Issues in water withdrawal from ISIMIP2b

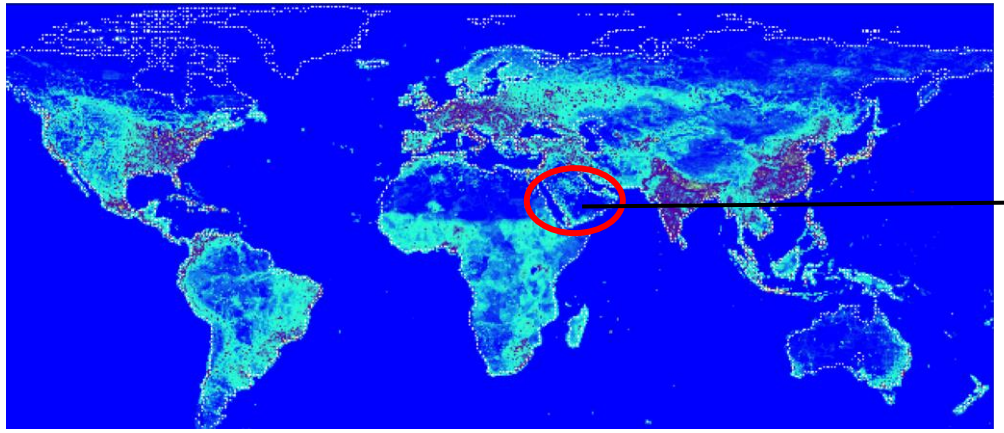
Provided input files for MATSIRO and LPJmL, histsoc

(calculated based on ISIMIP2a multimodel mean of WaterGAP, PCRGLOB-WB and H08 simulations)

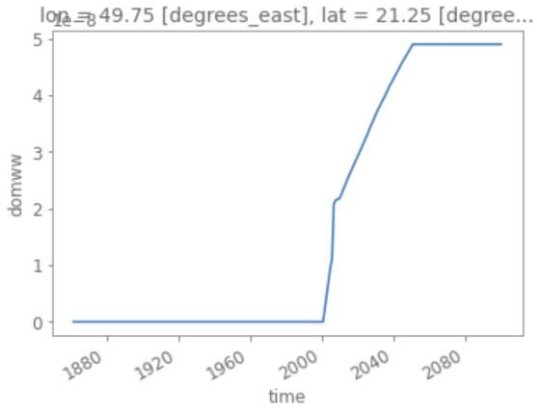
domww_histsoc_annual_1901-2005.nc
Path: /ISIMIP/ISIMIP2b/InputData/water_abstraction/histsoc/

Concatenated 1860-2099 timeseries for two individual grid cells
Histsoc (file shown on right)
Rcp60soc: SSP2 from Global Water Futures and Solutions, constant after 2050

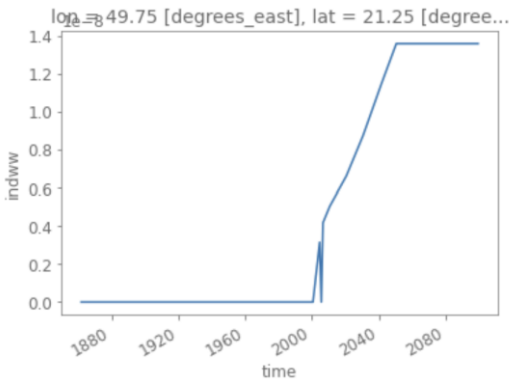
Domww histsoc 2000



Domestic withdrawal

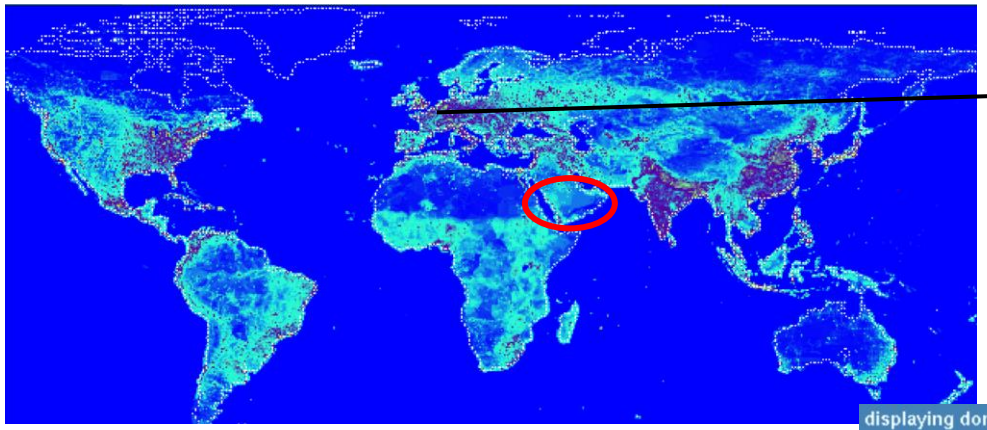


Industrial withdrawal

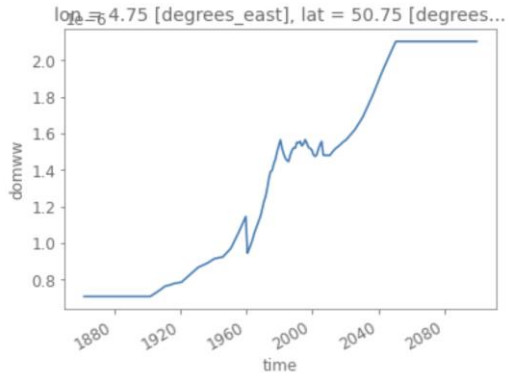


Sharp transition in **2000**, again transition in 2005-2006-2007 (different input files)

Domww histsoc 2001



Domestic withdrawal



Industrial withdrawal

displaying domestic water withdrawal
frame 101/105 31-Dec-2000 08:16:37
displayed range: 0 to 2.26161e+09 m3/yr (0 to 2.26161e+09 shown)
Current: (i=193, j=0) 0 (x=-83.25, y=83.75)

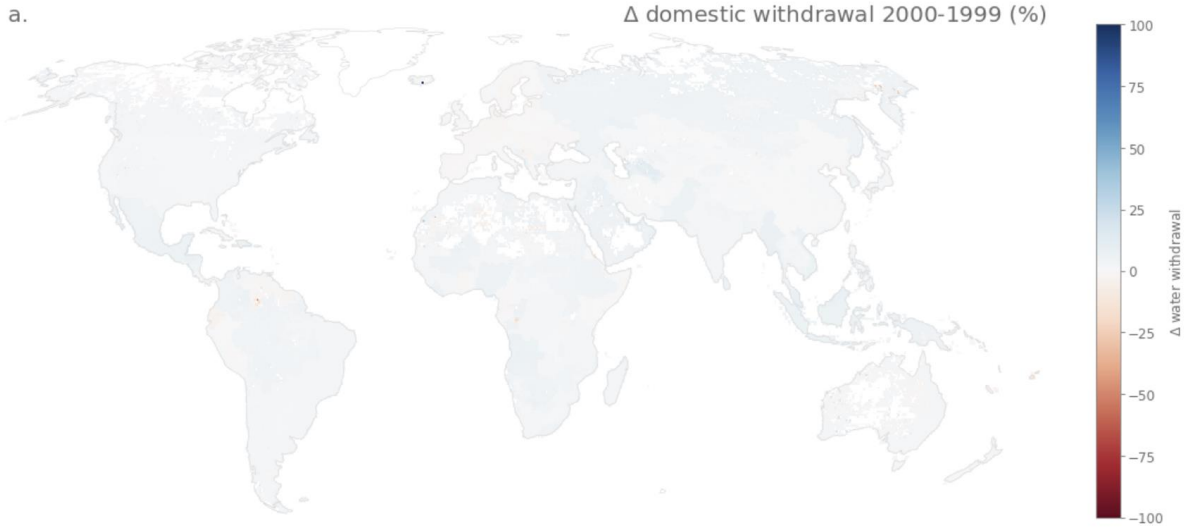
Provided input files for MATSIRO and LPJmL, histsoc

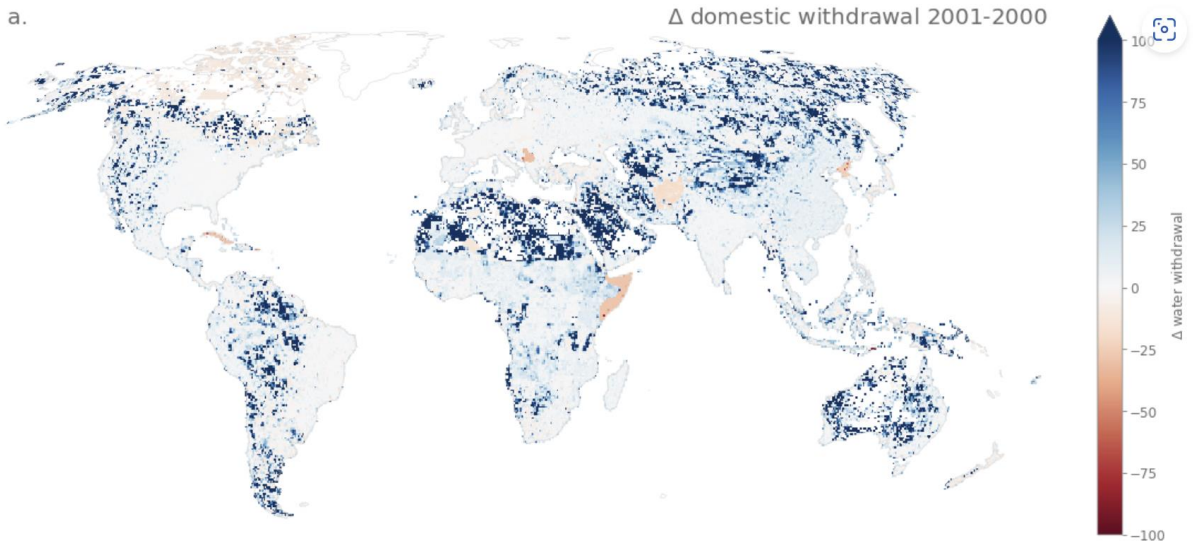
(calculated based on ISIMIP2a multimodel mean of WaterGAP, PCRGLOB-WB and H08 simulations)

domww_histsoc_annual_1901-2005.nc

Path: /ISIMIP/ISIMIP2b/InputData/water_abstraction/histsoc/

Spatial extent of the issue (shown are relative difference maps between 2000-1999 and 2001-2000) showing the difference in transitioning and which areas are affected by the issue





Sharp, unrealistic transitions in 2000-2001: along coastlines, Eastern China, …

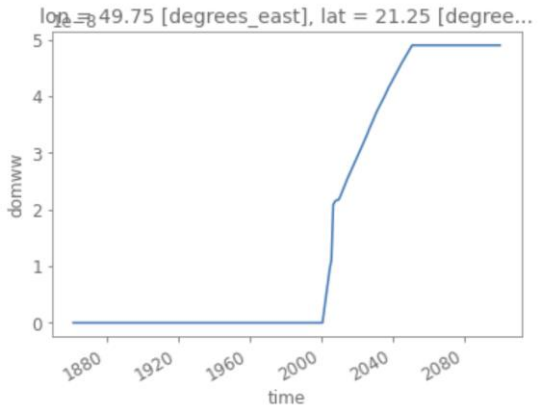
Concatenated 1860-2099 timeseries for two individual grid cells

Histsoc (file shown on right)

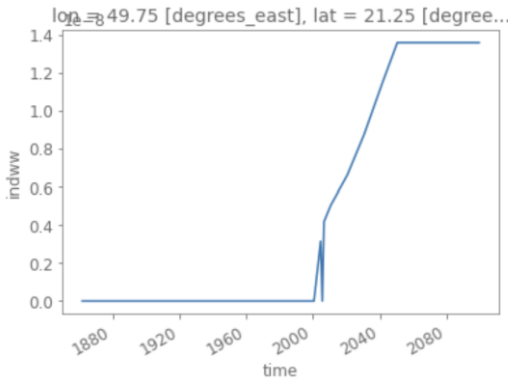
Rcp60soc: SSP2 from Global Water Futures and Solutions, constant after 2050

Grid cell in Saudi-Arabia

Domestic withdrawal

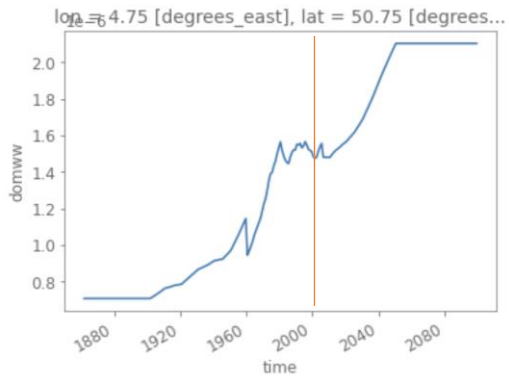


Industrial withdrawal

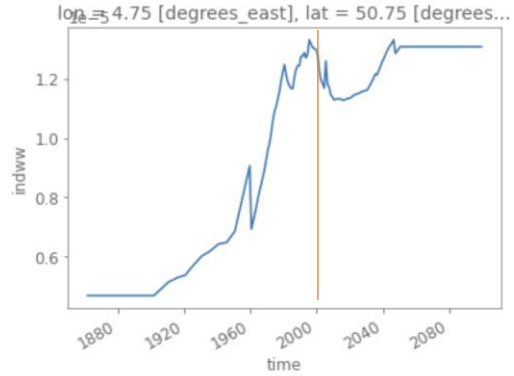


Grid cell in France

Domestic withdrawal

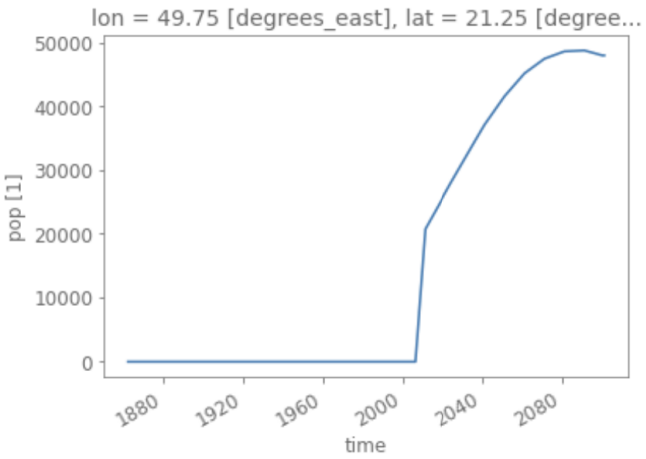


Industrial withdrawal

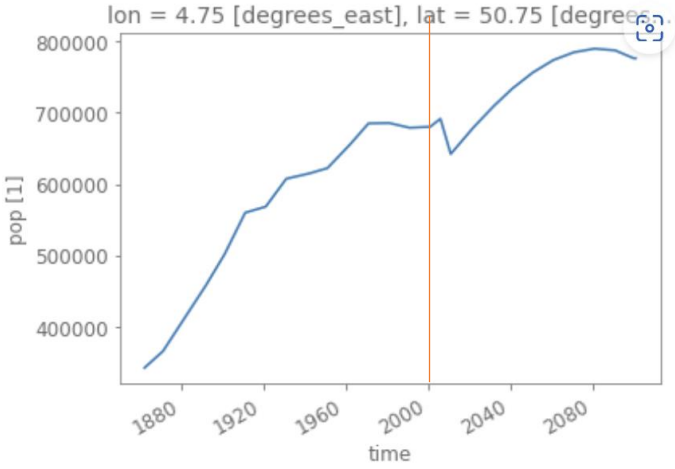


*Unrealistic transitions can directly be related to inconsistencies in original population dataset**

Population (uncorrected)



Population (uncorrected)



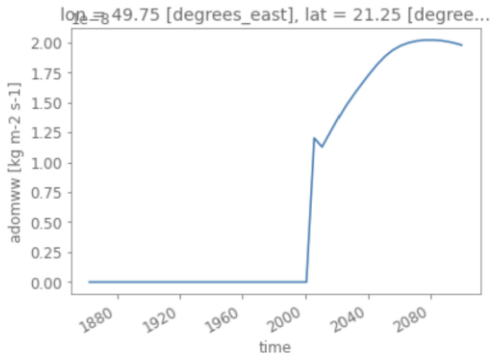
** See further slides for this issue*

Simulated withdrawals (for same grid cells and global mean)

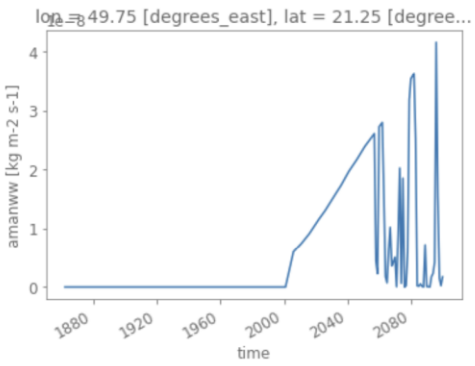
H08 (Had-GEM)

Grid cell in Saudi-Arabia

Domestic withdrawal

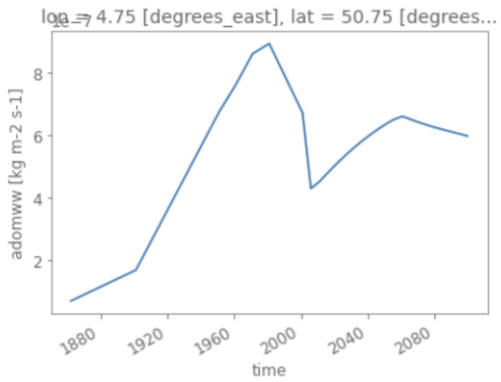


Industrial withdrawal

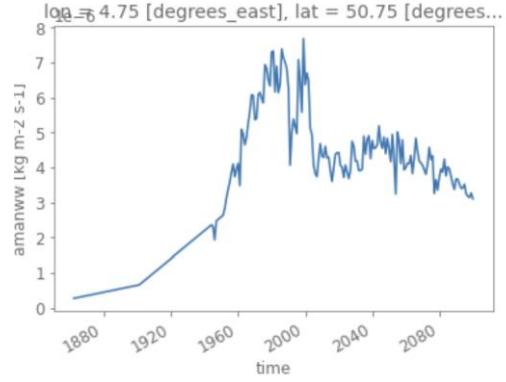


Grid cell in France

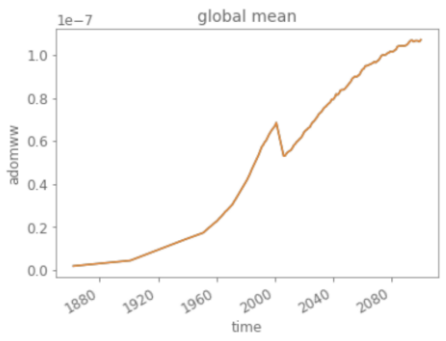
Domestic withdrawal



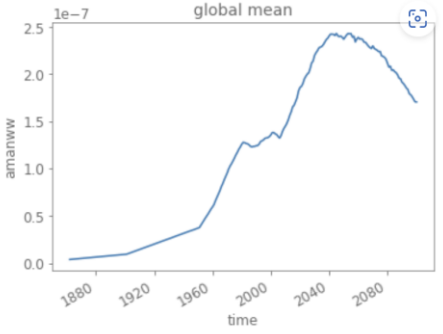
Industrial withdrawal



Domestic withdrawal



Industrial withdrawal

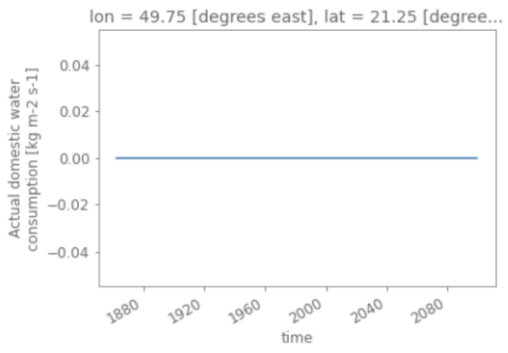


Simulated withdrawals (for same grid cells and global mean)

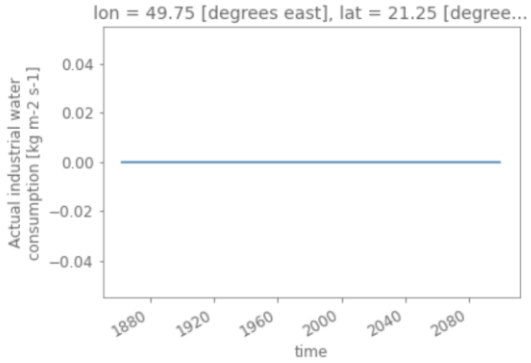
CWatM (Had-GEM)

Grid cell in Saudi-Arabia

Domestic withdrawal

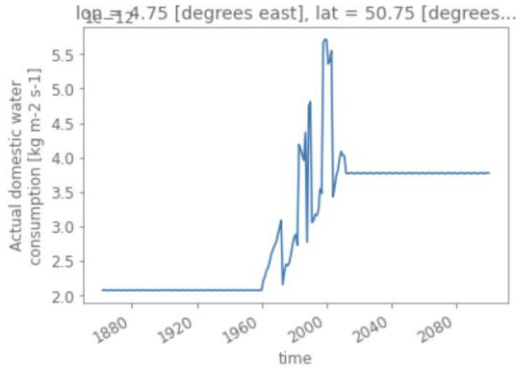


Industrial withdrawal

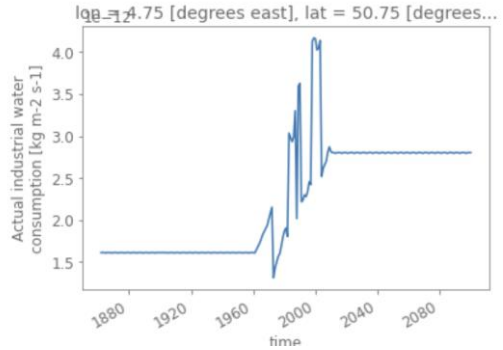


Grid cell in France

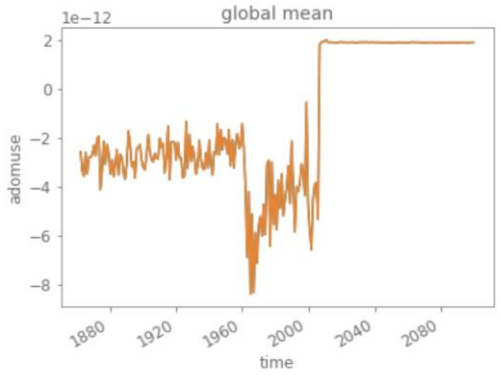
Domestic withdrawal



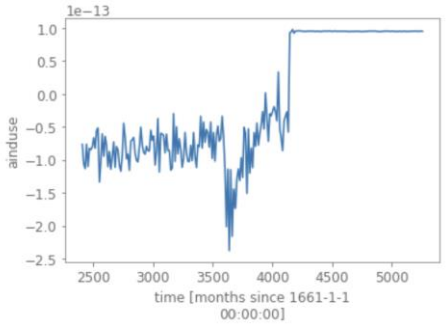
Industrial withdrawal



Global mean domestic withdrawal

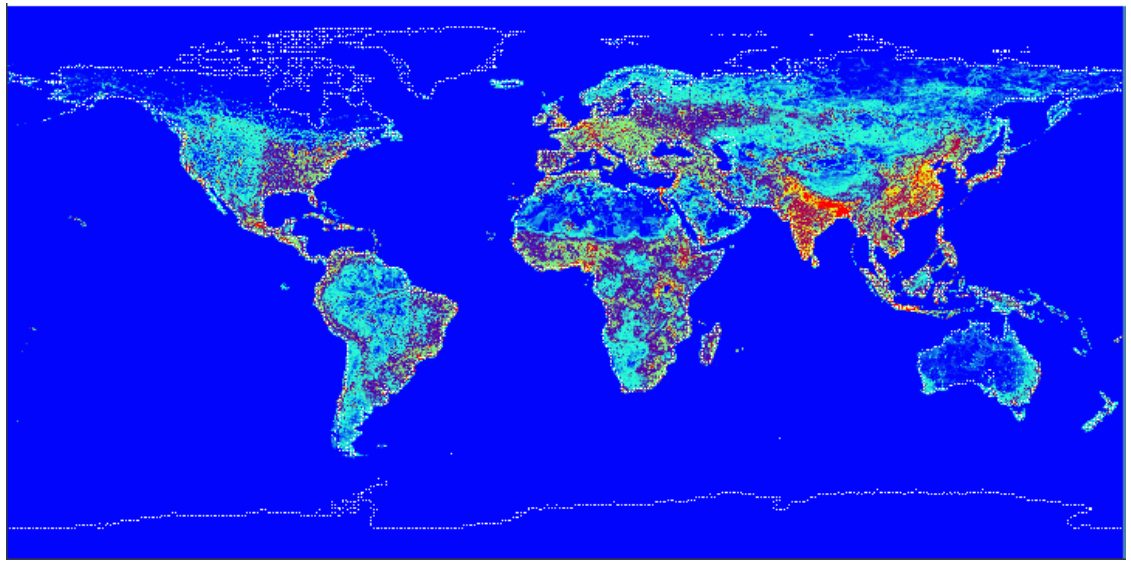


Global mean Industrial withdrawal

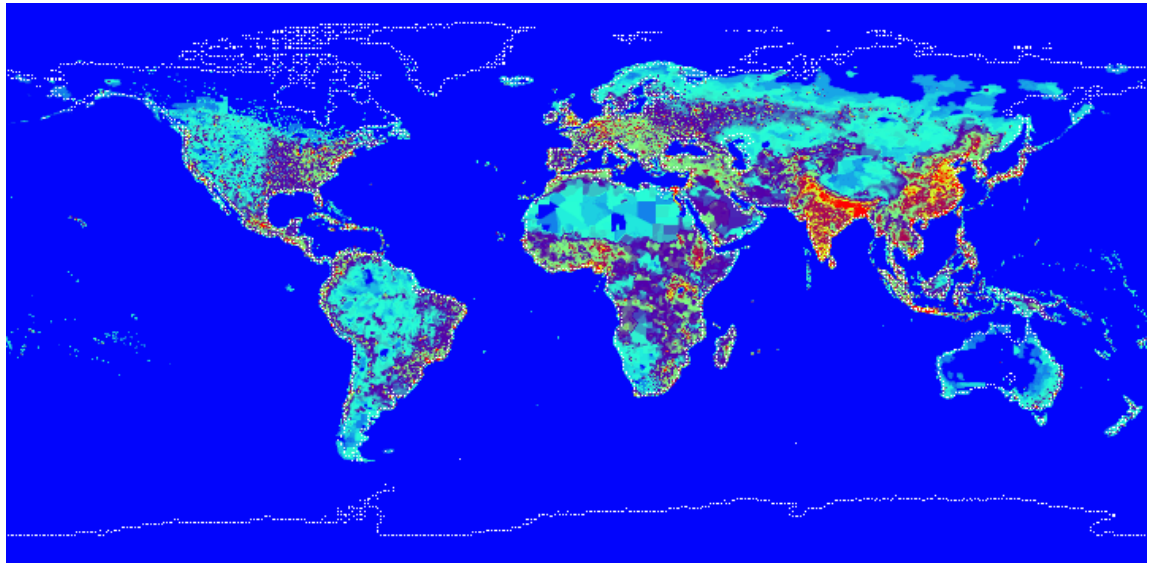


Population input dataset issues ISIMIP2b

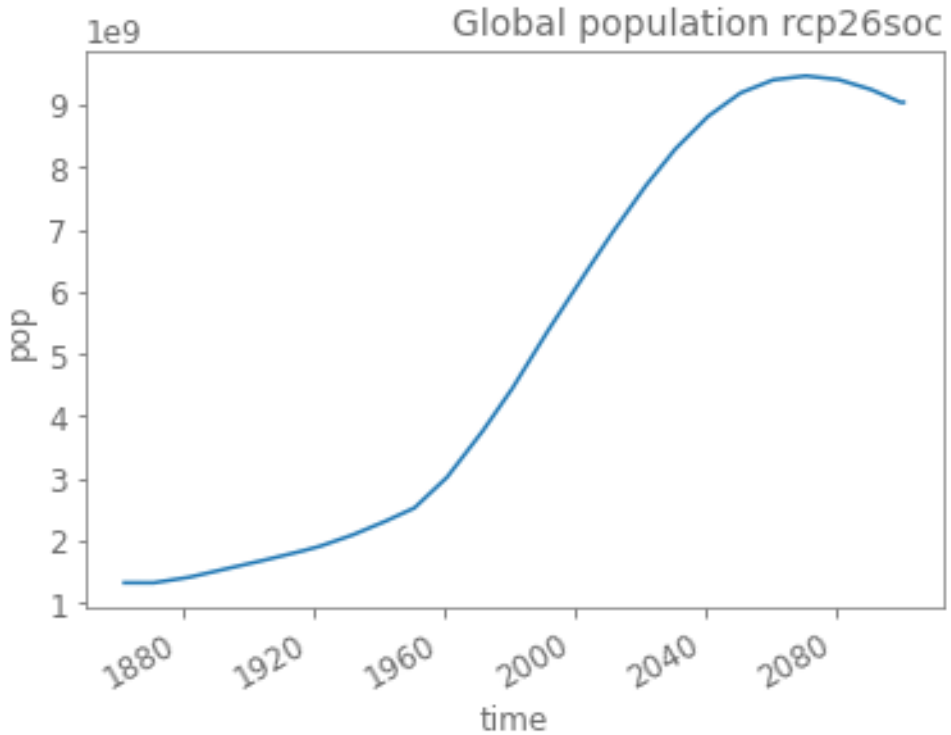
population_histsoc_0p5deg_annual_1861-2005.nc4
Population 2005

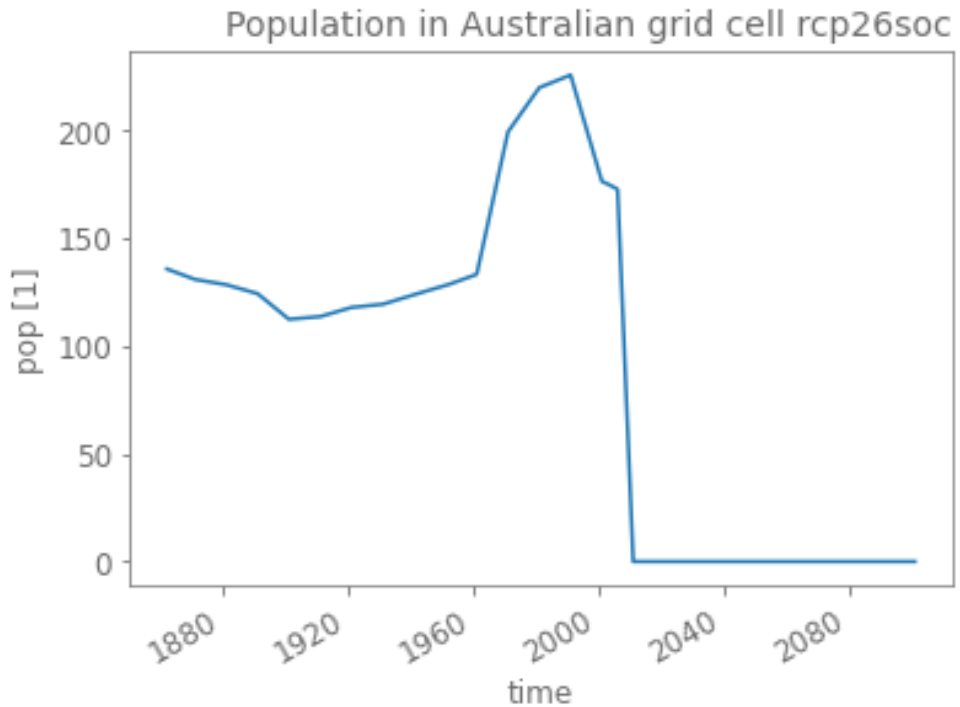


population_ssp2soc_0p5deg_annual_2006-2100.nc4
Population 2006



Inconsistencies: North-African countries, inland Australia, Siberia etc

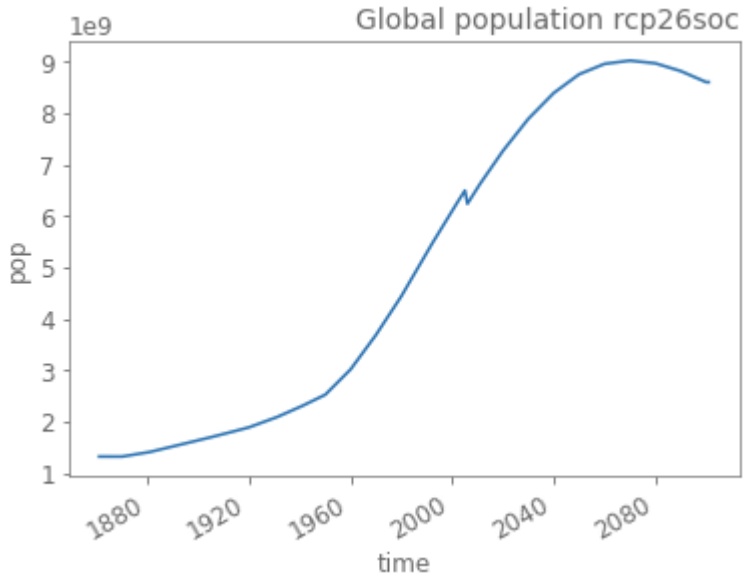


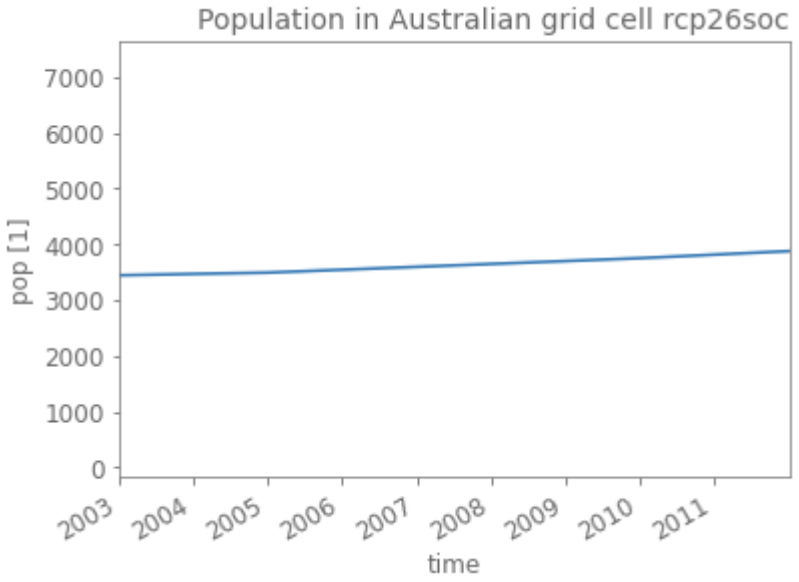


While the global population seems fine, there are problems in individual grid cells, like in this Austrialian grid cell

Corrected data

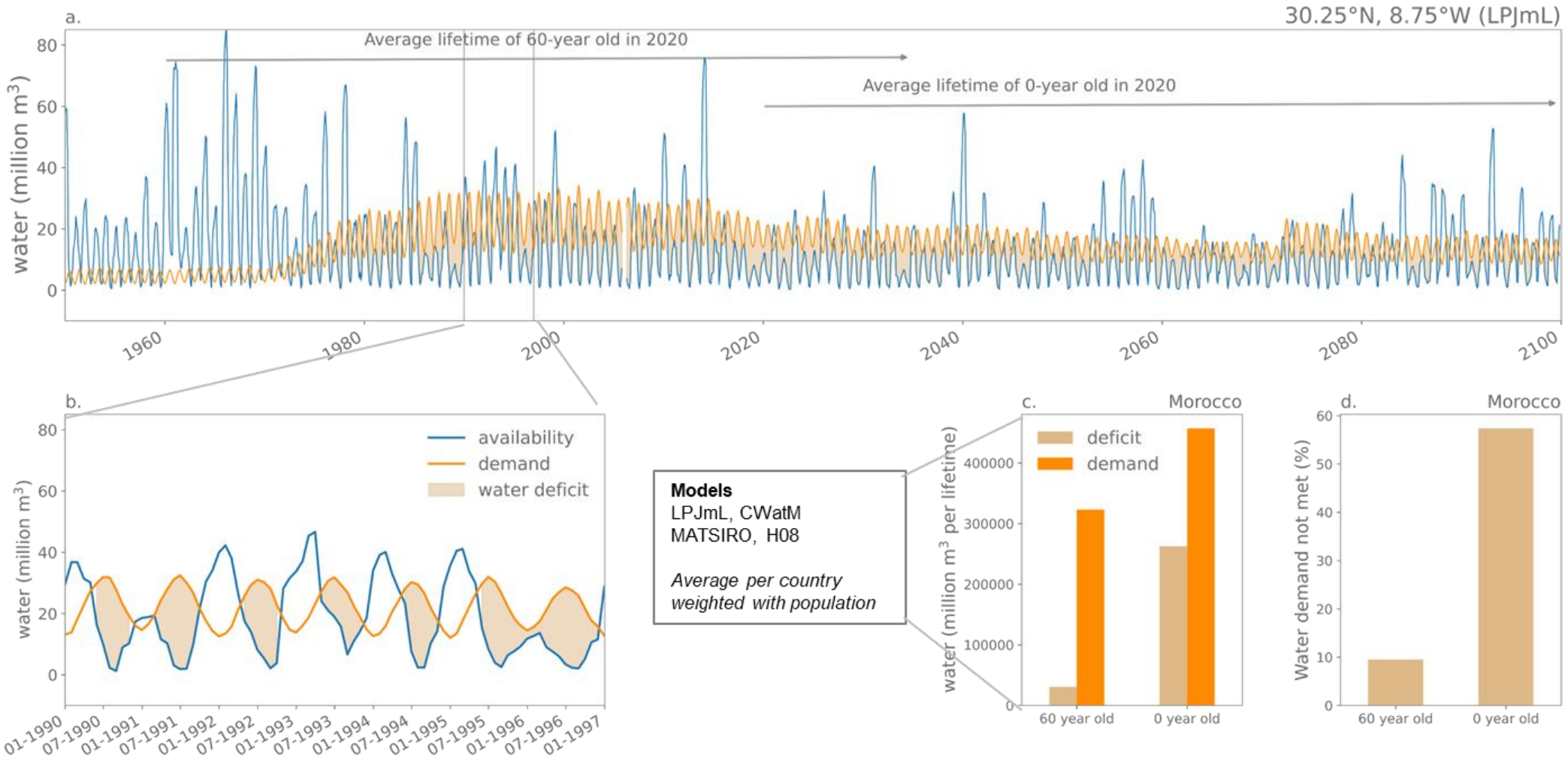
With corrected data





Recap: calculation of water deficit

Little recap: conceptual figure on lifetime water deficit calculation



Variables and defenitions used for water demand per ISIMIP model

Model	Irrigation demand	Domestic demand	Industrial demand	Total demand	Reference
CWatM	Potential irrigation withdrawal (pirrww)	Actual domestic use (adomuse)	Actual industrial use (ainduse)	Total potential water withdrawal (ptotww)	
H08	Potential irrigation withdrawal (pirrww)	Actual domestic withdra wal (adomww)	Actual industrial withdrawal (aindww)	Sum of sectors	
LPJmL	Potential irrigation withdrawal (pirrww)	Historical: multi-model mean of ISI MIP2a (WaterGAP, PCR-GLOBWB, H08) Future: multi-model mean of (Wat erGAP, PCR-GLOBWB, H08) under SSP2 (Wada et al., 2016) until 205 0, constant beyond	Historical: multi-model mean of IS IMIP2a (WaterGAP, PCR-GLOBWB , H08) Future: multi-model mean of (Wa terGAP, PCR-GLOBWB, H08) unde r SSP2 (Wada et al., 2016) until 2 050, constant beyond	Sum of sectors	
MATSIRO	Potential irrigation withdrawal (pirrww)			Sum of sectors	

Lifetime water deficit
Total water amount not present when demanded during lifetime

Annual amount of water that is not meeting monthly demand

$$D_{i,y} = \begin{cases} \sum_{m=1}^{12} (WD_{i,m} - WA_{i,m}) \; if \quad WD_{i,m} > WA_{i,m} \\ 0 \qquad\qquad\qquad\qquad if \quad WD_{i,m} < WA_{i,m} \end{cases}$$

$D_{i,y}$ Water deficit in cell i, month m (m³/ year)

$WD_{i,m}$ Total water demand in cell i, month m (m³/month)

$WA_{i,m}$ Total water availability in cell i, month m (m³/month)

For water deficit and demand of the different birth cohorts

$$D_{i,\,birth\_cohort} = \sum_{y=0}^{years\ lived} D_{i,y}/pop_{i,y}$$

$$WD_{i,birth\_cohort} = \sum_{y=0}^{years\ lived} WD_{i,y}/pop_{i,y}$$

$pop_{i,y}$ Number of people in cell i and year y (#people / year)

$D_{i,birth\_cohort}$ Water deficit per capita integrated over lifetime of birth cohort (m³/cap)

$WD_{i,birth\_cohort}$ Water demand per capita integrated over lifetime of birth cohort (m³/cap)

$WD\%_{i,birth\_cohort}$ Share of total water demand not met during lifetime (%)

Share of total water demand not met during lifetime

$$WD\%_{i,\,birth\_cohort} = D_{i,\,birth\_cohort}/WD_{i,birth\_cohort}$$

Water availability and demand
from the ISIMIP global water sector (0.5°)

Water availability: water from upstream and local runoff, corrected for environmental flow

$$WA_{i,m} = dis_{upstream,\,i,\,m} + qtot_{i,m} - EF_{i,m}$$

- $WA_{i,m}$ Water availability in cell i, month m (m^3/month)
- $dis_{upstream,i,m}$ Discharge of direct upstream cells of i (m^3/month)
- $qtot_{i,m}$ Local runoff in cell i (m^3/month)
- $EF_{i,m}$ Environmental flow (m^3/month)
  based on mean discharge (Pastor et al. 2014)

Water demand: taken as total potential water withdrawal (ptotww)

$$WW_{i,m} = WW_{industrial,\,i,\,m} + WW_{domestic,\,i,\,m} + WW_{irrigation,\,i,\,m}$$

Depending on the model availability, actual water use is used (but no water limitation, so actual = potential)

	domestic	industrial/man	irrigation
CWatM	adomuse	ainduse	pirrww
H08	adomww	amanww	pirrww
LPJmL	o	o	pirrww
MATSIRO	o	o	pirrww