Greenhouse gas emissions from inland waters: A perspective and research agenda for the tropics and subtropics

Annika Linkhorst, Nicholas S. Marzolf, Clément Duvert, Loris Deirmendjian, Allison M. Herreid, Luke C. Jeffrey, Carla López-Lloreda, Marcia N. Macedo, Diana Oviedo-Vargas, Diego A. Riveros-Iregui, Vanessa Solano, Keridwen M. Whitmore, Alberto V. Borges







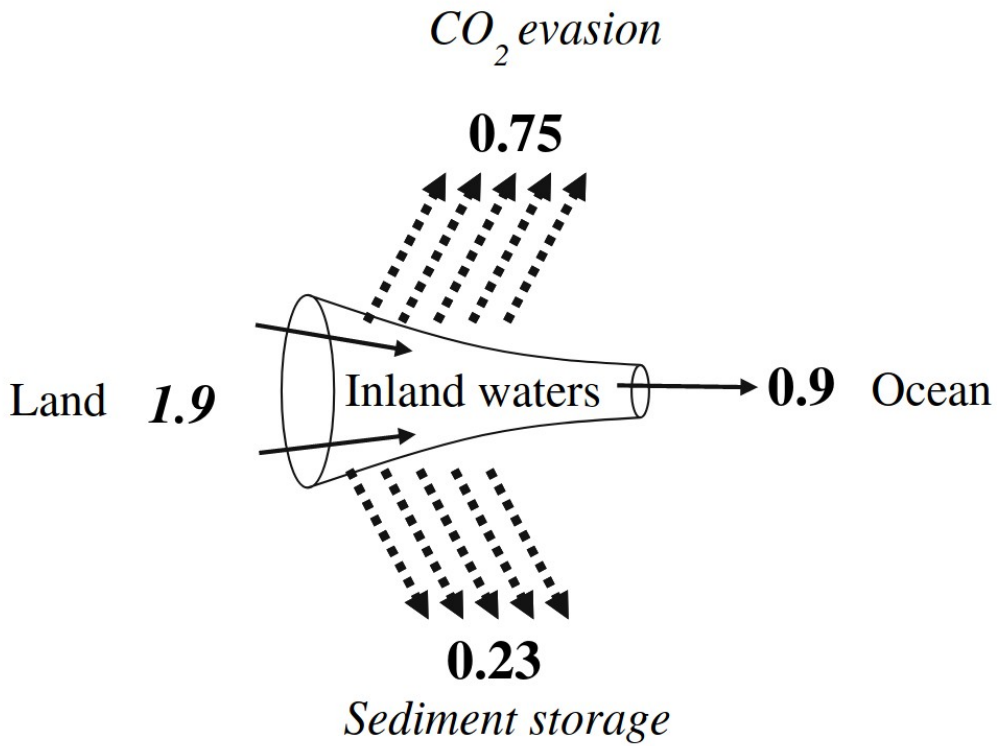






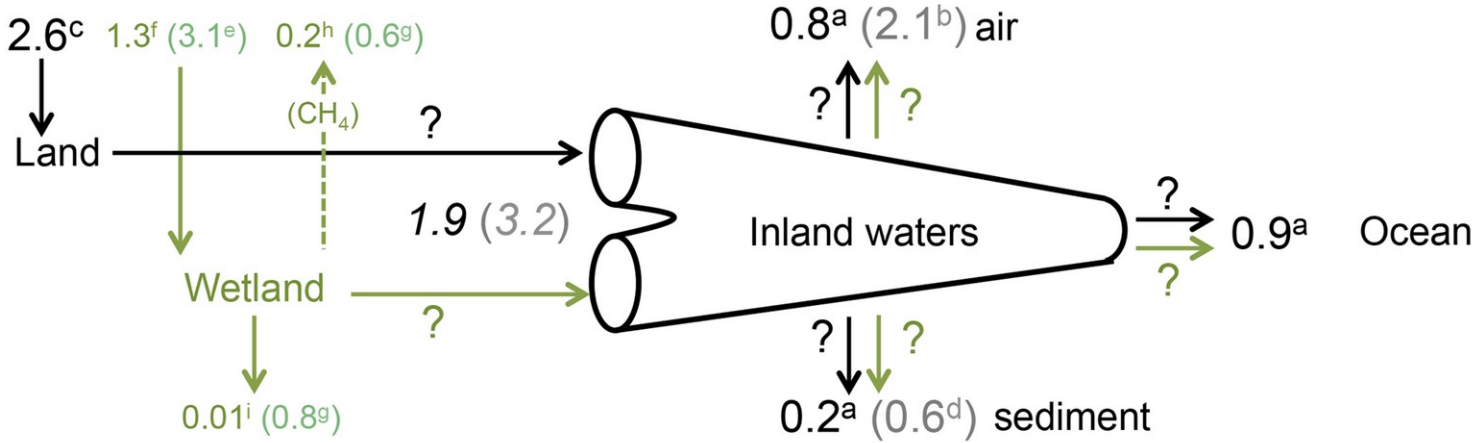

SS11: Greenhouse gases in tropical streams, rivers, lakes and wetlands: current work and future research needs

The active carbon pipe



Cole et al. 2007

The *replumbed* active carbon pipe



Abril & Borges 2018

Four-fold increase in global estimate

Table 1. Estimates of aquatic carbon fluxes (Pg).

Study	Exported to ocean	Outgassed	Stored	Photosynthesis	Input from land
Cole et al. (2007)	0.9	0.75	0.23	*0.3*	**1.1**
Battin et al. (2009)	0.9	1.2	0.6	*0.3*	**1.9**
Tranvik et al. (2009)	0.9	1.4	0.6	*0.3*	**2.1**
Bastviken et al. (2011)	*0.9*	1.48*	*0.6*	*0.3*	**2.2**
Regnier et al. (2013)	0.95	1.2	0.6	0.3	**2.5**
Raymond et al. (2013)	*0.95*	2.18	*0.6*	*0.3*	**3.4**
Borges et al. (2015)	*0.95*	2.78†,‡	*0.6*	*0.3*	**4.0**
Holgerson and Raymond (2016)	*0.95*	3.06†,‡	*0.6*	*0.3*	**4.3**
Sawakuchi et al. (2017)	*0.95*	3.88†,‡	*0.6*	*0.3*	**5.1**

Black values indicate an independent estimate was provided by the given study. Gray values were not refined by the given study but indicate where an estimate was applied from previous or future study.

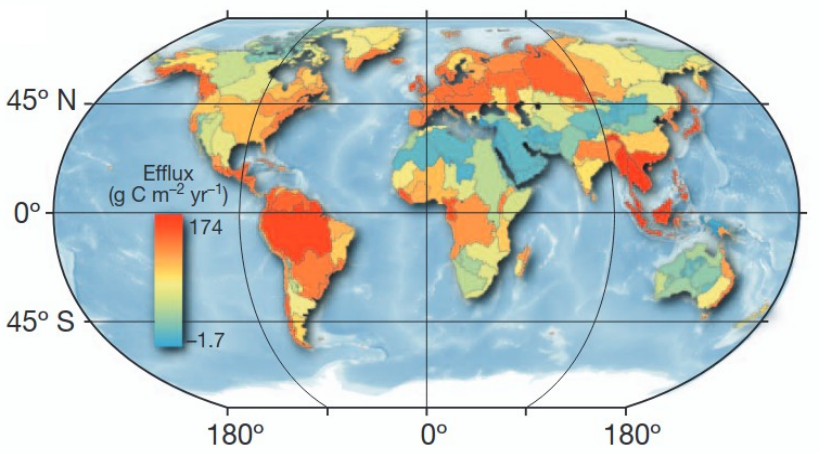
* Methane estimate added to previous study.

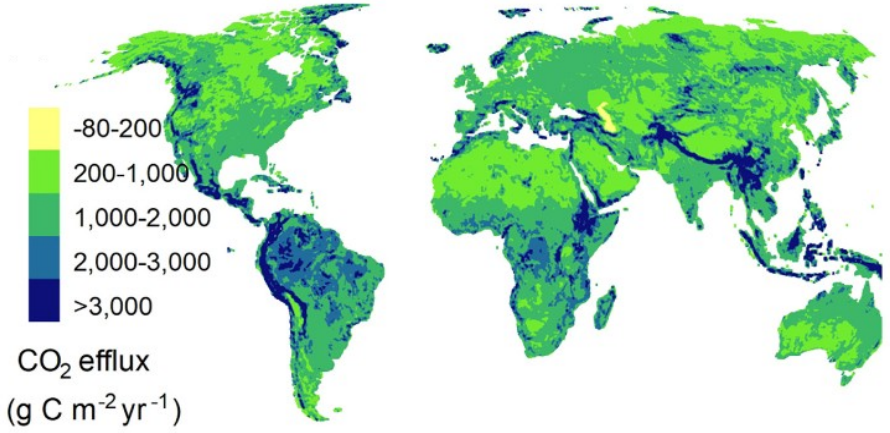
† Includes methane estimate from Bastviken et al. (2011).

‡ Estimate from study either added to or replaced previous estimate by Raymond et al. (2013).

Drake et al. 2018

Tropics are understudied; are they hotspots?





(CO2 efflux from streams and rivers)

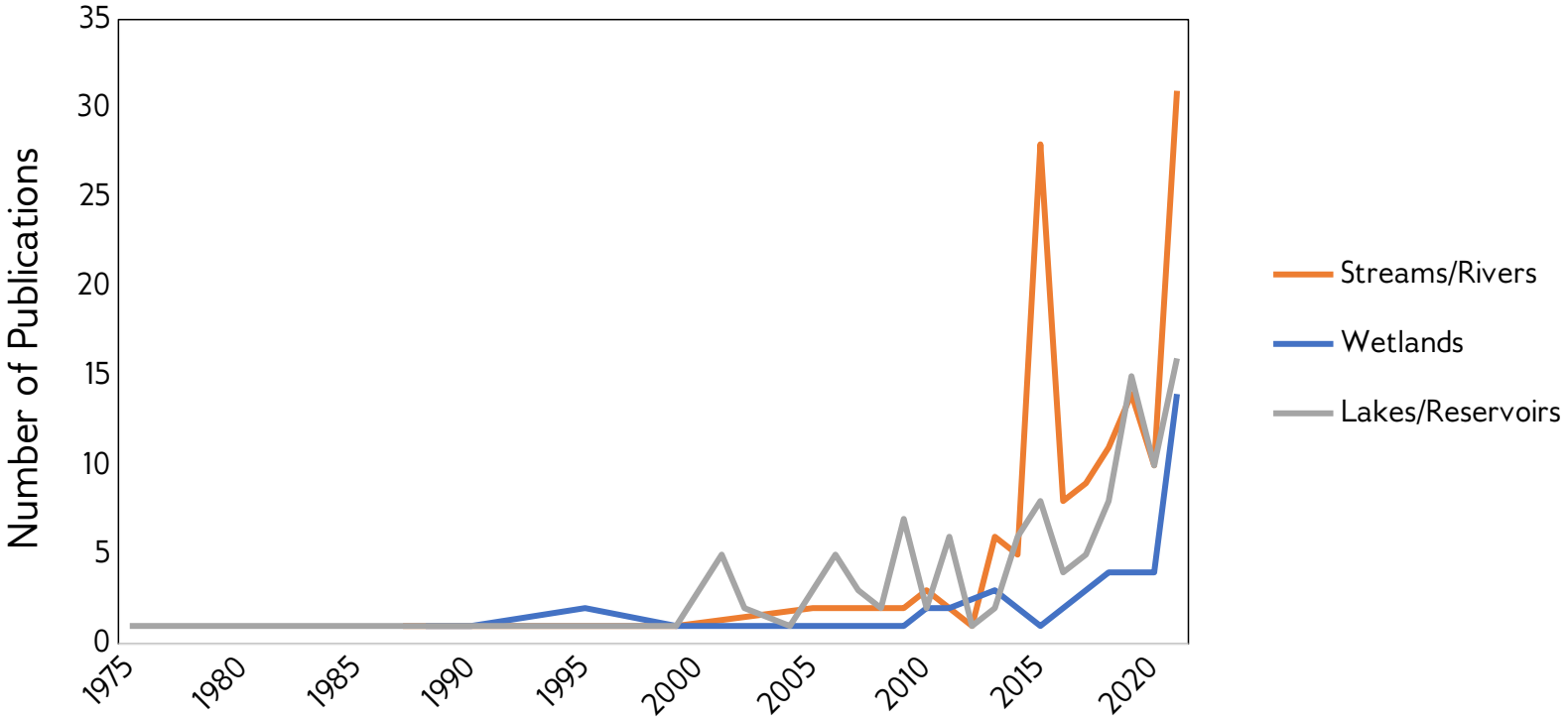
Raymond et al. 2013

Liu et al. 2022

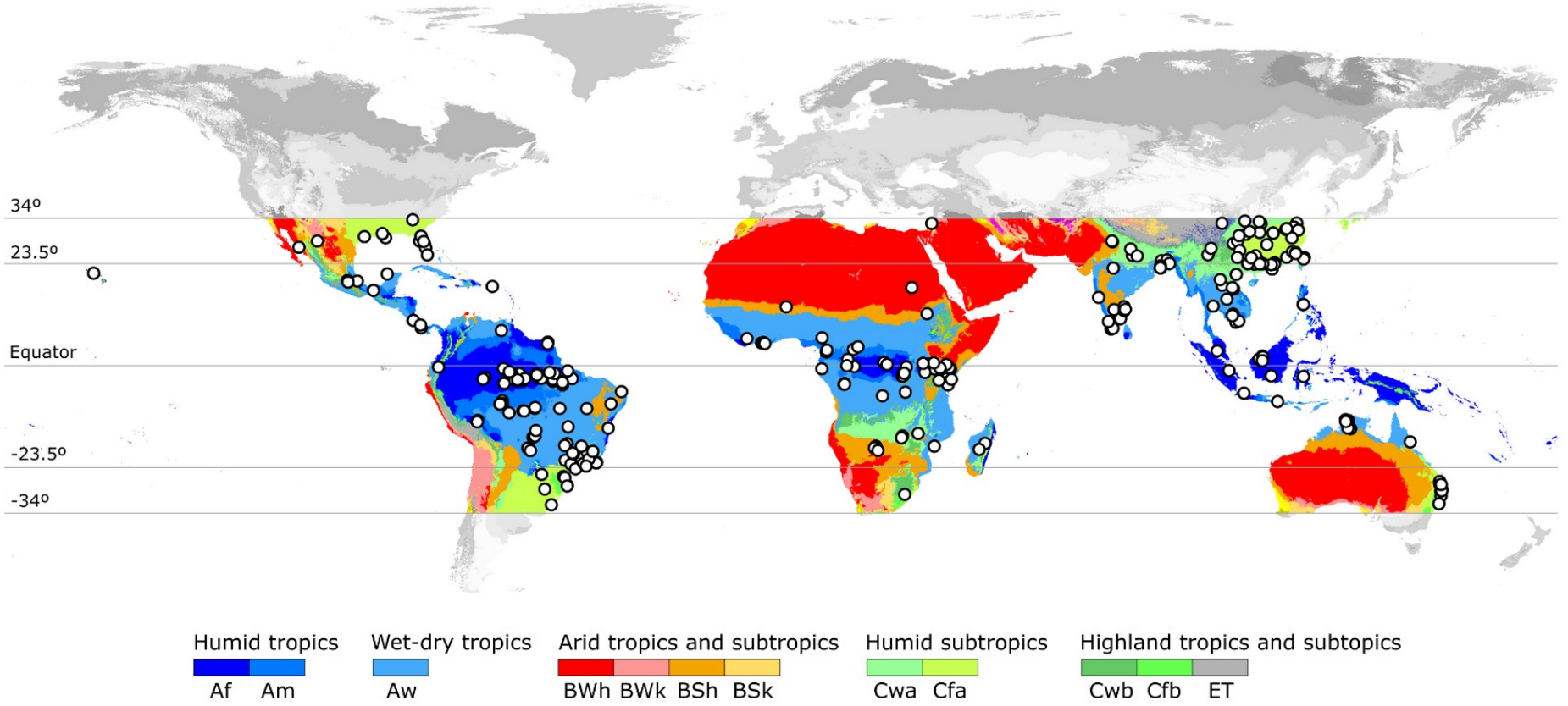
Objectives

- Literature review: publications with greenhouse gases from (sub)-tropical inland waters
  - CO_2, CH_4, N_2O
- Summarize data collection and methods
  - Indirect – calculate from pH & alkalinity
  - Direct – sensor, headspace, floating chamber
- Compare across inland water ecosystems
  - Streams/Rivers, Lakes/Reservoirs, Wetlands
- Determine spatial or temporal bias(es) in data collection
  - Köppen-Geiger Climate classes

Accelerating work in the tropics

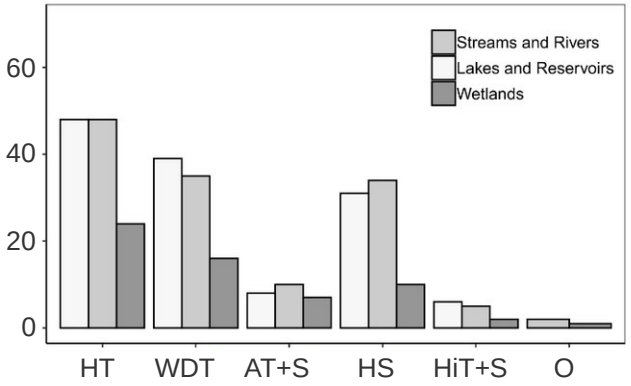


Tropical distribution of GHG studies

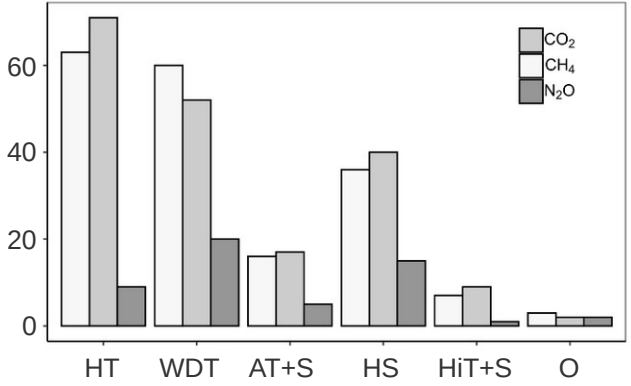


Distribution across Köppen-Geiger Climate Classes

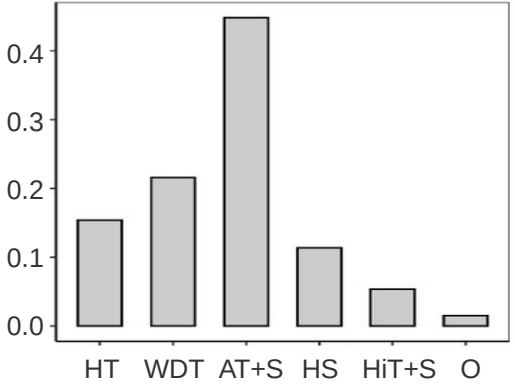
No. publications per system:



No. publications per gas:



Fraction of global (sub)tropical land area:



HT — Humid tropics: Af Am

WDT — Wet-dry tropics: Aw

AT+S — Arid tropics and subtropics: BWh BWk BSh BSk

HS — Humid subtropics: Cwa Cfa

HiT+S — Highland tropics and subtopics: Cwb Cfb ET

O: Others

Next Steps

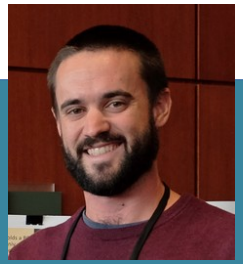
- Construct a database of GHG evasion from tropical inland waters
  - Extract GHG concentrations, fluxes, and site-specific data from publications
- Answer questions related to:
  - Importance of connectivity in linking aquatic and terrestrial BGC cycles
  - Are the tropics indeed a hotspot of GHG evasion?
  - Provide a nuanced understanding of the magnitude and drivers of emissions across diverse landscapes of the tropics

SS11: Greenhouse gases in tropical streams, rivers, lakes and wetlands: current work and future research needs

linkhorst@bafg.de

Feel free to reach out!

SS11: Greenhouse gases in tropical streams, rivers, lakes and wetlands: current work and future research needs



Nicholas Marzolf, *nmarzol@ncsu.edu*

Wed 14:15, DeVos Place – Grand Gallery E

"Continental-scale estimates of lotic ecosystem metabolism from NEON aquatic sites"

linkhorst@bafg.de