

# The WEF Nexus in LAC

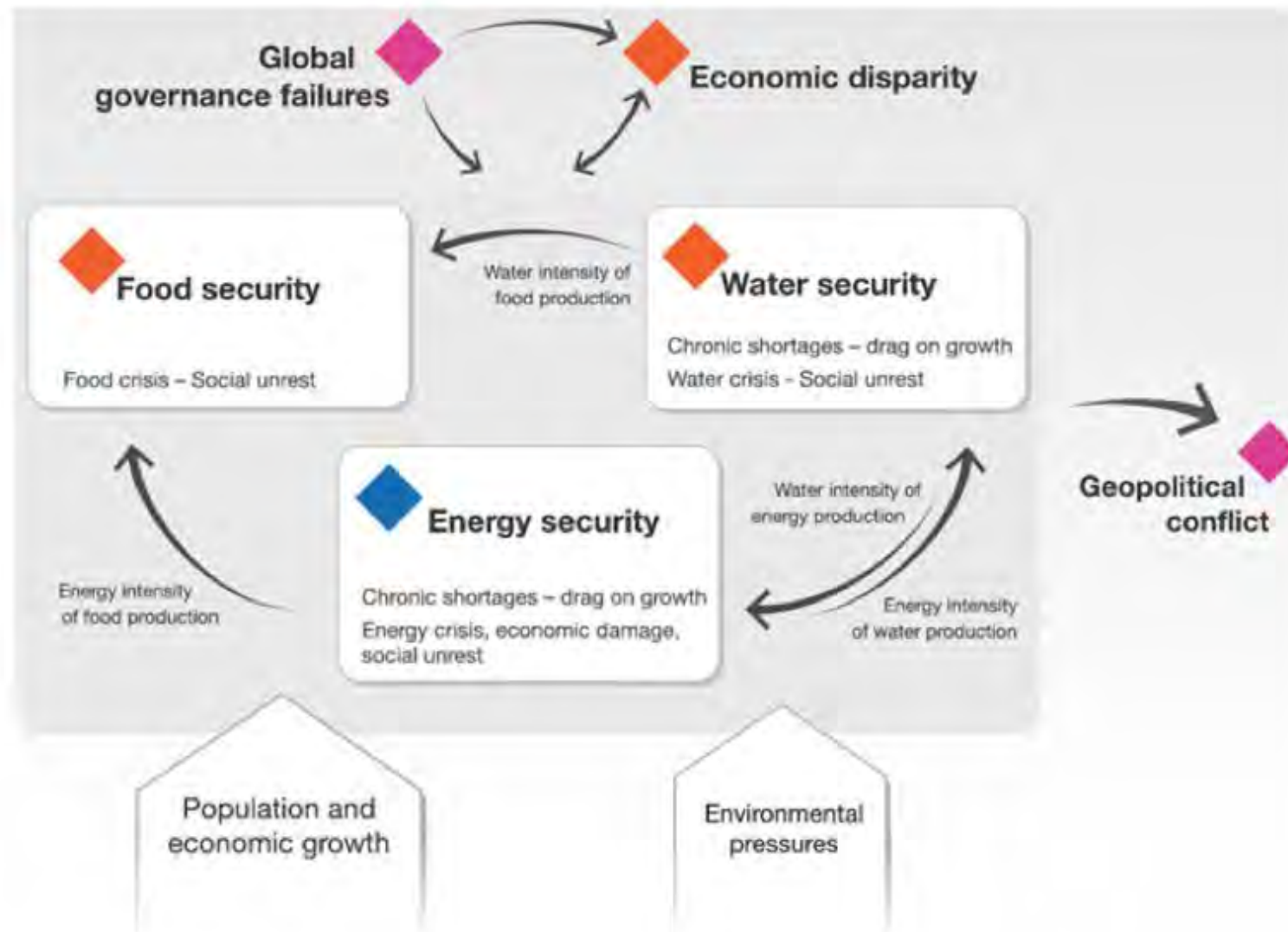
WSA Water Week, Panama, May 2017

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INE/WSA

# Que es el Nexo?

?



?

# Si, pero ....que es el Nexo?



# entonces,.....que significa esto del Nexo?



# U.S. Drought Monitor California

**April 7, 2015**

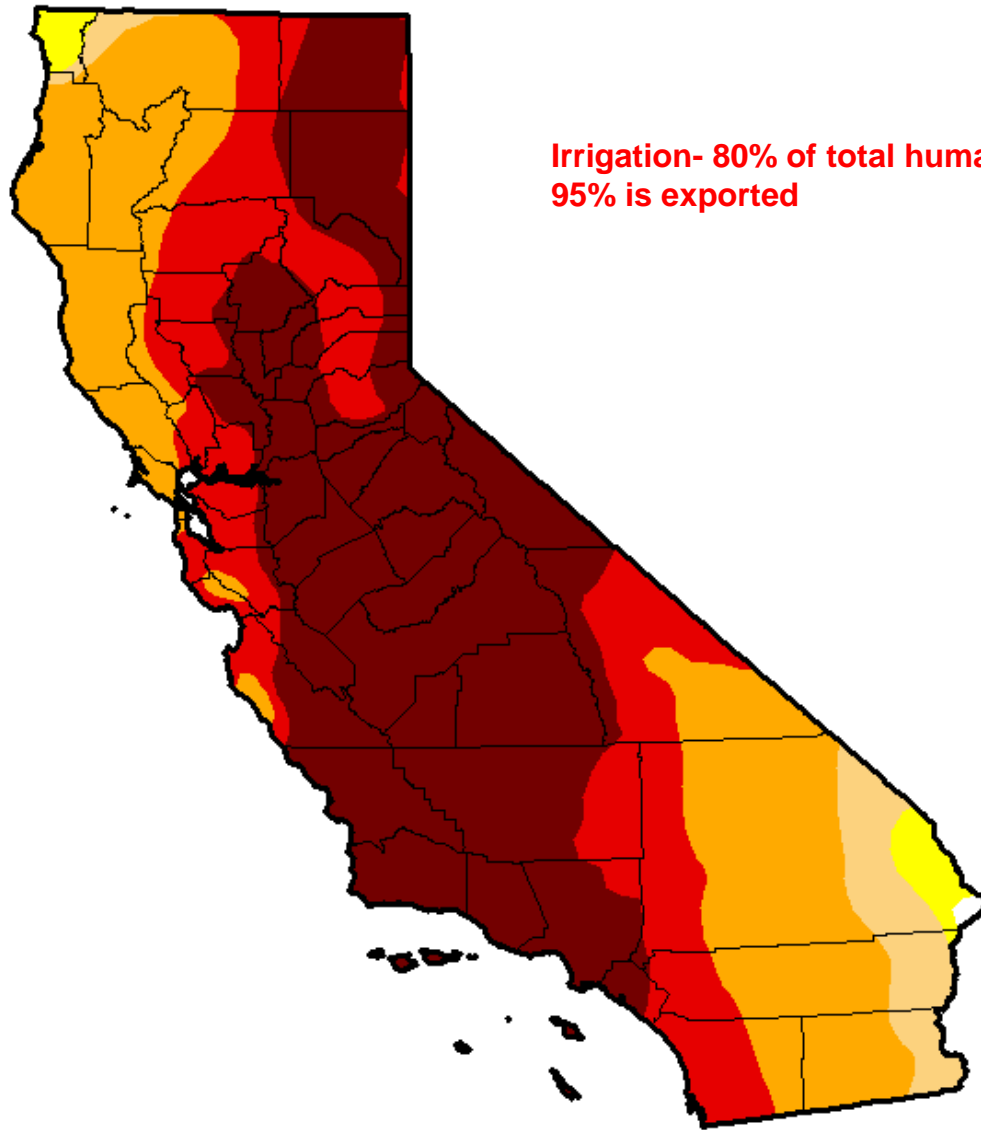
(Released Thursday, Apr. 9, 2015)

Valid 7 a.m. EST

*Drought Conditions (Percent Area)*

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	0.15	99.85	98.11	93.44	66.60	44.32
<b>Last Week</b> 3/31/2015	0.15	99.85	98.11	93.44	66.60	41.41
<b>3 Months Ago</b> 1/8/2015	0.00	100.00	98.12	94.34	77.94	32.21
<b>Start of Calendar Year</b> 12/31/2014	0.00	100.00	98.12	94.34	77.94	32.21
<b>Start of Water Year</b> 9/30/2014	0.00	100.00	100.00	95.04	81.92	58.41
<b>One Year Ago</b> 4/8/2014	0.00	100.00	99.81	95.21	68.76	23.49

**Irrigation- 80% of total human use  
95% is exported**



## Intensity:



*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.*

## **Author:**

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NCDC/NOAA



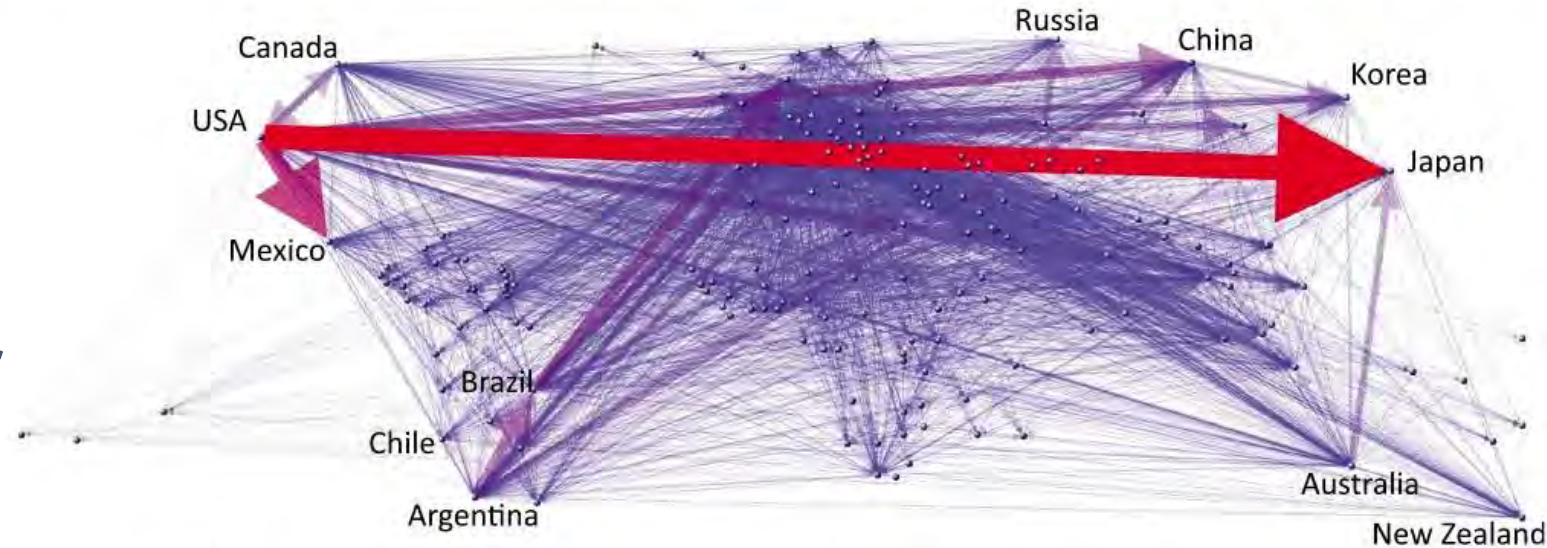
<http://droughtmonitor.unl.edu/>

# A GLOBAL MARKET: The “Virtual Water” Network

W05520

KONAR ET AL.: NETWORK ANALYSIS OF GLOBAL VIRTUAL WATER

W05520



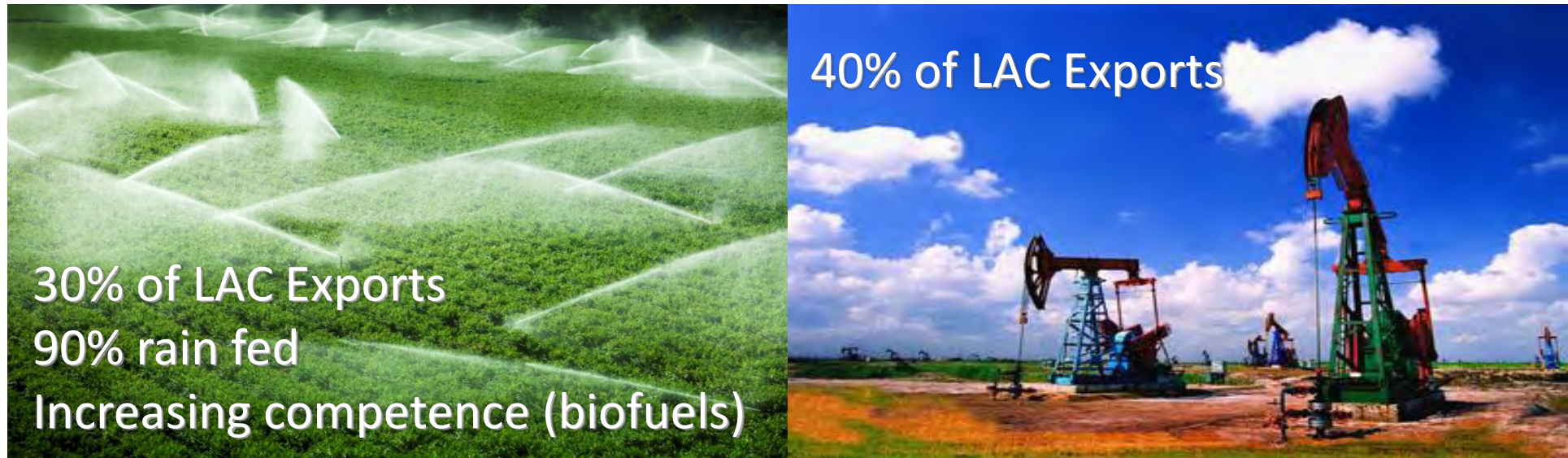
**Figure 2.** Map of the weighted and directed global virtual water trade network. Each point indicates a node, or nation, in the network. Bilateral trade between countries is displayed by a line between points, with an arrow indicating the direction of trade. The color and width of each line is scaled on the basis of the weight of the link it is representing. In this network, there are 166 nations that import, 151 nations that export, and 6033 links. Note that the export of virtual water from the United States to Japan is the largest link in the network, with a volume of  $29.2 \times 10^9 \text{ m}^3 \text{ yr}^{-1}$ , which accounts for approximately 5% of the entire volume in the network. The second largest link is that from the United States to Mexico, with a virtual water trade volume of  $20.2 \times 10^9 \text{ m}^3 \text{ yr}^{-1}$ , or approximately 3% of the flow volume.

8 B people by  
2030:  
45 % more water  
required

In an interconnected world, water is no longer a local problem only

# The importance of Nexus for LAC

Competitive **advantage** based on natural endowments: water, agriculture, and energy/minerals



# Nexus in LAC

Regional **demand for water, energy, and food** is expected to **grow exponentially** as income per capita and population rise

LAC water withdrawal for energy production:

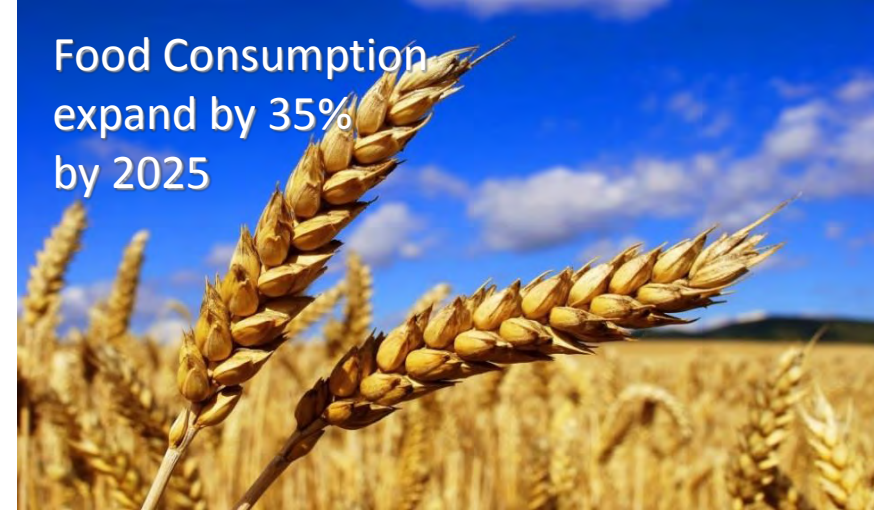
- 16 billion cubic meters in 2010
- 52 billion cubic meters in 2035

Largest & 7 times world average growth

Water Consumption  
expand by 35% by 2025



Food Consumption  
expand by 35%  
by 2025



Energy Consumption  
expand by 55% by 2025

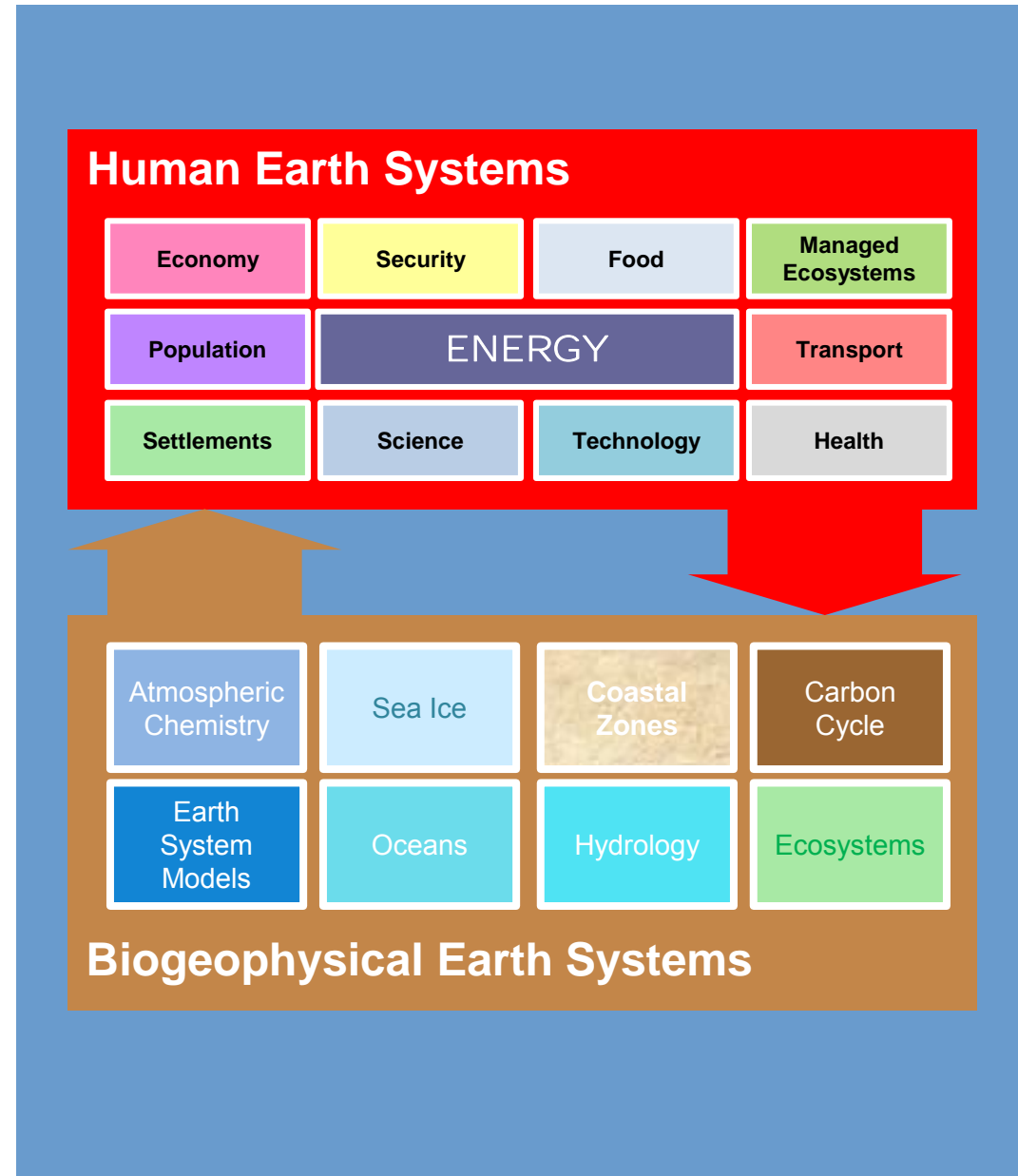


# The WEF Nexus at the IDB

- **IDB WEF Working Group** (WSA/ENE/RND/CSD)
- Sample **products** from such a team
  - Modeling and visualization **tools**
    - IAMs (GCAM, IMAGE...)
    - MRIO, LCA,...
    - HydroBID/SWAP+GAMS
  - Constant development of tailored **scenarios** for water, food, and energy
  - **Synergies and support** to other flagship initiatives, e.g., ESCI, Extractives, Biodiversity
- From multiple booking to **Integrated Portfolio of Lending** (Multisectoral Approach to Countries)

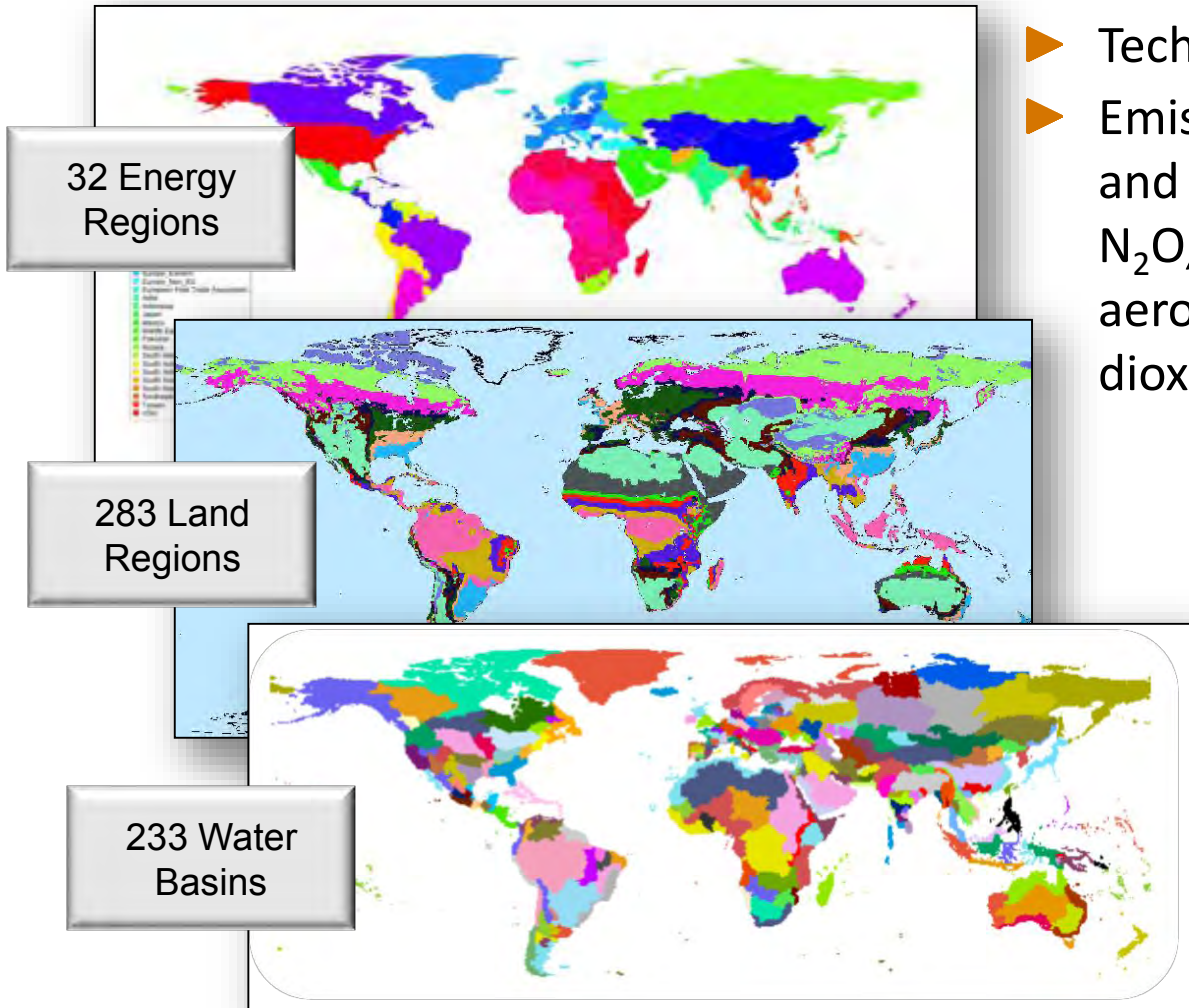
# Integrated Assessment Models (IAMs)

- IAMs integrate human and Earth system science.
- IAMs provide insights that would be otherwise unavailable from disciplinary research.
- IAMs capture interactions between complex and highly nonlinear systems.
- IAMs provide important, science-based decision support tools.
- IAMs support national, international, regional, and private-sector decisions.



# The Global Change Assessment (GCAM) Model

- ▶ GCAM is a global integrated assessment model
- ▶ GCAM links Economic, Energy, Land-use, Water, and Climate systems

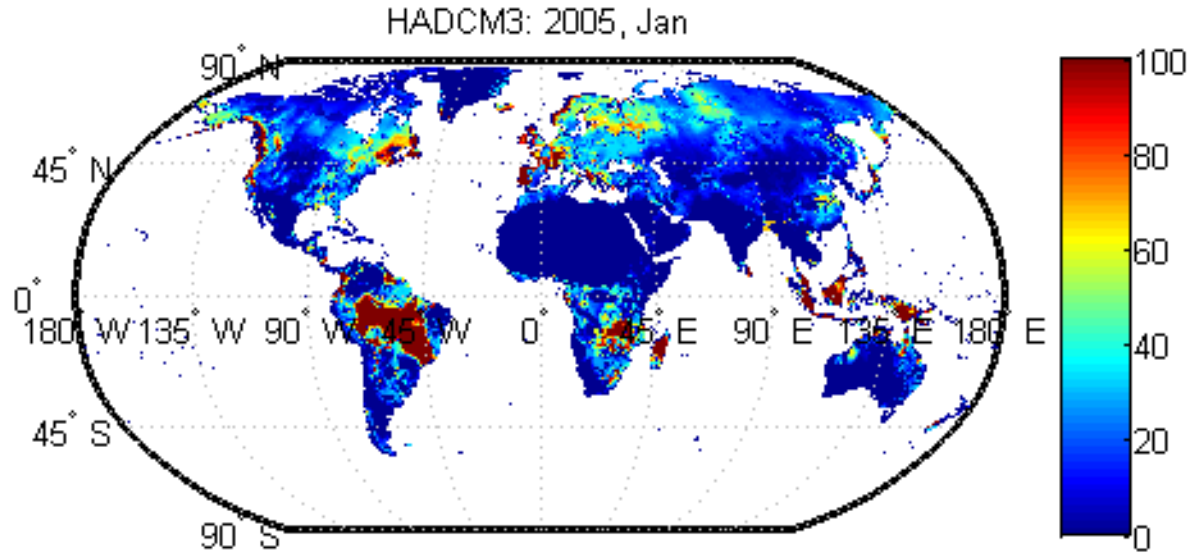


- ▶ Technology-rich model
- ▶ Emissions of 16 greenhouse gases and short-lived species: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, halocarbons, carbonaceous aerosols, reactive gases, sulfur dioxide.
- ▶ Runs in 1-year time-steps, working on subyearly (seasonally).
- ▶ GCAM has participated in virtually every major climate/energy/economics assessment over the last 20 years

# The GCAM Global Hydrologic Model



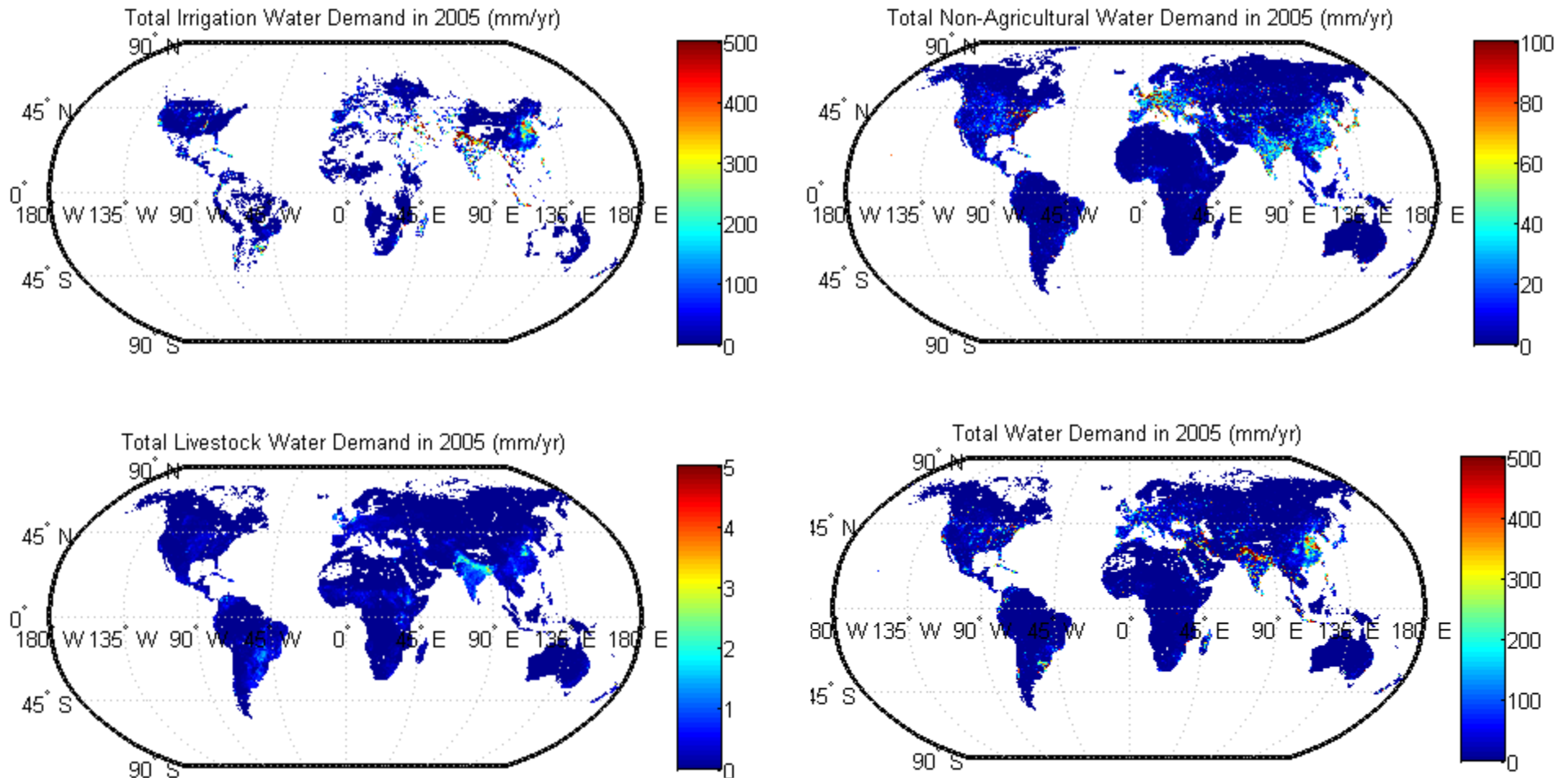
- ▶ GCAM has a global hydrologic model
- ▶ Modified River Transport Model scheme
- ▶ Simulates runoff and streamflow (1901-2100)
- ▶ Requires climate information from GCMs as inputs
- ▶ 233 basins globally
- ▶ 18 basins in the US consistent with the USGS WRRs
- ▶ Monthly temporal scale
- ▶ 0.5x0.5 degree spatial resolution



GCAM also accounts for non-renewable water sources such as fossil groundwater and desalinated water

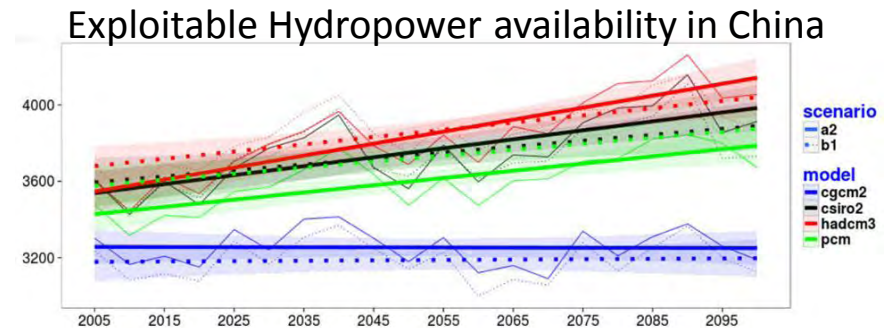
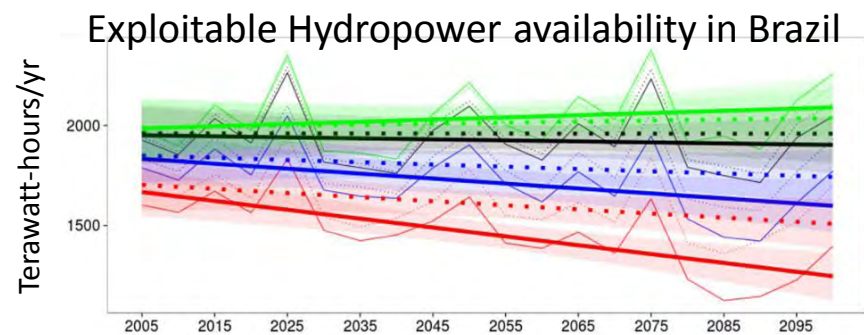
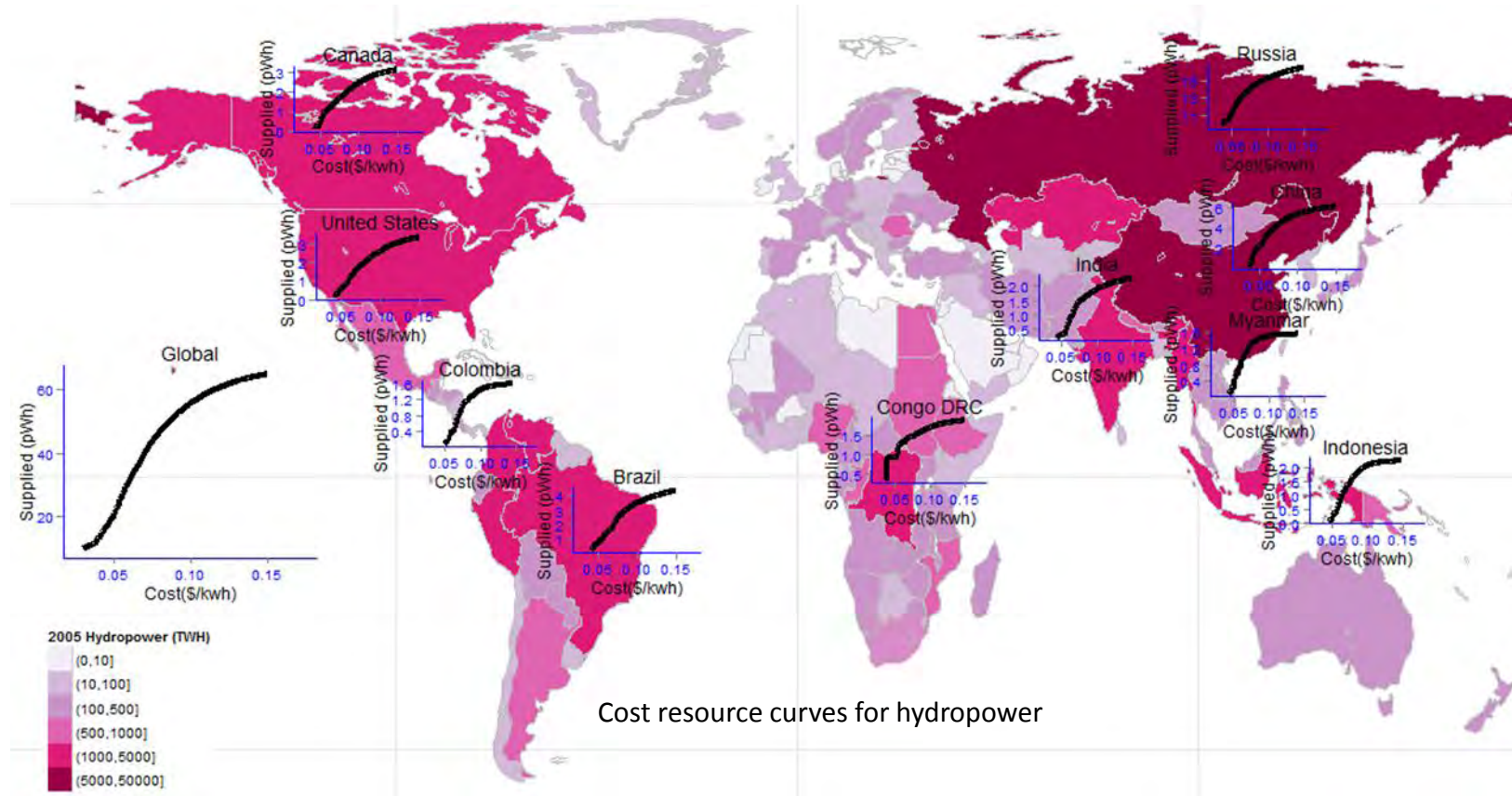
# Projecting water demands into the future

Gridded water demands can be generated by sector

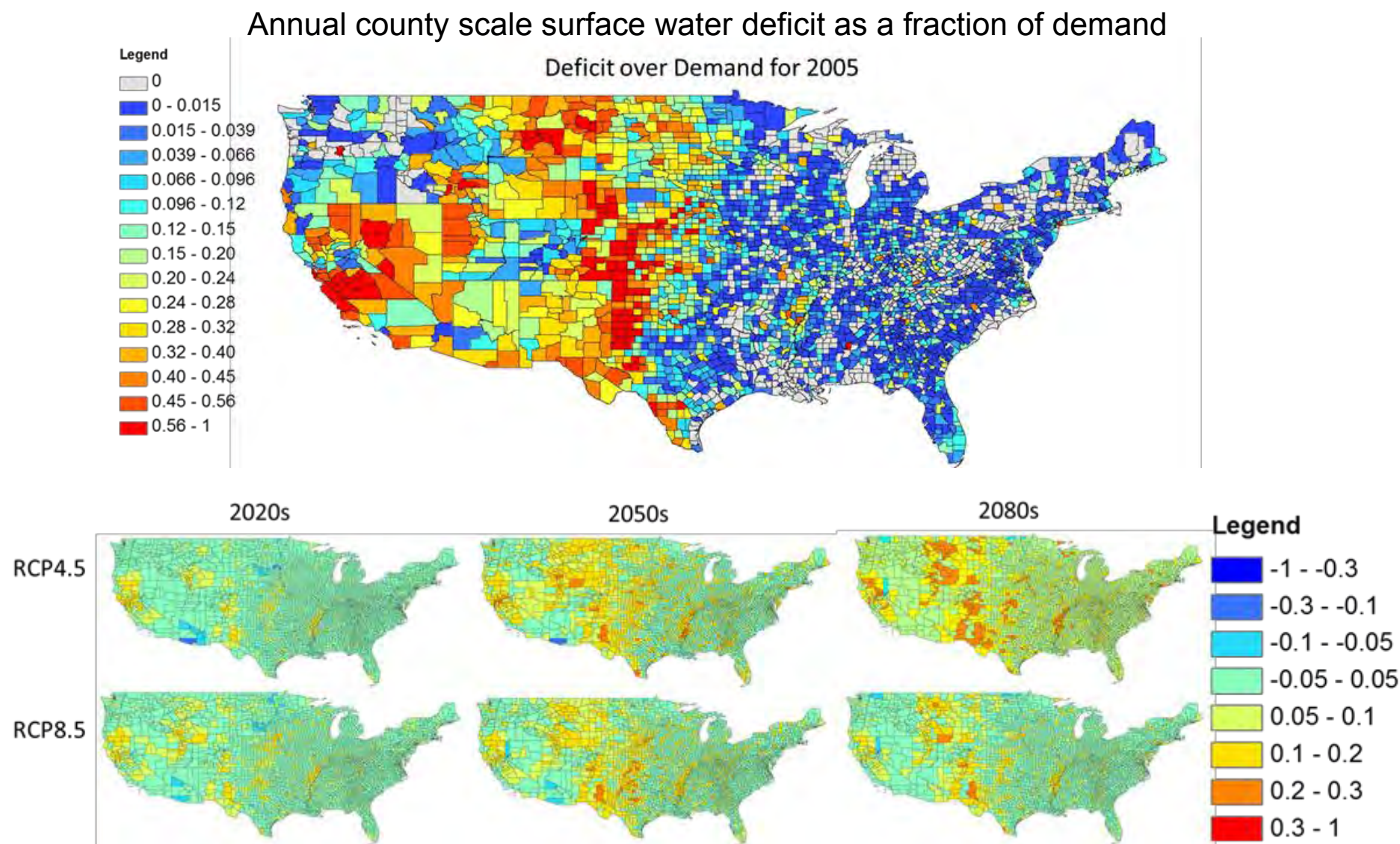


Hejazi et al. (2014). Integrated assessment of global water scarcity over the 21st century under multiple climate change mitigation policies, *Hydrology and Earth System Sciences*, 18, 2859-2883, doi:10.5194/hess-18-2859-2014

# The impact of climate change on hydropower availability in Brazil and China



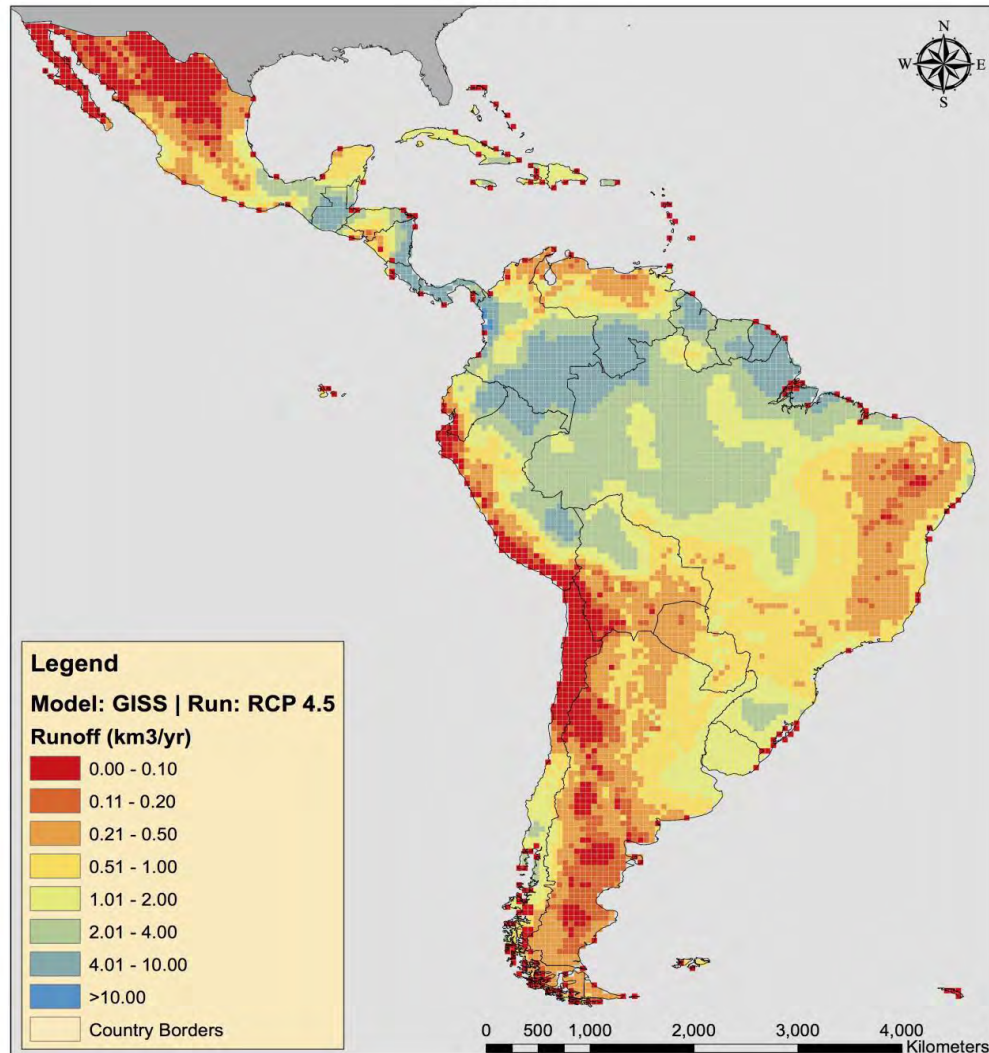
# In the USA, water deficit is projected to increase more with climate change mitigation that favors biomass



# ESW 2016: Regional Water Scarcity

Annual Runoff (km<sup>3</sup>/yr) for  
the Latin America and Caribbean (LAC) Region

2015



Values of Demand (D) and gap between Supply (S) and Demand in the LAC Region for the Period 2015-2100; Scenario SSP2

AGRICULTURAL WATER DEMAND						
		D (km <sup>3</sup> )	D (km <sup>3</sup> )	D (km <sup>3</sup> )	D (km <sup>3</sup> )	Total Change
ISO	COUNTRY	2015	2025	2050	2100	2015-2100
ARG	Argentina	15.68	18.12	22.04	23.48	50%
BLZ	Belize	0.04	0.04	0.06	0.08	106%
BOL	Bolivia	2.86	3.78	5.28	6.40	124%
BRA	Brazil	31.70	37.38	43.78	42.89	35%

ENERGY WATER DEMAND						
		D (km <sup>3</sup> )	D (km <sup>3</sup> )	D (km <sup>3</sup> )	D (km <sup>3</sup> )	Total Change
ISO	COUNTRY	2015	2025	2050	2100	2015-2100
ARG	Argentina	2.53	2.92	3.55	3.79	50%
BLZ	Belize	0.01	0.01	0.02	0.02	106%
BOL	Bolivia	0.06	0.08	0.11	0.13	124%
BRA	Brazil	10.14	11.96	14.00	13.72	35%

WSS WATER DEMAND						
		D (km <sup>3</sup> )	D (km <sup>3</sup> )	D (km <sup>3</sup> )	D (km <sup>3</sup> )	Total Change
ISO	COUNTRY	2015	2025	2050	2100	2015-2100
ARG	Argentina	3.44	3.97	4.83	5.15	50%
BLZ	Belize	0.01	0.01	0.01	0.01	106%
BOL	Bolivia	0.21	0.27	0.38	0.46	124%
BRA	Brazil	16.23	19.14	22.42	21.96	35%

# FEW 2017-2018: Casos de Estudio- Candidatos

- Uruguay
  - Nueva Agencia de CC – TC de CCs
  - Agricultura
- Sao Paulo- Brasil
  - Crisis de agua 2015: Competencia Sectorial-Espacial (SP-RJ)
  - TC WSA- Secretaria Agua-Energia- SABESP
  - Colaboracion ENE
- Peru
  - Cuencas vertiente Pacifico: Desafios seguridad hidrica y planes de inversion sectoriales
  - ANA: Planes de Cuenca- HydroBID
  - Agricultura

# What is next?: Downscaling capabilities

- Central America**
- 33,000 catchments and stream segments
  - Average catchment area: 84 km<sup>2</sup>
  - Average stream segment length: 10 km

- South America**
- 193,000 catchments and stream segments
  - Average catchment area: 92 km<sup>2</sup>
  - Average stream segment length: 11 km

- Caribbean**
- 3,300 catchments and stream segments
  - Average catchment area: 72 km<sup>2</sup>
  - Average stream segment length: 11 km

**It delineates more than  
230,000 basins with  
their respective river  
segments along LAC**

**HYDRO-BID**

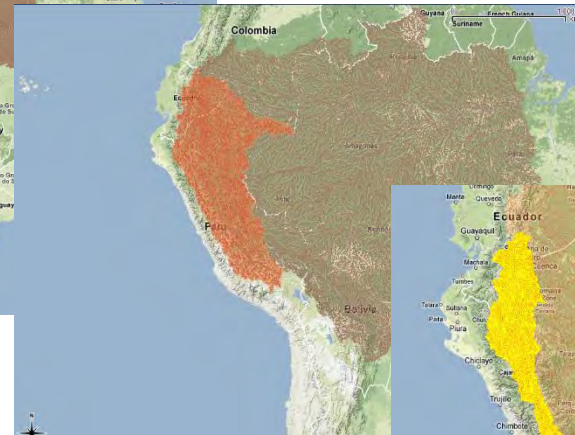


# What is next?: Downscaling capabilities

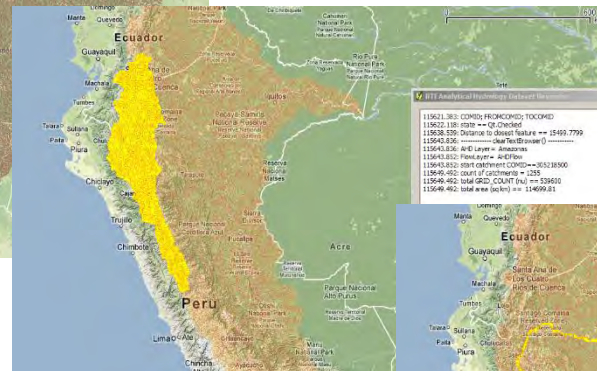
## Hydro-BID allows multiple scale water resources analysis



# Amazon Basin



## Marañón Basin

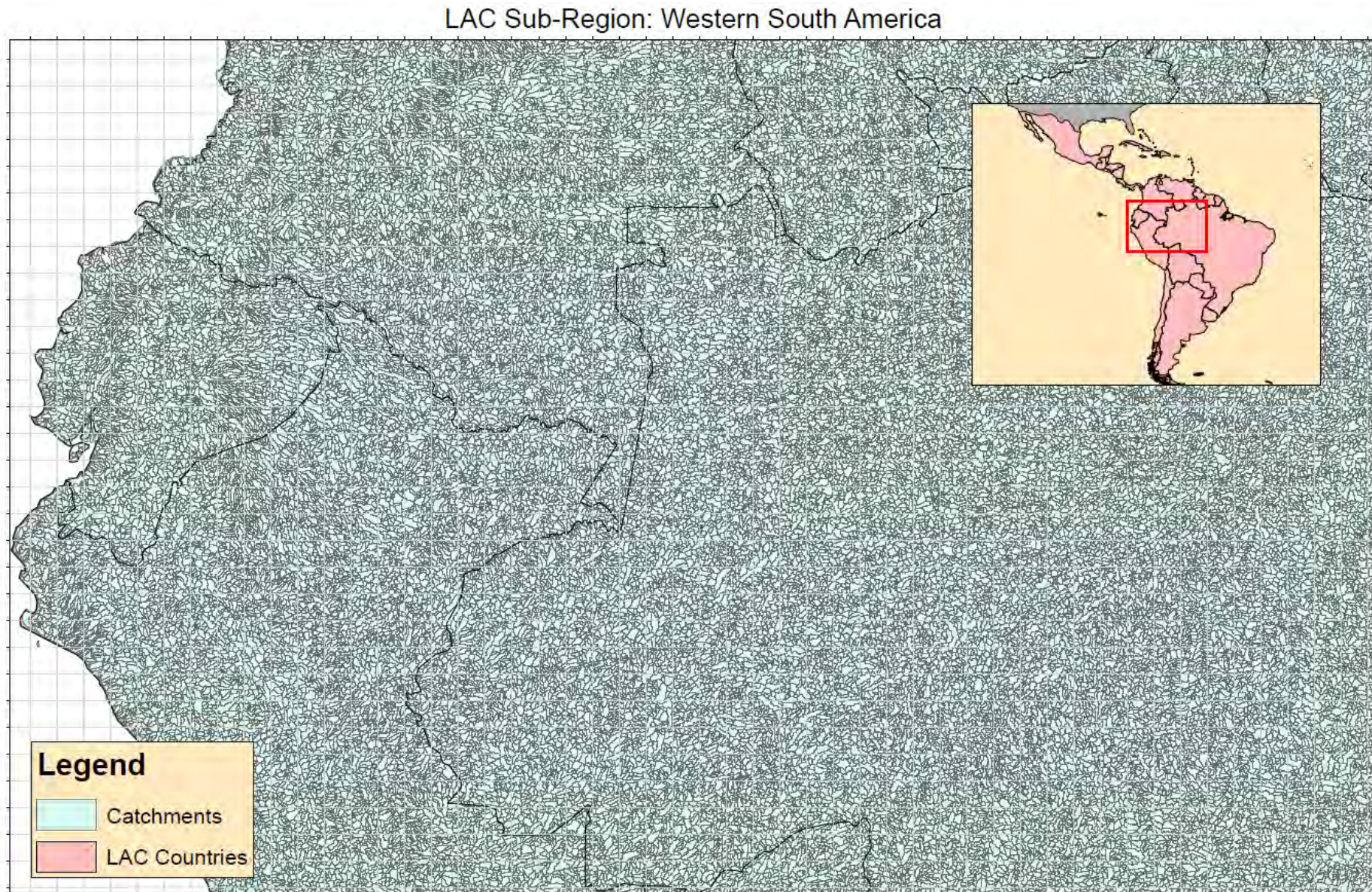


## Upstream Catchments

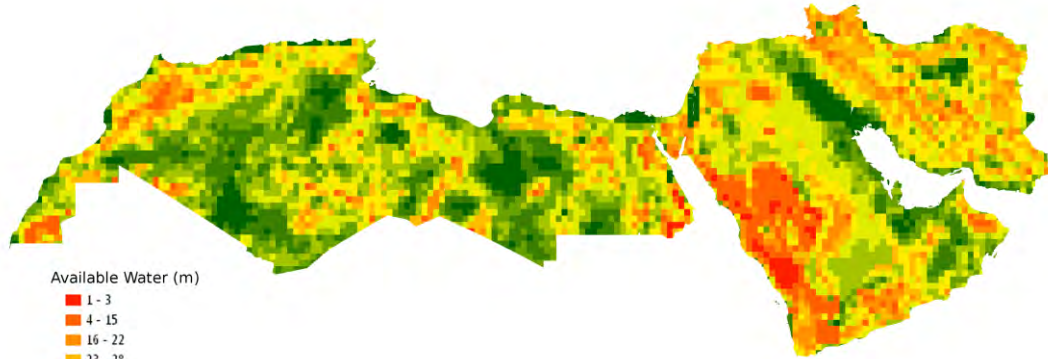


## Downstream Catchments

# What is next?: Downscaling capabilities



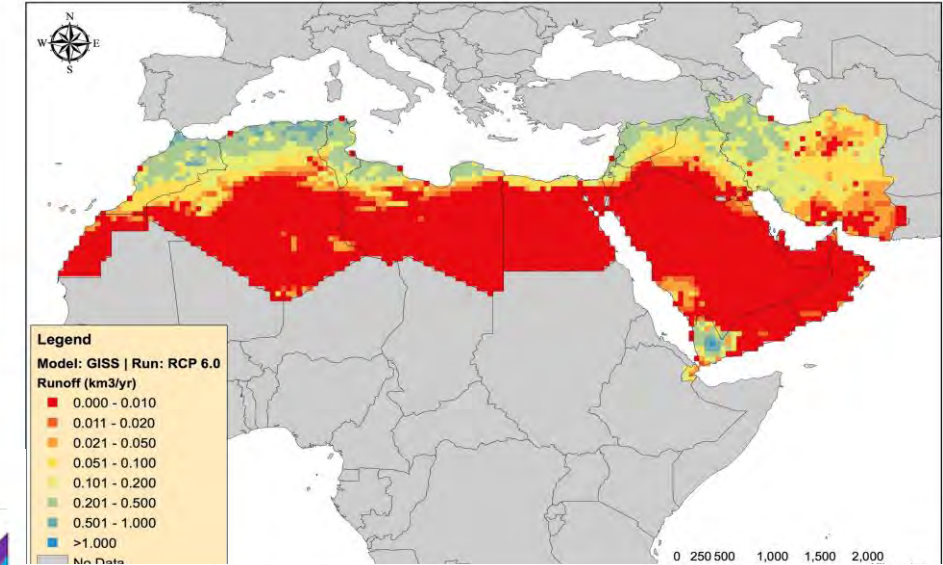
# What is next?: Groundwater



Spatial Distribution of estimated total available groundwater (depth of water column)

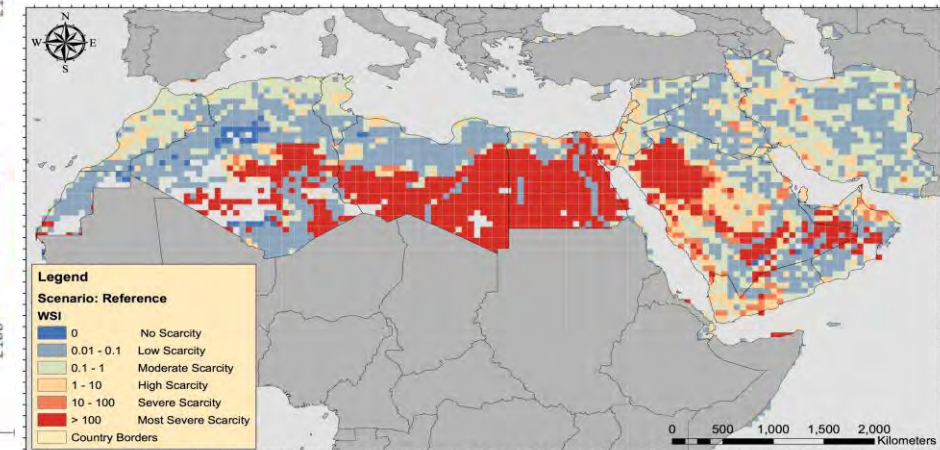


Annual Runoff (km<sup>3</sup>/yr) for Middle East and Northern Africa (MENA) Region  
2015



Water Scarcity Index (WSI) for  
the Middle East and North Africa (MENA) Region

2050



# What is next?: Dashboard

## GCAM Dashboard

### GCAM Project Data File

Browse... idb\_ndc\_climate.dat

Upload complete

### Select Scenario to Plot

Reference\_NoClimateImpacts ▼

### Select Query to Plot

Water withdrawals for electricity ▼

☒ Include  
Spatial  
Queries

☐ Plot Difference vs Another Scenario

Project Info

Map View

Time View

### Water withdrawals for electricity



0.0471 51.2 102 154 204  
km<sup>3</sup>

Year

1990

2050

2100

# GCAM Dashboard

## GCAM Project Data File

Browse... idb\_ndc\_climate.dat

Upload complete

## Select Scenario to Plot

Reference\_NoClimateImpacts

## Select Query to Plot

Water withdrawals by sector

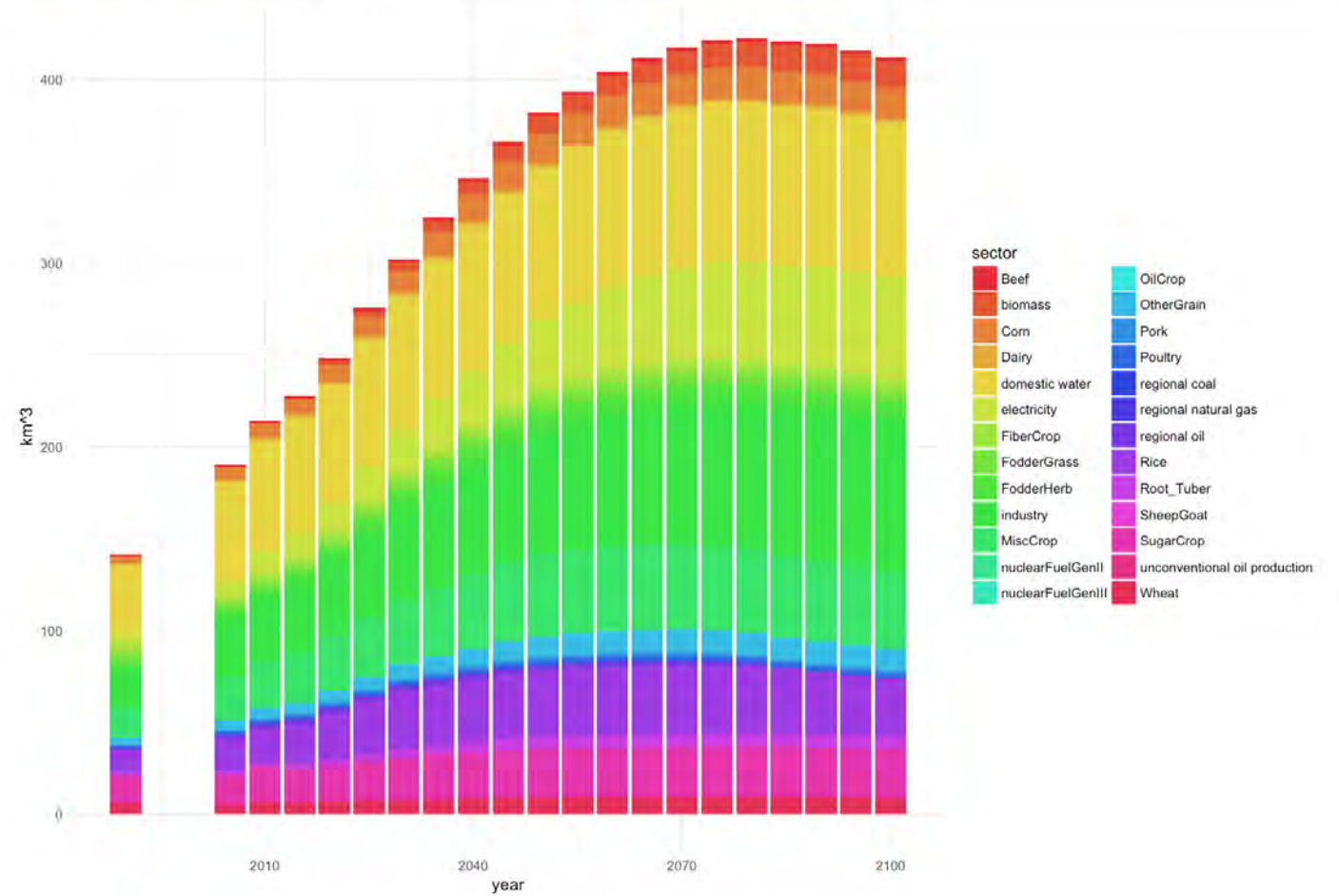
☒ Include  
Spatial  
Queries

☐ Plot Difference vs Another Scenario

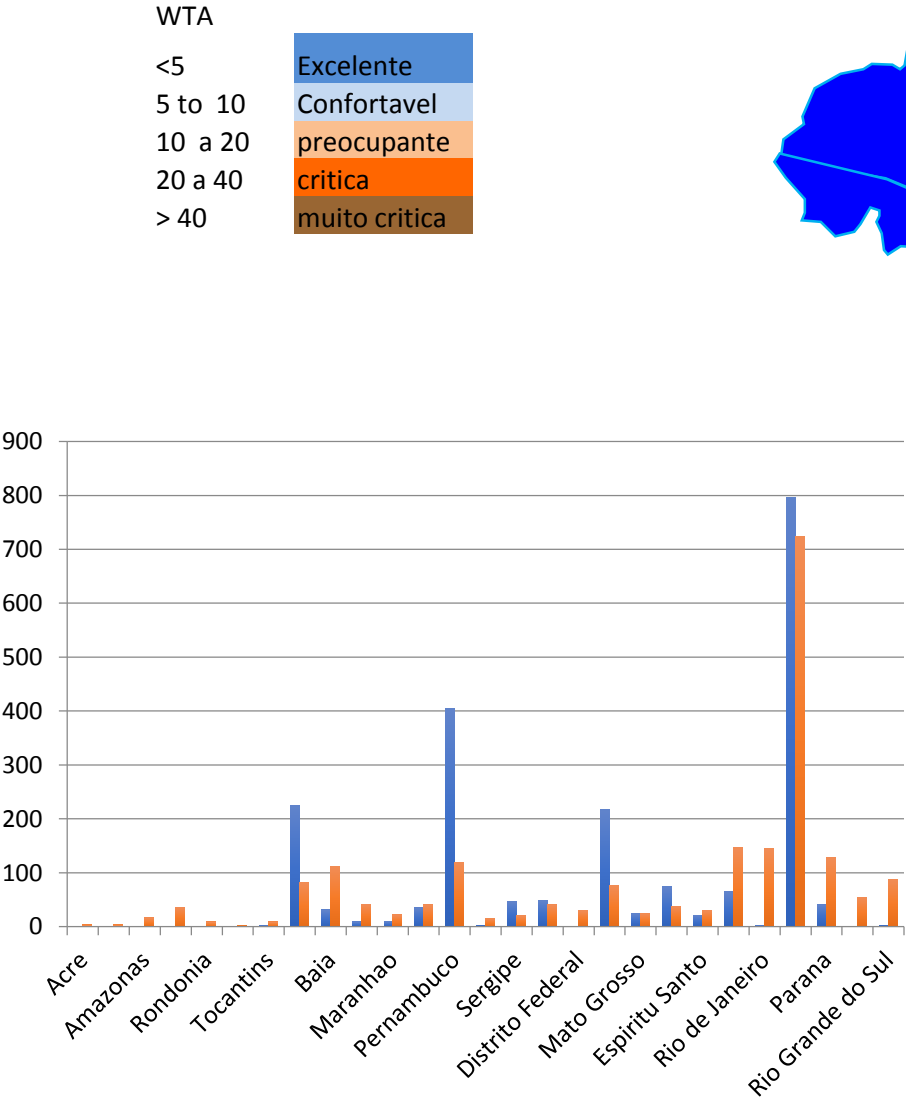
Project Info

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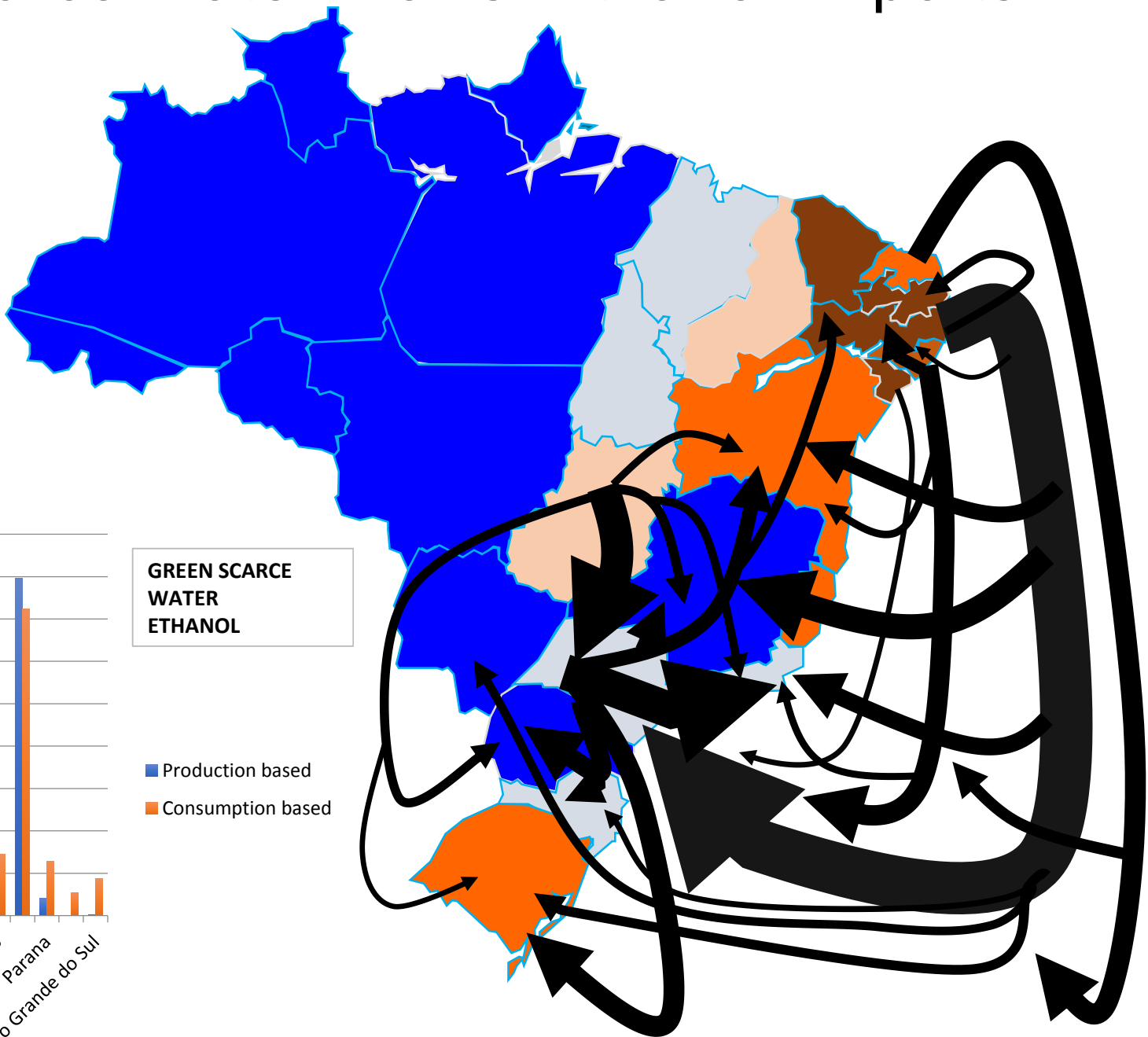


# Virtual Scarce Water Flows: Ethanol Exports



GREEN SCARCE  
WATER  
ETHANOL

■ Production based  
■ Consumption based





**IDB**

Inter-American  
Development Bank

*Gracias!*

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