46th Session of the World Climate Research Programme

Joint Scientific Committee

Partnership with the Global Carbon Project

Pierre Friedlingstein, Pep Canadell

WCRP World Climate Research Programme

WORLD METEOROLOGICAL ORGANIZATION

unesco

International Science Council

The GCP is a Global Research Project of

GCP Origins & Evolution

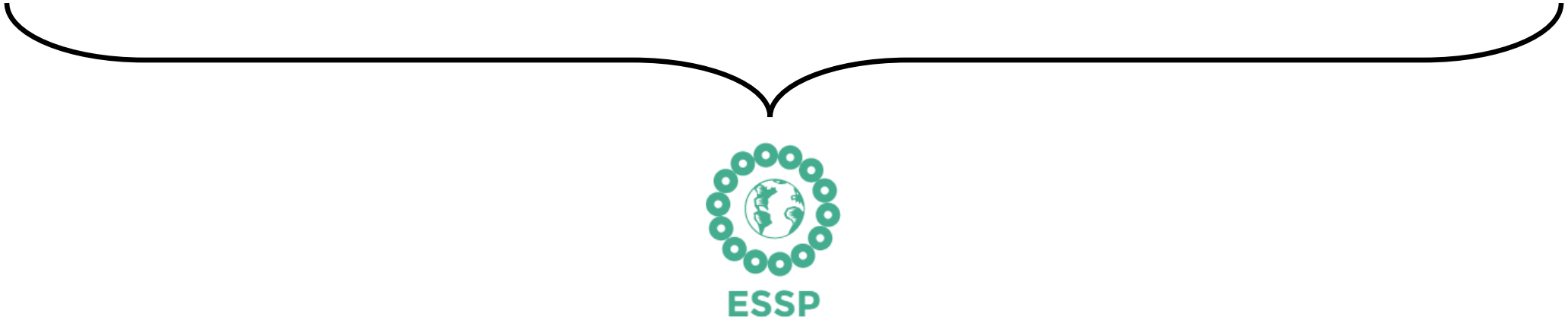
In the 1990s, GCTE (terrestrial), JGOFS (global oceans), etc. were IGBP projects with carbon research. Not much atmospheric carbon research.

GCP Origins & Evolution

IGBP saw the need to coordinate carbon among projects and start framing a possible new carbon project in late 1990s.

IGBP, with WCRP, IHDP and Diversitas, pushes for a new global research partnership: The Earth System Science Partnership, established in 2001.

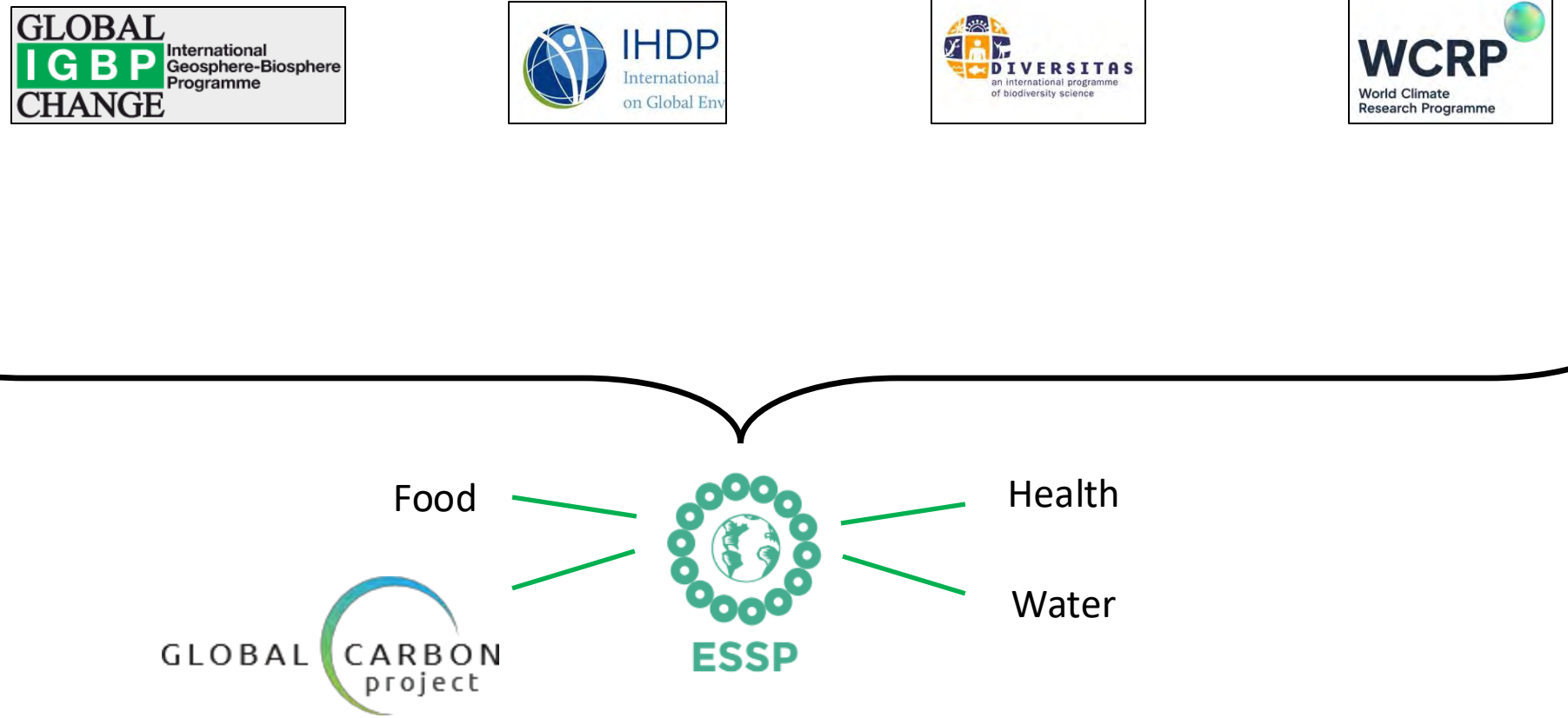
Programmes



GCP Origins & Evolution

ESSP establishes the Global Carbon Project in 2001, along with projects on water, food, and health (which no longer exist). The GCP had three co-chairs, Mike Raupach (IGBP), Oran Young (IHDP) and Bob Dickinson (WCRP).

Programmes

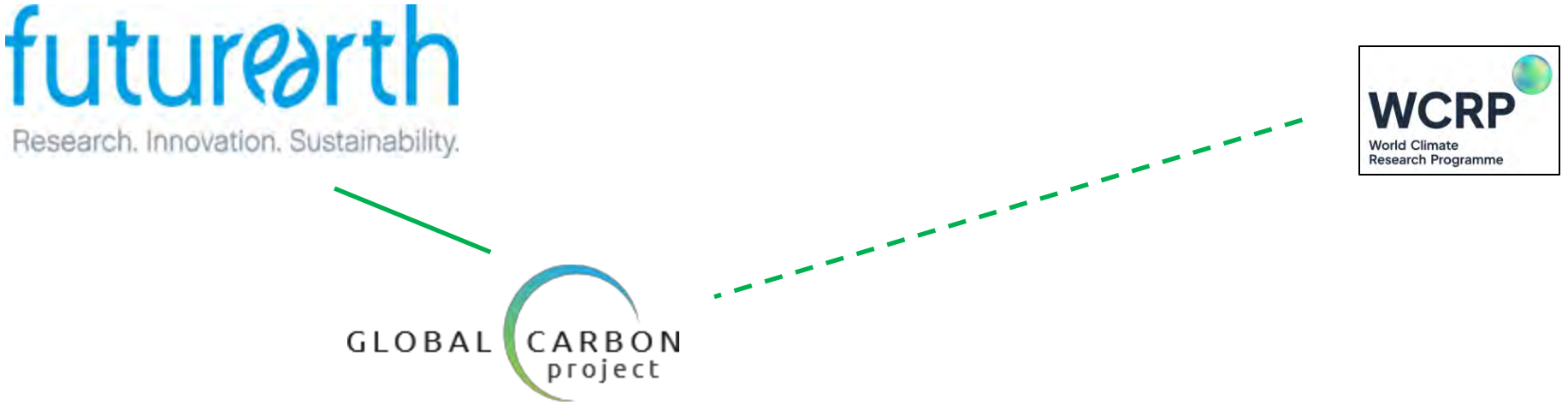


GCP Origins & Evolution

ESSP dissolves in 2012 (and with it IGBP, IHDP and Diversitas) to establish Future Earth, with a broader focus on global sustainability and science for action. WCRP remains but don't join FE. The GCP is transferred to FE.

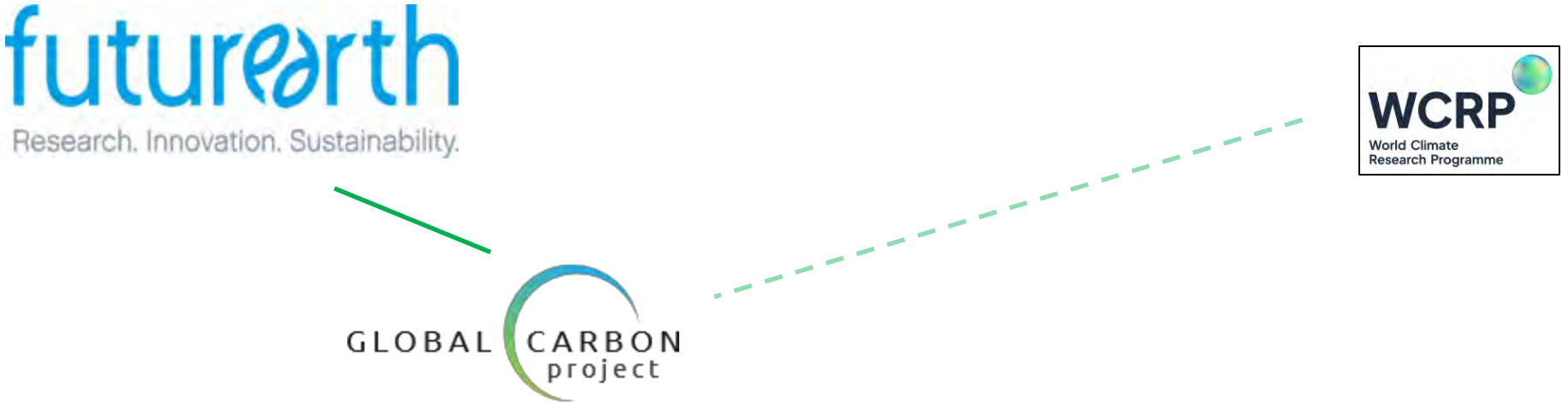
GCP Origins & Evolution

WCRP and the GCP sign a Scientific Partnership in 2017, recognizing their complementary scientific interests.



GCP Origins & Evolution

WCRP-GCP partnership ended in 2022. In 2024, WCRP reaffirms the commitment to continuing the partnership between WCRP and the Global Carbon Project.



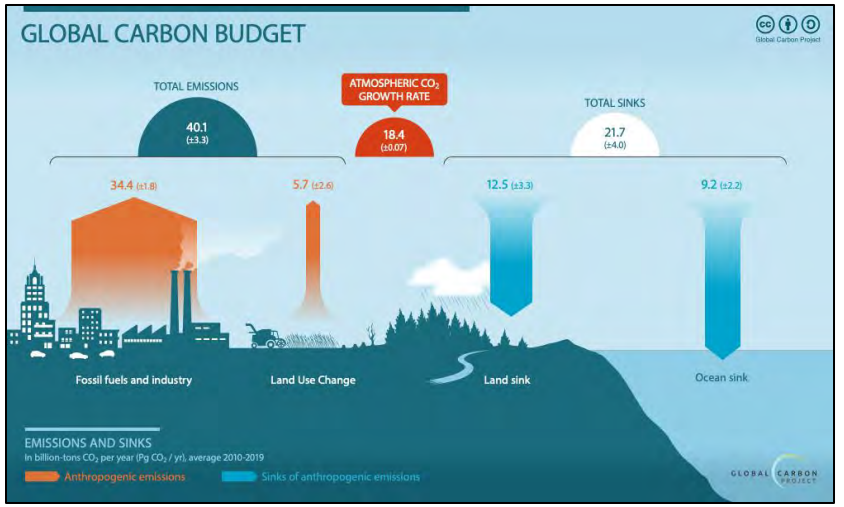
GCP Structure and Operational

- Scientific Steering Committee (12-15 members), and a big team of Activity Leaders who are the ones running the GCP research activities, which focus on tangible outcomes/products.
- GCP activities are volunteer-based, involving leadership and coordination of research community (hundreds of individual contributions).
- Building on national/EU funded projects, international coordination, support from host institutions, and volunteer work.
- There is an international GCP project coordination office (Canberra-AU) and three activity support offices (Exeter-UK-Carbon, Stanford-US-CH_4, Boston-US-N_2O); two regional/national GCP offices (Tsukuba-Japan and Seoul-Korea) all with some (limited) baseline funding.

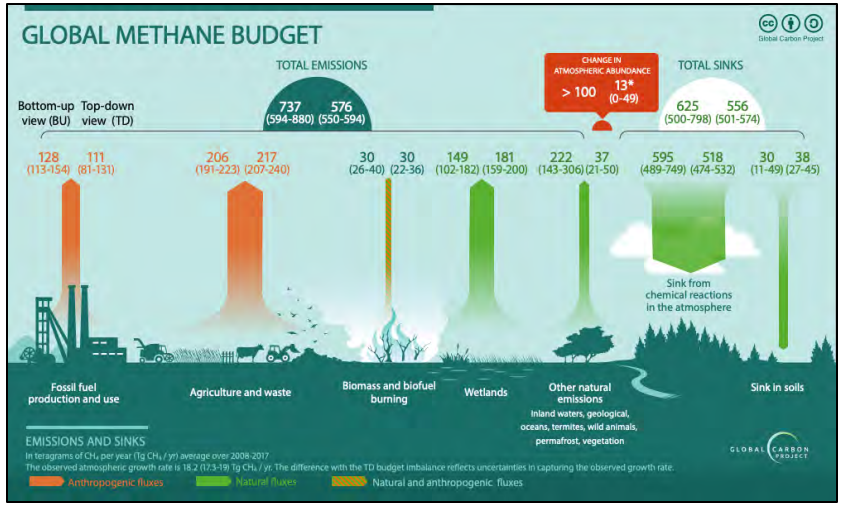
Global GHG Budgets

GLOBAL CARBON project

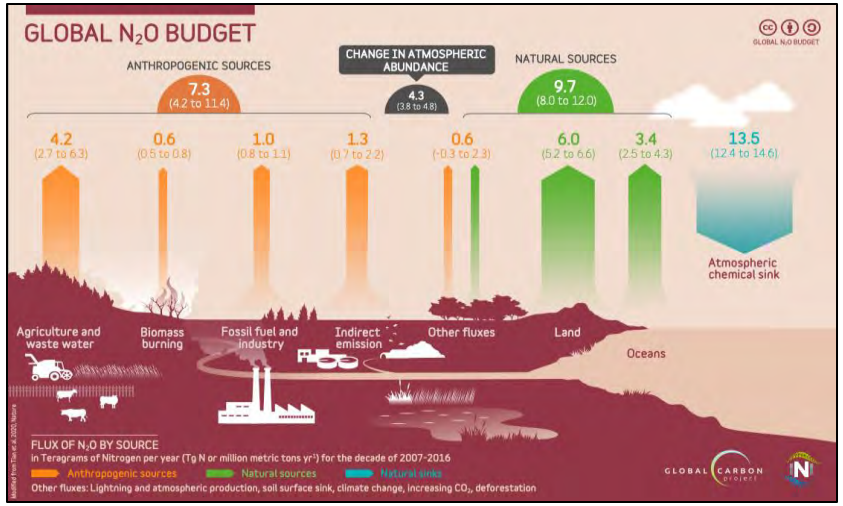
CO_2 – annual (19 published reports)



CH_4 ~ 3 years (2 published reports)



N_2O ~ 3 years (2 published reports)

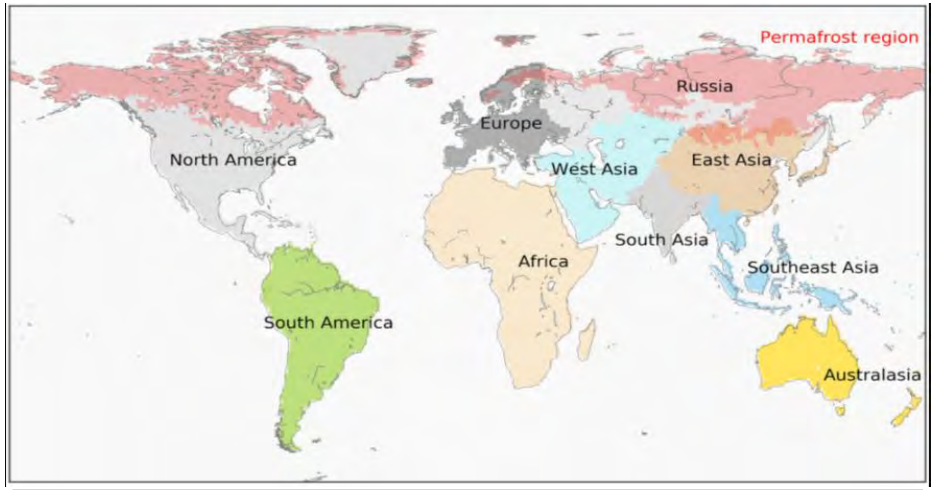


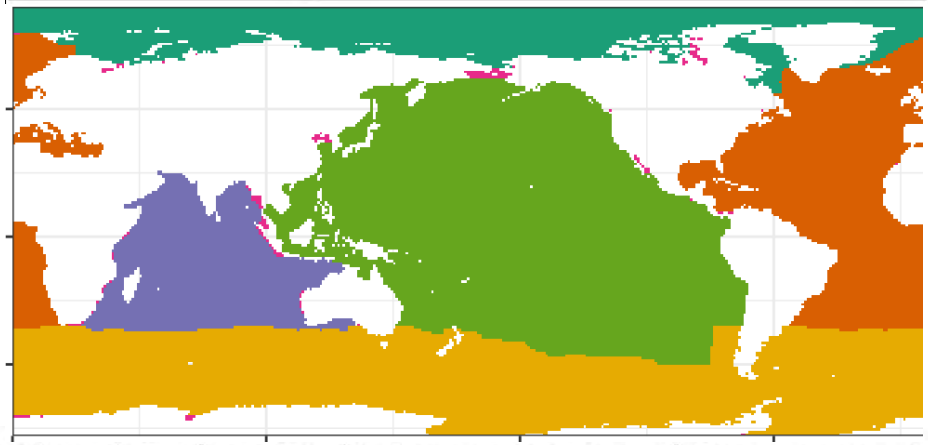
REgional Carbon Cycle Assessment and Processes (RECCAP)

GLOBAL CARBON project

RECCAP-2 (ending 2025)

20 Regional Budgets





Regional Carbon Cycle Assessment and Processes - 2

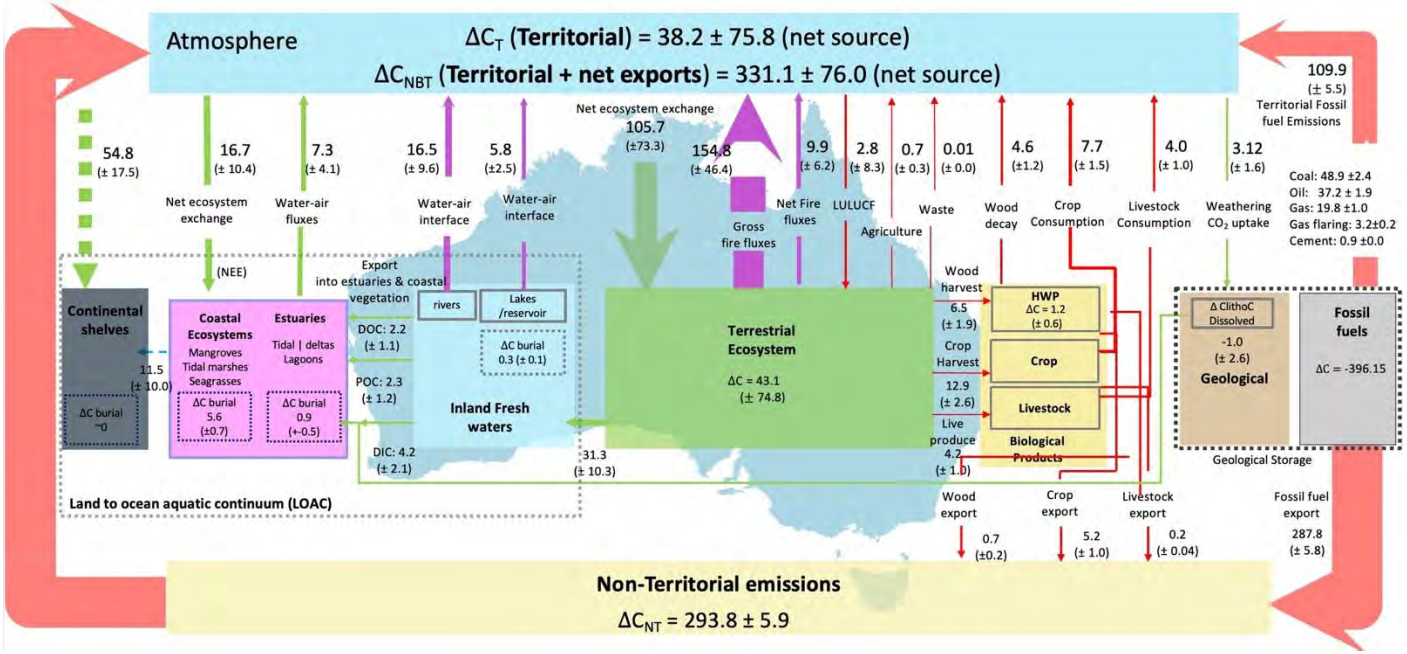
AGU Journals

Special Collections | First published: **16 August 2022** | Last updated: **17 April 2025**

NEW

RECCAP-3 (starting 2026)

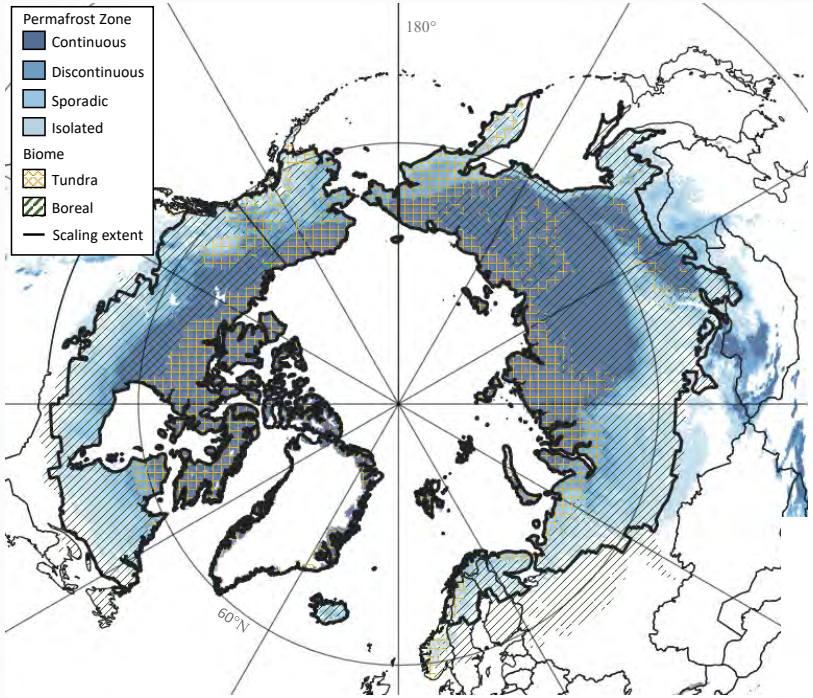
Focus on National GHG Budgets & Regions of Special Interest

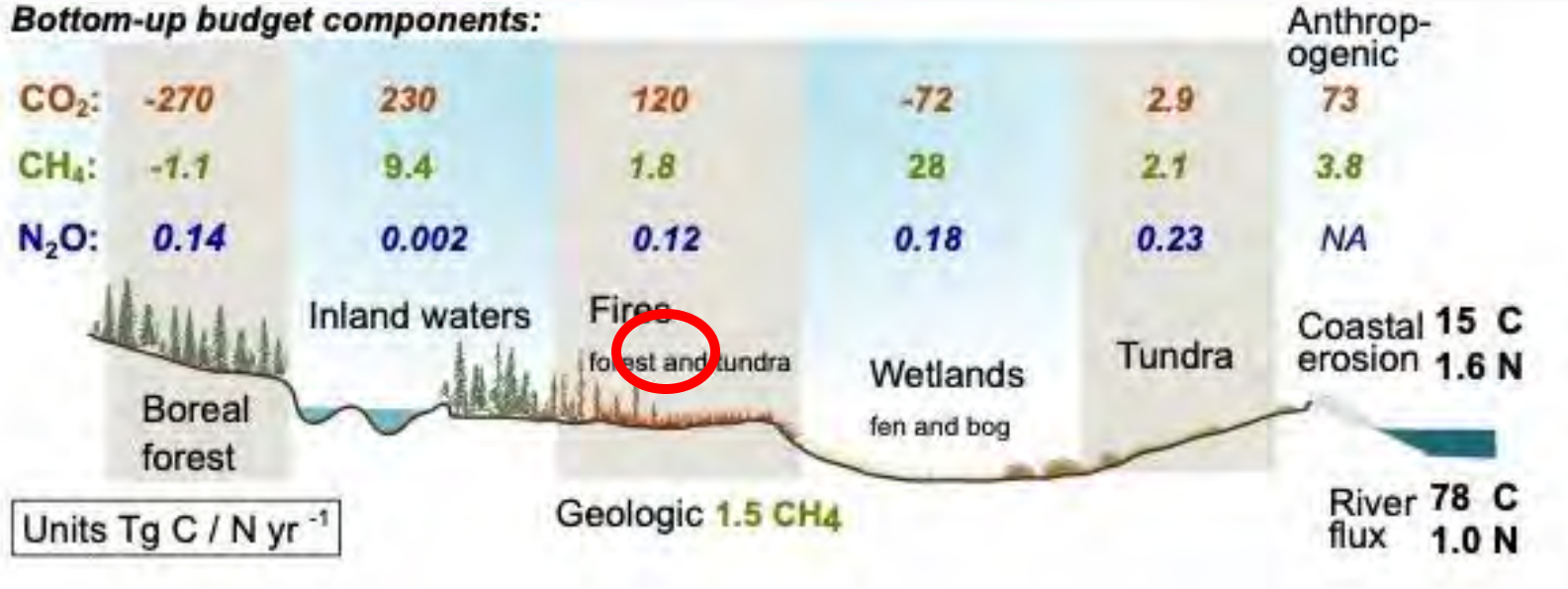


Canadell et al., 2025

Permafrost Region GHG Budgets

Regions of special interest in the Regional Carbon Cycle Assessment and Processes (RECCAP2)



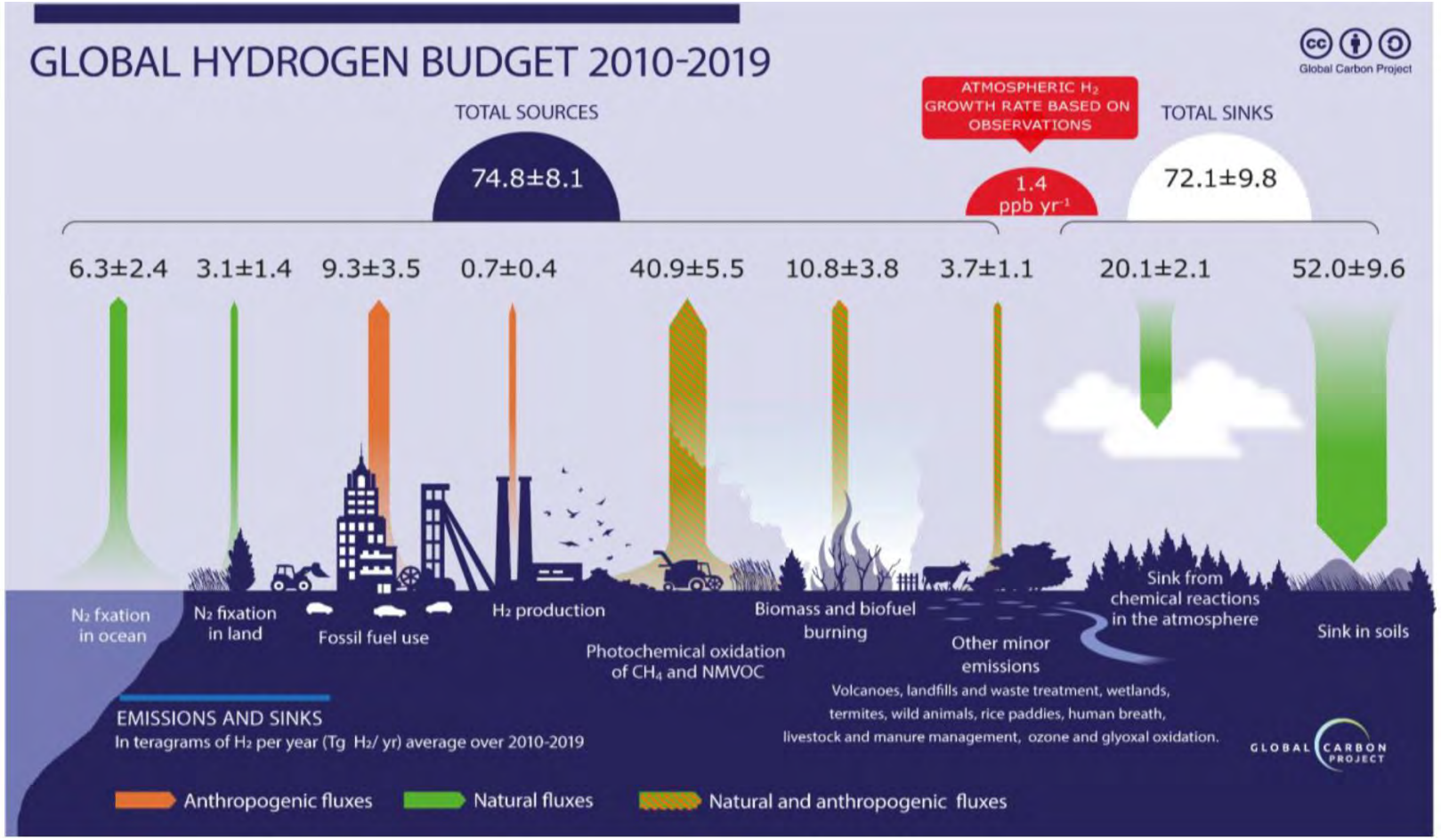


2000-2020

Ramage et al. 2024, GBC; Hugelius et al. 2024, GBC

Global Hydrogen Budget

NEW

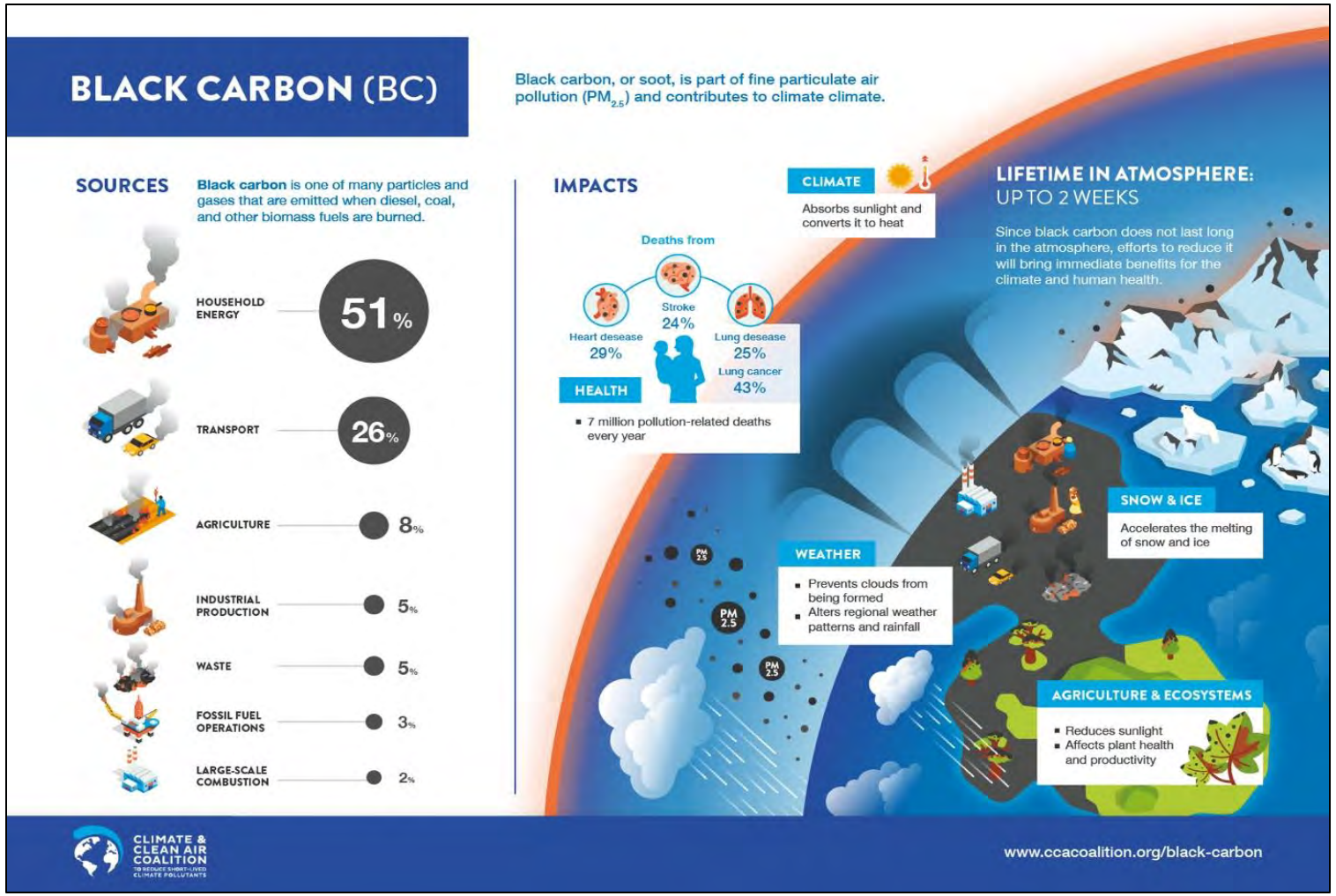


Ouyang, Jackson et al., in review

Global Black Carbon Budget

NEW

- under development -
(Lead: Rona Thompson)



High Impact Papers

GLOBAL CARBON project

Earth Syst. Sci. Data, 17, 965–1039, 2025
https://doi.org/10.5194/essd-17-965-2025

Earth System Science Data

Global Carbon Budget 2024

Pierre Friedlingstein[1,2], Michael O'Sullivan[1], Matthew W. Jones[3], Robbie M. Andrew[4], Judith Hauck[5,6], Peter Landschützer[7], Corinne Le Quéré[3], Hongmei Li[8,9], Ingrid T. Luijkx[10], Are Olsen[11,12], Glen P. Peters[4], Wouter Peters[10,13], Julia Pongratz[14,9], Clemens Schwingshackl[14], Stephen Sitch[1], Josep G. Canadell[15], Philippe Ciais[16], Robert B. Jackson[17,18], Simone R. Alin[19], Almut Arneth[20], Vivek Arora[21], Nicholas R. Bates[22], Meike Becker[11,12], Nicolas Bellouin[23], Carla F. Berghoff[24], Henry C. Bittig[25], Laurent Bopp[2], Patricia Cadule[2], Katie Campbell[26], Matthew A. Chamberlain[27], Naveen Chandra[28], Frédéric Chevallier[16], Louise P. Chini[29], Thomas Colligan[30], Jeanne Decayeux[31], Laique M. Djeutchouang[32,33], Xinyu Dou[34], Carolina Duran Rojas[1], Kazutaka Enyo[35], Wiley Evans[26], Amanda R. Fay[36], Richard A. Feely[19], Daniel J. Ford[1], Adrianna Foster[37], Thomas Gasser[38], Marion Gehlen[16], Thanos Gkritzalis[7], Giacomo Grassi[39], Luke Gregor[40], Nicolas Gruber[40], Özgür Gürses[5], Ian Harris[41], Matthew Hefner[42,43], Jens Heinke[44], George C. Hurtt[29], Yosuke Iida[35], Tatiana Ilyina[45,8,9], Andrew R. Jacobson[46,47], Atul K. Jain[48], Tereza Jarníková[49], Annika Jersild[50], Fei Jiang[30], Zhe Jin[51,52], Etsushi Kato[53], Ralph F. Keeling[54], Kees Klein Goldewijk[55], Jürgen Knauer[56,18], Jan Ivar Korsbakken[4], Xin Lan[46,47], Siv K. Lauvset[57,12], Nathalie Lefèvre[58], Zhu Liu[34], Junjie Liu[59,60], Lei Ma[29], Shamil Maksyutov[61], Gregg Marland[42,43], Nicolas Mayot[62], Patrick C. McGuire[63], Nicolas Metzl[58], Natalie M. Monacci[64], Eric J. Morgan[54], Shin-Ichiro Nakaoka[61], Craig Neill[27], Yosuke Niwa[61], Tobias Nützel[14], Lea Olivier[5,14], Tsuneo Ono[65], Paul I. Palmer[66,67], Denis Pierrot[68], Zhangcai Qin[69], Laure Resplandy[70,71], Alizée Roobaert[7], Thais M. Rosan[1], Christian Rödenbeck[72], Jörg Schwinger[57,12], T. Luke Smallman[66,67], Stephen M. Smith[73], Reinel Sospedra-Alfonso[21], Tobias Steinhoff[74,57], Qing Sun[75], Adrienne J. Sutton[19], Roland Séférian[31], Shintaro Takao[61], Hiroaki Tatebe[76,77], Hanqin Tian[78], Bronte Tilbrook[27,79], Olivier Torres[2], Etienne Tourigny[80], Hiroyuki Tsujino[81], Francesco Tubiello[82], Guido van der Werf[10], Rik Wanninkhof[68], Xuhui Wang[32], Dongxu Yang[83], Xiaojuan Yang[84], Zhen Yu[85], Wenping Yuan[86], Xu Yue[87], Sönke Zaehle[71], Ning Zeng[88,30], and Jiye Zeng[61]

Earth Syst. Sci. Data, 17, 1873–1958, 2025
https://doi.org/10.5194/essd-17-1873-2025

Earth System Science Data

Global Methane Budget 2000–2020

Marielle Saunois[1], Adrien Martinez[1], Benjamin Poulter[2], Zhen Zhang[3,4], Peter A. Raymond[5], Pierre Regnier[6], Josep G. Canadell[7], Robert B. Jackson[8], Prabir K. Patra[9,10], Philippe Bousquet[1], Philippe Ciais[1], Edward J. Dlugokencky[11], Xin Lan[11,12], George H. Allen[13], David Bastviken[14], David J. Beerling[15], Dmitry A. Belikov[16], Donald R. Blake[17], Simona Castaldi[18], Monica Crippa[19], Bridget R. Deemer[20], Fraser Dennison[21], Giuseppe Etiope[22,23], Nicola Gedney[24], Lena Höglund-Isaksson[25], Meredith A. Holgerson[26], Peter O. Hopcroft[27], Gustaf Hugelius[28], Akihiko Ito[29], Atul K. Jain[30], Rajesh Janardanan[31], Matthew S. Johnson[32], Thomas Kleinen[33], Paul B. Krummel[21], Ronny Lauerwald[34], Tingting Li[35], Xiangyu Liu[36], Kyle C. McDonald[37], Joe R. Melton[38], Jens Mühle[39], Jurek Müller[40], Fabiola Murguia-Flores[41], Yosuke Niwa[31,42], Sergio Noce[43], Shufen Pan[44], Robert J. Parker[45], Changhui Peng[46,47], Michel Ramonet[1], William J. Riley[48], Gerard Rocher-Ros[49], Judith A. Rosentreter[50], Motoki Sasakawa[31], Arjo Segers[51], Steven J. Smith[52,53], Emily H. Stanley[54], Joël Thanwerdas[55,a], Hanqin Tian[56], Aki Tsuruta[57], Francesco N. Tubiello[58], Thomas S. Weber[59], Guido R. van der Werf[60], Douglas E. J. Worthy[61], Yi Xi[1], Yukio Yoshida[31], Wenxin Zhang[62,63], Bo Zheng[64,65], Qing Zhu[48], Qiuan Zhu[66], and Qianlai Zhuang[36]

Earth Syst. Sci. Data, 16, 2543–2604, 2024
https://doi.org/10.5194/essd-16-2543-2024

Earth System Science Data

Global nitrous oxide budget (1980–2020)

Hanqin Tian[1,2], Naiqing Pan[1], Rona L. Thompson[3], Josep G. Canadell[4], Parvadha Suntharalingam[5], Pierre Regnier[6], Eric A. Davidson[7], Michael Prather[8], Philippe Ciais[9], Marilena Muntean[10], Shufen Pan[11,1], Wilfried Winiwarter[12,13], Sönke Zaehle[14], Feng Zhou[15], Robert B. Jackson[16,17], Hermann W. Bange[18], Sarah Berthet[19], Zihao Bian[20], Daniele Bianchi[21], Alexander F. Bouwman[22], Erik T. Buitenhuis[5], Geoffrey Dutton[23,33], Minpeng Hu[24], Akihiko Ito[25,26], Atul K. Jain[27], Aurich Jeltsch-Thömmes[28,29], Fortunat Joos[28,29], Sian Kou-Giesbrecht[30,31], Paul B. Krummel[32], Xin Lan[23,33], Angela Landolfi[34,18], Ronny Lauerwald[35], Ya Li[36], Chaoqun Lu[37], Taylor Maavara[38], Manfredi Manizza[39], Dylan B. Millet[40], Jens Mühle[39], Prabir K. Patra[41,42,43], Glen P. Peters[44], Xiaoyu Qin[36], Peter Raymond[45], Laure Resplandy[46], Judith A. Rosentreter[47,48], Hao Shi[36], Qing Sun[28,29], Daniele Tonina[49], Francesco N. Tubiello[50], Guido R. van der Werf[51], Nicolas Vuichard[9], Junjie Wang[22], Kelley C. Wells[40], Luke M. Western[23,52], Chris Wilson[53,54], Jia Yang[55], Yuanzhi Yao[56], Yongfa You[1], and Qing Zhu[57]

comment

Carbon analytics for net-zero emissions sustainable cities

Consensus on carbon accounting approaches at city-level is lacking and analytic frameworks to systematically link carbon mitigation with the Sustainable Development Goals are limited. A new accounting approach anchored upon key physical provisioning systems can help to address these knowledge gaps and facilitate urban transitions.

Anu Ramaswami, Kangkang Tong, Josep G. Canadell, Robert B. Jackson, Eleanor (Kellie) Stokes, Shobhakar Dhakal, Mario Finch, Peraphan Jittrapirom, Neelam Singh, Yoshiki Yamagata, Eli Yewdall, Leehi Yona and Karen C. Seto

Article

A comprehensive quantification of global nitrous oxide sources and sinks

https://doi.org/10.1038/s41586-020-2780-0
Received: 28 December 2019
Accepted: 14 August 2020
Published online: 7 October 2020
Check for updates

Hanqin Tian[1,2], Rongting Xu[1], Josep G. Canadell[3], Rona L. Thompson[4], Wilfried Winiwarter[4,5], Parvadha Suntharalingam[6], Eric A. Davidson[7], Philippe Ciais[8], Robert B. Jackson[9,10], Greet Janssens-Maenhout[11,12], Michael J. Prather[13], Pierre Regnier[14], Naiqing Pan[1,15], Shufen Pan[1], Glen P. Peters[16], Hao Shi[1], Francesco N. Tubiello[17], Sönke Zaehle[18], Feng Zhou[19], Almut Arneth[20], Gianna Battaglia[21], Sarah Berthet[22], Laurent Bopp[23], Alexander F. Bouwman[24,25,26], Erik T. Buitenhuis[6,27], Jinfeng Chang[8,28], Martyn P. Chipperfield[29,30], Shree R. S. Dangal[31], Edward Dlugokencky[32], James W. Elkins[33], Bradley D. Eyre[34], Bojie Fu[35,36], Bradley Hall[33], Akihiko Ito[37], Fortunat Joos[28], Paul B. Krummel[38], Angela Landolfi[18,39], Goulven G. Laruelle[40], Ronny Lauerwald[8,41,42], Wei Li[8,43], Sebastian Lienert[21], Taylor Maavara[43], Michael MacLeod[44], Dylan B. Millet[45], Stefan Olin[46], Prabir K. Patra[16,47], Ronald G. Prinn[48], Peter A. Raymond[49], Daniel J. Ruiz[34], Guido R. van der Werf[50], Nicolas Vuichard[8], Junjie Wang[28], Ray F. Weiss[30], Kelley C. Wells[45], Chris Wilson[30,51], Jia Yang[52] & Yuanzhi Yao[1]

nature climate change

ARTICLES

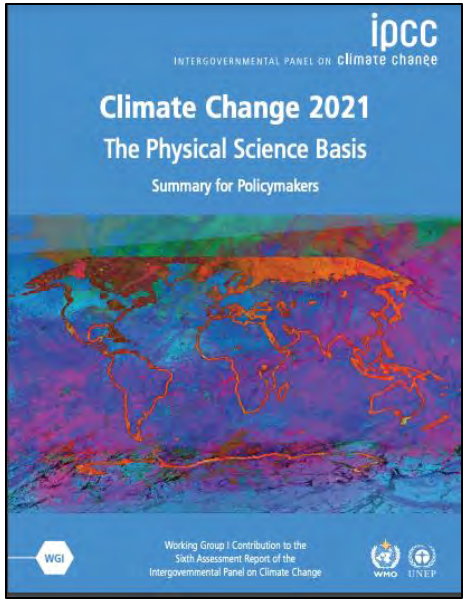
https://doi.org/10.1038/s41558-020-0797-x

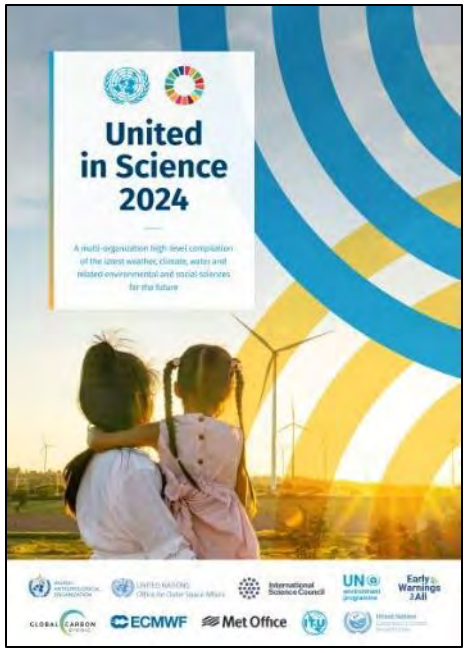
Check for updates

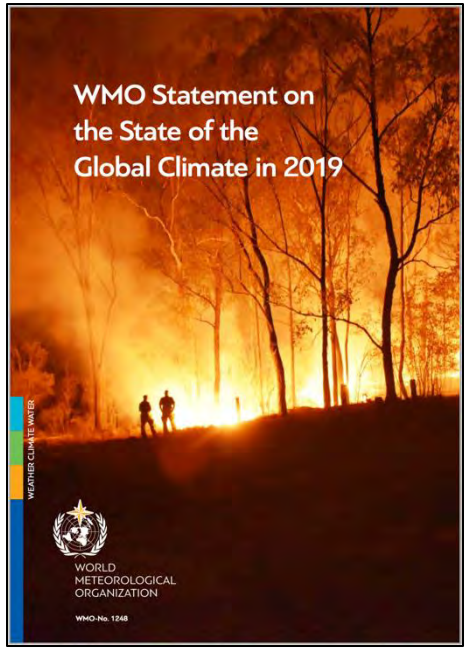
Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement

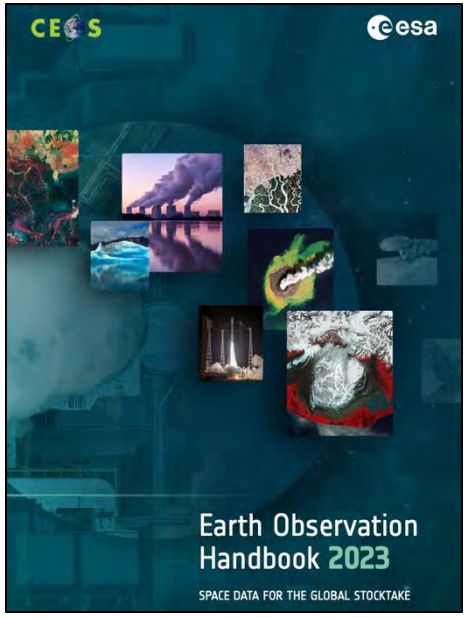
Corinne Le Quéré[1,2] ✉, Robert B. Jackson[3,4,5], Matthew W. Jones[1,2], Adam J. P. Smith[1,2], Sam Abernethy[3,6], Robbie M. Andrew[7], Anthony J. De-Gol[1,2], David R. Willis[1,2], Yuli Shan[8], Josep G. Canadell[9], Pierre Friedlingstein[10,11], Felix Creutzig[12,13] and Glen P. Peters[7]

Contributions to High-Impact Reports



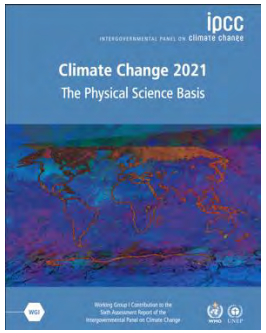






Dissemination

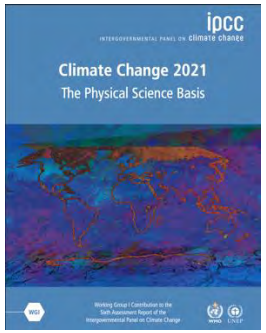
UN SG, COP & IPCC



Side events and press conferences at UN COPs for several years.

Dissemination

UN SG, COP & IPCC

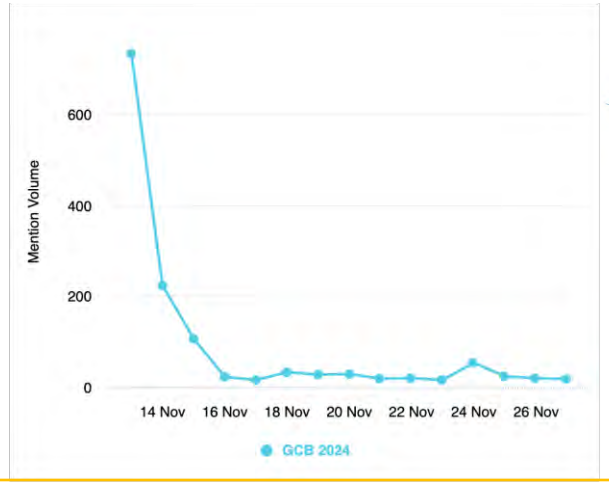


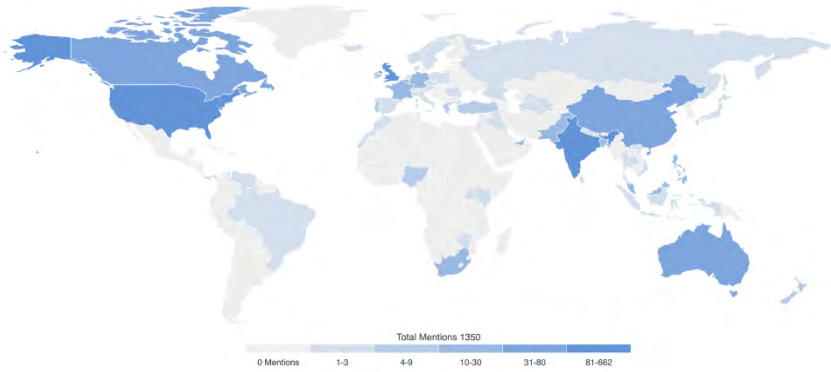
Side events and press conferences at UN COPs for several years.

Large international media coverage

GCB 2024 covered in >1000 outlets (US, EU, UK, India, Australia, China, …)

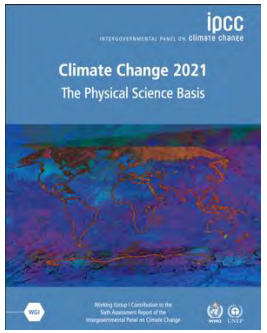
News





Dissemination

UN SG, COP & IPCC



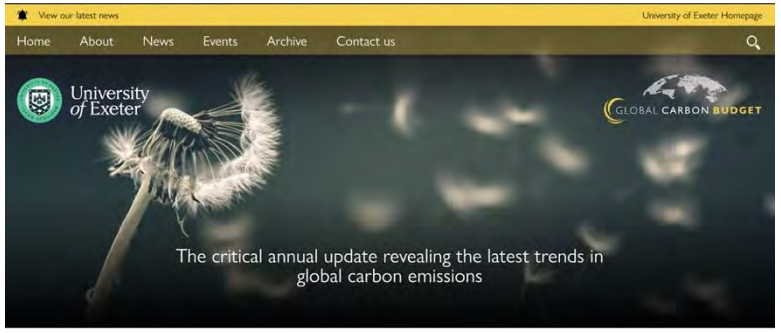
Side events and press conferences at UN COPs for several years

Large international media coverage

GCB 2024 covered in >1000 outlets (US, EU, UK, India, Australia, China, …)

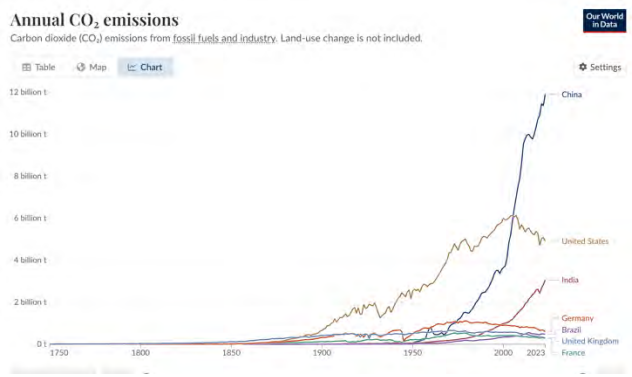
Data/figures/slides available via

- Our World in Data (top 10 chart, >1M views in 2024)
- GCB website, Carbon Atlas, ICOS



https://globalcarbonbudget.org/carbonbudget

www.globalcarbonatlas.org



https://ourworldindata.org/

WCRP – GCB links

Many natural links between GCP and WCRP CPs and LHAs

- ESMO: Global C cycle modelling and obs.
- SLC : TCRE, Tipping points
- CLIVAR : Ocean carbon/heat
- GEWEX : land carbon/water, SIF-MIP
- APARC : CH4, black C
- CLIC : permafrost C
- …

Thank You

WCRP
World Climate
Research Programme

www.wcrp-climate.org

WORLD METEOROLOGICAL ORGANIZATION

unesco
Intergovernmental Oceanographic Commission

International Science Council