About

Editorial board

Articles GMD

- Recent final revised papers
- Volumes and issues
- Special issues
- Full text search
- Title and author search

Articles GMDD

Highlight articles

Subscribe to alerts

Peer review

For authors

For reviewers

User ID

Password

New user? | Lost login?

Follow
@EGU_GMD

Journal metrics

IF 5-year 5.154
SNIP 3.654
IPP 1.812
SJR 5.140
h5-index 3.969
Definitions

Abstracted/indexed

- Science Citation Index Expanded
- Current Contents/PCE
- Scopus
- ADS
- Chemical Abstracts
- CLOCKSS
- CNKI
- DOAJ
- EBSCO
- GBA
- Gale/Cengage
- GeoBase
- GeoRef
- Google Scholar
- J-Gate
- Portico
- ProQuest
- World Public Library

Geosci. Model Dev., 7, 2747-2767, 2014
www.geosci-model-dev.net/7/2747/2014/
doi:10.5194/gmd-7-2747-2014
© Author(s) 2014. This work is distributed
under the Creative Commons Attribution 3.0 License.

Technical/Development/Evaluation Paper

21 Nov 2014

Modelling the role of fires in the terrestrial carbon balance by incorporating SPITFIRE into the global vegetation model ORCHIDEE – Part 1: simulating historical global burned area and fire regimes

C. Yue[1,2], P. Ciais[1], P. Cadule[1], K. Thonicke[3], S. Archibald[4,5], B. Poulter[6], W. M. Hao[7], S. Hantson[8,9], F. Mouillot[10], P. Friedlingstein[11], F. Maignan[1], and N. Viovy[1]

[1]Laboratoire des Sciences du Climat et de l'Environnement, LSCE CEA CNRS UVSQ, 91191 Gif-Sur-Yvette, France
[2]Laboratoire de Glaciologie et Géophysique de l'Environnement, UJF, CNRS, Saint Martin d'Hères CEDEX, France
[3]Potsdam Institute for Climate Impact Research (PIK) e.V., Telegraphenberg A31, 14473 Potsdam, Germany
[4]CSIR Natural Resources and Environment, P.O. Box 395, Pretoria 0001, South Africa
[5]School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, Private Bag X3,WITS, 2050, South Africa
[6]Institute on Ecosystems and Department of Ecology, Montana State University, Bozeman, MT 59717, USA
[7]US Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT, USA
[8]University of Alcalá, Department of Geography, Calle Colegios 2, Alcalá de Henares 28801, Spain

[9]Karlsruhe Institute of Technology, Institute of Meteorology and Climate research, Atmospheric Environmental Research, 82467 Garmisch-Partenkirchen, Germany
[10]IRD, UMR CEFE, 1919 route de mende, 34293 Montpellier CEDEX 5, France
[11]College of Engineering, Mathematics and Physical Sciences, University of Exeter, Exeter, EX4 4QE, UK

Received: 15 Feb 2014 – Published in Geosci. Model Dev. Discuss.: 10 Apr 2014
Revised: 17 Sep 2014 – Accepted: 16 Oct 2014 – Published: 21 Nov 2014

Abstract. Fire is an important global ecological process that influences the distribution of biomes, with consequences for carbon, water, and energy budgets. Therefore it is impossible to appropriately model the history and future of the terrestrial ecosystems and the climate system without including fire. This study incorporates the process-based prognostic fire module SPITFIRE into the global vegetation model ORCHIDEE, which was then used to simulate burned area over the 20th century. Special attention was paid to the evaluation of other fire regime indicators such as seasonality, fire size and fire length, next to burned area. For 2001–2006, the simulated global spatial extent of fire agrees well with that given by satellite-derived burned area data sets (L3JRC, GLOBCARBON, GFED3.1), and 76–92% of the global burned area is simulated as collocated between the model and observation, depending on which data set is used for comparison. The simulated global mean annual burned area is 346 Mha yr^{-1}, which falls within the range of 287–384 Mha yr^{-1} as given by the three observation data sets; and is close to the 344 Mha yr^{-1} by the GFED3.1 data when crop fires are excluded. The simulated long-term trend and variation of burned area agree best with the observation data in regions where fire is mainly driven by climate variation, such as boreal Russia (1930–2009), along with Canada and US Alaska (1950–2009). At the global scale, the simulated decadal fire variation over the 20th century is only in moderate agreement with the historical reconstruction, possibly because of the uncertainties of past estimates, and because land-use change fires and fire suppression are not explicitly included in the model. Over the globe, the size of large fires (the 95th quantile fire size) is underestimated by the model for the regions of high fire frequency, compared with fire patch data as reconstructed from MODIS 500 m burned area data. Two case studies of fire size distribution in Canada and US Alaska, and southern Africa indicate that both number and size of large fires are underestimated, which could be related with short fire patch length and low daily fire size. Future efforts should be directed towards building consistent spatial observation data sets for key parameters of the model in order to constrain the model error at each key step of the fire modelling.

Citation: Yue, C., Ciais, P., Cadule, P., Thonicke, K., Archibald, S., Poulter, B., Hao, W. M., Hantson, S., Mouillot, F., Friedlingstein, P., Maignan, F., and Viovy, N.: Modelling the role of fires in the terrestrial carbon balance by incorporating SPITFIRE into the global vegetation model ORCHIDEE – Part 1: simulating historical global burned area and fire regimes, Geosci. Model Dev., 7, 2747-2767, doi:10.5194/gmd-7-2747-2014, 2014.

Search GMD
Full Text
Final Revised Paper
- Companion paper
- Supplement (2024 KB)
PDF
FULL-TEXT XML

Citation

- BibTeX
- EndNote

Discussion Paper

Published on 10 Apr 2014

Share