Global assessment of water policy challenges under uncertainty in water scarcity projections


ILEAPS Conference
Mon, 11 Sep
Water scarcity

Water supply

Schewe et al., PNAS, 2014
Water scarcity

\[
\frac{\text{water demand}}{\text{water supply}}
\]

Satoh et al., Earth's Future
Water scarcity is projected to change

- What is the associated **uncertainty**?
- How does this **uncertainty change**?
- What are the most important **sources of uncertainty** (model and scenario uncertainty)?

Resulting policy implications?
5 Global Climate Models (GCMs) to force

3 Global Hydrological Models (GHMs) under

3 different water scenarios provide global estimates of water supply and water demand → water scarcity (dem/sup)
5 Global Climate Models (GCMs) to force

3 Global Hydrological Models (GHMs) under

3 different water scenarios provide global estimates of water supply and water demand → water scarcity (dem/sup)
Water scarcity projections

median water scarcity
2006-2015

Median water scarcity projections for the years 2010 and 2050 are shown. The maps indicate the regions where the demand/supply ratio is greater than 0.1, reflecting areas with significant water scarcity.

- **a) median - 2010**
- **c) median - 2050**

**Legend:**
- Dem/sup > 0.1

The projections highlight areas at risk of water scarcity due to high demand/supply ratios in the future.
median water scarcity

Change
2006-2015 to 2046-2055

dem/sup > 0.1
Uncertainty in water scarcity projections

25th quantile

75th quantile
Water scarcity projections

water scarcity IQR
2006-2015

water scarcity IQR
2046-2055

dem/sup > 0.1
Water scarcity projections

Water scarcity IQR

Change
2006-2015 to 2046-2055

dem/sup > 0.1

f) IQR - change [%]
Global Hydrological Models (GHM) are the main source of uncertainty in most regions.

Climate Models (GCM) are the main driver of uncertainty in many subtropical regions.

Uncertainty stemming from water scenarios (Scen) is less important.
Objectives

Water scarcity is projected to change

- What is the associated uncertainty?
- How does this uncertainty change?
- What are the most important sources of uncertainty (model and scenario uncertainty)?

Resulting policy implications?
Clustering

Identify regions of similar changes in uncertainty

**Characteristics:**
(at every gridpoint)

(i) initial IQR
(ii) decade-to-decade changes in IQR
# Clustering

## Challenges

<table>
<thead>
<tr>
<th>Median Water Scarcity (in 2050)</th>
<th>Low</th>
<th>Medium</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.4 non-, slightly water scarce</td>
<td>&lt; 0.4 non-, slightly water scarce</td>
<td>&gt; 0.4 severely water scarce</td>
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<td></td>
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<tr>
<th>Within-Area Range of Uncertainty (2010-50)</th>
<th>Low IQR &lt; 0.15</th>
<th>Low to Medium IQR &lt; 0.35</th>
<th>Medium to High IQR &gt; 0.6</th>
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<tr>
<th>Uncertainty (2010)</th>
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*Figures show the distribution of water scarcity and uncertainty across different regions.*
### Generic policy implications

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<th>Description</th>
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<td>- no immediate actions required - regular monitoring activities and risk reevaluations are advised</td>
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<td>- immediate actions may be advisable - transitional changes will likely suffice</td>
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<td>- start from implementing <strong>low or no-regret (soft path) transitional options</strong> (beneficial in any case)</td>
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<td>- Implications for farming practice: pressurized systems (sprinklers and drips) instead of surface irrigation, improved crop water productivity (new cultivars), soil management and irrigation scheduling</td>
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<td>- investments in <strong>large water infrastructure</strong> (dams, water transfer, water recycling and reuse, desalination)</td>
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## Generic policy implications

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- immediate actions are necessary - need for transformational changes
- investments in **large water infrastructure** (dams, water transfer, water recycling and reuse, desalination) - modular options that allow for additions and reversals
- **Relocation** of industries, development of **alternative livelihoods**
- risk-reduction strategies and dynamic adaptive policies - flexible water allocation and management rules, clear water use rights and priorities, water exchange in local water markets, virtual water trade in global food markets

### Implementation of these policies is challenged by governance structure and socio-political barriers.

### Successful adaptation requires:
- robust institutional infrastructure
- enhanced local institutional capacities
- functioning rules
- improved water governance

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Peter Greve  
Sep 11, 2017
Concluding remarks

Assessing both changes in **average water scarcity** and the **associated uncertainties** in model projections.

**Adequate policy-making** should recognize implications arising from **large uncertainties** in future projections.

Evaluating **alternative scenarios** beyond the average projection helps avoid **maladaptation**, **adverse path dependencies** and **large costs of error**.

Our results call for a **careful and deliberative design of water policy interventions**, especially in the medium-to-high challenge areas identified.
Thanks!

Peter Greve

greve@iiasa.ac.at