Emissions of climate-altering species from open vegetation fires in the Mediterranean region -A review on methods and data

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Introduction

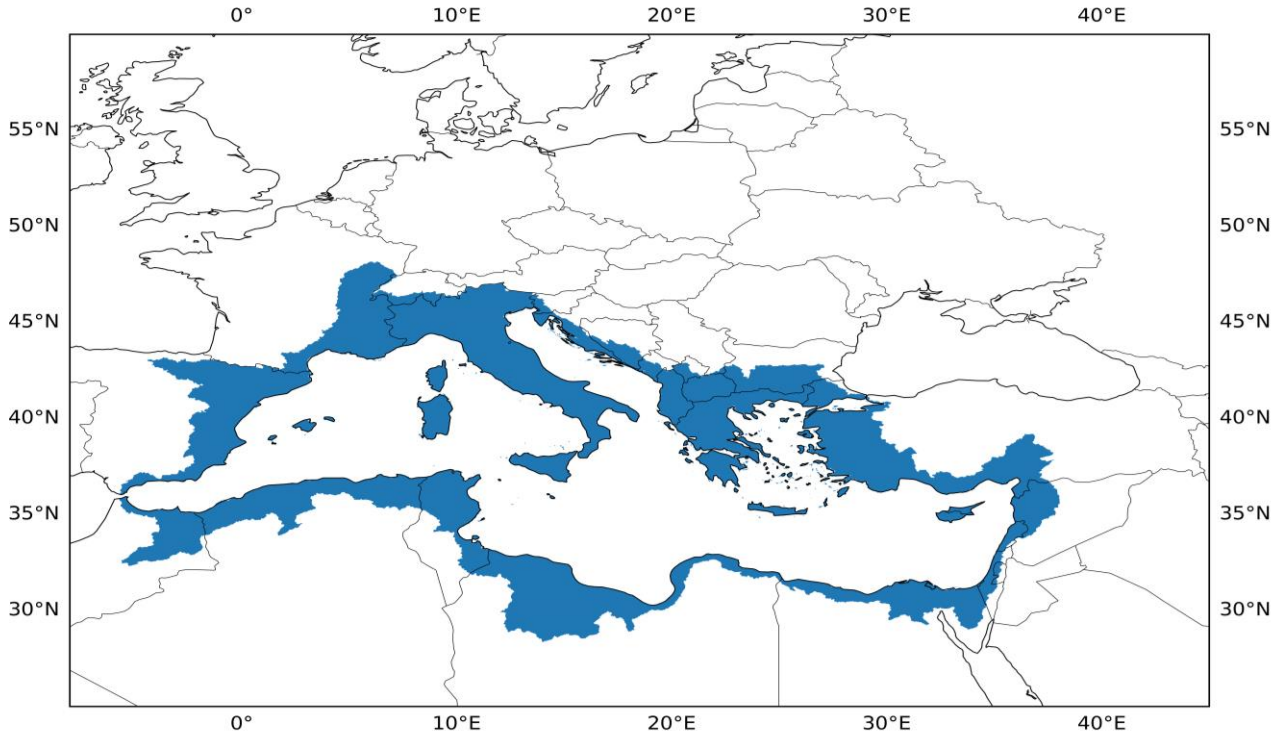
- Since the 19th century, GHG emissions have risen sharply, driving climate change.
- Wildfires are a relevant source (~17.5%) of the main GHGs (CO_2, CH_4, N_2O) and contribute ~30–40 % of global BC. The Mediterranean is a climate hotspot: rising aridity, heatwaves, extreme fire years (2007, 2012, 2017).
- Despite global progress, few studies target the Mediterranean; fire emissions here remain poorly quantified.
- This work fills the gap by reviewing methods & inventories (2003–2020) for GHG & BC emissions in the region.

Objective

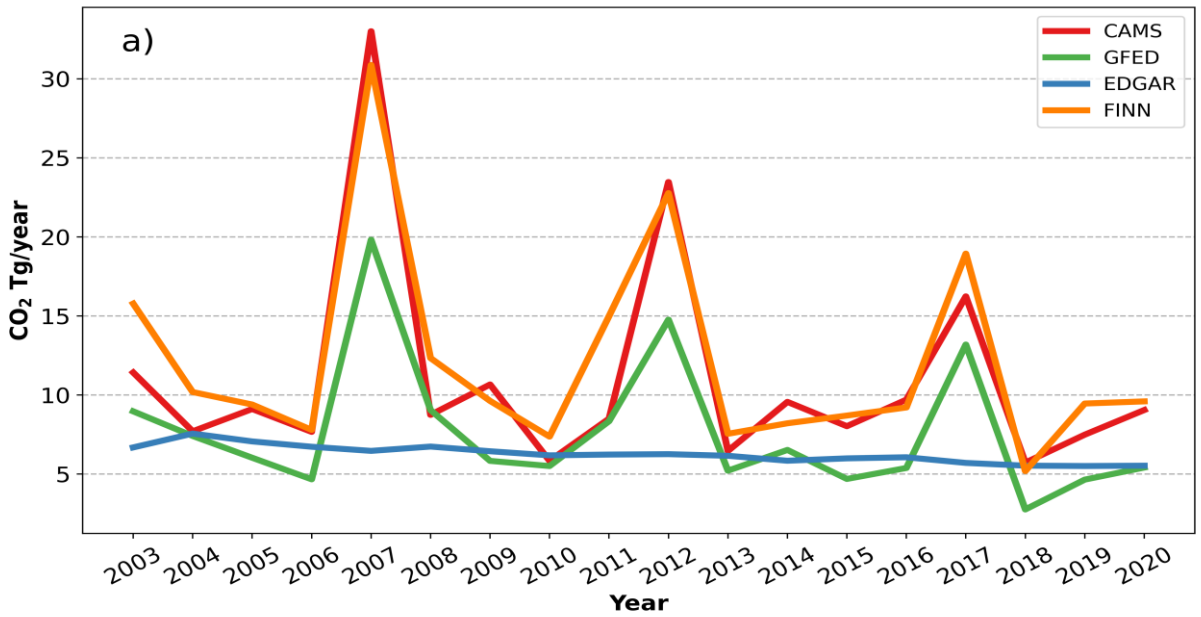
Emission estimates from four inventories (GFED, GFAS, FINN, EDGAR) were aggregated for the Mediterranean region (2003–2020), analyzing multi-annual and inter-annual variability, identifying major country contributors, and assessing discrepancies across datasets. GFED, GFAS, and FINN include all open vegetation fires (natural + anthropogenic), whereas EDGAR accounts only for anthropogenic emissions.

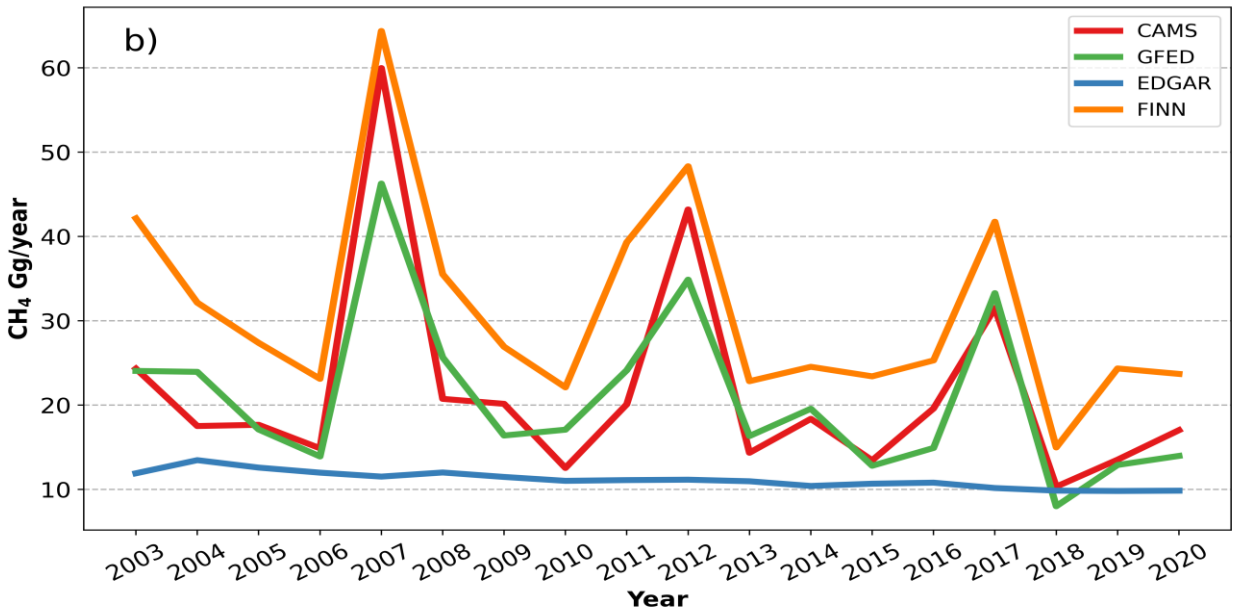
Study Region – Mediterranean Basin

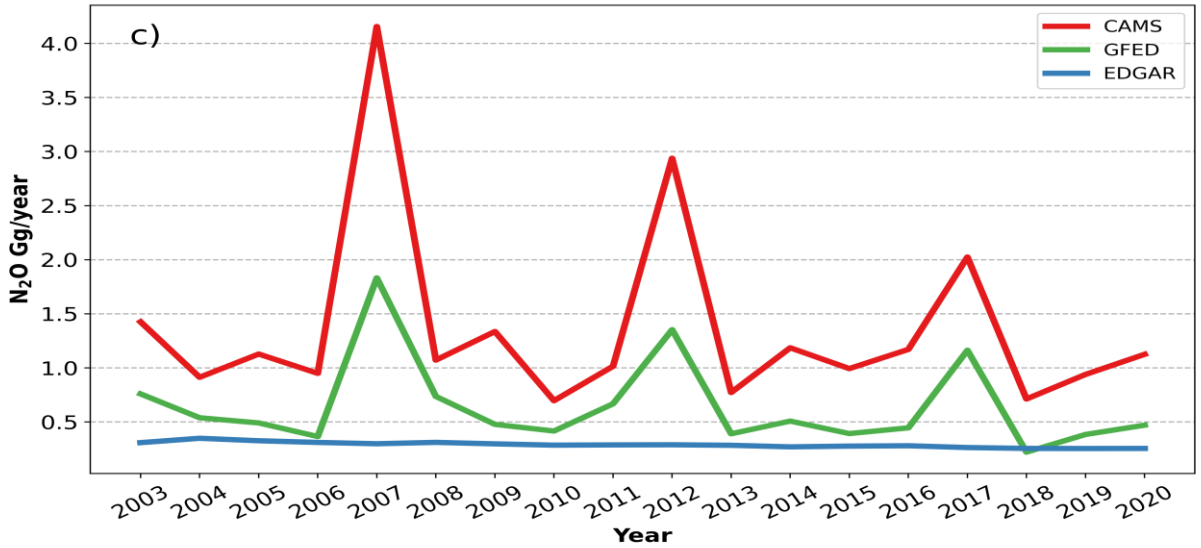
- Defined using HydroSHEDS catchments draining into the Mediterranean Sea (+ lower Nile).
- Represents ~1.5% of global land surface.
- Western/northern Iberian Peninsula not fully included in HydroSHEDS Mediterranean domain. Including it increases relative emission
- Contributes ~0.2–0.4% of global wildfire CO_2 emissions (2003–2020).

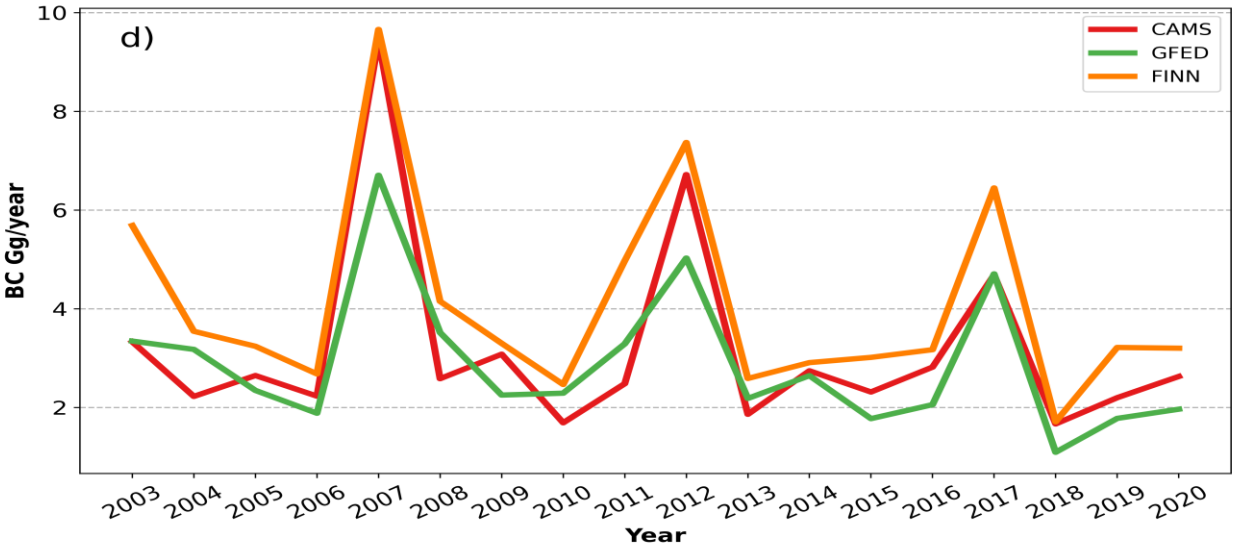


Results

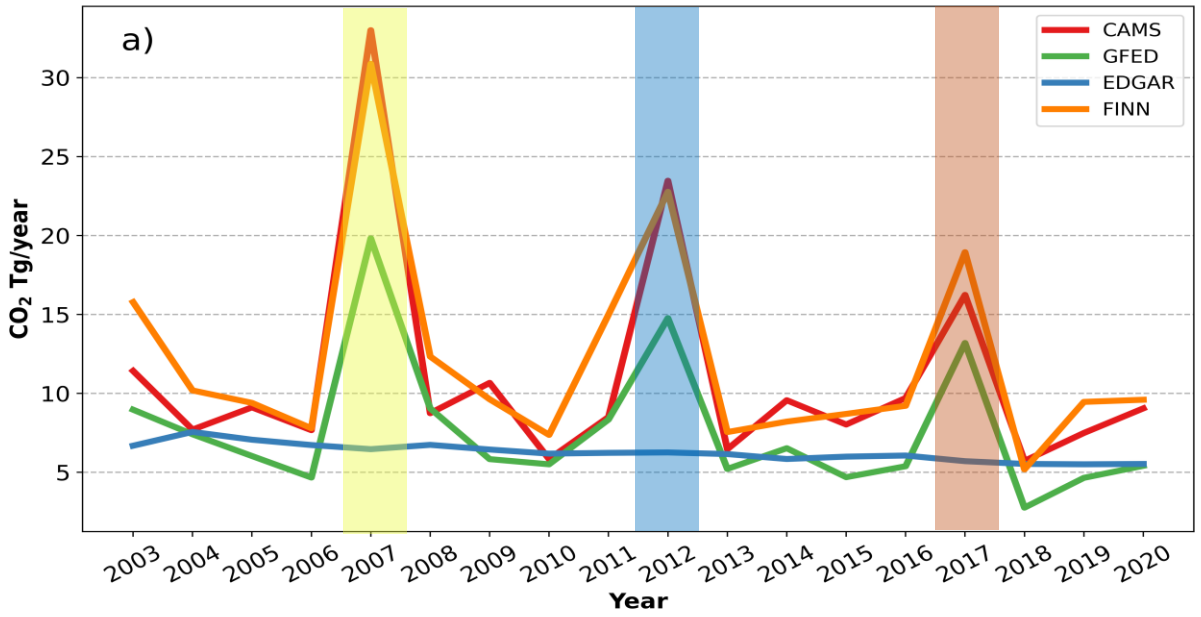

a)
CAMS
GFED
EDGAR
FINN
CO_2 Tg/year
Year

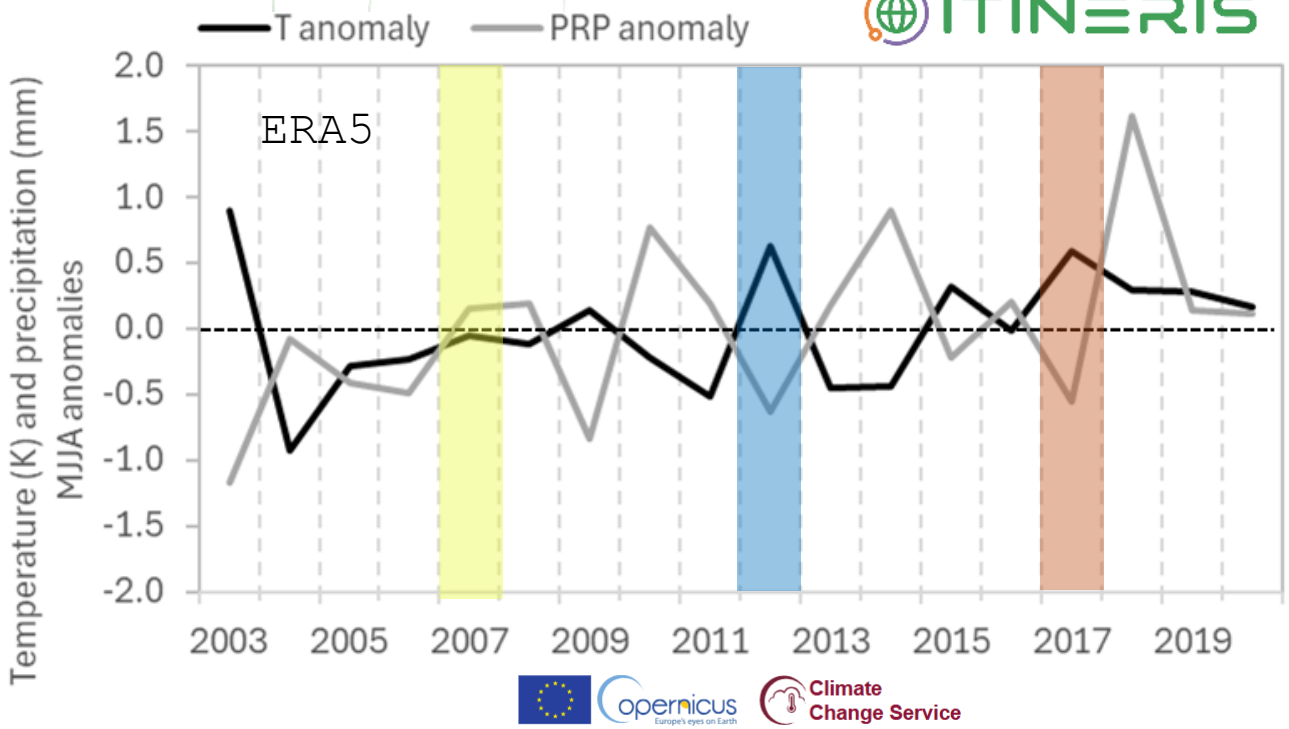

b)
CAMS
GFED
EDGAR
FINN
CH_4 Gg/year
Year


c)
CAMS
GFED
EDGAR
N_2O Gg/year
Year


d)
CAMS
GFED
FINN
BC Gg/year
Year

Possible Role of La NinA in Peak Emissions





- Emission peaks in 2007, 2012, 2017 coincided with La Niña events.
- ERA5 anomalies (May–Aug):
  - 2012 → hot & dry summer (positive T, negative P)
  - 2017 → severe drought, driest spring in 60 years
  - 2007 → no clear basin-scale anomalies; peaks driven by local extreme fires in Italy & Greece
- La Niña may enhance droughts via teleconnections, but antecedent droughts & human management also critical.
- Role of La Niña is possible but not conclusive → further studies needed.

Conclusion

•Wildfire emissions in the Mediterranean peaked in **2007, 2012,** and **2017**, *possibly linked* to La Niña.

•Other factors (e.g., weather conditions preceding actual fire seasons, human management, fuel availability and type/condition) can affect the occurrence of the emission peaks.

•**More studies are needed** to better understand the role of climate variability (e.g. La Niña) in peak fire years.

•The four inventories agree on peak years but differ in magnitude: **FINN gives the highest estimates, GFED the lowest**.

•**EDGAR** only includes agriculture and waste burning. Sometimes its CO_2 values are higher than GFED.

•**Anthropogenic emissions are declining**: CO_2 decreases by −0.09 Tg/yr, CH_4 by −0.16 Gg/yr, and N_2O by −4.2 Mg/yr. Turkey shows the largest decrease.

•Current reliance on bottom-up inventories creates uncertainties. **Top-down methods with observation data from environmental RIs are essential** to improve estimates.

THANKS!

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