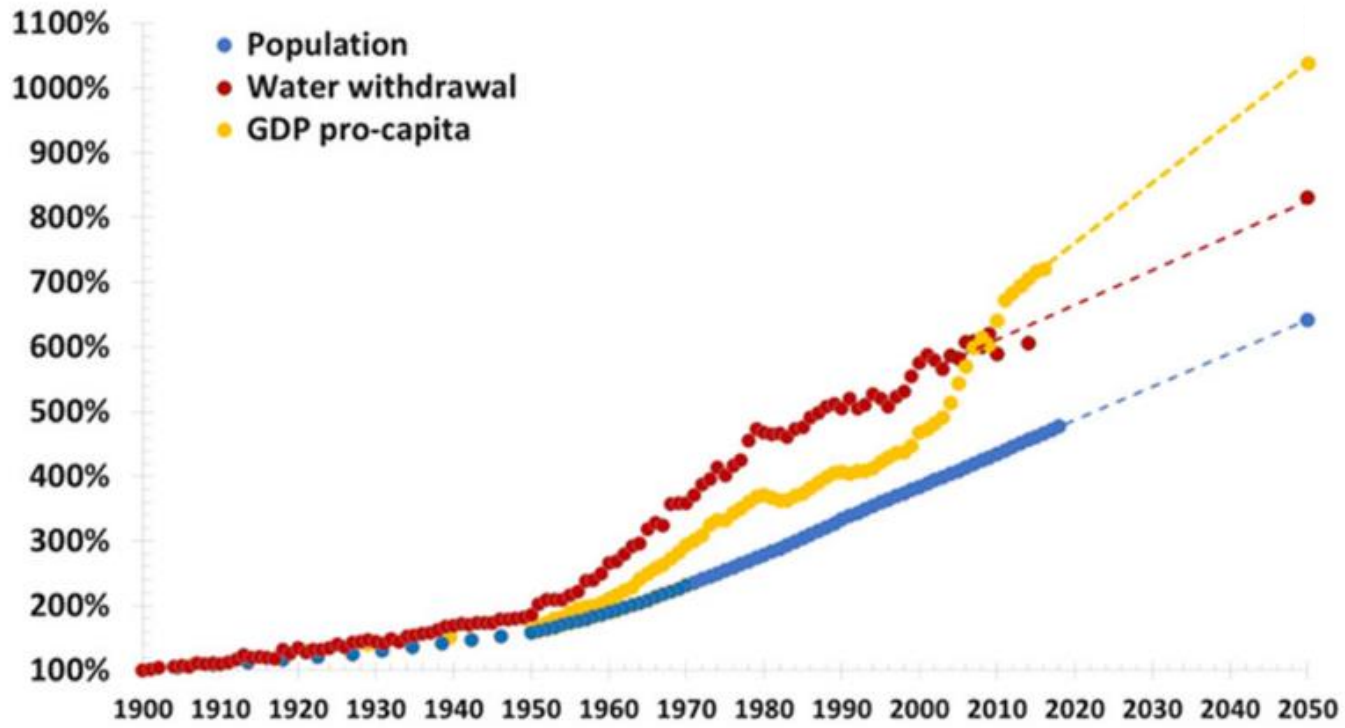
IMPLEMENTING SECTORAL WATER USAGE IN THE COMMUNITY

EARTH SYSTEM MODEL FOR PROJECTING FUTURE WATER RESOURCE AVAILABILITY

Sabin Taranu and Wim Thiery

POSITION THE PROBLEM

GLOBAL WATER USE



Source [1]

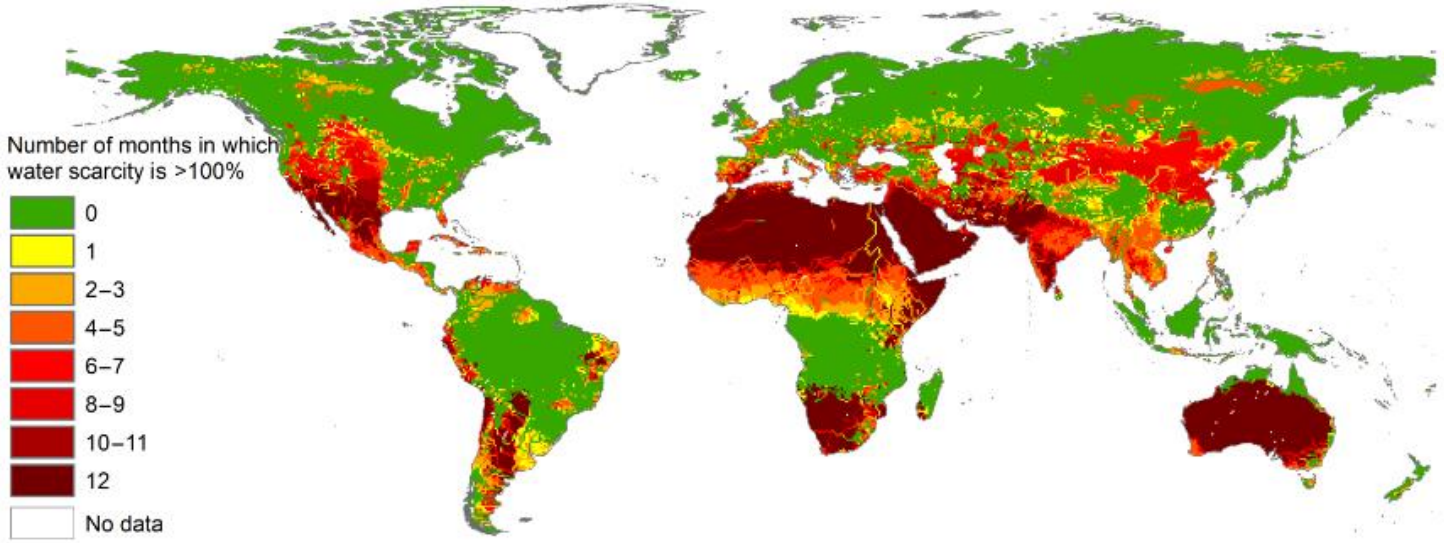
Key Point:

Population and standard of living are driving the increase in water withdrawal.

[1] Boretti, A. & Rosa, L. Reassessing the projections of the World Water Development Report. *npj Clean Water* **2**, 15 (2019).

POSITION THE PROBLEM

WATER SCARCITY



The number of months per year in which blue water scarcity exceeds 1.0 at 30 × 30 arc min resolution. Period: 1996–2005.

Source [2]

Key Point:

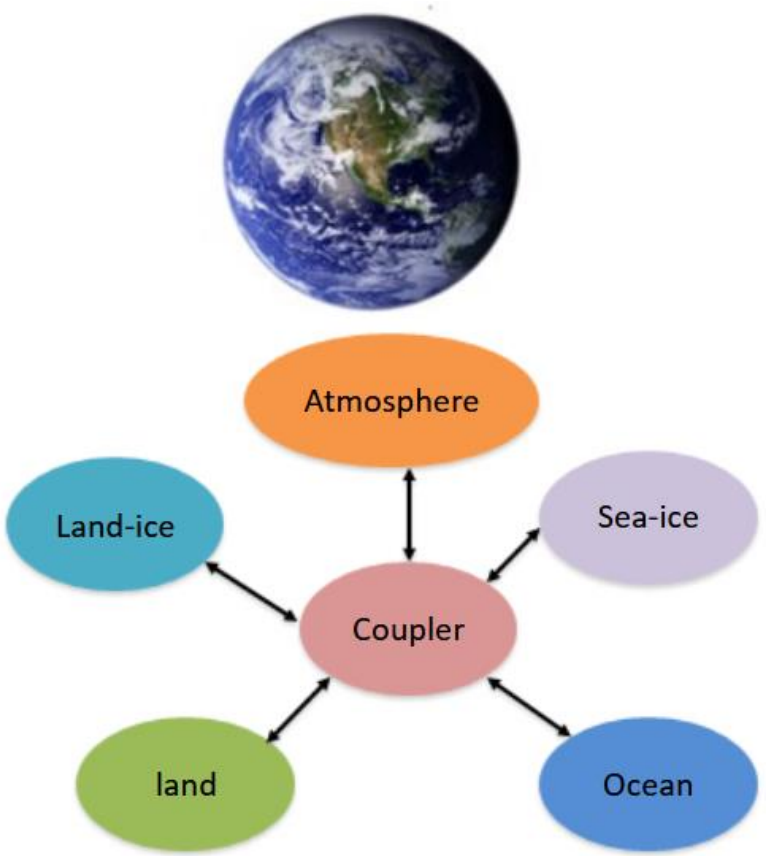
2/3 of the world population experience severe water scarcity for at least part of the year.

[2] Mekonnen, M. M. & Hoekstra, A. Y. Four billion people facing severe water scarcity. *Sci. Adv.* **2**, e1500323 (2016).

POSITION THE PROBLEM

ROLE OF EARTH SYSTEM MODELS

- Most comprehensive tool to study climate change



POSITION THE PROBLEM

ROLE OF EARTH SYSTEM MODELS

"The gaps in describing human–water interactions are one of the grand challenges in Earth system modeling."

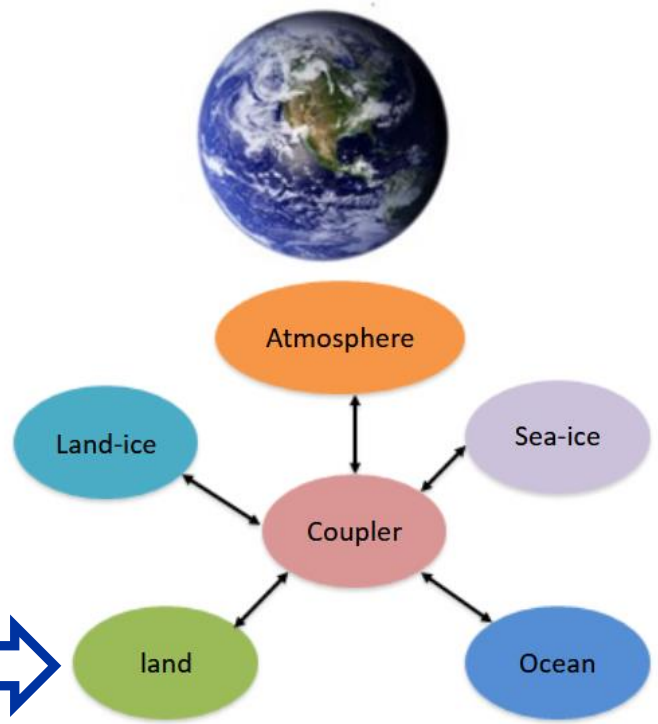
GEWEX, 2012

The Global Energy and Water Exchanges (GEWEX) project is an international research project and a core project of the World Climate Programme.

IMPLEMENT SECTORAL WATER USAGE

COMMUNITY EARTH SYSTEM MODEL (CESM)

Sectoral water demand



Input Data

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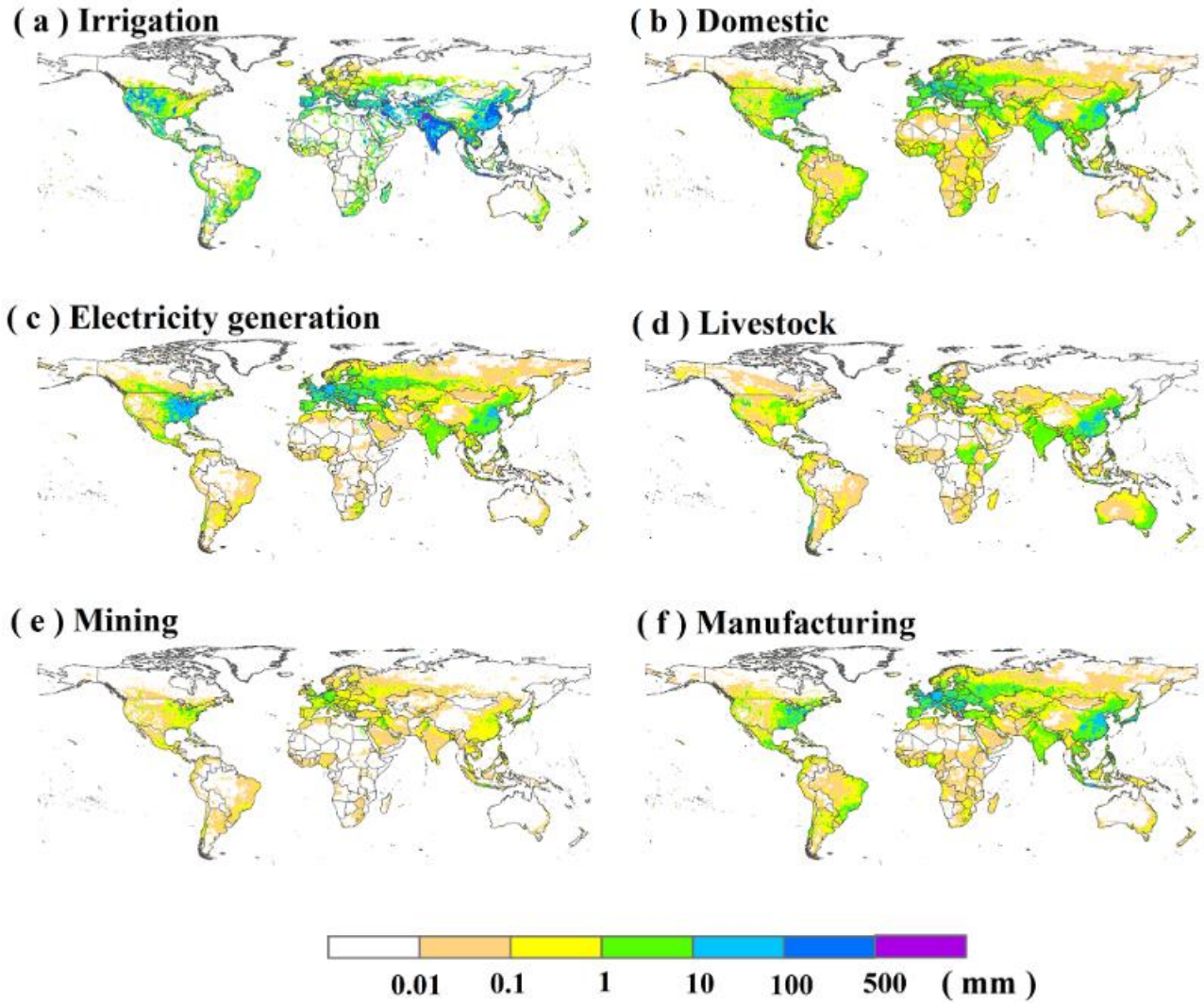
Sectors covered: domestic, thermoelectric, manufacturing, livestock and mining.



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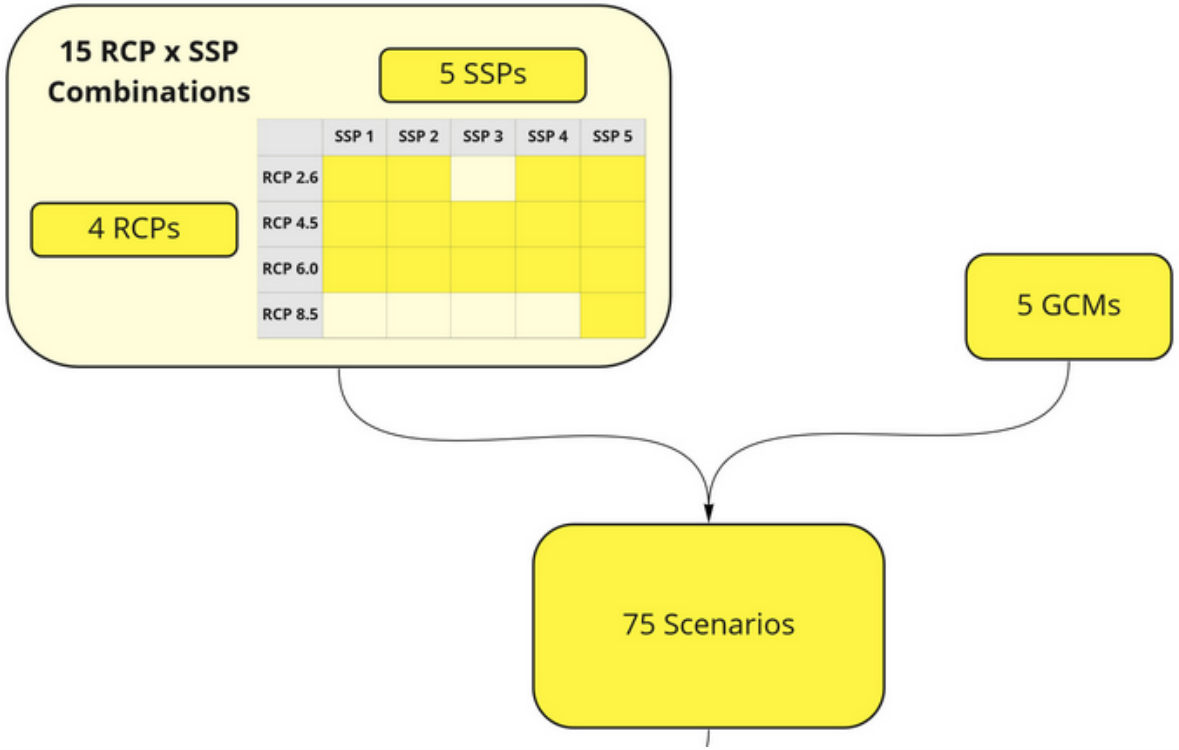
Sectors covered: same as *Huang et al, 2017*

Scenarios: 4 RCP and 5 SSP scenarios matrix



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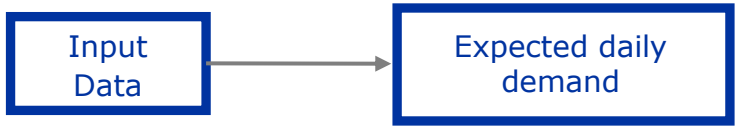

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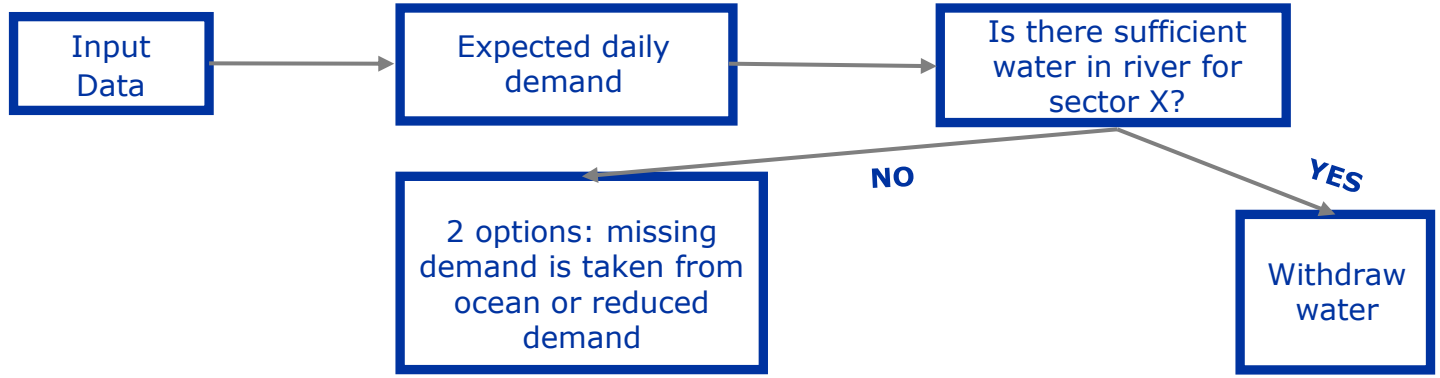

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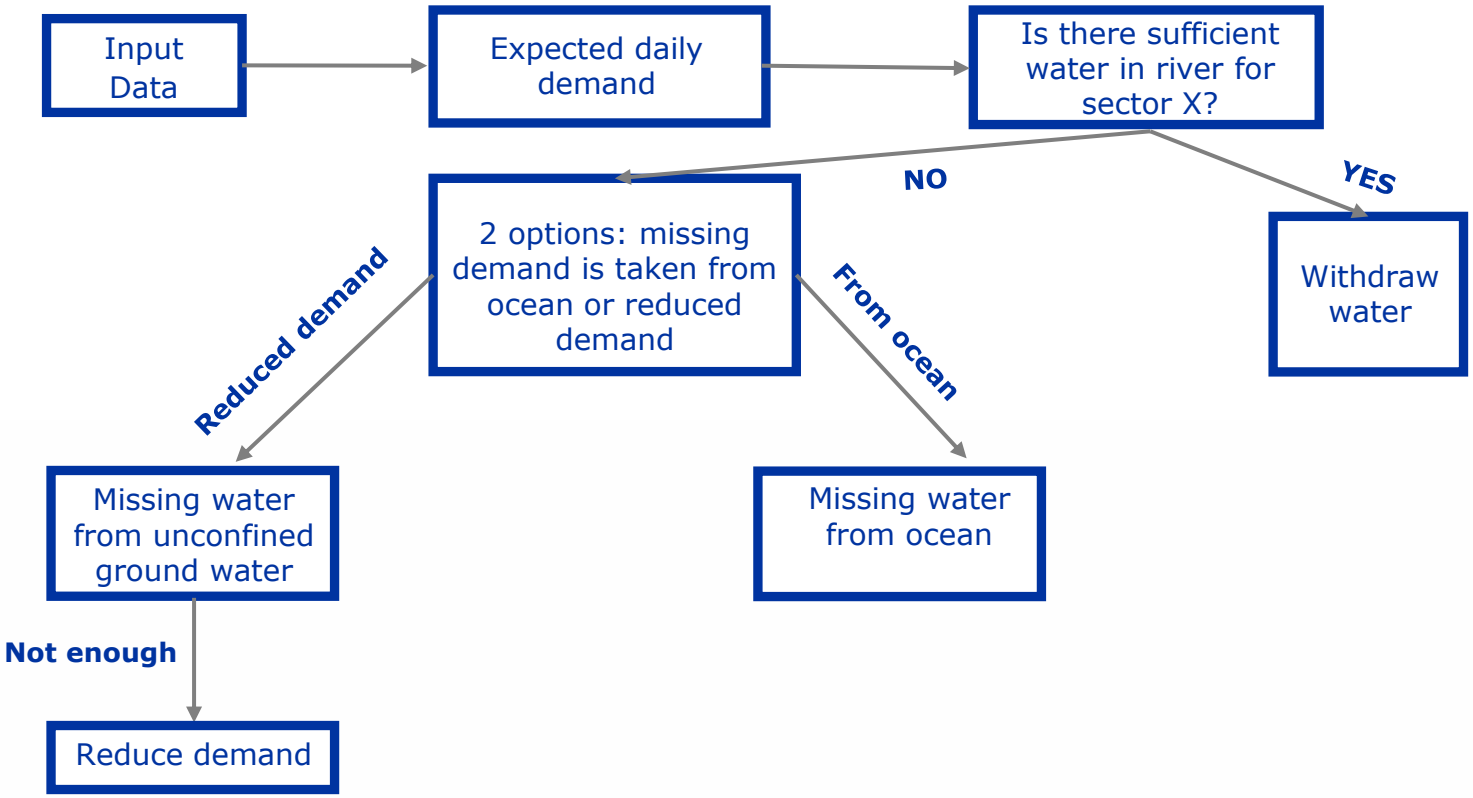

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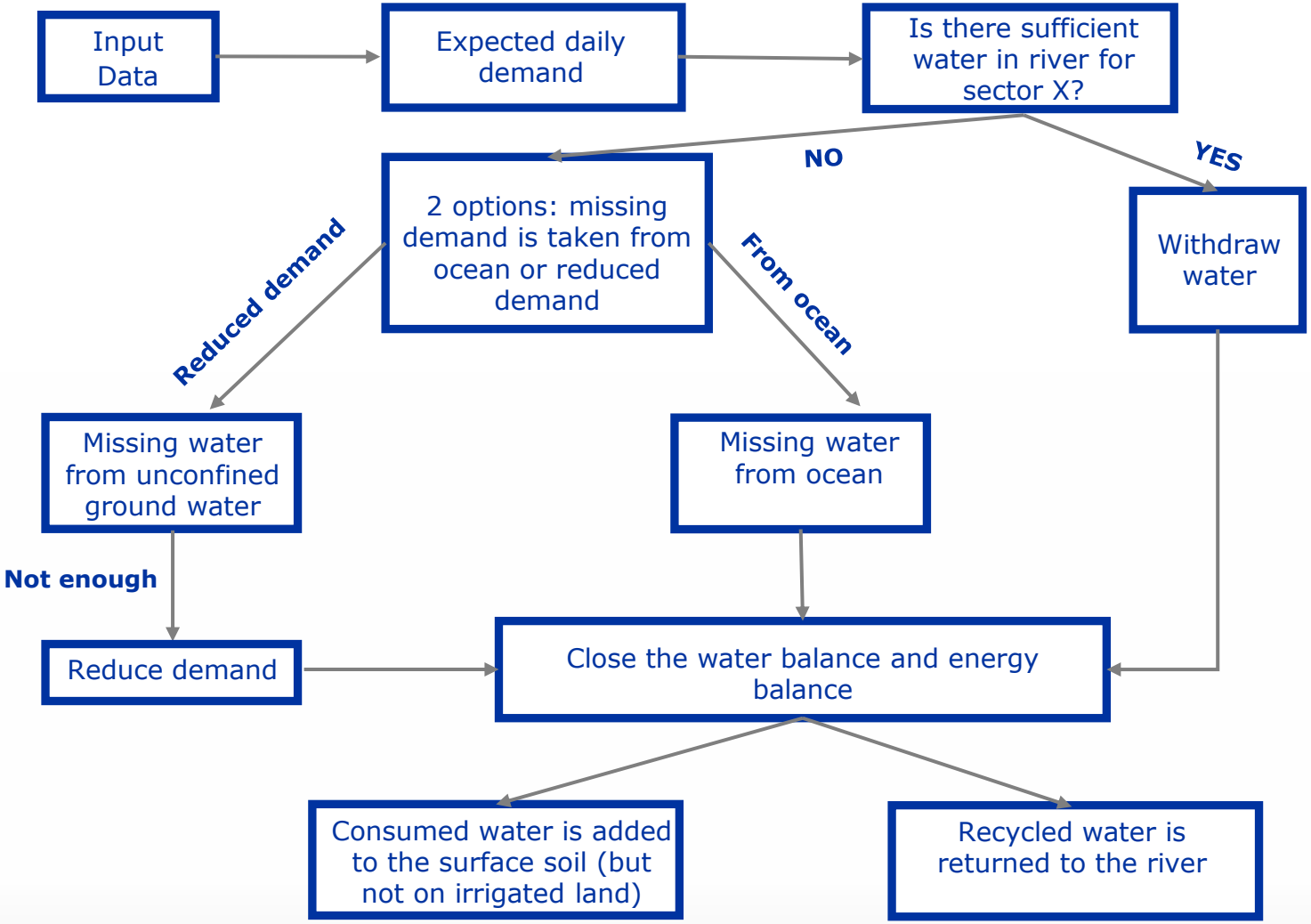

CESM2-SECTORWATER

ADVANTAGES OF OUR APPROACH

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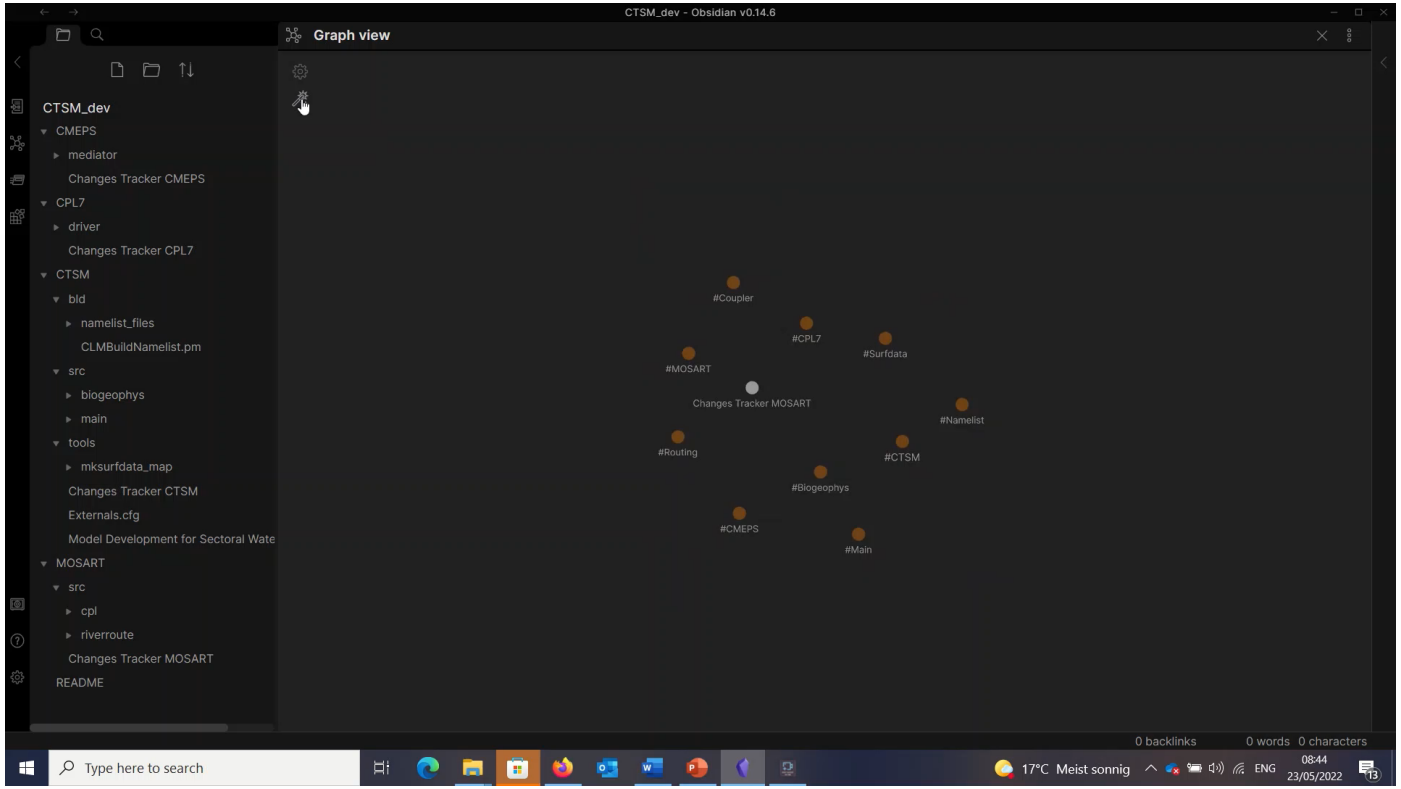
- Full coverage of human water usage.
- Sector priority: domestic > livestock > thermoelectric > manufacturing > mining > irrigation
- Both surface and groundwater usage as water sources
- Fully coupled (routing-land-atmosphere)
- New water futures (first ESM/Hydrological model to implement the new data)

CURRENT PROGRESS

HOW TO FOLLOW UP?

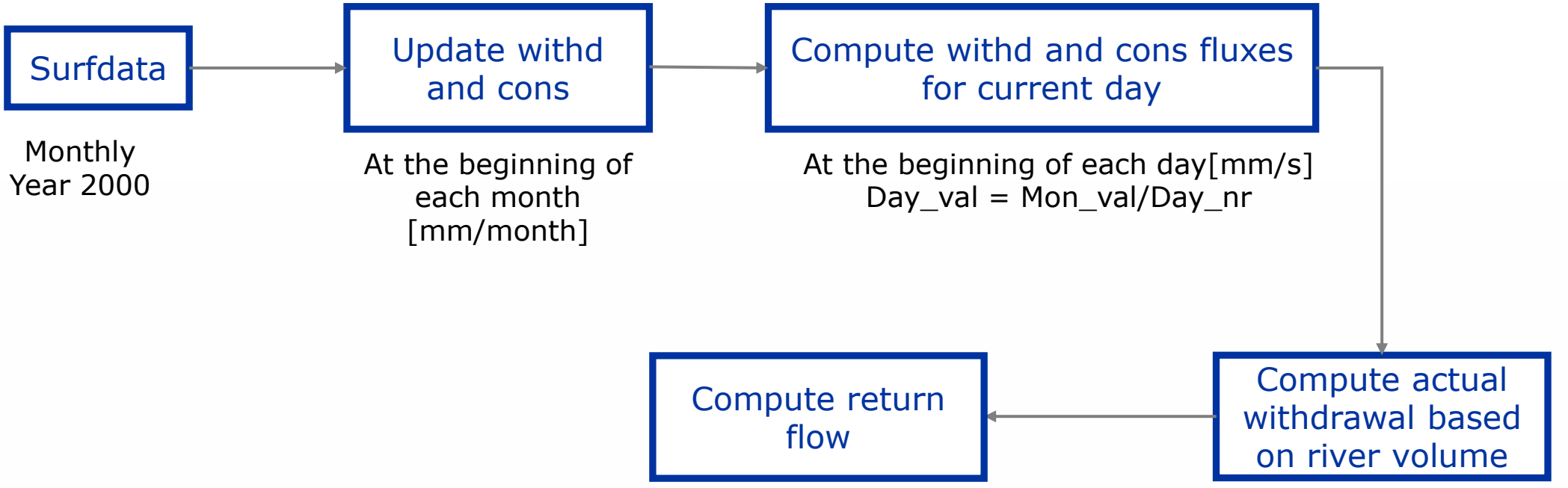


taranudev.github.io

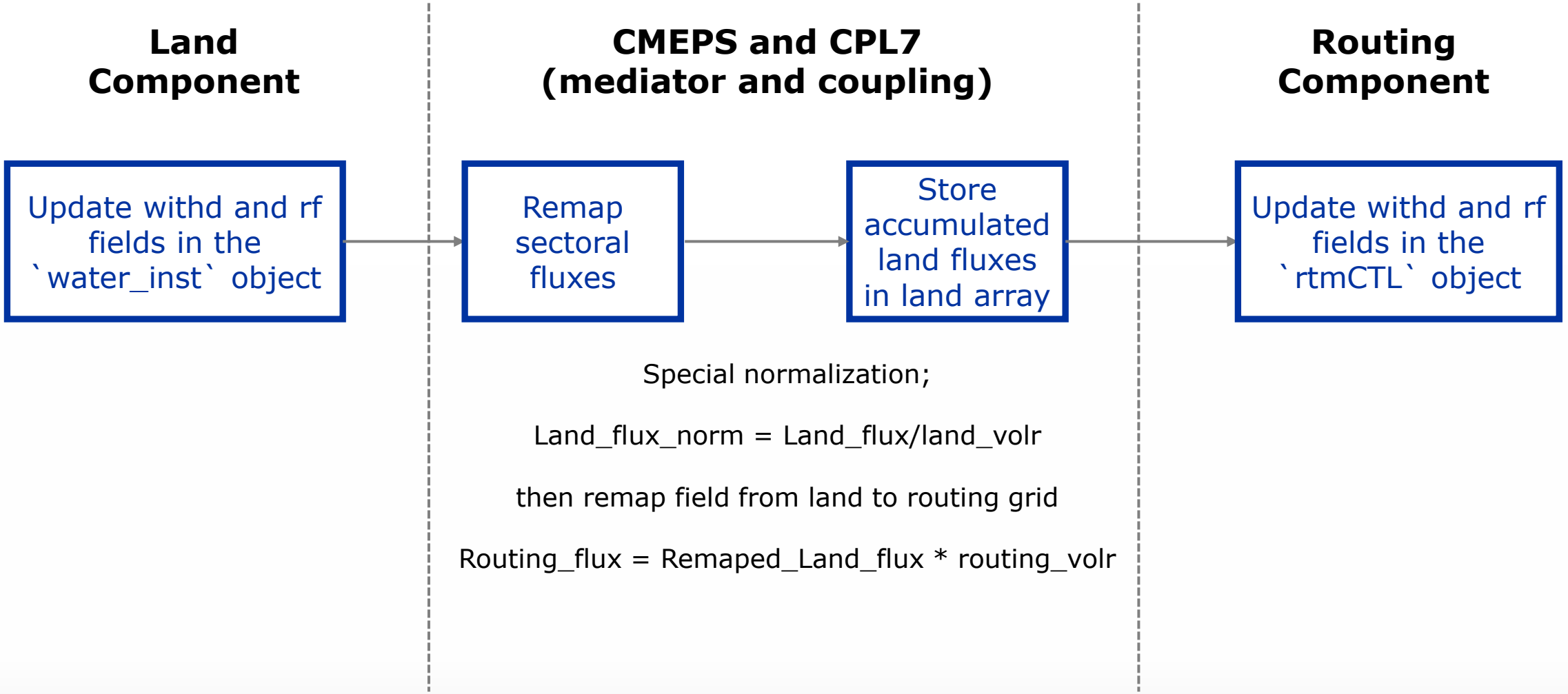
Progress can be followed on website

(scan QR code)

HOW WE COMPUTE WITHDRAWAL, CONSUMPTION AND RETURN FLOW?



HOW WE DO THE COUPLING WITH ROUTING MODEL?



WHAT HAPPENS IN THE ROUTING MODEL?

Obtained from coupler

If demand for river `r` is higher than water in river `r`

Then take only what available, the rest go to subsurface runoff

If subsurface runoff becomes negative send to ocean

Water is taken (withd) or added (rf) to the river total liquid water storage