REPLY TO SONG AND WANG:

Terrestrial CO_2 sink dominates net ecosystem carbon balance of the Tibetan Plateau

Da Wei[a], Yulan Zhang[b], Tanguang Gao[c], Lei Wang[d], and Xiaodan Wang[a,1]

We welcome the letter of Song and Wang (1) regarding aquatic carbon (C) export on the Tibetan Plateau (TP) and appreciate the opportunity to clarify our thinking. The net ecosystem C balance (NECB) includes CO_2 and CH_4 exchange, volatile organic C loss, and particulate and aquatic C transport. By contrast, our work focused on terrestrial CO_2 exchange (2), a subset of the NECB. We partly agree with Song and Wang regarding the importance of aquatic C loss, but their conclusion was reached based upon a catchment-scale case study (3). In an attempt to clarify how much the terrestrial CO_2 sink has been compromised at a regional scale, we expanded the NECB to incorporate rivers, lakes, thermokarst, wetlands, grasslands, and glaciers, thus forming a complete picture of the C cycle of the TP (Fig. 1).

The C entering into the river network was separated into three parts (4): outgassing (35%), burial (38%), and to the ocean (27%). For river outgassing, a recent study estimated 1.27 Tg $CH_4 \cdot y^{-1}$ (Tg = 10^{12} g) and 17.5 Tg $CO_2 \cdot y^{-1}$ for all of the TP's rivers (5). A loss of ∼10.6 Tg $C \cdot y^{-1}$ into the river burial and oceans through the river network was then estimated (4, 5). This estimate is at the high end of the

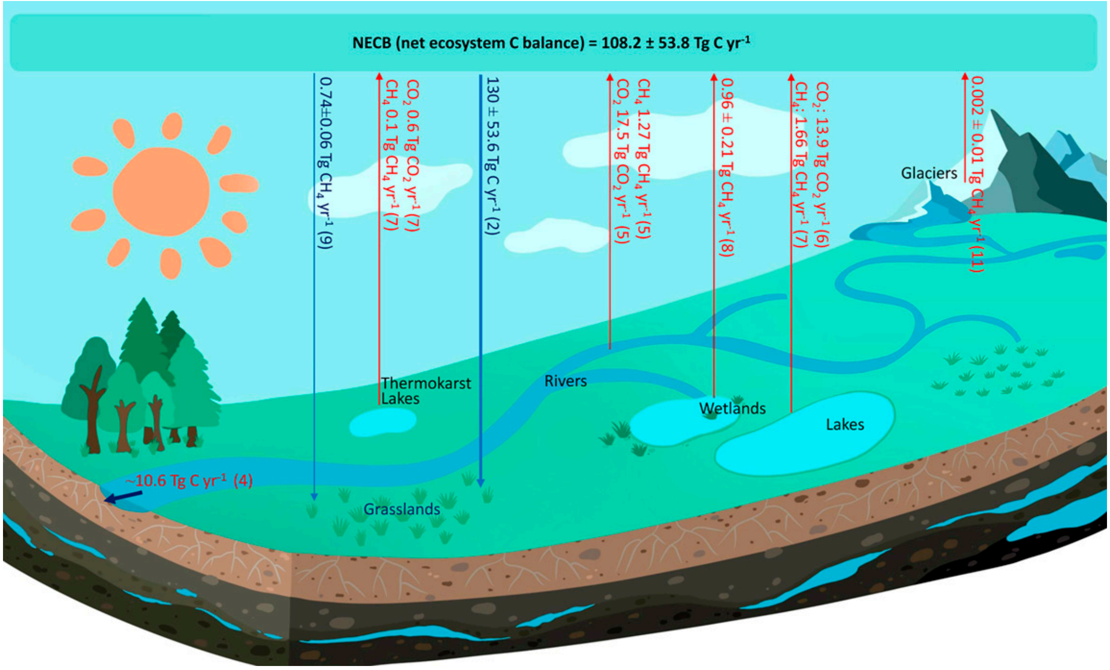

Fig. 1. Schematic map of the regional net ecosystem C balance of the Tibetan Plateau. The uncertainty ranges of lake and river C loss is not given, since they are estimates rather than direct observations.

[a]Institute of Mountain Hazards and Environment, Chinese Academy of Sciences, Chengdu 610041, China; [b]Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences, Lanzhou 730000, China; [c]College of Earth and Environmental Sciences, Lanzhou University, Lanzhou 730000, China; and [d]State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University, Beijing 100875, China

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[1]To whom correspondence may be addressed. Email: wxd@imde.ac.cn.

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uncertainty range, since ~40% of the rivers are within the endorheic region, i.e., the C is merely transported from one place to another, but still within the domain of the TP. Lakes contribute 13.9 Tg $CO_2 \cdot y^{-1}$ (6) and 1.7 Tg $CH_4 \cdot y^{-1}$, assuming their waters release CH_4 rates similar to thermokarst lakes (7)—and this is at the high end of the uncertainty range given most lakes have lower organic C content than thermokarst lakes/ponds. The thermokarst lakes and ponds add another 0.6 Tg $CO_2 \cdot y^{-1}$ and 0.1 Tg $CH_4 \cdot y^{-1}$ to the atmosphere, based on our recent measurements across 32 thermokarst lakes (7).

Besides the CO_2 uptake in terrestrial ecosystems (2), they also regulate the CH_4 exchange. Our observations and simulations (8–10) have characterized alpine grasslands as a considerable CH_4 sink of 0.74 ± 0.06 Tg $CH_4 \cdot y^{-1}$, while alpine marshlands emit 0.96 ± 0.21 Tg $CH_4 \cdot y^{-1}$. For glaciers, a potential C source under the warming climate, our recent measurements of four glaciers observed a C loss of 0.002 ± 0.01 Tg $CH_4 \cdot y^{-1}$ (11), which is a negligible but highly uncertain component of the NECB.

Therefore, we arrived at an NECB of 108.2 ± 53.8 Tg $C \cdot y^{-1}$ on the TP, indicating only 16.8% of the terrestrial CO_2 sink was compromised by other C sources (including aquatic C loss). Therefore, the full picture of the C cycle suggests that the terrestrial CO_2 sink dominates the regional NECB, although large uncertainty still exists and more observations are needed in the near future.

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