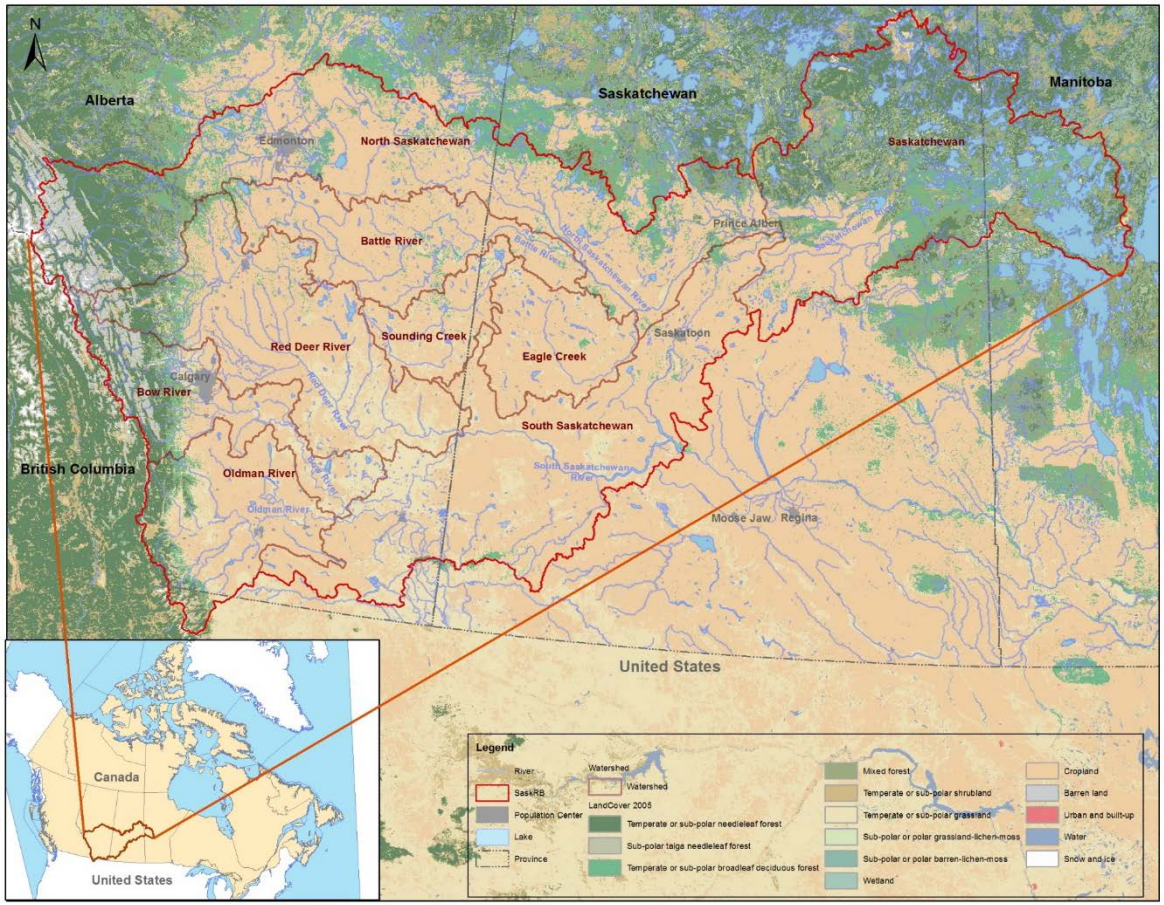
An Evaluation of Current and Future Water Allocation Strategies in the Saskatchewan River Basin

Leila Eamen

Saman Razavi, Roy Brouwer, Laurie Tollefson

University of Saskatchewan
Global Institute for Water Security
www.usask.ca/water

Objective



To develop a hydro-economic model by coupling a water management model with an economic model.

This hydro-economic model will evaluate water allocation strategies in the Saskatchewan River Basin.

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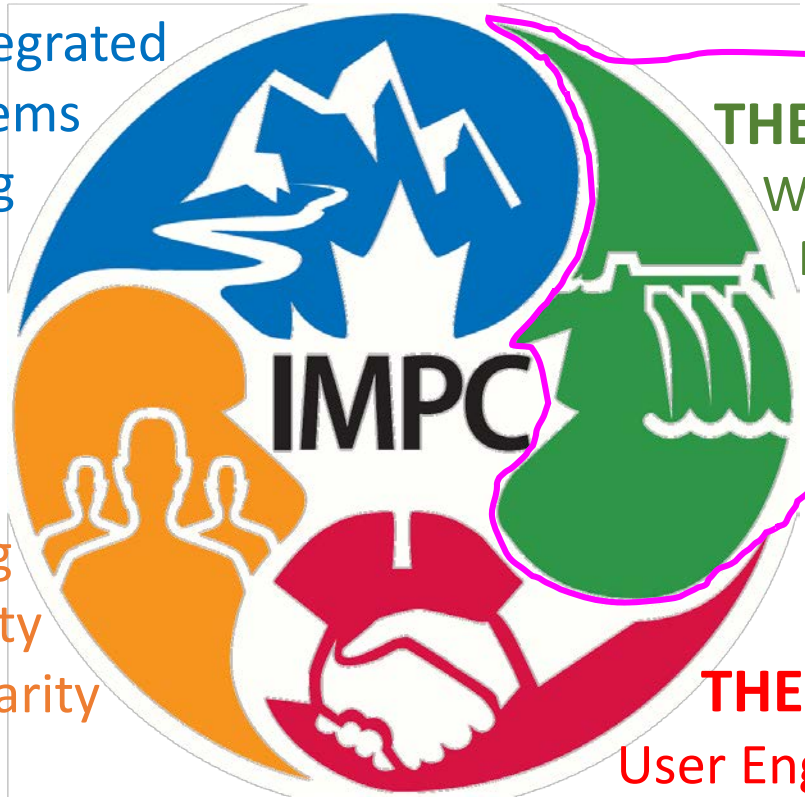
Research Themes

THEME A:
Integrated Earth Systems Modelling



THEME B:
Water Management Modelling, Coupling Human-driven and Natural Systems

THEME C:
Decision Making under Uncertainty and Non-stationarity

THEME D:
User Engagement and Knowledge Mobilization

Surface Water Withdrawals and Licenses in the Saskatchewan River Basin (2016)

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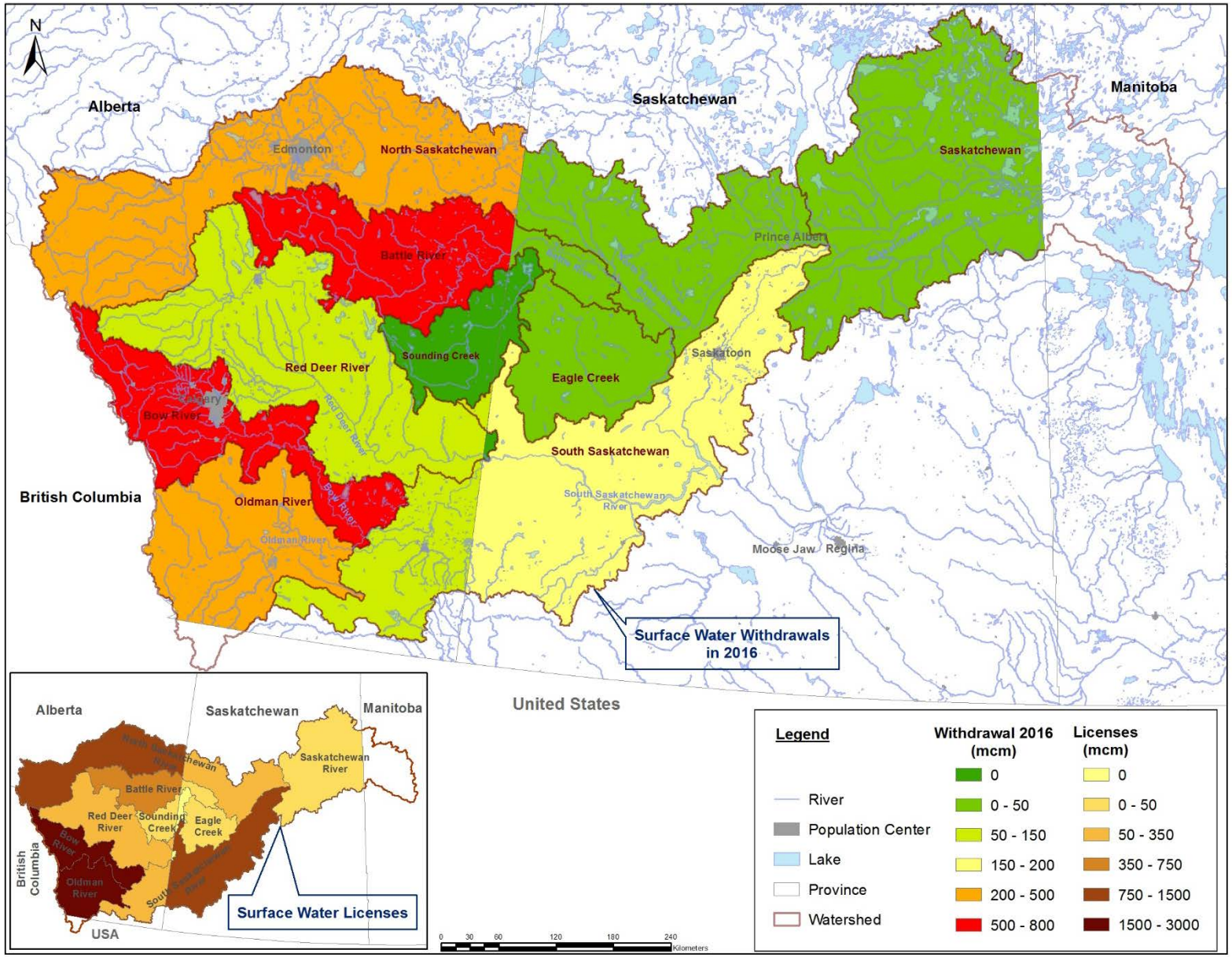

Surface Water Withdrawals and Licenses in the SaskRB-Saskatchewan Province (2005-2016)

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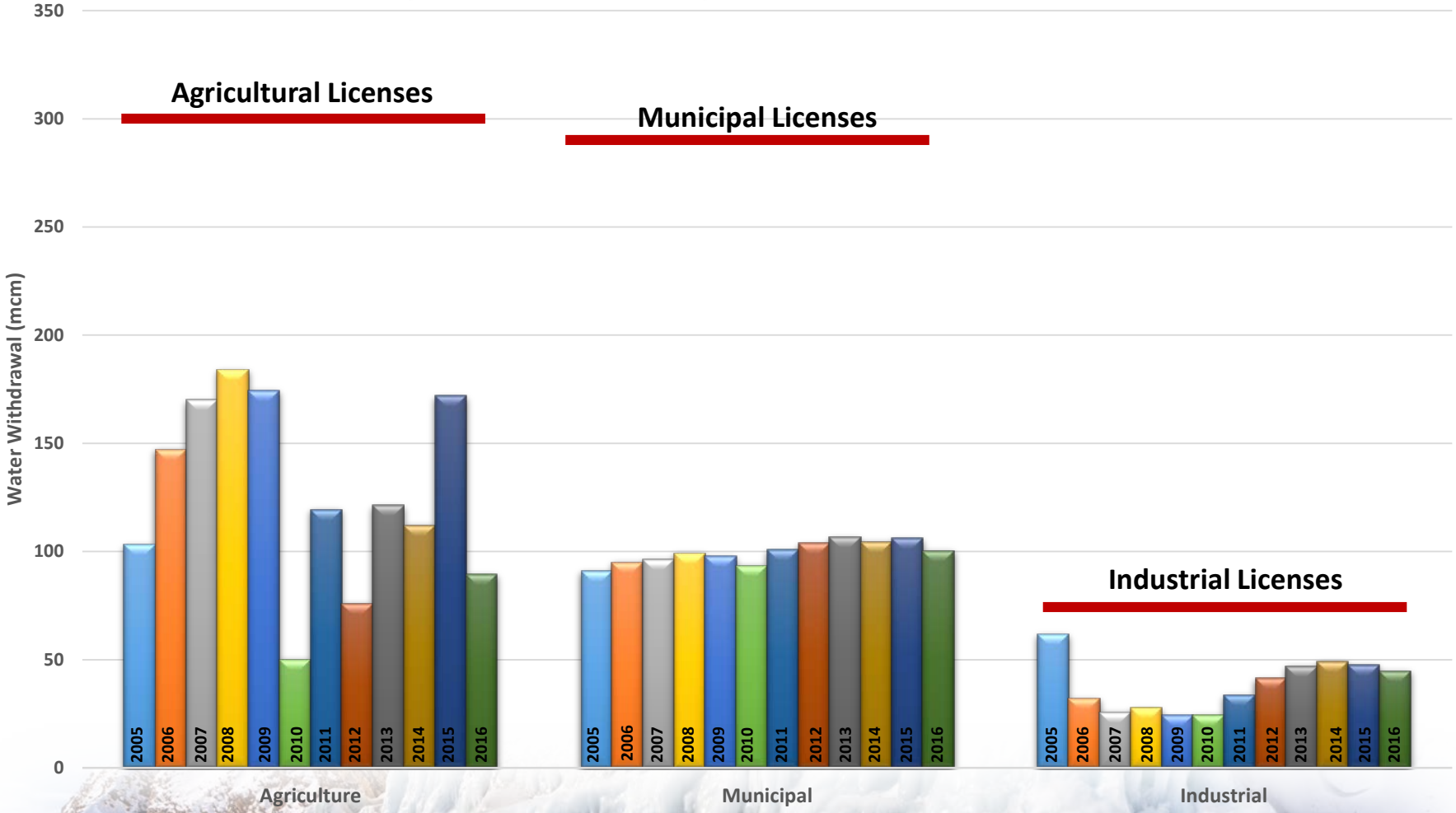

Surface Water Withdrawals and Licenses in the SaskRB-Alberta Province (2005-2016)

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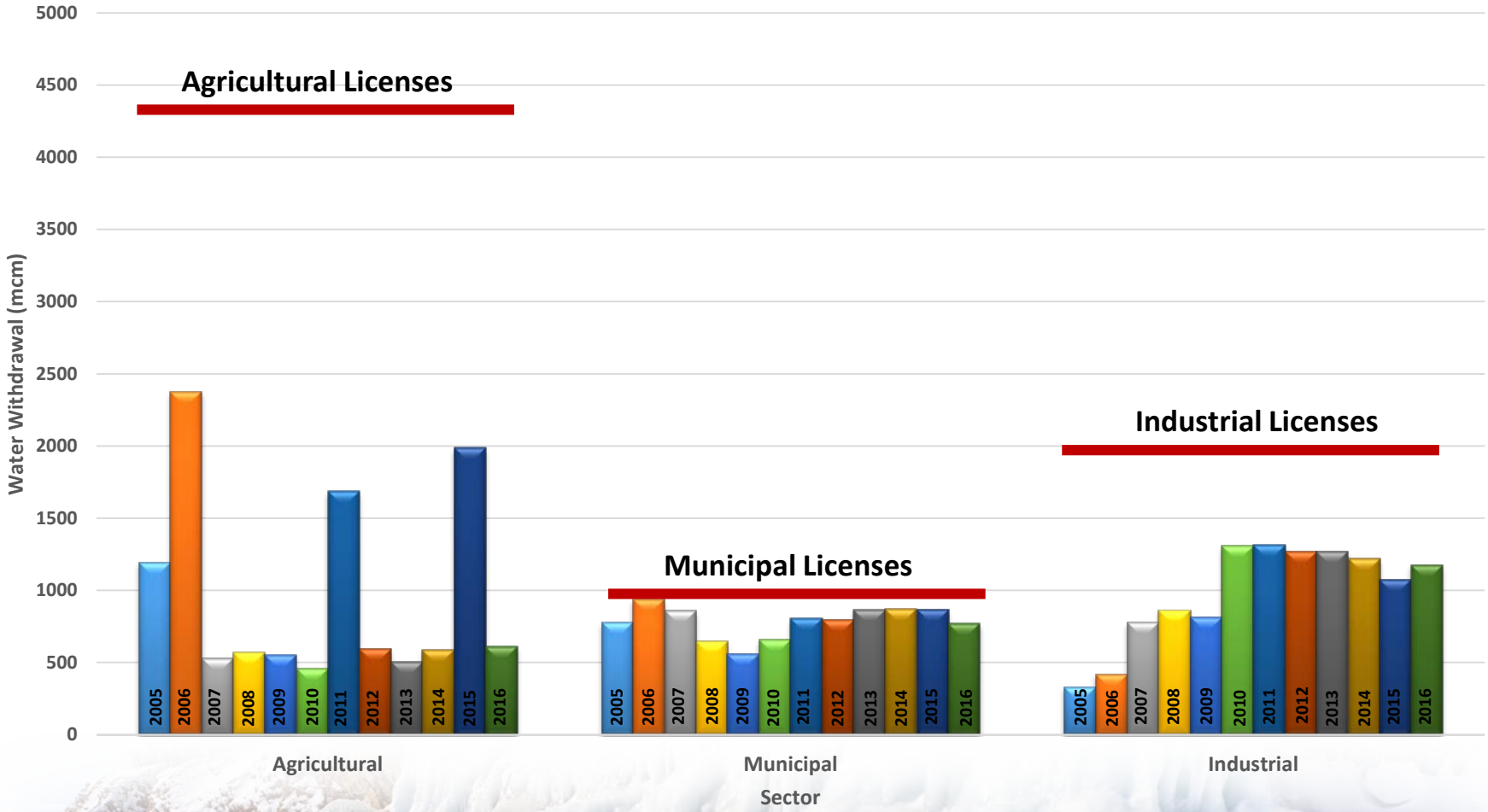

Why an Economic Approach?

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Increasing the spatial and temporal variability in the quantity of available water due to the climate change

Competing uses in the SaskRB

→ Complicated Water Allocation

Integrated Water Resources Management Model → Available Water

Hydro-Economic Model

Economics → Quantifying the economic value of production of each water use sector → Evaluating the impact of water allocation on each sector separately and on the entire economy

→ More Efficient Water Allocation Strategies

The Common Practice

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- Cost-Benefit Analysis (CBA)
  - Comparing the *Total Benefits* of a decision with its *Total costs*

- Limitations
  - *Not* capable of considering the *interdependencies* in an economy
  - The CBA *only* considers the *Direct Impacts*

The Proposed Economic Model

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- Input-Output Model
  - An analytical framework developed based on the Leontief Input-Output model and the Input-Output tables
  - An Input-Output table shows the flow of goods and services among both producing and final demand sectors

- Capabilities
  - Suitable for complex *multi-sector*, *multi-product* regions
  - Considering the *inter-industry relationships* within an economy
  - *Quantifying* the economic *interdependencies* in an economy
  - Evaluating both *Direct Impacts* and *Secondary Impacts* of each stimulus

- Limitations
  - The coarse *spatial resolution*. i.e. the I-O tables are available at national and provincial levels only
  - The I-O models do not consider the *price changes*

The Input-Output Model

The I-O Structure

Total Final Demand

		Producers as Consumers						Final Demand				Total Output
		Agriculture	Mining	Construction	Manufacturing	Utilities	Other Industry	Personal Consumption Expenditures	Private Domestic Investment	Government Purchases of Goods & Services	Net Exports of Goods & Services	
Producers	Agriculture											
	Mining											
	Construction											
	Manufacturing											
	Utilities											
	Other Industry											
Value Added	Employees											
	Business Owner and Capital											
	Government											
Total Input (X)												

Inter-industry Transactions (Matrix A)

Employee Compensation

Profit-type income and capital consumption allowances

Indirect Business Taxes

Gross Domestic Product

$$X = (I - A)^{-1} Y$$

The Hydro-economic Model

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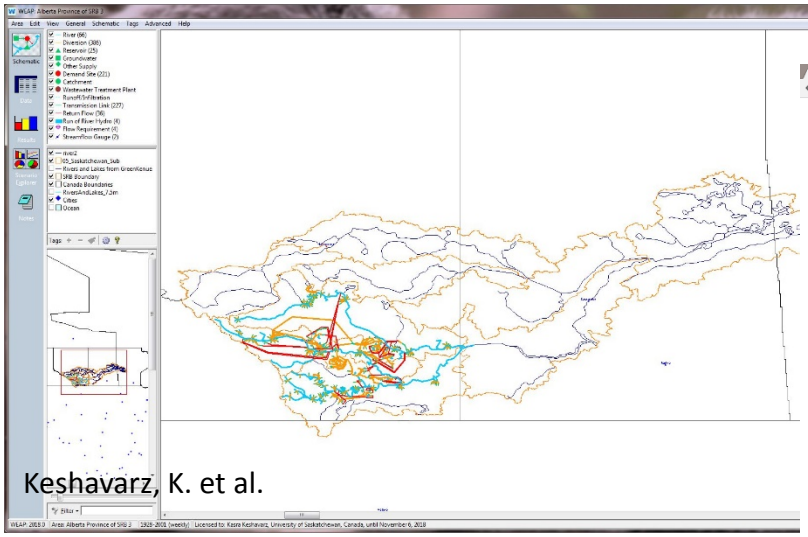
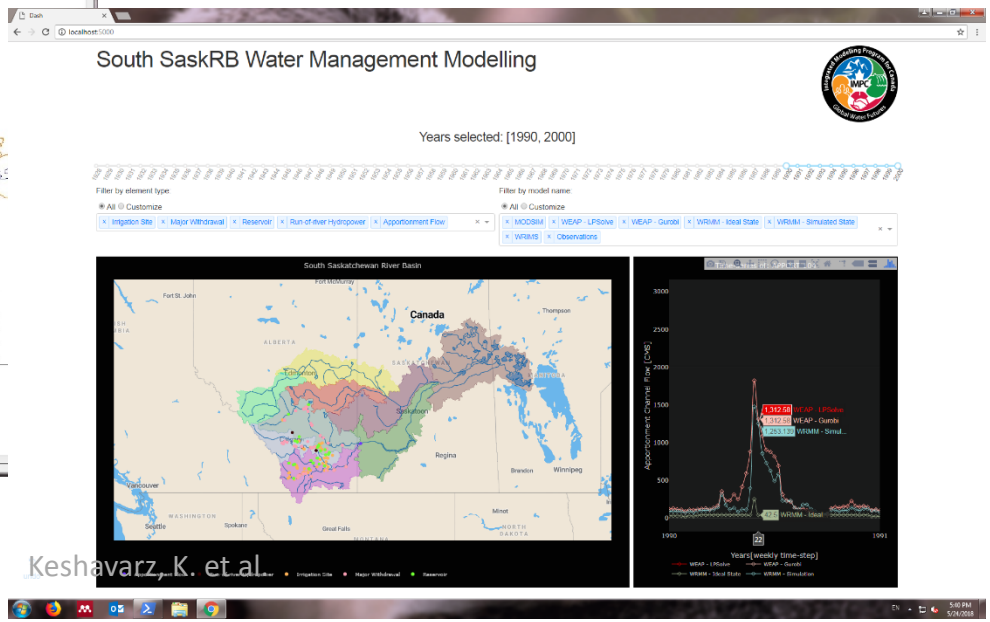
- Coupling the *I-O model* with a *Water Management Model* to study the alternative water allocation strategies





- Challenges:
  - Limited available data
    - Different *Industry Classification* between I-O tables and Water Use data
    - Separating the share of *surface and ground* water in the provincial I-O tables
    - Separating the share of *different watersheds* in the provincial I-O tables
  - Different temporal and spatial scales between the I-O and Water Management models

Conclusion

- Water withdrawals in both Saskatchewan and Alberta provinces are below the amount of water allocated through the licenses.
- The Hydro-Economic Model is a proper tool to evaluate different water allocation alternatives.
- The Input-Output model evaluates not only Direct Impacts of a water allocation strategy, but also its Secondary Impacts.
- Coupling I-O and Water Management models, we face different challenges including different spatial and temporal scales, different industry classifications, etc.

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