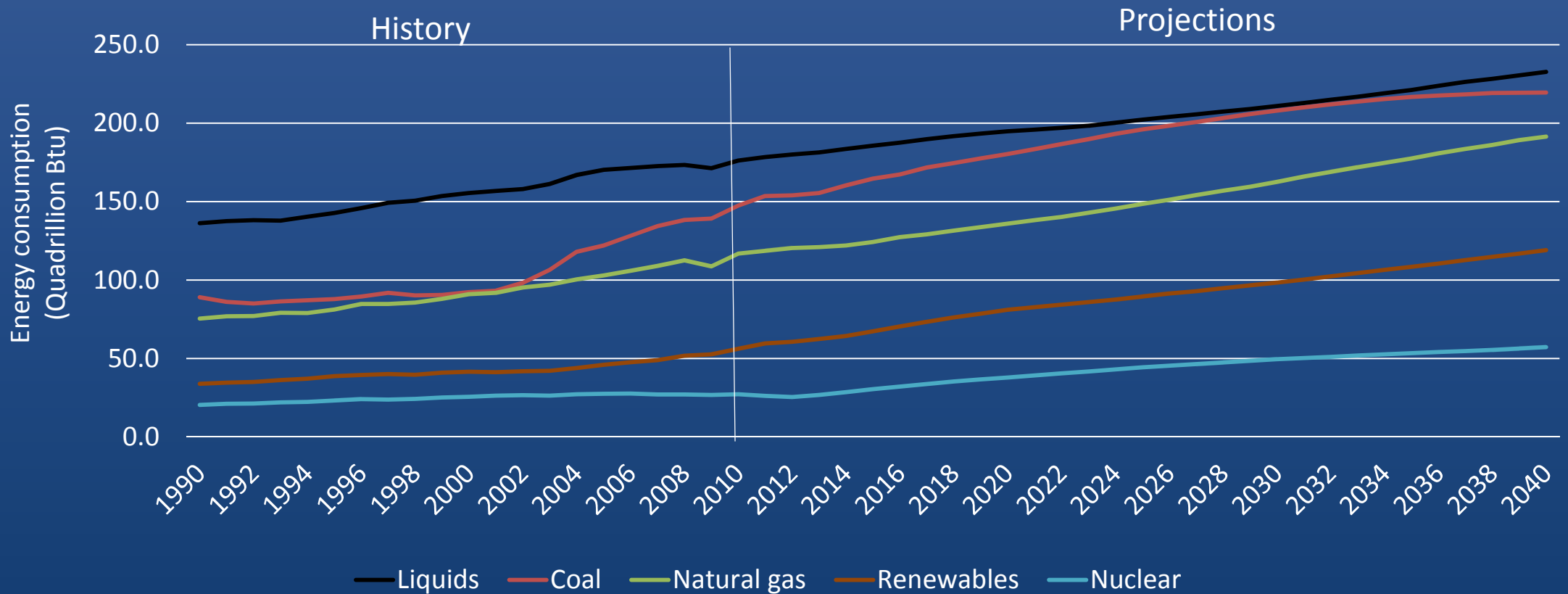


# Assessment of greenhouse gas emissions in a tropical Brazilian reservoir

ker: Guilherme S. D. Andrade

# Global Energy Demand

- It has been increasing since 1700s – Industrial revolution

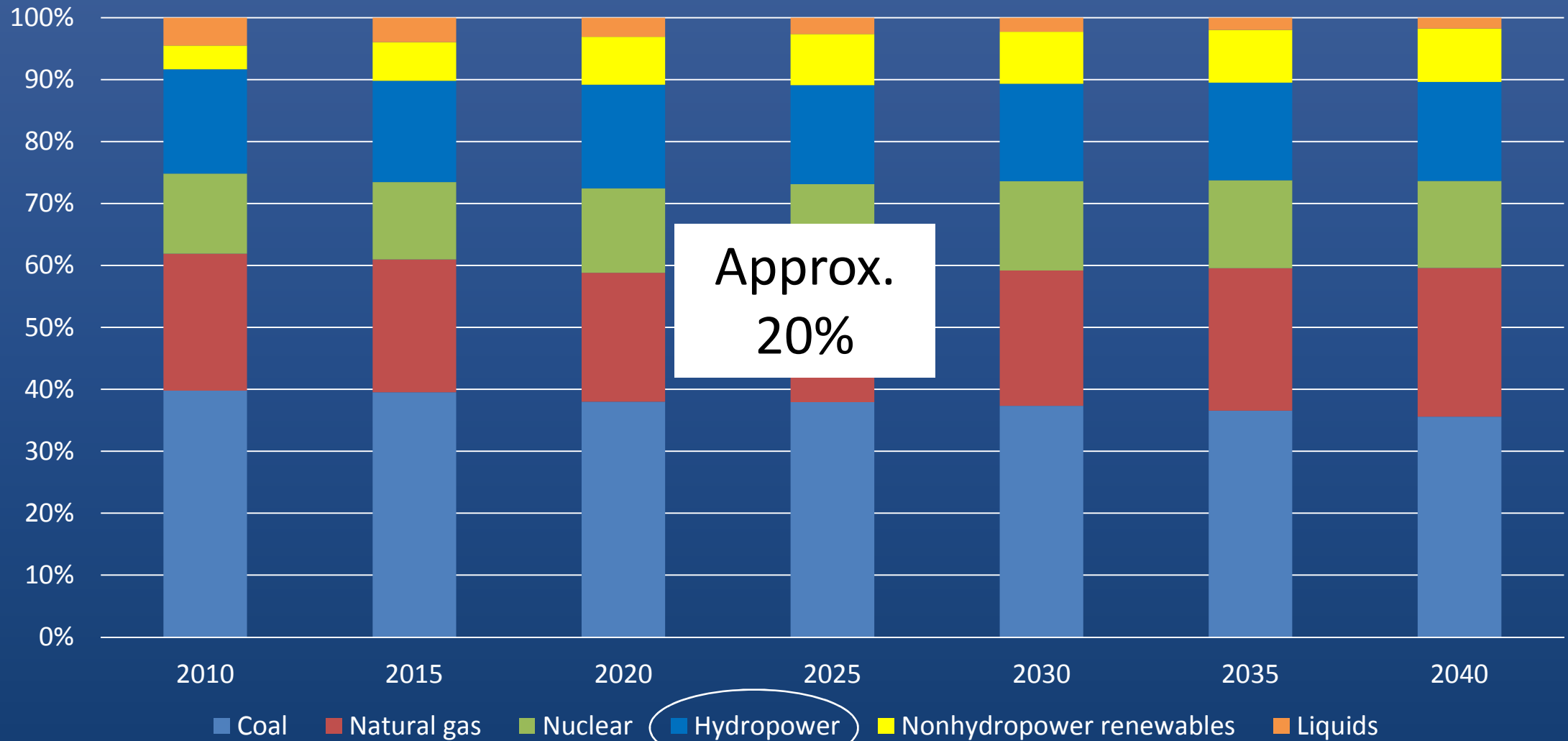


# The world has to generate more energy to attend the increasing demand

That is where countries such as China and Brazil appear!



# Importance of hydropower



# Energy production vs. Environmental impacts

## Soil

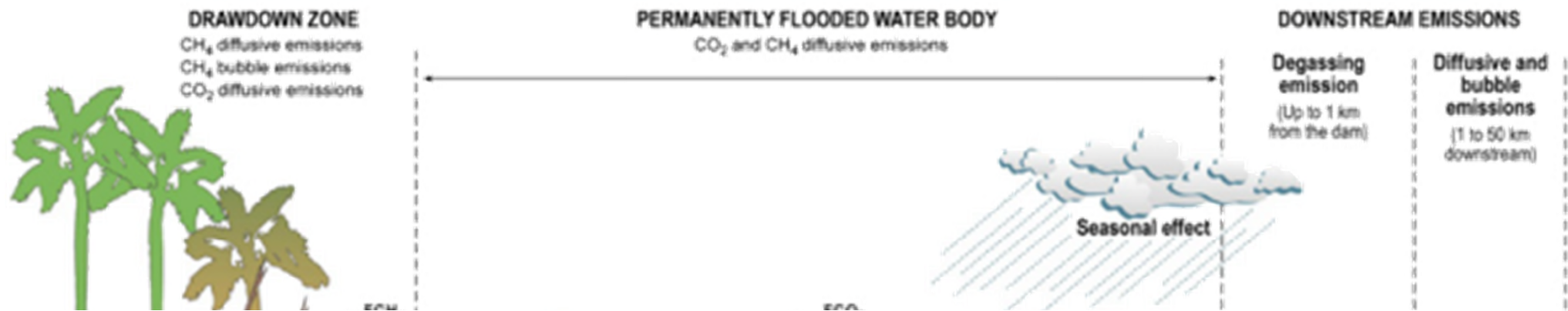
Flooding;  
Accommodation

## Water

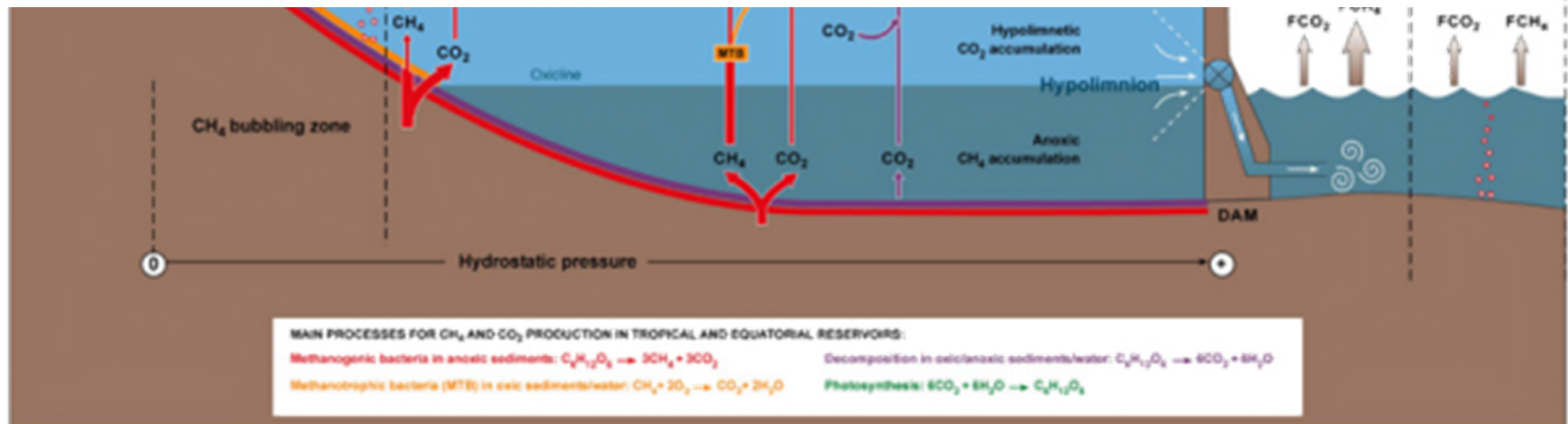
- Water quality
- Hydrology

## Atmosphere

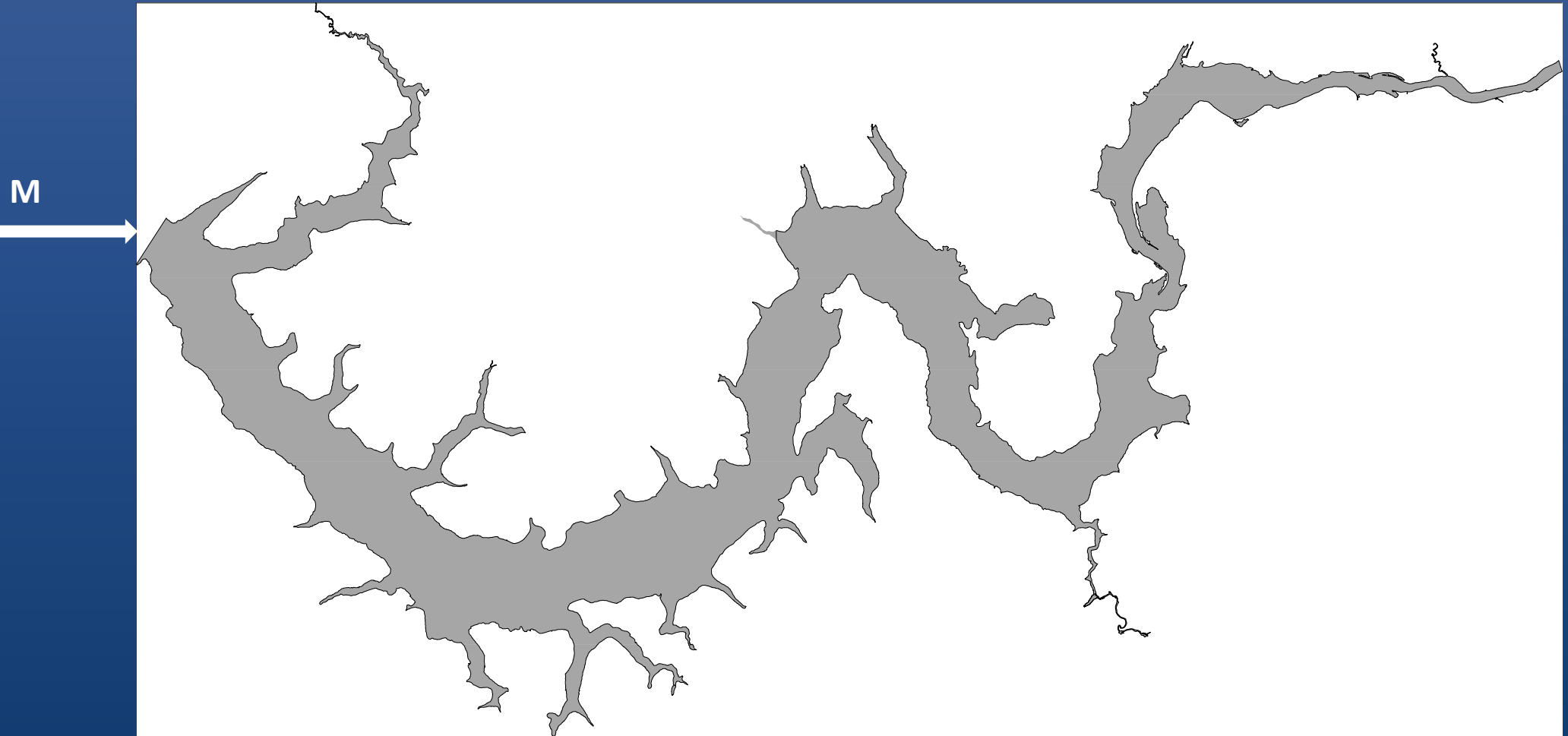
- GHG



# Is hydropower carbon free?



# Volta Grande reservoir



# Methods

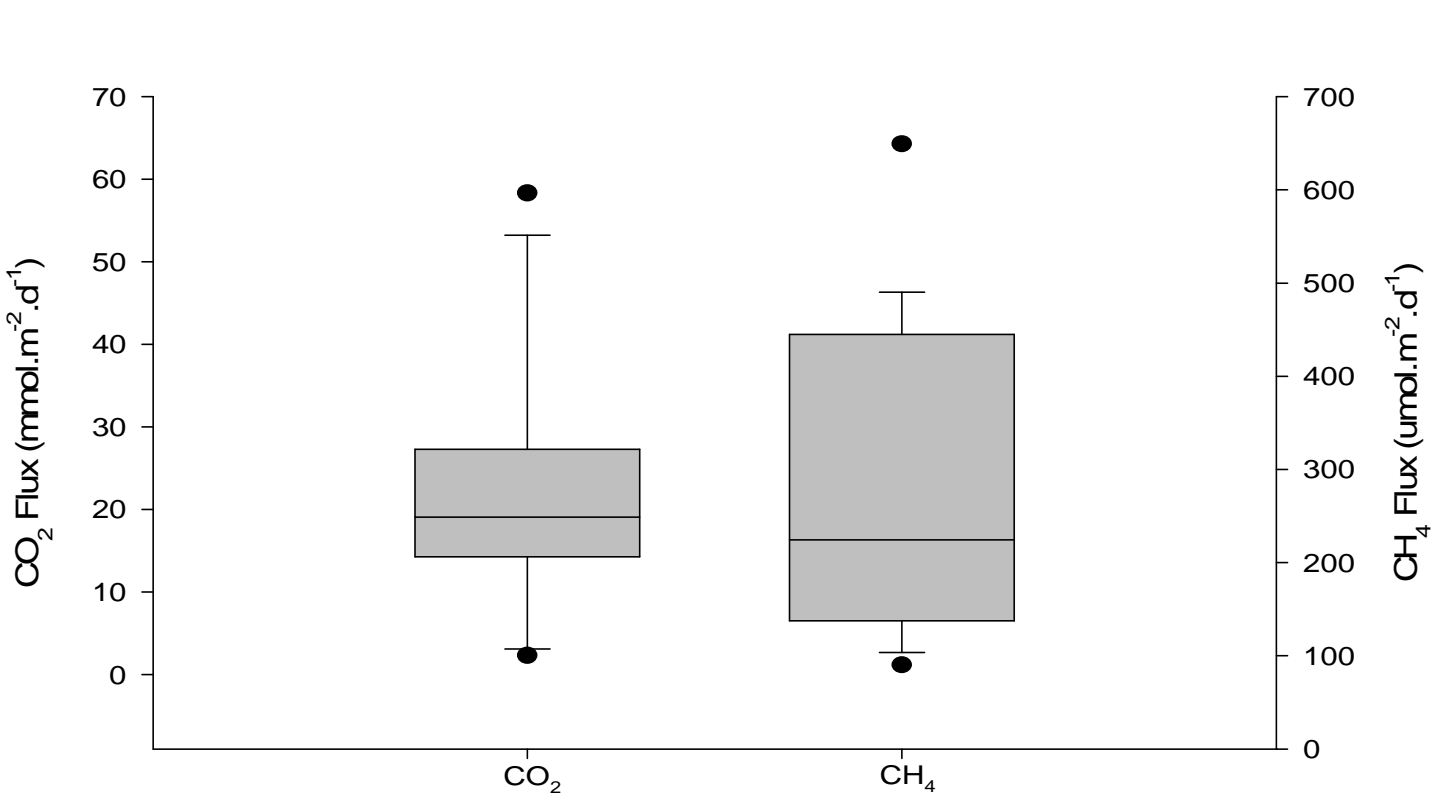
- *Thin Boundary Layer (TBL)*
  - $Fluxo = K_x \times (C_{water} - C_{sat})$
  - $K_x = K_{600} \times (Sc/600)^{-x}$
  - $Sc (CO_2) = 1911,1 - 118,11t + 3,4527t^2 - 0,04132t^3$
  - $Sc (CH_4) = 1897,8 - 14,28t + 3,4527t^2 - 0,03906t^3$
  - $K_{600} = 2,07 + (0,215 \times (1,22 \times U)^{1,7})$



# Considerations...

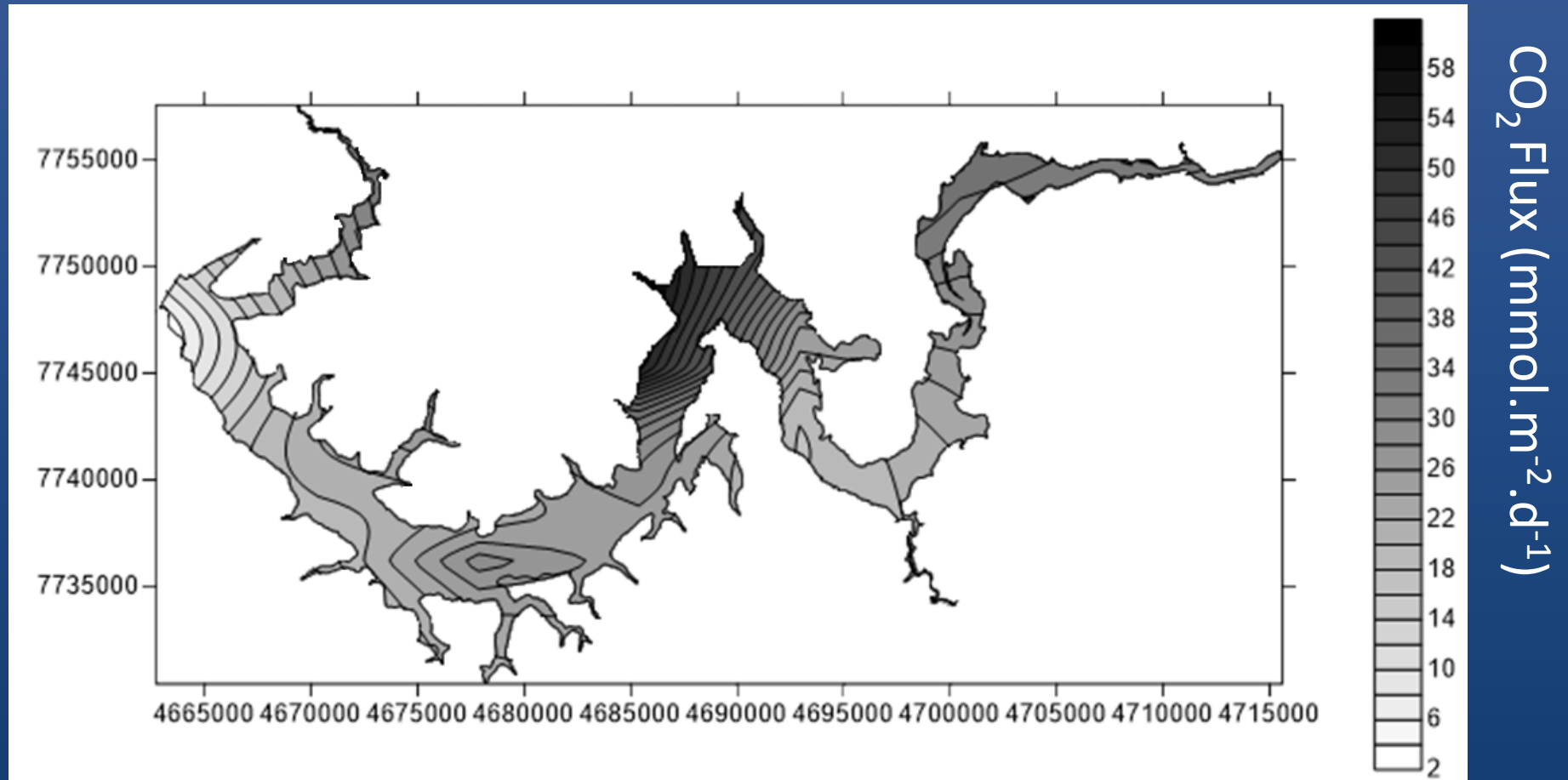
- It was considered only diffusive fluxes;
- Although different methods were employed worldwide, all of them are presented on the UNESCO/IHA guidelines

# Results and Discussion

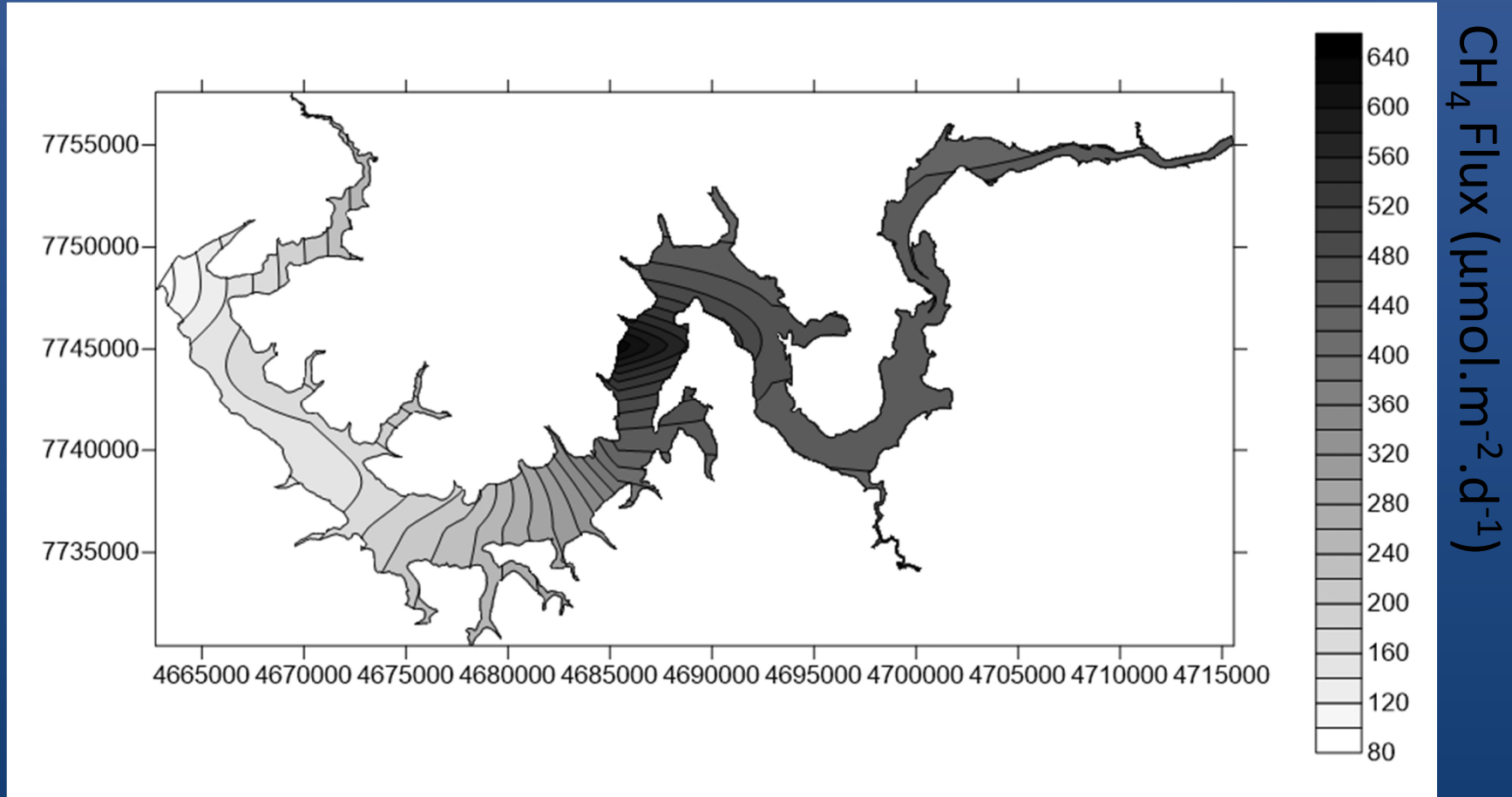


	CO <sub>2</sub> flux (mmol.m <sup>-2</sup> .d <sup>-1</sup> )	CH <sub>4</sub> flux (μmol.m <sup>-2</sup> .d <sup>-1</sup> )
Volta Grande	2.2 – 58.3	90.3 – 649.5
Tropical	3.8 – 192.5	436.4 – 8,104.7
Global	-23.6 – 192.5	2.4 – 8114

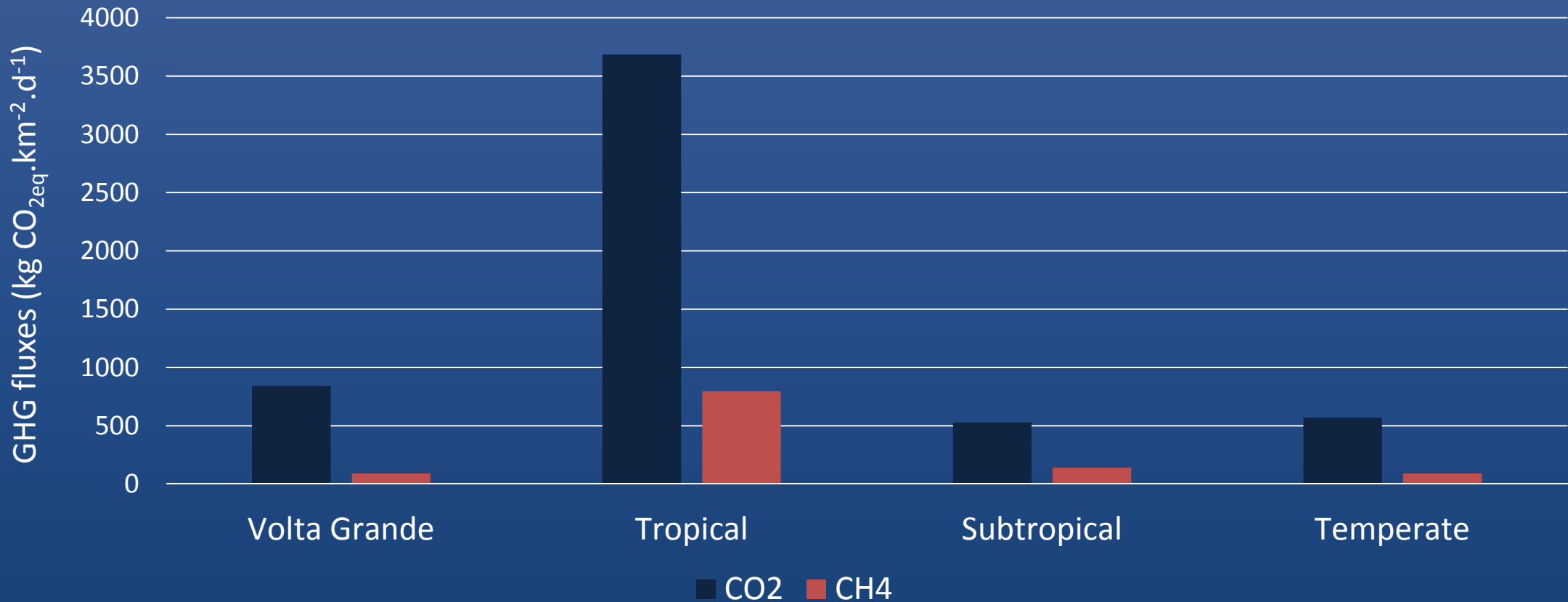
# CO<sub>2</sub> spatial variation



# CH<sub>4</sub> spatial variation



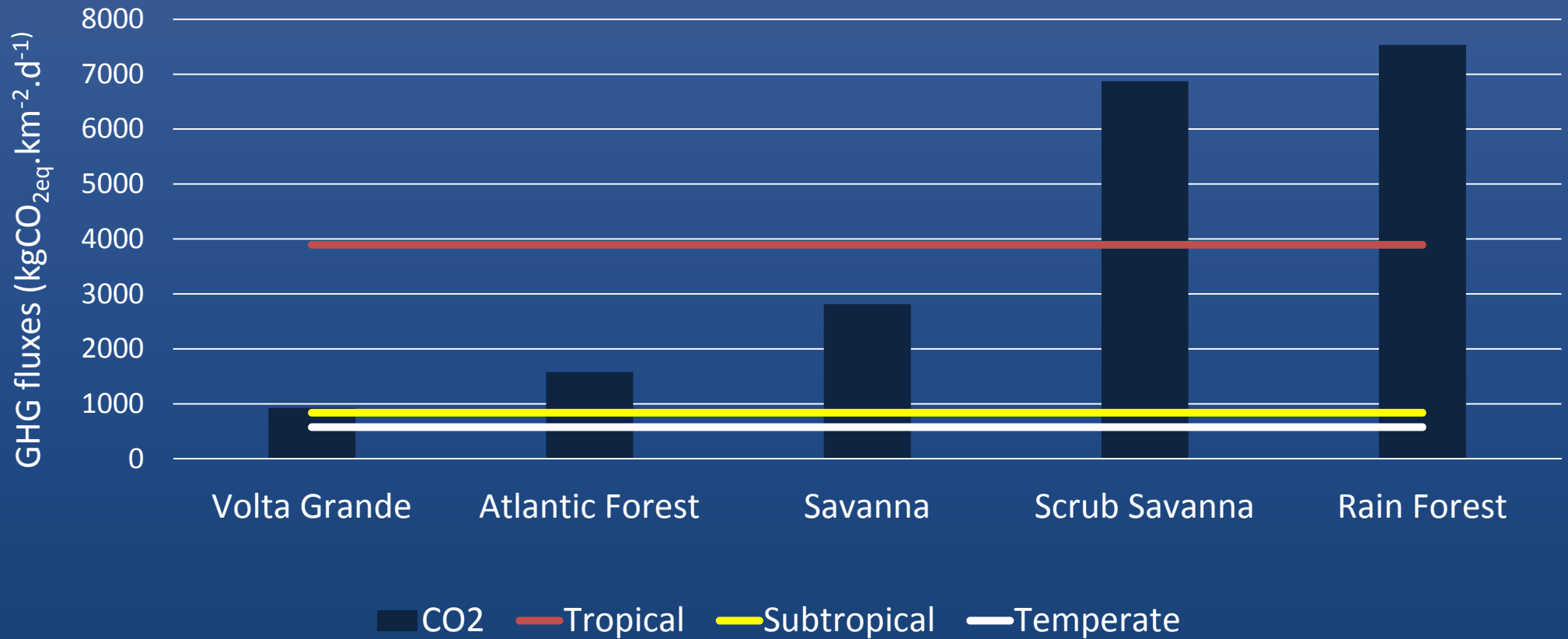
# Overall comparison...



There is a wide variation within tropical systems!

Sources: ABRIL *et al.*, 2005; Chanudet *et al.*, 2011; Demarty *et al.* 2011; Demarty *et al.* 2009; dos Santos *et al.*, 2006; Huttunen 2006; Kemenes *et al.*, 2011; Li & Zang, 2013; Roland *et al.*, 2010; Soumis *et al.* 2004 Tremblay *et al.* 2005; Wang *et al.*, 2011; Zhao *et al.*, 2011

# Examining the tropical region...



nd Volta Grande is **not** the one with the lowest emissions!!

# What could explain this pattern?

- Organic matter;
- Age;
- Type of reservoir;
- Watershed;
- Weather conditions;

Affect anaerobic / aerobic oxidation



GHG production and emission

# Concluding

- Extrapolation can lead to an overestimation!
- Our data are underestimating the fluxes and the atmospheric impacts!
- Few *in situ* measurements!
- Amazonian reservoirs have the highest impact level!



# Thank you!!

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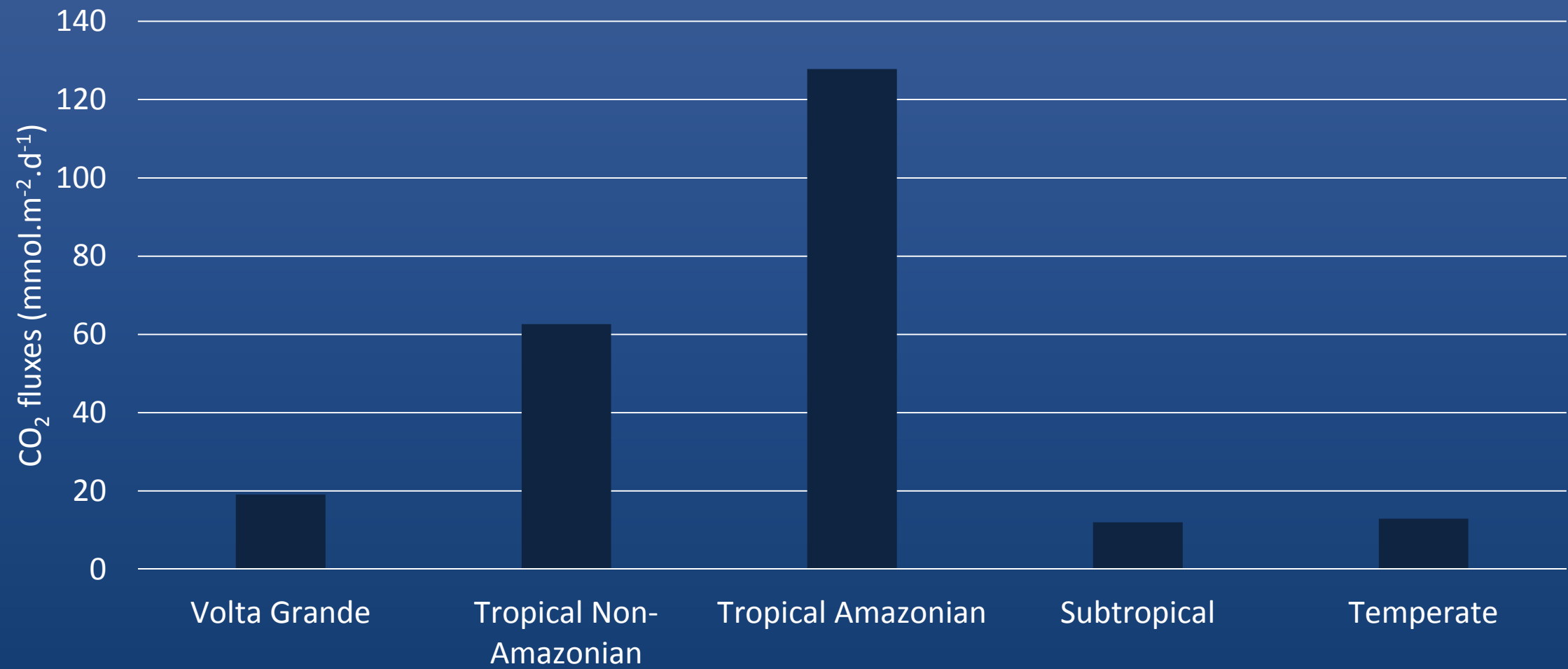
Undergraduates

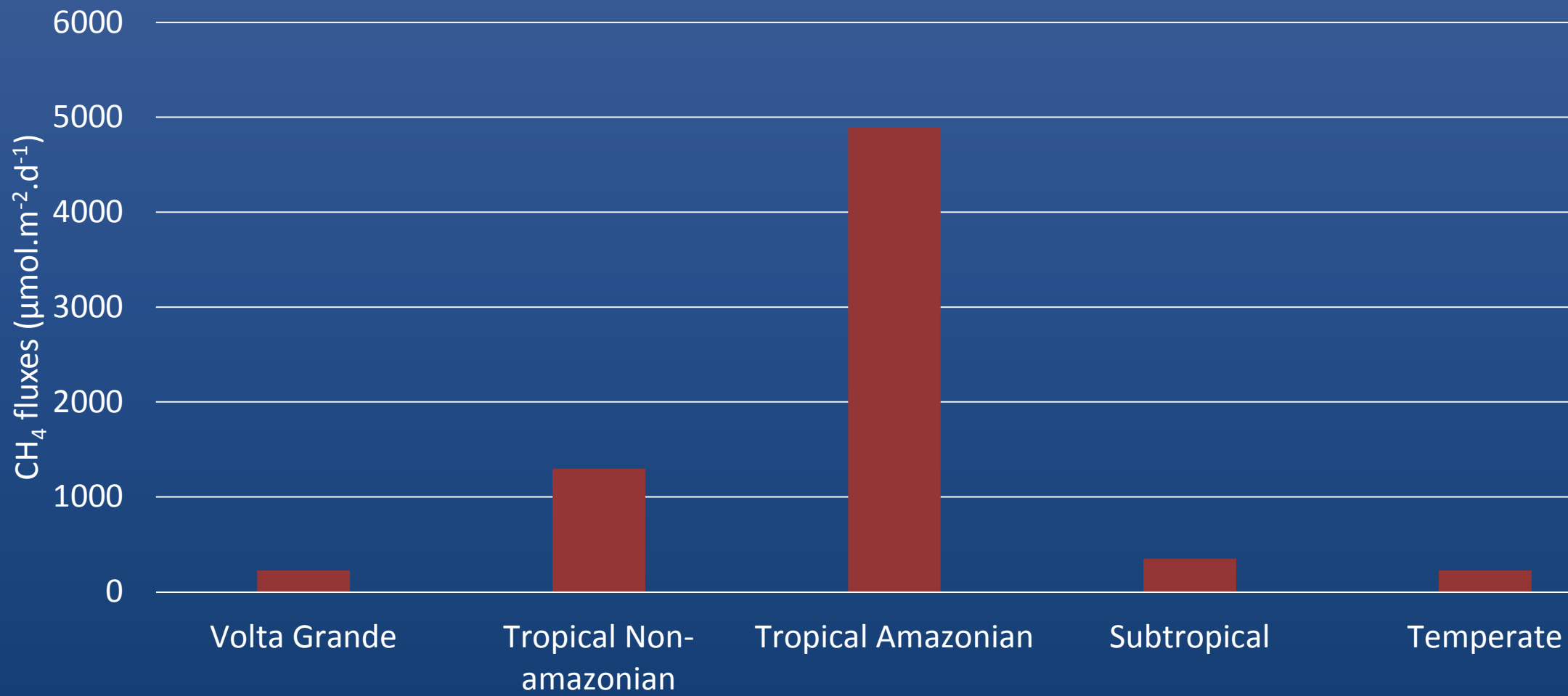
Arthur Paixão

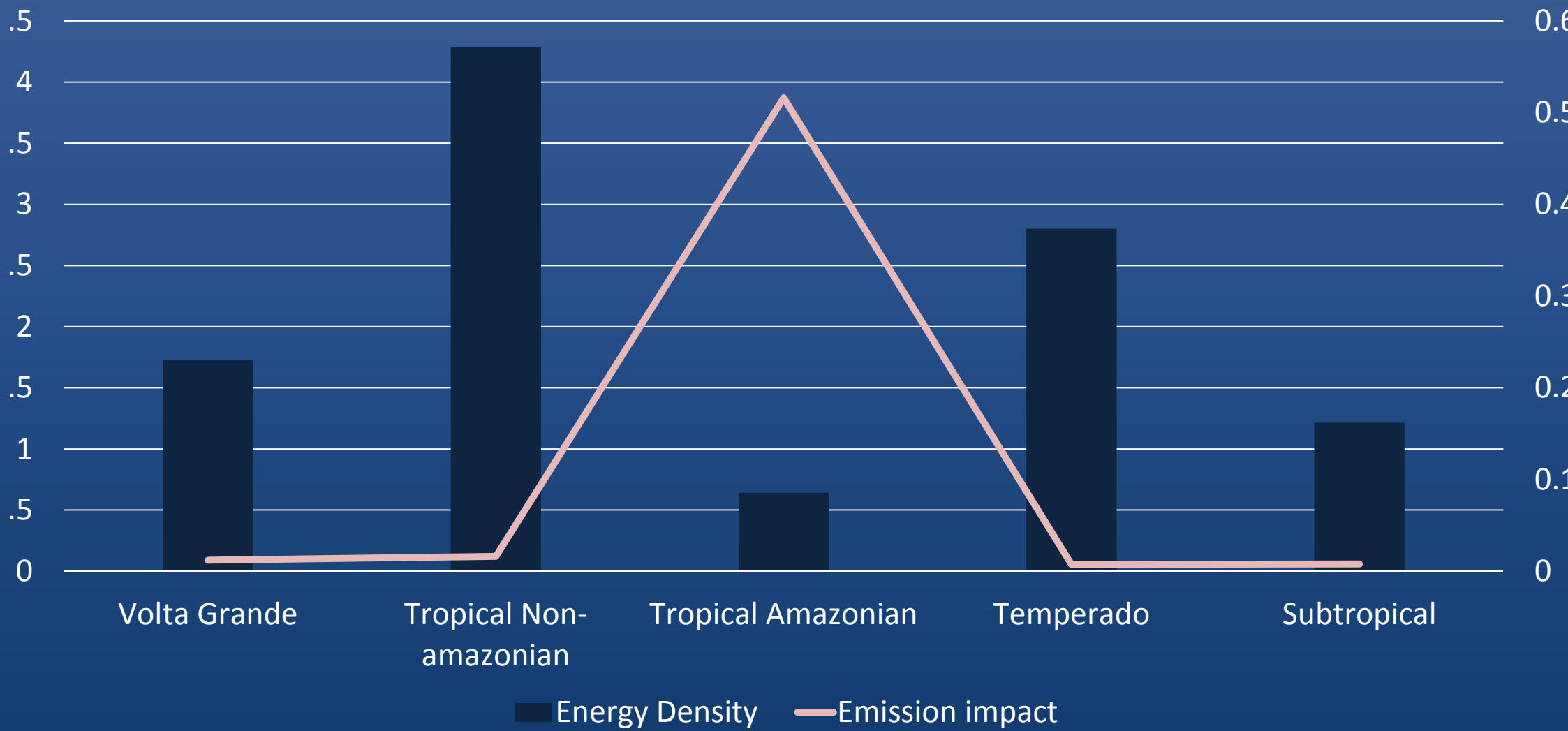
Karoline Costa

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# Additional information

