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Exploring implications of global groundwater depletion with GCAM

SEAN TURNER

Joint Global Change Research Institute
Pacific Northwest National Laboratory

U.S. DEPARTMENT OF ENERGY

Developments leading to this study

GCAM water supply module

- Users specify **availability** and **extraction cost**
  - Renewable **surface water**
  - Non-renewable **ground water**
  - Desalinated **seawater**

Xanthos

Global datasets

- Renewable **surface and subsurface water**
- Non-renewable **groundwater**

Yonkofski et al.

Groundwater is abundant, but often unviable for human use

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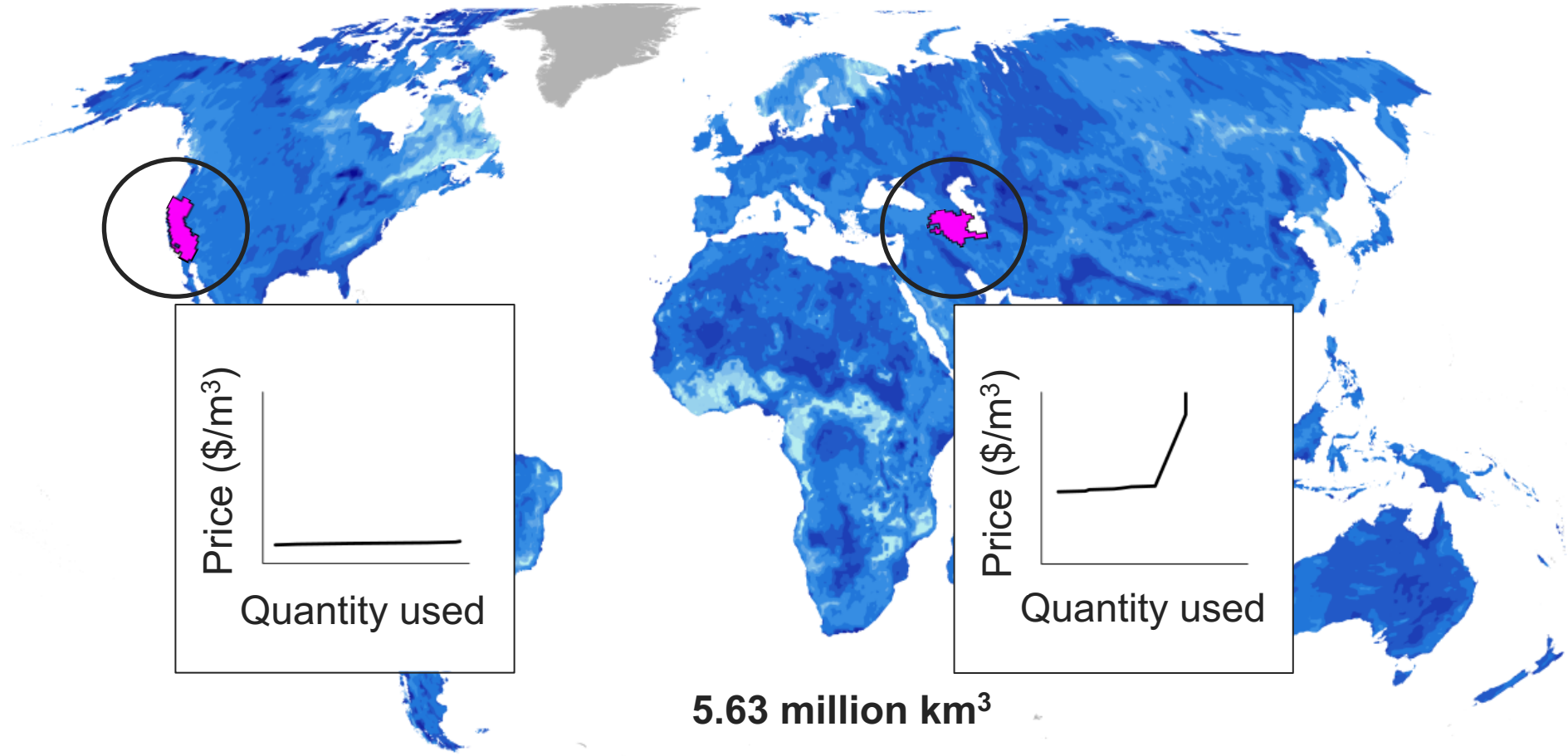

Groundwater will become exhausted in several basins *this century*

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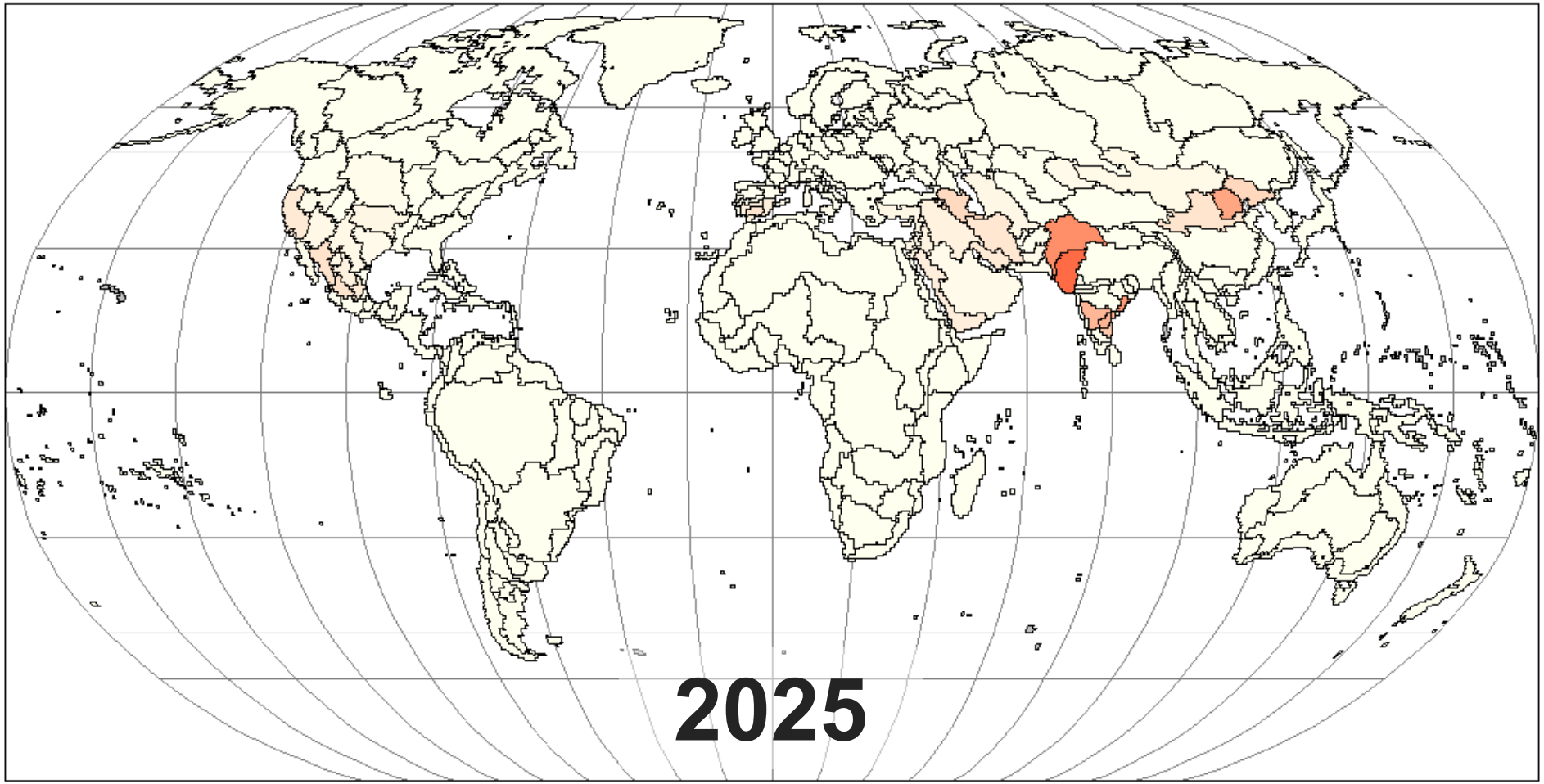

0 50 100 (% depletion from current volumes)

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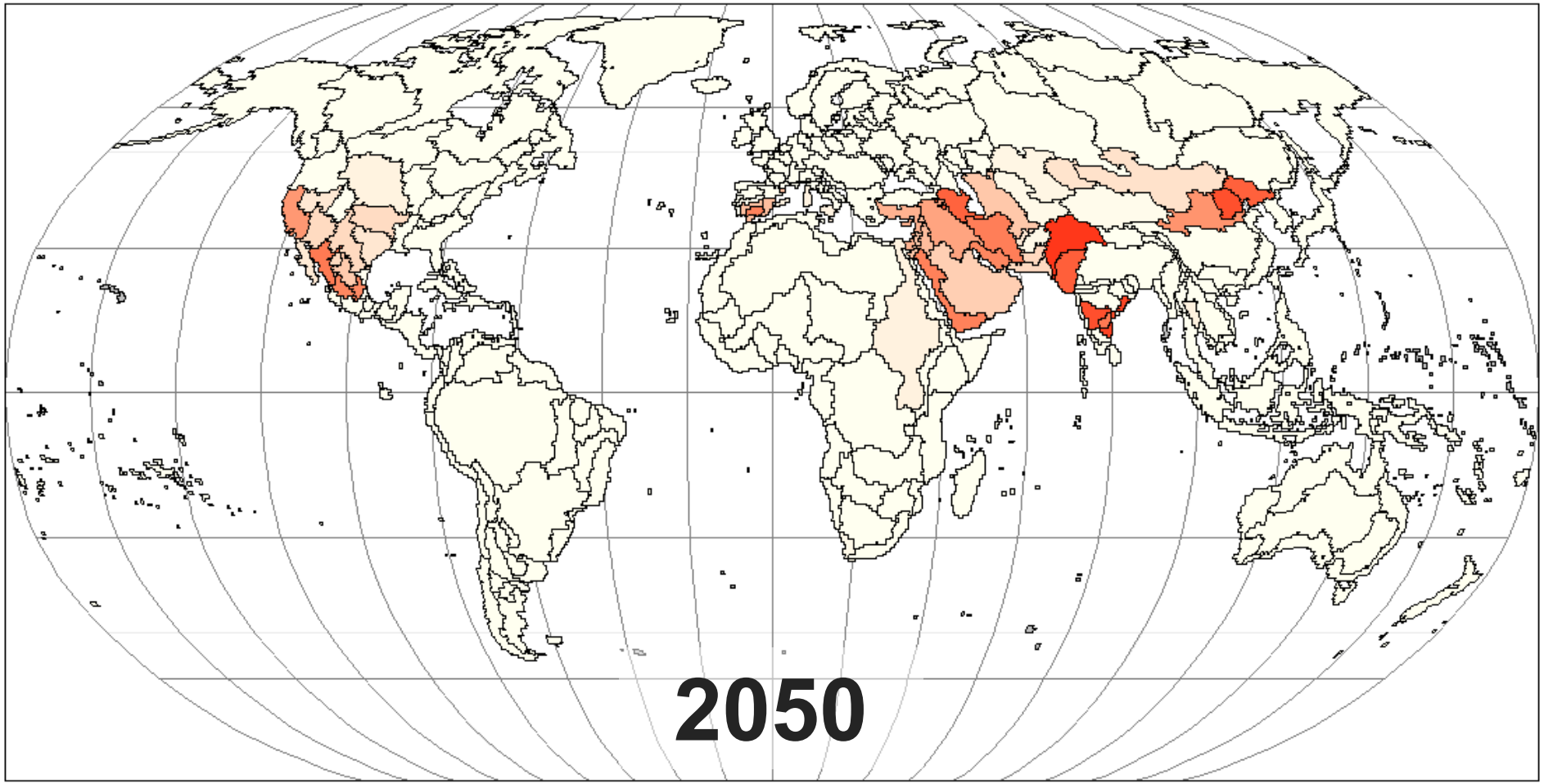

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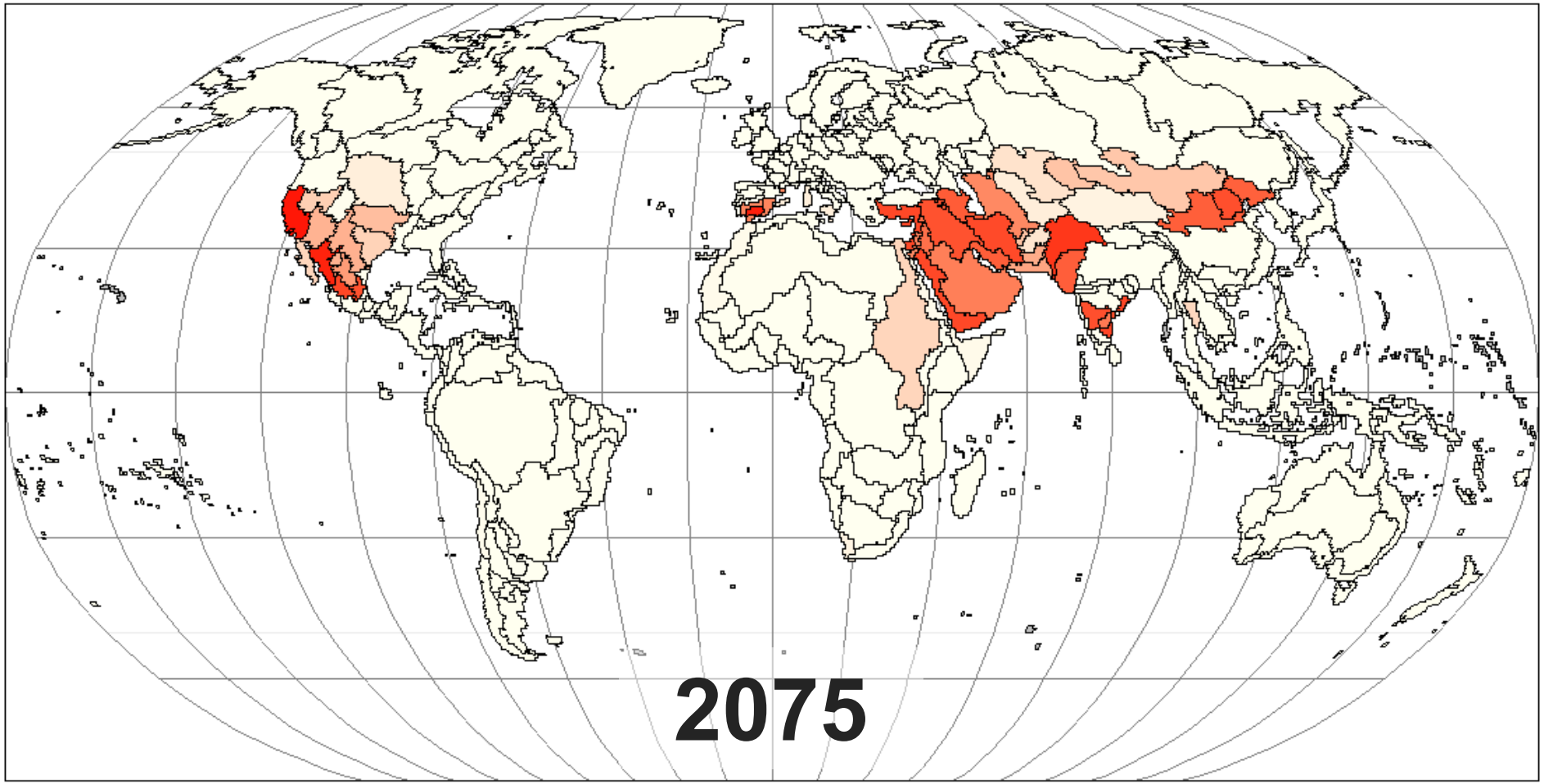

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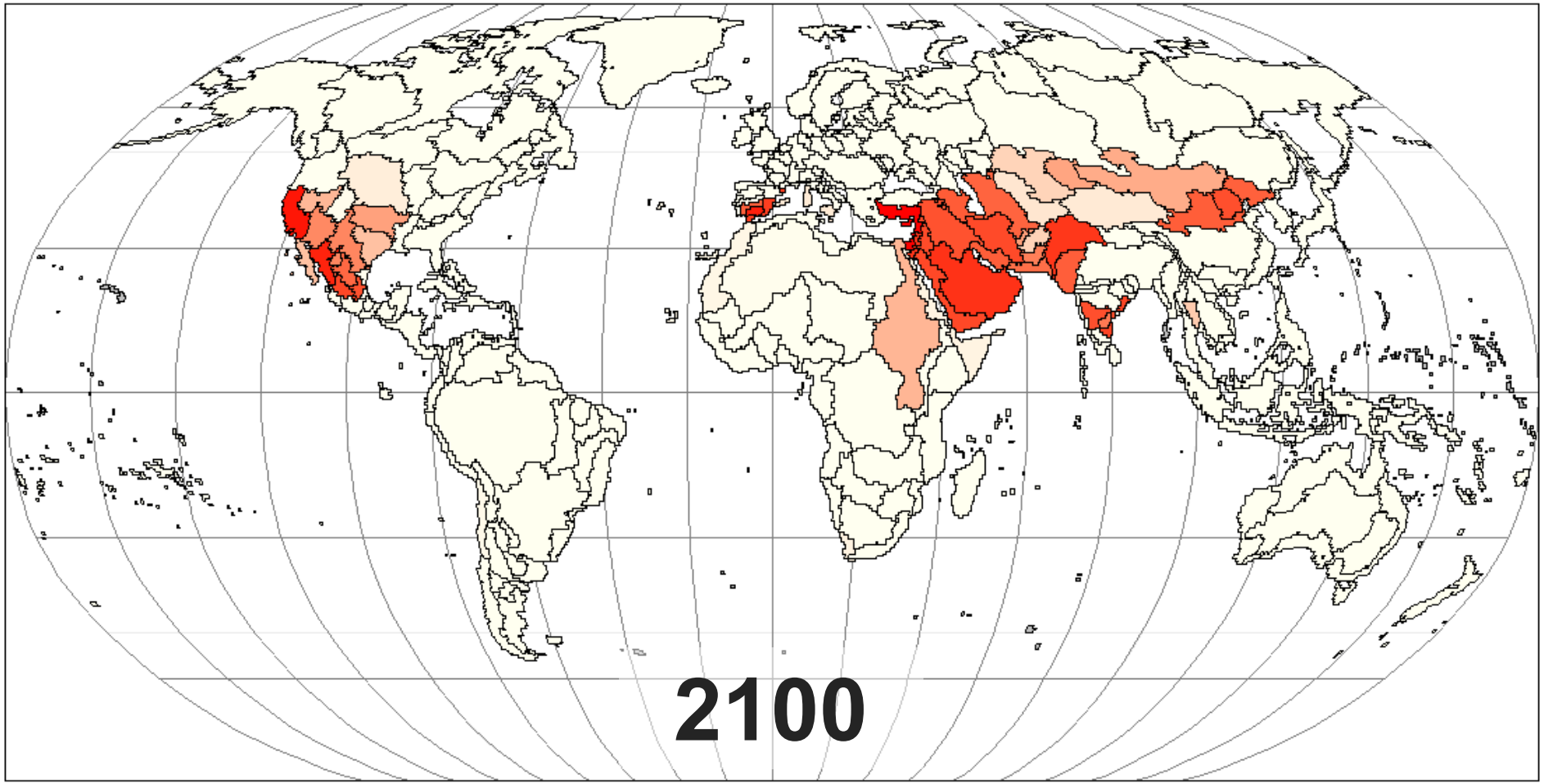

Groundwater constraints reduce total consumption and hasten peak withdrawal

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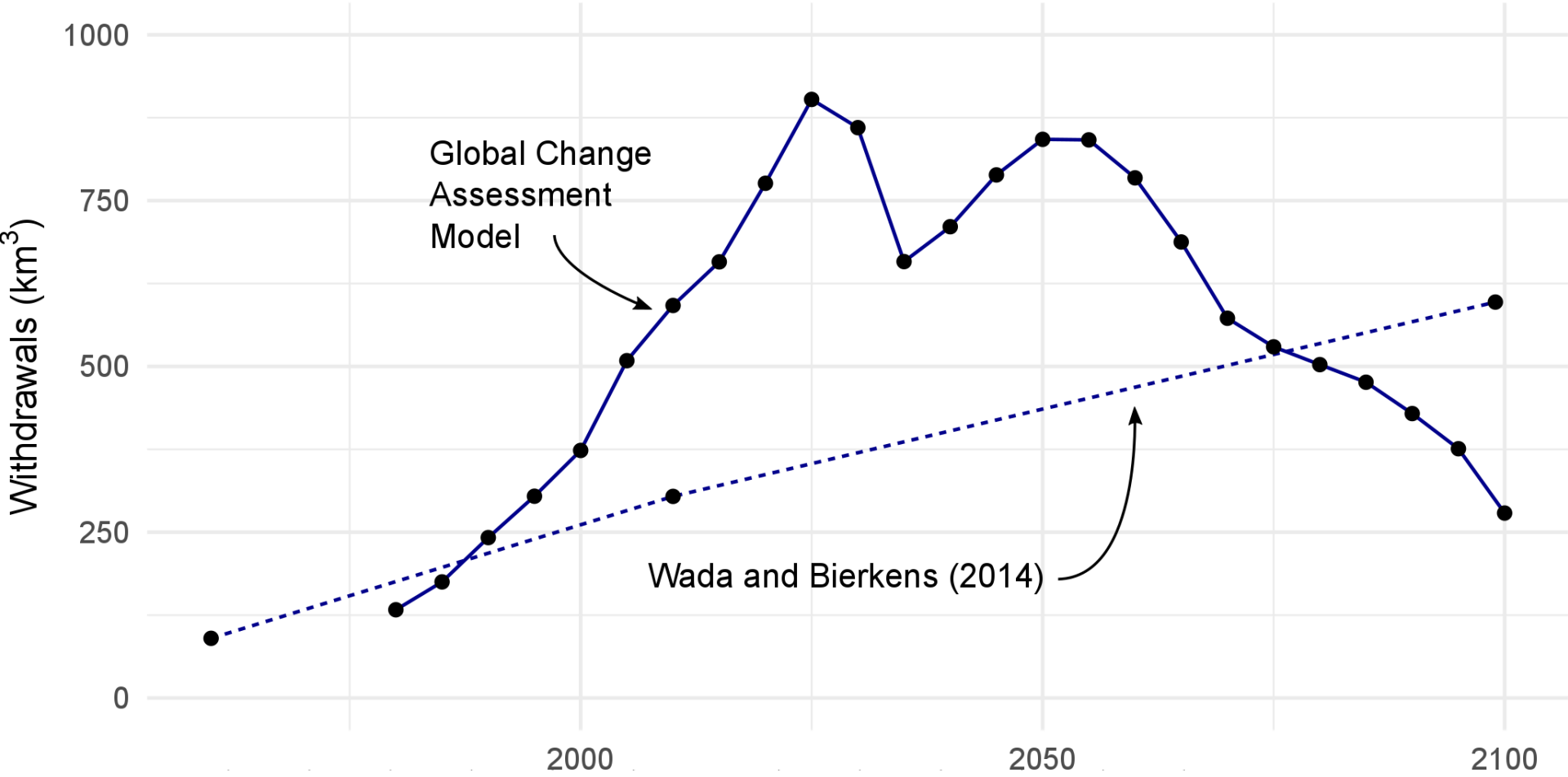

Most of the demand reduction comes from irrigated agriculture

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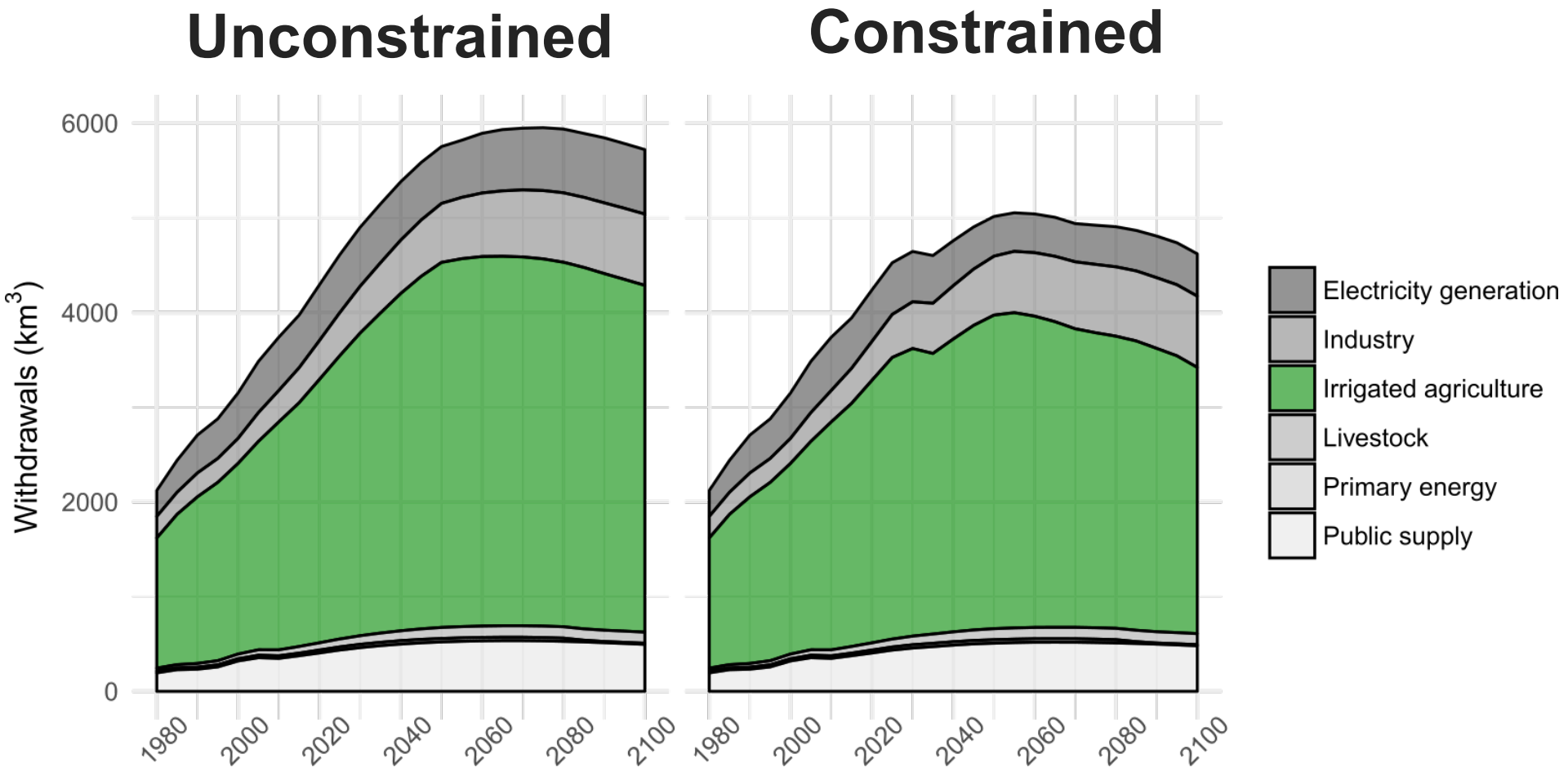
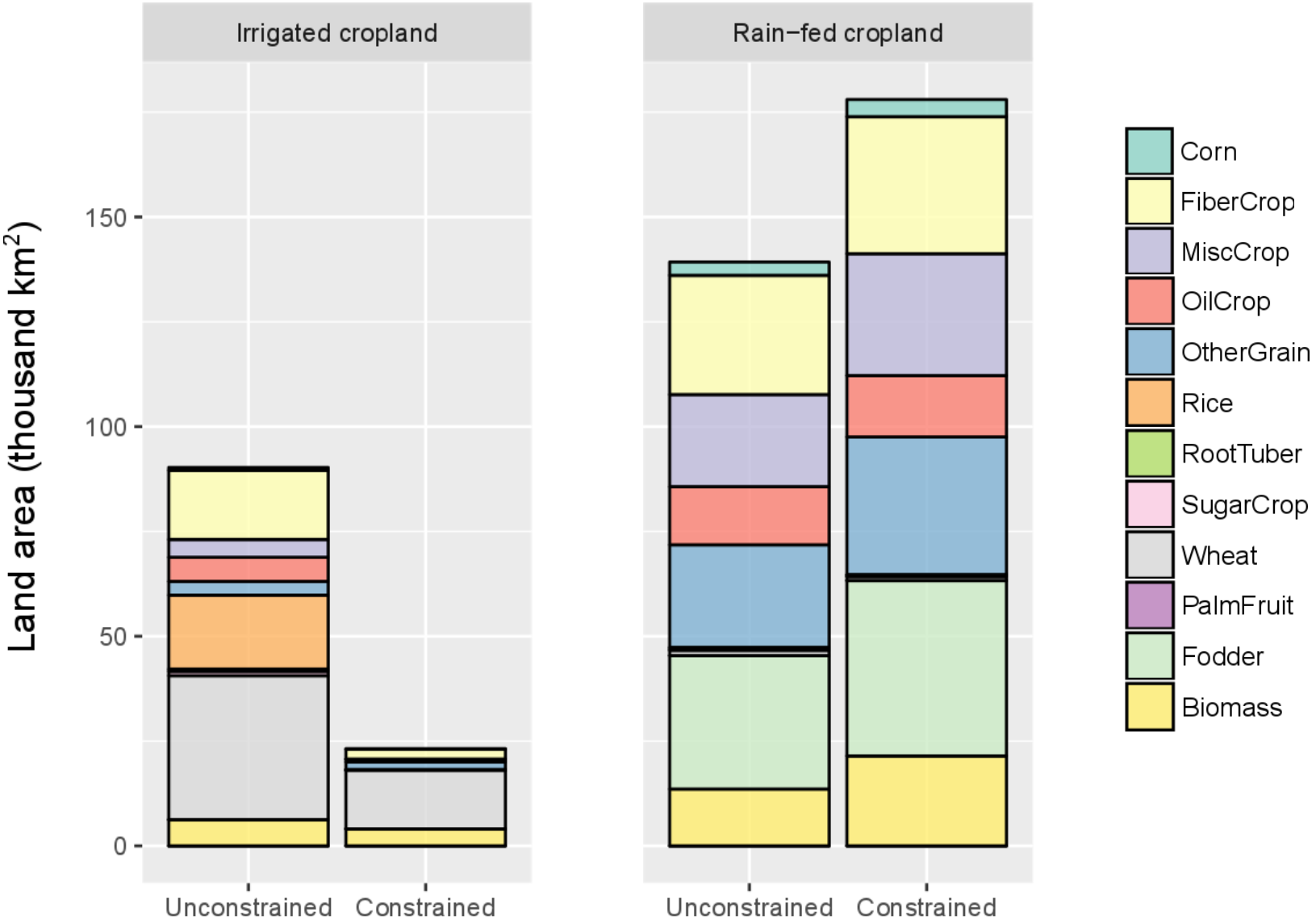


Year 2100 cropland allocation in the Sabarmati / NW India basins



Year 2100 cropland allocation in the Yangtze basin

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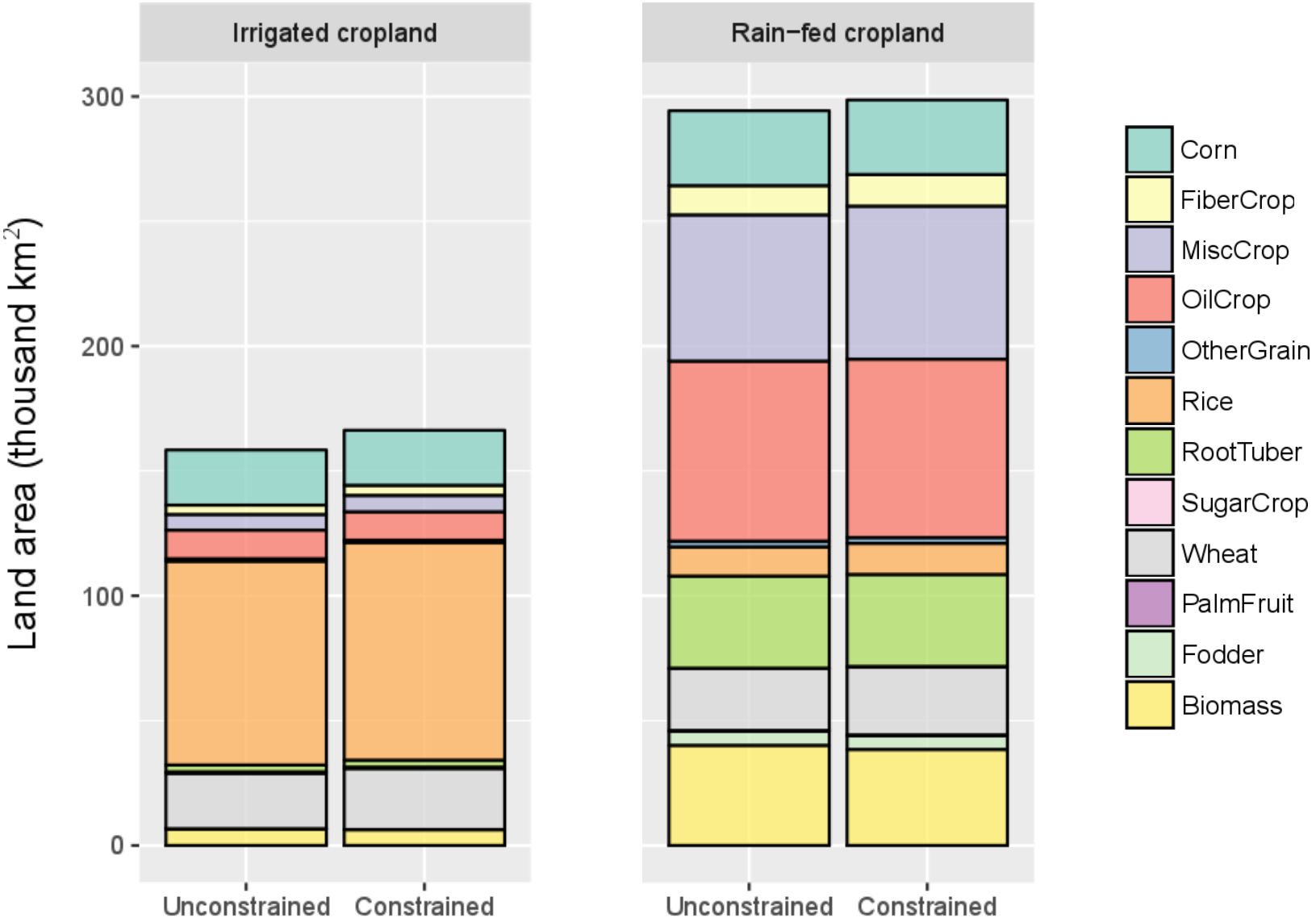
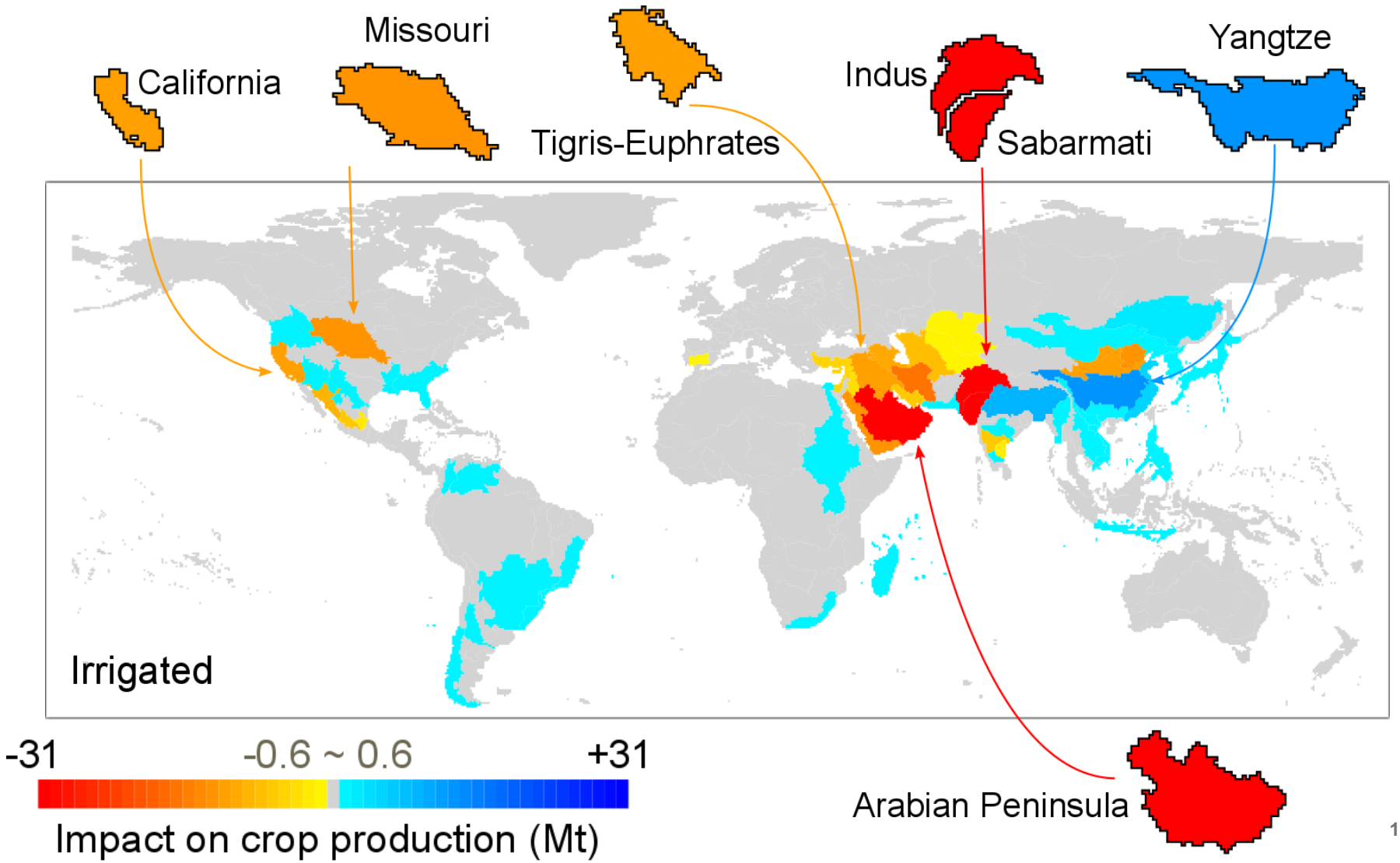


Irrigated agriculture declines and shifts to new regions



Rain-fed agriculture expands to make up the production shortfall

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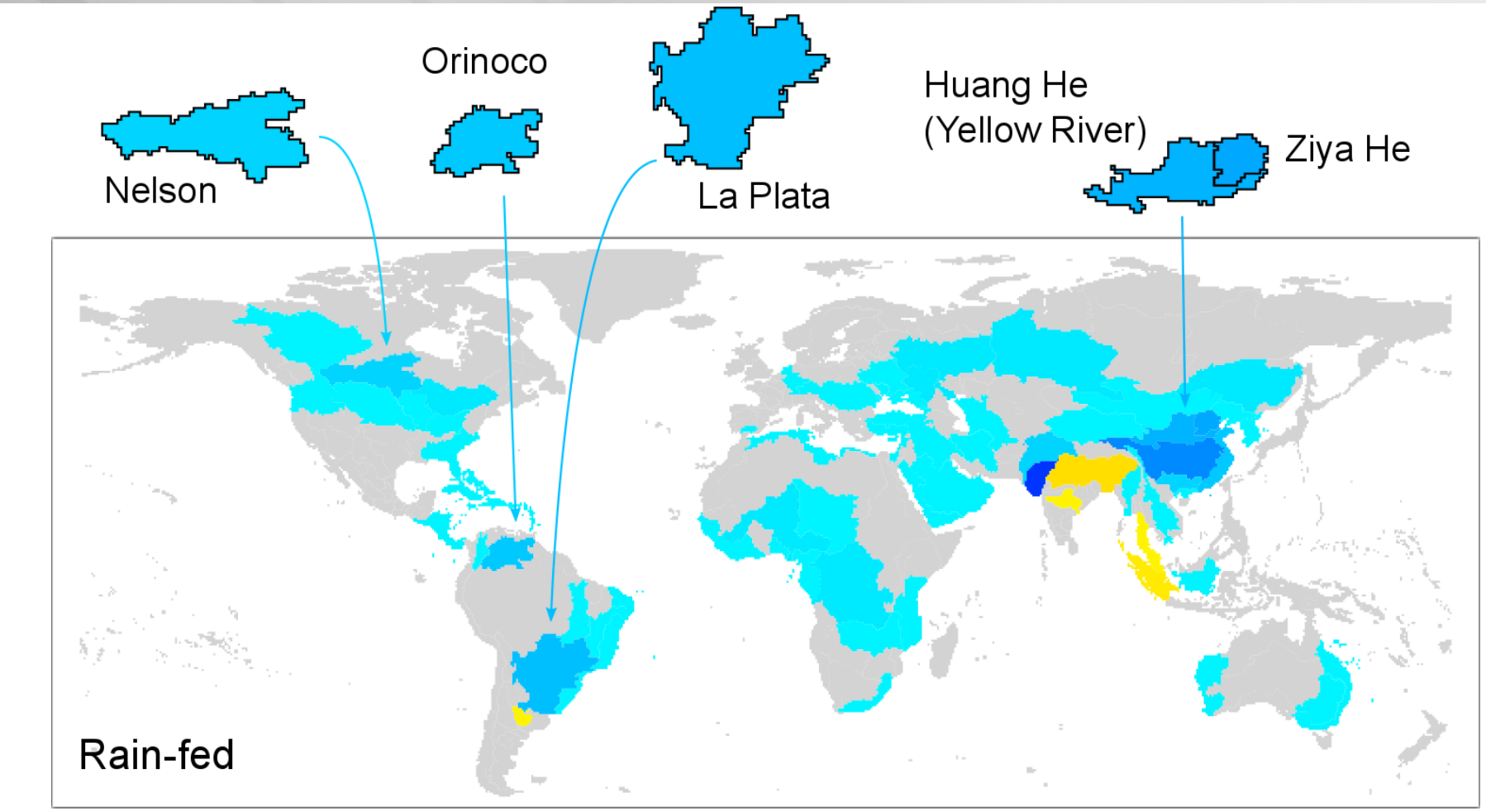

Middle East, India, Pakistan lose out… China, Brazil, Russia expand production

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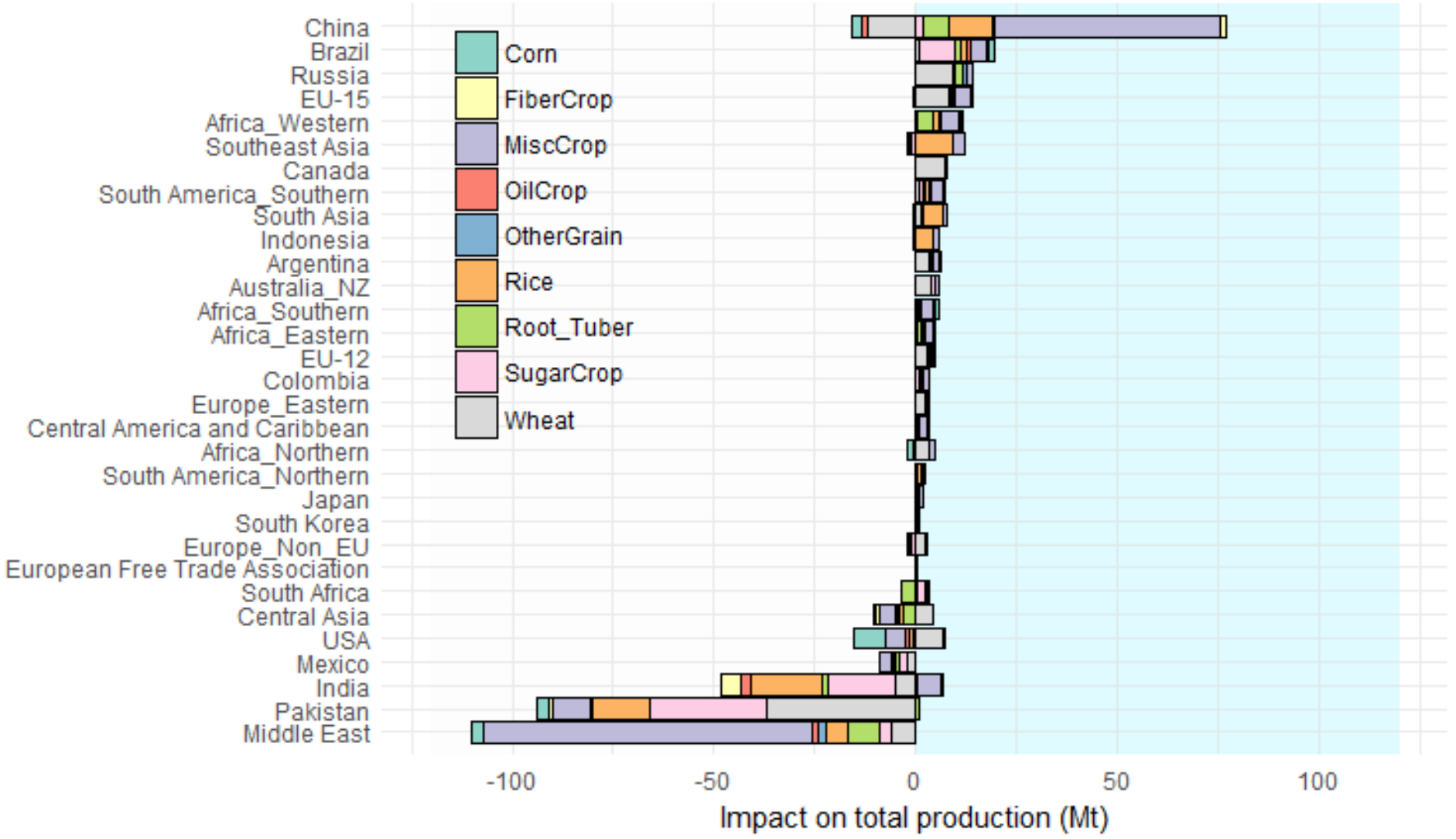

Conclusion: *groundwater depletion will affect where and how crops are produced*

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Future work

Add **climate change** impacts on **hydrology** and **crop yields**

Explore **electricity supply** adaptations

Explore sensitivity to **trade restrictions**

Model and data improvements

Refine **surface water** estimates using **reservoir models**

Incorporate **infrastructural costs** (e.g., conveyance)

Establish basin-specific **environmental thresholds**

sean.turner@pnnl.gov

Additional material…

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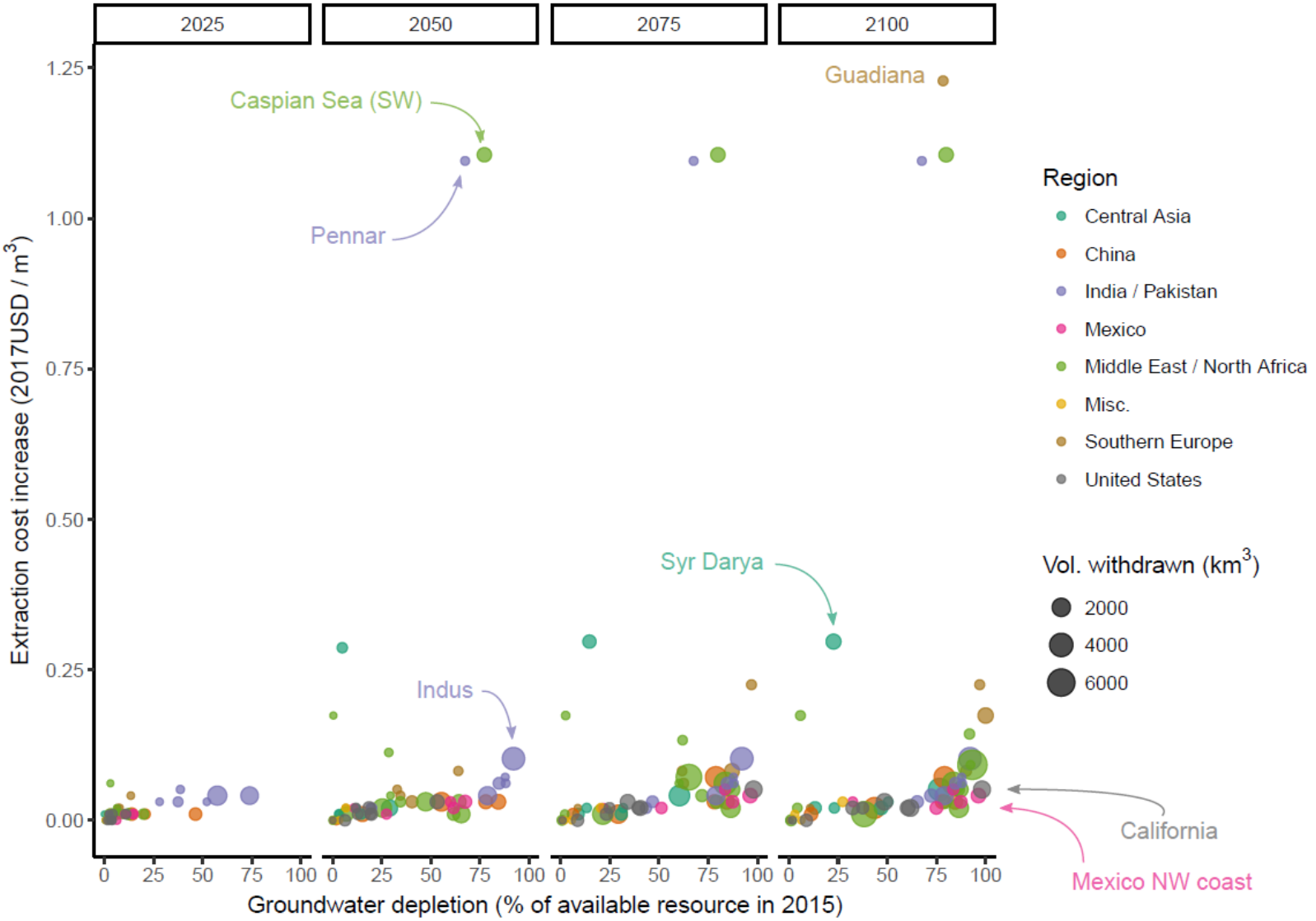
Depletion rate slows or halts when cost jumps



Impact of constraints on total withdrawals is similar to cross-study discrepancies

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