Corrigendum to “The global water resources and use model WaterGAP v2.2d: model description and evaluation” published in Geosci. Model Dev., 14, 1037–1079, 2021

Hannes Müller Schmied1,2, Denise Cáceres1, Stephanie Eisner3, Martina Flörke4, Claudia Herbert1, Christoph Niemann1, Thedini Asali Peiris1, Eklavyya Popat1, Felix Theodor Portmann1, Robert Reinecke1,5, Maike Schumacher6,7, Somayeh Shadkam1, Camelia-Eliza Telteu1, Tim Trautmann1, and Petra Döll1,2

1 Institute of Physical Geography, Goethe University Frankfurt, Frankfurt am Main, Germany
2 Senckenberg Leibniz Biodiversity and Climate Research Centre (SBiK-F), Frankfurt am Main, Germany
3 Norwegian Institute of Bioeconomy Research (NIBIO), Ås, Norway
4 Engineering Hydrology and Water Resources Management, Ruhr-University of Bochum, Bochum, Germany
5 International Centre for Water Resources and Global Change (UNESCO), Federal Institute of Hydrology, Koblenz, Germany
6 Institute of Physics and Meteorology, University of Hohenheim, Stuttgart, Germany
7 Computational Science Lab (CSL) at the University of Hohenheim, Stuttgart, Germany

Correspondence: Hannes Müller Schmied (hannes.mueller.schmied@em.uni-frankfurt.de)

Published: 16 March 2023

This corrigendum was written in order not only to reflect feedback we have received since the original paper was published but also to update the code and model output description. In particular, some typos, errors in wording, and references to figures present in the original manuscript submission are corrected (Sects. 1, 3, 4, 5); the description of the calculation of runoff is now written in an unambiguous way (Sect. 2); and a number error in Table 6 of the original paper, which was introduced during the production process, is corrected. Furthermore, the model code is now available open access and model output driven by an additional climate forcing is now available (Sect. 7).

1 Unit correction

The unit for the land-cover-specific degree-day factor $D_F$ (Sect. 4.3.3) is not mm d$^{-1}$ °C but mm d$^{-1}$ °C$^{-1}$.

2 Explicit description for runoff from land

The description of the variable runoff from land $R_l$ (Eq. 18 in Sect. 4.4.3) is ambiguous. Actually, Eq. (18) describes a part of $R_l$, the soil water outflow, which forms together with the soil water overflow and the urban runoff (see the sentences after Eq. 18) the total runoff. To be unambiguous, Sect. 4.4.3 starting after the sentence “$E_{pot, max}$ is set to 15 mm d$^{-1}$ globally” and until “$R_l$ is partitioned into fast surface and subsurface runoff” is replaced by the following:

Runoff from land $R_l$ (Eq. 15) is calculated as

$$R_l = R_1 + R_2 + R_3,$$  

(18a)

where $R_1$ is the runoff in urban areas and is calculated as

$$R_1 = \begin{cases} 0.5 P_{eff} f_{urban} & \text{for the urban land fraction,} \\ 0 & \text{otherwise.} \end{cases}$$  

(18b)

Here $f_{urban}$ is the fraction of urban areas of the grid cell (defined from MODIS data, Appendix C) and the amount of $R_1$ is subtracted from $P_{eff}$ before calculating $R_2$ and $R_3$.

$R_2$ is the soil water outflow that occurs when addition of $P_{eff}$ to the soil exceeds $S_{s,\text{max}}$. It is calculated as

$$R_2 = \begin{cases} P_{eff} + S_{s,t-1} - S_{s,\text{max}} & (P_{eff} + S_{s,t-1}) > S_{s,\text{max}}, \\ 0 & \text{otherwise,} \end{cases}$$  

(18c)
Table 6. Global-scale (excluding Antarctica and Greenland) water balance components for different time spans as simulated with WaterGAP 2.2d. All units in km$^3$ yr$^{-1}$. Long-term average volume balance error is calculated as the difference between component 1 and the sum of components 2, 3, and 7.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Precipitation</td>
<td>111 388</td>
<td>111 582</td>
<td>111 616</td>
<td>112 052</td>
<td>112 559</td>
</tr>
<tr>
<td>2</td>
<td>Actual evapotranspiration$^a$</td>
<td>70 734</td>
<td>71 604</td>
<td>71 979</td>
<td>72 225</td>
<td>72 328</td>
</tr>
<tr>
<td>3</td>
<td>Streamflow into oceans and inland sinks</td>
<td>40 659</td>
<td>40 009</td>
<td>39 678</td>
<td>39 930</td>
<td>40 357</td>
</tr>
<tr>
<td>4</td>
<td>Actual consumptive water use$^b$</td>
<td>906</td>
<td>1023</td>
<td>1146</td>
<td>1238</td>
<td>1302</td>
</tr>
<tr>
<td>5</td>
<td>Actual net abstraction from surface water</td>
<td>1002</td>
<td>1108</td>
<td>1220</td>
<td>1304</td>
<td>1353</td>
</tr>
<tr>
<td>6</td>
<td>Actual net abstraction from groundwater</td>
<td>−96</td>
<td>−85</td>
<td>−74</td>
<td>−66</td>
<td>−50</td>
</tr>
<tr>
<td>7</td>
<td>Change of total water storage</td>
<td>−6</td>
<td>−31</td>
<td>−40</td>
<td>−104</td>
<td>−125</td>
</tr>
<tr>
<td>8</td>
<td>Long-term average volume balance error</td>
<td>0.34</td>
<td>0.23</td>
<td>0.11</td>
<td>0.03</td>
<td>0.01</td>
</tr>
</tbody>
</table>

$^a$ Including actual consumptive water use. $^b$ Sum of rows 5 and 6.

3 Parameter correction

In Sect. 4.6.3 the maximum storage depth of local lakes and that of local wetlands have been interchanged. The maximum storage depth of local lakes is 5 m, whereas the maximum storage depth of local wetlands is 2 m.

4 Correct reference to Supplement figures

In Sect. 4.8, the numbers to the figures in the Supplement have been wrongly referenced. The references to Figs. S2–S5 should be read as references to Figs. S8–S11.

5 Textual correction

The description of Fig. 11b in the first section of Sect. 7.2.1 should be read as “The global map of inter-annual variability of runoff production (Fig. 11b), here defined as the ratio of runoff in a 1-in-10 dry year to total renewable water resources, shows regions with relatively constant and relatively variable annual runoff generation, in bluish and yellow colors, respectively” (it was accidentally written as “reddish” instead of “yellow”).

6 Error in Table 6

Due to an oversight in the production process, an error appeared in Table 6 (Sect. 7.3). The 4009 km$^3$ yr$^{-1}$ value should be replaced by 40 009 km$^3$ yr$^{-1}$ such that the correct table is Table 6 in this corrigendum.

7 Updated code and model output availability

The WaterGAP model v2.2d as described in this paper was re-calibrated and run with an alternative climate forcing, the so-called GSWP3-W5E5 forcing from ISIMIP3a (Frieler et
al., 2023), available for 1901–2019 (Lange et al., 2022). Furthermore, the source code for WaterGAP v2.2d is now publicly available. The “Code and data availability” section has been updated accordingly.

**Code and data availability.** The source code of WaterGAP 2.2d is publicly available online at https://doi.org/10.5281/zenodo.6902111 (Müller Schmied et al., 2022a). The model output data availability is described in Sect. 5. The standard model output is available online at https://doi.org/10.1594/PANGAEA.918447 (Müller Schmied et al., 2020) and https://doi.org/10.1594/PANGAEA.948461 (Müller Schmied et al., 2022b). For the latest papers published based on WaterGAP, we refer to http://www.watergap.de (Döll, 2020).

**References**


