Global violations of environmentally critical groundwater discharge

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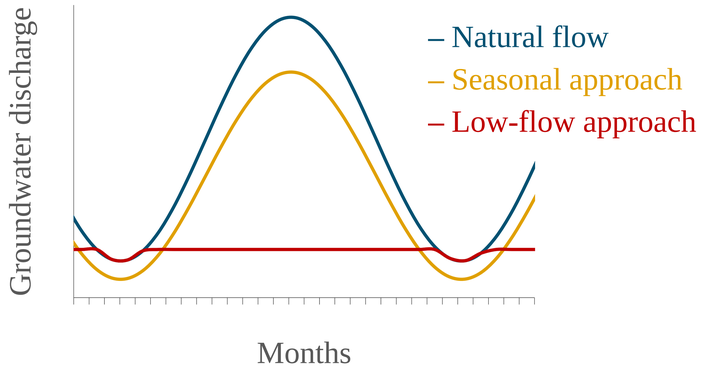
Background: Growing freshwater demands are increasing water use beyond sustainable levels, causing streamflow to drop below environmentally critical levels.

Knowledge gap: While environmentally critical streamflow is well studied, the environmentally critical contributions of *groundwater* to streamflow are less known.

Objective: Apply and compare different approaches of estimating environmentally critical groundwater discharge to better understand the influence of unsustainable groundwater abstractions on environmentally critical streamflow.

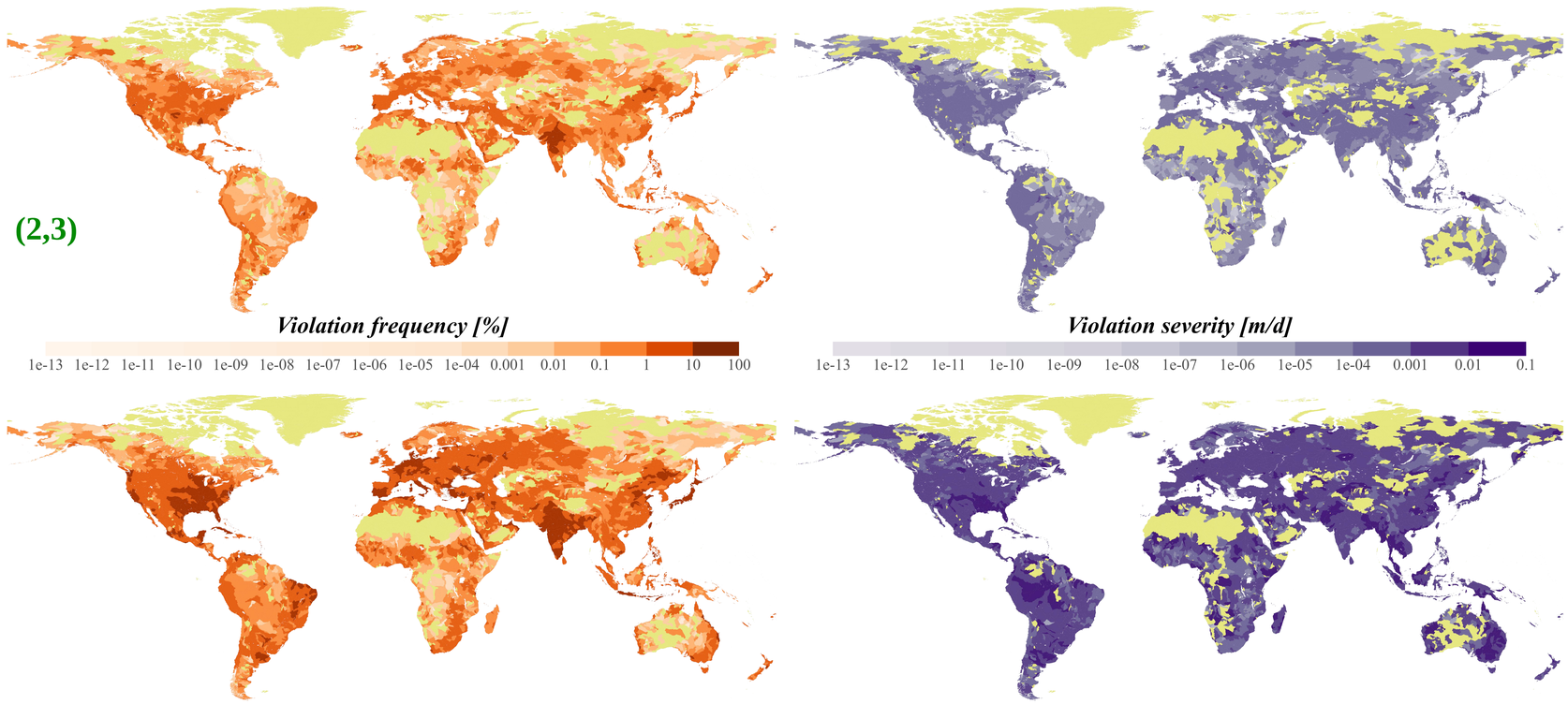
Outcome: Determine the suitability of each approach for inclusion in a newly developed dynamic water allocation scheme that will be integrated into a global-scale model.

(1) Thresholds of environmentally critical groundwater discharge



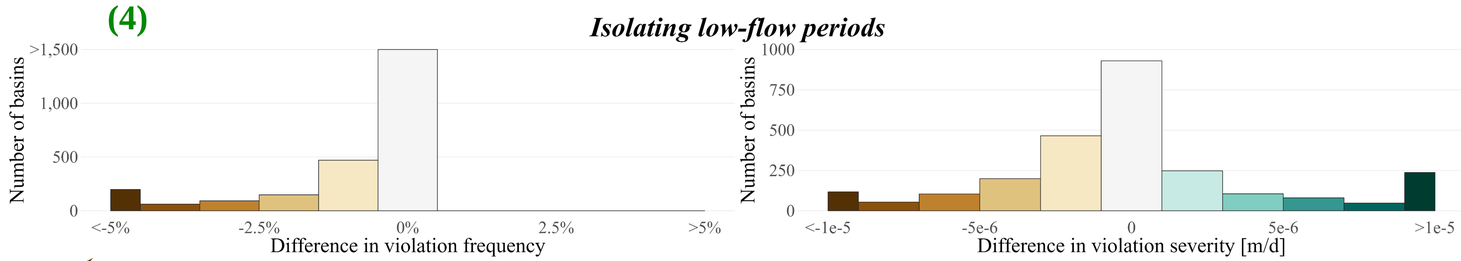
Low-flow approach

(2,3)



Seasonal approach

(4)



More frequent/severe low-flow violations — **More frequent/severe seasonal violations**

Results:

- The seasonal approach estimates more frequent and severe violations than the low-flow approach.
- But both approaches estimate similar spatial patterns of violations, identifying the same hotspots in highly irrigated regions.
- When low-flow periods are isolated, the approaches have very similar violation schemes.

Methodology:

(1) Apply thresholds of environmentally critical groundwater discharge → (2) Calculate historic violations of these thresholds → (3) Compare the frequency and severity of violations between approaches → (4) Compare violations during low-flow periods → Next steps: Analyze the timing and duration of violations