<u>This supplement is provided as answer to the editor's comment no.6, on the data sources for Fig. 3 in the manuscript</u>

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This supplement provides the methodology, and the data employed in producing the **Fig. 3** in the manuscript. Data is provided as necessary, and where the authors are permitted. For the data for which the first and the second authors do not have the right to publish, the readers are directed to the data sources and the necessary information (Publications, contacts etc.) on the data.

First the methodologies are provided. The required data are mentioned following the methodology. The data sources and links are provided at the bottom of all the explanations.

<u>The definition of water availability as used in the manuscript:</u>

Water available for a 0.5° grid as defined in this study is the simulated annual average river discharges out of the particular grid, which is the **potentially available water** to be used in the grid. Data were obtained from the Total Runoff Integrating Pathways (TRIP) of University of Tokyo (Further details are at the bottom of the explanations).

<u>Population projections utilized in the manuscript</u>

CEISIN gridded population (0.5°) was projected to the required year (*n*). Population growth was assumed to be uniform in a country. Projection factors were obtained using World Bank country population estimates from 2001-2010. Future projections start from 2011. From 2001 to 2010, projections follow the World Bank country population estimates. Exponential population growth model (World Bank, 2012) was employed in the projection between consecutive years. Projection factors are provided in separate files, for the year 2100.

National projection factors were disaggregated into 0.5° resolution using the National Identifier Grid of CEISIN-GPWv3 (2010), assuming uniform population growth within a nation. The population projection in a 0.5° resolution grid was done as follows. The year 2000 was assumed the base year for projections. Base year population counts per grid were obtained from CEISIN - GPWv3 (2010).

$$\text{Population in the year N} = \textit{population in the year } 2000 \times \textit{projection factor for the year } N \cdots (1)$$

<u>Methodology for Fig. 3</u>

<u>Fig. 3(a)</u>

This figure shows the per capita water availability situations in 2100, under the utilized water availability scenarios; A1b, B1 and A2, and under the no-policy population scenario, SC1 (For

details, please refer **section 2.1** and **Fig. 1** of the manuscript. Projection factors are provided in a separate file). All scenarios used in this figure are of horizontal resolution 0.5°. The annual per capita water available for each 0.5° grid was calculated as in equation (2).

$$\text{Per capita water available for each } 0.5° \text{ grid} = \frac{\text{potentially available water for a grid}}{\text{population count of the grid}} \quad \cdots(2)$$

For **Fig. 3(a)**, 0.5° grid values of per capita water available were classified according to the Falkenmark (1992) water stress indicator. However, the effects of population and climate change in Europe, Russia, the South and North Americas were not clear, as we are looking at the annual water availability. Therefore, two other additional classes, 1700-5000 m^3/year and >5000 m^3/year per capita were introduced.

Data used:

1. TRIP data for 2100, averaged over 4 GCM's (CCSM3, MIROC3.2, CGCM2.3.2 and UKMO).
2. Population count per grid, CEISIN, resolution 0.5°, UN adjusted.
3. Population projections for 2100, under scenario SC1. Projection factors are provided in a separate file.

<u>Fig. 3(b)</u>

This figure compares the calculated per capita water available for the year 2100, with that of the base year for projections, 2000 for each climate scenario, A1b, B1 and A2, and under the no policy population scenario, SC1. The ratio between the two water availabilities is used for each 0.5°grid.

$$Ratio = \frac{\textit{per capita water available per grid for } 2100_{(SRES_i\,,\,SC1)}}{\textit{per capita water available per grid for } 2000_{(SRES_i\,,\,CEISIN2000)}} \quad \cdots(3)$$

Here, $SRES_i$ is the climate scenario, which is one of A1b, B1 or A2. *SC1* is the no-policy population scenario. *SEICIN2000* is the base year population counts per grid obtained from CEISIN (2010).

The ratios are classified for producing **Fig. 3(b)**, basically around a range assumed to be the class of grids indicating a negligible change of per capita water availability. A ±20% was assumed to indicate the range of negligible change. The classification is a follows.

1.0 ± 20% (ie. 0.8-1.2) negligible change in per capita water availability

0.8-1.0	per capita water availability in 2100 has decreased by more than half that of 2000, but still a considerable change
< 0.5	per capita water availability in 2100 is reduced by half or more
1.2-5.0	per capita water availability has increased by an amount more than negligible, but less than 5 times that of 2000.
> 5.0	per capita water availability in 2100 has increased by more than 5 times that of the year 2000.

Data used:

1. TRIP data for 2000 and for 2100, averaged over 4 GCM's (CCSM3, MIROC3.2, CGCM2.3.2 and UKMO).
2. Population count per grid, CEISIN, resolution 0.5°, UN adjusted.
3. Population projections for 2100, under scenario SC1. Projection factors are provided in a separate file.

Fig. 3(c)

Fig. 3(c) is meant to explain the benefits of the population reduction policy scenario, SC2, over the no-policy population scenario, SC1 in increasing per capita water availability. This comparative benefit is termed "the gain in per capita water" in **Fig. 3(c)**. As the population scenarios used are only three (SC1, SC2 and SC3), the gain for a particular year (for 2100 is shown in figure) is the same for every climate scenario (A1b, B1 or A2). Here, $SRES_i$ is the climate scenario, which is one of A1b, B1 or A2.

$$Gain\ in\ per\ capita\ water = \frac{per\ capita\ water\ for\ each\ 0.5^\circ\ grid_{\ (2100,\ SRES_i,\ SC2)}}{per\ capita\ water\ for\ the\ grid_{\ (2100,\ SRES_i,\ SC1)}} \qquad \cdots(4)$$

For any climate scenario, this simplifies to:

$$Gain\ in\ per\ capita\ water = \frac{Population\ for\ each\ 0.5^\circ\ grid_{\ (2100,\ SC1)}}{Population\ for\ the\ grid_{\ (2100,\ SC2)}} \qquad \cdots(5)$$

Considering equation (1), equation (5) could again be simplified to,

$$Gain\ in\ per\ capita\ water = \frac{Population\ projection\ factor_{\ (2100,\ SC1)}}{Population\ projection\ factor_{\ (2100,\ SC2)}} \qquad \cdots(6)$$

This gives the same value for all 0.5° grids falling inside the same national boundary.

Data used:

1. Population projections for 2100, under scenarios SC1 and SC2. Projection factors are provided in a separate file.

Fig. 3(d)

This figure is similar to the **Fig. 3(c)**. **Fig. 3(d)** compares the gain/losses given by the policy applied population scenario, SC3 in 2100 over the no-policy population scenario, SC1. SC3 applies population reduction policies in some regions (indicated in blue in the figure) and population stabilization policies in some others (indicated in red in the figure). Similar to equation (6), the gain/loss given by SC3 in 2100 is given by,

$$Gain\ /\ loss\ in\ per\ capita\ water = \frac{Population\ projection\ factor_{\ (2100,\ SC1)}}{Population\ projection\ factor_{\ (2100,\ SC3)}} \qquad \cdots(7)$$

Data used:

1. Population projections for 2100, under scenarios SC1 and SC3. Projection factors are provided in a separate file.

Data utilized and the sources

1. Population projections for the population scenarios utilized for the study. These are works of the authors (N.K. Gunasekara and S. Kazama). The projection factors for the year 2100 are provided in a separate file. Using equation (1), the CEISIN 2000 gridded population of horizontal resolution 0.5° (data source 2) and the National Identifier Grid (data source 3), the gridded population scenarios of resolution 0.5° could be obtained.

   SC1 - no-policy population scenario
   SC2 – population reduction policies applied in some regions (indicated in blue in **Fig. 3(c)**).
   SC3 – population reduction policies applied in some regions (indicated in blue in the **Fig. 3(d)**) and population stabilization policies in some others (indicated in red in the **Fig. 3(d)**)
2. Gridded population of the world of resolution 0.5°, for the year 2000. Center for International Earth Science Information Network (CIESIN), Gridded Population of the World, version 3 (GPWv3). (CEISIN, 2010).
3. National Identifier Grid. International Earth Science Information Network (CIESIN), Gridded Population of the World, version 3 (GPWv3). (CEISIN, 2010).

4. Output annual average river discharges per grid of horizontal resolution 0.5° of the global river routing network Total Runoff Integrating Pathways (TRIP-1) of University of Tokyo (Please refer Oki et al. (1998) and Oki et al. (2001) for further information on TRIP). The input forcing to the TRIP to calculate discharge is the monthly runoff data from "WCRP CMIP3 Multi-Model Dataset Archive", which could be accessed here: http://www-pcmdi.llnl.gov/ipcc/about_ipcc.php/. Discharges were obtained for Special Report on Emissions Scenarios (SRES) A1b, B1 and A2, from runoff forcing under four Global Climate Models (GCM's) CCSM3, MIROC3.2, CGCM2.3.2 and UKMO. Please contact the Institute of Industrial Studies (IIS) of University of Tokyo for the data: Dr. D. Yamazaki (yamadai@rainbow.iis.u-tokyo.ac.jp).

References

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