

## **Development of a Pan-Canadian Hydro-Economic Model to Assess Climate-Induced Water Risks on the Canadian Economy: A Computable General Equilibrium Approach**

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Canada's economic development and long-term sustainability require access to water in adequate quantity and acceptable quality. Despite having an abundance of water resources, their future availability and quality are under increasing pressure. Assessing the effect of future water challenges on Canada's economy is therefore crucial for the design of cost-effective adaptation and mitigation strategies to timely inform policy and decision-making and spark the necessary behavioral changes in Canada's economy and society.

The Pan-Canadian hydro-economic model presented here represents an improvement from previous macro-economic models in GWF for water resources management. This model iteration contains a more detailed description of relevant macro-economic variables and is, therefore, capable of describing and analyzing more realistic industry responses, for example based on technology change and input factor substitution. The model also allows us to investigate the link between water availability and the trade balance. When water becomes scarcer and its price increases, the production of domestic water-intensive commodities becomes costlier, and this then results in increasing import of these commodities from foreign markets, which amplifies the Canadian economy's trade deficit.

The model is based on general equilibrium theory instead of linear input-output relationships, where the economy is modelled as an open system constrained by an accounting balance. Water is introduced both as a factor of production in industry and as a commodity for consumption. Crop production is divided into irrigated and rainfed production. Other water-relevant industries and commodities are modelled explicitly, such as water distribution and irrigation services. This includes for instance municipal water supply.

Consistent with GWF's goal of developing decision-support tools for water-associated risks, the model presented here is used to examine the direct and indirect economic effects of Canada-wide water supply and demand shocks due to climate or policy changes. We explore, among others, the benefits of implementing a novel water market in Canada as a coping mechanism with adverse climatic events that result in limited water resource availability.

The results show that, perhaps not unexpected, the Canadian economy is most sensitive to water disruptions in large water use industries such as paper manufacturing and irrigated crop production. However, implementing a water market across Canada is shown to balance out the total economic costs that industry-specific water disruptions would produce. This effect acts in both directions, damping the economic loss due to water cutbacks, but also possible gains from increasing water endowments as a result of climate change in parts of Canada where rainfall and temperatures might increase. The model is being spatially disaggregated following the major drainage basin areas in Canada to allow for spatially targeted scenarios and impact assessments.