Supplement of

A hydrological emulator for global applications – HE v1.0.0

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Figure captions

**Figure S1** Comparison between the monthly GRDC observations and the VIC, and the UNH/GRDC runoff products at Amazon, Columbia and Yenisey basins for the period of 1986-1995. Note that the basin delineation here is consistent with that of Dai et al. (2009), the streamflow data of each basin (km³ mon⁻¹) is transferred to the unit of mm mon⁻¹ by dividing by the basin area, and each dot on the scatter plot represent 2-dimensional monthly runoff/streamflow values.

**Figure S2** Comparison between the long-term annual mean VIC runoff product and the streamflow data in Dai et al. (2009) and UNH/GRDC runoff product during 1986-1995 across 260 global major basins. Note that the basin delineation here is consistent with that of Dai et al. (2009), and the streamflow of each basin (km³ yr⁻¹) is transferred to the unit of mm yr⁻¹ by dividing by the basin area.

**Figure S3** Kling-Gupta efficiency of the simulated basin-level total runoff across the global 235 basins (lump = lumped, dist = distributed, cal = calibration, the x-axis labels of “lump_val” or “dist_val” represent lumped/distributed scheme during validation period).

**Figure S4** Comparison of basin-specific long-term annual total runoff, direct runoff and baseflow estimates from the lumped abcd model against VIC product, across global 235 basins and for the calibration period of 1971-1990. Note that here only the total runoff is involved in the objective function.

**Figure S5** Spatial patterns of long-term annual ET (mm yr⁻¹) across global 235 basins: a) the mean of the LandFlux-EVAL merged data sets for 1989-2005; b) ET product from VIC simulation; c) ET estimates from the lumped abcd model (lump = lumped) for 1981-1990; and d) ET estimates from the distributed abcd model (dist = distributed) for 1981-1990.
Figure S1
Figure S2
Figure S3

Kling-Gupta Efficiency (KGE)
Figure S4
Table S1 Runtime for model calibration and simulation at Amazon basin for the lumped (lump) and distributed (dist) “abcd” model scheme, as well as for the VIC model.

<table>
<thead>
<tr>
<th></th>
<th>calibration</th>
<th>1000 years’ simulation</th>
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<tr>
<td>lump</td>
<td>0.16 min</td>
<td>0.03 s</td>
</tr>
<tr>
<td>dist</td>
<td>11.05 min</td>
<td>3.20 s</td>
</tr>
<tr>
<td>VIC</td>
<td>N/A</td>
<td>~ 1 week</td>
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