北京大学
PEKING UNIVERSITY

国家自然科学基金委员会
National Natural Science Foundation of China

Terrestrial ecosystems and Climate Change

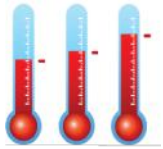
Shushi Peng

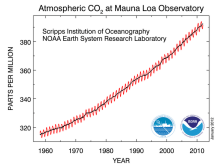
speng@pku.edu.cn

Sino-French Institute for Earth System Science,
College of Urban and Environmental Sciences,
Peking University, Beijing, China

Climate change and terrestrial ecosystems

Climate Change



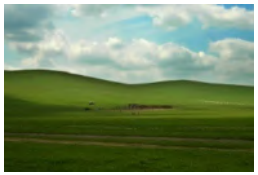


1 Impacts ? How?

2 Biogeophysical

3 Biogeochemical

Terrestrial ecosystems



Fate of anthropogenic CO_2 emissions (2011–2020)

Sources = **Sinks**

34.8 $GtCO_2$/yr

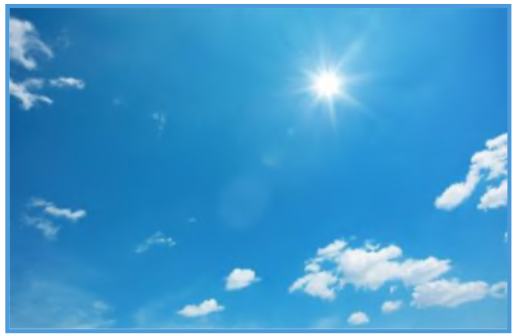
89%

11%

4.1 $GtCO_2$/yr

18.6 $GtCO_2$/yr

48%



29%

11.2 $GtCO_2$/yr

26%

10.2 $GtCO_2$/yr

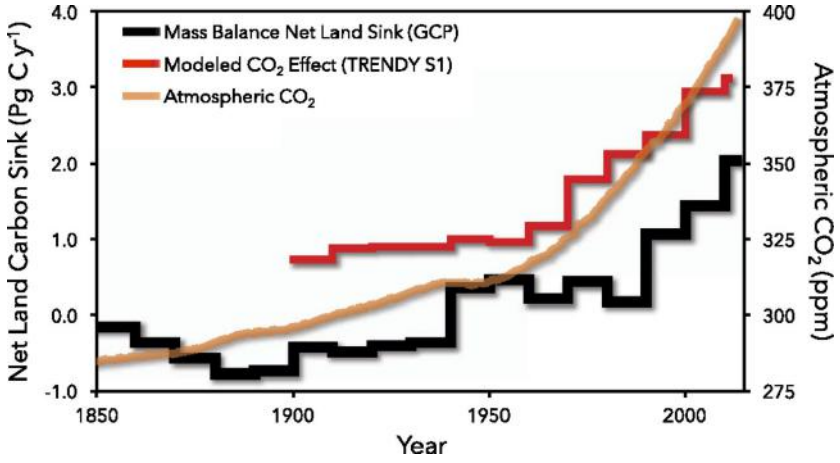
Budget Imbalance:
(the difference between estimated sources & sinks)

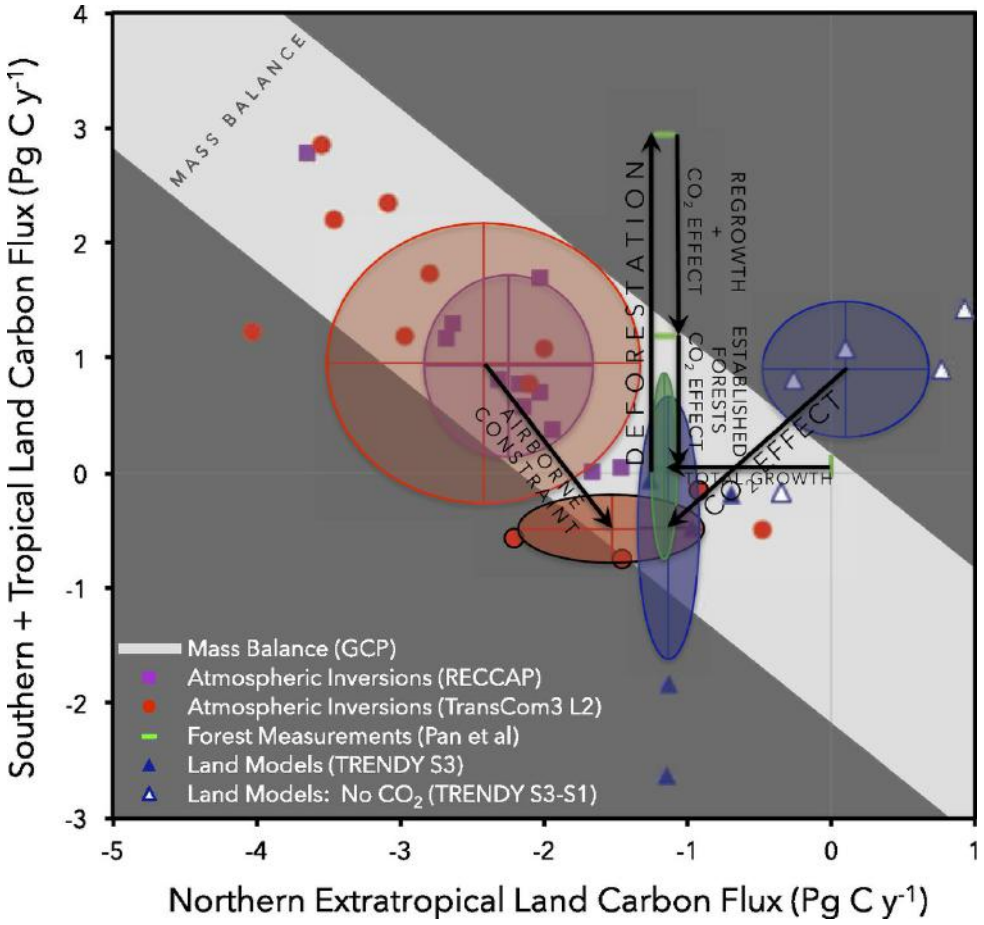
3%

-1.0 $GtCO_2$/yr

Source: Friedlingstein et al 2021; Global Carbon Project 2021

CO_2 fertiliation on land carbon sink

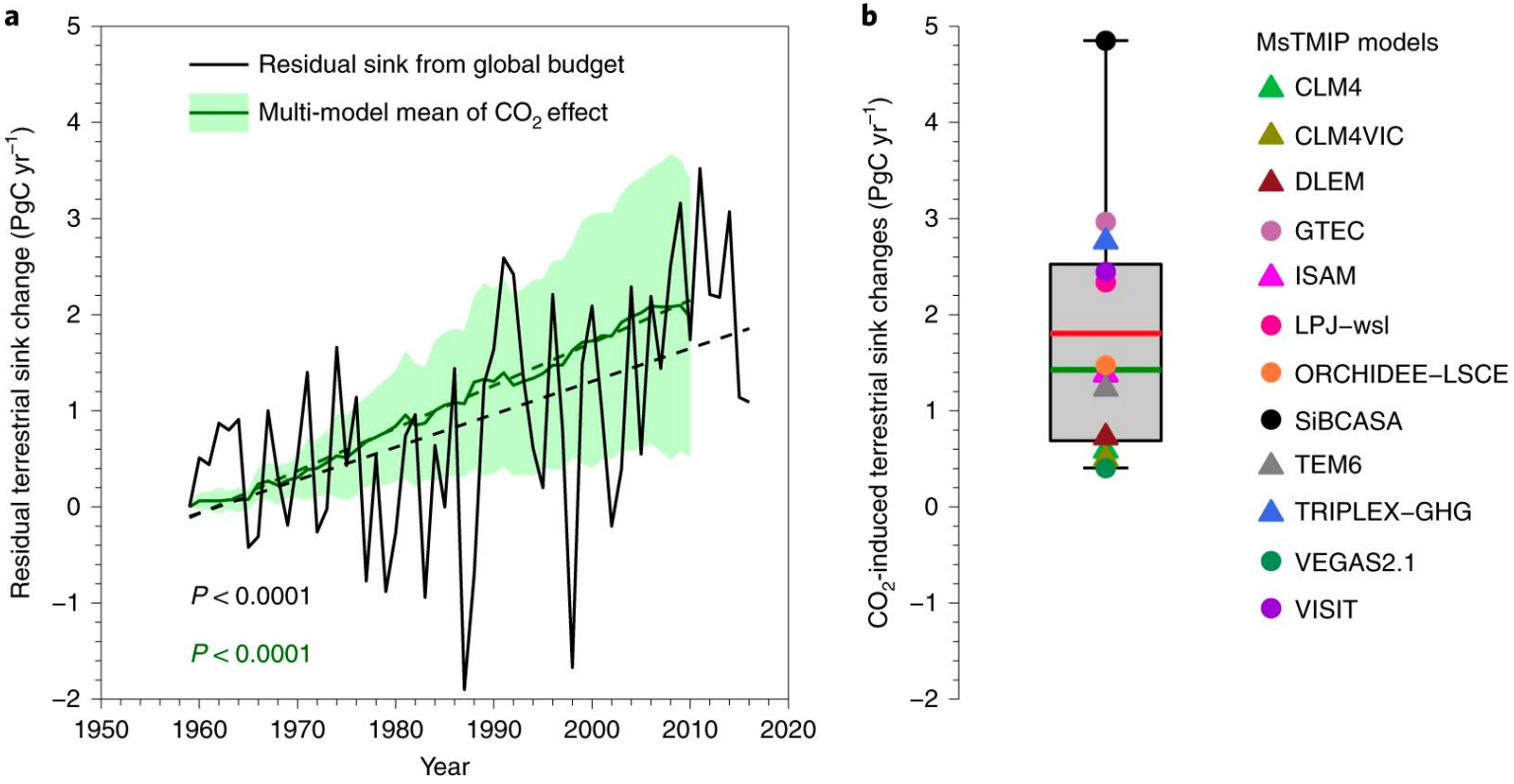




PNAS

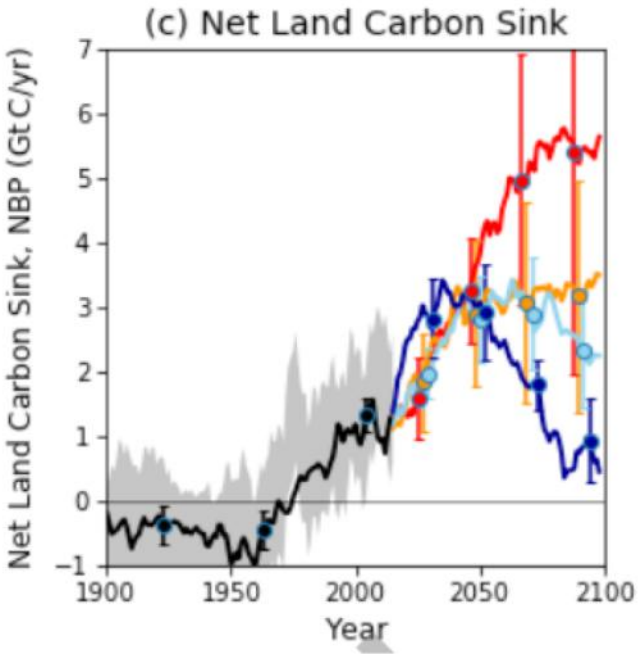
David Schimel et al. PNAS 2015;112:2:436-441

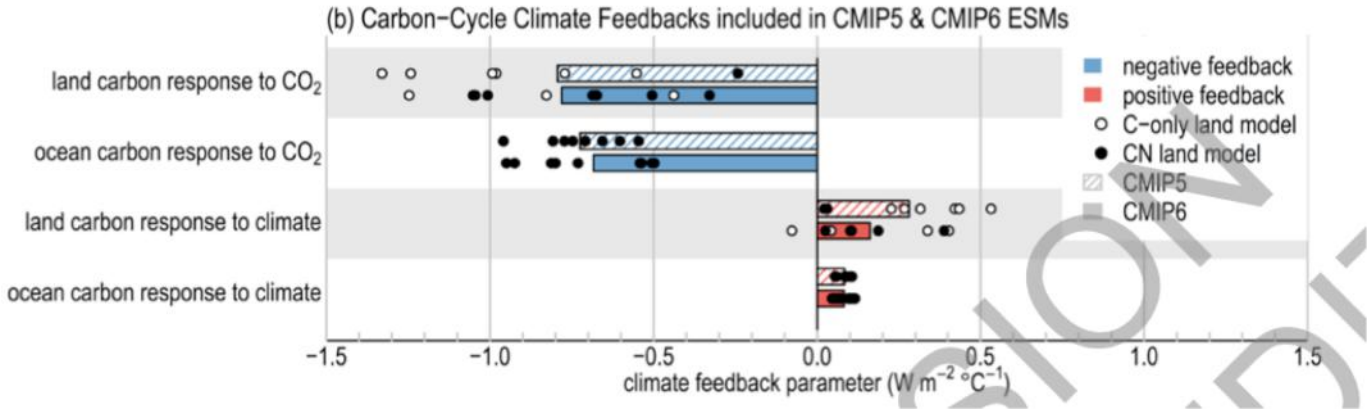
CO_2 fertiliation increases land carbon sink



Liu et al., Nature Geoscience, 2019

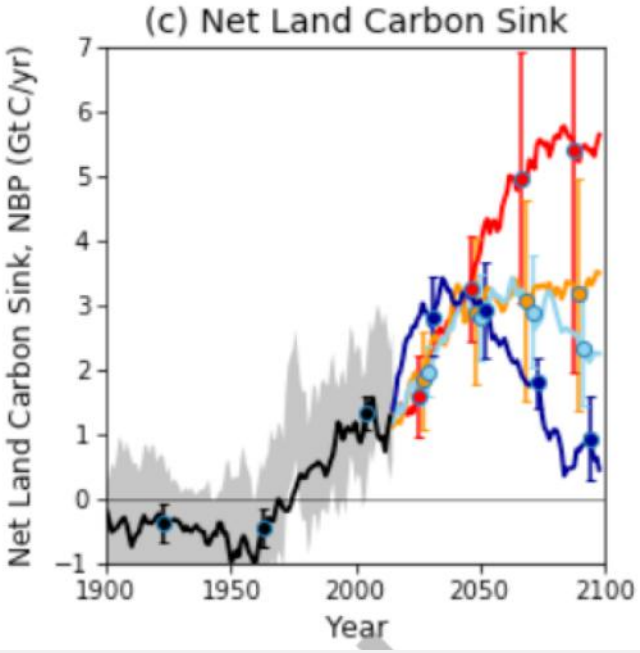
Can CO_2 fertiliation persist in future?



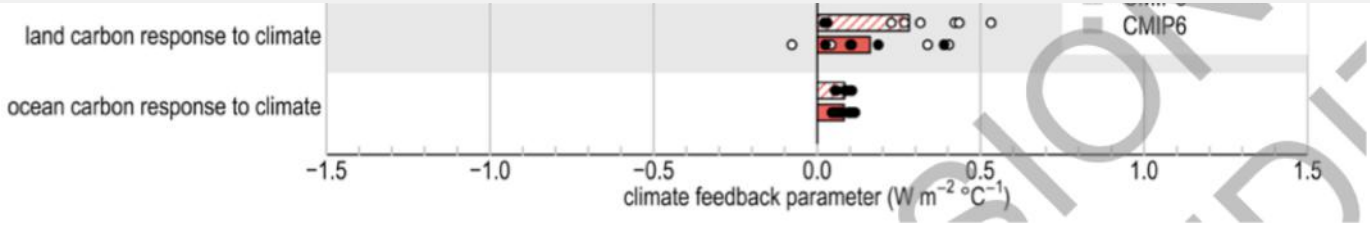


IPCC AR6, 2021

Can CO_2 fertiliation persist in future?



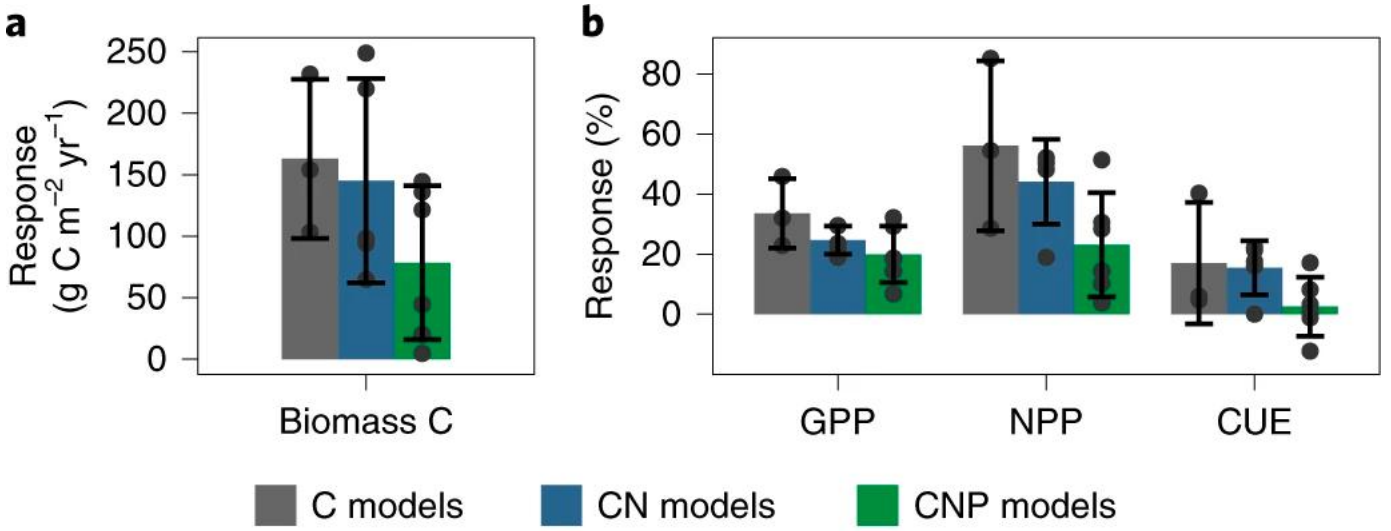
Nitrogen and phosphorus will constrain the CO_2 fertilization of land carbon sink.



IPCC AR6, 2021

The key is tropics

The predicted effect of eCO_2 on biomass C, productivity and biomass compartments for C, CN and CNP models.



ARTICLES
https://doi.org/10.1038/s41561-019-0404-9
nature geoscience

Amazon forest response to CO_2 fertilization dependent on plant phosphorus acquisition

Katrin Fleischer[1*], Anja Rammig[1], Martin G. De Kauwe[2,3], Anthony P. Walker[4], Tomas F. Domingues[5], Lucia Fuchslueger[6,7], Sabrina Garcia[6], Daniel S. Goll[8,9], Adriana Grandis[10], Mingkai Jiang[11], Vanessa Haverd[12], Florian Hofhansl[13], Jennifer A. Holm[14], Bart Kruijt[15], Felix Leung[16,17], Belinda E. Medlyn[11], Lina M. Mercado[16,18], Richard J. Norby[4], Bernard Pak[19], Celso von Randow[20], Carlos A. Quesada[6], Karst J. Schaap[6], Oscar J. Valverde-Barrantes[21], Ying-Ping Wang[19], Xiaojuan Yang[4], Sönke Zaehle[22], Qing Zhu[14] and David M. Lapola[23]

Climate change may reduce carbon sink

PERSPECTIVE
DOI: 10.1038/s41559-017-0274-8

nature ecology & evolution

Shifting from a fertilization-dominated to a warming-dominated period

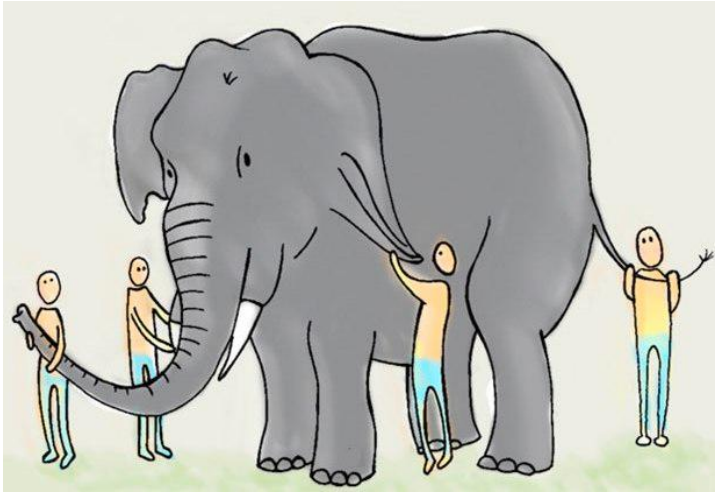
Josep Peñuelas[1,2*], Philippe Ciais[3], Josep G. Canadell[4], Ivan A. Janssens[5], Marcos Fernández-Martínez[1,2], Jofre Carnicer[1,2], Michael Obersteiner[6], Shilong Piao[7], Robert Vautard[3] and Jordi Sardans[1,2]

Do not forget drought and fire !

We need a better framework to work out

New theory
Traits/optimization

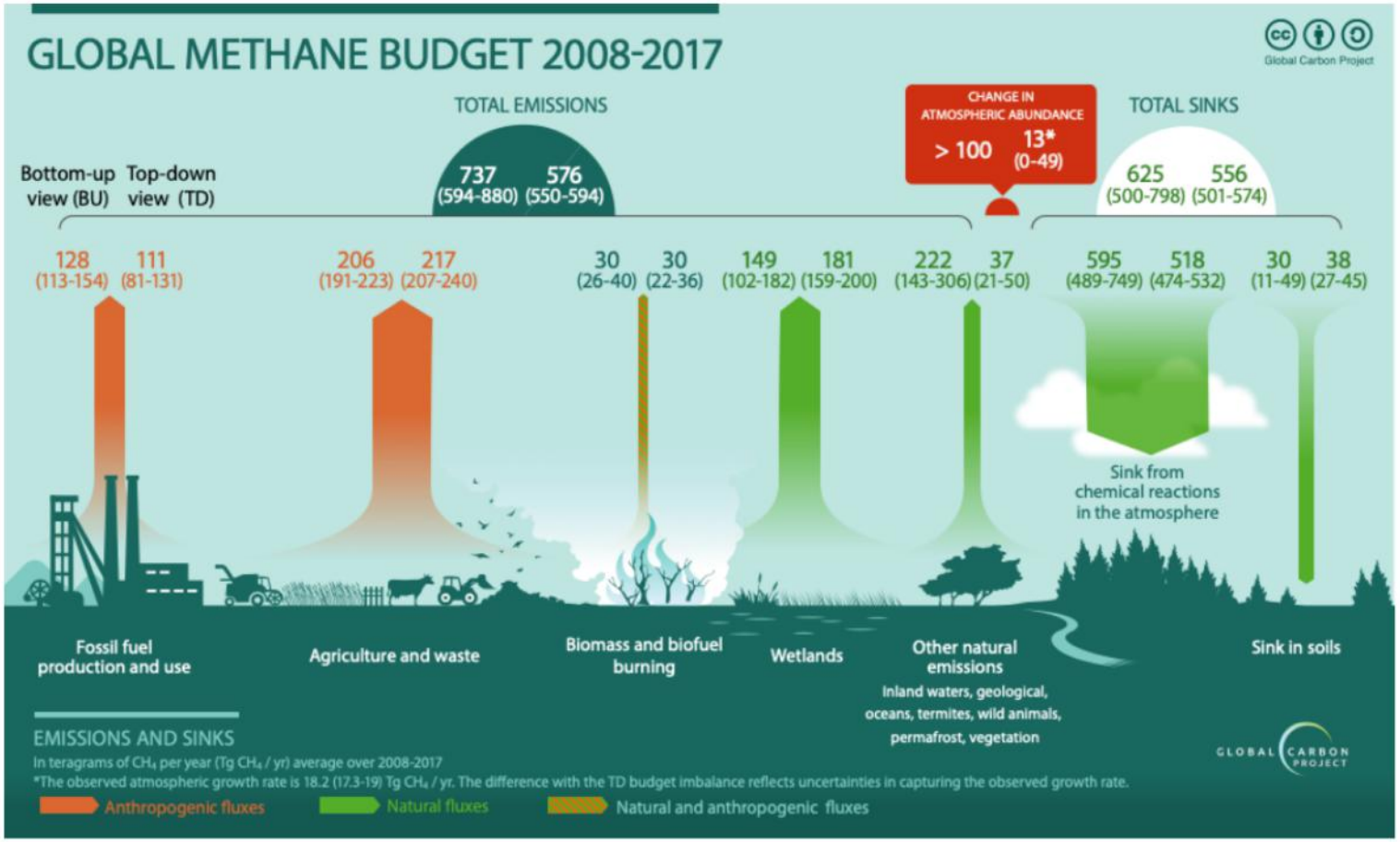
Atmospheric
inversion



^{13}C, ^{15}N isotopes
and Field experiments

Terrestrial Biosphere Model
Earth System Model

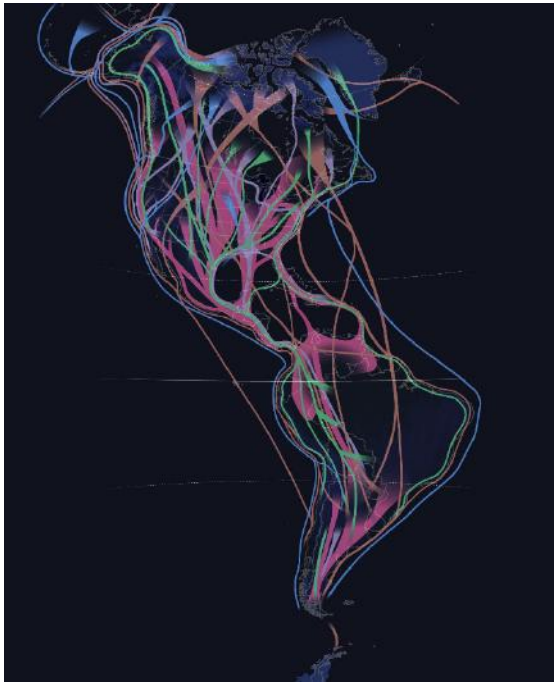
Global Methane Budget 2008-2017

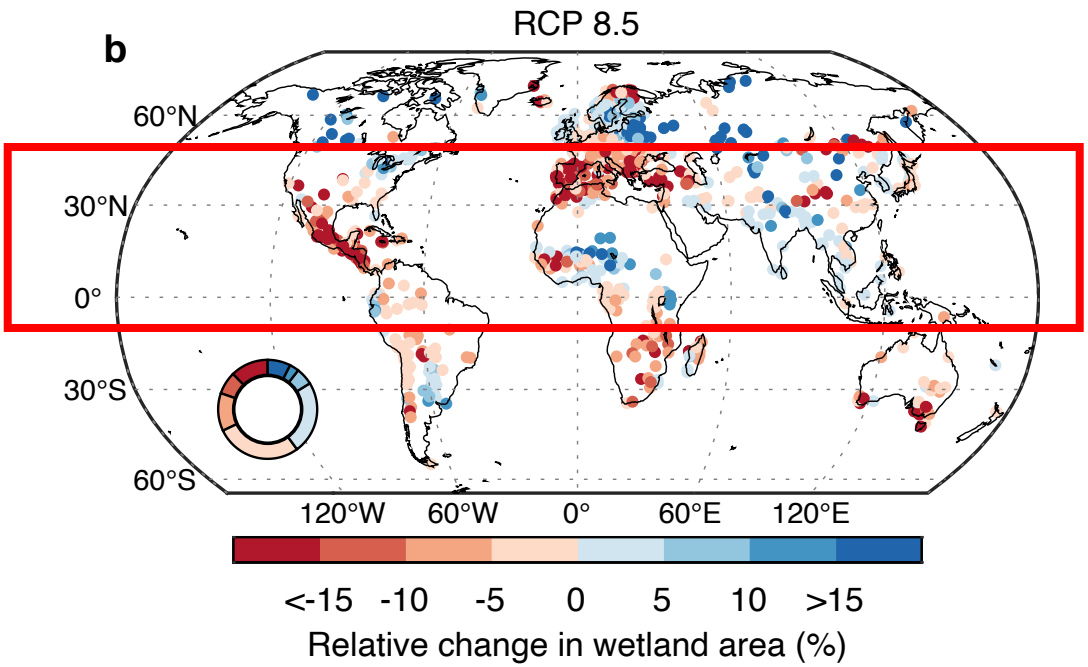


Source: Saunois et al. 2020, ESSD (Fig. 6)

Wetlands under future climate change

Bird Mitigation Map





nature climate change
ARTICLES
https://doi.org/10.1038/s41558-020-00942-2
Check for updates

Future impacts of climate change on inland Ramsar wetlands

Yi Xi[1], Shushi Peng[1✉], Philippe Ciais[2] and Youhua Chen[3]