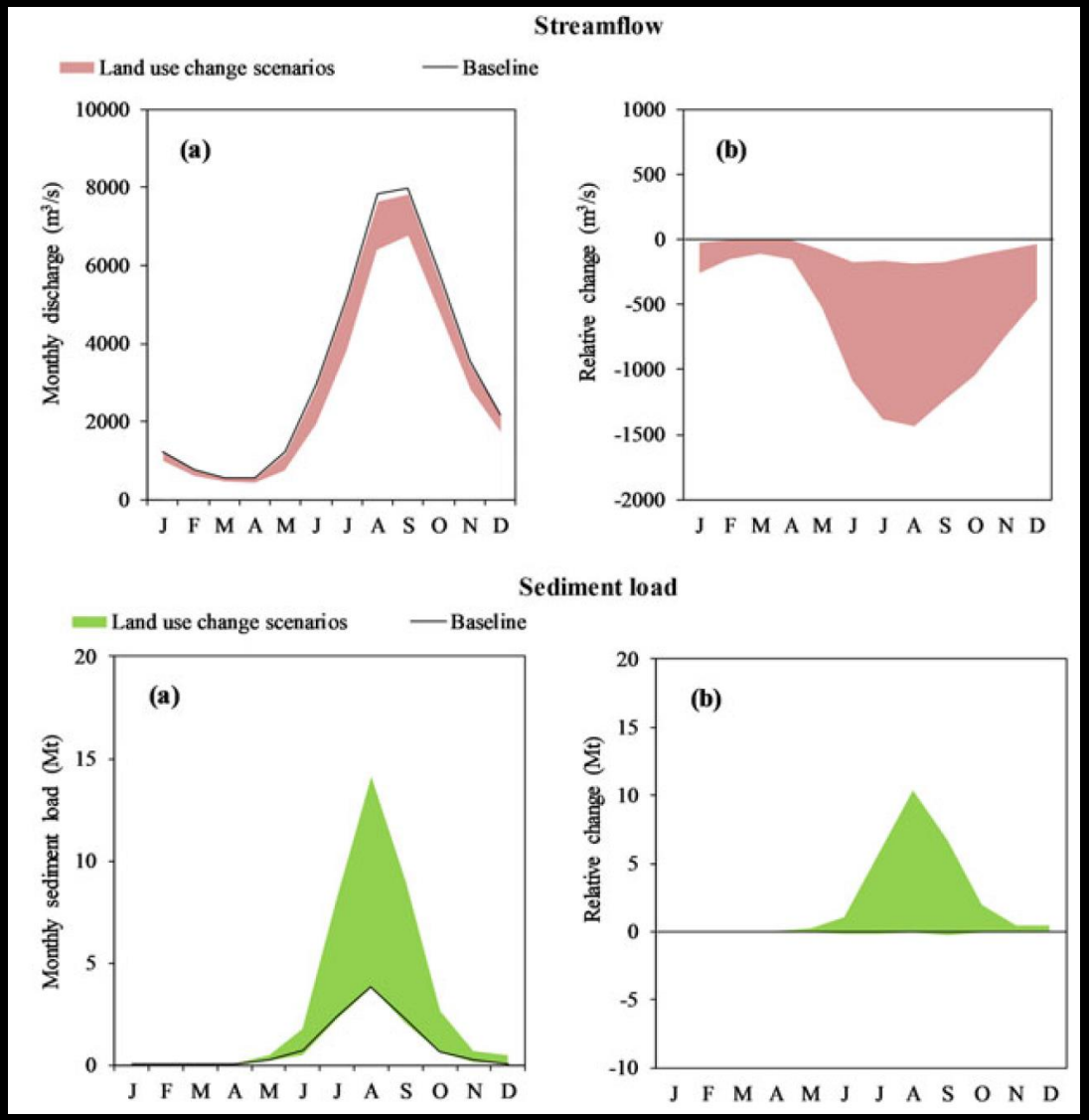
Effects on suspended sediments:



GCM: Global circulation model
RCP: Representative concentration pathway
MP: Model parameter

Shrestha, Cochrane, Arias, et al. 2016. *J of Hydrology*

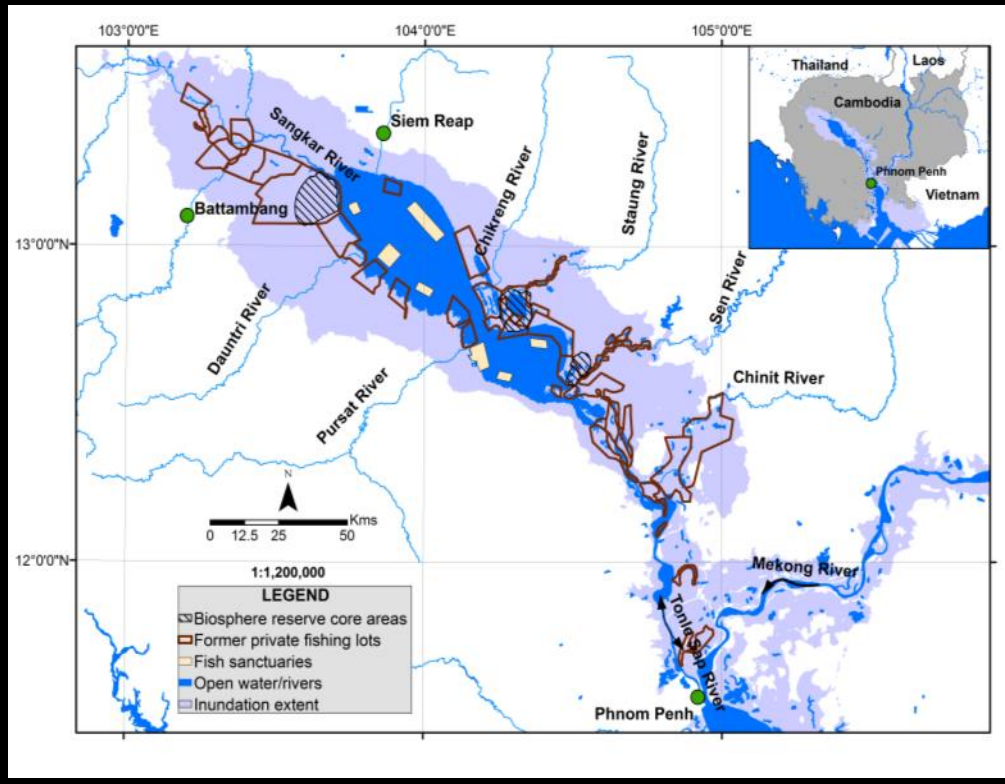
Effects of land use conversion just as uncertain…



Shrestha, Cochrane, Arias, et al. 2017. *Land Degradation and Development*

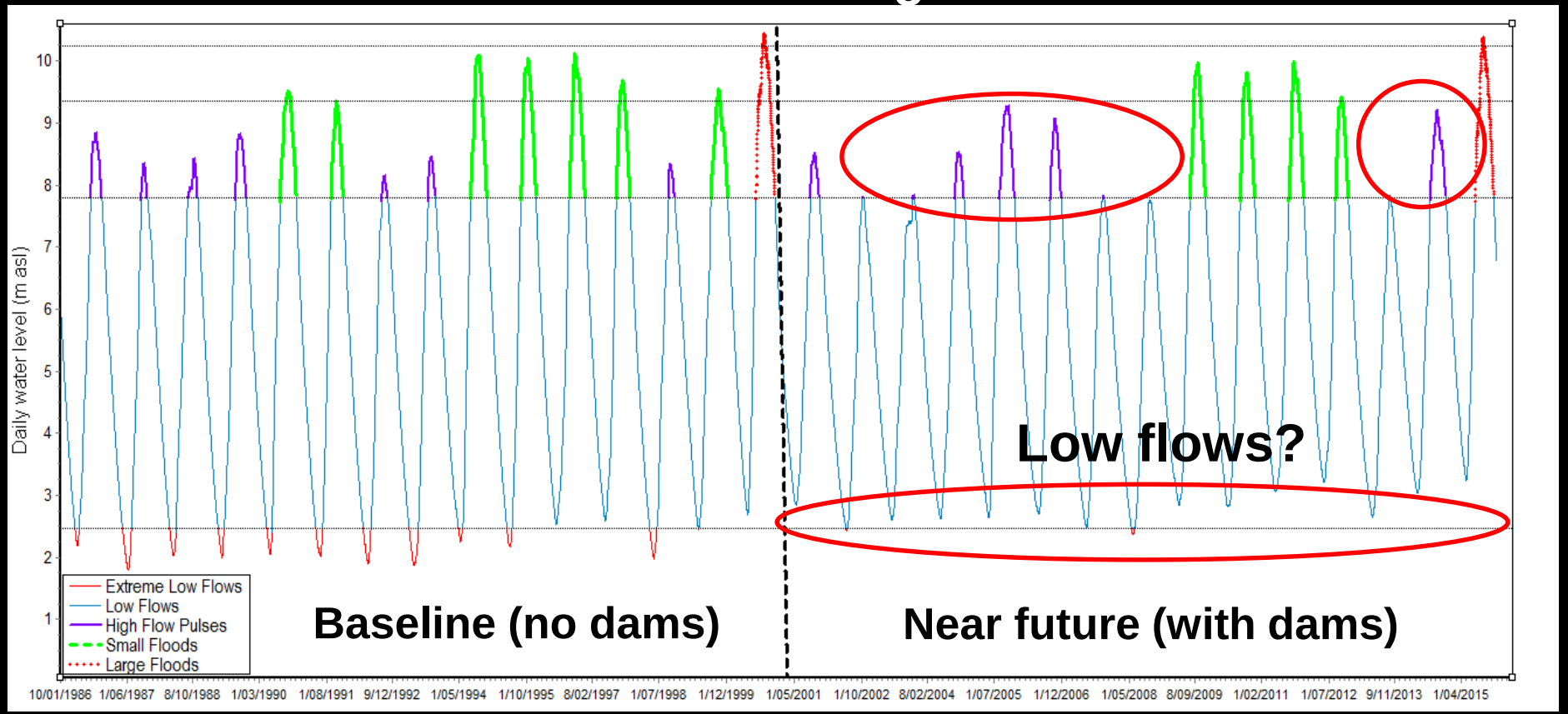
Mekong floodplains: The Tonle Sap in Cambodia

- 2,600-15,000 km^2
- Largest flow reversal system in the world
- UNESCO Biosphere reserve
- ~60% of fisheries in Cambodia
- 80% of protein Cambodians eat comes from aquatic animals
- Tonle Sap flood pulse changing with hydropower and climate in the Mekong



Simulated hydrological alterations from dams

high flows and small floods

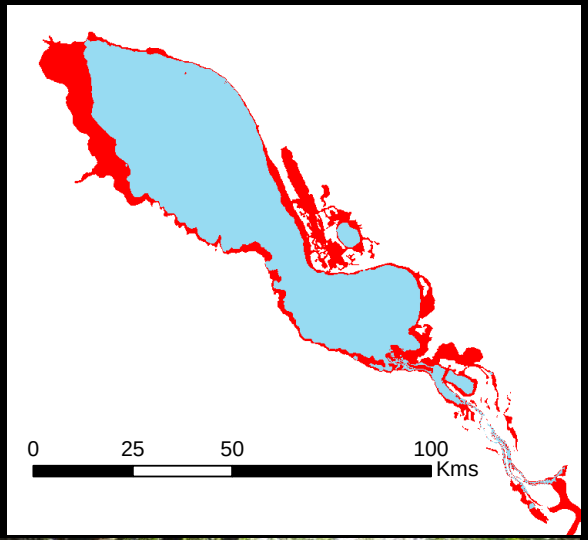


Arias, M.E., et al. (2014) *Hydrol. Earth Syst. Sci.*

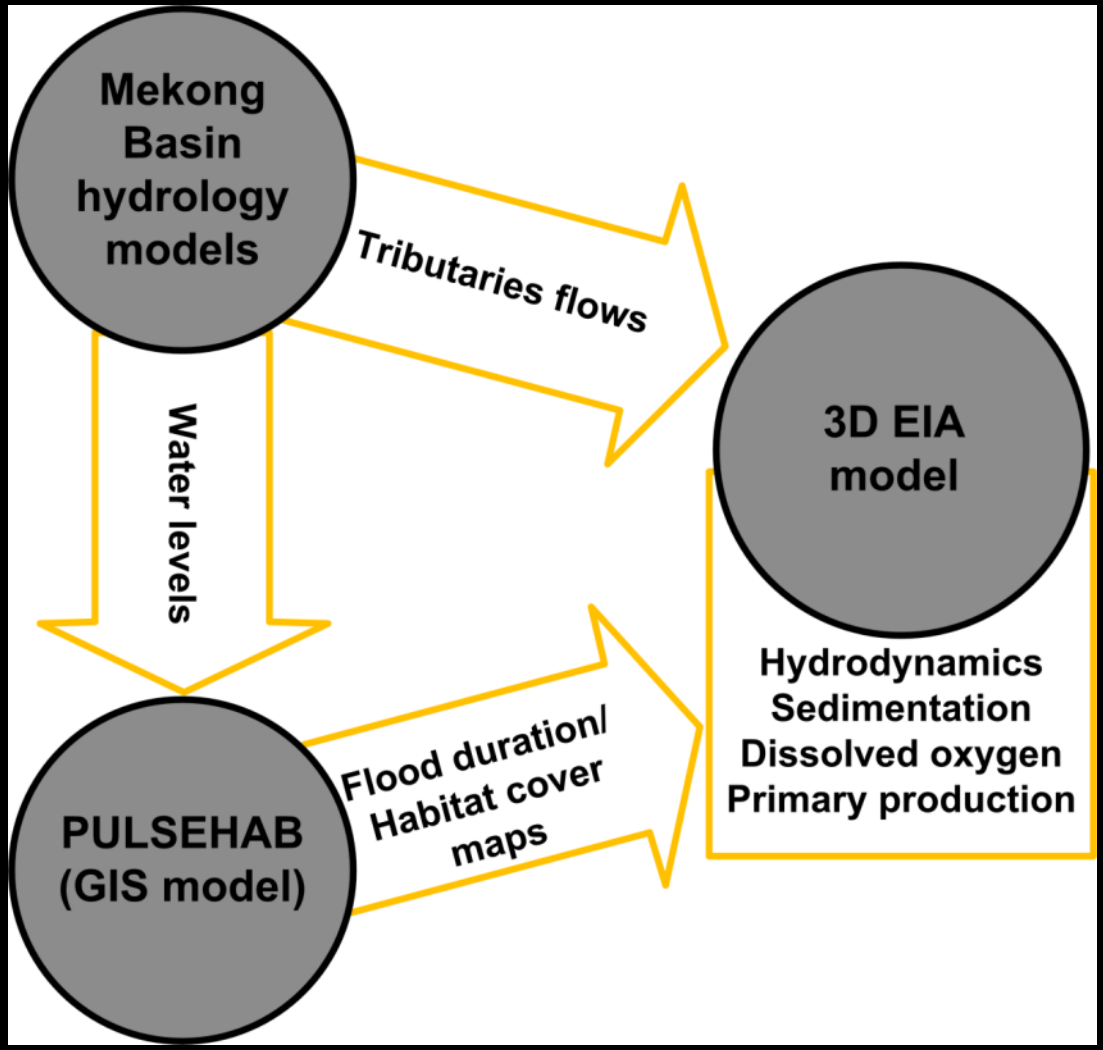
Implications of hydrological alterations to floodplains

- Loss of low flows
  - Permanent inundation of forest
  - Fish refuge and food?

Flood extent changes during dry season (+30%):



Production and landscape modeling procedures



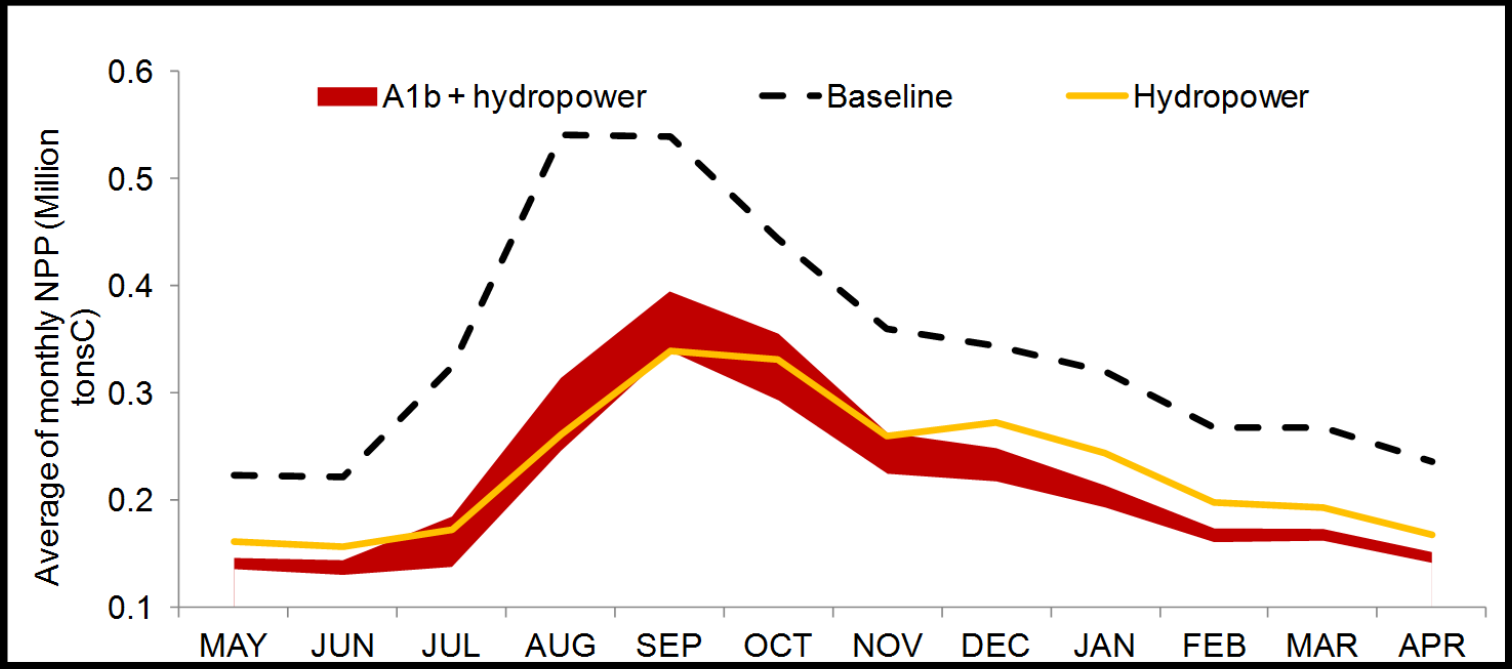
Arias, M.E., et al. (2014) *Ecological Modelling*

Landscape assessment

Arias, M.E., et al. (2012) *Journal of Environmental Management*.

Changes in aquatic ecosystem primary production

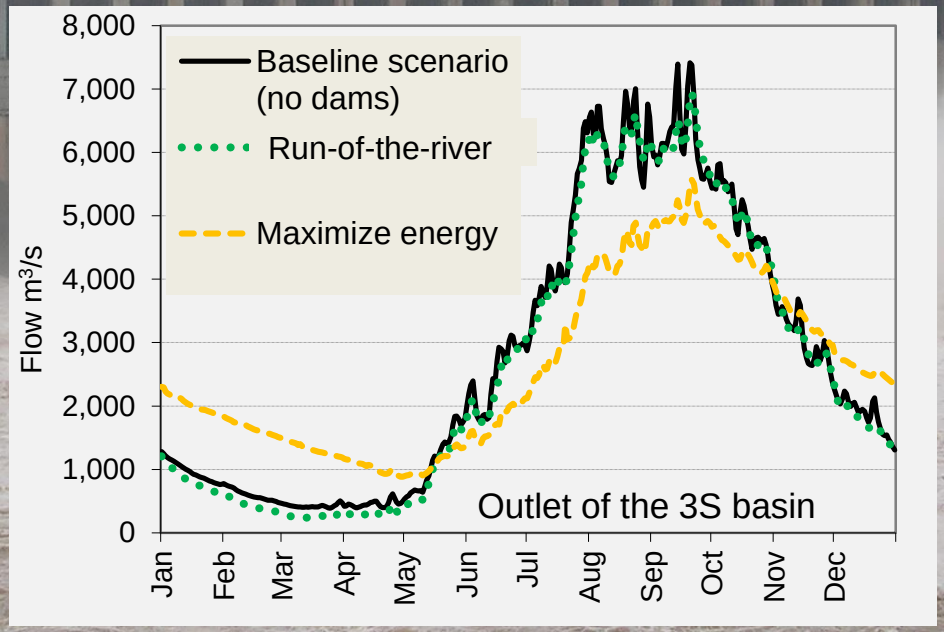
Total annual change from baseline historical conditions		
Climate change scenarios	Hydropower scenario	Climate change + hydropower scenarios
-11% to -18%	-33%	-33% to -41%



Arias, M.E., et al. (2014) *Ecological Modelling*

What can be done in the Mekong?

- Regional infrastructure planning
- Landscape adaptation
- Outreach and awareness
- Capacity building
- Multipurpose optimization of water infrastructure operations

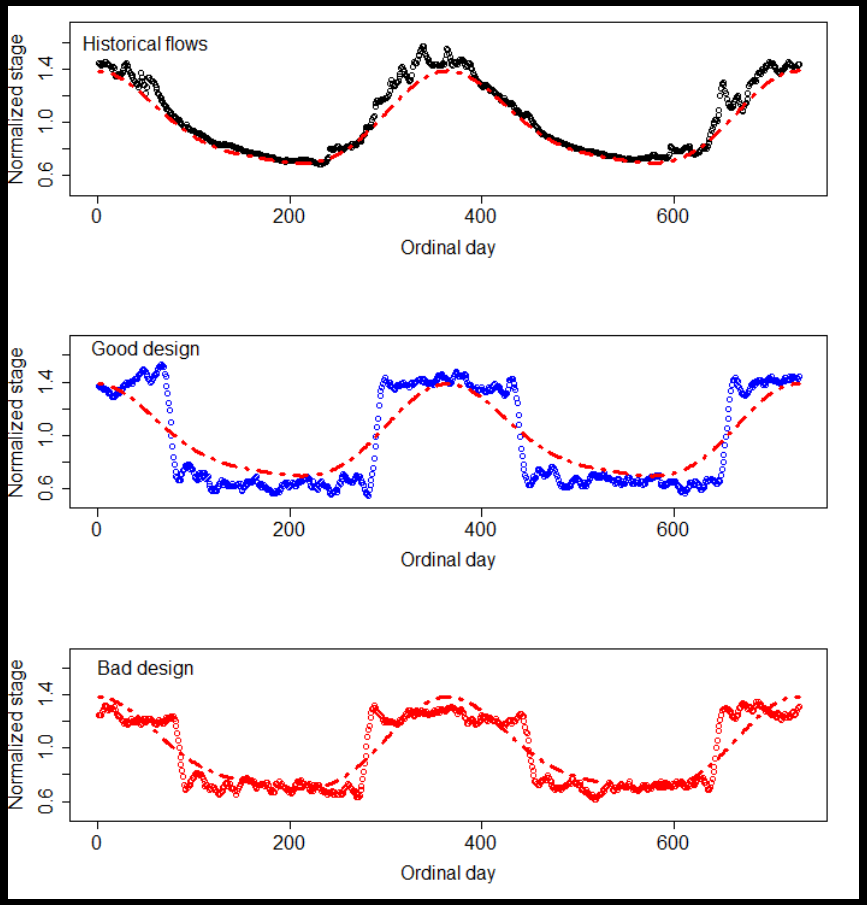


Piman, T., Cochrane, T.A., Arias, M.E., et al. 2013. ASCE Journal of Water Resources Planning and Management

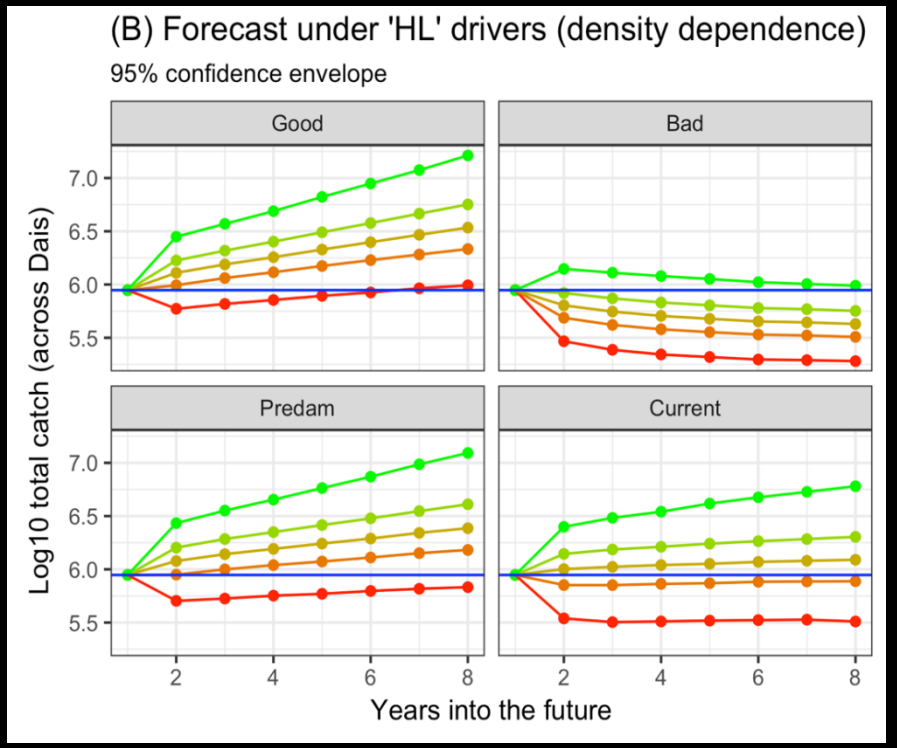
Alternative solutions: Designing flows

Water infrastructure could be operated to improve ecological productivity!

River flows:



Fish catch projections:

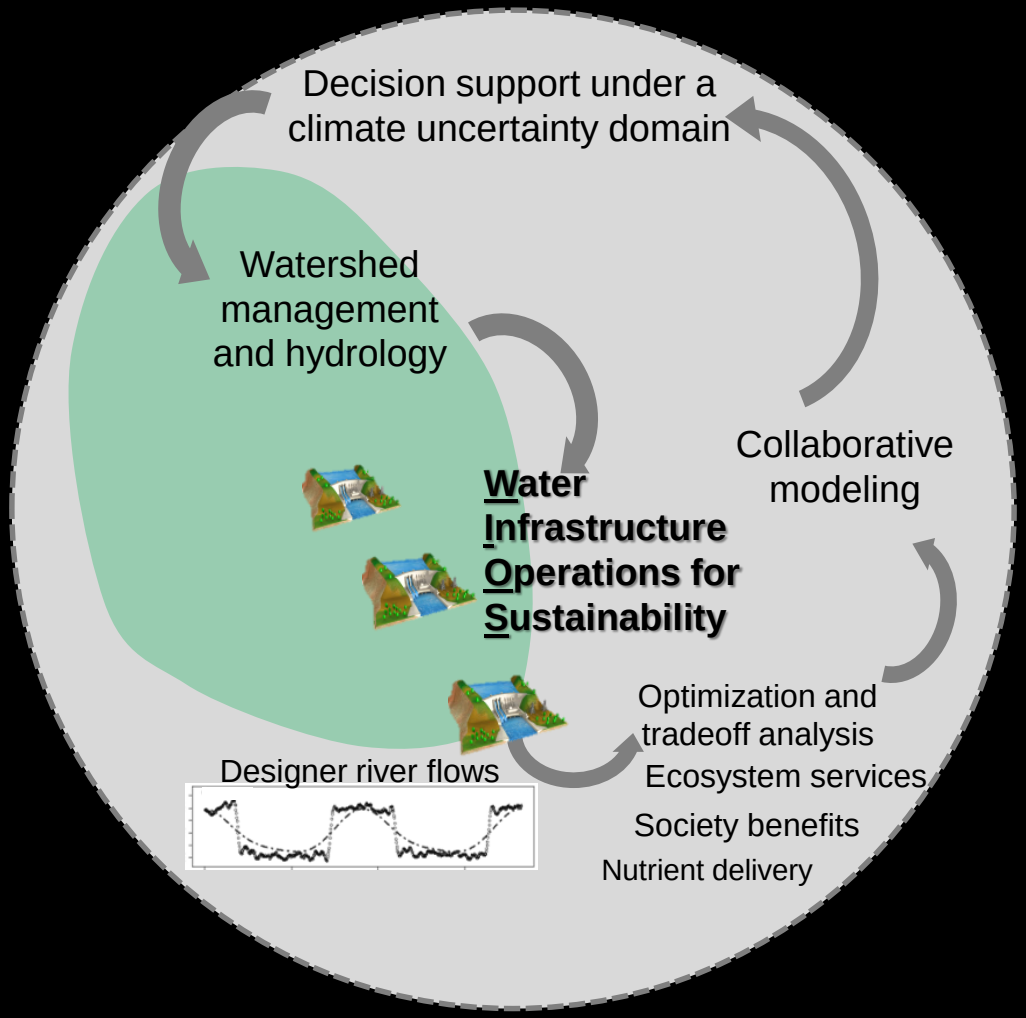


Sabo, J.L., Ruhi, A., Holtgrieve, G.W., Elliott, V., Arias, M.E., Ngor, P.B., Räsänen, T.A., So, N., 2017. Designing river flows to improve food security futures in the Lower Mekong Basin. *Science* 358.

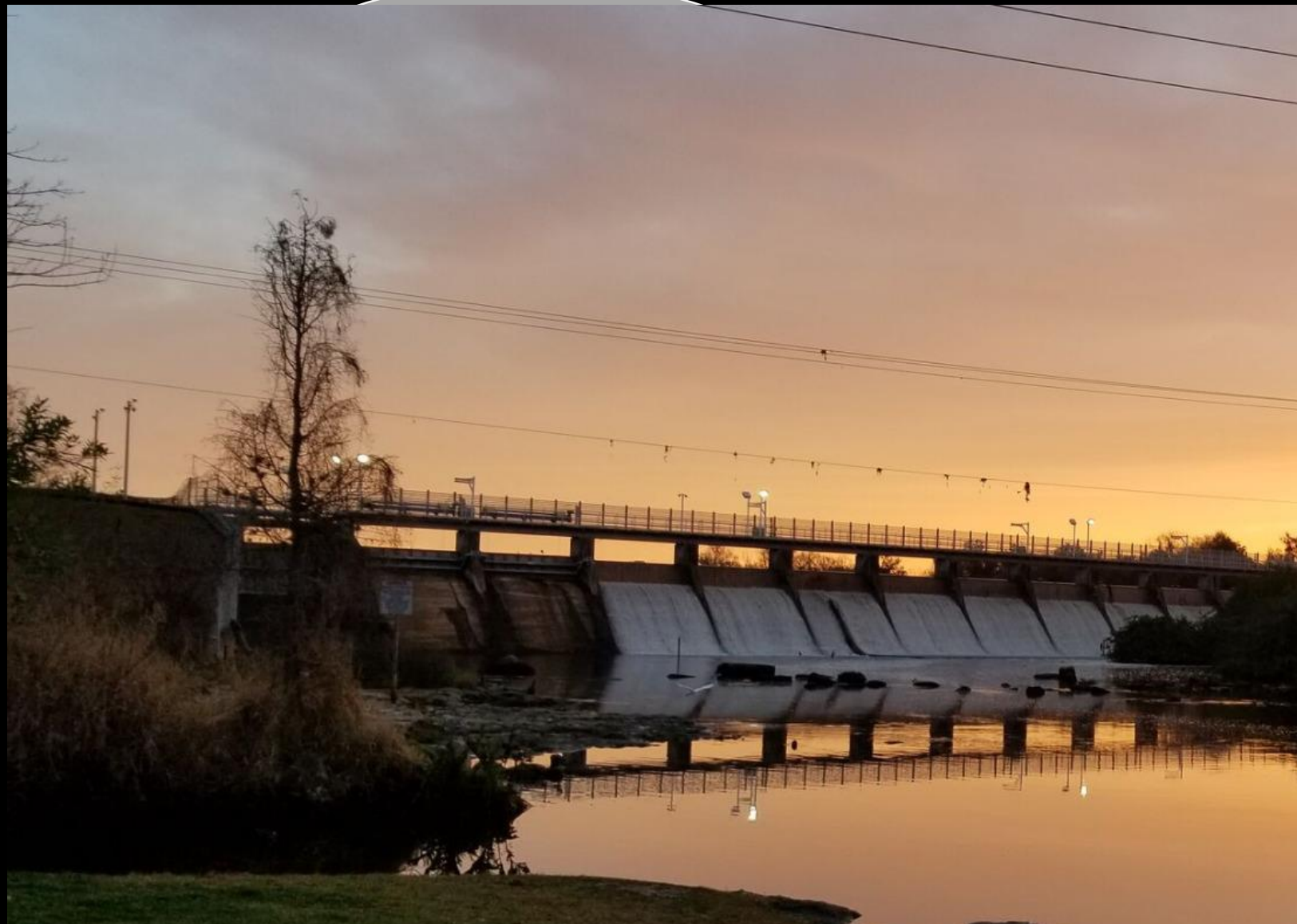
Prospects for Florida: Design flows for coastal sustainability

- Research question:
  - How can water infrastructure operations be optimized for both society and ecosystems while coping with climate uncertainty?

Water Infrastructure for Operations for Sustainability



Conclusions



THANKS!

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