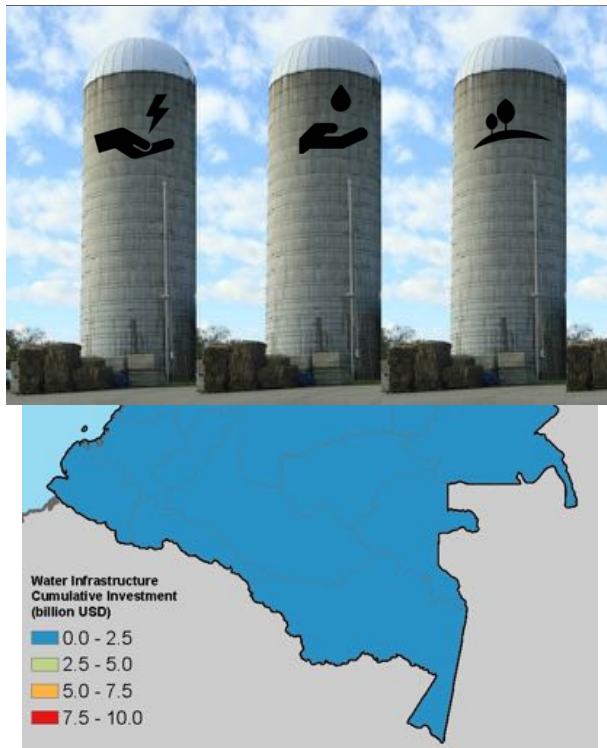


Applying a water-energy-food dynamics framework at sub-national scale in Latin America to facilitate integrated infrastructure investment planning



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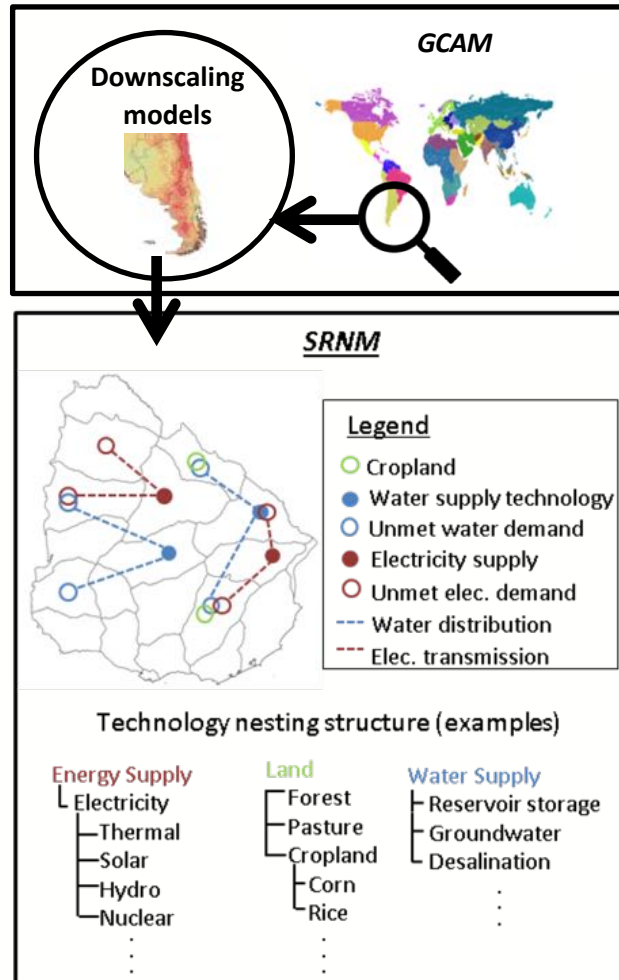
...and *many* others

Outline

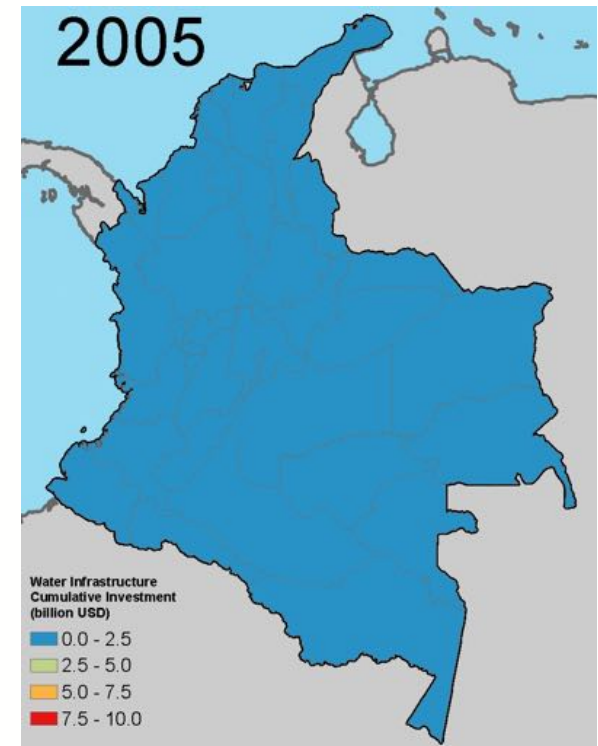
1. Research Questions



2. Modeling Advances



3. Examples of Insights



What kinds of questions are we tackling?

1. How would Colombia's planned climate change adaptation policies influence the evolution of its national and sub-national energy, water, and land systems in the context of a changing climate, and what sectoral synergies, conflicts, and infrastructure investment needs arise as a result?



DNP Departamento
Nacional
de Planeación

Capacity
building
(GCAM
Training)



Capacity
building
(scenario
refinement)



GOBIERNO DE COLOMBIA

What kinds of questions are we tackling?

2. How might Uruguay's plan to feed 50 million people by 2050 (i.e., the “50-50 plan”) impact the evolution of its national and sub-national energy, water, and land systems, including water quality, and accounting for climate change impacts on water supply and agriculture?



Capacity
building
(GCAM
Training)

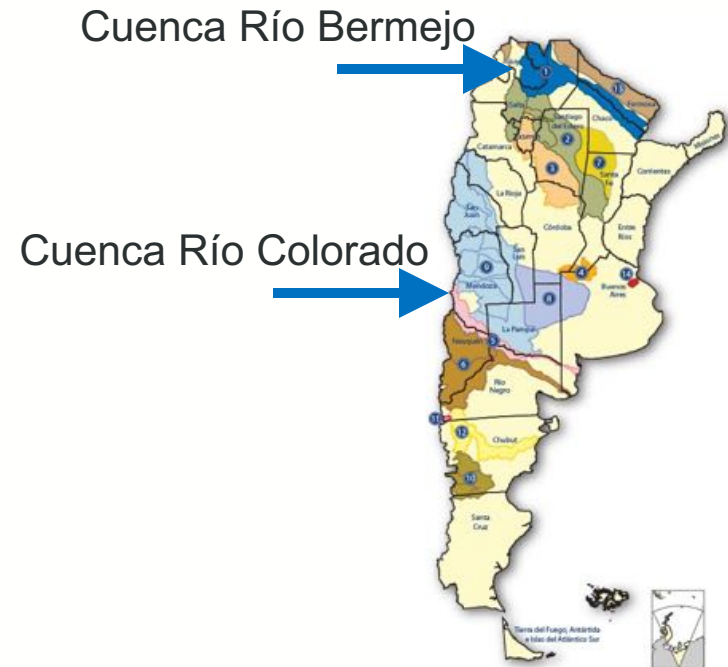


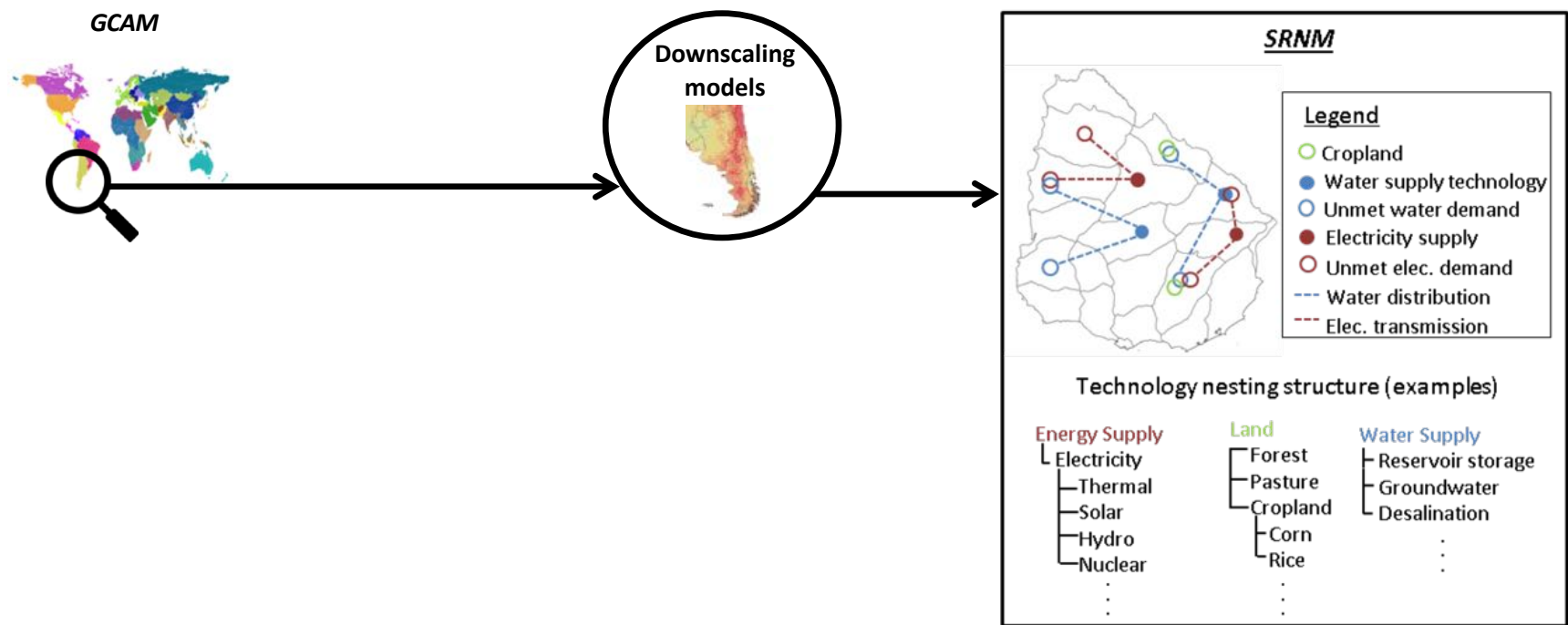
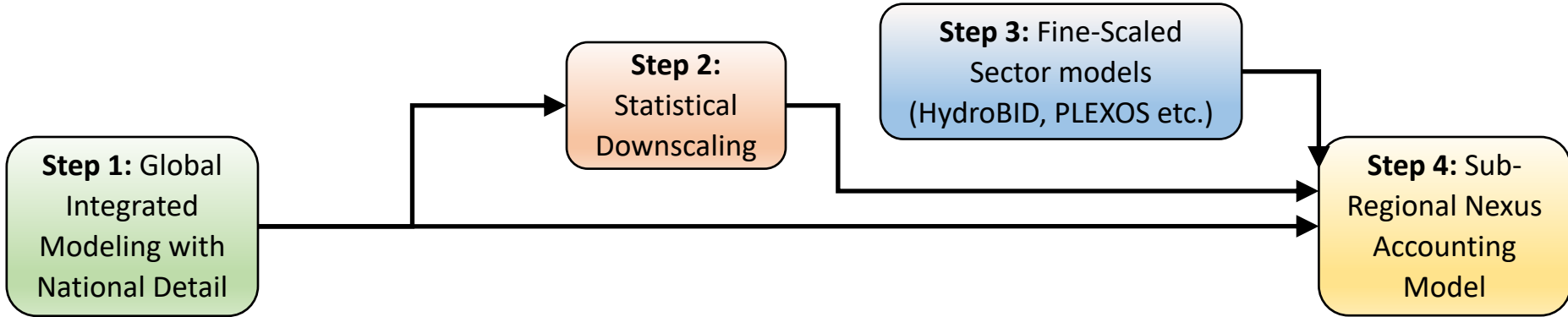
Capacity
building
(scenario
refinement)



What kinds of questions are we tackling?

3. What are the multi-sectoral synergies, tradeoffs, and conflicts occur as a result of specific infrastructure investment or planning activities in Argentina's Bermejo and Negro river basins?





Step 1: Global Integrated Modeling with National Detail

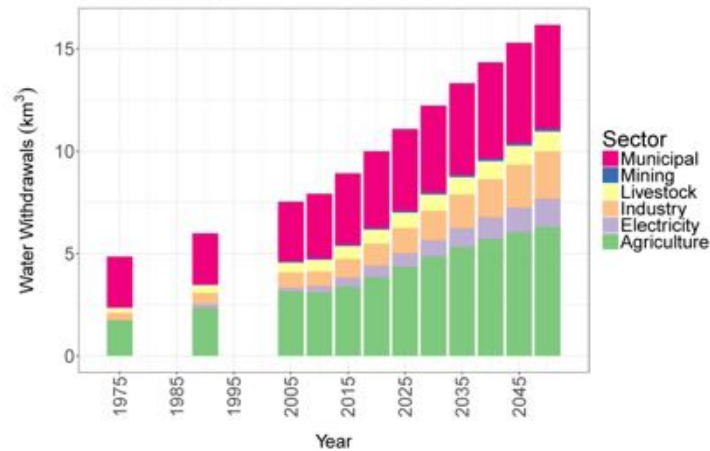
INPUTS

- Resources Bases
- Socioeconomics
- Technologies
 - Policies

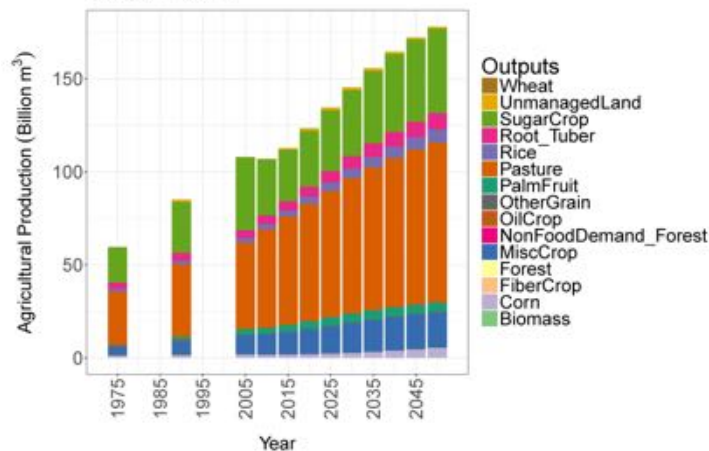
OUTPUTS

- Prices and Production Quantities
 - Land use
 - Water Demand

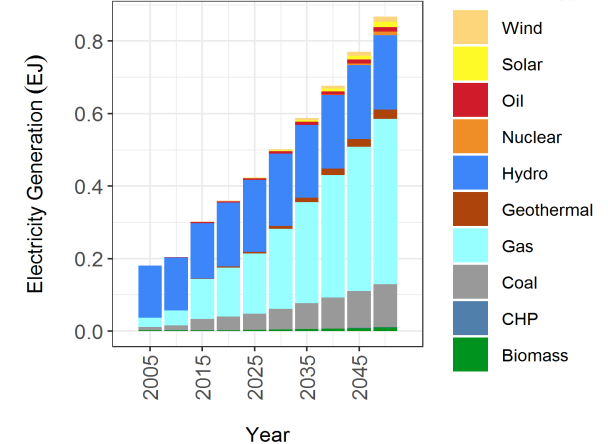
Colombia



Colombia



Technology



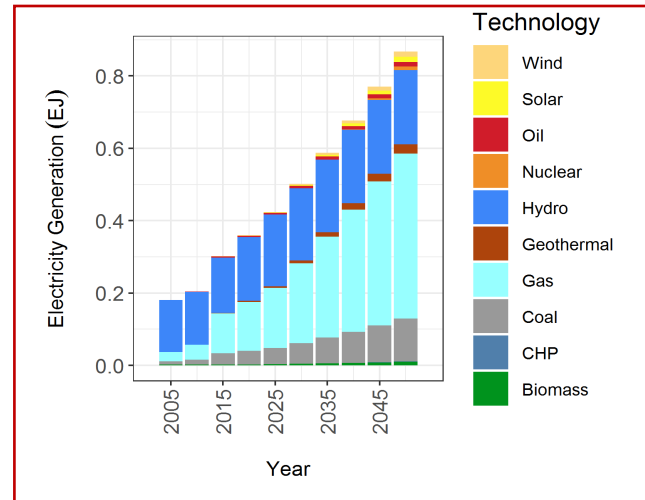
Step 1: Global Integrated Modeling with National Detail

INPUTS

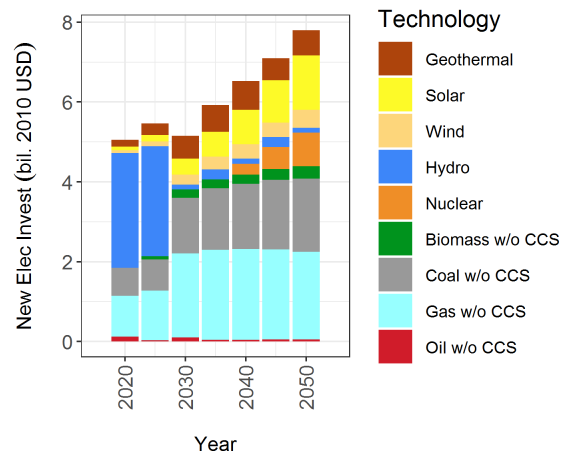
- Resources Bases
- Socioeconomics
- Technologies
 - Policies

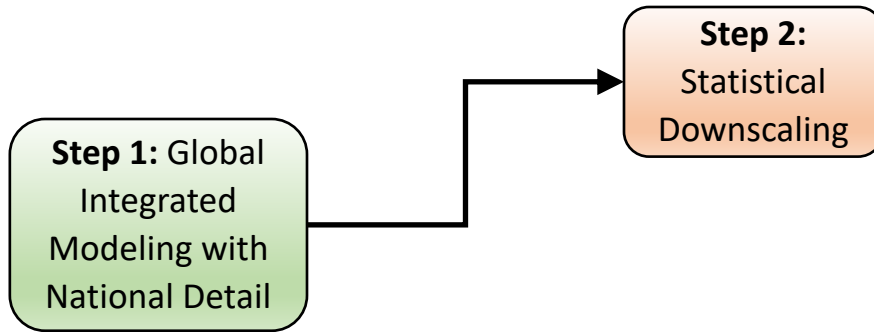
OUTPUTS

- Prices and Production Quantities
 - Land use
- Water Demand



National Investment Analysis





INPUTS

- Resources Bases
- Socioeconomic s
- Technologies
- Policies

INPUTS

By GCAM aggregated regions

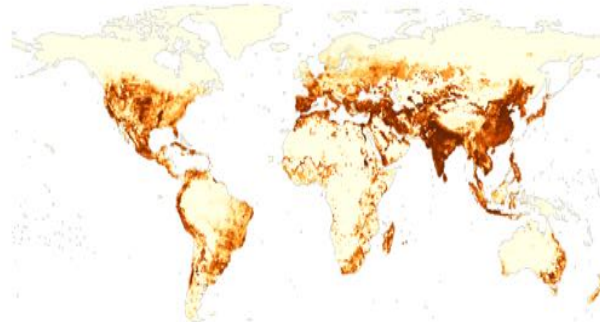


OUTPUTS

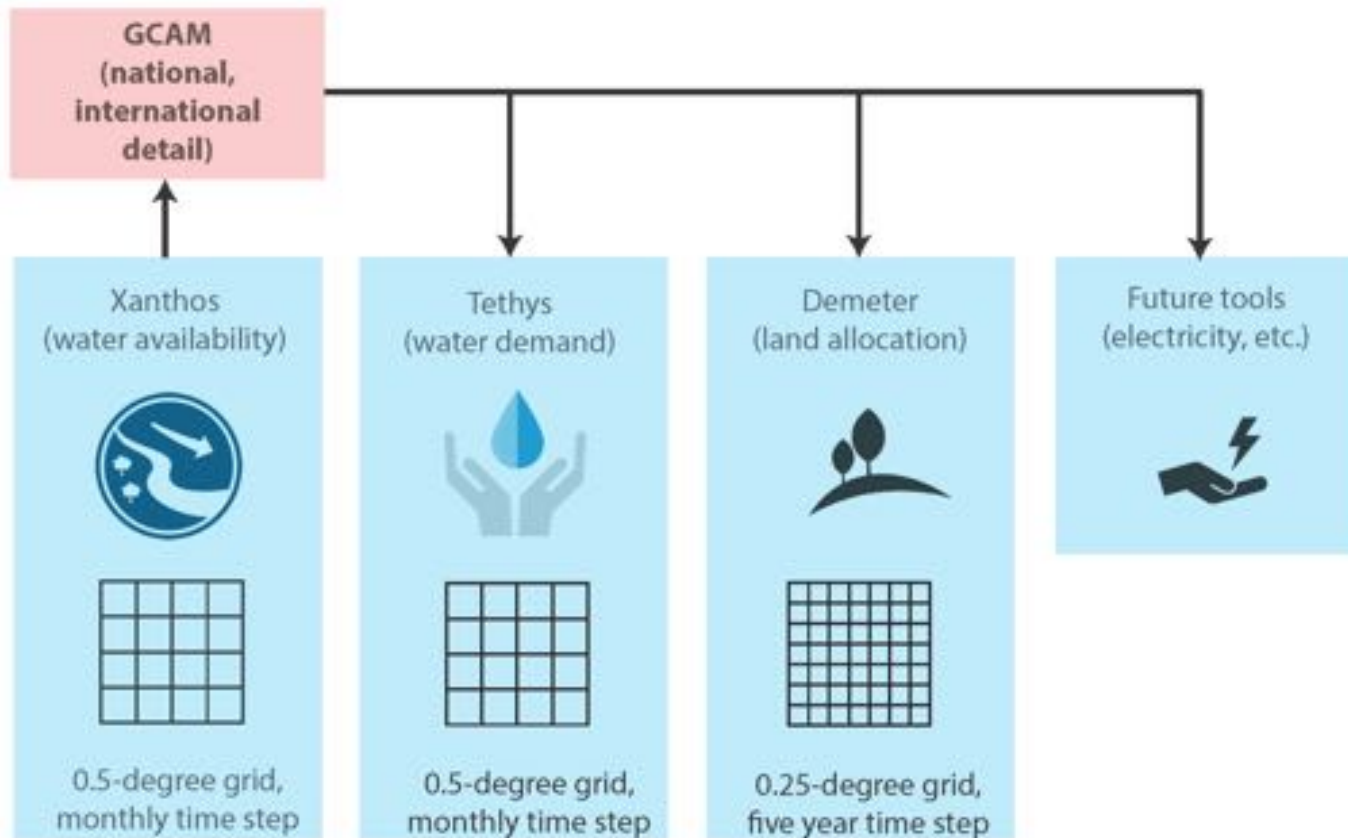
- Prices and Production Quantities
- Land use
- Water Demand

OUTPUTS

Downscaled gridded outputs

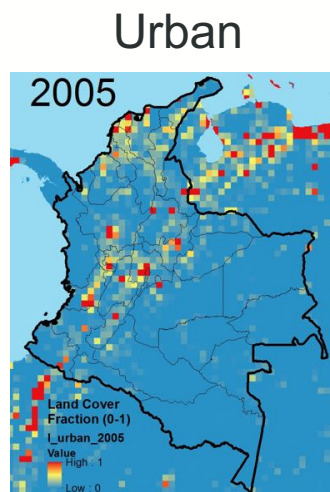
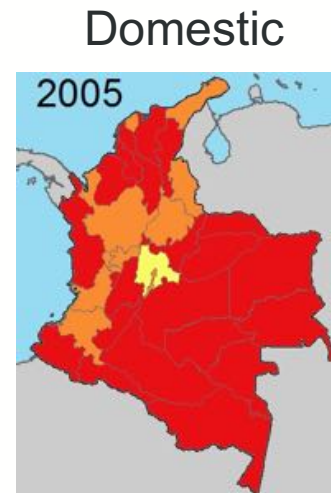
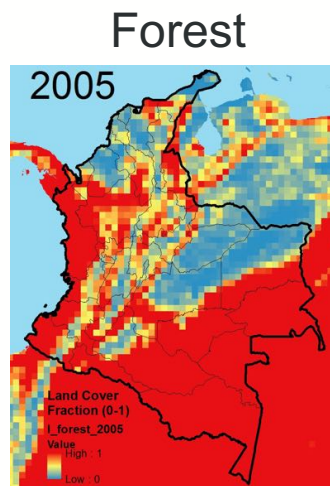
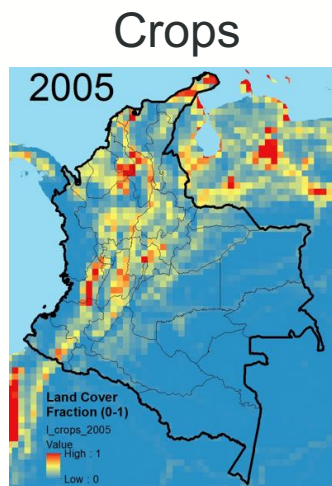


Integrated* Downscaling Framework

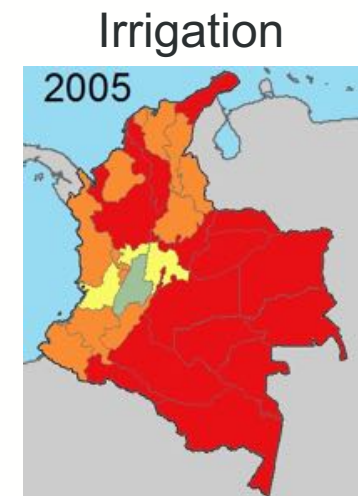


*Python programs are integrated, but coupling with GCAM is one-way

Gridded Land Cover & Sectoral Water Demand



Demand
depth (mm)



Regional Water Scarcity: Demand / Availability

Scarcity

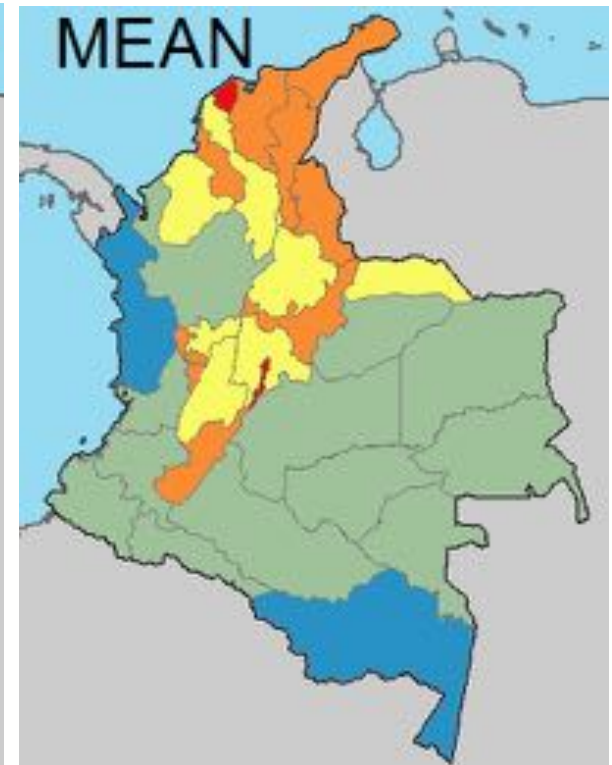
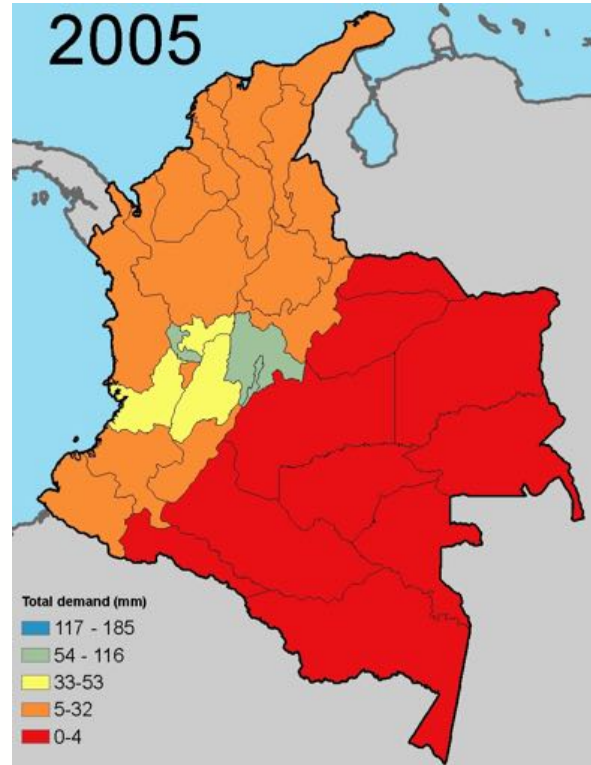
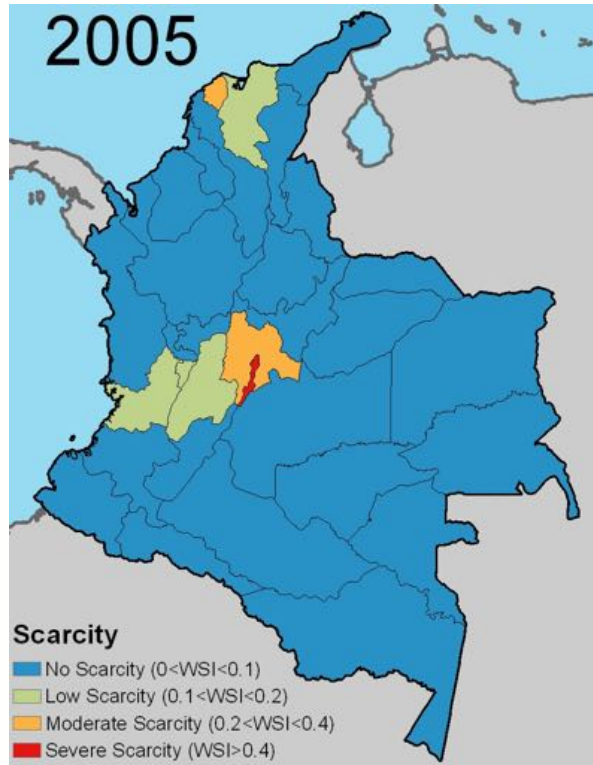


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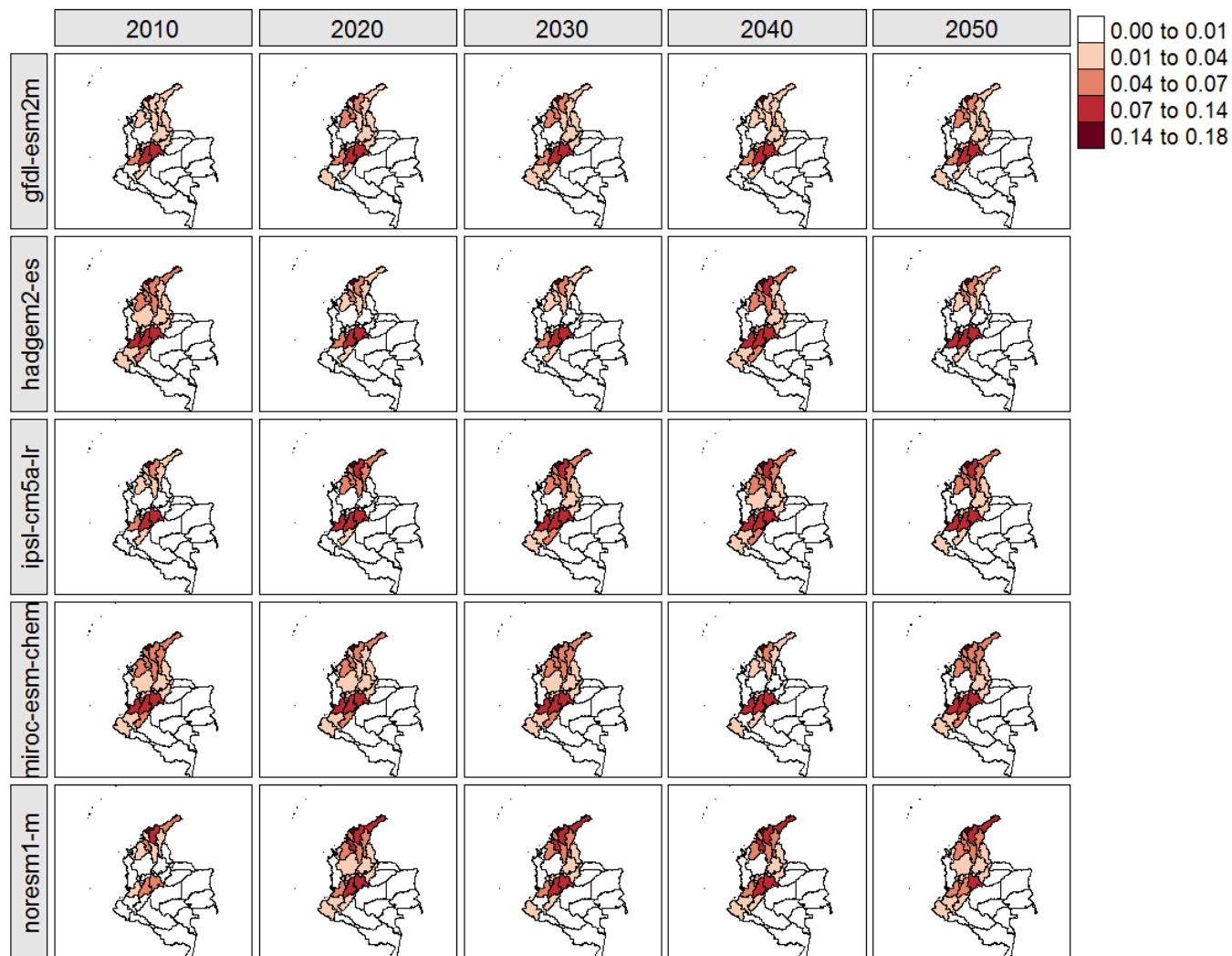
Demand

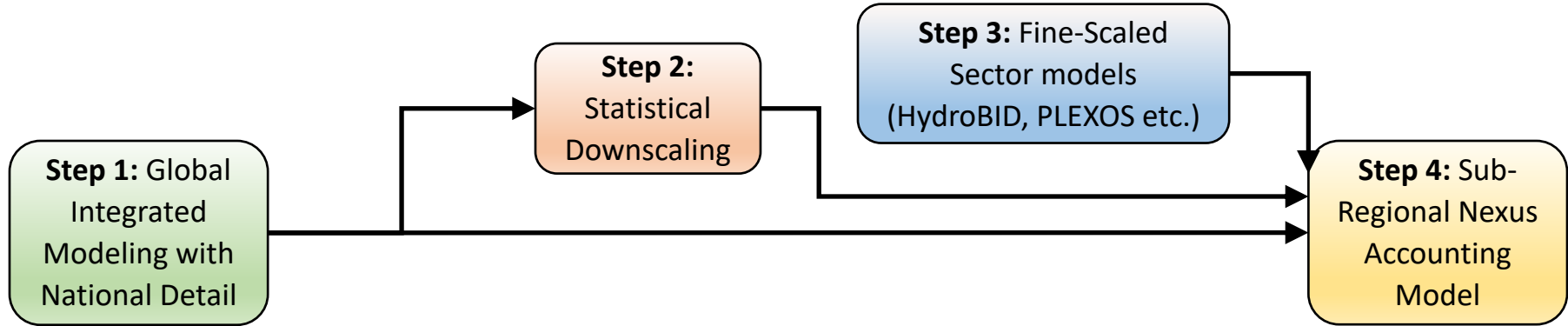


Runoff



Regional Water Scarcity: Climate Impacts





INPUTS

- Resources Bases
- Socioeconomic s
- Technologies
- Policies

OUTPUTS

- Prices and Production Quantities
- Land use
- Water Demand

INPUTS

By GCAM aggregated regions



OUTPUTS

Downscaled gridded outputs



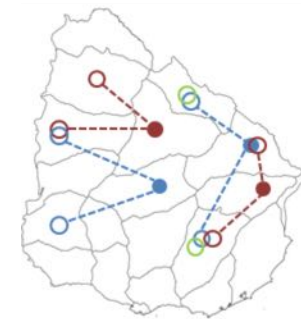
INPUTS

Gridded data + Spatial Scale Selected
+ Sector Specific Local Data



OUTPUTS

Re-aggregated outputs + sub-regional dynamics



Legend

- Cropland
- Water supply technology
- Unmet water demand
- Electricity supply
- Unmet elec. demand
- Water distribution
- Elec. transmission

Sub-regional Input Data Structure

SPATIAL TIER 1

SPATIAL TIER 2

SECTOR TIER 1

Sector	Units	Year	Spatial Unit	D
Electricity Demands	TWh	2015	Basin	
Electricity Supply	GW	2015	Basin	
Energy Demands	TWh	2015	Basin	
Energy supply	GW	2015	Basin	
Water Demand	m3	2015	Basin	
Water Supply	m3	2015	Basin	
Agriculture Demand	Mt	2015	Basin	
Agricultural Supply	Mt	2015	Basin	
Population	Mill	2015	Basin	
GDP	USD	2015	Basin	
Emissions	MTCO2	2015	Basin	

Sector	Units	Year	Spatial Unit	D
Electricity Demands	TWh	2015	SubBasin1	
Electricity Supply	GW	2015	SubBasin1	
Energy Demands	TWh	2015	SubBasin1	
Energy supply	GW	2015	SubBasin1	
Water Demand	m3	2015	SubBasin1	
Water Supply	m3	2015	SubBasin1	
Agriculture Demand	Mt	2015	SubBasin1	
Agricultural Supply	Mt	2015	SubBasin1	
Population	Mill	2015	SubBasin1	
GDP	USD	2015	SubBasin1	
Emissions	MTCO2	2015	SubBasin1	

Electricity Demands	TWh	2015	SubBasin2	
Electricity Supply	GW	2015	SubBasin2	
Energy Demands	TWh	2015	SubBasin2	
Energy supply	GW	2015	SubBasin2	
Water Demand	m3	2015	SubBasin2	
Water Supply	m3	2015	SubBasin2	
Agriculture Demand	Mt	2015	SubBasin2	
Agricultural Supply	Mt	2015	SubBasin2	
Population	Mill	2015	SubBasin2	
GDP	USD	2015	SubBasin2	
Emissions	MTCO2	2015	SubBasin2	

SECTOR TIER 2

Sector	Units	Year	Spatial Unit	Subsector	D
Electricity Demands	TWh	2015	Basin	Coal	
Electricity Demands	TWh	2015	Basin	Oil	
Electricity Demands	TWh	2015	Basin	Gas	
Electricity Demands	TWh	2015	Basin	Hydro	
Electricity Demands	TWh	2015	Basin	Wind	
Electricity Demands	TWh	2015	Basin	Nuclear	

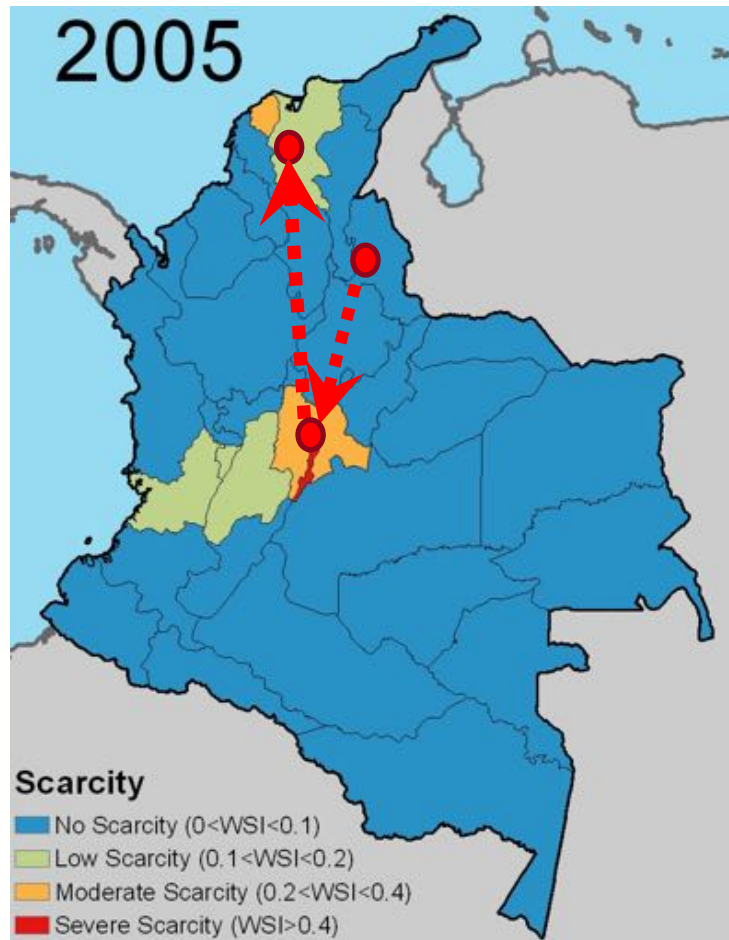
Sector	Units	Year	Spatial Unit	Subsector	D
Water Demands	TWh	2015	Basin	Municipal	
Water Demands	TWh	2015	Basin	Mining	
Water Demands	TWh	2015	Basin	Livestock	
Water Demands	TWh	2015	Basin	Industry	
Water Demands	TWh	2015	Basin	Electricity	
Water Demands	TWh	2015	Basin	Agriculture	

Sector	Units	Year	Spatial Unit	Subsector	D
Electricity Demands	TWh	2015	SubBasin1	Coal	
Electricity Demands	TWh	2015	SubBasin2	Coal	
Electricity Demands	TWh	2015	SubBasin3	Coal	
Electricity Demands	TWh	2015	SubBasin4	Coal	
Electricity Demands	TWh	2015	SubBasin5	Coal	
Electricity Demands	TWh	2015	SubBasin6	Coal	

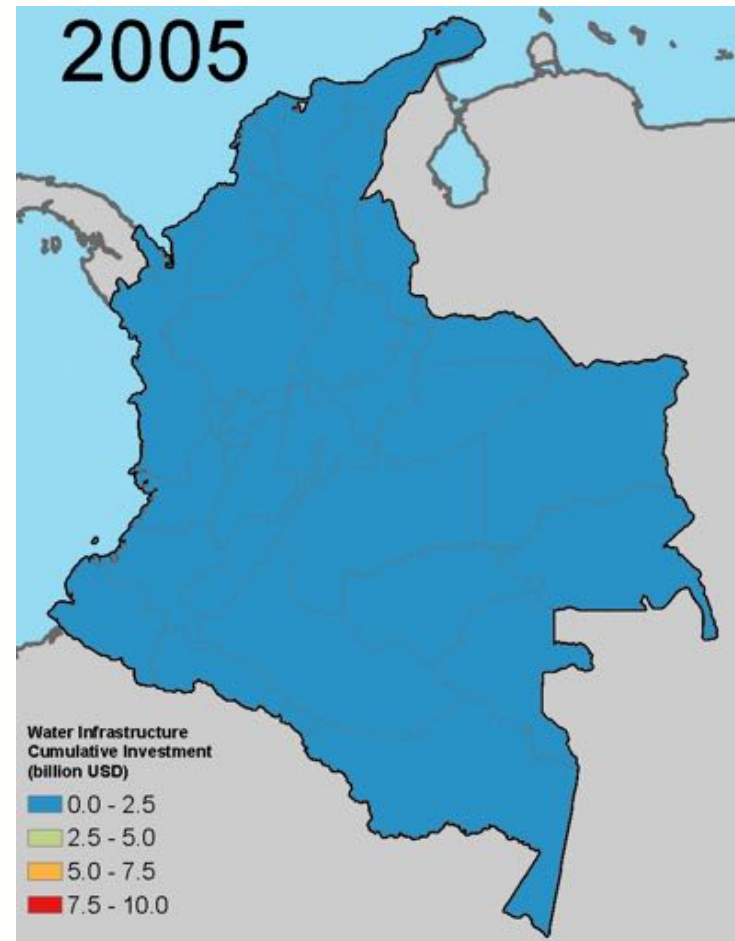
Sector	Units	Year	Spatial Unit	Subsector	D
Electricity Demands	TWh	2015	SubBasin1	Oil	
Electricity Demands	TWh	2015	SubBasin2	Oil	
Electricity Demands	TWh	2015	SubBasin3	Oil	
Electricity Demands	TWh	2015	SubBasin4	Oil	
Electricity Demands	TWh	2015	SubBasin5	Oil	
Electricity Demands	TWh	2015	SubBasin6	Oil	

Toward Infrastructure Investment Needs

Supply-Demand “Gaps”



...imply infrastructure needs



Conclusions

- Integrated sub-regional FEW modeling advances can improve joint institutional planning across sectors, at regional scales, and in the context of national and international efforts, such as emissions reduction efforts and sustainable development goals.
- Trans-scale, multi-model, multi-sector toolkit still under development, but currently being evaluated in Colombia, Uruguay, and Argentina.

Thanks! Questions?

Contact: twild@umd.edu