

*JGR: Biogeosciences*

Supporting Information for

**A process-model perspective on recent changes in the carbon cycle of North America**

Guillermo Murray-Tortarolo1\*, Benjamin Poulter2, Rodrigo Vargas3, Daniel Hayes4, Anna Michalak5, Christopher Williams6, Lisamarie Windham-Myers7, Jonathan A. Wang8, Kimberly P. Wickland9, Abhishek Chaterjee2, David Butman10, Hanqin Tian11, Stephen Sitch12, Pierre Friedlingstein13, Mike O’Sullivan13, Peter Briggs14, Vivek Arora15, Danica Lombardozzi16, Atul Jain17, Wenping Yuan18, Roland Séférian19, Julia Nabel20, Andy Wiltshire21, Almut Arneth22, Sebastian Lienert23, Sönke Zaehle20, Vladislav Bastrikov24, Daniel Goll25, Nicolas Vuichard24, Anthony Walker26, Etsushi Kato27, Xu Yue28, Zhen Zhang29, Werner Kurz30

**Affiliations:**

1 Instituto de Investigaciones en Ecosistemas y Sustentabilidad. Universidad Nacional Autónoma de México, Morelia, México

2 NASA Goddard Space Flight Center, Biospheric Sciences Lab., Greenbelt, USA

3 Department of Plant and Soil Science, University of Delaware, Newark, DE, USA

4School of Forest Resources, University of Maine, Orono, ME, USA

5 Department of Global Ecology, Carnegie Institution for Science, Stanford, CA, USA

6 Graduate School of Geography, Clark University, Worcester, MA, USA

7 U.S. Geological Survey, Water Resources Mission Area, Menlo Park, California, USA

8 Department of Earth System Science, University of California, Irvine, CA, USA

9United States Geological Survey, Water Resources Mission Area, Boulder, CO, USA

10 School of Environmental and Forest Sciences and with Civil and Environmental Engineering at the University of Washington, Seattle, WA, USA

11 International Center for Climate and Global Change Research, School of Forestry and Wildlife Sciences, Auburn University, Auburn, USA

12 Department of Geography, College of Life and Environmental Sciences, University of Exeter, Exeter, UK

13 College of Engineering, Mathematics and Physical Sciences, University of Exeter, Exeter, UK

14 Commonwealth Scientific and Industrial Research Organization (CSIRO) Oceans and Atmosphere, Aspendale, Australia

15 Canadian Centre for Climate Modelling and Analysis, Environment and Climate Change Canada, University of Victoria, Victoria, British Columbia, Canada

16 Climate and Global Dynamics Laboratory, National Center for Atmospheric Research, Boulder, CO, USA

17 Department of Atmospheric Sciences, University of Illinois, Urbana, IL, USA

18 School of Atmospheric Sciences, Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), Sun Yat-sen University, Zhuhai, China

19 CNRM, Université de Toulouse, Meteo-France, CNRS, Toulouse, France

20 Max Planck Institute for Meteorology, Hamburg, Germany

21 Met Office Hadley Centre, Exeter, UK

22 Institute of Meteorology and Climate Research/Atmospheric Environmental Research, Karlsruhe Institute of Technology, Garmisch–Partenkirchen, Germany

23 Climate and Environmental Physics, Physics Institute and Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland

24 Laboratoire des Sciences du Climat et de l'Environnement, Institut Pierre-Simon Laplace, CEA-CNRS-UVSQ, CE Orme des Merisiers, Gif-sur-Yvette CEDEX, France

25 Université Paris Saclay, CEA-CNRS-UVSQ, LSCE/IPSL, Gif sur Yvette, France

26 Environmental Sciences Division and Climate Change Science Institute, Oak Ridge National Laboratory, Oak Ridge, TN, USA

27 Institute of Applied Energy, Tokyo, Japan

28 School of Environmental Science and Engineering, Nanjing University of Information Science & Technology (NUIST), Nanjing 210044, China

29 Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD 20740, USA

\*Corresponding author: [gmurray@iies.unam.mx](mailto:gmurray@iies.unam.mx) ORCID: <https://orcid.org/0000-0002-5620-6070>

**Contents of this file**

Table S1

Table S2

Figure S1

Figure S2

Table S3

Figure S3

**Table S1. DGVMs characteristics and key processes included in this study. Additional information can be found in Friedlingstein et al. (2020) table A1.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Cable-pop** | **Classic** | **CLM5** | **DLME** | **IBIS** | **ISAM** | **ISBA** | **JSBACH** | **JULES.ES.10** | **LPJ.Guess** | **LPX.Bern** | **LPJ** | **OCN** | **ORCHIDEE** | **ORCHIDEE.CNP** | **ORCHIDEEv3** | **SDGVM** | **VISIT** | **YIBs** |
| **Original Resolution** | 1x1 | 2.185x2.185 | 1.25x0.9375 | 0.5x0.5 | 1x1 | 0.5x0.5 | 1x1 | 1.875x1.875 | 1.875x1.25 | 0.5x0.5 | 0.5x0.5 | 0.5x0.5 | 1x1 | 0.5x0.5 | 2x2 | 0.5x0.5 | 1x1 | 0.5x0.5 | 1x1 |
| **Fire** | No | Yes | Yes | No | No | No | Yes | Yes | No | Yes | Yes | Yes | No | No | No | No | Yes | Yes | No |
| **Harvest**  **(wood + crops)** | No | No | Yes | No | No | No | Yes | Yes | Yes | Yes | No | No | No | Yes: | Yes | No | No | No | No |
| **Grazing** | No | No | No | No | No | No | No | Yes | No | Yes | No | No | No | No | No | No | No | No | No |
| **FLUC** | No | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

**References**

Friedlingstein, P., Jones, M. W., O'sullivan, M., Andrew, R. M., Hauck, J., Peters, G. P., ... & Zaehle, S. (2019). Global carbon budget 2019. Earth System Science Data, 11(4), 1783-1838.

**Table S2. Model Ensemble Mean C fluxes by subregion and decade.**

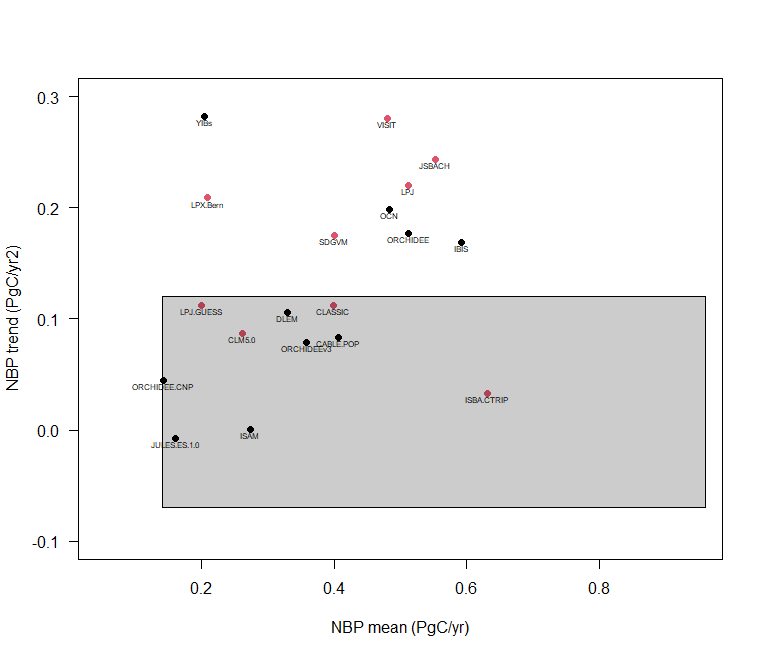
|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Region** | **Decade** | **NBP** | **NBP error** | **GPP** | **GPP error** | **RH** | **RH error** | **Ra** | **Ra Error** | **D** | **D error** |
| **USA** | 2000-2009 | 0.14 | 0.16 | 8.50 | 1.09 | 3.71 | 0.67 | 4.23 | 1.06 | 0.41 | 0.49 |
|  | 2010-2019 | 0.17 | 0.17 | 9.12 | 1.17 | 3.95 | 0.69 | 4.55 | 1.14 | 0.43 | 0.40 |
| **CAN** | 2000-2009 | 0.15 | 0.11 | 5.76 | 1.26 | 2.74 | 0.68 | 2.59 | 0.86 | 0.10 | 0.08 |
|  | 2010-2019 | 0.20 | 0.12 | 6.10 | 1.31 | 2.86 | 0.70 | 2.75 | 0.91 | 0.11 | 0.07 |
| **MEX** | 2000-2009 | 0.02 | 0.05 | 2.08 | 0.41 | 0.86 | 0.28 | 1.12 | 0.22 | 0.08 | 0.21 |
|  | 2010-2019 | 0.02 | 0.05 | 2.19 | 0.42 | 0.89 | 0.29 | 1.18 | 0.23 | 0.07 | 0.13 |
| **CA+C** | 2000-2009 | 0.01 | 0.02 | 1.87 | 0.83 | 0.71 | 0.22 | 1.09 | 0.64 | 0.02 | -0.08 |
|  | 2010-2019 | 0.01 | 0.02 | 1.91 | 0.83 | 0.72 | 0.22 | 1.12 | 0.65 | 0.02 | 0.05 |

**Figure S1: temporal NBP evolution in North America by individual Models from 2000-2019.**

Gráfico, Histograma

Descripción generada automáticamente

**Figure S2. Individual NBP model evaluation based on the mean and trend for the period 2000-2019. Grey rectangle indicates ranges of observed values from previous works as reported in Table 1 of the main text. Models that include a fire module are indicated in red.**



**Figure S3: gridded NBP during years with the lowest (left) and highest (right) NBP values in each decade. Mapa

Descripción generada automáticamente**

**Table S3 NBP separated for the conterminous USA and Alaska for 2000-2019.**

|  |  |  |
| --- | --- | --- |
| **Region** | **Period** | **NBP (PgC yr-1)** |
| Conterminous USA | 2000-2019 | 0.12 ± 0.13 |
| Alaska | 2000-2019 | 0.04 ± 0.05 |
| Whole USA | 2000-2019 | 0.16 ± 0.17 |

**Figure S4. Land mask employed for this work.**

Imagen que contiene Gráfico

Descripción generada automáticamente