EGU General Assembly 2020

EGU2020-7549, updated on 19 Oct 2021
https://doi.org/10.5194/egusphere-egu2020-7549
EGU General Assembly 2020

Similarities and differences among fifteen global water models in simulating the vertical water balance

Camelia-Eliza Telteu[1], Hannes Müller Schmied[2], Wim Thiery[3], Guoyong Leng[4], Peter Burek[5], Xingcai Liu[4], Julien Eric Stanislas Boulange[6], Lauren Paige Seaby[7], Manolis Grillakis[8], Yusuke Satoh[6], Oldrich Rakovec[9], Tobias Stacke[10], Jinfeng Chang[5,11], Niko Wanders[12], Fulu Tao[13,14,15], Ran Zhai[13,14], Harsh Lovekumar Shah[16], Tim Trautmann[1], Ganquan Mao[17], Aristeidis Koutroulis[8], Yadu Pokhrel[18], Luis Samaniego[9], Yoshihide Wada[5], Vimal Mishra[16], Junguo Liu[17], Simon Newland Gosling[19], Jacob Schewe[7], and Fang Zhao[20]

[1]Institute of Physical Geography, Goethe University Frankfurt, Frankfurt am Main, Germany (telteu@em.uni-frankfurt.de, hannes.mueller.schmied@em.uni-frankfurt.de, t.trautmann@em.uni-frankfurt.de)
[2]Senckenberg Leibniz Biodiversity and Climate Research Center, Frankfurt am Main, Germany
[3]Department of Hydrology and Hydraulic Engineering, Vrije Universiteit Brussel, Brussels, Belgium (wim.thiery@vub.be)
[4]Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China (lenggy@igsnrr.ac.cn, xingcailiu@igsnrr.ac.cn)
[5]International Institute for Applied Systems Analysis, Laxenburg, Austria (burek@iiasa.ac.at, changj@iiasa.ac.at, wada@iiasa.ac.at)
[6]National Institute for Environmental Studies, Tsukuba, Japan (boulange.julien@nies.go.jp, satoh.yusuke@nies.go.jp)
[7]Potsdam Institute for Climate Impact Research, Potsdam, Germany (seaby@pik-potsdam.de, jacob.schewe@pik-potsdam.de)
[8]School of Environmental Engineering, Technical University of Crete, Chania, Greece (manolis@hydromech.gr, aris@hydromech.gr)
[9]Helmholtz Centre for Environmental Research, Leipzig, Germany (oldrich.rakovec@ufz.de, luis.samaniego@ufz.de)
[10]Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Geesthacht, Germany (tobias.stacke@hzg.de)
[11]Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France
[12]Department of Physical Geography, Utrecht University, Utrecht, Netherlands (n.wanders@uu.nl)
[13]Key Laboratory of Land Surface Pattern and Simulation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China (taofl@igsnrr.ac.cn, zhair.15b@igsnrr.ac.cn)
[14]College of Resources and Environment, University of Chinese Academy of Sciences, Beijing, China
[15]Natural Resources Institute Finland, Helsinki, Finland
[16]Indian Institute of Technology Gandhinagar, Palaj, Gandhinagar, India (harsh.lovekumar.shah@iitgn.ac.in, vmishra@iitgn.ac.in)
[17]School of Environmental Science and Engineering, Southern University of Science and Technology, Shenzhen, China (maogq@sustech.edu.cn, liujg@sustech.edu.cn)
[18]Department of Civil and Environmental Engineering, Michigan State University, East Lansing, Michigan, United States of America (ypokhrel@egr.msu.edu)
[19]School of Geography, University of Nottingham, Nottingham, United Kingdom of Great Britain and Northern Ireland (Simon.Gosling@nottingham.ac.uk)
[20]School of Geographic Sciences, East China Normal University (fzhao@geo.ecnu.edu.cn)

Hydrological models have been developed in response to the need to understand the complex

water cycle of the Earth and to assess its interaction with historical and future climate scenarios. In the global water sector of the Inter-Sectoral Impact Model Intercomparison Project phase 2b (ISIMIP2b), six land surface models (LSMs), eight hydrological models (GHMs), and one dynamic vegetation model (DGVM) are contributing with transient simulations spanning from 1660 to 2300. The model simulations follow a common protocol and are driven by common bias adjusted climate model outputs combined with plausible socio-economic scenarios and representative concentration pathways. The main goal of this study is to highlight similarities and differences among these models in simulating the vertical water balance. The main similarity of these models consists in the water cycle simulation, even if the models have been developed for different purposes such as energy cycle (LSMs), water cycle (GHMs), or vegetation cycle (DGVM) simulation. In particular, we address the following research question: 1) what equations are used to compute water storages and water fluxes; 2) how different are the equations among the models; 3) how the equations were adjusted; 4) how many parameters are used by the models; 5) how often the parameters are used; 6) how similar or different are the parameters among the models. To this end, we apply a standard writing style of the water storages and water fluxes included in the models, to easily identify the similarities and differences among them. Most of the models include in their structure the canopy, soil, and snow storages, and almost half of them include the groundwater storage. Furthermore, we find that: 1) a model needs a very good documentation, this would help to easily identify and understand the equations in the code; 2) some modelers teams use common approaches resulting in similar equations of water storages or water fluxes, but different models structures still lead to different models results; 3) collaboration and communication among the modelers are necessary, on the one hand, for the realization of the models standard writing style, and on the other hand, for a better understanding of the models themselves, especially their strengths, limitations and results. Overall, our results (i) help to better explain the different models results and to attribute these to the differences in simulating specific processes; (ii) contribute to the remarkable efforts in creating a common protocol and a common input datasets for well-defined simulations; (iii) foster a better understanding of how the models work and finding new ways of improvement and development.