Critical Basin at Risk: Assessing and managing ecosystem pressures from development and climate change in the 3S basin

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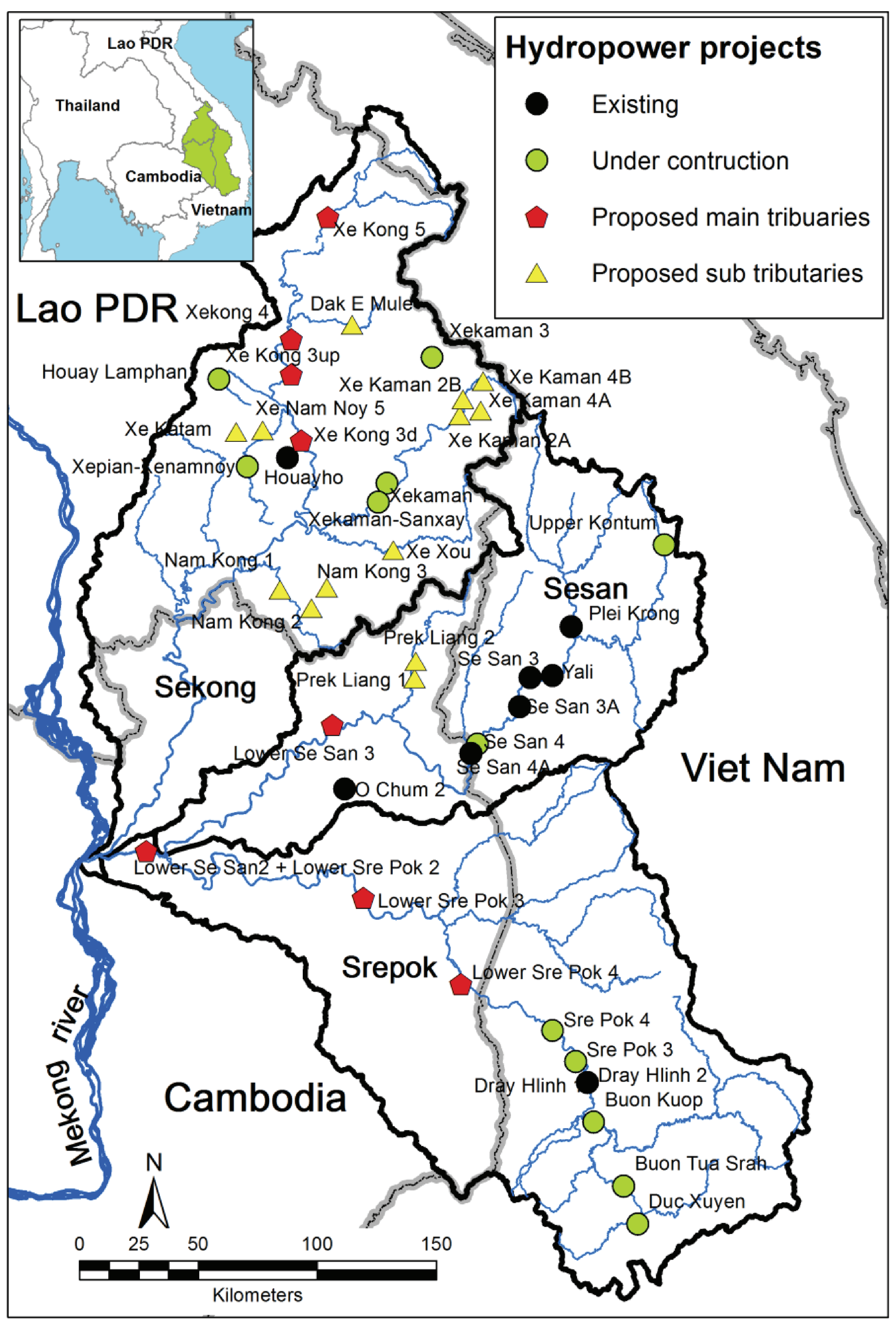
The transboundary Sesan, Srepok, and Srekong basins (3S) are rapidly developing. This development together with climate change are creating ecosystem pressures in the basins and downstream.

Our project aims to address these challenges:

Challenge 1: Improve current climate change and hydropower development modelling to address:

- land use change,
- sediment/nutrient transport,
- impact on riverine ecosystems.

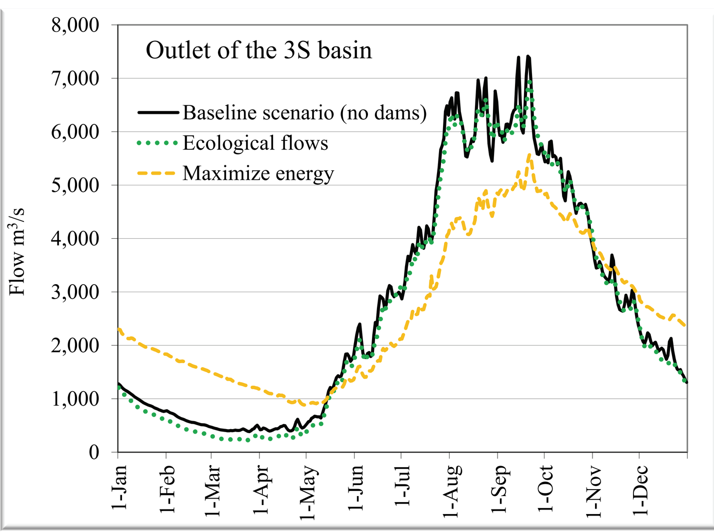


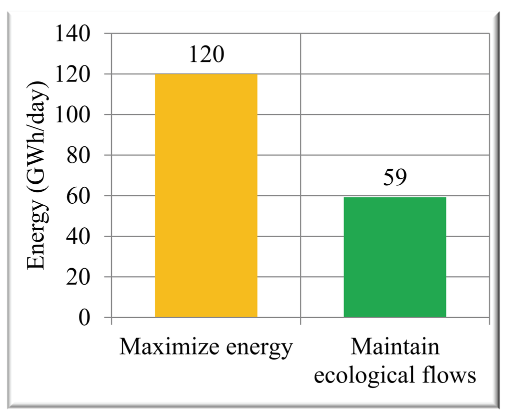
Challenge 2: Simulate development scenarios and assess operations, locations, and design of proposed hydropower and agro-industrial schemes.

Challenge 3: Provide a marginal cost/value analysis of water, nutrients, and sediment related to hydropower use, agriculture, riverine ecosystems, and downstream ecological productivity.

Challenge 4: Investigate a PES approach to key forest catchments in the 3S basin, where forest conservation can be viewed as an investment in hydropower electricity production.

Hydropower Operations and Energy





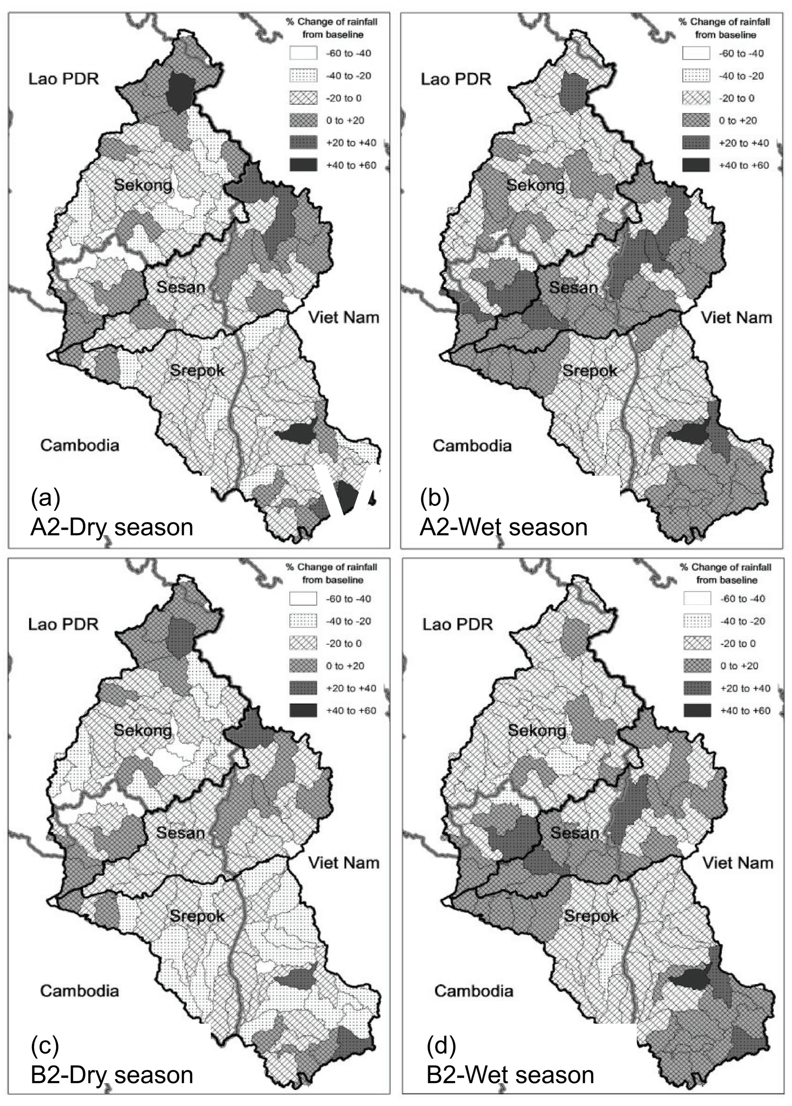
Hydropower operation scenarios:

- Operate reservoirs to maintain Ecological Flows
- Maximize energy production

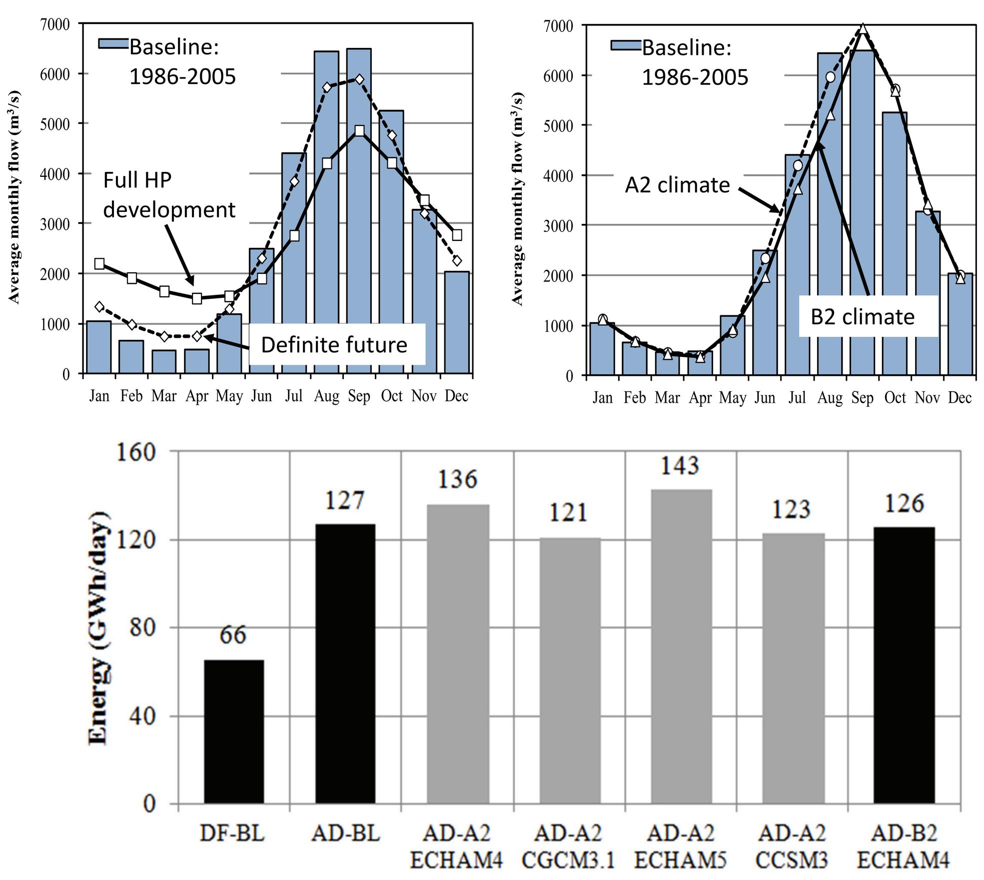
Ecological operations result in half energy generation.

Need to find the optimal operation regime to balance energy production and downstream ecosystem services

Climate Change

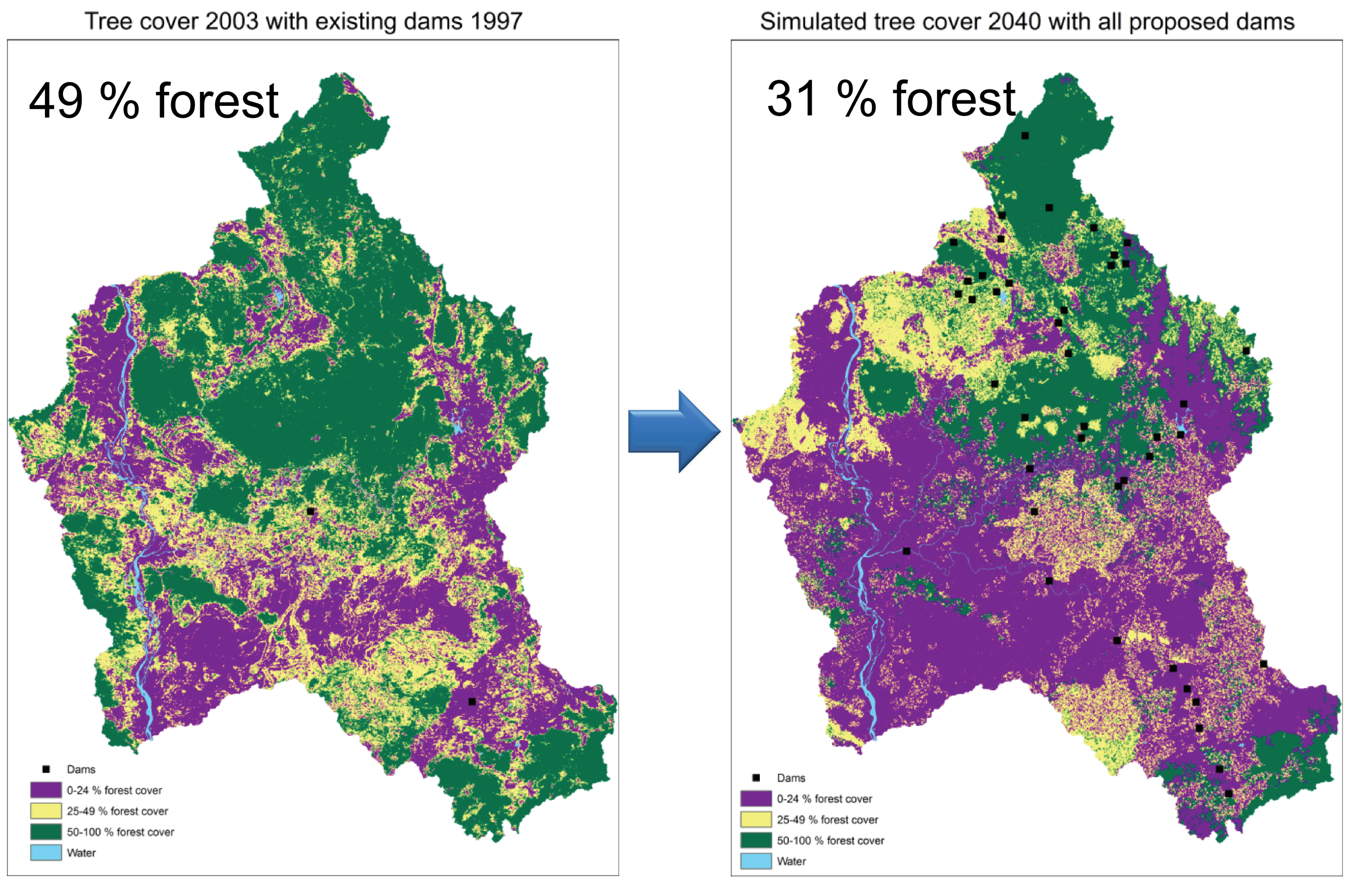


Hydropower and Climate Change



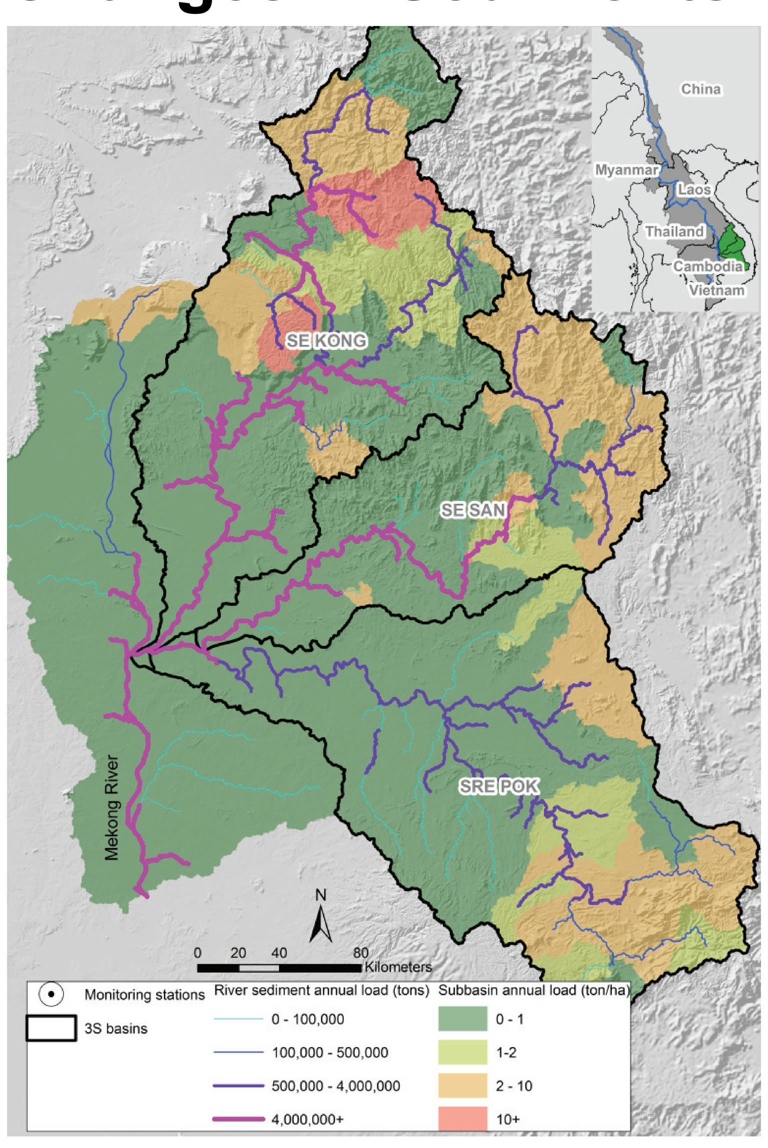
Impact of hydropower > climate change

Land Use Change Projections



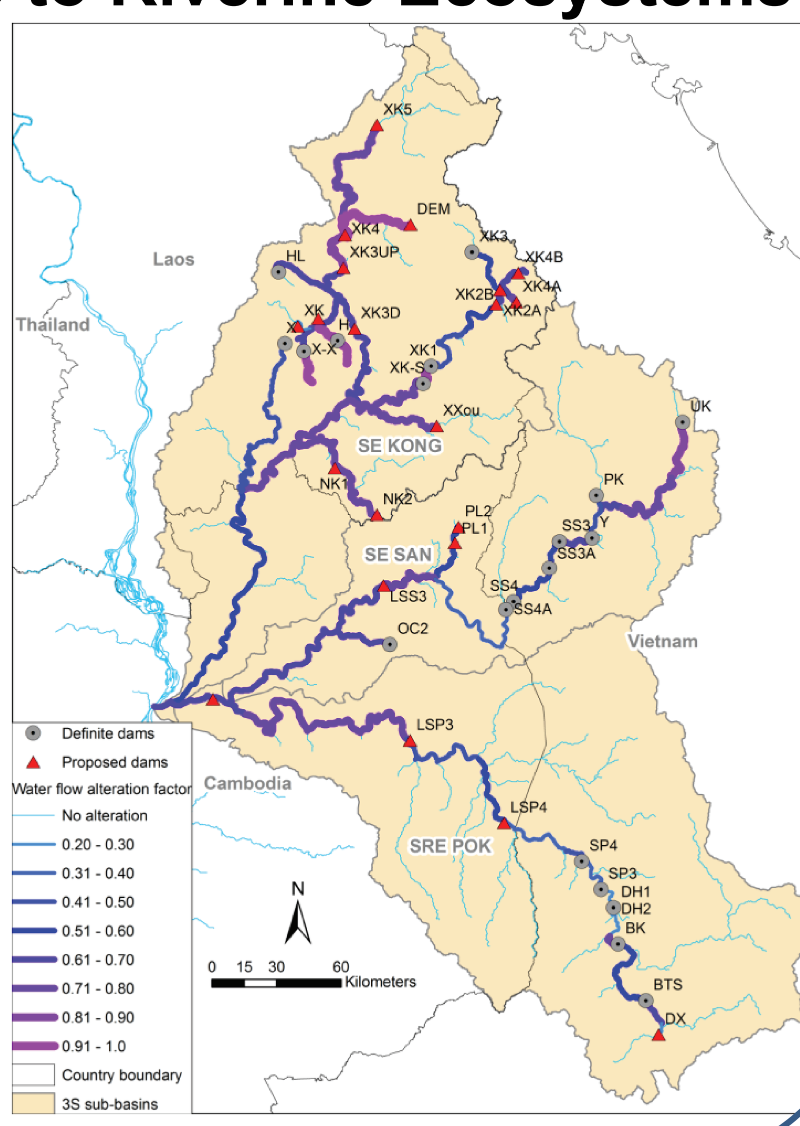
Land use change projection with Dinamica or Dyna-Clue and MODIS imagery

Changes in Sediments



Changes to Riverine Ecosystems

Hydropower
+
Climate Change
+
Land Use Change



Assessing Uncertainty for Future Management

There is a need to quantify the uncertainty in sediment predictions and its implication for the opportunity and cost of integrated sediment management for catchments with hydropower dams

Land use change modelling → Model: Dyna-CLUE → Approach: Ensemble Forecasting → Simulations: 24 (Land use Change)

SWAT Model → Automatic calibration using SUFI → 7 Objective Functions → 7 Model Configurations

3 GCMs, 3 Emission Scenarios, 3 Climate Sensitivity Settings → Method: Statistical downscaling → Approach: Change Factor Method → Scenarios: 27 (Climate Change)

Future sediment predictions

Uncertainty Sources (Sources of uncertainty): Land Use Change | Climate | Model

Implication for Opportunity and Cost of sediment management

Key References and Outputs

- Arias, M.E., Piman, T., Lauri, H., Cochrane, T.A. and Kummu, M. (2014) Dams on Mekong Tributaries as significant contributors of hydrological alterations to the Tonle Sap Floodplain in Cambodia. *Hydrology and Earth System Sciences Discuss* (11): 2177–2209.
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- Piman, T., Cochrane, T.A., Arias, M.E., Green, A. and Dat, N.D. (2013) Assessment of flow changes from hydropower development and operations in Sekong, Sesan and Srepok Rivers of the Mekong Basin. *Journal of Water Resources Planning and Management* 139(6): 723-732.
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